# VOLUME 2 OF 4

# THIS IS A TOTAL SMALL BUSINESS SET ASIDE

RFP NO: **W9127826RA012**
CADD NO: **MEF22007**

SPECIFICATIONS

FOR

# LRSO HARDWARE SOFTWARE DEVELOPMENT FACILITY

## EGLIN AIR FORCE BASE, FLORIDA
(OKALOOSA COUNTY)

***"GOOD ENGINEERING RESULTS IN A BETTER ENVIRONMENT"***

US Army Corps of Engineers ®
Mobile District

U.S. ARMY ENGINEER DISTRICT, MOBILE
100 Canal St
Mobile, Alabama 36602

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U.S. ARMY CORPS OF ENGINEERS
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SECTION 07 14 00

FLUID-APPLIED WATERPROOFING
**08/23**

PART 1 GENERAL

1.1 REFERENCES

The publications listed 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 | (2018; R 2022) Standard Specification for High Solids Content, Cold Liquid-Applied Elastomeric Waterproofing Membrane for Use With Separate Wearing Course |
| ASTM D1056 | (2020) Standard Specification for Flexible Cellular Materials - Sponge or Expanded Rubber |

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. 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

Fluid-Applied Membrane

Membrane Primer

Elastomeric Sheet

Flexible Foam-Backed Elastomeric Sheet

Solvent

Moisture Meter

Bond Breaker

SD-11 Closeout Submittals

Warranty

Information Card

Include copies of Safety Data Sheets for maintenance/repair materials.

## 1.3 PREWATERPROOFING CONFERENCE

Prior to starting application of waterproofing system, arrange and attend a prewaterproofing conference to ensure a clear understanding of drawings and specifications. Give the Contracting Officer 7 days advance written notice of the time and place of meeting. Ensure that the mechanical and electrical subcontractor, flashing and sheetmetal subcontractor, and other trades that may perform other types of work on or over the membrane after installation, attend this conference.

## 1.4 DELIVERY, STORAGE, AND HANDLING

Deliver waterproofing materials in manufacturer's original, unopened containers, with labels intact and legible. Containers of materials covered by a referenced specification number must bear the specification number, type, and class of the contents. Deliver materials in sufficient quantity to continue work without interruption. Store and protect materials in accordance with manufacturer's instructions, and use within their indicated shelf life. When hazardous materials are involved, adhere to special precautions of the manufacturer, unless precautions conflict with local, state, and federal regulations. Promptly remove from the site materials or incomplete work adversely affected by exposure to moisture or freezing. Store materials on pallets and cover from top to bottom with canvas tarpaulins.

## 1.5 ENVIRONMENTAL CONDITIONS

Apply materials when ambient temperature is 40 degrees F or above for a period of 24 hours prior to the application and when there is no ice, frost, surface moisture, or visible dampness on the substrate surface. Apply materials when air temperature is expected to remain above 40 degrees F during the cure period recommended by the manufacturer. Moisture test for substrate is specified under paragraph MOISTURE TEST. Work may be performed within heated enclosures, provided the surface temperature of the substrate is maintained at a minimum of 40 degrees F for 24 hours prior to the application of the waterproofing, and remains above that temperature during the cure period recommended by the manufacturer.

## 1.6 WARRANTY

Provide system material and workmanship warranties meeting specified requirements. Provide revisions or amendment to standard membrane manufacturer warranty to comply with the specified requirements. Provide a manufacturer's warranty that has no dollar limit, covers full system water-tightness, and has a minimum duration of 20 years.

### 1.6.1 Membrane Manufacturer Warranty

Provide the membrane manufacturer's 20-year no dollar limit system materials and installation workmanship warranty, including flashing, insulation, and accessories necessary for a watertight system construction. Write the warranty directly to the Government commencing at time of Government's acceptance of the work. Provide the following statements for such warranty:

a. If within the warranty period the system, as installed for its intended use in the normal climatic and environmental conditions of

the facility, becomes non-watertight, shows evidence of moisture intrusion within the assembly, blisters, splits, tears, 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 system assembly and correction of defective workmanship are the responsibility of the membrane manufacturer. All costs associated with the repair or replacement work are the responsibility of the membrane manufacturer.

b. The warranty must remain in full force and effect, including emergency temporary repairs performed by others, when the manufacturer or his approved applicator fail to perform the repairs within 72 hours of notification.

1.6.2 Continuance of Warranty

Repair or replacement work that becomes necessary within the warranty period must be approved and accomplished in a manner so as to restore the integrity of the system assembly and validity of the membrane manufacturer warranty for the remainder of the manufacturer warranty period.

## PART 2 PRODUCTS

### 2.1 FLUID-APPLIED MEMBRANE

ASTM C836/C836M.

### 2.2 MEMBRANE PRIMER

As recommended by the fluid-applied membrane manufacturer unless specifically prohibited by the manufacturer of the fluid-applied membrane.

### 2.3 SEALANT

As specified in Section 07 92 00 JOINT SEALANTS.

### 2.4 SEALANT PRIMER

As specified in Section 07 92 00 JOINT SEALANTS.

### 2.5 BOND BREAKER

As recommended by the fluid-applied membrane manufacturer. Bond breaker must not interfere with the curing process or other performance properties of the fluid-applied membrane. Submit material description and physical properties, application details, and recommendations regarding shelf life, application procedures, and precautions on flammability and toxicity.

### 2.6 ELASTOMERIC SHEET

Preformed; as recommended by the fluid-applied membrane manufacturer. Bond strength between the fluid-applied membrane and the preformed elastomeric sheet must be a minimum of one psi when tested in accordance with ASTM C836/C836M.

### 2.7 ELASTOMERIC SHEET ADHESIVE

As recommended by the elastomeric sheet manufacturer.

## 2.8 FLEXIBLE FOAM-BACKED ELASTOMERIC SHEET

Flexible foam-backed elastomeric sheet for protection over preformed elastomeric sheet at expansion joints must be 1/2 inch thick, minimum, closed cell foam conforming to ASTM D1056, Type 2, Class B, Grades 2 or 3, factory-bonded to 1/16 inch thick, minimum, preformed elastomeric sheet.

# PART 3 EXECUTION

## 3.1 PREPARATION

Coordinate work with that of other trades to ensure that components to be incorporated into the waterproofing system are available when needed. Inspect and approve surfaces immediately before application of waterproofing materials. Remove laitance, loose aggregate, sharp projections, grease, oil, dirt, curing compounds, and other contaminants which could adversely affect the complete bonding of the fluid-applied membrane to the concrete surface.

### 3.1.1 Flashings

Make penetrations through sleeves in structural slab watertight before application of waterproofing. After flashing is completed, cover elastomeric sheet with fluid-applied waterproofing during waterproofing application.

#### 3.1.1.1 Penetrations and Projections

Flash penetrations and projections through structural slab with an elastomeric sheet adhered to the concrete slab and the penetration. Leave elastomeric sheet unadhered for one inch over joint between penetration and concrete slab. Adhere elastomeric sheet a minimum of 6 inches onto horizontal deck.

#### 3.1.1.2 Walls and Vertical Surfaces

Flash wall intersections which are not of monolithic pour or constructed with reinforced concrete joints with an elastomeric sheet adhered to both vertical wall surfaces and concrete slab. Flash intersections which are monolithically poured or constructed with reinforced concrete joints with either an elastomeric sheet or a vertical grade of fluid-applied waterproofing adhered to vertical wall surfaces and concrete slab. Leave sheet unadhered for a distance of one inch from the corner on both vertical and horizontal surfaces.

### 3.1.2 Cracks and Joints

Prepare visible cracks and joints in substrate to receive fluid-applied waterproofing membrane by placing a bond breaker and an elastomeric slip sheet between membrane and substrate. Apply a 2 inch bond breaker to cracks that show movement followed by an elastomeric sheet adhered to the deck. Nonmoving cracks must be double coated with fluid-applied waterproofing.

### 3.1.3 Priming

Prime surfaces to receive fluid-applied waterproofing membrane. Apply primer as required by membrane manufacturer's printed instructions.

## 3.2 SPECIAL PRECAUTIONS

Protect waterproofing materials during transport and application. Do not dilute primers and other materials, unless specifically recommended by materials manufacturer. Keep containers closed except when removing contents. Do not mix remains of unlike materials. Thoroughly remove residual materials before using application equipment for mixing and transporting materials. Do not permit equipment on the project site that has residue of materials used on previous projects. Use cleaners only for cleaning, not for thinning primers or membrane materials. Ensure that workers and others who walk on cured membrane wear clean, soft-soled shoes to avoid damaging the waterproofing materials.

## 3.3 APPLICATION

Over primed surfaces, provide a uniform, wet, monolithic coating of fluid-applied membrane, 60 mils thick, plus or minus 5 mils by following manufacturer's printed instructions. Apply material by trowel, squeegee, roller, brush, spray apparatus, or other method recommended by membrane manufacturer. Check wet film thickness as specified in paragraph FILM THICKNESS and adjust application rate as necessary to provide a uniform coating of the thickness specified. Where possible, mark off surface to be coated in equal units to facilitate proper coverage. At expansion joints, control joints, prepared cracks, flashing, and terminations, carry membrane over preformed elastomeric sheet in a uniform 60 mil thick, plus or minus 5 mils, wet thickness to provide a monolithic coating. If membrane cures before next application, wipe previously applied membrane with a solvent to remove dirt and dust that could inhibit adhesion of overlapping membrane coat. Use solvent recommended by the membrane manufacturer, as approved.

### 3.3.1 Work Sequence

Perform work so that protection board is installed prior to using the waterproofed surface. Do not permanently install protection board until the membrane has passed the flood test specified under paragraph FLOOD TESTING. Move material storage areas as work progresses to prevent abuse of membrane and overloading of structural deck.

## 3.4 FIELD QUALITY CONTROL

### 3.4.1 Moisture Test

Prior to application of fluid-applied waterproofing, measure moisture content of substrate with a moisture meter in the presence of the Contracting Officer. Do not begin application until meter reading indicates "dry" range as per manufacturer's installation instructions.

### 3.4.2 Film Thickness

Measure wet film thickness every 100 square feet during application by placing flat metal plates on the substrate or using a mil-thickness gage especially manufactured for the purpose.

## 3.5 INFORMATION CARD

For each system application, provide a minimum 8-1/2 inch by 11 inch information card for facility records and a card laminated in plastic and

framed for interior display at access point, or a photoengraved 0.032 inch thick aluminum card for exterior display. Identify facility name and number; location; Contract number; approximate area; detailed 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 Contract information; membrane manufacturer warranty expiration, warranty reference number, and contact information. Install card at system access location as directed by the Contracting Officer and provide a paper copy to the Contracting Officer.

| FORM 1 | |
|---|---|
| FLUID-APPLIED WATERPROOFING SYSTEM COMPONENTS | |
| 1. Contract Number | |
| 2. Date Work Completed | |
| 3. Project Specification Designation | |
| 4. Substrate Material | |
| 5. Waterproofing | |
| a. Membrane | |
| b. Sealant | |
| c. Elastomeric Sheet | |
| d. Materials Manufacturer(s) | |
| 13. Wearing Surface Type | |
| Manufacturer's Name | |
| 14. Warranty | |
| a. Manufacturer warranty expiration | |
| b. Warranty reference number | |
| 15. Statement of Compliance or Exception | |
| Contractor's Signature | Date Signed |
| Inspector's Signature | Date Signed |

-- End of Section --

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SECTION 07 21 16

MINERAL FIBER BLANKET INSULATION
**08/23**

PART 1 GENERAL

1.1 REFERENCES

The publications listed 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 | (2023) 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 D3833/D3833M | (1996; R 2019) Standard Test Method for Water Vapor Transmission of Pressure-Sensitive Tapes |
| ASTM D5359 | (1998; R 2021) Standard Specification for Glass Cullet Recovered from Waste for Use in Manufacture of Glass Fiber |
| ASTM E84 | (2023) Standard Test Method for Surface Burning Characteristics of Building Materials |
| ASTM E136 | (2024b) 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 | (2017; Version 1.2) 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 ENERGY (DOE)

| | |
|---|---|
| Energy Star | (1992; R 2006) Energy Star Energy Efficiency Labeling System (FEMP) |

U.S. NATIONAL ARCHIVES AND RECORDS ADMINISTRATION (NARA)

| | |
|---|---|
| 29 CFR 1910.134 | Respiratory Protection |

UNDERWRITERS LABORATORIES (UL)

| | |
|---|---|
| UL 2818 | (2022) 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; G

Recycled Content for Insulation Materials; S

Energy Star Label for Insulation Materials; S

Pressure Sensitive Tape

Accessories

SD-07 Certificates

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, and a flame spread rating of 25 or less and a smoke developed rating of 150 or less when tested in accordance with ASTM E84.

Provide insulation with R-Value as indicated on drawings

2.1.1 Recycled Materials

Provide insulation materials containing the following minimum percentage of recycled material content by weight:

a. Fiberglass: 20 percent glass cullet complying with ASTM D5359

b. Mineral wool: 75 percent recovered materials content from slag

Provide data identifying percentage of recycled content for insulation materials.

2.1.2 Energy Star

Provide insulation materials that are Energy Star labeled. Provide data identifying Energy Star label for insulation materials.

2.1.3 Prohibited Materials

Do not provide asbestos-containing materials.

2.2 BLOCKING

Use only non-combustible materials meeting the requirements of ASTM E136 for blocking around heat producing devices.

2.3 PRESSURE SENSITIVE TAPE

As recommended by the vapor retarder manufacturer and having a water vapor permeance rating of one perm or less when tested in accordance with ASTM D3833/D3833M.

2.4 ACCESSORIES

2.4.1 Adhesive

As recommended by the insulation manufacturer. Provide non-aerosol adhesive products used on the interior of the building (defined as inside of the weatherproofing system) that meet either emissions requirements of CDPH SECTION 01350 (limit requirements for either office spaces regardless of space type) or VOC content requirements of SCAQMD Rule 1168. Provide aerosol adhesives used on the interior of the building that meet either emissions requirements of CDPH SECTION 01350 (use the office or classroom requirements, regardless of space type) or VOC content requirements of GS-36. Provide certification or validation of indoor air quality for adhesives.

2.4.2 Mechanical Fasteners

Corrosion resistant fasteners as recommended by the insulation manufacturer.

2.4.3 Wire Mesh

Corrosion resistant and as recommended by the insulation manufacturer.

PART 3 EXECUTION

3.1 EXISTING CONDITIONS

Before installing insulation, ensure that surfaces 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 Access Doors

Install permanent blocking to maintain accessibility to equipment or controls that require maintenance or adjustment.

## 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 conductors, that are not installed in conduit, between two layers of insulation.

#### 3.3.1.2 Continuity of Insulation

Install blanket insulation to butt tightly against adjoining blankets and to studs, headers and any obstructions. Provide continuity and integrity of insulation at corners, and wall to roof joints. 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 Sizing of Blankets

Provide only full width blankets when insulating between trusses, joists, or studs. Size width of blankets for a snug fit where trusses, joists or studs are irregularly spaced.

-- End of Section --

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SECTION 07 22 00

ROOF AND DECK INSULATION
**08/23**

PART 1 GENERAL

1.1 REFERENCES

The publications listed 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 C578 | (2023) Standard Specification for Rigid, Cellular Polystyrene Thermal Insulation |
| ASTM E84 | (2023) 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 |

SCIENTIFIC CERTIFICATION SYSTEMS (SCS)

| | |
|---|---|
| SCS | SCS Global Services (SCS) Indoor Advantage |

UNDERWRITERS LABORATORIES (UL)

| | |
|---|---|
| UL 1256 | (2002; Reprint Jul 2013) Fire Test of Roof Deck Constructions |
| UL 2818 | (2022) 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

Insulation Board Layout and Attachment; G

SD-03 Product Data

Insulation; G

Cover Board; G

Fasteners; G

Moisture Control; G

SD-06 Test Reports

Flame Spread Rating; G

SD-07 Certificates

Installer Qualifications; G

Acceptable Foam Blowing Agents; S

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 of fasteners on each board, transitions, tapered components, thicknesses of materials, and closure and termination conditions. Show locations of ridges, valleys, crickets. 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, perimeter, and corner 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 FIRE PERFORMANCE REQUIREMENTS

### 1.7.1 Insulation in Roof Systems

Comply with the requirements of ICC IBC or UL 1256. Roof insulation must have a flame spread rating of 75 or less when tested in accordance with ASTM E84. Additional documentation of compliance with flame spread rating is not required when insulation of the type used for this project as part of the specific roof assembly is listed and labeled as FM Class 1 approved.

### 1.7.2 Thermal Barrier Requirements

Separate polystyrene insulation from a steel deck with a thermal barrier of glass mat gypsum roof board or other approved barrier material in accordance with the requirements of the ICC IBC or FM 4450.

### 1.7.3 Fire Resistance Ratings for Roofs

Provide in accordance with ICC IBC Chapter 7 and Table 721.1(3) Min Fire and Smoke Protection For Floor and Roof Systems.

## 1.8 CERTIFICATIONS

Provide products 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 documentation from certification body.

## 1.9 DELIVERY, STORAGE, AND HANDLING

### 1.9.1 Delivery

Deliver materials to the project site in manufacturer's unopened and undamaged standard commercial containers bearing the following legible information:

a. Name of manufacturer

b. Brand designation

c. Specification number, type, and class, as applicable, where materials are covered by a referenced specification

Deliver materials in sufficient quantity to allow continuity of the work.

### 1.9.2 Storage and Handling

Store and handle materials in accordance with manufacturer's printed instructions. Protect from damage, exposure to open flame or other ignition sources, wetting, condensation, and moisture absorption. Keep materials wrapped and separated from off-gassing materials (such as drying paints and adhesives). Do not use materials that have visible moisture or biological growth. Store in an enclosed building or trailer that provides a dry, adequately ventilated environment. Replace damaged material with new material.

## 1.10 ENVIRONMENTAL CONDITIONS

As per manufacturer's recommendations or Government's instructions, 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

Cover completed work with cover board for the duration of construction. 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. Extruded Polystyrene (XPS) Board: In accordance with ASTM C578 REV A, Type IV or X.

### 2.1.2 Prohibited Materials

Products that contain high ozone depleting or high Global Warming Potential (GWP) blowing agents are prohibited. For a list of acceptable substitute foam blowing agents for the type of insulation used see https://www.epa.gov/snap/foam-blowing-agents. Provide validation of acceptable foam blowing agents that no prohibited materials are used.

### 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.

## 2.2 MOISTURE CONTROL

## 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 (https://www.approvalguide.com/) for Class I roof deck construction, and spaced to withstand uplift pressure of 90 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 90 psf in accordance with FM APP GUIDE.

PART 3 EXECUTION

3.1 EXAMINATION AND PREPARATION

3.1.1 Surface Inspection

Ensure surfaces are clean, smooth, and dry prior to application. Check roof deck surfaces, including surfaces sloped to roof drains and outlets, for defects before starting work.

The Contracting Officer will inspect and approve the surfaces immediately before starting installation. Prior to installing insulation, perform the following:

b. 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

To correct defects and inaccuracies in roof deck surface to eliminate poor drainage from hollow or low spots, perform the following:

d. Cover steel decks with a layer of insulation board of sufficient width to span the width of a deck rib opening, and in accordance with fire safety requirements. Secure with piercing or self-drilling, self-tapping fasteners of quantity and placement in accordance with FM APP GUIDE. Locate insulation joints parallel to ribs of deck on solid bearing surfaces only, not over open ribs.

3.2 INSULATION INSTALLATION

Apply insulation in layers with staggered joints. 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 Polystyrene Insulation

a. Over the top surface of non-composite polystyrene board, install 1/2 inch thick high density wood fiberboard, 3/4 inch thick expanded perlite board insulation, glass mat gypsum roof board, or other

overlayment approved by roofing sheet manufacturer. Tightly butt and stagger joints of field applied overlayment board at least 6 inches with respect to the polystyrene board below. Apply 6 inch wide glass fiber roofing tape centered over joints and edges of overlayment board.

## 3.3 PROTECTION

### 3.3.1 Protection of Applied Insulation

Completely cover each day's installation of insulation with finished roofing specified in 07 61 14.00 20 STANDING SEAM METAL ROOF 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 workday or whenever precipitation is imminent. Cutoffs must be two layers of bituminous-saturated felt set in plastic bituminous cement 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.

c. Verification of proper storage and handling of insulation and vapor retarder materials before, during, and after installation.

d. Inspection of vapor retarder application, including edge envelopes and mechanical fastening.

e. Inspection of mechanical fasteners; type, number, length, and spacing.

f. Coordination with other materials, cants, sleepers, and nailing strips.

g. Inspection of insulation joint orientation and laps between layers, joint width and bearing of edges of insulation on deck.

h. Installation of cutoffs and proper joining of work on subsequent days.

i. Continuation of complete roofing system installation to cover insulation installed same day.

j. Verification of required slope to each roof drain.

-- End of Section --

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SECTION 07 27 10

BUILDING AIR & WEATHER BARRIER SYSTEM
**08/23**

PART 1 GENERAL

1.1 SUMMARY

This Section specifies the construction and quality control of the installation of an air barrier system that will also function as a weather barrier. In this specification section, it is understood that the air barrier also will function as a weather barrier, to prevent the intrusion of liquid water and water vapor, and to drain it to the exterior.

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.

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 | (2022) Standard Test Method for Pull-Off Strength of Coatings Using Portable Adhesion Testers |
| ASTM E96/E96M | (2022a; E 2023) Standard Test Methods for Gravimetric Determination of Water Vapor Transmission Rate of Materials |
| ASTM E2178 | (2021a) Standard Test Method for Determining Air Leakage Rate and Calculation of Air Permeance of Building Materials |
| ASTM E2357 | (2018) Standard Test Method for Determining Air Leakage Rate of Air Barrier Assemblies |

NATIONAL FIRE PROTECTION ASSOCIATION (NFPA)

| | |
|---|---|
| NFPA 285 | (2023) Standard Fire Test Method for Evaluation of Fire Propagation |

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. For this project, the Air Barrier Envelope, or environmental separator, is defined as the exterior walls, roof and floor slab. 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 or produced to provide the primary resistance to airflow through an air barrier assembly of a building enclosure.

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

Material Samples For Air Barrier System; G

Manufacturer Data Sheet for ice & water shield product; G

SD-05 Design Data

Design Data And Calculations For The Air Barrier System; G

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 the following leakage requirements. Note that the following areas are used to calculate the area of the entire six-sided envelope:

Roof Area: 11,179 SF

Wall Area: 5,271 SF

Floor Slab Area: 10,845 SF.

The allowable leakage rate and the maximum leakage are at a differential test pressure of 75 Pa.

| Air Barrier Envelope | |
|---|---|
| Surface Area | 27,295 square feet |
| Architectural Only Test: | |
| Allowable leakage rate | 0.25 CFM/sq.ft |
| Maximum leakage | 6,824 total CFM |
| Architectural Plus HVAC System Test: | |
| Allowable leakage rate | 0.30 CFM/sq.ft |
| Maximum leakage | 88,189 total CFM |

## 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 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. Qualifications 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 performing the building pressurization test or another independent third-party entity, provided they meet the above requirements but must 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 a 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 and warranted air barrier system.

# PART 2 PRODUCTS

## 2.1 AIR BARRIER

Provide air barrier system of compatible parts from one or several manufacturers coordinated by the Contractor or provide a single warranted system provided by a primary manufacturer. The air barrier system as part of a tested exterior wall assembly must meet the conditions of acceptance as tested in accordance with NFPA 285. Materials used for roof assembly air barrier must conform to the appropriate UL and FM wind and fire requirements for the specified roof assemblies.

If a complete air barrier system from a single manufacturer is utilized, whether warranted or not warranted, the air barrier system must conform to ASTM E2357.

Materials in the following categories, as used in the air barrier system or assembly of the exterior wall system, are tested and are required to conform to ASTM E2178: Self-adhered sheet membranes, fluid applied membranes, spray polyurethane foam, mechanically fastened commercial building wrap, factory bonded membranes to sheathing, and adhesive backed commercial building wrap and accessory products.

Other materials used as an air barrier such as concrete, 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 they are not subject to material or environmental induced degradation in their final produced state once incorporated in the permanent construction.

All materials used must be identifiable through manufacturer testing data 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.

## 2.2 ICE & WATER SHIELD

Provide a self-adhering sheet membrane as an underlayment for the sloped roof. Provide manufacturer data sheet for ice & water shield product.

a. Cold applied, self adhering membrane shall be composed of a high strength polyethylene film coated on one side with a layer of rubberized asphalt adhesive and interwound with a disposable release sheet. An embossed, slip resistant surface is to be provided on the polyethylene surface. Color to be gray-black. Membrane thickness to be 40 mil. Maximum permeance to be 0.05 Perms. Install with a water-based primer.

# 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 and test to assure site conditions for application temperature, and dryness of substrates are within guidelines.

e. 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.

f. 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.

g. 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.

h. Measure application thickness of liquid applied materials to assure that manufacturer's specifications for the specific substrate are met.

i. Inspect to assure that the correct materials are installed for compatibility.

j. Inspect to assure proper transitions for change in direction and structural support at gaps.

k. Inspect to assure proper connection between assemblies (membrane and sealants) for cleaning, preparation and priming of surfaces, structural support, integrity and continuity of seal.

l. 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.

m. Provide cohesion tests for spray polyurethane foam (SPF).

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 --

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SECTION 07 42 13

METAL WALL AND SOFFIT PANELS
**05/11, CHG 2: 02/18**

PART 1 GENERAL

1.1 REFERENCES

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

AMERICAN ARCHITECTURAL MANUFACTURERS ASSOCIATION (AAMA)

| | |
|---|---|
| AAMA 501.1 | (2017) Standard Test Method for Water Penetration of Windows, Curtain Walls and Doors Using Dynamic Pressure |

AMERICAN IRON AND STEEL INSTITUTE (AISI)

| | |
|---|---|
| AISI S100 | (2016) North American Specification for the Design of Cold-Formed Steel Structural Members |

AMERICAN SOCIETY OF CIVIL ENGINEERS (ASCE)

| | |
|---|---|
| ASCE 7-16 | (2017; Errata 2018; Supp 1 2018) Minimum Design Loads and Associated Criteria for Buildings and Other Structures |

ASTM INTERNATIONAL (ASTM)

| | |
|---|---|
| ASTM B117 | (2019) Standard Practice for Operating Salt Spray (Fog) Apparatus |
| ASTM C920 | (2018) Standard Specification for Elastomeric Joint Sealants |
| ASTM D522/D522M | (2017) Mandrel Bend Test of Attached Organic Coatings |
| ASTM D523 | (2014; R 2018) Standard Test Method for Specular Gloss |
| ASTM D610 | (2008; R 2019) Standard Practice for Evaluating Degree of Rusting on Painted Steel Surfaces |
| ASTM D714 | (2002; R 2017) Standard Test Method for Evaluating Degree of Blistering of Paints |
| ASTM D822 | (2013; R 2018) Filtered Open-Flame Carbon-Arc Exposures of Paint and Related Coatings |
| ASTM D968 | (2022) Standard Test Methods for Abrasion Resistance of Organic Coatings by Falling |

| | |
|---|---|
| | Abrasive |
| ASTM D1308 | (2002; R 2013) Effect of Household Chemicals on Clear and Pigmented Organic Finishes |
| ASTM D1654 | (2008; R 2016; E 2017) Standard Test Method for Evaluation of Painted or Coated Specimens Subjected to Corrosive Environments |
| ASTM D2244 | (2021) Standard Practice for Calculation of Color Tolerances and Color Differences from Instrumentally Measured Color Coordinates |
| ASTM D2247 | (2015; R 2020) Standard Practice for Testing Water Resistance of Coatings in 100?Percent Relative Humidity |
| ASTM D2794 | (1993; R 2019) Standard Test Method for Resistance of Organic Coatings to the Effects of Rapid Deformation (Impact) |
| ASTM D3359 | (2017) Standard Test Methods for Rating Adhesion by Tape Test |
| ASTM D3363 | (2005; E 2011; R 2011; E 2012) Film Hardness by Pencil Test |
| ASTM D4214 | (2007; R 2015) Standard Test Method for Evaluating the Degree of Chalking of Exterior Paint Films |
| ASTM D4587 | (2011; R 2019; E 2019) Standard Practice for Fluorescent UV-Condensation Exposures of Paint and Related Coatings |
| ASTM D5894 | (2016) Standard Practice for Cyclic Salt Fog/UV Exposure of Painted Metal, (Alternating Exposures in a Fog/Dry Cabinet and a UV/Condensation Cabinet) |
| ASTM E84 | (2023) Standard Test Method for Surface Burning Characteristics of Building Materials |
| ASTM E331 | (2000; R 2023) Standard Test Method for Water Penetration of Exterior Windows, Skylights, Doors, and Curtain Walls by Uniform Static Air Pressure Difference |
| ASTM G152 | (2013; R 2021) Standard Practice for Operating Open Flame Carbon Arc Light Apparatus for Exposure of Nonmetallic Materials |
| ASTM G153 | (2013; R 2021) Standard Practice for Operating Enclosed Carbon Arc Light |

Apparatus for Exposure of Nonmetallic Materials

NATIONAL ASSOCIATION OF ARCHITECTURAL METAL MANUFACTURERS (NAAMM)

NAAMM AMP 500 (2006) Metal Finishes Manual

SHEET METAL AND AIR CONDITIONING CONTRACTORS' NATIONAL ASSOCIATION (SMACNA)

SMACNA 1793 (2012) Architectural Sheet Metal Manual, 7th Edition

UNDERWRITERS LABORATORIES (UL)

UL Bld Mat Dir (updated continuously online) Building Materials Directory

## 1.2 DEFINITIONS

Metal Wall Panel: Metal wall panels, attachment system components and accessories necessary for a complete weather-tight wall system.

## 1.3 DESCRIPTION OF WALL AND SOFFIT PANEL SYSTEMS

a. Wall Panels: At column wraps in front entry construction. Factory-formed and assembled metal panels fabricated from two metal facings that are bonded to a solid, extruded thermoplastic core, formed into profile for installation methods indicated. Include attachment assembly components and accessories required for weathertight system.

b. Metal soffit panels: Preformed aluminum flush panel soffit system.

### 1.3.1 Metal Wall Panel General Performance

Comply with performance requirements, conforming to AISI S100, without failure due to defective manufacture, fabrication, installation, or other defects in construction. Wall panels and accessory components must conform to the following standards:

ASTM D522/D522M for applied coatings

UL Bld Mat Dir

### 1.3.2 Water Penetration Under Static Pressure

No water penetration when tested according to ASTM E331.

### 1.3.3 Water Penetration Under Dynamic Pressure

No evidence of water leakage when tested according to AAMA 501.1.

## 1.4 SUBMITTALS

Government approval is required for submittals with a "G" or "S" classification. Submittals not having a "G" or "S" classification are for 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

Submit Documentation for the following items:

Qualification of Installation Contractor; G

Sample Warranty; G

SD-03 Product Data

Submit Manufacturer's catalog data for the following items:

Factory Color Finish

Closure Materials

Sealants and Caulking

Accessories

Soffits; G

Coating; G

SD-04 Samples

Submit as required each of the following samples:

Wall Panels, 12 inches long by actual panel width; G

Fasteners; G

Submit manufacturer's color charts and chips, approximately 4 by 4 inches, showing full range of colors, textures and patterns available for wall panels with factory applied finishes.Fasteners

SD-06 Test Reports

Submit test reports for the following in accordance with the referenced articles in this section.

Leakage Tests; G
Chalking Tests; G

SD-11 Closeout Submittals

Warranty; G

Maintenance Instructions; G

20 year "No Dollar Limit" warranty for labor and material

## 1.5 QUALITY ASSURANCE

### 1.5.1 Certified Qualification of Installation Contractor

The installation contractor must be approved and certified by the metal wall panel manufacturer prior to beginning the installation of the metal

wall panel system. Subcontracting by Certified Contractor for the metal wall panel work is not permitted.

1.5.2 Single Source

Obtain each type of metal wall panels, clips, closure materials and other accessories from the standard products of the single source from a single manufacturer to operate as a complete system for the intended use.

1.5.3 Manufacturer's Maintenance Instructions

Provide manufacturer's detailed written instructions including copies of Safety Data Sheets for maintenance and repair materials.

1.6 DELIVERY, HANDLING, AND STORAGE

Deliver and protect package components, sheets, metal wall panels, and other manufactured items to prevent damage or deformation during transportation and handling.

Unload, store, and erect metal wall panels in a manner to prevent bending, warping, twisting, and surface damage.

Stack and store metal wall panels horizontally on platforms or pallets, covered with suitable weather-tight and ventilated covering to ensure dryness, with positive slope for drainage of water. Do not store metal wall panels in contact with other materials that might cause staining, denting, or other surface damage.

Retain strippable protective covering on metal wall panel until actual installation.

1.7 PROJECT CONDITIONS

1.7.1 Field Measurements

Verify locations of wall framing and opening dimensions by field measurements before metal wall panel fabrication and indicate measurements on Shop Drawings.

1.7.2 Weather Limitations

Proceed with installation preparation only when existing and forecasted weather conditions permit Work to proceed without water entering into wall system or building.

1.8 WARRANTY

Warranty must conform to the Sample Warranty as reviewed and approved by the Contracting Officer.

1.8.1 20 Year "No Dollar Limit" Warranty for Labor and Material

Furnish manufacturer's no-dollar-limit warranty for the metal wall panel system. The warranty period is to be no less than 20 years from the date of Government acceptance of the work. The warranty is to be issued directly to the Government. The warranty is to provide that if within the warranty period the metal wall panel system shows evidence of corrosion, perforation, rupture or excess weathering due to deterioration of the wall

panel system resulting from defective materials and correction of the defective workmanship is to be the responsibility of the metal wall panel system manufacturer. Repairs that become necessary because of defective materials and workmanship while metal wall panel system is under warranty are to be performed within 24 hours after notification, unless additional time is approved by the Contracting Officer. Failure to perform repairs within 24 hours of notification will constitute grounds for having emergency repairs performed by others and not void the warranty.

## PART 2 PRODUCTS

### 2.1 Metal WALL PANELS

Factory-formed and assembled metal wall panels fabricated from two metal facings that are bonded to a solid, extruded thermoplastic core, formed into profile for installation methods indicated. Include attachment assembly components and accessories required for weathertight system.

#### 2.1.1 FABRICATION

Unless approved otherwise, fabricate and finish metal wall panels and accessories at the factory to greatest extent possible, by manufacturer's standard procedures and processes and as necessary to fulfill indicated and specified performance requirements. Comply with indicated profiles and with dimensional and structural requirements.

Provide panel profile, including major ribs and intermediate stiffening ribs, if any, for full length of panel. Fabricate metal wall panel side laps with factory-installed captive gaskets or separator strips that provide a tight seal and prevent metal-to-metal contact, in a manner that will seal weather-tight and minimize noise from movements within panel assembly.

a. Panel thickness: 0.157 inch

b. Core: Fire Retardent

c. Exterior Finish: PVDF Fluoropolymer: AAMA 2605. Fluoropolymer finish containing not less than 70 percent PVDF resin by weight in color coat. Prepare, pretreat, and apply coating to exposed metal surfaces to comply with coating and resin manufacturers' written instructions.

d. Color: As selected by Architect from Manufacturer's standard colors.

e. Attachment Assembly Components: Formed from extruded aluminum.

#### 2.1.2 Panel Accessories

Fabricate flashing and trim to comply with recommendations in SMACNA 1793 that apply to the design, dimensions, metal, and other characteristics of item indicated. Provide components required for a complete, weathertight panel system including trim, corner units, clips, flashings, sealants, gaskets, fillers, closure strips, and similar items. Match material and finish of metal panels unless otherwise indicated.

a. Miscellaneous Metal Subframing and Furring: ASTM C645, cold-formed, metallic-coated steel sheet ASTM A653/A653M, G90 (Z275 hot-dip galvanized) coating designation or ASTM A792/A792M, Class AZ50 (Class AZM150) aluminum-zinc-alloy coating designation unless otherwise

indicated. Provide Fabricator's standard sections as required for support and alignment of panel system.

b. Flashing and Trim: Provide flashing and trim formed from same material as metal panels as required to seal against weather and to provide finished appearance. Locations include, but are not limited to, corners, reveals, and fillers. Finish flashing and trim with same finish system as adjacent metal panels.

c. Panel fasteners: Self-tapping screws designed to withstand design loads. Provide exposed fasteners with heads matching color of metal panels by means of plastic caps or factory-applied coating. Provide PVC sealing washers for exposed fasteners.

d. Panel Sealants: ASTM C920; elastomeric polyurethane or silicone sealant; of type, grade, class, and use classifications required to seal joints in metal panels and remain weathertight; and as recommended in writing by metal panel manufacturer.

e. Fabricate cleats and attachment devices of size and metal thickness recommended by SMACNA 1793 or by metal wall panel manufacturer for application, but not less than thickness of metal being secured.

## 2.2 METAL PANEL SOFFITS

### 2.2.1 Flush Soffit Panels

a. Construction: .040 Aluminum.

b. Dimensions:

1. Panel thickness: 0.157 inch

2. Panel size: 12" wide X 1" hieght.

c. Exterior Finish: Manufacturer's standard 70% Kynar 500®/ Hylar 5000® polyvinylidenefluoride (PVDF), acrylic resins, pigments and solvents.

d. Color: As selected by Architect from Manufacturer's standard colors.

## 2.3 FINISH

### 2.3.1 Factory Color Finish

Comply with NAAMM AMP 500 for recommendations for applying and designating finishes. Noticeable variations in same piece are not acceptable. Variations in appearance of adjoining components are acceptable if they are within the range of approved samples and are assembled or installed to minimize contrast.

All panels are to receive a factory-applied PVDF Fluoropolymer polyvinylidene fluoride (for metal panel trim material at column wraps, and Kynar 500/Hylar 5000 (for metal soffit panels)Kynar 500/Hylar 5000 finish consisting of a baked-on top-coat with a manufacturer's recommended prime coat conforming to the following:

2.3.1.1 Metal Preparation

Carefully prepare all metal surface for painting on a continuous process coil coating line by alkali cleaning, hot water rinsing, application of chemical conversion coating, cold water rinsing, sealing with acid rinse, and thorough drying.

2.3.1.2 Prime Coating

Apply a base coat of epoxy paint, specifically formulated to interact with the top-coat, to the prepared surfaces by roll coating to a dry film thickness of 0.20 plus 0.05 mils. Prime coat must be oven cured prior to application of finish coat.

2.3.1.3 Exterior Finish Coating

Roll coat the finish coating over the primer by roll coating to dry film thickness of 0.80 plus 5 mils (3.80 plus 0.50 mils for Vinyl Plastisol) for a total dry film thickness of 1.00 plus 0.10 mils (4.00 plus 0.10 mils for Vinyl Plastisol). Oven-cure finish coat.

2.3.1.4 Interior Finish Coating

Apply a wash-coat on the reverse side over the primer by roll coating to a dry film thickness of 0.30 plus 0.05 mils for a total dry film thickness of 0.50 plus 0.10 mils. Oven-cured the wash coat.

2.3.1.5 Color

Provide exterior finish color as Standard White color as selected by the Contracting Officer from the manufacturer's standard color chart.

2.3.1.6 Physical Properties

coating must conform to the industry and manufacturer's standard performance criteria as listed by the following certified test reports:

| | |
|---|---|
| General: | ASTM D5894 and ASTM D4587 |
| Abrasion: | ASTM D968 |
| Adhesion: | ASTM D3359 |
| Chalking: | ASTM D4214 |
| Chemical Pollution: | ASTM D1308 |
| Color Change and Conformity: | ASTM D2244 |
| Creepage: | ASTM D1654 |
| Cyclic Corrosion Test: | ASTM D5894 |
| Flame Spread: | ASTM E84 |
| Flexibility: | ASTM D522/D522M |

| | |
|---|---|
| Formability: | ASTM D522/D522M |
| Gloss at 60 and 85 degrees: | ASTM D523 |
| Humidity: | ASTM D2247 and ASTM D714 |
| Oxidation: | ASTM D610 |
| Pencil Hardness: | ASTM D3363 |
| Reverse Impact: | ASTM D2794 |
| Salt Spray: | ASTM B117 |
| Weatherometer: | ASTM G152, ASTM G153 and ASTM D822 |

## 2.4 ACCESSORIES

### 2.4.1 Joint Sealants

#### 2.4.1.1 Sealants and Caulking

Provide approved gun type sealants for use in hand- or air-pressure caulking guns at temperatures above 40 degrees F (or frost-free application at temperatures above 10 degrees F with minimum solid content of 85 percent of the total volume. Sealants must dry with a tough, durable surface skin which permit remaining soft and pliable underneath, providing a weather-tight joint. No migratory staining is permitted on masonry.

Prime all joints receiving sealants with a compatible one-component or two-component primer as recommended by the wall panel manufacturer.

#### 2.4.1.2 Field-Applied

Sealant for field-applied caulking must be an approved gun grade, non-sag one component polysulfide or two-component polyurethane with an initial maximum Shore A durometer hardness of 25, and conforming to ASTM C920, Type II. Color to match panel colors.

#### 2.4.1.3 Pressure Sensitive Tape

Provide pressure sensitive tape sealant, 100 percent solid with a release paper backing; permanently elastic, non-sagging, non-toxic and non-staining as approved by the wall panel manufacturer.

## 2.5 REPAIR OF FINISH PROTECTION

Repair paint for color finish enameled wall or soffit panel must be compatible paint of the same formula and color as the specified finish furnished by the wall panel manufacturer.

## PART 3 EXECUTION

### 3.1 EXAMINATION

Examine substrates, areas, and conditions, with Installer present, for compliance with requirements for installation tolerances, metal wall panel supports, and other conditions affecting performance of the Work.

Examine primary and secondary wall framing to verify that structural panel support members and anchorages have been installed within alignment tolerances required by metal wall panel manufacturer, UL, ASTM, ASCE 7-16 and as required for the geographical area where construction will take place.

### 3.2 PREPARATION

Clean substrates of substances. Miscellaneous framing installation, including furring, and other miscellaneous wall panel support members and anchorage must be according to metal wall panel manufacturer's written instructions.

### 3.3 METAL PANEL INSTALLATION

Sheets are not to be subjected to overloading, abuse, or undue impact. Bent, chipped, or defective sheets shall not be applied.

Sheets must be erected true and plumb and in exact alignment with the horizontal and vertical edges of the building, securely anchored, and with the indicated eave, and sill.

Work is to allow for thermal movement of the wall panel, movement of the building structure, and to provide permanent freedom from noise due to wind pressure.

Field cutting metal panels by torch is not permitted.

#### 3.3.1 Metal Protection

Where dissimilar metals will contact each other or corrosive substrates, protect against galvanic action by painting contact surfaces with bituminous coating, by applying rubberized-asphalt underlayment to each contact surface, or by other permanent separation as recommended by metal wall panel manufacturer.

#### 3.3.2 Joint Sealers

Install gaskets, joint fillers, and sealants where indicated and where required for weatherproof performance of metal wall panel assemblies. Provide types of gaskets, fillers, and sealants indicated or, if not indicated, types recommended by metal wall panel manufacturer.

### 3.4 FASTENER INSTALLATION

Anchor metal wall panels and other components of the Work securely in place, using manufacturer's approved fasteners according to manufacturers' written instructions.

## 3.5 FLASHING, TRIM AND CLOSURE INSTALLATION

### 3.5.1 General Requirements

Comply with performance requirements, manufacturer's written installation instructions, and SMACNA 1793. Provide concealed fasteners where possible, and set units true to line and level as indicated. Install work with laps, joints, and seams to form permanently watertight and weather resistant.

Install sheet metal work is to form weather-tight construction without waves, warps, buckles, fastening stresses or distortion, and allow for expansion and contraction. Cutting, fitting, drilling, and other operations in connection with sheet metal required to accommodate the work of other trades is to be performed by sheet metal mechanics.

### 3.5.2 Metal Flashing

Exposed flashing and flashing subject to rain penetration to be bedded in the specified joint sealant.

Isolate flashing which is in contact with dissimilar metals by means of the specified asphalt mastic material to prevent electrolytic deterioration.

### 3.5.3 Closures

Install metal closure strips at open ends of corrugated or ribbed pattern walls, and at intersection of wall and wall unless open ends are concealed with formed eave flashing; and in other required areas.

Install mastic closure strips at intersection of the wall with metal walling; top and bottom of metal siding; heads of wall openings; and in other required locations.

## 3.6 WORKMANSHIP

Make lines, arises, and angles sharp and true. Free exposed surfaces from visible wave, warp, buckle, and tool marks. Fold back exposed edges neatly to form a 1/2 inch hem on the concealed side. Make sheet metal exposed to the weather watertight with provisions for expansion and contraction.

Make surfaces to receive sheet metal plumb and true, clean, even, smooth, dry, and free of defects and projections which might affect the application. For installation of items not shown in detail or not covered by specifications conform to the applicable requirements of SMACNA 1793. Provide sheet metal flashing in the angles formed where roof decks abut walls, curbs, ventilators, pipes, or other vertical surfaces and wherever indicated and necessary to make the work watertight.

## 3.7 ACCEPTANCE PROVISIONS

### 3.7.1 Erection Tolerances

Erect metal wall panels straight and true with plumb vertical lines correctly lapped and secured in accordance with the manufacturer's written instructions.

3.7.2 Leakage Tests

Finished application of metal wall panels are to be subject to inspection and test for leakage by request of the Contracting Officer, Architect/Engineer. Conduct inspection and tests at no cost to the Government.

Inspection and testing is to be made promptly after erection to permit correction of defects and the removal and replacement of defective materials.

3.7.3 Repairs to Finish

Scratches, abrasions, and minor surface defects of finish may be repaired with the specified repair materials. Finished repaired surfaces must be uniform and free from variations of color and surface texture.

Repaired metal surfaces that are not acceptable to the project requirements and or Contracting Officer are to be immediately removed and replaced with new material.

3.8 FIELD QUALITY CONTROL

3.8.1 Construction Monitoring

Make visual inspections as necessary to ensure compliance with specified requirements. Additionally, verify the following:

a. Materials comply with the specified requirements.

b. All materials are properly stored, handled and protected from damage. Damaged materials are removed from the site.

c. Framing and substrates are in acceptable condition, in compliance with specification, prior to application of wall panels.

d. Panels are installed without buckles, ripples, or waves and in uniform alignment and modulus.

e. Side laps are formed, sealed, fastened or seam locked as required.

f. The proper number, type, and spacing of attachment clips and fasteners are installed.

g. Installer adheres to specified and detailed application parameters.

h. Associated flashing and sheet metal are installed in a timely manner in accord with the specified requirements.

3.9 CLEAN-UP AND DISPOSAL

Clean all exposed sheet metal work at completion of installation. Remove metal shavings, filings, nails, bolts, and wires from work area. Remove grease and oil films, excess sealants, handling marks, contamination from steel wool, fittings and drilling debris and scrub the work clean. Exposed metal surfaces must be free of dents, creases, waves, scratch

marks, solder or weld marks, and damage to the finish coating.

Collect and place scrap/waste materials in containers. Promptly dispose of demolished materials. Do not allow demolished materials to accumulate on-site; transport demolished materials from government property and legally dispose of them.

-- End of Section --

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SECTION 07 60 00

FLASHING AND SHEET METAL
**08/23**

PART 1 GENERAL

1.1 REFERENCES

The publications listed 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 | (2023a) Standard Specification for General Requirements for Flat-Rolled Stainless and Heat-Resisting Steel Plate, Sheet, and Strip |
| ASTM A653/A653M | (2023) Standard Specification for Steel Sheet, Zinc-Coated (Galvanized) or Zinc-Iron Alloy-Coated (Galvannealed) by the Hot-Dip Process |
| ASTM A792/A792M | (2022) Standard Specification for Steel Sheet, 55% Aluminum-Zinc Alloy-Coated by the Hot-Dip Process |
| ASTM B32 | (2020) Standard Specification for Solder Metal |
| ASTM B69 | (2021) Standard Specification for Rolled Zinc |
| ASTM B101 | (2022) Standard Specification for Lead-Coated Copper Sheet and Strip for Building Construction |
| ASTM B209/B209M | (2021a) 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 B370 | (2022) Standard Specification for Copper Sheet and Strip for Building Construction |

| | |
|---|---|
| ASTM D1784 | (2020) Standard Specification for Rigid Poly(Vinyl Chloride) (PVC) Compounds and Chlorinated Poly(Vinyl Chloride) (CPVC) Compounds |
| ASTM D4586/D4586M | (2007; R 2018) Asphalt Roof Cement, Asbestos-Free |
| ASTM E2112 | (2023) Standard Practice for Installation of Exterior Windows, Doors and Skylights |

NATIONAL ROOFING CONTRACTORS ASSOCIATION (NRCA)

| | |
|---|---|
| NRCA 0429 | (2022) The NRCA Roofing Manual: Architectural Metal Flashing, Condensation and Air Leakage Control and Reroofing |

SHEET METAL AND AIR CONDITIONING CONTRACTORS' NATIONAL ASSOCIATION (SMACNA)

| | |
|---|---|
| SMACNA 1793 | (2012) Architectural Sheet Metal Manual, 7th Edition |

SINGLE PLY ROOFING INDUSTRY (SPRI)

| | |
|---|---|
| ANSI/SPRI/FM 4435/ES-1 | (2017) Test Standard for Edge Systems Used with Low Slope Roofing Systems |

## 1.2 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 work to permit continuous, uninterrupted roofing operations.

### 1.2.1 General Material Requirements

All materials specified in this Section installed in conjunction with the roofing system must be provided by the roofing system manufacturer, or by a manufacturer approved by the roofing system manufacturer for use in the roofing system, and must form a part of the Warranty as required by the applicable roofing system Section.

### 1.2.2 Additional Wind Uplift Requirements

All flashing and edge materials specified in this Section must be installed in conjunction with the requirements of the roofing system to meet the requirements of ES-1 wind uplift. Details must include but not limited to ANSI/SPRI/FM 4435/ES-1 (ES-1), "Wind Test Design Standard for Edge Systems" used with Low Slope Roofing Systems, Test Methods: RE-1, RE-2 and RE-3 using uplift roofing details of the NRCA 0429.

## 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

Gutters; G

Downspouts; G

Flashing at Roof Penetrations and Equipment Supports; G

Open Valley Flashing; G

Eave Flashing; G

SD-04 Samples

Finish Samples; 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.

## 1.5 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 MATERIALS

Use any metal listed by NRCA 0429 or SMACNA 1793 for a particular item, unless otherwise indicated. Provide materials and configurations in accordance with NRCA 0429 or SMACNA 1793 for each material, while also meeting the minimum thickness requirements specified in this Section. Different items need not be of the same metal, except that contact between dissimilar metals must be avoided.

Provide 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:

2.1.1 Exposed Sheet Metal Items

Provide exposed sheet metal items of the same material. Consider the following as exposed sheet metal: gutters, including hangers; downspouts; cap, valley, steeped, base, and eave flashings and related accessories.

2.1.2 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.

2.1.3 Copper, Sheet and Strip

Provide in accordance with ASTM B370, cold-rolled temper, H 00 (standard).

2.1.4 Lead-Coated Copper Sheet

Provide in accordance with ASTM B101.

2.1.5 Lead Sheet

Provide in a minimum weight of 4 pounds per square foot.

2.1.6 Steel Sheet, Zinc-Coated (Galvanized)

Provide in accordance with ASTM A653/A653M, a minimum of 24 gauge, and a minimum zinc coat weighting of 90 ounces per square feet.

2.1.7 Zinc Sheet and Strip

Provide in accordance with ASTM B69, Type I, a minimum of 0.024 inch thick.

2.1.8 Steel Sheet, Aluminum Zinc-Coated

Provide in accordance with ASTM A792/A792M, a minimum of 24 gauge.

2.1.9 Stainless Steel

Provide in accordance with ASTM A480/A480M, Type 302 or 304, 2D Finish, fully annealed, dead-soft temper, a minimum of 24 gauge.

2.1.10 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.

2.1.11 Aluminum Alloy Sheet and Plate

Provide in accordance with ASTM B209/B209M anodized clear form alloy, and temper appropriate for use. Provide material not less than 0.065-in in thickness.

2.1.12 Finishes

Provide exposed exterior sheet metal and aluminum with a baked on, factory applied coil fluoropolymer color coating or approved equal siliconized polyester coating. Dry film thickness of coatings must be 0.8 to 1.3 mils. Color to be selected from. Field applications of color coatings are prohibited and will be rejected.

2.1.13 Aluminum Alloy, Extruded Bars, Rods, Shapes, and Tubes

ASTM B221.

2.1.14 Solder

Provide in accordance with ASTM B32, 95-5 tin-antimony.

2.1.15 Reglets

2.1.15.1 Polyvinyl Chloride Reglets

Provide in accordance with ASTM D1784, Type II, Grade 1, Class 14333-D, 0.075 inch minimum thickness.

2.1.15.2 Metal Reglets

Provide factory fabricated caulked type or friction type reglets with a minimum opening of 1/4 inch and a depth of 1-1/4 inch, as approved.

2.1.15.2.1 Caulked Reglets

Provide with rounded edges, temporary reinforcing cores, and accessories as required for securing to adjacent construction. Provide built-up mitered corner pieces for inside and outside corners.

2.1.15.2.2 Friction Reglets

Provide with flashing receiving slots not less than 5/8 inch deep, one inch jointing tongues, and upper and lower anchoring flanges installed at 24 inch maximum snap-lock type receiver.

2.1.16 Bird Spikes

Provide 304 stainless steel spikes on flat ledge at entry portico with max. 2 1/2" spacing between spikes. Spikes to be max. 6" in height. Bird spikes to come assembled in strips; screw attach thru flashing to brick soldier course; seal penetrations with urethane sealant to prevent leakage.

2.1.17 Bituminous Plastic Cement

Provide in accordance with ASTM D4586/D4586M, Type I.

2.1.18 Fasteners

Use stainless steel fasteners to fasten. 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 Cleats

Provide cleats for sheet metal 18 inches and over in width. Space cleats evenly not over 12 inches on center unless otherwise specified or indicated. Unless otherwise specified, provide cleats of 2 inches wide by 3 inches long and of the same material and thickness as the sheet metal being installed. Secure one end of the cleat with two nails and the cleat folded back over the nailheads. Lock the other end into the seam. Pre-tin cleats for soldered seams.

3.1.3 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.

3.1.4 Seams

Straight and uniform in width and height with no solder showing on the face.

3.1.4.1 Loose-Lock Expansion Seams

Not less than 3 inches wide; provide minimum one inch movement within the joint. Completely fill the joints with the specified sealant, applied at not less than 1/8 inch thick bed.

3.1.5 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.

3.1.5.1 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.

3.1.6 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.

3.1.6.1 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.

3.1.6.2 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.

3.1.7 Protection from Contact with Dissimilar Materials

3.1.7.1 Copper or Copper-bearing Alloys

Paint with heavy-bodied bituminous paint surfaces in contact with dissimilar metal, or separate the surfaces by means of moistureproof building felts.

3.1.7.2 Aluminum

Do not allow aluminum surfaces in direct contact with other metals except stainless steel, zinc, or zinc coating. Where aluminum contacts another metal, paint the dissimilar metal with a primer followed by two coats of aluminum paint. Where drainage from a dissimilar metal passes over aluminum, paint the dissimilar metal with a non-lead pigmented paint.

3.1.7.3 Metal Surfaces

Paint surfaces in contact with masonry materials with alkali-resistant coatings such as heavy-bodied bituminous paint.

3.1.8 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.

3.1.9 Base Flashing

Extend up vertical surfaces of the flashing not less than 8 inches and not less than inches the roof covering. Where finish wall coverings form a counterflashing, extend the vertical leg of the flashing up behind the applied wall covering not less than 6 inches. Overlap the flashing strips with the previously laid flashing not less than 3 inches. Fasten the strips at their upper edge to the deck. Horizontal flashing at vertical surfaces must extend vertically above the roof surface and fastened at their upper edge to the deck a minimum of 6 inches on center with a minimum of 2 inch lap of any surface. Solder end laps and provide for expansion and contraction. Extend the metal flashing over crickets at the up-slope side of vertical surfaces extending through sloping roofs. Extend the metal flashings onto the roof covering not less than 4.5 inches at the lower side of vertical surfaces extending through the roof decks. Install and fit the flashings so as to be completely weathertight. Provide factory-fabricated base flashing for interior and exterior corners..

3.1.10 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. Fill caulked-type reglets or raked joints which receive counterflashing with caulking compound. Install counterflashing to provide a spring action against base flashing.

3.1.11 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.

3.1.11.1 Caulked Reglets

Wedge flashing in reglets with lead wedges every 18 inches, caulked full and solid with an approved compound.

3.1.11.2 Friction Reglets

Install flashing snap lock receivers at 24 inches on center maximum. When flashing has been inserted the full depth of the slot, caulk the slot, lock, and fill with sealant.

3.1.12 Gutters

The hung type of shape indicated and supported on underside by brackets that permit free thermal movement of the gutter. Provide gutters in sizes indicated complete with mitered corners, end caps, outlets, brackets, and other accessories necessary for installation. Bead with hemmed edge or reinforce the outer edge of gutter with a stiffening bar not less than 3/4 by 3/16 inch of material compatible with gutter. Fabricate gutters in sections not less than 8 feet. Lap the sections a minimum of one inch in the direction of flow or provide with concealed splice plate 6 inches minimum. Join the gutters, other than aluminum, by riveted and soldered joints. Join aluminum gutters with riveted sealed joints. Provide expansion-type slip joints midway between outlets. Install gutters below slope line of the roof. Support gutters on by cleats spaced not less than 36 inches apart. Adjust gutters to slope uniformly to outlets, with high points occurring midway between outlets. Fabricate hangers and fastenings from compatible metals.

3.1.13 Downspouts

Space supports for downspouts according to the manufacturer's recommendation for the masonry 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.

3.1.13.1 Terminations

Provide downspouts terminating in splash blocks with elbow-type fittings. Provide splash pans as specified.

3.1.14 Open Valley Flashing

Provide valley flashing free of longitudinal seams, of width sufficient to extend not less than 6 inches under the roof covering on each side. Provide a 1/2 inch fold on each side of the valley flashing. Lap the sheets not less than 6 inches in the direction of flow and secure to roofing construction with cleats attached to the fold on each side. Nail the tops of sheets to roof sheathing. Space the cleats not more than 12 inches on center. Provide exposed flashing not less than 4 inches in width at the top and increase one inch in width for each additional 8 feet in length. Where the slope of the valley is 4.5 inches or less per foot, or the intersecting roofs are on different slopes, provide an inverted V-joint, one inch high, along the centerline of the valley; and extend the edge of the valley sheets 8 inches under the roof covering on each side.

3.1.15 Eave Flashing

One piece in width, applied in 8 to 10 foot lengths with expansion joints spaced as specified in paragraph EXPANSION AND CONTRACTION. Provide a 3/4

inch continuous fold in the upper edge of the sheet to engage cleats spaced not more than 10 inches on center. Locate the upper edge of flashing not less than 18 inches from the outside face of the building, measured along the roof slope. Fold lower edge of the flashing over and loose-lock into a continuous edge strip on the fascia. Where eave flashing intersects metal valley flashing, secure with one inch flat locked joints with cleats that are 10 inches on center.

3.1.16 Flashing at Wall Openings

Install pan flashing in the rough opening sill at all penetrations in the exterior wall assemblies, such as louvers. Pan sill flashing must have end dams at both jambs a minimum of 2 in high and a rear dam of 2 in high. Flashing must comply with ASTM E2112 and SMACNA 1793.

3.1.17 Expansion Joints

Provide expansion joints in continuous sheet metal at 40 foot intervals for copper and stainless steel and at 32 foot intervals for aluminum,. Provide evenly spaced joints. 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 spacing. Conform to the requirements of Table I.

3.1.18 Flashing at Roof Penetrations and Equipment Supports

Provide metal flashing for all pipes, ducts, and conduits projecting through the roof surface and for equipment supports and similar items supported by or attached to the roof deck.

3.1.19 Single Pipe Vents

See Table I, footnote (d).

3.1.20 Through Wall Flashing

Provide through wall flashing as required in the applicable wall system Sections.

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 dissimilar sheet metals in contact to separate and deter galvanic interactions.

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

### 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. Provide 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-Coa Stainless Steel, inch | Zinc-Coated Steel, U.S. Std. Gage |
|---|---|---|---|---|---|
| | | | | | |
| Downspouts and leaders | 16 | .032 | .015 | .015 | 24 |
| Downspout clips and anchors | - | .040 clip .125 anchor | - | - | - |
| Downspout straps, 2-inch | 48 (a) | .060 | .050 | - | - |
| Flashings: | | | | | |
| Base | 20 | .040 | .018 | .018 | 24 |
| Cap (Counter-flashing) | 16 | .032 | .015 | .015 | 26 |
| Eave | 16 | - | .015 | .015 | 24 |
| Valley | 16 | .032 | .015 | .015 | - |
| Pipe vent sleave (d) | | | | | |
| Sheets, smooth | 20 | .050 | .018 | .018 | 24 |
| Edge strip | 24 | .050 | .025 | - | - |
| Gutters: | | | | | |
| Gutter section | 16 | .032 | .015 | .015 | 24 |
| Continuous cleat | 16 | .032 | .015 | .015 | 24 |

TABLE I. SHEET METAL WEIGHTS, THICKNESSES, AND GAGES

| Sheet Metal Items | Copper kilograms per square foot | Aluminum, inch | Stainless Steel, inch | Terne-Coa Stainless Steel, inch | Zinc-Coate Steel, U.S. Std. Gage |
|---|---|---|---|---|---|
| Hangers, dimensions | 1 inch by 1/8 inch (a) | 1 inch by .080 inch (c) | 1 inch by inch | - | - |
| Reglets (c) | 10 | - | .010 | .010 | - |

(a) Brass

(b) Not Used

(c) May be polyvinyl chloride.

(d) 2.5 pound minimum lead sleeve with 4 inch flange. Where lead sleeve is impractical, refer to paragraph SINGLE PIPE VENTS for optional material.

TABLE II. SHEET METAL JOINTS

| | TYPE OF JOINT | | |
|---|---|---|---|
| Item Designation | Copper, Terne-Coated Stainless Steel, Zinc-Coated Steel and Stainless Steel | Aluminum | Remarks |
| Flashings | | | |
| Base | One inch 3 inch lap for expansion joint | One inch flat locked, soldered; sealed; 3 inch lap for expansion joint | Aluminum manufacturer's recommended hard setting sealant for locked aluminum joints. Fill each metal expansion joint with a joint sealing compound. |
| 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. |
| Eave | One inch flat locked, cleated. One inch loose locked, sealed expansion joint, cleated. | One inch flat locked, locked, cleated one inch loose locked, sealed expansion joints, cleated | Same as base flashing. |
| Valley | 6 inch lap cleated | 6 inch lap cleated | -- |
| Edge strip | Butt | Butt | -- |
| | | | |
| 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 |
| Gutters | 1.5 inch lap, riveted and soldered | One inch flat locked riveted and sealed | Aluminum producers recommended hard setting sealant for locked aluminum joints. |
| (a) Provide a 3 inch lap elastomeric flashing with manufacturer's recommended sealant. | | | |
| (b) Seal Polyvinyl chloride reglet with manufacturer's recommended sealant. | | | |

-- End of Section --

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SECTION 07 61 14.00 20

STEEL STANDING SEAM ROOFING
**08/16, CHG 1: 08/18**

PART 1 GENERAL

1.1 REFERENCES

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

AMERICAN IRON AND STEEL INSTITUTE (AISI)

| | |
|---|---|
| AISI SG03-3 | (2002; Suppl 2001-2004; R 2008) Cold-Formed Steel Design Manual Set |

ASTM INTERNATIONAL (ASTM)

| | |
|---|---|
| ASTM A36/A36M | (2019) Standard Specification for Carbon Structural Steel |
| ASTM A653/A653M | (2023) Standard Specification for Steel Sheet, Zinc-Coated (Galvanized) or Zinc-Iron Alloy-Coated (Galvannealed) by the Hot-Dip Process |
| ASTM A792/A792M | (2022) Standard Specification for Steel Sheet, 55% Aluminum-Zinc Alloy-Coated by the Hot-Dip Process |
| ASTM A1008/A1008M | (2023) 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 | (2023) Standard Specification for Steel Sheet and Strip, Hot-Rolled, Carbon, Structural, High-Strength Low-Alloy, High-Strength Low-Alloy with Improved Formability, and Ultra-High Strength |
| ASTM B117 | (2019) Standard Practice for Operating Salt Spray (Fog) Apparatus |
| ASTM D522/D522M | (2017) Mandrel Bend Test of Attached Organic Coatings |
| ASTM D523 | (2014; R 2018) Standard Test Method for Specular Gloss |
| ASTM D714 | (2002; R 2017) Standard Test Method for Evaluating Degree of Blistering of Paints |
| ASTM D968 | (2022) Standard Test Methods for Abrasion Resistance of Organic Coatings by Falling |

Abrasive

ASTM D1654 (2008; R 2016; E 2017) Standard Test Method for Evaluation of Painted or Coated Specimens Subjected to Corrosive Environments

ASTM D2244 (2021) Standard Practice for Calculation of Color Tolerances and Color Differences from Instrumentally Measured Color Coordinates

ASTM D2247 (2015; R 2020) Standard Practice for Testing Water Resistance of Coatings in 100?Percent Relative Humidity

ASTM D4214 (2007; R 2015) Standard Test Method for Evaluating the Degree of Chalking of Exterior Paint Films

ASTM E1592 (2017) Standard Test Method for Structural Performance of Sheet Metal Roof and Siding Systems by Uniform Static Air Pressure Difference

ASTM G152 (2013; R 2021) Standard Practice for Operating Open Flame Carbon Arc Light Apparatus for Exposure of Nonmetallic Materials

ASTM G153 (2013; R 2021) Standard Practice for Operating Enclosed Carbon Arc Light Apparatus for Exposure of Nonmetallic Materials

SHEET METAL AND AIR CONDITIONING CONTRACTORS' NATIONAL ASSOCIATION (SMACNA)

SMACNA 1793 (2012) Architectural Sheet Metal Manual, 7th Edition

U.S. DEPARTMENT OF ENERGY (DOE)

Energy Star (1992; R 2006) Energy Star Energy Efficiency Labeling System (FEMP)

## 1.2 DEFINITIONS

### 1.2.1 Snap Together Seam

Panels so configured that the male and female portions of the seam interlock through the application of foot pressure or tamping with a mallet. Snap-on cap configurations are a type of snap together system.

### 1.2.2 Pre-Formed

Formed to the final, less field-formed seam, profile and configuration in the factory.

1.2.3 Roofing System

The roofing system is defined as the assembly of roofing components, including roofing panels, flashing, fasteners, and accessories which, when assembled properly result in a watertight installation.

1.2.4 SSMRS

Standing Seam Metal Roof System (SSMRS) is abbreviation of the entire roof system specified herein with all components and parts coming from a single manufacturer's system.

1.3 SYSTEM DESCRIPTION

1.3.1 Design Requirements

a. Panels must be continuous lengths up to manufacturer's standard longest lengths, with no joints or seams, except where indicated or specified. Ribs of adjoining sheets must be in continuous contact from eave to ridge. Individual panels of snap together type systems must be removable for replacement of damaged material.

b. There must be no exposed or penetrating fasteners except where shown on approved shop drawings. Fasteners into steel must be stainless steel. There must be a minimum of two fasteners per clip. Single fasteners will be allowed when supporting structural members are prepunched or predrilled.

c. Snap together type systems must have a capillary break and a positive side lap locking device. Field-formed seam type systems must be mechanically locked closed by the manufacturer's locking tool. The seam must include a continuous factory applied sealant when required by the manufacturer to withstand the wind loads specified.

d. Roof panel anchor clips must be concealed and designed to allow for longitudinal thermal movement of the panels, except where specific fixed points are indicated. Provide for lateral thermal movement in panel configuration or with clips designed for lateral and longitudinal movement.

1.3.2 Design Conditions

Design the system to resist positive and negative loads specified herein in accordance with the AISI SG03-3. Panels must support walking loads without permanent distortion or telegraphing of the structural supports.

1.3.2.1 Wind Uplift

Compute and apply the design uplift pressures for the roof system using a basic wind speed of 154 miles per hour (mph). Roof system and attachments must resist the following wind loads, in pounds per square foot (psf):

| | Negative |
|---|---|
| a. At eaves | 100 |

| | |
|---|---|
| b. At ridge | 130 |
| c. At building corners | 130 |
| c. At central areas | 90 |

The design uplift force for each connection assembly must be that pressure given for the area under consideration, multiplied by the tributary load area of the connection assembly, and multiplied by the appropriate factor of safety, as follows:

a. Single fastener in a connection: 3.0

b. Two or more fasteners in each connection: 2.25

1.3.2.2 Roof Live Loads

Loads must be applied on the horizontal projection of the roof structure. The minimum roof design live load must be 20 psf.

1.3.2.3 Thermal Movement

System must be capable of withstanding thermal movement based on a temperature range of 10 degrees F and 140 degrees F.

1.3.2.4 Deflection

Panels must be capable of supporting design loads between unsupported spans with deflection of not greater than L/180 of the span.

1.3.3 Structural Performance

The structural performance test methods and requirements of the Standing Seam Roofing Systems (SSRS) must be in accordance with ASTM E1592.

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

Roofing; G

SD-03 Product Data

Roofing Panels; G

Energy Star Label for Steel Roofing Product; S

Recycled Content for Steel Roofing Product; S

Attachment Clips

Accessories

Fasteners

Sealants

Sample Warranty Certificate; G

Submit for materials to be provided. Submit data sufficient to indicate conformance to specified requirements.

Downspout Terminations; G

SD-04 Samples

Roofing Panel

Submit a 12 inch long by full width section of typical panel.

For color selection, submit 2 by 4 inch metal samples in color, finish and texture specified and subsequently selected from manufacturer's standard color palette.

Sealants

Intermediate Support Section

Submit full size samples of each intermediate support section, 12 inches long.

SD-05 Design Data

Design Calculations

SD-06 Test Reports

Field Inspection; G

Submit manufacturer's technical representative's field inspection reports as specified in paragraph MANUFACTURER'S FIELD INSPECTION.

Structural Performance Tests

Finish Tests

SD-07 Certificates

Manufacturer's Technical Representative's Qualifications

Statement of Installer's Qualifications

Submit documentation from roofing manufacturer proving the manufacturer's technical representative meets below specified requirements. Include name, address, telephone number, and experience record.

Submit documentation proving the installer is factory-trained, has the specified experience, and authorized by the manufacturer

to install the products specified.

SD-08 Manufacturer's Instructions

Installation Manual; G

Submit manufacturers printed installation manual, instructions, and standard details.

SD-11 Closeout Submittals

Information Card

For each roofing installation, submit a typewritten card or photoengraved aluminum card containing the information listed on Form 1 located at the end of this section.

Warranty

1.5 DESIGN CALCULATIONS

Provide design calculations prepared by a professional engineer specializing in structural engineering verifying that system supplied and any additional framing meets design load criteria indicated. Coordinate calculations with manufacturer's test results. Include calculations for:

Wind load uplift design pressure at roof locations specified in paragraph WIND UPLIFT.

Clip spacing and allowable load per clip.

Fastening of clips to structure or intermediate supports.

Intermediate support spacing and framing and fastening to structure when required.

Allowable panel span at anchorage spacing indicated.

Safety factor used in design loading.

Governing code requirements or criteria.

Edge and termination details.

1.6 QUALITY ASSURANCE

1.6.1 Preroofing Conference

After submittals are received and approved but before roofing work, including associated work, is preformed, the Contracting Officer will hold a preroofing conference to review the following:

a. The drawings and specifications

b. Procedure for on site inspection and acceptance of the roofing substrate and pertinent structural details relating to the roofing system

c. 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

d. Safety requirements

The preroofing conference must be attended by the Contractor and personnel directly responsible for the roofing installation, , and the roofing manufacturer's technical representative. Conflicts among those attending the preroofing conference must be resolved and confirmed in writing before roofing work, including associated work, is begun.

1.6.2 Manufacturer

The SSMRS must be the product of a metal roofing industry - recognized manufacturer who has been in the practice of manufacturing SSMRS for a period of not less than 5 years and who has been involved in at least 5 projects similar in size and complexity to this project.

1.6.3 Manufacturer's Technical Representative

The representative must have authorization from manufacturer to approve field changes and be thoroughly familiar with the products and with installations in the geographical area where construction will take place. The manufacturer's representative must be an employee of the manufacturer with at least 5 years experience in installing the roof system. The representative must be available to perform field inspections and attend meetings as required herein, and as requested by the Contracting Officer.

1.6.4 Installer's Qualifications

The roofing system installer must be factory-trained, approved by the steel roofing system manufacturer to install the system, and must have a minimum of three years experience as an approved applicator with that manufacturer. The applicator must have applied five installations of similar size and scope as this project within the previous 3 years.

1.6.5 Single Source

Roofing panels, clips, closures, and other accessories must be standard products of the same manufacturer; must be the latest design by the manufacturer; and must have been designed by the manufacturer to operate as a complete system for the intended use.

1.6.6 Laboratory Tests For Panel Finish

The term "appearance of base metal" refers to the metal coating on steel. Panels must meet the following test requirements:

a. Formability Test: When subjected to a 180 degree bend over a 1/8 inch diameter mandrel in accordance with ASTM D522/D522M, exterior coating film may show only slight microchecking and no loss of adhesion.

b. Accelerated Weathering Test: Withstand a weathering test for a minimum of 2000 hours in accordance with ASTM G152 and ASTM G153, Method 1 without cracking, peeling, blistering, loss of adhesion of the protective coating, or corrosion of the base metal. Protective coating that can be readily removed from the base metal with a penknife blade or similar instrument will be considered to indicate

loss of adhesion.

c. Chalking Resistance: After the 2000-hour weatherometer test, exterior coating may not chalk greater than No. 8 rating when measured in accordance with ASTM D4214 test procedures.

d. Color Change Test:

After the 2000 -hour weatherometer test, exterior coating color change must not exceed 2 NBS units when measured in accordance with ASTM D2244 test procedure.

e. Salt Spray Test: Withstand a salt spray test for a minimum of 1000 hours in accordance with ASTM B117, including the scribe requirement in the test. Immediately upon removal of the panel from the test, the coating must receive a rating of 8, few blisters in field as determined by ASTM D714; and an average rating of 6, 1/8 inch failure at scribe, as determined by ASTM D1654. Rating Schedule No. 1.

f. Abrasion Resistance Test for Color Coating: When subjected to the falling sand test in accordance with ASTM D968, coating system must withstand a minimum of 50 liters of sand per mil thickness before appearance of base metal.

g. Humidity Test: When subjected to a humidity cabinet test in accordance with ASTM D2247 for 1000 hours, a scored panel must show no signs of blistering, cracking, creepage, or corrosion.

h. Gloss Test: The gloss of the finish must be 30 plus or minus 5 at an angle of 60 degrees, when measured in accordance with ASTM D523.

i. Glare Resistance Test:

Surfaces of panels that will be exposed to the exterior must have a specular reflectance of not more than 10 when measured in accordance with ASTM D523 at an angle of 85 degrees. Specular reflectance may be obtained with striations or embossing. Requirements specified under FORMABILITY TEST will be waived if necessary to conform to this requirement.

1.6.7 Shop Drawing Requirements

Submit roofing drawings to supplement the instructions and diagrams. Include design and erection drawings containing an isometric view of the roof showing the design uplift pressures and dimensions of edge, ridge and corner zones; and show typical and special conditions including flashings, materials and thickness, dimensions, fixing lines, anchoring methods, sealant locations, sealant tape locations, fastener layout, sizes, and spacing, terminations, penetrations, attachments, and provisions for thermal movement. Details of installation must be in accordance with the manufacturer's Standard Instructions and details or the SMACNA 1793. Prior to submitting shop drawings, have drawings reviewed and approved by the manufacturer's technical engineering department.

1.7 WARRANTY

Furnish manufacturer's no-dollar-limit materials and workmanship warranty for the roofing system. The warranty period must be not less than 20 years from the date of Government acceptance of the work. The warranty

must be issued directly to the Government. The warranty must provide that if within the warranty period the metal roofing system becomes non-watertight or shows evidence of corrosion, perforation, rupture or excess weathering due to deterioration of the roofing system resulting from defective materials or installed workmanship the repair or replacement of the defective materials and correction of the defective workmanship must be the responsibility of the roofing system manufacturer. Repairs that become necessary because of defective materials and workmanship while roofing is under warranty must be performed within 7 days after notification, unless additional time is approved by the Contracting Officer. Failure to perform repairs within the specified period of time will constitute grounds for having the repairs performed by others and the cost billed to the manufacturer. In addition, provide a 2 year contractor installation warranty.

## 1.8 DELIVERY, STORAGE AND HANDLING

Deliver, store, and handle preformed panels, bulk roofing products and other manufactured items in a manner to prevent damage or deformation.

### 1.8.1 Delivery

Provide adequate packaging to protect materials during shipment. Crated materials must not be uncrated until ready for use, except for inspection. Immediately upon arrival of materials at the jobsite, inspect materials for damage, dampness, and staining. Replace damaged or permanently stained materials that cannot be restored to like-new condition with satisfactory material. If materials are wet, remove the moisture and re-stack and protect the panels until used.

### 1.8.2 Storage

Stack materials on platforms or pallets and cover with tarpaulins or other suitable weathertight covering which prevents water trapping or condensation. Store materials so that water which might have accumulated during transit or storage will drain off. Do not store the panels in contact with materials that might cause staining, such as mud, lime, cement, fresh concrete or chemicals. Protect stored panels from wind damage.

### 1.8.3 Handling

Handle material carefully to avoid damage to surfaces, edges and ends.

# PART 2 PRODUCTS

## 2.1 ROOFING PANELS

Provide panels with interlocking ribs for securing adjacent sheets and with concealed clip fastening system for securing the roof covering to structural framing members. Fasteners must not penetrate the panels except at the ridge, eave, rakes, penetrations, and end laps. Backing plates and ends of panels at end laps must be predrilled or prepunched. Factory prepare ends of panels to be lapped by trimming part of seam, die-setting, or swaging ends of panels. Individual sheets must be sufficiently long to cover the entire length of any unbroken roof slope when such slope is 30 feet or less. Provide panels that extend over two or more spans when length of run exceeds 30 feet. Obtain Contracting Officer (KO) approval for sheets longer than 30 feet before submitting

shop drawings. Sheets must provide not less than 12 inches of coverage (width) in place. Provide panels with a minimum corrugation height of 1.75 inches (nominal). Make provisions for expansion and contraction at either ridge or eave, consistent with the type of system to be used. Form panels from coil stock without warping, waviness or ripples not part of the panel profile, and free of damage to the finish coating system.

Provide steel roofing product that is Energy Star labeled. Provide data identifying Energy Star label for steel roofing product.

2.1.1 Material

Zinc-coated steel conforming to ASTM A653/A653M, G90 coating designation or aluminum-zinc alloy coated steel conforming to ASTM A792/A792M, AZ 55 coating. Provide material with a minimum thickness of 0.023 inch thick (24 gage) minimum except when mid field of roof is subject to design wind uplift pressures of 60 psf or greater, entire roof system must have a minimum thickness of 0.030 inch (22 gage). Steel roofing materials must contain a minimum of 30 percent total recycled content. Provide data identifying percentage of recycled content for steel roofing product.

2.1.2 Texture

Smooth with raised intermediate ribs for added stiffness.

2.1.3 Finish

Factory color finish.

2.1.3.1 Factory Color Finish

Provide factory applied, thermally cured coating to exterior and interior of metal roof and wall panels and metal accessories. Provide exterior finish top coat of 70 percent resin polyvinylidene fluoride with not less than 0.8 mil dry film thickness. Provide exterior primer standard with panel manufacturer with not less than 0.8 mil dry film thickness. Interior finish must consist of 0.5 mil dry film thickness backer coat. Provide exterior and interior coating meeting test requirements specified below. Tests must have been performed on the same factory finish and thickness provided. Provide clear factory edge coating on all factory cut or unfinished edges.

2.2 INTERMEDIATE SUPPORTS

Fabricate panel subgirts, subpurlins, T-bars, Z-bars and tracks from galvanized steel conforming to ASTM A653/A653M, G90, Grade D ( 16 gage and heavier), Grade A ( 18 gage and lighter); or steel conforming to ASTM A36/A36M, ASTM A1011/A1011M , or ASTM A1008/A1008M prime painted with zinc-rich primer. Size, shape, thickness and capacity as required to meet the load and deflection criteria specified.

2.3 ATTACHMENT CLIPS

Fabricate clips from ASTM A1011/A1011M, or ASTM A1008/A1008M steel hot-dip galvanized in accordance with ASTM A653/A653M, G 90, or Series 300 stainless steel. Size, shape, thickness and capacity as required to meet the load, insulation thickness and deflection criteria specified.

## 2.4 ACCESSORIES

Sheet metal flashings, gutters, downspouts, trim, moldings, closure strips, pre-formed crickets, caps, equipment curbs, and other similar sheet metal accessories used in conjunction with preformed metal panels must be of the same material as used for the panels. Provide metal accessories with a factory color finish to match the roofing panels, except that such items which will be concealed after installation may be provided without the finish if they are stainless steel. Metal must be of a thickness not less than that used for the panels. Thermal spacer blocks and other thermal barriers at concealed clip fasteners must be as recommended by the manufacturer except that wood spacer blocks are not allowed.

### 2.4.1 Closures

#### 2.4.1.1 Rib Closures

Corrosion resisting steel, closed-cell or solid-cell synthetic rubber, neoprene or polyvinyl chloride pre-molded to match configuration of rib opening. Material for closures must not absorb water.

#### 2.4.1.2 Ridge Closures

Metal-clad foam or metal closure with foam secondary closure matching panel configuration for installation on surface of roof panel between panel ribs at ridge and headwall roof panel flashing conditions and terminations. Foam material must not absorb water.

### 2.4.2 Fasteners

Corrosion resisting steel, or nylon capped steel, type and size specified below or as otherwise approved for the applicable requirements. Design the fastening system to withstand the design loads specified. Exposed fasteners must be gasketed or have gasketed washers on the exterior side of the covering to waterproof the penetration. Washer material must be compatible with the covering; have a minimum diameter of 3/8 inch for structural connections; and gasketed portion of fasteners or washers must be neoprene or other equally durable elastomeric material approximately 1/8 inch thick.

#### 2.4.2.1 Screws

Not smaller than No. 14 diameter if self-tapping type and not smaller than No. 12 diameter if self-drilling and self-tapping.

#### 2.4.2.2 Bolts

Not smaller than 1/4 inch diameter, shouldered or plain shank as required, with proper nuts.

#### 2.4.2.3 Automatic End-Welded Studs

Automatic end-welded studs must be shouldered type with a shank diameter of not smaller than 3/16 inch and cap or nut for holding covering against the shoulder.

2.4.2.4 Explosive Driven Fasteners

Fasteners for use with explosive actuated tools must have a shank diameter of not smaller than 0.145 inch with a shank length of not smaller than 1/2 inch for fastening to steel and not smaller than 1 inch for fastening to concrete.

2.4.2.5 Rivets

Blind rivets must be stainless steel with 1/8 inch nominal diameter shank. Rivets must be threaded stem type if used for other than the fastening of trim. Rivets with hollow stems must have closed ends.

2.4.3 Sealants

Elastomeric type containing no oil or asphalt. Exposed sealant must cure to a rubberlike consistency. Concealed sealant must be the non-hardening type. Seam sealant must be factory-applied, non-skinning, non-drying, and must conform to the roofing manufacturer's recommendations. Silicone-based sealants must not be used in contact with finished metal panels and components unless approved otherwise by the Contracting Officer.

2.4.4 GASKETS AND INSULATING COMPOUNDS

Nonabsorptive and suitable for insulating contact points of incompatible materials. Insulating compounds must be nonrunning after drying.

2.5 DOWNSPOUT BOOT

Downspout terminations:Downspout Boots: contoured interior flow design with no boxed corners, weld seams or choke points; include integral lug slots and stainless steel fasteners.

a. Configuration: (select: Offset/
b. Material: Cast iron; ASTM A48/A48.
c. Finish: Manufacturer's standard powder coat matte black.
d. Accessories:
    1) Manufacturer's standard stainless steel fasteners for mounting onto building wall.
    2) Flexible rubber adapter for connection to drainage pipe

2.6 FALL PROTECTION

Basis of Design (Or Approved Equal): RoofSafe Rail System (https://www.fallprotect.com)

1. System Description:

a. System consists of horizontal rooftop rail including attachment carriage, clamps, base plates, spreader plates and end stops. System to be designed for two simultaneous users.
b. System to allow attachment at any point along rail.
c. Prepare system layout, design analysis and calculations certified by a licensed Professional Engineer.
d. Do not use system as a tieback anchor for facade maintenance.
e. Maximum allowable force on a single anchorage point: 12 kN (2,698 lbf)
f. System to allow attachment at any point along rail

2. Components:

a. Clamps: Manufacturer's standard non-penetrative clamps attached to standing seam metal roof ribs.
b. Base Plates: One-piece base plate profile which directs water away from fixing points.
c. End Stops: Stops incorporated at each end of the system to provide a buffer for attachment carriages.
d. Attachment Carriage: 4-wheel carriage.
e. Fabricated supports: Steel plates, shapes and bars: ASTM A36/A36M. Steel Tubing: ASTM A500/A500M.

3. Materials:

a. Stainless Steel: ASTM A666.
b. Aluminum: 6000 series alloy.
c. Connectors: Comply with OSHA regulation 1926.502.

## PART 3 EXECUTION

Do not install building construction materials that show visible evidence of biological growth.

### 3.1 EXAMINATION

Examine surfaces to receive standing seam metal roofing and flashing. Ensure that surfaces are plumb and true, clean, even, smooth, as dry and free from defects and projections which might affect the installation.

### 3.2 PROTECTION FROM CONTACT WITH DISSIMILAR MATERIALS

### 3.3 INSTALLATION

Install in accordance with the approved manufacturer's erection instructions, shop drawings, and diagrams. Panels must be in full and firm contact with attachment clips. Where prefinished panels are cut in the field, or where any of the factory applied coverings or coatings are abraded or damaged in handling or installation, they must, after necessary repairs have been made with material of the same color as the weather coating, be approved before being installed. Seal completely openings through panels. Correct defects or errors in the materials. Replace materials which cannot be corrected in an approved manner with nondefective materials. Provide molded closure strips where indicated and where necessary to provide weathertight construction. Use shims as required to ensure attachment clip line is true. Use a spacing gage at each row of panels to ensure that panel width is not stretched or shortened.

#### 3.3.1 Roof Panels

Apply roofing panels with the standing seams parallel to the slope of the roof. Provide roofing panels in longest practical lengths from ridge to eaves (top to eaves on shed roofs), with no transverse joints. Locate panel end laps such that fasteners do not engage supports or otherwise restrain the longitudinal thermal movement of panels. Attach panels to the structure with concealed clips incorporated into panel seams. Clip attachment must allow roof to move independently of the structure, except at fixed points as indicated.

3.3.2 Insulation Installation

See 07 22 00 ROOF AND DECK INSULATION for additional information. Install between covering and supporting members to present a neat appearance. Fold and staple seams unless approved otherwise by the Contracting Officer.

3.3.3 Flashings

Provide flashing, related closures and accessories as indicated and as necessary to provide a weathertight installation. Install flashing to ensure positive water drainage away from roof penetrations. Flash and seal the roof at the ridge, eaves, and projections through the roof. Place closure strips, flashing, and sealing material in an approved manner that will assure complete weathertightness. Details of installation which are not indicated must be in accordance with the SMACNA 1793, panel manufacturer's approved printed instructions and details, or the approved shop drawings. Allow for expansion and contraction of flashing.

3.3.4 Flashing Fasteners

Fastener spacings must be in accordance with the panel manufacturer's recommendations and as necessary to withstand the design loads indicated. Install fasteners in roof valleys as recommended by the manufacturer of the panels. Install fasteners in straight lines within a tolerance of 1/2 inch in the length of a bay. Drive exposed penetrating type fasteners normal to the surface and to a uniform depth to seat gasketed washers properly and drive so as not to damage factory applied coating. Exercise extreme care in drilling pilot holes for fastenings to keep drills perpendicular and centered. Do not drill through sealant tape. After drilling, remove metal filings and burrs from holes prior to installing fasteners and washers. Torque used in applying fasteners must not exceed that recommended by the manufacturer. Remove panels deformed or otherwise damaged by over-torqued fastenings, and provide new panels.

3.3.5 Rib and Ridge Closure/Closure Strips

Set closure/closure strips in joint sealant material and apply sealant to mating surfaces prior to adding panel.

3.4 PROTECTION OF APPLIED ROOFING

Do not permit storing, walking, wheeling, and trucking directly on applied roofing materials. Provide temporary walkways, runways, and platforms of smooth clean boards or planks as necessary to avoid damage to applied roofing materials, and to distribute weight to conform to indicated live load limits of roof construction.

3.5 CLEANING

Clean exposed sheet metal work at completion of installation. Remove metal shavings, filings, nails, bolts, and wires from roofs. Remove grease and oil films, excess sealants, handling marks, contamination from steel wool, fittings and drilling debris and scrub the work clean. Exposed metal surfaces must be free of dents, creases, waves, scratch marks, solder or weld marks and damage to the finish coating.

## 3.6 MANUFACTURER'S FIELD INSPECTION

Manufacturer's technical representative must visit the site as necessary during the installation process to assure panels, flashings, and other components are being installed in a satisfactory manner. Manufacturer's technical representative must perform a field inspection during the first 20 squares of roof panel installation and at substantial completion prior to issuance of warranty, as a minimum, and as otherwise requested by the Contracting Officer. Follow-up inspections of previously noted deficiencies or application errors must be performed as requested by the Contracting Officer. Each inspection visit must include a review of the entire installation to date. After each inspection, submit a report, signed by the manufacturer's technical representative, to the Contracting Officer noting the overall quality of work, deficiencies and any other concerns, and recommended corrective actions in detail. Notify Contracting Officer a minimum of 2 working days prior to site visit by manufacturer's technical representative.

## 3.7 COMPLETED WORK

Completed work must be plumb and true without oil canning, dents, ripples, abrasion, rust, staining, or other damage detrimental to the performance or aesthetics of the completed roof assembly.

## 3.8 INFORMATION CARD

For each roof, provide a typewritten card, laminated in plastic and framed for interior display or a photoengraved 0.032 inch thick aluminum card for exterior display. Card to be 8 1/2 by 11 inches minimum and contain the information listed on Form 1 at end of this section. Install card near point of access to roof, or where indicated. Send a photostatic paper copy to US Army Corps of Engineers, Mobile District Project Manager Bill Caswell via email at William.A.Caswell@usace.army.mil.

## 3.9 FORM ONE

FORM 1 - PREFORMED STEEL STANDING SEAM ROOFING SYSTEM COMPONENTS

1. Contract Number:

2. Building Number & Location:

3. NAVFAC Specification Number:

4. Deck/Substrate Type:

5. Slopes of Deck/Roof Structure:

6. Insulation Type & Thickness:

7. Insulation Manufacturer:

8. Vapor Retarder: ( )Yes ( )No

9. Vapor Retarder Type:

10. Preformed Steel Standing Seam Roofing Description:

a. Manufacturer (Name, Address, & Phone No.):
b. Product Name: c. Width: d. Gage:
e. Base Metal: f. Method of Attachment:

11. Repair of Color Coating:

a. Coating Manufacturer (Name, Address & Phone No.):
b. Product Name:
c. Surface Preparation:
d. Recoating Formula:
e. Application Method:

12. Statement of Compliance or Exception:_____
_____
_____

13. Date Roof Completed:

14. Warranty Period: From_____ To_____

15. Roofing Contractor (Name & Address):

16. Prime Contractor (Name & Address):

Contractor's Signature _____ Date:

Inspector's Signature _____ Date:

-- End of Section --

SECTION 07 84 00

FIRESTOPPING
**05/10**

PART 1 GENERAL

1.1 SUMMARY

Furnish and install tested and listed firestopping systems, combination of materials, or devices to form an effective barrier against the spread of flame, smoke and gases, and maintain the integrity of fire resistance rated walls, partitions, floors, and ceiling-floor assemblies, including through-penetrations and construction joints and gaps.

a. Through-penetrations include the annular space around pipes, tubes, conduit, wires, cables and vents.

b. Construction joints include those used to accommodate expansion, contraction, wind, or seismic movement; firestopping material shall not interfere with the required movement of the joint.

c. 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 E2174 | (2014b) Standard Practice for On-Site Inspection of Installed Fire Stops |
| ASTM E2393 | (2010a) Standard Practice for On-Site Inspection of Installed Fire Resistive Joint Systems and Perimeter Fire Barriers |
| ASTM E814 | (2023a) Standard Test Method for Fire Tests of Through-Penetration Fire Stops |
| ASTM E84 | (2023) Standard Test Method for Surface Burning Characteristics of Building Materials |

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 1479 | (2015) Fire Tests of Through-Penetration Firestops |
| UL 723 | (2020) UL Standard for Safety Test for Surface Burning Characteristics of Building Materials |
| UL Fire Resistance | (2014) Fire Resistance Directory |

## 1.3 SEQUENCING

Coordinate the specified work with other trades. Apply firestopping materials, at penetrations of pipes and ducts, prior to insulating, unless insulation meets requirements specified for firestopping. Apply firestopping materials. at building joints and construction gaps, prior to completion of enclosing walls or assemblies. Cast-in-place firestop devices shall be located and installed in place before concrete placement. Pipe, conduit or cable bundles shall be installed through cast-in-place device after concrete placement but before area is concealed or made inaccessible. Firestop material shall be inspected and approved prior to final completion and enclosing of any assemblies that may conceal installed firestop.

## 1.4 SUBMITTALS

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

SD-02 Shop Drawings

Firestopping System; G

SD-06 Test Reports

Inspection; G

SD-07 Certificates

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.

## 1.6 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.

## 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 SYSTEM DESCRIPTION, 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 = 1 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

F Rating = 1 hour, T Rating = 1 hour. Where the penetrating item is outside of a wall cavity the F rating must be equal to the fire resistance rating of the floor penetrated, and the T rating shall be in accordance with the requirements of ICC IBC.

2.2.3.2 Construction Joints and Gaps

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 and utility chutes.

c. Gaps at perimeter of fire-resistance rated walls and partitions, such as between the top of the walls and the bottom of roof decks.

d. Construction joints in floors and fire rated walls and partitions.

e. 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 Data and Communication Cabling

Cabling for data and communication applications shall be sealed with re-enterable firestopping products and devices as indicated.

3.2.2.1 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.

3.3 INSPECTION

The firestopped areas shall not be covered or enclosed until inspection is complete and approved by the Contracting Officer. The manufacturer's representative 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 to ASTM E2393 and ASTM E2174 for

firestop inspection, and document inspection results to be submitted.

-- End of Section --

SECTION 07 92 00

JOINT SEALANTS
**08/23**

PART 1 GENERAL

1.1 REFERENCES

The publications listed 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) Standard Test Method for Low-Temperature Flexibility of Latex Sealants After Artificial Weathering |
| ASTM C919 | (2022) Standard Practice for Use of Sealants in Acoustical Applications |
| ASTM C920 | (2018) Standard Specification for Elastomeric Joint Sealants |
| ASTM C1193 | (2016) Standard Guide for Use of Joint Sealants |
| ASTM C1311 | (2022) Standard Specification for Solvent Release Sealants |
| ASTM D217 | (2021a) Standard Test Methods for Cone Penetration of Lubricating Grease |
| ASTM D1056 | (2020) Standard Specification for Flexible Cellular Materials - Sponge or Expanded Rubber |
| ASTM D1667 | (2022) 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 | (2023) Standard Test Method for Surface Burning Characteristics of Building Materials |

CALIFORNIA DEPARTMENT OF PUBLIC HEALTH (CDPH)

| | |
|---|---|
| CDPH SECTION 01350 | (2017; Version 1.2) Standard Method for the Testing and Evaluation of Volatile Organic Chemical Emissions from Indoor Sources using Environmental Chambers |

SOUTH COAST AIR QUALITY MANAGEMENT DISTRICT (SCAQMD)

| | |
|---|---|
| SCAQMD Rule 1168 | (2017) Adhesive and Sealant Applications |

1.2 SUBMITTALS

Government approval is required for submittals with a "G" 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

Caulking; G

Cleaning Solvents; G

SD-06 Test Reports

Field Adhesion; G

SD-07 Certificates

Indoor Air Quality For Interior 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 ENVIRONMENTAL CONDITIONS

Apply sealant when the ambient temperature is between 40 and 90 degrees F.

1.5 DELIVERY AND STORAGE

Deliver materials to the jobsite in unopened manufacturers' sealed

shipping containers, with brand name, date of manufacture, and material designation clearly marked thereon. Label elastomeric sealant containers to identify type, class, grade, and use. Handle and store materials in accordance with manufacturer's printed instructions. Prevent exposure to foreign materials or subjection to sustained temperatures exceeding 90 degrees F or lower than 0 degrees F. Keep materials and containers closed and separated from absorptive materials such as wood and insulation.

## 1.6 QUALITY ASSURANCE

### 1.6.1 Compatibility with Substrate

Verify that each sealant is compatible for use with each joint substrate in accordance with sealant manufacturer's printed recommendations for each application.

### 1.6.2 Joint Tolerance

Provide joint tolerances in accordance with manufacturer's printed instructions.

# PART 2 PRODUCTS

## 2.1 SEALANTS

Provide sealant products that have been tested, found suitable, and documented as such by the manufacturer for the particular substrates to which they will be applied.

In areas with ambient temperatures that exceed 110 degrees F, do not use polybutene, bituminous, acrylic-latex, polyvinyl acetate latex sealants, polychloroprene (neoprene), polyvinyl chloride (PVC), and polyurethane foams, and neoprene, PVC, and styrene butadiene rubber extruded seals and closure strips due to these materials having maximum recommended surface temperature ranges from 130 to 180 degrees F.

### 2.1.1 Interior Sealants

Provide ASTM C920, Type S or M, Grade NS, Class 12.5, Use NT. Provide sealant products used on the interior of the building (defined as inside of the weatherproofing system) meeting either emissions requirements of CDPH SECTION 01350 (limit requirements for either office or classroom spaces regardless of space type) or VOC content requirements of SCAQMD Rule 1168. Provide certification or validation of indoor air quality for interior sealants. Location(s) and color(s) of sealant for the following (Note, color "as selected" refers to manufacturer's full range of color options):

| LOCATION | COLOR |
|---|---|
| a. Small voids between walls or partitions and adjacent lockers, casework, shelving, door frames, built-in or surface mounted equipment and fixtures, and similar items. | Match adjacent material color |

| LOCATION | COLOR |
|---|---|
| b. Perimeter of frames at doors, windows, and access panels which adjoin exposed interior concrete and masonry surfaces. | Match adjacent material color |
| c. Joints of interior masonry walls and partitions which adjoin columns, pilasters, concrete walls, and exterior walls unless otherwise detailed. | Match adjacent material color |
| d. Joints between edge members for acoustical tile and adjoining vertical surfaces. | Match adjacent material color |
| e. Interior locations, not otherwise indicated or specified, where small voids exist between materials specified to be painted. | Match adjacent material color |
| f. Joints formed between tile floors and tile base cove; joints between tile and dissimilar materials; joints occurring where substrates change. | Match adjacent material color |

2.1.2 Exterior Sealants

For joints in vertical surfaces, provide ASTM C920, Type S or M, Grade NS, Class 25, Use NT. For joints in horizontal surfaces, provide ASTM C920, Type S or M, Grade P, Class 25, Use T. Provide location(s) and color(s) of sealant as follows (Note, color "as selected" refers to manufacturer's full range of color options):

| LOCATION | COLOR |
|---|---|
| a. Joints and recesses formed where frames and subsills of windows, doors, louvers, and vents adjoin masonry, concrete, or metal frames. Use sealant at both exterior and interior surfaces of exterior wall penetrations. | Match adjacent surface color |
| b. Joints in exterior masonry walls. | Match adjacent material color |
| c. Masonry joints where shelf angles occur. | Gray |
| d. Joints in wash surfaces of stonework. | Match adjacent material color |
| e. Control joints. | Match adjacent surface color |
| f. Voids where items pass through exterior walls. | Match adjacent surface color |
| g. Metal reglets, where flashing is inserted into masonry joints, and where flashing is penetrated by coping dowels. | Match adjacent material color |

| LOCATION | COLOR |
|---|---|
| h. Metal-to-metal joints where sealant is indicated or specified. | Match adjacent material color |

2.1.3 Acoustical Sealants

Rubber or polymer based acoustical sealant in accordance with ASTM C919 to have a flame spread of 25 or less and a smoke developed rating of 50 or less when tested in accordance with ASTM E84. Provide non-staining acoustical sealant with a consistency of 250 to 310 when tested in accordance with ASTM D217. Acoustical sealant must remain flexible and adhesive after 500 hours of accelerated weathering as specified in ASTM C734. Provide sealant products used on the interior of the building (defined as inside of the weatherproofing system) meeting either emissions requirements of CDPH SECTION 01350 (limit requirements for either office or classroom spaces regardless of space type) or VOC content requirements of SCAQMD Rule 1168. Provide certification or validation of indoor air quality for interior acoustical sealants.

2.1.4 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.

2.1.4.1 Foam Strip

Provide foam strip of polyurethane foam with cross section dimensions per joint ratio chart. 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. Install 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 INTERIOR 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 INTERIOR SEALANTS above.

2.4 BACKSTOPS

Provide glass fiber roving, neoprene, butyl, polyurethane, or polyethylene foams free from oil or other staining elements as recommended by sealant manufacturer. Provide 25 to 33 percent oversized backing for closed cell

and 40 to 50 percent oversized backing for open cell material, unless otherwise indicated. Provide backstop material that is compatible with sealant. Do not use oakum or other types of absorptive materials as backstops.

2.4.1 Rubber

Provide in accordance with ASTM D1056, Type 2, closed cell, Class A, Grade , round cross section for cellular rubber sponge backing.

2.4.2 PVC

Provide in accordance with ASTM D1667, Grade VO 12, open-cell foam, round cross section for polyvinyl chloride (PVC) backing.

2.4.3 Synthetic Rubber

Provide in accordance with ASTM C509, Option I, Type I preformed rods or tubes for synthetic rubber backing.

2.4.4 Neoprene

Provide in accordance with ASTM D1056, closed cell expanded neoprene cord Type 2, Class C, Grade 2C2 for neoprene backing.

2.4.5 Butyl Rubber Based

Provide in accordance with ASTM C1311, from a single component, with solvent release. color as selected from manufacturer's full range of color choices.

2.4.6 Silicone Rubber Base

Provide in accordance with ASTM C920, from a single component, with solvent release, Non-sag. 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 I or II, 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 INTERIOR 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 residual adhesive prior to sealant application. For removing protective coatings and final cleaning, use non-staining solvents recommended by the manufacturer of the item(s) containing aluminum or bronze surfaces.

### 3.2.3 Concrete and Masonry Surfaces

Where surfaces have been treated with curing compounds, oil, or other such materials, remove materials by sandblasting or wire brushing. Remove laitance, efflorescence and loose mortar from the joint cavity. Remove resulting debris prior to sealant installation.

### 3.2.4 Wood Surfaces

Ensure wood surfaces that will be in contact with sealants are free of splinters, sawdust and other loose particles.

## 3.3 SEALANT PREPARATION

Do not add liquids, solvents, or powders to sealants. Mix multicomponent elastomeric sealants in accordance with manufacturer's printed instructions.

3.4 APPLICATION

3.4.1 Joint Width-To-Depth Ratios

Acceptable Ratios:

| JOINT WIDTH | JOINT DEPTH | |
|---|---|---|
| | Minimum | Maximum |
| For metal, glass, or other nonporous surfaces: | | |
| 1/4 inch (minimum) | 1/4 inch | 1/4 inch |
| over 1/4 inch | 1/2 of width | Equal to width |
| For concrete, masonry, and 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 hours then remove by wire brushing or sanding. Remove resulting debris.

b. Metal and Other Non-Porous Surfaces: Remove excess sealant with a solvent moistened cloth. Remove solvent residue in accordance with solvent manufacturer's printed instructions.

-- End of Section --

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SECTION 08 11 13

STEEL DOORS AND FRAMES
**08/20**

PART 1 GENERAL

1.1 REFERENCES

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

AMERICAN WELDING SOCIETY (AWS)

| | |
|---|---|
| AWS D1.1/D1.1M | (2020; Errata 1 2021) Structural Welding Code - Steel |

ASTM INTERNATIONAL (ASTM)

| | |
|---|---|
| ASTM A653/A653M | (2023) 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 | (2022a) Standard Specification for General Requirements for Steel Sheet, Metallic-Coated by the Hot-Dip Process |
| ASTM C578 | (2023) Standard Specification for Rigid, Cellular Polystyrene Thermal Insulation |
| ASTM C591 | (2022) 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 |

COUNCIL ON ENVIRONMENTAL QUALITY (CEQ) (WHITE HOUSE)

| | |
|---|---|
| HPSB Guiding Principles | (2016) Guiding Principles for Sustainable Federal Buildings and Determining Compliance with the Guiding Principles for Sustainable Federal Buildings |

NATIONAL ASSOCIATION OF ARCHITECTURAL METAL MANUFACTURERS (NAAMM)

| | |
|---|---|
| NAAMM HMMA 810 | (2009) Hollow Metal Doors |

STEEL DOOR INSTITUTE (SDI/DOOR)

| | |
|---|---|
| SDI/DOOR 111 | (2009) Recommended Details for Standard Steel Doors, Frames, and Accessories and Related Components |
| SDI/DOOR 113 | (2023) Standard Practice for Determining the Steady-State Thermal Transmittance of Steel Door and Frame Assemblies |
| SDI/DOOR A250.4 | (2022) Test Procedure and Acceptance Criteria for Physical Endurance for Steel Doors, Frames and Frame Anchors |
| SDI/DOOR A250.6 | (2020) Recommended Practice for Hardware Reinforcing on Standard Steel Doors and Frames |
| SDI/DOOR A250.8 | (2023) Specifications for Standard Steel Doors and Frames |
| SDI/DOOR A250.11 | (2022) Recommended Erection Instructions for Steel Frames |

U.S. DEPARTMENT OF DEFENSE (DOD)

| | |
|---|---|
| UFC 4-010-01 | (2018; with Change 2, 2022) DoD Minimum Antiterrorism Standards for Buildings |

## 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, AE

Frames; G, AE

Accessories; G, AE

Schedule of Doors; G, AE

Schedule of Frames; G, AE

SD-03 Product Data

Doors; G, AE

Recycled Content for Steel Door Product; S

Frames; G, AE

Recycled Content for Steel Frame Product; S

Accessories; G, AE

## 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 SUSTAINABILITY

### 2.1.1 Recycled Content

Sustainable strategies documentation relative to recycled content materials credit in accordance with HPSB Guiding Principles. Include in Sustainability eNotebook.

## 2.2 STANDARD STEEL DOORS

SDI/DOOR A250.8, except as specified otherwise. Prepare doors to receive door hardware as specified in Section 08 71 00 DOOR HARDWARE. Undercut where indicated. Provide exterior doors with top edge closed flush and sealed to prevent water intrusion. Provide doors at 1-3/4 inch thick, unless otherwise indicated. Provide door material that uses a minimum of 25 percent recycled content. Provide data indicating percentage of recycled content for steel door product.

### 2.2.1 Classification - Level, Performance, Model

#### 2.2.1.1 Maximum Duty Doors

SDI/DOOR A250.8, Level 4, 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.

## 2.3 CUSTOM STEEL DOORS

Provide custom hollow metal doors where nonstandard steel doors are indicated. Provide custom steel doors in the door size(s), design(s), materials, construction, gages, and finish as specified for custom steel doors and complying with the requirements of NAAMM HMMA 810. Fill all spaces in exterior doors with insulation. Close top and bottom edges with steel channels not lighter than 16 gage. Close tops of exterior doors flush with an additional channel and seal to prevent water intrusion. Prepare doors to receive hardware specified in Section 08 71 00 DOOR HARDWARE. Exterior doors much be tested in accordance with ASTM F2247 and ASTM F2927 to meet the requirements of UFC 4-010-01.

## 2.4 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.

## 2.5 ACCESSORIES

### 2.5.1 Astragals

For pairs of exterior steel doors which will not have aluminum astragals or removable mullions, as specified in Section 08 71 00 DOOR HARDWARE provide overlapping steel astragals with the doors.

## 2.6 INSULATION CORES

Provide insulating cores at all exterior doors, and provide an apparent U-factor of .48 in accordance with SDI/DOOR 113 and conforming to:

a. Rigid Cellular Polyisocyanurate Foam: ASTM C591, Type I or II, foamed-in-place or in board form, with oxygen index of not less than 22 percent when tested in accordance with ASTM D2863; or

b. Rigid Polystyrene Foam Board: ASTM C578, Type I or II; or

c. Mineral board: ASTM C612, Type I.

## 2.7 STANDARD STEEL FRAMES

SDI/DOOR A250.8, Level 4, except as otherwise specified. Form frames to sizes and shapes indicated, with welded corners. Provide steel frames for doors, 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.

2.7.1 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.

2.7.2 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.

2.7.3 Cased Openings

Fabricate frames for cased openings of same material, gage, and assembly as specified for metal door frames, except omit door stops and preparation for hardware.

2.7.4 Anchors

Provide anchors to secure the frame to adjoining construction. Provide steel anchors, zinc-coated not lighter than 18 gage.

2.7.4.1 Wall Anchors

Provide at least three anchors for each jamb. For frames which are more than 7.5 feet in height, provide one additional anchor for each jamb for each additional 2.5 feet or fraction thereof.

a. 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;

b. Completed openings: Secure frames to previously placed concrete or masonry with expansion bolts in accordance with SDI/DOOR 111; and

2.7.4.2 Floor Anchors

Provide floor anchors drilled for 3/8 inch anchor bolts at bottom of each jamb member.

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 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 doors and frames from hot dipped zinc coated steel, alloyed type, that complies with ASTM A924/A924M and ASTM A653/A653M. The coating weight must meet or exceed the minimum requirements for coatings having 0.4 ounces per square foot, total both sides, i.e., A40. Repair damaged zinc-coated surfaces by the application of zinc dust paint. Thoroughly clean and chemically treat to insure maximum paint adhesion. Factory prime as specified in SDI/DOOR A250.8.

### 2.10.3 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.

## 2.11 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.

# PART 3 EXECUTION

## 3.1 INSTALLATION

### 3.1.1 Frames

Set frames in accordance with SDI/DOOR A250.11. Plumb, align, and brace securely until permanent anchors are set. Anchor bottoms of frames with expansion bolts or powder-actuated fasteners. Build in or secure wall anchors to adjoining construction.

### 3.1.2 Doors

Hang doors in accordance with clearances specified in SDI/DOOR A250.8. After erection and glazing, clean and adjust hardware.

## 3.2 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 --

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SECTION 08 31 00

ACCESS DOORS AND PANELS
**05/17, CHG 1: 08/18**

PART 1 GENERAL

1.1 REFERENCES

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

AMERICAN WELDING SOCIETY (AWS)

| | |
|---|---|
| AWS D1.1/D1.1M | (2020; Errata 1 2021) Structural Welding Code - Steel |

ASTM INTERNATIONAL (ASTM)

| | |
|---|---|
| ASTM A36/A36M | (2019) Standard Specification for Carbon Structural Steel |
| ASTM A653/A653M | (2023) Standard Specification for Steel Sheet, Zinc-Coated (Galvanized) or Zinc-Iron Alloy-Coated (Galvannealed) by the Hot-Dip Process |
| ASTM A666 | (2023) Standard Specification for Annealed or Cold-Worked Austenitic Stainless Steel Sheet, Strip, Plate and Flat Bar |
| ASTM A1008/A1008M | (2023) 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 | (2022) Standard Test Methods for Fire Tests of Building Construction and Materials |
| ASTM E413 | (2022) Classification for Rating Sound Insulation |
| ASTM E1332 | (2016) Standard Classification for Rating Outdoor-Indoor Sound Attenuation |

MASTER PAINTERS INSTITUTE (MPI)

| | |
|---|---|
| MPI 79 | (2016) Primer, Alkyd, Anti-Corrosive for Metal |

NATIONAL FIRE PROTECTION ASSOCIATION (NFPA)

| | |
|---|---|
| NFPA 80 | (2022) Standard for Fire Doors and Other Opening Protectives |
| NFPA 252 | (2022) Standard Methods of Fire Tests of Door Assemblies |
| NFPA 288 | (2017) Standard Methods of Fire Tests of Horizontal Fire Door Assemblies Installed in Horizontal Fire Resistance-Rated Assemblies |

UNDERWRITERS LABORATORIES (UL)

| | |
|---|---|
| UL 10B | (2008; Reprint May 2020) Fire Tests of Door Assemblies |
| UL 263 | (2011; Reprint Aug 2021) UL Standard for Safety Fire Tests of Building Construction and Materials |

## 1.2 SUBMITTALS

Government approval is required for submittals with a "G" or "S" classification. Submittals not having a "G" or "S" classification are for 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 andlocations 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) of as indicated on the Drawings. Provide gasketing in accordance with manufacturer's written recommendations.

### 1.4.3 Fire-Rating Requirements

Provide access panels with a minimum fire-rating of as indicated on the Drawings.

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. 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 screwdriver operated cam lock. Provide plastic sleeve or stainless steel bushings to protect holes in surface finishes for screwdriver to access lock.

2.2.8 Accessories

Provide anchors in size, number and location on four sides to secure access door to substrate. Provide anchors in types as recommended by manufacturer's written installation instructions for each substrate indicated. Provide shims, bushings, clips, gaskets, and other devices as necessary for a complete installation.

2.3 FABRICATION

2.3.1 Thickness, Size, Edges

Fabricate frames for access doors of steel not lighter than 16 gage with welded joints and anchorage for securing to adjacent construction. Provide doors a minimum of 24 by 24 inches and of not lighter than 16 gage steel, with stiffened edges and welded attachments. Provide with eased (lightly rounded) edges, without burrs, snags or sharpness and exposed welds ground smooth.

2.3.2 Welding

Provide in accordance with AWS D1.1/D1.1M.

2.4 ACCESS ASSEMBLY TYPES

Unless indicated otherwise, provide flush-face steel access doors and panels with steel frames and flanges.

2.4.1 Fire-rated Doors

2.4.1.1 Door Construction

Provide ceiling access door construction in accordance with ASTM E119 or UL 263. Provide wall access doors in accordance with NFPA 252 or UL 10B.

2.4.1.2 Labels

Provide class B opening according to UL 10B or test by another nationally recognized laboratory, approved by the Contracting Officer. Provide fire-rating as indicated herein, with a maximum temperature rise of 216 degrees F.

2.4.1.3 Door Panel and Frame

Steel sheet, with mineral fiber insulation core, insulated sandwich type construction.

2.4.2 Acoustical Doors

Manufacturer's standard assembly rated in accordance with STC requirements indicated herein. Acoustical insulating materials must have a flame spread rating of no more than 25.

### 2.4.3 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 baked enamelProvide 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 --

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SECTION 08 34 01

FORCED ENTRY RESISTANT COMPONENTS
**08/09**

PART 1 GENERAL

1.1 REFERENCES

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

ALUMINUM ASSOCIATION (AA)

| | |
|---|---|
| AA DAF45 | (2003; Reaffirmed 2009) Designation System for Aluminum Finishes |

AMERICAN WELDING SOCIETY (AWS)

| | |
|---|---|
| AWS D1.1/D1.1M | (2020; Errata 1 2021) Structural Welding Code - Steel |

ASM INTERNATIONAL (ASM)

| | |
|---|---|
| ASM STFA | (2001; 6th Ed) The Surface Treatment and Finishing of Aluminum and Its Alloys (2 Vol.) |

ASTM INTERNATIONAL (ASTM)

| | |
|---|---|
| ASTM A123/A123M | (2024) Standard Specification for Zinc (Hot-Dip Galvanized) Coatings on Iron and Steel Products |
| ASTM A653/A653M | (2023) Standard Specification for Steel Sheet, Zinc-Coated (Galvanized) or Zinc-Iron Alloy-Coated (Galvannealed) by the Hot-Dip Process |
| ASTM D3951 | (2018) Commercial Packaging |
| ASTM E90 | (2009; R2016) Standard Test Method for Laboratory Measurement of Airborne Sound Transmission Loss of Building Partitions and Elements |

BUILDERS HARDWARE MANUFACTURERS ASSOCIATION (BHMA)

| | |
|---|---|
| ANSI/BHMA A156.1 | (2021) Butts and Hinges |
| ANSI/BHMA A156.4 | (2013) Door Controls - Closers |
| ANSI/BHMA A156.5 | (2020) Cylinder and Input Devices for Locks |
| ANSI/BHMA A156.13 | (2022) Mortise Locks & Latches Series 1000 |
| ANSI/BHMA A156.16 | (2023) Auxiliary Hardware |

| | |
|---|---|
| ANSI/BHMA A156.18 | (2020) Materials and Finishes |
| ANSI/BHMA A156.115 | (2016) Hardware Preparation in Steel Doors and Steel Frames |

GLASS ASSOCIATION OF NORTH AMERICA (GANA)

| | |
|---|---|
| GANA Glazing Manual | (2008) Glazing Manual |

NATIONAL ASSOCIATION OF ARCHITECTURAL METAL MANUFACTURERS (NAAMM)

| | |
|---|---|
| NAAMM HMMA 801 | (2012; R 2018) Glossary of Terms for Hollow Metal Doors and Frames |
| NAAMM HMMA 802 | (2007) Manufacturing of Hollow Metal Doors and Frames |
| NAAMM HMMA 810 | (2009) Hollow Metal Doors |
| NAAMM HMMA 820 | (2008) Hollow Metal Frames |

U.S. DEPARTMENT OF STATE (SD)

| | |
|---|---|
| SD Std-01.01 | (1993 Rev G Amended; Inx Certified Prod/Mfg) Certification Standard Forced Entry and Ballistic Resistance of Structural Systems |

## 1.2 SUBMITTALS

Government approval is required for submittals with a "G" or "S" classification. Submittals not having a "G" or "S" classification are for 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; G

SD-03 Product Data; G

Forced Entry Resistant Components; G

Installation; G

Components; G

SD-07 Certificates

Forced Entry Resistant Components; G

## 1.3 QUALITY ASSURANCE

Qualify welding procedures, welders, and welding operators in accordance with AWS D1.1/D1.1M. Forced entry resistant components must be certified as resistant to the forced entry test standards indicated herein. Test

forced entry resistant components as specified below. The test results and certification thereof must be approved by the Contracting Officer before delivery of the component to the job site.

| Component | Test Standard | Level Within Test Standard (If Any) | Minimum Attack Time (Minutes) |
|---|---|---|---|
| doors, door frames, door hardware | SD Std-01.01 | 5 Minute | 5 |

## 1.4 DELIVERY, STORAGE, AND HANDLING

Deliver Components to the job site with the manufacturer's name, and model number clearly marked thereon. Deliver, store, and handle components so as not to be damaged or deformed and in accordance with ASTM D3951. Carefully handle components to prevent damage to the faces, edges, corners, ends, and glazing where applicable. Clean, repair, or replace immediately abraded, scarred, or rusty areas upon detection of the damage. Replace damaged components that cannot be restored. Store components and equipment in a dry location on platforms or pallets that are ventilated adequately, free of dust, water, and other contaminants, and stored in a manner which permits easy access for inspection and handling. Submit lists including schedule of components to be incorporated in the work with manufacturer's model or catalog numbers, specification and drawing reference numbers, warranty information, threat level designated, sound transmission coefficient ratings, insulation "U" value, and number of items provided. Listing of similar products that have been satisfactorily in use for two years or more, including name of purchasers, locations of installations, dates of installations, and service organizations.

## 1.5 SEQUENCING AND SCHEDULING

When testing of a previously untested component is specified, allow sufficient lead time so that testing will not delay construction. The test results and component must be approved by the Contracting Officer before delivery of the component to the job site.

# PART 2 PRODUCTS

## 2.1 SYSTEM DESCRIPTION

### 2.1.1 General Requirements

Components covered in this specification are designed to resist forced entry attacks with increasing severity levels of hand, power, and thermal tools and weapons and explosives. The components include forced entry resistant personnel door/frame assemblies . Each type of forced entry resistant component must be a complete assembly produced by a single manufacturer. Provide movable and operable components that operate smoothly and freely. Design items for exterior installation to resist water and vapor penetration or entrapment. Submit manufacturer's descriptive data, installation instructions, and certificate and test report showing compliance with the specified forced entry test standard as specified in paragraph COMPONENT TEST REQUIREMENTS for all components.

Following approval of manufacturer's descriptive data, submit a schedule listing the items and components to be furnished. Submit manufacturer's certificate indicating that compliance with the installation instructions and drawings will provide the specified degree of forced entry resistance.

2.1.2 Other Submittal Requirements

Submit the following:

a. Manufacturer's descriptive data and finish samples.

b. The forced entry resistant door lock functions, for selection by the Contracting Officer.

c. Manufacturer's certificates attesting that components conform to the requirements on drawings and in specifications.

d. Testing reports from independent testing laboratories indicating conformance to regulatory requirements.

e. Manufacturer certification that compliance with the installation instructions and/or drawings will provide the specified degree of forced entry resistance.

2.2 COMPONENTS

For each type of forced entry resistant component, provide the standard product of a manufacturer regularly engaged in the manufacture of such products and duplicate items that have been tested and approved in accordance with the forced entry test standard specified in paragraph COMPONENT TEST REQUIREMENTS.

2.3 FORCED ENTRY RESISTANT PERSONNEL DOOR AND FRAME ASSEMBLIES

Provide doors and frames that are factory fabricated assemblies of indicated sizes. Provide doors consisting of steel, hardened steel, or reinforced internally with steel shapes and clad with aluminum. Provide interior composition and reinforcement determined by the manufacturer. Install rubber silencers on door frames. Close top edges of exterior doors flush and seal against water penetration, insulate, and provide with weatherstripping and thresholds. Provide locks and hinges that are the same or equal in performance and number as the hardware used on the tested door. Provide manufacturer's lock and hardware as a complete assembly. Furnish frames from the door fabricator, with anchorage to wall construction completely specified as to number of anchors, anchor size, material, and length.

2.3.1 Sound Rated Doors

Provide sound rated doors at locations indicated. Provide door assemblies complying with the forced entry test standard specified and consisting of door, hardware, frame, threshold, and adjustable gaskets. The assembly must have a laboratory Sound Transmission Class (STC) rating as indicated when tested in accordance with ASTM E90. Submit manufacturer's descriptive data, test report, and certification of the test report showing compliance with the specified requirements.

2.3.2 Door and Frame Fabrication

The subsurfaces must be flat, parallel, and plumb after fabrication. Provide doors that are reinforced and fully insulated in accordance with manufacturer's design. Anchor door frames as specified by the door manufacturer. Coordinate the door manufacturer's requirements for welding to wall reinforcement or casting frame embedments into wall before wall is placed. Miter or cope steel door frames and weld at the corners with welds ground smooth. Where structural channel frames are used, specify the size, weight, stops, welding, and anchorage into surrounding construction and test along with the door as an assembly. Make any necessary reinforcements in the door and the frame in the factory. Drill and tap door and frame as required for the specified hardware. Miter or cope frame channels and weld at corners with full penetration groove welds. Dress smoth exposed welds. Manufacture hollow metal doors and frames in accordance with NAAMM HMMA 801, NAAMM HMMA 802, NAAMM HMMA 810, and NAAMM HMMA 820 as a standard of quality, and meet the specified forced entry testing standard.

2.3.3 Preparation for Hardware

Prepare doors and frames for hardware in accordance with manufacturer's instructions. Drill and tap surface applied hardware in the field.

2.3.4 Hardware

Provide hardware for forced entry resistant door assemblies by the door assembly manufacturer to ensure a complete forced entry resistant assembly. Where test standard requires hardware to be tested with the door assembly, include locks and hinges in the labeling and/or test certification. Provide locks and hinges that are the same or equal in performance, quality, grade, and quantity as used on the successfully tested door assembly in accordance with the specified forced entry testing standard. Provide certification that the locks, latches, and hinges provide the same degree of forced entry resistance as required by the specified forced entry testing standard. Provide keying as specified in Section 08 71 00 DOOR HARDWARE.

2.3.4.1 Locks and Latchsets

Submit available lock functions for selection of function by the Contracting Officer. Provide mortise lock and latchsets, as a minimum, series 1000, operational Grade 1, Security Grade 1 or 1A, and conforming to ANSI/BHMA A156.13. Provide strikes for mortise locks and latches (including deadbolt locks), as a minimum, conforming to ANSI/BHMA A156.115 except strikes must be rectangular (without curved lip). Provide mortise-type locks and latches for doors 1-3/4 inches thick and over that have adjustable bevel fronts or otherwise conform to the shape of the door. Mortise locks must have armored fronts. Mortise locks and latches must have full escutcheon, through-bolted, extruded stainless steel trim. Provide lock finish 630 in accordance with ANSI/BHMA A156.18.

2.3.4.2 Hinges

Provide steel doors and frames required to resist the "very low" or "low" threat severity level that are up to and including 7 feet 0 inches high must, as a minimum, equipped with three Grade 1 hinges in accordance with ANSI/BHMA A156.1, minimum size 5 inches high, heavy, double, or triple weight as required for weight of door. For each additional 12 inches of

door height beyond 7 feet 0 inches, provide a minimum of one more hinge. Provide hinges that are full mortise, half mortise, full surface, or half surface design as recommended by the manufacturer for frame and door design and tamperproof unless mounted on the protected side of the door. Hinges must have nonremovable pins and be equipped with a safety stud. Spot welding of hinge pin will not be acceptable. Provide hinge manufacturer's certification that the hinge supplied meets applicable test requirements for ANSI/BHMA A156.1 type number of hinge specified and that the hinge is suitable for the size and weight of the door assembly on which it will be utilized. Furnish prime coated steel interior door hinges. Furnish nonferrous metal or stainless steel exterior door hinges.

2.3.4.3 Electric Strikes

Where required, provide electric strikes conforming to ANSI/BHMA A156.5 Grade 1. Furnish strike boxes with deadbolt and latch strikes for Grade 1. Provide fail secure strikes.

2.3.4.4 Door Closers

Provide manufacturer's recommended Grade 1, extra heavy duty closers conforming to ANSI/BHMA A156.4. Provide 630 door closer finish in accordance with ANSI/BHMA A156.18.

2.3.4.5 Door Stops and Holders

Provide extra heavy duty door stops and holders conforming to ANSI/BHMA A156.16, Type L11271 for wall mounted installation .

2.3.5 Frame Anchors

Provide jamb and head anchors with door/frame assembly as specified by the manufacturer and forced entry resistant to the same degree as the component. Coordinate concrete work with component manufacturers when the manufacturer specifies frame anchors to be embedded into a concrete or concrete masonry unit surface during construction.

2.3.6 Weatherstripping

Provide head and jambs of exterior doors with compression-type neoprene bulb or closed-cell neoprene adjustable type weatherstripping. Door stops must be weatherstripped with a surface-mounted sponge neoprene strip in bronze housing not less than 0.070 inch thick installed to make contact with the door. Install weatherstripping in conformance with the manufacturer's directions after completion of finish painting.

2.4 ACCESSORIES

Provide accessories for the installation of components into the surrounding structure. Anchorage must be forced entry resistant to the same degree as the component. Install in accordance with the manufacturer's recommended instructions. Materials, parts, bolts, anchors, supports, braces, fasteners, and connections necessary for completion of the work.

2.5 LABELING

Plainly and permanently label forced entry resistant components as to the applicable forced entry test standard and level within the test standard

under which the component was tested and approved. Label must be visible only from the protected side after component installation and include the following information: (1) manufacturer's name or identifying symbol; (2) model number, control number, or equivalent; (3) date of manufacture with the week, month or quarter, and year (this may be abbreviated or be in a traceable code such as the lot number); (4) correct mounting position (by removable label); and (5) forced entry resistant rating by indicating the test standard, level within the test standard (if any), and minutes of attack time withstood (if variable in the standard).

## 2.6 SHOP/FACTORY FINISHING

Unless otherwise specified, shop finish all factory or manufactured components as indicated below.

### 2.6.1 Ferrous Metal

Clean surfaces of ferrous metal, except galvanized and stainless steel surfaces, and factory prime for painting. Provide finish painting in accordance with Section 09 90 00 PAINTS AND COATINGS. Prior to shop painting, clean surfaces with solvents to remove grease and oil and with power wire-brushing or sandblasting to remove loose rust, loose mill scale, and other foreign substances. Do not shop paint surfaces of items to be embedded in concrete.

### 2.6.2 Galvanizing

Items specified to be galvanized must be hot-dip processed after fabrication. Galvanize in accordance with ASTM A123/A123M or ASTM A653/A653M.

### 2.6.3 Aluminum

Unless otherwise specified, aluminum items must be standard mill finish. When anodic coatings are specified, coatings must conform to ASM STFA, with treatment to a coating thickness not less than that specified for protective and decorative type finish in AA DAF45. Items to be anodized must receive a polished satin finish pretreatment and a clear lacquer overcoat conforming to the above-referenced standard.

# PART 3 EXECUTION

## 3.1 EXAMINATION

Field verify dimensions of rough openings for components and that surfaces of openings are level, plumb, and provide required clearances. Examine components for racking, twisting, and other malformation and corrected prior to installation. Replace damaged components that cannot be corrected. Protect surrounding work prior to installation of forced entry resistant components. Repair surrounding work, which is damaged as a result of the installation of forced entry resistant components, in an approved manner prior to acceptance. Protect glazed units from damage during adjacent work.

## 3.2 FABRICATION

Construct, assemble, weld, and equip components with all hardware and accessories required to complete the assembly in the shop of a competent fabricator.

## 3.3 FASTENERS

Fasteners exposed to view must match in color and finish and harmonize with the material to which fasteners are applied. Drill or neatly punch holes for bolts and screws. Reject work with poor matching holes . Conceal fasteners where practicable. Unless otherwise specified, provide fasteners conforming to Section 08 31 00 ACCESS DOORS AND PANELS.

## 3.4 CORROSION PROTECTION - DISSIMILAR MATERIALS

Give a protective coating to contact surfaces between dissimilar metals and aluminum surfaces in contact with concrete, masonry, pressure-treated wood, or absorptive materials subject to wetting in accordance with Section 09 90 00 PAINTS AND COATINGS.

## 3.5 INSTALLATION

The finished work must be free from defects. Install components plumb and level and secure rigidly in place. Install components in accordance with approved manufacturer's recommended instructions. Test operable parts of components for smooth operation in the presence of the Contracting Officer. Coordinate frame embedments into the construction where required by the component manufacturer. Replace or repair materials which incur damage as a result of adjacent finish work as specified above. Install glazing for window assemblies, which are not specified as factory glazed, in accordance with GANA Glazing Manual and the manufacturer's recommended instructions. Field glazing must occur only after concrete, masonry, ceiling, electrical, mechanical, plumbing and adjacent finish work has been completed. Properly install forced entry resistant door assemblies so that operating clearances and bearing surfaces conform to the manufacturer's instructions. Secure the bottom of door frames to the floor slab in accordance with the manufacturer's recommendations. Install weatherstripping and thresholds at exterior door openings to provide a weathertight installation. Submit Drawings showing (1) anchorage of components and appurtenances into the actual surrounding construction, (2) clearances for operation, and (3) hardware location and installation details. Submit complete drawings for forced entry resistant prefabricated guardhouses. Submit a copy of installation instructions and recommended cleaning and maintenance instructions.

## 3.6 MANUFACTURER'S FIELD SERVICES

Provide the services of a manufacturer's representative who is experienced in the installation, adjustment, and operation of the component specified. At the request of the Contracting Officer, the representative must supervise the installation, adjustment, and operation (if operable) of the component. The representative must be onsite 1 working days.

## 3.7 ADJUSTING/CLEANING

Make adjustments to assure smooth operation. Provide units that are weathertight when closed and locked. Clean components in accordance with manufacturer's instructions. Use only cleanser recommended by the manufacturer to clean polycarbonate, plastic, and applied hardcoats.

-- End of Section --

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 | (2023) 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 | (2023) 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 | (2023) Standard Specification for Grout for Masonry |
| 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 | (2024) Standard Test Method for Measurement of Airborne Sound Attenuation between Rooms in Buildings |
| ASTM E413 | (2022) Classification for Rating Sound Insulation |
| ASTM E1289 | (2008; R 2022) Standard Specification for Reference Specimen for Sound Transmission Loss |

NATIONAL FIRE PROTECTION ASSOCIATION (NFPA)

| | |
|---|---|
| NFPA 101 | (2021; TIA 21-1) Life Safety Code |
| NFPA 252 | (2022) Standard Methods of Fire Tests of Door Assemblies |

U.S. NATIONAL ARCHIVES AND RECORDS ADMINISTRATION (NARA)

| | |
|---|---|
| 36 CFR 1191 | Americans with Disabilities Act (ADA) Accessibility Guidelines for Buildings and Facilities; Architectural Barriers Act (ABA) Accessibility Guidelines |

## 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

Hollow Metal Sound Retardant Doors; G, AE

Door Frames; G, AE

Door Hardware; G, AE

Door Frame Sound Infill; G, AE

Thresholds; G, AE

SD-06 Test Reports

Wind Loading Tests; G, AE

Water Leakage Tests; G, AE

Acoustical Tests; G, AE

Air Infiltration Tests; G, AE

Positive Pressure Tests; G, AE

SD-07 Certificates

Hollow Metal Sound Retardant Doors; G, AE

Door Frames; G, AE

Door Hardware; G, AE

Thresholds; G

Assembly Test Reports

## 1.3 QUALITY CONTROL

Ensure work within this section is designed and furnished by one manufacturer, who has been engaged in the manufacture of Sound Retardant Hollow Metal Door systems for at least five years prior to the start of this work.

Provide sound control doors and frames, including gaskets, hinges and other hardware items essential for sound control as an assembly and by a single acoustical firm that specializes in producing noise-reducing door assemblies and systems.

### 1.3.1 Compliance and Labeling

#### 1.3.1.1 Category A Positive Pressure Fire Door Construction

Where requirements for positive pressure are met, include for doors all requirements as part of the door construction per Category A guidelines as published by ITS/Warnock-Hersey. Intumescent is not allowed on the frame. Applying smoke gasketing around the perimeter of the frame to meet the "S" smoke rating is permissible in instances where smoke control is required.

#### 1.3.1.2 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.

#### 1.3.1.3 Labeling

Ensure all positive pressure door assemblies carry the fire label for the complete opening, clearly identifying the:

a. Manufacturer

b. Third party testing and certification agency

c. Fire door rating

d. Installation limitations

e. Compatible frame, hardware component ratings

f. Compatible lite or vision panel component ratings

g. Required building code information, including temperature and smoke rating

g. STC rating if required.

Indicate fire-ratings of applicable components. Provide documentation of ABA/ADA accessibility compliance of applicable components, as required by 36 CFR 1191 Appendix D - Technical.

## 1.4 DELIVERY, STORAGE, AND HANDLING

Ship all doors in the manufacturer's undamaged individual cartons, securely bundled and wrapped with moisture-resistant covers and stored in accordance with the manufacturer's printed instructions in a dry, clean, and ventilated area.

Store all materials on planks in a dry location. Store doors and frames vertically with airspace between. Store doors on the edge to eliminate any potential damage to the door bottom seal. Cover all material to protect from damage but in a manner to allow proper circulation.

Maintain relative humidity in the building between 30 and 65 percent. Maintain the ambient temperature at 60 degrees F minimum at the time of installation of wood doors.

Perform final adjustment of seals when temperatures and humidity conditions replicate the interior conditions that will exist when the building is occupied.

## 1.5 WARRANTY

Manufacturer's warranty for 5 years from date of supply, covering material and workmanship. Failures include, but are not limited to, the following:

a. Failure to meet sound rating requirements

b. Faulty operation of sound seals

c. Deterioration of metals, metal finishes, and other materials beyond normal use or weathering.

# PART 2 PRODUCTS

## 2.1 SYSTEM DESCRIPTION

Provide sound retardant door assemblies of the thickness, width, and height indicated, complete with perimeter seals, seal housings, gasketing, automatic door bottoms, thresholds, door frames, and astragals as required to conform to the specified STC per ASTM E90 and ASTM E1289.

Submit fabrication drawings for Hollow Metal Sound Retardant Doors, 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; door frames; door hardware; and thresholds.

Provide assemblies that are complete with metal frame, sealing system, and Cam-lift hinges (when required).

2.1.1 Design Requirements

2.1.1.1 Door Design

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.

2.1.1.2 Frame Design

Provide sound Retardant Metal Frames conforming to ASTM A1008/A1008M, not less than 0.0747-inch thick, and free from pitting, scale, stretcher strains, fluting, and surface defects with integral trim and shipped with temporary spreader. Knockdown frames are not acceptable.

Provide frames with 2 inch faces, profiles and dimensions as indicated, with mitered reinforced corners, welded the full depth of frame and trim, with exposed surfaces ground smooth and flush. Close contact edges to hairline joints.

2.1.2 Performance Requirements

2.1.2.1 STC (Sound Transmission Classification) Rating

Provide doors with an STC per the door schedule.

2.2 FABRICATION

Provide doors that are minimum 16 gauge, 1 3/4 inch thick with welded, seamless construction. No visible joints are permitted on the exposed faces or edges. Join door skins at vertical edges by continuous welds, ground and dressed smooth to provide a flush finish. Reinforce top and bottom with 16 gauge continuous inverted steel channels spot welded to both faces. Finish both top and bottom to provide a smooth flush condition. Bevel both vertical edges 1/8 inch in 2 inches.

Clean and sand to smooth finish all doors to remove handling and storage marks, raised grain, minor surface marks and abrasions which are to receive a job site finish.

2.2.1 Hollow Metal Sound Retardant Doors

2.2.1.1 Construction

Conform to ASTM A1008/A1008M for door construction utilizing steel facing sheets. Conform stretcher level flatness to ASTM A568/A568M; not less than 0.0598 inch thick; free from pitting, scale, and surface defects; separated by a core construction designed to meet the required STC; and tested and rated in accordance with ASTM E90.

Provide doors that have flush seamless face sheets and vertical edges, with continuous welded and smooth joints. Provide edges that are flush or rabbeted as required for perimeter seals.

Provide door surfaces that are visually flat and free from warp, waviness, and other surface irregularities and defects. Maximum allowable warp or twist-can not exceed 1/8 inch when measured with a 7 foot straightedge along the diagonal and not exceed 1/16 inch when measured with a 7 foot straightedge in the width or in any position along the length of the door.

Provide hardware reinforcement that is steel drilled, tapped to template requirements and welded in place. Provide minimum thicknesses as follows:

a. Butts, 0.1494 inch

b. Lock strike, 0.1196 inch

c. Surface applied hardware 0.0747 inch

Provide doors, including sound retardant type, to bear the 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.

2.3 COMPONENTS

2.3.1 Frames

Construct frames for Sound Retardant Wood Swinging Doors from formed sheet steel or structural shapes and bars. Provide sheet steel that is commercial quality, level, cold rolled steel conforming to ASTM A1008/A1008Mor hot rolled, pickled and oiled steel conforming to ASTM A1011/A1011M. Comply steel shapes with ASTM A36/A36M and steel bars with ASTM A108, Grade 1018.

2.3.2 Door Frame Sound Infill

Grout: Comply with ASTM C476, with a slump of not more than 4 inches as measured according to ASTM C143/C143M.

Corrosion-Resistant Coating: Cold-applied asphalt mastic, compounded for 15 mil dry film thickness per coat. Provide inert-type noncorrosive compound free of asbestos fibers, sulfur components, and other deleterious

impurities.

2.3.3 Hardware Reinforcements

Factory mortise, reinforce, drill and tap frames for all mortise hardware as required by hardware manufacturer's template. Provide necessary reinforcement plates as required for surface mounted hardware; installer to perform all field drilling and tapping. Provide dust cover boxes on all frame mortises. Provide minimum thicknesses as follows:

a. Butts, 3/16 inch

b. Lock strike, 0.1196 inch

c. Surface applied hardware 0.0747 inch

2.3.4 Acoustic Seals

a. No adhesive seals allowed.

b. Seals/gaskets are to be mechanically attached.

c. Doorjambs, meeting stiles of double doors, and at the head of the door & frame shall receive self-aligning magnetic, compression seals. Door(s) to be held in closed position by magnetic force of perimeter seals, fire resistant (if UL rated).

d. Acoustic labyrinth shall be created when door is in closed position. Bottom of door leaf shall contain continuous, adjustable, gravity-activated seal that shall compress against the floor as the door is closed.

e. Raised sills and threshold drop seals are not acceptable.

2.3.5 Jamb Anchors

Provide number and spacing of anchors as follows:

2.3.5.1 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.

2.3.5.2 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.

2.3.5.3 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.

2.3.6 Door Hardware

Provide hardware required for STC rated assembly.

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.

2.4 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 door bottom seals to provide positive compression contact with the entire sealing surface with no gaps, openings, or breaks. Hinges or hardware which distort or pinch the perimeter seal during operation of the door will be rejected.

Install door bottom devices to seal the space between the door bottoms and the finished floor and the space between the seal and seal housing.

Field apply perimeter seal housings with mitered corners and with flush, aligned hairline joints.

Install components to manufacturer's written instructions. Coordinate with 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.

Each opening to be examined using an acoustic camera and a speaker system to ensure material installation is adequate and assemblies are performing as intended.

-- End of Section --

SECTION 08 71 00

DOOR HARDWARE
**02/16, CHG 4: 02/22**

PART 1 GENERAL

1.1 REFERENCES

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

BUILDERS HARDWARE MANUFACTURERS ASSOCIATION (BHMA)

| | |
|---|---|
| ANSI/BHMA A156.1 | (2021) Butts and Hinges |
| ANSI/BHMA A156.3 | (2020) Exit Devices |
| ANSI/BHMA A156.4 | (2013) Door Controls - Closers |
| ANSI/BHMA A156.5 | (2020) Cylinder and Input Devices for Locks |
| ANSI/BHMA A156.6 | (2021) Architectural Door Trim |
| ANSI/BHMA A156.7 | (2016) Template Hinge Dimensions |
| ANSI/BHMA A156.13 | (2022) Mortise Locks & Latches Series 1000 |
| ANSI/BHMA A156.15 | (2021) Release Devices Closer Holder, Electromagnetic and Electromechanical |
| ANSI/BHMA A156.16 | (2023) Auxiliary Hardware |
| ANSI/BHMA A156.18 | (2020) Materials and Finishes |
| ANSI/BHMA A156.21 | (2019) Thresholds |
| ANSI/BHMA A156.22 | (2021) Gasketing |
| 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 A156.31 | (2013) Electric Strikes and Frame Mounted Actuators |

NATIONAL FIRE PROTECTION ASSOCIATION (NFPA)

| | |
|---|---|
| NFPA 70 | (2026) National Electrical Code |
| NFPA 72 | (2022; ERTA 22-1) National Fire Alarm and Signaling Code |
| NFPA 80 | (2022) Standard for Fire Doors and Other |

| | |
|---|---|
| | Opening Protectives |
| NFPA 101 | (2021; TIA 21-1) Life Safety Code |
| NFPA 252 | (2022) Standard Methods of Fire Tests of Door Assemblies |

STEEL DOOR INSTITUTE (SDI/DOOR)

| | |
|---|---|
| SDI/DOOR A250.8 | (2023) Specifications for Standard Steel Doors and Frames |

U.S. NATIONAL ARCHIVES AND RECORDS ADMINISTRATION (NARA)

| | |
|---|---|
| 36 CFR 1191 | Americans with Disabilities Act (ADA) Accessibility Guidelines for Buildings and Facilities; Architectural Barriers Act (ABA) Accessibility Guidelines |

UNDERWRITERS LABORATORIES (UL)

| | |
|---|---|
| UL Bld Mat Dir | (updated continuously online) Building Materials Directory |

## 1.2 SUBMITTALS

Government approval is required for submittals with a "G" or "S" classification. Submittals not having a "G" or "S" classification are for 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

Manufacturer's Detail Drawings; G, AE

Verification of Existing Conditions; G, AE

Hardware Schedule; G, AE

Keying System; G, AE

SD-03 Product Data

Hardware Items; G, AE

Recycled Content; S

SD-08 Manufacturer's Instructions

Installation

SD-10 Operation and Maintenance Data

Hardware Schedule Items, Data Package 1; G, AE

SD-11 Closeout Submittals

Key Bitting; G

1.3 SHOP DRAWINGS

Submit manufacturer's detail drawings indicating all hardware assembly components and interface with adjacent construction. Indicate power components and wiring coordination for electrified hardware. Base shop drawings on verified field measurements and include verification of existing conditions.

1.4 PRODUCT DATA

Indicate fire-ratings at applicable components. Provide documentation of ABA/ADA accessibility compliance of applicable components, as required by 36 CFR 1191 Appendix D - Technical. Provide recycled content.

1.5 HARDWARE SCHEDULE

Provide Hardware Item List and Hardware Schedule containing the following information, and additional information as needed to identify the complete make up of each hardware set and its application to each opening:

1.5.1 Hardware Item List:

a. Hardware Type

b. Item Number

c. Quantity

d. Size(s)

e. Reference Publication / Type Number

f. Manufacturer's Name / Catalog Number

g. Key Control Symbols

h. UL Mark (If fire rated and listed)

i. BHMA Finish(es)

j. Remarks

1.5.2 Hardware Schedule

a. Hardware Set Number

b. Opening Number(s)

c. Opening Description (single/double leaf, hand, size, door/frame material)

d. RF Shielding

e. Sound Rating

f. Hardware Items

g. Quantity

h. Size

i. BHMA Finish

j. Remarks

In addition, submit hardware schedule data package 1 in accordance with Section 01 78 23 OPERATION AND MAINTENANCE DATA.

## 1.6 KEY BITTING CHART REQUIREMENTS

### 1.6.1 Requirements

Submit key bitting charts to the Contracting Officer prior to completion of the work. Include:

a. Complete listing of all keys (e.g. AA1 and AA2).

b. Complete listing of all key cuts (AA1-123456, AA2-123458).

c. Tabulation showing which key fits which door.

d. Copy of floor plan showing doors and door numbers.

e. Listing of 20 percent more key cuts than are presently required in each master system.

## 1.7 QUALITY ASSURANCE

### 1.7.1 Hardware Manufacturers and Modifications

Provide, as far as feasible, locks, hinges, and closers of one lock, hinge, or closer manufacturer's make. Modify hardware as necessary to provide features indicated or specified.

### 1.7.2 Key Shop Drawings Coordination Meeting

Prior to the submission of the key shop drawing, the Contracting Officer, Contractor, Door Hardware Subcontractor, using Activity and Base Locksmith must meet to discuss and coordinate key requirements for the facility.

## 1.8 DELIVERY, STORAGE, AND HANDLING

Deliver hardware in original individual containers, complete with necessary appurtenances including fasteners and instructions. Mark each individual container with item number as shown on hardware schedule. Deliver permanent keys and removable cores to the Contracting Officer, either directly or by certified mail. Deliver construction master keys with the locks.

# PART 2 PRODUCTS

## 2.1 TEMPLATE HARDWARE

Hardware applied to metal doors must be manufactured using a template. Provide templates to door and frame manufacturers in accordance with

ANSI/BHMA A156.7 for template hinges. Coordinate hardware items to prevent interference with other hardware.

## 2.2 HARDWARE FOR STC DOORS AND RF SHIELDED DOORS EXIT DOORS

Provide all hardware necessary to meet the requirements of NFPA 72 for door alarms, NFPA 80 for fire doors, NFPA 101 for exit doors, NFPA 252 for fire tests of door assemblies, ABA/ADA accessibility requirements, and all other requirements indicated, even if such hardware is not specifically mentioned in paragraph HARDWARE SCHEDULE. Provide Underwriters Laboratories, Inc. labels for such hardware in accordance with UL Bld Mat Dir or equivalent labels in accordance with another testing laboratory approved in writing by the Contracting Officer. Hardware for STC/RF doors shall be provided to meet the specified resistance requirements. If STC/RF doors require specific hardware not included in this Section, it shall be provided to meet the STC/RF door's requirements at no additional cost to the Government.

## 2.3 HARDWARE ITEMS

Clearly and permanently mark with the manufacturer's name or trademark, hinges, pivots, locks, latches, exit devices, bolts and closers where the identifying mark is visible after the item is installed. For closers with covers, the name or trademark may be beneath the cover. Coordinate electrified door hardware components with corresponding components specified in Division 28 ELECTRONIC SECURITY SYSTEMS (ESS).

### 2.3.1 Hinges

Provide in accordance with ANSI/BHMA A156.1. Provide hinges that are 4-1/2 by 4-1/2 inch unless otherwise indicated. Construct loose pin hinges for interior doors and reverse-bevel exterior doors so that pins are non-removable when door is closed. Other anti-friction bearing hinges may be provided in lieu of ball bearing hinges.

Interior hinges to be BHMA 652 finish (satin chrome plated) and must be cast or forged bronze or stainless steel. All fire rated doors must have a base metal of steel or stainless steel. Use full-mortise (butt) hinges except where special types are required. Use swing-clear hinges where necessary to keep door opening completely clear when door is opened 90 to 95 degrees. Use wide-throw hinges where necessary to keep door leaf clear of wall, casings, jambs, or reveals. All hinges to have a security stud with a minimum stud depth of 1/4" Hinges in doors that are exterior and that have exposed pins must be provided with anti-removal modifications, like welded, set screws, dog bolts, etc.

### 2.3.2 Continuous Hinges

Where continuous hinges are required, provide in accordance with ANSI/BHMA A156.26. Provide a heavy duty hinge that has capacity to handle the weight of the door. Provide continuous hinges if weight of the door exceeds the weight limit for regular hinges.

### 2.3.3 Locks and Latches

a. At exterior locations provide locksets of full stainless steel type 302 or 304 construction including fronts, strike, escutcheons, knobs, bolts and all interior working parts. Marine Grade I, fully non-ferrous.

b. In non-air-conditioned interior environments or humid interior environments, provide interior locksets on the same Marine Grade I, fully non-ferrous as exterior locksets.

2.3.3.1 Mortise Locks and Latches

Provide in accordance with ANSI/BHMA A156.13, Series 1000, Operational Grade 1, Security Grade 2. Provide mortise locks with escutcheons not less than 7 by 2-1/4 inch with a bushing at least 1/4 inch long. Cut escutcheons to fit cylinders and provide trim items with straight, beveled, or smoothly rounded sides, corners, and edges. Provide knobs and roses of mortise locks with screwless shanks and no exposed screws.

2.3.4 X-10 Security Locks

X-10 Security lock shall conform to FS FF-L-2740B, Type 1

2.3.5 Exit Devices

Provide in accordance with ANSI/BHMA A156.3, Grade 1. Provide adjustable strikes for rim type and vertical rod devices. Provide open back strikes for pairs of doors with mortise and vertical rod devices. Provide Provide escutcheons not less than 7 by 2-1/4 inch.

Use stainless steel or bronze base metal with plated finishes. Also include stainless steel fasteners and screws.

2.3.6 Exit Locks With Alarm

Provide in accordance with ANSI/BHMA A156.3 and ANSI/BHMA A156.29, Type E0431 (with full width horizontal actuating bar) for single doors; Type E0431 (with actuating bar) or E0471 (with actuating bar and top and bottom bolts, both leaves active) for pairs of doors, unless otherwise specified. Provide door alarms integrated with the fire alarm system in accordance with NFPA 72.

2.3.7 Cylinders and Cores

Provide cylinders for new locks, including locks provided under other sections of this specification. Provide fully compatible cylinders of Grade 1 products from products of one manufacturer with interchangeable cores that are removable by a special control key. Factory set the cores with seven pin tumblers using the A4 system and F keyway. Submit a core code sheet with the cores. Provide master keyed cores in one system for this project. Provide construction interchangeable cores.

2.3.8 Electrified Hardware

Comply with the requirements of NFPA 70 for wiring of electrified hardware.

2.3.8.1 Electric Strikes and Frame Mounted Actuators

Provide in accordance with ANSI/BHMA A156.31, Grade 1. Provide electric strikes and actuators as required to meet operational requirements. Provide electric strikes that remain secure during power failure. Provide strikes and actuators with a minimum opening force of 2300 pounds.

Provide facility interface devices that use direct current (dc) power to

energize the solenoids. Provide electric strikes and actuators that incorporate end-of-line resistors to facilitate line supervision by the system. If not incorporated into the electric strike or local controller, provide metal oxide resistors (MOVs) to protect the controller from reverse current surges.

2.3.8.1.1 Solenoid

Provide actuating solenoid for strikes and actuators that are rated for continuous duty, cannot dissipate more than 12 Watts and must operate on 12 or 24 Volts dc. Inrush current cannot exceed 1 ampere and the holding current cannot be greater than 500 milliamperes. Actuating solenoid must move from fully secure to fully open positions in less than 500 milliseconds.

2.3.8.1.2 Signal Switches

Provide strikes and actuators with signal switches to indicate to the system when the bolt is not engaged or the strike mechanism is unlocked. Signal switches must report a forced entry to the system.

2.3.8.1.3 Tamper Resistance

Provide strike guards that prevent tampering with the latch bolt of the locking hardware or the latch bolt keeper of the electric strike. Strike guards to bolt through the door using tamper resistant screws. Provide strike guards made of 1/8 inch thick brass and that are 11-1/14 inch high by 1-5/8 inch wide, with a minimum 5/32 inch wide offset.

2.3.8.1.4 Coordination

Provide electric strikes and actuators of a size, weight and profile compatible with each specified door frame. Field verify installation clearances prior to procurement.

2.3.8.1.5 Mounting Method

Provide electric strikes and actuators suitable for use with single and double doors, with mortise or rim type hardware specified, and for right or left hand mounting as specified. In double door installations, locate the lock in the active leaf and monitor the fixed leaf.

2.3.8.2 Electrified Mortise Locks

Provide in accordance with ANSI/BHMA A156.25, Grade 1. Provide electrified mortise locks that remain secure during power failure. Provide facility interface devices that use dc power to energize solenoids. Provide solenoids, resisters, and signal switches in accordance with paragraph ELECTRIC STRIKES AND FRAME MOUNTED ACTUATORS.

2.3.8.2.1 Power Transfer Hinges

Provide power transfer hinges with each electrified lock that route power and monitoring signals from the lockset to the door frame. Coordinate power transfer hinges with door frames.

2.3.8.3 Power Transfer Hinges

Provide power transfer hinges with each electrified lock that route power

and monitoring signals from the lockset to the door frame. Coordinate power transfer hinges with door frames.

2.3.8.4 Release Devices

In accordance with ANSI/BHMA A156.15, Grade 1.

2.3.8.4.1 Closer Holders

Provide header mounted closer holder devices connected by integral releasing to fire detecting devices.

2.3.9 Keying System

Provide a master keying system. Provide construction interchangeable cores. Provide key cabinet as specified.

2.3.10 Lock Trim

Provide cast, forged, or heavy wrought construction and commercial plain design for lock trim.

2.3.10.1 Lever Handles

Provide lever handles. Provide in accordance with ANSI/BHMA A156.3 for mortise locks of lever handles for exit devices. Provide lever handle locks with a breakaway feature (such as a weakened spindle or a shear key) to prevent irreparable damage to the lock when force in excess of that specified in ANSI/BHMA A156.13 is applied to the lever handle. Provide lever handles return to within 1/2 inch of the door face.

2.3.11 Keys

Furnish one file key, one duplicate key, and one working key for each key change and for each master and grand master keying system. Furnish one additional working key for each lock of each keyed-alike group. Furnish four great grand master keys, four construction master keys, and four control keys for removable cores. Furnish a quantity of key blanks equal to 20 percent of the total number of file keys. Stamp each key with appropriate key control symbol and "U.S. property - do not duplicate." Do not place room number on keys.

2.3.12 Door Bolts

Provide in accordance with ANSI/BHMA A156.16. Provide dustproof strikes for bottom bolts, except at doors having metal thresholds. Provide automatic latching flush bolts in accordance with ANSI/BHMA A156.3, Type 25.

2.3.13 Closers

Provide in accordance with ANSI/BHMA A156.4, Series C02000, Grade 1, with PT 4C. Provide with brackets, arms, mounting devices, fasteners, full size covers, except at storefront mounting, and other features necessary for the particular application. Size closers in accordance with manufacturer's printed recommendations, or provide multi-size closers, Sizes 1 through 6, and list sizes in the Hardware Schedule. Provide manufacturer's 10 year warranty.

Use stainless steel inside bracketed or door mounted closers on exterior doors. Non-ferrous closers, such as aluminum or cast bronze, are permissible where door utilization is minimal. On interior doors use closers of 302 or 304 stainless steel or non-ferrous materials. On surface-mounted closers use or apply rust inhibiting finish on all ferrous parts. Also apply this finish on concealed closers.

2.3.13.1 Identification Marking

Engrave each closer with manufacturer's name or trademark, date of manufacture, and manufacturer's size designation in locations that will be visible after installation.

2.3.14 Door Protection Plates

Provide in accordance with ANSI/BHMA A156.6.

2.3.14.1 Sizes of Armor, Mop and Kick Plates

2 inch less than door width for single doors; 1 inch less than door width for pairs of doors. Provide 8 inch kick plates for flush doors and 1 inch less than height of bottom rail for panel doors. Provide a minimum 36 inch armor plates for flush doors and completely cover lower panels of panel doors. Provide 4 inch mop plates.

2.3.15 Door Stops and Silencers

Provide in accordance with ANSI/BHMA A156.16. Silencers Type L03011. Provide three silencers for each single door, two for each pair.

2.3.16 Thresholds

Provide in accordance with ANSI/BHMA A156.21. Use J35100, with vinyl or silicone rubber insert in face of stop, for exterior doors opening out, unless specified otherwise.

2.3.17 Weatherstripping Gasketing

Provide in accordance with ANSI/BHMA A156.22. Provide the type and function designation where specified in paragraph HARDWARE SCHEDULE. Provide a set to include head and jamb seals, sweep strips, and, for pairs of doors, astragals. Air leakage of weatherstripped doors not to exceed the requirements of ANSI/BHMA A156.22. Provide weatherstripping with one of the following:

2.3.17.1 Extruded Aluminum Retainers

Extruded aluminum retainers not less than 0.050 inch wall thickness with vinyl, neoprene, silicone rubber, or polyurethane inserts. Provide clear (natural) anodized aluminum.

2.3.18 Soundproofing Gasketing

Provide in accordance with ANSI/BHMA A156.22. Provide adjustable doorstops at heads,jambs and automatic door bottoms in accordance with the hardware set, of extruded aluminum, clear (natural) anodized, surface applied, with vinyl fin seals between plunger and housing. Provide doorstops with solid neoprene tube, silicone rubber, or closed cell sponge gasket. Provide door bottoms with adjustable operating rod and silicone

rubber or closed cell sponge neoprene gasket. Provide doorstops that are mitered at corners. Provide type and function designation where specified in paragraph HARDWARE SETS.

2.3.19 Auxiliary Hardware (Other than locks)

Provide in accordance with ANSI/BHMA A156.16, Grade 1.

2.3.20 Special Tools

Provide special tools, such as spanner and socket wrenches and dogging keys, as required to service and adjust hardware items.

2.4 FASTENERS

Provide fasteners of type, quality, size, and quantity appropriate to the specific application. Fastener finish to match hardware. Provide stainless steel or nonferrous metal fasteners in locations exposed to weather. Verify metals in contact with one another are compatible and will avoid galvanic corrosion when exposed to weather.

2.5 FINISHES

Provide in accordance with ANSI/BHMA A156.18. Provide hardware in BHMA 630 finish (satin stainless steel), unless specified otherwise. Provide items not manufactured in stainless steel in BHMA 626 finish (satin chromium plated) over brass or bronze, except aluminum paint finish for surface door closers, and except BHMA 652 finish (satin chromium plated) BHMA 600 finish (primed for painting) for steel hinges. Provide hinges for exterior doors in stainless steel with BHMA 630 finish. Furnish exit devices in BHMA 626 finish in lieu of BHMA 630 finish except where BHMA 630 is specified under paragraph HARDWARE SETS. Match exposed parts of concealed closers to lock and door trim. Match hardware finish for aluminum doors to the doors.

2.6 KEY CABINET AND CONTROL SYSTEM

Provide in accordance with ANSI/BHMA A156.5, 4 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 INSTALLATION

Provide hardware in accordance with manufacturers' printed installation instructions. Fasten hardware to wood surfaces with full-threaded wood screws or sheet metal screws. Provide machine screws set in expansion shields for fastening hardware to solid concrete and masonry surfaces. Provide toggle bolts where required for fastening to hollow core construction. Provide through bolts where necessary for satisfactory installation.

3.1.1 Weatherstripping Installation

Provide full contact, weathertight seals that allow operation of doors without binding the weatherstripping.

3.1.1.1 Stop Applied Weatherstripping

Fasten in place with color matched sheet metal screws not more than 9 inch on center after doors and frames have been finish painted.

3.1.2 Soundproofing Installation

Provide as specified for stop applied weatherstripping.

3.1.3 Threshold Installation

Extend thresholds the full width of the opening and notch end for jamb stops. Set thresholds in a full bed of sealant and anchor to floor with cadmium-plated, countersunk, steel screws in expansion sleeves. For aluminum thresholds placed on top of concrete surfaces, coat the underside surfaces that are in contact with the concrete with fluid applied waterproofing as a separation measure prior to placement.

3.2 FIRE DOORS AND EXIT DOORS

Provide hardware in accordance with NFPA 72 for door alarms, NFPA 80 for fire doors, NFPA 101 for exit doors, and NFPA 252 for fire tests of door assemblies. .

3.3 HARDWARE LOCATIONS

Provide in accordance with SDI/DOOR A250.8, unless indicated or specified otherwise.

a. Kick and Armor Plates: Push side of single-acting doors. Both sides of double-acting doors.

b. Mop Plates: Bottom flush with bottom of door.

3.4 KEY CABINET AND CONTROL SYSTEM

Locate where directed. Tag one set of file keys and one set of duplicate keys. Place other keys in appropriately marked envelopes, or tag each key. Provide complete instructions for setup and use of key control system. On tags and envelopes, indicate door and room numbers or master or grand master key.

3.5 FIELD QUALITY CONTROL

After installation, protect hardware from paint, stains, blemishes, and other damage until acceptance of work. Submit notice of testing 15 days before scheduled, so that testing can be witnessed by the Contracting Officer. Adjust hinges, locks, latches, bolts, holders, closers, and other items to operate properly. Demonstrate that permanent keys operate respective locks, and give keys to the Contracting Officer. Correct, repair, and finish, errors in cutting and fitting and damage to adjoining work.

3.6 HARDWARE SETS

See drawings for hardware sets.

-- End of Section --

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SECTION 08 91 00

METAL WALL LOUVERS
**08/20**

PART 1 GENERAL

1.1 REFERENCES

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

AIR MOVEMENT AND CONTROL ASSOCIATION INTERNATIONAL, INC. (AMCA)

| | |
|---|---|
| AMCA 500-L | (2015) Laboratory Methods of Testing Louvers for Rating |
| AMCA 511 | (2010; R 2016) Certified Ratings Program for Air Control Devices |
| AMCA 540 | (2023) Test Method for Louvers Impacted by Wind Borne Debris |
| AMCA 550 | (2022) Test Method for High Velocity Wind Driven Rain Resistant Louvers |

ALUMINUM ASSOCIATION (AA)

| | |
|---|---|
| AA DAF45 | (2003; Reaffirmed 2009) Designation System for Aluminum Finishes |

AMERICAN ARCHITECTURAL MANUFACTURERS ASSOCIATION (AAMA)

| | |
|---|---|
| AAMA 611 | (2014) Voluntary Specification for Anodized Architectural Aluminum |

ASTM INTERNATIONAL (ASTM)

| | |
|---|---|
| ASTM A123/A123M | (2024) Standard Specification for Zinc (Hot-Dip Galvanized) Coatings on Iron and Steel Products |
| ASTM A653/A653M | (2023) 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 A1008/A1008M | (2023) Standard Specification for Steel, Sheet, Cold-Rolled, Carbon, Structural, High-Strength Low-Alloy, High-Strength Low-Alloy with Improved Formability, Solution Hardened, and Bake Hardenable |

| | |
|---|---|
| ASTM B209 | (2014) Standard Specification for Aluminum and Aluminum-Alloy Sheet and Plate |
| ASTM B221 | (2021) Standard Specification for Aluminum and Aluminum-Alloy Extruded Bars, Rods, Wire, Profiles, and Tubes |

1.2 SUBMITTALS

Government approval is required for submittals with a "G" or "S" classification. Submittals not having a "G" or "S" classification are for 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; G, AE

SD-03 Product Data

Metal Wall Louvers; G, AE

SD-04 Samples

Wall Louver Samples; G, AE

1.3 DELIVERY, STORAGE, AND PROTECTION

Deliver materials to the site in an undamaged condition. Carefully store materials off the ground to provide proper ventilation, drainage, and protection against dampness. Louvers must be free from nicks, scratches, and blemishes. Replace defective or damaged materials with new.

1.4 DETAIL DRAWINGS

Show all information necessary for fabrication and installation of wall louvers. Indicate materials, sizes, thicknesses, fastenings, and profiles.

1.5 COLOR SAMPLES

Colors of finishes for wall louver samples must closely approximate colors indicated. Where color is not indicated, submit the manufacturer's standard colors to the Contracting Officer for selection.

PART 2 PRODUCTS

2.1 MATERIALS

2.1.1 Galvanized Steel Sheet

ASTM A653/A653M, coating designation G90.

2.1.2 Aluminum Sheet

ASTM B209, alloy 3003 or 5005 with temper as required for forming.

2.1.3 Extruded Aluminum

ASTM B221, alloy 6063-T5 or -T52.

2.1.4 Stainless Steel

Type 302 or 304, with 2B finish.

2.1.5 Cold Rolled Steel Sheet

ASTM A1008/A1008M, Class 1, with matte finish. Use for interior louvers only.

2.2 METAL WALL LOUVERS

Wind driven rain resistant type, with bird screens and made to withstand a wind load of not less than 30 pounds per square foot. Wall louvers must bear the AMCA certified ratings program seal for air performance and water penetration in accordance with AMCA 500-L and AMCA 511. The rating must show a water penetration of 0.20 or less ounce per square foot of free area at a free velocity of 800 feet per minute. Wall louvers must be listed and tested in accordance with AMCA 540 and AMCA 550. The static pressure drop must not exceed 0.2 inches water gauge at a free area velocity of 800 feet per minute.

2.2.1 Extruded Aluminum Louvers

Fabricated of extruded 6063-T5 or -T52 aluminum with a wall thickness of not less than 0.081 inch.

2.2.2 Mullions and Mullion Covers

Same material and finish as louvers. Provide mullions for all louvers more than 5 feet in width at not more than 5 feet on centers. Provide mullion covers on both faces of joints between louvers.

2.2.3 Screens and Frames

For aluminum louvers, provide 1/2 inch square mesh, 14 or 16 gage aluminum or 1/4 inch square mesh, 16 gage aluminum bird screening. 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 FASTENERS AND ACCESSORIES

Provide stainless steel screws and fasteners for aluminum louvers and zinc-coated or stainless steel screws and fasteners for steel louvers. Provide other accessories as required for complete and proper installation.

2.4 FINISHES

2.4.1 Aluminum

Exposed aluminum surfaces must be factory finished with an anodic coating. Color must be clear anodized. Louvers must have the same finish.

2.4.1.1 Anodic Coating

Clean exposed aluminum surfaces and provide an anodized finish conforming to AA DAF45 and AAMA 611. Finish must be:

a. Architectural Class I ( 0.7 mil or thicker), designation AA-M10-C22-anodized.

2.4.2 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 Screens and Frames

Attach frames to louvers with screws or bolts.

3.2 PROTECTION FROM CONTACT OF DISSIMILAR MATERIALS

3.2.1 Copper or Copper-Bearing Alloys

Paint copper or copper-bearing alloys in contact with dissimilar metal with heavy-bodied bituminous paint or separate with inert membrane.

3.2.2 Aluminum

Where aluminum contacts metal other than zinc, paint the dissimilar metal with a primer and two coats of aluminum paint.

3.2.3 Metal

Paint metal in contact with mortar, concrete, or other masonry materials with alkali-resistant coatings such as heavy-bodied bituminous paint.

3.2.4 Wood

Paint wood or other absorptive materials that may become repeatedly wet and in contact with metal with two coats of aluminum paint or a coat of heavy-bodied bituminous paint.

-- End of Section --

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SECTION 09 29 00

GYPSUM BOARD
**08/16, CHG 4: 02/20**

PART 1 GENERAL

1.1 REFERENCES

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

AMERICAN NATIONAL STANDARDS INSTITUTE (ANSI)

| | |
|---|---|
| ANSI A108.11 | (1992; Reaffirmed 2005) Specifications for Interior Installation of Cementitious Backer Units |
| ANSI/ASA S12.2 | Criteria for Evaluating Room Noise |

ASTM INTERNATIONAL (ASTM)

| | |
|---|---|
| ASTM C475/C475M | (2017; R 2022) Standard Specification for Joint Compound and Joint Tape for Finishing Gypsum Board |
| ASTM C514 | (2004; R 2020) Standard Specification for Nails for the Application of Gypsum Board |
| ASTM C840 | (2020) Standard Specification for Application and Finishing of Gypsum Board |
| ASTM C954 | (2022) 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 | (2022) Standard Specification for Steel Self-Piercing Tapping Screws for the Application of Gypsum Panel Products or Metal Plaster Bases to Wood Studs or Steel Studs |
| ASTM C1047 | (2019) Standard Specification for Accessories for Gypsum Wallboard and Gypsum Veneer Base |
| ASTM C1177/C1177M | (2017) Standard Specification for Glass Mat Gypsum Substrate for Use as Sheathing |
| ASTM 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 | (2023) 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 D412 | (2016; R 2021) 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 D1037 | (2012; R 2020) Standard Test Methods for Evaluating Properties of Wood-Base Fiber and Particle Panel Materials |
| ASTM D1149 | (2007; R 2012) Standard Test Method for Rubber Deterioration - Surface Ozone Cracking in a Chamber |
| ASTM D2394 | (2017) Standard Test Methods for Simulated Service Testing of Wood and Wood-Base Finish Flooring |
| ASTM D3273 | (2021) Standard Test Method for Resistance to Growth of Mold on the Surface of Interior Coatings in an Environmental Chamber |
| ASTM D5420 | (2016) Standard Test Method for Impact Resistance of Flat, Rigid Plastic Specimen by Means of a Strike Impacted by a Falling Weight (Gardner Impact) |
| ASTM E84 | (2023) Standard Test Method for Surface Burning Characteristics of Building Materials |
| ASTM E336 | (2024) Standard Test Method for Measurement of Airborne Sound Attenuation between Rooms in Buildings |
| ASTM E695 | (2022) Standard Test Method of Measuring Relative Resistance of Wall, Floor, and Roof Construction to Impact Loading |
| ASTM E1130 | Standard Test Method for Objective Measurement of Speech Privacy in Open Plan Spaces Using Articulation Index |
| ASTM E2638 | Standard Test Method for Objective Measurement of the Speech Privacy Provided by a Closed Room |

| | |
|---|---|
| ASTM E2964 | Standard Test Method for Measurement of the Normalized Insertion Loss of Doors |

CALIFORNIA DEPARTMENT OF PUBLIC HEALTH (CDPH)

| | |
|---|---|
| CDPH SECTION 01350 | (2017; Version 1.2) 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 |

GYPSUM ASSOCIATION (GA)

| | |
|---|---|
| GA 214 | (2010) Recommended Levels of Gypsum Board Finish |
| GA 216 | (2016) Application and Finishing of Gypsum Panel Products |
| GA 253 | (2012) Application of Gypsum Sheathing |

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 3-101-01 | (2020; with Change 4, 2024) Architecture |

UNDERWRITERS LABORATORIES (UL)

| | |
|---|---|
| UL 2818 | (2022) 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

Cementitious Backer Units; G, AE

Glass Mat Water-Resistant Gypsum Tile Backing Board

Water-Resistant Gypsum Backing Board; G, AE

Glass Mat Covered or Reinforced Gypsum Sheathing; G, AE

Glass Mat Covered or Reinforced Gypsum Sheathing Sealant; G, AE

Abuse Resistant Gypsum Board; G, AE

Accessories; G, AE

Submit for each type of gypsum board and for cementitious backer units.

Gypsum Board; G, AE

Recycled Content for Gypsum Board; S

Recycled Content for Paper Facing and Gypsum Cores; S

VOC Content of Joint Compound; S

SD-06 Test Reports

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 Non-aerosol Adhesives; S

Indoor Air Quality for Aerosol Adhesives; 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 products certified to meet indoor air quality requirements by UL 2818 (Greenguard) Gold, SCS Global Services Indoor Advantage Gold or provide certification or validation by other third-party program that products meet the requirements of this Section. Provide current product certification documentation from certification body. When product does not have certification, provide validation that product meets the indoor air quality product requirements cited herein.

1.3.1.2 Adhesives and Sealants

Provide products certified to meet indoor air quality requirements by UL 2818 (Greenguard) Gold, SCS Global Services Indoor Advantage Gold or provide certification or validation by other third-party program that products meet the requirements of this Section. Provide current product certification documentation from certification body. When product does not have certification, provide validation that product meets the indoor air quality product requirements cited herein.

1.4 DELIVERY, STORAGE, AND HANDLING

1.4.1 Delivery

Deliver materials in the original packages, containers, or bundles with each bearing the brand name, applicable standard designation, and name of manufacturer, or supplier.

1.4.2 Storage

Keep materials dry by storing inside a sheltered building. Where necessary to store gypsum board and cementitious backer units outside, store off the ground, properly supported on a level platform, and protected from direct exposure to rain, snow, sunlight, and other extreme weather conditions. Provide adequate ventilation to prevent condensation. Store permanufacturer'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 and cementitious backer units flat to prevent sagging or damage to the edges, ends, and surfaces.

1.5 QUALIFICATIONS

Furnish type of gypsum board work specialized by the installer with a minimum of 3 years of documented successful experience.

1.6 SCHEDULING

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.

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.

## PART 2 PRODUCTS

### 2.1 MATERIALS

Conform to specifications, standards and requirements specified. Provide gypsum board types, gypsum backing board types, cementitious backing units, and joint treating materials manufactured from asbestos free materials only.Submit Safety Data Sheets and manufacturer maintenance instructions for gypsum materials including adhesives.

#### 2.1.1 Gypsum Board

ASTM C1396/C1396M. Gypsum board must contain a minimum of 5 percent post-consumer recycled content, or a minimum of 20 percent post-industrial recycled content. Provide data identifying percentage of recycled content for gypsum board. Paper facings must contain a minimum of 100 percent recycled paper content. Gypsum cores must contain a minimum of 95 percent post-industrial recycled gypsum content. Provide data identifying percentage of recycled content for paper facing and gypsum cores. Provide gypsum wall board and panels meeting the emissions requirements of CDPH SECTION 01350 (limit requirements for either office or classroom spaces regardless of space type). Provide certification or validation of indoor air quality for gypsum board.

##### 2.1.1.1 Regular

48 inch wide, 5/8 inch thick, tapered edges.

##### 2.1.1.2 RF Foil-Backed

If RF foil backed gypsum board is used, it must full comply with 13 49 20.00 10 RF SHIELDING. 48 inch wide, 5/8 inch thick, tapered edges.

##### 2.1.1.3 Type X (Special Fire-Resistant)

48 inch wide, 5/8 inch thick, tapered edges.

##### 2.1.1.4 Mold Resistant / Anti-Microbial Gypsum

ASTM D3273. 48 inch wide, 5/8 inch thick, tapered edges.

#### 2.1.2 Gypsum Backing Board

ASTM C1396/C1396M, gypsum backing board must be used as a base in a multilayer system.

##### 2.1.2.1 Regular

48 inch wide, 5/8 inch thick, square edges.

2.1.2.2 Foil-Backed

48 inch wide, 5/8 inch thick, square edges.

2.1.2.3 Type X (Special Fire-Resistant)

48 inch wide, 5/8 inch thick, square edges.

2.1.3 Regular Water-Resistant Gypsum Backing Board

ASTM C1396/C1396M

2.1.3.1 Regular

48 inch wide, 5/8 inch thick, tapered edges.

2.1.3.2 Type X (Special Fire-Resistant)

48 inch wide, 5/8 inch thick, tapered edges.

2.1.4 Glass Mat Water-Resistant Gypsum Tile Backing Board

ASTM C1178/C1178M

2.1.4.1 Regular

48 inch wide, 5/8 inch thick, square edges.

2.1.5 Glass Mat Covered or Reinforced Gypsum Sheathing

Exceeds physical properties of ASTM C1396/C1396M and ASTM C1177/C1177M. Provide 5/8 inch, gypsum sheathing. Provide gypsum board of with a noncombustible water-resistant core, with glass mat surfaces embedded to the gypsum core or reinforcing embedded throughout the gypsum core. Warrant gypsum sheathing board for at least twelve months against delamination due to direct weather exposure. Provide continuous, asphalt impregnated, building felt to cover exterior face of sheathing. Seal all joints, seams, and penetrations with compatible sealant.

2.1.5.1 Glass Mat Covered or Reinforced Gypsum Sheathing Sealant

Provide sealant compatible with glass mat covered or reinforced gypsum sheathing, rubber washers for masonry veneer anchors, and other associated cavity wall components such as anchors and through wall flashing. Provide sealants for glass mat covered or reinforced gypsum sheathing board edge seams and veneer anchor penetrations recommended by the glass mat covered or reinforced gypsum sheathing manufacturer and have the following performance requirements:

a. ASTM D412: Tensile Strength, 80 psi.
b. ASTM D412: Ultimate Tensile Strength (maximum elongation), 170 psi.
c. ASTM D624: Tear Strength, dieB, 27 ppi.
d. ASTM D1149: Joint Movement Capability after 14 Days cure, plus or minus 50 percent.

2.1.6 Abuse Resistant Gypsum Board

48 inch wide, 5/8 inch thick, tapered edges.
Reinforced gypsum panel with imbedded fiber mesh or lexan backing tested

in accordance with the following tests. Hard body impact test must attain a Level 2 performance in accordance with ASTM C1629/C1629M. Provide fasteners that meet manufacturer requirements and specifications stated within this section. Abuse resistant gypsum board, when tested in accordance with ASTM E84, have a flame spread rating of 25 or less and a smoke developed rating of 50 or less.

2.1.6.1 Soft Body Impact Test

ASTM E695 or ASTM D2394 for impact penetration and deformation. ASTM E695 using a 60 lb leather bag filled with steel pellets, resisting no less than 300 ft. lb. cumulative impact energy before failure or ASTM D2394 using 5.5 inch hemispherical projectile resisting no less than 264 ft. lb. before failure. Provide test specimen stud spacing a minimum 16 inch on center.

2.1.6.2 Hard Body Impact Test

Comply with hard body impact test in accordance with ASTM C1629/C1629M Classification Level 2.

2.1.6.3 Surface Abrasion Test

Comply with test surface abrasion test in accordance with ASTM C1629/C1629M.

2.1.6.4 Indentation Test

ASTM D5420 or ASTM D1037 for indentation resistance. ASTM D5420 using a 32 oz weight with a 5/8 inch hemispherical impacting head dropped once 3 feet creating not more than 0.137 inch indentation or ASTM D1037 using no less than 470 lb weight applied to the 0.438 inch diameter ball to create not more than a 0.0197 inch indentation depth.

2.1.7 Cementitious Backer Units

In accordance with the Tile Council of America (TCA) Handbook. Use 1/4" as floor underlayment on top of RF shielding.

2.1.8 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.

2.1.8.1 Embedding Compound

Specifically formulated and manufactured for use in embedding tape at gypsum board joints and compatible with tape, substrate and fasteners.

2.1.8.2 Finishing or Topping Compound

Specifically formulated and manufactured for use as a finishing compound.

2.1.8.3 All-Purpose Compound

Specifically formulated and manufactured to serve as both a taping and a

finishing compound and compatible with tape, substrate and fasteners.

2.1.8.4 Setting or Hardening Type Compound

Specifically formulated and manufactured for use with fiber glass mesh tape.

2.1.8.5 Joint Tape

Use cross-laminated, tapered edge, reinforced paper, or fiber glass mesh tape recommended by the manufacturer.

2.1.9 Fasteners

2.1.9.1 Nails

ASTM C514.

2.1.9.2 Screws

ASTM C1002, Type "G", Type "S" or Type "W" steel drill screws for fastening gypsum board to gypsum board, wood framing members and steel framing members less than 0.033 inch thick. ASTM C954 steel drill screws for fastening gypsum board to steel framing members 0.033 to 0.112 inch thick. Provide cementitious backer unit screws with a polymer coating.

2.1.9.3 Staples

No. 16 USS gage flattened galvanized wire staples with 7/16 inch wide crown outside measurement and divergent point for base ply of two-ply gypsum board application. Use as follows:

| Length of Legs | Thickness of Gypsum Board |
|---|---|
| 1-1/8 inches | 1/2 inch |
| 1-1/4 inches | 5/8 inch |

2.1.10 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 non-aerosol adhesives applied on the interior of the building (inside of the weatherproofing system). Provide certification or validation of indoor air quality for aerosol adhesives used on the interior of the building (inside of the weatherproofing system).

2.1.11 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.

2.1.12 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.

2.1.13 Water

Provide clean, fresh, and potable water.

PART 3 EXECUTION

3.1 EXAMINATION

3.1.1 Framing and Furring

Verify that framing and furring are securely attached and of sizes and spacing to provide a suitable substrate to receive gypsum board and cementitious backer units. Verify that all blocking, headers and supports are in place to support plumbing fixtures and to receive soap dishes, grab bars, towel racks, and similar items. Do not proceed with work until framing and furring are acceptable for application of gypsum board and cementitious backer units.

3.1.2 Building Construction Materials

Do not install building construction materials that show visual evidence of biological growth.

3.2 APPLICATION OF GYPSUM BOARD

Apply gypsum board to framing and furring members in accordance with ASTM C840 or GA 216 and the requirements specified. Apply gypsum board with separate panels in moderate contact; do not force in place. Stagger end joints of adjoining panels. Neatly fit abutting end and edge joints. Use gypsum board of maximum practical length; select panel sizes to minimize waste. Cut out gypsum board to make neat, close, and tight joints around openings. In vertical application of gypsum board, provide panels in lengths required to reach full height of vertical surfaces in one continuous piece. Lay out panels to minimize waste; reuse cutoffs whenever feasible. Surfaces of gypsum board and substrate members may 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 Semi-Solid Gypsum Board Partitions

Provide in accordance with ASTM C840, System IV or GA 216.

3.2.2 Solid Gypsum Board Partitions

Provide in accordance with ASTM C840, System V or GA 216.

3.2.3 Application of Gypsum Board to Steel Framing and Furring

Apply in accordance with ASTM C840, System VIII or GA 216.

3.2.4 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.

3.2.5 Exterior Application

Apply exterior gypsum board (such as at soffits) in accordance with ASTM C840, System XI or GA 216.

3.2.6 Glass Mat Covered or Fiber Reinforced Gypsum Sheathing

Apply glass mat covered or fiber reinforced gypsum sheathing in accordance to gypsum association publications GA 253. Follow gypsum sheathing manufacturer's requirements of design details for joints and fasteners and be properly installed to protect the substrate from moisture intrusion. Do not leave exposed surfaces of the glass mat covered or fiber reinforced gypsum sheathing beyond the manufacturer's recommendation without a weather barrier cladding. Provide continuous asphalt impregnated building felt over sheathing surface in shingle fashion with edges and ends lapped a minimum of 6 inch. Properly flash the openings. Seal all joints, seams, and penetrations with a compatible silicone sealant.

3.2.7 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. Control joints in STC rated walls and RF shielded walls must not compromise the wall rating.

3.2.8 Application of Abuse Resistant Gypsum Board

Apply in accordance with applicable system of ASTM C840 as specified or GA 216. Follow manufacturers written instructions on how to cut, drill and attach board.

3.3 APPLICATION OF CEMENTITIOUS BACKER UNITS

3.3.1 Application

In wet areas (tubs, shower enclosures, saunas, steam rooms, gang shower rooms), apply cementitious backer units in accordance with ANSI A108.11. Place a 15 lb. asphalt impregnated, continuous felt paper membrane behind cementitious backer units, between backer units and studs or base layer of gypsum board. Place membrane with a minimum 6 inch overlap of sheets laid shingle style.

3.3.2 Joint Treatment

ANSI A108.11.

## 3.4 FINISHING OF GYPSUM BOARD

Tape and finish gypsum board in accordance with ASTM C840, GA 214 and GA 216. Finish plenum areas above ceilings to Level 1 in accordance with GA 214. Finish water resistant gypsum backing board, ASTM C1396/C1396M, to receive ceramic tile to Level 2 in accordance with GA 214. Finish walls and ceilings to receive a heavy-grade wall covering or heave textured finish before painting to Level 3 in accordance with GA 214. Finish walls and ceilings without critical lighting to receive flat paints, light textures, or wall coverings to Level 4 in accordance with GA 214. Unless otherwise specified, finish all gypsum board walls, partitions and ceilings to Level 5 in accordance with GA 214. Provide joint, fastener depression, and corner treatment. Tool joints as smoothly as possible to minimize sanding and dust. Do not use self-adhering fiber glass mesh tape with conventional drying type joint compounds; use setting or hardening type compounds only. Provide treatment for water-resistant gypsum board as recommended by the gypsum board manufacturer. Protect workers, building occupants, and HVAC systems from gypsum dust.

### 3.4.1 Uniform Surface

Wherever gypsum board is to receive eggshell, semigloss or gloss paint finish, or where severe, up or down lighting conditions occur, finish gypsum wall surface in accordance to GA 214 Level 5. In accordance with GA 214 Level 5, apply a thin skim coat of joint compound to the entire gypsum board surface, after the two-coat joint and fastener treatment is complete and dry.

## 3.5 SEALING

Seal openings around pipes, fixtures, and other items projecting through gypsum board and cementitious backer units as specified in Section 07 92 00 JOINT SEALANTS. Apply material with exposed surface flush with gypsum board or cementitious backer units.

### 3.5.1 Sealing for Glass Mat or Reinforced Gypsum Board Sheathing

Apply silicone sealant in a 3/8 inch bead to all joints and trowel flat. Apply enough of the same sealant to all fasteners penetrating through the glass mat gypsum board surface to completely cover the penetration when troweled flat. Do not place construction and materials behind sheathing until a visual inspection of sealed joints during daylight hours has been completed by Contracting Officer.

## 3.6 PATCHING

Patch surface defects in gypsum board to a smooth, uniform appearance, ready to receive finishes.

## 3.7 SOUND RATED ASSEMBLIES

### 3.7.1 Sound Rated Assemblies

When sound rated assemblies are required, provide materials and application methods, including panels, insulation, types and spacing of fasteners, wall and ceiling framing in accordance with the contract document and the description of the assembly in the ASTM E90 Factory Test Report. Seal partitions continuously with acoustical foam or sealant (both sides) and finished to match wall wherever it abuts another element

such as the floor, ceiling, wall, column, mullion, or another system or assembly.

3.7.2 Acoustic Testing of Secure Areas

Contractor must provide acoustical testing of secure areas in order to demonstrate conformance with requirements indicated in documents. Contractor must hire an independent acoustical testing agency to perform acoustical tests in accordance with ASTM E336 Standard Test Method for Measurement of Airborne Sound Attenuation between Rooms in Buildings, ASTM E2964 Standard Test Method for Measurement of the Normalized Insertion Loss of Doors, and Section 1206.4.1 of UFC 3-101-01. Testing must be conducted to determine the noise isolation class NIC as indicated in the ASTM standard. Results must comply with ASTC equivalent to STC-45/NIC 40 for Sound Group 3 and ASTC equivalent to STC-50/NIC 45 for Sound Group 4 per ICD/ICS 705 Standards. Testing must be conducted and observed by the Contracting Officer Representative and Site Security Manager. The Accrediting Officer must be notified in advance and have the option to attend testing. Test locations in the building will be determined by the Site Security Manager. Contractor is responsible for providing a complete report of each test in accordance with Section 13 of ASTM E336 and ASTM E2964. Contractor is responsible for remediating failed tests and must have failed locations re-tested to demonstrate compliance. A government accreditation team will perform testing to validate conformance in accordance with a Construction Security Plan which will be provided to the Contractor after award of the contract. Testing is performed in accordance with ASTM E336, ASTM E2964 and Section 1206 of UFC 3-101-01.

An excerpt of Section 1206.4.1 from UFC 3-101-01 denoting the references which contain the testing standards and methodology is provided below. The Contractor should review ASTM E336, ASTM E2964, Section 1206.4 of UFC 3-101-01 and the annotated references to ensure compliance with testing requirements and to understand the testing methodology to be used.

3.7.2.1 UFC 3-101-01 Section 1206.4.1 - Interior Acoustics Reference Criteria

Spaces such as Special Access Program Facilities (SAPF) and Sensitive Compartmented Information Facilities (SCIF) must comply with specific criteria to be accredited for operation. Specialty spaces including television and radio broadcast facilities, music auditoria, large lecture halls (50 people or more), network operations centers, or other spaces will require an acoustical consultant as an integral member of the design team.

3.7.2.2 References

The following references include explanations, guidelines, design strategies, and prediction tools to aid in meeting the above required acoustic criteria.

•UFC 3-450-01 “Noise and Vibration Control”

•UFC 4-010-05 “\3\ SCIF/SAPF /3/ Planning, Design and Construction”

•Sound Matters from General Services Administration

- ANSI/ASA S12.2, Criteria for Evaluating Room Noise

- ASTM E1130, Standard Test Method for Objective Measurement of Speech Privacy in Open Plan Spaces Using Articulation Index

- ASTM E2638, Standard Test Method for Objective Measurement of the Speech Privacy Provided by a Closed Room

- ASTM E336 Standard Test Method for Measurement of Airborne Sound Attenuation between Rooms in Buildings

- ASTM E2964, Standard Test Method for Measurement of the Normalized Insertion Loss of Doors

. -- End of Section --

SECTION 09 30 10

CERAMIC, AND PORCELAIN 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 |

ASTM INTERNATIONAL (ASTM)

| | |
|---|---|
| ASTM C33/C33M | (2024) Standard Specification for Concrete Aggregates |
| ASTM C144 | (2018) Standard Specification for Aggregate for Masonry Mortar |
| ASTM C150/C150M | (2022) Standard Specification for Portland Cement |
| ASTM C206 | (2014; R 2022) Standard Specification for Finishing Hydrated Lime |
| ASTM C207 | (2018) Standard Specification for Hydrated Lime for Masonry Purposes |
| ASTM C241/C241M | (2021) Standard Test Method for Abrasion Resistance of Stone Subjected to Foot Traffic |
| ASTM C373 | (2018; R 2023)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 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 (2017; Version 1.2) 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 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 (2022) 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

SD-03 Product Data

Porcelain Tile; G

Recycled Content for Porcelain Tile; S

Mosaic Tile; G

Recycled Content for Mosaic Tile; S

Glazed Ceramic Wall Tile; G

Recycled Content for Glazed Ceramic Wall Tile; S

Transition Strips; G

Metal 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

Metal Strips; G

Grout; G

SD-07 Certificates

Indoor Air Quality for Adhesives; S

Indoor Air Quality for Sealants; S

Water Absorption Rates

SD-08 Manufacturer's Instructions

Manufacturer's Approved Cleaning Instructions

SD-10 Operation and Maintenance Data

Porcelain Tile, Data Package 1; G

Mosaic Tile, Data Package 1; G

Glazed Ceramic Wall Tile, Data Package 1; G

Transition Strips, Data Package 1; G

Metal Strips, Data Package 1; G

## 1.3 CERTIFICATIONS

### 1.3.1 Indoor Air Quality Certifications

Provide products certified to meet indoor air quality requirements by UL 2818 (Greenguard) Gold, SCS Global Services Indoor Advantage Gold or provide certification or validation by other third-party programs that products meet the requirements of this Section. Provide current product certification documentation from certification body.When product does not have certification, provide validation that product meets the indoor air quality product requirements cited in this Section.

### 1.3.2 Water Absorption Rates Certification

Provide certification for each tile type indicating compliance with the following water absorption (wa) rates per ANSI A137.1 criteria as tested per ASTM C373 requirements.

a. Porcelain and Mosaic Tile (Impervious): Provide water absorption (wa) of 0.5 percent or less.

b. Mosaic Tile (Vitreous): Provide water absorption (wa) of more than 0.5 percent, but not more than 3.0 percent.

d. Ceramic Wall Tile (Non-Vitreous): Provide maximum water absorption (wa) of 7.0 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. Provide a minimum breaking strength of 125 lbs. for wall tile and 250 lbs. for floor tile in accordance with ASTM C648. Provide floor tiles with a minimum wet dynamic coefficient of friction (DCOF) value of 0.42 when tested in accordance with ANSI A137.1 requirements. Provide glazed floor tile with a Class V-Heavy Commercial classification as rated by the manufacturer when tested in accordance with ASTM C1027 for visible abrasion resistance as related to foot traffic. For materials like tile, accessories, and transition strips submit samples of sufficient size to show color range, pattern, type and joints.

Submit manufacturers' descriptive product data for each type of ceramic, porcelain and glass tiling indicated. Include manufacturers' literature, finishes, profiles and thicknesses of materials.

Submit manufacturers' operations and maintenance data for each type of ceramic, porcelain and glass tiling indicated in accordance with Section 01 33 00 SUBMITTAL PROCEDURES.

2.1.1 Porcelain Tile

Provide unglazed through body (surface color and pattern go all the way through the tile body) and cove base and trim pieces. Blend tiles in factory and in a packages to have same color range and continuous blend for installation. Provide nominal tile size(s) of 3/8 inch thick as indicated on the material finish schedule drawing.

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 Mosaic Tile

Furnish unglazed, mosaic tile and trim composed of ceramic, porcelain, glass. Blend tiles in factory and in a packages to have same color range and continuous blend for installation. Provide nominal tile size(s) ofa mixture of standard sizes in a stock pattern as indicated on the material finish schedule drawing.

Provide mosaic tiling materials that contain a minimum of 3 percent recycled content. Provide data identifying percentage of recycled content

for mosaic tile.

2.1.3 Glazed Ceramic Wall Tile

Provide glazed ceramic wall tile that has square edges and trim with lead-free bright finish. Provide nominal tile size(s) as indicated on the material finish schedule drawing.

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 high-performance cement grout (latex-portland cement 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. Prohibited unless specifically indicated otherwise.

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 clear anodized aluminum transitions between tile and carpet or resilient flooring. Provide types as recommended by flooring manufacturer for both edges and transitions of flooring materials specified, or marble transitions appropriate for conditions. Categorize marble Group A as classified by MIA Design Manual. Provide a fine sand-rubbed finish marble, white, or gray in color. Provide minimum 12.0 marble abrasion when tested in accordance with ASTM C241/C241M. Provide transition strips that comply with 36 CFR 1191requirements.

2.6.2 Metal Strips

Provide metal transition strip (vertical) edge protection for outside tiled corners in all restrooms to feature a trapezoid-perforated anchoring leg that is secured in the mortar bond coat beneath the tile and a reveal that forms a symmetrically rounded outer corner with 1/4" radius along the surface edge in stainless steel.

Provide metal transition strip (horizontal) profile for tiled backsplash to be an anodized aluminum, decorative profile for wall edges, featuring a trapezoid-perforated anchoring leg that is secured in the mortar bond coat beneath the tile and a pronounced visible surface that establishes a clean line along tile edge and allows for decorative design. Follow manufacturer's instructions for proper design and installation, using thin-set mortar formulated for use with the product.

2.7 WATERPROOF MEMBRANE

2.7.1 General

Provide waterproofing membrane system or approved equal on all of the restroom floors, walls, and surfaces scheduled to receive a tile finish. 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 Orange-Polyethylene Shower Waterproof Membrane

Description: 0.020 inch thick, orange polyethylene membrane, with polypropylene fleece laminated on both sides, to meet or exceed requirements for load bearing, waterproof membranes for thin-set ceramic tile installation. Seams and corner material 0.004 inch thick, orange polyethlene membrane, with polypropylene fleece laminate on both sides, width as required.

## 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.

## 2.9 COLOR, TEXTURE, AND PATTERN

Provide color, pattern and texture as indicated on the material finish schedule drawing; colors listed are not intended to limit the selection of equal colors from other manufacturers. Provide floor and wall patterns as specified on the drawings.

# 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 and in accordance with manufacturer's written instructions.

## 3.4 INSTALLATION OF WALL TILE

Install wall tile in accordance with the TCNA Hdbk, and with grout joints as recommended by the manufacturer for the type of tile. Install large format floor tile (equal to or greater than 12 inch x 12 inch in accordance with medium thinset bed and smaller format tiles in accordance with a typical thinset mortar bed. 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 Workable or Cured Mortar Bed

Install tile over workable mortar bed or a cured mortar bed at the option of the Contractor. Install a 4 mil polyethylene membrane, metal lath, and scratch coat. Conform to TCNA Hdbk for workable mortar bed, materials, and installation of tile. Conform to TCNA Hdbk for cured mortar bed and materials.

### 3.4.2 Dry-Set Mortar and Latex-Portland Cement Mortar

Use dry-set or latex-portland cement to install tile in accordance with TCNA Hdbk. Use latex-portland cement when installing porcelain ceramic tile.

### 3.4.3 Organic Adhesive

Comply with the requirements of TCNA Hdbk method for organic adhesive installation of ceramic tile.

### 3.4.4 Ceramic Tile Grout

Prepare and install ceramic tile grout in accordance with TCNA Hdbk. Provide and apply manufacturer's standard product for sealing grout joints in accordance with manufacturer's recommendations.

### 3.4.5 Epoxy Resin Grout

Prepare and install epoxy resin grout in accordance with TCNA Hdbk.

### 3.4.6 Urethane Grout

Prepare and install urethane grout in accordance with TCNA Hdbk.

## 3.5 INSTALLATION OF FLOOR TILE

Install floor tile in accordance with TCNA Hdbk method over a workable or cured medium thinset bed using latex or polymer modified mortar and with grout joints as recommended by the manufacturer for the type of tile.

### 3.5.1 Workable or Cured Mortar Bed

Install floor tile over a workable mortar bed or a cured mortar bed at the option of the Contractor. Conform to TCNA Hdbk for workable mortar bed materials and installation. Conform to TCNA Hdbk for cured mortar bed materials and installation. Provide minimum 1/4 inch to maximum 3/8 inch joints in uniformed width.

### 3.5.2 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. Use latex-portland cement when installing porcelain ceramic tile.

### 3.5.3 Resinous Grout

When resinous grout is indicated, grout quarry tile with either furan grout conforming to ANSI A108/A118/A136.1 or epoxy resin grout conforming to ANSI A108/A118/A136.1. Rake and clean joints to the full depth of the tile and neutralize when recommended by the resin manufacturer. Install epoxy resin grout in conformance with TCNA Hdbk. Install resin grout in accordance with manufacturer's printed installation instructions. Provide a coating of wax applied from the manufacturer on all tile installed with furan resin. Follow manufacturer's printed installation instructions of installed resin grout for proportioning, mixing, installing, and curing. Maintain the recommended temperature in the area and on the surface to be grouted. Protect finished grout of grout stain.

### 3.5.4 Ceramic Tile Grout

Prepare and install ceramic tile grout in accordance with TCNA Hdbk. Provide and apply manufacturer's standard product for sealing grout joints in accordance with manufacturer's recommendations.

### 3.5.5 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. Compose concrete fill by volume of 1 part Portland cement to 3 parts fine aggregate to 4 parts coarse aggregate, and mix with water to as dry a 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.

## 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 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. and 8 to 12 feet each way in large exterior areas or areas exposed to direct sunlight or moisture. 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 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.

AMERICAN NATIONAL STANDARDS INSTITUTE (ANSI)

| | |
|---|---|
| ANSI/ASA S12.2 | Criteria for Evaluating Room Noise |

ASTM INTERNATIONAL (ASTM)

| | |
|---|---|
| ASTM E648 | (2019a) Standard Test Method for Critical Radiant Flux of Floor-Covering Systems Using a Radiant Heat Energy Source |
| ASTM E1130 | Standard Test Method for Objective Measurement of Speech Privacy in Open Plan Spaces Using Articulation Index |
| ASTM E2638 | Standard Test Method for Objective Measurement of the Speech Privacy Provided by a Closed Room |
| 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 F1869 | (2023) 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 | (2017; Version 1.2) Standard Method for the Testing and Evaluation of Volatile Organic Chemical Emissions from Indoor Sources using Environmental Chambers |

CARPET AND RUG INSTITUTE (CRI)

| | |
|---|---|
| CRI Green Label Plus | (2017) Green Label Plus Quality Manual |

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 | (2022) 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, AE

Recycled content for Conductive Vinyl Tile; S

Accessories; G

Adhesives; G

Warranty

SD-04 Samples

Static-Control Resilient Flooring; G AE

Moldings; G

Accessories; G

SD-06 Test Reports

Fire Resistance

Moisture, Alkalinity and Bond

Testing

SD-07 Certificates

Indoor Air Quality for Conductive 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 Conductive 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 certified to meet indoor air quality requirements by UL 2818 (Greenguard) Gold, SCS Global Services Indoor Advantage Gold, CRI Green Label Plus 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.

#### 1.4.1.2 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 five 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 Conductive Resilient Flooring

2.1.1.1 Conductive Vinyl Tile

Conductive 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 25,000 ohms (2.5 x 10 to the 4th) and 1,000,000 ohms (1.0 x 10 to the 6th) 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 Conductive Vinyl Tile containing a minimum of 10 percent recycled content. Provide data identifying percentage of recycled content for Conductive Vinyl Tile.

Provide certification of indoor air quality for Conductive Vinyl Tile.

2.2 ADHESIVES

Provide conductive adhesive as recommended by the manufacturer of the static-control flooring.

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.

2.3 MOLDINGS

Provide heavy duty tapered moldings of vinyl or rubber 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.

2.4 ACCESSORIES

Use accessories recommended by the manufacturer of the flooring.

2.5 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.

2.6 MANUFACTURER'S COLOR, PATTERN AND TEXTURE

Provide color, pattern and texture as indicated on the material finish schedule drawing. Provide flooring in any one continuous area or replacement of damaged flooring in continuous area from same production run with same shade and pattern.

2.7 FIRE RESISTANCE TESTING REQUIREMENTS

Provide a minimum average critical radiant flux of 0.22 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. Fiberglass mesh embedded backer board to be installed as underlayment to ensure protection of the RF Shield. Install underlayment in accordance with the approved manufacturer's installation instructions. Mechanical fasteners must meet the requirements for RF Shielding and must be covered with RF tape to ensure a constant boundary. 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 Self-Coving

The static-control resilient flooring must have a self-coving base and must be installed in accordance with the flooring manufacturer's printed installation instructions. Extend the self-cove up the walls, columns and pilasters 4 inches. Terminate the coving with a cove cap. Place a cove stick at the floor-wall junction to support the coving at the bend. Provide self-cove at room perimeter and at fixed vertical interruptions to the flooring. Provide protective metal corners at outside and inside 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.

Refer to ANSI/ASA S12.2, ASTM E1130, ASTM E2638, for sound attenuation properties and testing methods.

-- End of Section --

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.

AMERICAN NATIONAL STANDARDS INSTITUTE (ANSI)

| | |
|---|---|
| ANSI/ASA S12.2 | Criteria for Evaluating Room Noise |

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 E1130 | Standard Test Method for Objective Measurement of Speech Privacy in Open Plan Spaces Using Articulation Index |
| ASTM E2638 | Standard Test Method for Objective Measurement of the Speech Privacy Provided by a Closed Room |
| ASTM F710 | (2022) Standard Practice for Preparing Concrete Floors to Receive Resilient Flooring |
| ASTM F1482 | (2021) Standard Practice for Installation and Preparation of Panel Type Underlayments to Receive Resilient Flooring |
| ASTM F1700 | (2020) Standard Specification for Solid Vinyl Floor Tile |
| ASTM F1861 | (2021) Standard Specification for Resilient Wall Base |
| ASTM F1869 | (2023) 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 | (2017; Version 1.2) 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 | (2022) 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

Luxury Vinyl Tile

Recycled content for Luxury Vinyl Tile; S

Wall Base

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 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, and wall base products certified to meet indoor air quality requirements by FLOORSCORE, UL 2818 (Greenguard) Gold, SCS Global Services Indoor Advantage Gold or provide certification by other third-party programs. Provide current product certification documentation from certification body.

#### 1.3.1.2 Adhesives, Caulking and Sealants

Provide products certified to meet indoor air quality requirements by UL 2818 (Greenguard) Gold, SCS Global Services Indoor Advantage Gold or provide certification or validation by other third-party programs that products meet the requirements of this Section. Provide current product certification documentation from certification body. When product does not have certification, provide validation that product meets the indoor air quality product requirements cited herein.

## 1.4 DELIVERY, STORAGE, AND HANDLING

Deliver materials to the building site in original unopened containers bearing the manufacturer's name, style name, pattern color name and number, production run, project identification, and handling instructions. Store materials in a clean, dry, secure, and well-ventilated area with ambient air temperature maintained above 68 degrees F and below 85 degrees F, stacked according to manufacturer's recommendations. Protect materials from the direct flow of heat from hot-air registers, radiators and other heating fixtures and appliances. Observe ventilation and safety procedures specified in the MSDS. Do not store near materials that may offgas or emit harmful fumes, such as kerosene heaters, fresh paint, or adhesives.

## 1.5 ENVIRONMENTAL REQUIREMENTS

Maintain areas to receive resilient flooring at a temperature above 68 degrees F and below 85 degrees F for 3 days before application, during application and 2 days after application, unless otherwise directed by the flooring manufacturer for the flooring being installed. Maintain a

minimum temperature of 55 degrees F thereafter. Provide adequate ventilation to remove moisture from area and to comply with regulations limiting concentrations of hazardous vapors.

1.6 SCHEDULING

Schedule resilient flooring application after the completion of other work which would damage the finished surface of the flooring.

1.7 WARRANTY

Provide manufacturer's standard performance guarantees or warranties that extend beyond a one year period.

1.8 EXTRA MATERIALS

Provide extra flooring material of each color and pattern at the rate of 5 tiles for each 1000 tiles and 5 square feet for each 1000 square feet of sheet flooring installed. Provide extra wall base material composed of 20 linear feet of each type, color and pattern. Package all extra materials in original properly marked containers bearing the manufacturer's name, brand name, pattern color name and number, production run, and handling instructions. Provide extra materials from the same lot as those installed. Leave extra stock at the site in location assigned by Contracting Officer.

PART 2 PRODUCTS

2.1 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 0.118 inch with non slip/skid backing, Type B (embossed). Provide 13.19 by 26.38 inches tile. Provide tile with a factory protective finish that enhances cleanability and durability.

Provide Luxury Vinyl Tile containing a minimum of 35 percent recycled content. Provide data identifying percentage of recycled content for Luxury Vinyl Tile.

Provide certification of indoor air quality for Luxury Vinyl Tile.

2.2 WALL BASE

Conform to ASTM F1861, Type TV (thermoplastic vinyl), Style A (straight - installed with carpet) , and Style B (coved - installed with resilient flooring) . Provide 4 inch high and a minimum 1/8 inch thick wall base. Provide job formed corners in matching height, shape, and color.

Provide certification of indoor air quality for Wall Base.

2.3 MOULDING

Provide tapered mouldings of vinyl or 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 bevel change in level between 1/4 and 1/2 inch with a slope no greater than 1:2.

## 2.4 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.

## 2.5 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:

## 2.6 POLISH/FINISH

Provide polish finish as recommended by the manufacturer and conform to ASTM D4078 for polish.

## 2.7 CAULKING AND SEALANTS

Provide caulking and sealants in accordance with Section 07 92 00 JOINT SEALANTS.

## 2.8 MANUFACTURER'S COLOR, PATTERN AND TEXTURE

Provide color, pattern and texture for resilient flooring and accessories as indicated on the material finish schedule drawings. Color listed is not intended to limit the selection of equal colors from other manufacturers. Provide floor patterns as specified on the drawings. Provide flooring in any one continuous area or replacement of damaged flooring in continuous area from same production run with same shade and pattern. Submit scaled drawings indicating patterns (including location of patterns and colors) and dimensions. Submit manufacturer's descriptive data and three samples of each indicated color and type of flooring, base, mouldings, and accessories sized a minimum 2-1/2 by 4 inch. Submit Data Package 1 in accordance with Section 01 78 23 OPERATION AND MAINTENANCE DATA.

## 2.9 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

Fiberglass mesh embedded backer board to be installed as underlayment to ensure protection of the RF Shield. Install underlayment in accordance with the approved manufacturer's installation instructions. Mechanical fasteners must meet the requirements for RF Shielding and must be covered with RF tape to ensure a constant boundary.

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 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.

## 3.7 PLACING WALL BASE

Install wall base in accordance with manufacturer's printed installation instructions. Prepare and apply adhesives in accordance with manufacturer's printed directions. Tighten base joints and make even with adjacent resilient flooring. Fill voids along the top edge of base at masonry walls with caulk. Roll entire vertical surface of base with hand roller, and press toe of base with a straight piece of wood to ensure proper alignment. Avoid excess adhesive in corners.

## 3.8 CLEANING

Immediately upon completion of installation of flooring in a room or an area, dry and clean the flooring and adjacent surfaces to remove all surplus adhesive. Clean flooring as recommended in accordance with manufacturer's printed maintenance instructions and within the recommended time frame. As required by the manufacturer, apply the recommended number of coats and type of polish and finish in accordance with manufacturer's written instructions.

## 3.9 PROTECTION

From the time of installation until acceptance, protect flooring from damage as recommended by the flooring manufacturer. Remove and replace flooring which becomes damaged, loose, broken, or curled and wall base which is not tight to wall or securely adhered.

## 3.10 TESTING

Refer to ANSI/ASA S12.2, ASTM E1130, ASTM E2638, for sound attenuation properties and testing methods

-- End of Section --

SECTION 09 67 23.14

CHEMICAL RESISTANT RESINOUS FLOORING
**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 NATIONAL STANDARDS INSTITUTE (ANSI)

| | |
|---|---|
| ANSI/ASA S12.2 | Criteria for Evaluating Room Noise |

ASTM INTERNATIONAL (ASTM)

| | |
|---|---|
| ASTM C307 | (2023) Standard Test Method for Tensile Strength of Chemical-Resistant Mortar, Grouts, and Monolithic Surfacings |
| ASTM C413 | (2018; R 2023) Standard Test Method for Absorption of Chemical-Resistant Mortars, Grouts, and Monolithic Surfacings and Polymer Concretes |
| ASTM C531 | (2018) Standard Test Method for Linear Shrinkage and Coefficient of Thermal Expansion of Chemical-Resistant Mortars, Grouts, and Monolithic Surfacings, and Polymer Concretes |
| ASTM C579 | (2023) Standard Test Methods for Compressive Strength of Chemical-Resistant Mortars, Grouts, Monolithic Surfacings, and Polymer Concretes |
| ASTM C580 | (2018; R 2023) Standard Test Method for Flexural Strength and Modulus of Elasticity of Chemical-Resistant Mortars, Grouts, Monolithic Surfacings, and Polymer Concretes |
| ASTM C722 | (2018; R 2023) Standard Specification for Chemical-Resistant Resin Monolithic Floor Surfacings |
| ASTM D1308 | (2002; R 2013) Effect of Household Chemicals on Clear and Pigmented Organic Finishes |
| ASTM D4060 | (2019) Abrasion Resistance of Organic Coatings by the Taber Abraser |
| ASTM D4263 | (1983; R 2018) Standard Test Method for Indicating Moisture in Concrete by the |

| | |
|---|---|
| | Plastic Sheet Method |
| ASTM E162 | (2022) Standard Test Method for Surface Flammability of Materials Using a Radiant Heat Energy Source |
| ASTM E1130 | Standard Test Method for Objective Measurement of Speech Privacy in Open Plan Spaces Using Articulation Index |
| ASTM E2638 | Standard Test Method for Objective Measurement of the Speech Privacy Provided by a Closed Room |

CALIFORNIA DEPARTMENT OF PUBLIC HEALTH (CDPH)

| | |
|---|---|
| CDPH SECTION 01350 | (2017; Version 1.2) Standard Method for the Testing and Evaluation of Volatile Organic Chemical Emissions from Indoor Sources using Environmental Chambers |

NATIONAL FIRE PROTECTION ASSOCIATION (NFPA)

| | |
|---|---|
| NFPA 99 | (2021; TIA 20-1; TIA 21-2) Health Care Facilities Code |

NATIONAL TERRAZZO AND MOSAIC ASSOCIATION (NTMA)

| | |
|---|---|
| NTMA Info Guide | (2017) Terrazzo Reference Guide |

SOUTH COAST AIR QUALITY MANAGEMENT DISTRICT (SCAQMD)

| | |
|---|---|
| SCAQMD Rule 1113 | (2016) Architectural Coatings |

U.S. NATIONAL ARCHIVES AND RECORDS ADMINISTRATION (NARA)

| | |
|---|---|
| 29 CFR 1910 | Occupational Safety and Health 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

Flooring Systems; G

SD-03 Product Data

Sealer and Resin; G, AE

Floor Surfacing; G, AE

Conductive Sparkproof Flooring; G, AE

Indoor Air Quality for Primer; S

Indoor Air Quality for Top Coating; S

Indoor Air Quality for Sealer And Resin; S

Mixing; G

SD-04 Samples

Flooring Systems; G, AE

SD-06 Test Reports

Testing; G

SD-07 Certificates

Qualifications of Installer; G

SD-08 Manufacturer's Instructions

Application; G

SD-10 Operation and Maintenance Data

Flooring Systems; G

## 1.3 QUALITY ASSURANCE

### 1.3.1 Qualifications of Installer

Perform installation by an applicator approved by the manufacturer of the floor surfacing materials. Furnish a written statement from the manufacturer detailing the Qualifications of Installer.

### 1.3.2 Shop Drawings

Submit drawings indicating the type and layout of the flooring system for approval.

## 1.4 DELIVERY, STORAGE, AND HANDLING

Deliver the materials to the project site in unopened bags and containers clearly labeled with the name of the manufacturer, type of material, batch number, and date of manufacture. Store materials, other than aggregates, away from fire, sparks, or smoking areas. Maintain the storage area between 50 and 90 degrees F.

## 1.5 ENVIRONMENTAL REQUIREMENTS

Maintain the ambient room and floor temperatures at 65 degrees F, or above, for a period extending from 48 hours before installation until one week after installation. Cure concrete for at least 28 days and keep it free of water for at least 7 days prior to receiving surfacing in accordance with ASTM D4263. Measure and insure moisture content of wood substrates between 8 and 10 percent prior to application.

PART 2 PRODUCTS

2.1 MATERIALS

Provide materials (except aggregate) used in the flooring from a single manufacturer. Furnish and install trowel applied type epoxy finish of 3/8 inch thickness with properties and chemical resistance conforming to the requirements specified in NTMA Info Guide. thick, epoxy, polyester, or other resinous material conforming to ASTM C722 with Type A surfacings (chemical resistance and heavy traffic resistance) resin-based flooring. Provide 4 inch high integral cove base. Meet the following material requirements:

2.1.1 Primer

Type recommended by the manufacturer to penetrate into the pores of the substrate and bond with the floor surfacing matrix to form a permanent monolithic bond between substrate and surfacing matrix. 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 primer.

2.1.2 Aggregate

Provide silica sand, quartz, granite, or other suitable chemical resistant material having a Mohr's hardness of not less than 6.0 aggregate.

2.1.3 Binder

Provide thermo-setting epoxy binder.

2.1.4 Fillers

If required, provide inert silica, quartz or other hard aggregate material fillers as recommended by the flooring manufacturer. Furnish fillers in the quantity necessary to impart the required color and physical characteristics. Provide a filler containing sufficient fines to obtain an even-textured, nonslip type of surface on the finished topping.

2.1.5 Top Coating

Furnish clear color coating of type recommended by the manufacturer. Floor top coating 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 top coating.

2.2 FLOORING SYSTEMS

Submit cured samples of each floor finish or color combination and Data Package 1 in accordance with Section 01 78 23 OPERATION AND MAINTENANCE DATA. The complete systems, after curing, must have the following properties when tested in accordance with the test methods listed for each property.

2.2.1 Epoxy Matrix Floor Surfacing

2.2.1.1 Compressive Strength

ASTM C579; 10,000 psi minimum at 7 days.

2.2.1.2 Tensile Strength

ASTM C307; 1500 psi minimum at 7 days.

2.2.1.3 Flexural Modulus of Elasticity

ASTM C580; 500,000 psi minimum at 7 days.

2.2.1.4 Thermal Coefficient of Expansion

ASTM C531; 0.00004 inches per inch per degree F maximum.

2.2.1.5 Shrinkage

ASTM C531; 0.5 percent maximum.

2.2.1.6 Bond Strength

300 psi minimum with 100 percent concrete failure ( 2500 psi Compressive Strength Concrete).

2.2.1.7 Flame Spread Index

ASTM E162; 25 maximum.

2.2.1.8 Smoke Deposited

ASTM E162; 4 mg maximum.

2.2.1.9 Abrasion Resistance

ASTM D4060; 15 mg maximum weight loss.

2.2.1.10 Moisture Absorption

ASTM C413; 1.0 percent maximum.

2.2.1.11 Chemical Resistance

ASTM D1308; no effect when exposed to the following reagents for 7 days:

Acetic acid: 5 percent solution
Ammonium Hydroxide: 10 percent solution
Citric Acid: 5 percent solution
Coffee
Cola Syrup
Isopropyl Alcohol
Mineral Oil
Sodium Hydroxide: 5 percent solution
Tri-Sodium Phosphate: 5 percent solution
Urea: 6.6 percent solution

## 2.3 CONDUCTIVE SPARKPROOF FLOORING

Trowel or spray apply conductive sparkproof industrial resin-based flooring 1/4 inch thick, epoxy, polyester, or other resinous material conforming to ASTM C722with Type A surfacings (chemical resistance and moderate to heavy traffic resistance). Provide 4 inch high integral cove base. Ground conductive flooring and conform to the requirements for conductive flooring of NFPA 99.

## 2.4 SEALER AND RESIN

Provide a sealer product recommended by the industrial resin-based flooring manufacturer; when applied to the resin topping and dried, it must be nonslip and resistant to staining and suitable for the type application indicated. Floor resin and sealer 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 for Indoor Air Quality for Sealer and Resin.

## 2.5 ANTIMICROBIAL

Treat industrial resin-based flooring to be resistant to fungi and bacteria.

## 2.6 COLOR

Provide color as indicated on the materials finish legend drawing.

# PART 3 EXECUTION

## 3.1 SURFACE PREPARATION

Fiberglass mesh embedded backer board to be installed as underlayment to ensure protection of the RF Shield. Install underlayment in accordance with the approved manufacturer's installation instructions. Mechanical fasteners must meet the requirements for RF Shielding and must be covered with RF tape to ensure a constant boundary backer board to have 10,000 psi rating minimum .

Remove all dirt, dust, debris, and other loose particles by sweeping or vacuum cleaning. Protect adjacent surfaces not scheduled to receive the flooring by masking, or by other means, to maintain these surfaces free of the flooring material.

### 3.1.1 Concrete Surfaces

#### 3.1.1.1 Mechanical Cleaning

Completely remove dirt, wax, paint, laitance by grinding with a terrazzo machine, sanding with coarse open grid sandpaper, sand blasting, chipping, bush hammering, or wire brushing.

#### 3.1.1.2 Steam Cleaning

Completely remove all animal fats, grease, oil, wax using a high pressure steam cleaner equipped with a soap injection system. Scrape the surface to remove any build-up of debris. Then thoroughly saturate the surface

with hot caustic solution. Allow the solution to remain on the floor for 15 to 20 minutes. Apply steam, with caustic, over the presoaked area until all contamination is removed. Leach the caustic residue from the surface using one or more applications of steam without caustic. Flush the floor with warm water.

3.1.1.3 Acid Etching

Apply a 10 percent solution of muriatic acid at a rate of one quart/each 10 square feet of concrete surface. Allow the solution to stand until it stops bubbling but not less than 5 minutes. Remove the acid and wash the surfaces several times, as required, to remove all traces of the acid. Always dilute acid by pouring into water. Use face shield rubber gloves, and other safety equipment when using acids, alkalis, or solvents.

3.1.1.4 Air Drying

After cleaning, allow concrete surface to air dry thoroughly prior to application of surfacing. Blowers or oil free compressed air may be used. Do not use flame-drying methods. Prior to application of surfacing, test concrete surface for excessive moisture in at least two locations. Place rubber mats at each location with smooth side against concrete and place weight on top of mat to hold in position and ensure contact with concrete. Polyethylene with all edges taped may be used in lieu of mats. After 8 hours remove mat or sheeting and examine floor surface for moisture accumulation. If tests indicate accumulation of moisture at either location, perform additional air drying until additional tests show no moisture accumulation.

3.1.2 Substrate Cracks, Spalls, Joints, and Depressions

Fill all cracks, joints, spalls, and other depressions in the substrate with a latex underlayment, as recommended by the manufacturer compatible with the floor surfacing material.

3.2 MIXING

Proportion and mix the floor surfacing components in accordance with the manufacturer's instructions. Submit flooring manufacturer's descriptive data, mixing, proportioning, and installation instructions. Include maintenance literature for resinous flooring.

3.3 APPLICATION

Submit complete instructions for application of flooring system including any precautions or special handling instructions required to comply with OSHA 29 CFR 1910-Subpart Z. Apply primer, floor surfacing, and seal coat in accordance with the manufacturer's recommendations and the following requirements.

3.3.1 Primer

Apply primer uniformly over the entire area to receive floor surfacing using clean rubber squeegees or clean steel trowels. Do not allow primer to collect in depressions. Allow primer to dry thoroughly before the next coat is applied. Reprime porous areas or areas where primer has dried.

3.3.2 Floor Surfacing

Apply mixed surfacing material to provide a finish floor surfacing not less than 1/4 inch thick. The entire surfacing in any one room or area must be placed in one continuous operation without use of cold joints or divider strips. All surfaces must be flush, true to plane and line, and level within 1/4 inch in 10 feet.

3.3.3 Seal Coat

Apply seal coat uniformly covering all surfaces after floor surfacing has cured and as recommended by the supplier.

3.4 TESTING

Submit reports of tests for conductive sparkproof flooring, including analysis and interpretation of test results. Properly identify each report. Identify and record the test methods used.

Refer to ANSI/ASA S12.2, ASTM E1130, ASTM E2638, for sound attenuation properties and testing methods.

3.4.1 Electrical Resistance

Test the flooring between 30 and 45 days after flooring installation is completed, and prior to its use, in accordance with paragraph 12-4.1.3.8(b)(7) of NFPA 99. The resistance of the floor at any one location must be more than 5,000 ohms in areas with 110 volts service, more than 10,000 ohms in areas with 220 volt service, and average less than 1,000,000 ohms and more than 25,000 ohms in all areas. Perform tests using a technician experienced in such work.

3.4.2 Spark Resistance

Test the floor for spark resistance by stroking the floor vigorously with a 12 inch hardened steel file in a 3 foot arc. Perform the test for each 80 square feet of floor area. Perform the tests in a darkened space and only when the relative humidity of the atmosphere within the space does not exceed 50 percent. The floor must not produce a spark when tested under these conditions.

3.5 PROTECTION

Allow surfacing to set for a minimum period of 48 hours before traffic is allowed on the floor. Protect finished flooring from traffic by covering with 30 pound building paper or other equally effective means until final acceptance of the project.

-- End of Section --

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 |

AMERICAN NATIONAL STANDARDS INSTITUTE (ANSI)

| | |
|---|---|
| ANSI/ASA S12.2 | Criteria for Evaluating Room Noise |

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 | (2021) Standard Test Methods for 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 |
| ASTM E1130 | Standard Test Method for Objective Measurement of Speech Privacy in Open Plan Spaces Using Articulation Index |
| ASTM E2638 | Standard Test Method for Objective Measurement of the Speech Privacy Provided by a Closed Room |

CALIFORNIA DEPARTMENT OF PUBLIC HEALTH (CDPH)

| | |
|---|---|
| CDPH SECTION 01350 | (2017; Version 1.2) Standard Method for the Testing and Evaluation of Volatile Organic Chemical Emissions from Indoor Sources using Environmental Chambers |

CARPET AND RUG INSTITUTE (CRI)

| | |
|---|---|
| CRI 104 | (2015) Carpet Installation Standard for Commercial Carpet |
| CRI 105 | (2015) Carpet Installation Standard for Residential Carpet |
| CRI GLP QM | (2017) Green Label Plus Quality Manual |
| CRI Test Method 103 | (2015) Standard Test Method for the Evaluation of Texture Appearance Retention of Carpet Standards Program |

GREEN SEAL (GS)

| | |
|---|---|
| GS-36 | (2013) Adhesives for Commercial Use |

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 | (2022) 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

SD-08 Manufacturer's Instructions

Surface Preparation

SD-10 Operation and Maintenance Data

Cleaning and Protection

SD-11 Closeout Submittals

Warranty

1.3 CERTIFICATIONS

1.3.1 Indoor Air Quality Certifications

1.3.1.1 Floor Covering Materials

Provide carpet and cushion products certified to meet indoor air quality requirements by UL 2818 (GreenGuard) Gold, SCS Global Services Indoor Advantage Gold, CRI GLP QM or provide certification or validation by other third-party program that products meet the requirements of this Section. Provide current product certification documentation from certification body. When product does not have certification, provide validation that product meets the indoor air quality product requirements cited herein.

1.4 DELIVERY, STORAGE, AND HANDLING

Deliver materials to the site in the manufacturer's original wrappings and packages clearly labeled with the manufacturer's name, brand name, size, dye lot number, and related information. Remove materials from packaging and store them in a clean, dry, well ventilated area, 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, 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 40 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, Entrance Carpet

2.1.3.1 Carpet Construction

Tufted

2.1.3.2 Type

Modular tile 24 by 24, and 18 by 36 inches with 0.15 percent growth/shrink rate in accordance with ISO 2551. Entrance7.5 inch square

2.1.3.3 Pile Type

Textured loop

2.1.3.4 Pile Fiber

Commercial 100 percent branded (federally registered trademark) nylon continuous filament, nylon staple.

2.1.3.5 Gauge or Pitch

Minimum 1/12 inch in accordance with ASTM D5793

2.1.3.6 Stitches or Rows/Wires

Minimum 9.5 per square inch

2.1.3.7 Surface Pile Weight

Minimum 14 ounces per square yard. This does not include weight of backings. Determine weight in accordance with ASTM D5848.

2.1.3.8 Pile Thickness

Minimum 0.124 inch in accordance with ASTM D6859

2.1.3.9 Pile Density

Minimum 4,980

2.1.3.10 Dye Method

Solution dyed

2.1.3.11 Backing Materials

Provide primary backing materials like those customarily used and accepted by the trade for each type of carpet polypropylene or synthetic material. Provide secondary backing to suit project requirements of those customarily used and accepted by the trade for each type of carpet.

2.1.4 Physical Characteristics for Entrance Carpet

2.1.4.1 Carpet Construction

Tufted

2.1.4.2 Type

Entrance 20 by 20 inch square tile size.

2.1.4.3 Pile Type

Multilevel loop

2.1.4.4 Pile Fiber

Commercial 100 percent branded (federally registered trademark) nylon continuous filament, nylon staple.

2.1.4.5 Gauge or Pitch

Minimum 1/12 inch in accordance with ASTM D5793

2.1.4.6 Stitches or Rows/Wires

Minimum 11.3 per square inch

2.1.4.7 Surface Pile Weight

Minimum 25 ounces per square yard. This does not include weight of backings. Determine weight in accordance with ASTM D5848.

2.1.4.8 Pile Thickness

Minimum 0.255 inch in accordance with ASTM D6859

2.1.4.9 Pile Density

Minimum 5,740

2.1.4.10 Dye Method

Solution dyed

2.1.4.11 Backing Materials

Provide primary backing materials like those customarily used and accepted by the trade for each type of carpet polypropylene or synthetic material . Provide secondary backing to suit project requirements of those customarily used and accepted by the trade for each type of carpet.

## 2.2 PERFORMANCE REQUIREMENTS

### 2.2.1 Texture Appearance Retention Rating (TARR)

Provide carpet with a greater than or equal to 3.0 (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 3.5 kV when tested at 20 percent relative humidity and 70 degrees F in accordance with AATCC 134.

### 2.2.3 Flammability and Critical Radiant Flux Requirements

Comply with 16 CFR 1630 or ASTM D2859. Provide carpet in corridors and exits with a minimum average critical radiant flux of 0.45 watts per square centimeter when tested in accordance with ASTM E648.

### 2.2.4 Tuft Bind

Comply with ASTM D1335 for tuft bind force required to pull a tuft or loop free from carpet backing with a minimum 8 pound average force for modular carpet tile.

### 2.2.5 Colorfastness to Crocking

Comply dry and wet crocking with AATCC 165 and with a Class 4 minimum rating on the AATCC Color Transference Chart for all colors.

### 2.2.6 Colorfastness to Light

Comply colorfastness to light with AATCC 16, Test Option E "Water-Cooled Xenon-Arc Lamp, Continuous Light" and with a minimum 4 grey scale rating after 40 hours.

### 2.2.7 Colorfastness to Water

Comply colorfastness to water with AATCC 107 and with a minimum 4.0 gray scale rating and a minimum 4.0 transfer scale rating.

### 2.2.8 Delamination Strength

Provide delamination strength for tufted carpet with a secondary back of minimum 2.5 lbs/inch.

### 2.2.9 Antimicrobial

Nontoxic antimicrobial treatment in accordance with AATCC 174 Part I (qualitative), guaranteed by the carpet manufacturer to last the life of the carpet.

## 2.3 ADHESIVES AND CONCRETE PRIMER

Comply with applicable regulations regarding toxic and hazardous materials. Provide water resistant, mildew resistant, nonflammable, and nonstaining adhesives and concrete primers for carpet installation as required by the carpet manufacturer. Provide release adhesive for modular tile carpet as recommended by the carpet manufacturer. Provide adhesives

flashpoint of minimum 140 degrees F in accordance with ASTM D3278. Non-aerosol adhesive products used on the interior of the building (defined as inside of the weatherproofing system) must meet either emissions requirements of CDPH SECTION 01350 (limit requirements for either office or classroom spaces regardless of space type) or VOC content requirements of SCAQMD Rule 1168. Aerosol adhesive products used on the interior of the building (defined as inside of the weatherproofing system) must meet either emissions requirements of CDPH SECTION 01350 (limit requirements for either office or classroom spaces regardless of space type) or VOC content requirements of GS-36. Provide validation of indoor air quality for 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 a heavy-duty rubber molding designed for the type of carpet being installed. Provide color to match resilient base. Provide a floor flange of a minimum 1-1/2 inch wide and face a minimum 5/8 inch wide.

## 2.5 COLOR, TEXTURE, AND PATTERN

Provide color, texture, and pattern in accordance with the material finish schedule drawing.

# 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. Fiberglass mesh embedded backer board to be installed as underlayment to ensure protection of the RF Shield. Install underlayment in accordance with the approved manufacturer's installation instructions. Mechanical fasteners must meet the requirements for RF Shielding and must be covered with RF tape to ensure a constant boundary. 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, 2) Carpet Cushion, and 3) Moldings indicating areas receiving carpet, carpet types, patterns, direction of pile, location of seams, and locations of edge molding.

Do not install building construction materials that show visual evidence of biological growth.

### 3.4.1 Modular Tile Installation

Install modular tiles with manufacturer approved adhesive tab system adhesive and snug joints. Use installation methods as indicated on the drawings. Comply with manufacturer installation instructions for required drying time of releasable adhesive so it sets up properly. Provide accessibility to the subfloor where required.

### 3.4.2 Entrance Carpet Installation

Install tiles with releasable adhesive and snug joints. Use installation method as indicated on the drawings. Prepare regular, unnoticeable, and treated seams with a seam adhesive. Install breadths parallel, with carpet pile in the same direction. Match patterns accurately. Neatly cut and fit, securely, cutouts at door jambs, columns, and ducts. Locate seams at doorways parallel to and centered directly under doors. Do not make seams perpendicular to doors or at pivot points.

## 3.5 TESTING

Refer to ANSI/ASA S12.2, ASTM E1130, ASTM E2638, for sound attenuation properties and testing methods.

## 3.6 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.

3.6.1 Cleaning

As specified in Section 01 78 00 CLOSEOUT SUBMITTALS. After installation of the carpet, remove debris, scraps, and other foreign matter. Remove soiled spots and adhesive from the face of the carpet with appropriate spot remover. Cut off and remove protruding face yarn. Vacuum carpet clean.

3.6.2 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.

3.7 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. Remove non-retained scraps from site and recycle appropriately.

3.8 MAINTENANCE

3.8.1 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 --

SECTION 09 69 13

RIGID GRID ACCESS FLOORING
**11/15, 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.

ASTM INTERNATIONAL (ASTM)

| | |
|---|---|
| ASTM A780/A780M | (2020) Standard Practice for Repair of Damaged and Uncoated Areas of Hot-Dip Galvanized Coatings |
| 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 |

CALIFORNIA DEPARTMENT OF PUBLIC HEALTH (CDPH)

| | |
|---|---|
| CDPH SECTION 01350 | (2017; Version 1.2) Standard Method for the Testing and Evaluation of Volatile Organic Chemical Emissions from Indoor Sources using Environmental Chambers |

CEILINGS AND INTERIOR SYSTEMS CONSTRUCTION ASSOCIATION (CISCA)

| | |
|---|---|
| CISCA Access Floors | (2007) Recommended Test Procedures for Access Floors |

GREEN SEAL (GS)

| | |
|---|---|
| GS-36 | (2013) Adhesives for Commercial Use |

ICC EVALUATION SERVICE, INC. (ICC-ES)

| | |
|---|---|
| ICC-ES AC300 | (2014) Acceptance Criteria for Access Floors |

INTERNATIONAL CODE COUNCIL (ICC)

| | |
|---|---|
| ICC IBC | (2021) International Building Code |

NATIONAL FIRE PROTECTION ASSOCIATION (NFPA)

| | |
|---|---|
| NFPA 99 | (2021; TIA 20-1; TIA 21-2) Health Care Facilities Code |
| NFPA 253 | (2011) Standard Method of Test for Critical Radiant Flux of Floor Covering Systems Using a Radiant Heat Energy Source |

SOUTH COAST AIR QUALITY MANAGEMENT DISTRICT (SCAQMD)

| | |
|---|---|
| SCAQMD Rule 1168 | (2017) Adhesive and Sealant Applications |

1.2 SUBMITTALS

Government approval is required for submittals with a "G" or "S" classification. Submittals not having a "G" or "S" classification are for Contractor Quality Control approval. 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 Installation Drawings; G, AE

Fabrication Drawings; G, AE

SD-03 Product Data

Access Flooring System; G, AE

Recycled Content of Access Flooring System; S

Indoor Air Quality For Pedestal Adhesive; S

Indoor Air Quality For Adhesives; S

SD-04 Samples

Floor Panels

Floor Covering; G

Panel Support System; G, AE

Cut Outs; G, AE

SD-06 Test Reports

Factory Tests

Concentrated Load

Uniform Live Load

Rolling Load

Impact Load

Ultimate Load

Stringer Load

Pedestal Axial Load

Bonding Strength of Pedestal Adhesive

Electrical Resistance

Field Tests

SD-07 Certificates

Compliance with ICC-ES AC300

Compliance with ICC IBC

Certificate of Compliance

Qualification of Manufacturer

SD-10 Operation and Maintenance Data

Operation and Maintenance Manuals; G

SD-11 Closeout Submittals

Lifting Device

Warranty; G

## 1.3 SPARE PARTS

Provide four spare panels with identical floor covering pedestals and stringers for each 1,000 square feet of access flooring and total of 10 linear feet of cut-out trim. Store extra stock in same manner and location as project materials. Provide a minimum of three percent of total square yards of resilient flooring for future maintenance.

## 1.4 QUALITY CONTROL

### 1.4.1 Qualification of Manufacturer

Access flooring manufacturer must have at least 5 years experience in manufacturing access flooring systems. Certify that the manufacturer of the access flooring system meets requirements specified under paragraph entitled QUALIFICATION OF MANUFACTURER.

## 1.5 DELIVERY, STORAGE, AND HANDLING

### 1.5.1 Delivery

Deliver materials to site in undamaged condition, in original containers or packages, complete with accessories and instructions. Label packages with manufacturer's name and brand designations. Package materials covered by specific references bearing specification number, type and class as applicable.

1.5.2 Storage

Store all materials in original protective packaging in a safe, dry, and clean location. Store panels at temperatures between 40 and 90 degrees F, and between 20 and 80 percent humidity. Replace defective or damaged materials.

1.5.3 Handling

Handle and protect materials in a manner to prevent damage during the entire construction period.

1.6 WARRANTY

Minimum manufacturer warranty must have no dollar limit, cover full system, and must have a minimum duration of 5 years. Include an agreement to repair or replace floor panels, pedestals or stringers that fail within the warranty period in the standard performance guarantee or warranty. Failures include, but are not limited to, sagging and warping of panels; rusting and manufacturers defects of panels or support system. Static-dissipative vinyl tile provide manufacturer's standard performance guarantees or warranties that extend beyond one year, standard warranty must not be less than a five year wear warranty and ten year conductivity warranty.

PART 2 PRODUCTS

2.1 SYSTEM DESCRIPTION

a. Provide for self-alignment of floor panels, adjustable pedestals and readily removable floor panels covered as specified.

b. Lateral stability of floor support system must be independent of panels. Provide a finished assembly that is rigid and free of vibration, noises, and rocking panels. Provide bolted stringer system with equipotential plane grounding.

c. Submit certificate of compliance attesting that the installed access floor system meets specification requirements, including all special equipment loads and specific electrical and or cable requirements for the complete access flooring system including, but not limited to the following:

(1) Compliance with ICC-ES AC300 and Compliance with ICC IBC Acceptance Criteria for Access Floors.

(2) Load-bearing capabilities of pedestals, floor panels, and pedestal adhesive resisting force.

(3) Supporting independent laboratory test reports. For panel, stringer and pedestal load test results include concentrated loads at center of panel, panel edge midpoint, ultimate loads and uniform loads.

(4) Floor electrical characteristics.

(5) Material requirements.

(6) An elevated floor system free of defects in materials,

fabrication, finish, and installation, that will remain so for a period of not less than 1 year after completion.

d. Submit manufacturer's product data for access flooring system consisting of descriptive data, catalog cuts, and installation instructions. Include in the data information about any design and production techniques, total system including all accessories and finish coatings of under-floor components, procedures and policies used to conserve energy, reduce material, improve waste management or incorporate green building/recycled products into the manufacturer of their components or products. Include cleaning and maintenance instructions. Systems which contain zinc electroplated anti-corrosion coatings are prohibited.

2.1.1 Design Requirements

Conduct floor panel testing in accordance with CISCA Access Floors. When tested as specified, make all deflection and deformation measurements at the point of load application on the top surface of the panel. Floor panels must be capable of supporting the following loads:

a. Concentrated load of 1000 pounds on one square inch, at any point on panel, without a top-surface deflection more than 0.10 inch, and a permanent set not to exceed 0.01 inch in any of the specified tests. Testing must be in accordance with CISCA Access Floors, Section 1 Concentrated Loads with test panels being supported by understructure to be used with installed system instead of steel support blocks.

b. Uniform live load of 250 psf, without a top-surface deflection more than 0.06 inch, and a permanent set not to exceed 0.01 inch in any of the specified tests, when tested in accordance with CISCA Access Floors, Section 7 Uniform Load Test with test panels being supported by understructure to be used with installed system instead of steel support blocks.

c. A rolling load of 600 pounds applied through hard rubber surfaced wheel 6 inch diameter by 2 inch wide for 10,000 cycles over the same path. Permanent set at conclusion of test must not exceed 0.040 inch when tested in accordance with CISCA Access Floors, Section 3 Rolling Loads.

d. A rolling load of 800 pounds applied through a 3 inch diameter by 1-13/16 inch wide caster for 10 cycles over the same path, without developing a local overall surface deformation greater than 0.04 inch. In accordance with CISCA Access Floors, Section 3 Rolling Loads, the permanent deformation limit under rolling load must be satisfied in all of the specified tests.

e. An impact load of 150 pounds anywhere on the panel dropped from a height of 36 inches onto a 1 square inch area without failure of the system, according to CISCA Access Floors, Section 8 Drop Impact Load Test.

f. Ultimate Load. Panels must meet manufactures published Ultimate Load rating of 2000 pounds when tested in accordance with CISCA Access Floors, Section 2 Ultimate Loading.

g. Safety Factor. Panels must provide a minimum Safety Factor of 2 times the uniform load specified above in accordance with ICC-ES AC300.

h. Recycled Content. Provide Access Flooring System (panels, stringers and pedestals) containing a minimum of 18 percent recycled content. Provide data identifying percentage of recycled content of access flooring system.

2.1.2 Allowable Tolerances

2.1.2.1 Floor Panel Flatness

Plus or minus 0.035 inches on diagonal on top of panel or underneath edge.

2.1.2.2 Floor Panel Length

Plus or minus 0.015 inch.

2.1.2.3 Floor Panel Squareness

Plus or minus 0.02 inch in panel length.

2.1.3 Stringers

Provide stringers capable of supporting a 450 pound concentrated load at midspan without permanent deformation in excess of 0.010 inch, when tested in accordance with CISCA Access Floors, Section 4 Stringer Load Testing.

2.1.4 Pedestals

Pedestals must be capable of supporting a 5000 pound axial load without permanent deformation, when tested in accordance with CISCA Access Floors, Section 5 Pedestal Axial Load Test.

2.1.5 Bonding Strength of Pedestal Adhesive

Adhesive for anchoring pedestal bases must have a bonding strength capable of resisting an overturning moment of 1,000 lbf-in when a force is applied to the top of the pedestal in any direction, when tested in accordance with CISCA Access Floors, Section 6 Pedestal Overturning Moment Test. Pedestal adhesive must meet emissions requirement of CDPH SECTION 01350 (use the office or classroom requirements, regardless of space type). Provide validation of indoor air quality for pedestal adhesive.

2.1.6 Bond Strength of Factory Installed Covering

Bond strength of floor covering must be sufficient to permit handling of the panels by use of the panel lifting device, and to withstand moving caster loads up to 1000 pounds, without separation of the covering from the panel.

2.2 FLOOR PANELS

2.2.1 Floor System Drawings And Planer Quality

a. Submit Fabrication Drawings for elevated floor systems consisting of fabrication and assembly details to be performed in the factory.

b. Indicate on Location Drawings exact location of pedestals, ventilation openings, cable cutouts, and the panel installation pattern.

c. Provide Detail Drawings showing details of the pedestals,

pedestal-floor interlocks, floor panels, panel edging, floor openings, floor opening edging, floor registers, floor grilles, cable cutout treatment, perimeter base, expansion, and peripheral support facilities.

d. Design and workmanship of the floor, as installed, must be completely planar within plus or minus 0.060 inch in 10 feet, 0.100 inch for the entire floor, and 0.030 inch across panel joints.

e. Floor-panel joint-width tolerances must not exceed 0.017 inch as measured with a feeler gage at any point in any joint when the panels are installed and as long as the air leakage requirements specified in this section are met.

f. Submit three complete samples of floor panels.

2.2.2 Detailed Installation Drawings

Submit Detailed Installation Drawings that as a minimum indicate the following:

a. Location of panels

b. Layout of supports, panels, and cutout locations

c. Sizes and details of components

d. Details at floor perimeter and height above structural floor

e. Method of anchorage to structural subfloor

f. Lateral bracing

g. Typical cutout details

h. Gasketing, and perforated panels. Include air transfer capacity of panels

i. Description of factory coating

j. Floor finishes

k. Location of connection to building grounding electrode

2.2.3 Panel Construction

a. Base access floor system on a 24 by 24 inch square module providing minimum of 12 inch clearance between structural floor and underside of panel and stringer. Fabricate so accurate job cutting and fitting may be done using standard sizes for perimeters and around columns.

b. Do not expose metal on finished top surface of panels. Provide cutouts and cutout closures to accommodate utility systems and equipment intercabling. Reinforce cutouts to meet design load requirements. Provide extra support pedestals at each corner of cutout for cutout panels that do not meet specified design load requirements.

c. Panel design must provide for convenient panel removal for underfloor

servicing and for openings for new equipment. Use panels of uniform dimensions within specified tolerances. Permanently mark panels to indicate load rating and model number.

d. Machine square floor panels to within plus or minus 0.015 inch with edge straightness plus or minus 0.0025 inch. If plastic edging is applied to the panel, the tolerances apply to the panel before the plastic edging is applied.

2.2.4 Floor Covering

Surface floor panels with factory applied finish materials firmly bonded in place with waterproof adhesive. Provide finish flooring materials in corridors and exits with a critical radiant flux of not less than 0.22 watts per square centimeter (Class 2) when tested in accordance with ASTM E648 or NFPA 253. The electrical resistance must remain stable over the life expectancy of the floor covering. Any anti-static agent used in the manufacturing process must be an integral part of the material, not surface applied. Bolt heads or similar attachments must not rise above the traffic surface. Submit three separate samples of each specified floor covering finish and color.

2.2.4.1 Static-Dissipative Vinyl Flooring

Provide factory applied static-dissipative vinyl flooring that is a homogeneous vinyl product and conforms to ASTM F1700, Class I monolithic, Type A smooth surface. Provide electrical resistance from surface to surface and surface to ground between 1,000,000 ohms ($1.0 \times 10^6$) and 1,000,000,000 ohms ($1.0 \times 10^9$) when tested in accordance with ASTM F150. Material must consist of one piece to cover the face of the panel. Provide edge detail that is integral to the finish material.

Reference Section 09 62 38 STATIC-CONTROL FLOORING for additional requirements for static-dissipative flooring.

2.2.5 Resilient Base

Conform to ASTM F1861, resilient base, Style B (coved - installed with resilient flooring). Provide 4 inch high and a minimum 1/8 inch thick wall base. Provide preformed corners in matching height, shape, and color.

2.2.6 Adhesives

Provide adhesives as recommended by the manufacturer. Provide non-aerosol adhesive products that meet either emissions requirements of CDPH SECTION 01350 (use the requirements for either office or classroom, regardless of space type) or VOC content requirements of SCAQMD Rule 1168. Provide aerosol adhesives that meet either emissions requirements of CDPH SECTION 01350 (use the requirements for office or classroom, regardless of space type) or VOC content requirements of GS-36. Provide validation of indoor air quality for adhesives. Provide conductive adhesive as recommended by the manufacturer of the static-control flooring.

2.2.7 Lifting Device

At turn over provide one floor panel lifting device standard with the floor manufacturer, for each individual floor area (room or corridor). Furnish a minimum of two devices. For AIR FORCE projects, at turnover, provide a total of two suction-type floor panel lifting devices for each

floor area (room or corridor).

## 2.3 PANEL SUPPORT SYSTEM

Design support system to allow for 360 degree clearance in laying out cable and cutouts for service to machines and so that panel and stringer together take up maximum of 2 inches. Submit one sample of suspension system proposed for use.

### 2.3.1 Pedestals

Provide pedestals made of steel. Ferrous materials must have a factory-applied corrosion-resistant finish. Provide pedestal base plates with a minimum of 16 square inches of bearing surface and a minimum of 1/8 inch thickness. Pedestal shafts must be threaded to permit height adjustment within a range of approximately 2 inches, to permit overall floor adjustment within plus or minus 0.10 inch of the required elevation, and to permit leveling of the finished floor surface within 0.062 inch in 10 feet in all directions. Provide locking devices to positively lock the final pedestal vertical adjustments in place. Pedestal caps must interlock with stringers to preclude tilting or rocking of the panels.

### 2.3.2 Stringers

a. Stringers shall support each edge of panel.

b. Steel box stringer shall have conductive hot dipped galvanized coating and factory applied gasket. Zinc electroplating shall be prohibited on stringers and stringer fasteners.

c. Stringers shall be individually and rigidly fastened to the pedestal with one machine screw for each foot of stringer length. Bolts shall provide positive electrical contact between the stringers and pedestals. Connections depending on gravity or spring action are unacceptable.

d. Stringer grid shall be 2’ x 2’.

### 2.3.3 Gaskets

Provide continuous gasketing at contact surfaces between panel and stringers to deaden sound and seal off the underfloor cavity from above for air tightness, and to maintain panel alignment.

## 2.4 FACTORY TESTS

Factory test access flooring, using an independent laboratory, at the same position and maximum design elevation and in the same arrangement as shown on the drawings for installation so as to duplicate service conditions as much as possible.

### 2.4.1 Load Tests

Conduct floor panel, stringer, and pedestal testing in accordance with CISCA Access Floors to determine deformation and permanent set of panels and system due to concentrated, Uniform, rolling, impact and ultimate loading when panels are supported by actual understructure.

2.4.2 Bond Strength of Covering

Conduct test for bond strength of covering in accordance with CISCA Access Floors for rolling loads, except as specified. Panels must be tested with specified hard surface flooring and on the pedestals and stringers as specified for the installed floor. Brace the supports as necessary to prevent sideways movement during the test. Impose a test load of 1000 pounds on the test assembly through a 3 inches in diameter and 1 inch wide hard plastic caster. Roll the caster completely across the center of the panel. The panel must withstand 20 passes of the caster with no delamination or separation of the covering.

2.5 PERFORATED DIRECTIONAL AIR SUPPLY PANELS

Provide directional air supply floor panels that meet or exceed the design criteria specified for standard panels, are fabricated of light weight die cast aluminum with powder coat finish. Perforated air supply panels shall have minimum 25% open area utilizing manufacturer's standard uniform perforated pattern to allow for even air distribution. Panels shall be equipped with a manually adjustable damper accessible from the top surface.

2.6 CUT OUTS

Provide cable cutouts finished with rigid polyvinylchloride or molded polypropylene edging to conform to the appearance level of the floor surface and to cover raw edges of the cutout panel. Extrusion must be of a configuration to permit its effective and convenient use when new cable openings are required. Provide at least 24 feet of additional extrusion for future use. Submit three color samples for cut outs.

a. Provide non-metallic adapter for openings less than 4 inches wide. Secure adapter adhesively in cutout to preclude removal from panel. Provide at least two adapters per 1000 square feet for future use.

b. Openings larger than 4 inches wide must use rigid polyvinylchloride or molded polypropylene edging. Perform cutting of panels, including cutouts, outside of the building.

c. When size of cutout reduces the performance requirement of panel, provide intermediate stringers adjacent to cutouts.

2.7 COLOR

Color indicated on in accordance with the materials finish legend drawing. Color listed is not intended to limit the selection of equal colors from other manufacturers.

PART 3 EXECUTION

3.1 INSTALLATION

Install access flooring at the location and elevation and in the arrangement shown on the approved detailed installation drawings. The floor system must be of the rigid grid stringer type, complete with all supplemental items, and be the standard product of a manufacturer specializing in access flooring systems.

Install the floor system in accordance with the manufacturer's instructions. Open ends of the floor, where the floor system does not abut

wall or other construction, must have positive anchorage and rigid support. Maintain areas to receive access flooring between 60 and 90 degrees F, and between 20 and 70 percent humidity for 24 hours prior to and during installation.

3.1.1 Preparation for Installation

Clear out all debris in the area in which the floor system is to be installed. Thoroughly clean structural floor surfaces and remove all dust. Install floor coatings, required for dust or vapor control, prior to installation of pedestals, only if the pedestal adhesive will not damage the coating. If the coating and adhesive are not compatible, apply the coating after the pedestals have been installed and the adhesive has cured.

3.1.2 Pedestals

Pedestals must be accurately spaced, and set plumb and in true alignment. Set base plates in full and firm contact with the structural floor, and secured to the structural floor with adhesive or steel expansion anchors in accordance with manufacturer's instructions.

3.1.3 Stringers

Interlock stringers with the pedestal caps to preclude lateral movement, spaced uniformly in parallel lines at the indicated elevation.

3.1.4 Auxiliary Framing

Provide auxiliary framing or pedestals around columns and other permanent construction, at sides of ramps, at open ends of the floor, and beneath panels that are substantially cut to accommodate utility systems. Use special framing for additional lateral support as shown on the approved detailed installation drawings. Provide additional pedestals and stringers designed to specific heights and lengths to meet structural irregularities and design loads. Connect auxiliary framing to main framing.

3.1.5 Panels

Interlock panels with supports in a manner that will preclude lateral movement. Fasten perimeter panels, cutout panels, and panels adjoining columns, stairs, and ramps to the supporting components to form a rigid boundary for the interior panels. Level floors within the specified tolerances. Cut edges of steel finished as recommended by the panel manufacturer. Secure extruded vinyl edging in place at all cut edges of all panel cut-outs to prevent abrasion of cables.Where the space below the floor is a plenum, close cutouts for conduit and similar penetrations using self-extinguishing sponge rubber or air sealing grommets.

3.1.6 Resilient Base

Provide base at vertical wall intersections as indicated in the drawings. Apply the base after the floor system has been completely installed. 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 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.

3.1.7 Repair of Zinc Coating

Repair zinc coating that has been damaged, and cut edges of zinc-coated components and accessories, by the application of a galvanizing repair paint conforming to ASTM A780/A780M. Areas to be repaired must be thoroughly cleaned prior to application of the paint.

3.2 FIELD TESTS

Submit certified copies of test reports from an approved testing laboratory, attesting that the proposed floor system components meet the performance requirements specified.

3.2.1 Acceptance Tests

Conduct acceptance tests after installation of floor system. Make at least one test for each 1000 square feet of floor area. Conduct tests in presence of Contracting Officer and representatives of manufacturer and installer. Submit certified copies of test reports from an approved testing laboratory, attesting that the proposed floor system components meet the performance requirements specified.

3.2.2 Air Leakage

When the space below the finished floor is an air plenum, air leakage through the joints between panels and around the perimeter of the floor system must not exceed 0.1 cubic foot of air per minute per linear foot of joint subjected to 0.1 inches h2o, water gauge, positive pressure in the plenum, when tested in accordance with CISCA Access Floors, Section 10 Air Leakage Test. Measure the leakage rate on the finished raised floor system.

3.2.3 Grounding

Ground the access flooring system for safety hazard and static suppression. Provide positive contact between components for safe, continuous electrical grounding of entire floor system. Total system resistance from wearing surface of floor to building grounding electrode must be within range of 0.5 to 20,000 megohms.

3.2.3.1 Joint Resistance

Electrical joint resistance between individual stringer and pedestal junctions must be less than 0.1 milliohms. Electrical resistance between stringers and floor panels, as mounted in normal use, must be less than 3 ohms when tested in accordance with ASTM F150.

3.2.4 Electrical Resistance

Conduct testing of electrical resistance, in the completed installation, in the presence of the Contracting Officer in accordance with NFPA 99, modified by placing one electrode on the center of the panel surface and connecting the other electrode to the metal flooring support. Take measurements at five or more locations. Each measurement must be the average of five readings of 15 seconds duration at each location. During the tests, relative humidity must be 45 to 55 percent and temperature set

at 69 to 75 degrees F. Select panels used in the testing at random and include two panels most distant from the ground connection. Measure electrical resistance with instruments that are accurate within 2 percent and that have been calibrated within 60 days prior to the performance of the resistance tests. The metal-to-metal resistance from panel to supporting pedestal must not exceed 10 ohms. The resistance between the wearing surface of the floor covering and the ground connection, as measured on the completed installation, must be in accordance with paragraph FLOOR COVERING.

## 3.3 CLEANING AND PROTECTION

### 3.3.1 Cleaning

Keep the space below the completed floor free of all debris. Before any traffic or other work on the completed raised floor is started, clean the completed floor in accordance with the floor covering manufacturer's instructions. Do not permit seepage of cleaner between individual panels.

### 3.3.2 Protection

Protect traffic areas of raised floor systems with a covering of building paper, fiberboard, or other suitable material to prevent damage to the surface. Cover cutouts with material of sufficient strength to support the loads to be encountered. Place plywood or similar material on the floor to serve as runways for installation of heavy equipment not in excess of design load capacity. Maintain protection until the raised floor system is accepted.

### 3.3.3 Surplus Material Removal

Clean surfaces of the work, and adjacent surfaces soiled as a result of the work. Remove all installation equipment, surplus materials, and rubbish from the work site.

## 3.4 OPERATION AND MAINTENANCE MANUALS

Submit maintenance instructions for proper care of the floor panel surface. When conductive flooring is specified, also submit maintenance instructions to identify special cleaning and maintenance requirements to maintain "conductivity" properties of the panel finish.

-- End of Section --

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SECTION 09 90 00

PAINTS AND COATINGS
**02/21**

PART 1 GENERAL

1.1 RELATED REQUIREMENTS

1.1.1 Painting Included

Where a space or surface is indicated to be painted, include the following unless indicated otherwise.

a. Surfaces behind portable objects and surface mounted articles readily detachable by removal of fasteners, such as screws and bolts.

b. New factory finished surfaces that require identification or color coding and factory finished surfaces that are damaged during performance of the work.

c. Existing coated surfaces that are damaged during performance of the work.

1.1.1.1 Exterior Painting

Includes new surfaces, of the building and appurtenances. Also included are existing coated surfaces made bare by cleaning operations.

1.1.1.2 Interior Painting

Includes new surfaces 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.

1.1.4 Miscellaneous Painting

1.1.4.1 Lettering Building

Provide lettering as scheduled on the drawings, finished with a protective coating of spar varnish. Samples must be approved before application.

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 | (2023) 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)

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|---|---|
| MPI 2 | (2012) Aluminum Heat Resistant Enamel (up to 427 C and 800 F |
| MPI 3 | (2016) Primer, Alkali Resistant, Water Based |
| MPI 4 | (2016) Interior/Exterior Latex Block Filler |
| MPI 5 | (2015) Primer, Exterior Alkyd Wood |
| MPI 8 | (2016) Alkyd, Exterior Flat (MPI Gloss Level I) |
| MPI 9 | (2016) Alkyd, Exterior Gloss (MPI Gloss Level 6) |
| MPI 10 | (2016) Latex, Exterior Flat (MPI Gloss Level 1) |
| MPI 11 | (2016) Latex, Exterior Semi-Gloss, MPI Gloss Level 5 |
| MPI 16 | (2016) Stain, Exterior, Water Based, Solid Hide |
| MPI 19 | (2012) Primer, Zinc Rich, Inorganic |
| MPI 21 | (2012) Heat Resistant Coating, (Up to 205°C/402°F), MPI Gloss Level 6 |
| MPI 22 | (2012) Aluminum Paint, High Heat (up to 590° C/1100° F) |
| MPI 23 | (2015) Primer, Metal, Surface Tolerant |
| MPI 31 | (2012) Varnish, Polyurethane, Moisture Cured, Gloss (MPI Gloss Level 6) |
| MPI 38 | (2016) Elastomeric Coating, Exterior, |

| | |
|---|---|
| | Water Based, Non-Flat |
| MPI 39 | (2018) Primer, Latex, for Interior Wood |
| MPI 42 | (2012) Textured Coating, Latex, Flat |
| 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 90 | (2012) Stain, Semi-Transparent, for Interior Wood |
| MPI 94 | (2016) Alkyd, Exterior, Semi-Gloss (MPI Gloss Level 5) |
| MPI 95 | (2015) Primer, Quick Dry, for Aluminum |
| MPI 101 | (2016) Primer, Epoxy, Anti-Corrosive, for Metal |
| MPI 107 | (2016) Primer, Rust-Inhibitive, Water Based |
| MPI 108 | (2015) Epoxy, High Build, Low Gloss |
| MPI 113 | (2018) Elastomeric, Pigmented, Exterior, Water Based, Flat |
| MPI 119 | (2016) Latex, Exterior, Gloss (MPI Gloss Level 6) |
| MPI 120 | (2020) Epoxy, High Build, Self Priming, Low Gloss |
| MPI 134 | (2015) Primer, Galvanized, Water Based |
| MPI 139 | (2016) Latex, Interior, High Performance Architectural, (MPI Gloss Level 3) |
| MPI 145 | (2016) Latex, Interior, Institutional Low Odor/VOC, ( MPI Gloss Level 3) |
| MPI 147 | (May 2016) Latex, Interior, Institutional Low Odor/VOC, Semi-Gloss (MPI Gloss Level 5) |
| MPI 149 | (2016) Primer Sealer, Interior, Institutional Low Odor/VOC |

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|---|---|
| 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 161 | (2016) Light Industrial Coating, Exterior, Water Based ( MPI Gloss Level 3) |
| MPI 163 | (2016) Light Industrial Coating, Exterior, Water Based, Semi-Gloss (MPI Gloss Level 5) |
| MPI 164 | (2016) Light Industrial Coating, Exterior, Water Based, Gloss (MPI Gloss Level 6) |
| MPI 177 | (2020) Epoxy, Semi-Gloss (MPI Gloss Level 5) |
| MPI 214 | (2016) Latex, Exterior (MPI Gloss Level 2) |
| MPI ASM | (2019) Architectural Painting Specification Manual |
| MPI GPS-1-14 | (2014) Green Performance Standard GPS-1-14 |
| MPI GPS-2-14 | (2014) Green Performance Standard GPS-2-14 |
| MPI MRM | (2015) Maintenance Repainting Manual |

SOCIETY FOR PROTECTIVE COATINGS (SSPC)

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|---|---|
| SSPC 7/NACE No.4 | (2007) Brush-Off Blast Cleaning |
| SSPC Glossary | (2011) SSPC Protective Coatings Glossary |
| SSPC PA 1 | (2016) Shop, Field, and Maintenance Coating of Metals |
| SSPC QP 1 | (2019) Standard Procedure for Evaluating the Qualifications of Industrial/Marine Painting Contractors (Field Application to Complex Industrial Steel Structures and Other Metal Components) |
| SSPC SP 1 | (2015) Solvent Cleaning |
| SSPC SP 2 | (2018) Hand Tool Cleaning |
| SSPC SP 3 | (2018) Power Tool Cleaning |
| SSPC SP 6/NACE No.3 | (2007) Commercial Blast Cleaning |
| SSPC SP 10/NACE No. 2 | (2015) Near-White Blast Cleaning |
| SSPC VIS 1 | (2002; E 2004) Guide and Reference |

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|---|---|
| | Photographs for Steel Surfaces Prepared by Dry Abrasive Blast Cleaning |
| SSPC VIS 3 | (2004) Guide and Reference Photographs for Steel Surfaces Prepared by Hand and Power Tool Cleaning |
| SSPC VIS 4/NACE VIS 7 | (1998; E 2000; E 2004) Guide and Reference Photographs for Steel Surfaces Prepared by Waterjetting |
| SSPC-SP WJ-1/NACE WJ-1 | (2012) Clean to Bare Substrate, Waterjet Cleaning of Metals |
| SSPC-SP WJ-2/NACE WJ-2 | (2012) Very Thorough Cleaning, Waterjet Cleaning of Metals |
| SSPC-SP WJ-3/NACE WJ-3 | (2012) Thorough Cleaning, Waterjet Cleaning of Metals |
| SSPC-SP WJ-4/NACE WJ-4 | (2012) Light Cleaning, Waterjet Cleaning of Metals |

U.S. ARMY CORPS OF ENGINEERS (USACE)

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| EM 385-1-1 | (2024) Safety -- Safety and Occupational Health (SOH) Requirements Manual |

U.S. DEPARTMENT OF DEFENSE (DOD)

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| MIL-STD-101 | (2014; Rev C) Color Code for Pipelines and for Compressed Gas Cylinders |

U.S. ENVIRONMENTAL PROTECTION AGENCY (EPA)

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|---|---|
| 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 |

## 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 |

| Gloss Level | Description | Units at 60 degree angle | Units at 80 degree angle |
|---|---|---|---|
| G3 | Eggshell | 10 to 25 | 10 to 35 |
| G4 | Satin | 20 to 35 | 35 min |
| G5 | Semi-Gloss | 35 to 70 | |
| G6 | Gloss | 70 to 85 | |
| G7 | High Gloss | | |

Gloss is tested in accordance with ASTM D523. Historically, the Government has used Flat (G1 / G2), Eggshell (G3), Semi-Gloss (G5), and Gloss (G6).

1.3.11 MPI System Number

The MPI coating system number in each MPI Division found in either the MPI Architectural Painting Specification Manual or the Maintenance Repainting Manual and defined as an exterior (EXT/REX) or interior system (INT/RIN).

1.3.12 Paint

SSPC Glossary; (1) Any pigmented liquid, liquefiable, or mastic composition designed for application to a substrate in a thin layer that is converted to an opaque solid film after application. Used for protection, decoration, identification, or to serve some other functional purposes; (2) Application of a coating material.

1.3.13 REX

MPI short term designation for an exterior coating system used in repainting projects or over existing coating systems.

1.3.14 RIN

MPI short term designation for an interior coating system used in repainting projects or over existing coating systems.

1.4 SCHEDULING

Allow paint, polyurethane, varnish, and wood stain installations to cure prior to the installation of materials that adsorb VOCs.

1.5 SUBMITTALS

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

Samples of specified materials may be taken and tested for compliance with specification requirements.

SD-02 Shop Drawings

Piping Identification

SD-03 Product Data

Coating; 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

Indoor Air Quality for Consolidated Latex Paints

SD-08 Manufacturer's Instructions

Mixing

Manufacturer's Safety Data Sheets

SD-10 Operation and Maintenance Data

Coatings, Data Package 1; G

## 1.6 QUALITY ASSURANCE

### 1.6.1 Regulatory Requirements

#### 1.6.1.1 Environmental Protection

In addition to requirements specified elsewhere for environmental protection, provide coating materials that conform to the restrictions of the local Air Pollution Control District and regional jurisdiction. Notify Contracting Officer of any paint specified herein which fails to conform.

#### 1.6.1.2 Lead Content

Do not use coatings having a lead content over 0.06 percent by weight of nonvolatile content.

#### 1.6.1.3 Chromate Content

Do not use coatings containing zinc-chromate or strontium-chromate.

#### 1.6.1.4 Asbestos Content

Provide asbestos-free materials.

#### 1.6.1.5 Mercury Content

Provide materials free of mercury or mercury compounds.

1.6.1.6 Silica

Provide abrasive blast media containing no free crystalline silica.

1.6.1.7 Human Carcinogens

Provide materials that do not contain ACGIH 0100 confirmed human carcinogens (A1) or suspected human carcinogens (A2).

1.6.1.8 Carbon Based Fibers / Tubes

Materials must not contain carbon based fibers such as carbon nanotubes or carbon nanofibers. Intelligence Bulletin 65 ranks toxicity of carbon nanotubes on a par with asbestos.

1.6.2 SSPC QP 1 Certification

Contractors that perform surface preparation or coating application on steel substrates must be certified by the Society for Protective Coatings (formerly Steel Structures Painting Council) (SSPC) to the requirements of SSPC QP 1 prior to Contract award, and must remain certified while accomplishing any surface preparation or coating application. If a Contractor's certification expires, the firm will not be allowed to perform any work until the certification is reissued. Requests for extension of time for any delay to the completion of the project due to an inactive certification will not be considered. Notify the Contracting Officer of any change in Contractor certification status. Notify the Contracting Officer of all scheduled and unannounced on-site audits from SSPC and furnish a copy of all audit reports.

1.6.3 Approved Products List

The current MPI, "Approved Product List" which lists paint by brand, label, product name and product code as of the date of Contract award, will be used to determine compliance with the submittal requirements of this specification. The Contractor may choose to use a subsequent MPI "Approved Product List", however, only one list may be used for the entire Contract and each coating system is to be from a single manufacturer. Provide all coats on a particular substrate from a single manufacturer. No variation from the MPI Approved Products List is acceptable.

1.6.4 Paints and Coatings Indoor Air Quality Certifications

Provide paint and coating products certified to meet indoor air quality requirements by MPI GPS-1-14, MPI GPS-2-14 or provide certification by other third-party programs. Provide current product certification documentation from certification body.

Provide certification of 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.

1.6.5 Field Samples and Tests

The Contracting Officer may choose up to two coatings that have been delivered to the site to be tested at no cost to the Government. Take samples of each chosen product as specified in the paragraph SAMPLING PROCEDURE. Test each chosen product as specified in the paragraph TESTING

PROCEDURE. Remove products from the job site which do not conform, and replace with new products that conform to the referenced specification. Test replacement products that failed initial testing as specified in the paragraph TESTING PROCEDURE at no cost to the Government.

1.6.5.1 Sampling Procedure

Select paint at random from the products that have been delivered to the job site for sample testing. The Contractor must provide one quart samples of the selected paint materials. Take samples in the presence of the Contracting Officer, and label, and identify each sample. Provide labels in accordance with the paragraph PACKAGING, LABELING, AND STORAGE.

1.6.5.2 Testing Procedure

Provide Batch Quality Conformance Testing for specified products, as defined by and performed by MPI. As an alternative to Batch Quality Conformance Testing, the Contractor may provide Qualification Testing for specified products above to the appropriate MPI product specification, using the third-party laboratory approved under the paragraph QUALIFICATION TESTING laboratory for coatings. Include the backup data and summary of the test results within the qualification testing lab report. Provide a summary listing of all the reference specification requirements and the result of each test. Clearly indicate in the summary whether the tested paint meets each test requirement. Note that Qualification Testing may take 4 to 6 weeks to perform, due to the extent of testing required.

Submit name, address, telephone number, FAX number, and e-mail address of the independent third party laboratory selected to perform testing of coating samples for compliance with specification requirements. Submit documentation that laboratory is regularly engaged in testing of paint samples for conformance with specifications, and that employees performing testing are qualified. If MPI is chosen to perform the Batch Quality Conformance testing, the above submittal information is not required, only a letter is required from the Contractor stating that MPI will perform the testing.

1.7 PACKAGING, LABELING, AND STORAGE

Provide paints in sealed containers that legibly show the Contract specification number, designation name, formula or specification number, batch number, color, quantity, date of manufacture, manufacturer's formulation number, manufacturer's directions including any warnings and special precautions, and name and address of manufacturer. Furnish pigmented paints in containers not larger than 5 gallons. Store paints and thinners in accordance with the manufacturer's written directions, and as a minimum, stored off the ground, under cover, with sufficient ventilation to prevent the buildup of flammable vapors, and at temperatures between 40 to 95 degrees F.

1.8 SAFETY AND HEALTH

Comply with applicable Federal, State, and local laws and regulations, and with the ACCIDENT PREVENTION PLAN, including the Activity Hazard Analysis as specified in Section 01 35 26 GOVERNMENTAL SAFETY REQUIREMENTS and in Appendix A of EM 385-1-1. Include in the Activity Hazard Analysis the potential impact of painting operations on painting personnel and on others involved in and adjacent to the work zone.

1.8.1 Toxic Materials

To protect personnel from overexposure to toxic materials, conform to the most stringent guidance of:

a. The applicable manufacturer's Safety Data Sheets (SDS) or local regulation.

b. 29 CFR 1910.1000.

c. ACGIH 0100, threshold limit values.

Submit manufacturer's Safety Data Sheets for coatings, solvents, and other potentially hazardous materials, as defined in FED-STD-313.

1.9 ENVIRONMENTAL REQUIREMENTS

Comply, at minimum, with manufacturer recommendations for space ventilation during and after installation. Isolate area of application from rest of building when applying high-emission paints or coatings.

1.9.1 Coatings

Do not apply coating when air or substrate conditions are:

a. Less than 5 degrees F above dew point;

b. Below 50 degrees F or over 95 degrees F, unless specifically pre-approved by the Contracting Officer and the product manufacturer. Do not, under any circumstances, violate the manufacturer's application recommendations.

PART 2 PRODUCTS

2.1 MATERIALS

Conform to the coating specifications and standards referenced in PART 3. Submit Product Data Sheets for specified coatings and solvents. Provide preprinted cleaning and maintenance instructions for all coating systems. Submit Manufacturer's Instructions on Mixing: Detailed mixing instructions, minimum and maximum application temperature and humidity, pot life, and curing and drying times between coats.

2.2 COLOR SELECTION OF FINISH COATS

Provide colors of finish coats as indicated or specified. Allow Contracting Officer to select colors not indicated or specified. Manufacturers' names and color identification are used for the purpose of color identification only. Named products are acceptable for use only if they conform to specified requirements. Products of other manufacturers are acceptable if the colors are approximately the colors indicated and the product conforms to specified requirements.

Provide color, texture, and pattern of wall coating systems as indicated on the drawings. Submit manufacturer's samples of paint colors. Cross reference color samples to color scheme as indicated. Submit color stencil codes. Tint each coat progressively darker to enable confirmation of the

number of coats.

PART 3 EXECUTION

3.1 PROTECTION OF AREAS AND SPACES NOT TO BE PAINTED

Prior to surface preparation and coating applications, remove, mask, or otherwise protect hardware, hardware accessories, machined surfaces, radiator covers, plates, lighting fixtures, public and private property, and other such items not to be coated that are in contact with surfaces to be coated. Following completion of painting, reinstall removed items by workmen skilled in the trades. Restore surfaces contaminated by coating materials, to original condition and repair damaged items.

3.2 SURFACE PREPARATION

Remove dirt, splinters, loose particles, grease, oil, disintegrated coatings, and other foreign matter and substances deleterious to coating performance as specified for each substrate before application of paint or surface treatments. Remove oil and grease prior to mechanical cleaning. Schedule cleaning so that dust and other contaminants will not fall on wet, newly painted surfaces. Spot-prime exposed ferrous metals such as nail heads on or in contact with surfaces to be painted with water-thinned paints, with a suitable corrosion-inhibitive primer capable of preventing flash rusting and compatible with the coating specified for the adjacent areas. Refer to MPI ASM and MPI MRM for additional more specific substrate preparation requirements.

3.3 PREPARATION OF METAL SURFACES

3.3.1 Existing and New Ferrous Surfaces

a. Ferrous Surfaces including Shop-coated Surfaces and Small Areas That Contain Rust, Mill Scale and Other Foreign Substances: Solvent clean 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 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 1for 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.

b. Galvanized with Slight Coating Deterioration or with Little or No Rusting: Water jetting to SSPC-SP WJ-3/NACE WJ-3 to remove loose coating from surfaces with less than 20 percent coating deterioration and no blistering, peeling, or cracking. Use inhibitor as recommended by the coating manufacturer to prevent rusting.

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, 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 and existing uncoated 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 plaster and stucco surfaces are free from loose matter and that gypsum board is dry. Remove loose dirt and dust by brushing with a soft brush, rubbing with a dry cloth, or vacuum-cleaning prior to application of the first coat material. A damp cloth or sponge may be used if paint is water-based.

3.4.2.2 Repair of Minor Defects

Prior to painting, repair joints, cracks, holes, surface irregularities, and other minor defects with patching plaster or spackling compound and sand smooth.

3.4.2.3 Allowable Moisture Content

Latex coatings may be applied to damp surfaces, but not surfaces with droplets of water. Do not apply epoxies to damp surfaces as determined by ASTM D4263. Verify that new plaster to be coated has a maximum moisture content of 8 percent, when measured in accordance with ASTM D4444, Method A, unless otherwise authorized. In addition to moisture content requirements, allow new plaster to age a minimum of 30 days before preparation for painting.

3.5 PREPARATION OF WOOD AND PLYWOOD SURFACES

3.5.1 New Plywood and Wood Surfaces, Except Floors:

a. Surface Cleaning: Clean wood surfaces of foreign matter. Verify that surfaces are free from dust and other deleterious substances and in a condition approved by the Contracting Officer prior to receiving paint or other finish. Do not use water to clean uncoated wood. Scrape to

remove loose coatings. Lightly sand to roughen the entire area of previously enamel-coated wood surfaces.

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.

g. Prime Coat For New Exterior Surfaces: Prime coat wood doors before wood becomes dirty, warped.

## 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.

q. Floors: For nonslip surfacing on level floors, as the intermediate coat is applied, cover wet surface completely with almandite garnet, Grit No. 36, with maximum passing U.S. Standard Sieve No. 40 less than 0.5 percent. When the coating is dry, use a soft bristle broom to sweep up excess grit, which may be reused, and vacuum up remaining residue before application of the topcoat. For nonslip surfacing on ramps, provide MPI 77 with non-skid additive, applied by roller in accordance with manufacturer's instructions.

3.6.2 Mixing and Thinning of Paints

Reduce paints to proper consistency by adding fresh paint, except when thinning is mandatory to suit surface, temperature, weather conditions, application methods, or for the type of paint being used. Obtain written permission from the Contracting Officer to use thinners. Verify that the written permission includes quantities and types of thinners to use.

When thinning is allowed, thin paints immediately prior to application with not more than one pint of suitable thinner per gallon. The use of thinner does not relieve the Contractor from obtaining complete hiding, full film thickness, or required gloss. Thinning cannot cause the paint to exceed limits on volatile organic compounds. Do not mix paints of different manufacturers.

3.6.3 Two-Component Systems

Mix two-component systems in accordance with manufacturer's instructions. Follow recommendation by the manufacturer for any thinning of the first coat to ensure proper penetration and sealing for each type of substrate.

3.6.4 Coating Systems

a. Systems by Substrates: Apply coatings that conform to the respective specifications listed in the following Tables:

| Table for Exterior Applications | |
|---|---|
| MPI Division | Substrate Application |
| MPI Division 3 | Exterior Concrete Paint Table |
| MPI Division 4 | Exterior Concrete Masonry Units Paint Table |

| Table for Exterior Applications | |
|---|---|
| MPI Division 5 | Exterior Metal, Ferrous and Non-Ferrous Paint Table |
| MPI Division 6 | Exterior Wood; Dressed Lumber, Paneling, Decking, Shingles Paint Table |
| MPI Division 9 | Exterior Stucco Paint Table |
| MPI Division 10 | Exterior Cloth Coverings and Bituminous Coated Surfaces 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 Plaster, Gypsum Board, Textured Surfaces Paint Table |

b. Minimum Dry Film Thickness (DFT): Apply paints, primers, varnishes, enamels, undercoats, and other coatings to a minimum dry film thickness of 1.5 mil each coat unless specified otherwise in the Tables. Coating thickness, where specified, refers to the minimum dry film thickness.

c. Coatings for Surfaces Not Specified Otherwise: Coat unspecified surfaces the same as surfaces having similar conditions of exposure.

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 Exterior and Interior.

b. Prior to erection, apply two coats of specified primer to treat and prime wood and plywood surfaces which will be inaccessible after erection.

c. Apply stains in accordance with manufacturer's printed instructions.

## 3.10 PIPING IDENTIFICATION

Piping Identification, Including Surfaces In Concealed Spaces: Provide in accordance with MIL-STD-101. Place stenciling in clearly visible locations. On piping not covered by MIL-STD-101, stencil approved names or code letters, in letters a minimum of 1/2 inch high for piping and a minimum of 2 inches high elsewhere. Stencil arrow-shaped markings on piping to indicate direction of flow using black stencil paint.

## 3.11 INSPECTION AND ACCEPTANCE

In addition to meeting previously specified requirements, demonstrate mobility of moving components, including swinging and sliding doors, cabinets, and windows with operable sash, for inspection by the Contracting Officer. Perform this demonstration after appropriate curing and drying times of coatings have elapsed and prior to invoicing for final payment.

## 3.12 WASTE MANAGEMENT

As specified in the Waste Management Plan and as follows. Do not use kerosene or any such organic solvents to clean up water based paints. Properly dispose of paints or solvents in designated containers. Close and seal partially used containers of paint to maintain quality as necessary for reuse. Store in protected, well-ventilated, fire-safe area at moderate temperature. Place materials defined as hazardous or toxic waste in designated containers. Coordinate with manufacturer for take-back program. Set aside scrap to be returned to manufacturer for recycling into new product. When such a service is not available, contact local recyclers to reclaim the materials. Set aside extra paint for future color matches or reuse by the Government. Where local options exist for leftover paint recycling, collect all waste paint by type and provide for delivery to recycling or collection facility for reuse by local organizations.

## 3.13 PAINT TABLES

All DFT's are minimum values. Use only materials with a MPI GPS-1-14 green check mark having a minimum MPI "Environmentally Friendly" E1 rating based on VOC (EPA Method 24) content levels. Acceptable products are listed in the MPI Green Approved Products List, available at http://www.specifygreen.com/APL/ProductIdxByMPInum.asp.

### 3.13.1 Exterior Paint Tables

#### 3.13.1.1 MPI Division 3: Exterior Concrete Paint Table

A. Concrete; Vertical Surfaces, Undersides of Balconies and Soffits

(1) New concrete; vertical surfaces, including undersides of balconies and soffits but excluding tops of slabs

| Latex | | | | | |
|---|---|---|---|---|---|
| New and uncoated existing | Existing, previously painted | Primer | Intermediate | Topcoat | System DFT |
| MPI EXT 3.1A-G1 (Flat) | MPI REX 3.1A-G1 (Flat) | MPI 3 | MPI 10 | MPI 10 | 3.5 mils |
| MPI EXT 3.1A-G2 (Velvet) | MPI REX 3.1A-G2 (Velvet) | MPI 3 | MPI 214 | MPI 214 | 3.5 mils |
| MPI EXT 3.1A-G5 (Semigloss) | MPI REX 3.1A-G5 (Semigloss) | MPI 3 | MPI 11 | MPI 11 | 3.5 mils |
| MPI EXT 3.1A-G6 (Gloss) | MPI REX 3.1A-G6 (Gloss) | MPI 3 | MPI 119 | MPI 119 | 3.5 mils |
| Primer as recommended by manufacturer.<br>Topcoat: Coating to match adjacent surfaces. | | | | | |

(2) New concrete, textured system; vertical surfaces, including undersides of balconies and soffits but excluding tops of slabs

| Latex Aggregate | | | | | |
|---|---|---|---|---|---|
| New and uncoated existing | Existing, previously painted | Primer | Intermediate | Topcoat | System DFT |
| MPI EXT 3.1B-G2 (Flat) | MPI REX 3.1A-G1 (Flat) | MPI 42 | MPI 10 | MPI 10 | N/A |
| MPI EXT 3.1B-G5 (Semigloss) | MPI REX 3.1A-G5 (Semigloss) | MPI 42 | MPI 11 | MPI 11 | N/A |

| | | | | | |
|---|---|---|---|---|---|
| MPI EXT 3.1B-G6 (Gloss) | MPI REX 3.1A-G6 (Gloss) | MPI 42 | MPI 119 | MPI 119 | N/A |
| Texture - Fine Medium Coarse.<br>Surface preparation and number of coats in accordance with manufacturer's instructions.<br>Topcoat: Coating to match adjacent surfaces. | | | | | |

(3) New concrete, elastomeric system; vertical surfaces, including undersides of balconies and soffits but excluding tops of slabs

| Elastomeric Coating | | | | | |
|---|---|---|---|---|---|
| New and uncoated existing | Existing, previously painted | Primer | Intermediate | Topcoat | System DFT |
| MPI EXT 3.1F-G1 (Flat) | MPI REX 3.1F-G1 (Flat) | Per Manufacturer | MPI 113 | MPI 113 | 16 mils |
| MPI EXT 3.1F-G2/3 (Velvet) | MPI REX 3.1F-G2/3 (Velvet) | Per Manufacturer | MPI 38 | MPI 38 | 16 mils |
| Primer as recommended by manufacturer.<br>Topcoat: Coating to match adjacent surfaces.<br>Surface preparation and number of coats in accordance with manufacturer's instructions.<br>NOTE: Apply sufficient coats to achieve a minimum dry film thickness of 16 mils. | | | | | |

B. Cementitious Composition Board

(1) New Cementitious composition board (including Asbestos cement board)

| Latex | | | | | |
|---|---|---|---|---|---|
| New and uncoated existing | Existing | Primer | Intermediate | Topcoat | System DFT |
| MPI EXT 3.3A-G1 (Flat) | MPI REX 3.3A-G1 (Flat) | MPI 10 | MPI 10 | MPI 10 | N/A |
| MPI EXT 3.3A-G5 (Semigloss) | MPI REX 3.3A-G5 (Semigloss) | MPI 11 | MPI 11 | MPI 11 | N/A |
| MPI EXT 3.3A -G6 (Gloss) | MPI REX 3.3A-G6 (Gloss) | MPI 119 | MPI 119 | MPI 119 | N/A |
| Topcoat: Coating to match adjacent surfaces. | | | | | |

3.13.1.2 MPI Division 4: Exterior Concrete Masonry Units Paint Table

A. New concrete masonry on uncoated surface

| Latex | | | | | | |
|---|---|---|---|---|---|---|
| New | Existing | Block Filler | Primer | Intermediate | Topcoat | System DFT |
| MPI EXT 4.2A-G1 (Flat) | MPI REX 4.2A-G1 (Flat) | MPI 4 | N/A | MPI 10 | MPI 10 | 11 mils |
| MPI EXT 4.2A-G5 (Semigloss) | MPI REX 4.2A-G5 (Semigloss) | MPI 4 | N/A | MPI 11 | MPI 11 | 11 mils |
| MPI EXT 4.2A-G6 (Gloss) | MPI REX 4.2A-G6 (Gloss) | MPI 4 | N/A | MPI 119 | MPI 119 | 11 mils |
| Topcoat: Coating to match adjacent surfaces. | | | | | | |

B. New concrete masonry, textured system; on uncoated surface

| Latex Aggregate | | | | | |
|---|---|---|---|---|---|
| New | Existing | Primer | Intermediate | Topcoat | System DFT |
| MPI EXT 4.2B-G1 (Flat) | MPI REX 3.1A-G1 (Flat) | MPI 42 | MPI 42 | MPI 10 | N/A |
| MPI EXT 4.2B-G5 (Semigloss) | MPI REX 3.1A-G5 (Semigloss) | MPI 42 | MPI 42 | MPI 11 | N/A |
| MPI EXT 4.2B-G6 (Gloss) | MPI REX 3.1A-G6 (Gloss) | MPI 42 | MPI 42 | MPI 119 | N/A |
| Texture - Fine Medium Coarse.<br>Surface preparation and number of coats in accordance with manufacturer's instructions.<br>Topcoat: Coating to match adjacent surfaces. | | | | | |

C. New concrete masonry, elastomeric system; on uncoated surfaces

| Elastomeric Coating | | | | | |
|---|---|---|---|---|---|
| New and uncoated existing | Existing, previously painted | Primer | Intermediate | Topcoat | System DFT |
| MPI EXT 3.1F-G1 (Flat) | MPI REX 3.1F-G1 (Flat) | Per Manufacturer | MPI 113 | MPI 113 | 16 mils |

| |
|---|
| Primer as recommended by manufacturer.<br>Topcoat: Coating to match adjacent surfaces.<br>Surface preparation and number of coats in accordance with manufacturer's instructions.<br>NOTE: Apply sufficient coats of MPI 113 to achieve a minimum dry film thickness of 16 mils. |

3.13.1.3 MPI Division 5: Exterior Metal, Ferrous and Non-Ferrous Paint Table

A. Steel / Ferrous Surfaces

(1) New Steel that has been hand or power tool cleaned to SSPC SP 2 or SSPC SP 3

| Alkyd | | | | | |
|---|---|---|---|---|---|
| New | Existing, uncoated | Primer | Intermediate | Topcoat | System DFT |
| MPI EXT 5.1Q-G5 (Semigloss | MPI REX 5.1D-G5 (Semigloss) | MPI 23 | MPI 94 | MPI 94 | 5.25 mils |
| 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. | | | | | |

| Pigmented Polyurethane | | | | | |
|---|---|---|---|---|---|
| New | Existing | Primer | Intermediate | Topcoat | System DFT |
| MPI EXT 5.1J-G6 (Gloss) | MPI EXT 5.1J-G6 (Gloss) | MPI 101 | MPI 108 | MPI 72 | 8.5 mils |
| Topcoat: Coating to match adjacent surfaces. | | | | | |

(4) Metal floors (non-shop-primed surfaces or non-slip deck surfaces) with non-skid additive (NSA), load at manufacturer's recommendations

| Epoxy | | | | | |
|---|---|---|---|---|---|
| New | Existing | Primer | Intermediate | Topcoat | System DFT |
| MPI EXT 5.1S-G5 (Semi Gloss) | MPI EXT 5.1S-G5 (Semi Gloss) | MPI 120 | MPI 177 | MPI 177 | 5.25 mils |
| MPI EXT 5.1S-G6 (Gloss) | MPI EXT 5.1S-G6 (Gloss) | MPI 120 | MPI 77 | MPI 77 | 5.25 mils |
| Topcoat: Coating to match adjacent surfaces.<br>Load Non-Skid Additive at manufacturer's recommendations. | | | | | |

B. Exterior Galvanized Surfaces

(1) New Galvanized surfaces

| Waterborne Primer / Latex | | | | |
|---|---|---|---|---|
| New Galvanized Surfaces | Primer | Intermediate | Topcoat | System DFT |
| MPI EXT 5.3H-G1 (Flat) | MPI 134 | MPI 10 | MPI 10 | 4.5 mils |

| | | | | |
|---|---|---|---|---|
| EXT 5.3H-G5 (Semigloss) | MPI 134 | MPI 11 | MPI 11 | 4.5 mils |
| MPI EXT 5.3H-G6 (Gloss) | MPI 134 | MPI 119 | MPI 119 | 4.5 mils |
| Topcoat: Coating to match adjacent surfaces. | | | | |

| Waterborne Primer / Waterborne Light Industrial Coating | | | | |
|---|---|---|---|---|
| New Galvanized Surfaces | Primer | Intermediate | Topcoat | System DFT |
| MPI EXT 5.3J-G5 (Semigloss) | MPI 134 | MPI 163 | MPI 163 | 4.5 mils |
| MPI EXT 5.3J-G6 (Gloss) | MPI 134 | MPI 164 | MPI 164 | 4.5 mils |
| Topcoat: Coating to match adjacent surfaces. | | | | |

| Epoxy Primer / Waterborne Light Industrial Coating | | | | |
|---|---|---|---|---|
| New Galvanized Surfaces | Primer | Intermediate | Topcoat | System DFT |
| MPI EXT 5.3K-G5 (Semigloss) | MPI 101 | MPI 163 | MPI 163 | 5 mils |
| MPI EXT 5.3K-G6 (Gloss) | MPI 101 | MPI 164 | MPI 164 | 5 mils |
| Topcoat: Coating to match adjacent surfaces. | | | | |

| Pigmented Polyurethane | | | | |
|---|---|---|---|---|
| New Galvanized Surfaces | Primer | Intermediate | Topcoat | System DFT |
| MPI EXT 5.3L-G6 (Gloss) | MPI 101 | N/A | MPI 72 | 5 mils |
| Topcoat: Coating to match adjacent surfaces. | | | | |

(2) Galvanized surfaces with slight coating deterioration; little or no rusting

| Waterborne Light Industrial Coating |
|---|

| Galvanized Surfaces with slight coating deterioration | Primer | Intermediate | Topcoat | System DFT |
|---|---|---|---|---|
| MPI REX 5.3J-G5 (Semigloss) | MPI 134 | N/A | MPI 163 | 4.5 mils |
| Topcoat: Coating to match adjacent surfaces. | | | | |

| Pigmented Polyurethane | | | | |
|---|---|---|---|---|
| Galvanized Surfaces with slight coating deterioration | Primer | Intermediate | Topcoat | System DFT |
| MPI REX 5.3D-G6 (Gloss) | MPI 101 | N/A | MPI 72 | 5 mils |
| Topcoat: Coating to match adjacent surfaces. | | | | |

(3) Galvanized surfaces with severely deteriorated coating or rusting

| Waterborne Light Industrial Coating | | | | |
|---|---|---|---|---|
| Galvanized surfaces with severely deteriorated coating or rusting | Primer | Intermediate | Topcoat | System DFT |
| MPI REX 5.3L-G5(Semigloss) | MPI 101 | MPI 108 | MPI 163 | 8.5 mils |
| MPI REX 5.3L-G6(Gloss) | MPI 101 | MPI 108 | MPI 164 | 8.5 mils |
| Topcoat: Coating to match adjacent surfaces. | | | | |

| Pigmented Polyurethane | | | | |
|---|---|---|---|---|
| Galvanized surfaces with severely deteriorated coating or rusting | Primer | Intermediate | Topcoat | System DFT |

| | | | | |
|---|---|---|---|---|
| MPI REX 5.3D-G6(Gloss) | MPI 101 | MPI 72 | MPI 72 | 5 mils |
| Topcoat: Coating to match adjacent surfaces. | | | | |

C. Exterior Surfaces, Other Metals (Non-Ferrous)

(1) Aluminum, aluminum alloy and other miscellaneous non-ferrous metal items not otherwise specified except hot metal surfaces, roof surfaces, and new prefinished equipment

| Alkyd | | | | |
|---|---|---|---|---|
| New Galvanized Surfaces | Primer | Intermediate | Topcoat | System DFT |
| MPI EXT 5.4F-G1 (Flat | MPI 95 | MPI 8 | MPI 8 | 5 mils |
| MPI EXT 5.4F-G5 (Semigloss) | MPI 95 | MPI 94 | MPI 94 | 5 mils |
| MPI EXT 5.4F-G6 (Gloss) | MPI 95 | MPI 9 | MPI 9 | 5 mils |
| Topcoat: Coating to match adjacent surfaces. | | | | |

| Waterborne Light Industrial Coating | | | | |
|---|---|---|---|---|
| New Galvanized Surfaces | Primer | Intermediate | Topcoat | System DFT |
| MPI EXT 5.4F-G1 (Flat | MPI 95 | MPI 161 | MPI 161 | 5 mils |
| MPI EXT 5.4F-G5 (Semigloss) | MPI 95 | MPI 163 | MPI 163 | 5 mils |
| MPI EXT 5.4F-G6 (Gloss) | MPI 95 | MPI 164 | MPI 164 | 5 mils |
| Topcoat: Coating to match adjacent surfaces. | | | | |

D. Exterior Hot Surfaces

(1) Hot metal surfaces subject to temperatures up to 400 degrees F

| Heat Resistant Enamel | | | | |
|---|---|---|---|---|
| New | N/A | Intermediate | Topcoat | System DFT |
| MPI EXT 5.2A | MPI 21 | N/A | N/A | Per Manufacturer |
| Surface preparation and number of coats per manufacturer's instructions. | | | | |

(2) Ferrous metal subject to high temperature, up to 750 degrees F

| Inorganic Zinc Rich Coating | | | | |
|---|---|---|---|---|
| New | N/A | Intermediate | Topcoat | System DFT |
| MPI EXT 5.2C | MPI 19 | N/A | N/A | Per Manufacturer |
| Surface preparation and number of coats per manufacturer's instructions. | | | | |

| Heat Resistant Aluminum Enamel | | | | |
|---|---|---|---|---|
| New | N/A | Intermediate | Topcoat | System DFT |
| MPI EXT 5.2B | MPI 2 | N/A | N/A | Per Manufacturer |
| Surface preparation and number of coats per manufacturer's instructions. | | | | |

(3) New surfaces made bare subject to temperatures up to 1100 degrees F

(1) New surfaces made bare cleaning to SSPC SP 10/NACE No. 2 subject to temperatures up to 1100 degrees F

| Heat Resistant Coating | | | | | |
|---|---|---|---|---|---|
| New | Existing | N/A | Intermediate | Topcoat | System DFT |
| MPI EXT 5.2D | MPI REX 5.2D | MPI 22 | N/A | N/A | Per Manufacturer |
| Surface preparation and number of coats per manufacturer's instructions. | | | | | |

3.13.1.4 MPI Division 6: Exterior Wood; Dressed Lumber, Paneling, Decking, Shingles Paint Table

A. New Dressed lumber, Wood and plywood, including top, bottom and edges of doors not otherwise specified

| Alkyd | | | | | |
|---|---|---|---|---|---|
| New | Existing, uncoated | Primer | Intermediate | Topcoat | System DFT |
| MPI EXT 6.3B-G5 (Semigloss) | MPI EXT 6.3B-G5 (Semigloss) | MPI 5 | MPI 94 | MPI 94 | 5 mils |
| MPI EXT 6.3B-G6 (Gloss) | MPI EXT 6.3B-G6 (Gloss) | MPI 5 | MPI 9 | MPI 9 | 5 mils |
| Topcoat: Coating to match adjacent surfaces. | | | | | |

| Latex | | | | | |
|---|---|---|---|---|---|
| New | Existing, uncoated | Primer | Intermediate | Topcoat | System DFT |
| MPI EXT 6.3A-G1 (Flat) | MPI EXT 6.3A-G1 (Flat) | MPI 5 | MPI 10 | MPI 10 | 5 mils |
| MPI EXT 6.3A-G5 (Semigloss) | MPI EXT 6.3B-G5 (Semigloss) | MPI 5 | MPI 11 | MPI 11 | 5 mils |
| MPI EXT 6.3A-G6 (Gloss) | MPI EXT 6.3B-G6 (Gloss) | MPI 5 | MPI 119 | MPI 119 | 5 mils |
| Topcoat: Coating to match adjacent surfaces. | | | | | |

| Waterborne Solid Color Stain | | | | | |
|---|---|---|---|---|---|
| New | Existing, uncoated | Primer | Intermediate | Topcoat | System DFT |
| MPI EXT 6.3K | MPI EXT 6.3K | MPI 5 | MPI 16 | MPI 16 | 4.25 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

| Institutional Low Odor / Low VOC Latex | | | | | |
|---|---|---|---|---|---|
| New, uncoated Existing | Existing, previously painted | Primer | Intermediate | Topcoat | System DFT |
| | | | | | |
| MPI INT 3.1M-G3 (Eggshell) | MPI RIN 3.1L-G3 (Eggshell) | MPI 149 | MPI 145 | MPI 145 | 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.<br>Surface preparation, number of coats, and primer in accordance with manufacturer's instructions.<br>Topcoat: Coating to match adjacent surfaces. | | | | |

C. New Concrete in 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 |
| | | | | | |
| | | | | | |
| Topcoat: Coating to match adjacent surfaces. | | | | | |

3.13.2.2 MPI Division 4: Interior Concrete Masonry Units Paint Table

A. New Concrete Masonry

| Institutional Low Odor / Low VOC Latex | | | | | |
|---|---|---|---|---|---|
| New, uncoated Existing | Filler | Primer | Intermediate | Topcoat | System DFT |
| | | | | | |

| | | | | | |
|---|---|---|---|---|---|
| MPI INT 4.2E-G3 (Eggshell) | MPI 4 | N/A | MPI 145 | MPI 145 | 4 mils |
| | | | | | |
| | | | | | |
| Fill all holes in masonry surface | | | | | |

C. New Concrete masonry units in high humidity areas 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), and miscellaneous metal items not otherwise specified except floors, hot metal surfaces, and new prefinished equipment

| High Performance Architectural Latex | | | | |
|---|---|---|---|---|
| New, uncoated Existing | Primer | Intermediate | Topcoat | System DFT |
| | | | | |
| MPI INT 5.1R-G3 (Eggshell) | MPI 76 | MPI 139 | MPI 139 | 5 mils |

| | | | | |
|---|---|---|---|---|
| | | | | |
| Topcoat: Coating to match adjacent surfaces. | | | | |

(2) Metal in 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 |
| | | | | |
| | | | | |
| Topcoat: Coating to match adjacent surfaces. | | | | |

(3) Miscellaneous non-ferrous metal items not otherwise specified except floors, hot metal surfaces, and new prefinished equipment. Match surrounding finish

| High Performance Architectural Latex | | | | |
|---|---|---|---|---|
| New, uncoated Existing | Primer | Intermediate | Topcoat | System DFT |
| | | | | |
| MPI INT 5.4F-G3 (Eggshell) | MPI 95 | MPI 139 | MPI 139 | 5 mils |
| | | | | |
| | | | | |
| Topcoat: Coating to match adjacent surfaces. | | | | |

B. Hot Surfaces

(1) Hot metal surfaces subject to temperatures up to 400 degrees F

| Heat Resistant Enamel | | | | |
|---|---|---|---|---|
| New | N/A | Intermediate | Topcoat | System DFT |
| MPI INT 5.2A | MPI 21 | N/A | N/A | Per Manufacturer |
| Surface preparation and number of coats per manufacturer's instructions. | | | | |

(2) Ferrous metal subject to high temperature, up to 750 degrees F

| Heat Resistant Aluminum Enamel | | | | |
|---|---|---|---|---|
| New | N/A | Intermediate | Topcoat | System DFT |
| MPI INT 5.2B (Aluminum Finish) | MPI 2 | N/A | N/A | Per Manufacturer |
| Surface preparation and number of coats per manufacturer's instructions. | | | | |

(3) New and Existing Surfaces made bare subject to temperatures up to 1100 degrees F

(1) New surfaces made bare cleaning to SSPC SP 10/NACE No. 2 subject to temperatures up to 1100 degrees F:

| Heat Resistant Coating | | | | | |
|---|---|---|---|---|---|
| New | Existing | N/A | Intermediate | Topcoat | System DFT |
| MPI INT 5.2D | MPI RIN 5.2D | MPI 22 | N/A | N/A | Per Manufacturer |
| Surface preparation and number of coats per manufacturer's instructions. | | | | | |

3.13.2.4 MPI Division 6: Interior Wood Paint Table

A. Interior Wood and Plywood

(1) New Wood and plywood not otherwise specified

| Institutional Low Odor / Low VOC Latex | | | | |
|---|---|---|---|---|
| New, uncoated Existing | Primer | Intermediate | Topcoat | System DFT |
| | | | | |

| | | | | |
|---|---|---|---|---|
| | | | | |
| | | | | |
| MPI INT 6.3V-G5 (Semigloss) | MPI 39 | MPI 147 | MPI 147 | 4 mils |

B. Interior New Wood and Plywood, except floors; natural finish or stained

| Stained, Moisture Cured Urethane | | | | | | |
|---|---|---|---|---|---|---|
| New | Existing | Stain | Primer | Intermediate | Topcoat | System DFT |
| | | | | | | |
| MPI INT 6.4V-G6 (Gloss) | MPI RIN 6.4V-G6 (Gloss) | MPI 90 | MPI 31 | MPI 31 | MPI 31 | 4 mils |

G. Interior New Wood Doors; Natural Finish or Stained

| Stained, Moisture Cured Urethane | | | | | | |
|---|---|---|---|---|---|---|
| New | Existing, previously finished or stained | Stain | Primer | Intermediate | Topcoat | System DFT |
| | | | | | | |
| MPI INT 6.4V-G6 (Gloss) | MPI RIN 6.4V-G6 (Gloss) | MPI 90 | MPI 31 | MPI 31 | MPI 31 | 4 mils |
| Note: Sand between all coats per manufacturers recommendations. | | | | | | |

3.13.2.5 MPI Division 9: Interior Gypsum Board, Textured Surfaces Paint Table

A. Interior New Wallboard not otherwise specified

Institutional Low Odor / Low VOC Latex, New

| Institutional Low Odor / Low VOC Latex | | | | |
|---|---|---|---|---|
| New | Primer | Intermediate | Topcoat | System DFT |

| | | | | |
|---|---|---|---|---|
| | | | | |
| MPI INT 9.2M-G3 (Eggshell) | MPI 149 | MPI 145 | MPI 145 | 4 mils |
| | | | | |
| | | | | |
| Topcoat: Coating to match adjacent surfaces. | | | | |

B. Interior New Wallboard in restrooms,and other high humidity areas not otherwise specified

Epoxy, New, uncoated Existing

| Epoxy | | | | |
|---|---|---|---|---|
| New, uncoated Existing | Primer | Intermediate | Topcoat | System DFT |
| MPI INT 9.2E-G6 (Gloss) | MPI 50 | MPI 77 | MPI 77 | 4 mils |
| Topcoat: Coating to match adjacent surfaces. | | | | |

-- End of Section --

SECTION 10 11 00

VISUAL DISPLAY UNITS
**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 Z97.1 | (2015) Safety Glazing Materials Used in Buildings - Safety Performance Specifications and Methods of Test |

ASTM INTERNATIONAL (ASTM)

| | |
|---|---|
| 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 |

CALIFORNIA DEPARTMENT OF PUBLIC HEALTH (CDPH)

| | |
|---|---|
| CDPH SECTION 01350 | (2017; Version 1.2) 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 |

UNDERWRITERS LABORATORIES (UL)

| | |
|---|---|
| UL 2818 | (2022) GREENGUARD Certification Program For Chemical Emissions For Building Materials, Finishes And Furnishings |

1.2 DEFINITIONS

The term visual display unit when used herein includes presentation boards, markerboards, tackboards, board cases, display track systems, horizontal sliding units, copyboards, interactive whiteboards, and projection screens; submit manufacturer's descriptive data and catalog cuts plus manufacturer's installation instructions, and cleaning and maintenance instructions. Provide visual display units from manufacturer's standard product line. Submit certificate of compliance signed by Contractor attesting that visual display units conform to the requirements specified.

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

Placement Schedule; G

SD-03 Product Data

Visual Display Unit; G

SD-04 Samples

Aluminum; G

Glass; G

SD-07 Certificates

Indoor air quality for markerboards; S

Certificate of Compliance

SD-08 Manufacturer's Instructions

Manufacturer's Cleaning Instructions

Manufacturer's Printed Installation Instructions

SD-10 Operation and Maintenance Data

Visual Display Units, Data Package 1; G

1.4 CERTIFICATIONS

1.4.1 Indoor Air Quality

1.4.1.1 Indoor Air Quality for Visual Display Products

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 DELIVERY, STORAGE, AND HANDLING

Deliver materials to the building site in the manufacturer's original unopened containers and store them in a clean dry area with temperature maintained above 50 degrees F. Stack materials according to manufacturer's recommendations. Allow visual display units to acclimate

to the building temperature for 24 hours prior to installation.

1.6 WARRANTY

Provide manufacturer's warranty to repair or replace defective materials and workmanship for period of one year from date of final acceptance of the work.

PART 2 PRODUCTS

2.1 MATERIALS

For each type, submit a section of core material and backing showing the lamination of porcelain enamel coating on steel, colored cork, natural cork, woven fabric, non-woven fabric, as applicable. Submit a sample of hardwood, plastic laminate finish, or glass type, as applicable. Provide minimum 4 by 4 inch samples, or larger, showing range of color.

Submit manufacturers' descriptive product data for each type of visual display unit indicated. Include manufacturers' literature, finishes, profiles and thicknesses of materials.

Submit manufacturers' operations and maintenance data for each type of visual display unit in accordance with Section 01 78 23 OPERATIONS AND MAINTENANCE DATA.

2.1.1 Aluminum

Provide a minimum 0.06 inch thick, 6063-T5 or 6063-T6 aluminum alloy frame extrusion conforming to ASTM B221. Exposed aluminum must have anodized, satin finish. Use straight, single lengths wherever possible and keep joints to a minimum. Provide mitered corners with a hairline closure. Submit sections of frame, and marker rail.

2.1.2 Glass

Provide tempered glass in accordance with ANSI Z97.1 and ASTM C1048, Kind FT (fully tempered), Condition A (uncoated), Type I, Class I (clear), thickness as specified.

2.1.2.1 Magnetic Glass

Provide magnetic glass markerboard writing surface composed of tempered, low-iron, extra clear, safety writing glass with polished edges and steel backing permanently adhered to the back of the glass.

2.2 MARKERBOARD

2.2.1 Glass Markerboards

Provide markerboard with a smooth finish, magnetic glass writing surface units to be comprised of one piece, without joints whenever possible. When markerboard dimensions require delivery in separate sections, components must be prefit at the factory, disassembled for delivery and jointed at the site. Extend marker rail the full length of the markerboard.. The markerboard does not include a map rail. Dry erase markings must be removable with a felt eraser or dry erase cloth without ghosting. Supply each unit with an eraser and four different color compatible dry erase markers. Provide magnetic glass markerboard with 10

rare earth magnets. Provide markerboards that meet the 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 markerboards.

## 2.3 COLOR

Provide finish colors for required items as indicated in the FF&E package; colors listed are not intended to limit the selection of equal colors from other manufacturers.

# PART 3 EXECUTION

## 3.1 PLACEMENT SCHEDULE

Location, size and mounting height of visual display units as shown on the drawings.
Mounting height is defined as distance from finished floor to top of the visual display unit frame.

## 3.2 INSTALLATION

Do not install items that show visual evidence of biological growth. Perform installation and assembly in accordance with manufacturer's printed installation instructions. Use concealed fasteners. Attach visual display units to the walls with suitable devices to anchor each unit. Furnish and install trim items, accessories and miscellaneous items in total, including but not limited to hardware, grounds, clips, backing materials, adhesives, brackets, and anchorages incidental to or necessary for a sound, secure, complete and finished installation. Do not initiate installation until completion of room painting and finishing operations. Install visual display units in locations and at mounting heights indicated. Install visual display units level and plumb, and if applicable align doors and adjust hardware. Repair or replace damaged units as directed by the Contracting Officer.

## 3.3 CLEANING

Clean writing surfaces in accordance with manufacturer's cleaning instructions.

-- End of Section --

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.

ALUMINUM ASSOCIATION (AA)

| | |
|---|---|
| AA DAF45 | (2003; Reaffirmed 2009) Designation System for Aluminum Finishes |

AMERICAN WELDING SOCIETY (AWS)

| | |
|---|---|
| AWS C1.1M/C1.1 | (2019) Recommended Practices for Resistance Welding |
| AWS D1.1/D1.1M | (2020; Errata 1 2021) Structural Welding Code - Steel |
| AWS D1.2/D1.2M | (2014; Errata 1 2014; Errata 2 2020) Structural Welding Code - Aluminum |

ASTM INTERNATIONAL (ASTM)

| | |
|---|---|
| ASTM A36/A36M | (2019) Standard Specification for Carbon Structural Steel |
| ASTM A123/A123M | (2024) Standard Specification for Zinc (Hot-Dip Galvanized) Coatings on Iron and Steel Products |
| ASTM A653/A653M | (2023) Standard Specification for Steel Sheet, Zinc-Coated (Galvanized) or Zinc-Iron Alloy-Coated (Galvannealed) by the Hot-Dip Process |
| ASTM A924/A924M | (2022a) Standard Specification for General Requirements for Steel Sheet, Metallic-Coated by the Hot-Dip Process |
| ASTM A1011/A1011M | (2023) Standard Specification for Steel Sheet and Strip, Hot-Rolled, Carbon, Structural, High-Strength Low-Alloy, High-Strength Low-Alloy with Improved Formability, and Ultra-High Strength |
| ASTM B26/B26M | (2018; E 2018) Standard Specification for Aluminum-Alloy Sand Castings |
| ASTM B108/B108M | (2019) Standard Specification for Aluminum-Alloy Permanent Mold Castings |

| | |
|---|---|
| ASTM B209 | (2014) Standard Specification for Aluminum and Aluminum-Alloy Sheet and Plate |
| ASTM B221 | (2021) Standard Specification for Aluminum and Aluminum-Alloy Extruded Bars, Rods, Wire, Profiles, and Tubes |

## 1.2 GENERAL REQUIREMENTS

All exterior signage must be provided by a single manufacturer. Exterior signage must be of the design, detail, sizes, types, and message content shown on the drawings, must conform to the requirements specified, and must be provided at the locations indicated. Submit exterior signage schedule in electronic media with spread sheet format. Spread sheet must include sign location, sign type, and message. Signs must be complete with lettering, framing as detailed, and related components for a complete installation. Each sample must consist of a complete sign panel with letters and symbols. Samples may be installed in the work, provided each sample is identified and location recorded. Submit three color samples for each material requiring color and 12 inch square sample of sign face color sample.

### 1.2.1 Wind Load Requirements

Exterior signage must be designed to withstand 100 to 125 mph windload when installed in accordance with manufacturer installation instructions. 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, AE

SD-03 Product Data

Modular Exterior Signage System; G, AE

Installation

Exterior Signage; G

Wind Load Requirements

SD-04 Samples

Exterior Signage; G, AE

SD-10 Operation and Maintenance Data

Protection and Cleaning; G

1.4 QUALIFICATIONS

Signs 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.

1.7 EXTRA STOCK

Provide extra interchangeable message panels and extra stock of the following: message bars of each color and size for each color and sign types,, changeable message strips for sign type.

PART 2 PRODUCTS

2.1 MODULAR EXTERIOR SIGNAGE SYSTEM

Exterior signage must consist of a system of coordinated identification, and regulatory type signs located where shown on the drawings. Dimensions, details, materials, message content, and design of signage must be as shown. Submit manufacturer's descriptive data and catalog cuts.

2.1.1 Panel Type Signs

2.1.1.1 Panels

Modular message panels for exterior Room Identification and No Smoking sign panels must be provided in sizes shown on the signage drawings. Panels must be fabricated a minimum of 0.100 inch aluminum panel, with a painted finish in color as indicated on the material finish legend drawing; with exterior grade direct print non-raised copy/graphics. Use of exposed fasteners prohibited. Vertical edge profile to be square.

## 2.2 GRAPHICS FOR EXTERIOR SIGNAGE SYSTEMS

### 2.2.1 Graphics

Signage graphics must conform to the following:

a. Exterior Room Sign and No Smoking graphics to be exterior grade direct print non-raised copy/graphics 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 signage schedule for message content. Typeface and Type size: as indicated on drawings.

## 2.3 ALUMINUM ALLOY PRODUCTS

Aluminum alloy products must conform to ASTM B209 for sheet or plate, ASTM B221 for extrusions and ASTM B26/B26M or ASTM B108/B108M for castings. Aluminum extrusions must be provided at least 1/8 inch thick and aluminum plate or sheet at least 16 gauge thick. Welding for aluminum products must conform to AWS C1.1M/C1.1.

## 2.4 ANODIC COATING

Anodized finish must conform to AA DAF45 as follows:

Clear (natural) designation AA-M10-C22-A31, Architectural Class II 0.4 mil or thicker.

Integrated color anodized designation AA-M10-C22-A32, Architectural Class 0.4 to 0.7 mil.

Electrolytically deposited color - anodized designation AA-M10-C22-A34, Architectural Class II 0.4 to 0.7 mil.

## 2.5 STEEL PRODUCTS

Structural steel products must conform to ASTM A36/A36M. Sheet and strip steel products must conform to ASTM A1011/A1011M. Welding for steel products must conform to AWS D1.2/D1.2M.

## 2.6 ANCHORS AND FASTENERS

Exposed anchor and fastener materials must be compatible with metal to which applied and must match in color and finish and must be non-rusting, non-corroding, and non-staining. Exposed fasteners must be tamper-proof.

## 2.7 SHOP FABRICATION AND MANUFACTURE

### 2.7.1 Factory Workmanship

Work must be assembled in the shop, as far as practical, ready for installation at the site. Work that cannot be shop assembled must be given a trial fit in the shop to ensure proper field assembly. Holes for bolts and screws must be drilled or punched. Drilling and punching must

produce clean, true lines and surfaces. Welding to or on structural steel must be in accordance with AWS D1.1/D1.1M. Welding must be continuous along the entire area of contact. Exposed welds must be ground smooth. Exposed surfaces of work must have a smooth finish and exposed riveting must be flush. Fastenings must be concealed where practical. Items specified to be galvanized must be by hot-dip process after fabrication if practical. Galvanization must be in accordance with ASTM A123/A123M and ASTM A653/A653M, as applicable. Other metallic coatings of steel sheet must be in accordance with ASTM A924/A924M. Joints exposed to the weather must be formed to exclude water. Drainage and weep holes must be included as required to prevent condensation buildup.

### 2.7.2 Dissimilar Materials

Where dissimilar metals are in contact, or where aluminum is in contact with concrete, mortar, masonry, wet or pressure-treated wood, or absorptive materials subject to wetting, the surfaces must be protected with a coat of asphalt varnish or a coat of zinc-molybdate primer to prevent galvanic or corrosive action.

### 2.7.3 Shop Painting

Surfaces of miscellaneous metal work, except nonferrous metal, corrosion resisting steel, and zinc-coated work, must be given one coat of zinc-molybdate primer or an approved rust-resisting treatment and metallic primer in accordance with manufacturer's standard practice. Surfaces of items to be embedded in concrete must not be painted. Upon completion of work, damaged surfaces must be recoated.

## 2.8 COLOR, FINISH, AND CONTRAST

Color must be as indicated on the drawings.. Color listed is not intended to limit the selection of equal colors from other manufacturers. For buildings required to be handicapped-accessible, the characters and background of signs must be eggshell, matte, or other non-glare finish. Characters and symbols must contrast with their background - either light characters on a dark background or dark characters on a light background.

# PART 3 EXECUTION

## 3.1 INSTALLATION

Signs, plaques, or dimensional letters must be installed in accordance with approved manufacturer's instructions at locations shown on the approved detail drawings; submit drawings showing elevations of each type of sign; dimensions, details, and methods of mounting or anchoring; shape and thickness of materials; and details of construction. A schedule showing the location, each sign type, and message must be included. 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 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 DAF45 | (2003; Reaffirmed 2009) Designation System for Aluminum Finishes |
| 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 D635 | (2018) Standard Test Method for Rate of Burning and/or Extent and Time of Burning of Plastics in a Horizontal Position |

INTERNATIONAL CODE COUNCIL (ICC)

| | |
|---|---|
| ICC/ANSI A117.1 | (2009) Accessible and Usable Buildings and Facilities |

NATIONAL FIRE PROTECTION ASSOCIATION (NFPA)

| | |
|---|---|
| NFPA 101 | (2021; TIA 21-1) Life Safety Code |

NATIONAL INSTITUTE OF STANDARDS AND TECHNOLOGY (NIST)

| | |
|---|---|
| NIST SP 800-82 | (2015; Rev 2) Guide to Industrial Control Systems (ICS) Security |

U.S. DEPARTMENT OF DEFENSE (DOD)

| | |
|---|---|
| DOD 8510.01 | (2022) Risk Management Framework (RMF) for DoD Systems |
| DODI 8500.01 | (2014) Cybersecurity |
| UFC 4-010-06 | (2016; with Change 1, 2017) Cybersecurity of Facility-Related Control Systems |

U.S. NATIONAL ARCHIVES AND RECORDS ADMINISTRATION (NARA)

| | |
|---|---|
| 36 CFR 1191 | Americans with Disabilities Act (ADA) Accessibility Guidelines for Buildings and Facilities; Architectural Barriers Act (ABA) Accessibility Guidelines |

## 1.2 SUBMITTALS

Government approval is required for submittals with a "G" or "S" classification. Submittals not having a "G" or "S" classification are for 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 And Directional Signage System; G

Exit Door Tactile Sign; G

Door Tags; G

SD-04 Samples

Interior Signage; G

Software; G

Room Identification And Directional Signage System; G

Exit Door Tactile Sign; G

SD-10 Operation and Maintenance Data

Approved Manufacturer's Instructions; G

Protection and Cleaning; G

1.3 EXTRA MATERIALS

Provide extra frames and extra stock of the following: blank plates of each color and size for all sign types included in project, changeable message strips. Provide paper inserts and laser print templates to support end-user printing copy, one copy of the software for user produced signs and inserts after project completion, and equipment necessary for removal of signage parts and pieces.

1.4 QUALITY ASSURANCE

1.4.1 Samples

Submit interior signage samples of each of the following sign types showing typical quality, workmanship and color: all sign types included in project. Approved samples may be installed in the work, provided each sample is identified and location recorded.

1.4.2 Detail Drawings

Submit detail drawings showing elevations of each type of sign, dimensions, details and methods of mounting or anchoring, mounting height, shape and thickness of materials, and details of construction. Include a schedule showing the location, each sign type, and message.

1.4.3 Sign Fabricator

Sign Fabricator to follow room number strategies created by designer. The room numbering system to be reviewed and approved by the Contracting Officer and command end users during the shop drawing phase, and prior to fabrication.

1.4.4 Cybersecurity

a. The Risk Management Framework (RMF) is the process by which information systems are accredited for operation by a designated official from the Using Military Department. It is the standard process under which all DoD information systems achieve and maintain their Authority To Operate. The cybersecurity process is documented in DOD 8510.01 and NIST SP 800-82. Refer to UFC 4-010-06 and DODI 8500.01 for additional requirements.

b. All systems that are IP addressable or interface with the Assured Network required certification to operate. Coordinate with the Government to initiate and complete the accreditation process.

c. Cybersecurity requires input from the system vendor or provider and support from the local IMD. The local IMD-IA office is the point of contact for all Cyber Security requirements. The local CMIO is the point of contact for all clinical and functional system requirements.

1.5 DELIVERY, STORAGE, AND HANDLING

Package materials to prevent damage and deterioration during shipment, handling, storage and installation. Deliver products to the jobsite in

manufacturer's original packaging and store in a clean, dry area in accordance with manufacturer's instructions.

## 1.6 WARRANTY

Provide manufacturer's warranty to repair or replace defective interior signage materials and workmanship for a period of 2 years from date of final acceptance of the work.

# PART 2 PRODUCTS

## 2.1 ROOM IDENTIFICATION AND DIRECTIONAL SIGNAGE SYSTEM

Provide signs that are standard products of manufacturers regularly engaged in the manufacture of such products that essentially duplicate signs that have been in satisfactory use at least 2 years prior to bid opening. Obtain signage from a single manufacturer with edges and corners of finished letter forms and graphics true and clean.

### 2.1.1 Panel Sign Systems

Provide direct print acrylic with applied tactile graphics, sign is fabricated of 0.375 inch acrylic in two layers with smooth edge conforming to ANSI Z97.1. Provide signs that can accept images, raised copy and Braille with printable message inserts. Provide paper or acetate inserts with a 0.080 inch thick non glare acrylic window to allow sign to be updated.

### 2.1.2 Modular Sign Systems

Provide manufactured pre-engineered component-based sign system, consisting of a combination of aluminum extrusions, acrylic panels, and injection molded parts, pre-engineered and designed to create an updatable sign system that allows for easy and inexpensive updates and changes. Provide system with incremental widths and heights that permit the assembly of multiple inserts of variable size to create a single sign. Provide a tamper-resistant sign which requires a special tool to change inserts composed of rigid acrylic for applied graphics. Sign inserts are required to be front or side loading.

### 2.1.3 Standard Room Signs

Provide signs that include tactile letters, symbols and Braille for interior rooms or spaces where the sign is not likely to change over time. Tactile text descriptions are required for pictograms that are provided to identify a permanent room. Examples include interior signs that label restrooms, stairs, room numbers or letters, and room names. These permanent room signs can include paper inserts for updatable information.

#### 2.1.3.1 Tactile Letters, Symbols and Braille

Provide ADA compliant material per 36 CFR 1191 which is raised 1/32 inch from the first surface, has a minimum 5/8 inch in height and is an ADA acceptable font. The color of the tactile letters is required to contrast with the sign face color per ADA standards. The ADA required Braille has a minimum durometer reading of 90. All raised letters, numbers and symbols are to comply.

### 2.1.4 Directional Signs

Directional signs provide arrows with messages which point to critical destinations such as departments, offices, or other pertinent destinations. These can be a panel sign system with a series of permanently attached messages or a modular system with updatable inserts. Directional signs have header panels with applied or direct print messages.

### 2.1.5 Message Inserts

Provide updatable message inserts covered with a clear matte 0.015 inch vinyl protective overlay. The insert is typeset message laser printed on paper card stock. Provide paper and software with message template for creating text and symbols for computers identified for Government production of paper inserts after project completion. Manufacturer is required to offer online ordering capabilities to facilitate and expedite ordering packages of replacement, color-coated paper inserts. Furnish one suction device to assist in removing face sheet. Provide sliding inserts that slide horizontally exposing different graphic information as identified on the drawings.

### 2.1.6 Type of Mounting for Signs

Provide surface mounted signs mounted with concealed mechanical fastening through the holders. Secure inserts in holders with flexible plastic clips when captured by side profiles of extruded aluminum holders. Where signs occurs on RF-shielded walls, ONLY mount using double-faced tape consisting of acrylic adhesive on polyurethane foam used in conjunction with silicone adhesive. Provide signs with aluminum ceiling/projecting mount attachment extrusion to secure to ceiling or wall surface, along with matting ceiling/projecting mount track extrusion for hanging, projecting, and double-sided signs. Provide mounting for ceiling/projecting mount attachment extrusion by mechanical fasteners, selected based on wall or ceiling conditions. Mount track extrusion hinges over width of mount attachment and secured with 3.5 by 0.06 mm (6-32 inch) by 6 mm (1/4 inch) cone point stainless steel set screws.

### 2.1.7 Character Proportions and Heights

Letters and numbers on signs conform to 36 CFR 1191.

## 2.2 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.

## 2.3 DOOR TAGS

Provide one door tag plate for each room entry door.Provide room number as determined by Contracting Officer.

### 2.3.1 Engraved Copy

Machine engrave letters, numbers, symbols, and other graphics into panel sign on face to produce precisely formed copy and sharp images, incised to uniform depth. Melamine plastic engraving stock used for ADA compliant graphic is three-ply lamination contrasting color core meeting ASTM D635.

## 2.4 MATERIALS

### 2.4.1 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.

### 2.4.2 Anodic Coating

Anodized finish conforms to AA DAF45 as follows:

a. Clear (natural) designation AA-M10-C22-A31, Architectural Class II 0.4 mil or thicker.

b. Integral color anodized designation AA-M10-C22-A32, Architectural Class 0.4 to 0.7 mil.

c. Electrolytically deposited color-anodized designation AA-M10-C22-A34, Architectural Class II 0.4 to 0.7 mil.

### 2.4.3 Organic Coating

Organic coating conforms to AAMA 2604, with total dry film thickness not less than 1.2 mils.

### 2.4.4 Fabrication and Manufacture

#### 2.4.4.1 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.

#### 2.4.4.2 Dissimilar Materials

Where dissimilar metals are in contact, protect surfaces prevent galvanic or corrosive action.

### 2.4.5 Typeface

ADA-ABA compliant font for Room Signs, Helvetica NEUE 55 Roman.

## 2.5 GRAPHICS

Provide signage graphics for modular signs to the following:

### 2.5.1 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.

2.6 COLOR, FINISH, AND CONTRAST

Provide color as indicated on the room finish schedule and signage typical drawings; colors listed are not intended to limit the selection of equal colors from other manufacturers. Finish of eggshell, matte, or other non-glare finish for all signs as required in handicapped-accessible buildings.

PART 3 EXECUTION

3.1 PLACEMENT SCHEDULE

See Signage Plan drawings for locations.

3.2 INSTALLATION

Install signs plumb and true and in accordance with approved manufacturer's instructions at locations shown on the signage plan and schedule drawings. Submit operating instructions outlining the step-by-step procedures required for system operation. The instructions include simplified diagrams for the system as installed, the manufacturer's name, model number, service manual, parts list, and brief description of all equipment and their basic operating features. Provide each set permanently bound with a hard cover. The following identification must be inscribed on the covers: "OPERATING AND MAINTENANCE INSTRUCTIONS", name and location of the facility, name of the Contractor, and contract number. Submit in accordance with Section 01 78 23 OPERATING AND MAINTENANCE DATA. Mounting height and mounting location complies with 36 CFR 1191. Install required blocking. Do not install signs on doors or other surfaces until finishes on such surfaces have been installed. Signs installed on glass surfaces are installed with matching blank back-up plates in accordance with manufacturer's instructions.

Do not install items that show visual evidence of biological growth.

3.2.1 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.

3.2.2 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 10 21 13

TOILET COMPARTMENTS
**08/20**

PART 1 GENERAL

1.1 REFERENCES

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

ALUMINUM ASSOCIATION (AA)

| | |
|---|---|
| AA DAF45 | (2003; Reaffirmed 2009) Designation System for Aluminum Finishes |

ASTM INTERNATIONAL (ASTM)

| | |
|---|---|
| ASTM A123/A123M | (2024) 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 A336/A336M | (2021) Standard Specification for Alloy Steel Forgings for Pressure and High-Temperature Parts |
| ASTM A385/A385M | (2022) Standard Practice for Providing High-Quality Zinc Coatings (Hot-Dip) |
| ASTM B36/B36M | (2018) Standard Specification for Brass Plate, Sheet, Strip, and Rolled Bar |
| ASTM B86 | (2022) Standard Specification for Zinc and Zinc-Aluminum (ZA) Alloy Foundry and Die Castings |
| ASTM B221 | (2021) Standard Specification for Aluminum and Aluminum-Alloy Extruded Bars, Rods, Wire, Profiles, and Tubes |
| ASTM B456 | (2017; R 2022) Standard Specification for Electrodeposited Coatings of Copper Plus Nickel Plus Chromium and Nickel Plus Chromium |

CALIFORNIA DEPARTMENT OF PUBLIC HEALTH (CDPH)

| | |
|---|---|
| CDPH SECTION 01350 | (2017; Version 1.2) Standard Method for the Testing and Evaluation of Volatile Organic Chemical Emissions from Indoor Sources using Environmental Chambers |

INTERNATIONAL CODE COUNCIL (ICC)

| | |
|---|---|
| ICC A117.1 | (2017) Standard And Commentary Accessible and Usable Buildings and Facilities |

SCIENTIFIC CERTIFICATION SYSTEMS (SCS)

| | |
|---|---|
| SCS | SCS Global Services (SCS) Indoor Advantage |

SOCIETY OF AUTOMOTIVE ENGINEERS INTERNATIONAL (SAE)

| | |
|---|---|
| SAE AMS2460 | (2023; Rev B) Plating, Chromium |

U.S. GENERAL SERVICES ADMINISTRATION (GSA)

| | |
|---|---|
| CID A-A-60003 | (Basic; Notice 1) 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 |

UNDERWRITERS LABORATORIES (UL)

| | |
|---|---|
| UL 2818 | (2022) 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

Fabrication Drawings

Installation Drawings; G

SD-03 Product Data

Cleaning and Maintenance Instructions

Colors And Finishes

Anchoring Devices and Fasteners

Hardware and Fittings

Brackets

Door Hardware

Toilet Enclosures

Pilaster Shoes

Finishes; G

Recycled content for solid phenolic partitions and screens; S

SD-04 Samples

Colors and Finishes; G

Hardware and Fittings

Anchoring Devices and Fasteners

SD-07 Certificates

Warranty

Indoor air quality for solid phenolic, through-color partitions and screens; S

## 1.3 CERTIFICATIONS

### 1.3.1 Indoor Air Quality

#### 1.3.1.1 Solid Phenolic Products

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.

## 1.4 REGULATORY REQUIREMENTS

Comply with to ICC A117.1 code for access for the handicapped operation of toilet compartment door and hardware.

## 1.5 DELIVERY, STORAGE, AND HANDLING

Deliver materials in the manufacturer's original unopened packages with the brand, item identification, and project reference clearly marked. Store components in a dry location that is adequately ventilated; free from dust, water, other contaminants, and damage during delivery, storage, and construction.

## 1.6 WARRANTY

Provide manufacturer's warranty to repair or replace defective materials and workmanship for a period of 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, 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 Phenolic Core (Finish 4) (Finish 4A)

Provide solid phenolic panels of solid phenolic core of multiple layers of Kraft paper compressed under heat and pressure, impregnated with resins. Provide smooth material without creases or ripples, with a Flame Spread Index of 75 or less and a Smoke Developed Index of 450 or less. The surface laminate is fused to the resin-impregnated core.

2.2.2 Anchoring Devices and Fasteners

Provide steel anchoring devices and fasteners hot-dipped galvanized after fabrication, in conformance with ASTM A385/A385M and ASTM A123/A123M. Conceal all galvanized anchoring devices.

2.2.3 Brackets

Provide two-ear panel wall brackets, T-style, 1 inch stock. Provide stirrup style panel-to-pilaster brackets.

2.2.4 Hardware and Fittings

2.2.4.1 General Requirements

Provide hardware for the toilet partition system that complies with CID A-A-60003 for the specified type and style of partitions. Provide hardware finish highly resistant to alkalis, urine, and other common toilet room acids. Comply with 36 CFR 1191 of latching devices and hinges for handicap compartments; provide chrome-plated steel or stainless steel devices and hinges with door latches that operate without either tight grasping or twisting of the wrist of the operator. Submit three samples of each item, including anchoring devices and fasteners. Approved hardware samples may be installed in the work if properly identified.

| Material | Conformance Standard |
|---|---|
| Cold-rolled sheet steel | ASTM A336/A336M, commercial quality |
| Zinc-base alloy | ASTM B86, Alloy AC41-A |
| Brass | ASTM B36/B36M, Alloy C26800 |

| | |
|---|---|
| Aluminum | ASTM B221 |
| Corrosion-resistant steel | ASTM A167, Type 304 |

2.2.4.2 Finishes

a. Provide chrome plating that complies with ASTM B456.

b. Provide finish that complies with SAE AMS2460, Class I, Type I.

c. Provide aluminum with clear anodic coating that complies with AA DAF45.

d. Provide corrosion-resistant steel with a No. 4 finish.

e. Provide stainless steel with a No. 4 finish.

f. Provide exposed fasteners that match the hardware and fittings.

2.2.5 Door Hardware

2.2.5.1 Hinges

Provide adjustable hinges to hold in-swinging doors open at any angle up to 90 degrees and outswinging doors up to 10 degrees. Provide self-lubricating hinges with the indicated swing. Provide hinges that are surface-mounted type and have the following type of return movement:

a. Gravity return movement

2.2.5.2 Latch and Pull

Provide latch and pull that is a combination rubber-faced door strike and keeper equipped with emergency access. Provide surface mounted latch.

2.2.5.3 Coat Hooks

Provide coat hooks that are combination units with hooks and rubber tipped pins.

2.3 PARTITION PANELS AND DOORS

Fabricate partition panels, and pilasters of materials and construction listed:

Provide Phenolic partition panels not less than 1/2 inch thick and door and pilasters not less than 3/4 inch thick.
Provide solid phenolic toilet partitions and screens with recycled content of 10 percent minimum. Provide data identifying percentage of recycled content for solid phenolic partitions and screens.
Provide plastic laminate clad and solid phenolic, through-color toilet partitions and urinal screens to meet the 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 solid phenolic, through-color partitions and screens.

### 2.3.1 Toilet Enclosures

Provide toilet enclosures that comply with CID A-A-60003, Type I, Style A, floor supported, C, overhead braced. Furnish width, length, and height of toilet enclosures as shown. Finish surface of panels are solid phenolic, through-color (Finish 4), solid phenolic, color through the core (Finish 4A); water resistant; graffiti resistant; non-absorbent radius beveled edges. Reinforce panels indicated to receive toilet paper holders or grab bars for mounting of the items required, and provide cut outs for through partition toilet accessories. Provide grab bars to withstand a bending stress, shear stress, shear force, and a tensile force induced by 250 lbf. Grab bars cannot rotate within their fittings.

## 2.4 FLOOR-ANCHORED PARTITIONS

Provide pilasters in size indicated that are manufacturer's standard corrosion resistant anchoring assemblies complete with leveling adjustment nuts and pilasters for structural connection to floor. Provide anchoring device at the bottom of the pilaster consisting of a steel bar not less than 1/2 by 7/8 inch welded to the reinforced face sheets and having not less than two 3/8 inch round anchorage devices for securing to the floor slab. Provide anchorage devices complete with threaded rods, expansion shields, lock washers, and leveling-adjustment nuts. Provide shoes at pilasters to conceal anchorage.

## 2.5 OVERHEAD-BRACED PARTITIONS

Provide pilasters in sizes indicated that are manufacturer's standard corrosion-resistant supports, leveling mechanism, and anchors at pilasters to suit floor conditions. Provide shoes at pilasters to conceal supports and leveling mechanism. Provide anchoring device at the bottom of the pilaster consisting of a channel-shaped floor stirrup fabricated from not less than 0.0635 inch thick material and a leveling bolt. Secure the stirrup to the pilaster with not less than a 3/16 inch bolt and nut after the pilaster is leveled. Secure the stirrup to the floor with not less than two lead expansion shields and sheetmetal screws. Fabricate overhead brace from a continuous extruded aluminum tube not less than 1 inch wide by 1-1/2 inch high, 0.125 inch wall thickness. Finish is AA-C22A31 in accordance with AA DAF45. Set and secure brace into the top of each pilaster. Provide shoes at pilasters to conceal supports and leveling mechanism.

## 2.6 PILASTER SHOES

Provide shoes at pilasters to conceal floor-mounted anchorage. Provide stainless steel pilaster shoes. Height is a minimum 3 inches.

## 2.7 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; chrome plated aluminum door latch; door strike and keeper with rubber bumper; and cast alloy chrome plated coat hook and bumper. Provide latching devices and hinges for handicap compartments complying with 36 CFR 1191 and 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. Provide floor-mounted anchorage consisting of corrosion-resistant anchoring assemblies with threaded rods, lock washers, and leveling adjustment nuts at pilasters for structural connection to floor.

## 2.8 COLORS AND FINISHES

### 2.8.1 Colors

Provide color as indicated on the material finish schedule drawing; colors listed are not intended to limit the selection of equal colors from other manufacturers.

Submit three samples showing color and a finished edge on two adjacent sides and core construction, each not less than 12 inch square.

### 2.8.2 Finishes

#### 2.8.2.1 Finishes No. 4, No 4A

Provide manufacturer's standard through-color (Finish 4), color through the core (Finish 4A) formed under high pressure rendering a single component section not less than 1 inch thick. Colors extend throughout the panel thickness.

# PART 3 EXECUTION

## 3.1 PREPARATION

Take field measurements prior to the preparation of drawing and fabrication to ensure proper fits. Verify that field measurements, surfaces, substrates and conditions are as required, and ready to receive work. Verify correct spacing of plumbing fixtures. Verify correct location of built in framing, anchorage, and bracing. Report in writing to Contracting Officer prevailing conditions that adversely affect satisfactory execution of the work of this section. Do not proceed with work until unsatisfactory conditions have been corrected.

## 3.2 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.

b. Before application of an enamel coating system, solvent-clean galvanized-steel surfaces to remove processing compounds, oils, and other contaminants harmful to coating-system adhesion. After cleaning,coat the surfaces with a metal-pretreatment phosphate coating. After pretreatment, finish exposed galvanized-steel surfaces with a baked-enamel coating system as specified.

c. Provide an enamel coating system consisting of a factory-applied baked

acrylic enamel coating system. Provide a coating system that is a durable, washable, stain-resistant, and mar-resistant finish.

## 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 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 FLOOR-ANCHORED PARTITIONS

Secure pilasters to the floor with the anchorage device specified. Make all leveling devices readily accessible for leveling, plumbing, and tightening the installation. Level tops of doors with tops of pilasters when doors are in a closed position. Expansion shields have a minimum 2 inch penetration into the concrete slab.

## 3.5 OVERHEAD-BRACED PARTITIONS

Secure pilasters to the floor with the anchorage device specified. Make all leveling devices readily accessible for leveling, plumbing, and tightening the installation. Secure overhead brace to the pilaster face with not less than two fasteners per face. Expansion shields have a minimum 2 inch penetration into the concrete slab. Make tops of doors parallel with the overhead brace when doors are in a closed position.

## 3.6 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.

## 3.7 CLEANING

Touch up baked enamel and powder coat finish with the same color of paint that was used for the finish. Clean all surfaces and adjacent surfaces soiled as a result of the work, in an approved manner compliant with the manufacturer's recommended cleaning and protection from damage procedures until accepted. Remove all equipment, tools, surplus materials, and work debris from the site.

-- End of Section --

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SECTION 10 26 00

WALL AND DOOR PROTECTION
**08/20**

PART 1 GENERAL

1.1 REFERENCES

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

ALUMINUM ASSOCIATION (AA)

| | |
|---|---|
| AA DAF45 | (2003; Reaffirmed 2009) Designation System for Aluminum Finishes |

ASTM INTERNATIONAL (ASTM)

| | |
|---|---|
| ASTM A167 | (2011) Standard Specification for Stainless and Heat-Resisting Chromium-Nickel Steel Plate, Sheet, and Strip |
| ASTM B221 | (2021) Standard Specification for Aluminum and Aluminum-Alloy Extruded Bars, Rods, Wire, Profiles, and Tubes |
| ASTM 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 D5319 | (2017) Standard Specification for Glass-Fiber Reinforced Polyester Wall and Ceiling Panels |
| ASTM E84 | (2023) 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 | (2017; Version 1.2) Standard Method for the Testing and Evaluation of Volatile Organic Chemical Emissions from Indoor Sources using Environmental Chambers |

GREEN SEAL (GS)

GS-36 (2013) Adhesives for Commercial Use

SCIENTIFIC CERTIFICATION SYSTEMS (SCS)

SCS SCS Global Services (SCS) Indoor Advantage

SOCIETY OF AUTOMOTIVE ENGINEERS INTERNATIONAL (SAE)

SAE J1545 (2005; R 2021) Instrumental Color Difference Measurement for Exterior Finishes, Textiles and Colored Trim

SOUTH COAST AIR QUALITY MANAGEMENT DISTRICT (SCAQMD)

SCAQMD Rule 1168 (2017) Adhesive and Sealant Applications

UNDERWRITERS LABORATORIES (UL)

UL 2818 (2022) 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 or 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

Wall Covering and Panels; G

SD-03 Product Data

Corner Guards; G

Wall Covering and Panels; G

Recycled content for aluminum component of corner guards; S

Recycled content for steel component of corner guards; S

SD-04 Samples

Corner Guards; G

Wall Covering and Panels; G

SD-06 Test Reports

Fire Resistance Rating

SD-07 Certificates

Indoor air quality for wall covering/panels; S

Indoor air quality for adhesives; S

SD-10 Operation and Maintenance Data

Corner Guards, Data Package 1; G

Wall Covering and Panels, 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 products certified to meet indoor air quality requirements by UL 2818 (Greenguard) Gold, SCS Global Services Indoor Advantage Gold or provide certification or validation by other third-party program that products meet the requirements of this section. Provide current product certification documentation from certification body. When product does not have certification, provide validation that product meets the indoor air quality product requirements cited herein.

## 1.4 DELIVERY, STORAGE, AND HANDLING

Deliver materials to the project site in manufacturer's original unopened containers with seals unbroken and labels and trademarks intact. Keep materials dry, protected from weather and damage, and stored under cover. Store materials at approximately 70 degrees F for at least 48 hours prior to installation.

## 1.5 WARRANTY

Provide manufacturer's warranty to repair or replace defective materials and workmanship for a 1 year period of one year from date of final acceptance of the work.

# PART 2 PRODUCTS

## 2.1 STANDARD PRODUCTS

To the maximum extent possible, provide wall and door protection items that are standard products of a single manufacturer and furnished as detailed. Drawings show general configuration of products required, and items differing in minor details from those shown are acceptable.

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 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 indicated. 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.

### 2.2.2 Stainless Steel Corner Guards

Provide stainless steel base material that contains a minimum of 60 percent recycled content. Provide data identifying percentage of recycled content for steel component of corner guards. Fabricate stainless steel base material of 16 gauge thick material conforming to ASTM A167, type 430 or 304. Provide corner guards that extend 8' height as indicated on the drawings. Form corner guard to dimensions indicated.

## 2.3 WALL COVERING AND PANELS

Provide wall covering and panels consisting of high impact Fiberglass Reinforced thermosetting polyester resin (FRP) panel material complying with ASTM D5319 and high impact wall panels. Panel sizes are 4 by 8 feet. Provide wall covering material used on the interior of the building (defined as inside of the weatherproofing system) that meets either emissions requirements of CDPH SECTION 01350 (limit requirements for either office or classroom spaces regardless of space type) the VOC content requirements of SCAQMD Rule 1168, or VOC content requirements of GS-36. Provide certification of indoor air quality for wall covering/panels.

### 2.3.1 Fiberglass Reinforced Panel (FRP)

Provide 0.090 inch minimum thick wall covering. Provide smooth surface texture and apply sealant to assure watertight installation.

### 2.3.2 High Impact Wall Panels

Provide wall panel face and edge thickness that are 0.040 inch. Factory bond panel face to a 0.375 inch thick fiberboard core. Laminate the backside of the panel with a moisture resistant vapor barrier.

## 2.4 TRIM, FASTENERS AND ANCHORS

Provide aluminum, PVC free trim, fasteners and anchors for each specific installation as indicated.

## 2.5 FINISH

Submit samples indicating color and texture of materials requiring color and finish.

### 2.5.1 Aluminum Finish

Provide aluminum finish accordance with AA DAF45; exposed aluminum with designation AA-C22A31 chemically etched medium matte, with clear anodic coating. Provide Class II architectural coating that is 0.4 mil thick.

Provide concealed aluminum with mill finish as fabricated, uniform in natural color and free from surface blemishes.

2.5.2 Stainless Steel Finish

Provide stainless steel finish in accordance with ASTM A167, Type 302 or 304, finish number 4.

2.5.3 Resilient Material Finish

Provide resilient material finish of stipple texture with colors in accordance with SAE J1545.

2.6 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.

2.7 COLOR

Provide color as indicated on the material finish schedule drawing; colors listed are not intended to limit the selection of equal colors from other manufacturers.

PART 3 EXECUTION

3.1 INSTALLATION

a. Do not install items that show visual evidence of biological growth. Install items on surfaces that are clean, smooth, and free of obstructions.

b. Where wall panels, FRP, corner guards and other wall protection accessories occur at RF-shielded walls, the manufactured approved installation method should be adhesive only. If mechanical fastening is unavoidable due to manufacturer requirements, all fasteners must be concealed, approved materials for RF shielded walls, and fully covered with RF tape to ensure a constant boundary. Approval of installation method must be obtained prior to work.

3.1.1 Corner Guards

a. Mount guards on external corners of interior walls, partitions and columns and in accordance with manufacturer's written installation instructions.

3.1.1.1 Stainless Steel Guards

a. Mount guards on external corners of interior walls, partitions and columns and in accordance with manufacturer's recommendations.

b. Where corner guards are installed on walls, partitions or columns finished with plaster or ceramic tile, anchor corner guards as

indicated by the manufacturer's written instructions. Coat back surfaces of corner guards, where shown, with a non-flammable, sound deadening material. Overlap corner guards on finish plaster surfaces.

c. Where corner guards are installed on exposed masonry wall, partitions or columns, anchor corner guards as indicated by the manufacturer's written instructions. Grout spaces solid between guards and backing with portland cement and sand mortar.

d. Where corner guards are installed on gypsum board, clean surfaces and anchor guards with a neoprene solvent-type contact adhesive specifically manufactured for use on gypsum board construction. Remove excess adhesive from the guard edges and allow to cure undisturbed for 24 hours.

e. For wall guards, space brackets at no more than 3 feet on center and anchor to the wall in accordance with the manufacturer's installation instructions.

3.1.2 Wall Coverings and Panels

Install as indicated in accordance with manufacturer's written instructions.

-- End of Section --

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SECTION 10 28 13

TOILET ACCESSORIES
**08/20**

PART 1 GENERAL

1.1 REFERENCES

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

ASTM INTERNATIONAL (ASTM)

| | |
|---|---|
| ASTM C1036 | (2021) Standard Specification for Flat Glass |

U.S. DEPARTMENT OF DEFENSE (DOD)

| | |
|---|---|
| MIL-STD-1691 | (1994; Rev F) Construction and Material Schedule for Military Medical and Dental Facilities |

1.2 SUBMITTALS

Government approval is required for submittals with a "G" or "S" classification. Submittals not having a "G" or "S" classification are for 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

Recycled content for stainless steel toilet accessories; S

Finishes; G, AE

Accessory Items; G

Submit catalog numbers, literature, data sheets, construction details, profiles, anchoring and mounting requirements ,including

cutouts in other work and substrate preparation, and other pertinent data for each toilet accessory item to evaluate function, materials, dimensions and appearance.

SD-10 Operation and Maintenance Data

Accessory Items; G

Submit Data Package 1 for each toilet accessory item in accordance with Section 01 78 23 OPERATIONS AND MAINTENANCE DATA.

## 1.3 DELIVERY, STORAGE, AND HANDLING

Wrap toilet accessories for shipment and storage, then deliver to the jobsite in manufacturer's original packaging, and store in a clean, dry area protected from construction damage and vandalism.

## 1.4 WARRANTY

Provide manufacturer's warranty to repair or replace defective materials and workmanship for a period of one year from date of final acceptance of the work..

# PART 2 PRODUCTS

## 2.1 ACCESSORY ITEMS

Provide toilet accessories where indicated in accordance with Contractor-provided product schedule. Conform to the requirements for accessory items specified herein which are based on MIL-STD-1691 Joint Schedule Numbers (JSN). Provide each accessory item complete with the necessary mounting plates of sturdy construction with corrosion resistant surface.

Provide stainless steel products listed herein manufactured from materials containing a minimum of 50 percent recycled content. Provide data identifying percentage of recycled content for stainless steel toilet accessories.

### 2.1.1 Anchors and Fasteners

Provide corrosion-resistant anchors and fasteners capable of developing a restraining force commensurate with the strength of the accessory to be mounted and suited for use with the supporting construction. Provide tamperproof design exposed fasteners with finish to match the accessory. Provide fasteners proposed for use for each type of wall construction and mounting.

### 2.1.2 Finishes

Except where noted otherwise, provide the following finishes on metal:

| Metal | Finish |
|---|---|
| Stainless steel | No. 4 satin finish |
| Carbon steel, copper alloy, and brass | Chromium plated, bright |

2.1.3 Mirrors, Glass (MG)

Provide Type I transparent flat type, Class 1-clear glass for mirrors. Glazing Quality q1 1/4 inch thick conforming to ASTM C1036. Coat glass on one surface with silver coating, copper protective coating, and mirror backing paint. Provide highly adhesive pure silver coating of a thickness which provides reflectivity of 83 percent or more of incident light when viewed through 1/4 inch thick glass, free of pinholes or other defects. Provide copper protective coating with pure bright reflective copper, homogeneous without sludge, pinholes or other defects, of proper thickness to prevent "adhesion pull" by mirror backing paint. Provide mirror backing paint with two coats of special scratch and abrasion-resistant paint and baked in uniform thickness to provide a protection for silver and copper coatings which will permit normal cutting and edge fabrication.

2.1.4 Combination Paper Towel Dispenser/Waste Receptacle (PTDWR)

Provide recessed dispenser/receptacle with a capacity of 800 multi-fold or 500 sheets of C-fold towel. Design waste receptacle to be locked in unit and removable for service. Provide waste receptacle capacity of 4.9 gallons. Fabricate a minimum 22 gauge stainless steel welded construction unit with all exposed surfaces having a satin finish. Cabinet doors of warp-free construction, equipped with full length piano hinge and secured by tumber lock. Provide waste receptacle that accepts removable liner standard for unit manufacturer.

2.1.5 Disposal, Sanitary Napkin, SS, Surface Mounted (SND)

Surface mounted sanitary napkin receptacle. Unit made of stainless steel with satin finish and all welded construction. Unit has piano hinge attached at the top and an integral finger depression for opening. For use with disposable paper liners, available separately. Unit may be attached to wall or toilet partition.

Approximate size: 7 inches wide by 4 inches deep by 10 inches high.

2.1.6 Grab Bar, 1-1/4 Inch Diameter, SS, 2 Wall, W/C Accessible (GB)

Grab bar of 1-1/4 inch diameter satin finish stainless steel with peened gripping surface for use in toilet stall/room. Snap-on flange covers for concealed mounting are stainless steel and equipped with two screw holes for attachment to wall. Grab bars designed to meet and exceed ADA requirements for structural strength. Grab bars designed to withstand loads of 900 pounds when properly installed. Clearance from wall to grab bar is 1-1/2 inches to meet ADA and ANSI codes. Provide 18" vertical, 36" and 42" horizontal grab bars as indicated on the drawings.

2.1.7 Hook, Garment (H1)

Surface mounted safety hook made of stainless steel and secured to toilet partition and office doors (as shown on the furniture plan) with tamper

resistant mounting screws, exposed mounting. Mounting hardware to be included. Hook designed to snap down when it exceeds load limit.

2.1.8 Dispenser, Toilet Tissue, SS, 2-Roll, Surface Mounted (TTD)

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.

2.1.9 Soap Dispenser, Automatic (SD)

Provide soap dispenser surface mounted,with hands free operation liquid type consisting of a vertical Type 304 stainless steel tank with holding capacity of 40 fluid ounces with a corrosion-resistant all-purpose valve that dispenses liquid soaps, lotions, detergents and antiseptic soaps. Unit is battery operated.

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 on the drawings. 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 --

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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.

NATIONAL FIRE PROTECTION ASSOCIATION (NFPA)

| | |
|---|---|
| NFPA 1 | (2021) Fire Code |
| NFPA 10 | (2022; ERTA 1 2021) Standard for Portable Fire Extinguishers |
| NFPA 101 | (2021; TIA 21-1) Life Safety Code |
| NFPA 241 | (2022) Standard for Safeguarding Construction, Alteration, and Demolition Operations |

U.S. NATIONAL ARCHIVES AND RECORDS ADMINISTRATION (NARA)

| | |
|---|---|
| 29 CFR 1910.157 | (2003) Portable Fire Extinguishers |

UNDERWRITERS LABORATORIES (UL)

| | |
|---|---|
| UL 299 | (2012; May 2021) Dry Chemical Fire Extinguishers |
| UL 2129 | (2017; Reprint Apr 2021) UL Standard for Safety Halocarbon Clean Agent Fire Extinguishers |

1.2 SUBMITTALS

Government approval is required for submittals with a "G" or "S" classification. Submittals not having a "G" or "S" classification are for 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, AE

Accessories; G, AE

Cabinets; G, AE

Wall Brackets; G

Schedule; G

SD-03 Product Data

Fire Extinguishers; G, AE

Accessories; G, AE

Cabinets; G

Wall Brackets; G

Replacement Parts List; G

SD-04 Samples

Equipment Samples; G, AE

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 of each type of fire extinguisher being installed; one full-sized sample of each type of cabinet being installed; three samples of wall brackets and accessories of each type being used.

Use approved samples for installation, with proper identification and storage.

## 1.4 WARRANTY

Guarantee that Fire Extinguishers are free of defects in materials, fabrication, finish, and installation and that they will remain so for a period of not less than 6 years after completion.

Submit the manufacturer's warranty with inspection tag.

## 1.5 PROJECT SCHEDULE

For fire extinguishers. Coordinate final fire extinguisher schedule with fire protection cabinet schedule to ensure proper fit and function. Use same designations indicated on Drawings.

# PART 2 PRODUCTS

Submit fabrication drawings consisting of fabrication and assembly details

performed in the factory and product data for the following items: Fire Extinguishers; Accessories, cabinets, Wall Brackets.

2.1 SYSTEM DESCRIPTION

2.1.1 Types

Submit fire extinguishers certifications showing compliance with local codes and regulations.

Provide fire extinguishers conforming to NFPA 10. Provide quantity and placement in compliance with the applicable sections of NFPA 1, NFPA 101, NFPA 241, and 29 CFR 1910.157.

Provide multi-purpose dry chemical type fire extinguishers compliant with UL 299.

Provide clean agent type fire extinguishers compliant with UL 2129.

2.1.2 Material

Provide enameled steel extinguisher shell.

2.1.3 Size

10 pounds multi-purpose dry chemical type extinguishers. pounds clean agent type 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 enameled steel cabinets.

2.2.1.2 Type

Provide surface type cabinets.

2.2.1.3 Size

Dimension cabinets to accommodate the specified fire extinguishers.

2.2.2 Wall Brackets

2.2.2.1 Identification

Provide lettering complying with authorities having jurisdiction for

letter style, size, spacing, and location. Locate as indicated by the drawings.

Identify bracket-mounted fire extinguishers with the words "FIRE EXTINGUISHER" in red letter decals applied to mounting surface.

Orientation: Vertical.

## PART 3 EXECUTION

### 3.1 INSTALLATION

Install Fire Extinguishers where indicated on the drawings. Verify exact locations prior to installation.

Provide extinguishers which are fully charged and ready for operation upon installation. Provide extinguishers complete with Manufacturer's Warranty with Inspection Tag attached.

Install fire extinguishers in locations indicated and in compliance with requirements of authorities having jurisdiction.

Comply with the manufacturer's recommendations for all installations.

### 3.2 PROTECTION

#### 3.2.1 Repairing

Remove and replace damaged and unacceptable portions of completed work with new work at no additional cost to the Government.

Submit replacement parts list indicating specified items replacement part, replacement cost, and name, address and contact for replacement parts distributor.

#### 3.2.2 Cleaning

Clean all surfaces of the work, and adjacent surfaces which are soiled as a result of the work. Remove from the site all construction equipment, tools, surplus materials and rubbish resulting from the work.

-- End of Section --

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 A1008/A1008M | (2023) Standard Specification for Steel, Sheet, Cold-Rolled, Carbon, Structural, High-Strength Low-Alloy, High-Strength Low-Alloy with Improved Formability, Solution Hardened, and Bake Hardenable |

U.S. GENERAL SERVICES ADMINISTRATION (GSA)

| | |
|---|---|
| FS AA-L-00486 | (Rev J) Lockers, Clothing, Steel |

1.2 SUBMITTALS

Government approval is required for submittals with a "G" or "S" classification. Submittals not having a "G" or "S" classification are for 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, AE

Location; G

Installation

Numbering system

SD-03 Product Data

Material

Locking Devices

Lock Control Chart

Finish

Locker components

Assembly instructions

SD-04 Samples

Color chips; G, AE

1.3 DELIVERY, HANDLING, AND STORAGE

Deliver lockers and associated materials in their original packages, containers, or bundles bearing the manufacturer's name and the name of the material. Protect from weather, soil, and damage during delivery, storage, and construction.

1.4 FIELD MEASUREMENTS

To ensure proper fits, make field measurements prior to the preparation of drawings and fabrication. Verify correct location

1.5 QUALITY ASSURANCE

1.5.1 Color Chips

Provide a minimum of three color chips, not less than 3 inches square, of each color indicated on the material finish schedule drawing.

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 Cell Phone Lockers

Cell Phone lockers must be as follows:

1) Front-loading mini-storage lockers for cell phone, tablet storage, and computer storage shall be provided; Lockers shall meet ABA requirements for accessibility. Size: 35.75" Width x 40.75" High x 8.75" Deep. Location as indicated on drawings.

2) Lockers shall be recessed mounted, made entirely of heavy duty aluminum, with powder coated enamel finish. Front access panel swings on a continuous hinge. One compartment is required for a panel lock (included) and cannot be used for cell phone storage.

3) Each compartment door shall have a master keyed or resettable combination lock. Compartment identification of clear plastic cardholder (card included) to identify the compartment on door. Available in five (5) and seven (7) door high and three (3), four (4), and five (5) doors wide with standard A size doors (6-1/2" W x 5-1/4"H and larger B size doors (13" W x 5-1/4" H. Units feature 8" deep compartments.

4) 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.

5) Lockers shall be mounted in accordance with ABA guidelines. The lowest

point of any compartment shall be higher than 15 inches above finished floor. No less than 50 percent of all lockers shall be located below 48 inches above finished floor; no locker shall be located above 67 inches above finished floor level.

2.2 MATERIAL

2.2.1 Steel Sheet

ASTM A1008/A1008M, commercial quality, minimized spangle material. Prepare material surfaces for baked enamel finishing in accordance with FS AA-L-00486. Fabricate locker bodies from not less than 0.0239-inch thick steel sheet.

2.2.2 Finish

FS AA-L-00486.

2.2.2.1 Color

As indicated on the material finish schedule drawing.

2.3 COMPONENTS

2.3.1 Built-In Locks

FS AA-L-00486. Provide locking devices as resettable combination locks.Submit Lock Control Chart showing each lock required for the project, the locker identification plate number.

2.3.2 Doors

FS AA-L-00486, not less than 0.0598 inch thick steel sheet.

2.3.2.1 Hinges

In addition to the requirements of FS AA-L-00486, provide a continuous hinge for the front access panel..

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 steel 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 steel sheet.

2.3.6 Shelves

FS AA-L-00486. Fabricate from not less than 0.0598 inch thick steel sheet.

2.3.7 Label Holders

FS AA-L-00486.

2.3.8 Fastening Devices

Provide bolts, nuts, and rivets as specified in FS AA-L-00486.

PART 3 EXECUTION

3.1 ASSEMBLY AND INSTALLATION

Assemble lockers according to the locker manufacturer's instructions. Align lockers horizontally and vertically. Secure lockers to wall with screws as indicated. Bolt adjacent lockers together. Adjust doors to operate freely without sticking or binding and to ensure they close tightly.

3.2 NUMBERING SYSTEM

Install number plates on lockers consecutively.

3.3 FIELD QUALITY CONTROL

3.3.1 Testing

Government may request performance-characteristic tests on assembled lockers in accordance with FS AA-L-00486. Lockers not conforming will be rejected.

3.3.2 Repairing

Remove and replace damaged and unacceptable portions of completed work with new.

3.3.3 Cleaning

Clean surfaces of the work, and adjacent surfaces soiled as a result of the work, in an approved manner. Remove equipment, surplus materials, and rubbish from the site.

-- End of Section --

SECTION 11 13 19.23

STATIONARY DOCK LIFT
**09/24**

PART 1 GENERAL

1.1 REFERENCES

The publications listed 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 ELECTRICAL MANUFACTURERS ASSOCIATION (NEMA)

ANSI Z535.1 (2017) Safety Colors

AMERICAN NATIONAL STANDARDS INSTITUTE (ANSI)

ANSI MH29.1 (2012) Safety Requirements for Industrial Scissors Lifts

1.2 RELATED SECTIONS

The following are additional Sections not referenced within this specification but are likely required due to project location, to the extent of their applicability:

a. Section 03 30 00 CAST-IN-PLACE CONCRETE: Concrete pit.

b. Section 05 50 13 MISCELLANEOUS METAL FABRICATIONS: Perimeter guard rails and inserts. Dock slab and door protection edge angles.

c. Division 16 - Electrical: Connections to dock equipment.

1.3 SUBMITTALS

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

SD-02 Shop Drawings

Dock Equipment

SD-03 Product Data

Dock Equipment

Hydraulic Dock Lift

Remote Located Control Station

SD-05 Design Data

Electrical Requirements

SD-08 Manufacturer's Instructions

Safety Devices

SD-10 Operation and Maintenance Data

Operating Manuals

Maintenance Data

1.4 QUALITY ASSURANCE

a. Dock Lift Standard: Comply with applicable requirements of ANSI MH29.1 for construction and operation of dock lift(s).

b. Provide manufacturers standard 2 (two) year parts, 1 (one) year labor warranty.

c. Single Source Responsibility: Provide dock lift(s) as complete units produced by a single manufacturer, including necessary accessories and fittings.

1.5 WARRANTY

Special Warranty: Prepare and submit in accordance with Section 01 78 00 CLOSEOUT SUBMITTALS.

a. Manufacturer's standard one-year parts and labor warranty.

PART 2 PRODUCTS

2.1 SYSTEM DESCRIPTION

This Section describes the requirements for providing a dock scissors lift as shown on the Drawing and specified, to include:

a. Hydraulic Dock Scissor Lift

b. Concrete work for dock lift(s) as specified in Part 3.

C. Comply with ANSI MH29.1.

2.2 DOCK LIFTS (SCISSORS LIFTS)

Provide manufacturer's standard hydraulic dock lift of capacity, size, and construction indicated, consisting of a nonslip steel platform with beveled toe guards on all four sides, steel scissor legs, and hydraulic operating system, complete with controls, safety devices, and accessories required. Submit product data for dock equipment.

2.2.1 Type

Provide stationary single-scissor-type hydraulic dock lift designed for permanent, recessed installation in a preformed concrete pit at location indicated.

2.2.2 Rated Capacity

Provide lifting capacity of not less than 6000 lb with 4500 lb axle load at ends and 3000 lb axle loads at sides

2.2.3 Vertical Travel

Provide maximum vertical travel of 60 inches from a lowered height of 12 inches for a raised height of 60 inches.

2.2.4 Construction

Fabricate lift from structural steel shapes rigidly welded and reinforced for maximum strength, safety, and stability. Design assembly to withstand deformation during both operating and stored phases of service. Provide mounting brackets and removable lifting eyes for ease of installation.

a. Shop Drawings: Submit drawings indicating fabrication and erection of dock equipment including plans, elevations and large-scale details.

2.2.4.1 Platform

Fabricate platform from heavy steel plate with beveled toe guards on all four sides to comply with requirements of ANSI MH29.1. Provide matching, hinged, throw-over bridges where indicated and removable handrails.

a. Platform Surface: Nonskid, safety-tread deck plate.

b. Platform Size; 84 inches wide by 108 inches long.

2.2.4.2 Hinged Bridge

Provide hinged, throw-over bridge, heavy-duty, piano-type hinge welded to toe guard at end of platform. Provide bridge complete with heavy-duty lifting chains. Chamfer edge of bridge to minimize obstructing wheels of material-handling vehicles.

a. Bridge Material: Nonskid, safety-tread steel plate.

b. Bridge Size: 18 inches long by 72 inches wide.

c. Ergonomic Spring assisted Bridge.

2.2.4.3 Scissor Mechanism

Fabricate leg members from heavy, steel formed tube members to provide maximum strength and rigidity.

2.2.4.4 Cylinders

Equip lift with not less than two heavy-duty, high-pressure, hydraulic, ram-style cylinders. Rams shall be direct-displacement plunger type with positive internal stops as standard by manufacturer. Cylinder rods shall be chrome plated and polished to prevent rusting.

2.2.4.5 Bearings

Provide pivot points with self-lubricating, lifetime self lubricating bushings for minimum maintenance.

2.2.4.5.1 Operation

Provide manufacturer's standard, self-contained, electric, hydraulic power unit for raising and lowering lift, controlled from a remotely located push-button station.

a. Operating Manuals: Furnish operating and maintenance manuals and advise Owner on use and maintenance of equipment.

b. Maintenance Data: Submit manufacturer's maintenance and service data, including, address and telephone number of nearest authorized service representative.

c. Electrical Requirements: Coordinate wiring requirements and current characteristics with building electrical system.

d. Power Unit: Provide manufacturer's standard, self-contained, remotely located power unit of size, type, and operation needed for capacity of lift indicated. Power unit shall consist of a TEFC motor, high-pressure gear pump, valve manifold and oil reservoir.

    1. Manifold shall contain a relief valve, check valve, pressure-compensated flow-control valve and solenoid valve.

    2. Speed control: Provide manufacturer's standard pressure compensated flow control to maintain rated speed when the lift is loaded or unloaded.

    3. Free-fall protection: Provide a hydraulic velocity fuse at each cylinder to prevent the lift platform from free falling in the event of a severed hydraulic hose or broken hydraulic fitting.

    4. Oil sight gauge in the reservoir to determine oil level.

    5. Manual lowering valve located on power pack in case of power loss.

e. Remote located Control Station: Provide a weatherproof, multi-button control station of the constant-pressure type with NEMA 4x rated up and down push buttons. Controller shall consist of a magnetic motor starter with three pole-adjustable overloads and 115-VAC control transformer with a fused secondary prewired to terminal strips and enclosed in a NEMA , Type 12 box.

    1. Upper-Travel-Limit Switch: Equip unit with manufacturer's standard, adjustable, upper-travel-limit switch.

2.2.4.6 Safety Devices

Provide manufacturer's standard and original safety devices as follows:

a. Removable Handrails: Provide removable handrails on two sides of platform with a single, removable chain across each end. Handrails shall be 42 inches high with a mid-rail and 4-inch-high kick plate at bottom. Mount rail sockets flush with platform surface.

b. Maintenance Leg: Provide manufacturer's standard safety maintenance leg.

c. Toe Protection: Provide manufacturer's standard toe protection along entire unprotected side(s) of lift.

2.2.4.7 Finish and Color

Manufacturer's standard paint applied to factory-assembled and tested dock lifts before shipping. Provide toe guards with yellow and black stripes to comply with ANSI Z535.1, and paint remainder of surfaces in manufacturer's standard color.

PART 3 EXECUTION

3.1 DOCK-LIFT INSTALLATION

a. Coordinate forming recessed pit for dock lifts to ensure that depth is adequate to accommodate lift in proper relation to loading platform.

b. Attach dock lift securely, according to manufacturer's written instructions.

3.2 ADJUSTING AND CLEANING

a. Make necessary adjustments for safe, efficient operation of loading dock equipment.

b. After installation, restore marred abraded surfaces to the original condition.

-- End of Section --

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SECTION 12 48 13

ENTRANCE FLOOR MATS
**08/23**

PART 1 GENERAL

1.1 REFERENCES

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

ASTM INTERNATIONAL (ASTM)

| | |
|---|---|
| ASTM D2047 | (2017) Standard Test Method for Static Coefficient of Friction of Polish-Coated Floor Surfaces as Measured by the James Machine |
| ASTM E648 | (2019a) Standard Test Method for Critical Radiant Flux of Floor-Covering Systems Using a Radiant Heat Energy Source |

U.S. NATIONAL ARCHIVES AND RECORDS ADMINISTRATION (NARA)

| | |
|---|---|
| 36 CFR 1191 | Americans with Disabilities Act (ADA) Accessibility Guidelines for Buildings and Facilities; Architectural Barriers Act (ABA) Accessibility Guidelines |

1.2 SUSTAINABILITY REPORTING

This project has been designed to be compliant with the High Performance and Sustainable Building or HPSB Guiding Principles. In addition to the sustainable design requirements stated herein, refer to additional requirements found in Section 01 33 29 SUSTAINABILITY REPORTING.

1.2.1 EPA Comprehensive Procurement Guidelines

See Section 01 33 29 SUSTAINABILITY REPORTING for requirements associated with EPA-designated products.

1.2.2 USDA Biobased

See Section 01 33 29 SUSTAINABILITY REPORTING for requirements associated with USDA Biobased products.

1.3 SUBMITTALS

Government approval is required for submittals with a "G" or "S" classification. Submittals not having a "G" or "S" classification are for information only. When used, a code following the "G" classification 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 01 33 29 SUSTAINABILITY REPORTING. Submit the following in accordance with Section 01 33 00 SUBMITTAL PROCEDURES:

SD-02 Shop Drawings

Installation Drawings; G,

Detail Drawings; G, AE

SD-03 Product Data

Entrance Floor Mats; G, AE

Adhesives and Concrete Primers; G

SD-04 Samples

Entrance Floor Mats; G, AE

SD-08 Manufacturer's Instructions

Manufacturer's Instructions

SD-10 Operation and Maintenance Data

Protection, Maintenance, and Repair Information

## 1.4 QUALITY CONTROL

Comply with 36 CFR 1191 Americans with Disabilities Act (ADA) Accessibility Guidelines for Buildings and Facilities; Architectural Barriers Act (ABA) Accessibility Guidelines for installed entrance floor mats. Ensure that entrance floor mats are slip-resistant in accordance with ASTM D2047, with a minimum 0.60 coefficient of friction, for accessible routes and are structurally capable of withstanding a uniform floor load of 300 lb/sq ft. Ensure that flammability is in accordance with ASTM E648, Class 1, Critical Radiant Flux, minimum 0.45 watts/square centimeter.

## 1.5 DELIVERY, STORAGE, AND HANDLING

Deliver materials to the project site in their original packages or containers bearing labels clearly identifying the manufacturer, brand name, and quality or grade.

Store materials in their original unbroken packages or containers in the area in which they will be installed. Unwrap, inspect, and place mats at indicated locations. Remove all excess packing materials.

# PART 2 PRODUCTS

## 2.1 MANUFACTURED UNITS

### 2.1.1 Entrance Floor Mats

Submit the manufacturer's catalog data. Submit samples of assembled sections of floor mats showing corners, intersections, and other details of construction. Submit samples of exposed floor mats, and accessories.

#### 2.1.1.1 Carpet-Type Mats

Provide a PET polyester carpet tiles 24 by 24 inchbonded to a 1/8-inch to

1/4-inch-thick, flexible vinyl backing to form mats that are 3/8 inch thick with nonraveling edges.

2.1.2 Adhesives and Concrete Primers

Provide adhesives and concrete primers, where required, according to the manufacturer's recommendations.

2.1.3 Color and Size

Ensure that color is in accordance with the drawing A601 Room Finish Schedule. Ensure that the size of mat is as indicated on the finish plan drawing.

PART 3 EXECUTION

3.1 EXAMINATION

Comply with the manufacturer's requirements for substrates and floor conditions affecting installation of floor mats and frames. Ensure that all unsatisfactory conditions have been corrected before installation.

3.2 INSTALLATION

Submit detail drawings as required. Provide installation drawings. Provide the manufacturer's protection, maintenance, and repair information.

Install floor mats and frames according to manufacturer's instructions. Set mat tops at the height recommended by the manufacturer for the most effective cleaning action. Provide clearance between bottoms of doors and tops of mats.

-- End of Section --

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SECTION 12 50 00.13 10

FURNITURE AND FURNITURE INSTALLATION
**08/17, CHG 1: 11/18**

PART 1 GENERAL

Purchase and install furniture as identified within this specification. This specification section includes a Furniture, Fixtures and Equipment (FF&E) Package attachment.

The requirements of this specification also apply to systems furniture 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) Energy Standard for Buildings Except Low-Rise Residential Buildings |

ASTM INTERNATIONAL (ASTM)

| | |
|---|---|
| ASTM D4157 | (2013; R 2017) Standard Test Method for Abrasion Resistance of Textile Fabrics (Oscillatory Cylinder Method) |
| ASTM E84 | (2023) Standard Test Method for Surface Burning Characteristics of Building Materials |

BIFMA INTERNATIONAL (BIFMA)

| | |
|---|---|
| ANSI/BIFMA X5.1 | (2017) American National Standards For Office Furnishings - General Purpose Office Chairs |
| ANSI/BIFMA X5.3 | (2007; R2012) American National Standards For Office Furnishings - Vertical Files |
| ANSI/BIFMA X5.4 | (2012) American National Standards For Office Furnishings - Lounge Seating |
| ANSI/BIFMA X5.5 | (2014) American National Standards For Office Furnishings -Desk Products |
| ANSI/BIFMA X5.6 | (2016) American National Standards For Office Furnishings -Panel Systems |
| ANSI/BIFMA X5.9 | (2012) American National Standards For Office Furnishings - Storage Units |

NATIONAL FIRE PROTECTION ASSOCIATION (NFPA)

| | |
|---|---|
| NFPA 101 | (2021; TIA 21-1) Life Safety Code |
| NFPA 260 | (2013) Standard Methods of Tests and Classification System for Cigarette Ignition Resistance of Components of Upholstered Furniture |
| NFPA 265 | (2023; ERTA 1 2023) 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)

| | |
|---|---|
| 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 | (2020) 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

Grommet, Power and Communication Units, and Wire Management Locations; G

SD-03 Product Data

Product Data; G

Product Style Options; G

SD-04 Samples

Fabric and Finishes; G

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

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 QUALITY CONTROL for inspection requirements. The Contracting Officer must be allowed to participate in inspections. In addition provide services for existing furniture if required, reference paragraph on EXISTING FURNITURE for more information. Develop project timelines and establish shipping, receiving and installation dates that coordinate with the building construction schedule. Hold at a minimum weekly team meetings to brief the project team, include the Contracting Officer. Notify the Contracting Officer immediately of any scheduling problems, discontinued furniture items including fabrics and finishes, or other conditions which may cause delays, and recommend available substitutes, solutions, and

provide updated timeline to coordinate with building construction schedule. Substitutes and solutions must comply with the specification and be approved by the Contracting Officer.

## 1.4 FURNITURE PURCHASE

Purchase furniture, including checking accuracy of all acknowledgements and schedules from manufacturers and making necessary corrections to insure that the manufacturer has a correct understanding of the order and requirement. Provide furniture from the GSA Schedules and provide GSA pricing. Provide furniture from open market only when an item is not available on the GSA Schedules. See FAR clause 52.251-1 Government Supply Sources. Purchase furniture from the open market. The furniture provided needs to be available on the GSA Schedules to assist the User with future purchases. GSA information is provided FOR INFORMATIONAL PURPOSES ONLY. It is encouraged to solicit and provide GSA pricing on furniture. Compete the furniture purchase by obtaining a minimum of (3) separate proposals. Furniture is subject to FAR clause 52.236-5 Materials and Workmanship. If necessary to meet project timeline requirements, furniture may be purchased using manufacturers quick-ship programs or by coordinating factory times.

## 1.5 ALTERNATE DESIGN

When a manufacturer's product is unable to provide desk and workstation configurations and filing/storage that conform exactly to the furniture layouts shown in the contract drawings and specifications, alternate designs may be submitted for consideration by the Contracting Officer. Alternate designs must meet or exceed the following criteria. Alternate designs that are submitted but do not meet these criteria will be rejected.

### 1.5.1 Desk and Workstation Size and Configuration

The alternate design must provide desks and workstations of the same basic size and configuration shown, with only the sizes of the individual components within the desk and workstation changed to meet the standard product of the manufacturer.

### 1.5.2 Filing and Storage Size and Configuration

The alternate design must provide filing and storage of the same basic size and configuration shown, with only the size changed to meet the standard product of the manufacturer. The storage capacity must not be reduced.

### 1.5.3 Furniture Requirements

The furniture provided must comply with the drawings, specifications, and the requirements identified in the FF&E Package Attachment.

### 1.5.4 Layout

The storage capacity, number of desks and workstations, number of persons accommodated, width of aisles, and functionality must be maintained. Layout must comply with NFPA 101 and 36 CFR 1191.

## 1.6 AUTHORIZED DEALER, CERTIFIED FURNITURE INSTALLERS, LICENSED ELECTRICIAN AND CERTIFIED TELECOMMUNICATIONS INSTALLER

When required by the furniture manufacturer, furniture must be installed by an authorized dealer and a certified furniture installation crew must be used on the project. Services provided to reuse existing furniture must comply with manufactures warranty requirements to maintain warranty. If warranty for existing furniture to be reused has expired, services must be completed by a furniture installation crew with a minimum of 5 years experience. 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 Section12 59 00 Systems Furniture

b. Desks and Workstations - 12 year minimum

c. Filing and Storage - 12 year minimum

d. Seating

(1) Seating, unless otherwise noted - 10 year minimum

(2) 24/7 Seating (multiple shift use) - 10 year minimum

(3) Seating Mechanisms and Pneumatic Cylinders - 10 year minimum

(4) Lounge Seating - 10 year minimum

(5) Stacking Chairs - 10 year minimum

e. Tables

(1) Unless otherwise noted - 10 year minimum

(2) Table Mechanisms - 5 year minimum

(3) Table Ganging Device - 1 year minimum

f. Miscellaneous

(1) Fabric - 3 year minimum

(2) LED Task Lighting - 5 year minimum

(3) Task Lighting - 3 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 to be Reused

Disassemble, pack, move, store, transport to the project site and install existing furniture identified to be reused. This includes disconnecting and reconnecting furniture electrical connections at the building source. Coordinate with electrician for safe terminations or removal of disconnected building electric system supply circuits.

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. Do not exceed panel flame spread 25 for Class A, and do not exceed panel smoke development 450 for Class A, B, and C.

(b) Upholstered furniture must comply with TB 117-2013 or NFPA 260.

b. Provide furniture with no rough or sharp edges or exposed connections. Clips, screws, and other construction elements must be concealed wherever possible.

c. Items such as desks, workstations and systems furniture must include all necessary components to be structurally sound and must not be attached to the wall unless specified to be wall mounted in the contract documents.

d. Desks, workstations, storage, and tables must have leveling devices to compensate for uneven floors.

e. The underside of desks, workstations, and tables must be completely and smoothly finished.

f. The backside of freestanding desks, workstations, and 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. 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 and color as specified. 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

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.

d. Comply with double rub testing as specified in the FF&E Package Attachment. Fabric for seating must comply with a minimum of 55,000 double rubs unless otherwise noted. Perform double rub testing in accordance with the ASTM D4157 Wyzenbeek Method.

e. Provide vinyl, polypropylene or similar type fabric for seating only if allowed in FF&E Package Attachment.

f. Pattern:

(1) Provide patterned upholstery fabric to help hide soiling. Pattern is defined as follows:

(a) Solid Color: textured, single color or pattern smaller in size than the small size pattern

(b) Small Size Pattern: minimum 1/2 inch

(c) Medium Size Pattern: minimum 2 inch

(d) Large Size Pattern: minimum 5 inch

(2) Provide patterns as specified in the FF&E Package Attachment. as follows:

g. See FF&E Package Attachment 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. Main 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 Attachment for additional information.

2.4 FURNITURE LAYOUT

Provide furniture layout as indicated.

## PART 3 EXECUTION

### 3.1 BUILDING EXAMINATION

Become familiar with details of the work, inspect all areas and conditions under which furniture is to be installed, and coordinate scheduling of dedicated elevators and docks. Notify the Contracting Officer in writing of any conditions detrimental to the proper and timely completion of the installation. Work will proceed only when conditions have been corrected.

### 3.2 BUILDING PROTECTION

Protect building surfaces to prevent soiling and damage during delivery and installation. Any soiling and damage that occurs to the building during the installation of furniture must be cleaned and repaired, or replaced to its original condition and must be approved by the Contracting Officer.

### 3.3 INSTALLATION

#### 3.3.1 Installation Drawings

Installation drawings must include furniture layout, critical dimensions and locations of electrical and communications. Reflect field verified conditions in furniture layouts. Drawings must be at 1/4 inch = 1 foot scale, unless otherwise specified. Provide typical plans and isometrics/elevations of desks and workstations at a scale of 1/2 inch = 1 foot. When applicable, provide desk and workstation electrical and communications locations. When applicable include controlled-circuit identification for each furniture receptacle and coordinate with the building electrical system circuits in accordance with ASHRAE 90.1 - IP. Critical dimensions include, but are not limited to clearances and aisle widths. Drawings must include layout for furniture systems workstations for coordination purposes. Label furniture with furniture item code identified in this specification. Submit grommet, power and communication units, and wire management locations.

#### 3.3.2 Furniture Installation Procedures

Complete installation in accordance with manufacturer's installation instructions, assembly manuals, warranty requirements and approved installation drawings. Also comply with the following requirements:

a. Use material handling equipment with rubber wheels.

b. Furniture and components must be installed level, plumb, square, and with proper alignment with adjoining furniture.

c. Match keys to locks and check locking mechanisms.

d. Check drawers, doors, lighting, and other operable items and mechanisms for proper operation.

e. Remove all protective wrapping tape, residue, and related type items.

f. Securely interconnect furniture components where required.

g. Securely attach and anchor furniture components to the building when

required.

h. Securely anchor furniture such as shelving and storage units to the building when required by the manufacturer.

i. All items with an electrical plug, such as but not limited to task lighting and tables with electrical power, must be fully operational.

j. All hardwired furniture, such as but not limited to furniture systems, must be fully operational. Verify that voltage is present in electrical outlets. Verify controlled-circuit outlets are properly configured in accordance with the installation drawings.

k. Furniture must not block SIPRNET and 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.

3.5.9 Key Control System

Key Control System. Provide system in excel format; indicate lock number, room number and location of lock within rooms if more than one lock number.

-- End of Section --

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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 FOREST FOUNDATION (AFF)

| | |
|---|---|
| ATFS STANDARDS | (2015) American Tree Farm System Standards of Sustainability 2015-2020 |

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 C423 | (2023) 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 | (2023) Standard Test Method for Surface Burning Characteristics of Building Materials |
| ASTM E290 | (2022) 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 |

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 70 | (2026) National Electrical Code |
| NFPA 101 | (2021; TIA 21-1) Life Safety Code |
| NFPA 265 | (2023; ERTA 1 2023) 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 |

SCIENTIFIC CERTIFICATION SYSTEMS (SCS)

| | |
|---|---|
| SCS | SCS Global Services (SCS) Indoor Advantage |

SUSTAINABLE FOREST INITIATIVE (SFI)

| | |
|---|---|
| SFI 2015-2019 | (2015) Standards, Rules for Label Use, Procedures and Guidance |

TELECOMMUNICATIONS INDUSTRY ASSOCIATION (TIA)

| | |
|---|---|
| TIA-568.2 | (2018d) Balanced Twisted-Pair Telecommunications Cabling and Components Standards |
| TIA-569 | (2019e; Add 1 2022) Telecommunications Pathways and Spaces |

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 | (2020) UL Standard for Safety Test for Surface Burning Characteristics of Building Materials |
| UL 1286 | (2022; Reprint Aug 2023) UL Standard for Safety Office Furnishings |
| UL 2818 | (2022) GREENGUARD Certification Program For Chemical Emissions For Building |

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

Warranty; G

Workstations

Power and Communications

Recycled Content for system furniture components; S

SD-04 Samples

Workstations; G

Samples

SD-06 Test Reports

Selected Components; G

Panel Acoustics; G

Fire Safety; G

SD-07 Certificates

Workstations

Certified Sustainably Harvested wood; S

SD-10 Operation and Maintenance Data

Assembly Manuals; G

Maintenance Manuals; G

Cleaning; G

Maintenance Agreements

Installation; G

## 1.3 CERTIFICATIONS

### 1.3.1 Certified Sustainably Harvested Wood

Provide wood door panels certified as sustainably harvested by FSC STD 01 001, ATFS STANDARDS, CSA Z809-08, SFI 2015-2019, or other third party program certified by PEFC ST 2002:2013. Provide a letter of Certification of Sustainably Harvested Wood signed by the wood supplier. Identify certifying organization and their third party program name and indicate compliance with chain-of-custody program requirements. Submit sustainable wood certification data; identify each certified product on a line item basis. Provide current product certification documentation from certification body. Submit copies of invoices bearing certification numbers.

### 1.3.2 Indoor Air Quality Certifications

#### 1.3.2.1 Office Furniture Systems and Seating

Provide products certified to meet indoor air quality requirements by UL 2818 (Greenguard) Gold, SCS Global Services Indoor Advantage Gold, ANSI/BIFMA M7.1 Certification or provide certification 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 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 for panel flame spread and 450 for Class A, B and C panel smoke development.

### 1.4.3 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/date 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. 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-568.2 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. Provide storsge that is free from dirt and dust, water, and other contaminants, and that permits easy access for inspection and handling.

## 1.6 WARRANTY

Warrant the systems furniture for a minimum period of lifetime 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.

## 1.7 MAINTENANCE AGREEMENTS

Collect information from the manufacturer about maintenance agreement options, and submit to Contracting Officer. 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 and avoid landfilling and burning reclaimed materials. When such a service is not available through a manufacturer, local recyclers should be sought after to reclaim the materials.

# PART 2 PRODUCTS

## 2.1 MATERIALS

Provide System Furniture Components with a minimum of 55 percent recycled content. 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.

Panel glazing. Glazing samples with label designating the material and safety ratings.

2.2.3 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.

2.2.3.1 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.

2.2.3.2 Wiring Configuration

Provide alternate configurations that 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.

2.2.4 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.

2.2.4.1 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.

2.2.4.2 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 20 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).

2.2.4.3 Panel Glazing

Tempered glass must conform to ANSI Z97.1 and ASTM C1048, Kind FT, Condition A, Type I, Class 3 - Light reducing, tinted or translucent.

2.2.5 Pattern and Color

Provide pattern and color of finishes and fabrics for panel systems, components, and trim in accordance with the Product Data Sheets in the 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, 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 capability for work surfaces to attach to the panels in 1 - 2 inch increments. 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. Coordinate panel heights with the HVAC and electrical designs. Minimum panel thickness is 3 inches thick. System to have 100 percent off-modular capability with no defacement of any element caused by components when used in an off-modular application. Unique panel frames must not be required for off modular connections. Submit three sets of Assembly Manuals describing assembly and reconfiguration procedures.

2.3.2 Panel Finishes

Provide panels in the following options: safety glazed, tackable fabric, acoustical fabric, marker surface, paint, slat tile,. 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. Fabric must be factory installed.

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). 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. 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. Work surfaces must have 100 percent off-modular capability with no defacement of any element caused by components when used in an off-modular application. Provide mobile half round table to include casters of which a minimum 2 must be locking, and table must lock to the adjacent worksurface.

### 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 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, a handle for moving, 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 with the exception of drawer fronts. 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 painted steel, and plastic laminate 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 work surface hung, support work surfaces, free standing or 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. Depth to accommodate a standard three ring binder. Panel attached storage is required to have 100 percent off-modular compatibility with no defacement of any element caused by components when used in an off-modular application.

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. Provide overhead cabinet door that retracts into the cabinet. 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. The personal storage tower will include one full height wardrobe unit with coat rod, two file drawers, bookcase with two adjustable shelves, and hinged lockable doors.

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 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.

2.8.4 CPU Holder

Provide a mounting to support the computer hard drive. Desk top and floor locations are not acceptable.

2.8.5 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. Mount monitor arm on slat walls, or work surface.

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 100 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 nonpowered panels and bases , all power to be provided through surface-mounted conduit and workstation UPS devices (GFGI). See electrical and communication drawings. Electrical work not addressed in this section must conform to the requirements of Section 26 20 00 INTERIOR DISTRIBUTION SYSTEM.

2.11.1 Power Distribution

Provide power distribution as indicated on the electrical drawings.

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

Provide cleanup as specified in Section 01 78 00 CLOSEOUT SUBMITTALS. 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 --

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SECTION 13 49 20.00 10

RF SHIELDING
**10/07**

PART 1 GENERAL

1.1 REFERENCES

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

ASTM INTERNATIONAL (ASTM)

| | |
|---|---|
| ASTM A36/A36M | (2019) Standard Specification for Carbon Structural Steel |
| ASTM A123/A123M | (2024) Standard Specification for Zinc (Hot-Dip Galvanized) Coatings on Iron and Steel Products |
| 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 A653/A653M | (2023) Standard Specification for Steel Sheet, Zinc-Coated (Galvanized) or Zinc-Iron Alloy-Coated (Galvannealed) by the Hot-Dip Process |
| ASTM B545 | (2022) Standard Specification for Electrodeposited Coatings of Tin |

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 |
| IEEE 299 | (2006; R 2012) Standard Method for Measuring the Effectiveness of Electromagnetic Shielding Enclosures |

NATIONAL ELECTRICAL MANUFACTURERS ASSOCIATION (NEMA)

| | |
|---|---|
| NEMA ICS 6 | (1993; R 2016) Industrial Control and Systems: Enclosures |

NATIONAL FIRE PROTECTION ASSOCIATION (NFPA)

| | |
|---|---|
| NFPA 70 | (2026) National Electrical Code |
| NFPA 77 | (2024; ERTA 1 2023) Recommended Practice on Static Electricity |
| NFPA 80 | (2022) Standard for Fire Doors and Other |

Opening Protectives

NFPA 80A (2022) Recommended Practice for Protection of Buildings from Exterior Fire Exposures

NFPA 780 (2023) Standard for the Installation of Lightning Protection Systems

U.S. DEPARTMENT OF DEFENSE (DOD)

MIL-HDBK-419 (1987; Rev A) Grounding, Bonding, and Shielding for Electronic Equipments and Facilities Volumes 1 of 2 Basic Theory

MIL-STD-188-124 (1998; Rev B; Notice 2 1998; Notice 3 2000; Notice 4 2013) Grounding, Bonding and Shielding for Common Long Haul/Tactical Communications Systems, Including Ground Based Communications - Electronics Facilities and Equipments

UNDERWRITERS LABORATORIES (UL)

UL 486A-486B (2018; Reprint Jul 2023) UL Standard for Safety Wire Connectors

UL 1283 (2017) UL Standard for Safety Electromagnetic Interference Filters

## 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. 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 information only and for use as specified in Section 01 33 29 SUSTAINABILITY REQUIREMENTS AND REPORTING. Submit the following in accordance with Section 01 33 00 SUBMITTAL PROCEDURES:

SD-02 Shop Drawings

Installation; G

Approved Drawings; G

SD-03 Product Data

RF Shielding System; G

Installation; G

Quality Control Plan; G

Qualifications; G

RF Shielded Doors; G

Filter Assemblies; G

Penetrations; G

SD-10 Operation and Maintenance Data

Operating and Maintenance Manuals; G

Service Organization; G

1.3 QUALITY ASSURANCE

1.3.1 Shop Drawings

Provide fully coordinated installation and approved drawings including the complete integrated shielded enclosure systems. Provide the following integrated items including but not limited to: all steel shapes, steel deck, foil membrane systems, filters, doors, and penetrations. Detailed drawings showing location, number, and method of penetrating the shielding material shall be submitted. Drawings shall show erection details and sequence of erection.

1.3.2 Penetration Schedule

The penetration schedule shall list each penetration of the RF Shield made through the walls, floors, roofs, and ceiling. Each listed penetration shall have a unique number. Each listed penetration shall have a brief description (e.g., conduit, pipe, ductwork, structure, etc.)

1.3.3 Product Data

Provide Shielding system product data including manufacturer's data, catalog cuts, and printed documentation regarding the work for the shielding system. Products requiring submittals include, but are not limited to doors, windows, foil membrane system, bronze wool, and conductive silicone.

1.3.4 RF Shielding Specialist (RSS) and System Coordinator

Work performed under this section shall be supervised and inspected by the RSS as generally defined in paragraph RF Shielding Specialist (RSS) and System Coordinator above.

1.3.5 RSS Report

The RSS shall submit RF installation reports that include photographs, documents indicating locations photographs occurred, and a description documenting materials and methods use to construct RF assembly. Document all systems to be covered by concrete or other construction. All photographs shall be taken by the Government's photographer and note locations photos shall be taken for the reports. Every 2 weeks the RSS shall create a RF shielding report to be reviewed by the Government's field representative for approval and then forwarded to the CTTA.

1.3.6 RF Shielding Specialists, Installers and Testing Specialists

Provide the name and background qualifications of individuals who will be responsible for installation, supervision, and testing of the shielding systems on this project. Shielding and testing specialist credentials shall include a bachelor's degree in science or engineering and

post-degree training and experience with RF shielding. The RSS shall be a person familiar with construction work and the work interactions among multiple trades. The RSS shall have 2 years of "foreman" type experience.

1.3.6.1 Testing Experience

The testing specialist must have experience during the previous 5 years in shielded enclosure leak detection system (SELDS), IEEE 299, and other methods of shielded enclosure testing.

1.3.6.2 Work Experience

Provide RF shielded system by an experienced firm or individual that has been regularly and successfully engaged in the installation, supervision, and/or testing of equivalent RF shielded systems for at least the previous 5 years. The principal work of this firm or individual must be the satisfactory installation and construction of RF shielded protection systems. Include experience such as achieving specified requirements for shielded system attenuation and maintainability of attenuation levels on work performed.

1.3.6.3 Project Experience

Furnish a project experience list on projects of similar scope which have been completed during the previous 5 years. Include project completion dates and the name and telephone number of the user and/or owner of each project. Indicate project experience for installers such as installation responsibilities, performance, materials, and methods used. Project experience for the shielding specialist must indicate the responsibilities performed. Project experience for the testing specialist must indicate the test methods performed.

1.3.7 Filter and Electrical Work Requirements

Perform filter and electrical work in compliance with NFPA 70, UL 486A-486B, and UL 1283. The label and listing of the Underwriters Laboratories or other nationally recognized testing laboratory will be acceptable evidence that the material or equipment conforms to the applicable standards of that agency. In lieu of the label or listing, a certificate may be furnished from an acceptable testing organization adequately equipped and competent to perform such services. State that the items have been tested and that they conform to the specified standard.

1.3.8 Field Samples

Provide field samples for the following: RF shielding foil membrane system and tape, shielding fasteners, piping, duct, conduit penetrations, and any other element contributing to the continuation of the RF shielding system. These samples shall remain on the construction site in a readily accessible location for the duration of the construction for review and reference by contractor and Government personnel.

1.3.9 Pre-Installation Meeting

Hold a pre-installation meeting with the RSS, Contracting Office, Government CTTA, subcontractors and installers working in, on, or near the RF shield. Discuss coordination requirements and instructions to ensure the integrity of the RF shield.

Items to discuss, but are not limited to, at the RF pre-installation meeting:

a. Pre-construction meeting.

b. Mock-up inspection.

c. RF Construction inspection and approval process, including first inspection by CTTA and any reoccurring inspection required.

d. Accreditation testing as prerequisite for substantial completion.

## 1.4 RF MOCK-UP

RF mock-up shall include materials and systems noted on the construction documents and systems called for during the RF pre-construction meeting. Mock-up shall be constructed at designated areas and approved by the CTTA. Mock-up shall include, but is not limited to, the following systems that make up the overall assembly to be approved by the CTTA: Perimeter wall RF foil membrane system, seams between foil membrane modules, connection of wall and ceiling cap, connection of wall and roof, tape at penetrating steel beams, pope and conduit penetrations, duct work penetrations, conductive sealant and gasket locations, and any other transitions in RF shielding between elements.

## 1.5 DELIVERY, STORAGE, AND HANDLING

Protect equipment delivered and stored from excessive humidity and temperature variation, dirt, and other contaminants.

## 1.6 PROJECT/SITE CONDITIONS

Perform welding of RF shielding material and sheet steel at an ambient temperature of 50 degrees F minimum to 90 degrees F. Do not install shielding until the building has been weather enclosed. Do not perform sheet steel welding in direct sunlight.

## 1.7 MAINTENANCE

### 1.7.1 Maintenance Supplies and Procedures

Provide maintenance supplies sufficient for a 3 year period or 50,000 open-close cycles, whichever is greater, for each RF shielded door. Prominently display maintenance instructions required to maintain the door through the cycle count nearby.

### 1.7.2 Extra Materials

#### 1.7.2.1 RF Shielded Doors

Furnish one set RF gaskets (if used) for each hinged RF shielded door provided. In addition, provide one set of manufacturer recommended and Contracting Officer approved spare parts for RF shielded doors of each style installed.

#### 1.7.2.2 Tools

Furnish one full set of tools that are required to maintain the doors and are not typically available from tool vendors. Furnish environmentally

safe lubricants, cleaning solvents, or coatings in sufficient quantities to last for 6 months.

1.7.2.3 Special Tools

Provide one set of special tools, calibration devices, and instruments required for operation, calibration, and maintenance of the equipment.

1.7.3 Operating and Maintenance Manuals

Submit manufacturer's written instructions for operation and maintenance of RF Shielding system. Address all components and aspects of the RF shielding and include, but not be limited to, the following:

a. A complete set of assembly drawings to include penetration locations and installation details.

b. The construction specification on RF shielding.

c. Shield penetration schedule.

d. Power/signal filter schedule.

e. Test plan.

f. The prepared preventive maintenance instructions for periodic inspection, testing and servicing, lubrication, alignment, calibration, and adjustment events normally encountered. Extract complex preventive maintenance events from or refer to detailed vendor or manufacturer data. Derive this information from an evaluation of engineering data considering local environmental conditions, manufacturer's recommendations, estimated operating life for the specific application and use of the equipment, and types of job skills available at the operating site.

g. Spare parts data approved and verified by the shielding specialist prior to submission. Include a complete list of recommended parts and supplies with current unit prices and source of supply.

PART 2 PRODUCTS

2.1 SYSTEM REQUIREMENTS

2.1.1 General

Provide shielded facility that meets or exceeds minimum attenuation decibel (dB) levels specified. The RF shielding system includes, but is not limited to, the following:

a. The RF shield foil membrane.

b. RF shielded doors for access into the facility.

c. Electrical and electronic penetrations of the shield.

d. RF filter/surge arrester assemblies, including their RF enclosures.

e. Special protective measures for mission-essential equipment outside the RF shield.

f. Structural penetrations.

g. Mechanical and utility penetrations (such as air ducts, gas, and water).

h. Instrumentation and control.

i. Equipment door/access panels.

j. Sufficient supervisory and/or quality control personnel onsite to supervise the installation crew and to conduct in-progress quality assurance tests.

2.1.2 Factory Tests

Perform factory tests as specified. The Contracting Officer reserves the right to witness the specified factory tests. Notify the Contracting Officer at least 30 days before factory tests are scheduled to be performed. Include a detailed description of the test instrumentation and equipment, including calibration dates, a detailed description of the test procedure, and the recorded test data.

2.2 MATERIALS AND EQUIPMENT

2.2.1 Standard Products

Provide materials and equipment which are the standard products of a manufacturer regularly engaged in the manufacture of such products and essentially duplicate items that have been in satisfactory use for at least 2 years prior to bid opening. Support equipment by a service organization that is, in the opinion of the Contracting Officer, reasonably convenient to the site.

2.2.2 Nameplates

For each major item of equipment, secure a plate with the manufacturer's name, address, type or style, model or serial number, and catalog number to the item of equipment.

2.2.3 Testability

Design and build equipment and materials of the shielding to facilitate testing and maintenance.

2.3 RF SHIELDING EFFECTIVENESS

Provide RF shielded enclosure complete with all filters, doors, and/or waveguides with the following minimum RF shielding effectiveness attenuation. Use minimum electromagnetic field attenuation of 50 dB from 10 MHz to 18 GHz.

2.4 RF SHIELD FOIL MEMBRANE SYSTEM

2.4.1 Shielding for Opaque Walls

RF Shielding material shall be a heavy duty radiant barrier sheet comprised of a layer of woven polyethelene or foil back gypsum board. Film to be perforated to allow for water vapor permeability.

Tape for seams shall be conductive adhesive tape as recommended by manufacture for shielding purposes. General purpose construction adhesive for foil contact to gypsum wall board, sheathing, steel plate, steel shapes, door frames, and concrete surfaces shall be as recommended by manufacturer.

2.4.2 Penetrations

Seal penetrations of the shield, including bolts or fasteners, with puddle welds or full circumferential RF materials. Provide structural penetrations including beams, columns, and other metallic structural elements with continuously welded or brazed seams and joints between the penetrating element and the shield. Nonmetallic structural elements are not allowed to penetrate the electromagnetic barrier.

2.4.3 Floor Finish

Cover floor with Vapor permeable RF shielding.

2.5 RF SHIELDED DOORS

2.5.1 General

Material in shielded doors and frames must be steel conforming to ASTM A36/A36M or ASTM A568/A568M and stretcher-leveled and installed free of mill scale. Use thicker metal where indicated or required for its use and purpose. Provide metal thresholds of the type for proper shielding at the floor. Provide fire rated shielded doors and assemblies meeting NFPA 80 and NFPA 80A requirements and bearing the identifying label of a nationally recognized testing agency qualified to perform certification programs. Provide RF shielded doors by a single supplier who has been regularly engaged in the manufacture of these items for at least the previous 5 years. Supply assemblies complete with a rigid structural frame, hinges, latches, and parts necessary for operation. Duplicate assemblies that have been in satisfactory use for at least 2 years. Provide door frame consisting of steel suitable for bolting to the surrounding structure and shield. Provide RF filters, RF waveguide penetrations for door systems, and miscellaneous material for a complete system. Provide nonsagging and nonwarping enclosure door. The RF shielded door must provide a shielding effectiveness listed in the shielding section.The RF shielded doors must be prepared to accept the necessary door hardware without compromising the RF shielding. See Section 08 71 00 DOOR HARDWARE for more information. The RF shielded doors must also meet the STC rating as scheduled, see Section 08 34 73 SOUND CONTROL ASSEMBLIES for more information.

2.5.1.1 Electric Connectivity

Provide conductive door gasketing from the door to the door frame. Provide tape from the door frame and the RF shielding as required and shown on the drawings.

2.5.2 RF Shielded Door Factory Test

Provide test data on at least one shielded door of each type provided for the facility to verify that the RF shielded doors of the design supplied have been factory tested for compliance with this specification. Do not furnish test doors on the project. Submit test data reports in accordance

with paragraph SUBMITTALS.

2.5.2.1 Radio Frequency Shielding Test

Factory test RF shielded door in accordance with the requirements of this specification both before and after the mechanical tests described above.

2.6 ELECTROMAGNETIC FILTERS

Provide a filter for each power line penetrating the shielded enclosure. These lines include, but are not limited to, power lines. Enclose filters in metallic cases which protect the filter elements from moisture and mechanical damage. Ensure all external bonding or grounding surfaces are free from insulating protective finishes. Protect all exposed metallic surfaces against corrosion by plating, lead-alloy coating, or other means. The finish must provide good electrical contact when used on a terminal or as a conductor, have uniform texture and appearance, be adherent, and free from blisters, pinholes and other defects. Insertion loss in the stop band between the load side of the filter and the power supply side must be no less than the RF shielding attenuation specified. Each filter unit must be capable of being mounted individually and include one filter for each phase conductor of the power line and the neutral conductor. Include one filter for each conductor.

2.6.1 Enclosure

Mount filter units in an RF modified NEMA Type 1 enclosure in accordance with NEMA ICS 6. Make enclosures of corrosion resistant steel of 14 gauge minimum thickness with welded seams and galvanized bulkhead cover plates. Finish enclosure nonconductive surfaces with a corrosion-inhibiting primer and two coats of baked or finish enamel. The input compartment must house the individual line filters and the input terminals. Space live parts in accordance with NFPA 70. Use copper filter leads. Test filter enclosures for shielding effectiveness in accordance with IEEE 299 and Table I of this specification.

2.6.1.1 Filter Unit Mounting

Mount each filter unit individually in an enclosure containing one filter for each penetrating conductor. Attach one end of the individual filter case to the RF barrier plate between the two compartments to provide an RF tight seal between the rf barrier plate and the filter case. The terminals of the filters must project through openings in the RF barrier plate into the inner terminal compartment. Attach the case of each filter to both the enclosure and to the barrier plate to prevent undue stress being applied to the RF seal between the filter case and the RF barrier plate. Individual filters must be removable from the enclosure. Like filters must be interchangeable.

2.6.1.2 Conduit Connections to Enclosures

Provide load terminal and input compartments without knockouts, and provide each compartment with weldable threaded conduit hubs. RF weld hubs circumferentially in place and size and locate as required for the conduits indicated.

2.6.1.3 Access Openings and Cover Plates

Provide enclosures with separate clear front access cover plates on

terminal and power input compartments. Provide access cover plates which are hinged with RF gaskets and 3 inch maximum bolt spacing. Include thick cover plates and folded enclosure edges to prevent enclosure deformation, bolt spacers to prevent uneven gasket compression, and gasket mounting to facilitate replacement. All gasket contact areas must be tin-plated using the electrodeposited type I method in accordance with ASTM B545. Permanently fasten nuts and bolts to the enclosure by welding or captive attachments.

2.6.1.4 Operating Temperature

Provide filter assembly which is rated for continuous operation, with filters at rated voltage and full-load currents, in ambient temperatures from minus 55 to plus 65 degrees C (measured outside the RF filter enclosure). Use filter components that are suitable for continuous full load operation at a temperature from minus 55 to plus 85 degrees C.

2.6.1.5 Short Circuit Withstand

Label and build filters to have standard minimum short circuit withstand ratings as follows:

| FILTER RATED CURRENT, RMS AMPERE | SHORT CIRCUIT FULL LOAD AMPERES SYMMETRICAL |
|---|---|
| 0-100 | 10,000 |
| 101-400 | 14,000 |

2.6.1.6 Filter Connections

Provide individual filters with prewired standoffs and solderless lugs. Provide hexagonal head bolt or screw type lugs conforming to UL 486A-486B. Space live parts in accordance with NFPA 70.

2.6.2 Internal Encapsulated Filters (Filter Units)

2.6.2.1 Filter Construction

Individual filters must be heavy-duty type sealed in a steel case. After the filter is filled with an impregnating or encapsulating compound, weld the seams. When a solid potting compound is used to fill the filter, the filters may be mechanically secured and sealed with solder. Use hermetically sealed impregnated capacitors, or vacuum impregnate the complete filter assembly. Fabricate individual filter cases of no less than 14 gauge thick steel and finish with a corrosion-resistant plating,or one coat of corrosion-resistant primer and two coats of finish enamel. Fill the filter with an impregnating or potting compound that is chemically inactive with respect to the filter unit and case. The compound, either in the state of original application or as a result of having aged, must have no adverse effect on the performance of the filter. Use the same material for impregnating as is used for filling. Use copper filter terminals that can withstand the pull requirements specified and measured in accordance with paragraph RADIO FREQUENCY FILTERS.

2.6.2.2 Ratings

Provide filters in the current, voltage, and frequency ratings indicated

on the drawings.

2.6.2.3 Voltage Drop

Voltage drop through the filter at operation frequency must not exceed 2 percent of the rated line voltage when the filter is fully loaded with a resistive load (unity power factor). Measure voltage drop in accordance with paragraph Voltage Drop Measurements.

2.6.2.4 Drainage of Stored Charge

Provide filters with bleeder resistors to drain the stored charge from the capacitors when power is shut off. Drain stored charge in accordance with NFPA 70.

2.6.2.5 Operating Temperature Range

Mount individual filters in the filter enclosure operating at full load amperage and rated voltage that do not exceed plus 185 degrees F based on an ambient temperature of 150 degrees F outside the filter enclosure.

2.6.2.6 Harmonic Distortion

Harmonics generated by the insertion of a filter must not increase line voltage distortion more than 2.5 percent when measured with a unity power factor in accordance with the paragraph RADIO FREQUENCY FILTERS.

2.6.3 Marking of Filter Units

Mark each filter case with the rated current, rated voltage, manufacturer s name, type of impregnating or potting compound, operating frequency, and model number. In addition, provide individual filter cases, the filter enclosures, and supply and load panelboards of filtered circuits marked by the manufacturer with the following: "WARNING: Before working on filters, terminals must be temporarily grounded to ensure discharge of capacitors. Attach nameplates and warning labels securely.

2.6.4 Minimum Life

Design filter assemblies for a minimum service life of 15 years. Submit filter schedule including voltage, amperage, enclosure type (low, high, band pass), location, cut-off frequency, and band pass frequencies.

2.6.5 Power and Signal Line Factory Testing

Submit factory test report data for each filter configuration, voltage, and amperage which shows the ability of filters to meet the specified requirements. Base filter test reports on prior tests of the same filter assembly design and components. Submit test data reports in accordance with paragraph SUBMITTALS. Include the following in the test data:

a. Voltage Drop Measurements.

b. Insertion Loss Measurements.

c. Terminals.

2.6.5.1 Voltage Drop Measurements

Perform voltage drop measurements on filters with the components mounted in the filter assembly enclosure or mounted on a metal plate by the same holding method that will be used for mounting in the enclosure. Make measurements by using expanded scale-type meters.

2.6.5.2 Insertion Loss Measurements

Insertion loss measurements for power filters must have the following modifications. Install filters in the filter assembly enclosure. Operate load current power supply at the rated voltage of the filters and provide any current from no-load through rated full-load current. The rf signal generator must be a swept continuous wave (cw) source. Modify buffer networks to permit valid measurements over the entire frequency band on which insertion loss requirements are specified (14 kHz-1 Ghz). Provide receiver or network analyzer capable of operating over the entire frequency band on which insertion loss requirements are specified (14 kHz-1 Ghz). Use adequate sensitivity to provide a measurement dynamic range at least 10 dB greater than the insertion loss requirement. Use resistive load impedance which is capable of dissipating the rated full-load filter current. Make insertion loss measurements at 20 percent, 50 percent, and 100 percent of the filter full-load operating current. Do not perform load insertion loss measurements over the frequencies defined in the RF shielding effectiveness attenuation requirements for power filters. Perform load to source testing for TEMPEST.

2.6.5.3 Terminals Pull Test

The purpose of this test is to determine whether the design of the filter terminals can withstand the mechanical stresses to which they will be subjected during installation or disassembly in equipment. Perform testing with the components mounted in the filter assembly enclosure or mounted on a plate by the same holding method that will be used for mounting in the enclosure. Apply a force of 20 pounds to the terminal. The point of application of the force and the force applied must be in the direction of the axes of the terminations. Apply force gradually to the terminal and maintain for a period of 5 to 10 seconds. Check the terminals before and after the pull test for poor workmanship, faulty designs, inadequate methods of attaching of the terminals to the body of the part, broken seals, cracking of the materials surrounding the terminals, and the changes in electrical characteristics such as shorted or interrupted circuits. Measurements are to be made before and after the test.

2.7 PENETRATION PLATES

Provide penetration plates that are minimum 1/4 inch thick and sized as shown on the drawings. The penetration plate must overlap the shield penetration cutout dimension by a minimum of 6 inch on each side. Bolt the penetration plate to the shield with bolts 3 inch on center.

2.8 GALVANIZING

Galvanizing, when practical and not otherwise indicated, must be hot-dipped processed after fabrication. Galvanizing must be in accordance with ASTM A123/A123M, or ASTM A653/A653M, as applicable. Exposed fastenings must be galvanically compatible material. Avoid electrolytic couples and dissimilar metals that tend to seize or gall.

## 2.9 SECURITY BARS

Provide Security bars for all ventilation penetration exceeding 96 square inches or with any dimension 6 inches or greater. Submit detailed drawings of security bars. Security bars shall be a minimum of 1/2 inch diameter hardened steel, welded vertically and horizontally 6 inches on center; a deviation of 1/2 inch in vertical and/or horizontal spacing is permissible. An access door shall be installed inside the secure perimeter to allow visual inspection of the bars.

## 2.10 DUCTWORK PENETRATIONS

RF-shielded penetrations of HVAC ductwork shall be equipped with honeycomb waveguide vents that provide minimum electric field and plane wave attenuation indicated in paragraph RF SHIELDING EFFECTIVENESS. Waveguide construction shall be brass or steel core with a galvanized steel duct flange or sleeve as indicated. Waveguide connection to the duct shall be made via non-metallic flex connector so as not to defeat the grounding requirement. The ductwork to be installed inside of the enclosure shall be connected directly to the waveguide vent and as indicated. Frame the rough openings larger in both dimensions than the required sizes. Static pressure drop through waveguide assembly shall not exceed 0.1 inches w.g. at air velocity of 1,200 feet per minute.

# PART 3 EXECUTION

## 3.1 EXAMINATION

After becoming familiar with all details of the work, verify dimensions in the field, and advise the Contracting Officer of any discrepancy before performing the work.

## 3.2 INSTALLATION

### 3.2.1 Coordination

The RF shielding installer must instruct other trades in the presence and with the direction of the Government representative, in advance of the RF shielding system installation, to ensure that all individuals are aware of the critical installation requirements. Submit manufacturer's data, catalog cuts, and printed documentation regarding the work. Provide cleaners, solvents, coatings, finishes, physical barriers, and door threshold protectors as required to protect the shielding system from corrosion, damage, and degradation. Oblation approval of the shielding installation plan before construction begins.

### 3.2.2 Verification

Before, during, and after the RF shielding and penetration protection subsystem installation, the shielding specialist must verify and approve the installation for compliance with the specifications. Provide materials and methods, shop drawings, and other items for the shielding subsystem bearing an approval stamp of the shielding specialist. Provide compliance notification to the Contracting Officer before materials are installed or methods performed.

3.2.3 Inspection

During and after RF shielding and penetration protection subsystem installation, including RF filters and waveguides, a qualified shielding specialist must inspect the installation for compliance with the specifications. Complete the inspection before a finish or concrete topping coat is installed.

3.2.4 Manufacturer's Services

Provide the services of a manufacturer's representative who is experienced in the installation, adjustment, and operation of the equipment specified. Supervise the installation, adjustment, and testing of the equipment.

3.2.5 Posting Framed Instructions

Post framed instructions containing wiring and control diagrams under glass or in laminated plastic. Frame condensed operating instructions, prepared in typed form, as specified above and post beside the diagrams before acceptance testing of the system.

3.3 RF SHIELD FOIL MEMBRANE SYSTEM INSTALLATION

Install the RF shielded foil membrane system in accordance with this specification, the drawings, and the recommendations of the manufacturer and EM shielding specialist. Handle and install shielding foil membrane system without damage. Penetrations of the shield, other than those indicated on the drawings, will not be permitted, including fasteners and mounting bolts, without prior written authorization from the RSS and CTTA.

3.3.1 Surface Preparation

Clean and buff contacting surfaces to ensure firm contact with shielding foil membrane system. Remove all sharp edges on corners, edges, and transition points where the membrane is applied to ensure the membrane is not punctured during or after the installation.

3.3.2 Installation on Opaque Surfaces

Unroll RF shielding and cut to appropriate length. Cut 12 inches longer than surface to be covered. Apply to gypsum wall board, sheathing, steel plate, steel shapes, and door frame assemblies with approved adhesive or manufacturer conductive adhesive tape. Overlap joints by a minimum of 6 inches. Seal all seams and edges with manufacturer conductive adhesive tape. Extend RF shielding to top of wall and at least 6 inches on to underside of ceiling cap. Extent RF shielding to bottom of wall and at least 6 inches on to floor RF shielding. Provide penetrations as detailed on drawings with a minimum of 6 inches overlap.

3.4 SHIELDING PENETRATION INSTALLATION

Install penetrations in accordance with requirements of the penetration schedule and coordinate with system installation.

a. Where penetrations are encountered (i.e., conduits, pipes, structural steel members, HVAC, etc.) conductive tape shall be installed from the duct/pipe surface onto the foil shielding for 6 inches onto both surfaces. Provide grounding wires on the secure side of the duct/pipe

to ground bar within room.

b. A distance of 8 inches minimum shall be maintained between each penetration and adjoining penetrations, walls, floor, ceiling or structural elements. This distance is required for shielding to penetration decoupage sealing.

c. Non-metallic piping (i.e., plastic drain lines, chemical piping, etc.) shall be covered with conductive foil tape for a distance of 6 inches from the pipe surface onto the foil shielding. No grounding wires are required.

d. All conduits and pipes shall be rigidly fastened at the point of shielding penetration, mounting hardware to be placed on unshielded side (use conduit strap, channel, studs, blocking, etc., as required).

## 3.5 PENETRATION INSPECTION

Request and receive the Construction Engineer's approval of all penetrations. Failure to receive this approval may be cause for rejection and subsequent replacement at the Contractor's expense.

## 3.6 FIELD QUALITY CONTROL

Develop a quality control plan to ensure compliance with contract requirements; maintain quality control records for construction operations required under this section; and submit the quality control plan to the Contracting Officer. Furnish a copy of testing records, as well as the records of corrective actions taken. Perform in-progress and final acceptance testing of RF shielding and penetration protection system work as specified. Correct deficiencies at no additional cost to the Government. Maintain legible copies of the daily inspection reports by the shielding specialist at the project site, and deliver copies of the Construction Quality Control Report to the Contracting Officer on the third workday following the date of the report. Include the type of work being performed during the report period and locations, type of testing, deficiencies, corrective actions, unsolved problems, and recommendations to assure adequate quality control in the daily inspections. Attach results of inspections and tests performed in accordance with this specification to the daily Construction Quality Control Report.

## 3.7 FIELD TRAINING

Provide a field training course for designated operating and maintenance staff members. Provide training for a total period of 8 hours of normal working time and start after the system is functionally complete but prior to the final acceptance test. Cover all the items contained in the Operating and Maintenance Manuals.

## 3.8 SHIELDING QUALITY CONTROL

Integrate the Contractor's organizational structure for shielding quality control into the jobsite management. Perform testing by an independent testing firm.

### 3.8.1 Hardness Critical Item Schedule

Identify hardness critical items during the detail drawing submittal period. These items are those components and/or construction features

which singularly and collectively provide specified levels of HEMP protection, such as the RF shield, surge arresters, RF shielded doors, shield welding, electrical filters, honeycomb waveguides, and waveguides-below-cutoff.

3.8.1.1 Performance Test Plan by Independent Testing Firm

Independent testing firm to submit a performance test plan for Contracting Officer approval. Accomplish testing in three parts: (1) in-progress; (2) initial shielded enclosure effectiveness; and (3) final acceptance, shield enclosure effectiveness. Include in the test plan equipment listings (including calibration dates and antenna factors) and the proposed test report format. Also include specific test dates and durations during the overall construction period so that the Contracting Officer may be scheduled to observe the testing and so that repairs may be made to the shield and retests conducted. This separate testing schedule for the RF enclosure must show the points, during construction, when it begins and ends as well as a day-by-day test schedule. Indicate proposed dates and duration of lowest and highest frequency tests so that the Contracting Officer may be available for these final acceptance tests. Identify a test grid and provide plan for correlation of that grid to the structure.

3.8.1.2 Test Reports by Independent Testing Firm

Include the method of testing, equipment used, personnel, location of tests, and test results. Submit daily reports of results of each test performed on each portion of the shielding system to the Contracting Officer within 3 working days of the test. Clearly identify location of the area tested. Identify leaks detected during testing with sufficient accuracy to permit relocation for testing in accordance with test procedures. Submit reports of testing to the Contracting Officer with required certification by the testing agency representative or consultant. Submit three reports (in-progress test report, initial test report, and final acceptance test report) in accordance with the format described below.

Cover Page:
A cover page is required.

Administrative Data:
Test personnel.
Contract number.
Date of test.

Authentication:
Contractor personnel responsible for performance of the tests and witnessing organization or representatives.

Contents:
Shielded facility description.
Nomenclature of measurement equipment.
Serial numbers of measurement equipment.
Date of last calibration of measurement equipment.
Type of test performed.
Measured level of reference measurements and ambient level at each frequency and test point.
Measured level of attenuation in decibels at each frequency and test point.

Dynamic range at each test frequency and test point.
Test frequencies.
Location on the shielded enclosure of each test point.
Actual attenuation level at each test point.

Conclusions:
Include results of the tests in brief narrative form in this section.

Number of Copies of the Report:
Three copies.

## 3.9 GROUNDING

The contract drawings indicate the extent and general arrangement of the shielded enclosure grounding system. The grounding methods must be an equipotential grounding plane method in accordance with UL 1283, NFPA 70, NFPA 77, NFPA 780, IEEE 142, MIL-STD-188-124, and MIL-HDBK-419. For additional facility grounding requirements, see Section 26 20 00 INTERIOR DISTRIBUTION SYSTEM.

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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 | (2021) Malleable Iron Threaded Fittings, Classes 150 and 300 |
| ASME B16.4 | (2021) Gray Iron Threaded Fittings; Classes 125 and 250 |
| ASME B16.21 | (2021) Nonmetallic Flat Gaskets for Pipe Flanges |

AMERICAN SOCIETY OF SANITARY ENGINEERING (ASSE)

| | |
|---|---|
| ASSE 1015 | (2021) Performance Requirements for Double Check Backflow Prevention Assemblies |

AMERICAN WATER WORKS ASSOCIATION (AWWA)

| | |
|---|---|
| AWWA C104/A21.4 | (2022) Cement-Mortar Lining for Ductile-Iron Pipe and Fittings for Water |
| AWWA C110/A21.10 | (2021) Ductile-Iron and Gray-Iron Fittings |
| 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 2022; E 2022) Standard Specification for Ferritic Malleable Iron Castings |
| ASTM A53/A53M | (2024) 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 (2023) Standard Specification for Zinc Coating (Hot-Dip) on Iron and Steel Hardware

ASTM A183 (2014; R 2020) Standard Specification for Carbon Steel Track Bolts and Nuts

ASTM A536 (1984; R 2019; E 2019) Standard Specification for Ductile Iron Castings

FM GLOBAL (FM)

FM APP GUIDE (updated on-line) Approval Guide http://www.approvalguide.com/

INTELLIGENCE COMMUNITY STANDARD (ICS)

ICS 705-1 (2010) Physical and Technical Security Standard for Sensitive Compartmented Information Facilities

MANUFACTURERS STANDARDIZATION SOCIETY OF THE VALVE AND FITTINGS INDUSTRY (MSS)

MSS SP-71 (2018) Gray Iron Swing Check Valves, Flanged and Threaded Ends

NATIONAL FIRE PROTECTION ASSOCIATION (NFPA)

NFPA 13 (2022; ERTA 3 2022) Standard for the Installation of Sprinkler Systems

NFPA 24 (2022) Standard for the Installation of Private Fire Service Mains and Their Appurtenances

NFPA 291 (2022) Recommended Practice for Fire Flow Testing and Marking of Hydrants

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

U.S. DEPARTMENT OF DEFENSE (DOD)

UFC 3-600-01 (2016; with Change 6, 2021) Fire Protection Engineering for Facilities

| | |
|---|---|
| 796 CEOFA | (Oct 2023) Eglin AFB Fire Alarm and Suppression Specific Requirements for New Installation |

UNDERWRITERS LABORATORIES (UL)

| | |
|---|---|
| UL 193 | (2016) UL Standard for Safety Alarm Valves for Fire-Protection Service |
| UL 199 | (2020) UL Standard for Safety Automatic Sprinklers for Fire-Protection Service |
| UL 312 | (2022) UL Standard for Safety Check Valves for Fire-Protection Service |
| UL 405 | (2013; Bul. 2020) UL Standard for Safety Fire Department Connection Devices |
| UL 668 | (2004; Reprint Oct 2021) UL Standard for Safety Hose Valves for Fire-Protection Service |
| UL Fire Prot Dir | (2024) Fire Protection Equipment Directory |

## 1.2 SYSTEM DESCRIPTION

Provide wet pipe sprinkler system in all areas of the building. Except as modified herein, the system must meet the requirements of NFPA 13, UFC 3-600-01, and 796 CEOFA. Pipe sizes which are not indicated on the Contract drawings must be determined by hydraulic calculations.

### 1.2.1 Hydraulic Design

#### 1.2.1.1 Basis for Calculations

A waterflow test was performed on March 29, 2024 at LRSO Nomad and resulted in a static pressure of 40 psi with a residual pressure of 36 psi while flowing 865 gpm. Perform a fire hydrant flow test prior to shop drawing submittal in accordance with NFPA 291. Results must include hydrant elevations relative to the building and hydrant number/identifiers for the tested hydrants, including which were flowed, which had a gauge. This information must be presented in a tabular form if multiple hydrants were flowed. The results must be included with the hydraulic calculations. Hydraulic calculations must be based on flow test noted in this paragraph, unless verified by the Government Fire Protection Engineer and approved by Contracting Officer. Hydraulic calculations must be based upon the Hazen-Williams formula with a "C" value noted in NFPA 13 for piping, and 100 for existing underground piping. Hydraulic calculations must be based on operation of the fire pump provided in Section 21 30 10 FIRE PUMPS WITH DEDICATED ENCLOSURE. .

#### 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. 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.

e. 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.

f. 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 fire hydrant shown on the drawings closest to the point where the water service enters the building.

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

Alarm 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

Document Storage Cabinet; 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 30 days prior to commencing work on site, the prime Contractor must submit the following for review and approval. SD-02, SD-03 and SD-05 submittals received prior to the review and approval of the qualifications will be returned Disapproved Without Review.

1.4.1.1 Shop Drawing

Three copies of the shop drawings, no later than 28 days prior to the start of system installation. Working drawings conforming to the requirements prescribed in NFPA 13 and must be no smaller than the Contract Drawings. Each set of drawings must include the following:

a. A descriptive index with drawings listed in sequence by number. A legend sheet identifying device symbols, nomenclature, and conventions used in the package.

b. Floor plans drawn to a scale not less than 1/8-inch equals 1-foot clearly showing locations of devices, equipment, risers, and other details required to clearly describe the proposed arrangement.

c. Actual center-to-center dimensions between sprinklers on branch lines and between branch lines; from end sprinklers to adjacent walls; from walls to branch lines; from sprinkler feed mains, cross mains and branch lines to finished floor and roof or ceiling. A detail must show the dimension from the sprinkler and sprinkler deflector to the ceiling in finished areas.

d. Longitudinal and transverse building sections showing typical branch line and cross main pipe routing, elevation of each typical sprinkler above finished floor and elevation of "cloud" or false ceilings in relation to the building ceilings.

e. Plan and elevation views which establish that the equipment will fit the allotted spaces with clearance for installation and maintenance.

f. Riser layout drawings drawn to a scale of not less than 1/2-inch equals 1-foot to show details of each system component, clearances between each other and from other equipment and construction in the room.

g. Details of each type of riser assembly, pipe hanger, 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.

i. Include fire pump curve with shop drawings and hydraulic calculations.

1.4.1.2 Product Data

Three copies of annotated catalog data to show the specific model, type, and size of each item. Catalog cuts must also indicate the NRTL listing. The data must be highlighted to show model, size, options, and other pertinent information, that are intended for consideration. Data must be adequate to demonstrate compliance with all contract requirements. Product data for all equipment must be combined into a single submittal.

1.4.1.3 Hydraulic Calculations

Calculations must be as outlined in NFPA 13 except that calculations must be performed by computer using software intended specifically for fire protection system design using the design data shown on the drawings. Calculations must include isometric diagram indicating hydraulic nodes and pipe segments. Include fire pump curve with submittal.

1.4.1.4 Operating and Maintenance (O&M) Instructions

Submit in accordance with Section 01 78 23 OPERATION AND MAINTENANCE DATA as supplemented and modified by this specification section.

Provide six manuals and one pdf version on electronic media. The manuals must include the manufacturer's name, model number, parts list, list of parts and tools that should be kept in stock by the owner for routine maintenance, troubleshooting guide, and recommended service organization (including address and telephone number) for each item of equipment.

Submit spare parts data for each different item of material and equipment specified. The data must include a complete list of parts and supplies, and a list of parts recommended by the manufacturer to be replaced after 1-year and 3 years of service. Include a list of special tools and test equipment required for maintenance and testing of the products supplied.

1.4.2 Qualifications

1.4.2.1 Sprinkler System Designer

The sprinkler system designer must be certified as a Level III Technician by National Institute for Certification in Engineering Technologies (NICET) in the Water-Based Systems Layout subfield of Fire Protection Engineering Technology in accordance with NICET 1014-7.

1.4.2.2 Sprinkler System Installer

The sprinkler system installer must be regularly engaged in the installation of the type and complexity of system specified in the contract documents, and must have served in a similar capacity for at least three systems that have performed in the manner intended for a period of not less than 6 months.

1.4.3 Regulatory Requirements

Equipment and material must be listed or approved. Listed or approved, as used in this Section, means listed, labeled or approved by a Nationally Recognized Testing Laboratory (NRTL) such as UL Fire Prot Dir or FM APP GUIDE. The omission of these terms under the description of an item or equipment described must not be construed as waiving this requirement. All listings or approvals by testing laboratories must be from an existing ANSI or UL published standard. The recommended practices stated in the manufacturer's literature or documentation are mandatory requirements.

1.5 DELIVERY, STORAGE, AND HANDLING

Protect all equipment delivered and placed in storage from the weather, excessive humidity and temperature variations, dirt and dust, or other contaminants. All pipes must be either capped or plugged until installed.

## 1.6 EXTRA MATERIALS

Spare sprinklers and wrench(es) must be provided as spare parts in accordance with NFPA 13.

# PART 2 PRODUCTS

## 2.1 MATERIALS AND EQUIPMENT

### 2.1.1 Standard Products

Provide materials, equipment, and devices listed for fire protection service when so required by NFPA 13 or this specification. Select material from one manufacturer, where possible, and not a combination of manufacturers, for a classification of material. Material and equipment must be standard products of a manufacturer regularly engaged in the manufacture of the products for at least 2 years prior to bid.

### 2.1.2 Nameplates

Major components of equipment must have the manufacturer's name, address, type or style, model or serial number, catalog number, date of installation, installing Contractor's name and address, and the contract number provided on a new name plate permanently affixed to the item or equipment. Nameplates must be etched metal or plastic, permanently attached by screws to control units, panels or adjacent walls.

### 2.1.3 Identification and Marking

Pipe and fitting markings must include name or identifying symbol of manufacturer and nominal size. Pipe must be marked with ASTM designation. Valves and equipment markings must have name or identifying symbol of manufacturer, specific model number, nominal size, name of device, arrow indicating direction of flow, and position of installation (horizontal or vertical), except if valve can be installed in either position. Markings must be included on the body casting or on an etched or stamped metal nameplate permanently on the valve or cover plate.

### 2.1.4 Pressure Ratings

Valves, fittings, couplings, alarm switches, and similar devices must be rated for the maximum working pressures that can be experienced in the system, but in no case less than 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 Schedule 40 only.

2.3.1.2 Fittings

Fittings must be welded, threaded, or grooved-end type. Threaded fittings must be cast-iron conforming to ASME B16.4, malleable-iron conforming to ASME B16.3 or ductile-iron conforming to ASTM A536. Plain-end fittings with mechanical couplings, fittings that use steel gripping devices to bite into the pipe, steel press fittings and field welded fittings are not permitted. Fittings, mechanical couplings, and rubber gaskets must be supplied by the same manufacturer. Threaded fittings must use Teflon tape or manufacturer's approved joint compound. Reducing couplings are not permitted except as allowed by NFPA 13.

2.3.1.3 Grooved Mechanical Joints and Fittings

Joints and fittings must be designed for not less than 175 psi service and the product of the same manufacturer. Field welded fittings must not be used. Fitting and coupling housing must be malleable-iron conforming to ASTM A47/A47M, Grade 32510; ductile-iron conforming to ASTM A536, Grade 65-45-12. Rubber gasketed grooved-end pipe and fittings with mechanical couplings are permitted in pipe sizes 2 inches and larger. Gasket must be the flush type that fills the entire cavity between the fitting and the pipe. Nuts and bolts must be heat-treated steel conforming to ASTM A183 and must be cadmium-plated or zinc-electroplated.

2.3.1.4 Flanges

Flanges must conform to NFPA 13 and ASME B16.1. Gaskets must be non-asbestos compressed material in accordance with ASME B16.21, 1/16-inch thick, and full face or self-centering flat ring type.

2.3.2 Pipe Hangers and Supports

Provide galvanized pipe hangers, supports and seismic bracing in accordance with NFPA 13. Design and install seismic protection in accordance with the requirements of NFPA 13 section titled "Protection of Piping Against Damage Where Subject to Earthquakes for Seismic Design Category "D".

2.3.3 Valves

Provide valves of types approved for fire service. Valves must open by counterclockwise rotation.

2.3.3.1 Control Valve

Manually operated sprinkler control/gate valve must be as indicated on the drawings and must be listed.

2.3.3.2 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 2 inches.

2.3.3.3 Hose Valve

Valve must comply with UL 668.

2.3.4 Alarm Check Valves

Provide variable pressure type alarm check valve, standard trim piping, pressure gauges, bypass, retarding chamber, testing valves, and main drain, and other components as required for a fully operational system. Alarm valves must comply with UL 193.

2.4 ALARM INITIATING AND SUPERVISORY DEVICES

2.4.1 Sprinkler Alarm Switch

Vane or pressure-type flow switch(es) as indicated on the drawings. Vane type alarm actuating devices must have mechanical diaphragm controlled retard device adjustable from 10 to 60 seconds and must instantly recycle.

Furnish water motor gong on exterior of Fire Riser Room.

2.4.2 Valve Supervisory (Tamper) Switch

Switch shall provide mechanical (visual) and electrical supervision that the valve is in its proper orientation. A cable that wraps into the wheel and frame and plugs into the electronic unit shall be utilized. 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 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 flush 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 not permitted.

### 2.7.1 Pendent Sprinkler

Pendent sprinkler must be quick-response type. Assembly must include an integral escutcheon.

### 2.7.2 Upright Sprinkler

Upright sprinkler must be quick response type.

## 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 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.

### 2.8.3 Sprinkler Guard

Listed guard must be a steel wire cage designed to encase the sprinkler

and protect it from mechanical damage. Guards must be provided on sprinklers located within 7 feet of the floor.

2.8.4 Relief Valve

Relief valves must be listed and installed at the riser in accordance with NFPA 13.

2.8.5 Air Vent

Air vents must be of the automatic type and piped to drain to the building exterior.

2.8.6 Identification Sign

Valve identification sign must be minimum 6 inches wide by 2 inches high with enamel baked finish on minimum 18 gage steel or 0.024-inch aluminum with red letters on a white background or white letters on red background. Wording of sign must include, but not be limited to "main drain", "auxiliary drain", "inspector's test", "alarm test", "alarm line", and similar wording as required to identify operational components. Where there is more than one sprinkler system, signage must include specific details as to the respective system.

PART 3 EXECUTION

3.1 VERIFYING ACTUAL FIELD CONDITIONS

Before commencing work, examine all adjoining work on which the contractor's work that is dependent for perfect workmanship according to the intent of this specification section, and report to the Contracting Officer's Representative a condition that prevents performance of first class work. No "waiver of responsibility" for incomplete, inadequate or defective adjoining work will be considered unless notice has been filed before submittal of a proposal.

3.2 INSTALLATION

The installation must be in accordance with the applicable provisions of NFPA 13, NFPA 24 and publications referenced therein. Locate sprinklers in a consistent pattern with ceiling grid, lights, and air supply diffusers. Install sprinkler system over and under ducts, piping and platforms when such equipment can negatively affect or disrupt the sprinkler discharge pattern and coverage.

a. Piping offsets, fittings, and other accessories required must be furnished to provide a complete installation and to eliminate interference with other construction.

b. Wherever the contractor's work interconnects with work of other trades the Contractor must coordinate with other Contractors to insure all Contractors have the information necessary so that they may properly install all necessary connections and equipment. Identify all work items needing access (dampers and similar equipment) that are concealed above hung ceilings by permanent color coded pins/tabs in the ceiling directly below the item.

c. Provide required supports and hangers for piping, conduit, and equipment so that loading will not exceed allowable loadings of

structure. Submittal of a bid must be a deemed representation that the contractor submitting such bid has ascertained allowable loadings and has included in his estimates the costs associated in furnishing required supports.

3.2.1 Waste Removal

At the conclusion of each day's work, clean up and stockpile on site all waste, debris, and trash which may have accumulated during the day as a result of work by the contractor and of his presence on the job. Sidewalks and streets adjoining the property must be kept broom clean and free of waste, debris, trash and obstructions caused by work of the contractor, which will affect the condition and safety of streets, walks, utilities, and property.

3.3 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 3 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. 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.

c. 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 not greater than 6 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

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. 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.

c. An auxiliary drain must be provided at the most remote point in the system and piped to the exterior of the facility.

3.4.13 Air Vents

For every 10,000 square feet of wet fire suppression sprinkler system coverage install one air vent at the highest pointn downstream of each flow switch and each pressure switch. In order to effectively accomplish venting, it is necessary to choose a location where the greatest volume of trapped air is vented during the first fill and each subsequent drain and fill event. The vent connection to the system should be located off the top of horizontal piping at a high point in the system.

3.4.14 Installation of Fire Department Connection

Connection must be mounted on the exterior wall not llower than 3 feet and not highre than 4 feet.. 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.

3.4.15 Identification Signs

Signs must be affixed to each control valve, inspector test valve, main drain, auxiliary drain, test valve, and similar valves as appropriate or as required by NFPA 13. Main drain test results must be etched into main drain identification sign. Hydraulic design data must be etched into the nameplates and permanently affixed to each sprinkler riser as specified in NFPA 13. Provide labeling on the surfaces of all feed and cross mains to show the pipe function (e.g., "Sprinkler System", "Fire Department Connection", "Standpipe") and normal valve position (e.g. "Normally Open", "Normally Closed"). For pipe sizes 4-inch and larger provide white painted stenciled letters and arrows, a minimum of 2 inches in height and visible from at least two sides when viewed from the floor. For pipe sizes less than 4-inch, provide white painted stenciled letters and arrows, a minimum of 0.75-inch in height and visible from the floor.

3.4.16 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.

Locate the document storage cabinet adjacent to the sprinkler riser.

3.5 ELECTRICAL

Except as modified herein, electric equipment and wiring must be in accordance with Section 26 20 00 INTERIOR DISTRIBUTION SYSTEM.

3.6 PAINTING

Color code mark piping red.

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 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 installation fire alarm reporting system have been completed and tested to confirm communications are fully functional. Submit request for test at least 30 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. Marked-up red line drawings of the system as actually installed.

Government Final Tests will be witnessed by the 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. All testing must be conducted with Contractor supplied gauges complete with certification of calibration.

3.8.1 Site Specific Testing Requirements

The Eglin Resident Office utilizes a three-phase testing and inspection process for life safety systems included in this project.

Phase 1: Contractor testing and inspection: The Contractor tests and inspects the system and notes any issues. When the issues from the Contractor testing and inspection are addressed, the contractor

notifies the COR and requests a pre-test and pre-final inspection.

Phase 2: COR pre-test and pre-final inspection: At this time, the Contractor will be required to have all redlines, O&Ms, and test reports submitted to the COR. This pre-test and pre-final inspection will be conducted in the same manner as the final acceptance test and inspection. the COR performs the test and inspection and notes any issues. When the issues from the COR pre-test and pre-final inspection are addressed, the COR is requested to verify.

Phase 3: AHJ Notification: Once the COR has verified that the issues from the pre-test and pre-final inspection have been addressed, the Contractor requests a notification be provided to the AHJ. this notification must be a minimum of 14 days.

3.8.2 Underground Piping

3.8.2.1 Flushing

Underground piping must be flushed at a minimum of 10 fps in accordance with NFPA 24.

3.8.2.2 Hydrostatic Test

New underground piping must be hydrostatically tested in accordance with NFPA 24.

3.8.3 Aboveground Piping

3.8.3.1 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.

3.8.3.2 Flow Testing

The acceptance test required by NFPA 13 shall be completed immediately after draining completely and re-filling the wet fire suppression system. The air vents shall vent enough air to allow the flow switch to activate within the required 90 seconds immediately after re-filling the system. Venting the air by any other means is prohibited. Reducing the delay on the flow switch below 30 seconds is prohibited.

3.8.3.3 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.

3.8.4 Main Drain Flow Test

Following flushing of the underground piping, a main drain test must be made to verify the adequacy of the water supply. Static and residual pressures must be recorded on the certificate specified in paragraph SUBMITTALS.

3.9 SYSTEM ACCEPTANCE

Following acceptance of the system, as-built drawings and O&M manuals must be delivered to the Contracting Officer for review and acceptance. Submit six sets of detailed as-built drawings. The drawings must show the system as installed, including deviations from both the project drawings and the approved shop drawings. These drawings must be submitted within two weeks after the final acceptance test of the system. At least one set of as-built (marked-up) drawings must be provided at the time of, or prior to the final acceptance test.

a. Provide 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 --

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SECTION 21 22 00

CLEAN AGENT FIRE EXTINGUISHING SYSTEM
**05/11**

PART 1 GENERAL

1.1 REFERENCES

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

AMERICAN SOCIETY OF MECHANICAL ENGINEERS (ASME)

| | |
|---|---|
| ASME B16.11 | (2022) Forged Fittings, Socket-Welding and Threaded |
| ASME B16.3 | (2021) Malleable Iron Threaded Fittings, Classes 150 and 300 |

ASTM INTERNATIONAL (ASTM)

| | |
|---|---|
| ASTM A106/A106M | (2019a) Standard Specification for Seamless Carbon Steel Pipe for High-Temperature Service |
| ASTM A53/A53M | (2024) Standard Specification for Pipe, Steel, Black and Hot-Dipped, Zinc-Coated, Welded and Seamless |

U.S. DEPARTMENT OF DEFENSE (DOD)

| | |
|---|---|
| UFC 3-310-04 | (2013) Seismic Design of Buildings |
| UFC 3-600-01 | (2016; with Change 6, 2021) Fire Protection Engineering for Facilities |
| 796 CEOFA | (Oct 2023) Eglin AFB Fire Alarm and Suppression Specific Requirements for New Installation |

MANUFACTURERS STANDARDIZATION SOCIETY OF THE VALVE AND FITTINGS INDUSTRY (MSS)

| | |
|---|---|
| MSS SP-58 | (2018) Pipe Hangers and Supports - Materials, Design and Manufacture, Selection, Application, and Installation |

NATIONAL FIRE PROTECTION ASSOCIATION (NFPA)

| | |
|---|---|
| NFPA 2001 | (2022) Standard on Clean Agent Fire Extinguishing Systems |
| NFPA 70 | (2026) National Electrical Code |
| NFPA 72 | (2022; ERTA 22-1) National Fire Alarm and Signaling Code |

U.S. DEPARTMENT OF DEFENSE (DOD)

U.S. GENERAL SERVICES ADMINISTRATION (GSA)

| | |
|---|---|
| CID A-A-58092 | (Basic; Notice 1; Notice 2) Tape, Antiseize, Polytetrafluoroethylene |

UNDERWRITERS LABORATORIES (UL)

| | |
|---|---|
| UL 1242 | (2006; Reprint Apr 2022) UL Standard for Safety Electrical Intermediate Metal Conduit -- Steel |
| UL 268 | (2023) UL Standard for Safety Smoke Detectors for Fire Alarm Systems |
| UL 38 | (2023; Revision July 2023) Manual Signaling Boxes for Fire Alarm Systems |
| UL 6 | (2022) UL Standard for Safety Electrical Rigid Metal Conduit-Steel |
| UL 797 | (2007; Reprint Apr 2023) UL Standard for Safety Electrical Metallic Tubing -- Steel |
| UL 864 | (2023) UL Standard for Safety Control Units and Accessories for Fire Alarm Systems |

## 1.2 GENERAL REQUIREMENTS

### 1.2.1 Description of Work

The work includes the designing and providing of approved Clean Agent total flooding extinguishing systems for protection of rooms indicated on the drawings. The design, equipment, materials, installation and workmanship shall be in strict accordance with the required and advisory provisions of UFC 3-600-01, 796 CEOFA, and NFPA 2001, except as modified herein. Each system shall include all materials, accessories and equipment necessary to provide each system complete and ready for use. Design and install each system to give full consideration to built-in spaces, piping, electrical equipment, ductwork and all other construction and equipment and to be free from operating and maintenance difficulties. Devices and equipment for fire protection service shall be of a make and type listed by the Underwriter's Laboratories, Inc., or approved by the Factory Mutual System. In the publications referred to herein, the advisory provisions shall be considered to be mandatory, as though the word "shall" had been substituted for "should" wherever it appears; reference to the "authority having jurisdiction" shall be interpreted to mean the Government Fire Protection Engineer.

Acceptable Agent - FK-5-1-12

## 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.

All Shop Drawings, Product Data, and Design Data shall be submitted as one package for review and approval.

Submittals with an "S" are for inclusion in the Sustainability eNotebook, in conformance to Section 01 33 29 SUSTAINABILITY REPORTING. Submit the following in accordance with Section 01 33 00 SUBMITTAL PROCEDURES:

SD-01 Preconstruction Submittals

Qualified Fire Protection Engineer; G
Manufacturer's Representative; G

SD-02 Shop Drawings

Clean Agent system piping layout; G
Field wiring diagrams; G

SD-03 Product Data

Storage cylinders; G
Discharge heads; G
Manifolds; G
Discharge nozzles; G
Pipe; G
Pipe hangers and supports; G
Control panel; G
Manual actuation stations; G
Pressure switches; G
Storage batteries; G
Smoke detectors; G
Visual alarms; G
Battery charger; G
Fittings; G
Audible Alarm Bells; G
Warning Signs; G

SD-05 Design Data

Clean Agent discharge calculations; G
Battery capacity calculations; G

SD-07 Certificates

Record of Prior Installations; G
Clean Agent fire extinguishing system; G

SD-10 Operation and Maintenance Data

Clean Agent fire extinguishing system, Data Package 3; G

Submit in accordance with Section 01 78 23 OPERATION AND MAINTENANCE DATA.

SD-11 Closeout Submittals

Remote control station operating instructions; G
Record drawings; G

## 1.4 QUALITY ASSURANCE

### 1.4.1 Record of Prior Installations

Prior to installation, submit data showing of Clean Agent fire extinguishing systems of the same type and design as specified herein. The data shall include the names and locations of at least two locations where the Contractor has installed such systems. The Contractor shall indicate the type and design of these systems and certify that these systems have performed satisfactorily in the manner intended for a period of not less than 18 months.

### 1.4.2 Qualified Fire Protection Engineer

Refer to Specification section 21 13 13 WET PIPE SPRINKLER SYSTEM, FIRE PROTECTION for Qualified Fire Protection Engineer requirements.

### 1.4.3 Clean Agent Fire Extinguishing System

When preliminary field tests have been completed and all necessary corrections made, submit to the Contracting Officer a signed by the Qualified Fire Protection Engineer and dated letter attesting to the satisfactory completion of testing and stating that the systems is in operating condition. The letter shall include a written request for a formal inspection and test.

### 1.4.4 Manufacturer's Representative

Provide the services of a manufacturer's authorized representative or technician, experienced in the installation and operation of the type of system being provided to supervise the installation and testing, including final testing, adjustment of the system and to provide instruction to Government personnel.

## 1.5 DESIGN OF CLEAN AGENT FIRE EXTINGUISHING SYSTEMS

Design and installation of Clean Agent fire extinguishing systems shall conform to NFPA 2001, NFPA 70, and NFPA 72 and to the requirements as hereinafter specified.

### 1.5.1 Piping Layout and Wiring Diagrams

Annotate Clean Agent system piping layout with reference points for design. In field wiring diagrams, show locations of devices and points of the system. Prepare working drawings on sheets not smaller than 30 by 42 inches, in accordance with the requirements for "Working Plans" as specified in NFPA 2001. Include data essential to the proper installation of each system.

### 1.5.2 Calculations

Submit Clean Agent discharge calculations verifying total storage requirements, flooding concentrations, discharge times, flow through the piping network, pipe sizes, and nozzle orifice sizes, in accordance with the manufacturer's listed design manual and NFPA 2001. Submit substantiating battery capacity calculations showing capacity, supervisory and alarm power requirements.

1.5.3 Design Criteria

In accordance with NFPA 2001 for a Class C Energized Electrical Hazard. See Mechanical Drawings for design room temperatures. The Clean Agent concentration shall be based upon shutting down the heating, ventilation and air conditioning (HVAC) systems at the time of agent discharge. The required Clean Agent concentration shall be maintained in the protected area(s) for a minimum of ten minutes. The maximum Clean Agent liquid discharge time shall be 10 seconds.

1.5.4 Reserve Supplies

Not Required.

1.5.5 Record Drawings

Upon completion, and before final acceptance of the work, submit a complete set of as-built (record) working drawings, including complete as-built circuit diagrams, of each Clean Agent system for record purposes. The as-built working drawings shall be not smaller than 30 by 42 inches reproducible drawings with title block ( 8 by 4 inches) similar to full size contract drawings. The as-built working drawings shall be furnished in addition to the record drawings required by Section 01 78 00 CLOSEOUT SUBMITTALS.

1.6 SYSTEM CONTROL

Provide all apparatus, accessories, components and associated materials specified or necessary to furnish each system complete and ready for operation. All equipment shall be the current products of their manufacturers.

1.6.1 Controls

Detection and actuating control system shall be complete, Class A electrically supervised combination automatic and manual. Automatic actuation shall be accomplished by smoke detectors. Manual actuation shall be accomplished by electrical manual actuation stations.

1.6.2 Sequence of Operation

See Clean Agent Sequence of Operation Matrix drawing for details.

Set the Discharge Timer to 30 seconds.

1.6.3 Remote Control Station Operating Instructions

Submit the proposed legend for remote control station operating instructions.

PART 2 PRODUCTS

2.1 PIPING

Provide fittings for changes in direction of piping and for all connections. Make changes in piping sizes through standard reducing pipe fittings; the use of bushings is not permitted.

2.1.1 Pipe

ASTM A53/A53M or ASTM A106/A106M, black or zinc-coated, threaded, Schedule 40.

2.1.2 Fittings

ASME B16.11 or ASME B16.3, Class 300, zinc-coated, threaded, except Class 150 or 300 for pipe 3/4 inch or smaller.

2.1.3 Pipe Hangers and Supports

MSS SP-58, adjustable type. Rods, hangers and supports shall be zinc plated.

2.1.4 Discharge Nozzles

Fabricated of corrosion resistant materials. All nozzles shall be designed so that the orifice piece is connected directly to the supply pipe. The size of pipe and nozzles shall be determined from the calculated flow and terminal pressures in accordance with established, recognized test data contained in the manufacturer's listed design manual.

2.1.5 Storage Cylinders

Constructed of high strength alloy steel, conforming to all applicable specifications of the Department of Transportation. Container design shall permit on-site reconditioning and refilling when required. Safety valves, manifolds, pressure gauges, and pressure switches shall be provided.

2.1.6 Jointing Compound

Tape conforming to CID A-A-58092.

2.2 CONTROL PANEL

Control Panel shall comply with the applicable requirements of UL 864. Panel shall be modular, installed in a flush mounted steel cabinet with hinged door and cylinder lock. Control panel shall be a clean, uncluttered, and orderly assembled panel containing components and equipment required to provide the specified operating and supervisory functions of the system. The panel shall have prominent rigid plastic, phenolic or metal identification plates for LED/LCDs, zones, SLC, controls, meters, fuses, and switches.

a. Nameplates for fuses shall also include ampere rating. The LED/LCD displays shall be located on the exterior of the cabinet door or be visible through the cabinet door. Control panel switches shall be within the locked cabinet. A suitable means (single operation) shall be provided for testing the control panel visual indicating devices (meters or LEDs/LCDs). Meters and LEDs shall be plainly visible when the cabinet door is closed. Signals and LEDs/LCDs shall be provided to indicate by zone any alarm, supervisory or trouble condition on the system.

b. Loss of power, including batteries, shall not require the manual reloading of a program. Upon restoration of power, startup shall be automatic, and shall not require any manual operation. The loss of

primary power or the sequence of applying primary or emergency power shall not affect the transmission of alarm, supervisory or trouble signals.

c. Visual annunciation shall be provided for LED/LCD visual display as an integral part of the control panel and shall identify with a word description and id number each device. Cabinets shall be provided with ample gutter space to allow proper clearance between the cabinet and live parts of the panel equipment. If more than one modular unit is required to form a control panel, the units shall be installed in a single cabinet large enough to accommodate units. Cabinets shall be painted red.

2.2.1 Circuit Connections

Connect circuit conductors entering or leaving the panel to screw-type terminals with each conductor and terminal marked for identification.

2.3 SECONDARY POWER SUPPLY

Supply shall include nickel cadmium, lead calcium or sealed lead acid batteries and charger. Drycell batteries are not allowed. House batteries in a well constructed steel cabinet with cylinder lock.

2.3.1 STORAGE BATTERIES

Submit substantiating battery calculations for supervisory and alarm power requirements. Ampere-hour requirements for each system component and each panel component, and the battery recharging period shall be included. Provide storage batteries which are 24 Vdc sealed, lead-calcium type requiring no additional water with ample capacity, with primary power disconnected, to operate the fire alarm system for a period of 48 hours. Following this period of battery operation, the batteries shall have ample capacity to operate all components of the system, including all alarm signaling devices in the total alarm mode for a minimum period of 15 minutes. Locate batteries at the bottom of the panel. Provide batteries with overcurrent protection in accordance with NFPA 72. The lock shall be keyed the same as the fire alarm control panel.

2.3.2 Battery Charger

Battery charger shall be completely automatic, 24 Vdc with high/low charging rate, capable of restoring the batteries from full discharge (18 Volts dc) to full charge within 48 hours. A pilot light indicating when batteries are manually placed on a high rate of charge shall be provided as part of the unit assembly, if a high rate switch is provided.

2.4 MANUAL ACTUATION STATIONS

Manual actuation stations shall conform to the applicable requirements of UL 38. Manual stations shall be installed on flush mounted outlet boxes. Manual stations shall be mounted at 48 inches. Stations shall be double action type. Stations shall be finished of different color than the fire alarm system pull stations. Stations requiring the breaking of glass or plastic panels for operation are not acceptable. The use of a key or wrench shall be required to reset the station. Gravity or mercury switches are not acceptable. Switches and contacts shall be rated for the voltage and current upon which they operate. Manual actuation stations shall latch upon operation and remain latched until manually reset.

Stations shall have a separate screw terminal for each conductor.

## 2.5 SMOKE DETECTORS

Smoke detectors shall comply with the applicable requirements of NFPA 72 and UL 268. The detectors shall be provided as indicated. Detector base shall have screw terminals for making connections. No solder connections will be allowed. Design smoke detectors for detection of abnormal smoke densities. Smoke detectors shall be photoelectric type. Detectors shall contain a visible indicator LED/LCD that shows when the unit is in alarm condition. Detectors shall not be adversely affected by vibration or pressure.

### 2.5.1 Photoelectric Detectors

Detectors shall operate on a light scattering concept using an LED light source. Failure of the LED shall not cause an alarm condition. Detectors shall be factory set for sensitivity and shall require no field adjustments of any kind. Detectors shall have an obscuration rating in accordance with UL 268. Addressable smoke detectors shall be capable of having the sensitivity being remotely adjusted by the control panel.

## 2.6 INHIBIT SWITCH

Switch shall be guarded, spring-loaded type which operates only when pressure is manually applied to the switch. Activation of switch during normal (non-alarm) conditions shall cause activation of system trouble signals.

## 2.7 ALARM SIGNALING DEVICES

Provide each protected area with audible and visual alarms located where shown. All alarm circuits shall be electrically supervised. Provide separate and distinct audible and visual pre-discharge from the fire alarm system. Each signal device shall be provided with a rigid plastic or metal identification sign with lettering a minimum of 1.5 inches high. The pre-discharge alarm shall be labeled "CLEAN AGENT."

### 2.7.1 Audible Alarm Bells

10 inch surface mounted with matching mounting back box. Bells shall be of the vibrating type suitable for use in an electrically supervised circuit. Bells shall be of the underdome type and produce a sound output rating of at least 90 decibels at 10 feet.

### 2.7.2 Visual Alarms

Surface mounted lamp assembly suitable for use in an electrically supervised circuit. Lamp shall be the flashing rotary beacon type and powered from the control panel alarm circuit. Lamps shall provide a minimum of 50 candle power. Flash rate shall be between 60 and 120 flashes per minute. Lamps shall be protected by a thermo-plastic lens, red for pre-discharge alarms. Visual alarms may be part of an audio-visual alarm assembly.

## 2.8 WARNING SIGNS

Provide warning and safety instruction signs in accordance with NFPA 2001. Warning signs shall be enamel baked finish on minimum 18 gauge steel or

0.024 inch aluminum with red letters on a white background or white letters on red background.

2.9 ELECTRICAL WORK

2.9.1 Conduit

Conduit and fittings shall comply with NFPA 70, UL 6, UL 1242, and UL 797.

2.9.2 Wiring

Wiring shall conform to NFPA 70. The wiring shall be copper cable in accordance with the manufacturers requirements. Wiring for dc circuits shall be No. 16 AWG minimum. Wiring code color shall remain uniform throughout the circuit.

PART 3 EXECUTION

3.1 FIELD MEASUREMENTS

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 REQUIREMENTS

The installation shall be in accordance with the applicable provisions of NFPA 2001 and publications referenced therein. Seismically protect the system piping against damage from earthquakes. Install the seismic protection of the system piping in accordance with UFC 3-310-04. Support, bracing, and anchorage for piping shall be installed per design drawings where indicated. Supports, bracing, and anchorage for piping that are not shown on the drawings are the responsibility of the Contractor.

3.3 INSPECTION BY Qualified Fire Protection Engineer

Concurrent with the Final Test, certification by the Qualified Fire Protection Engineer that the Clean Agent System is installed in accordance with the contract requirements. The Qualified Fire Protection Engineer shall: 1) inspect the system periodically during the installation to assure that the system is being provided and installed in accordance with the contract requirements, 2) witness the preliminary and final tests, and sign the test results, 3) after completion of the system inspections and a successful final test, certify in writing that the system has been installed in accordance with the contract requirements. Any discrepancy shall be brought to the attention of the Contracting Officer in writing, no later than three working days after the discrepancy is discovered.

3.4 PIPE INSTALLATION

Cut screw-jointed pipe accurately and work into place without springing or forcing. Ream pipe ends and free pipe and fittings from burrs. Clean with solvent to remove all varnish and cutting oil prior to assembly. Make screw joints with tetrafluoroethylene tape applied to male thread only.

3.5 ELECTRICAL WORK

See Section 28 31 76 INTERIOR FIRE ALARM AND MASS NOTIFICATION SYSTEM,

ADDRESSABLE.

## 3.6 FIELD PAINTING

Clean, pretreat, prime, and finish paint new Clean Agent fire extinguishing systems, including piping, conduit, hangers and miscellaneous metalwork. Apply coatings only to clean, dry, surfaces using clean brushes. Clean surfaces to remove all dust, dirt, rust and loose mill scale. Color code mark piping as specified in Section 09 90 00 PAINTS AND COATINGS. Remove all devices which are painted and provide new clean devices of the proper type in lieu thereof.

## 3.7 FIELD TESTING

Refer to specification section 21 13 13 WET PIPE SPRINKLER SYSTEM, FIRE PROTECTION for testing requirements. Perform tests in the presence of the Contracting Officer and the Qualified Fire Protection Engineer to determine conformance with the specified requirements.

### 3.7.1 Preliminary Tests

Each piping system shall be pneumatically tested at 150 psig and shall show no leakage or reduction in gage pressure after 30 minutes. The contractor shall conduct complete preliminary tests, which shall encompass all aspects of system operation. Individually test all detectors, manual actuation stations, alarms, control panels, and all other components and accessories to demonstrate proper functioning.

### 3.7.2 Formal Inspection and Tests

Government Fire Protection Engineer will witness formal tests and approve all systems before they are accepted. The system shall be considered ready for such testing only after all necessary preliminary tests have been made and all deficiencies found have been corrected to the satisfaction of the equipment manufacturer's technical representative and the Contracting Officer. Submit the request for formal inspection at least 15 days prior to the date the inspection is to take place. The control panels and detection systems shall be in service for a "break-in" period of at least 15 consecutive days prior to the formal inspection. Experienced technicians regularly employed by the contractor in the installation of both the mechanical and electrical portions of such systems shall be present during the inspection and shall conduct the testing. All instruments, personnel, appliances and equipment for testing shall be furnished by the contractor. All necessary tests encompassing all aspects of system operation shall be made including the following, and any deficiency found shall be corrected and the system retested at no cost to the Government.

#### 3.7.2.1 System Function Tests Without Clean Agent Discharge

The entire detection/alarm/actuation system shall be operated. As a minimum, operation and supervision of the following functions and devices shall be demonstrated.

a. All operational and supervisory functions of the control panels, including the cross-zoning, pre-discharge alarm, discharge alarm and time delay features.

b. Each manual actuation station and associated circuit(s).

c. All smoke detectors and associated circuits.

d. All pre-discharge alarms and associated circuits.

e. All actuator circuits and discharge heads (without Clean Agent discharge).

f. Automatic fire dampers.

g. Activation of the building fire evacuation alarm system.

h. All of the above tests shall be repeated with the system on battery power only.

3.7.2.2 Clean Agent Discharge Tests

No agent discharge test is required. A Room Integrity Fan Test is required for each enclosure. Test shall be conducted in accordance with NFPA 2001 Appendix C. The use of temporary measures to close openings is not acceptable. Passing results shall be achieved and documented prior to completion of this phase of testing.

3.8 OPERATING INSTRUCTIONS

Provide operating instructions at each remote control station. Instructions shall clearly indicate all necessary steps for the operation of the system. Instructions shall be in raised or embossed white letters on red rigid plastic or red enameled steel backgrounds and shall be of adequate size to permit them to be easily read.

3.9 TRAINING REQUIREMENTS

Prior to final acceptance, the Contractor shall provide operation and maintenance training to the Contracting Officer Representatives. Each training session shall include emergency procedures, and unique maintenance and safety requirements. Training areas will be provided by the Government in the same building as the protected areas. The training conducted shall use operation and maintenance manuals called for in paragraph entitled "Operation and Maintenance Instructions, Parts and Testing." Dates and times of the training period shall be coordinated through the Contracting Officer not less then two weeks prior to the session. Government shall be provided with a simplified training manual providing a description of operation and controls, possible hazards to personnel, and restart procedures.

-- End of Section --

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SECTION 21 30 10

FIRE PUMPS WITH DEDICATED ENCLOSURE
**04/08, CHG 1: 08/13**

PART 1 GENERAL

1.1 SUMMARY

Except as modified in this Section or on the drawings, install fire pumps in conformance with UFC 3-600-01, 796 CEOFA, NFPA 20, NFPA 70, and NFPA 72. Provide pre-assembled fire pump equipment and enclosure as specified herein and in accordance with manufacturer guidelines. In the event of a conflict between specific provisions of this specification and applicable NFPA standards, this specification governs. Devices and equipment for fire protection service must be UL Fire Prot Dir listed or FM APP GUIDE approved. Interpret all reference to the authority having jurisdiction to mean the USACE HQ Fire Protection Engineer.

1.2 SEQUENCING

Fire pump and jockey shall be programmed to automatically start and stop in accordance with the example provided in Appendix A.14.2.6(4)(f).

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 ARCHITECTURAL MANUFACTURERS ASSOCIATION (AAMA)

| | |
|---|---|
| AAMA 2605 | (2020) Voluntary Specification, Performance Requirements and Test Procedures for Superior Performing Organic Coatings on Aluminum Extrusions and Panels |

AMERICAN SOCIETY OF CIVIL ENGINEERS (ASCE)

| | |
|---|---|
| ASCE 7 | (2017) Minimum Design Loads for Buildings and Other Structures |

AMERICAN SOCIETY OF MECHANICAL ENGINEERS (ASME)

| | |
|---|---|
| ASME B16.5 | (2020) Pipe Flanges and Flanged Fittings NPS 1/2 Through NPS 24 Metric/Inch Standard |
| ASME B16.39 | (2020) Standard for Malleable Iron Threaded Pipe Unions; Classes 150, 250, and 300 |
| ASME B31.1 | (2022) Power Piping |

AMERICAN WATER WORKS ASSOCIATION (AWWA)

| | |
|---|---|
| AWWA 10084 | (2017) Standard Methods for the Examination of Water and Wastewater |

| | |
|---|---|
| AWWA B300 | (2018) Hypochlorites |
| AWWA B301 | (2018) Liquid Chlorine |
| AWWA C111/A21.11 | (2017) Rubber-Gasket Joints for Ductile-Iron Pressure Pipe and Fittings |

ASTM INTERNATIONAL (ASTM)

| | |
|---|---|
| ASTM A36/A36M | (2019) Standard Specification for Carbon Structural Steel |
| ASTM A47/A47M | (1999; R 2022; E 2022) Standard Specification for Ferritic Malleable Iron Castings |
| ASTM A53/A53M | (2024) Standard Specification for Pipe, Steel, Black and Hot-Dipped, Zinc-Coated, Welded and Seamless |
| ASTM A183 | (2014; R 2020) Standard Specification for Carbon Steel Track Bolts and Nuts |
| ASTM A193/A193M | (2023) Standard Specification for Alloy-Steel and Stainless Steel Bolting Materials for High-Temperature Service and Other Special Purpose Applications |
| ASTM A194/A194M | (2023) Standard Specification for Carbon Steel, Alloy Steel, and Stainless Steel Nuts for Bolts for High-Pressure or High-Temperature Service, or Both |
| ASTM A536 | (1984; R 2019; E 2019) Standard Specification for Ductile Iron Castings |
| ASTM A653/A653M | (2023) Standard Specification for Steel Sheet, Zinc-Coated (Galvanized) or Zinc-Iron Alloy-Coated (Galvannealed) by the Hot-Dip Process |
| ASTM A795/A795M | (2021) Standard Specification for Black and Hot-Dipped Zinc-Coated (Galvanized) Welded and Seamless Steel Pipe for Fire Protection Use |
| ASTM A924/A924M | (2022a) Standard Specification for General Requirements for Steel Sheet, Metallic-Coated by the Hot-Dip Process |
| ASTM B135/B135M | (2017) Standard Specification for Seamless Brass Tube |
| ASTM F436 | (2011) Hardened Steel Washers |

FM GLOBAL (FM)

| | |
|---|---|
| FM APP GUIDE | (updated on-line) Approval Guide http://www.approvalguide.com/ |

METAL BUILDING MANUFACTURERS ASSOCIATION (MBMA)

| | |
|---|---|
| MBMA MBSM | (2018) Metal Building Systems Manual |

NATIONAL ELECTRICAL MANUFACTURERS ASSOCIATION (NEMA)

| | |
|---|---|
| NEMA MG 1 | (2021) Motors and Generators |

NATIONAL FIRE PROTECTION ASSOCIATION (NFPA)

| | |
|---|---|
| NFPA 20 | (2022;TIA 21-1; TIA 21-2) Standard for the Installation of Stationary Pumps for Fire Protection |
| NFPA 24 | (2022) Standard for the Installation of Private Fire Service Mains and Their Appurtenances |
| NFPA 70 | (2026) National Electrical Code |
| NFPA 72 | (2022; ERTA 22-1) National Fire Alarm and Signaling Code |
| NFPA 1963 | (2019) Standard for Fire Hose Connections |

STEEL DOOR INSTITUTE (SDI/DOOR)

| | |
|---|---|
| SDI/DOOR 111 | (2009) Recommended Details for Standard Steel Doors, Frames, and Accessories and Related Components |

U.S. DEPARTMENT OF DEFENSE (DOD)

| | |
|---|---|
| UFC 1-200-01 | (2019; with Change 1, Oct 2020) DoD Building Code |
| UFC 3-600-01 | (2016; with Change 6, 2021) Fire Protection Engineering for Facilities |
| 796 CEOFA | (Oct 2023) Eglin AFB Fire Alarm and Suppression Specific Requirements for New Installation |

UNDERWRITERS LABORATORIES (UL)

| | |
|---|---|
| UL 448 | (2020) UL Standard for Safety Centrifugal Stationary Pumps for Fire-Protection Service |
| UL Fire Prot Dir | (2024) Fire Protection Equipment Directory |

## 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

Qualified Fire Protection Engineer; G

No later than 14 days after the Notice to Proceed and prior to the submittal of the fire pump installation drawings

Enclosure Manufacturer Qualifications; G

SD-02 Shop Drawings

As-Built Drawings; G

Piping Layout; G

Pump Room; G

Enclosure Detail Drawings; G

SD-03 Product Data

Catalog Data; G

+

Spare Parts

Preliminary Tests

At least 14 days prior to the proposed date and time to begin Preliminary Tests

Field Tests; G

At least 2 weeks before starting field tests

Manufacturer's Representative; G

Field Training; G

Army Final Acceptance Test

Fire Pump Enclosure - Structural Requirements; G

Fire Pump Enclosure - Architectural Requirements; G

Miscellaneous Building Accessories; G

Fire Pump Enclosure - Mechanical Requirements; G

Fire Pump Enclosure - Fire Protection Requirements; G

Fire Pump Enclosure - Electrical Requirements; G

SD-05 Design Data

Fire Pump Installation Drawings; G

SD-06 Test Reports

Preliminary Tests

3 copies of the completed Preliminary Tests Reports, no later that 7 days after the completion of the Preliminary Tests.

Army Final Acceptance Test

SD-07 Certificates

Qualified Fire Protection Engineer

No later than 14 days after the Notice to Proceed and prior to the submittal of the fire pump installation drawings

Qualifications of Welders

Qualifications of Installer

Preliminary Test Certification

Final Test Certification

SD-10 Operation and Maintenance Data

Operating and Maintenance Instructions; G

At least 14 days prior to conducting field training

Flow Meter

Submit Data Package 2 for flow meter and controllers in accordance with Section 01 78 23 OPERATION AND MAINTENANCE DATA.

## 1.5 EXTRA MATERIALS

Submit Spare Parts data for each different item of equipment and material specified. Include a complete list of parts and supplies, with current unit prices and source of supply, and a list of parts recommended by the manufacturer to be replaced after 1 year and 3 years of service. Include a list of special tools and test equipment required for maintenance and testing of the products supplied by the Contractor.

## 1.6 QUALITY ASSURANCE

### 1.6.1 Qualified Fire Protection Engineer

See requirements in Section 21 13 13 WET PIPE SPRINKLER SYSTEMS, FIRE PROTECTION

### 1.6.2 Qualifications of Welders

Submit certificates of each welder's qualifications prior to site welding; certifications more than one year old are not acceptable.

### 1.6.3 Qualifications of Installer

Prior to installation, submit data for approval showing that the Contractor has successfully installed fire pumps and associated equipment

of the same type and design as specified herein, or that he has a firm contractual agreement with a subcontractor having such required experience. Include the names and locations of at least two installations where the Contractor, or the subcontractor referred to above, has installed such systems. Indicate the type and design of each system and certify that each system has performed satisfactorily in the manner intended for a period of not less than 18 months.

1.6.4 Enclosure Manufacturer Qualifications

Enclosure manufacturer to have a quality control program that follows building through to completion and is passed to the Government with all instruction manuals and final drawings. Additionally, the enclosure manufacturer to have been in the control building business for a minimum of five years, and able to supply proof of supplying at least 10 enclosures of a similar type in that time.

1.6.5 Preliminary Test Certification

When preliminary tests have been completed and corrections made, submit a signed and dated certificate with a request for a formal inspection and tests.

1.6.6 Final Test Certification

Concurrent with the Final Acceptance Test Report, submit certification by the Qualified Fire Protection Engineer that the fire pump installation is in accordance with the contract requirements, including signed approval of the Preliminary and Final Acceptance Test Reports. Submit data for approval showing the name and certification of all involved individuals with such qualifications at or prior to submittal of drawings.

1.6.7 Manufacturer's Representative

Perform work specified in this section under the supervision of and certified by a representative of the fire pump manufacturer. Submit the name and documentation of certification of the proposed Manufacturer's Representative, concurrent with submittal of the Qualified Fire Protection Engineer Qualifications. Engage the Manufacturer's Representative regularly in the installation of the type and complexity of fire pump(s) specified in the Contract documents. The representative is an individual who has served in a similar capacity for at least three systems that have performed in the manner intended for a period of not less than 6 months.

1.7 DELIVERY, STORAGE, AND HANDLING

Protect all equipment delivered and placed in storage from the weather, excessive humidity and temperature variations, dirt and dust, or other contaminants. Additionally, either cap or plug all pipes until installed.

PART 2 PRODUCTS

2.1 MATERIALS AND EQUIPMENT

a. Provide materials and equipment that are standard products of a manufacturer regularly engaged in the manufacture of such products and that essentially duplicates items that have been in satisfactory use for at least 2 years prior to bid opening.

b. Submit manufacturer's catalog data included with the Fire Pump Installation Drawings for each separate piece of equipment proposed for use in the system. Indicate the name of the manufacturer of each item of equipment, with data annotated to indicate model to be provided. In addition, provide a complete equipment list that includes equipment description, model number and quantity. Catalog data for material and equipment includes, but is not limited to, the following:

(1) Fire pumps, drivers and controllers including manufacturer's certified shop test characteristic curve for each pump. Shop test curve may be submitted after approval of catalog data but must be submitted prior to the final tests.

(2) Pressure maintenance pump and controller.

(3) Piping components.

(4) Valves, including gate, check, globe and relief valves.

(5) Gauges.

(6) Hose valve manifold test header and hose valves.

(7) Flow meter.

(8) Restrictive orifice union.

(9) Associated devices and equipment.

c. Provide a nameplate that identifies the manufacturer's name, address, type or style, model or serial number, and catalog number for all equipment. Affix standard nameplates securely in a conspicuous place and easy to read to pumps and motors. Provide nameplates and markings in accordance with UL 448. Provide electric motor nameplates with the minimum information required by NFPA 70, Section 430-7.

## 2.2 FIRE PUMP

Provide electric motor driven fire pump. Provide pump capacity rated at 500 gpm with a rated net pressure of 40 psi. Furnish no less than 150 percent of rated flow capacity at not less than 65 percent of rated net pressure. Provide centrifugal in-line fire pump. Equip horizontal pump with automatic air release devices. Use maximum rated pump speed of 3600 rpm when driving the pump at rated capacity. Provide pump that is automatic start and automatic stop. Provide pump conforming to the requirements of UL 448. Ensure fire pump discharge and suction gauges are oil-filled type.

## 2.3 REQUIREMENTS FOR FIRE PROTECTION SERVICE

### 2.3.1 General Requirements

Provide Materials and Equipment that have been tested by Underwriters Laboratories, Inc. and are listed in UL Fire Prot Dir or approved by Factory Mutual and listed in FM APP GUIDE. Where the terms "listed" or "approved" appear in this specification, such means listed in UL Fire Prot Dir or FM APP GUIDE.

2.3.2 Alarms

Provide audible and visual alarms as required by NFPA 20 on the controller. Provide remote supervision as required by NFPA 20, in accordance with NFPA 72. Activate alarm signal upon the following conditions: electric motor controller has operated into a pump running condition, loss of electrical power to electric motor starter, and phase reversal on line side of motor starter. Provide weatherproof exterior alarm devices. Provide alarm silencing switch and red signal lamp, with signal lamp arranged to come on when switch is placed in OFF position.

2.4 UNDERGROUND PIPING COMPONENTS

Comply with requirements in Section 21 13 13 WET PIPE SPRINKLER SYSTEMS, FIRE PROTECTION

2.5 ABOVEGROUND PIPING COMPONENTS

2.5.1 Pipe Sizes 2.5 inches and Larger

2.5.1.1 Pipe

Provide piping consisting of ASTM A53/A53M, Weight Class STD (Standard), Schedule 40 (except for Schedule 30 for pipe sizes 8 inchesand greater in diameter), Type E or Type S, Grade A; black steel pipe. Join steel pipe by means of flanges welded to the pipe or mechanical grooved joints only. Do not join piping by welding or weld fittings. Galvanize suction piping on the inside in accordance with NFPA 20.

2.5.1.2 Grooved Mechanical Joints and Fittings

Provide joints and fittings that are designed for no less than 175 psi service and are the product of the same manufacturer. Provide malleable iron fitting and coupling houses conforming to ASTM A47/A47M, Grade 32510; ductile iron conforming to ASTM A536, Grade 65-45-12. Provide flush type gasket that fills the entire cavity between the fitting and the pipe. Provide cadmium plated or zinc electroplated, heat-treated steel nuts and bolts conforming to ASTM A183.

2.5.1.3 Flanges

Provide ASME B16.5, Class 150 flanges. Provide flanges at valves, connections to equipment, and where indicated.

2.5.1.4 Gaskets

Provide AWWA C111/A21.11, cloth inserted red rubber gaskets.

2.5.1.5 Bolts

Provide ASTM A193/A193M, Grade B7 bolts. Do not extend bolts less than three full threads beyond the nut with bolts tightened to the required torque.

2.5.1.6 Nuts

Provide ASTM A194/A194M, Grade 7 nuts.

2.5.1.7 Washers

Provide washers meeting the requirements of ASTM F436. Provide flat circular washers under all bolt heads and nuts.

2.5.2 Piping Sizes 2 inches and Smaller

2.5.2.1 Steel Pipe

Provide ASTM A795/A795M, Weight Class STD (Standard), Schedule 40, Type E or Type S, Grade A, zinc-coated steel pipe with threaded end connections. Provide ASME B16.39, Class 150, zinc-coated threaded fittings. Provide ASME B16.39, Class 150, zinc-coated unions.

2.5.3 Pipe Hangers and Supports

Provide adjustable hangers and supports that are UL listed UL Fire Prot Dir or FM approved FM APP GUIDE. Finish of rods, nuts, washers, hangers, and supports must be zinc-plated after fabrication.

2.5.4 Valves

Provide valves that are UL listed UL Fire Prot Dir or FM approved FM APP GUIDE for fire protection service and with flange or threaded end connections.

2.5.4.1 Gate Valves and Control Valves

Provide outside screw and yoke (O.S.&Y.) type gate valves and control valves which open by counterclockwise rotation. Butterfly-type control valves are not permitted, except where shown on the drawings.

2.5.4.2 Tamper Switch

Equip the suction control valves, the discharge control valves, valves to test header and flow meter, and the by-pass control valves with valve tamper switches for monitoring by the fire alarm system.

2.5.4.3 Check Valve

Check valve must be clear open, swing type check valve with flange or threaded inspection plate.

2.5.4.4 Circulating Relief Valve

Provide an adjustable circulating relief valve for each fire pump in accordance with NFPA 20.

2.5.5 Hose Valve Manifold Test Header

Construct header of steel pipe. Provide ASME B16.5, Class 150 flanged inlet connection to hose valve manifold assembly. Provide approved bronze hose gate valve with 2.5 inch National Standard male hose threads with cap and chain; locate 3 feet above grade in the horizontal position for each test header outlet. Ensure welding is metallic arc process in accordance with ASME B31.1.

2.5.6 Pipe Sleeves

Provide a pipe sleeve at each location where piping passes entirely through walls, ceilings, roofs, and floors, including pipe entering buildings from the exterior. Secure sleeves in position and location during construction. Provide sleeves of sufficient length to pass through entire thickness of walls, ceilings, and floors. Provide one inch minimum clearance between exterior of piping or pipe insulation, and interior of sleeve or core-drilled hole. Firmly pack space with mineral wool insulation. Seal space at both ends of the sleeve or core-drilled hole with plastic waterproof cement which will dry to a firm but pliable mass, or provide a mechanically adjustable segmented elastomeric seal.

a. Sleeves in Masonry and Concrete Walls, Ceilings, Roofs, and Floors: Provide hot-dip galvanized steel, ductile-iron, or cast-iron pipe sleeves. Core drilling of masonry and concrete may be provided in lieu of pipe sleeves provided that cavities in the core-drilled hole be completely grouted smooth.

b. Sleeves in Other Than Masonry and Concrete Walls, Ceilings, Roofs, and Floors: Provide galvanized steel sheet pipe not less than 0.90 psf.

2.5.7 Escutcheon Plates

Provide one-piece or split-hinge metal plates for piping entering floors, walls, and ceilings in exposed areas. Provide polished stainless steel or chromium-plated finish on copper alloy plates in finished spaces. Provide paint finish on plates in unfinished spaces. Secure plates in place.

2.6 DISINFECTING MATERIALS

2.6.1 Liquid Chlorine

Provide liquid chlorine conforming to AWWA B301.

2.6.2 Hypochlorites

Provide calcium hypochlorite and sodium hypochlorite conforming to AWWA B300.

2.7 ELECTRIC MOTOR DRIVER

Provide motors, controllers, contactors, and disconnects with their respective pieces of equipment, as specified herein and provide electrical connections under Section 26 20 00 INTERIOR DISTRIBUTION SYSTEM. Provide controllers and contactors with a maximum of 120-volt control circuits, and auxiliary contacts for use with the controls furnished. When motors and equipment furnished are larger than sizes indicated, include the cost of providing additional electrical service and related work under this section. Provide motor conforming to NEMA MG 1 Design B type. Provide premium efficiency type integral size motors in accordance with NEMA MG 1. Provide motor horsepower of sufficient size so that the nameplate horsepower rating will not be exceeded throughout the entire published pump characteristic curve. The motor and fire pump controller must be fully compatible.

2.8 FIRE PUMP CONTROLLER

Provide automatic type controller which is UL listed UL Fire Prot Dir or

FM approved FM APP GUIDE for fire pump service. Arrange pump for automatic start and stop, and manual push-button stop. Accomplish automatic stopping only after all starting causes have returned to normal and after a minimum pump run time has elapsed. Provide controllers that are completely terminally wired, ready for field connections, and mounted in a NEMA Type 2 drip-proof enclosure arranged so that controller current carrying parts will not be less than 12 inches above the floor. Provide controller with voltage surge arresters installed in accordance with NFPA 20. Equip controller with a bourdon tube pressure switch or a solid state pressure switch with independent high and low adjustments, automatic starting relay actuated from normally closed contacts, visual alarm lamps and supervisory power light. Equip controller with a thermostat switch with adjustable setting to monitor the pump room temperature and to provide an alarm when temperatures falls below 40 degrees F Provide controller which is factory-equipped with a heater operated by thermostat to prevent moisture in the cabinet.

### 2.8.1 Controller for Electric Motor Driven Fire Pump

Controller must be electronic soft start starting type. Design controller as indicated. Provide controller and transfer switch with a short circuit rating of 100,000 amps r.m.s. symmetrical at 480 volts a.c.. Provide an automatic transfer switch (ATS) for fire pump in compliance with NFPA 20 and specifically listed for fire pump service. The ATS must transfer source of power to the alternate source upon loss of normal power. Controller must monitor pump running, loss of a phase or line power, phase reversal and pump room temperature. Display alarms individually in front of panel by lighting of visual lamps. Label each lamp with rigid etched plastic labels. Equip controller with terminals for remote monitoring of pump running, pump power supply trouble (loss of power or phase and phase reversal), and pump room trouble (pump room temperature ), and for remote start. Limited service fire pump controllers are not permitted. Equip controller with a 7-day electric pressure recorder with 24-hour spring wound back-up. Provide a readout of the system pressure from 0 to 15 hp, time, and date. Controller must require the pumps to run for ten minutes, prior to automatic shutdown. Equip the controller with an externally operable isolating switch which manually operates the motor circuit. Provide means in the controller for measuring current for all motor circuit conductors.

The alternate power source for this power is an emergency generator.

## 2.9 PRESSURE SENSING LINE

Provide a completely separate pressure sensing line for each fire pump and for the jockey pump. Arrange the sensing line in accordance with NFPA 20. Provide sensing line of 1/2 inch H58 brass tubing complying with ASTM B135/B135M. Equip the sensing line with two restrictive orifice unions each. Provide restricted orifice unions consisting of ground-face unions with brass restricted diaphragms drilled for a 3/32 inch. Mount restricted orifice unions in the horizontal position, no less than 5 feet apart on the sensing line. Provide two test connections for each sensing line. Test connections consist of two brass 1/2 inch globe valves and 1/4 inch gauge connection tee arranged in accordance with NFPA 20. Equip one of the test connections with a 0 to 300 psi water oil-filled gauge. Connect sensing line to the pump discharge piping between the discharge piping control valve and the check valve.

## 2.10 PRESSURE MAINTENANCE PUMP

### 2.10.1 General

Provide pressure maintenance pump that is electric motor driven, in-line vertical shaft, centrifugal type with a rated discharge of 10 gpm at 50 psig. Pump must draft as indicated and discharge into the system at the downstream side of the pump discharge gate valve. Provide an approved indicating gate valve of the outside screw and yoke (O.S.&Y.) type in the maintenance pump discharge and suction piping. Provide oil-filled water pressure gauge and approved check valve in the maintenance pump discharge piping. Provide swing type check valve with removable inspection plate.

### 2.10.2 Pressure Maintenance Pump Controller

Pump controller shall be varibale frequency drive type. Arrange pressure maintenance pump controller for automatic and manual starting and stopping and equip with a "manual-off-automatic" switch. Provide controller which is completely prewired, ready for field connections, and wall-mounted in a NEMA Type 2 drip-proof enclosure. Equip the controller with a bourdon tube pressure switch or a solid state pressure switch with independent high and low adjustments for automatic starting and stopping. Provide a sensing line connected to the pressure maintenance pump discharge piping between the control valve and the check valve. Provide sensing line conforming to paragraph, PRESSURE SENSING LINE. The sensing line must be completely separate from the fire pump sensing lines. Provide an adjustable run timer to prevent frequent starting and stopping of the pump motor. Set the run timer for 2 minutes.

## 2.11 HOSE VALVE MANIFOLD TEST HEADER

Connect hose valve test header by ASME B16.5, Class 150 flange inlet connection. Provide UL listed UL Fire Prot Dir or FM approved FM APP GUIDE bronze hose gate valves with 2.5 inches American National Fire Hose Connection Screw Standard Threads (NH) in accordance with NFPA 1963. Provide number of valves in accordance with NFPA 20. Equip each hose valve with a cap and chain, and locate no more than 3 feet and no less than 2 feet above grade.

## 2.12 FLOW METER

Provide meter that is UL listed UL Fire Prot Dir or FM approved FM APP GUIDE as flow meters for fire pump installation with direct flow readout device. Provide flow meter that is capable of metering any waterflow quantities between 50 percent and 150 percent of the rated flow of the pumps. Arrange piping to permit flow meter to discharge to pump suction and to discharge through test header. Provide automatic air release if flow meter piping between pump discharge and pump suction forms an inverted "U". Provide venturi type meter.

## 2.13 PRE-ASSEMBLED FIRE PUMP ENCLOSURE

This section covers the pre-assembled fire pump enclosure with all materials and accessories as needed for a complete enclosure as shown on the project drawings and as specified herein.

### 2.13.1 Description

The work shall include the furnishing, delivery, and installation of one

(1) pre-assembled, pre-engineered, steel building as specified herein. The enclosure shall be a structurally steel framed design, manufactured with Channelframe™ construction, or equivalent. Any other design must be pre-approved by the Government.

2.13.2 Design Requirements

2.13.2.1 Codes and Standards

The enclosure design and manufacture shall, as a minimum, conform to ASCE 7, MBMA MBSM, UFC 1-200-01, UFC 3-600-01, and NFPA 70. The enclosure manufacturer shall supply plans and calculations stamped by a registered professional engineer.

2.13.2.2 Loading

The building shall be designed to support loads as noted in ASCE 7. Unless noted otherwise, the following shall be the minimum design loads:

1. Roof Load - 30 PSF (20 PSF live and 10 PSF dead)
2. Ceiling Collateral Load - 10 PSF
3. Wall Load - weight of wall mounted equipment.
4. Floor Load - 250 PSF
5. Snow Load - 0 PSF
6. Wind Load - Per ASCE 7:

    a. Basic Wind Speed = 154 MPH
    b. Exposure Category = C
    c. Risk Category: III
    d. Components and Cladding pressures must be used for basis of design.

7. Seismic:

    a. Mapped Spectral Response Acceleration, Ss = 0.075
    b. Mapped Spectral Response Acceleration, S1 = 0.053
    c. Soil Site Class: D
    d. Seismic Design Category: B
    e. Risk Category: III

8. Attachment point must be design to support entire structure to be installed or removed from the attachment points.

2.13.3 Fire Pump Enclosure - Structural Requirements

2.13.3.1 Materials

The materials shall be new, unused, and fabricated in a workmanlike manner in a factory environment. Hot rolled steel must meet as a minimum standard ASTM A36/A36M, and all galvanized steel must meet as a minimum standard ASTM A653/A653M. The components and building parts shall be clearly marked on the drawings.

2.13.3.2 Base-Perimeter Angle System

The enclosure base-perimeter angle system shall follow the guidance as specified herein.

1. Enclosure Base

The enclosure base shall have a hot rolled steel angle framework, welded and galvanized with maximum deflection of 1/8" in 10' of length. Base shall be pre-drilled for anchoring to foundation.

2. Enclosure Base Framework

The enclosure base framework to be fully cleaned, primed and painted with a self-priming, VOC compliant, catalyzed coating system designed to provide an extremely durable finish, suitable for heavy industrial, severe coastal, chemical, or off shore environments with superior corrosion protection and resistance to fading. Paint system to have a minimum dry film thickness, per coat of 5 mils.

3. Enclosure Weld Standards

Weld standards must, at a minimum, meet AWS recommended practices including AWS codes D1.1 Structural Welding Code - Steel and D1.3 Structural Welding Code - Sheet Steel.

2.13.3.3 Foundation

Building reactions supplied by enclosure manufacturer to the foundation contractor.

2.13.4 Fire Pump Enclosure - Architectural Requirements

2.13.4.1 Enclosure

The enclosure components shall be as specified herein.

1. Framework

The enclosure shall have a complete, internal, self-supporting, structural steel frame which does not utilize or rely on the exterior panels or roof cover panels for any of its structural strength or framing. The building's stand-alone framework shall include 8- to 16-gauge, cold-formed, galvanized steel structural members. Building framework to have a flush wall, post and beam format with girts and purlins, and full trusses on both end walls which easily allows for future expansion and/or modifications. Wall and ceiling structural support system are to be designed to provide load carrying capability for anticipated equipment loads using 16-gauge galvanized steel hat channels behind liner panel for reinforcement as needed, with locations shown on approval drawings. Roof to have 8-gauge to 14-gauge solid web hot rolled steel trusses. Premanufactured fire pump houses shall have the entire floor area between the beams filled solid with concrete and fire pump frame must be grouted in.

2. Insulation

Exterior walls shall have a minimum of 3.5 inch fiberglass batt insulation and a vapor barrier. The ceiling shall have a minimum of 6 inch insulation and a vapor barrier. In addition to the insulation in the walls and ceiling, an additional 1 inch fiber-glass insulation blanket shall be installed over the entire building framework and under the exterior wall and roof panels, as a thermal break. The insulation system shall provide a minimum of R-14 in the walls, R-21 above the ceiling, and R-30 in the floor.

3. Roof

The design of the roof shall be the responsibility of the prefabricated building manufacturer. The roof shall have a pitch of not less than 1 inch in 12 inches. Roof to be either a gable or one way slope with pitch. Roof structure, wall structures and connections must be designed to allow lifting of the entire enclosure.

4. Exterior Walls

The exterior walls shall be 26 gauge minimum "Multi-Rib" ribbed steel panels with a PVDF resin-based finish over a galvalume substrate in manufacturer's standard colors. Exterior siding panels to be overlapped and installed with appropriate self-tapping fasteners with integral gaskets and shall be removable without any disturbance to interior panels. Butted seams are not allowed. All openings in walls are to be structurally framed, sleeved, trimmed, and provided with external drip caps. Repair or replacement of exterior panels must be able to be done entirely from outside.

5. Exterior Trim

The exterior trim package shall be fabricated from 26 gauge minimum Galvalume material with owner's choice of standard KYNAR colors.

6. Interior Finish

The enclosure's interior walls and ceiling shall be lined with flush-fit 22 gauge, roll-formed liner panels, with concealed fasteners and a baked-on White polyester finish over G-90 galvanized substrate. The enclosure interior shall feature a complete matching trim system including base, jamb, header, and ceiling trim. Liner to be reinforced with 14 gauge hat channels mounted vertically as needed for heavy wall mounted items.

7. Interior Dimensions

Interior dimensions must be coordinated with Fire Protection subcontractor and Fire Pump Equipment Supplier as required to accommodate the equipment and to meet the clearance requirements stated in NFPA 20 and UFC 3-600-01.

8. Fasteners, Adhesives, and Sealants

The fasteners, adhesives, and sealants utilized shall be of types approved for use on this type of structure as required by the appropriate agency or governing body, and these specifications.

9. Closures

Matching, pre-molded, closed cell elastomer closures provided by the siding and roof panel manufacturer shall be installed according to the manufacturer's recommendations at the eave line, beneath the roof panels, and where the trim meets the wall panels.

2.13.4.2 Door and Hardware

1. Doors shall at a minimum comply with Steel Door Institute directive SDI/DOOR 111. Door hardware shall include the following:

a. NRP stainless steel ball bearing hinges, minimum of Three (3) per door.
b. LCN4111 closer with hold open arm.
c. Weatherstripping and sweep, Reese #797B.
d. Threshold, Reese #V301.
e. Watershed, at top of door, Reese #202C; 203C.
f. Drip cap, extending 3" past door edge.

2. Doors and Frames

Doors to be constructed of no less than 18-gauge steel faced leafs with stiffeners and 16 gauge door frames. Doors and frames to be hot-dipped galvanized to ASTM A924/A924M and ASTM A653/A653M, then factory primed and painted with epoxy enamel to match the enclosure or the trim. Door to have insulated core.

3. Sizes and Quantity

Shall be 36" X 84" at a minimum or as indicated on the drawings. A minimum of one double door is required in accordance with NFPA 20 and UFC 3-600-01.

2.13.4.3 Miscellaneous Building Accessories

1. Telecommunications Board

If required, enclosure manufacturer to install a 7/16 inch thick white FRP veneer plywood telecommunications board over a 7/16 inch OSB backer with flush transition trim to wall liner. Painted plywood fastened over the wall liner is not acceptable. Size and quantity to be as indicated in the BOM.

2. PVC Chases

One inch PVC cable chases to be installed in the wall near the bottom of telecommunications board, and in diagonal building corners for ground leads. Chase(s) to be sealed with silicone caulk.

3. Fire Extinguisher

Wall-mounted, 10 pound, multi-purpose dry chemical fire extinguishers (minimum UL rating of 2A:10B:C) are to be provided in a convenient location at each doorway.

2.13.5 Fire Pump Enclosure - Mechanical Requirements

The building supplier shall use the following outdoor design temperature criteria for heating and ventilation calculations:

Winter: 28.0°F (99.6% dry-bulb)
Summer: 93.0°F, 76.7°F (0.4% dry-bulb, mean-coincident wet-bulb)

Prepare and submit detailed calculations for equipment sizing.

2.13.5.1 Heating System

Provide a heating system with sufficient capacity to maintain the interior enclosure temperature at minimum 40°F at the corresponding outdoor winter design temperature condition. Heating system capacity shall be sized

based on detailed load calculations following methods in the ASHRAE Fundamentals Handbook. Accurate determinations of wall and roof U-values shall be made from the actual enclosure specifications and shop drawings. Include the effects of infiltration air into the enclosure. The heating system shall consist of multiple wall-mounted electric unit heaters mounted along the enclosure perimeter. Unit heater throw distance must provide sufficient coverage of the associated exterior wall face. Heaters shall be controlled by integral thermostats and be equipped with disconnects.

2.13.5.2 Ventilation System

Minimum Standards

Intake to have insect screens and painted weather hood or wall louver. Exhaust to have a mounted propeller fan, back draft damper, insect screen, and painted steel weather hood or wall louver. Exhaust fans must be galvanized steel construction.

Size and Quantity

Unless otherwise indicated, intake and exhaust to be sized by building manufacturer based on size of the enclosure and to maintain the interior enclosure temperature at a maximum 104 degrees F at the corresponding outdoor summer design dry-bulb temperature condition.

Controls

Exhaust fan to be controlled by a manual on-off switch and a wall-mounted thermostat.

2.13.6 Fire Pump Enclosure - Fire Protection Requirements

2.13.6.1 Fire Suppression System

Provide automatic wet-pipe fire sprinkler system in accordance with the design criteria indicated on the drawings and as specified in SECTION 21 13 13 WET PIPE SPRINKLER SYSTEMS, FIRE PROTECTION.

2.13.6.2 Fire Detection and Alarm System

Provide automatic fire detection system in accordance with the design criteria indicated on the drawings and as specified in SECTION 28 31 76 INTERIOR FIRE ALARM AND MASS NOTIFICATION SYSTEM, ADDRESSABLE.

2.13.7 Fire Pump Enclosure - Electrical Requirements

2.13.7.1 Standards

All grounding, workmanship and materials shall conform, as a minimum, to the current edition of NFPA 70. All conduit shall be electrical thin wall metallic tubing (EMT) except service runs which are PVC, and flexible metallic conduit used for motor and fixture connections. All interior junction boxes are NEMA 1. All wiring and conduit is surface mounted and run tight to walls and ceiling. Conductors shall be 98% conductivity copper with 600 volt insulation, THHN, sized as required, 12 gauge minimum for line voltage wiring.

2.13.7.2 Materials

1. Lighting

Interior Lighting

Enclosure to be equipped with industrial 1' x 4' LED linear light fixtures with 4000 lumens, 4000K CCT, and 80 CRI. Lighting to be designed to provide a minimum of 20 foot candles at 2'6" above finished floor. Controls shall be manual switching only.

Exterior Lighting

Enclosure to have a LED exterior wall pack light fixture above each door with 3300 lumens, 4000K CCT, 80 CRI, and controlled by a built-in photocell.

Emergency Lighting/Exit Signs

Red LED exit signs to be installed at each enclosure exit. Exterior LED wall packs to be furnished with internal battery back-up. Interior 1' x 4' light fixtures to be furnished with internal battery back-up as needed to provide enclosure egress. All battery back-up lights must provide 90 minutes of use.

2. Receptacles

Interior Receptacles

Wall mounted 20 amp, 125 V AC duplex receptacles shall be installed in the quantity indicated on the drawings, with standard white cover plates, at 18 inches above floor level.

Exterior Receptacles

Weatherproof, 20 amp, 125 VAC, GFI protected duplex receptacles shall be installed as directed by the COR.

3. Switches

All switches are to be 20 amp, wall-mounted with standard white cover plates, at 48" above floor. Switches are standard single pole except lighting if more than one door is used and then switches to be three-way.

4. Telecommunication Systems

Refer to SECTION 26 20 00 INTERIOR DISTRIBUTION SYSTEM and SECTION 27 10 00 BUILDING TELECOMMUNICATIONS CABLING SYSTEM.

5. Grounding and Accessories

Interior ground bar, run to exterior ground ring as shown on drawings.

## PART 3 EXECUTION

### 3.1 EXAMINATION

After becoming familiar with all details of the work, verify all dimensions in the field, and advise the Contracting Officer of any discrepancy before performing the work.

### 3.2 INSPECTION BY QUALIFIED FIRE PROTECTION ENGINEER

Periodically perform a thorough inspection of the fire pump installation, including visual observation of the pump while running, to assure that the installation conforms to the contract requirements. Excessive vibration, leaks (oil or water), unusual noises, overheating, or other potential problems are not acceptable. Inspection includes piping and equipment clearance, access, supports, and guards. Bring any discrepancy to the attention of the Contracting Officer in writing, no later than three working days after the discrepancy is discovered. The Qualified Fire Protection Engineer must witness the preliminary and final acceptance tests and, after completion of the inspections and a successful final acceptance test, sign test results and certify in writing that the installation the fire pump installation is in accordance with the contract requirements.

### 3.3 INSTALLATION

Provide equipment, materials, workmanship, fabrication, assembly, erection, installation, examination, inspection and testing in accordance NFPA 20, except as modified herein. In addition, install the fire pump and engine in accordance with the written instructions of the manufacturer.

#### 3.3.1 Enclosure Detail Drawings

Submit four (4) sets of drawings for approval and an electronic file copy of same in AUTOCAD format to the Government for review. The drawings shall show at a minimum the enclosure floor plan, interior and exterior dimensions, elevations, suggested foundation elevations and dimensions, and the location of all primary accessories included with the building. A digital shop drawing shall be submitted at the time of shipping and prior to request for final payment. Digital files shall be in AUTOCAD format or other approved computer graphics format.

#### 3.3.2 Fire Pump Installation Drawings

Submit Fire Pump Installation Drawings consisting of a detailed plan view, detailed elevations and sections of the pump room, equipment and piping, drawn to a scale of not less than 1/2 inch = 1 foot. Indicate equipment, piping, and associated pump equipment to scale. Indicate all clearance, such as those between piping and equipment; between equipment and walls, ceiling and floors; and for electrical working distance clearance around all electrical equipment. Include a legend identifying all symbols, nomenclatures, and abbreviations. Indicate a complete piping and equipment layout including elevations and/or section views of the following:

a. Fire pumps, controllers, piping, valves, and associated equipment.

b. Sensing line for each pump including the pressure maintenance pump.

c. Restraint of underground water main at entry-and exit-points to the building including details of pipe clamps, tie rods, mechanical retainer glands, and thrust blocks.

d. A one-line schematic diagram indicating layout and sizes of all piping, devices, valves and fittings.

e. A complete point-to-point connection drawing of the pump power, control and alarm systems, as well as interior wiring schematics of each controller.

3.3.3 Pump Room Configuration

Provide detail plan view of the pump room including elevations and sections showing the fire pumps, associated equipment, and piping. Submit working drawings on sheets not smaller than 24 by 36 inches; include data for the proper installation of each system. Show piping schematic of pumps, devices, valves, pipe, and fittings. Provide an isometric drawing of the fire pump and all associated piping. Show point to point electrical wiring diagrams. Show piping layout and sensing piping arrangement. Show engine fuel and cooling system. Include:

a. Pumps, drivers, and controllers

b. Hose valve manifold test header

c. Circuit diagrams for pumps

d. Wiring diagrams of each controller

3.3.4 Accessories

Furnish piping offsets, fittings, and required accessories as specified to provide a complete installation and to eliminate interference with other construction.

3.4 PIPE AND FITTINGS

Piping must be inspected, tested and approved before burying, covering, or concealing. Provide fittings for changes in direction of piping and for all connections. Make changes in piping sizes using tapered reducing pipe fittings. Do not use bushings. Photograph all piping prior to burying, covering, or concealing.

3.4.1 Cleaning of Piping

Interior and ends of piping must be clean and free of any water or foreign material. Keep piping clean during installation by means of plugs or other approved methods. When work is not in progress, securely close open ends of the piping so that no water or foreign matter will enter the pipes or fittings. Inspect piping before placing in position.

3.4.2 Threaded Connections

Provide jointing compound for pipe threads consisting of Teflon pipe thread paste and apply to male threads only. Provide exposed ferrous pipe threads with one coat of zinc molybdate primer applied to a minimum of dry film thickness of 1 mil.

3.4.3 Pipe Hangers and Supports

Provide additional hangers and supports for concentrated loads in aboveground piping, such as for valves and risers.

3.4.3.1 Horizontal Piping

Space horizontal piping supports as follows:

| MAXIMUM SPACING (FEET) | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|
| Nominal Pipe Size (inches) | 1 and Under | 1.25 | 1.5 | 2 | 2.5 | 3 | 3.5 | 4 | 5 | 6+ |
| Steel Pipe | 7 | 8 | 9 | 10 | 11 | 12 | 13 | 14 | 16 | 17 |

3.4.4 Underground Piping

Install underground piping and fittings in conformance to NFPA 24. Anchor joints in accordance with NFPA 24. Provide concrete thrust block at elbow where pipe turns up towards floor, and restrain the pipe riser with steel rods from the elbow to the flange above the floor. After installation in accordance with NFPA 24, clean rods and nuts thoroughly and coat with asphalt or other corrosion-retard material approved by the Contracting Officer. Provide minimum cover depth of 3 feet.

3.4.5 Grooved Mechanical Joint

Prepare grooves according to the coupling manufacturer's instructions. Use grooved fittings, couplings, and grooving tools which are products of the same manufacturer. Ensure pipe and groove dimensions comply with the tolerances specified by the coupling manufacturer. Measure the diameter of grooves made in the field 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. Measure groove width and dimension of groove from end of pipe for each change in grooving tool setup to verify compliance with coupling manufacturer's tolerances. Do not use grooved joints in concealed locations, such as behind solid walls or ceilings, unless an access panel is shown on the drawings for servicing or adjusting the joint.

3.5 ELECTRICAL WORK

Provide electric motor and controls in accordance with NFPA 20, NFPA 72 and NFPA 70, unless more stringent requirements are specified herein or are indicated on the drawings. Provide electrical wiring and associated equipment in accordance with NFPA 20 and Section 26 20 00 INTERIOR DISTRIBUTION SYSTEM. Provide wiring in rigid metal conduit or intermediate metal conduit, except electrical metallic tubing conduit may be provided in dry locations not enclosed in concrete or where not subject to mechanical damage.

## 3.6 PIPE COLOR CODE MARKING

Color code marking of piping as specified in Section 09 90 00 PAINTS AND COATINGS. In accordance with UFC 3-600-01, provide labeling on the surfaces of the piping in the pump enclosure to show the water flow direction and pipe function (e.g., "Suction", "Discharge", "To Fire Department Connection", "To Bypass", "To Test Header", "To Sprinkler System"). Provide white painted stenciled letters and arrows, a minimum of 2-inches in height and visible from at least three sides when viewed from the floor.

## 3.7 FLUSHING

Flush the fire pump suction and discharge piping at 150 percent of rated capacity of each pump. Where the pump installation consists of more than one pump, the flushing is the total quantity of water flowing when all pumps are discharging at 150 percent of their rated capacities. The new pumps may be used to attain the required flushing volume. Do not flush underground piping using the fire pumps. Continue flushing operations until water is clear, but no less than 10 minutes. Submit a signed and dated flushing certificate before requesting field testing.

## 3.8 FIELD TESTS

Submit system diagrams that show the layout of equipment, piping, and storage units, and typed condensed sequence of operation, wiring and control diagrams, and operation manuals explaining preventative maintenance procedures, methods of checking the system for normal, safe operation, and procedures for safely starting and stopping the system must be framed under glass or laminated plastic. After approval, post these items where directed.

### 3.8.1 Hydrostatic Test

Hydrostatically test piping at 225 psig for a period of 2-hours, or at least 50 psi in excess of the maximum pressure, when the maximum pressure in the system is in excess of 200 psi in accordance with NFPA 20.

### 3.8.2 Preliminary Tests

Submit proposed procedures for Preliminary Tests prior to the proposed date and time to begin Preliminary Tests. The Qualified Fire Protection Engineer must take all readings and measurements. The Manufacturer's Representative, a representative of the fire pump controller manufacturer, and a representative of the diesel engine manufacturer (when supplied) must witness the complete operational testing of the fire pump and drivers. The fire pump controller manufacturer's representative and the diesel engine manufacturer's representative must each be an experienced technician employed by the respective manufacturers and capable of demonstrating operation of all features of respective components including trouble alarms and operating features. Thoroughly inspect and test fire pumps, drivers and equipment to insure that the system is correct, complete, and ready for operation. Ensure that pumps are operating at rated capacity, pressure and speed. Include manual starting and running to ensure proper operation and to detect leakage or other abnormal conditions, flow testing, automatic start testing, testing of automatic settings, sequence of operation check, test of required accessories; test of pump alarms devices and supervisory signals, test of pump cooling, operational test of relief valves, and test of automatic power transfer.

Pumps must run without abnormal noise, vibration or heating. If any component or system was found to be defective, inoperative, or not in compliance with the contract requirements during the tests and inspection, make corrections and repeat the entire preliminary. Submit Preliminary Tests Reports, to include both the Contractor's Material and Test Certificate for Underground Piping and the Contractor's Material and Test Certificate for Aboveground Piping. All items in the Report must be signed by the Qualified Fire Protection Engineer and the Manufacturer's Representative.

### 3.8.3 Army Final Acceptance Test

The Qualified Fire Protection Engineer must take all readings and measurements. The Manufacturer's Representative, the fire pump controller manufacturer's representative, and the diesel engine manufacturer's representative (when supplied) must also witness for the final tests. Repair any damage caused by hose streams or other aspects of the test. Submit proposed date and time to begin Army Final Acceptance Test, with the Acceptance Procedures. Provide notification at least 14 days prior to the proposed start of the test. Submit 3 copies of the completed Army Final Acceptance Test Reports, no later that 7 days after the completion of the tests. All items in the reports must be signed by the Qualified Fire Protection Engineer and the Manufacturer's Representative. Test reports in booklet form (each copy furnished in a properly labeled three ring binder) showing all field tests and measurements taken during the preliminary and final testing, and documentation that proves compliance with the specified performance criteria, upon completion of the installation and final testing of the installed system. Indicate the final position of the controls and pressure switches in each test report. Include the description of the hydrostatic test conducted on the piping and flushing of the suction and discharge piping. Include a copy of the manufacturer's certified pump curve for each fire pump in the report. Include a copy of the Contractor's Material & Test Certificates. Include the following in the final acceptance test:

#### 3.8.3.1 Flow Tests

Conduct flow tests using the test header, hoses and playpipe nozzles. Perform flow tests at churn (no flow), 75, 100, 125 and 150 percent capacity for each pump and at full capacity of the pump installation. Take flow readings from each nozzle by means of a calibrated pitot tube with gauge or other approved measuring equipment. Take rpm, suction pressure and discharge pressure reading as part of each flow test. Take voltage and ampere readings on each phase as part of each flow test for electric-motor driven pumps.

#### 3.8.3.2 Starting Tests

Test pumps for automatic starting and sequential starting. Test setting of the pressure switches when pumps are operated by pressure drop. Tests may be performed by operating the test connection on the pressure sensing lines. As a minimum, start each pump automatically 10 times and manually 10 times, in accordance with NFPA 20. Operate fire pumps for a period of a least 10 minutes for each of the starts and do not start more than 2 times in 10 hours. Indicate pressure settings that include automatic starting and stopping of the fire pump(s) on an etched plastic placard, attached to the corresponding pump controller.

3.8.3.3 Alarms

Test all pump alarms, both local and remote.

3.8.3.4 Miscellaneous

Test valve tamper switches. Verify pressure recorder operation relief valve settings, valve operations, operation and accuracy of meters and gauges, and other accessory devices.

3.8.3.5 Alternate Power Source

On installations with an alternate source of power and an automatic transfer switch, simulate and transfer loss of primary power while the pump is operating at peak load. Do not cause opening of overcurrent devices in either line when transferring from normal to emergency source and retransferring from emergency to normal source. Perform at least half of the manual and automatic starting operations listed with the fire pump connected to the alternate source.

3.8.3.6 Correction of Deficiencies

If equipment was found to be defective or non-compliant with contract requirements, perform corrective actions and repeat the tests. Conduct tests and repeat if necessary until the system has been demonstrated to comply with all contract requirements.

3.8.3.7 Test Documentation

The Manufacturer's Representative must supply a copy of the manufacturer's certified curve for each fire pump at the time of the test. The Qualified Fire Protection Engineer must record all test results and plot curve of each pump performance during the test. Record complete pump acceptance test data of each fire pump. The pump acceptance test data must be on forms that give the detail pump information such as that which is indicated in Figure A-11-2.6.3(f) of NFPA 20. Submit all test data records in a three ring binder.

3.8.4 Test Equipment

Provide all equipment and instruments necessary to conduct a complete final test, including 2.5 inch diameter hoses, playpipe nozzles, pitot tube gauges, portable digital tachometer, voltage and ampere meters, and calibrated oil-filled water pressure gauges. Provide all necessary supports to safely secure hoses and nozzles during the test. The Contractor must furnish water for the tests.

3.9 DISINFECTION

After all system components are installed including pumps, piping, and other associated work, and all hydrostatic tests are successfully completed, thoroughly flush the pumps and all piping to be disinfected with potable water until there is no visible sign of dirt or other residue, and hydrostatic test are successfully completed, flush each portion of the piping specified in this Section system to be disinfected thoroughly with potable water until all entrained dirt and other foreign materials are removed before introducing chlorinating material.

3.9.1 Chlorination

Provide chlorinating material consisting of hypochlorites or liquid chlorine. Feed the chlorinating material into the sprinkler piping at a constant rate of 50 parts per million (ppm). Use a properly adjusted hypochlorite solution injected into the system with a hypochlorinator, or liquid chlorine injected into the system through a solution-fed chlorinator and booster pump. Continue chlorination application until the entire system is filled. Keep the water in the system for a minimum of 24 hours. Open and close each valve in the system several times to ensure its proper disinfection. Following the 24-hour period, allow no less than 25 ppm chlorine residual to remain in the system.

3.9.2 Flushing

Flush the system with clean water until the residual chlorine is reduced to less than one part per million. Samples of water in disinfected containers for bacterial examination will be taken from several system locations which are approved by the Contracting Officer.

3.9.3 Sample Testing

Test samples for total coliform organisms (coliform bacteria, fecal coliform, streptococcal, and other bacteria) in accordance with AWWA 10084. Use either the multiple-tube fermentation technique or the membrane-filter technique testing method. Repeat disinfection until 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 SYSTEM STARTUP

Fully enclose or properly guard coupling, rotating parts, gears, projecting equipment, etc. so as to prevent possible injury to persons that come in close proximity of the equipment. Conduct testing of the fire pumps in a safe manner and ensure that all equipment is safely secured. Use hoses and nozzles to conduct flow tests that are in excellent condition and safely anchor and secure to prevent any misdirection of the hose streams.

Post operating instructions for pumps, drivers, controllers, and flow meters.

3.11 CLOSEOUT ACTIVITIES

3.11.1 Manufacturer's Warranty

Manufacturer shall guarantee that the complete enclosure will have no defects in materials and workmanship for a period of two years, except as limited or extended by the original equipment or component manufacturer. Metal exteriors, roofing and liner panel shall have a baked-on PVDF resin-based paint coating, over either a Galvalume or galvanized substrate, with a 20-year warranty against rust perforation (Galvalume), a 30-year Kynar 500 warranty against fading and chalking and a 40-year Kynar 500 warranty against flaking peeling and checking. Coatings to meet minimum performance requirements as set forth in AAMA 2605. (Kynar 500 is an approved coating).

3.11.2 Field Training

Conduct a training course for operating and maintenance personnel as designated by the Contracting Officer. Submit the proposed schedule for field training at least 14 days prior to the start of related training. Provide training for a period of 8 hours of normal working time and start after the fire pump installation is functionally complete and after the Final Acceptance Test. Cover all of the items contained in the approved Operating and Maintenance Instructions. Submit manuals listing step-by-step procedures required for system startup, operation, shutdown, and routine maintenance. Include the manufacturer's name, model number, parts list, list of parts and tools that should be kept in stock by the owner for routine maintenance including the name of a local supplier, simplified wiring and controls diagrams, troubleshooting guide, and recommended service organization (including address and telephone number) for each item of equipment. Submit Data Package 3 for fire pumps and drivers in accordance with Section 01 78 23 OPERATION AND MAINTENANCE DATA. Submit service organization that is capable of providing 4 hour onsite response to a service call on an emergency basis.

3.11.3 As-Built Drawings

Submit As-Built Drawings, no later than 14 days after completion of the Final Tests. Update the Fire Pump Installation Drawings to reflect as-built conditions after all related work is completed and prepare drawings on reproducible full-size mylar film.

3.12 PROTECTION

Carefully remove materials so as not to damage material which is to remain. Replace existing work damaged by the Contractor's operations with new work of the same construction.

-- End of Section --

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.

AMERICAN NATIONAL STANDARDS INSTITUTE (ANSI)

| | |
|---|---|
| ANSI Z21.22/CSA 4.4 | (2015; R 2020) Relief Valves for Hot Water Supply Systems |

AMERICAN SOCIETY OF HEATING, REFRIGERATING AND AIR-CONDITIONING ENGINEERS (ASHRAE)

| | |
|---|---|
| ASHRAE 18 | (2008; R 2013) Methods of Testing for Rating Drinking Water Coolers with Self-Contained Mechanical Refrigeration |

AMERICAN SOCIETY OF MECHANICAL ENGINEERS (ASME)

| | |
|---|---|
| ASME A112.6.1M | (1997; R 2017) Floor Affixed Supports for Off-the-Floor Plumbing Fixtures for Public Use |
| ASME A112.6.3 | (2019) Standard for Floor and Trench Drains |
| ASME A112.14.1 | (2003; R 2017; R 2022) Backwater Valves |
| ASME A112.19.2/CSA B45.1 | (2018; ERTA 2018) Standard for Vitreous China Plumbing Fixtures and Hydraulic Requirements for Water Closets and Urinals |
| ASME A112.19.3/CSA B45.4 | (2022) Stainless Steel Plumbing Fixtures |
| ASME A112.36.2M | (1991; R 2017) Cleanouts |
| ASME B1.20.1 | (2013; R 2018) Pipe Threads, General Purpose (Inch) |
| ASME B16.5 | (2020) Pipe Flanges and Flanged Fittings NPS 1/2 Through NPS 24 Metric/Inch Standard |
| ASME B16.15 | (2018) Cast Copper Alloy Threaded Fittings Classes 125 and 250 |
| ASME B16.18 | (2021) Cast Copper Alloy Solder Joint Pressure Fittings |
| ASME B16.21 | (2021) Nonmetallic Flat Gaskets for Pipe Flanges |

| | |
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| ASME B16.22 | (2021) Wrought Copper and Copper Alloy Solder Joint Pressure Fittings |
| ASME B16.23 | (2021) Cast Copper Alloy Solder Joint Drainage Fittings - DWV |
| ASME B16.29 | (2022) Wrought Copper and Wrought Copper Alloy Solder-Joint Drainage Fittings - DWV |
| ASME B16.34 | (2021) Valves - Flanged, Threaded and Welding End |
| ASME B16.50 | (2021) Wrought Copper and Copper Alloy Braze-Joint Pressure Fittings |
| ASME B31.1 | (2022) Power Piping |
| ASME B31.5 | (2022) Refrigeration Piping and Heat Transfer Components |
| ASME B40.100 | (2022) 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 CSD-1 | (2021) Control and Safety Devices for Automatically Fired Boilers |

AMERICAN SOCIETY OF SANITARY ENGINEERING (ASSE)

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|---|---|
| ASSE 1003 | (2020) Performance Requirements for Water Pressure Reducing Valves for Domestic Water Distribution Systems - (ANSI approved 2010) |
| ASSE 1010 | (2021) Performance Requirements for Water Hammer Arresters |
| ASSE 1017 | (2023) Performance Requirements for Temperature Actuated Mixing Valves for Hot Water Distribution Systems - (ANSI approved 2010) |
| ASSE 1018 | (2023) 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 1022 | (2023) Performance Requirements for Backflow Preventer for Beverage Dispensing Equipment (for carbonated and |

non-carbonated)

ASSE 1024 (2023) Performance Requirements for Dual Check Backflow Preventers

ASSE 1070 (2015) Performance Requirements for Water Temperature Limiting Devices

ASSE 1072 (2020) Performance Requirements for Barrier Type Trap Seal Protection for Floor Drains

AMERICAN WATER WORKS ASSOCIATION (AWWA)

AWWA 10084 (2017) Standard Methods for the Examination of Water and Wastewater

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 (2022) Grooved and Shouldered Joints

AWWA C651 (2014) Standard for Disinfecting Water Mains

AWWA C652 (2019) Disinfection of Water-Storage Facilities

AMERICAN WELDING SOCIETY (AWS)

AWS A5.8/A5.8M (2019) Specification for Filler Metals for Brazing and Braze Welding

AWS B2.2/B2.2M (2016) Specification for Brazing Procedure and Performance Qualification

ASTM INTERNATIONAL (ASTM)

ASTM A74 (2021) Standard Specification for Cast Iron Soil Pipe and Fittings

ASTM A105/A105M (2021) Standard Specification for Carbon Steel Forgings for Piping Applications

ASTM A193/A193M (2023) Standard Specification for Alloy-Steel and Stainless Steel Bolting Materials for High-Temperature Service and Other Special Purpose Applications

ASTM A515/A515M (2017; R2022) Standard Specification for Pressure Vessel Plates, Carbon Steel, for Intermediate- and Higher-Temperature Service

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| ASTM A516/A516M | (2017) Standard Specification for Pressure Vessel Plates, Carbon Steel, for Moderate- and Lower-Temperature Service |
| ASTM A888 | (2021a) Standard Specification for Hubless Cast Iron Soil Pipe and Fittings for Sanitary and Storm Drain, Waste, and Vent Piping Applications |
| ASTM B32 | (2020) Standard Specification for Solder Metal |
| ASTM B88 | (2022) 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 | (2022) Standard Specification for Copper Sheet and Strip for Building Construction |
| ASTM B813 | (2016) Standard Specification for Liquid and Paste Fluxes for Soldering of Copper and Copper Alloy Tube |
| ASTM B828 | (2016) Standard Practice for Making Capillary Joints by Soldering of Copper and Copper Alloy Tube and Fittings |
| ASTM C564 | (2020a) Standard Specification for Rubber Gaskets for Cast Iron Soil Pipe and Fittings |
| ASTM C920 | (2018) Standard Specification for Elastomeric Joint Sealants |
| ASTM D1785 | (2015; E 2018) Standard Specification for Poly(Vinyl Chloride) (PVC), Plastic Pipe, Schedules 40, 80, and 120 |
| ASTM D2308 | (2007; R 2013) Standard Specification for Thermoplastic Polyethylene Jacket for Electrical Wire and Cable |
| ASTM D2466 | (2017) Standard Specification for Poly(Vinyl Chloride) (PVC) Plastic Pipe Fittings, Schedule 40 |
| ASTM D2467 | (2015) Standard Specification for Poly(Vinyl Chloride) (PVC) Plastic Pipe Fittings, Schedule 80 |
| ASTM D2564 | (2020) Standard Specification for Solvent |

| | |
|---|---|
| | Cements for Poly(Vinyl Chloride) (PVC) Plastic Piping Systems |
| ASTM D2665 | (2014) Standard Specification for Poly(Vinyl Chloride) (PVC) Plastic Drain, Waste, and Vent Pipe and Fittings |
| ASTM D2672 | (2014) Joints for IPS PVC Pipe Using Solvent Cement |
| ASTM D2855 | (2015) Standard Practice for Making Solvent-Cemented Joints with Poly(Vinyl Chloride) (PVC) Pipe and Fittings |
| ASTM D3139 | (2019) Joints for Plastic Pressure Pipes Using Flexible Elastomeric Seals |
| ASTM D3212 | (2020) Standard Specification for Joints for Drain and Sewer Plastic Pipes Using Flexible Elastomeric Seals |
| ASTM D3311 | (2017) Standard Specification for Drain, Waste, and Vent (DWV) Plastic Fittings Patterns |
| ASTM E1 | (2014) Standard Specification for ASTM Liquid-in-Glass Thermometers |
| ASTM F477 | (2014; R 2021) Standard Specification for Elastomeric Seals (Gaskets) for Joining Plastic Pipe |
| ASTM F891 | (2016) Standard Specification for Coextruded Poly (Vinyl Chloride) (PVC) Plastic Pipe with a Cellular Core |
| ASTM F1760 | (2016; R 2020) Standard Specification for Coextruded Poly(Vinyl Chloride) (PVC) Non-Pressure Plastic Pipe Having Reprocessed-Recycled Content |
| ASTM F2389 | (2023) Standard Specification for Pressure-rated Polypropylene (PP) Piping Systems |

CAST IRON SOIL PIPE INSTITUTE (CISPI)

| | |
|---|---|
| CISPI 301 | (2018) Hubless Cast Iron Soil Pipe and Fittings for Sanitary and Storm Drain, Waste, and Vent Piping Applications |
| CISPI 310 | (2012) Coupling for Use in Connection with Hubless Cast Iron Soil Pipe and Fittings for Sanitary and Storm Drain, Waste, and Vent Piping Applications |

COPPER DEVELOPMENT ASSOCIATION (CDA)

| | |
|---|---|
| CDA A4015 | (2016; 14/17) Copper Tube Handbook |

INTERNATIONAL CODE COUNCIL (ICC)

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|---|---|
| ICC A117.1 | (2017) Standard And Commentary Accessible and Usable Buildings and Facilities |
| ICC IPC | (2021) International Plumbing Code |

INSTITUTE OF ELECTRICAL AND ELECTRONICS ENGINEERS (IEEE)

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|---|---|
| IEEE 515 | (2017) Standard for the Testing, Design, Installation, and Maintenance of Electrical Resistance Heat Tracing for Industrial Applications |

INTERNATIONAL SAFETY EQUIPMENT ASSOCIATION (ISEA)

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|---|---|
| ANSI/ISEA Z358.1 | (2014; R 2020) American National Standard for Emergency Eyewash and Shower Equipment |

MANUFACTURERS STANDARDIZATION SOCIETY OF THE VALVE AND FITTINGS INDUSTRY (MSS)

| | |
|---|---|
| MSS SP-25 | (2018) Standard Marking System for Valves, Fittings, Flanges and Unions |
| MSS SP-58 | (2018) Pipe Hangers and Supports - Materials, Design and Manufacture, Selection, Application, and Installation |
| MSS SP-67 | (2022) Butterfly Valves |
| MSS SP-70 | (2011) Gray Iron Gate Valves, Flanged and Threaded Ends |
| MSS SP-71 | (2018) Gray Iron Swing Check Valves, Flanged and Threaded Ends |
| MSS SP-72 | (2010a) Ball Valves with Flanged or Butt-Welding Ends for General Service |
| MSS SP-78 | (2011) Cast Iron Plug Valves, Flanged and Threaded Ends |
| MSS SP-80 | (2019) Bronze Gate, Globe, Angle and Check Valves |
| MSS SP-85 | (2011) Gray Iron Globe & Angle Valves Flanged and Threaded Ends |
| MSS SP-110 | (2010) Ball Valves Threaded, Socket-Welding, Solder Joint, Grooved and Flared Ends |

NATIONAL FIRE PROTECTION ASSOCIATION (NFPA)

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| NFPA 70 | (2026) National Electrical Code |
| NFPA 90A | (2024) Standard for the Installation of |

Air Conditioning and Ventilating Systems

NSF INTERNATIONAL (NSF)

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|---|---|
| NSF 372 | (2016) Drinking Water System Components - Lead Content |
| NSF/ANSI 14 | (2022) Plastics Piping System Components and Related Materials |
| NSF/ANSI 61 | (2022) 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)

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| PDI WH 201 | (2010) Water Hammer Arresters Standard |

SOCIETY OF AUTOMOTIVE ENGINEERS INTERNATIONAL (SAE)

| | |
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| SAE J1508 | (2023) Hose Clamp Specifications |

U.S. ENVIRONMENTAL PROTECTION AGENCY (EPA)

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| PL 93-523 | (1974; A 1999) Safe Drinking Water Act |

U.S. NATIONAL ARCHIVES AND RECORDS ADMINISTRATION (NARA)

| | |
|---|---|
| 10 CFR 430 | Energy Conservation Program for Consumer Products |
| 40 CFR 141.80 | National Primary Drinking Water Regulations; Control of Lead and Copper; General Requirements |

UNDERWRITERS LABORATORIES (UL)

| | |
|---|---|
| UL 174 | (2004; Reprint Dec 2021) UL Standard for Safety Household Electric Storage Tank Water Heaters |
| UL 1951 | (2011; Reprint Jun 2020) UL Standard for Safety Electric Plumbing Accessories |

## 1.2 SUBMITTALS

Government approval is required for submittals with a "G" or "S" classification. Submittals not having a "G" or "S" classification are for 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 shall indicate clearances required for maintenance and operation. Where piping and equipment are to be supported other than as indicated, details shall include loadings and proposed support methods. Mechanical drawing plans, elevations, views, and details, shall be drawn to scale.

SD-03 Product Data

Thermostatic Mixing Valves; G

Fixtures

List of installed fixtures with manufacturer, model, and flow rate.

Flush Valve Urinals

WaterSense Label for Urinal; S

Flush Tank Water Closets

WaterSense Label for Flush Tank Water Closet; SCountertop Lavatories

Kitchen Sinks

Drinking-Water Coolers; G

Water Heaters; G

Welding

A copy of qualified procedures and a list of names and identification symbols of qualified welders and welding operators.

Plumbing System

Diagrams, instructions, and other sheets proposed for posting. Manufacturer's recommendations for the installation of bell and spigot and hubless joints for cast iron soil pipe.

Electrical Heat Tracing; G

SD-06 Test Reports

Tests, Flushing and Disinfection

Test reports in booklet form showing all field tests performed to adjust each component and all field tests performed to prove compliance with the specified performance criteria, completion and testing of the installed system. Each test report shall indicate

the final position of controls.

SD-10 Operation and Maintenance Data

Plumbing System; G

Submit in accordance with Section 01 78 23 OPERATION AND MAINTENANCE DATA.

## 1.3 STANDARD PRODUCTS

Specified materials and equipment shall be standard products of a manufacturer regularly engaged in the manufacture of such products. Specified equipment shall essentially duplicate equipment that has performed satisfactorily at least two years prior to bid opening. Standard products shall have been in satisfactory commercial or industrial use for 2 years prior to bid opening. The 2-year use shall include applications of equipment and materials under similar circumstances and of similar size. The product shall have been for sale on the commercial market through advertisements, manufacturers' catalogs, or brochures during the 2 year period.

### 1.3.1 Alternative Qualifications

Products having less than a two-year field service record will be acceptable if a certified record of satisfactory field operation for not less than 6000 hours, exclusive of the manufacturer's factory or laboratory tests, can be shown.

### 1.3.2 Service Support

The equipment items shall be supported by service organizations. Submit a certified list of qualified permanent service organizations for support of the equipment which includes their addresses and qualifications. These service organizations shall be reasonably convenient to the equipment installation and able to render satisfactory service to the equipment on a regular and emergency basis during the warranty period of the contract.

### 1.3.3 Manufacturer's Nameplate

Each item of equipment shall have a nameplate bearing the manufacturer's name, address, model number, and serial number securely affixed in a conspicuous place; the nameplate of the distributing agent will not be acceptable.

### 1.3.4 Modification of References

In each of the publications referred to herein, consider the advisory provisions to be mandatory, as though the word, "shall" had been substituted for "should" wherever it appears. Interpret references in these publications to the "authority having jurisdiction", or words of similar meaning, to mean the Contracting Officer.

#### 1.3.4.1 Definitions

For the International Code Council (ICC) Codes referenced in the contract documents, advisory provisions shall be considered mandatory, the word "should" shall be interpreted as "shall." Reference to the "code official" shall be interpreted to mean the "Contracting Officer." For

Navy owned property, references to the "owner" shall be interpreted to mean the "Contracting Officer." For leased facilities, references to the "owner" shall be interpreted to mean the "lessor." References to the "permit holder" shall be interpreted to mean the "Contractor."

1.3.4.2 Administrative Interpretations

For ICC Codes referenced in the contract documents, the provisions of Chapter 1, "Administrator," do not apply. These administrative requirements are covered by the applicable Federal Acquisition Regulations (FAR) included in this contract and by the authority granted to the Officer in Charge of Construction to administer the construction of this project. References in the ICC Codes to sections of Chapter 1, shall be applied appropriately by the Contracting Officer as authorized by his administrative cognizance and the FAR.

1.4 DELIVERY, STORAGE, AND HANDLING

Handle, store, and protect equipment and materials to prevent damage before and during installation in accordance with the manufacturer's recommendations, and as approved by the Contracting Officer. Replace damaged or defective items.

1.5 PERFORMANCE REQUIREMENTS

1.5.1 Welding

Piping shall be welded in accordance with qualified procedures using performance-qualified welders and welding operators. Procedures and welders shall be qualified in accordance with ASME BPVC SEC IX. Welding procedures qualified by others, and welders and welding operators qualified by another employer, may be accepted as permitted by ASME B31.1. The Contracting Officer shall be notified 24 hours in advance of tests, and the tests shall be performed at the work site if practicable. Welders or welding operators shall apply their assigned symbols near each weld they make as a permanent record.

1.6 REGULATORY REQUIREMENTS

Unless otherwise required herein, plumbing work shall be in accordance with ICC IPC.

1.7 PROJECT/SITE CONDITIONS

The Contractor shall become familiar with details of the work, verify dimensions in the field, and advise the Contracting Officer of any discrepancy before performing any work.

1.8 INSTRUCTION TO GOVERNMENT PERSONNEL

When specified in other sections, furnish the services of competent instructors to give full instruction to the designated Government personnel in the adjustment, operation, and maintenance, including pertinent safety requirements, of the specified equipment or system. Instructors shall be thoroughly familiar with all parts of the installation and shall be trained in operating theory as well as practical operation and maintenance work.

Instruction shall be given during the first regular work week after the

equipment or system has been accepted and turned over to the Government for regular operation. The number of man-days (8 hours per day) of instruction furnished shall be as specified in the individual section. When more than 4 man-days of instruction are specified, use approximately half of the time for classroom instruction. Use other time for instruction with the equipment or system.

When significant changes or modifications in the equipment or system are made under the terms of the contract, provide additional instruction to acquaint the operating personnel with the changes or modifications.

## 1.9 ACCESSIBILITY OF EQUIPMENT

Install all work so that parts requiring periodic inspection, operation, maintenance, and repair are readily accessible. Install concealed valves and equipment requiring access, in locations freely accessible through access doors.

# PART 2 PRODUCTS

## 2.1 MATERIALS

Materials for various services shall be in accordance with TABLES I and II. Pipe schedules shall be selected based on service requirements. Pipe fittings shall be compatible with the applicable pipe materials. Plastic pipe, fittings, and solvent cement shall meet NSF/ANSI 14 and shall be NSF listed for the service intended. Plastic pipe, fittings, and solvent cement used for potable hot and cold water service shall bear the NSF seal "NSF-PW." Polypropylene pipe and fittings shall conform to dimensional requirements of Schedule 40, Iron Pipe size and shall comply with NSF/ANSI 14, NSF/ANSI 61 and ASTM F2389. Polypropylene piping that will be exposed to UV light shall be provided with a Factory applied UV resistant coating. Pipe threads (except dry seal) shall conform to ASME B1.20.1. Grooved pipe couplings and fittings shall be from the same manufacturer. Material or equipment containing a weighted average of greater than 0.25 percent lead shall not be used in any potable water system intended for human consumption, and shall be certified in accordance with NSF/ANSI 61, Annex G or NSF 372. In line devices such as water meters, building valves, check valves, meter stops, valves, fittings and back flow preventers shall comply with PL 93-523 and NSF/ANSI 61, Section 8. End point devices such as drinking water fountains, lavatory faucets, kitchen and bar faucets, residential ice makers, supply stops and end point control valves used to dispense water for drinking must meet the requirements of NSF/ANSI 61, Section 9. Hubless cast-iron soil pipe shall not be installed underground, under concrete floor slabs, or in crawl spaces below kitchen floors. Plastic pipe shall not be installed in air plenums. Plastic pipe shall not be installed in a pressure piping system in buildings greater than three stories including any basement levels.

### 2.1.1 Pipe Joint Materials

Grooved pipe and hubless cast-iron soil pipe shall not be used underground. Solder containing lead shall not be used with copper pipe. Cast iron soil pipe and fittings shall be marked with the collective trademark of the Cast Iron Soil Institute. Joints and gasket materials shall conform to the following:

a. Coupling for Cast-Iron Pipe: for hub and spigot type ASTM A74, AWWA C606. For hubless type: CISPI 310

b. Coupling for Steel Pipe: AWWA C606.

c. Flange Gaskets: Gaskets shall be made of non-asbestos material in accordance with ASME B16.21. Gaskets shall be flat, 1/16 inch thick, and contain Aramid fibers bonded with Styrene Butadiene Rubber (SBR) or Nitro Butadiene Rubber (NBR). Gaskets shall be the full face or self centering flat ring type. Gaskets used for hydrocarbon service shall be bonded with NBR.

d. Brazing Material: Brazing material shall conform to AWS A5.8/A5.8M, BCuP-5.

e. Brazing Flux: Flux shall be in paste or liquid form appropriate for use with brazing material. Flux shall be as follows: lead-free; have a 100 percent flushable residue; contain slightly acidic reagents; contain potassium borides; and contain fluorides.

f. Solder Material: Solder metal shall conform to ASTM B32.

g. Solder Flux: Flux shall be liquid form, non-corrosive, and conform to ASTM B813, Standard Test 1.

h. PTFE Tape: PTFE Tape, for use with Threaded Metal or Plastic Pipe.

i. Rubber Gaskets for Cast-Iron Soil-Pipe and Fittings (hub and spigot type and hubless type): ASTM C564.

j. Flexible Elastomeric Seals: ASTM D3139, ASTM D3212 or ASTM F477.

k. Plastic Solvent Cement for PVC Plastic Pipe: ASTM D2564 and ASTM D2855.

l. Flanged fittings including, but not limited to, flanges, bolts, nuts and bolt patterns shall be in accordance with ASME B16.5 class 150 and shall have the manufacturer's trademark affixed in accordance with MSS SP-25. Flange material shall conform to ASTM A105/A105M. Blind flange material shall conform to ASTM A516/A516M cold service and ASTM A515/A515M for hot service. Bolts shall be high strength or intermediate strength with material conforming to ASTM A193/A193M.

m. Copper tubing shall conform to ASTM B88, Type K or L.

2.1.2 Miscellaneous Materials

Miscellaneous materials shall conform to the following:

a. Water Hammer Arrester: PDI WH 201. Water hammer arrester shall be diaphragm or piston type.

b. Copper, Sheet and Strip for Building Construction: ASTM B370.

c. Hose Clamps: SAE J1508.

d. Supports for Off-The-Floor Plumbing Fixtures: ASME A112.6.1M.

e. Metallic Cleanouts: ASME A112.36.2M.

f. Plumbing Fixture Setting Compound: A preformed flexible ring seal molded from hydrocarbon wax material. The seal material shall be

nonvolatile nonasphaltic and contain germicide and provide watertight, gastight, odorproof and verminproof properties.

g. 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 shall not be used in thermometers.

2.1.3 Pipe Insulation Material

Insulation shall be as specified in Section 23 07 00 THERMAL INSULATION FOR MECHANICAL SYSTEMS.

2.2 PIPE HANGERS, INSERTS, AND SUPPORTS

Pipe hangers, inserts, and supports shall conform to MSS SP-58 and PART 3 of this specification.

2.3 VALVES

Valves shall be provided on supplies to equipment and fixtures. Valves 2-1/2 inches and smaller shall be bronze with threaded bodies for pipe and solder-type connections for tubing. Valves 3 inches and larger shall have flanged iron bodies and bronze trim. Pressure ratings shall be based upon the application. Valves shall conform to the following standards:

| Description | Standard |
|---|---|
| Butterfly Valves | MSS SP-67 |
| Cast-Iron Gate Valves, Flanged and Threaded Ends | MSS SP-70 |
| Cast-Iron Swing Check Valves, Flanged and Threaded Ends | MSS SP-71 |
| Ball Valves with Flanged Butt-Welding Ends for General Service | MSS SP-72 |
| Ball Valves Threaded, Socket-Welding, Solder Joint, Grooved and Flared Ends | MSS SP-110 |
| Cast-Iron Plug Valves, Flanged and Threaded Ends | MSS SP-78 |
| Bronze Gate, Globe, Angle, and Check Valves | MSS SP-80 |

| | |
|---|---|
| Steel Valves, Socket Welding and Threaded Ends | ASME B16.34 |
| Cast-Iron Globe and Angle Valves, Flanged and Threaded Ends | MSS SP-85 |
| Backwater Valves | ASME A112.14.1 |
| Vacuum Relief Valves | ANSI Z21.22/CSA 4.4 |
| Water Pressure Reducing Valves | ASSE 1003 |
| Water Heater Drain Valves | ASME BPVC SEC IV, Part HLW-810: Requirements for Potable-Water Heaters Bottom Drain Valve |
| Trap Seal Primer Valves | ASSE 1018 |
| Temperature and Pressure Relief Valves for Hot Water Supply Systems | ANSI Z21.22/CSA 4.4 |
| Temperature and Pressure Relief Valves for Automatically Fired Hot Water Boilers | ASME CSD-1 Safety Code No., Part CW, Article 5 |

2.3.1 Wall Hydrants (Frostproof)

ASSE 1019 with vacuum-breaker shall have a nickel-brass or nickel-bronze wall plate or flange with nozzle and detachable key handle. A brass or bronze operating rod shall be provided within a galvanized iron casing of sufficient length to extend through the wall so that the valve is inside the building, and the portion of the hydrant between the outlet and valve is self-draining. A brass or bronze valve with coupling and union elbow having metal-to-metal seat shall be provided. Valve rod and seat washer shall be removable through the face of the hydrant. The hydrant shall have 3/4 inch exposed hose thread on spout and 3/4 inch male pipe thread on inlet.

2.3.2 Relief Valves

Water heaters and hot water storage tanks shall have a combination pressure and temperature (P&T) relief valve. The pressure relief element of a P&T relief valve shall have adequate capacity to prevent excessive pressure buildup in the system when the system is operating at the maximum rate of heat input. The temperature element of a P&T relief valve shall have a relieving capacity which is at least equal to the total input of the heaters when operating at their maximum capacity. Relief valves shall be rated according to ANSI Z21.22/CSA 4.4. Relief valves for systems where the maximum rate of heat input is less than 200,000 Btuh shall have

3/4 inch minimum inlets, and 3/4 inch outlets. Relief valves for systems where the maximum rate of heat input is greater than 200,000 Btuh shall have 1 inch minimum inlets, and 1 inch outlets. The discharge pipe from the relief valve shall be the size of the valve outlet.

### 2.3.3 Thermostatic Mixing Valves

Mixing valves, thermostatic type, shall be line size and shall be constructed with rough or finish bodies either with or without plating. Each valve shall be constructed to control the mixing of hot and cold water and to deliver water at a desired temperature regardless of pressure or input temperature changes. The control element shall be of an approved type. The body shall be of heavy cast bronze, and interior parts shall be brass, bronze, corrosion-resisting steel or copper. The valve shall be equipped with necessary stops, check valves, unions, and sediment strainers on the inlets. Control element shall have adjustable range encompassing design water temperature setpoint and equipped with tamper-resistant limit device.

#### 2.3.3.1 Master Mixing Valve

Provide factory-tested lead-free master mixing valve in accordance with ASSE 1017. Set initial mixing valve outlet temperature as indicated on drawings.

#### 2.3.3.2 Point-of-Use Mixing Valve

Provide factory-tested lead-free point-of-use mixing valve in accordance with ASSE 1070 for lavatory and kitchen sink faucets. Mixing valve flow range shall be suitable for single fixture or multiple fixtures. Set initial mixing valve outlet temperature as indicated on drawings.

## 2.4 FIXTURES

Fixtures for use by the physically handicapped shall be in accordance with ICC A117.1. Vitreous China, nonabsorbent, hard-burned, and vitrified throughout the body shall be provided. Porcelain enameled ware shall have specially selected, clear white, acid-resisting enamel coating evenly applied on surfaces. No fixture will be accepted that shows cracks, crazes, blisters, thin spots, or other flaws. Fixtures shall be equipped with appurtenances such as traps, faucets, stop valves, and drain fittings. Each fixture and piece of equipment requiring connections to the drainage system, except grease interceptors, shall be equipped with a trap. Brass expansion or toggle bolts capped with acorn nuts shall be provided for supports, and polished chromium-plated pipe, valves, and fittings shall be provided where exposed to view. Fixtures with the supply discharge below the rim shall be equipped with backflow preventers. Internal parts of flush valves and flushometer valves, shower mixing valves, shower head face plates, pop-up stoppers of lavatory waste drains, and pop-up stoppers and overflow tees and shoes of bathtub waste drains may contain acetal resin, fluorocarbon, nylon, acrylonitrile-butadiene-styrene (ABS) or other plastic material, if the material has provided satisfactory service under actual commercial or industrial operating conditions for not less than 2 years. Plastic in contact with hot water shall be suitable for 180 degrees F water temperature.

2.4.1 Flush Valve Urinals

ASME A112.19.2/CSA B45.1, whitevitreous china, wall-mounted, wall outlet, siphon jet, integral trap, and extended side shields. Provide urinal with the rim 24 inches above the floor. Water flushing volume of the urinal and flush valve combination shall not exceed 0.5 gallons per flush. Urinals must meet the specifications of http://www.epa.gov/watersense/partners/product_program_specs.html and must be EPA WaterSense labeled products. Provide data identifying WaterSense label for urinal. Provide ASME A112.6.1M concealed chair carriers with vertical steel pipe supports. Provide large diameter flush valve including angle control-stop valve, vacuum breaker, tail pieces, slip nuts, and wall plates; exposed to view components shall be chromium-plated or polished stainless steel. Flush valves shall be nonhold-open type. Mount flush valves not less than 11 inches above the fixture.

2.4.2 Flush Tank Water Closets

ASME A112.19.2/CSA B45.1, white vitreous china, siphon jet, elongated bowl, pressure assisted, floor-mounted, floor outlet. Top of toilet seat height above floor shall be 14 to 15 inches, except 17 to 19 inches for wheelchair water closets. Gravity tank type water closets are not permitted. Provide wax bowl ring including plastic sleeve. Water flushing volume of the water closet shall not exceed 1.28 gallons per flush. Tank-type water closets must meet the specifications of http://www.epa.gov/watersense/partners/product_program_specs.html and must be EPA WaterSense labeled products. Provide data identifying WaterSense label for flush tank water closet. Provide white solid plastic elongated closed-front seat with cover.

2.4.3 Countertop Lavatories

Integral solid surface countertop lavatory conforming to requirements in Section 06 61 16 SOLID SURFACING FABRICATIONS. Provide two integral bowls. Provide with supply openings for use with top mounted centerset faucets. Provide template and mounting kit by lavatory manufacturer. Provide aerator with faucet. Provide lavatory faucets with a maximum flow rate of 0.5 gpm at a flowing pressure of 60 psi.

2.4.4 Kitchen Sinks

ASME A112.19.3/CSA B45.4, 20 gage stainless steel with integral mounting rim for flush installation, minimum dimensions of 17 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 shall not exceed 2.2 gpm when measured at a flowing water pressure of 60 psi. Provide stainless steel drain outlets and stainless steel cup strainers. Provide top mounted washerless sink faucets with hose spray.

2.4.5 Drinking-Water Coolers

ANSI/ASHRAE 18 with more than a single thickness of metal between the potable water and the refrigerant in the heat exchanger, wall-hung, bi-level bubbler style, air-cooled condensing unit, 8 gph minimum capacity, stainless steel splash receptor and basin, bottle filler and stainless steel cabinet, with 27 inch minimum knee clearance from front bottom of unit to floor. Bubblers shall be controlled by push levers or

push bars, or touch pads one on each side or one on front and both sides of the cabinets. Bubbler spouts shall be mounted at maximum of 36 inches above floor and at front of unit basin for ADA side, and 38 inches to 43 inches above floor for standing person side. Spouts shall direct water flow at least 4 inches above unit basin and trajectory parallel or nearly parallel to the front of unit. Provide ASME A112.6.1M concealed steel pipe chair carriers. Provide electric water cooler that is GreenSpec listed.

### 2.4.6 Precast Terrazzo Mop Sinks

Terrazzo shall be made of marble chips cast in white portland cement to produce 3000 psi minimum compressive strength 7 days after casting. Provide floor or wall outlet copper alloy body drain cast integral with terrazzo, with polished stainless steel strainers. Provide back mounted washerless service sink faucets with vacuum breaker, 0.75 inch external hose threads, and spout brace.

### 2.4.7 Emergency Eyewash

ANSI/ISEA Z358.1, portable gravity fed eyewash.

Polyethylene tank shall be equipped with threaded cap for inspection, cleaning, and filling, and shall have sufficient volume to provide 15 minutes of eyewash flow at 0.4 gpm. Provide eyewash with pull-down control arm to initiate flow from tank. Provide hardware for wall-mounting and portable waste receptor for collecting eyewash discharge.

## 2.5 BACKFLOW PREVENTERS

Backflow preventers for main water service shall be in accordance with Section 33 11 00 WATER UTILITY DISTRIBUTION PIPING.

Backflow preventers for beverage service equipment and coffee machines shall be dual check type conforming to ASSE 1022 or ASSE 1024.

## 2.6 DRAINS

### 2.6.1 Floor Drains

Floor drains shall consist of a galvanized body, integral seepage pan, and adjustable perforated or slotted chromium-plated bronze, nickel-bronze, or nickel-brass strainer, consisting of grate and threaded collar. Floor drains shall be cast iron except where metallic waterproofing membrane is installed. Drains shall be of double drainage pattern for embedding in the floor construction. The seepage pan shall have weep holes or channels for drainage to the drainpipe. The strainer shall be adjustable to floor thickness. A clamping device for attaching flashing or waterproofing membrane to the seepage pan without damaging the flashing or waterproofing membrane shall be provided when required. Drains shall be provided with threaded connection. Between the drain outlet and waste pipe, a neoprene rubber gasket conforming to ASTM C564 may be installed, provided that the drain is specifically designed for the rubber gasket compression type joint. Floor drains shall conform to ASME A112.6.3. Provide drain with trap primer connection, trap primer, and connection piping. Primer shall meet ASSE 1018.

## 2.7 TRAPS

### 2.7.1 Fixture Traps

Unless otherwise specified, traps for sinks and lavatories shall be copper-alloy adjustable tube type with slip joint inlet and swivel. Traps shall be without a cleanout. Provide traps with removable access panels for easy clean-out at sinks and lavatories. Tubes shall be copper alloy with walls not less than 0.032 inch thick within commercial tolerances, except on the outside of bends where the thickness may be reduced slightly in manufacture by usual commercial methods. Inlets shall have rubber washer and copper alloy nuts for slip joints above the discharge level. Swivel joints shall be below the discharge level and shall be of metal-to-metal or metal-to-plastic type as required for the application. Nuts shall have flats for wrench grip. Outlets shall have internal pipe thread, except that when required for the application, the outlets shall have sockets for solder-joint connections. The depth of the water seal shall be not less than 2 inches for sinks and lavatories and not less than 4 inches for floor drains. The interior diameter shall be not more than 1/8 inch over or under the nominal size, and interior surfaces shall be reasonably smooth throughout. A copper alloy "P" trap assembly consisting of an adjustable "P" trap and threaded trap wall nipple with cast brass wall flange shall be provided for lavatories. The assembly shall be a standard manufactured unit and may have a rubber-gasketed swivel joint. Traps for floor drains shall be as indicated in paragraph Traps in PART 3 of this specification.

### 2.7.2 Electronic Trap Seal Primer

Electronic surface mount trap primer consisting of a solenoid valve, vacuum breaker and adjustable timer to deliver a timed discharge of water to trap(s). Provide electronic trap seal primer with multiple outlets and hinged access door. ASSE 1072 and UL 1951 listed.

### 2.7.3 Barrier-Type Trap Seal Protection Device

For the floor drain in the fire pump structure, the trap must be protected with a barrier-type trap seal protection device conforming to ASSE 1072 and must be installed in accordance with the manufacturer's instructions.

## 2.8 WATER HEATERS

Water heater types and capacities shall be as indicated. Each water heater shall have replaceable anodes. Each primary water heater shall have controls with an adjustable range that includes 90 to 160 degrees F. The thermal efficiencies and standby heat losses shall conform to TABLE III in PART 3 of this Section for each type of water heater specified. The only exception is that storage water heaters and hot water storage tanks having more than 500 gallons storage capacity need not meet the standard loss requirement if the tank surface area is insulated to R-12.5 and if a standing light is not used. A factory pre-charged expansion tank shall be installed on the cold water supply to each water heater. Expansion tanks shall be specifically designed for use on potable water systems and shall be rated for 200 degrees F water temperature and 150 psi working pressure. The expansion tank size and acceptance volume shall be as indicated.

2.8.1 Automatic Storage Type

Heaters shall be complete with control system, temperature gauge, and pressure gauge, and shall have ASME rated combination pressure and temperature relief valve.

2.8.1.1 Electric Type

Electric type water heaters shall conform to UL 174 with copper heating element.

2.9 DOMESTIC WATER SERVICE METER

The requirements for metering and submetering are specified in Section 33 11 00 WATER UTILITY DISTRIBUTION PIPING.

2.10 ELECTRICAL WORK

Controllers and contactors shall have auxiliary contacts for use with the controls provided. Manual or automatic control and protective or signal devices required for the operation specified and any control wiring required for controls and devices specified, but not shown, shall be provided.

Power wiring and conduit for field installed equipment shall be provided under and conform to the requirements of Section 26 20 00 INTERIOR DISTRIBUTION SYSTEM.

2.11 MISCELLANEOUS PIPING ITEMS

2.11.1 Escutcheon Plates

Provide one piece or split hinge metal plates for piping entering floors, walls, and ceilings in exposed spaces. Provide chromium-plated on copper alloy plates or polished stainless steel finish in finished spaces. Provide paint finish on plates in unfinished spaces.

2.11.2 Pipe Sleeves

Provide where piping passes entirely through walls, ceilings, roofs, and floors. Sleeves are not required where drain, waste, and vent (DWV) piping passes through concrete floor slabs located on grade, except where penetrating a membrane waterproof floor.

2.11.2.1 Sleeves in Masonry and Concrete

Provide steel pipe sleeves or schedule 40 PVC plastic pipe sleeves. Sleeves are not required where drain, waste, and vent (DWV) piping passes through concrete floor slabs located on grade. Core drilling of masonry and concrete may be provided in lieu of pipe sleeves when cavities in the core-drilled hole are completely grouted smooth.

2.11.2.2 Sleeves Not in Masonry and Concrete

Provide 26 gage galvanized steel sheet or PVC plastic pipe sleeves.

2.11.3 Pipe Hangers (Supports)

Provide MSS SP-58 Type 1 with adjustable type steel support rods, except

as specified or indicated otherwise. Attach to steel joists with Type 19 or 23 clamps and retaining straps. Attach to Steel W or S beams with Type 21, 28, 29, or 30 clamps. Attach to steel angles and vertical web steel channels with Type 20 clamp with beam clamp channel adapter. Attach to horizontal web steel channel and wood with drilled hole on centerline and double nut and washer. Attach to concrete with Type 18 insert or drilled expansion anchor. Provide Type 40 insulation protection shield for insulated piping.

2.11.4 Nameplates

Provide 0.125 inch thick melamine laminated plastic nameplates, black matte finish with white center core, for equipment, gages, thermometers, and valves; valves in supplies to faucets will not require nameplates. Accurately align lettering and engrave minimum of 0.25 inch high normal block lettering into the white core. Minimum size of nameplates shall be 1.0 by 2.5 inches. Key nameplates to a chart and schedule for each system. Frame charts and schedules under glass and place where directed near each system. Furnish two copies of each chart and schedule.

2.11.5 Strainers

Strainers shall be Y-pattern type and equipped with a threaded blowoff outlet and shutoff valve. All strainers shall be the "lead-free" type complying with NSF/ANSI 61. The bodies shall have arrows clearly cast on the sides indicating the direction of flow. Removable stainless steel screen shall be 20 mesh for strainers below 4 inches and have 1/8 inch perforations for strainers 4 inches and above. Strainers shall have bronze body and threaded connections.

2.11.6 Ice Maker Boxes

Single piece recessed metallic box for wall-mounting, quarter turn shutoff valve, and water hammer arrester. Water inlet connection shall be threaded and water outlet connection shall be compression type. Shutoff valve shall be brass ball type and compliant with NSF/ANSI 61. Ice maker box shall allow water inlet connection from top or bottom sides.

2.12 Electrical Heat Tracing

Provide heat trace system for pipes, valves, and fittings where indicated that are in accordance with IEEE 515 and that is UL listed. System shall include all necessary components, including heaters, connection kits, end seals, identification labels, and controls to prevent freezing. Controller shall have ground fault current sensing and relaying equipment. Controller enclosure shall be NEMA 4 or 4X. Control systems by an ambient sensing thermostat set at 40 degrees F either directly or through an appropriate contactor.

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 using 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 voltage of 208 volts without the use of transformers.

Install power connection, end seals, splice kits and tee kit components in accordance with IEEE 515 and NFPA 70 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 water-tight. Test heat trace cable system in accordance with IEEE 515 after installation and before and after installation of the thermal insulation.

## PART 3 EXECUTION

### 3.1 GENERAL INSTALLATION REQUIREMENTS

Piping located in air plenums shall conform to NFPA 90A requirements. Piping located in shafts that constitute air ducts or that enclose air ducts shall be noncombustible in accordance with NFPA 90A. Installation of plastic pipe where in compliance with NFPA may be installed in accordance with PPFA Fire Man. The plumbing system shall be installed complete with necessary fixtures, fittings, traps, valves, and accessories. Water and drainage piping shall be extended 5 feet outside the building, unless otherwise indicated. A full port ball valve and drain shall be installed on the water service line inside the building approximately 6 inches above the floor from point of entry. Piping shall be connected to the exterior service lines or capped or plugged if the exterior service is not in place. Sewer and water pipes shall be laid in separate trenches, except when otherwise shown. Exterior underground utilities shall be at least 12 inches below the finish grade or as indicated on the drawings. If trenches are closed or the pipes are otherwise covered before being connected to the service lines, the location of the end of each plumbing utility shall be marked with a stake or other acceptable means. Valves shall be installed with control no lower than the valve body.

#### 3.1.1 Water Pipe, Fittings, and Connections

##### 3.1.1.1 Utilities

The piping shall be extended to fixtures, outlets, and equipment. The hot-water and cold-water piping system shall be arranged and installed to permit draining. The supply line to each item of equipment or fixture, except faucets, flush valves, or other control valves which are supplied with integral stops, shall be equipped with a shutoff valve to enable isolation of the item for repair and maintenance without interfering with operation of other equipment or fixtures. Supply piping to fixtures, faucets, hydrants, shower heads, and flushing devices shall be anchored to prevent movement.

##### 3.1.1.2 Cutting and Repairing

The work shall be carefully laid out in advance, and unnecessary cutting of construction shall be avoided. Damage to building, piping, wiring, or equipment as a result of cutting shall be repaired by mechanics skilled in the trade involved.

##### 3.1.1.3 Protection of Fixtures, Materials, and Equipment

Pipe openings shall be closed with caps or plugs during installation. Fixtures and equipment shall be tightly covered and protected against dirt, water, chemicals, and mechanical injury. Upon completion of the

work, the fixtures, materials, and equipment shall be thoroughly cleaned, adjusted, and operated. Safety guards shall be provided for exposed rotating equipment.

3.1.1.4 Mains, Branches, and Runouts

Piping shall be installed as indicated. Pipe shall be accurately cut and worked into place without springing or forcing. Structural portions of the building shall not be weakened. Aboveground piping shall run parallel with the lines of the building, unless otherwise indicated. Branch pipes from service lines may be taken from top, bottom, or side of main, using crossover fittings required by structural or installation conditions. Supply pipes, valves, and fittings shall be kept a sufficient distance from other work and other services to permit not less than 1/2 inch between finished covering on the different services. Bare and insulated water lines shall not bear directly against building structural elements so as to transmit sound to the structure or to prevent flexible movement of the lines. Water pipe shall not be buried in or under floors unless specifically indicated or approved. Changes in pipe sizes shall be made with reducing fittings. Use of bushings will not be permitted except for use in situations in which standard factory fabricated components are furnished to accommodate specific accepted installation practice. Change in direction shall be made with fittings, except that bending of pipe 4 inches and smaller will be permitted, provided a pipe bender is used and wide sweep bends are formed. The center-line radius of bends shall be not less than six diameters of the pipe. Bent pipe showing kinks, wrinkles, flattening, or other malformations will not be acceptable.

3.1.1.5 Pipe Drains

Pipe drains indicated shall consist of 3/4 inch hose bibb with renewable seat and full port ball valve ahead of hose bibb. At other low points, 3/4 inch brass plugs or caps shall be provided. Disconnection of the supply piping at the fixture is an acceptable drain.

3.1.1.6 Expansion and Contraction of Piping

Allowance shall be made throughout for expansion and contraction of water pipe. Each hot-water and hot-water circulation riser shall have expansion loops or other provisions such as offsets and changes in direction where indicated and required. Risers shall be securely anchored as required or where indicated to force expansion to loops. Branch connections from risers shall be made with ample swing or offset to avoid undue strain on fittings or short pipe lengths. Horizontal runs of pipe over 50 feet in length shall be anchored to the wall or the supporting construction about midway on the run to force expansion, evenly divided, toward the ends. Sufficient flexibility shall be provided on branch runouts from mains and risers to provide for expansion and contraction of piping. Flexibility shall be provided by installing one or more turns in the line so that piping will spring enough to allow for expansion without straining.

3.1.1.7 Commercial-Type Water Hammer Arresters

Commercial-type water hammer arresters shall be provided oncold-water supplies and shall be located as generally indicated, with precise location and sizing to be in accordance with PDI WH 201. Water hammer arresters, where concealed, shall be accessible by means of access doors or removable panels. Commercial-type water hammer arresters shall conform to ASSE 1010. Vertical capped pipe columns will not be permitted.

3.1.2 Joints

Installation of pipe and fittings shall be made in accordance with the manufacturer's recommendations. Mitering of joints for elbows and notching of straight runs of pipe for tees will not be permitted. Joints shall be made up with fittings of compatible material and made for the specific purpose intended.

3.1.2.1 Threaded

Threaded joints shall have American Standard taper pipe threads conforming to ASME B1.20.1. Only male pipe threads shall be coated with graphite or with an approved graphite compound, or with an inert filler and oil, or shall have a polytetrafluoroethylene tape applied.

3.1.2.2 Unions and Flanges

Unions, flanges and mechanical couplings shall not be concealed in walls, ceilings, or partitions. Unions shall be used on pipe sizes 2-1/2 inches and smaller; flanges shall be used on pipe sizes 3 inches and larger.

3.1.2.3 Cast Iron Soil, Waste and Vent Pipe

Bell and spigot compression and hubless gasketed clamp joints for soil, waste and vent piping shall be installed per the manufacturer's recommendations.

3.1.2.4 Copper Tube and Pipe

a. Brazed. Brazed joints shall be made in conformance with AWS B2.2/B2.2M, ASME B16.50, and CDA A4015 with flux and are acceptable for all pipe sizes. Copper to copper joints shall include the use of copper-phosphorus or copper-phosphorus-silver brazing metal without flux. Brazing of dissimilar metals (copper to bronze or brass) shall include the use of flux with either a copper-phosphorus, copper-phosphorus-silver or a silver brazing filler metal.

b. Soldered. Soldered joints shall be made with flux and are only acceptable for piping 2 inches and smaller. Soldered joints shall conform to ASME B31.5 and CDA A4015. Soldered joints shall not be used in compressed air piping between the air compressor and the receiver.

c. Copper Tube Extracted Joint. Mechanically extracted joints shall be made in accordance with ICC IPC.

3.1.3 Dissimilar Pipe Materials

Connections between ferrous and non-ferrous copper water pipe shall be made with dielectric unions or flange waterways. Dielectric waterways shall have temperature and pressure rating equal to or greater than that specified for the connecting piping. Waterways shall have metal connections on both ends suited to match connecting piping. Dielectric waterways shall be internally lined with an insulator specifically designed to prevent current flow between dissimilar metals. Dielectric flanges shall meet the performance requirements described herein for dielectric waterways. Connecting joints between plastic and metallic pipe shall be made with transition fitting for the specific purpose.

3.1.4 Pipe Sleeves and Flashing

Pipe sleeves shall be furnished and set in their proper and permanent location.

3.1.4.1 Sleeve Requirements

Unless indicated otherwise, provide pipe sleeves meeting the following requirements:

a. Secure sleeves in position and location during construction. Provide sleeves of sufficient length to pass through entire thickness of walls, ceilings, roofs, and floors.

b. A modular mechanical type sealing assembly may be installed in lieu of a waterproofing clamping flange and caulking and sealing of annular space between pipe and sleeve. The seals shall consist of interlocking synthetic rubber links shaped to continuously fill the annular space between the pipe and sleeve using galvanized steel bolts, nuts, and pressure plates. The links shall be loosely assembled with bolts to form a continuous rubber belt around the pipe with a pressure plate under each bolt head and each nut. After the seal assembly is properly positioned in the sleeve, tightening of the bolt shall cause the rubber sealing elements to expand and provide a watertight seal between the pipe and the sleeve. Each seal assembly shall be sized as recommended by the manufacturer to fit the pipe and sleeve involved.

c. Sleeves shall not be installed in structural members, except where indicated or approved. Rectangular and square openings shall be as detailed. Each sleeve shall extend through its respective floor, or roof, and shall be cut flush with each surface, except for special circumstances.

d. Unless otherwise indicated, sleeves shall be of a size to provide a minimum of 1/4 inch clearance between bare pipe or insulation and inside of sleeve or between insulation and inside of sleeve. Sleeves in bearing walls and concrete slab on grade floors shall be steel pipe or cast-iron pipe. Sleeves in nonbearing walls or ceilings may be steel pipe, cast-iron pipe, galvanized sheet metal with lock-type longitudinal seam, or plastic.

e. Except as otherwise specified, the annular space between pipe and sleeve, or between jacket over insulation and sleeve, shall be sealed as indicated with sealants conforming to ASTM C920 and with a primer, backstop material and surface preparation as specified in Section 07 92 00 JOINT SEALANTS. The annular space between pipe and sleeve, between bare insulation and sleeve or between jacket over insulation and sleeve shall not be sealed for interior walls which are not designated as fire rated.

f. Sleeves through below-grade walls in contact with earth shall be recessed 1/2 inch from wall surfaces on both sides. Annular space between pipe and sleeve shall be filled with backing material and sealants in the joint between the pipe and concrete wall as specified above. Sealant selected for the earth side of the wall shall be compatible with dampproofing/waterproofing materials that are to be applied over the joint sealant. Pipe sleeves in fire-rated walls

shall conform to the requirements in Section 07 84 00 FIRESTOPPING.

3.1.4.2 Flashing Requirements

Pipes passing through roof shall be installed through a 16 ounce copper flashing, each within an integral skirt or flange. Flashing shall be suitably formed, and the skirt or flange shall extend not less than 8 inchesfrom the pipe and shall be set over the roof or floor membrane in a solid coating of bituminous cement. The flashing shall extend up the pipe a minimum of 10 inches. For cleanouts, the flashing shall be turned down into the hub and caulked after placing the ferrule. Pipes passing through pitched roofs shall be flashed, using lead or copper flashing, with an adjustable integral flange of adequate size to extend not less than 8 inchesfrom the pipe in all directions and lapped into the roofing to provide a watertight seal. The annular space between the flashing and the bare pipe or between the flashing and the metal-jacket-covered insulation shall be sealed as indicated. Flashing for dry vents shall be turned down into the pipe to form a waterproof joint. Pipes, up to and including 10 inches in diameter, passing through roof or floor waterproofing membrane may be installed through a cast-iron sleeve with caulking recess, anchor lugs, flashing-clamp device, and pressure ring with brass bolts. Flashing shield shall be fitted into the sleeve clamping device. Pipes passing through wall waterproofing membrane shall be sleeved as described above. A waterproofing clamping flange shall be installed.

3.1.4.3 Waterproofing

Waterproofing at floor-mounted water closets shall be accomplished by forming a flashing guard from soft-tempered sheet copper. The center of the sheet shall be perforated and turned down approximately 1-1/2 inches to fit between the outside diameter of the drainpipe and the inside diameter of the cast-iron or steel pipe sleeve. The turned-down portion of the flashing guard shall be embedded in sealant to a depth of approximately 1-1/2 inches; then the sealant shall be finished off flush to floor level between the flashing guard and drainpipe. The flashing guard of sheet copper shall extend not less than 8 inches from the drainpipe and shall be lapped between the floor membrane in a solid coating of bituminous cement. If cast-iron water closet floor flanges are used, the space between the pipe sleeve and drainpipe shall be sealed with sealant and the flashing guard shall be upturned approximately 1-1/2 inches to fit the outside diameter of the drainpipe and the inside diameter of the water closet floor flange. The upturned portion of the sheet fitted into the floor flange shall be sealed.

3.1.4.4 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.

3.1.4.5 Pipe Penetrations of Slab on Grade Floors

Where pipes, fixture drains, floor drains, cleanouts or similar items penetrate slab on grade floors, except at penetrations of floors with

waterproofing membrane as specified in paragraphs FLASHING REQUIREMENTS and WATERPROOFING, a groove 1/4 to 1/2 inch wide by 1/4 to 3/8 inch deep shall be formed around the pipe, fitting or drain. The groove shall be filled with a sealant as specified in Section 07 92 00 JOINT SEALANTS.

3.1.4.6 Pipe Penetrations

Provide sealants for all pipe penetrations. All pipe penetrations shall be sealed to prevent infiltration of air, insects, and vermin.

3.1.5 Fire Seal

Where pipes pass through fire walls, fire-partitions, fire-rated pipe chase walls or floors above grade, a fire seal shall be provided as specified in Section 07 84 00 FIRESTOPPING.

3.1.6 Supports

3.1.6.1 General

Hangers used to support piping 2 inches and larger shall be fabricated to permit adequate adjustment after erection while still supporting the load. Pipe guides and anchors shall be installed to keep pipes in accurate alignment, to direct the expansion movement, and to prevent buckling, swaying, and undue strain. Piping subjected to vertical movement when operating temperatures exceed ambient temperatures shall be supported by variable spring hangers and supports or by constant support hangers. In the support of multiple pipe runs on a common base member, a clip or clamp shall be used where each pipe crosses the base support member. Spacing of the base support members shall not exceed the hanger and support spacing required for an individual pipe in the multiple pipe run. Threaded sections of rods shall not be formed or bent.

3.1.6.2 Pipe Hangers, Inserts, and Supports

Installation of pipe hangers, inserts and supports shall conform to MSS SP-58 except as modified herein.

a. Types 5, 12, and 26 shall not be used.

b. Type 3 shall not be used on insulated pipe.

c. Type 18 inserts shall be secured to concrete forms before concrete is placed. Continuous inserts which allow more adjustment may be used if they otherwise meet the requirements for type 18 inserts.

d. Type 19 and 23 C-clamps shall be torqued per MSS SP-58 and shall have both locknuts and retaining devices furnished by the manufacturer. Field-fabricated C-clamp bodies or retaining devices are not acceptable.

e. Type 20 attachments used on angles and channels shall be furnished with an added malleable-iron heel plate or adapter.

f. Type 24 may be used only on trapeze hanger systems or on fabricated frames.

g. Type 39 saddles shall be used on insulated pipe 4 inches and larger when the temperature of the medium is 60 degrees F or higher. Type 39

saddles shall be welded to the pipe.

h. Type 40 shields shall:

(1) Be used on insulated pipe less than 4 inches.

(2) Be used on insulated pipe 4 inches and larger when the temperature of the medium is 60 degrees F or less.

(3) Have a high density insert for all pipe sizes. High density inserts shall have a density of 8 pcf or greater.

i. Horizontal pipe supports shall be spaced as specified in MSS SP-58 and a support shall be installed not over 1 foot from the pipe fitting joint at each change in direction of the piping. Pipe supports shall be spaced not over 5 feet apart at valves. Operating temperatures in determining hanger spacing for PVC or CPVC pipe shall be 120 degrees F for PVC and 180 degrees F for CPVC. Horizontal pipe runs shall include allowances for expansion and contraction.

j. Vertical pipe shall be supported at each floor, except at slab-on-grade, at intervals of not more than 15 feet nor more than 8 feet from end of risers, and at vent terminations. Vertical pipe risers shall include allowances for expansion and contraction.

k. Type 35 guides using steel, reinforced polytetrafluoroethylene (PTFE) or graphite slides shall be provided to allow longitudinal pipe movement. Slide materials shall be suitable for the system operating temperatures, atmospheric conditions, and bearing loads encountered. Lateral restraints shall be provided as needed. Where steel slides do not require provisions for lateral restraint the following may be used:

(1) On pipe 4 inches and larger when the temperature of the medium is 60 degrees F or higher, a Type 39 saddle, welded to the pipe, may freely rest on a steel plate.

(2) On pipe less than 4 inches a Type 40 shield, attached to the pipe or insulation, may freely rest on a steel plate.

(3) On pipe 4 inches and larger carrying medium less that 60 degrees F a Type 40 shield, attached to the pipe or insulation, may freely rest on a steel plate.

l. Pipe hangers on horizontal insulated pipe shall be the size of the outside diameter of the insulation. The insulation shall be continuous through the hanger on all pipe sizes and applications.

m. Where there are high system temperatures and welding to piping is not desirable, the type 35 guide shall include a pipe cradle, welded to the guide structure and strapped securely to the pipe. The pipe shall be separated from the slide material by at least 4 inches or by an amount adequate for the insulation, whichever is greater.

n. Hangers and supports for plastic pipe shall not compress, distort, cut or abrade the piping, and shall allow free movement of pipe except where otherwise required in the control of expansion/contraction.

3.1.6.3 Structural Attachments

Attachment to building structure concrete and masonry shall be by cast-in concrete inserts, built-in anchors, or masonry anchor devices. Inserts and anchors shall be applied with a safety factor not less than 5. Supports shall not be attached to metal decking. Supports shall not be attached to the underside of concrete filled floor or concrete roof decks unless approved by the Contracting Officer. Masonry anchors for overhead applications shall be constructed of ferrous materials only.

3.1.7 Welded Installation

Plumbing pipe weldments shall be as indicated. Changes in direction of piping shall be made with welding fittings only; mitering or notching pipe to form elbows and tees or other similar type construction will not be permitted. Branch connection may be made with either welding tees or forged branch outlet fittings. Branch outlet fittings shall be forged, flared for improvement of flow where attached to the run, and reinforced against external strains. Beveling, alignment, heat treatment, and inspection of weld shall conform to ASME B31.1. Weld defects shall be removed and repairs made to the weld, or the weld joints shall be entirely removed and rewelded. After filler metal has been removed from its original package, it shall be protected or stored so that its characteristics or welding properties are not affected. Electrodes that have been wetted or that have lost any of their coating shall not be used.

3.1.8 Pipe Cleanouts

Pipe cleanouts shall be the same size as the pipe except that cleanout plugs larger than 4 inches will not be required. A cleanout installed in connection with cast-iron soil pipe shall consist of a long-sweep 1/4 bend or one or two 1/8 bends extended to the place shown. An extra-heavy cast-brass or cast-iron ferrule with countersunk cast-brass head screw plug shall be caulked into the hub of the fitting and shall be flush with the floor. Cleanouts in connection with other pipe, where indicated, shall be T-pattern, 90-degree branch drainage fittings with cast-brass screw plugs, except plastic plugs shall be installed in plastic pipe. Plugs shall be the same size as the pipe up to and including 4 inches. Cleanouts on pipe concealed in partitions shall be provided with chromium plated bronze, nickel bronze, nickel brass or stainless steel flush type access cover plates. Round access covers shall be provided and secured to plugs with securing screw. Square access covers may be provided with matching frames, anchoring lugs and cover screws. Cleanouts in finished walls shall have access covers and frames installed flush with the finished wall. Cleanouts installed in finished floors subject to foot traffic shall be provided with a chrome-plated cast brass, nickel brass, or nickel bronze cover secured to the plug or cover frame and set flush with the finished floor. Heads of fastening screws shall not project above the cover surface. Where cleanouts are provided with adjustable heads, the heads shall be cast iron or plastic.

3.2 WATER HEATERS AND HOT WATER STORAGE TANKS

3.2.1 Relief Valves

No valves shall be installed between a relief valve and its water heater or storage tank. The P&T relief valve shall be installed where the valve actuator comes in contact with the hottest water in the heater. Whenever possible, the relief valve shall be installed directly in a tapping in the

tank or heater; otherwise, the P&T valve shall be installed in the hot-water outlet piping. A vacuum relief valve shall be provided on the cold water supply line to a bottom fed water heater and mounted above and within 6 inches above the top of the tank or water heater.

3.2.2 Connections to Water Heaters

Connections of metallic pipe to water heaters shall be made with dielectric unions or flanges.

3.2.3 Expansion Tank

A pre-charged expansion tank shall be installed on the cold water supply between the water heater inlet and the cold water supply shut-off valve. The Contractor shall adjust the expansion tank air pressure, as recommended by the tank manufacturer, to match incoming water pressure.

3.3 FIXTURES AND FIXTURE TRIMMINGS

Polished chromium-plated pipe, valves, and fittings shall be provided where exposed to view. Angle stops, straight stops, stops integral with the faucets, or concealed type of lock-shield, and loose-key pattern stops for supplies with threaded, sweat or solvent weld inlets shall be furnished and installed with fixtures. Where connections between copper tubing and faucets are made by rubber compression fittings, a beading tool shall be used to mechanically deform the tubing above the compression fitting. Exposed traps and supply pipes for fixtures and equipment shall be connected to the rough piping systems at the wall, unless otherwise specified under the item. Floor and wall escutcheons shall be as specified. Drain lines and hot water lines of fixtures for handicapped personnel shall be insulated and do not require polished chrome finish. Plumbing fixtures and accessories shall be installed within the space shown.

3.3.1 Fixture Connections

Where space limitations prohibit standard fittings in conjunction with the cast-iron floor flange, special short-radius fittings shall be provided. Connections between earthenware fixtures and flanges on soil pipe shall be made gastight and watertight with a closet-setting compound or neoprene gasket and seal. Use of natural rubber gaskets or putty will not be permitted. Fixtures with outlet flanges shall be set the proper distance from floor or wall to make a first-class joint with the closet-setting compound or gasket and fixture used.

3.3.2 Flushometer Valves

Flushometer valves shall be secured to prevent movement by anchoring the long finished top spud connecting tube to wall adjacent to valve with approved metal bracket.

3.3.3 Height of Fixture Rims Above Floor

Lavatories shall be mounted with rim at height indicated on the drawings. Wall-hung drinking fountains and water coolers shall be installed with rim at height indicated on the drawings. Installation of fixtures for use by the physically handicapped shall be in accordance with ICC A117.1.

3.3.4 Fixture Supports

Fixture supports for off-the-floor lavatories, urinals, water closets, and other fixtures of similar size, design, and use, shall be of the chair-carrier type. The carrier shall provide the necessary means of mounting the fixture, with a foot or feet to anchor the assembly to the floor slab. Adjustability shall be provided to locate the fixture at the desired height and in proper relation to the wall. Support plates, in lieu of chair carrier, shall be fastened to the wall structure only where it is not possible to anchor a floor-mounted chair carrier to the floor slab.

3.3.4.1 Support for Solid Masonry Construction

Chair carrier shall be anchored to the floor slab. Where a floor-anchored chair carrier cannot be used, a suitable wall plate shall be imbedded in the masonry wall.

3.3.4.2 Support for Concrete-Masonry Wall Construction

Chair carrier shall be anchored to floor slab. Where a floor-anchored chair carrier cannot be used, a suitable wall plate shall be fastened to the concrete wall using through bolts and a back-up plate.

3.3.4.3 Support for Steel Stud Frame Partitions

Chair carrier shall be used. The anchor feet and tubular uprights shall be of the heavy duty design; and feet (bases) shall be steel and welded to a square or rectangular steel tube upright. Wall plates, in lieu of floor-anchored chair carriers, shall be used only if adjoining steel partition studs are suitably reinforced to support a wall plate bolted to these studs.

3.3.5 Backflow Prevention Devices

Plumbing fixtures, equipment, and pipe connections shall not cross connect or interconnect between a potable water supply and any source of nonpotable water. Backflow preventers shall be installed where indicated and in accordance with ICC IPC at all other locations necessary to preclude a cross-connect or interconnect between a potable water supply and any nonpotable substance. In addition backflow preventers shall be installed at all locations where the potable water outlet is below the flood level of the equipment, or where the potable water outlet will be located below the level of the nonpotable substance. Backflow preventers shall be located so that no part of the device will be submerged. Backflow preventers shall be of sufficient size to allow unrestricted flow of water to the equipment, and preclude the backflow of any nonpotable substance into the potable water system. Bypass piping shall not be provided around backflow preventers. Access shall be provided for maintenance and testing. Each device shall be a standard commercial unit.

3.3.6 Access Panels

Access panels shall be provided for concealed valves and controls, or any item requiring inspection or maintenance. Access panels shall be of sufficient size and located so that the concealed items may be serviced, maintained, or replaced.

3.3.7 Sight Drains

Sight drains shall be installed so that the indirect waste will terminate 2 inches above the flood rim of the funnel to provide an acceptable air gap.

3.3.8 Traps

Each trap shall be placed as near the fixture as possible, and no fixture shall be double-trapped. Traps installed on cast-iron soil pipe shall be cast iron. Traps installed on steel pipe or copper tubing shall be recess-drainage pattern, or brass-tube type. Traps installed on plastic pipe may be plastic conforming to ASTM D3311.

3.4 IDENTIFICATION SYSTEMS

3.4.1 Identification Tags

Identification tags made of brass, engraved laminated plastic, or engraved anodized aluminum, indicating service and valve number shall be installed on valves, except those valves installed on supplies at plumbing fixtures. Tags shall be 1-3/8 inch minimum diameter, and marking shall be stamped or engraved. Indentations shall be black, for reading clarity. Tags shall be attached to valves with No. 12 AWG, copper wire, chrome-plated beaded chain, or plastic straps designed for that purpose.

3.4.2 Pipe Color Code Marking

Color code marking of piping shall be as specified in Section 09 90 00 PAINTS AND COATINGS.

3.5 ESCUTCHEONS

Escutcheons shall be provided at finished surfaces where bare or insulated piping, exposed to view, passes through floors, walls, or ceilings, except in boiler, utility, or equipment rooms. Escutcheons shall be fastened securely to pipe or pipe covering and shall be satin-finish, corrosion-resisting steel, polished chromium-plated zinc alloy, or polished chromium-plated copper alloy. Escutcheons shall be either one-piece or split-pattern, held in place by internal spring tension or setscrew.

3.6 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.

3.6.1 Painting of New Equipment

New equipment painting shall be factory applied or shop applied, and shall be as specified herein, and provided under each individual section.

3.6.1.1 Factory Painting Systems

Manufacturer's standard factory painting systems may be provided subject to certification that the factory painting system applied will withstand 125 hours in a salt-spray fog test, except that equipment located outdoors shall withstand 500 hours in a salt-spray fog test. Salt-spray fog test

shall be in accordance with ASTM B117, and for that test the acceptance criteria shall be as follows: immediately after completion of the test, the paint shall show no signs of blistering, wrinkling, or cracking, and no loss of adhesion; and the specimen shall show no signs of rust creepage beyond 0.125 inch on either side of the scratch mark.

The film thickness of the factory painting system applied on the equipment shall not be less than the film thickness used on the test specimen. If manufacturer's standard factory painting system is being proposed for use on surfaces subject to temperatures above 120 degrees F, the factory painting system shall be designed for the temperature service.

3.6.1.2 Shop Painting Systems for Metal Surfaces

Clean, pretreat, prime and paint metal surfaces; except aluminum surfaces need not be painted. Apply coatings to clean dry surfaces. Clean the surfaces to remove dust, dirt, rust, oil and grease by wire brushing and solvent degreasing prior to application of paint, except metal surfaces subject to temperatures in excess of 120 degrees F shall be cleaned to bare metal.

Where more than one coat of paint is specified, apply the second coat after the preceding coat is thoroughly dry. Lightly sand damaged painting and retouch before applying the succeeding coat. Color of finish coat shall be aluminum or light gray.

a. Temperatures Less Than 120 Degrees F: Immediately after cleaning, the metal surfaces subject to temperatures less than 120 degrees F shall receive one coat of pretreatment primer applied to a minimum dry film thickness of 0.3 mil, one coat of primer applied to a minimum dry film thickness of one mil; and two coats of enamel applied to a minimum dry film thickness of one mil per coat.

b. Temperatures Between 120 and 400 Degrees F: Metal surfaces subject to temperatures between 120 and 400 degrees F shall receive two coats of 400 degrees F heat-resisting enamel applied to a total minimum thickness of 2 mils.

3.7 TESTS, FLUSHING AND DISINFECTION

3.7.1 Plumbing System

The following tests shall be performed on the plumbing system in accordance with ICC IPC, except that the drainage and vent system final test shall include the smoke test. The Contractor has the option to perform a peppermint test in lieu of the smoke test. If a peppermint test is chosen, the Contractor must submit a testing procedure and reasons for choosing this option in lieu of the smoke test to the Contracting Officer for approval.

a. Drainage and Vent Systems Test. The final test shall include a smoke test.

b. Building Sewers Tests.

c. Water Supply Systems Tests.

3.7.2 Defective Work

If inspection or test shows defects, such defective work or material shall be replaced or repaired as necessary and inspection and tests shall be repeated. Repairs to piping shall be made with new materials. Caulking of screwed joints or holes will not be acceptable.

3.7.3 System Flushing

3.7.3.1 During Flushing

Before operational tests or disinfection, potable water piping system shall be flushed with potable water. Sufficient water shall be used to produce a water velocity that is capable of entraining and removing debris in all portions of the piping system. This requires simultaneous operation of all fixtures on a common branch or main in order to produce a flushing velocity of approximately 4 fps through all portions of the piping system. In the event that this is impossible due to size of system, the Contracting Officer (or the designated representative) shall specify the number of fixtures to be operated during flushing. Contractor shall provide adequate personnel to monitor the flushing operation and to ensure that drain lines are unobstructed in order to prevent flooding of the facility. Contractor shall be responsible for any flood damage resulting from flushing of the system. Flushing shall be continued until entrained dirt and other foreign materials have been removed and until discharge water shows no discoloration. All faucets and drinking water fountains, to include any device considered as an end point device by NSF/ANSI 61, Section 9, shall be flushed a minimum of 0.25 gallons per 24 hour period, ten times over a 14 day period.

3.7.3.2 After Flushing

System shall be drained at low points. Strainer screens shall be removed, cleaned, and replaced. After flushing and cleaning, systems shall be prepared for testing by immediately filling water piping with clean, fresh potable water. Any stoppage, discoloration, or other damage to the finish, furnishings, or parts of the building due to the Contractor's failure to properly clean the piping system shall be repaired by the Contractor. When the system flushing is complete, the hot-water system shall be adjusted for uniform circulation. Flushing devices and automatic control systems shall be adjusted for proper operation according to manufacturer's instructions. Flow rates on fixtures must not exceed those stated in PART 2 of this Section. Unless more stringent local requirements exist, lead levels shall not exceed limits established by 40 CFR 141.80 (c)(1). The water supply to the building shall be tested separately to ensure that any lead contamination found during potable water system testing is due to work being performed inside the building.

3.7.4 Operational Test

Upon completion of flushing and prior to disinfection procedures, the Contractor shall subject the plumbing system to operating tests to demonstrate satisfactory installation, connections, adjustments, and functional and operational efficiency. Such operating tests shall cover a period of not less than 8 hours for each system and shall include the following information in a report with conclusion as to the adequacy of the system:

a. Time, date, and duration of test.

b. Water pressures at the most remote and the highest fixtures.

c. Operation of each fixture and fixture trim.

d. Operation of each valve, hydrant, and faucet.

e. Temperature of each domestic hot-water supply.

f. Operation of each floor by flooding with water.

g. Operation of each vacuum breaker and backflow preventer.

3.7.5 Disinfection

After all system components are provided and operational tests are complete, the entire domestic hot- and cold-water distribution system shall be disinfected. Before introducing disinfecting chlorination material, entire system shall be flushed with potable water until any entrained dirt and other foreign materials have been removed.

Water chlorination procedure shall be in accordance with AWWA C651 and AWWA C652 as modified and supplemented by this specification. The chlorinating material shall be hypochlorites or liquid chlorine. The chlorinating material shall be fed into the water piping system at a constant rate at a concentration of at least 50 parts per million (ppm). Feed a properly adjusted hypochlorite solution injected into the system with a hypochlorinator, or inject liquid chlorine into the system through a solution-feed chlorinator and booster pump until the entire system is completely filled.

Test the chlorine residual level in the water at 6 hour intervals for a continuous period of 24 hours. If at the end of a 6 hour interval, the chlorine residual has dropped to less than 25 ppm, flush the piping including tanks with potable water, and repeat the above chlorination procedures. During the chlorination period, each valve and faucet shall be opened and closed several times.

After the second 24 hour period, verify that no less than 25 ppm chlorine residual remains in the treated system. The 24 hour chlorination procedure must be repeated until no less than 25 ppm chlorine residual remains in the treated system.

Upon the specified verification, the system including tanks shall then be flushed with potable water until the residual chlorine level is reduced to less than one part per million. During the flushing period, each valve and faucet shall be opened and closed several times.

Take additional samples of water in disinfected containers, for bacterial examination, at locations specified by the Contracting Officer. Test these samples for total coliform organisms (coliform bacteria, fecal coliform, streptococcal, and other bacteria) in accordance with AWWA 10084. The testing method used shall be EPA approved for drinking water systems and shall comply with applicable local and state requirements.

Disinfection shall be repeated until bacterial tests indicate the absence of coliform organisms (zero mean coliform density per 100 milliliters) in the samples for at least 2 full days. The system will

not be accepted until satisfactory bacteriological results have been obtained.

## 3.8 POSTED INSTRUCTIONS

Framed instructions under glass or in laminated plastic, including wiring and control diagrams showing the complete layout of the entire system, shall be posted where directed. Condensed operating instructions explaining preventive maintenance procedures, methods of checking the system for normal safe operation, and procedures for safely starting and stopping the system shall be prepared in typed form, framed as specified above for the wiring and control diagrams and posted beside the diagrams. The framed instructions shall be posted before acceptance testing of the systems.

## 3.9 PERFORMANCE OF WATER HEATING EQUIPMENT

Standard rating condition terms are as follows:

DP = Draw pattern.

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.

UEF = Uniform energy factor.

V = Rated volume in gallons.

Q = Nameplate input rate in kW (Btu/h).

### 3.9.1 Storage Water Heaters

#### 3.9.1.1 Electric

a. Storage capacity less than 20 gallons does not have a minimum uniform energy factor (UEF).

b. Storage capacity more than or equal to 20 gallons and less than or equal to 55 gallons must have a uniform energy factor (UEF) calcuated in accordance with Table III.

3.10 TABLES

TABLE I

PIPE AND FITTING MATERIALS FOR DRAINAGE, WASTE, VENT AND CONDENSATE DRAIN PIPING SYSTEMS

| Item # | Pipe and Fitting Materials | SERVICE A | SERVICE B | SERVICE C | SERVICE D | SERVICE E |
|---|---|---|---|---|---|---|
| 1 | Cast iron soil pipe and fittings, hub and spigot, ASTM A74 with compression gaskets. Pipe and fittings shall be marked with the CISPI trademark. | X | | X | | |
| 2 | Cast iron soil pipe and fittings hubless, CISPI 301 and ASTM A888. Pipe and fittings shall be marked with the CISPI trademark. | | X | X | X | |
| 3 | Copper drainage tube, (DWV), ASTM B306 | | X | | X | X |
| 4 | Wrought copper and wrought alloy solder-joint drainage fittings. ASME B16.29 | | X | | X | X |
| 5 | Cast copper alloy solder joint drainage fittings, DWV, ASME B16.23 | | X | | X | X |
| 6 | Polyvinyl Chloride plastic drain, waste and vent pipe and fittings, ASTM D2665, ASTM F891, (Sch 40) ASTM F1760 | 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 |
|---|---|---|---|---|---|---|

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

TABLE II

PIPE AND FITTING MATERIALS FOR PRESSURE PIPING SYSTEMS

| Item # | Pipe and Fitting Materials | SERVICE A | SERVICE B | SERVICE C |
|---|---|---|---|---|
| 1 | Seamless copper water tube, ASTM B88, ASTM B88M | X** | X** | X*** |
| 2 | Wrought copper and bronze solder-joint pressure fittings, ASME B16.22 for use with Item 1 | X | X | X |
| 3 | Cast copper alloy solder-joint pressure fittings, ASME B16.18 for use with Item 1 | X | X | X |
| 4 | Polyvinyl chloride (PVC) plastic pipe, Schedules 40, 80, and 120, ASTM D1785 | | | X |
| 5 | Polyvinyl chloride (PVC) plastic pipe fittings, Schedule 40, ASTM D2466 | | | X |
| 6 | Socket-type polyvinyl chloride (PVC) plastic pipe fittings, schedule 80, ASTM D2467 | | | X |

TABLE II

PIPE AND FITTING MATERIALS FOR PRESSURE PIPING SYSTEMS

| Item # | Pipe and Fitting Materials | SERVICE A | SERVICE B | SERVICE C |
|---|---|---|---|---|
| 7 | Joints for IPS PVC pipe using solvent cement, ASTM D2672 | | | X |
| 8 | Fittings: brass or bronze; ASME B16.15, and ASME B16.18 ASTM B828 | X | X | |
| | SERVICE:<br>A - Cold Water Service Aboveground<br>B - Hot and Cold Water Distribution<br>180 degrees F Maximum Aboveground<br>C - Cold Water Service Belowground<br>Indicated types are minimum wall thicknesses.<br>** - Type L - Hard<br>*** - Type K - Hard temper with brazed joints only or type K-soft temper without joints in or under floors<br>**** - In or under slab floors only brazed joints | | | |

TABLE III

STANDARD RATING CONDITIONS AND MINIMUM PERFORMANCE RATINGS FOR WATER HEATING EQUIPMENT

| FUEL | STORAGE CAPACITY GALLONS | INPUT RATING | TEST PROCEDURE | REQUIRED PERFORMANCE | |
|---|---|---|---|---|---|
| | | | | DP | UEF |
| A. STORAGE WATER HEATERS | | | | | |
| Elect. | | | 10 CFR 430 | Very Small | 0.8808 - (0.0008 x V) |
| Elect. | | | | Low | 0.9254 - (0.0003 x V) |
| Elect. | | | | Medium | 0.9307 - (0.0002 x V) |
| Elect. | | | | High | 0.9349 - (0.0001 x V) |

TERMS:

DP = Draw pattern
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.
UEF = Uniform energy factor
V = Rated storage volume in gallons
Q = Nameplate input rate in Btu/h

-- End of Section --

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SECTION 23 05 93

TESTING, ADJUSTING, AND BALANCING FOR HVAC
**11/15**

PART 1 GENERAL

1.1 REFERENCES

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

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 | (2022; Addenda E-X 2022; Errata 1-2 2022; Errata 3 2023; Interpretation 1-3 2023) 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 |

1.2 DEFINITIONS

a. AABC: Associated Air Balance Council

b. COTR: Contracting Officer's Technical Representative

c. DALT: Duct air leakage test

d. DALT'd: Duct air leakage tested

e. HVAC: Heating, ventilating, and air conditioning; or heating, ventilating, and cooling

f. NEBB: National Environmental Balancing Bureau

g. Out-of-tolerance data: Pertains only to field acceptance testing of Final DALT or TAB report. When applied to DALT work, this phase means "a leakage rate measured during DALT field acceptance testing which exceeds the leakage rate allowed by SMACNA Leak Test Manual for an indicated duct construction and sealant class." When applied to TAB work this phase means "a measurement taken during TAB field acceptance testing which does not fall within the range of plus 5 to minus 5 percent of the original measurement reported on the TAB Report for a specific parameter."

h. Season of maximum heating load: The time of year when the outdoor temperature at the project site remains within plus or minus 30 degrees Fahrenheit of the project site's winter outdoor design temperature, throughout the period of TAB data recording.

i. Season of maximum cooling load: The time of year when the outdoor temperature at the project site remains within plus or minus 5 degrees Fahrenheit of the project site's summer outdoor design temperature, throughout the period of TAB data recording.

j. Season 1, Season 2: Depending upon when the project HVAC is completed and ready for TAB, Season 1 is defined, thereby defining Season 2. Season 1 could be the season of maximum heating load, or the season of maximum cooling load.

k. Sound measurements terminology: Defined in AABC MN-1, NEBB MASV, or SMACNA 1858 (TABB).

l. TAB: Testing, adjusting, and balancing (of HVAC systems)

m. TAB'd: HVAC Testing/Adjusting/Balancing procedures performed

n. TAB Agency: TAB Firm

o. TABB: Testing Adjusting and Balancing Bureau

1.2.1 Similar Terms

In some instances, terminology differs between the Contract and the TAB Standard primarily because the intent of this Section is to use the industry standards specified, along with additional requirements listed herein to produce optimal results.

The following table of similar terms is provided for clarification only. Contract requirements take precedent over the corresponding AABC, NEBB, or TABB requirements where differences exist.

| SIMILAR TERMS | | | |
|---|---|---|---|
| Contract Term | AABC Term | NEBB Term | TABB Term |
| TAB Standard | National Standards for Testing and Balancing Heating, Ventilating, and Air Conditioning Systems | Procedural Standards for Testing, Adjusting and Balancing of Environmental Systems | International Standards for Environmental Systems Balance |
| TAB Specialist | TAB Engineer | TAB Supervisor | TAB Supervisor |
| Systems Readiness Check | Construction Phase Inspection | Field Readiness Check & Preliminary Field Procedures | Field Readiness Check & Prelim. Field Procedures |

1.3 WORK DESCRIPTION

The work includes duct air leakage testing (DALT) and testing, adjusting, and balancing (TAB) of new heating, ventilating, and cooling (HVAC) air distribution systems including ducts, and piping which are located within, on, under, between, and adjacent to buildings.

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 systems and equipment and submit the specified DALT and TAB reports for approval. Conduct DALT testing in compliance with the requirements specified in SMACNA 1972 CD, except as supplemented and modified by this section. Conduct DALT and TAB work in accordance with the requirements of this section.

1.3.1 Air Distribution Systems

Test, adjust, and balance systems (TAB) in compliance with this section. Obtain Contracting Officer's written approval before applying insulation to exterior of air distribution systems as specified under Section 23 07 00 THERMAL INSULATION FOR MECHANICAL SYSTEMS.

1.3.2 TAB SCHEMATIC DRAWINGS

Show the following information on TAB Schematic Drawings and Reports:

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. 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 systems readiness check.

Submit three copies of the TAB Schematic Drawings and Report Forms to the Contracting Officer, no later than 21 days prior to the start of TAB field measurements.

1.4 SUBMITTALS

Government approval is required for submittals with a "G" or "S" classification. Submittals not having a "G" or "S" classification are for 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

TAB Firm; G

SD-02 Shop Drawings

TAB Schematic Drawings and Report Forms; G

SD-03 Product Data

TAB Procedures; G

Proposed procedures for TAB, submitted with the TAB Schematic Drawings and Report Forms.

Systems Readiness Check; G

TAB Verification; G

SD-06 Test Reports

Completed Pre-Final DALT Report; G

Certified Final DALT 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

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

## 1.5 QUALITY ASSURANCE

### 1.5.1 Independent TAB Agency and Personnel Qualifications

To secure approval for the proposed agency, submit information certifying that the TAB agency is a first tier subcontractor who is not affiliated with any other company participating in work on this contract, including design, furnishing equipment, or construction. Further, submit the following, for the agency, to Contracting Officer for approval:

a. Independent AABC or NEBB or TABB TAB agency:

TAB agency: AABC registration number and expiration date of current certification; or NEBB certification number and expiration date of current certification; or TABB certification number and expiration date of current certification.

TAB team supervisor: Name and copy of AABC or NEBB or TABB TAB supervisor certificate and expiration date of current certification.

TAB team field leader: Name and documented evidence that the team field leader has satisfactorily performed full-time supervision of TAB work in the field for not less than 3 years immediately preceding this contract's bid opening date.

TAB team field technicians: Names and documented evidence that each field technician has satisfactorily assisted a TAB team field leader in performance of TAB work in the field for not less than one year immediately preceding this contract's bid opening date.

Current certificates: Registrations and certifications are current, and valid for the duration of this contract. Renew Certifications which expire prior to completion of the TAB work, in a timely manner so that there is no lapse in registration or certification. TAB agency or TAB team personnel without a current registration or current certification are not to perform TAB work on this contract.

b. TAB Team Members: TAB team approved to accomplish work on this contract are full-time employees of the TAB agency. No other personnel is allowed to do TAB work on this contract.

c. Replacement of TAB team members: Replacement of members may occur if each new member complies with the applicable personnel qualifications and each is approved by the Contracting Officer.

1.5.2 Subcontractor Special Requirements

No work may be performed by a second tier subcontractor.

1.5.3 Instrument Calibration Certificates

It is the responsibility of the TAB firm to provide instrumentation that meets the minimum requirements of the standard under which the TAB Firm's qualifications are approved for use on a project. Instrumentation must be in proper operating condition and must be applied in accordance with the instrumentation's manufacturer recommendations.

All instrumentation must bear a valid NIST traceable calibration certificate during field work and during government acceptance testing. All instrumentation must be calibrated within no later than one year of the date of TAB work or government acceptance testing field work.

1.5.4 TAB Standard

Perform TAB in accordance with the requirements of the standard under which the TAB Firm's qualifications are approved, i.e., AABC MN-1, NEBB PROCEDURAL STANDARDS, or SMACNA 1780 unless otherwise specified herein. All recommendations and suggested practices contained in the TAB Standard are considered mandatory. Use the provisions of the TAB Standard, including checklists, report forms, etc., as nearly as practical, to satisfy the Contract requirements. Use the TAB Standard for all aspects of TAB, including qualifications for the TAB Firm and Specialist and calibration of TAB instruments. Where the instrument manufacturer calibration recommendations are more stringent than those listed in the TAB Standard, adhere to the manufacturer's recommendations.

All quality assurance provisions of the TAB Standard such as performance guarantees are part of this contract. For systems or system components not covered in the TAB Standard, TAB procedures must be developed by the TAB Specialist. Where new procedures, requirements, etc., applicable to the Contract requirements have been published or adopted by the body responsible for the TAB Standard used (AABC, NEBB, or TABB), the requirements and recommendations contained in these procedures and requirements are considered mandatory, including the latest requirements of ASHRAE 62.1.

1.5.5 Qualifications

1.5.5.1 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 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.

1.5.5.2 TAB Specialist

The TAB Specialist must be either a member of AABC,an experienced technician of the Firm certified by the NEBB, or a Supervisor certified by the TABB. The certification must be maintained for the entire duration of duties specified herein. If, for any reason, the Specialist loses subject certification during this period, immediately notify the Contracting Officer and submit another TAB Specialist for approval. Any individual that has been the subject of disciplinary action by either the AABC, the NEBB, or the TABB within the five years preceding Contract Award is not eligible to perform any duties related to the HVAC systems, including TAB. All work specified in this Section and in other related Sections performed by the TAB Specialist will be considered invalid if the TAB Specialist loses its certification prior to Contract completion and must be performed by the approved successor.

1.5.5.3 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.

1.5.6 Responsibilities

The Contractor is responsible for ensuring compliance with the requirements of this section. The following delineation of specific work responsibilities is specified to facilitate TAB execution of the various work efforts by personnel from separate organizations. This breakdown of specific duties is specified to facilitate adherence to the schedule listed in the paragraph TAB SUBMITTAL AND WORK SCHEDULE.

1.5.6.1 Contractor

a. TAB personnel: Ensure that the DALT work and the TAB work is accomplished by a group meeting the requirements specified in the paragraph TAB PERSONNEL QUALIFICATION REQUIREMENTS.

b. Pre-DALT/TAB meeting: Attend the meeting with the TAB Supervisor, and ensure that a representative is present for the sheetmetal contractor, mechanical contractor, electrical contractor, and automatic temperature controls contractor.

c. HVAC documentation: Furnish one complete set of the following HVAC-related documentation to the TAB agency:

(1) Contract drawings and specifications

(2) Approved submittal data for equipment

(3) Construction work schedule

(4) Up-to-date revisions and change orders for the previously listed items

d. Submittal and work schedules: Ensure that the schedule for submittals and work required by this section and specified in the paragraph TAB SUBMITTAL AND WORK SCHEDULE is met.

e. Coordination of supporting personnel:

Provide the technical personnel, such as factory representatives or HVAC controls installer required by the TAB field team to support the DALT and the TAB field measurement work.

Provide equipment mechanics to operate HVAC equipment and ductwork mechanics to provide the field designated test ports to enable TAB field team to accomplish the DALT and the TAB field measurement work. Ensure these support personnel are present at the times required by the TAB team, and cause no delay in the DALT and the TAB field work.

Conversely, ensure that the HVAC controls installer has required support from the TAB team field leader to complete the controls check out.

f. Deficiencies: Ensure that the TAB Agency supervisor submits all Design/Construction deficiency notifications directly to the Contracting officer within 3 days after the deficiency is encountered. Further, ensure that all such notification submittals are complete with explanation, including documentation, detailing deficiencies.

g. Prerequisite HVAC work: Complete check out and debugging of HVAC equipment, ducts, and controls prior to the TAB engineer arriving at the project site to begin the TAB work. Debugging includes searching for and eliminating malfunctioning elements in the HVAC system installations, and verifying all adjustable devices are functioning as designed. Include as prerequisite work items, the deficiencies pointed out by the TAB team supervisor in the design review report.

h. Prior to the TAB field team's arrival, ensure completion of the

applicable inspections and work items listed in the TAB team supervisor's pre-field engineering report. Do not allow the TAB team to commence TAB field work until all of the following are completed.

(1) HVAC system installations are fully complete.

(2) HVAC prerequisite checkout work lists specified in the paragraph PRE-FIELD TAB ENGINEERING REPORT are completed, submitted, and approved. Ensure that the TAB Agency gets a copy of the approved prerequisite HVAC work checklist.

(3) DALT field checks for all systems are completed.

(4) HVAC system filters are clean for both Season 1 and Season 2 TAB field work.

i. Advance notice: Furnish to the Contracting Officer with advance written notice for the commencement of the DALT field work and for the commencement of the TAB field work.

j. Insulation work: For required DALT work , ensure that insulation is not installed on ducts to be DALT'd until DALT work on the subject ducts is complete. Later, ensure that openings in duct and machinery insulation coverings for TAB test ports are marked, closed and sealed.

1.5.6.2 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 systems to satisfy the requirements of this specification section.

1.5.6.3 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 are designed in such a way that the TAB engineer can accomplish the work in compliance with the requirements of this section. Verify the presence and location of permanently installed test ports and other devices needed, including gauge cocks, thermometer wells, flow control devices, circuit setters, balancing valves, and manual volume dampers.

d. Support required: Specify the technical support personnel required from the Contractor other than the TAB agency; such as factory representatives for temperature controls or for complex equipment. Inform the Contractor in writing of the support personnel needed and when they are needed. Furnish the notice as soon as the need is anticipated, either with the design review report, or the pre-field engineering report, the during the DALT or TAB field work.

e. Pre-field DALT preliminary notification: Monitor the completion of the duct installation of each system and provide the necessary written

notification to the Contracting Officer.

f. Pre-field engineering report: Utilizing the following HVAC-related documentation; contract drawings and specifications, approved submittal data for equipment, up-to-date revisions and change orders; prepare this report.

g. Prerequisite HVAC work checklist: Ensure the Contractor gets a copy of this checklist at the same time as the pre-field engineering report is submitted.

h. Technical assistance for DALT work.

(1) Technical assistance: Provide immediate technical assistance to TAB field team.

(2) DALT field visit: Near the end of the DALT field work effort, visit the contract site to inspect the HVAC installation and the progress of the DALT field work. Conduct a site visit to the extent necessary to verify correct procedures are being implemented and to confirm the accuracy of the Pre-final DALT Report data which has been reported. Also, perform sufficient evaluation to allow the TAB supervisor to issue certification of the final report. Conduct the site visit full-time for a minimum of one 8 hour 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: 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.

1.5.6.4 TAB Team Field Leader

a. Field manager: Manage, in the field, the accomplishment of the work specified in Part 3, EXECUTION.

b. Full time: Be present at the contract site when DALT field work or TAB field work is being performed by the TAB team; ensure day-to-day TAB team work accomplishments are in compliance with this section.

c. Prerequisite HVAC work: Do not bring the TAB team to the contract site until a copy of the prerequisite HVAC Checklist, with all work items certified by the Contractor to be working as designed, reaches the office of the TAB Agency.

1.5.7 Test Reports

1.5.7.1 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 in SMACNA 1972 CD. In addition, submit in the report, a marked duct shop drawing which identifies each section of duct tested with assigned node numbers for each section. Include node numbers in the completed report forms to identify each duct section. The TAB supervisor must review and certify the report.

b. The TAB supervisor must include a copy of all calculations prepared in determining the duct surface area of each duct test section. In addition,provide the ductwork air leak testing (DALT) reports with a copy(s) of the calibration curve for each of the DALT test orifices used for testing.

c. Instruments: List the types of instruments actually used to measure the data. Include in the listing each instrument's unique identification number, calibration date, and calibration expiration date. Instruments must have been calibrated within one year of the date of use in the field. Instrument calibration must be traceable to the measuring standards of the National Institute of Standards and Technology.

d. Certification: Include the typed name of the TAB supervisor and the dated signature of the TAB supervisor.

1.5.7.2 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 shown on the drawings:

   (1) Measure and compile data on a continuous basis for the period in which TAB work affecting those rooms is being done.

   (2) Measure and record data only after the HVAC systems installations are complete, the systems fully balanced and the HVAC systems controls operating in fully automatic mode.

   (3) Data may be compiled using direct digital controls trend logging where available. Otherwise, temporarily install calibrated time versus temperature/humidity recorders for this purpose. The HVAC systems and controls must be fully operational a minimum of 24 hours in advance of commencing data compilation. Include the specified data in the Season I and Season 2 TAB Report.

c. System Diagrams: Provide updated diagrams with final installed locations of all terminals and devices, any numbering changes, and actual test locations. Use a key numbering system on the diagram which identifies each outlet contained in the outlet airflow report sheets.

d. Static Pressure Profiles: Report static pressure profiles for air duct systems. Report static pressure data for all supply, return, relief, exhaust and outside air ducts for the systems listed. Include the following in the static pressure report data, in addition to AABC/NEBB/TABB required data:

   (1) Report supply fan, return fan, relief fan, and exhaust fan inlet and discharge static pressures.

   (2) Report static pressure drop across DX coils, 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.

Branch Main Ducts: Take readings at branch main ducts.

VAV Terminals: Take readings at inlet static pressure at VAV terminal box primary air branch ducts.

e. Duct Traverses: Report duct traverses for main and branch main supply, return, exhaust, relief and outside air ducts. This includes all ducts, including those which lack 7 1/2 duct diameters upstream and 2 1/2 duct diameters downstream of straight duct unobstructed by duct fittings/offsets/elbows. The TAB Agency must evaluate and report findings on the duct traverses taken. Evaluate the suitability of the duct traverse measurement based on satisfying the qualifications for a pilot traverse plane as defined by AMCA 203, "Field Measurements", Section 8, paragraph 8.3, "Location of Traverse Plane."

f. Instruments: List the types of instruments actually used to measure the tab data. Include in the listing each instrument's unique identification number, calibration date, and calibration expiration date.

Instrumentation, used for taking wet bulb temperature readings must provide accuracy of plus or minus 5 percent at the measured face velocities. Submit instrument manufacturer's literature to document instrument accuracy performance is in compliance with that specified.

g. Certification: Include the typed name of the TAB supervisor and the dated signature of the TAB supervisor.

h. Performance Curves: The TAB Supervisor must include, in the TAB Reports, factory pump curves and fan curves for pumps and fans TAB'd on the job.

i. Calibration Curves: The TAB Supervisor must include, in the TAB Reports, a factory calibration curve for installed flow control balancing valves, flow venturi's and flow orifices TAB'd on the job.

## 1.6 SEQUENCING AND SCHEDULING

### 1.6.1 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.

#### 1.6.1.1 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.

### 1.6.2 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 prior to start of work, 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.

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 30 calendar days after completion of successful DALT Work Field Check, submit Season 1 TAB report.

Pre-Field TAB Engineering Report: Within 30 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.

1.6.2.1 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. 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.

## 1.7 WARRANTY

Furnish workmanship and performance warranty for the DALT and TAB system work performed for a period not less than 1 year 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 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.

3.2 DALT PROCEDURES

3.2.1 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.

3.2.2 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.

3.2.3 Ductwork To Be DALT'd

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.

3.2.4 DALT Testing

Perform DALT on the HVAC duct sections of each system as selected by the COTR. Use the duct class, seal class, leakage class and the leak test pressure data indicated on the drawings, to comply with the procedures specified in SMACNA 1972 CD.

In spite of specifications of SMACNA 1972 CD to the contrary, DALT ductwork of construction class of 3-inch water gauge static pressure and below if indicated to be DALT'd. Complete DALT work on the COTR selected ductwork within 48 hours after the particular ductwork was selected for DALT. Separately conduct DALT work for large duct systems to enable the DALT work to be completed in 48 hours.

3.2.5 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.

3.2.6 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.

3.2.7 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.

3.2.8 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.

3.2.9 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.

3.3 TAB PROCEDURES

3.3.1 TAB Field Work

Test, adjust, and balance the HVAC systems until measured flow rates (air 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 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 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.

3.3.2 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.

3.3.3 TAB Air Distribution Systems

3.3.3.1 Units With Coils

Report heating and cooling performance capacity tests for electric resistance heating and DX coils for the purpose of verifying that the coils meet the indicated design capacity. Submit the following data and calculations with the coil test reports:

a. For air handlers with capacities greater than 7.5 tons (90,000 Btu) cooling, such as factory manufactured units, central built-up units and rooftop units, conduct capacity tests in accordance with AABC MN-4, procedure 3.5, "Coil Capacity Testing."

   Do not determine entering and leaving wet and dry bulb temperatures by single point measurement, but by the average of multiple readings in compliance with paragraph 3.5-5, "Procedures", (in subparagraph d.) of AABC MN-4, Procedure 3.5, "Coil Capacity Testing."

   Submit part-load coil performance data from the coil manufacturer converting test conditions to design conditions; use the data for the purpose of verifying that the coils meet the indicated design capacity in compliance with AABC MN-4, Procedure 3.5, "Coil Capacity Testing," paragraph 3.5.7, "Actual Capacity Vs. Design Capacity" (in subparagraph c.).

b. For units with capacities of 7.5 tons (90,000 Btu) or less, such as fan coil units, duct mounted reheat coils associated with VAV terminal units, and unitary units, such as 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.

3.3.3.2 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.

3.3.3.3 Exhaust Fans

Exhaust fan systems including fans, ducts, plenums, grilles, and hoods for exhaust air.

3.3.4 Sound Measurement Work

3.3.4.1 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.

3.3.4.2 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.

3.3.4.3 Timing

Measure sound levels at times prescribed by AABC or NEBB or TABB.

3.3.4.4 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.

3.3.4.5 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.

3.3.4.6 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.

3.3.5 TAB Work on Performance Tests Without Seasonal Limitations

3.3.5.1 Performance Tests

In addition to the TAB proportionate balancing work on the air

distribution systems, accomplish TAB work on the HVAC systems which directly transfer thermal energy. TAB the operational performance of the cooling systems.

3.3.5.2 Ambient Temperatures

On each tab report form used for recording data, record the outdoor and indoor ambient dry bulb temperature range and the outdoor and indoor ambient wet bulb temperature range within which the report form's data was recorded. Record these temperatures at beginning and at the end of data taking.

3.3.5.3 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.

3.3.5.4 Refrigeration Units

For refrigeration compressors/condensers/condensing units, report data as required by NEBB Form TAB 15-83, NEBB PROCEDURAL STANDARDS, including refrigeration operational data.

3.3.6 TAB Work on Performance Tests With Seasonal Limitations

3.3.6.1 Performance Tests

Accomplish proportionate balancing TAB work on the air distribution systems, in other words, accomplish adjusting and balancing of the air 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.

3.3.6.2 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.

3.3.6.3 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.

3.3.6.4 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.

3.3.7 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 motor speeds. Further, this TAB work includes changing out fan sheaves if required to obtain air 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.

3.3.8 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.

3.3.9 TAB Reports

After completion of the TAB work, prepare a pre-final TAB report 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 the TAB report is considered incomplete until the TAB work is accomplished to within the accuracy range specified in the paragraph WORKMANSHIP of this section.

Prepare the report neatly and legibly; the pre-final TAB report is the final TAB report minus the TAB supervisor's review and certification. Obtain, at the contract site, the TAB supervisor's review and certification of the TAB report.

Verbally notify the COTR that the field check of the TAB report data can commence; give this verbal notice 48 hours in advance of field check commencement. Do not schedule field check of the TAB report until the specified workmanship requirements have been met or written approval of the deviations from the requirements have been received from the Contracting Officer.

3.3.10 Quality Assurance - COTR TAB Field Acceptance Testing

3.3.10.1 TAB Field Acceptance Testing

During the field acceptance testing, verify, in the presence of the COTR, random selections of data (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 computer room units, and air handling units (central stations).

Group 2: 25 percent of the VAV terminal boxes and associated diffusers and registers.

Group 3: 25 percent of the return grilles, return registers, exhaust grilles and exhaust registers.

Group 4: 25 percent of the exhaust fans.

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.

3.3.10.2 Additional COTR TAB Field Acceptance Testing

If any of the acceptance testing measurements for a given equipment group is found not to fall within the range of plus 5 to minus 5 percent of the TAB Report data, terminate data verification for all affected data for that group. The affected data for the given group will be disapproved. Make the necessary corrections and prepare a revised TAB Report. Reschedule acceptance testing of the revised report data with the COTR.

Further, if any data on the TAB Report for a given field acceptance test group is out-of-tolerance, then field test data for one additional field test group as specified herein. Continue this increase field test work until out-of-tolerance data ceases to to be found. This additional field testing is up and above the original 25 percent of the of reported data entries to be field tested.

If there are no more similar field test groups from which to choose, additional field testing from another, but different, type of field testing group must be tested.

3.3.10.3 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.

3.4 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.

3.5 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.

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) 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 | (2023a) Standard Specification for Chromium and Chromium-Nickel Stainless Steel Plate, Sheet, and Strip for Pressure Vessels and for General Applications |
| ASTM A580/A580M | (2023) 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 C518 | (2017) Standard Test Method for Steady-State Thermal Transmission Properties by Means of the Heat Flow Meter Apparatus |
| ASTM C534/C534M | (2023) Standard Specification for Preformed Flexible Elastomeric Cellular Thermal Insulation in Sheet and Tubular Form |
| ASTM C547 | (2022a) Standard Specification for Mineral |

| | |
|---|---|
| | Fiber Pipe Insulation |
| ASTM C552 | (2022) 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 2023) Standard Specification for Thermal Insulation for Use in Contact with Austenitic Stainless Steel |
| ASTM C916 | (2020) Standard Specification for Adhesives for Duct Thermal Insulation |
| ASTM C920 | (2018) Standard Specification for Elastomeric Joint Sealants |
| ASTM C921 | (2010; R 2015) Standard Practice for Determining the Properties of Jacketing Materials for Thermal Insulation |
| ASTM C1136 | (2023) 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 | (2017; R 2021) 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 | (2023) Standard Test Method for Surface Burning Characteristics of Building Materials |
| ASTM E96/E96M | (2022a; E 2023) Standard Test Methods for Gravimetric Determination of Water Vapor Transmission Rate of Materials |
| ASTM E2231 | (2021) Standard Practice for Specimen Preparation and Mounting of Pipe and Duct Insulation Materials to Assess Surface |

Burning Characteristics

CALIFORNIA DEPARTMENT OF PUBLIC HEALTH (CDPH)

CDPH SECTION 01350 (2017; Version 1.2) 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 (2024) Standard for the Installation of Air Conditioning and Ventilating Systems

NFPA 90B (2024) 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 | (2023; Reprint Jan 2024) UL Standard for Safety Tests for Flammability of Plastic Materials for Parts in Devices and Appliances |
| UL 723 | (2020) UL Standard for Safety Test for Surface Burning Characteristics of Building Materials |
| UL 2818 | (2022) GREENGUARD Certification Program For Chemical Emissions For Building Materials, Finishes And Furnishings |

## 1.2 SYSTEM DESCRIPTION

### 1.2.1 General

Provide field-applied insulation and accessories on mechanical systems as specified herein; factory-applied insulation is specified under the piping, duct or equipment to be insulated.

## 1.3 SUBMITTALS

Government approval is required for submittals with a "G" or "S" classification. Submittals not having a "G" or "S" classification are for 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:

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

SD-03 Product Data

Pipe Insulation Systems; G

Duct Insulation Systems; G

SD-04 Samples

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

1.4 CERTIFICATIONS

1.4.1 Adhesives and Sealants

Provide products certified to meet indoor air quality requirements by UL 2818 (Greenguard) Gold, SCS Global Services Indoor Advantage Gold or provide certification or validation by other third-party programs that products meet the requirements of this Section. Provide current product certification documentation from certification body. When product does not have certification, provide validation that product meets the indoor air quality product requirements cited herein.

1.5 QUALITY ASSURANCE

1.5.1 Installer Qualification

Qualified installers will have successfully completed three or more similar type jobs within the last 5 years.

1.6 DELIVERY, STORAGE, AND HANDLING

Deliver materials in the manufacturer's unopened containers. Protect materials delivered and placed in storage 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. Attach manufacturer's stamp or label giving the name of the manufacturer and brand, and a description of the material, date codes, and approximate shelf life (if applicable) to packages or standard containers of insulation, jacket material, cements, adhesives, and coatings delivered for use, and samples required for approval. Insulation packages and containers must 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. Include the product number, k-value, thickness and furnished accessories including adhesives, sealants and jackets for each mechanical system requiring insulation. The product data must be copyrighted, have an identifying or publication number, and have been published prior to the issuance date of this solicitation. Submit materials furnished under this section 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. Determine flame spread, and smoke developed indexes, 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. Ensure insulation exterior is cleanable, grease resistant, non-flaking and non-peeling. Provide compatible materials that do not contribute to corrosion, soften, or otherwise attack surfaces to which applied in either wet or dry state. Use materials on stainless steel surfaces meeting ASTM C795 requirements. Do not use calcium silicate on chilled or cold water systems. Use asbestos free materials. Provide product recognized under UL 94 (if containing plastic) and listed in FM APP GUIDE.

2.2.1 Adhesives

Provide non-aerosol adhesive products used on the interior of the building (defined as inside of the weatherproofing system) that meet either emissions requirements of CDPH SECTION 01350 (limit requirements for either office or classroom spaces regardless of space type) or VOC content requirements of SCAQMD Rule 1168 (HVAC duct sealants must meet limit requirements of "Other" category within SCAQMD Rule 1168 sealants table). Provide aerosol adhesives used on the interior of the building that meet either emissions requirements of CDPH SECTION 01350 (use the office or classroom requirements, regardless of space type) or VOC content requirements of GS-36. Provide certification or validation of indoor air quality for adhesives.

2.2.1.1 Acoustical Lining Insulation Adhesive

Provide a nonflammable, fire-resistant adhesive conforming to ASTM C916, Type I.

2.2.1.2 Mineral Fiber Insulation Cement

Provide cement in accordance with ASTM C195.

2.2.1.3 Lagging Adhesive

Lagging is the material used for thermal insulation, especially around a cylindrical object. This may include the insulation as well as the cloth/material covering the insulation. To resist mold/mildew, use

lagging adhesive meeting ASTM D5590 with 0 growth rating. Provide nonflammable and fire-resistant lagging adhesives that have a maximum flame spread index of 25 and a maximum smoke developed index of 50 when tested in accordance with ASTM E84. Ensure adhesive is MIL-A-3316, Class 1, pigmented white and 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. Apply lagging adhesives in strict accordance with the manufacturer's recommendations for pipe and duct insulation.

2.2.1.4 Contact Adhesive

Adhesives may be any of, but not limited to, the neoprene based, rubber based, or elastomeric type that have a maximum flame spread index of 25 and a maximum smoke developed index of 50 when tested in accordance with ASTM E84. Ensure adhesive does not adversely affect, initially or in service, the insulation to which it is applied, nor cause any corrosive effect on metal to which it is applied. Ensure that any solvent dispersing medium or volatile component of the adhesive has no objectionable odor and does not contain any benzene or carbon tetrachloride. Ensure dried adhesive does 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 must 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 must 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, use properly installed protective vapor retarder/barriers and vapor stops 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

Provide fibrous glass cloth, with 20X20 maximum mesh size, and glass tape with maximum flame spread index of 25 and a maximum smoke developed index of 50 when tested in accordance with ASTM E84. Provide tape consisting of 4 inch wide rolls. Provide Class 3 tape that is 4.5 ounces/square yard. Elastomeric Foam Tape: Black vapor-retarder foam tape with acrylic adhesive containing an anti-microbial additive.

2.2.7 Staples

Outward clinching type ASTM A167, Type 304 or 316 stainless steel.

2.2.8 Jackets

2.2.8.1 Aluminum Jackets

Provide aluminum jackets consisting of corrugated, embossed or smooth sheet, 0.016 inch nominal thickness; ASTM B209, Temper H14, Temper H16, Alloy 3003, 5005, or 3105. Do not use corrugated aluminum jacket outdoors. Aluminum jacket securing bands must 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 must be 2 by 0.016 inch aluminum matching jacket material. Ensure bands for insulation below ground are 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, use bands at the circumferential joints that are designed by the manufacturer to seal the joints and hold the jacket in place.

2.2.8.2 Polyvinyl Chloride (PVC) Jackets

Polyvinyl chloride (PVC) jacket and fitting covers must 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

Provide laminated self-adhesive vapor barrier/weatherproofing jacket, greater than 3 plies standard grade, silver, white, black and embossed or greater than 8 ply (minimum 2.9 mils adhesive); with 0.0000 permeability when tested in accordance with ASTM E96/E96M, using the water transmission rate test method; heavy duty, white or natural; and UV resistant. Flexible Elastomeric exterior foam with factory applied, UV Jacket made with a cold weather acrylic adhesive. Construction of laminate designed to provide UV resistance, high puncture, tear resistance and excellent Water Vapor Transmission (WVT) rate.

2.2.8.4 Vapor Barrier/Vapor Retarder

Apply the following criteria to determine which system is required.

a. On ducts, equip piping and equipment operating below 60 degrees F or located outside with a vapor barrier.

b. Install ducts, pipes and equipment that are located inside and that always operate above 60 degrees F 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. Use jackets on insulation exposed in finished areas that 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. Ensure all non-metallic jackets 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. Provide product which meets all physical property and performance requirements of ASTM C1136, Type I, except a minimum burst strength of 85 psi. ASTM D2863 Limited Oxygen Index (LOI) is a minimum of 31.

In addition, do not use paper or other moisture-sensitive material for the outer exposed surface or the inner-most surface contacting the insulation. Ensure the outer exposed surface is white and has an emittance no less than 0.80. Ensure the outer exposed surface is paintable.

2.2.9.2 Vapor Retarder/Vapor Barrier Mastic Coatings

2.2.9.2.1 Vapor Barrier

The vapor barrier must 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. Ensure permeability is less than 0.02 when tested in accordance with ASTM E96/E96M. Provide products meeting UL 723 or ASTM E84 flame and smoke requirements and that are UV resistant.

2.2.9.2.2 Vapor Retarder

Provide fire and water resistant vapor retarder coating appropriately selected for either outdoor or indoor service. Color must be white. Ensure the water vapor permeance of the compound is in accordance with ASTM C755, Section 7.2.2, Table 2, for insulation type and service conditions. Provide nonflammable, fire resistant coating. To resist mold/mildew, provide coating meeting ASTM D5590 with 0 growth rating. Ensure coating meets MIL-PRF-19565 Type II (if selected for indoor service) and is Qualified Products Database listed. Determine all other application and service properties 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. Provide vapor retarder with 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

Provide PVDC film vapor retarder with 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

Ensure the vapor barrier is 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). Provide vapor barrier meeting 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). Provide tape 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. Provide jacket with 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

Provide 1/2 inch wide; 26 gauge stainless steel insulation bands.

2.2.13 Sealants

Choose sealants from the butyl polymer type, the styrene-butadiene rubber type, or the butyl type of sealants. Provide sealants with 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 Aboveground Cold Pipeline ( -30 to 60 deg. F)

Provide insulation for outdoor, indoor, exposed or concealed applications, as follows:

#### 2.3.1.1 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.

#### 2.3.1.2 Flexible Elastomeric Cellular Insulation

Closed-cell, foam- or expanded-rubber materials containing anti-microbial additive, complying with ASTM C534/C534M, Grade 1, Type I or II. Type I, Grade 1 for tubular materials. Type II, Grade 1, for sheet materials. Ensure Type I and II have vapor retarder/vapor barrier skin on one or both sides of the insulation, and require an additional exterior vapor retarder covering for high relative humidity and below ambient temperature applications.

### 2.3.2 Aboveground Hot Pipeline (Above 60 deg. F)

Provide insulation for outdoor, indoor, exposed or concealed applications meeting the following requirements. Supply the insulation with manufacturer's recommended factory-applied jacket/vapor barrier.

#### 2.3.2.1 Mineral Fiber

ASTM C547, Types I, II or III, supply the insulation with manufacturer's recommended factory-applied jacket.

#### 2.3.2.2 Cellular Glass

ASTM C552, Type II and Type III. Supply the insulation with manufacturer's recommended factory-applied jacket.

#### 2.3.2.3 Flexible Elastomeric Cellular Insulation

Closed-cell, foam- or expanded-rubber materials containing anti-microbial additive, complying with ASTM C534/C534M, Grade 1, Type I or II to 220 degrees F service. Type I for tubular materials. Type II for sheet materials.

## 2.4 DUCT INSULATION SYSTEMS

### 2.4.1 Duct Insulation

Provide ASTM C534/C534M Grade 1, Type II, flexible elastomeric closed cell

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

Calculate the minimum thickness in accordance with ASHRAE 90.1 - IP.

2.4.1.2 Blanket Insulation

Calculate minimum thickness in accordance with ASHRAE 90.1 - IP.

2.4.2 Acoustical Duct Lining

2.4.2.1 General

For ductwork indicated or specified in Section 23 30 00 HVAC AIR DISTRIBUTION to be acoustically lined, provide external insulation in accordance with this specification section and in addition to the acoustical duct lining. Do not use acoustical lining in place of duct wrap or rigid board insulation (insulation on the exterior of the duct).

2.4.2.2 Duct Liner

Flexible Elastomeric Acoustical and Conformable Duct Liner Materials: Flexible Elastomeric Thermal, Acoustical and Conformable Insulation Compliance with ASTM C534/C534M Grade 1, Type II; and NFPA 90A or NFPA 90B as applicable.

2.4.3 Duct Insulation Jackets

2.4.3.1 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.

2.4.3.2 Metal Jackets

2.4.3.2.1 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.

2.4.3.2.2 Stainless Steel Jackets

ASTM A167 or ASTM A240/A240M; Type 304, minimum thickness of 33 gauge ( 0.010 inch), smooth surface with factory-applied polyethylene and kraft paper moisture barrier on inside surface. Provide stainless steel bands, minimum width of 1/2 inch.

2.4.3.3 Vapor Barrier/Weatherproofing Jacket

Provide vapor barrier/weatherproofing jacket that is 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).

PART 3 EXECUTION

3.1 APPLICATION - GENERAL

Apply insulation to unheated and uncooled piping and equipment. Do not compress flexible elastomeric cellular insulation at joists, studs, columns, ducts, and hangers. The insulation must not pull apart after a one hour period; replace any insulation found to pull apart after one hour.

3.1.1 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. Identify each material used 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. Keep approved display sample sections 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

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, install material in accordance with the manufacturer's written instructions. Do not apply insulation materials until tests specified in other sections of this specification are completed. Remove material such as rust, scale, dirt and moisture from surfaces to receive insulation. Keep insulaton clean and dry. Do not remove insulation from its shipping containers until the day it is ready to use and return to like containers or equally protect from dirt and moisture at the end of each workday. Thoroughly clean insulation that becomes dirty prior to use. If insulation becomes wet or if cleaning does

not restore the surfaces to like new condition, reject the insulation, and immediately remove from the jobsite. Stagger joints on multi layer insulation. Mix mineral fiber thermal insulating cement with demineralized water when used on stainless steel surfaces. Install insulation, jacketing and accessories 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, seal the penetration 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

Paint 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. Do not use flexible elastomeric cellular insulation 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. Ensure insulation seals at seams and joints are not capable of being pulled apart one hour after application. Replace insulation that can be pulled apart one hour after installation.

#### 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

Welding is not permitted 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

Install pipe insulation 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. Install full length units of insulation using a single cut piece to complete a run. Do not use cut pieces or scraps abutting each other. Omit pipe insulation on the following:

a. Pipe used solely for fire protection.

b. Chromium plated pipe to plumbing fixtures. However, for fixtures used by the physically handicapped, insulate the hot water supply and drain, including the trap, 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

Provide continuous pipe insulation 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

Provide 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 which extends 2 inches beyond either side of the wall and secure on each end with a band.

3.2.1.2.2 Penetrating Floors

Extend the aluminum jacket from a point below the backup material to a point 10 inches above the floor with one band at the floor and one not more than 1 inch from the end of the aluminum jacket.

3.2.1.2.3 Penetrating Waterproofed Floors

Extend the aluminum jacket rom below the backup material to a point 2 inches above the flashing with a band 1 inch from the end of the aluminum jacket.

3.2.1.2.4 Penetrating Exterior Walls

Continue the aluminum jacket required for pipe exposed to weather through the sleeve to a point 2 inches beyond the interior surface of the wall.

3.2.1.2.5 Hot Water Pipes Supplying Lavatories or Other Similar Heated Service

Terminate the insulation on the backside of the finished wall. Protect the insulation termination with two coats of vapor barrier coating with a minimum total thickness of 1/16 inch applied with glass tape embedded between coats (if applicable). Extend the coating out onto the insulation 2 inches and seal the end of the insulation. Overlap glass tape seams 1 inch. Caulk the annular space between the pipe and wall penetration with approved fire stop material. Cover the pipe and wall penetration with a properly sized (well fitting) escutcheon plate. Ensure the escutcheon plate overlaps the wall penetration at least 3/8 inches.

3.2.1.2.6 Domestic Cold Water Pipes Supplying Lavatories or Other Similar Cooling Service

Terminate the insulation on the finished side of the wall (i.e., insulation must cover the pipe throughout the wall penetration). Protect the insulation with two coats of weather barrier mastic (breather emulsion type weatherproof mastic impermeable to water and permeable to air) with a minimum total thickness of 1/16 inch. Extend the mastic out onto the insulation 2 inches and 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. Ensure the escutcheon plate overlaps the wall penetration by at least 3/8 inches.

3.2.1.3 Pipes Passing Through Hangers

Ensure insulation, whether hot or cold application, is continuous through hangers. Support all horizontal pipes 2 inches and smaller 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, install insulation inserts as specified below for piping larger than 2 inches, or factory insulated hangers (designed with a load bearing core) can be used.

3.2.1.3.1 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. Install an insulation insert of cellular glass or calcium silicate between each shield and the pipe. Ensure the insert covers the 360-degree arc of the pipe. Provide inserts that are the same thickness as the insulation, and 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. Ensure the insulation jacket is continuous over the wooden dowel, wooden block, or insulation insert. Support the vertical weight of the pipe with hangers located in a horizontal section of the pipe. When the pipe riser is longer than 30 feet, support the weight of the pipe additionally with hangers in the vertical run of the pipe that are directly clamped to the pipe, penetrating the pipe insulation. Use insulated hangers and seal the insulation jacket as indicated herein for anchors in a similar service.

3.2.1.3.2 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. Use jacket material to cover inserts in flexible elastomeric cellular insulation conforming to ASTM C1136, Type 1, and is allowed to be of a different material than the adjoining insulation material.

3.2.1.4 Flexible Elastomeric Cellular Pipe Insulation

Use tubular form flexible elastomeric cellular pipe insulation for pipe sizes 6 inches and less. Grade 1, Do not stretch Type II sheet insulation used on pipes larger than 6 inches around the pipe. Stagger seams when applying multiple layers of insulation. Insulate sweat fittings with miter-cut pieces the same size as on adjacent piping. Insulate screwed fittings with sleeved fitting covers fabricated from miter-cut pieces and overlap and seal to the adjacent pipe insulation. Type II requires an additional exterior vapor retarder/barrier covering for high relative humidity and below ambient temperature applications.

3.2.1.5 Pipes in High Abuse Areas

In high abuse areas such as janitor closets and traffic areas in equipment rooms, kitchens, and mechanical rooms, utilize welded PVC, aluminum or flexible laminate cladding (comprised of elastomeric, plastic or metal foil laminate) laminated self-adhesive (minimum 2 mils adhesive, 3 mils embossed) vapor barrier/weatherproofing jacket, - less than 0.0000 permeability; (greater than 3 ply, standard grade, silver, white, black and embossed) jackets. Protect pipe insulation to the 6 foot level.

3.2.1.6 Pipe Insulation Material and Thickness

Pipe insulation materials must be as listed in Table 1 and must meet or exceed the requirements of ASHRAE 90.1 - IP.

TABLE 1

Insulation Material for Piping

| | Material | Specification | Type | Class | VR/VB Req'd |
|---|---|---|---|---|---|
| Service | | | | | |
| 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 Piping (Max 200 F) | | | | | |
| | Mineral Fiber | ASTM C547 | I | 1 | No |
| | Cellular Glass | ASTM C552 | II | 2 | No |
| | Flexible Elastomeric Cellular | ASTM C534/C534M | I | | No |
| Refrigerant Suction Piping (35 degrees F nominal) | | | | | |
| | Flexible Elastomeric Cellular | ASTM C534/C534M | I | | No |
| Exposed Lavatory Drains, Exposed Domestic Water Piping & Drains to Areas for Handicapped Personnel | | | | | |
| | Flexible Elastomeric Cellular | ASTM C534/C534M | I | | No |
| Condensate Drain Located Inside Building | | | | | |
| | Cellular Glass | ASTM C552 | II | 2 | No |
| | Flexible Elastomeric Cellular | ASTM C534/C534M | I | | No |
| Note: VR/VB = Vapor Retarder/Vapor Barrier | | | | | |

TABLE 2

Piping Insulation Thickness (inch)

| | Material | Tube And Pipe Size (inch) | | | | |
|---|---|---|---|---|---|---|
| | | <1 | 1-<1.5 | 1.5-<4 | 4-<8 | > or = >8 |
| Service | | | | | | |
| Cold Domestic Water Piping, Makeup Water & Drinking Fountain Drain Piping | | | | | | |
| | Cellular Glass | 1.5 | 1.5 | 1.5 | N/A | N/A |
| | Flexible Elastomeric Cellular | 1 | 1 | 1 | N/A | N/A |

TABLE 2

Piping Insulation Thickness (inch)

| Service | | | | | | |
|---|---|---|---|---|---|---|
| | Material | Tube And Pipe Size (inch) | | | | |
| | | <1 | 1-<1.5 | 1.5-<4 | 4-<8 | > or = >8 |
| Hot Domestic Water Supply & Piping (Max 200 F) | | | | | | |
| | Mineral Fiber | 1 | 1 | 1 | N/A | N/A |
| | Cellular Glass | 1.5 | 1.5 | 1.5 | N/A | N/A |
| | Flexible Elastomeric Cellular | 1 | 1 | 1 | N/A | N/A |
| Refrigerant Suction Piping (35 degrees F nominal) | | | | | | |
| | Flexible Elastomeric Cellular | 1 | 1 | 1 | N/A | N/A |
| Exposed Lavatory Drains, Exposed Domestic Water Piping & Drains to Areas for Handicapped Personnel | | | | | | |
| | Flexible Elastomeric Cellular | 0.5 | 0.5 | 0.5 | N/A | N/A |
| Condensate Drain Located Inside Building | | | | | | |
| | Cellular Glass | 1.5 | 1.5 | 1.5 | 1.5 | 1.5 |
| | Flexible Elastomeric Cellular | 1 | 1 | 1 | N/A | N/A |

3.2.2 Aboveground Cold Pipelines

Insulate the following cold pipelines for minus 30 to plus 60 degrees F in accordance with Table 2 except those piping listed in subparagraph Pipe Insulation in PART 3 as to be omitted. This includes but is not limited to the following:

a. Make-up water.

b. Refrigerant suction lines.

c. Air conditioner condensate drains.

d. Exposed lavatory drains and domestic water lines serving plumbing fixtures for handicap persons.

e. Domestic cold and chilled drinking water.

3.2.2.1 Insulation Material and Thickness

Determine insulation thickness for cold pipelines using Table 2.

3.2.2.2 Factory or Field applied Jacket

Cover insulation with a factory applied vapor retarder jacket/vapor barrier or field applied seal welded PVC jacket or greater than 3 ply laminated self-adhesive (minimum 2 mils adhesive, 3 mils embossed) vapor barrier/weatherproofing jacket - less than 0.0000 permeability, standard grade, sliver, white, black and embossed for use with Mineral Fiber, Cellular Glass, and Phenolic Foam Insulated Pipe. For insulation inside the building, to be protected with an aluminum jacket or greater than 3 ply vapor barrier/weatherproofing self-adhesive (minimum 2 mils adhesive, 3 mils embossed) product, less than 0.0000 permeability, standard grade, Embossed Silver, White & Black, install the insulation and vapor retarder jacket as specified herein. Install the aluminum jacket or greater than 3 ply vapor barrier/weatherproofing self-adhesive (minimum 2 mils adhesive, 3 mils embossed) product, less than 0.0000 permeability, standard grade, embossed silver, White & Black, 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, provide aluminum jackets or greater than 3 ply vapor barrier/weatherproofing self-adhesive (minimum 2 mils adhesive, 3 mils embossed) product, less than 0.0000 permeability, standard grade, embossed silver, white & black, for pipe insulation to the 6 ft level.

3.2.2.3 Installing Insulation for Straight Runs Hot and Cold Pipe

Apply insulation to the pipe with tight butt joints. Seal all butted joints and ends with joint sealant and seal with a vapor retarder coating, greater than 3 ply laminate jacket - less than 0.0000 perm adhesive tape or PVDC adhesive tape.

3.2.2.3.1 Longitudinal Laps of the Jacket Material

Overlap not less than 1-1/2 inches. Provide butt strips 3 inches wide for circumferential joints.

3.2.2.3.2 Laps and Butt Strips

Secure with adhesive and staple on 4 inch centers if not factory self-sealing. If staples are used, seal in accordance with paragraph STAPLES below. Note that staples are not required with cellular glass systems.

3.2.2.3.3 Factory Self-Sealing Lap Systems

May be used when the ambient temperature is between 40 and 120 degrees F during installation. Install the lap system in accordance with manufacturer's recommendations. Use a stapler only if specifically recommended by the manufacturer. Where gaps occur, replace the section or repair the gap by applying adhesive under the lap and then stapling.

3.2.2.3.4 Staples

Coat all staples, including those used to repair factory self-seal lap systems, with a vapor retarder coating or PVDC adhesive tape or greater

than 3 ply laminate jacket - 0.0000 perm adhesive tape. Coat all seams, except those on factory self-seal systems, with vapor retarder coating or PVDC adhesive tape or greater than 3 ply laminate jacket - less than 0.0000 perm adhesive tape.

3.2.2.3.5 Breaks and Punctures in the Jacket Material

Patch by wrapping a strip of jacket material around the pipe and secure it with adhesive, staple, and coat with vapor retarder coating or PVDC adhesive tape or greater than 3 ply laminate jacket - less than 0.0000 perm adhesive tape. Extend the patch not less than 1-1/2 inches past the break.

3.2.2.3.6 Penetrations Such as Thermometers

Fill the voids in the insulation and seal with vapor retarder coating or PVDC adhesive tape or greater than 3 ply laminate jacket - less than 0.0000 perm adhesive tape.

3.2.2.3.7 Flexible Elastomeric Cellular Pipe Insulation

Install by slitting the tubular sections and applying them onto the piping or tubing. Alternately, whenever possible slide un-slit sections over the open ends of piping or tubing. Secure all seams and butt joints and seal with adhesive. When using self seal products, secure only the butt joints 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.

3.2.2.4 Insulation for Fittings and Accessories

a. Butt pipe insulation tightly to the insulation of the fittings and accessories. Seal the butted joints and ends with joint sealant and seal with a vapor retarder coating or PVDC adhesive tape or greater than 3 ply laminate jacket - less than 0.0000 perm adhesive tape.

b. Place precut or preformed insulation around all fittings and accessories and 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 must 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. Use insulation of the same thickness and conductivity as the adjoining pipe insulation. If nesting size insulation is used, overlap the insulation 2 inches or one pipe diameter. Elbows insulated using segments must 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) Ensure MICA plates 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. 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, ensure the detail drawings are 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 must 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. Overlap tap seams 1 inch. Extend the coating out onto the adjoining pipe insulation 2 inches. Protect fabricated insulation with a factory vapor retarder jacket 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, seal the joints with a vapor retarder coating and a 4 inch wide ASJ tape which matches the jacket of the pipe insulation.

d. Insulate anchors attached directly to the pipe for a sufficient distance to prevent condensation but no less than 6 inches from the insulation surface.

e. Mark insulation to show 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. Use factory precut or premolded insulation segments under the fitting covers for elbows. Use insulation segmentswhich are the same insulation as the pipe insulation including same density, thickness, and thermal conductivity. Secure the covers by PVC vapor retarder tape, adhesive, seal welding or with tacks made for securing PVC covers. Seal seams in the cover, and tacks and laps to adjoining pipe insulation jacket, 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

Insulate all hot pipe lines above 60 degrees F, except those piping listed in subparagraph Pipe Insulation in PART 3 as to be omitted, in accordance with Table 2. This includes but is not limited to the following:

a. Domestic hot water supply system.

Cover insulation, 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

Butt pipe insulation tightly to the insulation of the fittings and accessories. Seal butted joints and ends with joint sealant. Mark insulation to show 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. Use 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. Use insulation that is the same thickness and conductivity as the adjoining pipe insulation. If nesting size insulation is used, do not overlap insulation 2 inches or one pipe diameter. Elbows insulated using segments must conform to MICA Tables 12.20 "Mitered Insulation Elbow".

3.2.4 Piping Exposed to Weather

Insulate and jacket piping exposed to weather as specified for the applicable service inside the building. After this procedure, apply a laminated self-adhesive (minimum 2 mils adhesive, 3 mils embossed) vapor barrier/weatherproofing jacket - less than 0.0000 permeability (greater than 3 ply, standard grade, silver, white, black and embossed aluminum jacket, stainless steel or PVC jacket.

PVC jacketing requires no factory-applied jacket beneath it, however apply an all service jacket if factory applied jacketing is not furnished. Treat flexible elastomeric cellular insulation exposed to weather 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. Overlap the jacket no less than 2 inches at longitudinal and circumferential joints and secure with bands at no more than 12 inch centers. Overlap longitudinal joints down to shed water and locate at 4 or 8 o'clock positions. Seal joints on piping 60 degrees F and below 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, caulk joints to prevent moisture penetration. Seal joints on piping above 60 degrees F with a moisture retarder.

3.2.4.2 Insulation for Fittings

Insulate and finish flanges, unions, valves, fittings, and accessories as specified for the applicable service. Apply two coats of breather emulsion type weatherproof mastic (impermeable to water, permeable to air) recommended by the insulation manufacturer with glass tape embedded between coats. Overlap tap no less than 1 inch and the adjoining aluminum jacket no less than 2 inches. Factory preformed aluminum jackets may be used in lieu of the above. Provide molded PVC fitting covers when PVC

jackets are used for straight runs of pipe. Provide PVC fitting covers that have adhesive welded joints and are 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

Provide ultraviolet resistant PVC jacket that is adhesive welded weather tight with manufacturer's recommended adhesive. 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 - IP.

Install corner angles on external corners of insulation on ductwork in exposed finished spaces before covering with jacket. Omit duct insulation on exposed supply and return ducts in air conditioned spaces where the difference at design conditions between duct air temperature and room air temperature is less than 15 degrees F unless otherwise shown. Air conditioned spaces are 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).

Table 3

Minimum Duct Insulation

| | Cooling and Heating | |
|---|---|---|
| | Tempurature Difference | Insulation R-Value (h sf F)/Btu |
| Inside building envelope or in unconditioned spaces | <15 | None Required |
| | 15 < TD < 40 | R-6 |

These R-values do not include the film resistance's. The required minimum thicknesses do not consider water vapor transmission and condensation. Additional insulation, vapor retarders, or both, may be required to limit vapor transmission and condensation. Where exterior walls are used as plenum walls, wall insulation shall be required by the most restrictive condition of this section or the insulation for the building envelope. Cooling ducts are those designed to convey mechanically cooled air or

return ducts in such systems. Heating ducts are those designed to convey mechanically heated air or return ducts in such systems. Thermal resistance will be measured in accordance with ASTM C518 at a mean temperature of 75 degrees F. The Temperature Difference is at design conditions between the space within which the duct is located and the design air temperature in the duct. Resistance for runouts to terminal devices less than 10 feet in length need not exceed 3.5 (h sf F)/Btu. Unconditioned spaces include crawlspaces and attics.

3.3.1 Insulation and Vapor Retarder/Vapor Barrier for Cold Air Duct

Provide insulation and vapor retarder/vapor barrier for the following cold air ducts and associated equipment.

a. Supply ducts.

b. Return air ducts where required by Table 3.

c. Relief ducts.

d. Flexible run-outs (field-insulated).

e. Plenums.

f. Coil headers and return bends.

g. Coil casings.

h. Fresh air intake ducts.

i. Filter boxes.

j. Mixing boxes).

Use insulation for rectangular ducts that is flexible type where concealed, minimum density 3/4 pcf, and rigid type where exposed, minimum density 3 pcf. Provide insulation for both concealed or exposed round/oval ducts that is 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. Provide insulation for all exposed ducts with either a white, paint-able, factory-applied Type I jacket or a field applied vapor retarder/vapor barrier jacket coating finish as specified. Ensure the total field applied dry film thickness is approximately 1/16 inch. Provide insulation on all concealed duct with a factory-applied Type I or II vapor retarder/vapor barrier jacket. Continue duct insulation through sleeves and prepare openings except firewall penetrations. Duct insulation terminating at fire dampers, must 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, except where prohibited by the fire damper manufacturer. Provide duct insulation and vapor retarder/vapor barrier to cover the collar, neck, and un-insulated surfaces of diffusers, registers and grills. Apply vapor retarder/vapor barrier materials to form a complete unbroken vapor seal over the insulation. Seal sheet metal duct in accordance with Section 23 30 00 HVAC AIR DISTRIBUTION.

3.3.1.1 Installation on Concealed Duct

a. For rectangular, oval or round ducts, attach flexible insulation by

applying adhesive around the entire perimeter of the duct in 6 inch wide strips on 12 inch centers.

b. For rectangular and oval ducts, 24 inches and larger, additionally secure insulation to bottom of ducts using mechanical fasteners. Space fasteners on 16 inch centers and no more than 16 inches from duct corners.

c. For rectangular, oval and round ducts, provide mechanical fasteners on sides of duct risers for all duct sizes. Space fasteners on 16 inch centers and no more than 16 inches from duct corners.

d. Impale insulation on the mechanical fasteners (self stick pins) where used and press thoroughly into the adhesive. Take care to ensure vapor retarder/vapor barrier jacket joints overlap 2 inches. Do not compress insulation to a thickness less than that specified. Carry insulation over standing seams and trapeze-type duct hangers.

e. Where mechanical fasteners are used, install self-locking washers and trim and bend the pin over.

f. Secure jacket overlaps with staples and tape as necessary to ensure a secure seal. Coat staples, tape and seams 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. Cover breaks in the jacket material with patches of the same material as the vapor retarder jacket. Do not extend patches less than 2 inches beyond the break or penetration in all directions and secure with tape and staples. Seal staples and tape joints 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, fill voids in the insulation and seal the penetration 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. Seal insulation terminations and pin punctures and flash with a reinforced vapor retarder coating finish or tape with a brush coat of vapor retarder coating.. Ensure the coating overlaps the adjoining insulation and un-insulated surface 2 inches. Extend pin puncture coatings 2 inches from the puncture in all directions.

j. Where insulation standoff brackets occur, extend insulation under the bracket and terminate the jacket at the bracket.

3.3.1.2 Installation on Exposed Duct Work

a. For rectangular ducts, secure rigid insulation to the duct by mechanical fasteners on all four sides of the duct, space no more than 12 inches apart and no more than 3 inches from the edges of the insulation joints. Provide a minimum of two rows of fasteners for each side of duct 12 inches and larger. Provide one row for each side of duct less than 12 inches. Provide mechanical fasteners that are corrosion resistant as G60 coated galvanized steel, and 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, bring insulation up to standing seams, reinforcing, and other vertical projections and do not carry over. Continue vapor retarder/barrier jacket across seams, reinforcing, and projections. When height of projections is greater than the insulation thickness, carry over insulation and jacket . Apply insulation with joints tightly butted. Neatly bevel insulation around name plates and access plates and doors.

c. Impale insulation on the fasteners; install self-locking washers and trim and bend the pin 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. Cover breaks and ribs or standing seam penetrations in the jacket material with a patch of the same material as the jacket. Do not extend patches less than 2 inches beyond the break or penetration and secure with tape and staple. Seal staples and joints with a brush coat of vapor retarder coating.

f. At jacket penetrations such as hangers, thermometers, and damper operating rods, fill the voids in the insulation and seal the penetrations with a flashing sealant.

g. Seal and flash insulation terminations and pin punctures with a reinforced vapor retarder coating finish. Ensure coating overlaps the adjoining insulation and un-insulated surface 2 inches. Extend pin puncture coatings 2 inches from the puncture in all directions.

h. Insulate oval and round ducts, flexible type, with factory Type I jacket insulation with minimum density of 3/4 pcf, attach in accordance with MICA standards.

3.3.2 Insulation for Warm Air Duct

Provide insulation and vapor barrier for the following warm air ducts and associated equipment:.

a. Supply ducts.

b. Return air ducts where required by Table 3.

c. Relief air ducts

d. Flexible run-outs (field insulated).

e. Plenums.

f. Coil-headers and return bends.

g. Coil casings.

h. Fresh air intake ducts.

i. Filter boxes.

j. Mixing boxes.

k. Exhaust ducts passing through concealed spaces exhausting conditioned air.

Provide insulation for rectangular ducts that is flexible type where concealed, and rigid type where exposed. Provide insulation on exposed ducts with a white, paint-able, factory-applied Type II jacket, or finish with adhesive finish. Use flexible type insulation for round ducts, with a factory-applied Type II jacket. Provide insulation on concealed duct with a factory-applied Type II jacket. Accomplish adhesive finish where indicated to be used by applying two coats of adhesive with a layer of glass cloth embedded between the coats. Ensure total dry film thickness is approximately 1/16 inch. Continue duct insulation through sleeves and prepare openings. Terminate duct insulation at fire dampers and flexible connections.

3.3.2.1 Installation on Concealed Duct

a. For rectangular, oval and round ducts, attach insulation by applying adhesive around the entire perimeter of the duct in 6 inch wide strips on 12 inch centers.

b. For rectangular and oval ducts 24 inches and larger, secure insulation to the bottom of ducts using mechanical fasteners. Space fasteners on 18 inch centers and no more than 18 inches from duct corner.

c. For rectangular, oval and round ducts, provide mechanical fasteners on sides of duct risers for all duct sizes. Space fasteners on 18 inch centers and no more than 18 inches from duct corners.

d. Impale insulation on the mechanical fasteners where used. Do not compress insulation to a thickness less than that specified. Carry insulation over standing seams and trapeze-type hangers.

e. Install self-locking washers where mechanical fasteners are used and trim and bend the pin over.

f. Do not overlap insulation jacket less than 2 inches at joints and secure the lap and staple on 4 inch centers.

3.3.2.2 Installation on Exposed Duct

a. For rectangular ducts, secure the rigid insulation to the duct using mechanical fasteners on all four sides of the duct, space no more than 16 inches apart and no more than 6 inches from the edges of the insulation joints. Provide a minimum of two rows of fasteners 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. Form duct insulation with factory-applied jacket with minimum jacket seams, and fasten each piece of rigid insulation to the duct using mechanical fasteners. When the height of projection is less than the insulation thickness, bring insulation up to standing seams, reinforcing, and other vertical projections and do not carry over the projection. Continue jacket across seams, reinforcing, and projections. Where the height of projections is greater than the insulation thickness, carry insulation and jacket over the projection.

c. Impale insulation on the fasteners; install self-locking washers and trim and bend the pin over.

d. Seal joints on jacketed insulation with a 4 inch wide strip of tape and brush with vapor retarder coating.

e. Cover breaks and penetrations in the jacket material with a patch of the same material as the jacket. Extend patches no less than 2 inches beyond the break or penetration and secure with adhesive and staple.

f. Seal insulation terminations and pin punctures with tape and brush with vapor retarder coating.

g. Insulate oval and round ducts, flexible type, with factory Type I jacket insulation, minimum density of 3/4 pcf attach by staples spaced no more than 16 inches and no more than 6 inches from the degrees of joints. Seal joints in accordance with item "d." above.

3.3.3 Ducts Handling Air for Dual Purpose

For air handling ducts for dual purpose below and above 60 degrees F, insulate ducts as specified for cold air duct.

3.3.4 Duct Test Holes

After duct systems have been tested, adjusted, and balanced, repair breaks in the insulation and jacket in accordance with the applicable section of this specification for the type of duct insulation to be repaired.

-- End of Section --

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SECTION 23 09 00

INSTRUMENTATION AND CONTROL FOR HVAC
**02/19, CHG 3: 05/21**

PART 1 GENERAL

1.1 SUMMARY

Provide a complete Direct Digital Control (DDC) system, except for the Front End which is existing, 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 or Niagara BACnet systems, and other referenced Sections.

Eglin AFB has an existing base-wide Utility Monitoring and Control System located in Building 696 called the "Energy Management and Control System" ("EMCS") which performs supervisory monitoring and control of building and utility systems. The EMCS shall be modified to accommodate new equipment and devices installed under this contract. Modifications are described in Section 25 10 10 UTILITY MONITORING AND CONTROL SYSTEM (UMCS) FRONT-END AND INTEGRATION.

1.1.1 Proprietary Systems

1.1.1.1 Proprietary Systems Exempted From Open Protocol Requirements

The following systems are specifically exempted from the open protocol requirements of Section 23 09 23.02 BACNET DIRECT DIGITAL CONTROL FOR HVAC AND OTHER BUILDING CONTROL SYSTEMS:

a. A simple split (DX) system consisting of a single indoor unit and a single outdoor unit from the same manufacturer.

1.1.1.2 Implementation of Proprietary Systems

For proprietary systems exempted from open protocol requirements, a proprietary network and DDC hardware communicating via proprietary protocol are permitted. For these systems a building control network meeting the requirements of Section 23 09 23.02 BACNET DIRECT DIGITAL CONTROL FOR HVAC AND OTHER BUILDING CONTROL SYSTEMS must also be provided, along with a gateway or interface to connect the proprietary system to the open building control network.

The proprietary system gateway or interface must provide the required functionality as shown on the points schedule. Scheduling, alarming, trending, overrides, network inputs, network outputs and other protocol related requirements must be met on the open protocol control system as specified in Section 23 09 23.02 BACNET DIRECT DIGITAL CONTROL FOR HVAC AND OTHER BUILDING CONTROL SYSTEMS.

1.1.2 System Requirements

Provide systems meeting the requirements this Section and other Sections referenced by this Section, and which have the following characteristics:

a. The system implements the control sequences of operation shown in the Contract Drawings using DDC hardware to control mechanical and electrical equipment

b. The system meet the requirements of this specification as a stand-alone system and does not require connection to any other system.

c. Control sequences reside in DDC hardware in the building. The building control network is not dependent upon connection to a Utility Monitoring and Control System (UMCS) Front End or to any other system for performance of control sequences. To the greatest extent practical, the hardware performs control sequences without reliance on the building network, 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.

h. All Niagara Framework components have an unrestricted interoperability license with a Niagara Compatibility Statement (NiCS) following the Tridium Open NiCS Specification and have a value of "ALL" for "Station Compatibility In", "Station Compatibility Out", "Tool Compatibility In" and "Tool Compatibility Out". Note that this will result in the following entries in the license file:

```
accept.station.in="*"
accept.station.out="*"
accept.wb.in="*"
accept.wb.out="*"
```

### 1.1.3 End to End Accuracy

Select products, install and configure the system such that the maximum error of a measured value as read from the DDC Hardware over the network is less than the maximum allowable error specified for the sensor or instrumentation.

### 1.1.4 Verification of Dimensions

After becoming familiar with all details of the work, verify all dimensions in the field, and advise the Contracting Officer of any

discrepancy before performing any work.

1.1.5 Drawings

The Government will not indicate all offsets, fittings, and accessories that may be required on the drawings. Carefully investigate the mechanical, electrical, and finish conditions that could affect the work to be performed, arrange such work accordingly, and provide all work necessary to meet such conditions.

1.2 RELATED SECTIONS

Related work specified elsewhere:

a. Section 23 09 23.02 BACNET DIRECT DIGITAL CONTROL FOR HVAC AND OTHER BUILDING CONTROL SYSTEMS for BACnet systems with Niagara Framework.

b. Section 23 09 13 INSTRUMENTATION AND CONTROL DEVICES FOR HVAC

c. Section 25 08 10 UTILITY MONITORING AND CONTROL SYSTEMS TESTING

d. Section 25 10 10 UTILITY MONITORING AND CONTROL SYSTEMS (UMCS) FRONT END AND INTEGRATION

e. Section 25 05 11.25 CYBERSECURITY FOR FACILITY-RELATED CONTROL SYSTEMS - BCS

f. 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.

AMERICAN SOCIETY OF HEATING, REFRIGERATING AND AIR-CONDITIONING ENGINEERS (ASHRAE)

| | |
|---|---|
| ASHRAE 135 | (2020; Interpretation 1-8 2021; Errata 1-2 2021; Addenda CD 2021; Addenda BV-CE 2022; Interpretation 9-12 2022; Interpretation 13-24 2023; Addenda BV-CF 2023; Errata 3 2023) BACnet—A Data Communication Protocol for Building Automation and Control Networks |
| ASHRAE FUN IP | (2021) Fundamentals Handbook, I-P Edition |

INSTITUTE OF ELECTRICAL AND ELECTRONICS ENGINEERS (IEEE)

| | |
|---|---|
| IEEE C62.41 | (1991; R 1995) Recommended Practice on Surge Voltages in Low-Voltage AC Power Circuits |

NATIONAL ELECTRICAL MANUFACTURERS ASSOCIATION (NEMA)

| | |
|---|---|
| NEMA 250 | (2020) Enclosures for Electrical Equipment (1000 Volts Maximum) |

NATIONAL FIRE PROTECTION ASSOCIATION (NFPA)

| | |
|---|---|
| NFPA 70 | (2026) National Electrical Code |
| NFPA 90A | (2024) Standard for the Installation of Air Conditioning and Ventilating Systems |

TRIDIUM, INC (TRIDIUM)

| | |
|---|---|
| Niagara Framework | (2021) NiagaraAX User's Guide |
| Tridium Open NiCS | (2021) Understanding the NiagaraAX Compatibility Statement (NiCS) |

UNDERWRITERS LABORATORIES (UL)

| | |
|---|---|
| UL 5085-3 | (2006; Reprint Jan 2022) UL Standard for Safety Low Voltage Transformers - Part 3: Class 2 and Class 3 Transformers |

## 1.4 DEFINITIONS

The following list of definitions includes terms used in Sections referenced by this Section and are included here for completeness. The definitions contained in this Section may disagree with how terms are defined or used in other documents, including documents referenced by this Section. The definitions included here are the authoritative definitions for this Section and all Sections referenced by this Section.

After each term the protocol related to that term is included in parenthesis.

### 1.4.1 Alarm Generation (All protocols)

Alarm Generation is the monitoring of a value, comparison of the value to alarm conditions and the creation of an alarm when the conditions set for the alarm are met. 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) |

| The following is a list of some BIBBs used by this or referenced Sections: | |
|---|---|
| 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 Niagara Framework 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
3) via the Niagara Framework

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 Fox Protocol (Niagara Framework)

The protocol used for communication between components in the Niagara Framework. By default, Fox uses TCP port 1911.

1.4.32 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.

A Niagara Framework Supervisory Gateway is one type of Gateway.

1.4.33 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.

1.4.34 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.

1.4.35 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".

1.4.36 I/O Expansion Unit (All protocols)

An I/O expansion unit provides additional point capacity to a digital controller.

1.4.37 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.

1.4.38 JACE (Niagara Framework)

Java Application Control Engine. See paragraph NIAGARA FRAMEWORK SUPERVISORY GATEWAY.

1.4.39 Local-Area Network (LAN) (All protocols)

A communication network that spans a limited geographic area and uses the same basic communication technology throughout.

1.4.40 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.

1.4.41 MAC Address (All protocols)

Media Access Control address. The physical device address that identifies a device on a Local Area Network.

1.4.42 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.

1.4.43 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.

1.4.44 Network Number (BACnet)

A site-specific number assigned to each network. This network number must be unique throughout the BACnet Internetwork.

1.4.45 Niagara Framework (Niagara Framework)

A set of hardware and software specifications for building and utility control owned by Tridium Inc. and licensed to multiple vendors. The Framework consists of front end (M&C) software, web based clients, field level control hardware, and engineering tools. While the Niagara Framework is not adopted by a recognized standards body and does not use an open licensing model, it is sufficiently well-supported by multiple HVAC vendors to be considered a de-facto Open Standard.

1.4.46 Niagara Framework Supervisory Gateway (Niagara Framework)

DDC Hardware component of the Niagara Framework. A typical Niagara architecture has Niagara specific supervisory gateways at the IP level and other (non-Niagara specific) controllers on field networks (TP/FT-10, MS/TP, etc.) beneath the Niagara supervisory gateways. The Niagara specific controllers function as a gateway between the Niagara framework protocol (Fox) and the field network beneath. These supervisory gateways may also be used as general purpose controllers and also have the capability to provide a web-based user interface.

Note that different vendors refer to this component by different names. The most common name is "JACE"; other names include (but are not limited to)"EC-BOS", "FX-40", "TMN", "SLX", and "UNC".

1.4.47 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.

1.4.48 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.

1.4.49 Object Instance (BACnet)

See paragraph OBJECT IDENTIFIER

1.4.50 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.

1.4.51 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 Niagara Framework Systems, a property, setting, or value is Operator Configurable when it is configurable from a Niagara Framework Front End.

1.4.52 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).

1.4.53 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.

1.4.54 Packaged Unit (All protocols)

See packaged equipment.

1.4.55 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.

1.4.56 Physical Segment (BACnet)

A single contiguous medium to which BACnet devices are attached (ASHRAE 135 ).

1.4.57 Polling (All protocols)

A device periodically requesting data from another device.

1.4.58 Points (All protocols)

Physical and virtual inputs and outputs. See also paragraph INPUT/OUTPUT (I/O).

1.4.59 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).

1.4.60 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.

1.4.61 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.

1.4.62 Repeater (All protocols)

A device that connects two control network segments and retransmits all information received on one side onto the other.

1.4.63 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.

1.4.64 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.

1.4.65 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.

1.4.66 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 paragraph PROPRIETARY.

1.4.67 Standard BACnet Services (BACnet)

ASHRAE 135 services other than ConfirmedPrivateTransfer or UnconfirmedPrivateTransfer. See paragraph PROPRIETARY.

1.4.68 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.

1.4.69 UMCS Network (All protocols)

The UMCS Network connects multiple building or facility control networks to the Monitoring and Control Software.

1.4.70 Writable Property (BACnet)

A Property is Writable when it can be changed through the use of one or more of the WriteProperty services defined in ASHRAE 135, Clause 15 regardless of the value of any other Property. Note that in the ASHRAE 135 standard, some Properties may be writable when the Out of Service Property is TRUE; for purposes of this Section, Properties that are only writable when the Out of Service Property is TRUE are not considered to be Writable.

1.5 PROJECT SEQUENCING

TABLE II: PROJECT SEQUENCING lists the sequencing of submittals as specified in paragraph SUBMITTALS (denoted by an 'S' in the 'TYPE' column) and activities as specified in PART 3 EXECUTION (denoted by an 'E' in the 'TYPE' column). TABLE II does not specify overall project milestone and completion dates; these dates are specified in the contract documents.

a. Sequencing for Submittals: The sequencing specified for submittals is

the deadline by which the submittal must be initially submitted to the Government. Following submission there will be a Government review period as specified in Section 01 33 00 SUBMITTAL PROCEDURES. If the submittal is not accepted by the Government, revise the submittal and resubmit it to the Government within 14 days of notification that the submittal has been rejected. Upon resubmittal there will be an additional Government review period. If the submittal is not accepted the process repeats until the submittal is accepted by the Government.

b. Sequencing for Activities: The sequencing specified for activities indicates the earliest the activity may begin.

c. Abbreviations: In TABLE II the abbreviation AAO is used for 'after approval of' and 'ACO' is used for 'after completion of'.

## 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-02 Shop Drawings

DDC Contractor Design Drawings; G

Draft As-Built Drawings; G

Final As-Built Drawings; G

SD-03 Product Data

Programming Software; G

Controller Application Programs; G

Configuration Software; G

Controller Configuration Settings; G

Manufacturer's Product Data; G

Niagara Framework Supervisory Gateway Backups; G

Niagara Framework Engineering Tool; G

Maintenance Laptop; 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 electronic 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 2copies 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 electronic 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.

1.8.5 Niagara Framework Supervisory Gateway Backups

For each Niagara Framework Supervisory Gateway, provide a backup of all software within the Niagara Framework Supervisory Gateway, including configuration settings. This backup must be sufficient to allow the restoration of the Niagara Framework Supervisory Gateway or the replacement of the Niagara Framework Supervisory Gateway.

Submit backups for each Niagara Framework Supervisory Gateway on CD-ROM as a Technical Data Package. Mark each backup indicating clearly the source Niagara Framework Supervisory Gateway.

1.8.6 Niagara Framework Engineering Tool(for all Niagara Framework system)

Provide a Niagara Framework Engineering Tool in accordance with Section 23 09 23.02 BACNET DIRECT DIGITAL CONTROL FOR HVAC AND OTHER BUILDING CONTROL SYSTEMS. Submit software user manuals with the Niagara Framework Engineering Tool submittal.

Submit the Niagara Framework Engineering Tool on CD-ROM as a Technical Data Package. Submit electronic copies of the software user manual for the Niagara Framework Engineering Tool.

1.8.7 Maintenance Laptop

Provide one maintenance laptop computer under this contract for use as a programming and troubleshooting tool. The maintenance laptop is specified in Part 2 of this section and shall, at a minimum, have the following software installed: (1) Configuration Tool Software, (2) Controller Programming Software, (3) Niagara Framework Engineering Tool, and (4) a commercially available web browser. See Section 23 09 23.02 BACNET DIRECT DIGITAL CONTROL FOR HVAC AND OTHER BUILDING CONTROL SYSTEMS for specific software requirements.

1.9 QUALITY CONTROL CHECKLISTS

The QC Checklist for Niagara Framework Based BACnet Systems in APPENDIX A of this Section must be completed by the Contractor's Chief Quality Control (QC) Representative and submitted as indicated.

The QC Representative must verify each item indicated and initial in the space provided to indicate that the requirement has been met. The QC Representative must sign and date the Checklist prior to submission to the Government.

1.9.1 Pre-Construction Quality Control (QC) Checklist

Complete items indicated as Pre-Construction QC Checklist items in the QC Checklist. Submit electronic 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 electronic 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 electronic copies of the Closeout QC Checklist.

PART 2 PRODUCTS

Provide products meeting the requirements of Section 23 09 13 INSTRUMENTATION AND CONTROL DEVICES FOR HVAC, Section 23 09 23.02 BACNET DIRECT DIGITAL CONTROL FOR HVAC AND OTHER BUILDING CONTROL SYSTEMS for BACnet or Niagara BACnet systems, other referenced Sections, and this Section.

All DDC products shall be compatible with "Niagara AX Framework" Rev. 3.6 or later.

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 electronically.

## 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 15 to 120 degrees F and temperature conditions outside this range normally encountered at the installed location.

d. Humidity: 10 to 95 percent relative humidity, noncondensing and humidity conditions outside this range normally encountered at the installed location.

## 2.4 WIRELESS CAPABILITY

For products incorporating any wireless capability (including but not limited to radio frequency (RF), infrared and optical), provide products for which wireless capability can be permanently disabled at the device. Optical and infrared capabilities may be disabled via a permanently affixed opaque cover plate.

## 2.5 ENCLOSURES

Enclosures supplied as an integral (pre-packaged) part of another product are acceptable. Provide two Enclosure Keys for each lockable enclosure on a single ring per enclosure with a tag identifying the enclosure the keys operate. Provide enclosures meeting the following minimum requirements:

### 2.5.1 Outdoors

For enclosures located outdoors, provide enclosures meeting NEMA 250 Type 4 requirements.

2.5.2 Mechanical and Electrical Rooms

For enclosures located in mechanical or electrical rooms, provide enclosures meeting NEMA 250 Type 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.

2.5.4 Equipment Racks

Provide standard 19-inch, wall-mounted, key-lockable equipment racks, compatible with the electronic equipment provided. Racks shall be minimum 12U, constructed of aluminum or steel with bolted or welded construction with a powder-coated finish. Racks shall have a swing-gate feature to allow rear access of electronic equipment. Equipment racks shall have a tempered-glass, full-size front window. Equipment racks shall have a copper grounding bar and shall be grounded to earth.

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.

2.7 BACKUP POWER

Certain electrical loads will be backed by facility uninterruptible power supplies (UPS) as indicated on the drawings. In addition, smaller, panel-mounted UPSs dedicated to a single control or equipment panel shall be provided as shown.

2.7.1 Panel-Mounted Uninterruptible Power Supplies (UPSs)

Provide uninterruptible power supplies (UPSs) as self-contained units suitable for powering the equipment identified on the drawings upon outage of their normal power source. UPSs shall be sized to provide a minimum of five minutes of operation of the connected loads.

Provide the UPS complete with all necessary power supplies, transformers, rectifiers, batteries, and accessories. Provide mounting accessories to support the UPS off the bottom of the panel.

UPSs shall have integral visual indication of normal power operation, UPS operation, and abnormal operation, and visual and audible indication of incoming power loss and low battery power. Provide UL 1778 approved UPS.

2.8 MAINTENANCE ACCESSORIES

2.8.1 Maintenance Laptop

The maintenance laptop shall be a portable personal computer specifically provided to allow programming, configuration, startup, and troubleshooting the control system specified in this and related sections. At a minimum, it shall be loaded with the software listed in Part 1 of this section and connectable to the associated controller or equipment.

The maintenance laptop shall have a nominal 15.6-inch active color matrix liquid crystal display, capable of displaying up to 16.7 million colors at a minimum resolution of 1920 by 1080 pixels, and a dual-core, 64-bit processor operating at a minimum of 3.1 GHz. The portable workstation shall have, as a minimum, 250 GB solid-state hard drive, 16 GB of RAM, integral pointing device, serial port or external USB-type serial converter, HDMI or DisplayPort video port for an external color monitor, rechargeable battery, battery charger, compatible 10/100/1000Base-T network adapter, external USB-type or integral 8X DVD+/-RW burner combo drive, integrated audio, one high-power (500 mA) output USB port and at least one USB 3.0 port. The maintenance laptop shall be provided with the proper cables, connectors, adapters, media converters, and software required to connect to all controllers and equipment furnished under this and related sections.

# 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 or Niagara 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 matter that provides clearance for control system maintenance by maintaining access space required to calibrate, remove, repair, or replace control system devices. Install control system such that it does not interfere with the clearance requirements for mechanical and electrical system maintenance.

### 3.1.2 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

See Section 25 05 11.25 - CYBERSECURITY FOR FACILITY-RELATED CONTROL SYSTEMS - BCS.

3.2 DRAWINGS AND CALCULATIONS

Provide drawings in the form and arrangement indicated and shown. Use the same abbreviations, symbols, nomenclature and identifiers shown. Assign a unique identifier as shown to each control system element on a drawing. When packaging drawings, group schedules by system. When space allows, it is permissible to include multiple schedules for the same system on a single sheet. Except for drawings covering all systems, do not put information for different systems on the same sheet.

Submit hardcopy drawings on ISO A1 34 by 22 inches sheets, and electronic drawings in PDF and in AutoCAD format. In addition, submit electronic drawings in editable Excel format for all drawings that are tabular, including but not limited to the Point Schedule and Equipment Schedule.

a. Submit DDC Contractor Design Drawings consisting of each drawing indicated with pre-construction information depicting the intended control system design and plans. Submit DDC Contractor Design Drawings as a single complete package: Electronic 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: Electronic 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: Electronic 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 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.

3.2.5 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.

3.2.6 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.

3.2.7 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.

3.2.8 DDC Hardware Schedule

Provide a single DDC Hardware Schedule for the entire project and including following information for each device.

3.2.8.1 DDC Hardware Identifier

The Unique DDC Hardware Identifier for the device.

3.2.8.2 HVAC System

The system "name" used to identify a specific system (the name used on the system schematic drawing for that system).

3.2.8.3 BACnet Device Information

3.2.8.3.1 Device Object Identifier

The Device Object Identifier: The Object_Identifier of the Device Object

3.2.8.3.2 Network Number

The Network Number for the device.

3.2.8.3.3 MAC Address

The MAC Address for the device

3.2.8.3.4 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.

3.2.8.3.5 Proprietary Services Information

If the device uses non-standard ASHRAE 135 services as defined and permitted in Section 23 09 23.02 BACNET DIRECT DIGITAL CONTROL FOR HVAC AND OTHER BUILDING CONTROL SYSTEMS, indicate that the device uses non-standard services and include a description of all non-standard services used. Describe usage and content such that a device from another vendor can interoperate with the device using the non-standard service. Provide descriptions with sufficient detail to allow a device from a different manufacturer to be programmed to both read and write the non-standard service request:

a. read: interpret the data contained in the non-standard service and;

b. write: given similar data, generate the appropriate non-standard service request.

3.2.8.3.6 Alarming Information

Indicate whether the device is used for alarm generation, and which types of alarm generation the device implements: intrinsic, local algorithmic, remote algorithmic.

3.2.8.3.7 Scheduling Information

Indicate whether the device is used for scheduling.

3.2.8.3.8 Trending Information

Indicate whether the device is used for trending, and indicate if the device is used to trend local values, remote values, or both.

3.2.8.4 Niagara Station ID

The Niagara Station ID for each Niagara Framework Supervisory Gateway

3.2.9 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:

3.2.9.1 Point Name

The abbreviated name for the point using the indicated naming convention.

3.2.9.2 Description

A brief functional description of the point such as "Supply Air Temperature".

3.2.9.3 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.

3.2.9.4 Settings

The value and units of any setpoints, configured setpoints, configuration parameters, and settings related to each point.

3.2.9.5 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.

3.2.9.6 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.

3.2.9.7 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.

3.2.9.8 Niagara Station ID

The Niagara Station ID of the Niagara Framework Supervisory Gateway the point is mapped into.

3.2.9.9 Network Data Exchange Information (Gets Data From, Sends Data To)

Provide the DDC Hardware Identifier of other DDC Hardware the point is shared with.

3.2.9.10 Override Information (Object Type and Instance Number)

For each point requiring an Override and not residing in a Niagara Framework Supervisory Gateway, indicate if the Object for the point is Commandable or, if the use of a separate Object was specifically approved by the Contracting Officer, provide the Object Type and Instance Number of the Object to be used in overriding the point.

3.2.9.11 Alarm Information

For Niagara BACnet systems: Indicate the Alarm Generation Type and Notification Class Object Instance Number for each point requiring an alarm. (Note that not all alarms will have a Notification Class Object.)

3.2.9.12 Configuration Information

Indicate the means of configuration associated with each point. For points in a Niagara Framework Supervisory Gateway, indicate the point within the Niagara Framework Supervisory Gateway used to configure the value. For other points:

a. For Operator Configurable Points indicate BACnet Object and Property information (Name, Type, Identifiers) containing the configurable value. Indicate whether the property is writable always, or only when Out_Of_Service is TRUE.

b. For Configurable Points indicate the BACnet Object and Property information as for Operator Configurable points, or identification of the configurable settings from within the engineering software for the device or identification of the hardware settings on the device.

3.2.10 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.

3.2.11 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.

3.2.12 Sequences of Operation

Provide HVAC control system sequence of operation and in the same format as the Contract Drawings. Within these drawings, refer to devices by their unique identifiers. Submit sequences of operation for each HVAC system

3.2.13 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 and each M&C Client 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 based on Section 25 08 10 UTILITY MONITORING AND CONTROL SYSTEM TESTING 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 electronic copies of the PVT Procedures. The PVT Procedures may be submitted as a Technical Data Package. Note that the PVT includes all HVAC equipment monitored and controlled by the instrumentation and control system described in this section. A separate PVT specified in Section 25 10 10 UTILITY MONITORING AND CONTROL SYSTEM (UMCS) HEAD END AND INTEGRATION includes all monitored and controlled equipment as shown.

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 Niagara Trend Log 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-Builts and completion of balancing. UNLESS GOVERNMENT WITNESSING OF A TEST IS SPECIFICALLY WAIVED BY THE GOVERNMENT, PERFORM ALL TESTS WITH A GOVERNMENT WITNESS. Do not conduct tests during scheduled seasonal off periods of base heating and cooling systems. If the system experiences any failures during the endurance test portion of the PVT, repair the system repeat the endurance test portion of the PVT until the system operates continuously and without failure for the specified endurance test period.

3.5.3 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. Perform inspections in June and December. During each inspection perform the indicated tasks:

a. Perform visual checks and operational tests of equipment.

b. Clean control system equipment including interior and exterior surfaces.

c. Check and calibrate each field device. Check and calibrate 50 percent of the total analog inputs and outputs during the first inspection. Check and calibrate the remaining 50 percent of the analog inputs and outputs during the second major inspection. Certify analog test instrumentation accuracy to be twice the specified accuracy of the device being calibrated. Randomly check at least 25 percent of all binary inputs and outputs for proper operation during the first inspection. Randomly check at least 25 percent of the remaining binary inputs and outputs during the second inspection. If more than 20 percent of checked inputs or outputs failed the calibration check during any inspection, check and recalibrate all inputs and outputs during that inspection.

d. Run system software diagnostics and correct diagnosed problems.

e. Resolve any previous outstanding problems.

3.7.4 Scheduled Work

This work must be performed during regular working hours, Monday through Friday, excluding Federal holidays.

3.7.5 Emergency Service

The Government will initiate service calls when the system is not functioning properly. Qualified personnel must be available to provide service to the system. A telephone number where the service supervisor can be reached at all times must be provided. Service personnel must be at the site within 24 hours after receiving a request for service. The control system must be restored to proper operating condition as required per Section 01 78 00 CLOSEOUT SUBMITTALS.

3.7.6 Operation

After performing scheduled adjustments and repairs, verify control system operation as demonstrated by the applicable tests of the performance verification test.

3.7.7 Records and Logs

Keep dated records and logs of each task, with cumulative records for each major component, and for the complete system chronologically. Maintain a continuous log for all devices, including initial analog span and zero calibration values and digital points. Keep complete logs and provide logs for inspection onsite, demonstrating that planned and systematic adjustments and repairs have been accomplished for the control system.

3.7.8 Work Requests

Record each service call request as received and include its location, date and time the call was received, nature of trouble, names of the service personnel assigned to the task, instructions describing what has to be done, the amount and nature of the materials to be used, the time and date work started, and the time and date of completion. Submit a record of the work performed within 5 days after work is accomplished.

3.7.9 System Modifications

Submit recommendations for system modification in writing. Do not make system modifications, including operating parameters and control settings, without prior approval of the Government.

3.8 TRAINING

Conduct a training course for operating staff members designated by the Government in the maintenance and operation of the system, including specified hardware and software. Conduct 16 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 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 electronically. Provide one hardcopy manual for each trainee on the Course Attendee List and 2 additional copies for archive at the project site. Provide 2 copies of the Course Attendee List with the archival copies. Training Documentation may be submitted as a Technical Data Package.

**APPENDIX A**

| | | |
|---|---|---|
| **QC CHECKLIST FOR NIAGARA FRAMEWORK BASED BACNET SYSTEMS** | | |
| This checklist is not all-inclusive of the requirements of this specification and should not be interpreted as such.<br><br>Instructions: Initial each item in the space provided (\|____\|) verifying that the requirement has been met. | | |
| This checklist is for (circle one:)<br><br>Pre-Construction QC Checklist Submittal<br><br>Post-Construction QC Checklist Submittal<br><br>Close-out QC Checklist Submittal | | |
| Items verified for Pre-Construction, Post-Construction and Closeout QC Checklist Submittals: | | |
| 1 | All DDC Hardware is numbered on Control System Schematic Drawings. | \|____\| |
| 2 | Signal lines on Control System Schematic are labeled with the signal type. | \|____\| |
| 3 | Local Display Panel (LDP) Locations are shown on Control System Schematic drawings. | \|____\| |
| Items verified for Post-Construction and Closeout QC Checklist Submittals: | | |
| 4 | All sequences are performed as specified using DDC Hardware. | \|____\| |
| 5 | Training schedule and course attendee list has been developed and coordinated with shops and submitted. | \|____\| |
| Items verified for Closeout QC Checklist Submittal: | | |
| 6 | Final As-built Drawings, including all Points Schedule drawings, accurately represent the final installed system. | \|____\| |
| 7 | Programming software has been submitted for all programmable controllers. | \|____\| |
| 8 | All software has been licensed to the Government. | |

| | **QC CHECKLIST FOR NIAGARA FRAMEWORK BASED BACNET SYSTEMS** | |
|---|---|---|
| 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 Niagara Framework objects and services, and BACnet Instrinsic Alarming as indicated. | \|____\| |
| 15 | All Properties indicated as required to be Writable are Writable and Overrides have been provided as indicated | \|____\| |
| | _____ _____ | |
| | (QC Representative Signature) (Date) | |

-- End of Section --

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SECTION 23 09 13

INSTRUMENTATION AND CONTROL DEVICES FOR HVAC
**11/15, CHG 2: 05/21**

PART 1 GENERAL

1.1 SUMMARY

This section provides for the instrumentation control system components excluding direct digital controllers, network controllers, gateways, etc., that are necessary for a completely functional automatic control system. When combined with a Direct Digital Control (DDC) system, the Instrumentation and Control Devices covered under this section must be a complete system suitable for the control of the heating, ventilating and air conditioning (HVAC) and other building-level systems as specified and indicated.

a. Install hardware to perform the control sequences as specified and indicated and to provide control of the equipment as specified and indicated.

b. Install hardware such that individual control equipment can be replaced by similar control equipment from other equipment manufacturers with no loss of system functionality.

c. Install and configure hardware such that the Government or their agents are able to perform repair, replacement, and upgrades of individual hardware without further interaction with the installing Contractor.

1.1.1 Verification of Dimensions

After becoming familiar with all details of the work, verify all dimensions in the field, and advise the Contracting Officer of any discrepancy before performing any work.

1.1.2 Drawings

The Government will not indicate all offsets, fittings, and accessories that may be required on the drawings. Carefully investigate the mechanical, electrical, and finish conditions that could affect the work to be performed, arrange such work accordingly, and provide all work necessary to meet such conditions.

1.2 RELATED SECTIONS

Related work specified elsewhere.

Section 23 30 00 HVAC AIR DISTRIBUTION

Section 23 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 B40.100 | (2022) Pressure Gauges and Gauge Attachments |

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 | (2026) National Electrical Code |
| NFPA 90A | (2024) Standard for the Installation of Air Conditioning and Ventilating Systems |

UNDERWRITERS LABORATORIES (UL)

| | |
|---|---|
| UL 555 | (2006; Reprint Aug 2016) UL Standard for Safety Fire Dampers |
| UL 555S | (2014; Reprint Oct 2020) UL Standard for Safety Smoke Dampers |
| UL 5085-3 | (2006; Reprint Jan 2022) UL Standard for Safety Low Voltage Transformers - Part 3: Class 2 and Class 3 Transformers |

## 1.4 SUBMITTALS

Submittal requirements are specified in Section 23 09 00 INSTRUMENTATION AND CONTROL FOR HVAC.

## 1.5 DELIVERY AND STORAGE

Store and protect products from the weather, humidity, and temperature variations, dirt and dust, and other contaminants, within the storage condition limits published by the equipment manufacturer.

## 1.6 INPUT MEASUREMENT ACCURACY

Select, install and configure sensors, transmitters and DDC Hardware such that the maximum error of the measured value at the input of the DDC hardware is less than the maximum allowable error specified for the sensor or instrumentation.

# PART 2 PRODUCTS

## 2.1 EQUIPMENT

### 2.1.1 General Requirements

All products used to meet this specification must meet the indicated requirements, but not all products specified here will be required by every project. All products must meet the requirements both Section 23 09 00 INSTRUMENTATION AND CONTROL FOR HVAC and this Section.

### 2.1.2 Operation Environment Requirements

Unless otherwise specified, provide products rated for continuous operation under the following conditions:

#### 2.1.2.1 Pressure

Pressure conditions normally encountered in the installed location.

#### 2.1.2.2 Vibration

Vibration conditions normally encountered in the installed location.

#### 2.1.2.3 Temperature

a. Products installed indoors: Ambient temperatures in the range of 32 to 112 degrees F and temperature conditions outside this range normally encountered at the installed location.

b. Products installed outdoors or in unconditioned indoor spaces: Ambient temperatures in the range of 15 to 120 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.

## 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.

Use only fiber optic cable at locations where control signals pass through the secure space boundary indicated on the drawings. Refer to Section 13 49 20.00 10 RADIO FREQUENCY (RF) SHIELDING and drawing details regarding electrical and fiber optic penetration requirements.

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 DAMPERS

2.4.1 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 1,000 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.

2.4.2 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.

2.4.3 Damper Types

2.4.3.1 Flow Control Dampers

Provide parallel-blade or opposed blade type dampers for outside air, return air, relief air, exhaust, face and bypass dampers as indicated on the Damper Schedule. Blades must have interlocking edges. The channel frames of the dampers must be provided with jamb seals to minimize air leakage. Unless otherwise indicated, dampers must meet AMCA 511 Class 1A requirements. Outside air damper seals must be suitable for an operating temperature range of -40 to +167 degrees F. Dampers must be rated at not less than 2,000 ft/min air velocity.

2.4.3.2 Smoke Dampers

Provide smoke-damper and actuator assemblies which meet the current requirements of NFPA 90A, UL 555, and UL 555S. For combination fire and smoke dampers provide dampers rated for 250 degrees F Class II leakage per UL 555S.

2.5 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.

2.5.1 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.

2.5.2 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.

2.5.3 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.

2.5.3.1 Sensor Accuracy and Stability of Control

2.5.3.1.1 Conditioned Space Temperature

Plus or minus 0.5 degree F over the operating range.

2.5.3.1.2 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.

2.5.3.1.3 Duct Temperature

Plus or minus 0.5 degree F.

2.5.3.1.4 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.

2.5.3.2 Transmitter Drift

The maximum allowable transmitter drift: 0.25 degrees F per year.

2.5.3.3 Point Temperature Sensors

Point Sensors must be encapsulated in epoxy, series 300 stainless steel, anodized aluminum, or copper.

2.5.3.4 Temperature Sensor Details

2.5.3.4.1 Room Type

Provide the sensing element components within a decorative protective cover suitable for surrounding decor.

2.5.3.4.2 Duct Probe Type

Ensure the probe is long enough to properly sense the air stream

temperature.

2.5.3.4.3 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.

2.5.3.4.4 Outside Air Type

Provide the sensing element rated for outdoor use.

2.5.4 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.

2.5.5 Differential Pressure Instrumentation

2.5.5.1 Differential Pressure Sensors

Provide Differential Pressure Sensors with ranges as indicated or as required for the application. Pressure sensor ranges must not exceed the high end range indicated on the Points Schedule by more than 50 percent. The over pressure rating must be a minimum of 150 percent of the highest design pressure of either input to the sensor. The accuracy must be plus or minus 1 percent of full scale. The sensor must have a maximum drift of 2 percent per year

2.5.5.2 Differential Pressure Switch

Provide differential pressure switches with a user-adjustable setpoint which are sized for the application such that the setpoint is between 25 percent and 75 percent of the full range. The over pressure rating must be a minimum of 150 percent of the highest design pressure of either input to the sensor. The switch must have two sets of contacts and each contact must have a rating greater than it's connected load. Contacts must open or close upon rise of pressure above the setpoint or drop of pressure below the setpoint as indicated.

2.5.6 Flow Sensors

2.5.6.1 Airflow Measurement Array (AFMA)

2.5.6.1.1 Airflow Straightener

Provide AFMAs which contain an airflow straightener if required by the AFMA manufacturer's published installation instructions. The straightener must be contained inside a flanged sheet metal casing, with the AFMA located as specified according to the published recommendation of the AFMA manufacturer. In the absence of published documentation, provide airflow straighteners if there is any duct obstruction within 5 duct diameters upstream of the AFMA. Air-flow straighteners, where required, must be constructed of 0.125 inch aluminum honeycomb and the depth of the straightener must not be less than 1.5 inches.

2.5.6.1.2 Resistance to Airflow

The resistance to air flow through the AFMA, including the airflow straightener must not exceed 0.2 inch water gauge at an airflow of 2,000 fpm. AFMA construction must be suitable for operation at airflows of up to 3,000 fpm over a temperature range of 40 to 120 degrees F.

2.5.6.1.3 Outside Air Temperature

In outside air measurement or in low-temperature air delivery applications, provide an AFMA certified by the manufacturer to be accurate as specified over a temperature range of -20 to +120 degrees F.

2.5.6.1.4 Electronic AFMA

Each electronic AFMA must consist of an array of velocity sensing elements of the resistance temperature detector (RTD) or thermistor type. The sensing elements must be distributed across the duct cross section in the quantity and pattern specified or recommended by the published application data of the AFMA manufacturer. Electronic AFMAs must have an accuracy of plus or minus 5 percent over a range of 125 to 5,000 fpm and the output must be temperature compensated over a range of 32 to 212 degrees F.

2.5.6.1.5 Fan Inlet Measurement Devices

Fan inlet measurement devices cannot be used unless indicated on the drawings or schedules.

2.5.7 Electrical Instruments

Provide Electrical Instruments with an input range as indicated or sized for the application. Unless otherwise specified, AC instrumentation must be suitable for 60 Hz operation.

2.5.7.1 Current Transducers

Current transducers must accept an AC current input and must have an accuracy of plus or minus 2 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.

2.5.7.2 Current Sensing Relays (CSRs)

Current sensing relays (CSRs) must provide a normally-open contact with a voltage and amperage rating greater than its connected load. Current sensing relays must be of split-core design. The CSR must be rated for operation at 200 percent of the connected load. Voltage isolation must be a minimum of 600 volts. The CSR must auto-calibrate to the connected load or be adjustable and field calibrated. Current sensors for variable frequency applications must be rated for variable frequency operation.

2.5.7.3 Voltage Transducers

Voltage transducers must accept an AC voltage input and have an accuracy of plus or minus 0.25 percent of full scale. The device must have a means for calibration. Line side fuses for transducer protection must be provided.

2.5.8 Occupancy Sensors

Occupancy sensors must have occupancy-sensing sensitivity adjustment and an adjustable off-delay timer with a setpoint of 15 minutes. Adjustments accessible from the face of the unit are preferred. Occupancy sensors must be rated for operation in ambient air temperatures ranging from 40 to 95 degrees F or temperatures normally encountered in the installed location. Sensors integral to wall mount thermostats must have an auto-off switch. Wall switch sensors must be decorator style and must fit behind a standard decorator type wall plate. All occupancy sensors, power packs, and slave packs must be UL listed. In addition to any outputs required for lighting control, the occupancy sensor must provide an output for the HVAC control system.

2.5.8.1 Passive Infrared (PIR) Occupancy Sensors

PIR occupancy sensors must have a multi-level, multi-segmented viewing lens and a conical field of view with a viewing angle of 180 degrees and a detection of at least 20 feet unless otherwise indicated or specified. PIR Sensors must provide field-adjustable background light-level adjustment with an adjustment range suitable to the light level in the sensed area, room or space. PIR sensors must be immune to false triggering from RFI and EMI.

2.5.8.2 Ultrasonic Occupancy Sensors

Ultrasonic sensors must operate at a minimum frequency 32 kHz and must be designed to not interfere with hearing aids.

2.5.8.3 Dual-Technology Occupancy Sensor (PIR and Ultrasonic)

Dual-Technology Occupancy Sensors must meet the requirements of both PIR and Ultrasonic Occupancy Sensors.

2.5.9 Floor Mounted Leak Detector

Leak detectors must use electrodes mounted at slab level with a minimum built-in-vertical adjustment of 0.125 inches. Detector must have a binary output. The indicator must be manual reset type.

2.5.10 Temperature Switch

2.5.10.1 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.

2.5.11 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.

2.6 INDICATING DEVICES

All indicating devices must display readings in English (inch-pound) units.

2.6.1 Thermometers

Provide bi-metal type thermometers at locations indicated. Thermometers must have either 9 inch long scales or 3.5 inch diameter dials, with insertion, immersion, or averaging elements. Provide matching thermowells for pipe-mounted installations. Select scale ranges suitable for the intended service, with the normal operating temperature near the scale's midpoint. The thermometer's accuracy must be plus or minus 2 percent of the scale range.

2.6.1.1 Piping System Thermometers

Piping system thermometers must have brass, malleable iron or aluminum alloy case and frame, clear protective face, permanently stabilized glass tube with indicating-fluid column, white face, black numbers, and a 9 inch scale. Piping system thermometers must have an accuracy of plus or minus 1 percent of scale range. Thermometers for piping systems must have rigid stems with straight, angular, or inclined pattern. Thermometer stems must have expansion heads as required to prevent breakage at extreme temperatures. On rigid-stem thermometers, the space between bulb and stem must be filled with a heat-transfer medium.

2.6.1.2 Air-Duct Thermometers

Air-duct thermometers must have perforated stem guards and 45-degree adjustable duct flanges with locking mechanism.

2.6.2 Pressure Gauges

Provide pipe-mounted pressure gauges at the locations indicated. Gauges

must conform to ASME B40.100 and have a 4 inch diameter dial and shutoff cock. Select scale ranges suitable for the intended service, with the normal operating pressure near the scale's midpoint. The gauge's accuracy must be plus or minus 2 percent of the scale range.

Gauges must be suitable for field or panel mounting as required, must have black legend on white background, and must have a pointer traveling through a 270-degree arc. Gauge range must be suitable for the application with an upper end of the range not to exceed 150 percent of the design upper limit. Accuracy must be plus or minus 3 percent of scale range. Gauges must meet requirements of ASME B40.100.

### 2.6.3 Low Differential Pressure Gauges

Gauges for low differential pressure measurements must be a minimum of 3.5 inch (nominal) size with two sets of pressure taps, and must have a diaphragm-actuated pointer, white dial with black figures, and pointer zero adjustment. Gauge range must be suitable for the application with an upper end of the range not to exceed 150 percent of the design upper limit. Accuracy must be plus or minus two percent of scale range.

## 2.7 OUTPUT DEVICES

### 2.7.1 Actuators

Actuators must be electric (electronic). All actuators must be normally open (NO), normally closed (NC) or fail-in-last-position (FILP) as indicated. Normally open and normally closed actuators must be of mechanical spring return type. Electric actuators must have an electronic cut off or other means to provide burnout protection if stalled. Actuators must have a visible position indicator. Electric actuators must provide position feedback to the controller as indicated. Actuators must smoothly and fully open or close the devices to which they are applied. Electric actuators must have a full stroke response time in both directions of 90 seconds or less at rated load. Electric actuators must be of the foot-mounted type with an oil-immersed gear train or the direct-coupled type. Where multiple electric actuators operate from a common signal, the actuators must provide an output signal identical to its input signal to the additional devices. All actuators must be rated for their operating environment. Actuators used outdoors must be designed and rated for outdoor use. Actuators under continuous exposure to water, such as those used in sumps, must be submersible.

Actuators incorporating an integral network connection are considered DDC Hardware and must meet the DDC Hardware requirements of Section 23 09 23.02 BACNET DIRECT DIGITAL CONTROL FOR HVAC AND OTHER BUILDING CONTROL SYSTEMS.

#### 2.7.1.1 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.

#### 2.7.1.2 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 or maintained 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.

Momentary push-buttons used for emergency shutdown and reset applications must have a red mushroom head push-button operator that releases back to initial position after being pressed. Quantity and types of contacts must be suitable for the application. The push-button operator must be furnished with a clear, hinged cover to protect the switch from being accidentally pressed.

Maintained push-buttons used for clean agent removal exhaust system must have a red mushroom head push-button operator that latches when pushed and releases when pulled. Quantity and types of contacts must be suitable for the application. The push-button operator must be furnished with a clear, hinged cover to protect the switch from being accidentally pressed.

## 2.9 MULTIFUNCTION DEVICES

Multifunction devices are products which combine the functions of multiple sensor, user input or output devices into a single product. Unless otherwise specified, the multifunction device must meet all requirements of each component device. Where the requirements for the component devices conflict, the multifunction device must meet the most stringent of the requirements.

### 2.9.1 Current Sensing Relay Command Switch

The Current Sensing Relay portion must meet all requirements of the Current Sensing Relay input device. The Command Switch portion must meet all requirements of the Relay output device except that it must have at least one normally-open (NO) contact.

Current Sensing Relays used for Variable Frequency Drives must be rated for Variable Frequency applications unless installed on the source side of the drive. If used in this situation, the threshold for showing status must be set to allow for the VFD's control power when the drive is not enabled and provide indication of operation when the drive is enabled at minimum speed.

### 2.9.2 Thermostats

Thermostats must be multifunction devices incorporating a temperature sensor and one or more of the following as specified:

a. A temperature indicating device.

b. A User Input Device which must adjust a temperature setpoint output.

c. A User Input Momentary Contact Button and an output to the control system indicating zone occupancy.

d. A two position User Input Switch labeled with 'AUTO' and 'ON' positions and providing corresponding output to the control system.

Thermostats cannot contain mercury (Hg).

# PART 3 EXECUTION

## 3.1 INSTALLATION

### 3.1.1 General Installation Requirements

Perform the installation under the supervision of competent technicians regularly employed in the installation of DDC systems.

#### 3.1.1.1 Device Mounting Criteria

All devices must be installed in accordance with manufacturer's recommendations and as specified and indicated. Control devices to be installed in piping and ductwork must be provided with required gaskets, flanges, thermal compounds, insulation, piping, fittings, and manual valves for shutoff, equalization, purging, and calibration. Strap-on temperature sensing elements must not be used except as specified. Spare thermowells must be installed adjacent to each thermowell containing a

sensor and as indicated. Devices located outdoors must have a weathershield.

3.1.1.2 Labels and Tags

Match labels and tags to the unique identifiers indicated on the As-Built drawings. Label all enclosures and instrumentation. Tag all sensors and actuators in mechanical rooms. Tag airflow measurement arrays to show flow rate range for signal output range, duct size, and pitot tube AFMA flow coefficient. Tag duct static pressure taps at the location of the pressure tap. Provide plastic or metal tags, mechanically attached directly to each device or attached by a metal chain or wire. Labels exterior to protective enclosures must be engraved plastic and mechanically attached to the enclosure or instrumentation. Labels inside protective enclosures may 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 thermostats and sensors located in occupied spaces, 48 inchesabove the floor unless otherwise indicated. Install adjustable devices to be ADA compliant unless otherwise indicated on the Room Sensor Schedule:

a. Thermostats for Fan Coil Units may be either unit or wall mounted but not mounted on an exterior wall.

b. Wall mount all other thermostats.

3.1.4 Indication Devices Installed in Piping and Liquid Systems

Provide snubbers for gauges in piping systems subject to pulsation. For gauges for steam service use pigtail fittings with cock. Install thermometers and temperature sensing elements in liquid systems in thermowells. Provide spare Pressure/Temperature Ports (Pete's Plug) for all temperature and pressure sensing elements installed in liquid systems for calibration/testing.

3.1.5 Occupancy Sensors

Provide a sufficient quantity of occupancy sensors to provide complete coverage of the area (room or space). Occupancy sensors are to be ceiling or wall mounted. Install occupancy sensors in accordance with NFPA 70 requirements and the manufacturer's instructions. Do not locate occupancy sensors within 6 feet of HVAC outlets or heating ducts, or where they can "see" beyond any doorway. Installation above doorway(s) is preferred. Do not use ultrasonic sensors in spaces containing ceiling fans. Install

sensors to detect motion to within 2 feet of all room entrances and to not trigger due to motion outside the room. Set the off-delay timer to 15 minutes unless otherwise indicated. Adjust sensors prior to beneficial occupancy, but after installation of furniture systems, shelving, partitions, etc. For each controlled area, provide one hundred percent coverage capable of detecting small hand-motion movements, accommodating all occupancy habits of single or multiple occupants at any location within the controlled room.

### 3.1.6 Switches

#### 3.1.6.1 Temperature Limit Switch

Provide a temperature limit switch (freezestat) to sense the temperature at the location indicated. Provide a sufficient number of temperature limit switches (freezestats) to provide complete coverage of the duct section but no less than 1 foot in length per square foot of cross sectional area. Install manual reset limit switches in approved, accessible locations where they can be reset easily. Install temperature limit switch (freezestat) sensing elements in a side-to-side (not top-to-bottom) serpentine pattern with the relay section at the highest point and in accordance with the manufacturer's installation instructions.

#### 3.1.6.2 Hand-Off Auto Switches

Wire safety controls such as smoke detectors and freeze protection thermostats to protect the equipment during both hand and auto operation.

### 3.1.7 Temperature Sensors

Install temperature sensors in locations that are accessible and provide a good representation of sensed media. Installations in dead spaces are not acceptable. Calibrate and install sensors according to manufacturer’s instructions. Select sensors only for intended application as designated or recommended by manufacturer.

#### 3.1.7.1 Room Temperature Sensors

Mount the sensors on interior walls to sense the average room temperature at the locations indicated. Avoid locations near heat sources such as copy machines or locations by supply air outlet drafts. Mount the center of all user-adjustable sensors 48 inches above the floor to meet ADA requirements. Non user-adjustable sensors can be mounted as indicated in paragraph ROOM INSTRUMENT MOUNTING.

#### 3.1.7.2 Duct Temperature Sensors

##### 3.1.7.2.1 Probe Type

Place tip of the sensor in the middle of the airstream or in accordance with manufacturer's recommendations or instructions.Provide a gasket between the sensor housing and the duct wall. Seal the duct penetration air tight. When installed in insulated duct, provide enclosure or stand off fitting to accommodate the thickness of duct insulation to allow for maintenance or replacement of the sensor and wiring terminations. Seal the duct insulation penetration vapor tight.

3.1.7.2.2 Averaging Type

Weave the sensing element in a serpentine fashion from side to side perpendicular to the flow, across the duct or air handler cross-section, using durable non-metal supports in accordance with manufacturer's installation instructions. Avoid tight radius bends or kinking of the sensing element. Prevent contact between the sensing element and the duct or air handler internals. Provide a duct access door at the sensor location. The access door must be hinged on the side, factory insulated, have cam type locks, and be as large as the duct will permit, maximum 18 by 18 inches. For sensors inside air handlers, the sensors must be fully accessible through the air handler's access doors without removing any of the air handler's internals.

3.1.7.3 Immersion Temperature Sensors

Provide thermowells for sensors measuring piping, tank, or pressure vessel temperatures. Locate wells to sense continuous flow conditions. Do not install wells using extension couplings. When installed on insulated piping, provide stand enclosure or stand off fitting to accommodate the thickness of the pipe insulation and allow for maintenance or replacement of the sensor or wiring terminations. Where piping diameters are smaller than the length of the wells, provide wells in piping at elbows to sense flow across entire area of well. Wells must not restrict flow area to less than 70 percent of pipe area. Increase piping size as required to avoid restriction. Provide the sensor well with a heat-sensitive transfer agent between the sensor and the well interior ensuring contact between the sensor and the well.

3.1.7.4 Outside Air Temperature Sensors

Provide outside air temperature sensors on the building's north side with a protective weather shade that does not inhibit free air flow across the sensing element, and protects the sensor from snow, ice, and rain. Location must not be near exhaust hoods and other areas such that it is not influenced by radiation or convection sources which may affect the reading. Provide a shield to shade the sensor from direct sunlight.

3.1.8 Air Flow Measurement Arrays (AFMA)

Install AFMAs with the manufacturer's recommended minimum distances between upstream and downstream disturbances. Airflow straighteners may be used to reduce minimum distances as recommended by the AFMA manufacturer.

3.1.9 Duct Static Pressure Sensors

Locate the duct static pressure sensing tap at 67 percent of the distance between the air handling unit and last air terminal unit. If the transmitter output is a 0-10 Vdc signal, locate the transmitter in the same enclosure as the air handling unit (AHU) controller for the AHU serving the terminal units. If a remote duct static pressure sensor is to be used, run the signal wire back to the controller for the air handling unit.

3.1.10 Relative Humidity Sensors

Install relative humidity sensors on interior walls or in supply air ducts at least 10 feet downstream of humidity injection elements.

### 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 nay be non-spring return unless indicated otherwise. Do not mount actuators in the air stream. Do not connect multiple actuators to a common drive shaft. Install actuators so that their action seal the damper to the extent required to maintain leakage at or below the specified rate and so that they move the blades smoothly throughout the full range of motion.

#### 3.1.11.2 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 Thermometers and Gauges

#### 3.1.12.1 Thermometers

Mount devices to allow reading while standing on the floor or ground, as applicable.

### 3.1.13 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.

3.1.14 Copper Tubing

Provide hard-drawn copper tubing in exposed areas and either hard-drawn or annealed copper tubing in concealed areas. Use only tool-made bends. Use only brass or copper solder joint type fittings, except for connections to apparatus. For connections to apparatus use brass compression type fittings.

3.1.15 Plastic Tubing

Install plastic tubing within covered raceways or conduit except when otherwise specified. Do not use plastic tubing for applications where the tubing could be subjected to a temperature exceeding 130 degrees F. For fittings, use brass or acetal resin of the compression or barbed push-on type for instrument service. Except in walls and exposed locations, plastic multitube instrument tubing bundle without conduit or raceway protection may be used where a number of air lines run to the same points, provided the multitube bundle is enclosed in a protective sheath, is run parallel to the building lines and is adequately supported as specified.

-- End of Section --

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.

All DDC controls for this project shall be compatible with the site's existing base-wide "Niagara AX Framework" Energy Management and Control System (EMCS). Modifications to the existing EMCS front end programming to accommodate new equipment and devices installed under this contract are described in Section 25 10 10 UTILITY MONITORING AND CONTROL SYSTEM (UMCS) FRONT-END AND INTEGRATION.

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 and Fox as the communications protocols. The system must use standard ASHRAE 135 Objects and Properties and the Niagara Framework. The system must use standard ASHRAE 135 Services and the Niagara Framework exclusively for communication over the network. Gateways to packaged units must communicate with other DDC hardware using ASHRAE 135 or the Fox protocol exclusively and may communicate with packaged equipment using other protocols. The control system must be installed such that any two ASHRAE 135 devices on the Internetwork can communicate using standard ASHRAE 135 Services.

   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 or Niagara Framework Objectsas indicated and as needed to meet the requirements of this specification.

c. The existing base-wide EMCS will remain in place and shall be modified under this contract to include the new facility. The DDC system specified herein shall utilize a new network pathway to the EMCS as

shown on the drawings.

d. Use Niagara Framework hardware and software exclusively for scheduling, trending, and communication with a front end (UMCS). Use Niagara Framework or standard BACnet Objects and services for alarming. Use the Fox protocol for all communication between Niagara Framework Supervisory Gateways; use the ASHRAE 135 protocol for all other building communication.

e. Use Niagara Framework AX.

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; Interpretation 1-8 2021; Errata 1-2 2021; Addenda CD 2021; Addenda BV-CE 2022; Interpretation 9-12 2022; Interpretation 13-24 2023; Addenda BV-CF 2023; Errata 3 2023) 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 | (2022) Ethernet |

TELECOMMUNICATIONS INDUSTRY ASSOCIATION (TIA)

| | |
|---|---|
| TIA-485 | (1998a; R 2012) Electrical Characteristics of Generators and Receivers for Use in Balanced Digital Multipoint Systems |

TRIDIUM, INC (TRIDIUM)

| | |
|---|---|
| Niagara Framework | (2021) NiagaraAX User's Guide |
| Tridium Open NiCS | (2021) Understanding the NiagaraAX Compatibility Statement (NiCS) |

U.S. FEDERAL COMMUNICATIONS COMMISSION (FCC)

| | |
|---|---|
| FCC Part 15 | Radio Frequency Devices (47 CFR 15) |

UNDERWRITERS LABORATORIES (UL)

| | |
|---|---|
| UL 916 | (2015; Reprint Oct 2021) UL Standard for Safety Energy Management Equipment |

1.3 DEFINITIONS

For definitions related to this section, see Section 23 09 00 INSTRUMENTATION AND CONTROL FOR HVAC.

1.4 SUBMITTALS

Submittal requirements related to this Section are specified in Section 23 09 00 INSTRUMENTATION AND CONTROL FOR HVAC.

PART 2 PRODUCTS

All products used to meet this specification must meet the indicated requirements, but not all products specified here will be required by every project. All products must meet the requirements both Section 23 09 00 INSTRUMENTATION AND CONTROL FOR HVAC and this Section.

2.1 NETWORK HARDWARE

2.1.1 BACnet Router

All BACnet Routers must be BACnet/IP Routers and must perform layer 3 routing of ASHRAE 135 packets over an IP network in accordance with ASHRAE 135 Annex J and Clause 6. The router must provide the appropriate connection to the IP network and connections to one or more ASHRAE 135 MS/TP networks. Devices used as BACnet Routers must meet the requirements for DDC Hardware, and except for Niagara Framework Supervisory Gateways, devices used as BACnet routers must support the NM-RC-B BIBB.

2.1.2 BACnet Gateways

In addition to the requirements for DDC Hardware, the BACnet Gateway must be a Niagara Framework Supervisory Gateway or 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 , except for Niagara Framework Supervisory Gateways, they are not DDC Hardware and must not be used when DDC Hardware is required. (Niagara Framework Supervisory Gateways are both Gateways and DDC Hardware.)

2.1.3 LAN Switches

2.1.3.1 Rack-Mounted Switches

Rack-mounted switches shall provide communication among network devices using copper and optical fiber cables. Rack-mounted switches shall include 10/100/1000 Base-T downlink ports, 1000 Base-LX uplink ports, and 1000 Base-LX and 100 Base-FX downlink ports as required by the application. Switches shall be modular and expandable from a minimum of 24 ports up to 48 ports. Twenty percent spare ports shall be provided.

All switches shall be managed and shall support Rapid Spanning Tree Protocol. Each port shall have an LED indicator for network status. Switches shall permit online network changes without disturbing network devices. Malfunctioning network devices shall be automatically removed from service without shutting down the network. Switches shall include redundant power supplies and shall have small form factor pluggable (SFP) downlink ports.

2.1.3.2 Industrial Switches

Switches located in non-rack type enclosures shall be industrial type, DIN-rail mountable, and include 10/100 Base-T and 100 Base-FX ports as required by the application. One spare copper port shall be provided.

Industrial switches shall operate on 24 VDC or 120 VAC. All network switches shall be managed and support Rapid Spanning Tree Protocol. Switches shall have a minimum of eight ports expandable to 16 by adding modules. Each port shall have an LED indicator for network status. Switches shall permit online network changes without disturbing network devices. Malfunctioning network devices shall be automatically removed from service without shutting down the network.

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.

c. All control network segments passing through RF shielding, between secured and unsecured areas, and outside the building shall be optical fiber. Provide fiber optic converters as necessary.

## 2.3 DIRECT DIGITAL CONTROL (DDC) HARDWARE

### 2.3.1 General Requirements

All DDC Hardware must meet the following requirements:

a. It must be locally powered and must incorporate a light to indicate the device is receiving power.

b. It must conform to the BTL Guide

c. It must be BACnet Testing Laboratory (BTL) Listed.

d. The Manufacturer's Product Data submittal for each piece of DDC Hardware must include the Protocol Implementation Conformance Statement (PICS) for that hardware as specified in Section 23 09 00 INSTRUMENTATION AND CONTROL FOR HVAC.

e. It must communicate and be interoperable in accordance with ASHRAE 135 and have connections for BACnet IP or MS/TP control network wiring.

f. Other than devices controlling terminal units or functioning solely as a BACnet Router, it must support DS-COV-B, DS-RPM-A and DS-RPM-B BIBBs.

g. Devices supporting the DS-RP-A BIBB must also support the DS-COV-A BIBB.

h. Application programs, configuration settings and communication information must be stored in a manner such that they persist through loss of power:

   (1) Application programs must persist regardless of the length of time power is lost.

   (2) Configured settings must persist for any loss of power less than 2,500 hours.

   (3) Communication information, including but not limited to COV subscriptions, event reporting destinations, Notification Class Object settings, and internal communication settings, must persist for any loss of power less than 2,500 hours.

i. Internal Clocks:

   (1) Clocks in DDC Hardware incorporating a Clock must continue to function for 120 hours upon loss of power to the DDC Hardware.

   (2) DDC Hardware incorporating a Clock must support the DM-TS-B or DM-UTC-B BIBB.

j. It must have all functionality indicated and required to support the application (Sequence of Operation or portion thereof) in which it is used, including but not limited to providing Objects or Niagara Framework Points as specified and as indicated on the Points Schedule.

k. In addition to these general requirements and the DDC Hardware Input-Output (I/O) Function requirements, all DDC Hardware must also meet any additional requirements for the application in which it is used (e.g. scheduling, alarming, trending, etc.).

l. It must meet FCC Part 15 requirements and have UL 916 or equivalent safety listing.

m. Except for Niagara Framework Supervisory Gateways, Device must support Commandable Objects to support Override requirements as detailed in PART 3 EXECUTION

n. User interfaces which allow for modification of Properties or settings must be password-protected.

o. Devices communicating BACnet MS/TP must meet the following requirements:

(1) Must have a configurable Max_Master Property.

(2) DDC Hardware other than hardware controlling a single terminal unit must have a configurable Max_Info_Frames Property.

(3) Must respond to any valid request within 50 msec with either the appropriate response or with a response of "Reply Postponed".

(4) Must use twisted pair with reference and shield (3-wire media) wiring, or twisted pair with shield (2-wire media) wiring and use half-wave rectification.

p. Devices communicating BACnet/IP must use UDP Port 0xBAC0. Devices with configurable UDP Ports must default to 0xBAC0.

q. All Device IDs, Network Numbers, and BACnet MAC addresses of devices must be fully configurable without limitation, except MS/TP MAC addresses may be limited by ASHRAE 135 requirements.

r. Except for Niagara Framework Supervisory Gateways, 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 either Niagara Framework Supervisory Gateways or DDC Hardware controlling a single terminal unit, all Objects (including Device Objects) must:

(1) Have a configurable Object Name Property of at least 12 characters in length.

(2) Have a configurable Object Description Property of at least 24 characters in length.

t. For programmable DDC Hardware, provide and license to the project site all programming software required to program the Hardware in accordance with Section 23 09 00 INSTRUMENTATION AND CONTROL FOR HVAC.

u. For programmable DDC Hardware, provide copies of the installed

application programs (all software that is not common to every controller of the same manufacturer and model) as source code compatible with the supplied programming software in accordance with Section 23 09 00 INSTRUMENTATION AND CONTROL FOR HVAC. The submitted application program must be the complete application necessary for controller to function as installed and be sufficient to allow replacement of the installed controller with another controller of the same type.

2.3.2 Hardware Input-Output (I/O) Functions

DDC Hardware incorporating hardware input-output (I/O) functions must meet the following requirements:

2.3.2.1 Analog Inputs

DC Hardware analog inputs (AIs) must be implemented using ASHRAE 135 Analog Input Objects and perform analog to digital (A-to-D) conversion with a minimum resolution of 8 bits plus sign or better as needed to meet the accuracy requirements specified in Section 23 09 00. Signal conditioning including transient rejection must be provided for each analog input. Analog inputs must be capable of being individually calibrated for zero and span. Calibration via software scaling performed as part of point configuration is acceptable. The AI must incorporate common mode noise rejection of at least 50 dB from 0 to 100 Hz for differential inputs, and normal mode noise rejection of at least 20 dB at 60 Hz from a source impedance of 10,000 ohms.

2.3.2.2 Analog Outputs

DDC Hardware analog outputs (AOs) must be implemented using ASHRAE 135 Analog Output Objects and perform digital to analog (D-to-A) conversion with a minimum resolution of 8 bits plus sign, and output a signal with a range of 4-20 mAdc or 0-10 Vdc. Analog outputs must be capable of being individually calibrated for zero and span. Calibration via software scaling performed as part of point configuration is acceptable. DDC Hardware with Hand-Off-Auto (H-O-A) switches for analog outputs must provide for overriding the output through the range of 0 percent to 100 percent.

2.3.2.3 Binary Inputs

DDC Hardware binary inputs (BIs) must be implemented using ASHRAE 135 Binary Input Objects and accept contact closures and must ignore transients of less than 5 milli-second duration. Protection against a transient 50VAC must be provided.

2.3.2.4 Binary Outputs

DDC Hardware binary outputs (BOs) must be implemented using ASHRAE 135 Binary Output Objects and provide relay contact closures or triac outputs for momentary and maintained operation of output devices. DDC Hardware with H-O-A switches for binary outputs must provide for overriding the output open or closed.

2.3.2.4.1 Relay Contact Closures

Closures must have a minimum duration of 0.1 second. Relays must provide at least 180V of isolation. Electromagnetic interference suppression must

be provided on all output lines to limit transients to 50 Vac. Minimum contact rating must be 0.5 amperes at 24 Vac.

2.3.2.4.2 Triac Outputs

Triac outputs must provide at least 180 V of isolation. Minimum contact rating must be 0.5 amperes at 24 Vac.

2.3.2.5 Pulse Accumulator

DDC Hardware pulse accumulators must be implemented using either an ASHRAE 135 Accumulator Object or an ASHRAE 135 Analog Value Object where the Present_Value is the totalized pulse count. Pulse accumulators must accept contact closures, ignore transients less than 5 msec duration, protect against
transients of 50 VAC, and accept rates of at least 20 pulses per second.

2.3.2.6 ASHRAE 135 Objects for Hardware Inputs and Outputs

The requirements for use of ASHRAE 135 objects for hardware input and outputs includes devices where the hardware sensor or actuator is integral to the controller (e.g. a VAV box with integral damper actuator, a smart sensor, a VFD, etc.)

2.3.2.7 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 the Niagara Framework or 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 Niagara Framework points or ASHRAE 135 Properties as indicated on the Points Schedule and as specified. LDPs must be either BTL Listed as a B-OD, B-OWS, B-AWS, or be an integral part of another piece of DDC Hardware listed as a B-BC. For LDPs listed as B-OWS or B-AWS, the hardware must be BTL listed and the product must come factory installed with all applications necessary for the device to function as an LDP.

The adjustment of values using display and navigation buttons must be password protected.

2.3.4 Expansion Modules and Tethered Hardware

A single piece of DDC Hardware may consist of a base unit and also:

a. An unlimited number of hardware expansion modules, where the individual hardware expansion modules are designed to directly connect, both mechanically and electrically, to the base unit hardware. The expansion modules must be commercially available as an optional add-on to the base unit.

b. A single piece of hardware connected (tethered) to a base unit by a single cable where the cable carries a proprietary protocol between

the base unit and tethered hardware. The tethered hardware must not contain control logic and be commercially available as an optional add-on to the base unit as a single package.

Note that this restriction on tethered hardware does not apply to sensors or actuators using standard binary or analog signals (not a communications protocol); sensors or actuators using standard binary or analog signals are not considered part of the DDC Hardware.

Hardware capable of being installed stand-alone, or without a separate base unit, is DDC Hardware and must not be used as expansion modules or tethered hardware.

2.3.5 Supervisory Control Requirements

2.3.5.1 Scheduling Hardware

DDC Hardware used for scheduling must meet the following requirements:

a. It must be BTL Listed as a B-BC and support the SCHED-E-B BIBB.

b. It is preferred, but not required, that devices support the DM-OCD-B BIBB on all Calendar and Schedule Objects, such that a front end BTL listed as a B-AWS may create or delete Calendar and Schedule Objects. It is also preferred but not required that devices supporting the DM-OCD-B BIBB accept any valid value for properties of Calendar and Schedule Objects. Note that there are additional requirements in the EXECUTION Part of this Section for Devices which do not support the DM-OCD-B BIBB as specified.

c. The Date_List property of all Calendar Objects must be writable.

d. The Present_Value Property of Schedule must support the following values: 1, 2, 3, 4.

2.3.5.2 Alarm Generation Hardware

Non-Niagara Framework DDC Hardware used for alarm generation must meet the following requirements:

a. Device must support the AE-N-I-B BIBB

b. The Recipient_List Property must be Writable for all Notification Class Objects used for alarm generation.

c. For all Objects implementing Intrinsic Alarming, the following Properties must be Writable:

(1) Time_Delay
(2) High_Limit
(3) Low_Limit
(4) Deadband
(5) Event_Enable
(6) Time_Delay_Normal

d. It is preferred, but not required, that devices support the DM-OCD-B BIBB on all Notification Class Objects. It is also preferred, but not required that devices supporting the DM-OCD-B BIBB accept any valid value as an initial value for properties of Notification Class Objects.

d. For Event Enrollment Objects used for alarm generation, the following Properties must be Writable:

(1) Event_Parameters
(2) Event_Enable
(3) Time_Delay_Normal

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.

2.3.6 Niagara Framework Supervisory Gateway

Any device implementing the Niagara Framework is a Niagara Framework Supervisory Gateway and must meet these requirements. In addition to the general requirements for all DDC Hardware, Niagara Framework Supervisory Gateway Hardware must:

a. Be direct digital control hardware.

b. Have an unrestricted interoperability license and its Niagara Compatibility Statement (NiCS) must follow the Tridium Open NiCS Specification.

c. Manage communications between a field control network and the Niagara Framework Monitoring and Control Software, and between itself and other Niagara Framework Supervisory Gateways. Niagara Framework Supervisory Gateway Hardware must use Fox protocol for communication with other Niagara Framework Components, regardless of the manufacturer of the other components.

d. Be fully programmable using the Niagara Framework Engineering Tool and must support the following:

(1) Time synchronization, Calendar, and Scheduling using Niagara Scheduling Objects

(2) Alarm generation and routing using the Niagara Alarm Service

(3) Trending using the Niagara History Service and Niagara Trend Log Objects

(4) Integration of field control networks using the Niagara Framework Engineering Tool

(5) Configuration of integrated field control system using the Niagara Framework Engineering Tool when supported by the field control system

e. Meet the following minimum hardware requirements:

(1) Two 10/100/1000 Mbps Ethernet Port(s)

(2) One or more MS/TP ports.

f. Provide access to field control network data and supervisory functions via web interface and support a minimum of 16 simultaneous users. Note: implementation of this capability may not be required on all projects.

g. Submit a backup of each Niagara Framework Supervisory Gateway as specified in Section 23 09 00 INSTRUMENTATION AND CONTROL FOR HVAC. The backup must be sufficient to restore a Niagara Framework Supervisory Gateway to the final as-built condition such that a new Niagara Framework Supervisory Gateway loaded with the backup is indistinguishable in functionality from the original.

2.4 NIAGARA FRAMEWORK ENGINEERING TOOL

The Niagara Framework Engineering Tool must be Niagara Workbench or an

equivalent Niagara Framework engineering tool software must:

a. Have an unrestricted interoperability license and its Niagara Compatibility Statement (NiCS) must follow the Tridium Open NiCS Specification.

b. Be capable of performing network configuration for Niagara Framework Supervisory Gateways and Niagara Framework Monitoring and Control Software.

c. Be capable of programming and configuring of Niagara Framework Supervisory Gateways and Niagara Framework Monitoring and Control Software.

d. Be capable of discovery of Niagara Framework Supervisory Gateways and all points mapped into each Niagara Framework Supervisory Gateway and making these points accessible to Niagara Framework Monitoring and Control Software.

Monitoring and Control Software is specified in Section 25 10 10 UTILITY MONITORING AND CONTROL SYSTEM (UMCS) FRONT END AND INTEGRATION.

## PART 3 EXECUTION

### 3.1 CONTROL SYSTEM INSTALLATION3.1.1 Niagara Framework Engineering Tool

Provide a Niagara Framework Engineering Tool.

### 3.1.2 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.

Provide an IP network (LAN) drop within three feet of each building level supervisory controller and provide a patch cable between the LAN drop and the building level supervisory controller.

Except for the IP Network and as permitted for the non-BACnet side of Gateways, use exclusively ASHRAE 135 networks.

#### 3.1.2.1 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 fiber-optic isolation where the cable passes through RF shielding or between secured and unsecured spaces.

Use UDP port 0xBAC0 for all BACnet traffic on the IP network. (Note that in a Niagara Framework system there may not be BACnet traffic on the IP Network)

3.1.2.2 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, between multiple buildings, or where the cable passes through RF shielding or between secured and unsecured spaces.

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 Niagara Framework Supervisory Gateway configured as 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.

3.1.2.3 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.

d. Use the Fox protocol for all traffic both originating and terminating at Niagara Framework components. Use the Fox protocol for all traffic originating or terminating at a Niagara Framework UMCS (including traffic to or from a future UMCS). All other traffic, including traffic between ASHRAE 135 devices and traffic between Niagara

Framework Supervisory Gateways and ASHRAE 135 devices must be in accordance with ASHRAE 135.

3.1.3 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.

3.1.3.1 Device Identifiers, Network Addresses, and IP addresses

a. Do not use any Device Identifier or Network Number already used by another BACnet system at the project site. Coordinate Device IDs and Network Numbers with the installation. The installation POC is Bldg 696.

b. Coordinate device IP addresses with installation. The installation POC is Bldg 696.

3.1.3.2 ASHRAE 135 Object Name Property and Object Description Property

Configure the Object_Names and Object_Descriptions properties of all ASHRAE 135 Objects (including Device Objects) as indicated on the Points Schedule (Point Name and Point Description) and as specified. At a minimum:

a. Except for DDC Hardware controlling a single terminal unit, configure the Object_Name and Object_Description properties of all Objects (including Device Objects) as indicated on the Points Schedule and as specified.

b. In DDC Hardware controlling a single terminal unit, configure the Device Object_Name and Device Object_Description as indicated on the Points Schedule and as specified.

When Points Schedule entries exceed the length limitations in the device, notify the Contracting Officer and provide recommended alternatives for approval.

3.1.3.3 Niagara Framework Point Names and Descriptions

Configure the names and descriptions of all Points in Niagara Framework Supervisory Gateways as indicated on the Points Schedule and as specified.

3.1.3.4 Niagara Station IDs

Ensure that Niagara Station IDs of new Niagara Framework Supervisory Gateways are maintained as unique within UMCS front-end, including

ensuring they do not conflict with any existing Niagara Station ID.

3.1.3.5 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.

3.1.3.6 Local Display Panels

Provide LDPs to display and override values of points in a Niagara Framework Supervisory Gateway or 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.

3.1.3.7 MS/TP Slave Devices

Configure all MS/TP devices as Master devices. Do not configure any devices to act as slave devices.

3.1.3.8 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.

3.1.3.9 Engineering Units

Configure devices to use English (Inch-Pound) engineering units as follows:

a. Temperature in degrees F

b. Air flows in cubic feet per minute (CFM)

c. Water in gallons per minute (GPM)

e. Differential Air pressures in inches of water column (IWC)

f. Water 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)

3.1.3.10 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.

3.1.3.11 Use of BACnet Objects

Except as specifically indicated for Niagara Framework Objects, Use only standard non-proprietary ASHRAE 135 Objects and services to accomplish the project scope of work as follows:

a. Use Analog Input or Analog Output Objects for all analog hardware I/O. Do not use Analog Value Object for analog hardware I/O) .

b. Use Binary Input or Binary Output Objects for all binary hardware I/O. Do not use Binary Value Objects for binary hardware I/O.

c. Use Analog Value Objects for analog setpoints.

d. Use Accumulator Objects or Analog Value Objects for pulse inputs.

e. For occupancy modes, use Multistate Value Objects and the correspondence between value and occupancy mode specified in paragraph OCCUPANCY MODES.

f. Use Schedule Objects and Calendar Objects for all scheduling. Use Trend Log Objects or Trend Log Multiple Objects for all trending and Notification Class Objects for trend log upload. Use a combination of Event Enrollment Objects,Intrinsic Alarming, and Notification Class Objects for alarm generation.
f. Use a combination of Niagara Framework Alarm Extensions and Alarm Services, Intrinsic Alarming, and Notification Class Objects for alarm generation.

g. For all other points shown on the Points Schedule as requiring an ASHRAE 135 Object, use the Object type shown on the Points Schedule or, if no Object Type is shown, use a standard Object appropriate to

the point.

3.1.3.11.1 Niagara Framework Objects

Points in the Niagara Framework Supervisory Gateway, even if used in a sequence or are shown on the Points Schedule, are not required to be exposed as BACnet Objects unless they are required to be available on the network by another device or sequence of operation (i.e. there is some other reason they are needed).

Use a Niagara Framework Supervisory Gateway as specified for all scheduling and trending. Use a Niagara Framework Supervisory Gateway as specified for all alarming except for intrinsic alarming.

3.1.3.12 Use of Standard BACnet Services

Except as noted in this paragraph, for all DDC Hardware (including Niagara Frameworks Supervisory Gateways when communicating with non-Niagara Framework DDC Hardware) use Standard BACnet Services as defined in this specification (which excludes some ASHRAE 135 services) exclusively for application control functionality and communication.

DDC Hardware that cannot meet this requirement may use non-standard services provided they can provide identical functionality using Standard BACnet Services when communicating with BACnet devices from a different vendor. When implementing non-standard services, document all non-standard services in the DDC Hardware Schedule as specified and as specified in Section 23 09 00 INSTRUMENTATION AND CONTROL FOR HVAC.

3.1.3.13 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

   (3) The Niagara Framework

b. For every property, setting or value in non-Niagara Framework Hardware shown on the Points Schedule or otherwise indicated as Operator Configurable, provide a value that is retained through loss of power and can be changed via one or more of:

   (1) A Writable Property of a standard BACnet Object

   (2) A Property of a standard BACnet Object that is Writable when Out_Of_Service is TRUE and Out_Of_Service is Writable.
   (3) Using some other method supported by a Niagara Framework Supervisory Gateway

c. Configure Niagara Framework Supervisory Gateways such that the property, setting or value is configurable from a Niagara Framework Front End.

d. For every property, setting or value in a Niagara Framework Supervisory Gateway which is shown on the Points Schedule or otherwise

indicated as Operator Configurable, configure the value to be configurable from within the Niagara Framework such that it can be configured from a system graphic page at a Niagara Framework Front End.

3.1.3.14 Niagara Framework Engineering Tool

Use the Niagara Framework Engineering Tool to fully discover the field control system and make all field control system information available to the Niagara Framework Supervisory Gateway. Ensure that all points on the points schedule are available to the front end via the Fox protocol.

3.1.4 Scheduling, Alarming, Trending, and Overrides

3.1.4.1 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.
Configure schedules in Niagara Framework Supervisory Gateway using Niagara Schedule Objects as indicated on the Points Schedule and as specified. When the schedule is controlling occupancy modes in DDC Hardware other than a Niagara Framework Supervisory Gateway use the indicated correspondence between value and occupancy mode.

3.1.4.2 Alarm Configuration

Configure alarm generation and management as indicated on the Points Schedule and as specified. Configure alarm generation in Niagara Framework Supervisory Gateways using Niagara Framework Alarm Extensions and Alarm Services or in other DDC Hardware (not Niagara Framework Supervisory Gateways) using ASHRAE 135 Intrinsic Alarming. Configure alarm management and routing for all alarms, including those generated via intrinsic alarming in other devices, in the Niagara Framework Supervisory Gateway such that the alarms are able to be accessed from the Niagara Framework Front End.

Where Intrinsic Alarming is used, configure intrinsic alarming as specified in paragraph "Configuration of ASHRAE 135 Intrinsic Alarm Generation". Configure a Niagara Framework Supervisory Gateway to provide a means to configure the intrinsic alarm parameters such that the Intrinsic Alarm is configurable from the front end via the Niagara Framework.

3.1.4.3 Configuration of ASHRAE 135 Intrinsic Alarm Generation

Intrinsic alarm generation must meet the following requirements:

Configure alarm generation as indicated on the Points Schedule and as specified using Intrinsic Alarming in accordance with ASHRAE 135 or Algorithmic Alarming in accordance with ASHRAE 135. Alarm generation must meet the following requirements:

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.

g. Configure the Recipient_List Property of the Notification Class Object to point to the Niagara Framework Supervisory Gateway managing the alarm.

3.1.4.4 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.)

3.1.4.5 Trend Log Configuration

a. Configure trends in Trend Log or Trend Log Multiple Objects as indicated on the Points Schedule and as specified.

b. Configure all trend logs (including any provided to support future trends) to save data on regular intervals using the BUFFER_FULL event to request trend upload from the front end.

c. Configure Trend Log Objects with a minimum Buffer_Size property value of 1,000 and Trend Log Multiple Objects with a minimum Buffer_Size property value of 1,000 per point trended (for example, a Trend Log Multiple Object used to trend 3 points must have a Buffer_Size Property value of at least 3,000).

d. Configure a Notification Class Object in devices doing trending (including devices supporting future trends) to handle the BUFFER_FULL event.

e. When possible, trend each point using an Object in the device containing the point. When it is necessary to trend using a an Object in another device, all trends not on the same Device as the Object being trended must be on a singe device (i.e. all Trend Log and Trend Log Multiple Objects used for remote trending within a sequence must be on the same device).

f. For each trend log, including any trend logs provided to support

future trending, configure the following properties as specified:

(1) Logging_Type: Set to Polling

(2) Stop_When_Full: Set to Wrap Around

(3) Buffer_Size: Set to 400 or greater.

(4) Notification_Threshold: Set to 90 percent of full

(5) Notification_Class: Set to the Notification Class Object in that device

(6) Event_Enable: Set to TRUE

(7) Log_Interval: Set to 15 minutes.

g. Future Trending support. Provide support for future trending:

(1) Provide one or more devices on the Building Control Network Backbone IP network which support both the T-VMT-E-B and DM-OCD-B BIBBs for Trend Log Objects. Provide sufficient devices to support the creation of at leastone 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.

3.1.4.6 Trending

Perform all trending using a Niagara Framework Supervisory Gateway using Niagara Framework History Extensions and Niagara Framework History Service exclusively.

3.1.4.7 Overrides

Provide an override for each point shown on the Points Schedule as requiring an override. Use the Niagara Framework for all overrides to points in Niagara Framework Supervisory Gateways. For overrides to other points, provide an override to a point in a Niagara Framework Supervisory Gateway via the Niagara Framework where the Niagara Framework Supervisory Gateway overrides the other point as specified.

Unless otherwise approved, provide Commandable Objects to support all Overrides in non-Niagara Framework Supervisory Gateway DDC Hardware. With specific approval from the Contracting Officer, Overrides for points which are not hardware outputs and which are in DDC hardware controlling a single terminal unit may support overrides via an additional Object provided for the override. No other means of implementing Overrides may be used.

a. Where Commandable Objects are used, ensure that WriteProperty service requests with a Priority of 10 or less take precedence over the

SEQUENCE VALUE and that WriteProperty service request with a priority of 11 or more have a lower precedence than the SEQUENCE VALUE.

b. For devices implementing overrides via additional Objects, provide Objects which are NOT Written to as part of the normal Sequence of Operations and are Writable when Out_Of_Service is TRUE and Out_Of_Service is Writable. Use this point as an Override of the normal value when Out_Of_Service is TRUE and the normal value otherwise. Note these Objects may be modified as part of the sequence via local processes, but must not be modified by local processes when Out_Of_Service is TRUE.

3.1.5 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.

3.1.5.1 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, or to Niagara Framework points, 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, or to Niagara Framework points, as indicated in the Points Schedule and as specified.

c. Configure gateway to support the DS-COV-B BIBB for all points mapped to BACnet Objects.

d. Do not use non-BACnet control hardware for controlling built-up units or any other equipment that was not furnished with factory-installed controls. (Note: A Niagara Framework Supervisory Gateway is BACnet control hardware.)

e. Do not use non-BACnet control hardware for system scheduling functions.

f. Each gateway must communicate with and perform protocol translation for non-BACnet control hardware controlling one and only one package unit or a single non-BACnet system specifically permitted by Section 23 09 00.

g. Connect one network port on the gateway to the Building Control Backbone IP Network or to a BACnet MS/TP network and the other port to the single piece of controlled equipment or the non-BACnet system specifically permitted by Section 23 09 00..

h. For gateways to existing package units or simple split systems, non-BACnet network wiring connecting the gateway to the package unit

must not exceed 10 feet in length and must connect to exactly two devices: the controlled equipment (packaged unit) or split system interface and the gateway.

-- End of Section --

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SECTION 23 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 | (2022) Method of Testing Capacity of Thermostatic Refrigerant Expansion Valves |
| ASHRAE 90.1 - IP | (2019) Energy Standard for Buildings Except Low-Rise Residential Buildings |

AMERICAN SOCIETY OF MECHANICAL ENGINEERS (ASME)

| | |
|---|---|
| ASME B16.22 | (2021) Wrought Copper and Copper Alloy Solder Joint Pressure Fittings |
| ASME B16.26 | (2018) Standard for Cast Copper Alloy Fittings for Flared Copper Tubes |
| ASME B31.1 | (2022) Power Piping |
| ASME B31.5 | (2022) Refrigeration Piping and Heat Transfer Components |

| | |
|---|---|
| ASME B40.100 | (2022) 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 D1.1/D1.1M | (2020; Errata 1 2021) Structural Welding Code - Steel |
| AWS Z49.1 | (2021) Safety in Welding and Cutting and Allied Processes |

ASTM INTERNATIONAL (ASTM)

| | |
|---|---|
| ASTM A53/A53M | (2024) Standard Specification for Pipe, Steel, Black and Hot-Dipped, Zinc-Coated, Welded and Seamless |
| ASTM A653/A653M | (2023) Standard Specification for Steel Sheet, Zinc-Coated (Galvanized) or Zinc-Iron Alloy-Coated (Galvannealed) by the Hot-Dip Process |
| ASTM B32 | (2020) Standard Specification for Solder Metal |
| ASTM B62 | (2017) Standard Specification for Composition Bronze or Ounce Metal Castings |
| ASTM 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 B813 | (2016) Standard Specification for Liquid and Paste Fluxes for Soldering of Copper and Copper Alloy Tube |
| ASTM D520 | (2000; R 2011) Zinc Dust Pigment |
| ASTM D3308 | (2012; R 2017) Standard Specification for PTFE Resin Skived Tape |

ASTM E84 (2023) 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

## 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

Refrigerant Piping System; G

SD-03 Product Data

Refrigerant Piping System

Qualifications

Refrigerant Piping Tests

SD-06 Test Reports

Refrigerant Piping Tests

SD-07 Certificates

Service Organization

SD-10 Operation and Maintenance Data

Operation and Maintenance Manuals; G

Demonstrations; G

## 1.3 QUALITY ASSURANCE

### 1.3.1 Qualifications

Submit 2 copies of qualified procedures, and list of names and identification symbols of qualified welders and welding operators, prior to non-factory welding operations. Weld piping in accordance with the qualified procedures using performance qualified welders and welding operators. Procedures and welders must be qualified in accordance with ASME BPVC SEC IX. Welding procedures qualified by others, and welders and welding operators qualified by another employer may be accepted as permitted by ASME B31.1. Notify the Contracting Officer 24 hours in advance of tests to be performed at the work site, if practical. The

welder or welding operator must apply the personally assigned symbol near each weld made, as a permanent record.

1.3.2 Contract Drawings

Because of the small scale of the drawings, it is not possible to indicate all offsets, fittings, and accessories that may be required. Carefully investigate the plumbing, fire protection, electrical, structural and finish conditions that would affect the work to be performed and arrange such work accordingly, furnishing required offsets, fittings, and accessories to meet such conditions.

1.4 DELIVERY, STORAGE, AND HANDLING

Protect stored items from the weather, humidity and temperature variations, dirt and dust, or other contaminants. Proper protection and care of all material both before and during installation is the Contractor's responsibility. Replace any materials found to be damaged at the Contractor's expense. During installation, cap piping and similar openings to keep out dirt and other foreign matter.

1.5 MAINTENANCE

1.5.1 General

Submit Data Package 2 plus operation and maintenance data complying with the requirements of Section 01 78 23 OPERATION AND MAINTENANCE DATA and as specified herein.

PART 2 PRODUCTS

2.1 STANDARD COMMERCIAL PRODUCTS

a. Provide materials and equipment which are standard products of a manufacturer regularly engaged in the manufacturing of such products, that are of a similar material, design and workmanship and that have been in satisfactory commercial or industrial use for 2 years prior to bid opening.

b. The 2 year use must include applications of equipment and materials under similar circumstances and of similar size. The 2 years' experience must be satisfactorily completed by a product which has been sold or is offered for sale on the commercial market through advertisements, manufacturer's catalogs, or brochures. Products having less than a 2-year field service record will be acceptable if a certified record of satisfactory field operation, for not less than 6000 hours exclusive of the manufacturer's factory tests, can be shown.

c. Products must be supported by a service organization. System components must be environmentally suitable for the indicated locations. Submit a certified list of qualified permanent service organizations for support of the equipment which includes their addresses and qualifications. The service organizations must be reasonably convenient to the equipment installation and be able to render satisfactory service to the equipment on a regular and emergency basis during the warranty period of the contract.

d. Exposed equipment moving parts, parts that produce high operating temperature, parts which may be electrically energized, and parts that

may be a hazard to operating personnel must be insulated, fully enclosed, guarded, or fitted with other types of safety devices. Install safety devices so that proper operation of equipment is not impaired. Welding and cutting safety requirements must be in accordance with AWS Z49.1.

e. Provide the manufacturer's standard catalog data, at least 5 weeks prior to the purchase or installation of a particular component. Highlight the data to show information such as, but not limited to, material, size, options, performance charts, and curves in adequate detail to demonstrate compliance with contract requirements. Include the manufacturer's recommended installation instructions and procedures in the data provided. Provide data for the following components as a minimum:

(1) Piping and Fittings
(2) Valves
(3) Piping Accessories
(4) Pipe Hangers, Inserts, and Supports

## 2.2 REFRIGERANT PIPING SYSTEM

Provide refrigerant piping, valves, fittings, and accessories in accordance with ASHRAE 15 & 34 and ASME B31.5, except as specified herein. Refrigerant piping, valves, fittings, and accessories must be compatible with the fluids used and capable of withstanding the pressures and temperatures of the service. Refrigerant piping, valves, and accessories used for refrigerant service must be cleaned, dehydrated, and sealed (capped or plugged) prior to shipment from the manufacturer's plant. Submit drawings, at least 5 weeks prior to beginning construction, provided in adequate detail to demonstrate compliance with contract requirements. Drawings must consist of:

a. Piping layouts which identify all valves and fittings.

b. Plans and elevations which identify clearances required for maintenance and operation.

## 2.3 PIPE, FITTINGS, AND END CONNECTIONS (JOINTS)

### 2.3.1 Copper Tubing

Provide copper tubing conforming to ASTM B280 annealed or hard drawn as required. Copper tubing must bear the product identification markings in accordance with ASTM B280, "ACR" must be present on copper tubing. Copper tubing must be soft annealed where bending is required and hard drawn where no bending is required. Soft annealed copper tubing must not be used in sizes larger than 1-3/8 inches. Joints must be brazed except that joints on lines 7/8 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.

2.3.2 Solder

Solder must conform to ASTM B32, grade Sb5, tin-antimony alloy for service pressures up to 150 psig. Solder flux must be liquid or paste form, non-corrosive and conform to ASTM B813.

2.3.3 Brazing Filler Metal

Filler metal must conform to AWS A5.8/A5.8M, Type BAg-5 with AWS Type FB3-A or Type FB3-C flux, except Type BCuP-3, BCuP-4, or BCuP-5 may be used for brazing copper-to-copper joints. BAlSi-4 with AWS Type FB1-A flux may be used when joining copper piping to aluminum components.

2.3.4 Brazing Flux

Brazing flux must conform to AWS A5.31/A5.31M, Type FB3-A or Type FB3-C when using Type BAg-5 filler metal. Type FB1-A is to be used with Type BAlSi-4 filler metal.

2.3.5 Press Fittings

Press fittings are not acceptable for use in refrigerant piping systems.

2.4 VALVES

Valves must be designed, manufactured, and tested specifically for refrigerant service. The valve material and all internal components must be compatible with the specific refrigerant and lubricant used. Valve bodies must be of brass, bronze, orsteel construction. Valves 1 inch and smaller must have brazed or socket welded connections. Valves larger than 1 inch must have butt welded end connections. Do not use threaded end connections, except in pilot pressure or gauge lines where maintenance disassembly is required and welded flanges cannot be used. Internal parts must be removable for inspection or replacement without applying heat or breaking pipe connections. Valve stems exposed to the atmosphere must be stainless steel or corrosion resistant metal plated carbon steel. Direction of flow must be legibly and permanently indicated on the valve body. Control valve inlets must be fitted with integral or adapted strainer or filter where recommended or required by the manufacturer. Purge, charge and receiver valves must be of manufacturer's standard configuration.

2.4.1 Refrigerant Stop Valves

Valve must be the globe or full-port ball type with a back-seating stem especially packed for refrigerant service. Valve packing must be replaceable under line pressure. Provide valve with a handwheel or wrench operator and a seal cap. Valve must be the straight or angle pattern design as indicated.

2.4.2 Check Valves

Valve must be the swing or lift type as required to provide positive shutoff at the differential pressure indicated. Valve must be provided with resilient seat.

2.4.3 Liquid Solenoid Valves

Provide valves that comply with AHRI 760 I-P and are suitable for

continuous duty with applied voltages 15 percent under and 5 percent over nominal rated voltage at maximum and minimum encountered pressure and temperature service conditions. Valves must be direct-acting or pilot-operating type, packless, except that packed stem, seal capped, manual lifting provisions must be furnished. Provide solenoid coils that are moisture-proof, UL approved, totally encapsulated or encapsulated and metal jacketed as required. Valves must have safe working pressure of 610 psi and a maximum operating pressure differential of at least 200 psi at 85 percent rated voltage. Valves must have an operating pressure differential suitable for the refrigerant used.

2.4.4 Expansion Valves

Provide valve conforming to AHRI 750 I-P and ASHRAE 17. Valve must be the diaphragm and spring-loaded type with internal or external equalizers, and bulb and capillary tubing. Provide valve with an external superheat adjustment along with a seal cap. Internal equalizers may be utilized where flowing refrigerant pressure drop between outlet of the valve and inlet to the evaporator coil is negligible and pressure drop across the evaporator is less than the pressure difference corresponding to 2 degrees F of saturated suction temperature at evaporator conditions. Bulb charge must be determined by the manufacturer for the application and such that liquid will remain in the bulb at all operating conditions. Do not use gas limited liquid charged valves and other valve devices for limiting evaporator pressure without a distributor or discharge tube or effective means to prevent loss of control when bulb becomes warmer than valve body. Pilot-operated valves must have a characterized plug to provide required modulating control. A de-energized solenoid valve may be used in the pilot line to close the main valve in lieu of a solenoid valve in the main liquid line. Provide an isolatable pressure gauge in the pilot line, at the main valve. Automatic pressure reducing or constant pressure regulating expansion valves may be used only where indicted or for constant evaporator loads.

2.4.5 Electronic Expansion Valves

Valve must conform to AHRI 1370 I-P and ASHRAE 17. The valve must prevent the return of liquid to the compressor in the event of power loss or low superheat.

2.4.6 Safety Relief Valves

Valve must be the two-way type, unless indicated otherwise. Valve must bear the ASME code symbol. Valve capacity must be certified by the National Board of Boiler and Pressure Vessel Inspectors. Valve must be of an automatically reseating design after activation.

2.4.7 Evaporator Pressure Regulators, Direct-Acting

Valve must include a diaphragm/spring assembly, external pressure adjustment with seal cap, and pressure gauge port. Valve must maintain a constant inlet pressure by balancing inlet pressure on diaphragm against an adjustable spring load. Pressure drop at system design load must not exceed the pressure difference corresponding to a 2 degrees F change in saturated refrigerant temperature at evaporator operating suction temperature. Spring must be selected for indicated maximum allowable suction pressure range.

2.4.8 Refrigerant Access Valves

Provide refrigerant access valves and hose connections in accordance with AHRI 720.

2.5 PIPING ACCESSORIES

2.5.1 Filter Driers

Driers must conform to AHRI 710 I-P. Sizes 5/8 inch and larger must be the full flow, replaceable core type. Sizes 1/2 inch and smaller must be the sealed type. Cores must be of suitable desiccant that will not plug, cake, dust, channel, or break down, and must remove water, acid, and foreign material from the refrigerant. Construct filter driers so that none of the desiccant will pass into the refrigerant lines. Minimum bursting pressure must be 1,500 psi.

2.5.2 Sight Glass and Liquid Level Indicator

2.5.2.1 Assembly and Components

Assembly must be pressure- and temperature-rated and constructed of materials suitable for the service. Glass must be borosilicate type. Ferrous components subject to condensation must be electro-galvanized.

2.5.2.2 Gauge Glass

Gauge glass must include top and bottom isolation valves fitted with automatic checks, and packing followers; red-line or green-line gauge glass; elastomer or polymer packing to suit the service; and gauge glass guard.

2.5.2.3 Bull's-Eye and Inline Sight Glass Reflex Lens

Provide bull's-eye and inline sight glass reflex lens for dead-end liquid service. For pipe line mounting, provide two plain lenses in one body suitable for backlighted viewing.

2.5.2.4 Moisture Indicator

Indicator must be a self-reversible action, moisture reactive, color changing media. Indicator must be furnished with full-color-printing tag containing color, moisture, and temperature criteria. Unless otherwise indicated, the moisture indicator must be an integral part of each corresponding sight glass.

2.5.3 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.

2.5.4 Pressure and Vacuum Gauges

Provide gauges conforming to ASME B40.100 with throttling type needle

valve or a pulsation dampener and shut-off valve. Gauge must be a minimum of 3-1/2 inches in diameter with a range from 0 psig to approximately 1.5 times the maximum system working pressure. Select each gauge range so that at normal operating pressure, the needle is within the middle-third of the range.

2.5.5 Temperature Gauges

Provide industrial duty type temperature gauges for the required temperature range. Gauges must have Fahrenheit scale in 2 degrees graduations scale (black numbers) on a white face. The pointer must be adjustable. Provide rigid stem type temperature gauges in thermowells located within 5 feet of the finished floor. Provide universal adjustable angle type or remote element type temperature gauges in thermowells located 5 to 7 feet above the finished floor. Provide remote element type temperature gauges in thermowells located 7 feet above the finished floor.

2.5.5.1 Stem Cased-Glass

Provide stem cased-glass case composed of polished stainless steel or cast aluminum, 9 inches long, with clear acrylic lens, and non-mercury filled glass tube with indicating-fluid column.

2.5.5.2 Bimetallic Dial

Provide bimetallic dial type case that is greater than 3-1/2 inches, stainless steel, and hermetically sealed with clear acrylic lens. Bimetallic element must be silicone dampened and unit fitted with external calibrator adjustment. Accuracy must be one percent of dial range.

2.5.5.3 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.

2.5.5.4 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.

2.5.6 Pipe Hangers, Inserts, and Supports

Provide pipe hangers, inserts, guides, and supports conforming to MSS SP-58.

2.5.7 Escutcheons

Escutcheons must be chromium-plated iron or chromium-plated brass, either one piece or split pattern, held in place by internal spring tension or set screws.

## 2.6 FABRICATION

### 2.6.1 Factory Coating

Unless otherwise specified, equipment and component items, when fabricated from ferrous metal, must be factory finished with the manufacturer's standard finish, except that items located outside of buildings must have weather resistant finishes that will withstand 500 hours exposure to the salt spray test specified in ASTM B117 using a 5 percent sodium chloride solution. Immediately after completion of the test, the specimen must show no signs of blistering, wrinkling, cracking, or loss of adhesion and no sign of rust creepage beyond 1/8 inch on either side of the scratch mark. Cut edges of galvanized surfaces where hot-dip galvanized sheet steel is used must be coated with a zinc-rich coating conforming to ASTM D520, Type I.

### 2.6.2 Factory Applied Insulation

Factory installed insulation must be in accordance with ASHRAE 90.1 - IP. Refrigerant suction lines between the cooler and each compressor must be insulated with not less than 1/2 inch thick unicellular plastic foam. Factory insulated items installed outdoors are not required to be fire-rated. As a minimum, factory insulated items installed indoors must have a flame spread index no higher than 25 and a smoke developed index no higher than 50. Factory insulated items (no jacket) installed indoors and which are located in air plenums, in ceiling spaces, and in attic spaces must have a flame spread index no higher than 25 and a smoke developed index no higher than 50. Flame spread and smoke developed indexes must be determined by ASTM E84. Test insulation in the same density and installed thickness as the material to be used in the actual construction. Test material supplied by a manufacturer with a jacket as a composite material. Provide jackets, facings, and adhesives that have a flame spread index less than 25 and a smoke developed index less than 50 when tested in accordance with ASTM E84.

# PART 3 EXECUTION

## 3.1 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.

### 3.1.1 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.

3.1.2 Functional Requirements

Install piping with minimum pitch of 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.

3.1.3 Fittings and End Connections

3.1.3.1 Threaded Connections

Make threaded connections with tapered threads and make tight with PTFE tape complying with ASTM D3308 or equivalent thread-joint compound applied to the male threads only. Do not show more than three threads after the joint is made.

3.1.3.2 Brazed Connections

Perform brazing in accordance with AWS BRH, except as modified herein. During brazing, fill the pipe and fittings with a pressure regulated inert gas, such as nitrogen, to prevent the formation of scale. Before brazing copper joints, clean both the outside of the tube and the inside of the fitting with a wire fitting brush until the entire joint surface is bright and clean. Do not use brazing flux on copper-to-copper connections. Remove surplus brazing material at all joints. 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.

3.1.3.3 Welded Connections

Make branch connections with welding tees or forged welding branch outlets. Thoroughly clean pipe of all scale and foreign matter before the piping is assembled. During welding, fill the pipe and fittings with an inert gas, such as nitrogen, to prevent the formation of scale. Beveling, alignment, heat treatment, and inspection of weld must conform to ASME B31.1. Remove and reweld weld defects at no additional cost to the Government. Store and dry electrodes in accordance with AWS D1.1/D1.1M or as recommended by the manufacturer. Do not use electrodes that have been wetted or that have lost any of their coating.

3.1.3.4 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.

3.1.3.5 Flanged Connections

Flanged joints must be assembled square end tight with matched flanges, gaskets, and bolts. Provide gaskets that are suitable for use with the refrigerants to be handled.

### 3.1.4 Valves

#### 3.1.4.1 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. 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 driers 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.

#### 3.1.4.2 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.

#### 3.1.4.3 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.

### 3.1.5 Filter Drier

Provide a liquid line filter drier on each refrigerant circuit located such that all liquid refrigerant passes through a filter drier. Size dryers in accordance with the manufacturer's recommendations for the system in which it is installed. Install driers such that it can be isolated from the system, the isolated portion of the system evacuated, and the filter drier replaced. Install driers in the horizontal position except replaceable core filter driers may be installed in the vertical position with the access flange on the bottom.

### 3.1.6 Sight Glass

Install a moisture indicating sight glass in all refrigerant circuits down stream of all filter driers and where indicated. Provide full line size sight glasses.

### 3.1.7 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.

### 3.1.8 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.

### 3.1.9 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. Thermowells for insertion thermometers and thermostats must extend beyond thermal insulation surface not less than 1 inch.

### 3.1.10 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.

#### 3.1.10.1 Hangers

Do not use Type 3 on insulated piping. Type 24 may be used only on trapeze hanger systems or on fabricated frames.

#### 3.1.10.2 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.

#### 3.1.10.3 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.

#### 3.1.10.4 Angle Attachments

Furnish Type 20 attachments used on angles and channels with an added malleable-iron heel plate or adapter.

#### 3.1.10.5 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.

3.1.10.6 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.

3.1.10.7 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.

3.1.10.8 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.

3.1.10.9 Steel Slides

Where steel slides do not require provisions for restraint of lateral movement, an alternate guide method may be used. On piping 4 inches and larger, usea Type 39 saddle. On piping under 4 inches, a Type 40 protection shield may be attached to the pipe or insulation and freely rest on a steel slide plate.

3.1.10.10 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.

3.1.10.11 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.

3.1.10.12 Structural Attachments

Attachment to building structure concrete and masonry must be by cast-in concrete inserts, built-in anchors, or masonry anchor devices. Inserts and anchors must be applied with a safety factor not less than 5. Do not attach supports to metal decking. Construct masonry anchors for overhead applications of ferrous materials only. Provide structural steel brackets required to support piping, headers, and equipment, but not shown, under this section.

3.1.11 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.

3.1.12 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.

3.1.13 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.

3.1.13.1 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.

3.1.13.2 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.

3.1.13.2.1 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.

3.1.13.2.2 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.

3.1.13.3 Fire-Rated Penetrations

Seal penetration of fire-rated walls, partitions, and floors as specified in Section 07 84 00 FIRESTOPPING.

3.1.13.4 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.

3.1.14 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.

3.1.15 Field Applied Insulation

Field installed insulation is specified in Section 23 07 00 THERMAL INSULATION FOR MECHANICAL SYSTEMS, except as defined differently herein.

3.1.16 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.

3.1.16.1 Color Coding

Color coding for piping identification is specified in Section 09 90 00 PAINTS AND COATINGS.

3.1.17 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.

3.2 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.

3.3 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 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 2 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 2 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 2 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. Include piping layouts and simplified wiring and control diagrams of the system as installed in the manuals.

3.4 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 2 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.

3.4.1 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.

3.4.2 Pneumatic Test

Provide pressure control and excess pressure protection at the source of test pressure. Valves must be wide open, except those leading to the atmosphere. Test gas must be dry nitrogen, with minus 70 degree F dewpoint and less than 5 ppm oil. Apply test pressure in two stages before any refrigerant pipe is insulated or covered. In accordance with ASME B31.5, a preliminary test not to exceed 25 psi must be applied as a means of locating major leaks. Every joint being tested must be coated with a thick soap or color indicating solution. The second stage test pressure must be at least 110 percent of the design pressure, but cannot exceed 130 percent of the design pressure of any component in the system. For large systems that are not completely visible, the pressure in the system must be gradually increased to one-half of the test pressure after which the pressure must be increased in steps of one-tenth of the test pressure, until the required test pressure has been reached. The test pressure must be continuously maintained for at leas 24 hours, after which it can be reduced to the leak test pressure. A correction factor of 0.3 psi will be allowed for each degree F change between test space initial and final ambient temperature, plus for increase and minus for a decrease. The leak test pressure must be the design pressure, or a pressure specified in the engineering design. To repair leaks, the joint must be taken apart, thoroughly cleaned, and reconstructed as a new joint. Joints repaired by caulking, re-melting, or back-welding/brazing are not acceptable. Following repair, the entire system must be retested using the pneumatic tests described above. Reassemble the entire system once the pneumatic tests are satisfactorily completed.

3.4.3 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.

3.4.4 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.

3.4.5 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.

3.4.6 Contractor's Responsibility

At all times during the installation and testing of the refrigeration system, take steps to prevent the release of refrigerants into the atmosphere. The steps must include, but not be limited to, procedures which will minimize the release of refrigerants to the atmosphere and the use of refrigerant recovery devices to remove refrigerant from the system and store the refrigerant for reuse or reclaim. At no time will the allowable leak rate exceed the leak rates allowed in Section 608 of the Clean Air Act: 30 percent of the full charge per year for industrial refrigeration, 20 percent of the full charge per year for commercial refrigeration, and 10 percent of the full charge per year for comfort cooling. Any system leaks within the first year must be repaired in accordance with the requirements herein at no cost to the Government including material, labor, and refrigerant if the leak is the result of defective equipment, material, or installation.

-- End of Section --

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SECTION 23 30 00

HVAC AIR DISTRIBUTION
**05/20, CHG 1: 02/22**

PART 1 GENERAL

1.1 REFERENCES

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

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 |

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 |

AMERICAN BEARING MANUFACTURERS ASSOCIATION (ABMA)

| | |
|---|---|
| ABMA 9 | (2015) Load Ratings and Fatigue Life for Ball Bearings |
| ABMA 11 | (2014) Load Ratings and Fatigue Life for Roller Bearings |

AMERICAN SOCIETY OF HEATING, REFRIGERATING AND AIR-CONDITIONING ENGINEERS (ASHRAE)

| | |
|---|---|
| ASHRAE 52.2 | (2012) Method of Testing General Ventilation Air-Cleaning Devices for Removal Efficiency by Particle Size |

| | |
|---|---|
| ASHRAE 62.1 | (2022; Addenda E-X 2022; Errata 1-2 2022; Errata 3 2023; Interpretation 1-3 2023) Ventilation for Acceptable Indoor Air Quality |
| ASHRAE 68 | (1997) Laboratory Method of Testing to Determine the Sound Power In a Duct |
| ASHRAE 70 | (2023) Method of Testing the Performance of Air Outlets and Inlets |

AMERICAN SOCIETY OF MECHANICAL ENGINEERS (ASME)

| | |
|---|---|
| ASME A13.1 | (2020) Scheme for the Identification of Piping Systems |

ASTM INTERNATIONAL (ASTM)

| | |
|---|---|
| ASTM A53/A53M | (2024) Standard Specification for Pipe, Steel, Black and Hot-Dipped, Zinc-Coated, Welded and Seamless |
| ASTM A123/A123M | (2024) Standard Specification for Zinc (Hot-Dip Galvanized) Coatings on Iron and Steel Products |
| ASTM A167 | (2011) Standard Specification for Stainless and Heat-Resisting Chromium-Nickel Steel Plate, Sheet, and Strip |
| ASTM A924/A924M | (2022a) Standard Specification for General Requirements for Steel Sheet, Metallic-Coated by the Hot-Dip Process |
| ASTM B117 | (2019) Standard Practice for Operating Salt Spray (Fog) Apparatus |
| ASTM B280 | (2020) Standard Specification for Seamless Copper Tube for Air Conditioning and Refrigeration Field Service |
| ASTM B766 | (2023) 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 E477 | (2020) Standard Test Method for Laboratory Measurements of Acoustical and Airflow Performance of Duct Liner Materials and Prefabricated Silencers |
| ASTM E2016 | (2022) Standard Specification for Industrial Woven Wire Cloth |

CALIFORNIA DEPARTMENT OF PUBLIC HEALTH (CDPH)

| | |
|---|---|
| CDPH SECTION 01350 | (2017; Version 1.2) 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 | (2021) 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 | (2026) National Electrical Code |
| NFPA 90A | (2024) Standard for the Installation of Air Conditioning and Ventilating Systems |
| NFPA 701 | (2023; ERTA 1 2023) Standard Methods of Fire Tests for Flame Propagation of Textiles and Films |

SHEET METAL AND AIR CONDITIONING CONTRACTORS' NATIONAL ASSOCIATION (SMACNA)

| | |
|---|---|
| SMACNA 1966 | (2020) HVAC Duct Construction Standards Metal and Flexible, 4th 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 | (2022) UL Standard for Safety Electrical Rigid Metal Conduit-Steel |
| UL 555 | (2006; Reprint Aug 2016) UL Standard for Safety Fire Dampers |
| UL 555S | (2014; Reprint Oct 2020) UL Standard for Safety Smoke Dampers |
| UL 586 | (2009; Reprint Sep 2022) UL Standard for Safety High-Efficiency Particulate, Air Filter Units |
| UL 900 | (2015; Reprint Aug 2022) UL Standard for Safety Standard for Air Filter Units |
| UL 1995 | (2015; Reprint Aug 2022) UL Standard for Safety Heating and Cooling Equipment |
| UL Bld Mat Dir | (updated continuously online) Building Materials Directory |

## 1.2 SYSTEM DESCRIPTION

Furnish ductwork, piping offsets, fittings, and accessories as required to provide a complete installation. Coordinate the work of the different trades to avoid interference between piping, equipment, structural, and electrical work. Provide complete, in place, all necessary offsets in piping and ductwork, and all fittings, and other components, required to install the work as indicated and specified.

### 1.2.1 Mechanical Equipment Identification

The number of charts and diagrams must be equal to or greater than the number of mechanical equipment rooms. Where more than one chart or diagram per space is required, mount these in edge pivoted, swinging leaf, extruded aluminum frame holders which open to 170 degrees.

#### 1.2.1.1 Charts

Provide chart listing of equipment by designation numbers and capacities such as flow rates, pressure and temperature differences, heating and cooling capacities, horsepower, pipe sizes, and voltage and current characteristics.

### 1.2.2 Service Labeling

Label equipment, including fans, air handlers, terminal units, etc. with labels made of self-sticking, plastic film designed for permanent installation. Provide labels in accordance with the equipment tags on the drawings.

Identify similar services with different temperatures or pressures. Where pressures could exceed 125 pounds per square inch, gage, include the maximum system pressure in the label. Label and arrow piping in accordance with the following:

a. Each point of entry and exit of pipe passing through walls.

b. Each change in direction, i.e., elbows, tees.

c. In congested or hidden areas and at all access panels at each point required to clarify service or indicated hazard.

d. In long straight runs, locate labels at distances within eyesight of each other not to exceed 75 feet. All labels must be visible and legible from the primary service and operating area.

| For Bare or Insulated Pipes | |
|---|---|
| for Outside Diameters of | Lettering |
| 1/2 thru 1-3/8 inch | 1/2 inch |
| 1-1/2 thru 2-3/8 inch | 3/4 inch |
| 2-1/2 inch and larger | 1-1/4 inch |

1.2.3 Color Coding

Color coding of all piping systems must be in accordance with ASME A13.1.

1.3 SUBMITTALS

Government approval is required for submittals with a "G" or "S" classification. Submittals not having a "G" or "S" classification are for 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

Duct Access Doors; G

Manual Balancing Dampers; G

Automatic Smoke-Fire Dampers; G

Sound Attenuation Equipment; G

Diffusers

Registers and Grilles

In-Line Centrifugal Fans; G

Air Handling Units; G

Constant Volume, Single Duct Terminal Units; G

Variable Volume, Single Duct Terminal Units; G

Reheat Units; G

Indoor Air Quality for Duct Sealants; S

SD-06 Test Reports

Performance Tests; G

Damper Acceptance Test; G

SD-07 Certificates

Ozone Depleting Substances Technician Certification

SD-08 Manufacturer's Instructions

Manufacturer's Installation Instructions

Operation and Maintenance Training

SD-10 Operation and Maintenance Data

Operation and Maintenance Manuals; G

Manual Balancing Dampers; G

Automatic Smoke-Fire Dampers; G

In-Line Centrifugal Fans; G

Air Handling Units; G

Constant Volume, Single Duct Terminal Units; G

Variable Volume, Single Duct Terminal Units; G

Reheat Units; G

SD-11 Closeout Submittals

Indoor Air Quality During Construction; S

## 1.4 QUALITY ASSURANCE

Except as otherwise specified, approval of materials and equipment is based on manufacturer's published data.

a. Where materials and equipment are specified to conform to the standards of the Underwriters Laboratories, the label of or listing with reexamination in UL Bld Mat Dir, and UL 6 is acceptable as sufficient evidence that the items conform to Underwriters Laboratories requirements. In lieu of such label or listing, submit a written certificate from any nationally recognized testing agency, adequately equipped and competent to perform such services, stating that the items have been tested and that the units conform to the specified requirements. Outline methods of testing used by the specified agencies.

b. Where materials or equipment are specified to be constructed or tested, or both, in accordance with the standards of the ASTM International (ASTM), the ASME International (ASME), or other standards, a manufacturer's certificate of compliance of each item is acceptable as proof of compliance.

c. Conformance to such agency requirements does not relieve the item from compliance with other requirements of these specifications.

d. Where products are specified to meet or exceed the specified energy efficiency requirement of FEMP-designated or ENERGY STAR covered product categories, equipment selected must have as a minimum the efficiency rating identified under "Energy-Efficient Products" at http://femp.energy.gov/procurement.

1.4.1 Prevention of Corrosion

Protect metallic materials against corrosion. Provide rust-inhibiting treatment and standard finish for the equipment enclosures. Do not use aluminum in contact with earth, and where connected to dissimilar metal. Protect aluminum by approved fittings, barrier material, or treatment. Provide hot-dip galvanized ferrous parts such as anchors, bolts, braces, boxes, bodies, clamps, fittings, guards, nuts, pins, rods, shims, thimbles, washers, and miscellaneous parts not of corrosion-resistant steel or nonferrous materials in accordance with ASTM A123/A123M for exterior locations and cadmium-plated in conformance with ASTM B766 for interior locations.

1.4.2 Asbestos Prohibition

Do not use asbestos and asbestos-containing products.

1.4.3 Ozone Depleting Substances Technician Certification

All technicians working on equipment that contain ozone depleting refrigerants must be certified as a Section 608 Technician to meet requirements in 40 CFR 82, Subpart F. Provide copies of technician certifications to the Contracting Officer at least 14 calendar days prior to work on any equipment containing these refrigerants.

1.4.4 Detail Drawings

Submit detail drawings showing equipment layout, including assembly and installation details and electrical connection diagrams; ductwork layout showing the location of all supports and hangers, typical hanger details, gauge reinforcement, reinforcement spacing rigidity classification, and static pressure and seal classifications. Include any information required to demonstrate that the system has been coordinated and functions properly as a unit on the drawings and show equipment relationship to other parts of the work, including clearances required for operation and maintenance. Submit drawings showing bolt-setting information, and foundation bolts prior to concrete foundation construction for all equipment indicated or required to have concrete foundations. Submit function designation of the equipment and any other requirements specified throughout this Section with the shop drawings.

1.4.5 Test Procedures

Conduct performance tests as required in Section 23 05 93 TESTING, ADJUSTING AND BALANCING FOR HVAC and Section 23 09 00 INSTRUMENTATION AND CONTROL FOR HVAC.

1.5 DELIVERY, STORAGE, AND HANDLING

Protect stored equipment at the jobsite from the weather, humidity and temperature variations, dirt and dust, or other contaminants. Additionally, cap or plug all pipes until installed.

PART 2 PRODUCTS

2.1 STANDARD PRODUCTS

Provide components and equipment that are "standard products" of a manufacturer regularly engaged in the manufacturing of products that are of a similar material, design and workmanship. "Standard products" is defined as being in satisfactory commercial or industrial use for 2 years before bid opening, including applications of components and equipment under similar circumstances and of similar size, satisfactorily completed by a product that is sold on the commercial market through advertisements, manufacturers' catalogs, or brochures. Products having less than a 2-year field service record are acceptable if a certified record of satisfactory field operation, for not less than 6,000 hours exclusive of the manufacturer's factory tests, can be shown. Provide equipment items that are supported by a service organization. In product categories covered by ENERGY STAR or the Federal Energy Management Program, provide equipment that is listed on the ENERGY STAR Qualified Products List or that meets or exceeds the FEMP-designated Efficiency Requirements.

2.2 STANDARD PRODUCTS

Except for the fabricated duct, plenums and casings specified in paragraphs "Metal Ductwork" and "Plenums and Casings for Field-Fabricated Units",
provide components and equipment that are standard products of manufacturers regularly engaged in the manufacturing of products that are of a similar material, design and workmanship. This requirement applies to all equipment, including diffusers, registers, fire dampers, and balancing dampers.

a. Standard products are defined as components and equipment that have been in satisfactory commercial or industrial use in similar applications of similar size for at least two years before bid opening.

b. Prior to this two year period, these standard products must have been sold on the commercial market using advertisements in manufacturers' catalogs or brochures. These manufacturers' catalogs, or brochures must have been copyrighted documents or have been identified with a manufacturer's document number.

c. Provide equipment items that are supported by a service organization. In product categories covered by ENERGY STAR or the Federal Energy Management Program, provide equipment that is listed on the ENERGY STAR Qualified Products List or that meets or exceeds the FEMP-designated Efficiency Requirements.

2.3 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.

2.4 EQUIPMENT GUARDS

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.

2.5 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 or provide permanently sealed and lubricated bearings.

e. Where two-speed or variable-speed motors are indicated, solid-state variable-speed controllers are allowed to accomplish the same function. Use solid-state variable-speed controllers for motors rated 10 hp or less and adjustable frequency drives for larger motors. Provide variable frequency drives for motors as specified in Section 26 29 23 ADJUSTABLE SPEED DRIVE SYSTEMS UNDER 600 VOLTS.

## 2.6 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.

## 2.7 PAINTING

Paint equipment units in accordance with approved equipment manufacturer's standards unless specified otherwise. Field retouch only if approved by manufacturer. Otherwise, return equipment to the factory for refinishing.

## 2.8 INDOOR AIR QUALITY

Provide equipment and components that comply with the requirements of ASHRAE 62.1 unless more stringent requirements are specified herein.

## 2.9 DUCT SYSTEMS

### 2.9.1 Metal Ductwork

Provide metal ductwork construction, including all fittings and components, that complies with SMACNA 1966, as supplemented and modified by this specification.

a. Construct ductwork meeting the requirements for the duct system static pressure indicated on the Duct Construction Schedule.

b. Provide radius type elbows with a centerline radius of 1.5 times the width or diameter of the duct where space permits. Otherwise, elbows having a minimum radius equal to the width or diameter of the duct or square elbows with factory fabricated turning vanes are allowed.

c. Unless indicated otherwise, provide ductwork that meets the requirements of Seal Class A. Provide ductwork in VAV systems upstream of the VAV boxes that meets the requirements of Seal Class A.

d. Provide sealants that conform to fire hazard classification specified in Section 23 07 00 THERMAL INSULATION FOR MECHANICAL SYSTEMS and are suitable for the range of air distribution and ambient temperatures to which it is exposed. Do not use pressure sensitive tape as a sealant. Provide duct sealant products that meet either emissions requirements of CDPH SECTION 01350 (limit requirements for either office or classroom spaces regardless of space type) or VOC content requirements of SCAQMD Rule 1168 (HVAC duct sealants are classified as "Other" within the SCAQMD Rule 1168 sealants table). Provide validation of indoor air quality for duct sealants.

e. Make spiral lock seam duct, and flat oval with duct sealant and lock with not less than 3 equally spaced drive screws or other approved methods indicated in SMACNA 1966. Apply the sealant to the exposed male part of the fitting collar so that the sealer is on the inside of the joint and fully protected by the metal of the duct fitting. Apply one brush coat of the sealant over the outside of the joint to at least 2 inch band width covering all screw heads and joint gap. Dents in the male portion of the slip fitting collar are not acceptable.

f. Fabricate outdoor air intake ducts and plenums with watertight soldered or brazed joints and seams.

2.9.1.1 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.

2.9.2 Duct Access Doors

Provide hinged access doors conforming to SMACNA 1966 in ductwork and plenums where indicated and at all air flow measuring primaries, automatic dampers, fire dampers, coils, thermostats, security bars, waveguides, 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. Use insulated type doors in insulated ducts.

2.9.3 Manual Balancing Dampers

Furnish manual balancing dampers with accessible operating mechanisms. Use galvanized or stainless steel operators (with all exposed edges rounded) in finished portions of the building. Provide manual volume control dampers that are operated by locking-type quadrant operators. Install dampers that are 2 gauges heavier than the duct in which installed. Unless otherwise indicated, provide opposed blade type multileaf dampers with maximum blade width of 12 inches. Provide access doors or panels for all concealed damper operators and locking setscrews. Provide stand-off mounting brackets, bases, or adapters not less than the thickness of the insulation when the locking-type quadrant operators for dampers are installed on ducts to be thermally insulated, to provide clearance between the duct surface and the operator. Provide stand-off mounting items that are integral with the operator or standard accessory of the damper manufacturer.

2.9.4 Automatic Smoke-Fire Dampers

Multiple blade type, 165 degrees F fusible fire damper link; smoke damper assembly to include electric damper operator. UL 555 as a 1.5 hour rated fire damper; further qualified under UL 555S as a leakage rated damper. Provide a leakage rating under UL 555S that is no higher than Class III at an elevated temperature Category B (250 degrees F for 30 minutes). Ensure that pressure drop in the damper open position does not exceed 0.1 inch

water gauge with average duct velocities of 2,500 fpm.

2.9.5 Air Deflectors (Turning Vanes) and Branch Connections

Provide air deflectors (turning vanes) at all duct mounted supply outlets, at takeoff or extension collars to supply outlets, at duct branch takeoff connections, and at 90 degree elbows, as well as at locations as indicated on the drawings or otherwise specified. Conical branch connections or 45 degree entry connections are allowed in lieu of deflectors for branch connections. Furnish all air deflectors (turning vanes), except those installed in 90 degree elbows, with an approved means of adjustment. Provide easily accessible means for adjustment inside the duct or from an adjustment with sturdy lock on the face of the duct. When installed on ducts to be thermally insulated, provide external adjustments with stand-off mounting brackets, integral with the adjustment device, to provide clearance between the duct surface and the adjustment device not less than the thickness of the thermal insulation. Provide factory-fabricated air deflectors consisting of curved turning vanes or louver blades designed to provide uniform air distribution and change of direction with minimum turbulence or pressure loss. Provide factory or field assembled air deflectors (turning vanes). Make adjustment from the face of the diffuser or by position adjustment and lock external to the duct. Provide stand-off brackets on insulated ducts as described herein. Provide fixed air deflectors (turning vanes) in 90 degree elbows.

2.9.6 Sound Attenuation Equipment

2.9.6.1 Double Wall Acoustic Duct

Double wall acoustic duct shall be constructed with an outer solid galvanized steel shell and an inner perforated metal liner. The cavity between the outer shell and inner liner shall contain a minimum of 1-1/2 pound density, 1 inch thick fiberglass insulation that conforms to ASTM C1071 and that meets the requirements of NFPA 90A. The inner liner shall be fabricated from 24 gauge or thicker galvanized steel, perforated with maximum 0.125 inch diameter holes on staggered centers to ensure an open area of not less than 23 percent. The acoustical performance of the double wall acoustic duct shall meet or exceed the requirements of ASTM E477 for duct borne noise transmission, insertion loss, and noise reduction coefficient. All duct sections shall be joined by slip-fit or flanged connections manufactured in accordance with SMACNA standards. Increase duct sizes shown to compensate for the thickness of the liner and insulation used.

2.9.7 Diffusers, Registers, and Grilles

Provide factory-fabricated units of aluminum that distribute the specified quantity of air evenly over space intended without causing noticeable drafts, air movement faster than 50 fpm in occupied zone, or dead spots anywhere in the conditioned area. Provide outlets for diffusion, spread, throw, and noise level as required for specified performance. Certify performance according to ASHRAE 70. Provide sound rated and certified inlets and outlets according to ASHRAE 70. Provide noise criteria 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. Where the inlet and outlet openings are located less than 7 feet above the floor, protect them by a grille or screen according to NFPA 90A.

2.9.7.1 Diffusers

Provide diffuser types indicated. Provide diffusers with air deflectors of the type indicated. Provide suitable trim for flush mounted diffusers. For connecting the duct to diffuser, provide duct collar that is airtight and does not interfere with volume controller. Provide return or exhaust units that are similar to supply diffusers.

2.9.7.2 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. Achieve four-way directional control by a grille face which can be rotated in 4 positions or by adjustment of horizontal and vertical vanes. Provide grilles as specified for registers, without volume control damper.

2.9.8 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 LOUVERS.

2.9.9 Bird Screens and Frames

Provide bird screens that conform to ASTM E2016, No. 2 mesh, aluminum or stainless steel. Provide "medium-light" rated aluminum screens. Provide "light" rated stainless steel screens. Provide removable type frames fabricated from either stainless steel or extruded aluminum.

2.10 AIR SYSTEMS EQUIPMENT

2.10.1 Fans

Test and rate fans according to AMCA 210. Calculate system effect on air moving devices in accordance with AMCA 201 where installed ductwork differs from that indicated on drawings. Install air moving devices to minimize fan system effect. Where system effect is unavoidable, determine the most effective way to accommodate the inefficiencies caused by system effect on the installed air moving device. The sound power level of the fans must not exceed 85 dBA when tested according to AMCA 300 and rated in accordance with AMCA 301. Provide all fans with an AMCA seal. Connect fans to the motors either directly or indirectly with V-belt drive as indicated. Use V-belt drives designed for not less than 150 percent of the connected driving capacity. Provide variable pitch motor sheaves for 15 hp and below. 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. 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.

2.10.1.1 In-Line Centrifugal Fans

Provide in-line fans with centrifugal backward inclined blades and adjustable motor mounts. Mount fans in a welded tubular casing. Provide a fan that axially flows the air in and out. 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 open dripproof or totally enclosed enclosure. Provide magnetic motor starters across-the-line with general-purpose enclosures. Provide remote manual switch with pilot indicating light where indicated.

2.10.2 Coils

Provide fin-and-tube type coils constructed of seamless copper tubes and aluminum fins mechanically bonded or soldered to the tubes. Provide copper tube wall thickness that is a minimum of 0.016 inches. Provide aluminum fins that are 0.0055 inch minimum thickness. Provide casing and tube support sheets that are not lighter than 16 gauge galvanized steel, formed to provide structural strength. When required, provide multiple tube supports to prevent tube sag. Mount coils for counterflow service. Rate and certify coils to meet the requirements of AHRI 410. Provide factory applied phenolic, vinyl or epoxy/electrodeposition coating.

2.10.2.1 Direct-Expansion Coils

Provide suitable direct-expansion coils for the refrigerant involved. Provide refrigerant piping that conforms to ASTM B280 and clean, dehydrate and seal. Provide seamless copper tubing suction headers or seamless or resistance welded steel tube suction headers with copper connections. Provide supply headers that consist of a distributor which distributes the refrigerant through seamless copper tubing equally to all circuits in the coil. Provide circuited tubes to ensure minimum pressure drop and maximum heat transfer. Provide circuiting that permits refrigerant flow from inlet to suction outlet without causing oil slugging or restricting refrigerant flow in coil. Provide field installed coils which are completely dehydrated and sealed at the factory upon completion of pressure tests. Pressure test coils in accordance with UL 1995 and manufacturer's requirements.

2.10.3 Air Filters

List air filters according to requirements of UL 900, except list high efficiency particulate air filters of 99.97 percent efficiency by the DOP Test method under the Label Service to meet the requirements of UL 586.

2.10.3.1 Extended Surface Pleated Panel Filters

Provide 2 inch depth, sectional, disposable type filters of the size and MERV indicated when tested according to ASHRAE 52.2. Provide initial resistance at 500 fpm that does not exceed 0.36 inches water gauge. Provide UL Class 2 filters, and nonwoven cotton and synthetic fiber mat media. Attach a wire support grid bonded to the media to a moisture resistant fiberboard frame. Bond all four edges of the filter media to

the inside of the frame to prevent air bypass and increase rigidity.

2.10.3.2 Cartridge Type Filters

Provide 4 inch depth, sectional, replaceable dry media type filters of the size and MERV indicated 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 filter media with corrugated aluminum separators, sealed inside the filter cell to form a totally rigid filter assembly. Fluctuations in filter face velocity or turbulent airflow have no effect on filter integrity or performance. Install each filter with an extended surface pleated media panel filter as a prefilter in a factory preassembled side access housing, or a factory-made sectional frame bank, as indicated.

2.10.3.3 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.

2.10.3.4 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 graduated in 0.01 inch of water, with a minimum range of 1 inch of water beyond the specified final resistance for the filter bank on which each gauge is applied. Provide each gauge with a screw operated zero adjustment and two static pressure tips with integral compression fittings, two molded plastic vent valves, two 5 foot minimum lengths of 1/4 inch diameter vinyl tubing, and all hardware and accessories for gauge mounting.

2.11 AIR HANDLING UNITS

2.11.1 Factory-Fabricated Air Handling Units

Provide single-zone draw-through type units as indicated. Units must include fans, coils, airtight insulated casing, prefilters, secondary filteraccess sections where indicated, combination sectional filter-mixing box, and appurtenances required for specified operation. Provide 2 inch deflection spring type vibration isolators. 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.

2.11.1.1 Casings

Provide the following:

a. Casing sections 2 inch double wall type, constructed of a minimum 18 gauge galvanized steel, or 18 gauge corrosion-resisting sheet steel conforming to ASTM A167, Type 304. Design and construct casing with an integral insulated structural galvanized steel base frame such that exterior panels are non-load bearing.

b. Individually removable exterior panels with standard tools. Removal must not affect the structural integrity of the unit. Furnish casings with access sections 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 minimum 18 gauge 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. Access doors must be a minimum 18 inches wide, the full height of the unit casing minus manufacturer's minimum edge distances or a minimum of 6 foot, whichever is less.

d. Double-wall insulated type drain pan (thickness equal to exterior casing) constructed of 16 gauge corrosion resisting sheet steel conforming to ASTM A167, Type 304, conforming to ASHRAE 62.1. Construct drain pans water tight, treated to prevent corrosion, and designed for positive condensate drainage. Construct drain pan to allow for easy visual inspection, including underneath the coil without removal of the coil and to allow complete and easy physical cleaning of the pan underneath the coil without removal of the coil. Provide coils that are individually removable from the casing.

e. Casing insulation that conforms to NFPA 90A. Insulate single-wall casing sections handling conditioned air with not less than 1 inch thick, 1-1/2 pound density coated fibrous glass material having a thermal conductivity not greater than 0.23 Btu/hr-sf-F. Insulate double-wall casing sections handling conditioned air with not less than 2 inches of the same insulation specified for single-wall casings. Foil-faced insulation is not an acceptable substitute for use with double wall casing. Seal double wall insulation completely by inner and outer panels.

f. Factory applied fibrous glass insulation that conforms to ASTM C1071, except that the minimum thickness and density requirements do not apply, and that meets the requirements of NFPA 90A. Make air handling unit casing insulation uniform over the entire casing. Foil-faced insulation is not an acceptable substitute for use on double-wall access doors and inspections doors and casing sections.

g. Duct liner material, coating, and adhesive that conforms to fire-hazard requirements specified in Section 23 07 00 THERMAL INSULATION FOR MECHANICAL SYSTEMS. Protect exposed insulation edges and joints where insulation panels are butted with a metal nosing strip or coat to meet erosion resistance requirements of ASTM C1071.

h. A latched and hinged access door, in the mixing box section, fan, and coil sections. Plus additional access doors and access sections where indicated.

2.11.1.2 Cooling Coils

Provide coils as specified in paragraph AIR SYSTEMS EQUIPMENT.

2.11.1.3 Air Filters

Provide air filters as specified in paragraph AIR SYSTEMS EQUIPMENT for types and thickness indicated.

2.11.1.4 Fans

Provide the following:

a. Direct-drive plenum fan, single width, single inlet multi-blade type. Plenum fan shall be rated in accordance with and certified by AMCA for performance. Motor shall operate at variable speeds driven by a compatible VFD as specified in Section 26 29 23 ADJUSTABLE SPEED DRIVE SYSTEMS UNDER 600 VOLTS. Provide motor with a shaft grounding ring to discharge static and induced shaft currents to ground. Fan motor assembly shall be dynamically balanced at the factory. Provide motors with open drip proof or totally enclosed enclosures.

b. 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.

c. Fan bearings that are sealed against dust and dirt and are precision self-aligning ball or roller type, with L10 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 standard coating.

d. 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.

2.11.1.5 Access Sections and Filter/Mixing Boxes

Provide access sections where required and furnish with access doors as shown. Construct access sections and filter/mixing boxes in a manner identical to the remainder of the unit casing and equip with access doors. Design mixing boxes to minimize air stratification and to promote thorough mixing of the air streams.

2.12 TERMINAL UNITS

2.12.1 Variable Air Volume (VAV) Terminal Units

a. Provide VAV single duct terminal units that are the type, size, and capacity shown. Provide actuators and controls as specified in paragraph SUPPLEMENTAL COMPONENTS/SERVICES, subparagraph CONTROLS. For each VAV terminal unit, provide a temperature sensor in the unit discharge ductwork.

b. Provide unit enclosures that are constructed of galvanized steel not lighter than 22 gauge or aluminum sheet not lighter than 18 gauge. Provide single or multiple discharge outlets as required. Units with flow limiters are not acceptable. Provide unit air volume that is factory preset and readily field adjustable without special tools. Provide reheat coils as indicated.

c. Attach a flow chart to each unit. Base acoustic performance of the terminal units upon units tested according to AHRI 880 I-P with the

calculations prepared in accordance with AHRI 885. Provide maximum discharge sound power level as indicated. Show discharge sound power for minimum and 1-1/2 inches water gauge inlet static pressure. Provide acoustical lining according to NFPA 90A.

2.12.1.1 Constant Volume, Single Duct Terminal Units

Provide constant volume, single duct, terminal units that contain within the casing, a constant volume regulator. Provide volume regulators that control air delivery to within plus or minus 5 percent of specified air flow subjected to inlet pressure from 3/4 to 6 inch water gauge.

2.12.1.2 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 external differential pressure taps separate from the control pressure taps for air flow measurement with a 0 to 1 inch water gauge range.

2.12.1.3 Reheat Units

2.12.1.3.1 Electric Resistance Heaters

Provide the duct-mounting type integral to VAV unit electric resistance heaters consisting of a nickel-chromium resistor mounted on refractory material and a steel or aluminum frame for attachment to ductwork. Provide electric duct heater that meets the requirement of Underwriters Laboratories and NFPA 70 and is provided with a built-in or surface-mounted high-limit thermostat. Interlock electric duct heaters electrically so that they cannot be energized unless there is minimum required airflow through the VAV terminal unit. Heaters shall be equipped with a silicon-controlled-rectifier (SCR) controller to modulate the heater load according to the temperature control signal. Provide integral transformer for powering 24V controls and hinged access door for electric heat/controls area.

2.13 FACTORY PAINTING

Factory paint new equipment, which are not of galvanized construction. Paint with a corrosion resisting paint finish according to ASTM A123/A123M or ASTM A924/A924M. Clean, phosphatize and coat internal and external ferrous metal surfaces with a paint finish which has been tested according to ASTM B117, ASTM D1654, and ASTM D3359. Submit evidence of satisfactory paint performance for a minimum of 125 hours for units to be installed indoors and 500 hours for units to be installed outdoors. Provide rating of failure at the scribe mark that is not less than 6, average creepage not greater than 1/8 inch. Provide rating of the inscribed area that is not less than 10, no failure. On units constructed of galvanized steel that have been welded, provide a final shop docket of zinc-rich protective paint on exterior surfaces of welds or welds that have burned through from the interior according to ASTM D520 Type I.

Field paint factory painting that has been damaged prior to acceptance by the Contracting Officer in compliance with the requirements of paragraph FIELD PAINTING OF MECHANICAL EQUIPMENT.

## 2.14 SUPPLEMENTAL COMPONENTS/SERVICES

### 2.14.1 Refrigerant Piping

The requirements for refrigerant piping are specified in Section 23 23 00 REFRIGERANT PIPING.

### 2.14.2 Condensate Drain Lines

Provide and install condensate drainage for each item of equipment that generates condensate in accordance with Section 22 00 00 PLUMBING, GENERAL PURPOSE except as modified herein.

### 2.14.3 Insulation

The requirements for shop and field applied insulation are specified in Section 23 07 00 THERMAL INSULATION FOR MECHANICAL SYSTEMS.

### 2.14.4 Controls

The requirements for controls are specified in Section 23 09 00 INSTRUMENTATION AND CONTROL FOR HVAC.

### 2.14.5 Refrigerant Leak Detection System

Refrigerant leak detection system for equipment utilizing A2L type refrigerants must be continuously-operating and designed for the refrigerant in use. Sensors must utilize thermal conductivity technology and must have automated self-calibration and self-diagnostics. Quantity of sensors must be suitable for the monitored area. Accuracy must be +/- 5% across the sensor's rated lower flammability limit (LFL) measurement range. System must be provided with an alarm relay output which energizes when the sensor(s) detects a refrigerant concentration at or above the alarm threshold for the refrigerant in use. System's output must be capable of initiating corresponding actions for air distribution system as indicated on the drawings.

# PART 3 EXECUTION

## 3.1 EXAMINATION

After becoming familiar with all details of the work, verify all dimensions in the field, and advise the Contracting Officer of any discrepancy before performing the work.

## 3.2 INSTALLATION

a. Install materials and equipment in accordance with the requirements of the contract drawings and approved manufacturer's installation instructions. Accomplish installation by workers skilled in this type of work. Perform installation so that there is no degradation of the designed fire ratings of walls, partitions, ceilings, and floors.

b. No installation is permitted to block or otherwise impede access to any existing machine or system. Install all hinged doors to swing open a minimum of 120 degrees. Provide an area in front of all access doors that clears a minimum of 3 feet. In front of all access doors to electrical circuits, clear the area the minimum distance to energized circuits as specified in OSHA Standards, part 1910.333

(Electrical-Safety Related work practices)and an additional 3 feet.

c. Except as otherwise indicated, install emergency switches and alarms in conspicuous locations. Mount all indicators, to include gauges, meters, and alarms in order to be easily visible by people in the area.

3.2.1 Condensate Drain Lines

Provide water seals in the condensate drain from all units. Provide a depth of each seal as indicated on the drawings for the unit to which the drain is connected. Provide water seals that are constructed of 2 tees and an appropriate U-bend with the open end of each tee plugged. Provide pipe cap or plug cleanouts where indicated. Connect drains indicated to connect to the sanitary waste system using an indirect waste fitting. Insulate air conditioner drain lines as specified in Section 23 07 00 THERMAL INSULATION FOR MECHANICAL SYSTEMS.

3.2.2 Equipment and Installation

Provide frames and supports for tanks, compressors, pumps, valves, air handling units, fans, coils, dampers, and other similar items requiring supports. Floor mount 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. Submit foundation drawings as specified in paragraph DETAIL DRAWINGS. Provide concrete for foundations as specified in Section 03 30 00 CAST-IN-PLACE CONCRETE.

3.2.3 Access Panels

Install access panels for concealed valves, vents, controls, dampers, and items requiring inspection or maintenance of sufficient size, and locate them so that the concealed items are easily serviced and maintained or completely removed and replaced.

3.2.4 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.

3.2.5 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.

### 3.2.6 Insulation

Provide thickness and application of insulation materials for ductwork, piping, and equipment according to Section 23 07 00 THERMAL INSULATION FOR MECHANICAL SYSTEMS. Externally insulate outdoor air intake ducts and plenums up to the point where the outdoor air reaches the conditioning unit.

### 3.2.7 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.

## 3.3 EQUIPMENT PADS

Provide equipment pads to the dimensions shown or, if not shown, to conform to the shape of each piece of equipment served with the minimum indicated margin around the equipment and supports. Allow equipment bases and foundations, when constructed of concrete or grout, to cure a minimum of 14 calendar days before being loaded.

## 3.4 CUTTING AND PATCHING

Install work in such a manner and at such time that a minimum of cutting and patching of the building structure is required. Make holes in exposed locations, in or through existing floors, by drilling and smooth by sanding. Use of a jackhammer is permitted only where specifically approved. Make holes through masonry walls to accommodate sleeves with an iron pipe masonry core saw.

## 3.5 CLEANING

Thoroughly clean surfaces of piping and equipment that have become covered with dirt, plaster, or other material during handling and construction before such surfaces are prepared for final finish painting or are enclosed within the building structure. Before final acceptance, clean mechanical equipment, including piping, ducting, and fixtures, and free from dirt, grease, and finger marks. When the work area is in an occupied space such as office, laboratory or warehouse protect all furniture and equipment from dirt and debris. Incorporate housekeeping for field construction work which leaves all furniture and equipment in the affected area free of construction generated dust and debris; and, all floor surfaces vacuum-swept clean.

## 3.6 PENETRATIONS

Provide sleeves and prepared openings for duct mains, branches, and other penetrating items, and install during the construction of the surface to be penetrated. Cut sleeves flush with each surface. Place sleeves for round duct 15 inches and smaller. Build framed, prepared openings for round duct larger than 15 inches and square, rectangular or oval ducts. Sleeves and framed openings are also required where grilles, registers, and diffusers are installed at the openings. Provide one inch clearance between penetrating and penetrated surfaces except at grilles, registers, and diffusers, or for wall penetrations of RF and secure barriers. 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 Finish Painting

The requirements for finish painting of items only primed at the factory, and surfaces not specifically noted otherwise, are specified in Section 09 90 00 PAINTS AND COATINGS.

3.8 IDENTIFICATION SYSTEMS

Provide identification tags made of brass, engraved laminated plastic, or engraved anodized aluminum, indicating service and item number on all valves and dampers. Provide tags that are 1-3/8 inch minimum diameter with stamped or engraved markings. Make indentations black for reading clarity. Attach tags to valves with No. 12 AWG 0.0808-inch diameter corrosion-resistant steel wire, copper wire, chrome-plated beaded chain or plastic straps designed for that purpose.

3.9 DUCTWORK LEAK TEST

Requirements for ductwork air leak testing are specified in Section 23 05 93 TESTING, ADJUSTING, AND BALANCING FOR HVAC.

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 removed for test. 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 2 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 8 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 --

SECTION 23 81 00

DECENTRALIZED UNITARY HVAC EQUIPMENT
**05/18, 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.

AIR-CONDITIONING, HEATING AND REFRIGERATION INSTITUTE (AHRI)

| | |
|---|---|
| AHRI 365 | (2009) Commercial and Industrial Unitary Air-Conditioning Condensing Units |
| AHRI 700 | (2016) Specifications for Fluorocarbon Refrigerants |
| ANSI/AHRI 210/240 | (2008; Add 1 2011; Add 2 2012) Performance Rating of Unitary Air-Conditioning & Air-Source Heat Pump Equipment |

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 90.1 - IP | (2019) Energy Standard for Buildings Except Low-Rise Residential Buildings |

AMERICAN WELDING SOCIETY (AWS)

| | |
|---|---|
| AWS Z49.1 | (2021) Safety in Welding and Cutting and Allied Processes |

ASTM INTERNATIONAL (ASTM)

| | |
|---|---|
| ASTM B117 | (2019) Standard Practice for Operating Salt Spray (Fog) Apparatus |
| ASTM C1071 | (2019) Standard Specification for Fibrous Glass Duct Lining Insulation (Thermal and Sound Absorbing Material) |
| ASTM D520 | (2000; R 2011) Zinc Dust Pigment |
| ASTM E84 | (2023) Standard Test Method for Surface Burning Characteristics of Building Materials |

NATIONAL ELECTRICAL MANUFACTURERS ASSOCIATION (NEMA)

| | |
|---|---|
| NEMA MG 1 | (2021) Motors and Generators |
| NEMA MG 2 | (2014) Safety Standard for Construction and Guide for Selection, Installation and Use of Electric Motors and Generators |

UNDERWRITERS LABORATORIES (UL)

| | |
|---|---|
| UL 1995 | (2015; Reprint Aug 2022) UL Standard for Safety Heating and Cooling Equipment |
| UL 60335-2-40 | (2022) Standard for Household and Similar Electrical Appliances — Safety — Part 2-40: Particular Requirements for Electrical Heat Pumps, Air-Conditioners and Dehumidifiers |

## 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

Spare Parts

Posted Instructions

Coil Corrosion Protection

System Performance Tests

Training; G

Inventory

Manufacturer's Standard Catalog Data

SD-06 Test Reports

Refrigerant Tests, Charging, and Start-Up; G

System Performance Tests; G

SD-07 Certificates

Service Organizations

SD-10 Operation and Maintenance Data

Operation and Maintenance Manuals; G

SD-11 Closeout Submittals

Ozone Depleting Substances; S

1.3 QUALITY ASSURANCE

Carefully investigate the plumbing, fire protection, electrical, structural and finish conditions that would affect the work to be performed and arrange such work accordingly, furnishing required offsets, fittings, and accessories to meet such conditions. Submit drawings consisting of:

a. Equipment layouts which identify assembly and installation details.

b. Plans and elevations which identify clearances required for maintenance and operation.

c. Wiring diagrams which identify each component individually and interconnected or interlocked relationships between components.

d. Foundation drawings, bolt-setting information, and foundation bolts prior to concrete foundation construction for equipment indicated or required to have concrete foundations.

e. Details, if piping and equipment are to be supported other than as indicated, which include loadings and type of frames, brackets, stanchions, or other supports.

f. Automatic temperature control diagrams and control sequences.

g. Installation details which includes the amount of factory set superheat and corresponding refrigerant pressure/temperature.

h. Equipment schedules.

1.4 DELIVERY, STORAGE, AND HANDLING

Protect stored items from the weather, humidity and temperature variations, dirt and dust, or other contaminants. Properly protect and care for all material both before and during installation. Submit an inventory of all the stored items. Replace any materials found to be damaged, at no additional cost to the Government. During installation, cap piping and similar openings capped to keep out dirt and other foreign matter.

1.5 WARRANTY

Provide equipment with the Manufacturer's Standard Warranty.

PART 2 PRODUCTS

2.1 MATERIALS

Provide Manufacturer's standard catalog data, at least 5 weeks prior to the purchase or installation of a particular component, highlighted to show material, size, options, performance charts and curves, etc. in adequate detail to demonstrate compliance with contract requirements. Data includes manufacturer's recommended installation instructions and procedures. If vibration isolation is specified for a unit, include

vibration isolator literature containing catalog cuts and certification that the isolation characteristics of the isolators provided meet the manufacturer's recommendations. Submit data for each specified component. Minimum efficiency requirements must be in accordance with ASHRAE 90.1 - IP.

2.1.1 Standard Products

Provide materials and equipment that are standard products of a manufacturer regularly engaged in the manufacturing of such products, which are of a similar material, design and workmanship. The standard products must have been in satisfactory commercial or industrial use for 2 years prior to bid opening. The 2 year use includes applications of equipment and materials under similar circumstances and of similar size. The 2 years' experience must be satisfactorily completed by a product which has been sold or is offered for sale on the commercial market through advertisements, manufacturer's catalogs, or brochures. Products having less than a 2 year field service record will be acceptable if a certified record of satisfactory field operation, for not less than 6,000 hours exclusive of the manufacturer's factory tests, can be shown. Products must be supported by a service organization. Ensure system components are environmentally suitable for the indicated geographic locations.

2.1.2 Product Sustainability Criteria

2.1.2.1 Energy Efficient Equipment

Provide equipment meeting the efficiency requirements as stated within this section and provide documentation in conformance with Section 01 33 29 SUSTAINABILITY REQUIREMENTS AND REPORTING paragraph ENERGY EFFICIENT EQUIPMENT.

2.1.2.2 Electrical Equipment / Motors

Provide electrical equipment, motors, motor efficiencies, and wiring which are in accordance with Section 26 20 00 INTERIOR DISTRIBUTION SYSTEM. Electrical motor driven equipment specified must be provided complete with motors, motor starters, and controls. Electrical characteristics must be as shown, and unless otherwise indicated, all motors of 1 horsepower and above with open, dripproof, totally enclosed, or explosion proof fan cooled enclosures, must be the premium efficiency type in accordance with NEMA MG 1. Field wiring must be in accordance with manufacturer's instructions. Each motor must conform to NEMA MG 1 and NEMA MG 2 and be of sufficient size to drive the equipment at the specified capacity without exceeding the nameplate rating of the motor. Motors must be continuous duty with the enclosure specified. Motor starters must be provided complete with thermal overload protection and other appurtenances necessary for the motor control indicated. Motors must be furnished with a magnetic across-the-line or reduced voltage type starter as required by the manufacturer. Motor duty requirements must allow for maximum frequency start-stop operation and minimum encountered interval between start and stop. Motors must be sized for the applicable loads. Motor torque must be capable of accelerating the connected load within 20 seconds with 80 percent of the rated voltage maintained at motor terminals during one starting period. Motor bearings must be fitted with grease supply fittings and grease relief to outside of enclosure. Manual or automatic control and protective or signal devices required for the operation specified and any control wiring required for controls and

devices specified, but not shown, must be provided.

2.1.2.3 Ozone Depleting Substances

Unitary air conditioning equipment must not use CFC-based refrigerants. Refrigerant may be an approved alternative refrigerant in accordance with EPA's Significant New Alternative Policy (SNAP) listing. Provide documentation in conformance with Section 01 33 29 SUSTAINABILITY REQUIREMENTS AND REPORTING paragraph OZONE DEPLETING SUBSTANCES.

2.1.3 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.

2.1.4 Safety Devices

Exposed moving parts, parts that produce high operating temperature, parts which may be electrically energized, and parts that may be a hazard to operating personnel must be insulated, fully enclosed, guarded, or fitted with other types of safety devices. Safety devices must be installed so that proper operation of equipment is not impaired. Welding and cutting safety requirements must be in accordance with AWS Z49.1.

2.2 EQUIPMENT

2.2.1 Split-System Air Conditioners and Heat Pumps

2.2.1.1 Mini Split-System Heat Pumps (Not Exceeding 65,000 Btu/hr)

Provide an air-cooled, split system which employs a remote heat pump unit, a separate wall mounted indoor unit, and interconnecting refrigerant piping. Provide the heat pump type unit conforming to applicable Underwriters Laboratories (UL) standards including UL 1995. Unit must be rated in accordance with ANSI/AHRI 210/240. Provide indoor unit with necessary fans, air filters, and condensate pump. 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 propeller type fans for the unit specified. Fan and condenser motors must have open, drip proof, or totally enclosed enclosures. Design unit to operate at outdoor ambient temperatures up to 115 degrees F.

2.2.1.1.1 Energy Efficiency

Heat pumps must have a minimum seasonal energy efficiency ratio (SEER) of 14.3 and, a minimum Heating Seasonal Performance Factor (HSPF) of 7.5.

2.2.1.1.2 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 or aluminum. Avoid contact of dissimilar metals. Test coils in accordance with ASHRAE 15 & 34 at the factory and ensure suitability for the working pressure of the installed system.

Dehydrate and seal each coil testing and prior to evaluation and charging.

Coat condenser 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 1,000 hours exposure to the salt spray test specified in ASTM B117 using a 5 percent sodium chloride solution. See additional requirements in paragraph Coil Corrosion Protection.

2.2.1.1.3 Compressor

Provide direct drive variable speed inverter scroll type compressor.Provide compressor with internal over temperature and pressure protector; sump heater; oil pump; high pressure and low pressure controls; and liquid line dryer.

2.2.1.1.4 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. Refrigeration circuit must have reversing valve for heating operation.

2.2.1.1.5 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. Provide unit with microprocessor controls to provide all 24V control functions.

Controls must include a control system interface to a BACnet Control system. The control system interface, as well as any network between physically separate units, must meet the requirements of Section 23 09 23.02 BACNET DIRECT DIGITAL CONTROL FOR HVAC AND OTHER BUILDING CONTROL SYSTEMS.

Communication networks between physically separate units in a split system must be in accordance with either Section 23 09 23.02 BACNET DIRECT DIGITAL CONTROL FOR HVAC AND OTHER BUILDING CONTROL SYSTEMS and must match the protocol used by the control system interface.

2.2.1.1.6 Air Filters

Provide filters of the sectional or panel 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). Provide throwaway filter on all units below 6 Tons.

2.2.1.1.7 Fans

Provide direct driven, statically and dynamically balanced fans. Design the outdoor fan so that condensate will evaporate without drip, splash, or spray on building exterior. Provide indoor fan with a minimum two-speed motor with built-in overload protection. Fan motors must be the

inherently protected, permanent split-capacitor type.

2.2.1.2 Large-Capacity Split-System Air Conditioners (Greater Than 65,000 Btu/h)

Provide an air-cooled, split system which employs remote condensing units, a separate floor mounted indoor unit as specified in Section 23 30 00 HVAC AIR DISTRIBUTION, and interconnecting refrigerant piping. Provide the air conditioning type unit conforming to applicable Underwriters Laboratories (UL) standards including UL 1995 and UL 60335-2-40. Unit must be rated in accordance with AHRI 365. Provide the manufacturer's standard propeller type condenser or outdoor fans. Enclose fan condenser motors in opendrip proof or totally enclosed enclosures and permanently lubricate ball bearings.

2.2.1.2.1 Air-To-Refrigerant Coil

Provide coils with all aluminum microchannel type tubes of 3/8 inch minimum diameter with fins that are mechanically bonded or soldered to the tubes. Provide casing of galvanized steel. Avoid contact of dissimilar metals. Test coils in accordance with ASHRAE 15 & 34 at the factory and ensure suitability for the working pressure of the installed system. Dehydrate and seal each coil testing and prior to evaluation and charging. Provide each unit with a factory operating charge of refrigerant and oil or a holding charge. Field charge unit shipped with a holding charge with refrigerant and oil. Provide separate expansion devices for each compressor circuit.

Coat condenser coil with a uniformly applied epoxy electrodepositionphenolic type coating to all coil surface areas without material bridging between fins. Apply coating at either the coil or coating manufacturer's factory. Coating process must ensure complete coil encapsulation and be capable of withstanding a minimum 6,000 hours exposure to the salt spray test specified in ASTM B117 using a 5 percent sodium chloride solution. See additional requirements in paragraph Coil Corrosion Protection.

2.2.1.2.2 Compressor

Provide direct drive, scroll type compressors capable of operating at partial load conditions. Compressor must be capable of continuous operation down to the lowest step of unloading as specified. Equip compressors of 10 tons and larger with capacity reduction devices to produce automatic capacity reduction of at least 50 percent. Dual compressor units must be in a manifold configuration for capacity sharing. Start compressors in the unloaded position. Provide each compressor with vibration isolators, crankcase heater, thermal overloads, high and low pressure safety cutoffs and protection against short cycling.

2.2.1.2.3 Refrigeration Circuit

Refrigerant-containing components must comply with ASHRAE 15 & 34 and be factory tested, cleaned, dehydrated, charged, and sealed. Provide refrigerant charging valves and connections, and pumpdown valves for each circuit. Provide 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. Provide a refrigerant suction line thermostatic control to prevent freeze-up during heating cycle.

#### 2.2.1.2.4 Unit Controls

Provide unit internally prewired with a 24 volt control circuit powered by an internal transformer. Provide terminal blocks for power wiring and external control wiring. Head pressure controls must sustain unit operation with ambient temperature of 20 degrees F. Adjustable-cycle timers must prevent short-cycling. Stage multiple compressors by means of a time delay. Internally protect unit by fuses or a circuit breaker in accordance with UL 1995.

Controls must include a control system interface to a BACnet Control system. The control system interface, as well as any network between physically separate units, must meet the requirements of Section 23 09 23.02 BACNET DIRECT DIGITAL CONTROL FOR HVAC AND OTHER BUILDING CONTROL SYSTEMS.

## 2.3 COMPONENTS

### 2.3.1 Refrigerant and Oil

Refrigerant must be one of the fluorocarbon gases. Refrigerants must have number designations and safety classifications in accordance with ASHRAE 15 & 34. Refrigerants must meet the requirements of AHRI 700 as a minimum. Provide a complete charge of refrigerant for the installed system as recommended by the manufacturer. Lubricating oil must be of a type and grade recommended by the manufacturer for each compressor. Where color leak indicator dye is incorporated, charge must be in accordance with manufacturer's recommendation.

### 2.3.2 Coil Frost Protection

Provide each circuit with a manufacturer's standard coil frost protection system. The coil frost protection system must use a temperature sensor in the suction line of the compressor to shut the compressor off when coil frosting occurs. Use timers to prevent the compressor from rapid cycling.

### 2.3.3 Cabinet Construction

Casings for the specified unitary equipment must be constructed of galvanized steel or aluminum sheet metal and galvanized or aluminum structural members. Minimum thickness of single wall exterior surfaces must be 18 gauge galvanized steel or 0.071 inch thick aluminum on units with a capacity above 20 tons and 20 gauge galvanized steel or 0.064 inch thick aluminum on units with a capacity less than 20 tons. Casing must be fitted with lifting provisions, access panels or doors, fan vibration isolators, electrical control panel, corrosion-resistant components, structural support members, insulated condensate drip pan and drain, and internal insulation in the cold section of the casing. Where double-wall insulated construction is proposed, minimum exterior galvanized sheet metal thickness must be 20 gauge. Provisions to permit replacement of major unit components must be incorporated. Penetrations of cabinet surfaces, including the floor, must be sealed. Unit must be fitted with a drain pan which extends under all areas where water may accumulate. Drain pan must be fabricated from Type 300 stainless steel, galvanized steel with protective coating as required, or an approved plastic material. Pan insulation must be water impervious. Extent and effectiveness of the insulation of unit air containment surfaces must prevent, within limits of the specified insulation, heat transfer between the unit exterior and

ambient air, heat transfer between the two conditioned air streams, and condensation on surfaces. Insulation must conform to ASTM C1071. Paint and finishes must comply with the requirements specified in paragraph FACTORY COATING.

2.3.3.1 Indoor Cabinet

Indoor cabinets must be suitable for the specified indoor service and enclose all unit components.

2.3.3.2 Outdoor Cabinet

Outdoor cabinets must be suitable for outdoor service with a weathertight, insulated and corrosion-protected structure. Cabinets constructed exclusively for indoor service which have been modified for outdoor service are not acceptable.

2.3.4 Refrigerant Piping

Provide refrigerant piping in accordance with Section 23 23 00 REFRIGERANT PIPING.

2.3.5 Ductwork

Provide ductwork in accordance with Section 23 30 00 HVAC AIR DISTRIBUTION.

2.3.6 Temperature Controls

Provide temperature controls in accordance with Section 23 09 23.02 BACnet DIRECT DIGITAL CONTROL FOR HVAC AND OTHER BUILDING CONTROL SYSTEMS.

2.4 FINISHES

2.4.1 Coil Corrosion Protection

Provide coil with a uniformly applied epoxy electrodeposition or phenolic type coating to all coil surface areas without material bridging between fins. Submit product data on the type coating selected, the coating thickness, the application process used, the estimated heat transfer loss of the coil, and verification of conformance with the salt spray test requirement. Coating must be applied at either the coil or coating manufacturer's factory. Coating process must ensure complete coil encapsulation.

2.4.2 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.

2.4.2.1 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.

2.4.3 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.

2.5 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.

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. Provide foundation drawings, bolt-setting information, and foundation bolts prior to concrete foundation construction for all equipment indicated or required to have concrete foundations. Concrete for foundations must be as specified in Section 03 30 00 CAST-IN-PLACE CONCRETE. Equipment must be properly leveled, aligned, and secured in place in accordance with manufacturer's instructions.

3.2.2 Field Applied Insulation

Apply field applied insulation as specified in Section 23 07 00 THERMAL INSULATION FOR MECHANICAL SYSTEMS, except as defined differently herein.

3.2.3 Field Painting

Painting required for surfaces not otherwise specified, and finish painting of items only primed at the factory are specified in Section 09 90 00 PAINTS AND COATINGS.

3.3 CLEANING AND ADJUSTING

Equipment must be wiped clean, with all traces of oil, dust, dirt, or paint spots removed. Temporary filters must be provided for all fans that are operated during construction, and new filters must be installed after all construction dirt has been removed from the building. System must be maintained in this clean condition until final acceptance. Bearings must be properly lubricated with oil or grease as recommended by the manufacturer. Belts must be tightened to proper tension. Control valves and other miscellaneous equipment requiring adjustment must be adjusted to setting indicated or directed. Fans must be adjusted to the speed indicated by the manufacturer to meet specified conditions. Testing, adjusting, and balancing must be as specified in Section 23 05 93 TESTING, ADJUSTING, AND BALANCING OF HVAC SYSTEMS.

3.4 TRAINING

Conduct a training course for the operating staff as designated by the Contracting Officer. The training period must consist of a total 8 hours of normal working time and start after the system is functionally completed but prior to final acceptance tests.

a. Submit a schedule, at least 2 weeks prior to the date of the proposed training course, which identifies the date, time, and location for the training.

b. Submit the field posted instructions, at least 2 weeks prior to construction completion, including equipment layout, wiring and control diagrams, piping, valves and control sequences, and typed condensed operation instructions. The condensed operation instructions must include preventative maintenance procedures, methods

of checking the system for normal and safe operation, and procedures for safely starting and stopping the system. The posted instructions must be framed under glass or laminated plastic and be posted where indicated by the Contracting Officer.

c. The posted instructions must cover all of the items contained in the approved operation and maintenance manuals as well as demonstrations of routine maintenance operations. Submit 2 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.

## 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 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. Two 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 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 --

SECTION 23 81 23

COMPUTER ROOM AIR CONDITIONING UNITS
**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.

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 | (2012) Method of Testing General Ventilation Air-Cleaning Devices for Removal Efficiency by Particle Size |
| ASHRAE 90.1 - IP | (2019) Energy Standard for Buildings Except Low-Rise Residential Buildings |

AMERICAN SOCIETY OF MECHANICAL ENGINEERS (ASME)

| | |
|---|---|
| ASME B31.5 | (2022) Refrigeration Piping and Heat Transfer Components |

ASTM INTERNATIONAL (ASTM)

| | |
|---|---|
| ASTM B117 | (2019) Standard Practice for Operating Salt Spray (Fog) Apparatus |
| ASTM C1071 | (2019) Standard Specification for Fibrous Glass Duct Lining Insulation (Thermal and Sound Absorbing Material) |
| ASTM C1338 | (2019) Standard Test Method for Determining Fungi Resistance of Insulation Materials and Facings |

ASTM G21 (2015; R 2021; E 2021) Standard Practice for Determining Resistance of Synthetic Polymeric Materials to Fungi

ETL TESTING LABORATORIES (ETL)

ETL DLP (updated continuously) ETL Listed Mark Directory

NATIONAL FIRE PROTECTION ASSOCIATION (NFPA)

NFPA 70 (2026) National Electrical Code

NFPA 90A (2024) Standard for the Installation of Air Conditioning and Ventilating Systems

U.S. NATIONAL ARCHIVES AND RECORDS ADMINISTRATION (NARA)

40 CFR 82 Protection of Stratospheric Ozone

UNDERWRITERS LABORATORIES (UL)

UL 181 (2013; Reprint Dec 2021) UL Standard for Safety Factory-Made Air Ducts and Air Connectors

UL Elec Equip Dir (2011) Electrical Appliance and Utilization Equipment Directory

## 1.2 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.

## 1.3 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

Computer Room Air Conditioner; G

Space Temperature Control System Drawings; G

Refrigerants; S

Leak Detection; G

SD-06 Test Reports

Manufacturer's Factory Test Plans; G

Factory Test Reports; G

Field Test Schedule; G

Manufacturer's Field Test Plans; G

Field Test Reports; G

SD-07 Certificates

Credentials of the Manufacturer's Field Test Representative; G

Ozone Depleting Substances Technician Certification

Certified List Of Qualified Permanent Service Organizations

SD-08 Manufacturer's Instructions

Installation Manual for Each Type of CRAC

SD-10 Operation and Maintenance Data

Computer Room Air Conditioner Operation and Maintenance Data, Data Package 4; G

SD-11 Closeout Submittals

Indoor Air Quality During Construction; S

## 1.4 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.

## 1.5 QUALIFICATIONS

### 1.5.1 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.

## 1.6 QUALIFICATIONS

### 1.6.1 Material and Equipment Qualifications

Provide materials and equipment that are standard products of manufacturers regularly engaged in the manufacturer 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 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 two-year period.

### 1.6.2 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 6,000 hours, exclusive of the manufacturer's factory or laboratory tests, can be shown.

### 1.6.3 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.

### 1.6.4 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.

### 1.6.5 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.

#### 1.6.5.1 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."

#### 1.6.5.2 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.

## 1.7 PROJECT REQUIREMENTS

### 1.7.1 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.

### 1.7.2 Energy Efficiency

Provide equipment with minimum efficiencies as required by ASHRAE 90.1 - IP.

## 1.8 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, factory assembled, and factory tested. Equipment must be listed in UL Elec Equip Dir or ETL DLP for computer room application. CRACs must include room cabinet and frame, floor stand, fan section, filter section, cooling coil, compressors, humidifier, controls, and, interconnecting piping internal to the CRAC. Provide units rated in accordance with AHRI 1360.

### 2.1.1 Unit Airflow Configuration

#### 2.1.1.1 Downflow Units

The CRAC must draw return air in at the top or sides of the cabinet and discharge supply air at the bottom of the cabinet.

#### 2.1.1.2 Upflow Units

The CRAC must draw return air in at the bottom or sides of the cabinet and discharge supply air at the top of the cabinet.

### 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 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.

For upflow units, provide double deflection return grilles integral to unit and supply air plenum with top duct connection. Grilles must be factory coated the same as the unit cabinet.

2.1.2.3 Cabinet Interiors Sound Attenuation

Provide a factory-installed sound attenuation system in the interior of the CRAC cabinet.

CRAC cabinet panels interior must be provided with 1 inch of 1-1/2 pound per cubic foot fiber glass insulation on interior of cabinet panels. Insulation must be applied to the cabinet panels with 100 percent adhesive coverage and both the insulation and the adhesive must conform to NFPA 90A. Insulation must be rated for 6000 fpm per UL 181 and ASTM C1071. Insulation must resist the growth of microorganisms per ASTM C1338 and ASTM G21.

Fans and compressors located in the CRAC interior cabinet must be provided with vibration isolators between their respective support frames and the cabinet framing.

CRAC manufacturer's standard interior cabinet sound attenuation materials and finishes will be acceptable if equivalent to the above requirements and approved by the Contracting Officer.

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.

2.1.3.2 Motor and Drive

Provide fan wheel directly coupled to motor shaft. Provide variable speed electronically commutated motor with integrated electronic control board and direct microprocessor control signaling for speed control.

2.1.4 Cooling Coil

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 22 gage Type 304 stainless steel with nonferrous connections and a condensate pump system complete with integral pump discharge check valve, integral float switches, reservoir, and pump and motor assembly. Condensate pump must have a secondary float switch for transmitting alarms when the condensate level exceeds its high limit.

2.1.5 Filters

Provide UL listed 4 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 Compressor

Provide compressor that is direct drive,hermetic digital scroll 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.

2.1.6.1 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 nitrogen and sealed. Provide refrigerant charging valves and connections, and pumpdown valves for each circuit. Provide filter-drier in each liquid line.

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 humidifier pan with water high level and low level alarms. Arrange system to be cleanable and serviceable. Provide water chemistry requirements with humidifier submittal data. Humidifier must be equipped with minimum 1 inch air gap to prevent backflow into the water supply connection.

Provide infrared type humidifier, including high intensity quartz lamps mounted above and out of water supply. The capacity shall be as indicated.

2.1.8 Condenser

Provide condenser circuit pre-piped with start-up and head pressure controls to maintain system operation at ambient temperatures down to 20 degrees F.

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.

2.1.8.1 Air-cooled Condenser

Provide remote air-cooled condenser arranged for vertical air discharge, designed and manufactured specifically for permanent outdoor installation. Condenser performance must be rated in accordance with ANSI/AHRI 460.

2.1.8.1.1 Condenser Fans

Provide direct-driven propeller fans with factory balanced aluminum or glass-reinforced polymer blades and equipped with fan guards. Provide electronically commutated fan motors with totally enclosed enclosures.

2.1.8.1.2 Condenser Coils

Air-cooled condenser coils must be all aluminum microchannel type 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.

2.1.8.1.3 Unit Casing

Provide air-cooled condenser casings and mounting legs manufactured from aluminum or galvanized steel with manufacturer's standard corrosion-resistant finish.

2.1.9 Floorstand

Provide an adjustable floorstand for each CRAC for freestanding installation on the main building structural floor. Floorstand must elevate the unit to the height of the raised computer floor as indicated and must allow for leveling and locking at the desired height. Floorstand must be retractable, or removable, for installing the unit directly on the raised floor. Unit must be fully gasketed (rubber or neoprene) to prevent air leakage at the raised floor penetration.

## 2.2 INSTRUMENTATION AND CONTROLS

All controls provided under this section must comply with the requirements of Section 25 05 11.25 CYBERSECURITY FOR FACILITY-RELATED CONTROL SYSTEMS - BCS.

### 2.2.1 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 09 23.02 BACNET DIRECT DIGITAL CONTROL FOR HVAC AND OTHER BUILDING CONTROL SYSTEMS.

#### 2.2.1.1 Display Panel

Provide color LED touchscreen display with graphical menu 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.

#### 2.2.1.2 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, and leak detection. Provide field accessible local audible alarm with silence pushbutton. Provide push-to-test lamps or all-lamp test pushbutton.

#### 2.2.1.3 Leak Detection

Provide rope moisture detection system for each computer room. Leak detection must be designed for installation on the subfloor below the raised floor of the computer room. Leak detection system must interface with the associated CRAC control panel to alarm upon detection of moisture on the subfloor.

#### 2.2.1.4 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.

2.2.2 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.

Refer to controls drawings for minimum points required to interface with the HVAC control system.

2.3 CORROSION PROTECTION FOR COASTAL INSTALLATIONS

2.3.1 Epoxy or Phenolic Finish Coating System

Condenser coil must be coated with a uniformly applied epoxy electrodeposition or phenolic type coating to all coil surface areas without material bridging between fins. 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 2,000 hours exposure to the salt spray test specified in ASTM B117 using a 5 percent sodium chloride solution.

2.4 FACTORY PAINTING SYSTEMS

Provide manufacturer's standard factory painting. Certify that the factory painting system applied to indoor units will withstand 125 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.

2.5 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 the minimum Short Circuit Current Rating (SCCR) indicated on the electrical drawings.

2.5.1 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.

2.5.2 Electrical Control Wiring

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.

2.6 METAL DUCTWORK

Requirements for HVAC metal ductwork are specified in Section 23 30 00 HVAC AIR DISTRIBUTION.

2.7 SOURCE QUALITY CONTROL

Provide factory test plans, factory test schedules, factory tests and factory test reports on each of the CRACs.

2.7.1 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 30 calendar days before scheduled factory test date.

2.7.1.1 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.

2.7.1.2 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.

2.7.1.3 Test Configuration

Plans shall indicate that tests are to be performed for a minimum of four continuous hours. 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. Tests shall include a pressurized raised floor discharge configuration at the specified or indicated height above the floor, with or without the air discharge elbows; and phenolic coated coils.

2.7.1.4 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.

2.7.1.5 Thermal Testing

Plans shall provide thermal testing utilizing refrigerant. Thermal testing shall verify CRAC sensible cooling, total cooling performance scheduled on the contract drawings.

2.7.1.6 Specialized Components

Include procedures for field testing and field adjusting specialized components, such as pressure valves.

2.7.1.7 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.

2.7.2 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.

2.7.3 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.

2.7.4 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.

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 B31.5, 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, controls, 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.

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.

3.2 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 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 along with the factory test plans specified herein before. 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. 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. Tests must include a pressurized raised floor discharge configuration at the specified or indicated height above the floor, with or without the air discharge elbows; and corrosion protection.

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 refrigerant. Thermal testing must verify CRAC sensible cooling, total cooling performance scheduled on the contract drawings.

3.3.1.8 Specialized Components

Include procedures for field testing and field adjusting specialized components, such as 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 23 83 00.00 20

ELECTRIC SPACE HEATING EQUIPMENT
**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.

NATIONAL FIRE PROTECTION ASSOCIATION (NFPA)

NFPA 70 (2026) National Electrical Code

UNDERWRITERS LABORATORIES (UL)

UL 1025 (1980; R 1990, Bul. 1991) Electric Air Heaters

1.2 GENERAL REQUIREMENTS

Section 26 20 00 INTERIOR DISTRIBUTION SYSTEM, applies to this section, with the additions and modifications specified herein.

1.3 SUBMITTALS

Government approval is required for submittals with a "G" or "S" classification. Submittals not having a "G" or "S" classification are for 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

Heater Installation Drawing

SD-03 Product Data

Electric Unit Heaters

SD-10 Operation and Maintenance Data

Electric Unit Heaters, Data Package 5

Submit in accordance with Section 01 78 23 OPERATION AND MAINTENANCE DATA.

PART 2 PRODUCTS

2.1 ELECTRIC UNIT HEATERS

UL 1025; wattage, voltage, phase, number of steps, Btu/hr and CFM as indicated. Provide control-circuit terminals and single source of power supply. Heaters shall be 3-phase, with load balanced on each of the three

phases. Limit leaving air temperature to 140 degrees F with entering air of60 degrees F.

2.1.1 Enclosure

Minimum 20 gage steel.

2.1.2 Heating Element

Nickel chromium heating wire element, free from expansion noise and 60 Hz hum. Embed element in magnesium-oxide insulating refractory. Seal element in high-mass steel or corrosion-resisting metallic sheath with fins. Enclose element ends in terminal box. Provide not more than six fins per inch. Limit fin surface temperature 550 degrees F at any point during normal operation.

2.1.3 Controls

Include limit controls for overheat protection of heaters.

2.1.4 Wiring

Completely factory-prewired to terminal strips, ready to receive branch circuit and control connections for 140 degrees F copper wiring.

2.1.5 Thermostat

Provide tamper resistant integral thermostat, adjustable without requiring removal of heater components. Thermostat operating range shall be approximately 40 degrees F to a maximum of 75 degrees F with operating differential of 3 degrees F or less.

2.1.6 Disconnect Means

Provide factory-installed safety disconnect switch in the housing or in an auxiliary matching control section with "off" position marking on the face plate.

PART 3 EXECUTION

3.1 INSTALLATION

Install in conformance with the approved heater installation drawing, NFPA 70, UL listing, and manufacturer's instructions, with necessary clearances for air circulation, maintenance, inspection, service testing and repair. Connect to electrical supply in accordance with Section 26 20 00 INTERIOR DISTRIBUTION SYSTEM.

3.1.1 Unit Heaters

Mount units plumb, square and level with ceiling and walls.

3.2 FIELD QUALITY CONTROL

Provide necessary personnel, instruments, and equipment to perform tests. Notify the Contracting Officer 5 working days prior to scheduled testings and locations.

3.2.1 Field Inspection

Prior to initial operation, inspect installed equipment for conformance with drawings and specifications.

3.2.2 Insulation Resistance Tests

Test 600-volt wiring to verify that no short circuits or grounds exist. Tests shall be made using an instrument which applies a voltage of approximately 500 volts and provides a direct reading of resistance in ohms.

3.2.3 Operational Tests

Test equipment circuits and devices to demonstrate proper operation.Test each item of control equipment not less than 5 times.

-- End of Section --