



**US Army Corps  
of Engineers**  
Louisville District

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# **Solicitation For**

## **Manned/Unmanned Tactical Vehicle Lab (MUMT), Detroit Arsenal, Detroit, MI**

**P2: 506474**

**Design-Bid-Build**

**Specifications - Vol 2 of 3 (Div 08-23)  
Certified Final Design**

**12 May 2025  
W912QR25R0052**

**ARIMS: 200A  
Disposition: Maintain for 15yrs after construction**

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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) Structural Welding Code - Steel

#### ASTM INTERNATIONAL (ASTM)

ASTM A653/A653M (2020) Standard Specification for Steel Sheet, Zinc-Coated (Galvanized) or Zinc-Iron Alloy-Coated (Galvannealed) by the Hot-Dip Process

ASTM A879/A879M (2012; R 2017) Standard Specification for Steel Sheet, zinc Coated by the Electrolytic Process for Applications Requiring Designation of the Coating Mass on Each Surface

ASTM A924/A924M (2020) Standard Specification for General Requirements for Steel Sheet, Metallic-Coated by the Hot-Dip Process

ASTM C578 (2019) Standard Specification for Rigid, Cellular Polystyrene Thermal Insulation

ASTM C591 (2021) Standard Specification for Unfaced Preformed Rigid Cellular Polyisocyanurate Thermal Insulation

ASTM C612 (2014; R 2019) Standard Specification for Mineral Fiber Block and Board Thermal Insulation

ASTM D2863 (2019) Standard Test Method for Measuring the Minimum Oxygen Concentration to Support Candle-Like Combustion of Plastics (Oxygen Index)

ASTM E1300 (2016) Standard Practice for Determining Load Resistance of Glass in Buildings

ASTM F2247 (2018) Standard Test Method for Metal Doors Used in Blast Resistant Applications (Equivalent Static Load Method)

ASTM F2248 (2012) Standard Practice for Specifying an

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Equivalent 3-Second Duration Design  
 Loading for Blast Resistant Glazing  
 Fabricated with Laminated Glass

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

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 80 (2019) Standard for Fire Doors and Other  
 Opening Protectives

NFPA 105 (2019) Standard for Smoke Door Assemblies  
 and Other Opening Protectives

NFPA 252 (2017) Standard Methods of Fire Tests of  
 Door Assemblies

STEEL DOOR INSTITUTE (SDI/DOOR)

SDI/DOOR 111 (2009) Recommended Details for Standard  
 Steel Doors, Frames, and Accessories and  
 Related Components

SDI/DOOR 113 (2013; R2018) Standard Practice for  
 Determining the Steady-State Thermal  
 Transmittance of Steel Door and Frame  
 Assemblies

SDI/DOOR A250.6 (2015) Recommended Practice for Hardware  
 Reinforcing on Standard Steel Doors and  
 Frames

SDI/DOOR A250.8 (2017) Specifications for Standard Steel  
 Doors and Frames

SDI/DOOR A250.11 (2012) Recommended Erection Instructions  
 for Steel Frames

U.S. DEPARTMENT OF DEFENSE (DOD)

UFC 4-010-01 (2018;with Change 1, 2020) DoD Minimum  
 Antiterrorism Standards for Buildings

U.S. GREEN BUILDING COUNCIL (USGBC)

LEED v4 BDC Ref Guide (2013; R 2020) USGBC LEED Reference Guide

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for Building Design and Construction, v4

LEED v4.1 BDC Ref Guide (2023) LEED v4.1 Building Design and  
 Construction Reference Guide

UNDERWRITERS LABORATORIES (UL)

UL 10C (2016; Reprint May 2021) UL Standard for  
 Safety Positive Pressure Fire Tests of  
 Door Assemblies

## 1.2 SUSTAINABILITY REPORTING

Work of this section is intended to contribute to the achievement of, or compliance with, the requirements of the Guiding Principles Validation and LEED Prerequisites and attempted Credits. Refer to Section 01 33 29.00 06 SUSTAINABILITY REPORTING for specific documentation requirements and list of Prerequisites, attempted Credits and LEED version.

Comply with product, material content, performance criteria, activity, documentation, and other technical requirements as described in the LEED v4 BDC Ref Guide or LEED v4.1 BDC Ref Guide as applicable.

Collect, organize, and submit product data, drawings, diagrams, photos and cost information necessary to demonstrate compliance with LEED v4 BDC Ref Guide or LEED v4.1 BDC Ref Guide requirements as applicable.

Data collection shall commence with the notice to proceed and will only be deemed complete upon acceptance of the Final Sustainability Notebook and LEED Online submission by the Contracting Officer, the LEED Project Administrator, and the Green Building Certification Institute.

## 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

Doors; G, AE

Frames; G, AE

Accessories

Schedule of Doors; G, AE

Schedule of Frames; G, AE

### SD-03 Product Data

Doors; G, AE

Recycled Content for Steel Door Product; S



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Frames; G, AE

Recycled Content for Steel Frame Product; S

Accessories

Environmental Product Declarations; S

Embodied Carbon Optimization Report/Action Plan; S

Extended Producer Responsibility; S

Local/Regional Materials; S

Material Ingredient Reporting; S

Low-Emitting Materials; S

#### 1.4 SUSTAINABLE DESIGN REQUIREMENTS

##### 1.4.1 Environmental Product Declarations

At a minimum, use materials or products with an Environmental Product Declaration in accordance with the LEED Implementation Plan. See Section 01 33 29.00 06 SUSTAINABILITY REPORTING for cumulative materials requirements and LEED Implementation Plan.

##### 1.4.2 Embodied Carbon Optimization Report/Action Plan

At a minimum, use materials or products with an Embodied Carbon Optimization Report/Action Plan in accordance with the LEED Implementation Plan. See Section 01 33 29.00 06 SUSTAINABILITY REPORTING for cumulative materials requirements and LEED Implementation Plan.

##### 1.4.3 Sourcing of Raw Materials

Provide products that meet one or more of the following categories:

###### 1.4.3.1 Extended Producer Responsibility

At a minimum, use materials or products from manufacturers that participate in an extended producer responsibility program in accordance with the LEED Implementation Plan. Provide manufacturer letter verifying extended producer responsibility program is in place and that product is eligible. See Section 01 33 29.00 06 SUSTAINABILITY REPORTING for cumulative materials requirements and LEED Implementation Plan.

###### 1.4.3.2 Recycled Content Materials

At a minimum, use materials or products with recycled content in accordance with the LEED Implementation Plan. Provide manufacturers product literature identifying the percentage of recycled material incorporated within each product used. See Section 01 33 29.00 06 SUSTAINABILITY REPORTING for cumulative materials requirements and LEED Implementation Plan. If recycled content minimum is specified in this section, the greater of the two percentages governs.

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#### 1.4.4 Material Ingredient Reporting

At a minimum, use materials or products with chemical inventory to at least 0.1% (1000 ppm) in accordance with the LEED Implementation Plan. Provide Health Product Declaration (HPD), Cradle to Cradle Certificate, Declare label, or other manufacturer's published content inventory in compliance with LEED v4.1 Material Ingredient Reporting credit. See Section 01 33 29.00 06 SUSTAINABILITY REPORTING for cumulative materials requirements and LEED Implementation Plan.

#### 1.4.5 Local/Regional Materials

Use materials or products extracted, harvested, or recovered, as well as manufactured, within a 100 mile radius from the project site, if available from a minimum of three sources. provide a letter from the manufacturer stating the extraction location, manufacturing location, and purchasing location of the products provided, referencing the project name and location specifically and distance to the project site. See Section 01 33 29.00 06 SUSTAINABILITY REPORTING for cumulative materials requirements and LEED Implementation Plan.

#### 1.4.6 Low-Emitting Materials

Use only interior door and frame products that comply with LEED v4.1 BDC Ref Guide requirements for emissions. Submit certification or validation of compliance with CDPH SECTION 01350 emissions requirements. See Section 01 33 29.00 06 SUSTAINABILITY REPORTING for low-emitting material requirements.

### 1.5 DELIVERY, STORAGE, AND HANDLING

Deliver doors, frames, and accessories undamaged and with protective wrappings or packaging. Provide temporary steel spreaders securely fastened to the bottom of each welded frame. Store doors and frames on platforms under cover in clean, dry, ventilated, and accessible locations, with 1/4 inch airspace between doors. Remove damp or wet packaging immediately and wipe affected surfaces dry. Replace damaged materials with new.

## PART 2 PRODUCTS

### 2.1 STANDARD STEEL DOORS

SDI/DOOR A250.8, except as specified otherwise. Prepare doors to receive door hardware as specified in Section 08 71 00 DOOR HARDWARE. Undercut where indicated. Provide exterior doors with top edge closed flush and sealed to prevent water intrusion. Provide doors at 1-3/4 inch thick, unless otherwise indicated. Provide door material that uses a minimum of 25 percent recycled content. Provide data indicating percentage of recycled content for steel door product. Provide exterior glazing in accordance with ASTM F2248 and ASTM E1300. Exterior doors must be tested in accordance with ASTM F2247 or ASTM F2927 to meet requirements of UFC 4-010-01.

#### 2.1.1 Classification - Level, Performance, Model

##### 2.1.1.1 Extra Heavy Duty Doors

SDI/DOOR A250.8, Level 3, physical performance Level A, Model 2 with core

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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.

## 2.2 ACCESSORIES

### 2.2.1 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.

### 2.2.2 Moldings

Provide moldings around glass of interior and exterior doors and louvers of interior doors. Provide nonremovable moldings on outside of exterior doors and on corridor side of interior doors. Other moldings may be stationary or removable. Secure inside moldings to stationary moldings, or provide snap-on moldings.

## 2.3 INSULATION CORES

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

- a. Rigid Cellular Polyisocyanurate Foam: ASTM C591, Type I or II, foamed-in-place or in board form, with oxygen index of not less than 22 percent when tested in accordance with ASTM D2863; or
- b. Rigid Polystyrene Foam Board: ASTM C578, Type I or II; or
- c. Mineral board: ASTM C612, Type I.

## 2.4 STANDARD STEEL FRAMES

SDI/DOOR A250.8, Level 3, except as otherwise specified. Form frames to sizes and shapes indicated, with welded corners. Provide steel frames for doors, sidelights, and interior glazed panels, unless otherwise indicated. Provide frame product that uses a minimum of 25 percent recycled content. Provide data indicating percentage of recycled content for steel frame product.

### 2.4.1 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.

### 2.4.2 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

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to 16 inch on center. Miter molded shapes at corners. Butt or miter square or rectangular beads at corners.

#### 2.4.3 Terminated Stops

Where indicated, terminate interior door frame stops 6 inch above floor. Do not terminate stops of frames for soundproof, doors.

#### 2.4.4 Cased Openings

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

#### 2.4.5 Anchors

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

##### 2.4.5.1 Wall Anchors

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

- a. Masonry: Provide anchors of corrugated or perforated steel straps or 3/16 inch diameter steel wire, adjustable or T-shaped;
- b. Stud partitions: Weld or otherwise securely fasten anchors to backs of frames. Design anchors to be fastened to closed steel studs with sheet metal screws, and to open steel studs by wiring or welding;
- c. Completed openings: Secure frames to previously placed concrete or masonry with expansion bolts in accordance with SDI/DOOR 111; and

##### 2.4.5.2 Floor Anchors

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

#### 2.5 FIRE AND SMOKE DOORS AND FRAMES

Provide fire and smoke doors and frames in accordance with NFPA 80 and NFPA 105 and this specification. Include insulated core materials in fire doors where indicated in the door schedule.

##### 2.5.1 Labels

Provide fire doors and frames bearing the label of Underwriters Laboratories (UL), Factory Mutual Engineering and Research (FM), or Warnock Hersey International (WHI) attesting to the rating required. Testing must be in accordance with NFPA 252 or UL 10C. Provide labels that are metal with raised letters, bearing the name or file number of the door and frame manufacturer. Labels must be permanently affixed at the factory to frames and to the hinge edge of the door. Do not paint door and labels.

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### 2.5.2 Oversized Doors

For fire doors and frames which exceed the size for which testing and labeling are available, furnish certificates stating that the doors and frames are identical in design, materials, and construction to a door which has been tested and meets the requirements for the class indicated.

### 2.5.3 Astragal on Fire and Smoke Doors

On pairs of labeled fire doors, conform to NFPA 80 and UL requirements.  
On smoke control doors, conform to NFPA 105.

## 2.6 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.

## 2.7 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.

## 2.8 FINISHES

### 2.8.1 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..

### 2.8.2 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.

## 2.9 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. Design other frames in exposed masonry walls or

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partitions to allow sufficient space between the inside back of trim and masonry to receive caulking compound.

## 2.10 PROVISIONS FOR GLAZING

Materials are specified in Section 08 81 00, GLAZING.

## PART 3 EXECUTION

### 3.1 INSTALLATION

#### 3.1.1 Frames

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

#### 3.1.2 Doors

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

#### 3.1.3 Fire and Smoke Doors and Frames

Install fire doors and frames, including hardware, in accordance with NFPA 80. Install fire rated smoke doors and frames in accordance with NFPA 80 and NFPA 105.

### 3.2 PROTECTION

Protect doors and frames from damage. Repair damaged doors and frames prior to completion and acceptance of the project or replace with new, as directed. Wire brush rusted frames until rust is removed. Clean thoroughly. Apply an all-over coat of rust-inhibitive paint of the same type used for shop coat.

### 3.3 CLEANING

Upon completion, clean exposed surfaces of doors and frames thoroughly. Remove mastic smears and other unsightly marks.

-- End of Section --

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## SECTION 08 14 00

## WOOD DOORS

**08/16, CHG 1: 08/18**

## PART 1 GENERAL

## 1.1 REFERENCES

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

## ASTM INTERNATIONAL (ASTM)

ASTM E90 (2009; R2016) Standard Test Method for Laboratory Measurement of Airborne Sound Transmission Loss of Building Partitions and Elements

ASTM E2226 (2015; R 2019b) Standard Practice for Application of Hose Stream

## CALIFORNIA AIR RESOURCES BOARD (CARB)

CARB 93120 (2007) Airborne Toxic Control Measure (ATCM) to Reduce Formaldehyde Emissions from Composite Wood Products

## FOREST STEWARDSHIP COUNCIL (FSC)

FSC STD 01 001 (2015) Principles and Criteria for Forest Stewardship

## NATIONAL FIRE PROTECTION ASSOCIATION (NFPA)

NFPA 80 (2022) Standard for Fire Doors and Other Opening Protectives

NFPA 252 (2022) Standard Methods of Fire Tests of Door Assemblies

## U.S. GREEN BUILDING COUNCIL (USGBC)

LEED v4 BDC Ref Guide (2013; R 2020) USGBC LEED Reference Guide for Building Design and Construction, v4

LEED v4.1 BDC Ref Guide (2023) LEED v4.1 Building Design and Construction Reference Guide

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

40 CFR 770 Formaldehyde Standards for Composite Wood Products

## UNDERWRITERS LABORATORIES (UL)

UL 10B (2008; Reprint May 2020) Fire Tests of

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## Door Assemblies

### WINDOW AND DOOR MANUFACTURERS ASSOCIATION (WDMA)

ANSI/WDMA I.S.1A (2013) Interior Architectural Wood Flush  
 Doors

ANSI/WDMA I.S.6A (2013) Interior Architectural Stile and  
 Rail Doors

### WOODWORK INSTITUTE (WI)

NAAWS 3.1 (2017; 2018 Errata Edition) North American  
 Architectural Woodwork Standards

## 1.2 SUSTAINABILITY REPORTING

Work of this section is intended to contribute to the achievement of, or compliance with, the requirements of the Guiding Principles Validation and LEED Prerequisites and attempted Credits. Refer to Section 01 33 29.00 06 SUSTAINABILITY REPORTING for specific documentation requirements and list of Prerequisites, attempted Credits and LEED version.

Comply with product, material content, performance criteria, activity, documentation, and other technical requirements as described in the LEED v4 BDC Ref Guide or LEED v4.1 BDC Ref Guide as applicable.

Collect, organize, and submit product data, drawings, diagrams, photos and cost information necessary to demonstrate compliance with LEED v4 BDC Ref Guide or LEED v4.1 BDC Ref Guide requirements as applicable.

Data collection shall commence with the notice to proceed and will only be deemed complete upon acceptance of the Final Sustainability Notebook and LEED Online submission by the Contracting Officer, the LEED Project Administrator, and the Green Building Certification Institute.

## 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

Doors; G, AE

Submit drawings or catalog data showing each type of door unit. Indicate within drawings and data the door types and construction, sizes, thickness, methods of assembly, and glazing.

### SD-03 Product Data

Doors; G, AE

Recycled Content for Door Cores; S



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Accessories

Water-resistant Sealer

Sample Warranty

Sound Transmission Class Rating; G, AE

Fire Resistance Rating; G, AE

Environmental Product Declarations; S

Embodied Carbon Optimization Report/Action Plan; S

Extended Producer Responsibility; S

Local/Regional Materials; S

Material Ingredient Reporting; S

SD-04 Samples

Door Finish Colors; G, AE

Submit a minimum of three color selection samples, minimum 3 by 5 inches in size representing wood stain for selection by the Contracting Officer.

SD-06 Test Reports

Cycle-Slam

Hinge Loading Resistance

Submit cycle-slam test report for doors tested in accordance with ANSI/WDMA I.S.1A, and hinge loading resistance test report for doors tested in accordance with ANSI/WDMA I.S.6A.

SD-07 Certificates

Certified Sustainably Harvested Flush Wood Doors; S

Indoor Air Quality for Particleboard and Agrifiber Door Cores: S

SD-11 Closeout Submittals

Warranty

1.4 SUSTAINABLE DESIGN REQUIREMENTS

1.4.1 Environmental Product Declarations

At a minimum, use materials or products with an Environmental Product Declaration in accordance with the LEED Implementation Plan. See Section 01 33 29.00 06 SUSTAINABILITY REPORTING for cumulative materials requirements and LEED Implementation Plan.

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#### 1.4.2 Embodied Carbon Optimization Report/Action Plan

At a minimum, use materials or products with an Embodied Carbon Optimization Report/Action Plan in accordance with the LEED Implementation Plan. See Section 01 33 29.00 06 SUSTAINABILITY REPORTING for cumulative materials requirements and LEED Implementation Plan.

#### 1.4.3 Sourcing of Raw Materials

Provide products that meet one or more of the following categories:

##### 1.4.3.1 Extended Producer Responsibility

At a minimum, use materials or products from manufacturers that participate in an extended producer responsibility program in accordance with the LEED Implementation Plan. Provide manufacturer letter verifying extended producer responsibility program is in place and that product is eligible. See Section 01 33 29.00 06 SUSTAINABILITY REPORTING for cumulative materials requirements and LEED Implementation Plan.

##### 1.4.3.2 Recycled Content Materials

At a minimum, use materials or products with recycled content in accordance with the LEED Implementation Plan. Provide manufacturers product literature identifying the percentage of recycled material incorporated within each product used. See Section 01 33 29.00 06 SUSTAINABILITY REPORTING for cumulative materials requirements and LEED Implementation Plan. If recycled content minimum is specified in this section, the greater of the two percentages governs.

##### 1.4.4 Material Ingredient Reporting

At a minimum, use materials or products with chemical inventory to at least 0.1% (1000 ppm) in accordance with the LEED Implementation Plan. Provide Health Product Declaration (HPD), Cradle to Cradle Certificate, Declare label, or other manufacturer's published content inventory in compliance with LEED v4.1 Material Ingredient Reporting credit. See Section 01 33 29.00 06 SUSTAINABILITY REPORTING for cumulative materials requirements and LEED Implementation Plan.

##### 1.4.5 Local/Regional Materials

Use materials or products extracted, harvested, or recovered, as well as manufactured, within a 100 mile radius from the project site, if available from a minimum of three sources. provide a letter from the manufacturer stating the extraction location, manufacturing location, and purchasing location of the products provided, referencing the project name and location specifically and distance to the project site. See Section 01 33 29.00 06 SUSTAINABILITY REPORTING for cumulative materials requirements and LEED Implementation Plan.

#### 1.5 CERTIFICATIONS

##### 1.5.1 Certified Sustainably Harvested Wood

Provide wood certified as sustainably harvested by FSC STD 01 001. 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

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requirements. Submit sustainable wood certification data; identify each certified product on a line item basis. Submit copies of invoices bearing certification numbers.

#### 1.5.2 Indoor Air Quality Certification

##### 1.5.2.1 Composite Wood, Wood Structural Panel and Agrifiber Products

For purposes of this specification, composite wood and agrifiber products include particleboard, medium-density fiberboard (MDF), wheatboard, strawboard, panel substrates, and door cores. Provide products certified to meet requirements of both 40 CFR 770 and CARB 93120. Provide current product certification documentation from certification body.

#### 1.6 DELIVERY, STORAGE, AND HANDLING

Deliver doors to Project site in an undamaged condition and protect against damage and dampness. Stack doors flat under cover. Support on blocking, a minimum of 4-inches thick, located at each end and at the midpoint of the door. Store doors in a well-ventilated building so that they will not be exposed to excessive moisture, heat, dryness, direct sunlight, or extreme changes of temperature and humidity. Do not store in a building under construction until concrete, masonry work, and joint compound for gypsum board finishing are dry. Replace defective or damaged doors with new ones.

#### 1.7 WARRANTY

Warrant doors free of defects as set forth in the door manufacturer's standard door warranty.

### PART 2 PRODUCTS

#### 2.1 DOORS

Provide doors of the types, sizes, and designs indicated free of urea-formaldehyde resins.

##### 2.1.1 Flush Doors

Conform to ANSI/WDMA I.S.1A for flush doors. Provide solid-core doors with lock blocks and 1 inch minimum thickness hinge stile. Hardwood stile edge bands of doors receives a natural finish, compatible with face veneer. No visible finger joints will be accepted in stile edge bands. When used, locate finger-joints under hardware. Provide certified sustainably harvested flush wood doors.

##### 2.1.1.1 Interior Flush Doors

Provide particleboard or agrifiber-core, Type II flush doors conforming to ANSI/WDMA I.S.1A with faces of select premium white maple. Hardwood veneers must be plain sliced. Door cores must have a minimum recycled content of 45 percent. Provide data identifying percentage of recycled content for door cores. Products must contain no added urea-formaldehyde resins. Provide certification of indoor air quality for particleboard and agrifiber door cores.

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#### 2.1.2 Acoustical Doors

ANSI/WDMA I.S.1A, solid core, constructed to provide Sound Transmission Class rating of 45 when tested in accordance with ASTM E90. See Section 08 34 73 ("Sound Control Door Assemblies")

#### 2.1.3 Composite-Type Fire Doors

Provide doors specified or indicated to have a fire resistance rating conforming to the requirements of UL 10B, ASTM E2226, or NFPA 252 for the class of door scheduled. Affix a permanent metal label with raised or incised markings indicating testing agency's name and approved hourly fire rating to hinge edge of each door.

### 2.2 ACCESSORIES

#### 2.2.1 Door Light Openings

Provide glazed openings with the manufacturer's standard wood moldings. Provide moldings for doors to receive natural finish of the same wood species and color as the wood face veneers. Lip type moldings for flush doors.

#### 2.2.2 Additional Hardware Reinforcement

Provide the minimum lock blocks to secure the specified hardware. The measurement of top, bottom, and intermediate rail blocks are a minimum 5 inch by full-core width. Comply with the manufacturer's labeling requirements for reinforcement blocking, but not mineral material similar to the core.

### 2.3 FABRICATION

#### 2.3.1 Marking

Stamp each door with a brand, stamp, or other identifying mark indicating quality and construction of the door.

#### 2.3.2 Quality and Construction

Identify the standard on which the construction of the door was based.

#### 2.3.3 Adhesives and Bonds

ANSI/WDMA I.S.1A. Use Type II bond for interior doors. Provide a nonstaining adhesive on doors with a natural finish.

#### 2.3.4 Prefitting

Provide factory-prefinished and factory-prefitted doors for the specified hardware, door frame, and door-swing indicated. Machine and size doors at the factory by the door manufacturer in accordance with the standards under which the doors are produced and manufactured. The work includes sizing, beveling edges, mortising, and drilling for hardware and providing necessary beaded openings for glass and louvers. Provide the door manufacturer with the necessary hardware samples and frame and hardware schedules to coordinate the work.

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### 2.3.5 Finishes

#### 2.3.5.1 Factory Finish

Provide doors finished at the factory by the door manufacturer as follows:

WDMA System TR-8 (UV cured acrylated polyester/urethane) or TR-2 (catalyzed lacquer) or TR-4 (conversion varnish) factory finish systems that utilize water-based stains and finishes with ultraviolet UV protection. The coating is NAAWS 3.1 premium, medium rubbed sheen, open-grain effect. Use stain when required to produce the finish specified for color. Seal edges, cutouts, trim, and wood accessories, and apply two coats of finish compatible with the door face finish. Touch-up finishes that are scratched or marred, or where exposed fastener holes are filled, in accordance with the door manufacturer's instructions. Match color and sheen of factory finish using materials compatible for field application.

#### 2.3.5.2 Color

Provide door finish colors as indicated on drawings.

#### 2.3.6 Water-Resistant Sealer

Provide manufacturer's standard water-resistant sealer compatible with the specified finish.

### 2.4 SOURCE QUALITY CONTROL

Meet or exceed the following minimum performance criteria of stiles of "B" label fire doors utilizing standard mortise leaf hinges:

- a. Cycle-slam: Extra Heavy Duty Doors: 1,000,000 cycles with no loose hinge screws or other visible signs of failure when tested in accordance with the requirements of ANSI/WDMA I.S.1A.
- b. Hinge loading resistance: Averages of ten test samples not less than Extra Heavy Duty doors: 550 pounds force when tested for direct screw withdrawal in accordance with ANSI/WDMA I.S.6A using a No. 12, 1-1/4-inch long, steel, fully threaded wood screw. Drill 5/32-inch-diameter pilot hole, use 1-1/2-inch-diameter opening around screw for bearing surface, and engage screw full, except for last 1/8 inch. Do not use a steel plate to reinforce screw area.

## PART 3 EXECUTION

### 3.1 INSTALLATION

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

Before installation, seal top and bottom edges of doors with the approved water-resistant sealer. Seal cuts made on the job immediately after cutting using approved water-resistant sealer. Fit, trim, and hang doors with a 1/16-inch minimum, 1/8-inch maximum clearance at sides and top, and a 3/16-inch minimum, 1/4-inch maximum clearance over thresholds. Provide 3/8-inch minimum, 7/16-inch maximum clearance at bottom where no threshold occurs. Bevel edges of doors at the rate of 1/8 inch in 2 inch. Door warp must not exceed 1/4 inch when measured in accordance with ANSI/WDMA I.S.1A.

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3.1.1.1 Fire Doors

Install fire doors in accordance with NFPA 80. Do not paint over labels.

-- 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 (2020) Standard Specification for Steel  
 Sheet, Zinc-Coated (Galvanized) or  
 Zinc-Iron Alloy-Coated (Galvannealed) by  
 the Hot-Dip Process

ASTM A666 (2015) Standard Specification for Annealed  
 or Cold-Worked Austenitic Stainless Steel  
 Sheet, Strip, Plate and Flat Bar

ASTM A1008/A1008M (2021a) Standard Specification for Steel,  
 Sheet, Cold-Rolled, Carbon, Structural,  
 High-Strength Low-Alloy, High-Strength  
 Low-Alloy with Improved Formability,  
 Solution Hardened, and Bake Hardenable

##### MASTER PAINTERS INSTITUTE (MPI)

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

##### U.S. GREEN BUILDING COUNCIL (USGBC)

LEED v4 BDC Ref Guide (2013; R 2020) USGBC LEED Reference Guide  
 for Building Design and Construction, v4

LEED v4.1 BDC Ref Guide (2023) LEED v4.1 Building Design and  
 Construction Reference Guide

##### 1.2 SUSTAINABILITY REPORTING

Work of this section is intended to contribute to the achievement of, or compliance with, the requirements of the Guiding Principles Validation and LEED Prerequisites and attempted Credits. Refer to Section 01 33 29.00 06 SUSTAINABILITY REPORTING for specific documentation requirements and list of Prerequisites, attempted Credits and LEED version.

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Comply with product, material content, performance criteria, activity, documentation, and other technical requirements as described in the LEED v4 BDC Ref Guide or LEED v4.1 BDC Ref Guide as applicable.

Collect, organize, and submit product data, drawings, diagrams, photos and cost information necessary to demonstrate compliance with LEED v4 BDC Ref Guide or LEED v4.1 BDC Ref Guide requirements as applicable.

Data collection shall commence with the notice to proceed and will only be deemed complete upon acceptance of the Final Sustainability Notebook and LEED Online submission by the Contracting Officer, the LEED Project Administrator, and the Green Building Certification Institute.

### 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

Access Doors And Panels; G, AE

#### SD-03 Product Data

Access Doors And Panels; G, AE

Hardware Including Locks and Keys; G, AE

Accessories; G, AE

Recycled Content; S

Environmental Product Declarations; S

Embodied Carbon Optimization Report/Action Plan; S

Extended Producer Responsibility; S

Local/Regional Materials; S

Material Ingredient Reporting; S

#### SD-04 Samples

Finishes; G, AE

### 1.4 SUSTAINABLE DESIGN REQUIREMENTS

#### 1.4.1 Environmental Product Declarations

At a minimum, use materials or products with an Environmental Product Declaration in accordance with the LEED Implementation Plan. See Section 01 33 29.00 06 SUSTAINABILITY REPORTING for cumulative materials



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requirements and LEED Implementation Plan.

#### 1.4.2 Embodied Carbon Optimization Report/Action Plan

At a minimum, use materials or products with an Embodied Carbon Optimization Report/Action Plan in accordance with the LEED Implementation Plan. See Section 01 33 29.00 06 SUSTAINABILITY REPORTING for cumulative materials requirements and LEED Implementation Plan.

#### 1.4.3 Sourcing of Raw Materials

Provide products that meet one or more of the following categories:

##### 1.4.3.1 Extended Producer Responsibility

At a minimum, use materials or products from manufacturers that participate in an extended producer responsibility program in accordance with the LEED Implementation Plan. Provide manufacturer letter verifying extended producer responsibility program is in place and that product is eligible. See Section 01 33 29.00 06 SUSTAINABILITY REPORTING for cumulative materials requirements and LEED Implementation Plan.

##### 1.4.3.2 Recycled Content Materials

At a minimum, use materials or products with recycled content in accordance with the LEED Implementation Plan. Provide manufacturers product literature identifying the percentage of recycled material incorporated within each product used. See Section 01 33 29.00 06 SUSTAINABILITY REPORTING for cumulative materials requirements and LEED Implementation Plan. If recycled content minimum is specified in this section, the greater of the two percentages governs.

##### 1.4.4 Material Ingredient Reporting

At a minimum, use materials or products with chemical inventory to at least 0.1% (1000 ppm) in accordance with the LEED Implementation Plan. Provide Health Product Declaration (HPD), Cradle to Cradle Certificate, Declare label, or other manufacturer's published content inventory in compliance with LEED v4.1 Material Ingredient Reporting credit. See Section 01 33 29.00 06 SUSTAINABILITY REPORTING for cumulative materials requirements and LEED Implementation Plan.

##### 1.4.5 Local/Regional Materials

Use materials or products extracted, harvested, or recovered, as well as manufactured, within a 100 mile radius from the project site, if available from a minimum of three sources. provide a letter from the manufacturer stating the extraction location, manufacturing location, and purchasing location of the products provided, referencing the project name and location specifically and distance to the project site. See Section 01 33 29.00 06 SUSTAINABILITY REPORTING for cumulative materials requirements and LEED Implementation Plan.

#### 1.5 MISCELLANEOUS REQUIREMENTS

For access doors and panels provide the following:

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#### 1.5.1 Shop Drawings

For field assembled access doors and panels, provide plans, elevations, sections, and details for each type of access door and panel assembly. Indicate frame, surface and edge construction, materials, and accessories. Indicate types of finished surfaces and details for panel edge conditions. Provide a door schedule with a unique number for each access door and panel, specific location in the project, location of hinges and hardware for each door.

#### 1.5.2 Product Data

For shop assembled access doors and panels, provide literature indicating sizes, types, frame and edge construction, finishes, hardware, accessories such as gaskets, seals and weatherstripping, and location of each door and panel in the project. Provide details of adjoining work for each condition indicated.

#### 1.5.3 Finish Samples

Submit two color charts from manufacturer's standard color and finish options for each type of frame and panel assembly finish indicated.

### 1.6 PERFORMANCE REQUIREMENTS

#### 1.6.1 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.

### 1.7 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.

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#### 2.2.4 Metallic Coated Steel Sheet

Provide in accordance with ASTM A653/A653M, Commercial Steel (CS), Type B; with minimum G60 (Z180) or A60 (ZF180) metallic coating.

#### 2.2.5 Hardware

Provide automatic closing devices. Provide latch releases operable from insides of doors.

#### 2.2.6 Hinges

Provide concealed spring hinges, 175 degrees of opening, with 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.

### 2.5 FINISHES

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.

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### 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 FIELD PAINTING

Field painting primed access doors in accordance with the requirements of Section 09 90 00 PAINTS AND COATINGS.

#### 3.6 DISSIMILAR MATERIALS

Where dissimilar metals are in contact, protect surfaces with a coating in accordance with MPI 79 to prevent galvanic or corrosive action.

#### 3.7 ADJUSTMENT

Adjust hardware so that door panel opens freely. Adjust door when closed center door panel in frame.

#### 3.8 ENVIRONMENTAL CONDITIONS

Do not paint surfaces when damp or exposed to weather, when surface temperature is below 45 degrees F or over 95 degrees F, unless approved by the Contracting Officer.

-- End of Section --

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## SECTION 08 33 23

### OVERHEAD COILING DOORS

**08/20**

#### PART 1 GENERAL

##### 1.1 REFERENCES

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

#### AMERICAN SOCIETY OF CIVIL ENGINEERS (ASCE)

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

#### AMERICAN SOCIETY OF HEATING, REFRIGERATING AND AIR-CONDITIONING ENGINEERS (ASHRAE)

ASHRAE FUN IP (2017) Fundamentals Handbook, I-P Edition

#### AMERICAN SOCIETY OF MECHANICAL ENGINEERS (ASME)

ASME B29.400 (2001; (R 2008) (R 2013) (R 2018)) Combination, "H" Type Mill Chains, and Sprockets

#### ASTM INTERNATIONAL (ASTM)

ASTM A36/A36M (2019) Standard Specification for Carbon Structural Steel

ASTM A47/A47M (1999; R 2018; E 2018) Standard Specification for Ferritic Malleable Iron Castings

ASTM A53/A53M (2020) Standard Specification for Pipe, Steel, Black and Hot-Dipped, Zinc-Coated, Welded and Seamless

ASTM A153/A153M (2016a) Standard Specification for Zinc Coating (Hot-Dip) on Iron and Steel Hardware

ASTM A307 (2021) Standard Specification for Carbon Steel Bolts, Studs, and Threaded Rod 60 000 PSI Tensile Strength

ASTM A653/A653M (2020) Standard Specification for Steel Sheet, Zinc-Coated (Galvanized) or Zinc-Iron Alloy-Coated (Galvannealed) by the Hot-Dip Process

ASTM A780/A780M (2020) Standard Practice for Repair of Damaged and Uncoated Areas of Hot-Dip

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#### Galvanized Coatings

ASTM A924/A924M	(2020) Standard Specification for General Requirements for Steel Sheet, Metallic-Coated by the Hot-Dip Process
ASTM E84	(2020) Standard Test Method for Surface Burning Characteristics of Building Materials
ASTM E330/E330M	(2014) Structural Performance of Exterior Windows, Doors, Skylights and Curtain Walls by Uniform Static Air Pressure Difference
ASTM F568M	(2007) Standard Specification for Carbon and Alloy Steel Externally Threaded Metric Fasteners

#### DOOR AND ACCESS SYSTEM MANUFACTURERS ASSOCIATION (DASMA)

ANSI/DASMA 108	(2017) Standard Method for Testing Sectional Garage Doors, Rolling Doors and Flexible Doors: Determination of Structural Performance Under Uniform Static Air Pressure Difference
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#### NATIONAL ELECTRICAL MANUFACTURERS ASSOCIATION (NEMA)

NEMA ICS 1	(2000; R 2015) Standard for Industrial Control and Systems: General Requirements
NEMA ICS 2	(2000; R 2020) Industrial Control and Systems Controllers, Contactors, and Overload Relays Rated 600 V
NEMA ICS 6	(1993; R 2016) Industrial Control and Systems: Enclosures
NEMA MG 1	(2018) Motors and Generators
NEMA ST 1	(1988; R 1994; R 1997) Specialty Transformers (Except General Purpose Type)

#### NATIONAL FIRE PROTECTION ASSOCIATION (NFPA)

NFPA 70	(2020; ERTA 20-1 2020; ERTA 20-2 2020; TIA 20-1; TIA 20-2; TIA 20-3; TIA 20-4) National Electrical Code
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#### U.S. GREEN BUILDING COUNCIL (USGBC)

LEED v4 BDC Ref Guide	(2013; R 2020) USGBC LEED Reference Guide for Building Design and Construction, v4
LEED v4.1 BDC Ref Guide	(2023) LEED v4.1 Building Design and Construction Reference Guide

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#### UNDERWRITERS LABORATORIES (UL)

UL 325 (2017; Reprint Feb 2020) UL Standard for  
 Safety Door, Drapery, Gate, Louver, and  
 Window Operators and Systems

### 1.2 SUSTAINABILITY REPORTING

Work of this section is intended to contribute to the achievement of, or compliance with, the requirements of the Guiding Principles Validation and LEED Prerequisites and attempted Credits. Refer to Section 01 33 29.00 06 SUSTAINABILITY REPORTING for specific documentation requirements and list of Prerequisites, attempted Credits and LEED version.

Comply with product, material content, performance criteria, activity, documentation, and other technical requirements as described in the LEED v4 BDC Ref Guide or LEED v4.1 BDC Ref Guide as applicable.

Collect, organize, and submit product data, drawings, diagrams, photos and cost information necessary to demonstrate compliance with LEED v4 BDC Ref Guide or LEED v4.1 BDC Ref Guide requirements as applicable.

Data collection shall commence with the notice to proceed and will only be deemed complete upon acceptance of the Final Sustainability Notebook and LEED Online submission by the Contracting Officer, the LEED Project Administrator, and the Green Building Certification Institute.

### 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

Overhead Coiling Doors; G, AE

Counterbalancing Mechanism; G, AE

Electric Door Operators; G, AE

Bottom Bars; G, AE

Guides; G, AE

Mounting Brackets; G, AE

Hood; G, AE

Installation Drawings; G, AE

#### SD-03 Product Data

Overhead Coiling Doors; G, AE

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Hardware; G, AE

Counterbalancing Mechanism; G, AE

Electric Door Operators; G, AE

Recycled content for steel curtain slats; S

Environmental Product Declarations; S

Embodied Carbon Optimization Report/Action Plan; S

Extended Producer Responsibility; S

Local/Regional Materials; S

Material Ingredient Reporting; S

#### SD-05 Design Data

Overhead Coiling Doors; G, AE

Hardware; G, AE

Counterbalancing Mechanism; G

Electric Door Operators; G, AE

#### SD-10 Operation and Maintenance Data

Operation and Maintenance Manuals, Data Package 2; G, AE

#### SD-11 Closeout Submittals

Warranty; G, AE

### 1.4 SUSTAINABLE DESIGN REQUIREMENTS

#### 1.4.1 Environmental Product Declarations

At a minimum, use materials or products with an Environmental Product Declaration in accordance with the LEED Implementation Plan. See Section 01 33 29.00 06 SUSTAINABILITY REPORTING for cumulative materials requirements and LEED Implementation Plan.

#### 1.4.2 Embodied Carbon Optimization Report/Action Plan

At a minimum, use materials or products with an Embodied Carbon Optimization Report/Action Plan in accordance with the LEED Implementation Plan. See Section 01 33 29.00 06 SUSTAINABILITY REPORTING for cumulative materials requirements and LEED Implementation Plan.

#### 1.4.3 Sourcing of Raw Materials

Provide products that meet one or more of the following categories:

##### 1.4.3.1 Extended Producer Responsibility

At a minimum, use materials or products from manufacturers that



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participate in an extended producer responsibility program in accordance with the LEED Implementation Plan. Provide manufacturer letter verifying extended producer responsibility program is in place and that product is eligible. See Section 01 33 29.00 06 SUSTAINABILITY REPORTING for cumulative materials requirements and LEED Implementation Plan.

#### 1.4.3.2 Recycled Content Materials

At a minimum, use materials or products with recycled content in accordance with the LEED Implementation Plan. Provide manufacturers product literature identifying the percentage of recycled material incorporated within each product used. See Section 01 33 29.00 06 SUSTAINABILITY REPORTING for cumulative materials requirements and LEED Implementation Plan. If recycled content minimum is specified in this section, the greater of the two percentages governs.

#### 1.4.4 Material Ingredient Reporting

At a minimum, use materials or products with chemical inventory to at least 0.1% (1000 ppm) in accordance with the LEED Implementation Plan. Provide Health Product Declaration (HPD), Cradle to Cradle Certificate, Declare label, or other manufacturer's published content inventory in compliance with LEED v4.1 Material Ingredient Reporting credit. See Section 01 33 29.00 06 SUSTAINABILITY REPORTING for cumulative materials requirements and LEED Implementation Plan.

#### 1.4.5 Local/Regional Materials

Use materials or products extracted, harvested, or recovered, as well as manufactured, within a 100 mile radius from the project site, if available from a minimum of three sources. provide a letter from the manufacturer stating the extraction location, manufacturing location, and purchasing location of the products provided, referencing the project name and location specifically and distance to the project site. See Section 01 33 29.00 06 SUSTAINABILITY REPORTING for cumulative materials requirements and LEED Implementation Plan.

### 1.5 QUALITY CONTROL

#### 1.5.1 Warranty

Furnish a written guarantee that the helical spring and counterbalance mechanism are free from defects in material and workmanship for not less than two years after completion and acceptance of the project.

Warrant that upon notification by the Government, any defects in material, workmanship, and door operation are immediately correct within the same time period covered by the guarantee, at no cost to the Government.

#### 1.5.2 Operation And Maintenance Submittals

Submit 6 copies of the operation and maintenance manuals 30 calendar days prior to testing the Overhead Coiling Door Assemblies. Update and resubmit data for final approval no later than 30 calendar days prior to cContract completion.

Submit Operation and Maintenance Manuals for Overhead Coiling Door Assemblies, including the following items:

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Manual Door Operators

Electric Door Operators

Hood

Counterbalancing Mechanism

Painting

Provide operation and maintenance manuals which are consistent with manufacturer's standard brochures, schematics, printed instructions, operating procedures, and safety precautions.

## 1.6 DELIVERY, STORAGE, AND HANDLING

Deliver doors to the jobsite wrapped in a protective covering with the brands and names clearly marked thereon. Store doors in an adequately ventilated dry location that is free from dirt and dust, water, or other contaminants. Store in a manner that permits easy access for inspection and handling. Handle doors carefully to prevent damage. Remove damaged items that cannot be restored to like-new condition and provide new items.

## PART 2 PRODUCTS

### 2.1 SYSTEM DESCRIPTION

Provide overhead coiling doors with interlocking slats, complete with anchoring and door hardware, guides, hood, and operating mechanisms, and designed for use on openings as indicated. Doors must be spring counterbalanced, rolling type, and designed for use on interior openings, as indicated. Doors must be operated by electric-power with auxiliary hand chain operation. Doors to be surface-mounted type with guides at jambs set back a sufficient distance to provide a clear opening when door is in open position. Mount exterior doors as indicated on interior face of walls.

#### 2.1.1 Design Requirements

##### 2.1.1.1 Door Detail Shop Drawings

Provide installation drawings for door assemblies which show: elevations of each door type, shape and thickness of materials, finishes, details of joints and connections, details of guides and fittings, rough opening dimensions, location and description of hardware, anchorage locations, and counterbalancing mechanism and door operator details. Show locations of replaceable fusible links on wiring diagrams for power, signal and controls. For motor-operated doors include supporting brackets for motors, location, type, and ratings of motors, and safety devices. Include a schedule showing the location of each door with the drawings.

#### 2.1.2 Performance Requirements

##### 2.1.2.1 Wind Loading

Design and fabricate door assembly to withstand the wind loading pressure of at least 20 pounds per square foot in accordance with ANSI/DASMA 108. Provide test data showing compliance with ASTM E330/E330M. Sound engineering principles may be used to interpolate or extrapolate test

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results to door sizes not specifically tested. Ensure that the complete assembly meets or exceeds the requirements of ASCE 7-16.

#### 2.1.2.2 Operational Cycle Life

Design all portions of the door, hardware and operating mechanism that are subject to movement, wear, or stress fatigue to operate through a minimum number of 10 cycles per day. One complete cycle of door operation is defined as when the door is in the closed position, moves to the fully open position, and returns to the closed position.

### 2.2 COMPONENTS

#### 2.2.1 Overhead Coiling Doors

##### 2.2.1.1 Curtain Materials and Construction

Provide curtain slats fabricated from Grade A steel sheets conforming to ASTM A653/A653M, with the additional requirement of a minimum yield point of 33,000 psi. Provide 20 gauge sheets, Grade 40 steel with galvanized steel zinc coating in conformance with ASTM A653/A653M and ASTM A924/A924M. Provide steel curtain slats containing a minimum of 20 percent recycled content. Submit data identifying percentage of recycled content for steel curtain slats.

Fabricate doors from interlocking cold-rolled slats, with section profiles as specified, designed to withstand the specified wind loading. Ensure the provided slats are continuous without splices for the width of the door.

Provide slats filled with manufacturer's standard thermal insulation, complying with the maximum flame-spread and smoke-developed indexes of 75 and 450, respectively, according to ASTM E84. Enclose the insulation completely within the slat faces on the interior surface of the slats.

##### 2.2.1.2 Non-Insulated Curtains

Form curtains from the manufacturer's standard shapes of interlocking slats.

##### 2.2.1.3 Insulated Curtains

Form curtains from manufacturer's standard shapes of interlocking slats. Supply a slat system with a minimum R-value of 9 when calculated in accordance with ASHRAE FUN IP. Slats to consist of a urethane core not less than 1-1/2 inch thick, completely enclosed within metal facings. Slat steel thickness as required by the size of the door to meet specified performance requirements. The insulated slat assembly requires a flame spread rating of not more than 25 and a smoke development factor of not more than 50 when tested in accordance with ASTM E84.

##### 2.2.1.4 Curtain Bottom Bar

Install curtain bottom bars as pairs of angles or using extrusions from the manufacturer's standard steel, stainless and aluminum extrusions not less than 2.0 by 2.0 inches by 0.188 inch. Do not use aluminum on doors more than 16 feet wide. Ensure steel extrusions conform to ASTM A36/A36M.

Galvanize angles and fasteners in accordance with ASTM A653/A653M and ASTM A924/A924M. Coat welds and abrasions with paint conforming to

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ASTM A780/A780M.

#### 2.2.1.5 Endlocks (and Windlocks)

Provide endlocks of Grade B cast steel conforming to ASTM A47/A47M, galvanized in accordance with ASTM A153/A153M. Secure locks at every other curtain slat. In addition to endlocks, exterior doors which are more than 16 feet wide or which have a design wind load of more than 20 pounds per square foot, must have windlocks of manufacturer's standard design. Windlocks must prevent curtain from leaving guide because of deflection from wind pressure or other forces.

#### 2.2.1.6 Weather Stripping

Provide a hood baffle inside the hood that is a minimum 1/16 inch thick sheet of vinyl, neoprene rubber or equivalent. Provide guide weather stripping that is a minimum 1/16 inch thick sheet of vinyl, neoprene rubber, or equivalent.

Provide bottom bar weather-stripping that is a minimum 1/16 inch thick sheet of vinyl, neoprene rubber, or equivalent.

#### 2.2.1.7 Locking Devices

Ensure that the slide bolt engages through slots in tracks for locking by padlock, located on both left and right jamb sides, operable from coil side.

Provide a locking device assembly which includes cylinder lock, operating handle, cam plate, and adjustable locking bars to engage through slots in tracks.

Provide a chain lock keeper suitable for a standard padlock.

#### 2.2.1.8 Safety Interlock

Equip power-operated doors with a safety interlock switch to disengage power supply when the door is locked, or provide an operator with an internal lock sensing device to prevent the door opening when the door is locked.

#### 2.2.2 Hardware

Ensure that all hardware conforms to ASTM A153/A153M, ASTM A307, and ASTM F568M.

##### 2.2.2.1 Guides

Fabricate curtain jamb guides from the manufacturer's standard angles or channels of same material and finish as curtain slats unless otherwise indicated. Provide guides with sufficient depth or incorporate a steel locking bar to retain the curtain in place under the wind pressure specified. Ensure curtain operates smoothly. Slot bolt holes for track adjustment.

##### 2.2.2.2 Hood

Provide a hood with a minimum 24-gauge sheet metal, flanged at top for attachment to header and flanged at bottom to provide longitudinal

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stiffness. The hood encloses the curtain coil and counterbalance mechanism.

Hoods for openings more than 12 feet in width must have intermediate support brackets to prevent excessive sag. Provide a weather baffle at the lintel or inside the hood of each exterior door.

### 2.2.3 Counterbalancing Mechanism

Counterbalance doors by means of manufacturer's standard mechanism with an adjustable-tension, steel helical torsion spring mounted, around a steel shaft and contained in a spring barrel connected to top of curtain with barrel rings. Use grease-sealed or self-lubricating bearings for rotating members.

#### 2.2.3.1 Brackets

Provide the manufacturer's standard mounting brackets with one located at each end of the counterbalance barrel conforming to ASTM A36/A36M. Provide brackets of hot-rolled steel.

#### 2.2.3.2 Counterbalance Barrels

Curtain must roll up on a barrel supported at head of opening on brackets and be balanced by a torsion spring system in the barrel. Fabricate spring barrel of manufacturer's standard hot-formed, structural-quality, welded or seamless carbon-steel pipe, conforming to ASTM A53/A53M or equivalent. Ensure the barrel is of sufficient diameter and wall thickness to support rolled-up curtain without distortion of slats. Limit barrel deflection to not more than 0.03 inch per foot of span under full load.

##### a. Barrel

Provide steel pipe capable of supporting curtain load with maximum deflection of 0.03 inches per foot of width.

##### b. Spring Balance

Provide an oil-tempered, heat-treated steel helical torsion spring assembly designed for proper balance of door. Ensure that effort to operate manually operated units does not exceed 25 lbs. At least 80 percent of the door weight must be counterbalanced at any position. Provide wheel for applying and adjusting spring torque.

### 2.2.4 Electric Door Operators

Provide electrical wiring and door operating controls conforming to the applicable requirements of NFPA 70 and UL 325. The door manufacturer must furnish automatic control and safety devices, including extra flexible type SO cable and spring-loaded automatic takeup reel or equivalent device, as required for proper operation of the doors. Conduit, wiring, and mounting of controls are specified in Section 26 20 00 INTERIOR DISTRIBUTION SYSTEM.

Electric door-operator assemblies need to be the sizes and capacities recommended and provided by the door manufacturer for specified doors. Furnish complete assemblies with electric motors and factory-prewired motor controls, starter, gear reduction units, solenoid-operated brakes,

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clutch, remote-control stations, manual or automatic control devices, and accessories as required for proper operation of the doors.

Design the operators so that motors may be removed without disturbing the limit-switch adjustment and affecting the emergency auxiliary operators.

Provide a manual operator of crank-gear or chain-gear mechanisms with a release clutch to permit manual operation of doors in case of power failure. Arrange the emergency manual operator so that it may be put into and out of operation from floor level, and its use does not affect the adjustment of the limit switches. Provide an electrical or mechanical device that automatically disconnects the motor from the operating mechanism when the emergency manual operating mechanism is engaged.

#### 2.2.4.1 Door-Operator Types

Provide an operator mounted to the right or left door head plate with the operator on top of the door-hood assembly and connected to the door drive shaft with drive chain and sprockets. Headroom is required for this type of mounting.

#### 2.2.4.2 Electric Motors

Provide motors which are the high-starting-torque, reversible, constant-duty electrical type with overload protection of sufficient torque and horsepower to move the door in either direction from any position. Ensure they produce a door-travel speed of not less than 8 nor more than 12 inches per second without exceeding the horsepower rating.

Provide motors which conform to NEMA MG 1 designation, temperature rating, service factor, enclosure type, and efficiency to the requirements specified. Motors must be suitable for operation on current of the characteristics indicated. Single-phase motors must not have commutation or more than one starting contact. Motor enclosures must be the drip-proof type or NEMA TEFC and TENV type. Install motors in approved locations.

#### 2.2.4.3 Motor Bearings

Select bearings with bronze-sleeve or heavy-duty ball or roller antifriction type with full provisions for the type of thrust imposed by the specific duty load.

Pre-lubricate and factory seal bearings in motors less than 1/2 horsepower.

Equip motors coupled to worm-gear reduction units with either ball or roller bearings.

Equip bearings in motors 1/2 horsepower or larger with lubrication service fittings. Fit lubrication fittings with color-coded plastic or metal dust caps.

In any motor, bearings that are lubricated at the factory for extended duty periods do not need to be lubricated for a given number of operating hours. Display this information on an appropriate tag or label on the motor with instructions for lubrication cycle maintenance.

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#### 2.2.4.4 Motor Starters, Controls, and Enclosures

Provide each door motor with: a factory-wired, unfused, disconnect switch; a reversing, across-the-line magnetic starter with thermal overload protection; 24-volt operating coils with a control transformer limit switch; and a safety interlock assembled in a NEMA ICS 6 type enclosure as specified herein. Ensure control equipment conforms to NEMA ICS 1 and NEMA ICS 2.

Provide adjustable switches, electrically interlocked with the motor controls and set to stop the door automatically at the fully open and fully closed position.

#### 2.2.4.5 Control Enclosures

Provide control enclosures that conform to NEMA ICS 6 for NEMA Type 4.

#### 2.2.4.6 Transformer

Provide starters with 230/460 to 115 volt control transformers with one secondary fuse when required to reduce the voltage on control circuits to 24volts or less. Provide a transformer conforming to NEMA ST 1.

#### 2.2.4.7 Sensing-Edge Device

Provide each door with a pneumatic or electric sensing device that meets UL 325, extends the full width of the door, and is located within a U-section neoprene or rubber astragal, mounted on the bottom rail of the bottom door section. Device needs to immediately stop and reverse the door upon contact with an obstruction in the door opening or upon failure of the device or any component of the control system and cause the door to return to its user-defined open position. Any momentary door-closing circuit must be automatically locked out and the door must be operable manually or with constant pressure controls until the failure or damage has been corrected. A sensing device is not a substitute for a limit switch.

Connect sensing device to the control circuit through a retracting cord and reel.

#### 2.2.4.8 Remote-Control Stations

Remote control stations must be at least 5 feet above the floor line, and all switches must be located so that the operator will have complete visibility of the door at all times. Provide interior remote control stations that are full-guarded, momentary-contact three-button, heavy-duty, surface-mounted NEMA ICS 6 type enclosures as specified. Mark buttons "OPEN," "CLOSE," and "STOP." The "OPEN" and "STOP" buttons must be of the type requiring only momentary pressure to operate. The "CLOSE" button must be of the type either requiring constant pressure to maintain the closing motion of the door or momentary pressure when installed with a monitored entrapment detection device which, upon failure of the device or any component of the control system, cause the door to return to its full open position. When the door is in motion and the "STOP" button is pressed, ensure the door stops instantly and remains in the stopped position. From the stopped position, the door may then be operated in either direction by the "OPEN" or "CLOSE" buttons. When the door is in motion, and the "CLOSE" button of the constant pressure type is released, the door must stop and remain in the stop position or reverse to the user

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set up position; from the stop position, the door may then be operated in either direction by the "OPEN" or "CLOSE" buttons. Controls must be adjustable to automatically stop the doors at their fully open and closed positions. Open and closed positions must be readily adjustable.

#### 2.2.4.9 Speed-Reduction Units

Provide speed-reduction units consisting of hardened-steel worm and bronze worm gear assemblies or planetary gear reducers running in oil or grease and inside a sealed casing, coupled to the motor through a flexible coupling. Drive shafts need to rotate on ball- or roller-bearing assemblies that are integral with the unit.

Provide minimum ratings of speed reduction units in accordance with AGMA provisions for class of service.

Ground worm gears to provide accurate thread form; machine teeth for all other types of gearing. Surface harden all gears.

Provide antifriction type bearings equipped with oil seals.

#### 2.2.4.10 Chain Drives

Provide roller chains that are a power-transmission series steel roller type conforming to ASME B29.400, with a minimum safety factor of 10 times the design load.

Heat-treat or otherwise harden roller-chain side bars, rollers, pins, and bushings.

Provide high-carbon steel chain sprockets with machine-cut hardened teeth, finished bore and keyseat, and hollow-head setscrews.

#### 2.2.4.11 Brakes

Provide 360-degree shoe brakes or shoe and drum brakes. Ensure the brakes are solenoid-operated and electrically interlocked to the control circuit to set automatically when power is interrupted.

#### 2.2.4.12 Clutches

Ensure clutches are friction type or adjustable centrifugal type.

#### 2.2.4.13 Weather/Smoke Seal Sensing Edge

Provide automatic stop control by an automatic sensing switch within neoprene astragal extending the full width of door bottom bar.

Provide an electric sensing edge device. Ensure the door immediately stops downward travel when contact occurs before door fully closes. Provide a self-monitoring sensing edge connection to the motor operator. Provide a self-monitoring wireless sensing edge connection to the motor operator; eliminating the need for a physical traveling electric cord connection between bottomw bar sensing edge device and motor operator. Supervised system alters normal door operation; preventing damage, injury or death due to an inoperable sensing edge system.



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### 2.2.5 Surface Finishing

Comply with NAAMM's "Metal Finishes Manual for Architectural and Metal Products" for recommendations for applying and designating finishes. Noticeable variations in the same metal component are not acceptable. Variations in appearance of adjoining components are acceptable if they are within the range of approved samples and are assembled or installed to minimize contrast.

#### 2.2.5.1 Baked-Enamel or Powder-Coat Finish

Manufacturer's standard baked-on finish consisting of prime coat and thermosetting topcoat. Comply with the coating manufacturer's written instructions for cleaning, pretreatment, application, and minimum dry film thickness.

## PART 3 EXECUTION

### 3.1 INSTALLATION

Install overhead coiling door assembly, anchors and inserts for guides, brackets, motors, switches, hardware, and other accessories in accordance with approved detail drawings and manufacturer's written instructions. Upon completion of installation, ensure doors are free from all distortion.

Install overhead coiling doors, motors, hoods, and operators at the mounting locations as indicated for each door in the Contract Documents and as required by the manufacturer.

Install overhead coiling doors, switches, and controls along accessible routes in compliance with regulatory requirements for accessibility and as required by the manufacturer.

### 3.2 ADJUSTING AND CLEANING

#### 3.2.1 Acceptance Provisions

After installation, adjust the hardware and moving parts. Lubricate bearings and sliding parts as recommended by manufacturer to provide smooth operating functions for ease movement, free of warping, twisting, or distortion of the door assembly.

Adjust seals to provide a weather-tight fit around entire perimeter.

Engage a factory-authorized service representative to perform startup service and checks according to the manufacturer's written instructions.

Test the door opening and closing operation when activated by controls system. Adjust controls and safeties. Replace damaged and malfunctioning controls and equipment. Reset the door-closing mechanism after a successful test.

Test and make final adjustment of new doors at no additional cost to the Government.

#### 3.2.1.1 Maintenance and Adjustment

Not more than 90 calendar days after completion and acceptance of the project, examine, lubricate, test, and re-adjust doors as required for

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proper operation.

#### 3.2.1.2 Cleaning

Clean doors in accordance with manufacturer's approved instructions.

-- End of Section --

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## SECTION 08 34 73

## SOUND CONTROL DOOR ASSEMBLIES

**11/19, CHG 1: 02/21**

## PART 1 GENERAL

## 1.1 REFERENCES

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

## AMERICAN WELDING SOCIETY (AWS)

AWS D1.3/D1.3M (2018) Structural Welding Code - Sheet Steel

## ASTM INTERNATIONAL (ASTM)

ASTM A36/A36M (2019) Standard Specification for Carbon Structural Steel

ASTM A108 (2013) Standard Specification for Steel Bar, Carbon and Alloy, Cold-Finished

ASTM A568/A568M (2019a) Standard Specification for Steel, Sheet, Carbon, Structural, and High-Strength, Low-Alloy, Hot-Rolled and Cold-Rolled, General Requirements for

ASTM A1008/A1008M (2021) Standard Specification for Steel, Sheet, Cold-Rolled, Carbon, Structural, High-Strength Low-Alloy, High-Strength Low-Alloy with Improved Formability, Solution Hardened, and Bake Hardenable

ASTM A1011/A1011M (2018a) Standard Specification for Steel Sheet and Strip, Hot-Rolled, Carbon, Structural, High-Strength Low-Alloy, High-Strength Low-Alloy with Improved Formability, and Ultra-High Strength

ASTM C143/C143M (2020) Standard Test Method for Slump of Hydraulic-Cement Concrete

ASTM C476 (2020) Standard Specification for Grout for Masonry

ASTM D6866 (2022) Standard Test Methods for Determining the Biobased Content of Solid, Liquid, and Gaseous Samples Using Radiocarbon Analysis

ASTM E90 (2009; R2016) Standard Test Method for Laboratory Measurement of Airborne Sound Transmission Loss of Building Partitions and Elements

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ASTM E336 (2020) Standard Test Method for  
 Measurement of Airborne Sound Attenuation  
 between Rooms in Buildings

ASTM E413 (2016) Classification for Rating Sound  
 Insulation

ASTM E1289 (2008; R 2016) Standard Specification for  
 Reference Specimen for Sound Transmission  
 Loss

CALIFORNIA AIR RESOURCES BOARD (CARB)

CARB 93120 (2007) Airborne Toxic Control Measure  
 (ATCM) to Reduce Formaldehyde Emissions  
 from Composite Wood Products

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

FOREST STEWARDSHIP COUNCIL (FSC)

FSC STD 01 001 (2015) Principles and Criteria for Forest  
 Stewardship

NATIONAL FIRE PROTECTION ASSOCIATION (NFPA)

NFPA 80 (2019) Standard for Fire Doors and Other  
 Opening Protectives

U.S. GREEN BUILDING COUNCIL (USGBC)

LEED v4 BDC Ref Guide (2013; R 2020) USGBC LEED Reference Guide  
 for Building Design and Construction, v4

LEED v4.1 BDC Ref Guide (2023) LEED v4.1 Building Design and  
 Construction Reference Guide

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

40 CFR 770 Formaldehyde Standards for Composite Wood  
 Products

WOODWORK INSTITUTE (WI)

NAAWS 3.1 (2017; 2018 Errata Edition) North American  
 Architectural Woodwork Standards

P2#: 506474 - Manned/Unmanned Tactical Vehicle Lab (MUMT)  
 Detroit Arsenal, MI

## 1.2 SUSTAINABILITY REPORTING

Work of this section is intended to contribute to the achievement of, or compliance with, the requirements of the Guiding Principles Validation and LEED Prerequisites and attempted Credits. Refer to Section 01 33 29.00 06 SUSTAINABILITY REPORTING for specific documentation requirements and list of Prerequisites, attempted Credits and LEED version.

Comply with product, material content, performance criteria, activity, documentation, and other technical requirements as described in the LEED v4 BDC Ref Guide or LEED v4.1 BDC Ref Guide as applicable.

Collect, organize, and submit product data, drawings, diagrams, photos and cost information necessary to demonstrate compliance with LEED v4 BDC Ref Guide or LEED v4.1 BDC Ref Guide requirements as applicable.

Data collection shall commence with the notice to proceed and will only be deemed complete upon acceptance of the Final Sustainability Notebook and LEED Online submission by the Contracting Officer, the LEED Project Administrator, and the Green Building Certification Institute.

## 1.3 SUBMITTALS

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

### SD-02 Shop Drawings

Fabrication Drawings

### SD-03 Product Data

Hollow Metal Sound Retardant Doors; G

Wood Sound Retardant Doors; G

Door Frames; G

Door Hardware; G

Door Frame Sound Infill; G

Vision Panels; G

Thresholds; G

Environmental Product Declarations; S

Embodied Carbon Optimization Report/Action Plan; S

Extended Producer Responsibility; S

Bio-Based Materials; S

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Certified Wood; S

Local/Regional Materials; S

Material Ingredient Reporting; S

Recycled Content For Metal Sound Retardant Doors; S

#### SD-06 Test Reports

Acoustical Tests; G

Positive Pressure Tests; G

#### SD-07 Certificates

Hollow Metal Sound Retardant Doors; G

Wood Sound Retardant Doors; G

Door Frames; G

Door Hardware; G

Vision Panels; G

Thresholds; G

Assembly Test Reports

Certified Sustainably Harvested Wood Sound Retardant Doors; S

Indoor Air Quality For Particleboard And Agrifiber Door Cores; S

### 1.4 SUSTAINABLE DESIGN REQUIREMENTS

#### 1.4.1 Environmental Product Declarations

At a minimum, use materials or products with an Environmental Product Declaration in accordance with the LEED Implementation Plan. See Section 01 33 29.00 06 SUSTAINABILITY REPORTING for cumulative materials requirements and LEED Implementation Plan.

#### 1.4.2 Embodied Carbon Optimization Report/Action Plan

At a minimum, use materials or products with an Embodied Carbon Optimization Report/Action Plan in accordance with the LEED Implementation Plan. See Section 01 33 29.00 06 SUSTAINABILITY REPORTING for cumulative materials requirements and LEED Implementation Plan.

#### 1.4.3 Sourcing of Raw Materials

Provide products that meet one or more of the following categories:

##### 1.4.3.1 Extended Producer Responsibility

At a minimum, use materials or products from manufacturers that participate in an extended producer responsibility program in accordance with the LEED Implementation Plan. Provide manufacturer letter verifying

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extended producer responsibility program is in place and that product is eligible. See Section 01 33 29.00 06 SUSTAINABILITY REPORTING for cumulative materials requirements and LEED Implementation Plan.

#### 1.4.3.2 Bio-Based Materials

At a minimum, use materials or products with bio-based content in accordance with the LEED Implementation Plan. Provide manufacturer signed letter confirming ASTM D6866 test method was conducted validating bio-based material weight within product, type of bio-based material used within product, and confirmation raw material was legally harvested. See Section 01 33 29.00 06 SUSTAINABILITY REPORTING for cumulative materials requirements and LEED Implementation Plan. If bio-based content minimum is specified in this section, the greater of the two percentages governs.

#### 1.4.3.3 Certified Wood

Use FSC-certified wood. See Section 01 33 29.00 06 SUSTAINABILITY REPORTING for cumulative materials requirements and LEED Implementation Plan. Indicate compliance with FSC STD 01 001 and identify certifying organization. Submit FSC certification numbers; identify each certified products on a line-item basis. Submit copies of invoices for all wood products bearing the FSC certification numbers for certified wood products as part of the closeout submittal.

#### 1.4.3.4 Recycled Content Materials

At a minimum, use materials or products with recycled content in accordance with the LEED Implementation Plan. Provide manufacturers product literature identifying the percentage of recycled material incorporated within each product used. See Section 01 33 29.00 06 SUSTAINABILITY REPORTING for cumulative materials requirements and LEED Implementation Plan. If recycled content minimum is specified in this section, the greater of the two percentages governs.

#### 1.4.4 Material Ingredient Reporting

At a minimum, use materials or products with chemical inventory to at least 0.1% (1000 ppm) in accordance with the LEED Implementation Plan. Provide Health Product Declaration (HPD), Cradle to Cradle Certificate, Declare label, or other manufacturer's published content inventory in compliance with LEED v4.1 Material Ingredient Reporting credit. See Section 01 33 29.00 06 SUSTAINABILITY REPORTING for cumulative materials requirements and LEED Implementation Plan.

#### 1.4.5 Local/Regional Materials

Use materials or products extracted, harvested, or recovered, as well as manufactured, within a 100 mile radius from the project site, if available from a minimum of three sources. provide a letter from the manufacturer stating the extraction location, manufacturing location, and purchasing location of the products provided, referencing the project name and location specifically and distance to the project site. See Section 01 33 29.00 06 SUSTAINABILITY REPORTING for cumulative materials requirements and LEED Implementation Plan.

#### 1.4.6 Low-Emitting Materials

Use only interior metal door and frame products that comply with

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LEED v4.1 BDC Ref Guide requirements for emissions. Submit certification or validation of compliance with CDPH SECTION 01350 emissions requirements. See Section 01 33 29.00 06 SUSTAINABILITY REPORTING for low-emitting material requirements.

## 1.5 CERTIFICATIONS

### 1.5.1 Certified Sustainably Harvested Wood

Provide wood certified as sustainably harvested by FSC STD 01 001. Provide a letter of Certification of Sustainably Harvested Wood signed by the wood supplier. Identify certifying organization and their third-party program name and indicate compliance with chain-of-custody program requirements. Submit sustainable wood certification data; identify each certified product on a line item basis. Submit copies of invoices bearing certification numbers.

### 1.5.2 Indoor Air Quality Certification

#### 1.5.2.1 Composite Wood, Wood Structural Panel and Agrifiber Products

For purposes of this specification, composite wood and agrifiber products include particleboard, medium-density fiberboard (MDF), wheatboard, strawboard, panel substrates, and door cores. Provide products certified to meet requirements of both 40 CFR 770 and CARB 93120. Provide current product certification documentation from certification body.

## 1.6 QUALITY CONTROL

Ensure work within this section is designed and furnished by one manufacturer, who has been engaged in the manufacture of sound-retardant wood swinging door and hollow-metal door systems for at least five years prior to the start of this work.

Provide acoustic assemblies manufactured by a single source specializing in the production of this type work for a minimum of five years.

### 1.6.1 Compliance and Labeling

#### 1.6.1.1 Compliance with Accessibility Requirements

Americans with Disabilities Act/Architectural Barriers Act (ADA/ABA)  
36 CFR 1191

Accessibility Guidelines for Buildings and Facilities (ADAAG) 36 CFR 1191

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

Where requirements for positive pressure are met, include for doors all requirements as part of the door construction per Category A guidelines as published by ITS/Warnock-Hersey. Intumescent is not allowed on the frame.

#### 1.6.1.3 Labeling

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

a. Manufacturer



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- b. Third-party testing and certification agency
- c. Fire door rating
- d. Installation limitations
- e. Compatible frame and hardware component ratings
- f. Compatible lite or vision panel component ratings
- g. STC rating

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.

#### 1.7 DELIVERY, STORAGE, AND HANDLING

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

Deliver and store wood doors in the building following the installation of concrete, terrazzo, plaster, or other wet materials, and only after the building has dried out and has a roof.

Store materials on planks in a dry location. Store doors and frames vertically with minimum 3/4-inch airspace between. Store doors on hinge edge to eliminate potential damage to the door bottom seal. Cover 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.

#### 1.8 WARRANTY

Manufacturer's warranty for five 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

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height indicated, complete with perimeter seals, seal housings, gasketing, automatic door bottoms, thresholds, and door frames as required to conform to the specified STC per ASTM E90 and ASTM E1289.

Submit fabrication drawings for Hollow Metal Sound Retardant Doors, Wood Sound Retardant Doors, Door Frames, and Door Frame Sound Infill.

Submit certificates showing conformance with the referenced standards in this Section, and manufacturer's catalog data including STC ratings and UL fire rating, where applicable, for the following items: Hollow metal sound retardant doors; wood sound retardant doors; door frames; door hardware; vision panels; and thresholds.

Provide assemblies that are complete with metal frame, hollow-metal or wood doors, sealing system, and Cam-lift hinges. Where vision lights are specified for doors, provide metal loose stops and field-install glass and glazing when shipped separately.

## 2.1.1 Design Requirements

### 2.1.1.1 Door Design

Provide sound-retardant wood swinging doors that are a 1-3/4-inch thickness construction with sizes as indicated on Drawings. No visible seams are permitted on door faces. Provide face gauges, internal sound-retardant core, and perimeter door edge construction per manufacturer's standard for the specified STC rating. No lead or asbestos is permitted in door construction to achieve STC performance. Provide face veneer species cut and color as selected from manufacturer's full range of available colors and patterns. No lead or asbestos is permitted in door construction to achieve performance requirements.

### 2.1.1.2 Frame Design

Provide soundretardant 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 of at least 45.

## 2.2 FABRICATION

Provide hollow-metal 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.

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Clean and sand to smooth finish all doors to remove handling and storage marks, raised grain, minor surface marks and abrasions.

#### 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 door material that uses a minimum of 25 percent recycled content. Provide data indicating percentage of recycled content for metal sound retardant doors.

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

Where scheduled, provide fire-rated doors, including sound-retardant type, to bear the UL 1-1/2-hour B label fire rating and the specified STC.

##### 2.2.1.2 Coating

Thoroughly clean all mill scale, rust, oil, grease, dirt, and other foreign materials from surfaces before the application of the shop coat of paint.

Shop-paint the exposed door surfaces.

#### 2.2.2 Wood Sound-Retardant Doors

Construct doors with wood veneer facings separated by a core construction designed to meet the specified STC. Test, rate, and label in accordance with ASTM E90. Provide certified sustainably harvested wood sound retardant doors. Products must contain no added urea-formaldehyde resins. Provide certification of indoor air quality for particleboard and agrifiber door cores.

Comply with the NAAWS 3.1, "Guide Specifications and Quality Certification Program," for premium-grade constructions and to the requirements specified.

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Perform beveling, prefittting, machining, mortising, and routing for hardware, perimeter seals, and door bottom cutouts at the mill.

Furnish premium-grade door facings with standard thickness face veneers conforming to NAAWS 3.1, Type 1 for stain and transparent factory-applied finish.

#### 2.2.2.1 Faces

Single-ply wood veneer not less than 1/50-inch thick.

- a. Species: Select white maple.
- b. Cut: Rotary cut whole-piece faces.
- c. Room Match: Match door faces within each separate room or area of building. Corridor-door faces do not need to match where they are separated by 20 feet or more.
- d. Room Match: Provide door faces of compatible color and grain within each separate room or area of building.

#### 2.2.3 Door Finishing

Conform factory-finishing of Sound-Retardant Wood Swinging Doors in accordance with AWI Quality Standards. Provide factory-applied finish of a water-base stain and ultraviolet (UV) cured polyurethane sealer to comply with EPA Title 5 guidelines for Volatile Organic Compound (VOC) emissions limitations. Conform finish to meet or exceed performance standards of NAAWS 3.1 catalyzed polyurethane.

### 2.3 COMPONENTS

#### 2.3.1 Frames

Construct frames for sound-retardant wood swinging doors from formed sheet steel or structural shapes and bars. Provide sheet steel that is commercial quality, level, cold-rolled steel conforming to ASTM A1008/A1008M or hot-rolled, pickled and oiled steel conforming to ASTM A1011/A1011M. Steel shapes must comply with ASTM A36/A36M and steel bars must comply 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 (DFT) 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 mortise hardware as required by hardware manufacturer's template. Provide necessary reinforcement plates as required for surface-mounted hardware; installer to perform field-drilling and -tapping. Provide dust cover boxes on frame mortises. Provide minimum thicknesses as follows:

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- a. Butts: 3/16 inch
- b. Lock Strike: 0.1196 inch
- c. Surface-Applied Hardware: 0.0747 inch

#### 2.3.4 Jamb Anchors

Provide number and spacing of anchors as follows:

##### 2.3.4.1 Masonry Type

Locate anchors not more than 18 inches from top and bottom of frame.  
Space anchors not more than 32 inches on center and as follows:

- a) Three anchors per jamb from 60 to 90 inches in height.

##### 2.3.4.2 Stud-Wall Type

Locate anchors not more than 18 inches from top and bottom of frame.  
Space anchors not more than 32 inches on center and as follows:

- a) Four anchors per jamb from 60 to 90 inches in height.

##### 2.3.4.3 Post-Installed Expansion Type

Locate anchors not more than 6 inches from top and bottom of frame. Space anchors not more than 26 inches on center.

#### 2.3.5 Door Hardware

Provide the following STC related hardware with the door; cam-lift hinges, perimeter seals, door bottoms, thresholds, and hardware standoff brackets.

Include on Fabrication Drawings a finish hardware schedule for each door and a hollow-metal door frame schedule for each door indicating profile, dimensions, hardware reinforcement, and frame anchorage. Also indicate perimeter seals, door-bottom devices, and other hardware items that are assembled in the shop.

Refer to Section 08 71 00 DOOR HARDWARE for remaining hardware requirements.

#### 2.3.6 Vision Panels

Furnish doors with vision panels complete with glazing. Provide 0.0747-inch steel or wood frames, moldings, and stops to match the door finish, with profile indicated. Assemble with mitered corners and flush joints, and secured with countersunk Phillips-head screws.

Provide a single thickness of acoustical laminated glass, set in glazing gaskets and frames as required to meet the specified STC.

- a. Exception for Fire-Rated Door Openings: Provide fire-protection-rated laminated glazing with the specified STC -- that also complies with Section 08 81 00 ("Glazing") -- set in UL-listed frames.

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#### 2.3.7 Head and Jamb Seals

Provide self-aligning magnetic compression seals. Door shall be held in closed position by magnetic force or perimeter seals.

- a. Exception for Fire-Rated Door Openings: Seals must be UL-listed for scheduled fire resistance.

Install seals in formed steel or extruded-aluminum shapes designed to receive and hold seals and to provide concealed adjustable attachment to door frames. Provide concealed adjustment screws that are not more than 12 inches on center and provide at least 3/8-inch adjustment.

#### 2.3.8 Door Bottoms

Neoprene or silicone gasket held in place by metal housing; mortised into bottom edge of door.

##### 2.3.8.1 Automatic Door Bottoms

Neoprene or silicone gasket, held in place by metal housing, that automatically drops to form seal when door is closed; mounted to bottom edge of door with screws.

Mounting: Mortised or semi-mortised into bottom of door -- or surface mounted on face of door -- as required by testing to achieve STC rating specified.

#### 2.3.9 Thresholds

Provide flat, smooth, unfluted thresholds as recommended by manufacturer; fabricated from mill-finish aluminum or satin-finish stainless steel.

### 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 indicating that the sound transmission classification (STC) of the proposed door assembly, 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.

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#### 2.4.4 Guarantee

Provide written guarantee that each door delivered to the project is equal in construction, sound transmission classification (STC), and positive-pressure test rating where applicable, with appropriate labeling and markings, to that of the sample door tested. Clearly state in written guarantee that each door assembly, when installed in accordance with the manufacturer's printed instructions, has an in-place STC within 3 decibels of the specimen tested. Submit the following test data and Certificates with the written Guarantee:

- a. Acoustical Tests
- b. 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

Thoroughly clean surfaces of 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 and concrete wall construction. Spot-grout frames in gypsum-board 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 doors, hardware, and seals in accordance with the approved Shop Drawings, hardware schedules, and the printed instructions

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of the door manufacturer.

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

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

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

Install fire-rated wood doors and frames in accordance with NFPA 80.

Install components to manufacturer's written instructions. Coordinate with masonry, gypsum-board, and concrete 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 ASTC or NIC rating points below the specified laboratory STC rating. Examine, adjust, and retest any installation not meeting that criteria until compliance is obtained.

#### 3.3.1 Testing and Performance

Provide assemblies that are identical to those tested at an independent acoustical laboratory qualified under the National Voluntary Laboratory Accreditation Program (NVLAP) by the National Institute for Science and Technology (NIST) in accordance with ASTM E90 and ASTM E413. For the assembly test reports include the laboratory name, test report number, and date of test.

-- End of Section --



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## SECTION 08 51 13

## ALUMINUM WINDOWS

05/19

## PART 1 GENERAL

## 1.1 REFERENCES

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

## 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

AAMA 701/702 (2011) Voluntary Specification for Pile  
Weatherstripping and Replaceable  
Fenestration Weatherseals

AAMA 907 (2015) Voluntary Specification for  
Corrosion Resistant Coatings on Carbon  
Steel Components Used in Windows, Doors  
and Skylights

AAMA 1503 (2009) Voluntary Test Method for Thermal  
Transmittance and Condensation Resistance  
of Windows, Doors and Glazed Wall Sections

AAMA/WDMA/CSA 101/I.S.2/A440 (2017) North American Fenestration  
Standard/Specification for Windows, Doors,  
and Skylights

AMERICAN SOCIETY OF HEATING, REFRIGERATING AND AIR-CONDITIONING  
ENGINEERS (ASHRAE)

ASHRAE 169 (2013) Climate Data for Building Design  
Standards

## NATIONAL FENESTRATION RATING COUNCIL (NFRC)

NFRC 100 (2020) Procedure for Determining  
Fenestration Product U-Factors

NFRC 200 (2020) Procedure for Determining  
Fenestration Product Solar Heat Gain  
Coefficient and Visible Transmittance at  
Normal Incidence

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U.S. DEPARTMENT OF ENERGY (DOE)

Energy Star

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

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

Windows; G-AE

Fabrication Drawings

SD-03 Product Data

Windows; G-AE

Recycled Content of Aluminum Windows; S

Hardware; G-AE

Fasteners; G-AE

Window Performance; G-AE

Thermal-Barrier Windows; G-AE

Mullions; G

Weatherstripping; G-AE

Accessories; G

Adhesives

Thermal Performance; G-AE

SD-04 Samples

Finish Sample

Window Sample

SD-05 Design Data

Structural Calculations for Deflection; G

Design Analysis; G

SD-06 Test Reports

Minimum Condensation Resistance Factor

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## SD-10 Operation and Maintenance Data

### Windows, Data Package 1; G

Submit in accordance with Section 01 78 23 OPERATION AND  
MAINTENANCE DATA.

### Plastic Identification

## 1.3 QUALITY ASSURANCE

### 1.3.1 Qualification of Manufacturer

Window manufacturer must specialize in designing and manufacturing the type of aluminum windows specified in this section, and have a minimum of five (5) years of documented successful experience. Manufacturer must have the facilities capable of meeting contract requirements, single-source responsibility and warranty.

### 1.3.2 Shop Drawing Requirements

Take field measurements prior to preparation of drawings and fabrications. Provide drawings that indicate elevations of windows, full-size sections, thickness and gages of metal, fastenings, proposed method of anchoring, size and spacing of anchors, details of construction, method of glazing, details of operating hardware, mullion details, method and materials for weatherstripping, method of attaching screens, material and method of attaching subframes, stools, casings, sills, trim, installation details, and other related items.

### 1.3.3 Sample Requirements

#### 1.3.3.1 Finish Sample Requirements

Submit color chart of standard factory color coatings when factory-finish color coating is to be provided.

#### 1.3.3.2 Window Sample Requirements

Submit one full-size corner of each window type proposed for use. Where screens or weatherstripping is required, fit sample with such items that are to be used.

### 1.3.4 Design Data Requirements

Submit calculations to substantiate compliance with deflection requirements. A registered Professional Engineer must provide calculations.

Submit design analysis with calculations showing that the design of each different size and type of aluminum window unit and its anchorage to the structure. Calculations verifying the structural performance of each window proposed for use, under the given loads, must be prepared and signed by a registered professional engineer. Reflect the window components and anchorage devices to the structure, as determined by the design analysis, in the shop drawings.

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#### 1.3.5 Test Report Requirements

Submit test reports for each type of window attesting that identical windows have been tested and meet the requirements specified herein for conformance to AAMA/WDMA/CSA 101/I.S.2/A440 including test size, and minimum condensation resistance factor (CRF).

#### 1.3.6 Certification

Each prime window unit must bear the AAMA Label warranting that the product complies with AAMA/WDMA/CSA 101/I.S.2/A440. Certified test reports attesting that the prime window units meet the requirements of AAMA/WDMA/CSA 101/I.S.2/A440, including test size, will be acceptable in lieu of product labeling.

#### 1.4 DELIVERY AND STORAGE

Deliver windows to project site in an undamaged condition. Use care in handling and hoisting windows during transportation and at the jobsite. Store windows and components out of contact with the ground, under a weathertight covering, so as to prevent bending, warping, or otherwise damaging the windows. Repair damaged windows to an "as new" condition as approved. If windows can not be repaired, provide a new unit.

#### 1.5 PLASTIC IDENTIFICATION

Label plastic products provided to indicate their polymeric composition according to the following list. Where products are not labeled, provide product data indicating polymeric information in Operation and Maintenance Manual.

- a. Type 1: Polyethylene Terephthalate (PET, PETE).
- b. Type 2: High Density Polyethylene (HDPE).
- c. Type 3: Vinyl (Polyvinyl Chloride or PVC).
- d. Type 4: Low Density Polyethylene (LDPE).
- e. Type 5: Polypropylene (PP).
- f. Type 6: Polystyrene (PS).
- g. Type 7: Other. Use of this code indicates that the package in question is made with a resin other than the six listed above, or is made of more than one resin listed above, and used in a multi-layer combination.

#### 1.6 PERFORMANCE REQUIREMENTS

##### 1.6.1 Wind Loading Design Pressure

Design window components, including mullions, hardware, and anchors, to withstand a wind-loading design pressure as indicated in the Structural drawings.

##### 1.6.2 Tests

Test windows proposed for use in accordance with

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AAMA/WDMA/CSA 101/I.S.2/A440 for the particular type and quality window specified.

Perform tests by a nationally recognized independent testing laboratory equipped and capable of performing the required tests. Submit the results of the tests as certified laboratory reports required herein.

Minimum design load for a uniform-load structural test must be 50 psf.

#### 1.7 DRAWINGS

Submit the Fabrication Drawings for aluminum window units showing complete window assembly including hardware, weatherstripping, and subframe assembly details.

#### 1.8 WINDOW PERFORMANCE

Aluminum windows must meet the following performance requirements. Perform testing requirements by an independent testing laboratory or agency.

##### 1.8.1 Structural Performance

Structural test pressures on window units must be for positive load (inward) and negative load (outward). After testing, there will be no glass breakage, permanent damage to fasteners, hardware parts, support arms or actuating mechanisms or any other damage which could cause window to be inoperable. There must be no permanent deformation of any main frame, sash or ventilator member in excess of the requirements established by AAMA/WDMA/CSA 101/I.S.2/A440 for the window types and classification specified in this section.

##### 1.8.2 Air Infiltration

Air infiltration must not exceed the amount established by AAMA/WDMA/CSA 101/I.S.2/A440 for each window type.

##### 1.8.3 Water Penetration

Water penetration must not exceed the amount established by AAMA/WDMA/CSA 101/I.S.2/A440 for each window type.

##### 1.8.4 Thermal Performance

Windows (including frames and glass) will be independently tested and certified with a Solar Heat Gain Coefficient (SHGC) determined according to NFRC 200 procedures and a whole window U-factor determined in accordance with NFRC 100 within the ranges as indicated below according to the ASHRAE 169 Climate Zone of the project location. Windows used solely within the interior of a conditioned envelope are exempted from meeting U-Factor and SHGC requirements, unless otherwise noted. Provide visual Transmittance (VT) of 0.5 or greater. Submit documentation supporting compliance with Energy Star, FEMP designated, and Passive House qualifications as applicable.

###### 1.8.4.1 Northern Climate

Windows installed within Climate Zone 5 will have a U-Factor of 0.27 BTU/h·ft<sup>2</sup>·degrees F or less and a SHGC of 0.36 or less.

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#### 1.8.4.2 Subarctic Climate

#### 1.9 WARRANTY

Provide Manufacturer's standard performance guarantees or warranties that extend beyond a 1 year period.

### PART 2 PRODUCTS

#### 2.1 WINDOWS

Provide prime windows that comply with AAMA/WDMA/CSA 101/I.S.2/A440 and the requirements specified herein. In addition to compliance with AAMA/WDMA/CSA 101/I.S.2/A440, window framing members for each individual light of glass must not deflect to the extent that deflection perpendicular to the glass light exceeds L/175 of the glass edge length when subjected to uniform loads at specified design pressures. Provide Structural calculations for deflection to substantiate compliance with deflection requirements. Provide windows of types, performance classes, performance grades, combinations, and sizes indicated or specified. Provide aluminum window frames with a minimum recycled content of 20 percent. Provide data identifying percentage of recycled content of aluminum windows. Design windows to accommodate hardware, glass, weatherstripping, screens, and accessories to be furnished. Each window must be a complete factory assembled unit with or without glass installed. Dimensions shown are minimum. Provide windows with insulating glass and thermal break necessary to achieve a minimum Condensation Resistance Factor (CRF) of 45 when tested in accordance with AAMA 1503. Provide manufacturer's standard hardware fabricated from aluminum, stainless steel, carbon steel complying with AAMA 907, or other corrosion-resistant material compatible with adjacent materials; designed to smoothly operate, tightly close, and securely lock windows, and sized to accommodate sash weight and dimensions.

##### 2.1.1 Glass and Glazing

Materials are specified in Section 08 81 00 GLAZING.

##### 2.1.2 Caulking and Sealing

Are specified in Section 07 92 00 JOINT SEALANTS.

##### 2.1.3 Weatherstripping

AAMA/WDMA/CSA 101/I.S.2/A440. Provide for all ventilating (operable) sash for all windows. Provide woven wool pile weatherstripping 0.210 inch thick, conforming to AAMA 701/702, or polypropylene multifilament fiber weatherstripping installed in an integral weatherstripping groove in the sash or frame, and flexible polyvinylchloride weatherstripping installed in the sill member.

#### 2.2 FABRICATION

Fabrication of window units must comply with AAMA/WDMA/CSA 101/I.S.2/A440.

##### 2.2.1 Provisions for Glazing

Design windows and rabbets suitable for glass thickness shown or specified.

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Design sash for outside double glazing.

#### 2.2.2 Fasteners

Use window manufacturer's standard for windows, trim, and accessories. Self-tapping sheet-metal screws are not acceptable for material more than 1/16 inch thick.

#### 2.2.3 Adhesives

Provide joint sealants as specified in Section 07 92 00 JOINT SEALANTS. For interior application of joint sealants, comply with applicable regulations regarding reduced VOC's, and as specified in Section 07 92 00 JOINT SEALANTS.

#### 2.2.4 Drips and Weep Holes

Provide continuous drips over heads of top ventilators. Where fixed windows adjoin ventilators, drips must be continuous across tops of fixed windows. Provide drips and weep holes as required to return water to the outside.

#### 2.2.5 Accessories

Provide windows complete with necessary hardware, fastenings, clips, fins, anchors, glazing beads, and other appurtenances necessary for complete installation and proper operation. Furnish extruded aluminum subframe receptors and subsill with each window unit.

##### 2.2.5.1 Hardware

AAMA/WDMA/CSA 101/I.S.2/A440. The item, type, and functional characteristics must be the manufacturer's standard for the particular window type. Provide hardware of suitable design and of sufficient strength to perform the function for which it is used. Equip all operating ventilators with a lock or latching device which can be secured from the inside.

##### 2.2.5.2 Fasteners

Provide concealed anchors of the type recommended by the window manufacturer for the specific type of construction. Anchors and fasteners must be compatible with the window and the adjoining construction. Provide a minimum of three anchors for each jamb located approximately 6 inches from each end and at midpoint.

##### 2.2.5.3 Window Anchors

Anchoring devices for installing windows must be made of aluminum, cadmium-plated steel, stainless steel, or zinc-plated steel conforming to AAMA/WDMA/CSA 101/I.S.2/A440.

#### 2.2.6 Finishes

Comply with NAAMM's "Metal Finishes Manual" for applying and designating finishes. Exposed aluminum surfaces must be factory finished with an anodic coating. Color must be as indicated. All windows must have the same finish.

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#### 2.2.6.1 Anodic Coating

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

- a. Architectural Class II ( 0.4 mil to 0.7 mil), designation AA-M10-C22-A34, electrolytically deposited color anodized.

#### 2.3 THERMAL-BARRIER WINDOWS

Provide thermal-barrier windows, complete with accessories and fittings, where indicated.

Specify material and construction except as follows:

- a. Aluminum alloy must be 6063-T6.
- b. Frame construction, including operable sash, must be factory-assembled and factory-sealed inner and outer aluminum completely separated from metal-to-metal contact. Join assembly by a continuous, concealed, low conductance divider housed in an interlocking extrusion of the inner frame. Metal fasteners, straps, or anchors must not bridge the connection between the inner and outer frame.
- c. Operating hardware for each sash must consist of spring-loaded nylon cushion blocks and pin locks designed to lock in predetermined locations.
- d. Sash must be completely separated from metal-to-metal contact by means of woven-pile weatherstripping, plastic, or elastomeric separation members.
- e. Operating and storm sash must be factory-glazed with the type of glass indicated and of the quality specified in Section 08 81 00 GLAZING.

#### 2.4 MULLIONS

Provide mullions between multiple-window units where indicated.

Provide profiles for mullions and mullion covers, reinforced as required for the specified wind loading, and securely anchored to the adjoining construction. Mullion extrusion will include serrations or pockets to receive weatherstripping, sealant, or tape at the point of contact with each window flange.

Mullion assembly must include aluminum window clamps or brackets screwed or bolted to the mullion and the mullion cover.

Mullion cover must be screw-fastened to the mullion unless otherwise indicated.

Mullion reinforcing members must be fabricated of the materials specified in AAMA/WDMA/CSA 101/I.S.2/A440 and meet the specified design loading.



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## PART 3 EXECUTION

### 3.1 INSTALLATION

#### 3.1.1 Method of Installation

Install in accordance with the window manufacturer's printed instructions and details. Build in windows as the work progresses or install without forcing into prepared window openings. Set windows at proper elevation, location, and reveal; plumb, square, level, and in alignment; and brace, strut, and stay properly to prevent distortion and misalignment. Protect ventilators and operating parts against accumulation of dirt and building materials by keeping ventilators tightly closed and locked to frame. Bed screws or bolts in sill members, joints at mullions, contacts of windows with sills, built-in fins, and subframes in mastic sealant of a type recommended by the window manufacturer. Install and caulk windows in a manner that will prevent entrance of water and wind. Fasten insect screens securely in place.

Any materials that show visual evidence of biological growth due to the presence of moisture must not be installed on the building project.

#### 3.1.2 Dissimilar Materials

Where aluminum surfaces are in contact with, or fastened to masonry, concrete, wood, or dissimilar metals, except stainless steel or zinc, protect the aluminum surface from dissimilar materials as recommended in the Appendix to AAMA/WDMA/CSA 101/I.S.2/A440. Do not coat surfaces in contact with sealants after installation with any type of protective material. Do not apply coatings or lacquers to surfaces to which caulking and glazing components must adhere.

#### 3.1.3 Anchors and Fastenings

Make provision for securing units to each other, to masonry, and to other adjoining construction. Windows installed in masonry walls must have head and jamb members designed to recess into masonry wall not less than 7/16 inch.

#### 3.1.4 Adjustments After Installation

After installation of windows and completion of glazing and field painting, adjust all ventilators and hardware to operate smoothly and to provide weathertight sealing when ventilators are closed and locked. Lubricate hardware and operating parts as necessary. Verify that products are properly installed, connected, and adjusted.

### 3.2 CLEANING

Clean interior and exterior surfaces of window units of mortar, plaster, paint spattering spots, and other foreign matter to present a neat appearance, to prevent fouling of weathering surfaces and weather-stripping, and to prevent interference with the operation of hardware. Replace all stained, discolored, or abraded windows that cannot be restored to their original condition with new windows.

-- End of Section --

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## SECTION 08 60 45

### TRANSLUCENT PANELS

08/20

#### PART 1 GENERAL

##### 1.1 SUMMARY

Provide commercially available translucent fiberglass sandwich panel wall systems which satisfy all requirements contained in this section and have been verified by load testing and independent design analyses (if required) to meet specified design requirements. Provide UV-stabilized, shatterproof and energy efficient panel systems. Provide light transmitting fiberglass reinforced translucent face sheets in the manufacturing of panel systems for daylighting applications. Systems must meet requirements of UFC 4-010-01.

##### 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.

#### 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

AAMA/WDMA/CSA 101/I.S.2/A440 (2017) North American Fenestration  
 Standard/Specification for Windows, Doors,  
 and Skylights

#### ASTM INTERNATIONAL (ASTM)

ASTM C297/C297M (2016) Flatwise Tensile Strength of  
 Sandwich Constructions

ASTM D572 (2004; R 2019) Rubber Deterioration by  
 Heat and Oxygen

ASTM D1002 (2010; R 2019) Apparent Shear Strength of  
 Single-Lap-Joint Adhesively Bonded Metal  
 Specimens by Tension Loading  
 (Metal-to-Metal)

ASTM D1003 (2013) Haze and Luminous Transmittance of  
 Transparent Plastics

ASTM D1037 (2012) Evaluating Properties of Wood-Base  
 Fiber and Particle Panel Materials

ASTM D2244 (2016) Standard Practice for Calculation

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of Color Tolerances and Color Differences  
 from Instrumentally Measured Color  
 Coordinates

ASTM D3841	(2016) Standard Specification for Glass Fiber-Reinforced Polyester Plastic Panels
ASTM E72	(2015) Conducting Strength Tests of Panels for Building Construction
ASTM E283	(2019) Standard Test Method for Determining the Rate of Air Leakage Through Exterior Windows, Curtain Walls, and Doors Under Specified Pressure Differences Across the Specimen
ASTM E331	(2000; R 2016) Standard Test Method for Water Penetration of Exterior Windows, Skylights, Doors, and Curtain Walls by Uniform Static Air Pressure Difference
ASTM E661	(2003;R 2015; E 2015) Standard Test Method for Performance of Wood and Wood-Based Floor and Roof Sheathing Under Concentrated Static and Impact Loads
ASTM E695	(2003; R 2015; E 2015) Measuring Relative Resistance of Wall, Floor, and Roof Construction to Impact Loading

#### 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
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#### ICC EVALUATION SERVICE, INC. (ICC-ES)

ICC-ES AC04	(2012; R 2015) Acceptance Criteria for Sandwich Panels
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#### NATIONAL FENESTRATION RATING COUNCIL (NFRC)

NFRC 100	(2020) Procedure for Determining Fenestration Product U-Factors
NFRC 200	(2020) Procedure for Determining Fenestration Product Solar Heat Gain Coefficient and Visible Transmittance at Normal Incidence

#### U.S. DEPARTMENT OF DEFENSE (DOD)

UFC 4-010-01	(2018; with Change 1, 2020; Change 2, 2022) DoD Minimum Antiterrorism Standards for Buildings
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#### U.S. GREEN BUILDING COUNCIL (USGBC)

LEED v4 BDC Ref Guide (2013; R 2020) USGBC LEED Reference Guide  
 for Building Design and Construction, v4

LEED v4.1 BDC Ref Guide (2023) LEED v4.1 Building Design and  
 Construction Reference Guide

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

29 CFR 1910.23 (Nov 2016) Ladders

#### UNDERWRITERS LABORATORIES (UL)

UL 972 (2006; Reprint Nov 2020) UL Standard for  
 Safety Burglary Resisting Glazing Material  
 Type

### 1.3 SUSTAINABILITY REPORTING

Work of this section is intended to contribute to the achievement of, or compliance with, the requirements of the Guiding Principles Validation and LEED Prerequisites and attempted Credits. Refer to Section 01 33 29.00 06 SUSTAINABILITY REPORTING for specific documentation requirements and list of Prerequisites, attempted Credits and LEED version.

Comply with product, material content, performance criteria, activity, documentation, and other technical requirements as described in the LEED v4 BDC Ref Guide or LEED v4.1 BDC Ref Guide as applicable.

Collect, organize, and submit product data, drawings, diagrams, photos and cost information necessary to demonstrate compliance with LEED v4 BDC Ref Guide or LEED v4.1 BDC Ref Guide requirements as applicable.

Data collection shall commence with the notice to proceed and will only be deemed complete upon acceptance of the Final Sustainability Notebook and LEED Online submission by the Contracting Officer, the LEED Project Administrator, and the Green Building Certification Institute.

### 1.4 SUBMITTALS

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

SD-02 Shop Drawings

Shop Drawings; G, AE

SD-03 Product Data

Translucent Panels; G, AE

Recycled Content for Aluminum Framing Materials; S

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Environmental Product Declarations; S

Embodied Carbon Optimization Report/Action Plan; S

Extended Producer Responsibility; S

Local/Regional Materials; S

Material Ingredient Reporting; S

Low-Emitting Materials; S

Warranty

SD-06 Test Reports

Test Reports

SD-07 Certificates

Systems

Qualifications

## 1.5 SUSTAINABLE DESIGN REQUIREMENTS

### 1.5.1 Environmental Product Declarations

At a minimum, use materials or products with an Environmental Product Declaration in accordance with the LEED Implementation Plan. See Section 01 33 29.00 06 SUSTAINABILITY REPORTING for cumulative materials requirements and LEED Implementation Plan.

### 1.5.2 Embodied Carbon Optimization Report/Action Plan

At a minimum, use materials or products with an Embodied Carbon Optimization Report/Action Plan in accordance with the LEED Implementation Plan. See Section 01 33 29.00 06 SUSTAINABILITY REPORTING for cumulative materials requirements and LEED Implementation Plan.

### 1.5.3 Sourcing of Raw Materials

Provide products that meet one or more of the following categories:

#### 1.5.3.1 Extended Producer Responsibility

At a minimum, use materials or products from manufacturers that participate in an extended producer responsibility program in accordance with the LEED Implementation Plan. Provide manufacturer letter verifying extended producer responsibility program is in place and that product is eligible. See Section 01 33 29.00 06 SUSTAINABILITY REPORTING for cumulative materials requirements and LEED Implementation Plan.

#### 1.5.3.2 Recycled Content Materials

At a minimum, use materials or products with recycled content in accordance with the LEED Implementation Plan. Provide manufacturers product literature identifying the percentage of recycled material incorporated within each product used. See Section 01 33 29.00 06

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SUSTAINABILITY REPORTING for cumulative materials requirements and LEED Implementation Plan. If recycled content minimum is specified in this section, the greater of the two percentages governs.

#### 1.5.4 Material Ingredient Reporting

At a minimum, use materials or products with chemical inventory to at least 0.1% (1000 ppm) in accordance with the LEED Implementation Plan. Provide Health Product Declaration (HPD), Cradle to Cradle Certificate, Declare label, or other manufacturer's published content inventory in compliance with LEED v4.1 Material Ingredient Reporting credit. See Section 01 33 29.00 06 SUSTAINABILITY REPORTING for cumulative materials requirements and LEED Implementation Plan.

#### 1.5.5 Local/Regional Materials

Use materials or products extracted, harvested, or recovered, as well as manufactured, within a 100 mile radius from the project site, if available from a minimum of three sources. provide a letter from the manufacturer stating the extraction location, manufacturing location, and purchasing location of the products provided, referencing the project name and location specifically and distance to the project site. See Section 01 33 29.00 06 SUSTAINABILITY REPORTING for cumulative materials requirements and LEED Implementation Plan.

#### 1.5.6 Low-Emitting Materials

Use translucent panel products with an interior that complies with LEED v4.1 BDC Ref Guide requirements for emissions. Submit manufacturer's documentation that translucent panels are inherently nonemitting or comply with CDPH SECTION 01350 for emissions. See Section 01 33 29.00 06 SUSTAINABILITY REPORTING for low-emitting material requirements.

### 1.6 QUALITY ASSURANCE

- a. Provide documentation of Qualifications for the following: The manufacturer is a company specializing in the manufacture of the specified products with a minimum of 10 years documented experience. The installer has documented experience of 5 years minimum performing the work specified.
- b. Before fabrication, provide a full service mock-up of one translucent panel unit complete with glass and AAMA certification label for structural purposes and NFRC temporary and Permanent Label for certification of thermal performance rating for review of skylight construction and quality of hardware operation.

### 1.7 DELIVERY, STORAGE, AND HANDLING

Provide factory assembled system modules to the greatest extent possible. Ship panels to the jobsite in rugged shipping units, ready for erection. Affix conspicuous decals on all translucent panels warning individuals against sitting or stepping on the units. Store translucent panels on the long edge, several inches above the ground, blocked and under cover to prevent warping. Deliver units in manufacturer's original containers, dry, undamaged, with seals and labels intact. Deliver, store and protect all products in accordance with manufacturer's recommendations.

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## 1.8 WARRANTY

Provide the manufacturer's complete warranty for materials, workmanship, and installation. The warranty is for 5 years from the time of project completion and with no proration. The warranty must guarantee, but not be limited to, the following:

- a. No change in light transmission and color of the panels after exposure to heat of 300 degrees F for 25 minutes. In accordance with ASTM D2244, panels do not darken more than 3.0 Delta E units after 5 years of outdoor weathering in South Florida at 45 degrees facing south. Document compliance with this requirement in submitted Test Reports.
- b. There is no delamination of the panel affecting appearance, performance, weatherability or structural integrity of the panels or the completed system.
- c. There is no fiberbloom on the panel face.
- d. Change in light transmission of no more than 6 percent in accordance with ASTM D1003, and in color (yellowing index) no more than 10 points in comparison to the original specified value over a 10 year period.
- e. Provide a single source warranty for the glazing panels and the framing system. Third party warranty for the glazing panels will not be accepted.

## PART 2 PRODUCTS

### 2.1 TRANSLUCENT PANELS

Fabricate panels of glass-fiber reinforced polyester conforming to the specified requirements and other appropriate lab test specified criteria. Submit certified Test Reports from independent testing laboratory for each type and class of panel system. Reports must verify that the material meets specified performance requirements. Previously completed test reports will be acceptable if they are current and indicative of products used on this project. Size and color of panels as indicated.

### 2.2 GLASS-FIBER PANELS

Provide glass-fiber reinforced polyester panels conforming to ASTM D3841, Class CC1 and to the requirements of AAMA/WDMA/CSA 101/I.S.2/A440.

#### 2.2.1 Weatherability

Provide the exposed faces of fiberglass sandwich type panels with a permanent glass veil erosion barrier embedded integrally to provide maximum long term resistance to reinforcing fiber exposure. The exterior face sheet must be uniform in strength and resistant to penetration by pencil point.

#### 2.2.2 Non Combustible Grid Core

Use 6063-T6 aluminum I-beams with provisions for mechanical interlocking of muntin-mullion and perimeter to prevent high and low intersections which do not allow full bonding surface to contact with face material. I-beam width no less than 7/16 inch. Machine I-beam grid to tolerances of not greater than plus or minus 0.002 inch for flat panels. Panels must

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withstand 1200 degrees F fire for a minimum of one hour without collapse or exterior flaming.

#### 2.2.3 Adhesive

Use heat and pressure resin-type laminate adhesive engineered for structural sandwich panel use; which passes testing requirements specified by the International Conference of Building Officials' "Acceptance Criteria for Sandwich Panel Adhesive". Provide with the following minimum strength:

- a. Tensile Strength of 750 psi in accordance with ASTM C297/C297M after two exposures to six cycles each of the aging conditions prescribed in ASTM D1037.
- b. Shear Strength, after exposure to five separate aging conditions in accordance with ASTM D1002:
  - (1) 540 psi at 50 percent relative humidity and 73 degrees F.
  - (2) 800 psi under accelerated aging in accordance with ASTM D1037 at room temperature.
  - (3) 250 psi under accelerated aging in accordance with ASTM D1037 at 182 degrees F.
  - (4) 1400 psi after 500 hour Oxygen Bomb in accordance with ASTM D572.
  - (5) 100 psi at 182 degrees F.

#### 2.2.4 Panel Construction

Provide panels consisting of fiberglass faces laminated to an aluminum I-beam grid core and deflecting no more than 1.9 inches at 30 psf in 10 feet in accordance with ASTM E72, without a supporting frame. Include manufacturing facilities, sandwich panel components and production sandwich panels in the quality control inspections and required testing, conducted at least once each year, for conformance with ICC-ES AC04 or equivalent. Provide aluminum framing materials with a minimum recycled content of 20 percent. Provide data identifying percentage of recycled content for aluminum framing materials.

### 2.3 COMMON PANEL REQUIREMENTS

#### 2.3.1 Appearance

Provide face sheets uniform in color to prevent splotchy appearance and completely free of ridges and wrinkles which prevent proper surface contact. Clusters of air bubbles/pinholes which collect moisture and dirt are not acceptable.

#### 2.3.2 Panel Fabrication

Panel construction must meet the following requirements:

- a. Light transmission 35 percent; color Crystal.
- b. Assembled panel thickness 2-3/4 inches.



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- c. Grid size as indicated.

### 2.3.3 Thermal Performance

Provide non-residential translucent panel system (including frames and glass) certified by the National Fenestration Rating Council with a whole-unit Solar Heat Gain Coefficient (SHGC) maximum of 0.39 determined according to NFRC 200 procedures and a U-factor maximum of 0.23 Btu/hr-ft<sup>2</sup>-F in accordance with NFRC 100.

### 2.3.4 Condensation Index Rating

The condensation index rating must be 80 as determined using National Fenestration Rating Council approved software THERM.

## 2.4 TRANSLUCENT PANEL SYSTEMS

Submit manufacturer's certificate that the systems meet or exceed specified requirements. Provide systems evaluated and listed (the whole and translucent panel as a unit, not just a glazing material in the unit) by the recognized building code authorities: ICC and SBCCI-Public Safety Testing and Evaluation Services Inc. Product ratings determined using NFRC 100 and NFRC 200 must be authorized for certification and properly labeled by the manufacturer. Provide translucent panel systems meeting the following requirements:

- a. Integral perimeter framing system assembly by the manufacturer.
- b. Exterior panel faces crystal in color. Interior panel faces crystal in color.
- c. Air infiltration at 1.57 psf less than 0.04 cfm/ft<sup>2</sup> and at 6.24 psf less than 0.1 cfm/ft<sup>2</sup> in accordance with ASTM E283.
- d. Water penetration at test pressure of 15 psf equals zero in accordance with ASTM E331.
- e. Manufacturer is responsible for maximum system deflection, in accordance with the applicable building code, and without damage to system performance. Calculate deflection in accordance with engineering principles.
- f. Incorporate weepage elements within the perimeter framework of the glazing system for drainage of any condensation or water penetration.
- g. System must accommodate movement within the system; movement between the system and perimeter framing components; dynamic loading and release of loads; and deflection of supporting members. Achieve this without damage to system or components, deterioration of weather seals and fenestration properties specified.
- h. The exterior panel face must repel an impact of 50 foot-pounds without fracture or tear when impacted by a 3.25 inch diameter, 5 pound free falling ball dropped from a vertical distance of 10 feet when tested in accordance with UL 972.
- i. Provide system meeting the fall through requirements of 29 CFR 1910.23 as demonstrated by testing in accordance with ASTM E661 or ASTM E695,

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thereby not requiring supplemental screens or railings.

- j. Exposed aluminum color must be selected from the manufacturer's standard range. Provide corrosion resistant anodized finish complying with AA DAF45 and AAMA 611 must be Architectural Class I (0.7 mil or thicker), designation AA-M10-C22-A42, integral dark bronze color anodized.
- k. Provide a system requiring no scheduled recoating to maintain its performance or for UV resistance.
- l. Design criteria:
  - (1) Wind Load as indicated on Structural Drawings.
  - (2) Frame Blast Loads: Design framing to resist 50 pounds per square foot blast load at L/160 deflection.
  - (3) Anchor Blast Loads: Design anchors to resist 100 pounds per square foot blast load.
- m. Use 6063-T6 and 6063-T5 extruded aluminum; all fasteners of stainless steel or plated steel.

## 2.5 FLEXIBLE SEALING TAPE

Provide manufacturer's standard pre-applied sealing tape to closure system at the factory under controlled conditions.

## PART 3 EXECUTION

### 3.1 EXAMINATION

Field verify all submitted opening sizes, dimensions and tolerances; preparation of openings includes isolating dissimilar materials from aluminum system to avoid damage by electrolysis. The installer must examine area of installation to verify readiness of site conditions and to notify the Contractor about any defects requiring correction. Verify when structural support is ready to receive all specified work and to convene a pre-installation conference, if approved by the Contracting Officer, including the Contractor, skylight installer and all parties directly affecting and affected by the specified work. Do not install any materials that show visual evidence of biological growth due to the presence of moisture. Do not commence work until conditions are satisfactory.

### 3.2 ERECTION

Erect translucent skylight system in accordance with the approved shop drawings supplied by the manufacturer. Submit drawings showing fabrication details, materials, dimensions, installation methods, anchors, and relationship to adjacent construction. Fasten and seal in accordance with the manufacturer's shop drawings. Remove all panel, after other trades have completed work on adjacent materials. Carefully inspect and adjust panel installation as necessary to ensure proper installation and weather-tight conditions. provide all staging, lifts and hoists required for the complete installation and field measuring. Install system clean of dirt, debris or staining and thoroughly examined for removal of all protective material prior to final inspection of the designated work area. Do not use snow rakes on roof windows or skylights.

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-- End of Section --

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## SECTION 08 71 00

## DOOR HARDWARE

02/16, CHG 3: 08/20

## PART 1 GENERAL

## 1.1 REFERENCES

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

## ASTM INTERNATIONAL (ASTM)

ASTM E283	(2019) Standard Test Method for Determining the Rate of Air Leakage Through Exterior Windows, Curtain Walls, and Doors Under Specified Pressure Differences Across the Specimen
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## 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	(2015) Architectural Door Trim
ANSI/BHMA A156.7	(2016) Template Hinge Dimensions
ANSI/BHMA A156.8	(2021) Door Controls - Overhead Stops and Holders
ANSI/BHMA A156.10	(2017) Power Operated Pedestrian Doors
ANSI/BHMA A156.13	(2017) Mortise Locks & Latches Series 1000
ANSI/BHMA A156.15	(2021) Release Devices Closer Holder, Electromagnetic and Electromechanical
ANSI/BHMA A156.16	(2018) Auxiliary Hardware
ANSI/BHMA A156.17	(2019) Self Closing Hinges & Pivots
ANSI/BHMA A156.18	(2020) Materials and Finishes
ANSI/BHMA A156.19	(2013) Power Assist & Low Energy Power Operated Doors
ANSI/BHMA A156.21	(2019) Thresholds
ANSI/BHMA A156.22	(2017) Door Gasketing and Edge Seal Systems

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ANSI/BHMA A156.23	(2010) Electromagnetic Locks
ANSI/BHMA A156.24	(2012) Delayed Egress Locking Systems
ANSI/BHMA A156.25	(2013) Electrified Locking Devices
ANSI/BHMA A156.26	(2012) Continuous Hinges
ANSI/BHMA A156.31	(2013) Electric Strikes and Frame Mounted Actuators
ANSI/BHMA A156.36	(2010) Auxiliary Locks

#### NATIONAL FIRE PROTECTION ASSOCIATION (NFPA)

NFPA 70	(2020; ERTA 20-1 2020; ERTA 20-2 2020; TIA 20-1; TIA 20-2; TIA 20-3; TIA 20-4) National Electrical Code
NFPA 72	(2019; TIA 19-1; ERTA 1 2019; TIA 21-1; ERTA 1 2021) National Fire Alarm and Signaling Code
NFPA 80	(2019) Standard for Fire Doors and Other Opening Protectives
NFPA 101	(2021) Life Safety Code
NFPA 252	(2017) Standard Methods of Fire Tests of Door Assemblies

#### STEEL DOOR INSTITUTE (SDI/DOOR)

SDI/DOOR A250.8	(2017) Specifications for Standard Steel Doors and Frames
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#### U.S. GREEN BUILDING COUNCIL (USGBC)

LEED v4 BDC Ref Guide	(2013; R 2020) USGBC LEED Reference Guide for Building Design and Construction, v4
LEED v4.1 BDC Ref Guide	(2023) LEED v4.1 Building Design and Construction Reference Guide

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

36 CFR 1191	Americans with Disabilities Act (ADA) Accessibility Guidelines for Buildings and Facilities; Architectural Barriers Act (ABA) Accessibility Guidelines
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#### UNDERWRITERS LABORATORIES (UL)

UL Bld Mat Dir	(updated continuously online) Building Materials Directory
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## 1.2 SUSTAINABILITY REPORTING

Work of this section is intended to contribute to the achievement of, or compliance with, the requirements of the Guiding Principles Validation and LEED Prerequisites and attempted Credits. Refer to Section 01 33 29.00 06 SUSTAINABILITY REPORTING for specific documentation requirements and list of Prerequisites, attempted Credits and LEED version.

Comply with product, material content, performance criteria, activity, documentation, and other technical requirements as described in the LEED v4 BDC Ref Guide or LEED v4.1 BDC Ref Guide as applicable.

Collect, organize, and submit product data, drawings, diagrams, photos and cost information necessary to demonstrate compliance with LEED v4 BDC Ref Guide or LEED v4.1 BDC Ref Guide requirements as applicable.

Data collection shall commence with the notice to proceed and will only be deemed complete upon acceptance of the Final Sustainability Notebook and LEED Online submission by the Contracting Officer, the LEED Project Administrator, and the Green Building Certification Institute.

## 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

Manufacturer's Detail Drawings; G, AE

Verification of Existing Conditions; G

Hardware Schedule; G, AE

Keying System; G, AE

### SD-03 Product Data

Hardware Items; G, AE

Environmental Product Declarations; S

Embodied Carbon Optimization Report/Action Plan; S

Extended Producer Responsibility; S

Local/Regional Materials; S

Material Ingredient Reporting; S

### SD-08 Manufacturer's Instructions

Installation

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#### SD-10 Operation and Maintenance Data

Hardware Schedule Items, Data Package 1; G, AE

#### SD-11 Closeout Submittals

##### Key Bitting

### 1.4 SUSTAINABLE DESIGN REQUIREMENTS

#### 1.4.1 Environmental Product Declarations

At a minimum, use materials or products with an Environmental Product Declaration in accordance with the LEED Implementation Plan. See Section 01 33 29.00 06 SUSTAINABILITY REPORTING for cumulative materials requirements and LEED Implementation Plan.

#### 1.4.2 Embodied Carbon Optimization Report/Action Plan

At a minimum, use materials or products with an Embodied Carbon Optimization Report/Action Plan in accordance with the LEED Implementation Plan. See Section 01 33 29.00 06 SUSTAINABILITY REPORTING for cumulative materials requirements and LEED Implementation Plan.

#### 1.4.3 Sourcing of Raw Materials

Provide products that meet one or more of the following categories:

##### 1.4.3.1 Extended Producer Responsibility

At a minimum, use materials or products from manufacturers that participate in an extended producer responsibility program in accordance with the LEED Implementation Plan. Provide manufacturer letter verifying extended producer responsibility program is in place and that product is eligible. See Section 01 33 29.00 06 SUSTAINABILITY REPORTING for cumulative materials requirements and LEED Implementation Plan.

##### 1.4.4 Material Ingredient Reporting

At a minimum, use materials or products with chemical inventory to at least 0.1% (1000 ppm) in accordance with the LEED Implementation Plan. Provide Health Product Declaration (HPD), Cradle to Cradle Certificate, Declare label, or other manufacturer's published content inventory in compliance with LEED v4.1 Material Ingredient Reporting credit. See Section 01 33 29.00 06 SUSTAINABILITY REPORTING for cumulative materials requirements and LEED Implementation Plan.

##### 1.4.5 Local/Regional Materials

Use materials or products extracted, harvested, or recovered, as well as manufactured, within a 100 mile radius from the project site, if available from a minimum of three sources. provide a letter from the manufacturer stating the extraction location, manufacturing location, and purchasing location of the products provided, referencing the project name and location specifically and distance to the project site. See Section 01 33 29.00 06 SUSTAINABILITY REPORTING for cumulative materials requirements and LEED Implementation Plan.

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### 1.5 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.

### 1.6 PRODUCT DATA

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

### 1.7 HARDWARE SCHEDULE

Prepare and submit hardware schedule in the following form:

Hardware Item	Quantity	Size	Reference Publication Type No.	Finish	Mfr Name and Catalog No.	Key Control Symbols	UL Mark (If fire-rated and listed)	BHMA Finish Designation

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

### 1.8 KEY BITTING CHART REQUIREMENTS

#### 1.8.1 Requirements

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

- Complete listing of all keys (e.g. AA1 and AA2).
- Complete listing of all key cuts (AA1-123456, AA2-123458).
- Tabulation showing which key fits which door.
- Copy of floor plan showing doors and door numbers.
- Listing of 20 percent more key cuts than are presently required in each master system.

### 1.9 QUALITY ASSURANCE

#### 1.9.1 Hardware Manufacturers and Modifications

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



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### 1.9.2 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.

### 1.10 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 FIRE DOORS AND EXIT DOORS

Provide all hardware necessary to meet the requirements of NFPA 72 for door alarms, NFPA 80 for fire doors, NFPA 101 for exit doors, NFPA 252 for fire tests of door assemblies, ABA/ADA accessibility requirements, and all other requirements indicated, even if such hardware is not specifically mentioned in paragraph HARDWARE SCHEDULE. Provide Underwriters Laboratories, Inc. labels for such hardware in accordance with UL Bld Mat Dir or equivalent labels in accordance with another testing laboratory approved in writing by the Contracting Officer.

### 2.3 HARDWARE ITEMS

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

#### 2.3.1 Hinges

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

#### 2.3.2 Continuous Hinges

Where continuous hinges are required, provide in accordance with ANSI/BHMA A156.26.

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### 2.3.3 Pivots

Provide in accordance with ANSI/BHMA A156.17.

### 2.3.4 Locks and Latches

- a. At exterior locations provide locksets of full stainless steel type 302 or 304 construction including fronts, strike, escutcheons, knobs, bolts and all interior working parts. Marine Grade I, fully non-ferrous.
- b. In non-air-conditioned interior environments or humid interior environments, provide interior locksets on the same Marine Grade I, fully non-ferrous as exterior locksets.

#### 2.3.4.1 Mortise Locks and Latches

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

#### 2.3.4.2 Auxiliary Locks

Provide in accordance with ANSI/BHMA A156.36, Grade 1.

### 2.3.5 Exit Devices

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

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

### 2.3.6 Cylinders and Cores

Provide cylinders and cores for new locks, including locks provided under other sections of this specification. Provide cylinders and cores with seven pin tumblers. Provide cylinders from the products of one manufacturer, and provide cores from the products of one manufacturer. Government approved manufacturers include Best Lock Corporation, Schlage or government approved equal. Provide fully compatible rim cylinders, mortise cylinders, and knobs of bored locksets with products of the Best Lock Corporation having interchangeable cores which are removable by special control keys. Stamp each interchangeable core with a key control symbol in a concealed place on the core. 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.

### 2.3.7 Push Button Mechanisms

Provide in accordance with ANSI/BHMA A156.5, Grade 1.

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### 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 maintained during power failure. Provide a separate power supply for electric strikes, other locking devices and ancillary parts. 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

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electrified mortise locks that remain maintained during power failure. Provide facility interface devices that use dc power to energize solenoids. Provide solenoids, resistors, and signal switches in accordance with paragraph ELECTRIC STRIKES AND FRAME MOUNTED ACTUATORS.

#### 2.3.8.2.1 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 Operated Pedestrian Door Hardware

Provide in accordance with ANSI/BHMA A156.10, Grade 1.

#### 2.3.8.4 Release Devices

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

#### 2.3.8.5 Power Assist and Low Energy Power Operated Doors

Provide in accordance with ANSI/BHMA A156.19, Grade 1.

#### 2.3.8.6 Electromagnetic Locks

Provide in accordance with ANSI/BHMA A156.23, Grade 1. Provide electromagnetic locks that do not contain any moving parts and depend solely upon electromagnetism to secure a portal by generating at least 1200 pounds of holding force. The lock must interface with the local processors without external, internal or functional alteration of the local processor. The electromagnetic lock must incorporate an end of line resistor to facilitate line supervision by the system. Provide metal-oxide resistors (MOVs) to protect controllers from reverse current surges, if not incorporated into the electromagnetic lock or local controller.

##### 2.3.8.6.1 Armature

Provide electromagnetic locks with internal circuitry to eliminate residual magnetism and inductive kickback. Provide actuating armature that operates on 12 or 24 Volts dc and cannot dissipate more than 12 Watts. Holding current must be less than 500 milliamperes. Actuating armature must take less than 300 milliseconds to change the status of the lock from fully secure to fully open or fully open to fully secure.

##### 2.3.8.6.2 Tamper Resistance

Provide lock mechanism encased in hardened guard barriers to deter forced entry.

##### 2.3.8.6.3 Mounting Method

Provide electromagnetic lock suitable for use with single and double door with mortise or rim type hardware and compatible with right or left hand mounting.

#### 2.3.8.7 Delayed Egress Locking System

Provide in accordance with ANSI/BHMA A156.24, Grade 1.

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### 2.3.9 Keying System

Provide an extension of the existing keying system.

### 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.

#### 2.3.10.2 Texture

Provide knurled or abrasive coated knobs or lever handles for doors which are accessible to blind persons and which lead to dangerous areas.

### 2.3.11 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. 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

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be visible after installation.

#### 2.3.14 Overhead Holders

Provide in accordance with ANSI/BHMA A156.8.

#### 2.3.15 Door Protection Plates

Provide in accordance with ANSI/BHMA A156.6.

##### 2.3.15.1 Sizes of Kick Plates

2 inch less than door width for single doors; 1 inch less than door width for pairs of doors. Provide 10 inch kick plates for flush doors . Provide a minimum 12 inch x 24 inch armor plates for flush doors except 16 inch high armor plates on fire doors.

##### 2.3.15.2 Edge Guards

Stainless steel, of same height as armor plates. Apply to hinge stile .

#### 2.3.16 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.

#### 2.3.17 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.

#### 2.3.18 Weatherstripping Gasketing

Provide in accordance with ANSI/BHMA A156.22. Provide the type and function designation where specified in paragraph HARDWARE SCHEDULE. Provide a set to include head and jamb seals, sweep strips, and, for pairs of doors, astragals. Air leakage of weatherstripped doors not to exceed 1.25 cubic feet per minute of air per square foot of door area when tested in accordance with ASTM E283. Provide weatherstripping with one of the following:

##### 2.3.18.1 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.

##### 2.3.18.2 Interlocking Type

Zinc or bronze not less than 0.018 inch thick.

##### 2.3.18.3 Spring Tension Type

Spring bronze or stainless steel not less than 0.008 inch thick.

#### 2.3.19 Soundproofing Gasketing

Provide in accordance with ANSI/BHMA A156.22. Provide adjustable

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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.

#### 2.3.20 Rain Drips

Provide in accordance with ANSI/BHMA A156.22. Provide extruded aluminum rain drips, not less than 0.08 inch thick, clear anodized. Provide rain drips with a 4 inch overlap on each side of each exterior door that is not protected by an awning, roof, eave or other horizontal projection. Set drips in sealant and fasten with stainless steel screws.

##### 2.3.20.1 Door Rain Drips

Approximately 1-1/2 inch high by 5/8 inch projection. Align bottom with bottom edge of door.

##### 2.3.20.2 Overhead Rain Drips

Approximately 1-1/2 inch high by 2-1/2 inch projection. Align bottom with door frame rabbet.

#### 2.3.21 Auxiliary Hardware (Other than locks)

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

#### 2.3.22 Special Tools

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

### 2.4 FASTENERS

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

### 2.5 FINISHES

Provide in accordance with ANSI/BHMA A156.18. Provide hardware in BHMA 630 finish (satin stainless steel), unless specified otherwise. Provide items not manufactured in stainless steel in BHMA 626 finish (satin chromium plated) over brass or bronze, except aluminum paint finish for surface door closers, and except BHMA 652 finish (satin chromium plated) for steel hinges. Provide hinges for exterior doors in stainless steel with BHMA 630 finish or chromium plated brass or bronze with BHMA 626 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.

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## 2.6 KEY CABINET AND CONTROL SYSTEM

Provide in accordance with ANSI/BHMA A156.5, Type E8331 (25 hooks) .

## 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.

##### 3.1.1.2 Interlocking Type Weatherstripping

Provide interlocking, self adjusting type on heads and jambs and flexible hook type at sills. Nail weatherstripping to door 1 inch on center and to heads and jambs at 4 inch on center.

##### 3.1.1.3 Spring Tension Type Weatherstripping

Provide spring tension type on heads and jambs. Provide bronze nails with bronze. Provide stainless steel nails with stainless steel. Space nails not more than 1-1/2 inch on center.

#### 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. .



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### 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

-- End of Section --

## Hardware Sets

**Set #1 - Exterior**

Doors: 103B

2	Continuous Hinge	662HD	628
1	Semi-Auto Flushbolt	3820 X 3810	630
1	Dust Proof Strike	3911	630
1	Exit Device	TYPE 3 FUNC 3 DS	630AM
2	Flush Pull	1111C	630
2	Door Closer	C72061 PT4C/D/F/G 1.5" BORE	689
2	Kick Plate	J102 8"	630
1	Threshold	896 S	628
1	Weatherstrip	700 ES	
1	Astragal	158 SA	
1	Door Sweep	C627 A	

**Set #2 - Exterior**

Doors: 104A, 105A

1	Continuous Hinge	662HD	628
1	Deadlock	48H-7R PATD	626
1	Flush Pull	1111C	630
1	Door Closer	C72061 PT4C/D/F/G 1.5" BORE	689
1	Kick Plate	J102 8"	630
1	Weatherstrip	700 ES	
1	Door Sweep	C627 A	
1	Threshold	896 S	628

**Set #3 – not used****Set #4 - Exterior, Aluminum**

Doors: 102C

2	Continuous Hinge	662HD	628
1	Exit Device	TYPE 6 FUNC 2 CD	630AM
1	Exit Device	TYPE 6 FUNC 3 CD	630AM
1	Rim Cylinder	12E-72 PATD	626
2	Mortise Cylinder	1E-74 PATD	626
2	Door Pull	AP312 20"	630
2	Door Closer	C72061 PT4C/D/F/G 1.5" BORE	689
2	Door Sweep	C627 A	
1	Threshold	896 S	628

**Set #5 - Card Reader**

Doors: 102A, 101A, 102B

2	Continuous Hinge	662HD	628
2	Power Transfer	PT1000	689
2	Exit Device	TYPE 8 FUNC 8 ELR FL TS DS	630AM
2	Rim Cylinder	12E-72 PATD	626
2	Door Closer	C72021 PT4C/D/F/G 1.5" BORE	689
2	Kick Plate	J102 8"	630
1	Power Supply	ELR152	
2	Door Position Switch	HSS SERIES, CONCEALED	
1	Card Reader	BY SECURITY	
1	Gasketing	2525	
1	Saddle Threshold	427	628

**Set #6 - Overhead**

Doors: 145E, 145F, 145G, 145H, 145J, 145K, 145L, 145M, 145N, 147C, 147D

1	Padlock	41B-772T PATD M1	606
2	Door Position Switch	AS REQUIRED	

**Set #7**

Doors: 103A

1	Continuous Hinge	662HD	628
1	Exit Device	FL 2108 X 4908D	630AM
1	Rim Cylinder	12E-72 PATD	626
1	Door Closer	C72021 PT4C/D/F/G 1.5" BORE	689
1	Kick Plate	J102 8"	630
1	Gasketing	2525	

**Set #8 - All Glass**

Doors: 108A, 109A, 110A, 111A, 112A, 113A, 118A, 119A, 121A, 122A, 123A, 124A, 125A, 126A, 127A, 128A, 129A, 130A, 131A, 132A, 135A, 136A, 137B, 138A, 138B

1	Mortise Cylinder	1E-74 PATD	626
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NOTE: All hardware by glass door manufacturer.

**Set #9**

Doors: 114A

3	Butt Hinge	A8112 4.5" x 4.5"	652
1	Passage Set	45H-0N14M	630AM
1	Wall Bumper	L03011	626
3	Silencer	1229A GREY	

**Set #10 - Monitored**

Doors: 145C, 145D

1	Continuous Hinge	662HD	628
1	Exit Device	TYPE 1 FUNC 1 DS	630AM
1	Door Closer	C72021 PT4C/D/F/G 1.5" BORE	689
1	Kick Plate	J102 8"	630
1	Door Position Switch	HSS SERIES, CONCEALED	
1	Weatherstrip	700 ES	
1	Door Sweep	C627 A	
1	Threshold	896 S	628

**Set #11 - Card Reader**

Doors: 145A, 145B

2	Continuous Hinge	662HD	628
2	Power Transfer	PT1000	689
2	Exit Device	TYPE 2 FUNC 8 ELR FL TS DS LBR	630AM
2	Rim Cylinder	12E-72 PATD	626
2	Door Closer	C72021 PT4C/D/F/G 1.5" BORE	689
2	Kick Plate	J102 8"	630
1	Power Supply	ELR152	
1	Door Position Switch	HSS SERIES, CONCEALED	
1	Card Reader	BY SECURITY	
1	Gasketing	2525	

**Set #12 - Card Reader**

Doors: 146A

1	Continuous Hinge	662HD	628
1	Power Transfer	PT1000	689
1	Electromechanical Lock	45HW-7DEU14N PATD DS RQE	630AM
1	Door Closer	C72011 PT4C/D/F 1.5" BORE	689
1	Kick Plate	J102 8"	630
1	Wall Bumper	1270CVSV	626
1	Door Position Switch	HSS SERIES, CONCEALED	
1	Card Reader	BY SECURITY	
1	Gasketing	2525	

**Set #13**

Doors: 148A, 149A, 151A, 152A

3	Butt Hinge	A8112 4.5" x 4.5"	652
1	Passage Set	45H-0N14M	630AM

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1	Door Closer	C72021 PT4C/D/F/G 1.5" BORE
1	Kick Plate	J102 8"
1	Gasketing	2525

689  
630

## Set #14

Doors: 116A, 150A

3	Butt Hinge	A8112 4.5" x 4.5"
1	Lockset	45H-7R14N PATD
1	Door Closer	C72011 PT4C/D/F 1.5" BORE
1	Kick Plate	J102 8"
1	Wall Bumper	1270CVSV
1	Gasketing	2525

652  
630AM  
689  
630  
626

## Set #15

Doors: 117A, 120A, 141A, 142A

3	Butt Hinge	A8112 4.5" x 4.5"
1	Lockset	45H-7AB14N PATD
1	Door Closer	C72051 PT4C/D/F 1.5" BORE
1	Kick Plate	J102 8"
1	Wall Bumper	1270CVSV
1	Coat Hook	AM801
1	Gasketing	2525
1	Auto Door Bottom	4447 S

652  
630AM  
689  
630  
626  
630

## Set #16

Doors: 139A

3	Butt Hinge	A8112 4.5" x 4.5"
1	Lockset	45H-7R14N PATD
1	Overhead Stop	N 4020 SERIES
3	Silencer	1229A

652  
630AM  
630  
GREY

## Set #17 - Card Reader

Doors: 140A, 147B

1	Continuous Hinge	662HD
1	Power Transfer	PT1000
1	Electromechanical Lock	45HW-7DEU14N PATD DS RQE
1	Door Closer	C72021 PT4C/D/F/G 1.5" BORE
1	Kick Plate	J102 8"
1	Door Position Switch	HSS SERIES, CONCEALED
1	Card Reader	BY SECURITY
1	Gasketing	2525

628  
689  
630AM  
689  
630

## Set #18

Doors: 100B, 101B

2	Continuous Hinge	662HD
2	Dummy Touchbar	N673DR
2	Door Pull	AP312 20"
2	Door Closer	C72061 PT4C/D/F/G 1.5" BORE
2	Auto Door Bottom	220NA

628  
630  
630  
689

## Set #19 - Card Reader

Doors: 106A

1	Continuous Hinge	662HD
1	Power Transfer	PT1000
1	Electromechanical Lock	45HW-7DEU14N PATD DS RQE
1	Door Closer	C72021 PT4C/D/F/G 1.5" BORE
1	Kick Plate	J102 8"
1	Door Position Switch	HSS SERIES, CONCEALED
1	Card Reader	BY SECURITY
1	Gasketing	2525

628  
689  
630AM  
689  
630

**Set #20 - Monitored**

Doors: 107B

2	Continuous Hinge	662HD	628
1	Semi-Auto Flushbolt	3820 X 3810	630
1	Dust Proof Strike	3911	630
1	Exit Device	TYPE 3 FUNC 1 DS	630AM
2	Door Closer	C72061 PT4C/D/F/G 1.5" BORE	689
2	Kick Plate	J102 8"	630
2	Door Position Switch	HSS SERIES, CONCEALED	
1	Weatherstrip	700 ES	
1	Astragal	158 SA	
2	Door Sweep	C627 A	
1	Threshold	896 S	628

**Set #21 - Monitored**

Doors: 143A, 143B

3	Butt Hinge	A8112 4.5" x 4.5"	652
1	Lockset	45H-7AB14N PATD	630AM
1	Kick Plate	J102 8"	630
1	Wall Bumper	1270CVSV	626
1	Gasketing	2525	
1	Auto Door Bottom	4447 S	

**Set #22 - Monitored**

Doors: 147A

2	Continuous Hinge	662 HD	628
2	Power Transfer	PT1000	689
1	Semi-Auto Flushbolt	3820 X 3810	630
1	Dust Proof Strike	3911	630
1	Exit Device	TYPE 3 FUNC 1 DS	630AM
2	Door Closer	C72061 PT4C/D/F/G 1.5" BORE	689
2	Kick Plate	J102 8"	630
2	Door Position Switch	HSS SERIES, CONCEALED	
1	Power Supply	ELR 152	
1	Card Reader	BY SECURITY	
1	Weatherstrip	700 ES	
1	Astragal	158 SA	
2	Door Sweep	C627 A	
1	Threshold	896 S	628

## Opening List

Opening	Hdw Set
100A	5
100B	18
101A	5
101B	18
102A	5
102B	5
102C	4
103A	7
103B	1
104A	2
105A	2
106A	19
107B	20
108A	8
109A	8
110A	8
111A	8
112A	8
113A	8
114A	9
116A	14
117A	15
118A	8
119A	8
120A	15
121A	8
122A	8
123A	8
124A	8
125A	8
126A	8
127A	8
128A	8
129A	8
130A	8
131A	8
132A	8
135A	8
136A	8
137B	8
138A	8
138B	8
139A	16
140A	17
141A	15
142A	15
143A	21
144A	21
145A	11
145B	11
145C	10
145D	10
145E	6
145F	6
145G	6
145H	6
145J	6
145K	6
145L	6

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145M	6
145N	6
146A	12
147A	22
147B	17
147C	6
147D	6
148A	13
149A	13
150A	14
151A	13
152A	13

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## GLAZING

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## PART 1 GENERAL

## 1.1 REFERENCES

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

## AMERICAN ARCHITECTURAL MANUFACTURERS ASSOCIATION (AAMA)

AAMA 800 (2016) Voluntary Specifications and Test  
Methods for Sealants

## AMERICAN NATIONAL STANDARDS INSTITUTE (ANSI)

ANSI Z97.1 (2015) Safety Glazing Materials Used in  
Buildings - Safety Performance  
Specifications and Methods of Test

## ASTM INTERNATIONAL (ASTM)

ASTM C509 (2006; R 2021) Standard Specifiaction for  
Elastomeric Cellular Preformed Gasket and  
Sealing Material

ASTM C864 (2005; R 2015) Dense Elastomeric  
Compression Seal Gaskets, Setting Blocks,  
and Spacers

ASTM C920 (2018) Standard Specification for  
Elastomeric Joint Sealants

ASTM C1021 (2008; R 2014) Standard Practice for  
Laboratories Engaged in Testing of  
Building Sealants

ASTM C1036 (2021) Standard Specification for Flat  
Glass

ASTM C1048 (2018) Standard Specification for  
Heat-Strengthened and Fully Tempered Flat  
Glass

ASTM C1087 (2016) Standard Test Method for  
Determining Compatibility of  
Liquid-Applied Sealants with Accessories  
Used in Structural Glazing Systems

ASTM C1172 (2019) Standard Specification for  
Laminated Architectural Flat Glass

ASTM C1184 (2014) Standard Specification for  
Structural Silicone Sealants



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ASTM C1281	(2016) Standard Specification for Preformed Tape Sealants for Glazing Applications
ASTM D395	(2016; E 2017) Standard Test Methods for Rubber Property - Compression Set
ASTM D2287	(2019) Nonrigid Vinyl Chloride Polymer and Copolymer Molding and Extrusion Compounds
ASTM E1300	(2016) Standard Practice for Determining Load Resistance of Glass in Buildings
ASTM E2190	(2010) Standard Specification for Insulating Glass Unit Performance and Evaluation

#### CALIFORNIA DEPARTMENT OF PUBLIC HEALTH (CDPH)

CDPH SECTION 01350	(20170; Version 1.2) Standard Method for the Testing and Evaluation of Volatile Organic Chemical Emissions from Indoor Sources using Environmental Chambers
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#### GLASS ASSOCIATION OF NORTH AMERICA (GANA)

GANA Glazing Manual	(2008) Glazing Manual
GANA Sealant Manual	(2008) Sealant Manual

#### INSULATING GLASS MANUFACTURERS ALLIANCE (IGMA)

IGMA TB-1200	(1983; R 2016) Guidelines for Insulating Glass Dimensional Tolerances
IGMA TB-3001	(2001) Guidelines for Sloped Glazing
IGMA TM-3000	(1990; R 2016) North American Glazing Guidelines for Sealed Insulating Glass Units for Commercial & Residential Use

#### U.S. GREEN BUILDING COUNCIL (USGBC)

LEED v4 BDC Ref Guide	(2013; R 2020) USGBC LEED Reference Guide for Building Design and Construction, v4
LEED v4.1 BDC Ref Guide	(2023) LEED v4.1 Building Design and Construction Reference Guide

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

16 CFR 1201	Safety Standard for Architectural Glazing Materials
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### 1.2 SUSTAINABILITY REPORTING

Work of this section is intended to contribute to the achievement of, or compliance with, the requirements of the Guiding Principles Validation and

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LEED Prerequisites and attempted Credits. Refer to Section 01 33 29.00 06 SUSTAINABILITY REPORTING for specific documentation requirements and list of Prerequisites, attempted Credits and LEED version.

Comply with product, material content, performance criteria, activity, documentation, and other technical requirements as described in the LEED v4 BDC Ref Guide or LEED v4.1 BDC Ref Guide as applicable.

Collect, organize, and submit product data, drawings, diagrams, photos and cost information necessary to demonstrate compliance with LEED v4 BDC Ref Guide or LEED v4.1 BDC Ref Guide requirements as applicable.

Data collection shall commence with the notice to proceed and will only be deemed complete upon acceptance of the Final Sustainability Notebook and LEED Online submission by the Contracting Officer, the LEED Project Administrator, and the Green Building Certification Institute.

### 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

Insulating Glass

Glazing Accessories

Sealants

Joint Backer

Environmental Product Declarations; S

Embodied Carbon Optimization Report/Action Plan; S

Extended Producer Responsibility; S

Recycled Content Materials; S

Local/Regional Materials; S

Material Ingredient Reporting; S

Low-Emitting Materials; S

#### SD-04 Samples

Insulating Glass

Glazing Compound

Glazing Tape

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Sealing Tapes

SD-07 Certificates

Insulating Glass

SD-08 Manufacturer's Instructions

Setting and Sealing Materials

Glass Setting

SD-11 Closeout Submittals

Warranty for Insulated Glass Units

#### 1.4 SUSTAINABLE DESIGN REQUIREMENTS

##### 1.4.1 Environmental Product Declarations

At a minimum, use materials or products with an Environmental Product Declaration in accordance with the LEED Implementation Plan. See Section 01 33 29.00 06 SUSTAINABILITY REPORTING for cumulative materials requirements and LEED Implementation Plan.

##### 1.4.2 Embodied Carbon Optimization Report/Action Plan

At a minimum, use materials or products with an Embodied Carbon Optimization Report/Action Plan in accordance with the LEED Implementation Plan. See Section 01 33 29.00 06 SUSTAINABILITY REPORTING for cumulative materials requirements and LEED Implementation Plan.

##### 1.4.3 Sourcing of Raw Materials

Provide products that meet one or more of the following categories:

###### 1.4.3.1 Extended Producer Responsibility

At a minimum, use materials or products from manufacturers that participate in an extended producer responsibility program in accordance with the LEED Implementation Plan. Provide manufacturer letter verifying extended producer responsibility program is in place and that product is eligible. See Section 01 33 29.00 06 SUSTAINABILITY REPORTING for cumulative materials requirements and LEED Implementation Plan.

###### 1.4.3.2 Recycled Content Materials

At a minimum, use materials or products with recycled content in accordance with the LEED Implementation Plan. Provide manufacturers product literature identifying the percentage of recycled material incorporated within each product used. See Section 01 33 29.00 06 SUSTAINABILITY REPORTING for cumulative materials requirements and LEED Implementation Plan. If recycled content minimum is specified in this section, the greater of the two percentages governs.

###### 1.4.4 Material Ingredient Reporting

At a minimum, use materials or products with chemical inventory to at

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least 0.1% (1000 ppm) in accordance with the LEED Implementation Plan. Provide Health Product Declaration (HPD), Cradle to Cradle Certificate, Declare label, or other manufacturer's published content inventory in compliance with LEED v4.1 Material Ingredient Reporting credit. See Section 01 33 29.00 06 SUSTAINABILITY REPORTING for cumulative materials requirements and LEED Implementation Plan.

#### 1.4.5 Local/Regional Materials

Use materials or products extracted, harvested, or recovered, as well as manufactured, within a 100 mile radius from the project site, if available from a minimum of three sources. provide a letter from the manufacturer stating the extraction location, manufacturing location, and purchasing location of the products provided, referencing the project name and location specifically and distance to the project site. See Section 01 33 29.00 06 SUSTAINABILITY REPORTING for cumulative materials requirements and LEED Implementation Plan.

#### 1.4.6 Low-Emitting Materials

Use glazing and setting products so that the interior complies with LEED v4.1 BDC Ref Guide requirements for emissions. Submit manufacturer's documentation identifying compliance with CDPH SECTION 01350 for emissions or product is inherently nonemitting. See Section 01 33 29.00 06 SUSTAINABILITY REPORTING for low-emitting material requirements.

### 1.5 SYSTEM DESCRIPTION

Fabricate and install watertight and airtight glazing systems to withstand thermal movement and wind loading without glass breakage, gasket failure, deterioration of glazing accessories, or defects in the work. Glazed panels must comply with the safety standards, in accordance with ANSI Z97.1, and comply with indicated wind/snow loading in accordance with ASTM E1300.

### 1.6 QUALITY CONTROL

Submit two 8 by 10 inch samples of each of the following: tinted glass, spandrel and insulating glass units.

Submit three samples of each other material. Samples of plastic sheets must be minimum 5 by 7 inches.

### 1.7 DELIVERY, STORAGE, AND HANDLING

Deliver products to the site in unopened containers, labeled plainly with manufacturers' names and brands. Store glass and setting materials in safe, enclosed dry locations and do not unpack until needed for installation. Handle and install materials in a manner that will protect them from damage.

### 1.8 ENVIRONMENTAL REQUIREMENTS

Do not start glazing work until the outdoor temperature is above 40 degrees F and rising, unless procedures recommended by the glass manufacturer and approved by the Contracting Officer are made to warm the glass and rabbet surfaces. Provide ventilation to prevent condensation of moisture on glazing work during installation. Do not perform glazing work during damp or rainy weather.

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## 1.9 WARRANTY

### 1.9.1 Warranty for Insulated Glass Units

Warranty insulating glass units against development of material obstruction to vision (such as dust, fogging, or film formation on the inner glass surfaces) caused by failure of the hermetic seal, other than through glass breakage, for a 10-year period following acceptance of the work. Provide new units for any units failing to comply with terms of this warranty within 45 working days after receipt of notice from the Government.

## PART 2 PRODUCTS

### 2.1 GLASS

ASTM C1036, unless specified otherwise. In doors and sidelights, provide safety glazing material conforming to 16 CFR 1201.

#### 2.1.1 Clear Glass

For interior glazing (i.e., pass and observation windows), 1/4 inch thick glass should be used.

#### 2.1.2 Annealed Glass

Annealed glass must be Type I transparent flat type, Class 1 - clear, Quality q3 - glazing select, 88 percent light transmittance, 0.94 percent shading coefficient, conforming to ASTM C1036.

#### 2.1.3 Laminated Glass

ASTM C1172, Laminated glass fabricated from two nominal 1/8 inch pieces of Type I, Kind HS or FT, Class 1, Quality Q3, flat heat strengthened fully tempered clear glass conforming to ASTM C1048. Flat glass to be laminated together with a minimum of 0.030 inch thick, clear polyvinyl butyral laminate, conforming to requirements of 16 CFR 1201 and ASTM C1172. The total thickness of nominally 1/4 inches. Color to be clear.

#### 2.1.4 Mirrors

##### 2.1.4.1 Glass Mirrors

Glass for mirrors must be Type I transparent flat type, Class 1-clear, Glazing Quality q1 1/4 inch thick conforming to ASTM C1036. Glass must be coated on one surface with silver coating, copper protective coating, and mirror backing paint. Silver coating must be highly adhesive pure silver coating of a thickness which must provide reflectivity of 83 percent or more of incident light when viewed through 1/4 inch thick glass, and must be free of pinholes or other defects. Copper protective coating must be pure bright reflective copper, homogeneous without sludge, pinholes or other defects, and must be of proper thickness to prevent "adhesion pull" by mirror backing paint. Mirror backing paint must consist of two coats of special scratch and abrasion-resistant paint, and must be baked in uniform thickness to provide a protection for silver and copper coatings which will permit normal cutting and edge fabrication.

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#### 2.1.5 Tempered Glass

ASTM C1048, Kind FT (fully tempered), Condition A (uncoated), Type I, Class 1 (transparent), Quality q3, 1/4 inch thick. Color must be clear. Provide wherever safety glazing material is indicated or specified.

#### 2.1.6 Heat-Strengthened Glass

ASTM C1048, Kind HS (heat strengthened), Condition A (uncoated), Type I, Class 1 (clear), Quality q3, 1/4 inch thick.

### 2.2 INSULATING GLASS UNITS

Two panes of glass separated by a dehydrated airspace, filled with argon gas and hermetically sealed, conforming to ASTM E2190. Submit performance and compliance documentation for each type of insulating glass.

Dimensional tolerances must be as specified in IGMA TB-1200. Spacer must be black, roll-formed, thin-gauge, C-section steel thermally broken aluminum, with bent or tightly welded or keyed and sealed joints to completely seal the spacer periphery and eliminate moisture and hydrocarbon vapor transmission into airspace through the corners. Primary seal must be compressed polyisobutylene and the secondary seal must be a specially formulated silicone.

#### 2.2.1 Insulated Glass Unit Basis of Design

- a. Basis of Design for Exterior Windows - provide products similar to Vitro Solarban 60 on Optigray Low-e #2.
- b. Transmittance Visible Light: 50 percent
- c. Visible Light Reflectance - Exterior: 8 percent
- d. Visible Light Reflectance - Interior: 11 percent
- e. NFRC Winter Conditions: 0.29 Btu/(hr x sqft x F)
- f. NFRC Summer Conditions: 0.26 Btu/(hr x sqft x F)
- g. Shading Coefficient (SC): 0.35
- h. Solar Heat Gain Coefficient (SHGC): 0.30

#### 2.2.2 Low Emissivity Coatings

Interior and exterior glass panes for Low-E insulating units must be Type I annealed or fully tempered flat glass, Class 2-tinted with anti-reflective low-emissivity coating or heat-strengthened or fully tempered glass complying with ASTM C1048, Condition C on No. 2 surface (inside surface of exterior pane), Quality q3 - glazing select, conforming to ASTM C1036.

### 2.3 Glazing Schedule

G1 Exterior windows: 1" insulated glazing consisting of 1/4" outer pane and an inner plane of laminated glazing consisting of two nominal 1/8" pieces of Type I, Kind HS or FT, Class 1, Quality Q3 flat heat strengthened fully

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tempered per paragraph 2.1.3. Constructed and tinted per article 2.2

G2 Interior vision lights: ¼" clear tempered glass per paragraph 2.1.5.

G3 Interior Glazed Office Partitions: Double-paned, tempered glazing with one layer ¼" clear tempered glass and one ¼" layer of two nominal 1/8" pieces of Type I, Kind HS or FT, Class 1, Quality Q3 flat heat strengthened fully tempered per paragraph 2.1.3.

G4 Sound Control Interior Windows: ½" laminated glazing consisting of two nominal 1/4" pieces of Type I, Kind HS or FT, Class 1, Quality Q3 flat heat strengthened fully tempered clear glass laminated per paragraph 2.1.3.

## 2.4 SETTING AND SEALING MATERIALS

Provide as specified in the GANA Glazing Manual, IGMA TM-3000, IGMA TB-3001, and manufacturer's recommendations, unless specified otherwise herein. Do not use metal sash putty, nonskinning compounds, nonresilient preformed sealers, or impregnated preformed gaskets. Materials exposed to view and unpainted must be gray or neutral color. Sealant testing must be performed by a testing agency qualified according to ASTM C1021.

Submit glass manufacturer's recommendations for setting and sealing materials and for installation of each type of glazing material specified.

### 2.4.1 Putty and Glazing Compound

Provide glazing compound as recommended by manufacturer for face-glazing metal sash. Putty must be linseed oil type. Do not use putty and glazing compounds with insulating glass or laminated glass.

### 2.4.2 Glazing Compound

Use for face glazing metal sash. Do not use with insulating glass units or laminated glass.

### 2.4.3 Sealants

Provide elastomeric and structural sealants. Comply with Section 07 92 00 JOINT SEALANTS for VOC and emissions requirements.

#### 2.4.3.1 Elastomeric Sealant

ASTM C920, Type S, Grade NS, Class 12.5, Use G. Use for channel or stop glazing metal sash. Sealants must be chemically compatible with setting blocks, edge blocks, and sealing tapes, with sealants used in manufacture of insulating glass units. Color of sealant must be white.

#### 2.4.3.2 Structural Sealant

ASTM C1184, Type S.

### 2.4.4 Joint Backer

Joint backer must have a diameter size at least 25 percent larger than joint width; type and material as recommended in writing by glass and sealant manufacturer.

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#### 2.4.5 Glazing Tapes

##### 2.4.5.1 Back-Bedding Mastic Glazing Tapes

Preformed, butyl-based, 100 percent solids elastomeric tape; nonstaining and nonmigrating in contact with nonporous surfaces; with or without spacer rod as recommended in writing by tape and glass manufacturers for application indicated; and complying with ASTM C1281 and AAMA 800 for products indicated below:

- a. AAMA 804.3 tape, where indicated.
- b. AAMA 806.3 tape, for glazing applications in which tape is subject to continuous pressure.
- c. AAMA 807.3 tape, for glazing applications in which tape is not subject to continuous pressure.

##### 2.4.5.2 Expanded Cellular Glazing Tapes

Closed-cell, PVC foam tapes; factory coated with adhesive on both surfaces; and complying with AAMA 800 for the following types:

- a. AAMA 810.1, Type 1, for glazing applications in which tape acts as the primary sealant.
- b. AAMA 810.1, Type 2, for glazing applications in which tape is used in combination with a full bead of liquid sealant.

#### 2.4.6 Sealing Tapes

Preformed, semisolid, PVC-based material of proper size and compressibility for the particular condition, complying with ASTM D2287. Use only where glazing rabbet is designed for tape and tape is recommended by the glass or sealant manufacturer. Provide spacer shims for use with compressible tapes. Tapes must be chemically compatible with the product being set.

#### 2.4.7 Setting Blocks and Edge Blocks

Closed-cell neoprene setting blocks must be dense extruded type conforming to ASTM C509 and ASTM D395, Method B, Shore A durometer between 70 and 90. Edge blocking must be Shore A durometer of 50 (plus or minus 5). Provide silicone setting blocks when blocks are in contact with silicone sealant. Profiles, lengths and locations must be as required and recommended in writing by glass manufacturer. Block color must be black.

#### 2.4.8 Glazing Gaskets

Glazing gaskets must be extruded with continuous integral locking projection designed to engage into metal glass holding members to provide a watertight seal during dynamic loading, building movements and thermal movements. Glazing gaskets for a single glazed opening must be continuous one-piece units with factory-fabricated injection-molded corners free of flashing and burrs. Glazing gaskets must be in lengths or units recommended by manufacturer to ensure against pull-back at corners. Provide glazing gasket profiles as recommended by the manufacturer for the intended application.



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#### 2.4.8.1 Fixed Glazing Gaskets

Fixed glazing gaskets must be closed-cell (sponge) smooth extruded compression gaskets of cured elastomeric virgin neoprene compounds conforming to ASTM C509, Type 2, Option 1.

#### 2.4.8.2 Wedge Glazing Gaskets

Wedge glazing gaskets must be high-quality extrusions of cured elastomeric virgin neoprene compounds, ozone resistant, conforming to ASTM C864, Option 1, Shore A durometer between 65 and 75.

#### 2.4.8.3 Aluminum Framing Glazing Gaskets

Glazing gaskets for aluminum framing must be permanent, elastic, non-shrinking, non-migrating, watertight and weathertight.

#### 2.4.9 Accessories

Provide as required for a complete installation, including glazing points, clips, shims, angles, beads, and spacer strips. Provide noncorroding metal accessories. Provide primer-sealers and cleaners as recommended by the glass and sealant manufacturers. Use ASTM C1087 to determine whether priming and other specific joint preparation techniques are required to obtain rapid, optimum adhesion of glazing sealants to surface.

### 2.5 MIRROR ACCESSORIES

#### 2.5.1 Mastic

Mastic for setting mirrors must be a polymer type mirror mastic resistant to water, shock, cracking, vibration and thermal expansion. Provide mastic compatible with mirror backing paint, and as approved by mirror manufacturer.

#### 2.5.2 Mirror Frames

Provide mirrors with mirror frames (J-mold channels) fabricated of one-piece roll-formed Type 304 stainless steel with No. 4 brushed satin finish and concealed fasteners which will keep mirrors snug to wall. Frames must be 1-1/4 by 1/4 by 1/4 inch continuous at top and bottom of mirrors. Concealed fasteners of type to suit wall construction material must be provided with mirror frames.

#### 2.5.3 Mirror Clips

Provide clips with concealed fasteners of type to suit wall construction material.

## PART 3 EXECUTION

Any materials that show visual evidence of biological growth due to the presence of moisture must not be installed on the building project.

### 3.1 PREPARATION

Preparation, unless otherwise specified or approved, must conform to applicable recommendations in the GANA Glazing Manual, GANA Sealant Manual, IGMA TB-3001, IGMA TM-3000, and manufacturer's recommendations. Determine

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the sizes to provide the required edge clearances by measuring the actual opening to receive the glass. Grind smooth in the shop glass edges that will be exposed in finish work. Leave labels in place until the installation is approved, except remove applied labels on heat-absorbing glass and on insulating glass units as soon as glass is installed. Securely fix movable items or keep in a closed and locked position until glazing compound has thoroughly set.

### 3.2 GLASS SETTING

Shop glaze or field glaze items to be glazed using glass of the quality and thickness specified or indicated. Glazing, unless otherwise specified or approved, must conform to applicable recommendations in the GANA Glazing Manual, GANA Sealant Manual, IGMA TB-3001, IGMA TM-3000, and manufacturer's recommendations. Aluminum windows, wood doors, and wood windows may be glazed in conformance with one of the glazing methods described in the standards under which they are produced, except that face puttying with no bedding will not be permitted. Handle and install glazing materials in accordance with manufacturer's instructions. Use beads or stops which are furnished with items to be glazed to secure the glass in place. Verify products are properly installed, connected, and adjusted.

#### 3.2.1 Sheet Glass

Cut and set with the visible lines or waves horizontal.

#### 3.2.2 Insulating Glass Units

Do not grind, nip, or cut edges or corners of units after the units have left the factory. Springing, forcing, or twisting of units during setting will not be permitted. Handle units so as not to strike frames or other objects. Installation must conform to applicable recommendations of IGMA TB-3001 and IGMA TM-3000.

#### 3.2.3 Installation of Laminated Glass

Sashes which are to receive laminated glass must be weeped to the outside to allow water drainage into the channel.

### 3.3 CLEANING

Clean glass surfaces and remove labels, paint spots, putty, and other defacement as required to prevent staining. Glass must be clean at the time the work is accepted.

### 3.4 PROTECTION

Protect glass work immediately after installation. Identify glazed openings with suitable warning tapes, cloth or paper flags, attached with non-staining adhesives. Protect reflective glass with a protective material to eliminate any contamination of the reflective coating. Place

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protective material far enough away from the coated glass to allow air to circulate to reduce heat buildup and moisture accumulation on the glass. Upon removal, separate protective materials for reuse or recycling. Remove and replace glass units which are broken, chipped, cracked, abraded, or otherwise damaged during construction activities with new units.

-- End of Section --

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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

#### 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 A653/A653M (2020) Standard Specification for Steel  
 Sheet, Zinc-Coated (Galvanized) or  
 Zinc-Iron Alloy-Coated (Galvannealed) by  
 the Hot-Dip Process

ASTM B209 (2014) Standard Specification for Aluminum  
 and Aluminum-Alloy Sheet and Plate

ASTM B221 (2021) Standard Specification for Aluminum  
 and Aluminum-Alloy Extruded Bars, Rods,  
 Wire, Profiles, and Tubes

#### U.S. GREEN BUILDING COUNCIL (USGBC)

LEED v4 BDC Ref Guide (2013; R 2020) USGBC LEED Reference Guide  
 for Building Design and Construction, v4

LEED v4.1 BDC Ref Guide (2023) LEED v4.1 Building Design and  
 Construction Reference Guide

##### 1.2 SUSTAINABILITY REPORTING

Work of this section is intended to contribute to the achievement of, or compliance with, the requirements of the Guiding Principles Validation and LEED Prerequisites and attempted Credits. Refer to Section 01 33 29.00 06

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SUSTAINABILITY REPORTING for specific documentation requirements and list of Prerequisites, attempted Credits and LEED version.

Comply with product, material content, performance criteria, activity, documentation, and other technical requirements as described in the LEED v4 BDC Ref Guide or LEED v4.1 BDC Ref Guide as applicable.

Collect, organize, and submit product data, drawings, diagrams, photos and cost information necessary to demonstrate compliance with LEED v4 BDC Ref Guide or LEED v4.1 BDC Ref Guide requirements as applicable.

Data collection shall commence with the notice to proceed and will only be deemed complete upon acceptance of the Final Sustainability Notebook and LEED Online submission by the Contracting Officer, the LEED Project Administrator, and the Green Building Certification Institute.

### 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

Wall Louvers

#### SD-03 Product Data

Metal Wall Louvers

Environmental Product Declarations; S

Embodied Carbon Optimization Report/Action Plan; S

Extended Producer Responsibility; S

Recycled Content Materials; S

Local/Regional Materials; S

Material Ingredient Reporting; S

Low-Emitting Materials; S

#### SD-04 Samples

Wall Louver Samples; G, AE

### 1.4 SUSTAINABLE DESIGN REQUIREMENTS

#### 1.4.1 Environmental Product Declarations

At a minimum, use materials or products with an Environmental Product Declaration in accordance with the LEED Implementation Plan. See Section 01 33 29.00 06 SUSTAINABILITY REPORTING for cumulative materials

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requirements and LEED Implementation Plan.

#### 1.4.2 Embodied Carbon Optimization Report/Action Plan

At a minimum, use materials or products with an Embodied Carbon Optimization Report/Action Plan in accordance with the LEED Implementation Plan. See Section 01 33 29.00 06 SUSTAINABILITY REPORTING for cumulative materials requirements and LEED Implementation Plan.

#### 1.4.3 Sourcing of Raw Materials

Provide products that meet one or more of the following categories:

##### 1.4.3.1 Extended Producer Responsibility

At a minimum, use materials or products from manufacturers that participate in an extended producer responsibility program in accordance with the LEED Implementation Plan. Provide manufacturer letter verifying extended producer responsibility program is in place and that product is eligible. See Section 01 33 29.00 06 SUSTAINABILITY REPORTING for cumulative materials requirements and LEED Implementation Plan.

##### 1.4.3.2 Recycled Content Materials

At a minimum, use materials or products with recycled content in accordance with the LEED Implementation Plan. Provide manufacturers product literature identifying the percentage of recycled material incorporated within each product used. See Section 01 33 29.00 06 SUSTAINABILITY REPORTING for cumulative materials requirements and LEED Implementation Plan. If recycled content minimum is specified in this section, the greater of the two percentages governs.

##### 1.4.4 Material Ingredient Reporting

At a minimum, use materials or products with chemical inventory to at least 0.1% (1000 ppm) in accordance with the LEED Implementation Plan. Provide Health Product Declaration (HPD), Cradle to Cradle Certificate, Declare label, or other manufacturer's published content inventory in compliance with LEED v4.1 Material Ingredient Reporting credit. See Section 01 33 29.00 06 SUSTAINABILITY REPORTING for cumulative materials requirements and LEED Implementation Plan.

##### 1.4.5 Local/Regional Materials

Use materials or products extracted, harvested, or recovered, as well as manufactured, within a 100 mile radius from the project site, if available from a minimum of three sources. provide a letter from the manufacturer stating the extraction location, manufacturing location, and purchasing location of the products provided, referencing the project name and location specifically and distance to the project site. See Section 01 33 29.00 06 SUSTAINABILITY REPORTING for cumulative materials requirements and LEED Implementation Plan.

##### 1.4.6 Low-Emitting Materials

Use products that comply with LEED v4.1 BDC Ref Guide requirements for emissions. Submit manufacturer's documentation that product is inherently nonemitting. See Section 01 33 29.00 06 SUSTAINABILITY REPORTING for low-emitting material requirements.

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### 1.5 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.

### 1.6 DETAIL DRAWINGS

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

### 1.7 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.

### 2.2 METAL WALL LOUVERS

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

#### 2.2.1 Extruded Aluminum Louvers

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

#### 2.2.2 Screens and Frames

For aluminum louvers, provide 14 or 16 gage aluminum or 1/4 inch square mesh, 16 gage aluminum bird screening. Mount screens in removable, rewirable frames of same material and finish as the louvers.

### 2.3 FASTENERS AND ACCESSORIES

Provide stainless steel screws and fasteners for aluminum louvers and zinc-coated or stainless steel screws and fasteners for steel louvers.

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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 match adjacent surface.

#### 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-A42, integral color or A44, electrolytically deposited color anodized.

## 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 Wood

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

-- End of Section --



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## SECTION 09 22 00

### SUPPORTS FOR PLASTER AND GYPSUM BOARD

**02/10, CHG 2: 08/18**

#### PART 1 GENERAL

##### 1.1 REFERENCES

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

##### ASTM INTERNATIONAL (ASTM)

ASTM A463/A463M	(2015; R 2020; E 2020) Standard Specification for Steel Sheet, Aluminum-Coated, by the Hot-Dip Process
ASTM A653/A653M	(2020) Standard Specification for Steel Sheet, Zinc-Coated (Galvanized) or Zinc-Iron Alloy-Coated (Galvannealed) by the Hot-Dip Process
ASTM C645	(2014; E 2015) Nonstructural Steel Framing Members
ASTM C754	(2020) Standard Specification for Installation of Steel Framing Members to Receive Screw-Attached Gypsum Panel Products
ASTM C841	(2003; R 2013) Installation of Interior Lathing and Furring
ASTM C847	(2014a) Standard Specification for Metal Lath

##### NATIONAL ASSOCIATION OF ARCHITECTURAL METAL MANUFACTURERS (NAAMM)

NAAMM EMLA 920	(2009) Guide Specifications for Metal Lathing and Furring
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##### U.S. GREEN BUILDING COUNCIL (USGBC)

LEED v4 BDC Ref Guide	(2013; R 2020) USGBC LEED Reference Guide for Building Design and Construction, v4
LEED v4.1 BDC Ref Guide	(2023) LEED v4.1 Building Design and Construction Reference Guide

##### UNDERWRITERS LABORATORIES (UL)

UL Fire Resistance	(2014) Fire Resistance Directory
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##### 1.2 SUSTAINABILITY REPORTING

Work of this section is intended to contribute to the achievement of, or

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compliance with, the requirements of the Guiding Principles Validation and LEED Prerequisites and attempted Credits. Refer to Section 01 33 29.00 06 SUSTAINABILITY REPORTING for specific documentation requirements and list of Prerequisites, attempted Credits and LEED version.

Comply with product, material content, performance criteria, activity, documentation, and other technical requirements as described in the LEED v4 BDC Ref Guide or LEED v4.1 BDC Ref Guide as applicable.

Collect, organize, and submit product data, drawings, diagrams, photos and cost information necessary to demonstrate compliance with LEED v4 BDC Ref Guide or LEED v4.1 BDC Ref Guide requirements as applicable.

Data collection shall commence with the notice to proceed and will only be deemed complete upon acceptance of the Final Sustainability Notebook and LEED Online submission by the Contracting Officer, the LEED Project Administrator, and the Green Building Certification Institute.

### 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

Metal Support Systems

Recycled Content for Metal Support Systems; S

Environmental Product Declarations; S

Embodied Carbon Optimization Report/Action Plan; S

Extended Producer Responsibility; S

Local/Regional Materials; S

Material Ingredient Reporting; S

### 1.4 SUSTAINABLE DESIGN REQUIREMENTS

#### 1.4.1 Environmental Product Declarations

At a minimum, use materials or products with an Environmental Product Declaration in accordance with the LEED Implementation Plan. See Section 01 33 29.00 06 SUSTAINABILITY REPORTING for cumulative materials requirements and LEED Implementation Plan.

#### 1.4.2 Embodied Carbon Optimization Report/Action Plan

At a minimum, use materials or products with an Embodied Carbon Optimization Report/Action Plan in accordance with the LEED Implementation Plan. See Section 01 33 29.00 06 SUSTAINABILITY REPORTING for cumulative materials requirements and LEED Implementation Plan.

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#### 1.4.3 Sourcing of Raw Materials

Provide products that meet one or more of the following categories:

##### 1.4.3.1 Extended Producer Responsibility

At a minimum, use materials or products from manufacturers that participate in an extended producer responsibility program in accordance with the LEED Implementation Plan. Provide manufacturer letter verifying extended producer responsibility program is in place and that product is eligible. See Section 01 33 29.00 06 SUSTAINABILITY REPORTING for cumulative materials requirements and LEED Implementation Plan.

##### 1.4.3.2 Recycled Content Materials

At a minimum, use materials or products with recycled content in accordance with the LEED Implementation Plan. Provide manufacturers product literature identifying the percentage of recycled material incorporated within each product used. See Section 01 33 29.00 06 SUSTAINABILITY REPORTING for cumulative materials requirements and LEED Implementation Plan. If recycled content minimum is specified in this section, the greater of the two percentages governs.

##### 1.4.4 Material Ingredient Reporting

At a minimum, use materials or products with chemical inventory to at least 0.1% (1000 ppm) in accordance with the LEED Implementation Plan. Provide Health Product Declaration (HPD), Cradle to Cradle Certificate, Declare label, or other manufacturer's published content inventory in compliance with LEED v4.1 Material Ingredient Reporting credit. See Section 01 33 29.00 06 SUSTAINABILITY REPORTING for cumulative materials requirements and LEED Implementation Plan.

##### 1.4.5 Local/Regional Materials

Use materials or products extracted, harvested, or recovered, as well as manufactured, within a 100 mile radius from the project site, if available from a minimum of three sources. provide a letter from the manufacturer stating the extraction location, manufacturing location, and purchasing location of the products provided, referencing the project name and location specifically and distance to the project site. See Section 01 33 29.00 06 SUSTAINABILITY REPORTING for cumulative materials requirements and LEED Implementation Plan.

#### 1.5 DELIVERY, STORAGE, AND HANDLING

Deliver materials to the job site and store in ventilated dry locations permitting easy access for inspection and handling. If materials are stored outdoors, stack materials off the ground, supported on a level platform, and fully protected from the weather. Handle materials carefully to prevent damage. Remove damaged items and provide new items.

## PART 2 PRODUCTS

### 2.1 MATERIALS

Provide steel materials for metal support systems with galvanized coating ASTM A653/A653M, G-60; aluminum coating ASTM A463/A463M, T1-25; or a

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55-percent aluminum-zinc coating.

Provide metal support systems containing a minimum of 20 percent recycled content. Provide data identifying percentage of recycled content for metal support systems.

#### 2.1.1 Materials for Attachment of Lath

##### 2.1.1.1 Suspended and Furred Ceiling Systems and Wall Furring

ASTM C841, and ASTM C847.

##### 2.1.1.2 Non-load Bearing Wall Framing

NAAMM EMLA 920.

#### 2.1.2 Materials for Attachment of Gypsum Wallboard

##### 2.1.2.1 Suspended and Furred Ceiling Systems

ASTM C645.

##### 2.1.2.2 Non-load Bearing Wall Framing and Furring

ASTM C645, but not thinner than 0.0179 inch thickness, with 0.0329 inch minimum thickness supporting wall hung items such as cabinetwork, equipment and fixtures.

##### 2.1.2.3 Furring Structural Steel Columns

ASTM C645. Steel (furring) clips and support angles listed in UL Fire Resistance may be provided in lieu of steel studs for erection of gypsum wallboard around structural steel columns.

##### 2.1.2.4 Z-Furring Channels with Wall Insulation

Not lighter than 26 gage galvanized steel, Z-shaped, with 1-1/4 inch and 3/4 inch flanges and depth as required by the insulation thickness provided.

### PART 3 EXECUTION

#### 3.1 INSTALLATION

##### 3.1.1 Systems for Attachment of Lath

##### 3.1.1.1 Suspended and Furred Ceiling Systems and Wall Furring

ASTM C841, except as indicated otherwise.

##### 3.1.1.2 Non-load Bearing Wall Framing

NAAMM EMLA 920, except provide framing members 16 inches o.c. unless indicated otherwise.

##### 3.1.2 Systems for Attachment of Gypsum Wallboard

##### 3.1.2.1 Suspended and Furred Ceiling Systems

ASTM C754, except provide framing members 16 inches o.c. unless indicated

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otherwise.

#### 3.1.2.2 Non-load Bearing Wall Framing and Furring

ASTM C754, except as indicated otherwise.

#### 3.1.2.3 Furring Structural Steel Columns

Install studs or galvanized steel clips and support angles for erection of gypsum wallboard around structural steel columns in accordance with the UL Fire Resistance, design number(s) of the fire resistance rating indicated.

#### 3.1.2.4 Z-Furring Channels with Wall Insulation

Install Z-furring channels vertically spaced not more than 24 inches o.c. Locate Z-furring channels at interior and exterior corners in accordance with manufacturer's printed erection instructions. Fasten furring channels to masonry and concrete walls with powder-driven fasteners or hardened concrete steel nails through narrow flange of channel. Space fasteners not more than 24 inches o.c.

### 3.2 ERECTION TOLERANCES

Provide framing members which will be covered by finish materials such as wallboard, plaster, or ceramic tile set in a mortar setting bed, within the following limits:

- a. Layout of walls and partitions: 1/4 inch from intended position;
- b. Plates and runners: 1/4 inch in 8 feet from a straight line;
- c. Studs: 1/4 inch in 8 feet out of plumb, not cumulative; and
- d. Face of framing members: 1/4 inch in 8 feet from a true plane.

Provide framing members which will be covered by ceramic tile set in dry-set mortar, latex-portland cement mortar, or organic adhesive within the following limits:

- a. Layout of walls and partitions: 1/4 inch from intended position;
- b. Plates and runners: 1/8 inch in 8 feet from a straight line;
- c. Studs: 1/8 inch in 8 feet out of plumb, not cumulative; and
- d. Face of framing members: 1/8 inch in 8 feet from a true plane.

-- End of Section --

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## SECTION 09 29 00

## GYPSUM BOARD

08/16, CHG 4: 02/20

## PART 1 GENERAL

## 1.1 REFERENCES

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

## AMERICAN NATIONAL STANDARDS INSTITUTE (ANSI)

ANSI A108.11 (1992; Reaffirmed 2005) Specifications for  
Interior Installation of Cementitious  
Backer Units

## ASTM INTERNATIONAL (ASTM)

ASTM C475/C475M (2017) Standard Specification for Joint  
Compound and Joint Tape for Finishing  
Gypsum Board

ASTM C840 (2020) Standard Specification for  
Application and Finishing of Gypsum Board

ASTM C954 (2018) Standard Specification for Steel  
Drill Screws for the Application of Gypsum  
Panel Products or Metal Plaster Bases to  
Steel Studs from 0.033 in. (0.84 mm) to  
0.112 in. (2.84 mm) in Thickness

ASTM C1002 (2020) Standard Specification for Steel  
Self-Piercing Tapping Screws for the  
Application of Gypsum Panel Products or  
Metal Plaster Bases to Wood Studs or Steel  
Studs

ASTM C1047 (2019) Standard Specification for  
Accessories for Gypsum Wallboard and  
Gypsum Veneer Base

ASTM C1396/C1396M (2017) Standard Specification for Gypsum  
Board

ASTM C1629/C1629M (2018a) Standard Classification for  
Abuse-Resistant Nondecorated Interior  
Gypsum Panel Products and Fiber-Reinforced  
Cement Panels

ASTM D226/D226M (2017) Standard Specification for  
Asphalt-Saturated Organic Felt Used in  
Roofing and Waterproofing

ASTM D1037 (2012) Evaluating Properties of Wood-Base  
Fiber and Particle Panel Materials

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ASTM D2394	(2017) Standard Test Methods for Simulated Service Testing of Wood and Wood-Base Finish Flooring
ASTM D3273	(2016) 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 D6866	(2022) Standard Test Methods for Determining the Biobased Content of Solid, Liquid, and Gaseous Samples Using Radiocarbon Analysis
ASTM E84	(2020) Standard Test Method for Surface Burning Characteristics of Building Materials
ASTM E336	(2020) Standard Test Method for Measurement of Airborne Sound Attenuation between Rooms in Buildings
ASTM E695	(2003; R 2015; E 2015) Measuring Relative Resistance of Wall, Floor, and Roof Construction to Impact Loading

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
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FM GLOBAL (FM)

FM APP GUIDE	(updated on-line) Approval Guide <a href="http://www.approvalguide.com/">http://www.approvalguide.com/</a>
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GREEN SEAL (GS)

GS-36	(2013) Adhesives for Commercial Use
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GYPSUM ASSOCIATION (GA)

GA 214	(2010) Recommended Levels of Gypsum Board Finish
GA 216	(2010) Application and Finishing of Gypsum Panel Products

SCIENTIFIC CERTIFICATION SYSTEMS (SCS)

SCS	SCS Global Services (SCS) Indoor Advantage
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#### SOUTH COAST AIR QUALITY MANAGEMENT DISTRICT (SCAQMD)

SCAQMD Rule 1168 (2017) Adhesive and Sealant Applications

#### U.S. GREEN BUILDING COUNCIL (USGBC)

LEED v4 BDC Ref Guide (2013; R 2020) USGBC LEED Reference Guide  
 for Building Design and Construction, v4

LEED v4.1 BDC Ref Guide (2023) LEED v4.1 Building Design and  
 Construction Reference Guide

#### UNDERWRITERS LABORATORIES (UL)

UL 2818 (2013) GREENGUARD Certification Program  
 For Chemical Emissions For Building  
 Materials, Finishes And Furnishings

UL Fire Resistance (2014) Fire Resistance Directory

### 1.2 SUSTAINABILITY REPORTING

Work of this section is intended to contribute to the achievement of, or compliance with, the requirements of the Guiding Principles Validation and LEED Prerequisites and attempted Credits. Refer to Section 01 33 29.00 06 SUSTAINABILITY REPORTING for specific documentation requirements and list of Prerequisites, attempted Credits and LEED version.

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### 1.3 SUBMITTALS

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

Accessories

Submit for each type of gypsum board and for cementitious backer



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units.

Gypsum Board

Recycled Content for Gypsum Board; S

VOC Content of Joint Compound; S

Abuse Resistant Gypsum Board

Environmental Product Declarations; S

Embodied Carbon Optimization Report/Action Plan; S

Extended Producer Responsibility; S

Bio-Based Materials; S

Local/Regional Materials; S

Material Ingredient Reporting; S

#### SD-06 Test Reports

ASTM E90 Factory Test Report; G

ASTM E336 Field Test Report; G

#### SD-07 Certificates

Asbestos Free Materials; G, AE

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

### 1.4 SUSTAINABLE DESIGN REQUIREMENTS

#### 1.4.1 Environmental Product Declarations

At a minimum, use materials or products with an Environmental Product Declaration in accordance with the LEED Implementation Plan. See Section 01 33 29.00 06 SUSTAINABILITY REPORTING for cumulative materials requirements and LEED Implementation Plan.

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#### 1.4.2 Embodied Carbon Optimization Report/Action Plan

At a minimum, use materials or products with an Embodied Carbon Optimization Report/Action Plan in accordance with the LEED Implementation Plan. See Section 01 33 29.00 06 SUSTAINABILITY REPORTING for cumulative materials requirements and LEED Implementation Plan.

#### 1.4.3 Sourcing of Raw Materials

Provide products that meet one or more of the following categories:

##### 1.4.3.1 Extended Producer Responsibility

At a minimum, use materials or products from manufacturers that participate in an extended producer responsibility program in accordance with the LEED Implementation Plan. Provide manufacturer letter verifying extended producer responsibility program is in place and that product is eligible. See Section 01 33 29.00 06 SUSTAINABILITY REPORTING for cumulative materials requirements and LEED Implementation Plan.

##### 1.4.3.2 Bio-Based Materials

At a minimum, use materials or products with bio-based content in accordance with the LEED Implementation Plan. Provide manufacturer signed letter confirming ASTM D6866 test method was conducted validating bio-based material weight within product, type of bio-based material used within product, and confirmation raw material was legally harvested. See Section 01 33 29.00 06 SUSTAINABILITY REPORTING for cumulative materials requirements and LEED Implementation Plan. If bio-based content minimum is specified in this section, the greater of the two percentages governs.

##### 1.4.3.3 Recycled Content Materials

At a minimum, use materials or products with recycled content in accordance with the LEED Implementation Plan. Provide manufacturers product literature identifying the percentage of recycled material incorporated within each product used. See Section 01 33 29.00 06 SUSTAINABILITY REPORTING for cumulative materials requirements and LEED Implementation Plan. If recycled content minimum is specified in this section, the greater of the two percentages governs.

#### 1.4.4 Material Ingredient Reporting

At a minimum, use materials or products with chemical inventory to at least 0.1% (1000 ppm) in accordance with the LEED Implementation Plan. Provide Health Product Declaration (HPD), Cradle to Cradle Certificate, Declare label, or other manufacturer's published content inventory in compliance with LEED v4.1 Material Ingredient Reporting credit. See Section 01 33 29.00 06 SUSTAINABILITY REPORTING for cumulative materials requirements and LEED Implementation Plan.

#### 1.4.5 Local/Regional Materials

Use materials or products extracted, harvested, or recovered, as well as manufactured, within a 100 mile radius from the project site, if available from a minimum of three sources. provide a letter from the manufacturer stating the extraction location, manufacturing location, and purchasing location of the products provided, referencing the project name and location specifically and distance to the project site. See Section

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01 33 29.00 06 SUSTAINABILITY REPORTING for cumulative materials requirements and LEED Implementation Plan.

## 1.5 CERTIFICATIONS

### 1.5.1 Indoor Air Quality Certifications

Submit required indoor air quality certifications in one submittal package.

#### 1.5.1.1 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.

#### 1.5.1.2 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.

## 1.6 DELIVERY, STORAGE, AND HANDLING

### 1.6.1 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.

### 1.6.2 Storage

Keep materials dry by storing inside a sheltered building. Where necessary to store gypsum board and cementitious backer units outside, store off the ground, properly supported on a level platform, and protected from direct exposure to rain, snow, sunlight, and other extreme weather conditions. Provide adequate ventilation to prevent condensation. Store per manufacturer's recommendations for allowable temperature and humidity range. Do not store gypsum wallboard with materials which have high emissions of volatile organic compounds (VOCs) or other contaminants. Do not store panels near materials that may offgas or emit harmful fumes, such as kerosene heaters, fresh paint, or adhesives. Do not use materials that have visible moisture or biological growth.

### 1.6.3 Handling

Neatly stack gypsum board and cementitious backer units flat to prevent sagging or damage to the edges, ends, and surfaces.

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## 1.7 QUALIFICATIONS

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

## 1.8 SCHEDULING

Commence application only after the area scheduled for gypsum board work is completely weathertight. The heating, ventilating, and air-conditioning systems must be complete and in operation prior to application of the gypsum board. If the mechanical system cannot be activated before gypsum board is begun, the gypsum board work may proceed in accordance with an approved plan to maintain the environmental conditions specified below. Apply gypsum board prior to the installation of finish flooring and acoustic ceiling.

## 1.9 ENVIRONMENTAL REQUIREMENTS

Do not expose the gypsum board to excessive sunlight prior to gypsum board application. Maintain a continuous uniform temperature of not less than 50 degrees F and not more than 80 degrees F for at least one week prior to the application of gypsum board work, while the gypsum board application is being done, and for at least one week after the gypsum board is set. Shield air supply and distribution devices to prevent any uneven flow of air across the plastered surfaces. Provide ventilation to exhaust moist air to the outside during gypsum board application, set, and until gypsum board jointing is dry. In glazed areas, keep windows open top and bottom or side to side 3 to 4 inches. Reduce openings in cold weather to prevent freezing of joint compound when applied. For enclosed areas lacking natural ventilation, provide temporary mechanical means for ventilation. In unglazed areas subjected to hot, dry winds or temperature differentials from day to night of 20 degrees F or more, screen openings with cheesecloth or similar materials. Avoid rapid drying. During periods of low indoor humidity, provide minimum air circulation following gypsum boarding and until gypsum board jointing complete and is dry.

## 1.10 FIRE RESISTIVE CONSTRUCTION

Comply with specified fire-rated assemblies for design numbers indicated per UL Fire Resistance or FM APP GUIDE.

## PART 2 PRODUCTS

### 2.1 MATERIALS

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

#### 2.1.1 Gypsum Board

ASTM C1396/C1396M. Gypsum board must contain a minimum of 95 percent post-consumer recycled content. Provide data identifying percentage of recycled content for gypsum board. 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

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gypsum board.

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

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

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

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

#### 2.1.2 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 for 1-hour and a flame spread rating of 75 or less and a smoke developed rating of 100 or less for 1-hour.

##### 2.1.2.1 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.

##### 2.1.2.2 Hard Body Impact Test

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

##### 2.1.2.3 Surface Abrasion Test

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

##### 2.1.2.4 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.

#### 2.1.3 Cementitious Backer Units

In accordance with the Tile Council of America (TCA) Handbook.

#### 2.1.4 Joint Treatment Materials

ASTM C475/C475M. Product must be low emitting VOC types with VOC limits not exceeding 50 g/L. Provide data identifying VOC content of joint compound. 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

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other slow releasing compounds.

#### 2.1.4.1 Embedding Compound

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

#### 2.1.4.2 Finishing or Topping Compound

Specifically formulated and manufactured for use as a finishing compound.

#### 2.1.4.3 All-Purpose Compound

Specifically formulated and manufactured to serve as both a taping and a finishing compound and compatible with tape, substrate and fasteners.

#### 2.1.4.4 Setting or Hardening Type Compound

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

#### 2.1.4.5 Joint Tape

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

#### 2.1.5 Fasteners

##### 2.1.5.1 Screws

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

#### 2.1.6 Adhesives

Provide non-aerosol adhesive products used on the interior of the building (defined as inside of the weatherproofing system) meeting both emissions requirements of CDPH SECTION 01350 (limit requirements for either office or classroom spaces regardless of space type) and VOC content requirements of SCAQMD Rule 1168. Provide aerosol adhesive products used on the interior of the building (defined as inside of the weatherproofing system) meeting both emissions requirements of CDPH SECTION 01350 (limit requirements for either office or classroom spaces regardless of space type) and 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).

##### 2.1.6.1 Adhesive for Fastening Gypsum Board to Metal Framing

Not permitted.

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#### 2.1.6.2 Adhesive for Fastening Gypsum Board to Wood Framing

Not permitted.

#### 2.1.6.3 Adhesive for Laminating

Not permitted.

#### 2.1.7 Gypsum Studs

Provide one inch minimum thickness and 6 inch minimum width. Studs may be of one inch thick gypsum board or multilayers fastened to required thickness. Conform to ASTM C1396/C1396M for material and GA 216 for installation.

#### 2.1.8 Accessories

ASTM C1047. Fabricate from corrosion protected steel designed for intended use. Accessories manufactured with paper flanges are not acceptable. Flanges must be free of dirt, grease, and other materials that may adversely affect bond of joint treatment. Provide prefinished or job decorated materials.

#### 2.1.9 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.

#### 2.1.10 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

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minimize waste. Cut out gypsum board to make neat, close, and tight joints around openings. In vertical application of gypsum board, provide panels in lengths required to reach full height of vertical surfaces in one continuous piece. Lay out panels to minimize waste; reuse cutoffs whenever feasible. Surfaces of gypsum board and substrate members may not be bonded together with an adhesive. Treat edges of cutouts for plumbing pipes, screwheads, and joints with water-resistant compound as recommended by the gypsum board manufacturer. Provide type of gypsum board for use in each system specified herein as indicated.

### 3.2.1 Application of Gypsum Board to Steel Framing and Furring

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

### 3.2.2 Control Joints

Install expansion and contraction joints in ceilings and walls in accordance with ASTM C840, System XIII or GA 216. Fill control joints between studs in fire-rated construction with firesafing insulation to match the fire-rating of construction.

### 3.2.3 Application of 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 heavy textured finish before painting to Level 3 in accordance with GA 214. Finish walls and ceilings without critical lighting to receive flat paints, light textures, or wall coverings to Level 4 in accordance with GA 214. Unless otherwise specified, finish all gypsum board walls, partitions and ceilings to Level 5 in accordance with GA 214. Provide joint, fastener depression, and corner treatment. Tool joints as smoothly as possible to minimize sanding and dust. Do not use self-adhering fiber glass mesh tape with conventional drying type joint compounds; use setting or hardening type compounds only. Provide treatment for water-resistant gypsum board as recommended by the gypsum board manufacturer. Protect



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workers, building occupants, and HVAC systems from gypsum dust.

#### 3.4.1 Uniform Surface

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

#### 3.5 SEALING

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

#### 3.6 FIRE-RESISTANT ASSEMBLIES

Wherever fire-rated construction is indicated, provide materials and application methods, including types and spacing of fasteners, wall and ceiling framing in accordance with the specifications contained in UL Fire Resistance for the Design Number(s) indicated. Joints of fire-rated gypsum board enclosures must be closed and sealed in accordance with UL test requirements or GA requirements. Seal penetrations through rated partitions and ceilings tight in accordance with tested systems.

#### 3.7 SOUND RATED ASSEMBLIES

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

#### 3.8 PATCHING

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

#### 3.9 SOUND RATED ASSEMBLY FIELD TESTING

Provide third party testing of sound rated assemblies tested in accordance with ASTM E336. Provide the ASTM E336 Field Test Report verifying that the installed assemblies perform no less than five ASTC rating points below the ASTM E90 Factory Test Report. Examine, modify adjust, and retest any installation not meeting the STC Rating until compliance is obtained.

-- End of Section --

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## SECTION 09 30 10

CERAMIC, QUARRY, AND GLASS TILING  
 08/20

## PART 1 GENERAL

## 1.1 REFERENCES

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

## AMERICAN NATIONAL STANDARDS INSTITUTE (ANSI)

ANSI 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 A1064/A1064M (2017) Standard Specification for  
 Carbon-Steel Wire and Welded Wire  
 Reinforcement, Plain and Deformed, for  
 Concrete

ASTM C33/C33M (2018) Standard Specification for Concrete  
 Aggregates

ASTM C144 (2018) Standard Specification for  
 Aggregate for Masonry Mortar

ASTM C150/C150M (2021) Standard Specification for Portland  
 Cement

ASTM C206 (2014) Standard Specification for  
 Finishing Hydrated Lime

ASTM C207 (2018) Standard Specification for Hydrated  
 Lime for Masonry Purposes

ASTM C373 (2018) Standard Test Methods for  
 Determination of Water Absorption and  
 Associated Properties by Vacuum Method for  
 Pressed Ceramic Tiles and Glass Tiles and  
 Boil Method for Extruded Ceramic Tiles and  
 Non-tile Fired Ceramic Whiteware Products

ASTM C648 (2020) Standard Test Method for Breaking  
 Strength of Ceramic Tile

ASTM C847 (2014a) Standard Specification for Metal  
 Lath

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ASTM C1178/C1178M (2013) Standard Specification for Glass  
 Mat Water-Resistant Gypsum Backing Panel

ASTM F446 (2019) Standard Consumer Safety  
 Specification for Grab Bars and  
 Accessories Installed in the Bathing Area

#### 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

#### TILE COUNCIL OF NORTH AMERICA (TCNA)

TCNA Hdbk (2017) Handbook for Ceramic, Glass, and  
 Stone Tile Installation

#### U.S. GREEN BUILDING COUNCIL (USGBC)

LEED v4 BDC Ref Guide (2013; R 2020) USGBC LEED Reference Guide  
 for Building Design and Construction, v4

LEED v4.1 BDC Ref Guide (2023) LEED v4.1 Building Design and  
 Construction Reference Guide

#### UNDERWRITERS LABORATORIES (UL)

UL 2818 (2013) GREENGUARD Certification Program  
 For Chemical Emissions For Building  
 Materials, Finishes And Furnishings

### 1.2 SUSTAINABILITY REPORTING

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Comply with product, material content, performance criteria, activity, documentation, and other technical requirements as described in the LEED v4 BDC Ref Guide or LEED v4.1 BDC Ref Guide as applicable.

Collect, organize, and submit product data, drawings, diagrams, photos and cost information necessary to demonstrate compliance with

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### 1.3 SUBMITTALS

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

Transition Strips; G

Metal Strips; G

Setting-Bed; G

Mortar, Grout, and Adhesive; G

Reinforcing Wire Fabric

Cementitious Backer Units; G

Glass-Mat Gypsum Water-Resistant Backing Board; G

Waterproof Membrane; G

Crack Isolation Membrane; G

Environmental Product Declarations; S

Embodied Carbon Optimization Report/Action Plan; S

Extended Producer Responsibility; S

Local/Regional Materials; S

Material Ingredient Reporting; S

#### SD-04 Samples

Tile; G

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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

Transition Strips, Data Package 1; G

Metal Strips, Data Package 1; G

### 1.4 SUSTAINABLE DESIGN REQUIREMENTS

#### 1.4.1 Environmental Product Declarations

At a minimum, use materials or products with an Environmental Product Declaration in accordance with the LEED Implementation Plan. See Section 01 33 29.00 06 SUSTAINABILITY REPORTING for cumulative materials requirements and LEED Implementation Plan.

#### 1.4.2 Embodied Carbon Optimization Report/Action Plan

At a minimum, use materials or products with an Embodied Carbon Optimization Report/Action Plan in accordance with the LEED Implementation Plan. See Section 01 33 29.00 06 SUSTAINABILITY REPORTING for cumulative materials requirements and LEED Implementation Plan.

#### 1.4.3 Sourcing of Raw Materials

Provide products that meet one or more of the following categories:

##### 1.4.3.1 Extended Producer Responsibility

At a minimum, use materials or products from manufacturers that participate in an extended producer responsibility program in accordance with the LEED Implementation Plan. Provide manufacturer letter verifying extended producer responsibility program is in place and that product is eligible. See Section 01 33 29.00 06 SUSTAINABILITY REPORTING for cumulative materials requirements and LEED Implementation Plan.

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#### 1.4.3.2 Recycled Content Materials

At a minimum, use materials or products with recycled content in accordance with the LEED Implementation Plan. Provide manufacturers product literature identifying the percentage of recycled material incorporated within each product used. See Section 01 33 29.00 06 SUSTAINABILITY REPORTING for cumulative materials requirements and LEED Implementation Plan. If recycled content minimum is specified in this section, the greater of the two percentages governs.

#### 1.4.4 Material Ingredient Reporting

At a minimum, use materials or products with chemical inventory to at least 0.1% (1000 ppm) in accordance with the LEED Implementation Plan. Provide Health Product Declaration (HPD), Cradle to Cradle Certificate, Declare label, or other manufacturer's published content inventory in compliance with LEED v4.1 Material Ingredient Reporting credit. See Section 01 33 29.00 06 SUSTAINABILITY REPORTING for cumulative materials requirements and LEED Implementation Plan.

#### 1.4.5 Local/Regional Materials

Use materials or products extracted, harvested, or recovered, as well as manufactured, within a 100 mile radius from the project site, if available from a minimum of three sources. provide a letter from the manufacturer stating the extraction location, manufacturing location, and purchasing location of the products provided, referencing the project name and location specifically and distance to the project site. See Section 01 33 29.00 06 SUSTAINABILITY REPORTING for cumulative materials requirements and LEED Implementation Plan.

### 1.5 CERTIFICATIONS

#### 1.5.1 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.

#### 1.5.2 Water Absorption Rates Certification

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

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

### 1.6 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.

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#### 1.7 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.

#### 1.8 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.

#### 1.9 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..

#### 1.10 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 .50 when tested in accordance with ANSI A137.1 requirements.

##### 2.1.1 Porcelain Tile

Provide unglazed, porcelain tile and cove base and trim pieces. Provide tile with a V2 aesthetic classification. Blend tiles in factory and in a packages to have same color range and continuous blend for installation. Provide nominal tile size(s) of 12 by 24 and 2 by 6 inch and 3/8 inch thick.

Provide porcelain tiling materials that contain a minimum of 5 percent recycled content. Provide data identifying percentage of recycled content for porcelain tile.

##### 2.1.2 Accessories

Provide built-in type accessories of the same materials and finish as the wall tile. Provide accessories as follows:

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	Quantity	Location
Recessed soap holder and hand hold combination: support static load in compliance with ASTM F446	1	each shower stall

## 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.

### 2.2.6 Reinforcing Wire Fabric

Conform to ASTM A1064/A1064M for wire fabric. Provide 2 by 2 inch mesh, 16/16 wire or 1-1/2 by 2 inch mesh, 16/13 wire.

## 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 both emissions requirements of CDPH SECTION 01350 (limit requirements for either office or classroom spaces regardless of space type) and VOC content requirements of SCAQMD Rule 1168. Provide aerosol adhesives used on the interior of the building meeting both emissions requirements of CDPH SECTION 01350 (limit requirements for either office or classroom spaces regardless of space type) and 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.



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#### 2.4.1 Dry-Set Portland Cement Mortar

TCNA Hdbk.

#### 2.4.2 Latex-Portland Cement Mortar

TCNA Hdbk.

#### 2.4.3 Organic Adhesive

TCNA Hdbk, Type I. Water-resistant. Comply with ANSI A108/A118/A136.1.

#### 2.4.4 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.

#### 2.4.5 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.

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## 2.6.2 Metal Strips

Provide Cove trim shapes, height to match tile and setting thickness, designed specifically for flooring, and wall applications. Provide extruded radiused, clear anodized aluminum edging at tile surfaces with exposed outside and inside corners.

## 2.7 WATERPROOF MEMBRANE

### 2.7.1 General

Manufacturer's standard product that complies with ANSI A108/A118/A136.1 and is recommended by the manufacturer for the application indicated. Include reinforcement and accessories recommended by manufacturer.

### 2.7.2 Chlorinated-Polyethylene Shower Waterproof Membrane

Nonplasticized, chlorinated polyethylene faced on both sides with nonwoven polyester fabric; 0.040 inch nominal thickness.

## 2.8 CRACK ISOLATION MEMBRANE

### 2.8.1 General

Manufacturer's standard product that complies with ANSI A108/A118/A136.1 and is recommended by the manufacturer for the application indicated. Include reinforcement and accessories recommended by manufacturer.

### 2.8.2 Chlorinated-Polyethylene Crack Isolation Membrane

Nonplasticized, chlorinated polyethylene faced on both sides with nonwoven polyester fabric; 0.030 inch nominal thickness.

## 2.9 COLOR, TEXTURE, AND PATTERN

Provide color, pattern and texture as indicated; colors listed are not intended to limit the selection of equal colors from other manufacturers..

## PART 3 EXECUTION

### 3.1 PREPARATORY WORK AND WORKMANSHIP

Inspect surface to receive tile in conformance to the requirements of TCNA Hdbk for surface conditions for the type setting bed specified and for workmanship. Provide variations of tiled surfaces that fall within maximum values shown below:

TYPE	WALLS	FLOORS
Dry-Set Mortar	1/8 inch in 8 ft.	1/8 inch in 10 ft.
Organic Adhesives	1/8 inch in 8 ft.	1/16 inch in 3 ft.
Latex-Portland Cement Mortar	1/8 inch in 8 ft.	1/8 inch in 10 ft.

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TYPE	WALLS	FLOORS
Epoxy	1/8 inch in 8 ft.	1/8 inch in 10 ft.

### 3.2 GENERAL INSTALLATION REQUIREMENTS

Do not start tile work until roughing in for mechanical and electrical work has been completed and tested, and built-in items requiring membrane waterproofing have been installed and tested. Close space, in which tile is being set, to traffic and other work. Keep closed until tile is firmly set. Do not start floor tile installation in spaces requiring wall tile until after wall tile has been installed. Apply tile in colors and patterns indicated in the area shown on the drawings. Install tile with the respective surfaces in true even planes to the elevations and grades shown. Provide special shapes as required for sills, jambs, recesses, offsets, external corners, and other conditions to provide a complete and neatly finished installation. Solidly back tile bases and coves with mortar. Do not walk or work on newly tiled floors without using kneeling boards or equivalent protection of the tiled surface. Keep traffic off horizontal portland cement mortar installations for at least 72 hours. Keep all traffic off epoxy installed floors for at least 40 hours after grouting, and heavy traffic off for at least 7 days, unless otherwise specifically authorized by manufacturer. Dimension and draw detail drawings at a minimum scale of 1/4 inch = 1 foot. Include drawings of pattern at inside corners, outside corners, termination points and location of all equipment items such as thermostats, switch plates, mirrors and toilet accessories mounted on surface. Submit drawings showing ceramic tile pattern elevations and floor plans. Submit manufacturer's preprinted installation instructions.

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

### 3.3 INSTALLATION OF SUBSTRATES

#### 3.3.1 Cementitious Backer Units and Glass-Mat Water-Resistant Backing Board

Install as specified in Section 09 29 00 GYPSUM BOARD.in accordance with manufacturer's written instructions.

### 3.4 INSTALLATION OF WALL TILE

Install wall tile in accordance with the TCNA Hdbk, method B, EJ, or W series where appropriate and with grout joints as recommended by the manufacturer for the type of tile.

#### 3.4.1 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.

#### 3.4.2 Organic Adhesive

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

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### 3.4.3 Epoxy Resin Grout

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

## 3.5 INSTALLATION OF FLOOR TILE

Install floor tile in accordance with TCNA Hdbk method specified herein and with grout joints as recommended by the manufacturer for the type of tile. Install shower receptors in accordance with TCNA Hdbk method B414.

### 3.5.1 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 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 Waterproof and Crack Isolation Membranes

Install as indicated in accordance with manufacturer's written instructions.

## 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.

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### 3.7 EXPANSION JOINTS

Form and seal joints as specified in Section 07 92 00 JOINT SEALANTS.

#### 3.7.1 Walls

Provide expansion joints at control joints in backing material. Wherever backing material changes, install an expansion joint to separate the different materials.

#### 3.7.2 Floors

Provide expansion joints over construction joints, control joints, and expansion joints in concrete slabs in accordance with TCNA Hdbk method EJ171 type to suit conditions. Provide expansion joints where tile abuts restraining surfaces such as perimeter walls, curbs and columns and at intervals of 20 to 25 feet each way in large interior floor areas. 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 --

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## SECTION 09 51 00

ACOUSTICAL CEILINGS  
08/20

## PART 1 GENERAL

## 1.1 REFERENCES

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

## ASTM INTERNATIONAL (ASTM)

ASTM A489	(2018; E 2018) Standard Specification for Carbon Steel Eyebolts
ASTM A641/A641M	(2019) Standard Specification for Zinc-Coated (Galvanized) Carbon Steel Wire
ASTM A653/A653M	(2020) Standard Specification for Steel Sheet, Zinc-Coated (Galvanized) or Zinc-Iron Alloy-Coated (Galvannealed) by the Hot-Dip Process
ASTM A1008/A1008M	(2021) Standard Specification for Steel, Sheet, Cold-Rolled, Carbon, Structural, High-Strength Low-Alloy, High-Strength Low-Alloy with Improved Formability, Solution Hardened, and Bake Hardenable
ASTM B633	(2019) Standard Specification for Electrodeposited Coatings of Zinc on Iron and Steel
ASTM C423	(2009a) Sound Absorption and Sound Absorption Coefficients by the Reverberation Room Method
ASTM C635/C635M	(2017) Standard Specification for Manufacture, Performance, and Testing of Metal Suspension Systems for Acoustical Tile and Lay-In Panel Ceilings
ASTM C636/C636M	(2013) Standard Practice for Installation of Metal Ceiling Suspension Systems for Acoustical Tile and Lay-In Panels
ASTM C834	(2017) Standard Specification for Latex Sealants
ASTM D6866	(2022) Standard Test Methods for Determining the Biobased Content of Solid, Liquid, and Gaseous Samples Using Radiocarbon Analysis

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ASTM E413	(2016) Classification for Rating Sound Insulation
ASTM E580/E580M	(2020) Standard Practice for Installation of Ceiling Suspension Systems for Acoustical Tile and Lay-in Panels in Areas Subject to Earthquake Ground Motions
ASTM E795	(2016) Standard Practices for Mounting Test Specimens During Sound Absorption Tests
ASTM E1111/E1111M	(2014) Standard Test Method for Measuring the Interzone Attenuation of Open Office Components
ASTM E1264	(2019) Acoustical Ceiling Products
ASTM E1414/E1414M	(2021a) Standard Test Method for Airborne Sound Attenuation Between Rooms Sharing a Common Ceiling Plenum
ASTM E1477	(1998a; R 2017; E 2018) Standard Test Method for Luminous Reflectance Factor of Acoustical Materials by Use of Integrating-Sphere Reflectometers

CALIFORNIA DEPARTMENT OF PUBLIC HEALTH (CDPH)

CDPH SECTION 01350	(20170; Version 1.2) Standard Method for the Testing and Evaluation of Volatile Organic Chemical Emissions from Indoor Sources using Environmental Chambers
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GREEN SEAL (GS)

GS-36	(2013) Adhesives for Commercial Use
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SCIENTIFIC CERTIFICATION SYSTEMS (SCS)

SCS	SCS Global Services (SCS) Indoor Advantage
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SOUTH COAST AIR QUALITY MANAGEMENT DISTRICT (SCAQMD)

SCAQMD Rule 1168	(2017) Adhesive and Sealant Applications
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U.S. DEPARTMENT OF DEFENSE (DOD)

UFC 3-301-01	(2019) Structural Engineering
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U.S. GREEN BUILDING COUNCIL (USGBC)

LEED v4 BDC Ref Guide	(2013; R 2020) USGBC LEED Reference Guide for Building Design and Construction, v4
LEED v4.1 BDC Ref Guide	(2023) LEED v4.1 Building Design and Construction Reference Guide

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#### UNDERWRITERS LABORATORIES (UL)

UL 2818 (2013) GREENGUARD Certification Program  
 For Chemical Emissions For Building  
 Materials, Finishes And Furnishings

### 1.2 SUSTAINABILITY REPORTING

Work of this section is intended to contribute to the achievement of, or compliance with, the requirements of the Guiding Principles Validation and LEED Prerequisites and attempted Credits. Refer to Section 01 33 29.00 06 SUSTAINABILITY REPORTING for specific documentation requirements and list of Prerequisites, attempted Credits and LEED version.

Comply with product, material content, performance criteria, activity, documentation, and other technical requirements as described in the LEED v4 BDC Ref Guide or LEED v4.1 BDC Ref Guide as applicable.

Collect, organize, and submit product data, drawings, diagrams, photos and cost information necessary to demonstrate compliance with LEED v4 BDC Ref Guide or LEED v4.1 BDC Ref Guide requirements as applicable.

Data collection shall commence with the notice to proceed and will only be deemed complete upon acceptance of the Final Sustainability Notebook and LEED Online submission by the Contracting Officer, the LEED Project Administrator, and the Green Building Certification Institute.

### 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

Recycled Content for Type IV Ceiling Tiles; S

Recycled Content for Suspension Systems; S

Environmental Product Declarations; S

Embodied Carbon Optimization Report/Action Plan; S

Extended Producer Responsibility; S

Bio-Based Materials; S

Local/Regional Materials; S

Material Ingredient Reporting; S



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Acoustical Performance; G, AE

SD-04 Samples

Acoustical Units; G, AE

SD-07 Certificates

Indoor Air Quality for Type IV Ceiling Tiles; S

Indoor Air Quality for Adhesives; S

Indoor Air Quality for Sealants; S

#### 1.4 SUSTAINABLE DESIGN REQUIREMENTS

##### 1.4.1 Environmental Product Declarations

At a minimum, use materials or products with an Environmental Product Declaration in accordance with the LEED Implementation Plan. See Section 01 33 29.00 06 SUSTAINABILITY REPORTING for cumulative materials requirements and LEED Implementation Plan.

##### 1.4.2 Embodied Carbon Optimization Report/Action Plan

At a minimum, use materials or products with an Embodied Carbon Optimization Report/Action Plan in accordance with the LEED Implementation Plan. See Section 01 33 29.00 06 SUSTAINABILITY REPORTING for cumulative materials requirements and LEED Implementation Plan.

##### 1.4.3 Sourcing of Raw Materials

Provide products that meet one or more of the following categories:

###### 1.4.3.1 Extended Producer Responsibility

At a minimum, use materials or products from manufacturers that participate in an extended producer responsibility program in accordance with the LEED Implementation Plan. Provide manufacturer letter verifying extended producer responsibility program is in place and that product is eligible. See Section 01 33 29.00 06 SUSTAINABILITY REPORTING for cumulative materials requirements and LEED Implementation Plan.

###### 1.4.3.2 Bio-Based Materials

At a minimum, use materials or products with bio-based content in accordance with the LEED Implementation Plan. Provide manufacturer signed letter confirming ASTM D6866 test method was conducted validating bio-based material weight within product, type of bio-based material used within product, and confirmation raw material was legally harvested. See Section 01 33 29.00 06 SUSTAINABILITY REPORTING for cumulative materials requirements and LEED Implementation Plan. If bio-based content minimum is specified in this section, the greater of the two percentages governs.

###### 1.4.3.3 Recycled Content Materials

At a minimum, use materials or products with recycled content in accordance with the LEED Implementation Plan. Provide manufacturers product literature identifying the percentage of recycled material

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incorporated within each product used. See Section 01 33 29.00 06 SUSTAINABILITY REPORTING for cumulative materials requirements and LEED Implementation Plan. If recycled content minimum is specified in this section, the greater of the two percentages governs.

#### 1.4.4 Material Ingredient Reporting

At a minimum, use materials or products with chemical inventory to at least 0.1% (1000 ppm) in accordance with the LEED Implementation Plan. Provide Health Product Declaration (HPD), Cradle to Cradle Certificate, Declare label, or other manufacturer's published content inventory in compliance with LEED v4.1 Material Ingredient Reporting credit. See Section 01 33 29.00 06 SUSTAINABILITY REPORTING for cumulative materials requirements and LEED Implementation Plan.

#### 1.4.5 Local/Regional Materials

Use materials or products extracted, harvested, or recovered, as well as manufactured, within a 100 mile radius from the project site, if available from a minimum of three sources. provide a letter from the manufacturer stating the extraction location, manufacturing location, and purchasing location of the products provided, referencing the project name and location specifically and distance to the project site. See Section 01 33 29.00 06 SUSTAINABILITY REPORTING for cumulative materials requirements and LEED Implementation Plan.

### 1.5 CERTIFICATIONS

#### 1.5.1 Indoor Air Quality Certifications

##### 1.5.1.1 Ceiling Tiles

Provide products certified to meet indoor air quality requirements by UL 2818 (Greenguard) Gold, SCS Global Services Indoor Advantage Gold or provide certification or validation by other third-party programs that products meet the requirements of this section. Provide current product certification documentation from certification body.

##### 1.5.1.2 Adhesives and Sealants

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

### 1.6 DELIVERY, STORAGE. AND HANDLING

Deliver materials to the site in the manufacturer's original unopened containers with brand name and type clearly marked. Carefully handle and store materials in dry, watertight enclosures. Immediately before installation, store acoustical units for not less than 24 hours at the same temperature and relative humidity as the space where they will be installed in order to assure proper temperature and moisture acclimation.

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## 1.7 ENVIRONMENTAL REQUIREMENTS

Maintain a uniform temperature of not less than 60 degrees F nor more than 85 degrees F and a relative humidity of not more than 70 percent for 24 hours before, during, and 24 hours after installation of acoustical units.

## 1.8 SCHEDULING

Complete and dry interior finish work such as plastering, concrete and terrazzo work before ceiling installation. Complete mechanical, electrical, and other work above the ceiling line; install and start operating heating, ventilating, and air conditioning systems in order to maintain temperature and humidity requirements.

## 1.9 WARRANTY

Provide manufacturer's warranty to repair or replace defective materials and workmanship including but not limited to, sagging and warping of panels and rusting and of grid systems, for a period of ten years from date of final acceptance of the work.

## 1.10 EXTRA MATERIALS

Furnish spare tiles, from the same lot as those installed, of each color at the rate of 5 tiles for each 1000 tiles installed.

# PART 2 PRODUCTS

## 2.1 SYSTEM DESCRIPTION

Provide sound controlling units mechanically mounted on a ceiling suspension system for acoustical treatment. Provide the unit size, texture, finish, and color as specified. Coordinate the entire ceiling system with other details, like the location of access panels and ceiling penetrations, for instance, shown on the drawings. The Contractor is responsible for the final assembly and performance of the specified work. Provide the location and extent of acoustical treatment as shown on the approved detail drawings. Submit drawings showing suspension system, method of anchoring and fastening, details, and reflected ceiling plan.

### 2.1.1 Acoustical Performance

#### 2.1.1.1 Ceiling Sound Transmission

Provide ceiling systems with the specified Ceiling Attenuation Class (CAC) ratings as determined in accordance with ASTM E1414/E1414M and ASTM E413. Provide sound attenuators over light fixtures, air terminals and other ceiling penetrations, provide acoustical blanket insulation on top of the ceiling or adjacent to partitions to provide lightweight acoustical plenum barriers above partitions as required to achieve the specified CAC ratings. Provide test ceiling continuous at the partition and assembled in the suspension system in the same manner that the ceiling will be installed on the project.

#### 2.1.1.2 Ceiling Sound Absorption

Determine the Noise Reduction Coefficient (NRC) in accordance with ASTM C423. Determine Articulation Class (AC) in accordance with ASTM E1111/E1111M.

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### 2.1.2 Light Reflectance

Determine light reflectance factor in accordance with ASTM E1477 test method.

## 2.2 ACOUSTICAL UNITS

Submit samples of each type of acoustical unit and each type of suspension grid tee section showing texture, finish, and color. Conform acoustical units to ASTM E1264, Class A, and the following requirements:

### 2.2.1 Units for Exposed-Grid System

#### 2.2.1.1 Type ACT-1

IV (non-asbestos mineral fiber with membrane-faced overlay). Provide Type IV Acoustical Ceiling Tiles containing a minimum of 60 percent recycled content. Provide data identifying percentage of recycled content for Type IV ceiling tiles. Provide certification of indoor air quality for Type IV Ceiling Tiles.

#### 2.2.1.2 Flame Spread

Class A, 25 or less

#### 2.2.1.3 Pattern

E G

#### 2.2.1.4 Minimum NRC

90 when tested on mounting Type E-400 of ASTM E795.

#### 2.2.1.5 Minimum Light Reflectance Coefficient

90

#### 2.2.1.6 Nominal Size

24 by 24 inch

#### 2.2.1.7 Edge Detail

Fineline Bevel

#### 2.2.1.8 Finish

Factory-applied standard finish. See paragraph COLORS AND STANDARDS.

#### 2.2.1.9 Minimum CAC

30

## 2.3 SUSPENSION SYSTEM

Provide standard as indicated suspension system conforming to ASTM C635/C635M for intermediate-duty systems. Provide surfaces exposed to view of. Provide wall molding having a flange of not less than 9/16 inch. Provide mitered corners. Provide a suspension system with a

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maximum deflection of 1/360 of the span length capable of supporting the finished ceiling, light fixtures, air diffusers, and accessories, as shown.

Conform seismic details to the guidance in UFC 3-301-01 and ASTM E580/E580M.

Provide Suspension System containing a minimum of 15 percent recycled content. Provide data identifying percentage of recycled content for suspension systems.

## 2.4 HANGERS

Provide hangers and attachment capable of supporting a minimum 300 pound ultimate vertical load without failure of supporting material or attachment.

### 2.4.1 Wires

Conform wires to ASTM A641/A641M, Class 1, 0.08 inch (12 gauge) inch in diameter.

### 2.4.2 Straps

Provide straps of 1 by 3/16 inch galvanized steel conforming to ASTM A653/A653M, with a light commercial zinc coating or ASTM A1008/A1008M with an electrodeposited zinc coating conforming to ASTM B633, Type RS.

### 2.4.3 Rods

Provide 3/16 inch diameter threaded steel rods, zinc or cadmium coated.

### 2.4.4 Eyebolts

Provide eyebolts of weldless, forged-carbon-steel, with a straight-shank in accordance with ASTM A489. Provide minimum 1/4 inch, zinc coated eyebolts.

### 2.4.5 Masonry Anchorage Devices

Comply with ASTM C636/C636M for anchorage devices for eyebolts .

## 2.5 ACCESS PANELS

Provide access panels that match adjacent acoustical units, designed and equipped with suitable framing and fastenings for removal and replacement without damage. Size panel to be not less than 12 by 12 inch or more than 12 by 24 inch.

- a. Attach an identification plate of 0.032 inch thick aluminum, 3/4 inch in diameter, stamped with the letters "AP" and finished the same as the unit, near one corner on the face of each access panel.
- b. Identify ceiling access panel by a number utilizing white identification plates or plastic buttons with contrasting numerals. Provide plates or buttons of minimum 1 inch diameter and securely attached to one corner of each access unit. Provide a typewritten card framed under glass listing the code identification numbers and corresponding system descriptions listed above. Mount the framed card where directed and furnish a duplicate card to the Contracting Officer. Code identification system is as follows:

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- (1) Fire detection/alarm system
- (2) Air conditioning controls
- (3) Plumbing system
- (4) Heating and steam systems
- (5) Air conditioning duct system
- (6) Sprinkler system
- (7) Intercommunication system
- (8) Telephone junction boxes

## 2.6 ADHESIVE

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

## 2.7 FINISHES

Use manufacturer's standard textures, patterns and finishes as specified for acoustical units and suspension system members. Treat ceiling suspension system components to inhibit corrosion.

## 2.8 COLORS AND PATTERNS

Use colors and patterns for acoustical units and suspension system components as indicated; colors listed are not intended to limit the selection of equal colors from other manufacturers.

## 2.9 ACOUSTICAL SEALANT

Conform acoustical sealant to ASTM C834, nonstaining. Provide sealants used on the interior of the building (defined as inside of the weatherproofing system) in accordance with requirements of Section 07 92 00 JOINT SEALANTS. that meet either emissions requirements of CDPH SECTION 01350 (limit the 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 of indoor air quality for Sealants.

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## PART 3 EXECUTION

### 3.1 INSTALLATION

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

Examine surfaces to receive directly attached acoustical units for unevenness, irregularities, and dampness that would affect quality and execution of the work. Rid areas, where acoustical units will be cemented, of oils, form residue, or other materials that reduce bonding capabilities of the adhesive. Complete and dry interior finish work such as plastering, concrete, and terrazzo work before installation. Complete and approve mechanical, electrical, and other work above the ceiling line prior to the start of acoustical ceiling installation. Provide acoustical work complete with necessary fastenings, clips, and other accessories required for a complete installation. Do not expose mechanical fastenings in the finished work. Lay out hangers for each individual room or space. Provide hangers to support framing around beams, ducts, columns, grilles, and other penetrations through ceilings. Keep main runners and carrying channels clear of abutting walls and partitions. Provide at least two main runners for each ceiling span. Wherever required to bypass an object with the hanger wires, install a subsuspension system so that all hanger wires will be plumb.

#### 3.1.1 Suspension System

Install suspension system in accordance with ASTM C636/C636M and as specified herein. Do not suspend hanger wires or other loads from underside of steel decking.

##### 3.1.1.1 Plumb Hangers

Install hangers plumb and not pressing against insulation covering ducts and pipes. Where lighting fixtures are supported from the suspended ceiling system, provide hangers at a minimum of four hangers per fixture and located not more than 6 inch from each corner of each fixture.

##### 3.1.1.2 Splayed Hangers

Splay (slope or slant) hangers around obstructions, offsetting the resulting horizontal force by bracing, countersplaying, or other acceptable means.

#### 3.1.2 Wall Molding

Provide wall molding where ceilings abut vertical surfaces. Miter corners where wall moldings intersect or install corner caps. Secure wall molding not more than 3 inch from ends of each length and not more than 16 inch on centers between end fastenings. Provide wall molding springs at each acoustical unit in semi-exposed or concealed systems.

#### 3.1.3 Acoustical Units

Install acoustical units in accordance with the approved installation instructions of the manufacturer. Ensure that edges of acoustical units are in close contact with metal supports, with each other, and in true alignment. Arrange acoustical units so that units less than one-half width are minimized. Hold units in exposed-grid system in place with

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manufacturer's standard hold-down clips, if units weigh less than 1 psf or if required for fire resistance rating.

#### 3.1.4 Acoustical Sealant

Seal all joints around pipes, ducts or electrical outlets penetrating the ceiling. Apply a continuous ribbon of acoustical sealant on vertical web of wall or edge moldings.

#### 3.1.5 Adhesive Application

Wipe back of tile to remove accumulated dust. Daub acoustical units on back side with four equal daubs of adhesive. Apply daubs near corners of tiles. Ensure that contact area of each daub is at least 2 inch diameter in final position. Press units into place, aligning joints and abutting units tight and uniform without differences in joint widths.

### 3.2 CEILING ACCESS PANELS

Locate ceiling access panels directly under the items which require access.

### 3.3 CLEANING

Following installation, clean dirty or discolored surfaces of acoustical units and leave them free from defects. Remove units that are damaged or improperly installed and provide new units as directed.

-- End of Section --



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## SECTION 09 62 38

## STATIC-CONTROL FLOORING

**08/17, CHG 1: 08/18**

## PART 1 GENERAL

## 1.1 REFERENCES

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

## ASTM INTERNATIONAL (ASTM)

ASTM D6866	(2022) Standard Test Methods for Determining the Biobased Content of Solid, Liquid, and Gaseous Samples Using Radiocarbon Analysis
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 F1869	(2022) Standard Test Method for Measuring Moisture Vapor Emission Rate of Concrete Subfloor Using Anhydrous Calcium Chloride
ASTM F2170	(2019a) Standard Test Method for Determining Relative Humidity in Concrete Floor Slabs Using in situ Probes

## CALIFORNIA DEPARTMENT OF PUBLIC HEALTH (CDPH)

CDPH SECTION 01350	(2010; Version 1.1) Standard Method for the Testing and Evaluation of Volatile Organic Chemical Emissions from Indoor Sources using Environmental Chambers
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## ELECTROSTATIC DISCHARGE ASSOCIATION (ESD)

ESD S6.1	(2019) Standard for the Protection of Electrostatic Discharge Susceptible Items - Grounding
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## GREEN SEAL (GS)

GS-36	(2013) Adhesives for Commercial Use
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#### 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

#### U.S. GREEN BUILDING COUNCIL (USGBC)

LEED v4 BDC Ref Guide

(2013; R 2020) USGBC LEED Reference Guide  
 for Building Design and Construction, v4

LEED v4.1 BDC Ref Guide

(2023) LEED v4.1 Building Design and  
 Construction Reference Guide

#### UNDERWRITERS LABORATORIES (UL)

UL 2818

(2013) GREENGUARD Certification Program  
 For Chemical Emissions For Building  
 Materials, Finishes And Furnishings

### 1.2 SCHEDULING

Schedule static-control flooring work after any other work which would damage the finished surface of the flooring.

### 1.3 SUSTAINABILITY REPORTING

Work of this section is intended to contribute to the achievement of, or compliance with, the requirements of the Guiding Principles Validation and LEED Prerequisites and attempted Credits. Refer to Section 01 33 29.00 06 SUSTAINABILITY REPORTING for specific documentation requirements and list of Prerequisites, attempted Credits and LEED version.

Comply with product, material content, performance criteria, activity, documentation, and other technical requirements as described in the LEED v4 BDC Ref Guide or LEED v4.1 BDC Ref Guide as applicable.

Collect, organize, and submit product data, drawings, diagrams, photos and cost information necessary to demonstrate compliance with LEED v4 BDC Ref Guide or LEED v4.1 BDC Ref Guide requirements as applicable.

Data collection shall commence with the notice to proceed and will only be deemed complete upon acceptance of the Final Sustainability Notebook and LEED Online submission by the Contracting Officer, the LEED Project Administrator, and the Green Building Certification Institute.

### 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.

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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 Static-Dissipative Vinyl Tile; S

Accessories; G, AE

Adhesives; G, AE

Warranty

Environmental Product Declarations; S

Embodied Carbon Optimization Report/Action Plan; S

Extended Producer Responsibility; S

Bio-Based Materials; S

Material Ingredient Reporting; S

Local/Regional Materials; S

SD-04 Samples

Static-Control Resilient Flooring; G, AE

Special Treatment Materials; G, AE

Accessories; G, AE

SD-06 Test Reports

Fire Resistance

Moisture, Alkalinity and Bond

Testing

SD-07 Certificates

Indoor Air Quality for Static-Dissipative Vinyl Tile; S  
Indoor Air Quality for Adhesives; S

Qualifications of Applicator

SD-08 Manufacturer's Instructions

Static-Control Resilient Flooring; G, AE

Accessories; G, AE

SD-10 Operation and Maintenance Data

Static-Control Resilient Flooring; G, AE

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Accessories; G, AE

1.4.1 Samples

1.4.1.1 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.

1.4.1.2 Special Treatment Materials

Submit three samples showing system and installation method.

1.4.1.3 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.

1.5 SUSTAINABLE DESIGN REQUIREMENTS

1.5.1 Environmental Product Declarations

At a minimum, use materials or products with an Environmental Product Declaration in accordance with the LEED Implementation Plan. See Section 01 33 29.00 06 SUSTAINABILITY REPORTING for cumulative materials requirements and LEED Implementation Plan.

1.5.2 Embodied Carbon Optimization Report/Action Plan

At a minimum, use materials or products with an Embodied Carbon Optimization Report/Action Plan in accordance with the LEED Implementation Plan. See Section 01 33 29.00 06 SUSTAINABILITY REPORTING for cumulative materials requirements and LEED Implementation Plan.

1.5.3 Sourcing of Raw Materials

Provide products that meet one or more of the following categories:

1.5.3.1 Extended Producer Responsibility

At a minimum, use materials or products from manufacturers that participate in an extended producer responsibility program in accordance with the LEED Implementation Plan. Provide manufacturer letter verifying extended producer responsibility program is in place and that product is eligible. See Section 01 33 29.00 06 SUSTAINABILITY REPORTING for cumulative materials requirements and LEED Implementation Plan.

1.5.3.2 Bio-Based Materials

At a minimum, use materials or products with bio-based content in accordance with the LEED Implementation Plan. Provide manufacturer signed letter confirming ASTM D6866 test method was conducted validating bio-based material weight within product, type of bio-based material used

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within product, and confirmation raw material was legally harvested. See Section 01 33 29.00 06 SUSTAINABILITY REPORTING for cumulative materials requirements and LEED Implementation Plan. If bio-based content minimum is specified in this section, the greater of the two percentages governs.

#### 1.5.3.3 Recycled Content Materials

At a minimum, use materials or products with recycled content in accordance with the LEED Implementation Plan. Provide manufacturers product literature identifying the percentage of recycled material incorporated within each product used. See Section 01 33 29.00 06 SUSTAINABILITY REPORTING for cumulative materials requirements and LEED Implementation Plan. If recycled content minimum is specified in this section, the greater of the two percentages governs.

#### 1.5.4 Material Ingredient Reporting

At a minimum, use materials or products with chemical inventory to at least 0.1% (1000 ppm) in accordance with the LEED Implementation Plan. Provide Health Product Declaration (HPD), Cradle to Cradle Certificate, Declare label, or other manufacturer's published content inventory in compliance with LEED v4.1 Material Ingredient Reporting credit. See Section 01 33 29.00 06 SUSTAINABILITY REPORTING for cumulative materials requirements and LEED Implementation Plan.

#### 1.5.5 Local/Regional Materials

Use materials or products extracted, harvested, or recovered, as well as manufactured, within a 100 mile radius from the project site, if available from a minimum of three sources. provide a letter from the manufacturer stating the extraction location, manufacturing location, and purchasing location of the products provided, referencing the project name and location specifically and distance to the project site. See Section 01 33 29.00 06 SUSTAINABILITY REPORTING for cumulative materials requirements and LEED Implementation Plan.

### 1.6 CERTIFICATIONS

#### 1.6.1 Indoor Air Quality Certifications

##### 1.6.1.1 Floor Covering Materials

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

##### 1.6.1.2 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.

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#### 1.7 EXTRA MATERIALS

Provide extra material from same dye lot for future maintenance. Provide a minimum of 2 percent of total square yards of each flooring and base type, pattern, and color.

#### 1.8 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.

#### 1.9 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.

##### 1.9.1 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.

#### 1.10 ENVIRONMENTAL CONDITIONS

Provide temporary ventilation during work of this section.

##### 1.10.1 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.

#### 1.11 WARRANTY

##### 1.11.1 Static-Control Resilient Flooring

Provide manufacturer's standard performance guarantees or warranties including a five year wear warranty and ten year conductivity warranty.

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## PART 2 PRODUCTS

### 2.1 STATIC-CONTROL RESILIENT FLOORING

#### 2.1.1 Static-Dissipative Resilient Flooring

##### 2.1.1.1 Static-Dissipative Vinyl Tile

Static-dissipative vinyl tile must be a homogeneous vinyl product and conform to ASTM F1700. Provide electrical resistance from surface to surface and surface to ground between 1,000,000 ohms ( $1.0 \times 10$  to the 6th) and 1,000,000,000 ohms ( $1.0 \times 10$  to the 9th) when tested in accordance with ASTM F150. Tile must be 12 inches square and 1/8 inch thick.

Provide Static-Dissipative Vinyl Tile containing a minimum of 10 percent recycled content. Provide data identifying percentage of recycled content for Static-Dissipative Vinyl Tile.

Provide certification of indoor air quality for Static-Dissipative Vinyl Tile.

### 2.2 ADHESIVES

Provide static-dissipative adhesive as recommended by the manufacturer of the static-control flooring. Provide adhesive for wall base as recommended by the wall base manufacturer.

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

### 2.3 ACCESSORIES

Use accessories recommended by the manufacturer of the flooring.

### 2.4 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.

### 2.5 MANUFACTURER'S COLOR, PATTERN AND TEXTURE

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

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## 2.6 FIRE RESISTANCE TESTING REQUIREMENTS

Provide a minimum average critical radiant flux of 0.45 watts per square centimeter for flooring in corridors and exits when tested in accordance with ASTM E648.

## PART 3 EXECUTION

### 3.1 SURFACE PREPARATION

Before any work under this section is begun, defects such as rough or scaling concrete, low spots, high spots, and uneven surfaces must be corrected, and damaged portions of concrete slabs must be repaired in accordance with flooring manufacturer's recommended instructions. Floor must be in a level plane with a maximum variation of 1/8 inch every 10 feet, except where indicated as sloped. Repair cracks and irregularities and prepare the subfloor in accordance with flooring manufacturer's recommended instructions. Curing and sealing compounds should not be used on concrete surfaces to receive flooring unless they have been tested and approved by the flooring manufacturer. In addition, remove paint, varnish, oils, release agents, sealers, waxes, and adhesives, as required by the flooring product in accordance with manufacturer's printed installation instructions. If a curing compound is required, it must be coordinated for compatibility with the flooring adhesive.

### 3.2 MOISTURE, ALKALINITY AND BOND TESTS

Determine the suitability of the concrete subfloor for receiving the flooring with regard to moisture content and pH level by moisture and alkalinity tests. Conduct moisture testing in accordance with ASTM F1869 or ASTM F2170, unless otherwise recommended by the flooring manufacturer. Conduct alkalinity testing as recommended by the flooring manufacturer. Determine the compatibility of the flooring adhesives to the concrete floors by a bond test in accordance with the flooring manufacturer's recommendations.

### 3.3 GENERAL INSTALLATION

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

### 3.4 INSTALLATION OF STATIC-CONTROL RESILIENT TILE FLOORING

Install static-control resilient flooring, ground connections and accessories in accordance with the approved manufacturer's installation instructions. Tile lines and joints must be kept square, symmetrical, tight, and even. Tile at the perimeter of the area to be finished may vary as necessary to maintain full-size tiles in the field, but no perimeter tile may be less than one-half the field tile size, except where irregular shaped rooms make it impossible. Tile must be cut, fitted, and scribed to walls, partitions, and projections after field flooring has been applied. Install grounding strips in accordance with manufacturer's installation instructions. Protect edges of flooring material meeting hard surface flooring with molding and install in accordance with the molding manufacturer's printed instructions.

### 3.5 INSTALLATION OF STATIC-CONTROL RESILIENT SHEET FLOORING

Install static-control resilient sheet flooring, ground connections and



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accessories in accordance with manufacturer's printed installation instructions. Prepare and apply adhesives in accordance with manufacturer's printed directions. Provide square, symmetrical, tight, and even flooring lines and joints. Keep each floor in true, level plane, except where slope is indicated. Cut flooring to fit around all permanent fixtures, built-in furniture and cabinets, pipes, and outlets. Lay out sheets to minimize waste. Cut, fit, and scribe flooring to walls and partitions after field flooring has been applied. Finish joints flush, free from voids, recesses, and raised areas. 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.

### 3.6 CLEANING AND PROTECTION

The flooring must be cleaned in accordance with the manufacturer's recommendations. Flooring must be protected by a covering of heavy-duty building paper before foot traffic is permitted. Lap and secure edges of kraft paper protection to provide a continuous cover. Boardwalks must be placed over flooring in areas where subsequent building operations might damage the floor. Remove and replace flooring that becomes loose, broken, or curled prior to acceptance, or flooring that does not conform to resistance requirements of ASTM F150.

### 3.7 TESTING

Test the flooring in accordance with and conform to the requirements of ESD S6.1.

-- End of Section --

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## SECTION 09 65 00

RESILIENT FLOORING  
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## PART 1 GENERAL

## 1.1 REFERENCES

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

## ASTM INTERNATIONAL (ASTM)

ASTM D4078	(2002; R 2015) Water Emulsion Floor Polish
ASTM D6866	(2022) Standard Test Methods for Determining the Biobased Content of Solid, Liquid, and Gaseous Samples Using Radiocarbon Analysis
ASTM E648	(2019a) Standard Test Method for Critical Radiant Flux of Floor-Covering Systems Using a Radiant Heat Energy Source
ASTM F710	(2021) Standard Practice for Preparing Concrete Floors to Receive Resilient Flooring
ASTM F1482	(2021) Standard Practice for Installation and Preparation of Panel Type Underlayments to Receive Resilient Flooring
ASTM F1700	(2020) Standard Specification for Solid Vinyl Floor Tile
ASTM F1861	(2021) Standard Specification for Resilient Wall Base
ASTM F1869	(2016a) Standard Test Method for Measuring Moisture Vapor Emission Rate of Concrete Subfloor Using Anhydrous Calcium Chloride
ASTM F2170	(2019a) Standard Test Method for Determining Relative Humidity in Concrete Floor Slabs Using in situ Probes

## CALIFORNIA DEPARTMENT OF PUBLIC HEALTH (CDPH)

CDPH SECTION 01350	(2010; Version 1.1) Standard Method for the Testing and Evaluation of Volatile Organic Chemical Emissions from Indoor Sources using Environmental Chambers
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#### 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. GREEN BUILDING COUNCIL (USGBC)

LEED v4 BDC Ref Guide (2013; R 2020) USGBC LEED Reference Guide  
 for Building Design and Construction, v4

LEED v4.1 BDC Ref Guide (2023) LEED v4.1 Building Design and  
 Construction Reference Guide

#### UNDERWRITERS LABORATORIES (UL)

UL 2818 (2013) GREENGUARD Certification Program  
 For Chemical Emissions For Building  
 Materials, Finishes And Furnishings

### 1.2 SUSTAINABILITY REPORTING

Work of this section is intended to contribute to the achievement of, or compliance with, the requirements of the Guiding Principles Validation and LEED Prerequisites and attempted Credits. Refer to Section 01 33 29.00 06 SUSTAINABILITY REPORTING for specific documentation requirements and list of Prerequisites, attempted Credits and LEED version.

Comply with product, material content, performance criteria, activity, documentation, and other technical requirements as described in the LEED v4 BDC Ref Guide or LEED v4.1 BDC Ref Guide as applicable.

Collect, organize, and submit product data, drawings, diagrams, photos and cost information necessary to demonstrate compliance with LEED v4 BDC Ref Guide or LEED v4.1 BDC Ref Guide requirements as applicable.

Data collection shall commence with the notice to proceed and will only be deemed complete upon acceptance of the Final Sustainability Notebook and LEED Online submission by the Contracting Officer, the LEED Project Administrator, and the Green Building Certification Institute.

### 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

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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

Environmental Product Declarations; S

Embodied Carbon Optimization Report/Action Plan; S

Extended Producer Responsibility; S

Bio-Based Materials; S

Local/Regional Materials; S

Material Ingredient Reporting; S

#### 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

### 1.4 SUSTAINABLE DESIGN REQUIREMENTS

#### 1.4.1 Environmental Product Declarations

At a minimum, use materials or products with an Environmental Product Declaration in accordance with the LEED Implementation Plan. See Section 01 33 29.00 06 SUSTAINABILITY REPORTING for cumulative materials

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requirements and LEED Implementation Plan.

#### 1.4.2 Embodied Carbon Optimization Report/Action Plan

At a minimum, use materials or products with an Embodied Carbon Optimization Report/Action Plan in accordance with the LEED Implementation Plan. See Section 01 33 29.00 06 SUSTAINABILITY REPORTING for cumulative materials requirements and LEED Implementation Plan.

#### 1.4.3 Sourcing of Raw Materials

Provide products that meet one or more of the following categories:

##### 1.4.3.1 Extended Producer Responsibility

At a minimum, use materials or products from manufacturers that participate in an extended producer responsibility program in accordance with the LEED Implementation Plan. Provide manufacturer letter verifying extended producer responsibility program is in place and that product is eligible. See Section 01 33 29.00 06 SUSTAINABILITY REPORTING for cumulative materials requirements and LEED Implementation Plan.

##### 1.4.3.2 Bio-Based Materials

At a minimum, use materials or products with bio-based content in accordance with the LEED Implementation Plan. Provide manufacturer signed letter confirming ASTM D6866 test method was conducted validating bio-based material weight within product, type of bio-based material used within product, and confirmation raw material was legally harvested. See Section 01 33 29.00 06 SUSTAINABILITY REPORTING for cumulative materials requirements and LEED Implementation Plan. If bio-based content minimum is specified in this section, the greater of the two percentages governs.

##### 1.4.3.3 Recycled Content Materials

At a minimum, use materials or products with recycled content in accordance with the LEED Implementation Plan. Provide manufacturers product literature identifying the percentage of recycled material incorporated within each product used. See Section 01 33 29.00 06 SUSTAINABILITY REPORTING for cumulative materials requirements and LEED Implementation Plan. If recycled content minimum is specified in this section, the greater of the two percentages governs.

#### 1.4.4 Material Ingredient Reporting

At a minimum, use materials or products with chemical inventory to at least 0.1% (1000 ppm) in accordance with the LEED Implementation Plan. Provide Health Product Declaration (HPD), Cradle to Cradle Certificate, Declare label, or other manufacturer's published content inventory in compliance with LEED v4.1 Material Ingredient Reporting credit. See Section 01 33 29.00 06 SUSTAINABILITY REPORTING for cumulative materials requirements and LEED Implementation Plan.

#### 1.4.5 Local/Regional Materials

Use materials or products extracted, harvested, or recovered, as well as manufactured, within a 100 mile radius from the project site, if available from a minimum of three sources. provide a letter from the manufacturer stating the extraction location, manufacturing location, and purchasing

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location of the products provided, referencing the project name and location specifically and distance to the project site. See Section 01 33 29.00 06 SUSTAINABILITY REPORTING for cumulative materials requirements and LEED Implementation Plan.

## 1.5 CERTIFICATES

### 1.5.1 Indoor Air Quality

Submit required indoor air quality certifications and validations in one submittal package.

#### 1.5.1.1 Floor Covering Materials

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

#### 1.5.1.2 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.

## 1.6 DELIVERY, STORAGE, AND HANDLING

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

## 1.7 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.

## 1.8 SCHEDULING

Schedule resilient flooring application after the completion of other work

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which would damage the finished surface of the flooring.

#### 1.9 WARRANTY

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

#### 1.10 EXTRA MATERIALS

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

### PART 2 PRODUCTS

#### 2.1 LUXURY VINYL TILE TYPE B

Conform to ASTM F1700 Class III printed film with a minimum wear layer thickness 0.55mm (22 mil) and minimum overall thickness 0.197 inch, Type B (embossed). Provide 25cm x 150cm 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 TS (vulcanized thermoset rubber), 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 clear anodized aluminum 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 both emissions requirements of CDPH SECTION 01350 (limit requirements for either office or classroom spaces regardless of space type) and VOC content requirements

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of SCAQMD Rule 1168. Provide aerosol adhesives used on the interior of the building that meet both emissions requirements of CDPH SECTION 01350 (use the office or classroom requirements, regardless of space type) and 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.

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

## 2.9 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

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



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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

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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.

-- End of Section --

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## SECTION 09 67 23.15

## FUEL RESISTIVE RESINOUS FLOORING, 3-COAT SYSTEM

02/21

## PART 1 GENERAL

## 1.1 REFERENCES

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

## ASTM INTERNATIONAL (ASTM)

ASTM C679	(2015) Tack-Free Time of Elastomeric Sealants
ASTM D412	(2016) Standard Test Methods for Vulcanized Rubber and Thermoplastic Elastomers - Tension
ASTM D638	(2014) Standard Test Method for Tensile Properties of Plastics
ASTM D1308	(2002; R 2013) Effect of Household Chemicals on Clear and Pigmented Organic Finishes
ASTM D2240	(2015; E 2017) Standard Test Method for Rubber Property - Durometer Hardness
ASTM D3925	(2002; R 2015) Sampling Liquid Paints and Related Pigmented Coatings
ASTM D4541	(2017) Standard Test Method for Pull-Off Strength of Coatings Using Portable Adhesion Testers
ASTM D6237	(2019) Standard Guide for Painting Inspectors (Concrete and Masonry Substrates)
ASTM D6866	(2022) Standard Test Methods for Determining the Biobased Content of Solid, Liquid, and Gaseous Samples Using Radiocarbon Analysis
ASTM E11	(2020) Standard Specification for Woven Wire Test Sieve Cloth and Test Sieves

## 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
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#### INTERNATIONAL CONCRETE REPAIR INSTITUTE (ICRI)

ICRI 310.2R (2013) Selecting and Specifying Concrete  
 Surface Preparation for Sealers, Coatings,  
 Polymer Overlays, and Concrete Repair

#### MASTER PAINTERS INSTITUTE (MPI)

MPI 211 (2018) Floor Coating, Primer, Thin Film,  
 for Aircraft Maintenance Facilities

MPI 212 (2018) Floor Coating, Thin Film, for  
 Aircraft Maintenance Facilities

#### SCIENTIFIC CERTIFICATION SYSTEMS (SCS)

SCS SCS Global Services (SCS) Indoor Advantage

#### SOCIETY FOR PROTECTIVE COATINGS (SSPC)

SSPC QP 5 (2012) Standard Procedure for Evaluating  
 the Qualifications of Coating and Lining  
 Inspection Companies

SSPC QP 8 (2015) Standard Procedure for Evaluating  
 the Qualifications of Contracting Firms  
 that Install Polymer Coatings, Surfacing,  
 Linings or FRP Composites on Concrete and  
 Other Cementitious Substrates

SSPC QS 1 (2015) Standard Procedure for Evaluating a  
 Contractor's Advanced Quality Management  
 System

SSPC-TU 2/NACE 6G197 (1997) Design, Installation, and  
 Maintenance of Coating Systems for  
 Concrete Used in Secondary Containment

#### U.S. GREEN BUILDING COUNCIL (USGBC)

LEED v4 BDC Ref Guide (2013; R 2020) USGBC LEED Reference Guide  
 for Building Design and Construction, v4

LEED v4.1 BDC Ref Guide (2023) LEED v4.1 Building Design and  
 Construction Reference Guide

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

29 CFR 1910.134 Respiratory Protection

29 CFR 1910.1000 Air Contaminants

29 CFR 1926.59 Hazard Communication

#### 1.1.1.1 SUSTAINABILITY REPORTING

Work of this section is intended to contribute to the achievement of, or  
 compliance with, the requirements of the Guiding Principles Validation and  
 LEED Prerequisites and attempted Credits. Refer to Section 01 33 29.00 06

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SUSTAINABILITY REPORTING for specific documentation requirements and list of Prerequisites, attempted Credits and LEED version.

Comply with product, material content, performance criteria, activity, documentation, and other technical requirements as described in the

LEED v4 BDC Ref Guide or

LEED v4.1 BDC Ref Guide as applicable.

Collect, organize, and submit product data, drawings, diagrams, photos and cost information necessary to demonstrate compliance with

LEED v4 BDC Ref Guide or

LEED v4.1 BDC Ref Guide requirements as applicable.

Data collection shall commence with the notice to proceed and will only be deemed complete upon acceptance of the Final Sustainability Notebook and LEED Online submission by the Contracting Officer, the LEED Project Administrator, and the Green Building Certification Institute.

#### UNDERWRITERS LABORATORIES (UL)

UL 2818	(2013) GREENGUARD Certification Program For Chemical Emissions For Building Materials, Finishes And Furnishings
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## 1.2 SUBMITTALS

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

Joint Sealant; G

Thin Film Flooring System; G

White Aluminum Oxide Non-Skid Grit; G

Environmental Product Declarations; S

Embodied Carbon Optimization Report/Action Plan; S

Extended Producer Responsibility; S

Bio-Based Materials; S

Local/Regional Materials; S

Material Ingredient Reporting; S

#### SD-05, Design Data

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Environmental Control System

SD-06 Test Reports

Joint Sealant Test Report; G  
Primer Coat; G  
Urethane Topcoat; G  
White Aluminum Oxide Non-Skid Grit; G  
Patch Test Demonstration; G  
Daily Inspection Report; G  
Adhesion Testing; G

SD-07 Certificates

Coating Work Plan; G  
Joint Sealant Certificates; G  
Thin Film Flooring System Certificates; G  
Qualifications of Certified Industrial Hygienist (CIH)  
Qualifications of Certified Protective Coatings Specialist (PCS)  
Qualifications of Coating Inspection Company  
Qualifications of QC Specialist Coating Inspector  
Qualifications of Coating Contractors; G  
Warranty; G  
Indoor Air Quality For Thin Film Flooring System; S

SD-08 Manufacturer's Instructions

Joint Sealant Manufacturer's Instructions; G  
Thin Film Flooring System Manufacturer's Instructions; G  
Water-Based Alkaline Degreaser; G

SD-11 Closeout Submittals

Inspection Logbook; G

1.3 SUSTAINABLE DESIGN REQUIREMENTS

1.3.1 Environmental Product Declarations

At a minimum, use materials or products with an Environmental Product Declaration in accordance with the LEED Implementation Plan. See Section 01 33 29.00 06 SUSTAINABILITY REPORTING for cumulative materials

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requirements and LEED Implementation Plan.

#### 1.3.2 Embodied Carbon Optimization Report/Action Plan

At a minimum, use materials or products with an Embodied Carbon Optimization Report/Action Plan in accordance with the LEED Implementation Plan. See Section 01 33 29.00 06 SUSTAINABILITY REPORTING for cumulative materials requirements and LEED Implementation Plan.

#### 1.3.3 Sourcing of Raw Materials

Provide products that meet one or more of the following categories:

##### 1.3.3.1 Extended Producer Responsibility

At a minimum, use materials or products from manufacturers that participate in an extended producer responsibility program in accordance with the LEED Implementation Plan. Provide manufacturer letter verifying extended producer responsibility program is in place and that product is eligible. See Section 01 33 29.00 06 SUSTAINABILITY REPORTING for cumulative materials requirements and LEED Implementation Plan.

##### 1.3.3.2 Bio-Based Materials

At a minimum, use materials or products with bio-based content in accordance with the LEED Implementation Plan. Provide manufacturer signed letter confirming ASTM D6866 test method was conducted validating bio-based material weight within product, type of bio-based material used within product, and confirmation raw material was legally harvested. See Section 01 33 29.00 06 SUSTAINABILITY REPORTING for cumulative materials requirements and LEED Implementation Plan. If bio-based content minimum is specified in this section, the greater of the two percentages governs.

#### 1.3.4 Material Ingredient Reporting

At a minimum, use materials or products with chemical inventory to at least 0.1% (1000 ppm) in accordance with the LEED Implementation Plan. Provide Health Product Declaration (HPD), Cradle to Cradle Certificate, Declare label, or other manufacturer's published content inventory in compliance with LEED v4.1 Material Ingredient Reporting credit. See Section 01 33 29.00 06 SUSTAINABILITY REPORTING for cumulative materials requirements and LEED Implementation Plan.

#### 1.3.5 Local/Regional Materials

Use materials or products extracted, harvested, or recovered, as well as manufactured, within a 100 mile radius from the project site, if available from a minimum of three sources. provide a letter from the manufacturer stating the extraction location, manufacturing location, and purchasing location of the products provided, referencing the project name and location specifically and distance to the project site. See Section 01 33 29.00 06 SUSTAINABILITY REPORTING for cumulative materials requirements and LEED Implementation Plan.

## CERTIFICATES

### Indoor Air Quality

Submit required indoor air quality certifications and validations in one

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submittal package.

#### 1.3.6 Floor Covering Materials

Provide fuel resistive resinous flooring 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.

#### 1.3.7 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 QUALITY ASSURANCE

#### 1.4.1 Qualifications of Certified Protective Coatings Specialist (PCS)

Submit name, address, telephone number, FAX number, and e-mail address of the independent third party PCS. Submit documentation that the specialist is certified by SSPC: The Society for Protective Coatings (SSPC) as a PCS, including certification number and date of certification/recertification. If the PCS is employed by the same coating inspection company to which the coating inspector is employed, this does not violate the independent third-party requirements. The PCS must remain certified during the entire project, and the Contracting Officer must be notified of any change in certification status within 10 days of the change. The PCS must not be the designated coating inspector.

#### 1.4.2 Coating Work Plan

- a. Include Coating Work Plan in Quality Control Plan.
- b. Provide procedures for reviewing Contract Documents immediately after award to identify errors, omissions, and discrepancies so that any such issues can be resolved prior to project planning and development of detailed procedures.
- c. Provide procedures for verification of key processes during Initial Phase to ensure that Contract requirements can be met. Key processes must include surface preparation, coating application and curing, inspection, and documentation, and any other process that might adversely impact orderly progression of work.
- d. Provide procedures for all phases of coating operations, including planned work, rework, repair, inspection, and documentation. Address mobilization and setup, surface preparation, coating application, coating initial cure, tracking and correction of non-compliant work, and demobilization. Coordinate work processes with health and safety plans and confined space entry plans. For each process, provide procedures that include appropriate work instructions, material and equipment requirements, personnel qualifications, controls, and process verification procedures. Provide procedures for inspecting



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work to verify and document compliance with Contract requirements, including inspection forms and checklists, and acceptance and rejection criteria.

- e. Provide procedures for correcting non-compliant work. Detailed procedures are required in advance to avoid delays in meeting overcoat windows as well as to avoid delays in production. Provide procedures for repairing defects in the coating film, such as runs, drips, sags, holidays, overspray, as well as how to correct coating thickness non-compliance, any other areas of repair or rework that might be adversely affected by delays in preparing and approving new procedures.
- f. If a procedure is based on a proposed or approved request for deviation, the deviation must be referenced. Changes to procedures must be noted by submittal number and date approved, clearly delineating old requirements and new requirements, so that the records provide a continuous log of requirements and procedures.

#### 1.4.3 Design Data

##### 1.4.3.1 Environmental Control System

Submit design details of the proposed environmental control system to include ventilation, humidity control, and temperature regulation. Provide calculations for humidity control during separate surface preparation and coating application procedures, ventilation requirements during coating application, and maximum allowable coating application rates to coincide with ventilation. Include basis of design data on local conditions. Provide equipment layout sketches and procedures showing function of each piece of equipment and fail-safe measures. A Certified Industrial Hygienist must approve calculations, work procedures and personal protective equipment.

#### 1.4.4 Test Reports

##### 1.4.4.1 Joint Sealant Test Report

Submit test results that confirm sealant complies with the requirements of Table Ia. Samples must have been tested within the last three years.

##### 1.4.4.2 Daily Inspection Report

Submit one copy of the daily inspection report to the Contracting Officer within 24 hours of the date recorded.

#### 1.4.5 Certificates

##### 1.4.5.1 Qualifications of Certified Industrial Hygienist (CIH)

Submit name, address, telephone number, FAX number, and e-mail address of the independent third party CIH. Submit documentation that hygienist is certified by the American Board of Industrial Hygiene in comprehensive practice, including certification number and date of certification/recertification. Provide evidence of experience with hazards involved in industrial coating application work.

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#### 1.4.5.2 Qualifications of Coating Inspection Company

Submit documentation that the coating inspection company performing all coating inspection functions is certified by SSPC to the requirements of SSPC QP 5 prior to Contract award. The coating inspection company submitted and approved must remain and not changed through completion of the Contract. The coating inspection company must remain so certified for the duration of the project. If a coating inspection company's certification expires, the firm will not be allowed to perform any inspection functions, and all surface preparation and coating application work must stop, until the certification is reissued. Requests for extension of time for any delay to the completion of the project due to an inactive certification will not be considered. Notify the Contracting Officer of any change in coating inspection company certification status. Notify the Contracting Officer of all scheduled and unannounced on-site inspections from SSPC and furnish a copy of all inspection reports.

#### 1.4.5.3 Qualifications of QC Specialist Coating Inspector

Submit documentation that each coating inspector is employed, and qualified to SSPC QP 5, Level II, by the selected coating inspection company. Each inspector must remain employed by the coating inspection company while performing any coating inspection functions. In addition to the handwritten records, the inspector must employ an electronic reporting program with functionality as outlined in Table II. The Administrator must be the designated Government Representative for the project.

#### 1.4.5.4 Qualifications of Coating Contractors

All Contractors that perform surface preparation or coating application must be certified to SSPC QP 8 and should also be SSPC QS 1 certified prior to Contract award and must remain certified while accomplishing any surface preparation or coating application. The painting Contractors must remain so certified for the duration of the project. If a Contractor's certification expires, the firm will not be allowed to perform any work until the certification is reissued. Requests for extension of time for any delay to the completion of the project due to an inactive certification will not be considered. Notify the Contracting Officer of any change in Contractor certification status. Notify the Contracting Officer of all scheduled and unannounced on-site audits from SSPC and furnish a copy of all audit reports.

Minimum requirements for the installation Contractor are as follows: Completed three or more jobs within the past two years applying the specified materials to concrete surfaces in which the total area exceeds 200,000 square feet. Submit documentation listing location of work, point of contact at job site, total square footage of applied materials, listing of both materials and equipment used, and validation from coating manufacturer documenting quality of materials purchased per job for work totaling 200,000 square feet within the past two years. In addition to the above requirements, be certified by the material manufacturer(s) to install the submitted coatings and sealant. Submit copy of certificates.

#### 1.4.5.5 Joint Sealant Certificates

Submit literature documenting the past performance of the sealant's use in automotive or aircraft maintenance shops. Minimum requirements are two or more maintenance shops with joint work totaling 10,000 linear feet where the sealant has performed for two years with less than 1 percent combined

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sealant failures and defects. List location of shops, total linear feet of sealant applied per shop, shop point of contact, date sealant was applied, and the name of the installed sealant material.

#### 1.4.5.6 Thin Film Flooring System Certificates

Provide manufacturer's certification of conformance to Contract requirements.

#### 1.4.6 Product Data

##### 1.4.6.1 Joint Sealant Manufacturer's Instructions

Submit manufacturer's printed instructions to include detailed application procedures, minimum and maximum application temperatures, and curing procedures. In accordance with 29 CFR 1926.59, include Safety Data Sheets (SDS) for the sealant to be used at the job site.

##### 1.4.6.2 Thin Film Flooring System Manufacturer's Instructions

Submit manufacturer's printed instructions to include detailed mixing, minimum and maximum application temperatures, acceptable atmospheric and interior climatic conditions, application procedures, curing procedures, and procedures for maintenance cleaning of flooring system. Provide explicit instructions detailing surface preparation, recoat windows and remedial actions in case recoat windows are missed, and, if applicable, solvent-wiping between coats with acceptable types and grades of solvents. In accordance with 29 CFR 1926.59, include SDSs for the coatings to be used at the job site.

##### 1.4.6.3 Water-Based Alkaline Degreaser

Submit manufacturer's printed instructions to include detailed mixing, rate of dilution, application procedures, and rinsing procedures. In accordance with 29 CFR 1926.59, include SDSs for the water-based alkaline degreaser to be used at this job site.

#### 1.5 DELIVERY, STORAGE, AND HANDLING

Store coatings and sealant in spaces with temperatures from 40 degrees F to 75 degrees F. Inspect materials on site for damage prior to use. Return to manufacturer packaged materials in dented, rusty, or leaking containers. Conduct testing by manufacture of returned materials with an expired shelf life and if compliant, reissue a shelf life extension.

#### 1.6 COATING HAZARDS

Ensure that employees are trained in all aspects of the safety plan. Follow the coating manufacturer's written safety precautions throughout mixing, application, and curing of coatings. Comply with respiratory protection requirements in 29 CFR 1910.134 and safe levels of airborne contaminants in 29 CFR 1910.1000.

#### 1.7 JOB SITE REFERENCES

Make available to the Contracting Officer at least one copy each of ASTM D4541, ASTM D6237, SSPC-TU 2/NACE 6G197, and ICRI 310.2R, including replica standards ICRI 310.2R CSP 1 through CSP 9, at the job site.

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## 1.8 PATCH TEST DEMONSTRATION

Prior to the submitted flooring system's approval, apply the complete coating system to a 10 foot by 10 foot square section of concrete as prepared in accordance with PART 3 EXECUTION. Within this area, perform three adhesion tests as described in the paragraph ADHESION TESTING. If adhesion testing produces cohesive failures within the concrete, no less than 40 mils concrete removed over 95 percent of each pull-off coupon, or adhesion more than 400 psi, patch test adhesion is acceptable. If concrete surface preparation was insufficient, apply an additional coating system patch to properly prepared concrete followed by the above adhesion testing. If adhesion results are unacceptable for both the topcoats and the primer, submit a new coating system manufactured by a different coating vendor. Apply a patch of the new coating system and subject patch to the above requirements for adhesion prior to approval. If customer is not satisfied with the non-skid grit application, adjustments to the specifications can be made. Grit coarser than No. 60 aluminum oxide is not recommended.

## 1.9 WARRANTY

Warranty materials and workmanship for a minimum period of one year following coating and sealant application. The following terms and conditions form a part of the warranty: If the applied coating system develops either blisters (chemical), checks, softening, or lifting within one year following application, rework each area at Contractor's expense. The following conditions are excluded from the warranty: A) concrete cracking, flooring system mirrors cracks in concrete; B) cosmetic imperfections due to scratching and gouging; C) application to metallic concrete finishes; and D) application to concrete with a rate of Moisture Vapor Emission (MVE) greater than 3.5 pounds moisture per 24 hours, 1000 square feet. If the coating system's adhesion is in question, perform one adhesion test per 100 square feet as described in the paragraph ADHESION TESTING. To satisfy the warranty, each adhesion test must produce cohesive failures, concrete removal over 95 percent of each pull-off coupon, or adhesion no less than 400 psi. Require two additional adhesion tests to confirm results for each area failing to meet adhesion requirements. Within the warranty period, remove to sound material and rework all areas unable to meet adhesion requirements. There must be zero percent sealant failures within one year. Within the warranty period, remove and rework all sealant material with chemically attacked surfaces or lifting from joint walls. Topcoat cracking over sealant is excluded from warranty.

## PART 2 PRODUCTS

### 2.1 JOINT SEALANT

Formulate the joint sealant to exhibit the properties as listed in Table Ia.

### 2.2 THIN FILM FLOORING SYSTEM

A three-coat industrial flooring system consisting of primer and two urethane topcoats. Apply the coating system at a Dry Film Thickness (DFT) ranging from 13 to 20 mils and contain a broadcast of aluminum oxide non-skid grit.

The thin film flooring system used on the interior of the building

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(defined as inside of the weatherproofing system) must meet both emissions requirements of CDPH SECTION 01350 (limit requirements for either office or classroom spaces regardless of space type) and VOC content requirements of SCAQMD Rule 1113. Provide validation of indoor air quality for thin film flooring system.

#### 2.2.1 Primer Coat

In addition to the requirements of the thin film flooring system, use MPI 211 primer coat.

#### 2.2.2 Urethane Topcoat

In addition to the requirements of the thin film flooring system, use MPI 212 top coat.

#### 2.3 WHITE ALUMINUM OXIDE NON-SKID GRIT

Size No. 60, dust free (washed and dry), minimum 99 percent pure, having the following sieve analysis when tested using a 2.2 pound sample (ASTM E11 ):

Sieve No. 40	100 percent passing
Sieve No. 50	15-30 percent retained
Sieve No. 60	70-85 percent retained
Sieve No. 70	0-15 percent retained

### PART 3 EXECUTION

#### 3.1 COATING SAMPLE COLLECTION

The Contracting Officer and QC Manager must witness all material sampling. Notify the Contracting Officer a minimum of three days in advance of sampling. Obtain liquid samples of each component of primer and topcoat by random selection from sealed containers and in accordance with ASTM D3925. Samples may be either individual cans of liquid material or 1.0 quart quantities of properly mixed, extracted, and sealed liquid material. Identify samples by designated name, specification number, batch number, project Contract number, sample date, intended use, and quantity involved. When the applied coating system has met the requirements defined in the paragraph ADHESION TESTING, return coating to the installation Contractor for proper disposal.

#### 3.2 DEGREASING

On both coated and uncoated concrete, degrease entire floor by scrubbing using a solution of hot potable water, 120 degrees F to 170 degrees F, and a concentrated water-based alkaline degreaser. Perform two complete degreasing cycles on the entire floor surface. Allow solution to soak into surfaces prior to scrubbing and remove using hot potable water under a minimum of 4,000 psi. Rinsing is complete when the rinse water appears clear. If the industrial detergent is not biodegradable, collect all rinse water and dispose as hazardous waste. Squeegees and shop vacuums may be used to collect pooling rinse water. Fans may be used to aid drying of floor surfaces.

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### 3.3 SURFACE PREPARATION

Shot blast entire floor to produce a level of coarseness equal to ICRI 310.2R CSP 3. Overlap each pass of shot blasting by 1/4 inches to 1/2 inches. Add new shot to shot blasting equipment prior to blasting. Prepare surfaces inaccessible to shot blasting, base of perimeter walls and under secured equipment, using diamond disk grinding or light scarification to produce a level of coarseness equal to ICRI 310.2R CSP 2 or ICRI 310.2R CSP 4, respectively. Resulting surfaces must appear clean and contain the appropriate level of surface coarseness. If the resulting level of cleanliness cannot be determined, place numerous drops of water on surfaces that appear contaminated. If the water drops soak into concrete, the surfaces are free of hydrocarbon contamination (oils, grease, skydrol). If the water drops bead up and do not flatten out, surfaces require additional degreasing as detailed in the Article DEGREASING. Shot blasting coarse concrete or broom finished concrete can produce a level of coarseness equal to ICRI 310.2R CSP 5: employ a best-effort attempt to minimize over-shot-blasting of coarse concrete. If coarse concrete is encountered, shot blasting to a level of coarseness equal to ICRI 310.2R CSP 5 is acceptable: however, extremely coarse concrete can require resurfacing prior to the flooring system's installation. Sweep, vacuum, and run a high powered magnet over all surfaces to be coated, including joints.

### 3.4 JOINT TREATMENT

Use the "Conventional Sealed Joint" as detailed in Figure 1 of SSPC-TU 2/NACE 6G197 to seal joints. Employ measures to reduce contamination from equipment and foot traffic. Limit floor access to essential Contractor personnel. Confirm joint surfaces are sufficiently clean.

#### 3.4.1 Install Backer Rod

Install a continuous length of round, closed-cell polyethylene backer rod into each joint using a backer rod tool. For 1/2 inch, 3/8 inch, and 1/4 inch wide joints, place backer rod to a depth of 3/8 inch (depth equals the distance from the concrete's surface to the highest point on the backer rod). For joints greater than or equal to 3/4 inch width, place backer to a depth of 5/8 inch below the concrete's surface. Fit backer rod tight between joint walls (30 percent compression). Remove and reinstall all backer rod that is installed using either the incorrect size (loose fit) or at the incorrect depth. Following backer rod installation, apply painter's tape to surfaces adjacent joints to protect from sealant.

#### 3.4.2 Joint Sealant Application

Apply sealant directly into joints using a bulk-caulking gun. At room temperature, the resulting sealant application must exhibit a concave recess between 1/8 inch to 1/16 inch below the concrete's surface. Remove and reapply cured sealant remaining either flush or greater. Following sealant application, remove painter's tape and sealant drips on concrete surfaces. Cure sealant a minimum of 24 hours, prior to the application of coatings.

### 3.5 PRE-APPLICATION TESTING FOR CONTAMINATION

Spot check surfaces for oil/grease contamination using the water break

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test. At a rate of 5 tests per 1000 square feet, place one to two drops of water onto surfaces and observe for beading. Test all other surfaces that show visible signs of potential contamination. Apply additional degreasing techniques to surfaces displaying water beading in accordance with the Article DEGREASING.

### 3.6 COATING APPLICATION

Vacuum flooring space one additional time prior to coating application.

#### 3.6.1 Primer Application

Apply MPI 211 epoxy primer to flooring space at 7.0 mils to 15.0 mils Dry Film Thickness (DFT). If the prepared concrete resembles an ICRI 310.2R CSP 3 surface, apply the primer at a minimum of 7.0 mils DFT. If the prepared concrete resembles an ICRI 310.2R CSP 5 surface, apply the primer at a maximum of 15.0 mils DFT. The previously applied sealant may be lightly coated.

#### 3.6.2 Non-Skid Grit Broadcast

Broadcast non-skid grit at a rate of 1.5 pounds per 100 square feet into the second urethane top coat and backroll. Map floor into 600 square foot sections where 9.0 pounds of non-skid grit is pre-weighed, placed into clean buckets and used in its entirety per marked 600 square foot section.

#### 3.6.3 Application of Topcoats

Apply two coats of MPI 211 epoxy urethane topcoat to the epoxy primer and broadcast white aluminum oxide non-skid grit directly into the second urethane topcoat.

##### 3.6.3.1 First Topcoat

Apply a full coat of the urethane topcoat at a spreading rate from 2.5 to 3.2 mils Dry Film Thickness (DFT). Stripe coat perimeter edges and around equipment footings. Monitor and record a minimum of one Wet Film Thickness (WFT) reading per 600 square feet of floor surface. Sealant is to be lightly coated.

##### 3.6.3.2 Second Topcoat

Apply a second coat of the urethane topcoat at a spreading rate of 2.5 to 3.2 mils DFT. Stripe coat perimeter edges and around equipment footings. Monitor and record a minimum of one WFT reading per 600 square feet of floor surface prior to broadcasting non-skid grit. When the correct WFT has been applied per 600 square feet of area, immediately and evenly broadcast non-skid grit directly into the second topcoat of urethane and backroll in two directions. Test the adhesion of the thin film flooring system in accordance with the paragraph ADHESION TESTING.

##### 3.6.3.3 Walkway Stripe and Grounding Rod Markings

Place the walkway stripe and grounding rod markings according to Government drawings, if applicable. When the second topcoat is within its recoat window, apply a walkway stripe of the red/orange urethane topcoat at 3.0 mils DFT, completely hiding the top coat, in one coat. If insufficient hiding occurs, apply one additional coat of the walkway stripe. Lightly broadcast non-skid grit into the wet walkway stripe. Use

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solvent-resistant tape to protect the floor coating against stripe coat bleed. A thin clear coat of either epoxy or urethane may be required to prevent stripe coat bleed prior to the full application of the colored stripe coat. Apply grounding rod markings using similar procedures, urethane top coat, and colors and size according to Government drawings.

### 3.7 CURING

Cure installed materials to display performance equal to manufacturer's product literature. Remove and reapply improperly cured material.

### 3.8 FIELD QUALITY CONTROL

#### 3.8.1 Coating Inspector

Consider the Coating Inspector as a QC Specialist, who works for the QC Manager, and qualified in accordance with Section 01 45 00.15 06 CONTRACTOR QUALITY CONTROL. The Coating Inspector must be present during all field tests, surface preparation, flooring application, initial cure of the flooring system, and during all flooring repair work. The Coating Inspector must provide all tools/equipment necessary to perform field tests and inspection. The Coating Inspector is responsible for field tests and specified level of inspection.

#### 3.8.2 Inspection

Document weather conditions, job site occurrences, and report conditions and occurrences potentially detrimental to the flooring system. The listed inspection requirements are in addition to the QC inspection and reporting requirements defined in Section 01 45 00.15 06 CONTRACTOR QUALITY CONTROL. The Coating Inspector must prepare a project reference sheet outlining all requirements, tests, test methods, and evaluation criteria, and hold regular meetings with Contractor personnel, including shot blasting operators and applicators, to review requirements/evaluation criteria for upcoming work prior to execution. At the start of coating operations and every hour following until daily work is complete, record air temperature, substrate temperature, and relative humidity. Following the application of each coat, inspect surfaces for improperly cured material, blisters, inadequate or excessive coating thickness, and other defects. Document each inspection, test, non-compliant area, and location of each non-compliant area. List method of evaluation, evaluation criteria, areas requiring rework, and all other pertinent observations.

##### 3.8.2.1 Daily Inspection Report

Submit to the Contracting Officer one copy of the daily inspection report completed each day when performing work under this Section. Use Appendix X1 "Inspection Checklist" of ASTM D6237 to monitor daily activity and to assist in preparing the daily inspection report. Note each non-compliant issue and each issue identified for rework in accordance with the QC documentation procedures of Section 01 45 00.15 06 CONTRACTOR QUALITY CONTROL. Use of forms containing entry blocks for all required data is encouraged. The data must be legible and presented in a professional format. Submit report within 24 hours of the report date.

##### 3.8.2.2 Inspection Logbook

Maintain a continuous record of all activity related to this Section on a daily basis. A computer / software package as outlined in Table II is



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preferred to record all information provided in the Daily Inspection Reports, as well as other pertinent observations and information including photo documentation where appropriate. The designated Government Representative for the project is assigned the highest level Administrator privileges and only the Administrator must be able to modify reports. In areas where photography is not allowed, the computer must come with verification that the camera / photo capability has been removed.

Alternatively, a continuous record of all activity related to this Section must be maintained in an Inspection Logbook on a daily basis. The logbook must be hard or spiral bound with consecutively numbered pages, and must be used to record all information provided in the Daily Inspection Reports, as well as other pertinent observations and information. Submit the original Inspection Logbook to the Contracting Officer upon completion of the project and prior to final payment.

#### 3.8.2.3 Inspection Equipment

Use equipment in good condition, operational within its design range, and calibrated as required by the specified standard for use with each device.

#### 3.8.3 Adhesion Testing

Perform a minimum of three adhesion tests in accordance with ASTM D4541 to the thin film flooring system. Select three random flooring locations spaced a minimum of 20 feet between each location. Prior to attaching pull-off coupons, lightly sand flooring surface and attach pull-off coupons containing a grit-blasted anchor profile. Adhere directly to the center of each sanded surface a 3/4 inch diameter pull-off coupon. When pull-off coupon adhesive has sufficiently cured, score circumference of each pull-off coupon to concrete substrate. Test adhesion and evaluate results. If testing produces cohesive failures within the concrete, no less than 40 mils concrete removed over 95 percent of each pull-off coupon, or adhesion more than 400 psi coating system's adhesion is acceptable. If the above requirements are not satisfied, then perform one adhesion test per 100 square feet using the above procedures. Perform two additional tests per non-compliant area to confirm results. Remove to sound material and rework all areas unable to meet adhesion requirements. Repair each adhesion test using a combination of primer, sand-filled epoxy mortar (for deep cohesive failures, if applicable), and two urethane topcoats. Make repairs flush with adjacent coatings and display an equivalent appearance.

#### 3.9 FINAL CLEANUP

Following completion of the work, remove debris, equipment, and materials from the site. Remove temporary connections to Government or Contractor furnished water and electrical services. Restore existing facilities in and around the work areas to their original condition.

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TABLE I - MATERIALS REQUIREMENTS	
TABLE Ia	
Test	Minimum Requirement (maximum where indicated)
Sealant System (two-pack: self-leveling)	Polysulfide (Manganese Cure; MnO <sub>2</sub> ) or Urethane
Percent Volume Solids	100 percent
Chemical Resistance to JP-8 plus 100 Fuel at 70 degrees F (ASTM D1308) (see note 1)	48 hours immersion: 2.0 percent (max) weight increase, 5.0 percent (max) volume increase, 2.0 percent (max) weight loss
Chemical Resistance to Motor Oils at 70 degrees F (ASTM D1308) (see note 1)	48 hours immersion: 2.0 percent (max) weight increase, 5.0 percent (max) volume increase, 2.0 percent (max) weight loss
Chemical Resistance to Skydrols at 70 degrees F (ASTM D1308) (see note 1)	48 hours immersion: 2.0 percent (max) weight increase, 5.0 percent (max) volume increase, 2.0 percent (max) weight loss
Hardness (ASTM D2240: Shore A)	20
Tensile Strength (ASTM D412) (or ASTM D638)	150 psi
Percent Elongation (ASTM D412) (or ASTM D638)	500 percent
Tack Free at 65 degrees F (ASTM C679)	12 hours maximum
Adhesion to Concrete	140 psi
Adhesion to Urethane Topcoats (paintable sealant)	140 psi
NOTES: (1) Immerse and test a minimum of three 2 inch by 1/2 inch by 1/2 inch section of cured sealant.	

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TABLE II
Reporting Program Requirements QA/QC
Administrative Controls:
Administrators must be able to turn on and off unique access to specific jobs and Contracts.
Administrators must be able to remotely enable and disable access for users.
All enabled users must view the same active report in real time. There must be no opportunity for multiple versions of the same report to exist.
Administrators must be able to setup unique approval processes for each project and promote or remove unique people from this process at any time.
Administrators must be able to associate Contract specific documents and specification limits quickly and easily.
Administrators must be able to associate PDS, SDS, blueprints, scope of work and Contracts uniquely to each job.
Objectivity Controls:
Data Entry fields must be by multi-selectable choices, numeric keypads, pickers and skip logic to ensure repeatable data entry in a way that makes running analytics and metrics easy and objective.
The program / hardware package must be able to communicate with inspection devices that provide (batch) data export capability such as Elcometer and Defelsko gages.
The program / hardware package must automatically time, date and GPS stamp all reports without input or interference from the inspector.
Real Time Syncing:
Forms must be available for approved associates to view at all times.
Retrievable storage must be provided for all job related reports and documents for a minimum time of 5 years from completion of the job or project. Archiving of the documents after 5 years will be the responsibility of the Government.
Document Library:
All reports must be in searchable and annotatable PDF format.
The Administrator must be able to upload and annotate job specific reports in real time. Examples include but not limited to Safety Data Sheets, Product Data Sheets and Blueprints.

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TABLE II
Annotations and modifications must be locked and associated with the document. Only the Administrator has rights to modify or delete annotations or allow modifications to the document library especially all related inspection reports.
Customization:
The program must be capable of being customized to specific jobs, Contracts or specifications.

-- End of Section --

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## SECTION 09 68 00

## CARPETING

11/17, CHG 2: 08/20

## PART 1 GENERAL

## 1.1 REFERENCES

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

## AMERICAN ASSOCIATION OF TEXTILE CHEMISTS AND COLORISTS (AATCC)

AATCC 16	(2004; E 2008; E 2010) Colorfastness to Light
AATCC 107	(2013) Colorfastness to Water
AATCC 134	(2016) Electrostatic Propensity of Carpets
AATCC 165	(2013) Colorfastness to Crocking: Textile Floor Coverings - Crockmeter Method
AATCC 174	(2016) Antimicrobial Activity Assessment of New Carpets

## ASTM INTERNATIONAL (ASTM)

ASTM D297	(2015; R 2019) Rubber Products - Chemical Analysis
ASTM D1335	(2017; E 2018) Standard Test Method for Tuft Bind of Pile Yarn Floor Coverings
ASTM D2859	(2016) Standard Test Method for Ignition Characteristics of Finished Textile Floor Covering Materials
ASTM D3278	(1996; R 2011) Flash Point of Liquids by Small Scale Closed-Cup Apparatus
ASTM D3676	(2013) Rubber Cellular Cushion Used for Carpet or Rug Underlay
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

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ASTM D6866 (2022) Standard Test Methods for  
 Determining the Biobased Content of Solid,  
 Liquid, and Gaseous Samples Using  
 Radiocarbon Analysis

ASTM D7330 (2015) Standard Test Method for Assessment  
 of Surface Appearance Change in Pile Floor  
 Coverings Using Standard Reference Scales

ASTM E648 (2019a) Standard Test Method for Critical  
 Radiant Flux of Floor-Covering Systems  
 Using a Radiant Heat Energy Source

#### CALIFORNIA DEPARTMENT OF PUBLIC HEALTH (CDPH)

CDPH SECTION 01350 (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. GREEN BUILDING COUNCIL (USGBC)

LEED v4 BDC Ref Guide (2013; R 2020) USGBC LEED Reference Guide

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for Building Design and Construction, v4

LEED v4.1 BDC Ref Guide (2023) LEED v4.1 Building Design and  
 Construction Reference Guide

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

16 CFR 1630 Standard for the Surface Flammability of  
 Carpets and Rugs (FF 1-70)

UNDERWRITERS LABORATORIES (UL)

UL 2818 (2013) GREENGUARD Certification Program  
 For Chemical Emissions For Building  
 Materials, Finishes And Furnishings

## 1.2 SUSTAINABILITY REPORTING

Work of this section is intended to contribute to the achievement of, or compliance with, the requirements of the Guiding Principles Validation and LEED Prerequisites and attempted Credits. Refer to Section 01 33 29.00 06 SUSTAINABILITY REPORTING for specific documentation requirements and list of Prerequisites, attempted Credits and LEED version.

Comply with product, material content, performance criteria, activity, documentation, and other technical requirements as described in the LEED v4 BDC Ref Guide or LEED v4.1 BDC Ref Guide as applicable.

Collect, organize, and submit product data, drawings, diagrams, photos and cost information necessary to demonstrate compliance with LEED v4 BDC Ref Guide or LEED v4.1 BDC Ref Guide requirements as applicable.

Data collection shall commence with the notice to proceed and will only be deemed complete upon acceptance of the Final Sustainability Notebook and LEED Online submission by the Contracting Officer, the LEED Project Administrator, and the Green Building Certification Institute.

## 1.3 SUBMITTALS

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

SD-02 Shop Drawings

Installation Drawings; G

SD-03 Product Data

Carpet; G

Recycled Content for Carpeting; S

Moldings; G



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Environmental Product Declarations; S

Embodied Carbon Optimization Report/Action Plan; S

Extended Producer Responsibility; S

Bio-Based Materials; S

Local/Regional Materials; S

Material Ingredient Reporting; S

#### SD-04 Samples

Carpet; G

Moldings; G

#### SD-06 Test Reports

Moisture and Alkalinity Tests; G

#### SD-07 Certificates

Indoor Air Quality for Carpet; S

Indoor Air Quality for Aerosol Adhesives; S

Indoor Air Quality for Non-Aerosol Adhesives; S

Indoor Air Quality for Concrete Primer; S

#### SD-08 Manufacturer's Instructions

Surface Preparation

#### SD-10 Operation and Maintenance Data

Cleaning and Protection

#### SD-11 Closeout Submittals

Warranty

### 1.4 SUSTAINABLE DESIGN REQUIREMENTS

#### 1.4.1 Environmental Product Declarations

At a minimum, use materials or products with an Environmental Product Declaration in accordance with the LEED Implementation Plan. See Section 01 33 29.00 06 SUSTAINABILITY REPORTING for cumulative materials requirements and LEED Implementation Plan.

#### 1.4.2 Embodied Carbon Optimization Report/Action Plan

At a minimum, use materials or products with an Embodied Carbon Optimization Report/Action Plan in accordance with the LEED Implementation Plan. See Section 01 33 29.00 06 SUSTAINABILITY REPORTING for cumulative materials requirements and LEED Implementation Plan.

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#### 1.4.3 Sourcing of Raw Materials

Provide products that meet one or more of the following categories:

##### 1.4.3.1 Extended Producer Responsibility

At a minimum, use materials or products from manufacturers that participate in an extended producer responsibility program in accordance with the LEED Implementation Plan. Provide manufacturer letter verifying extended producer responsibility program is in place and that product is eligible. See Section 01 33 29.00 06 SUSTAINABILITY REPORTING for cumulative materials requirements and LEED Implementation Plan.

##### 1.4.3.2 Bio-Based Materials

At a minimum, use materials or products with bio-based content in accordance with the LEED Implementation Plan. Provide manufacturer signed letter confirming ASTM D6866 test method was conducted validating bio-based material weight within product, type of bio-based material used within product, and confirmation raw material was legally harvested. See Section 01 33 29.00 06 SUSTAINABILITY REPORTING for cumulative materials requirements and LEED Implementation Plan. If bio-based content minimum is specified in this section, the greater of the two percentages governs.

##### 1.4.3.3 Recycled Content Materials

At a minimum, use materials or products with recycled content in accordance with the LEED Implementation Plan. Provide manufacturers product literature identifying the percentage of recycled material incorporated within each product used. See Section 01 33 29.00 06 SUSTAINABILITY REPORTING for cumulative materials requirements and LEED Implementation Plan. If recycled content minimum is specified in this section, the greater of the two percentages governs.

##### 1.4.4 Material Ingredient Reporting

At a minimum, use materials or products with chemical inventory to at least 0.1% (1000 ppm) in accordance with the LEED Implementation Plan. Provide Health Product Declaration (HPD), Cradle to Cradle Certificate, Declare label, or other manufacturer's published content inventory in compliance with LEED v4.1 Material Ingredient Reporting credit. See Section 01 33 29.00 06 SUSTAINABILITY REPORTING for cumulative materials requirements and LEED Implementation Plan.

##### 1.4.5 Local/Regional Materials

Use materials or products extracted, harvested, or recovered, as well as manufactured, within a 100 mile radius from the project site, if available from a minimum of three sources. provide a letter from the manufacturer stating the extraction location, manufacturing location, and purchasing location of the products provided, referencing the project name and location specifically and distance to the project site. See Section 01 33 29.00 06 SUSTAINABILITY REPORTING for cumulative materials requirements and LEED Implementation Plan.

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## 1.5 CERTIFICATIONS

### 1.5.1 Indoor Air Quality Certifications

#### 1.5.1.1 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.

#### 1.5.2 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.

#### 1.5.3 Paints and Coatings

Provide paint and coating 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.

## 1.6 DELIVERY, STORAGE, AND HANDLING

Deliver materials to the site in the manufacturer's original wrappings and packages clearly labeled with the manufacturer's name, brand name, size, dye lot number, and related information. Remove materials from packaging and store them in a clean, dry, well ventilated area (100 percent outside air supply, minimum of 1.5 air changes per hour, and no recirculation), protected from damage, soiling, and moisture, and strong contaminant sources and residues, and maintain at a temperature above 60 degrees F for 2 days prior to installation. Do not store carpet or carpet tiles with materials which have high emissions of volatile organic compounds (VOCs) or other contaminants, including paints and adhesives. Do not store carpet near materials that may off gas or emit harmful fumes, such as kerosene heaters, fresh paint, or adhesives.

## 1.7 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.

## 1.8 WARRANTY

Provide manufacturer's standard performance guarantees or warranties including minimum ten year wear warranty, two year material and

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workmanship and ten year tuft bind and delamination.

## PART 2 PRODUCTS

### 2.1 CARPET

Furnish first quality carpet that is free of visual blemishes, streaks, poorly dyed areas, fuzzing of pile yarn, spots or stains, and other physical and manufacturing defects. Provide carpet materials and treatments as reasonably nonallergenic and free of other recognized health hazards. Provide a static control construction on all grade carpets which gives adequate durability and performance. Submit manufacturer's catalog data and printed documentation stating physical characteristics, durability, resistance to fading, and flame resistance characteristics for each type of carpet material and installation accessory. Submit manufacturer's Product Data for 1) Carpet, 2) Moldings, and 3) Carpet Cushion. Also, submit Samples of the following:

- a. Carpet: Two "Production Quality" samples 18 by 18 inches of each carpet proposed for use, showing quality, pattern, and color specified
- b. Moldings: Two samples of each type minimum 12 inches long
- c. Carpet Cushion: Two samples minimum 6 by 6 inches

#### 2.1.1 Recycled Content

Carpeting must contain a minimum of 37.4 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 Carpet

##### 2.1.3.1 Carpet Construction (EF-1)

PVC Grid with Tufted Carpet

##### 2.1.3.2 Type

Modular tile 7.87 by 7.87 inch square with 0.15 percent growth/shrink rate in accordance with ISO 2551.

##### 2.1.3.3 Pile Type

Cut Pile

##### 2.1.3.4 Pile Fiber

Commercial 100 percent branded (federally registered trademark) WearOn Nylon.

##### 2.1.3.5 Gauge or Pitch

Minimum 5/32 inch in accordance with ASTM D5793

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#### 2.1.3.6 Stitches or Rows/Wires

Minimum 9.5 per square inch

#### 2.1.3.7 Surface Pile Weight

Minimum 24 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 0.186 inch in accordance with ASTM D6859

#### 2.1.3.9 Pile Density

Minimum 4,684

#### 2.1.3.10 Dye Method

PrintWork Precision Dyeing

#### 2.1.3.11 Backing Materials

Provide primary backing materials like those customarily used and accepted by the trade for each type of carpet. Provide secondary backing to suit project requirements of those customarily used and accepted by the trade for each type of carpet.

#### 2.1.3.12 Attached Cushion

Provide an attached cushion PVC-Free WellBac Comfort Plus Cushion. Do not exceed the maximum ash content of 50 percent when tested in accordance with ASTM D297. Pass the accelerated aging test in accordance with ASTM D3676 for the cushion.

### 2.2 PERFORMANCE REQUIREMENTS

#### 2.2.1 Texture Appearance Retention Rating (TARR)

Provide carpet with a greater than or equal to 3.5 (Severe) TARR traffic level classification in accordance with ASTM D7330 or CRI Test Method 103.

#### 2.2.2 Static Control

Provide static control to permanently regulate static buildup to less than 3.5 kV when tested at 20 percent relative humidity and 70 degrees F in accordance with AATCC 134.

#### 2.2.3 Flammability and Critical Radiant Flux Requirements

Comply with 16 CFR 1630 or ASTM D2859. Provide carpet in corridors and exits with a minimum average critical radiant flux of 0.22 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.

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#### 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 both emissions requirements of CDPH SECTION 01350 (limit requirements for either office or classroom spaces regardless of space type) and VOC content requirements of SCAQMD Rule 1168. Aerosol adhesive products used on the interior of the building (defined as inside of the weatherproofing system) must meet both emissions requirements of CDPH SECTION 01350 (limit requirements for either office or classroom spaces regardless of space type) and 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 both emissions requirements of CDPH SECTION 01350 (limit requirements for either office or classroom spaces regardless of space type) and VOC content requirements of SCAQMD Rule 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 vinyl molding designed for the type of carpet being installed. Provide floor flange of a minimum 1 1/2 inches wide. Provide color to match resilient base .

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## 2.5 TAPE

Provide tape for seams as recommended by the carpet manufacturer for the type of seam used in broadloom installation. Seam sealant must have a maximum VOC content of no more than 50 grams/liter. Do not use sealants that contain 1,1,1-trichloroethane or toluene.

## 2.6 COLOR, TEXTURE, AND PATTERN

Provide color, texture, and pattern in accordance with the drawings .

# PART 3 EXECUTION

## 3.1 SURFACE PREPARATION

Do not install carpet on surfaces that are unsuitable and will prevent a proper installation. Prepare subfloor in accordance with flooring manufacturer's recommended instructions. Repair holes, cracks, depressions, or rough areas using material recommended by the carpet or adhesive manufacturer. Free floor of any foreign materials and sweep clean. Before beginning work, test subfloor with glue and carpet to determine "open time" and bond. Submit three copies of the manufacturer's printed Installation instructions for the carpet, including Surface Preparation, seaming techniques, and recommended adhesives and tapes.

## 3.2 MOISTURE AND ALKALINITY TESTS

Test concrete slab for moisture content and excessive alkalinity in accordance with CRI 104/CRI 105. Submit three copies of reports of Moisture and Alkalinity Tests including content of concrete slab stating date of test, person conducting the test, and the area tested.

## 3.3 PREPARATION OF CONCRETE SUBFLOOR

Do not commence installation of the carpeting until concrete substrate is at least 90 days old. Prepare the concrete surfaces in accordance with the carpet manufacturer's instructions. Match carpet, when required, and adhesives to prevent off-gassing to a type of curing compounds, leveling agents, and concrete sealer.

## 3.4 INSTALLATION

Isolate area of installation from rest of building. Perform all work by manufacturer's approved installers. Conduct installation in accordance with the manufacturer's printed instructions and CRI 104/CRI 105. Protect edges of carpet meeting hard surface flooring with molding and install in accordance with the molding manufacturer's printed instructions. Use autofoam mothproofing system for wool carpets. Follow ventilation, personal protection, and other safety precautions recommended by the adhesive manufacturer. Continue ventilation during installation and for at least 72 hours following installation. Do not permit traffic or movement of furniture or equipment in carpeted area for 24 hours after installation. Complete other work which would damage the carpet prior to installation of carpet. Submit three copies of Installation Drawings for 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.

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

#### 3.4.1 Entrance Carpet Installation

Install flooring in accordance with the manufacturer's printed installation instructions.

#### 3.5 CLEANING AND PROTECTION

Submit three copies of carpet manufacturer's maintenance instructions describing recommended type of cleaning equipment and material, spotting and cleaning methods, and cleaning cycles.

##### 3.5.1 Cleaning

As specified in Section 00 80 00.00 06 SPECIAL PROVISIONS. After installation of the carpet, remove debris, scraps, and other foreign matter. Remove soiled spots and adhesive from the face of the carpet with appropriate spot remover. Cut off and remove protruding face yarn. Vacuum carpet clean with a high-efficiency particulate air (HEPA) filtration vacuum.

##### 3.5.2 Protection

Protect the installed carpet from soiling and damage with heavy, reinforced, nonstaining kraft paper, plywood, or hardboard sheets. Lap and secure edges of kraft paper protection to provide a continuous cover. Restrict traffic for at least 48 hours. Remove protective covering when directed by the Contracting Officer.

#### 3.6 REMNANTS

Manage waste as specified in the Waste Management Plan. Remove non-retained scraps from site and recycle appropriately.

#### 3.7 MAINTENANCE

##### 3.7.1 Extra Materials

Provide extra material from same dye lot consisting of uncut carpet tiles for future maintenance. Provide a minimum of three percent of total square yards of each carpet type, pattern, and color.

-- End of Section --



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## SECTION 09 84 20

### ACOUSTICAL WALL PANELS

**08/16, CHG 1: 08/18**

#### PART 1 GENERAL

##### 1.1 REFERENCES

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

#### ASTM INTERNATIONAL (ASTM)

ASTM C423	(2009a) Sound Absorption and Sound Absorption Coefficients by the Reverberation Room Method
ASTM D6866	(2022) Standard Test Methods for Determining the Biobased Content of Solid, Liquid, and Gaseous Samples Using Radiocarbon Analysis
ASTM E84	(2020) 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
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#### CARPET AND RUG INSTITUTE (CRI)

CRI GLP QM	(2017) Green Label Plus Quality Manual
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#### SCIENTIFIC CERTIFICATION SYSTEMS (SCS)

SCS	SCS Global Services (SCS) Indoor Advantage
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#### U.S. GREEN BUILDING COUNCIL (USGBC)

LEED v4 BDC Ref Guide	(2013; R 2020) USGBC LEED Reference Guide for Building Design and Construction, v4
LEED v4.1 BDC Ref Guide	(2023) LEED v4.1 Building Design and Construction Reference Guide

#### UNDERWRITERS LABORATORIES (UL)

UL 2818	(2013) GREENGUARD Certification Program For Chemical Emissions For Building Materials, Finishes And Furnishings
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## 1.2 SUSTAINABILITY REPORTING

Work of this section is intended to contribute to the achievement of, or compliance with, the requirements of the Guiding Principles Validation and LEED Prerequisites and attempted Credits. Refer to Section 01 33 29.00 06 SUSTAINABILITY REPORTING for specific documentation requirements and list of Prerequisites, attempted Credits and LEED version.

Comply with product, material content, performance criteria, activity, documentation, and other technical requirements as described in the LEED v4 BDC Ref Guide or LEED v4.1 BDC Ref Guide as applicable.

Collect, organize, and submit product data, drawings, diagrams, photos and cost information necessary to demonstrate compliance with LEED v4 BDC Ref Guide or LEED v4.1 BDC Ref Guide requirements as applicable.

Data collection shall commence with the notice to proceed and will only be deemed complete upon acceptance of the Final Sustainability Notebook and LEED Online submission by the Contracting Officer, the LEED Project Administrator, and the Green Building Certification Institute.

## 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

Installation

Acoustical Wall Panels; G, AE

Recycled Content For Recycled PET Felt; S

Environmental Product Declarations; S

Embodied Carbon Optimization Report/Action Plan; S

Extended Producer Responsibility; S

Bio-Based Materials; S

Local/Regional Materials; S

Material Ingredient Reporting; S

### SD-04 Samples

Acoustical Wall Panels; G, AE

### SD-07 Certificates

Acoustical Wall Panels

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Indoor Air Quality For Acoustical Wall Panels; S

SD-11 Closeout Submittals

Warranty

1.4 SUSTAINABLE DESIGN REQUIREMENTS

1.4.1 Environmental Product Declarations

At a minimum, use materials or products with an Environmental Product Declaration in accordance with the LEED Implementation Plan. See Section 01 33 29.00 06 SUSTAINABILITY REPORTING for cumulative materials requirements and LEED Implementation Plan.

1.4.2 Embodied Carbon Optimization Report/Action Plan

At a minimum, use materials or products with an Embodied Carbon Optimization Report/Action Plan in accordance with the LEED Implementation Plan. See Section 01 33 29.00 06 SUSTAINABILITY REPORTING for cumulative materials requirements and LEED Implementation Plan.

1.4.3 Sourcing of Raw Materials

Provide products that meet one or more of the following categories:

1.4.3.1 Extended Producer Responsibility

At a minimum, use materials or products from manufacturers that participate in an extended producer responsibility program in accordance with the LEED Implementation Plan. Provide manufacturer letter verifying extended producer responsibility program is in place and that product is eligible. See Section 01 33 29.00 06 SUSTAINABILITY REPORTING for cumulative materials requirements and LEED Implementation Plan.

1.4.3.2 Bio-Based Materials

At a minimum, use materials or products with bio-based content in accordance with the LEED Implementation Plan. Provide manufacturer signed letter confirming ASTM D6866 test method was conducted validating bio-based material weight within product, type of bio-based material used within product, and confirmation raw material was legally harvested. See Section 01 33 29.00 06 SUSTAINABILITY REPORTING for cumulative materials requirements and LEED Implementation Plan. If bio-based content minimum is specified in this section, the greater of the two percentages governs.

1.4.3.3 Recycled Content Materials

At a minimum, use materials or products with recycled content in accordance with the LEED Implementation Plan. Provide manufacturers product literature identifying the percentage of recycled material incorporated within each product used. See Section 01 33 29.00 06 SUSTAINABILITY REPORTING for cumulative materials requirements and LEED Implementation Plan. If recycled content minimum is specified in this section, the greater of the two percentages governs.

1.4.4 Material Ingredient Reporting

At a minimum, use materials or products with chemical inventory to at

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least 0.1% (1000 ppm) in accordance with the LEED Implementation Plan. Provide Health Product Declaration (HPD), Cradle to Cradle Certificate, Declare label, or other manufacturer's published content inventory in compliance with LEED v4.1 Material Ingredient Reporting credit. See Section 01 33 29.00 06 SUSTAINABILITY REPORTING for cumulative materials requirements and LEED Implementation Plan.

#### 1.4.5 Local/Regional Materials

Use materials or products extracted, harvested, or recovered, as well as manufactured, within a 100 mile radius from the project site, if available from a minimum of three sources. provide a letter from the manufacturer stating the extraction location, manufacturing location, and purchasing location of the products provided, referencing the project name and location specifically and distance to the project site. See Section 01 33 29.00 06 SUSTAINABILITY REPORTING for cumulative materials requirements and LEED Implementation Plan.

### CERTIFICATIONS

#### 1.5 Indoor Air Quality Certifications

##### 1.5.1 Acoustical Wall Panel Materials

Provide acoustical wall panel 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.

#### 1.6 DELIVERY, STORAGE, AND HANDLING

Protect materials delivered and placed in storage from the weather, humidity and temperature variations, dirt, dust, or other contaminants.

#### 1.7 WARRANTY

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

### PART 2 PRODUCTS

#### 2.1 SYSTEM DESCRIPTION

##### 2.1.1 Design

Provide Recycled PET Felt acoustical wall panel materials in the manufacturer's standard sizes and finishes of the type, design and configuration indicated. Provide data identifying percentage of recycled content for recycled PET felt.

#### 2.2 ACOUSTICAL WALL PANELS

Wall panels must conform to the following:

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#### 2.2.1 Indoor Air Quality Requirements

Products must meet emissions requirements of CDPH SECTION 01350. Provide certification or validation of indoor air quality for acoustical wall panels.

#### 2.2.2 Panel Width

Widths up to 48 inches Panel width must be as detailed.

#### 2.2.3 Panel Height

Heights 96 inches. Panel height must be as detailed.

#### 2.2.4 Thickness

Panel thickness as required to meet the indicated NRC range .95 minimum.

#### 2.2.5 Fire Rating for the Complete Composite System

Class A, 200 or less smoke density and flame spread less than 25, when tested in accordance with ASTM E84.

#### 2.2.6 Noise Reduction Coefficient (NRC) Range

.95 minimum ASTM C423

#### 2.2.7 Edge Detail

Square.

#### 2.2.8 Core Type

Recycled PET core

#### 2.2.9 Mounting Acoustical Panels

Mount acoustical panels by manufacturer's standard mechanical fasteners .

### 2.3 COLOR

As indicated . Color listed is not intended to limit the selection of equal colors from other manufacturers.

## PART 3 EXECUTION

### 3.1 SURFACE CONDITIONS

Must be clean, smooth, oil free and prepared in accordance with panel manufacturer's instructions. Do not begin installation until all wet work, such as, plastering, painting, and concrete are completely dry.

### 3.2 INSTALLATION

Panel installation must be by personnel familiar with and normally engaged in installation of acoustical wall panels. Apply panels in accordance with the manufacturer's installation instructions. Submit manufacturer's installation instructions and recommended cleaning instructions.

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### 3.3 CLEANING

Following installation, clean dirty or stained panel surfaces in accordance with manufacturer's instructions and leave free from defects. Remove and replace panels that are damaged, discolored, or improperly installed.

-- End of Section --

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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.

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### 1.1.3 Mechanical and Electrical Painting

Includes field coating of interior and exterior new surfaces.

a. Where a space or surface is indicated to be painted, include the following items unless indicated otherwise.

- (1) Exposed piping, conduit, and ductwork;
- (2) Supports, hangers, air grilles, and registers;
- (3) Miscellaneous metalwork and insulation coverings.

b. Do not paint the following, unless indicated otherwise:

- (1) New zinc-coated, aluminum, and copper surfaces under insulation
- (2) New aluminum jacket on piping
- (3) New interior ferrous piping under insulation.

#### 1.1.3.1 Fire Extinguishing Sprinkler Systems

Clean, pretreat, prime, and paint new fire extinguishing sprinkler systems including valves, piping, conduit, hangers, supports, miscellaneous metalwork, and accessories. Apply coatings to clean, dry surfaces, using clean brushes.

## 1.2 REFERENCES

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

### AMERICAN CONFERENCE OF GOVERNMENTAL INDUSTRIAL HYGIENISTS (ACGIH)

ACGIH 0100	(2017; Suppl 2020) Documentation of the Threshold Limit Values and Biological Exposure Indices
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### AMERICAN SOCIETY OF MECHANICAL ENGINEERS (ASME)

ASME A13.1	(2020) Scheme for the Identification of Piping Systems
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### ASTM INTERNATIONAL (ASTM)

ASTM D235	(2002; R 2012) Mineral Spirits (Petroleum Spirits) (Hydrocarbon Dry Cleaning Solvent)
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ASTM D523	(2014; R 2018) Standard Test Method for Specular Gloss
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ASTM D4263	(1983; R 2018) Standard Test Method for Indicating Moisture in Concrete by the Plastic Sheet Method
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ASTM D4444	(2013; R 2018) Standard Test Method for Laboratory Standardization and Calibration
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#### 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 D6866 | (2022) Standard Test Methods for Determining the Biobased Content of Solid, Liquid, and Gaseous Samples Using Radiocarbon Analysis      |
| ASTM F1869 | (2016a) Standard Test Method for Measuring Moisture Vapor Emission Rate of Concrete Subfloor Using Anhydrous Calcium Chloride           |

#### 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 |
|--------------------|------------------------------------------------------------------------------------------------------------------------------------------------------------|

#### CENTERS FOR DISEASE CONTROL AND PREVENTION (CDC)

- |                          |                                                                 |
|--------------------------|-----------------------------------------------------------------|
| Intelligence Bulletin 65 | (2013) Occupational Exposure to Carbon Nanotubes and Nanofibers |
|--------------------------|-----------------------------------------------------------------|

#### MASTER PAINTERS INSTITUTE (MPI)

- |        |                                                                       |
|--------|-----------------------------------------------------------------------|
| MPI 2  | (2012) Aluminum Heat Resistant Enamel (up to 427 C and 800 F)         |
| MPI 4  | (2016) Interior/Exterior Latex Block Filler                           |
| MPI 8  | (2016) Alkyd, Exterior Flat (MPI Gloss Level I)                       |
| MPI 9  | (2016) Alkyd, Exterior Gloss (MPI Gloss Level 6)                      |
| MPI 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 39 | (2018) Primer, Latex, for Interior Wood                               |
| MPI 50 | (2015) Primer Sealer, Latex, Interior                                 |
| MPI 56 | (2012) Varnish, Interior, Polyurethane, Oil Modified, Gloss           |
| MPI 57 | (2012) Varnish, Interior, Polyurethane,                               |

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	Oil Modified, Satin
MPI 72	(2016) Polyurethane, Two-Component, Pigmented, Gloss (MPI Gloss Level 6-7)
MPI 76	(2016) Primer, Alkyd, Quick Dry, for Metal
MPI 77	(2015) Epoxy, Gloss
MPI 79	(2016) Primer, Alkyd, Anti-Corrosive for Metal
MPI 90	(2012) Stain, Semi-Transparent, for Interior Wood
MPI 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 141	(2016) Latex, Interior, High Performance Architectural, Semi-Gloss (MPI Gloss Level 5)
MPI 144	(2016) Latex, Interior, Institutional Low Odor/VOC, (MPI Gloss Level 2)
MPI 145	(2016) Latex, Interior, Institutional Low Odor/VOC, ( MPI Gloss Level 3)
MPI 146	(2016) Latex, Interior, Institutional Low Odor/VOC, (MPI Gloss Level 4)
MPI 147	(May 2016) Latex, Interior, Institutional Low Odor/VOC, Semi-Gloss (MPI Gloss Level 5)
MPI 149	(2016) Primer Sealer, Interior, Institutional Low Odor/VOC
MPI 153	(2016) Light Industrial Coating, Interior, Water Based, Semi-Gloss (MPI Gloss Level 5)
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 GPS-1-14	(2014) Green Performance Standard GPS-1-14
MPI MRM	(2015) Maintenance Repainting Manual

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# SCIENTIFIC CERTIFICATION SYSTEMS (SCS)

SCS SCS Global Services (SCS) Indoor Advantage

# SOCIETY FOR PROTECTIVE COATINGS (SSPC)

SSPC 7/NACE No.4	(2007) Brush-Off Blast Cleaning
SSPC Glossary	(2011) SSPC Protective Coatings Glossary
SSPC PA 1	(2016) Shop, Field, and Maintenance Coating of Metals
SSPC QP 1	(2019) Standard Procedure for Evaluating the Qualifications of Industrial/Marine Painting Contractors (Field Application to Complex Industrial Steel Structures and Other Metal Components)
SSPC SP 1	(2015) Solvent Cleaning
SSPC SP 2	(2018) Hand Tool Cleaning
SSPC SP 3	(2018) Power Tool Cleaning
SSPC SP 6/NACE No.3	(2007) Commercial Blast Cleaning
SSPC SP 10/NACE No. 2	(2007) Near-White Blast Cleaning
SSPC VIS 1	(2002; E 2004) Guide and Reference Photographs for Steel Surfaces Prepared by Dry Abrasive Blast Cleaning
SSPC VIS 3	(2004) Guide and Reference Photographs for Steel Surfaces Prepared by Hand and Power Tool Cleaning
SSPC VIS 4/NACE VIS 7	(1998; E 2000; E 2004) Guide and Reference Photographs for Steel Surfaces Prepared by Waterjetting
SSPC-SP WJ-1/NACE WJ-1	(2012) Clean to Bare Substrate, Waterjet Cleaning of Metals
SSPC-SP WJ-2/NACE WJ-2	(2012) Very Thorough Cleaning, Waterjet Cleaning of Metals
SSPC-SP WJ-3/NACE WJ-3	(2012) Thorough Cleaning, Waterjet Cleaning of Metals
SSPC-SP WJ-4/NACE WJ-4	(2012) Light Cleaning, Waterjet Cleaning of Metals

# SOUTH COAST AIR QUALITY MANAGEMENT DISTRICT (SCAQMD)

SCAQMD Rule 1113 (2016) Architectural Coatings

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U.S. ARMY CORPS OF ENGINEERS (USACE)

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

U.S. ENVIRONMENTAL PROTECTION AGENCY (EPA)

EPA 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. GREEN BUILDING COUNCIL (USGBC)

LEED v4 BDC Ref Guide (2013; R 2020) USGBC LEED Reference Guide  
 for Building Design and Construction, v4

LEED v4.1 BDC Ref Guide (2023) LEED v4.1 Building Design and  
 Construction Reference Guide

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

29 CFR 1910.1000 Air Contaminants

UNDERWRITERS LABORATORIES (UL)

UL 2818 (2013) GREENGUARD Certification Program  
 For Chemical Emissions For Building  
 Materials, Finishes And Furnishings

### 1.3 DEFINITIONS

#### 1.3.1 Qualification Testing

Qualification testing is the performance of all test requirements listed in the product specification. This testing is accomplished by MPI to qualify each product for the MPI Approved Product List, and may also be accomplished by Contractor's third-party testing lab if an alternative to Batch Quality Conformance Testing by MPI is desired.

#### 1.3.2 Batch Quality Conformance Testing

Batch quality conformance testing determines that the product provided is the same as the product qualified to the appropriate product specification. This testing must be accomplished by an MPI testing lab.

#### 1.3.3 Coating

SSPC Glossary; (1) A liquid, liquefiable, or mastic composition that is converted to a solid protective, decorative, or functional adherent film after application as a thin layer; (2) Generic term for paint, lacquer, enamel.

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#### 1.3.4 DFT or dft

Dry film thickness, the film thickness of the fully cured, dry paint or coating.

#### 1.3.5 DSD

Degree of Surface Degradation, the MPI system of defining degree of surface degradation. Five levels are generically defined under the Assessment sections in the MPI MRM, MPI Maintenance Repainting Manual.

#### 1.3.6 EXT

MPI short term designation for an exterior coating system.

#### 1.3.7 INT

MPI short term designation for an interior coating system.

#### 1.3.8 Loose Paint

Paint or coating that can be removed with a dull putty knife.

#### 1.3.9 mil / mils

The English measurement for 0.001 in or one one-thousandth of an inch.

#### 1.3.10 MPI Gloss Levels

MPI system of defining gloss. Seven gloss levels (G1 to G7) are generically defined under the Evaluation sections of the MPI Manuals. Traditionally, Flat refers to G1/G2, Eggshell refers to G3, Semigloss refers to G5, and Gloss refers to G6.

Gloss levels are defined by MPI as follows:

Gloss Level	Description	Units at 60 degree angle	Units at 80 degree angle
G1	Matte or Flat	0 to 5	10 max
G2	Velvet	0 to 10	10 to 35
G3	Eggshell	10 to 25	10 to 35
G4	Satin	20 to 35	35 min
G5	Semi-Gloss	35 to 70	
G6	Gloss	70 to 85	
G7	High Gloss		

Gloss is tested in accordance with ASTM D523. Historically, the Government has used Flat (G1 / G2), Eggshell (G3), Semi-Gloss (G5), and Gloss (G6).

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#### 1.3.11 MPI System Number

The MPI coating system number in each MPI Division found in either the MPI Architectural Painting Specification Manual or the Maintenance Repainting Manual and defined as an exterior (EXT/REX) or interior system (INT/RIN).

#### 1.3.12 Paint

SSPC Glossary; (1) Any pigmented liquid, liquefiable, or mastic composition designed for application to a substrate in a thin layer that is converted to an opaque solid film after application. Used for protection, decoration, identification, or to serve some other functional purposes; (2) Application of a coating material.

#### 1.3.13 REX

MPI short term designation for an exterior coating system used in repainting projects or over existing coating systems.

#### 1.3.14 RIN

MPI short term designation for an interior coating system used in repainting projects or over existing coating systems.

#### 1.4 SCHEDULING

Allow paint, polyurethane, varnish, and wood stain installations to cure prior to the installation of materials that adsorb VOCs, including carpets, textiles, unprimed gypsum wallboard, acoustical ceiling panels,.

#### 1.5 SUSTAINABILITY REPORTING

Work of this section is intended to contribute to the achievement of, or compliance with, the requirements of the Guiding Principles Validation and LEED Prerequisites and attempted Credits. Refer to Section 01 33 29.00 06 SUSTAINABILITY REPORTING for specific documentation requirements and list of Prerequisites, attempted Credits and LEED version.

Comply with product, material content, performance criteria, activity, documentation, and other technical requirements as described in the LEED v4 BDC Ref Guide or LEED v4.1 BDC Ref Guide as applicable.

Collect, organize, and submit product data, drawings, diagrams, photos and cost information necessary to demonstrate compliance with LEED v4 BDC Ref Guide or LEED v4.1 BDC Ref Guide requirements as applicable.

Data collection shall commence with the notice to proceed and will only be deemed complete upon acceptance of the Final Sustainability Notebook and LEED Online submission by the Contracting Officer, the LEED Project Administrator, and the Green Building Certification Institute.

#### 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

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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, AE

Product Data Sheets

Environmental Product Declarations; S

Embodied Carbon Optimization Report/Action Plan; S

Extended Producer Responsibility; S

Bio-Based Materials; S

Recycled Content Materials; S

Local/Regional Materials; S

Material Ingredient Reporting; S

SD-04 Samples

Color; G, AE

SD-07 Certificates

Qualification Testing laboratory for coatings; G

Indoor Air Quality For Primers And Paints; S

SD-08 Manufacturer's Instructions

Application InstructionsMixing

Manufacturer's Safety Data Sheets

SD-10 Operation and Maintenance Data

Coatings, Data Package 1; G

1.7 QUALITY ASSURANCE

1.7.1 Regulatory Requirements

1.7.1.1 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

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conform.

#### 1.7.1.2 Lead Content

Do not use coatings having a lead content over 0.06 percent by weight of nonvolatile content.

#### 1.7.1.3 Chromate Content

Do not use coatings containing zinc-chromate or strontium-chromate.

#### 1.7.1.4 Asbestos Content

Provide asbestos-free materials.

#### 1.7.1.5 Mercury Content

Provide materials free of mercury or mercury compounds.

#### 1.7.1.6 Silica

Provide abrasive blast media containing no free crystalline silica.

#### 1.7.1.7 Human Carcinogens

Provide materials that do not contain ACGIH 0100 confirmed human carcinogens (A1) or suspected human carcinogens (A2).

#### 1.7.1.8 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.

#### 1.7.2 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.

#### 1.7.3 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.



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#### 1.7.4 SUSTAINABLE DESIGN REQUIREMENTS

##### 1.7.4.1 Environmental Product Declarations

At a minimum, use materials or products with an Environmental Product Declaration in accordance with the LEED Implementation Plan. See Section 01 33 29.00 06 SUSTAINABILITY REPORTING for cumulative materials requirements and LEED Implementation Plan.

##### 1.7.4.2 Embodied Carbon Optimization Report/Action Plan

At a minimum, use materials or products with an Embodied Carbon Optimization Report/Action Plan in accordance with the LEED Implementation Plan. See Section 01 33 29.00 06 SUSTAINABILITY REPORTING for cumulative materials requirements and LEED Implementation Plan.

##### 1.7.4.3 Sourcing of Raw Materials

Provide products that meet one or more of the following categories:

###### 1.7.4.3.1 Extended Producer Responsibility

At a minimum, use materials or products from manufacturers that participate in an extended producer responsibility program in accordance with the LEED Implementation Plan. Provide manufacturer letter verifying extended producer responsibility program is in place and that product is eligible. See Section 01 33 29.00 06 SUSTAINABILITY REPORTING for cumulative materials requirements and LEED Implementation Plan.

###### 1.7.4.3.2 Bio-Based Materials

At a minimum, use materials or products with bio-based content in accordance with the LEED Implementation Plan. Provide manufacturer signed letter confirming ASTM D6866 test method was conducted validating bio-based material weight within product, type of bio-based material used within product, and confirmation raw material was legally harvested. See Section 01 33 29.00 06 SUSTAINABILITY REPORTING for cumulative materials requirements and LEED Implementation Plan. If bio-based content minimum is specified in this section, the greater of the two percentages governs.

###### 1.7.4.3.3 Recycled Content Materials

At a minimum, use materials or products with recycled content in accordance with the LEED Implementation Plan. Provide manufacturers product literature identifying the percentage of recycled material incorporated within each product used. See Section 01 33 29.00 06 SUSTAINABILITY REPORTING for cumulative materials requirements and LEED Implementation Plan. If recycled content minimum is specified in this section, the greater of the two percentages governs.

##### 1.7.4.4 Material Ingredient Reporting

At a minimum, use materials or products with chemical inventory to at least 0.1% (1000 ppm) in accordance with the LEED Implementation Plan. Provide Health Product Declaration (HPD), Cradle to Cradle Certificate, Declare label, or other manufacturer's published content inventory in compliance with LEED v4.1 Material Ingredient Reporting credit. See Section 01 33 29.00 06 SUSTAINABILITY REPORTING for cumulative materials

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requirements and LEED Implementation Plan.

#### 1.7.4.5 Local/Regional Materials

Use materials or products extracted, harvested, or recovered, as well as manufactured, within a 100 mile radius from the project site, if available from a minimum of three sources. provide a letter from the manufacturer stating the extraction location, manufacturing location, and purchasing location of the products provided, referencing the project name and location specifically and distance to the project site. See Section 01 33 29.00 06 SUSTAINABILITY REPORTING for cumulative materials requirements and LEED Implementation Plan.

#### 1.7.5 Paints and Coatings Indoor Air Quality Certifications

Provide paint and coating 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.

#### 1.7.6 Field Samples and Tests

The Contracting Officer may choose up to two coatings that have been delivered to the site to be tested at no cost to the Government. Take samples of each chosen product as specified in the paragraph SAMPLING PROCEDURE. Test each chosen product as specified in the paragraph TESTING PROCEDURE. Remove products from the job site which do not conform, and replace with new products that conform to the referenced specification. Test replacement products that failed initial testing as specified in the paragraph TESTING PROCEDURE at no cost to the Government.

##### 1.7.6.1 Sampling Procedure

Select paint at random from the products that have been delivered to the job site for sample testing. The Contractor must provide one quart samples of the selected paint materials. Take samples in the presence of the Contracting Officer, and label, and identify each sample. Provide labels in accordance with the paragraph PACKAGING, LABELING, AND STORAGE.

##### 1.7.6.2 Testing Procedure

Provide Batch Quality Conformance Testing for specified products, as defined by and performed by MPI. As an alternative to Batch Quality Conformance Testing, the Contractor may provide Qualification Testing for specified products above to the appropriate MPI product specification, using the third-party laboratory approved under the paragraph QUALIFICATION TESTING laboratory for coatings. Include the backup data and summary of the test results within the qualification testing lab report. Provide a summary listing of all the reference specification requirements and the result of each test. Clearly indicate in the summary whether the tested paint meets each test requirement. Note that Qualification Testing may take 4 to 6 weeks to perform, due to the extent of testing required.

Submit name, address, telephone number, FAX number, and e-mail address of the independent third party laboratory selected to perform testing of coating samples for compliance with specification requirements. Submit documentation that laboratory is regularly engaged in testing of paint

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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.

#### 1.8 PACKAGING, LABELING, AND STORAGE

Provide paints in sealed containers that legibly show the Contract specification number, designation name, formula or specification number, batch number, color, quantity, date of manufacture, manufacturer's formulation number, manufacturer's directions including any warnings and special precautions, and name and address of manufacturer. Furnish pigmented paints in containers not larger than 5 gallons. Store paints and thinners in accordance with the manufacturer's written directions, and as a minimum, stored off the ground, under cover, with sufficient ventilation to prevent the buildup of flammable vapors, and at temperatures between 40 to 95 degrees F. Do not store paint, polyurethane, varnish, or wood stain products with materials that have a high capacity to absorb VOC emissions. Do not store paint, polyurethane, varnish, or wood stain products in occupied spaces.

#### 1.9 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 26.00 06 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.

##### 1.9.1 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.

#### 1.10 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.

##### 1.10.1 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

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pre-approved by the Contracting Officer and the product manufacturer.  
Do not, under any circumstances, violate the manufacturer's  
application recommendations.

#### 1.10.2 Post-Application

Vacate space for as long as possible after application. Wait a minimum of 48 hours before occupying freshly painted rooms. Maintain one of the following ventilation conditions during the curing period, or for 72 hours after application:

- a. Supply 100 percent outside air 24 hours a day.
- b. Supply airflow at a rate of 6 air changes per hour, when outside temperatures are between 55 degrees F and 85 degrees F and humidity is between 30 percent and 60 percent.
- c. Supply airflow at a rate of 1.5 air changes per hour, when outside air conditions are not within the range stipulated above.

### PART 2 PRODUCTS

#### 2.1 MATERIALS

Conform to the coating specifications and standards referenced in PART 3. Submit Product Data Sheets for specified coatings and solvents. Provide preprinted cleaning and maintenance instructions for all coating systems. Submit Manufacturer's Instructions on Mixing: Detailed mixing instructions, minimum and maximum application temperature and humidity, pot life, and curing and drying times between coats.

#### 2.2 COLOR SELECTION OF FINISH COATS

Provide colors of finish coats as indicated or specified. Allow Contracting Officer to select colors not indicated or specified. Manufacturers' names and color identification are used for the purpose of color identification only. Named products are acceptable for use only if they conform to specified requirements. Products of other manufacturers are acceptable if the colors are approximately the colors indicated and the product conforms to specified requirements.

Provide color, texture, and pattern of wall coating systems as indicated. 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.

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### 3.2 SURFACE PREPARATION

#### 3.2.1 Additional Requirements for Preparation of Surfaces With Existing Coatings

Before application of coatings, perform the following on surfaces covered by soundly-adhered coatings, defined as those which cannot be removed with a putty knife:

- a. Test existing finishes for lead before sanding, scraping, or removing. If lead is present, refer to paragraph Toxic Materials.
- b. The requirements specified are minimum. Comply also with the application instructions of the paint manufacturer and specific surface preparation requirements as outlined in MPI MRM Exterior Surface Preparation and Interior Surface Preparation.

### 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 or SSPC SP 10/NACE No. 2 / SSPC-SP WJ-2/NACE WJ-2.
- c. Metal Floor Surfaces to Receive Nonslip Coating: Clean in accordance with SSPC SP 10/NACE No. 2.

#### 3.3.2 Final Ferrous Surface Condition:

##### 3.3.2.1 Tool Cleaned Surfaces

Comply with SSPC SP 2 and SSPC SP 3. Use as a visual reference, photographs in SSPC VIS 3 for the appearance of cleaned surfaces.

##### 3.3.2.2 Abrasive Blast Cleaned Surfaces

Comply with SSPC 7/NACE No.4, SSPC SP 6/NACE No.3, and SSPC SP 10/NACE No. 2. Use as a visual reference, photographs in SSPC VIS 1 for the appearance of cleaned surfaces.

##### 3.3.2.3 Waterjet Cleaned Surfaces

Comply with SSPC-SP WJ-1/NACE WJ-1, SSPC-SP WJ-2/NACE WJ-2, SSPC-SP WJ-3/NACE WJ-3 or SSPC-SP WJ-4/NACE WJ-4. Use as a visual reference, photographs in SSPC VIS 4/NACE VIS 7 for the appearance of

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cleaned surfaces.

### 3.3.3 Galvanized Surfaces

- a. New or Existing Galvanized Surfaces With Only Dirt and Zinc Oxidation Products: Clean with solvent, steam, or non-alkaline detergent solution in accordance with SSPC SP 1. Completely remove coating by brush-off abrasive blast if the galvanized metal has been passivated or stabilized. Do not "passivate" or "stabilize" new galvanized steel to be coated. If the absence of hexavalent stain inhibitors is not documented, test as described in ASTM D6386, Appendix X2, and remove by one of the methods described therein.

### 3.3.4 Non-Ferrous Metallic Surfaces

Aluminum and aluminum-alloy, lead, copper, and other nonferrous metal surfaces.

Surface Cleaning: Solvent clean in accordance with SSPC SP 1 and wash with mild non-alkaline detergent to remove dirt and water soluble contaminants.

### 3.3.5 Terne-Coated Metal Surfaces

Solvent clean surfaces with mineral spirits, ASTM D235. Wipe dry with clean, dry cloths.

## 3.4 PREPARATION OF CONCRETE AND CEMENTITIOUS SURFACE

### 3.4.1 Concrete and Masonry

- a. Curing: Allow concrete, stucco and masonry surfaces to cure at least 30 days before painting, and concrete slab on grade to cure at least 90 days before painting.
- b. Surface Cleaning: Remove the following deleterious substances.
  - (1) Dirt, Chalking, Grease, and Oil: Wash new surfaces with a solution composed of 1/2 cup trisodium phosphate, 1/4 cup household detergent, and 4 quarts of warm water. Then rinse thoroughly with fresh water. For large areas, water blasting may be used.
  - (2) Fungus and Mold: Wash new surfaces with a solution composed of 1/2 cup trisodium phosphate, 1/4 cup household detergent, one quart 5 percent sodium hypochlorite solution and 3 quarts of warm water. Rinse thoroughly with fresh water.
  - (3) Paint and Loose Particles: Remove by wire brushing.
  - (4) Efflorescence: Remove by scraping or wire brushing followed by washing with a 5 to 10 percent by weight aqueous solution of hydrochloric (muriatic) acid. Do not allow acid to remain on the surface for more than five minutes before rinsing with fresh water. Do not acid clean more than 4 square feet of surface, per workman, at one time.
- c. Cosmetic Repair of Minor Defects: Repair or fill mortar joints and minor defects, including but not limited to spalls, in accordance with

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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, Plaster, and Stucco

#### 3.4.2.1 Surface Cleaning

Verify that plaster and stucco surfaces are free from loose matter and that gypsum board is dry. Remove loose dirt and dust by brushing with a soft brush, rubbing with a dry cloth, or vacuum-cleaning prior to application of the first coat material. A damp cloth or sponge may be used if paint is water-based.

#### 3.4.2.2 Repair of Minor Defects

Prior to painting, repair joints, cracks, holes, surface irregularities, and other minor defects with patching plaster or spackling compound and sand smooth.

#### 3.4.2.3 Allowable Moisture Content

Latex coatings may be applied to damp surfaces, but not surfaces with droplets of water. Do not apply epoxies to damp surfaces as determined by ASTM D4263. Verify that new plaster to be coated has a maximum moisture content of 8 percent, when measured in accordance with ASTM D4444, Method A, unless otherwise authorized. In addition to moisture content requirements, allow new plaster to age a minimum of 30 days before preparation for painting.

### 3.5 PREPARATION OF WOOD AND PLYWOOD SURFACES

#### 3.5.1 New Plywood and Wood Surfaces, Except Floors:

- a. Surface Cleaning: Clean wood surfaces of foreign matter. Verify that surfaces are free from dust and other deleterious substances and in a condition approved by the Contracting Officer prior to receiving paint or other finish. Do not use water to clean uncoated wood.
- b. 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.
- c. Prime or touch up wood surfaces adjacent to surfaces to receive water-thinned paints before applying water-thinned paints.
- d. Cracks and Nailheads: Set and putty stop nailheads and putty cracks after the prime coat has dried.
- e. 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

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varnish, plasticized with 5 ounces of castor oil per gallon. Scrape away existing coatings from knotty areas, and sand before treating. Prime before applying any putty over shellacked area.

(2) Open Joints and Other Openings: Fill with whiting putty, linseed oil putty. Sand smooth after putty has dried.

(3) Checking: Where checking of the wood is present, sand the surface, wipe and apply a coat of pigmented orange shellac. Allow to dry before paint is applied.

### 3.6 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.



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- 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,

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application methods, or for the type of paint being used. Obtain written permission from the Contracting Officer to use thinners. Verify that the written permission includes quantities and types of thinners to use.

When thinning is allowed, thin paints immediately prior to application with not more than one pint of suitable thinner per gallon. The use of thinner does not relieve the Contractor from obtaining complete hiding, full film thickness, or required gloss. Thinning cannot cause the paint to exceed limits on volatile organic compounds. Do not mix paints of different manufacturers.

### 3.6.3 Two-Component Systems

Mix two-component systems in accordance with manufacturer's instructions. Follow recommendation by the manufacturer for any thinning of the first coat to ensure proper penetration and sealing for each type of substrate.

### 3.6.4 Coating Systems

- a. Systems by Substrates: Apply coatings that conform to the respective specifications listed in the following Tables:

Table for Exterior Applications	
MPI Division	Substrate Application
MPI Division 3	Exterior Concrete Paint Table
MPI Division 4	Exterior Concrete Masonry Units Paint Table
MPI Division 5	Exterior Metal, Ferrous and Non-Ferrous Paint Table
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

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Table for Interior Applications	
MPI Division 9	Interior Plaster, Gypsum Board, Textured Surfaces Paint Table

- b. Minimum Dry Film Thickness (DFT): Apply paints, primers, varnishes, enamels, undercoats, and other coatings to a minimum dry film thickness of 1.5 mil each coat unless specified otherwise in the Tables. Coating thickness, where specified, refers to the minimum dry film thickness.
- c. Coatings for Surfaces Not Specified Otherwise: Coat unspecified surfaces the same as surfaces having similar conditions of exposure.
- d. Existing Surfaces Damaged During Performance of the Work, Including New Patches In Existing Surfaces: Coat surfaces with the following:
  - (1) One coat of primer.
  - (2) One coat of undercoat or intermediate coat.
  - (3) One topcoat to match adjacent surfaces.
- e. Existing Coated Surfaces To Be Painted: Apply coatings conforming to the respective specifications listed in the Tables herein, except that pretreatments, sealers and fillers need not be provided on surfaces where existing coatings are soundly adhered and in good condition. Do not omit undercoats or primers.

### 3.7 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.

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### 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 ASME A13.1. Place stenciling in clearly visible locations. On piping not covered by ASME A13.1, 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" E3 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>.

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### 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 and uncoated existing 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
Primer as recommended by manufacturer. Topcoat: Coating to match adjacent surfaces. Surface preparation and number of coats in accordance with manufacturer's instructions. NOTE: Apply sufficient coats to achieve a minimum dry film thickness of 16 mils.					

#### 3.13.1.2 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-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

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Alkyd					
New	Existing, uncoated	Primer	Intermediate	Topcoat	System DFT
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
Topcoat: Coating to match adjacent surfaces.					

## B. Exterior Galvanized Surfaces

(1) New Galvanized surfaces

Epoxy Primer / Waterborne Light Industrial Coating				
New Galvanized Surfaces	Primer	Intermediate	Topcoat	System DFT
MPI EXT 5.3K-G6 (Gloss)	MPI 101	MPI 164	MPI 164	5 mils
Topcoat: Coating to match adjacent surfaces.				

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Pigmented Polyurethane				
New Galvanized Surfaces	Primer	Intermediate	Topcoat	System DFT
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-G6 (Gloss)	MPI 95	MPI 9	MPI 9	5 mils
Topcoat: Coating to match adjacent surfaces.				

(2) Surfaces adjacent to painted surfaces; Mechanical, Electrical, Fire extinguishing sprinkler systems including valves, conduit, hangers, supports, exposed copper piping, and miscellaneous metal items not otherwise specified except floors, hot metal surfaces, and new prefinished equipment

Alkyd				
New	Primer	Intermediate	Topcoat	System DFT
MPI EXT 5.1D-G1 (Flat)	MPI 79	MPI 8	MPI 8	5.25 mils

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Topcoat: Coating to match adjacent surfaces.
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#### D. Exterior Hot Surfaces

(1) Hot metal surfaces subject to temperatures up to 400 degrees F

(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.				

(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.					

#### 3.13.2 Interior Paint Tables

Primer and paint products used on the interior of the building (defined as inside of the weatherproofing system) must meet both emissions requirements of CDPH SECTION 01350 (limit requirements for either office or classroom spaces regardless of space type) and VOC content requirements of SCAQMD Rule 1113. Provide validation of indoor air quality for primers and paints

##### 3.13.2.1 MPI Division 3: Interior Concrete Paint Table

A. New and uncoated existing Concrete, vertical surfaces, not specified otherwise



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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.					

### 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					

### 3.13.2.3 MPI Division 5: Interior Metal, Ferrous and Non-Ferrous Paint Table

#### A. Interior Steel / Ferrous Surfaces

(1) Metal, Mechanical, Electrical, Fire extinguishing sprinkler systems including valves, conduit, hangers, supports, Surfaces adjacent to painted surfaces (Match surrounding finish), exposed copper piping, and miscellaneous metal items not otherwise specified except floors, hot metal surfaces, and new prefinished equipment

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High Performance Architectural Latex				
New, uncoated Existing	Primer	Intermediate	Topcoat	System DFT
MPI INT 5.1R-G5 (Semigloss)	MPI 76	MPI 141	MPI 141	5 mils
Topcoat: Coating to match adjacent surfaces.				

(2) 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-G5 (Semigloss)	MPI 95	MPI 141	MPI 141	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

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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 INT 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 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

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MPI INT 6.3V-G5 (Semigloss)	MPI 39	MPI 147	MPI 147	4 mils

B. Interior New Wood Doors; Natural Finish or Stained

Stained, oil-modified polyurethane						
New	Existing, previously finished or stained	Stain	Primer	Intermediate	Topcoat	System DFT
MPI INT 6.3E-G4	MPI RIN 6.3E-G4	MPI 90	MPI 57	MPI 57	MPI 57	4 mils
MPI INT 6.5B-G6 (Gloss)	MPI RIN 6.5B-G6 (Gloss)	MPI 90	MPI 56	MPI 56	MPI 56	4 mils
Note: Sand between all coats per manufacturers recommendations.						

3.13.2.5 MPI Division 9: Interior Plaster, 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-G2 (Flat)	MPI 149	MPI 144	MPI 144	4 mils
MPI INT 9.2M-G3 (Eggshell)	MPI 149	MPI 145	MPI 145	4 mils
MPI INT 9.2M-G4 (Satin)	MPI 149	MPI 146	MPI 146	4 mils
MPI INT 9.2M-G5 (Semigloss)	MPI 149	MPI 147	MPI 147	4 mils

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Topcoat: Coating to match adjacent surfaces.
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B. Interior New Wallboard in toilets, restrooms, shower areas, areas requiring a high degree of sanitation, and other high humidity areas not otherwise specified

Waterborne Light Industrial Coating					
New, uncoated Existing	Existing, previously painted	Primer	Intermediate	Topcoat	System DFT
MPI INT 9.2L-G5(Semigloss)	MPI RIN 9.2L-G5 (Semigloss)	MPI 50	MPI 153	MPI 153	4 mils
Topcoat: Coating to match adjacent surfaces.					

-- End of Section --

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## 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.

##### ASTM INTERNATIONAL (ASTM)

ASTM D6866	(2022) Standard Test Methods for Determining the Biobased Content of Solid, Liquid, and Gaseous Samples Using Radiocarbon Analysis
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ASTM F148	(2013) Binder Durability of Cork Composition Gasket Materials
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##### 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
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##### SCIENTIFIC CERTIFICATION SYSTEMS (SCS)

SCS	SCS Global Services (SCS) Indoor Advantage
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##### U.S. GREEN BUILDING COUNCIL (USGBC)

LEED v4 BDC Ref Guide	(2013; R 2020) USGBC LEED Reference Guide for Building Design and Construction, v4
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LEED v4.1 BDC Ref Guide	(2023) LEED v4.1 Building Design and Construction Reference Guide
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##### UNDERWRITERS LABORATORIES (UL)

UL 2818	(2013) GREENGUARD Certification Program For Chemical Emissions For Building Materials, Finishes And Furnishings
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##### 1.2 DEFINITIONS

The term visual display unit when used herein includes presentation boards, markerboards, tackboards and 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.

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### 1.3 SUSTAINABILITY REPORTING

Work of this section is intended to contribute to the achievement of, or compliance with, the requirements of the Guiding Principles Validation and LEED Prerequisites and attempted Credits. Refer to Section 01 33 29.00 06 SUSTAINABILITY REPORTING for specific documentation requirements and list of Prerequisites, attempted Credits and LEED version.

Comply with product, material content, performance criteria, activity, documentation, and other technical requirements as described in the LEED v4 BDC Ref Guide or LEED v4.1 BDC Ref Guide as applicable.

Collect, organize, and submit product data, drawings, diagrams, photos and cost information necessary to demonstrate compliance with LEED v4 BDC Ref Guide or LEED v4.1 BDC Ref Guide requirements as applicable.

Data collection shall commence with the notice to proceed and will only be deemed complete upon acceptance of the Final Sustainability Notebook and LEED Online submission by the Contracting Officer, the LEED Project Administrator, and the Green Building Certification Institute.

### 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

Placement Schedule; G, AE

#### SD-03 Product Data

Visual Display Unit; G, AE

Environmental Product Declarations; S

Embodied Carbon Optimization Report/Action Plan; S

Extended Producer Responsibility; S

Bio-Based Materials; S

Recycled Content Materials; S

Local/Regional Materials; S

Material Ingredient Reporting; S

#### SD-04 Samples

Porcelain Enamel; G

Cork; G

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#### SD-07 Certificates

Indoor air quality for markerboards; S

Indoor air quality for tackboards; 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

### 1.5 SUSTAINABLE DESIGN REQUIREMENTS

#### 1.5.1 Environmental Product Declarations

At a minimum, use materials or products with an Environmental Product Declaration in accordance with the LEED Implementation Plan. See Section 01 33 29.00 06 SUSTAINABILITY REPORTING for cumulative materials requirements and LEED Implementation Plan.

#### 1.5.2 Embodied Carbon Optimization Report/Action Plan

At a minimum, use materials or products with an Embodied Carbon Optimization Report/Action Plan in accordance with the LEED Implementation Plan. See Section 01 33 29.00 06 SUSTAINABILITY REPORTING for cumulative materials requirements and LEED Implementation Plan.

#### 1.5.3 Sourcing of Raw Materials

Provide products that meet one or more of the following categories:

##### 1.5.3.1 Extended Producer Responsibility

At a minimum, use materials or products from manufacturers that participate in an extended producer responsibility program in accordance with the LEED Implementation Plan. Provide manufacturer letter verifying extended producer responsibility program is in place and that product is eligible. See Section 01 33 29.00 06 SUSTAINABILITY REPORTING for cumulative materials requirements and LEED Implementation Plan.

##### 1.5.3.2 Bio-Based Materials

At a minimum, use materials or products with bio-based content in accordance with the LEED Implementation Plan. Provide manufacturer signed letter confirming ASTM D6866 test method was conducted validating bio-based material weight within product, type of bio-based material used within product, and confirmation raw material was legally harvested. See Section 01 33 29.00 06 SUSTAINABILITY REPORTING for cumulative materials requirements and LEED Implementation Plan. If bio-based content minimum is specified in this section, the greater of the two percentages governs.



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#### 1.5.3.3 Recycled Content Materials

At a minimum, use materials or products with recycled content in accordance with the LEED Implementation Plan. Provide manufacturers product literature identifying the percentage of recycled material incorporated within each product used. See Section 01 33 29.00 06 SUSTAINABILITY REPORTING for cumulative materials requirements and LEED Implementation Plan. If recycled content minimum is specified in this section, the greater of the two percentages governs.

#### 1.5.4 Material Ingredient Reporting

At a minimum, use materials or products with chemical inventory to at least 0.1% (1000 ppm) in accordance with the LEED Implementation Plan. Provide Health Product Declaration (HPD), Cradle to Cradle Certificate, Declare label, or other manufacturer's published content inventory in compliance with LEED v4.1 Material Ingredient Reporting credit. See Section 01 33 29.00 06 SUSTAINABILITY REPORTING for cumulative materials requirements and LEED Implementation Plan.

#### 1.5.5 Local/Regional Materials

Use materials or products extracted, harvested, or recovered, as well as manufactured, within a 100 mile radius from the project site, if available from a minimum of three sources. provide a letter from the manufacturer stating the extraction location, manufacturing location, and purchasing location of the products provided, referencing the project name and location specifically and distance to the project site. See Section 01 33 29.00 06 SUSTAINABILITY REPORTING for cumulative materials requirements and LEED Implementation Plan.

### 1.6 CERTIFICATIONS

#### 1.6.1 Indoor Air Quality

##### 1.6.1.1 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.

### 1.7 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.

### 1.8 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.

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## 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, and colored cork. 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 Porcelain Enamel

Provide markerboard writing surface composed of porcelain enamel fused to a nominal 28 gauge thick steel, laminated to a minimum 1/4 inch thick core material with a steel or foil backing sheet. Writing surface must be capable of supporting paper by means of magnets. Markerboard surface for display track system may be a powder paint dry erase surface adhered to a nominal 18 gauge thick steel.

#### 2.1.2 Cork

Provide a continuous resilient sheet made from soft, clean, granulated cork relatively free from hardback and dust and bonded with a binder suitable for the purpose intended; wearing surface to be free from streaks, spots, cracks or other imperfections that would impair its usefulness or appearance. Provide seasoned material and a clean cut made not less than 1/2 inch from the edge and must show no evidence of soft sticky binder.

##### 2.1.2.1 Colored Cork

Provide colored cork composed of pure cork and natural color pigments that are combined under heat and pressure with linseed oil. Colored cork must be colored throughout and be washable. The burlap backing must be deeply imbedded and keyed to the work sheet being partially concealed in it and meeting the requirements of ASTM F148.

### 2.2 MARKERBOARD

#### 2.2.1 Porcelain Markerboard

Provide a factory assembled markerboard with a porcelain enamel, magnetic writing surface. Unit 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. Provide aluminum frame with marker rail constructed of the same material as the frame and extending the full length of the markerboard inches long. The markerboard includes a map rail with a tackable insert extending the full length of the markerboard, map hooks and clips for holding sheets of paper. Provide two map hooks for each 4 feet of map rail. Dry erase markings must be removable with a felt eraser or dry cloth without ghosting. Supply each unit with an eraser and four different color compatible dry erase markers. Provide

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magnetic 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 TACKBOARDS

Provide tackboards that meet the emissions requirements of CDPH SECTION 01350 (limit requirements for either office or classroom spaces regardless of space type). Provide certification or validation of indoor air quality for tackboards.

### 2.3.1 Cork

Provide tackboard consisting of a minimum 1/8 inch thick colored cork with burlap backing laminated to a minimum 3/8 inch thick insulation board or fiber board, and an aluminum frame.

## 2.4 COLOR

Provide finish colors for required items as indicated; 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.

## 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 --

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## 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 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 (2020) 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 ELECTRICAL MANUFACTURERS ASSOCIATION (NEMA)

ANSI/NEMA LD 3 (2005) Standard for High-Pressure  
Decorative Laminates

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#### NATIONAL FIRE PROTECTION ASSOCIATION (NFPA)

NFPA 101 (2021) Life Safety Code

#### NATIONAL INSTITUTE OF STANDARDS AND TECHNOLOGY (NIST)

NIST SP 800-82 (2015; Rev 2) Guide to Industrial Control  
 Systems (ICS) Security

#### U.S. DEPARTMENT OF DEFENSE (DOD)

DOD 8510.01 (2020; Change 1-2020) Risk Management  
 Framework (RMF) for DoD Information  
 Technology (IT)

DODI 8500.01 (2014) Cybersecurity

UFC 4-010-06 (2016; with Change 1, 2017) Cybersecurity  
 of Facility-Related Control Systems

#### U.S. GREEN BUILDING COUNCIL (USGBC)

LEED v4 BDC Ref Guide (2013; R 2020) USGBC LEED Reference Guide  
 for Building Design and Construction, v4

LEED v4.1 BDC Ref Guide (2023) LEED v4.1 Building Design and  
 Construction Reference Guide

#### 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

Work of this section is intended to contribute to the achievement of, or compliance with, the requirements of the Guiding Principles Validation and LEED Prerequisites and attempted Credits. Refer to Section 01 33 29.00 06 SUSTAINABILITY REPORTING for specific documentation requirements and list of Prerequisites, attempted Credits and LEED version.

Comply with product, material content, performance criteria, activity, documentation, and other technical requirements as described in the LEED v4 BDC Ref Guide or LEED v4.1 BDC Ref Guide as applicable.

Collect, organize, and submit product data, drawings, diagrams, photos and cost information necessary to demonstrate compliance with LEED v4 BDC Ref Guide or LEED v4.1 BDC Ref Guide requirements as applicable.

Data collection shall commence with the notice to proceed and will only be deemed complete upon acceptance of the Final Sustainability Notebook and LEED Online submission by the Contracting Officer, the LEED Project Administrator, and the Green Building Certification Institute.

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### 1.3 SUBMITTALS

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

Environmental Product Declarations; S

Embodied Carbon Optimization Report/Action Plan; S

Extended Producer Responsibility; S

Recycled Content Materials; S

Local/Regional Materials; S

Material Ingredient Reporting; S

#### 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

### 1.4 SUSTAINABLE DESIGN REQUIREMENTS

#### 1.4.1 Environmental Product Declarations

At a minimum, use materials or products with an Environmental Product Declaration in accordance with the LEED Implementation Plan. See Section 01 33 29.00 06 SUSTAINABILITY REPORTING for cumulative materials requirements and LEED Implementation Plan.

#### 1.4.2 Embodied Carbon Optimization Report/Action Plan

At a minimum, use materials or products with an Embodied Carbon

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Optimization Report/Action Plan in accordance with the LEED Implementation Plan. See Section 01 33 29.00 06 SUSTAINABILITY REPORTING for cumulative materials requirements and LEED Implementation Plan.

#### 1.4.3 Sourcing of Raw Materials

Provide products that meet one or more of the following categories:

##### 1.4.3.1 Extended Producer Responsibility

At a minimum, use materials or products from manufacturers that participate in an extended producer responsibility program in accordance with the LEED Implementation Plan. Provide manufacturer letter verifying extended producer responsibility program is in place and that product is eligible. See Section 01 33 29.00 06 SUSTAINABILITY REPORTING for cumulative materials requirements and LEED Implementation Plan.

##### 1.4.3.2 Recycled Content Materials

At a minimum, use materials or products with recycled content in accordance with the LEED Implementation Plan. Provide manufacturers product literature identifying the percentage of recycled material incorporated within each product used. See Section 01 33 29.00 06 SUSTAINABILITY REPORTING for cumulative materials requirements and LEED Implementation Plan. If recycled content minimum is specified in this section, the greater of the two percentages governs.

##### 1.4.4 Material Ingredient Reporting

At a minimum, use materials or products with chemical inventory to at least 0.1% (1000 ppm) in accordance with the LEED Implementation Plan. Provide Health Product Declaration (HPD), Cradle to Cradle Certificate, Declare label, or other manufacturer's published content inventory in compliance with LEED v4.1 Material Ingredient Reporting credit. See Section 01 33 29.00 06 SUSTAINABILITY REPORTING for cumulative materials requirements and LEED Implementation Plan.

##### 1.4.5 Local/Regional Materials

Use materials or products extracted, harvested, or recovered, as well as manufactured, within a 100 mile radius from the project site, if available from a minimum of three sources. provide a letter from the manufacturer stating the extraction location, manufacturing location, and purchasing location of the products provided, referencing the project name and location specifically and distance to the project site. See Section 01 33 29.00 06 SUSTAINABILITY REPORTING for cumulative materials requirements and LEED Implementation Plan.

#### 1.5 EXTRA MATERIALS

Provide 5 extra frames for each size of frame and extra stock of the following: 5 blank plates of each color and size for all sign types included in project. Provide 5 paper inserts and one copy of the software for user produced signs and inserts after project completion and equipment necessary for removal of signage parts and pieces.

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## 1.6 QUALITY ASSURANCE

### 1.6.1 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.

### 1.6.2 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.

### 1.6.3 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.

### 1.6.4 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.

## 1.7 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.

## 1.8 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.



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## PART 2 PRODUCTS

### 2.1 ROOM IDENTIFICATION AND DIRECTIONAL SIGNAGE SYSTEM

Provide signs, plaques, directories, and dimensional building letters that are standard products of manufacturers regularly engaged in the manufacture of such products that essentially duplicate signs that have been in satisfactory use at least 2 years prior to bid opening. Obtain signage from a single manufacturer with edges and corners of finished letter forms and graphics true and clean.

#### 2.1.1 Modular Sign Systems

Provide manufactured pre-engineered component-based sign system, consisting of a combination of aluminum extrusions and injection molded parts, pre-engineered and designed to create an updatable sign system that allows for easy and inexpensive updates and changes. Provide 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 extruded aluminum for applied graphics. Provide continuous removable endcaps in square 1/8 inch thick profile. Sign inserts are required to be side loading.

#### 2.1.2 Standard Room Signs

Provide signs that include tactile letters, symbols and Braille for interior rooms or spaces where the sign is not likely to change over time. Tactile text descriptions are required for pictograms that are provided to identify a permanent room. Examples include interior signs that label restrooms, stairs, room numbers or letters, and room names. These permanent room signs can include paper inserts for updatable information.

##### 2.1.2.1 Tactile Letters, Symbols and Braille

Provide ADA compliant material per 36 CFR 1191 which is raised 1/32 inch from the first surface, has a minimum 5/8 inch in height and is an ADA acceptable font. The color of the tactile letters is required to contrast with the sign face color per ADA standards. The ADA required Braille has a minimum durometer reading of 90. All raised letters, numbers and symbols are to comply.

#### 2.1.3 Message Inserts

Provide updatable message inserts covered with a clear matte 0.015 inch vinyl protective overlay. The insert is typeset message laser printed on paper card stock. Provide paper and software with message template for creating text and symbols for computers identified for Government production of paper inserts after project completion. Manufacturer is required to offer online ordering capabilities to facilitate and expedite ordering packages of replacement, color-coated paper inserts. Furnish one suction device to assist in removing face sheet. Provide sliding inserts that slide horizontally exposing different graphic information as identified on the drawings.

#### 2.1.4 Type of Mounting for Signs

Provide surface mounted signs mounted with concealed mechanical fastening

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through the holders . Secure inserts in holders when captured by side profiles of extruded aluminum holders. Mount framed plaques with manufacturer's standard (1/6 inch) 1.59 mm thick closed cell vinyl foam with adhesive backing. Adhesive must be transparent, long aging, high tech formulation on two sides of the vinyl foam. 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.

#### 2.1.5 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 MATERIALS

##### 2.3.1 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.

##### 2.3.2 Anodic Coating

Anodized finish conforms to AA DAF45 as follows:

- a. Electrolytically deposited color-anodized designation AA-M10-C22-A34, Architectural Class II 0.4 to 0.7 mil.

##### 2.3.3 Organic Coating

Organic coating conforms to AAMA 2604, with total dry film thickness not less than 1.2 mils.

##### 2.3.4 Plastic Laminate Sheet

ANSI/NEMA LD 3, general purpose HGS grade, 0.048 inch nominal thickness.

##### 2.3.5 Fabrication and Manufacture

###### 2.3.5.1 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

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practicable.

#### 2.3.5.2 Dissimilar Materials

Where dissimilar metals are in contact, protect surfaces prevent galvanic or corrosive action.

#### 2.3.6 Typeface

ADA-ABA compliant font for Room Signs Helvetica Regular.

### 2.4 GRAPHICS

Provide signage graphics for modular signs to the following:

#### 2.4.1 Subsurface Copy

Copy is transferred to the back face of clear acrylic sheeting forming the panel face to produce precisely formed opaque image. This method bonds all sign elements (color, graphics, lettering, Braille and substrate) into a single unit.

#### 2.4.2 First Surface Copy Direct Print (Non-Tactile)

Message may be applied to panel using a direct print process. Original art is defined as artwork that is a first generation reproduction of the specified art. Provide clean edges and corners.

#### 2.4.3 Photopolymer

Integral graphics and Braille achieved by photomechanical stratification processes. Provide photopolymer used for ADA compliant graphics of the type that has a minimum durometer reading of 90. Tactile graphics are raised 1/32 inch from the first surface of plaque by photomechanical stratification process.

#### 2.4.4 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.

#### 2.4.5 Graphic Blast Raised Copy

Background is sandblasted to a uniform depth of 1/32 inch leaving raised text and Braille. Background is factory-finished with polyurethane paint.

### 2.5 COLOR, FINISH, AND CONTRAST

Provide color as indicated; colors listed are not intended to limit the selection of equal colors from other manufacturers. Finish of eggshell, matte, or other non-glare finish for all signs as required in handicapped-accessible buildings.

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## PART 3 EXECUTION

### 3.1 INSTALLATION

Install signs plumb and true and in accordance with approved manufacturer's instructions at locations shown on the detail drawings. Submit operating instructions outlining the step-by-step procedures required for system operation. The instructions include simplified diagrams for the system as installed, the manufacturer's name, model number, service manual, parts list, and brief description of all equipment and their basic operating features. Provide each set permanently bound with a hard cover. The following identification must be inscribed on the covers: "OPERATING AND MAINTENANCE INSTRUCTIONS", name and location of the facility, name of the Contractor, and contract number. Submit in accordance with Section 01 78 23 OPERATING AND MAINTENANCE DATA. Mounting height and mounting location complies with 36 CFR 1191. Install required blocking. Do not install signs on doors or other surfaces until finishes on such surfaces have been installed. Signs installed on glass surfaces are installed with a laminate back panel to match the sign background color.

Do not install items that show visual evidence of biological growth.

#### 3.1.1 Anchorage

Provide anchorage in accordance with approved manufacturer's instructions. Anchorage not otherwise specified or shown includes slotted inserts, expansion shields, and powder-driven fasteners when approved for concrete; toggle bolts and through bolts for masonry; machine carriage bolts for steel; lag bolts and screws for wood. Provide exposed anchor and fastener materials compatible with metal to which applied with matching color and finish.

- a. Signs mounted to painted gypsum board surfaces must be removable for painting maintenance.
- b. Mount signs to lay-in ceiling grids with clip connections to ceiling tees.
- c. Install signs mounted on metal surfaces with magnetic tape.
- d. Install signs mounted on fabric surfaces with hook and loop tape or pin mount.
- e. Install signs to workstation panels with panel clips.

#### 3.1.2 Protection and Cleaning

Protect the work against damage during construction. Adjust hardware and electrical equipment for proper operation. Clean glass, frames, and other sign surfaces at completion of signage installation in accordance with the manufacturer's written instructions.

-- End of Section --

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## SECTION 10 21 13

TOILET COMPARTMENTS  
08/20

## PART 1 GENERAL

## 1.1 REFERENCES

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

## ALUMINUM ASSOCIATION (AA)

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

## ASTM INTERNATIONAL (ASTM)

ASTM A123/A123M (2017) Standard Specification for Zinc  
(Hot-Dip Galvanized) Coatings on Iron and  
Steel Products

ASTM 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 (2020) Standard Practice for Providing  
High-Quality Zinc Coatings (Hot-Dip)

ASTM A666 (2015) Standard Specification for Annealed  
or Cold-Worked Austenitic Stainless Steel  
Sheet, Strip, Plate and Flat Bar

ASTM B36/B36M (2018) Standard Specification for Brass  
Plate, Sheet, Strip, and Rolled Bar

ASTM B86 (2018; E 2021) Standard Specification for  
Zinc and Zinc-Aluminum (ZA) Alloy Foundry  
and Die Castings

ASTM B221 (2020) Standard Specification for Aluminum  
and Aluminum-Alloy Extruded Bars, Rods,  
Wire, Profiles, and Tubes

ASTM B456 (2017) Standard Specification for  
Electrodeposited Coatings of Copper Plus  
Nickel Plus Chromium and Nickel Plus  
Chromium

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#### 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 (2013; Rev A) Plating, Chromium

#### U.S. GENERAL SERVICES ADMINISTRATION (GSA)

CID A-A-60003 (Basic) Partitions, Toilet, Complete

#### U.S. GREEN BUILDING COUNCIL (USGBC)

LEED v4 BDC Ref Guide (2013; R 2020) USGBC LEED Reference Guide  
 for Building Design and Construction, v4

LEED v4.1 BDC Ref Guide (2023) LEED v4.1 Building Design and  
 Construction Reference Guide

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

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

#### UNDERWRITERS LABORATORIES (UL)

UL 2818 (2013) GREENGUARD Certification Program  
 For Chemical Emissions For Building  
 Materials, Finishes And Furnishings

### 1.2 SUSTAINABILITY REPORTING

Work of this section is intended to contribute to the achievement of, or compliance with, the requirements of the Guiding Principles Validation and LEED Prerequisites and attempted Credits. Refer to Section 01 33 29.00 06 SUSTAINABILITY REPORTING for specific documentation requirements and list of Prerequisites, attempted Credits and LEED version.

Comply with product, material content, performance criteria, activity, documentation, and other technical requirements as described in the LEED v4 BDC Ref Guide or LEED v4.1 BDC Ref Guide as applicable.

Collect, organize, and submit product data, drawings, diagrams, photos and cost information necessary to demonstrate compliance with LEED v4 BDC Ref Guide or LEED v4.1 BDC Ref Guide requirements as applicable.

Data collection shall commence with the notice to proceed and will only be deemed complete upon acceptance of the Final Sustainability Notebook and LEED Online submission by the Contracting Officer, the LEED Project Administrator, and the Green Building Certification Institute.

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### 1.3 SUBMITTALS

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

Sound-Deadening Cores

Anchoring Devices and Fasteners

Hardware and Fittings

Brackets

Door Hardware

Toilet Enclosures

Pilaster Shoes

Finishes; G, AE

Recycled content for stainless steel partitions and screens; S

Environmental Product Declarations; S

Embodied Carbon Optimization Report/Action Plan; S

Extended Producer Responsibility; S

Local/Regional Materials; S

Material Ingredient Reporting; S

#### SD-04 Samples

Hardware and Fittings

Anchoring Devices and Fasteners

#### SD-07 Certificates

Warranty

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#### 1.4 SUSTAINABLE DESIGN REQUIREMENTS

##### 1.4.1 Environmental Product Declarations

At a minimum, use materials or products with an Environmental Product Declaration in accordance with the LEED Implementation Plan. See Section 01 33 29.00 06 SUSTAINABILITY REPORTING for cumulative materials requirements and LEED Implementation Plan.

##### 1.4.2 Embodied Carbon Optimization Report/Action Plan

At a minimum, use materials or products with an Embodied Carbon Optimization Report/Action Plan in accordance with the LEED Implementation Plan. See Section 01 33 29.00 06 SUSTAINABILITY REPORTING for cumulative materials requirements and LEED Implementation Plan.

##### 1.4.3 Sourcing of Raw Materials

Provide products that meet one or more of the following categories:

###### 1.4.3.1 Extended Producer Responsibility

At a minimum, use materials or products from manufacturers that participate in an extended producer responsibility program in accordance with the LEED Implementation Plan. Provide manufacturer letter verifying extended producer responsibility program is in place and that product is eligible. See Section 01 33 29.00 06 SUSTAINABILITY REPORTING for cumulative materials requirements and LEED Implementation Plan.

###### 1.4.3.2 Recycled Content Materials

At a minimum, use materials or products with recycled content in accordance with the LEED Implementation Plan. Provide manufacturers product literature identifying the percentage of recycled material incorporated within each product used. See Section 01 33 29.00 06 SUSTAINABILITY REPORTING for cumulative materials requirements and LEED Implementation Plan. If recycled content minimum is specified in this section, the greater of the two percentages governs.

###### 1.4.4 Material Ingredient Reporting

At a minimum, use materials or products with chemical inventory to at least 0.1% (1000 ppm) in accordance with the LEED Implementation Plan. Provide Health Product Declaration (HPD), Cradle to Cradle Certificate, Declare label, or other manufacturer's published content inventory in compliance with LEED v4.1 Material Ingredient Reporting credit. See Section 01 33 29.00 06 SUSTAINABILITY REPORTING for cumulative materials requirements and LEED Implementation Plan.

###### 1.4.5 Local/Regional Materials

Use materials or products extracted, harvested, or recovered, as well as manufactured, within a 100 mile radius from the project site, if available from a minimum of three sources. provide a letter from the manufacturer stating the extraction location, manufacturing location, and purchasing location of the products provided, referencing the project name and location specifically and distance to the project site. See Section 01 33 29.00 06 SUSTAINABILITY REPORTING for cumulative materials requirements and LEED Implementation Plan.



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## 1.5 CERTIFICATIONS

### 1.5.1 Indoor Air Quality

#### 1.5.1.1 Laminated Plastic and 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.

## 1.6 REGULATORY REQUIREMENTS

Comply with to ICC A117.1 code for access for the handicapped operation of toilet compartment door and hardware.

## 1.7 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.

## 1.8 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, room entrance screens, urinal screens, system of panels, hardware, and support components. Furnish the partition system from a single manufacturer, with a standard product as shown in the most recent catalog data. Submit Fabrication Drawings for toilet partitions and urinal screens consisting of fabrication and assembly details to be performed in the factory. Submit manufacturer's Cleaning and Maintenance Instructions in accordance with Section 01 78 23 OPERATIONS AND MAINTENANCE DATA.

### 2.2 MATERIALS

#### 2.2.1 Stainless Steel Sheet (Finish 2)

Provide stainless steel sheet conforming to ASTM A666, 300 series commercial stainless steel sheet suitable for exposed applications with a Flame Spread Index of 0 and a Smoke Developed Index of 0. Provide smooth material, without creases or ripples. Provide face sheet of minimum of 0.048 inch ((18 gauge) thickness. Provide with No. 4 finish .

#### 2.2.2 Sound-Deadening Cores

Provide sound deadening consisting of treated kraft paper honeycomb cores

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with a cell size of not more than 1 inch. Provide resin-material content weighing not less than 11 percent of the finished core weight. Face expanded cores on both sides with kraft paper.

### 2.2.2.3 Anchoring Devices and Fasteners

Provide steel anchoring devices and fasteners hot-dipped galvanized after fabrication, in conformance with ASTM A385/A385M and ASTM A123/A123M. Conceal all galvanized anchoring devices.

### 2.2.2.4 Brackets

Provide two-ear panel wall brackets, T-style, 1 inch stock. Provide stirrup style panel-to-pilaster brackets.

### 2.2.2.5 Hardware and Fittings

#### 2.2.2.5.1 General Requirements

Provide hardware for the toilet partition system that complies with CID A-A-60003 for the specified type and style of partitions. Provide hardware finish highly resistant to alkalis, urine, and other common toilet room acids. Comply with 36 CFR 1191 of latching devices and hinges for handicap compartments; provide 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 302

#### 2.2.2.5.2 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.

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## 2.2.6 Door Hardware

### 2.2.6.1 Hinges

Provide hinges that are cutout-insert type and have the following type of return movement:

- a. Gravity return movement

### 2.2.6.2 Latch and Pull

Provide latch and pull that is a combination rubber-faced door strike and keeper equipped with emergency access. Provide concealed latch.

### 2.2.6.3 Coat Hooks

Provide coat hooks that are combination units with hooks and rubber tipped pins.

## 2.3 PARTITION PANELS AND DOORS

Fabricate partition panels, and pilasters of materials and construction listed:

Provide stainless steel partition panels and doors in finished thickness of no less than 1 inch and pilasters no less than 1-1/4 inches, both with face sheets no less than 0.038 inch.

Provide stainless steel toilet partitions and screens with recycled content of 50 percent minimum. Provide data identifying percentage of recycled content for stainless steel partitions and screens.

### 2.3.1 Toilet Enclosures

Provide toilet enclosures that comply with CID A-A-60003, Type I, Style C, overhead braced. Furnish width, length, and height of toilet enclosures as shown. Finish surface of panels are stainless steel (Finish 2); water resistant; graffiti resistant; non-absorbent radius beveled edges. Reinforce panels indicated to receive toilet paper holders or grab bars for mounting of the items required, and provide cut outs for through partition toilet accessories. Provide grab bars to withstand a bending stress, shear stress, shear force, and a tensile force induced by 250 lbf. Grab bars cannot rotate within their fittings.

## 2.4 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.

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## 2.5 PILASTER SHOES

Provide shoes at pilasters to conceal floor-mounted anchorage. Provide stainless steel pilaster shoes. Height is a minimum 3 inches.

## 2.6 HARDWARE

Provide hardware for the toilet partition system that complies with CID A-A-60003 for the specified type and style of partitions. Provide hardware pre-drilled by manufacturer. Use a hardware finish that is highly resistant to alkalis, urine, and other common toilet room acids. Hardware includes: chrome plated nonferrous cast pivot hinges, gravity type, adjustable for door close positioning; nylon bearings; 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 chrome-plated steel or 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.

# 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 stainless-steel face sheets with formed edges. Laminate face sheets via pressure to the sound-deadening core with edges sealed with a continuous locking strip and corners mitered and welded. Ground all welds smooth. Provide concealed reinforcement for installation of hardware, fittings, and accessories. Surface of face sheets must be, free from wave, warp, or buckle.

## 3.3 INSTALLATION

Do not install items that show visual evidence of biological growth. Install partitions rigid, straight, plumb, and level, with the panels centered between the fixtures. Provide a panel clearance of not more than 1/2 inch and secure the panels to walls and pilasters with continuous full height wall brackets. Locate wall brackets so that holes for wall bolts occur in masonry or tile joints. Secure panels to pilasters with brackets matching the wall brackets. Provide for adjustment due to minor floor variations. Locate head rail joints at pilaster center lines. Install adjacent components for consistency of line and plane. Equip each door

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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, room entrance screens, and urinal screens showing plans, elevations, details of construction, hardware, reinforcing and blocking, fittings, mountings and escutcheons. Indicate on drawings the type of partition, location, mounting height, cutouts, and reinforcement required for toilet-room accessories.

#### 3.4 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.

#### 3.5 FINAL ADJUSTMENT

After completion of the installation, make final adjustments to the pilaster-leveling devices, door hardware, and other working parts of the partition assembly. Doors have a uniform vertical edge clearance of approximately 3/16 inch and rest open at approximately 30 degrees when unlatched.

#### 3.6 CLEANING

Clean all surfaces and adjacent surfaces soiled as a result of the work, in an approved manner compliant with the manufacturer's recommended cleaning and protection from damage procedures until accepted. Remove all equipment, tools, surplus materials, and work debris from the site.

-- End of Section --

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## SECTION 10 23 10

## GLAZED INTERIOR WALL AND DOOR ASSEMBLIES

**06/24**

## PART 1 GENERAL

## 1.1 SECTION INCLUDES

Framed double-glazed interior wall and door assemblies.

## 1.2 RELATED REQUIREMENTS

Section 08 71 00 DOOR HARDWARE.

## 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 611 (2014) Voluntary Specification for  
 Anodized Architectural Aluminum

## ASTM INTERNATIONAL (ASTM)

ASTM B221 (2021) Standard Specification for Aluminum  
 and Aluminum-Alloy Extruded Bars, Rods,  
 Wire, Profiles, and Tubes

ASTM C920 (2018) Standard Specification for  
 Elastomeric Joint Sealants

ASTM C1036 (2021) Standard Specification for Flat  
 Glass

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

## U.S. GREEN BUILDING COUNCIL (USGBC)

LEED v4 BDC Ref Guide (2013; R 2020) USGBC LEED Reference Guide  
 for Building Design and Construction, v4

LEED v4.1 BDC Ref Guide (2023) LEED v4.1 Building Design and  
 Construction Reference Guide

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#### 1.4 ADMINISTRATIVE REQUIREMENTS

##### 1.4.1 Pre-Installation Meeting

Convene at project site seven calendar days prior to scheduled beginning of construction activities of this section to review section requirements.

- a. Require attendance by representatives of installer, other entities directly affecting, or affected by, construction activities of this section.
- b. Notify Contracting Officer's Representative four calendar days in advance of scheduled meeting date.

##### 1.4.2 Sustainability Reporting

Work of this section is intended to contribute to the achievement of, or compliance with, the requirements of the Guiding Principles Validation and LEED Prerequisites and attempted Credits. Refer to Section 01 33 29.00 06 SUSTAINABILITY REPORTING for specific documentation requirements and list of Prerequisites, attempted Credits and LEED version.

Comply with product, material content, performance criteria, activity, documentation, and other technical requirements as described in the LEED v4 BDC Ref Guide or LEED v4.1 BDC Ref Guide as applicable.

Collect, organize, and submit product data, drawings, diagrams, photos and cost information necessary to demonstrate compliance with LEED v4 BDC Ref Guide or LEED v4.1 BDC Ref Guide requirements as applicable.

Data collection shall commence with the notice to proceed and will only be deemed complete upon acceptance of the Final Sustainability Notebook and LEED Online submission by the Contracting Officer, the LEED Project Administrator, and the Green Building Certification Institute.

##### 1.4.3 Shop Drawings

Provide shop drawings showing layout, dimensions, identification of components, and interface with adjacent construction.

1. Include field measurements of openings.
2. Include Elevations Showing:
  - a. Locations and identification of manufacturer-supplied door hardware and fittings.
  - b. Locations and sizes of cut-outs and drilled holes for other door hardware.
3. Include Details Showing:
  - a. Requirements for support and bracing of overhead track.
  - b. Installation details.
  - c. Appearance of manufacturer-supplied door hardware and fittings.

##### 1.4.4 Manufacturer's Descriptive Literature

Provide manufacturer's descriptive literature for each component in partition assembly.

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#### 1.4.5 Selection Samples

Provide two sets, representing manufacturer's full range of available metal materials and finishes.

#### 1.4.6 Verification Samples

Provide two samples, minimum size 2 by 3 inches, representing actual material and finish of exposed metal.

#### 1.4.7 Design Data

Provide design calculations, bearing seal and signature of structural engineer licensed to practice in the State in which the Project is located, showing loads at points of attachment to the building structure.

#### 1.4.8 Manufacturer's Installation Instructions

Provide Manufacturer's Installation Instructions. Include complete preparation, installation, and cleaning requirements.

#### 1.4.9 Warranty Documentation

Submit manufacturer warranty and ensure that forms have been completed in Owner's name and registered with manufacturer

### 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

Shop Drawings; G

#### SD-03 Product Data

Manufacturer's Descriptive Literature for each component in partition assembly; G,

Environmental Product Declarations; S

Embodied Carbon Optimization Report/Action Plan; S

Extended Producer Responsibility; S

Local/Regional Materials; S

Material Ingredient Reporting; S

#### SD-04 Samples

Selection Samples; G

Verification Samples; G



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#### SD-05 Design Data

Design Calculations; G

Design calculations, bearing seal and signature of structural engineer licensed to practice in the State in which the Project is located, showing loads at points of attachment to the building structure.

#### SD-07 Certificates

Installer Certificate; G

Contractor to certify that installer of partition assemblies meets specified qualifications.

#### SD-08 Manufacturer's Instructions

Manufacturer's Installation Instructions; G

Include complete preparation, installation, and cleaning requirements.

#### SD-10 Operation and Maintenance Data

Manufacturer-supplied Operating Hardware; G

#### SD-11 Closeout Submittals

Manufacturer Warranty; G

Warranty Documentation: Submit manufacturer warranty and ensure that forms have been completed in Owner's name and registered with manufacturer.

### 1.6 SUSTAINABLE DESIGN REQUIREMENTS

#### 1.6.1 Environmental Product Declarations

At a minimum, use materials or products with an Environmental Product Declaration in accordance with the LEED Implementation Plan. See Section 01 33 29.00 06 SUSTAINABILITY REPORTING for cumulative materials requirements and LEED Implementation Plan.

#### 1.6.2 Embodied Carbon Optimization Report/Action Plan

At a minimum, use materials or products with an Embodied Carbon Optimization Report/Action Plan in accordance with the LEED Implementation Plan. See Section 01 33 29.00 06 SUSTAINABILITY REPORTING for cumulative materials requirements and LEED Implementation Plan.

#### 1.6.3 Sourcing of Raw Materials

Provide products that meet one or more of the following categories:

##### 1.6.3.1 Extended Producer Responsibility

At a minimum, use materials or products from manufacturers that

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participate in an extended producer responsibility program in accordance with the LEED Implementation Plan. Provide manufacturer letter verifying extended producer responsibility program is in place and that product is eligible. See Section 01 33 29.00 06 SUSTAINABILITY REPORTING for cumulative materials requirements and LEED Implementation Plan.

#### 1.6.3.2 Recycled Content Materials

At a minimum, use materials or products with recycled content in accordance with the LEED Implementation Plan. Provide manufacturers product literature identifying the percentage of recycled material incorporated within each product used. See Section 01 33 29.00 06 SUSTAINABILITY REPORTING for cumulative materials requirements and LEED Implementation Plan. If recycled content minimum is specified in this section, the greater of the two percentages governs.

#### 1.6.4 Material Ingredient Reporting

At a minimum, use materials or products with chemical inventory to at least 0.1 percent (1000 ppm) in accordance with the LEED Implementation Plan. Provide Health Product Declaration (HPD), Cradle to Cradle Certificate, Declare label, or other manufacturer's published content inventory in compliance with LEED v4.1 Material Ingredient Reporting credit. See Section 01 33 29.00 06 SUSTAINABILITY REPORTING for cumulative materials requirements and LEED Implementation Plan.

#### 1.6.5 Local/Regional Materials

Use materials or products extracted, harvested, or recovered, as well as manufactured, within a 100 mile radius from the project site, if available from a minimum of three sources. Provide a letter from the manufacturer stating the extraction location, manufacturing location, and purchasing location of the products provided, referencing the project name and location specifically and distance to the project site. See Section 01 33 29.00 06 SUSTAINABILITY REPORTING for cumulative materials requirements and LEED Implementation Plan.

#### 1.6.6 Low-Emitting Materials

Use only glazed interior wall and door products that comply with LEED v4.1 BDC Ref Guide requirements for emissions. Submit certification or validation of compliance with CDPH SECTION 01350 emissions requirements. See Section 01 33 29.00 06 SUSTAINABILITY REPORTING for low-emitting material requirements.

### 1.7 QUALITY CONTROL

#### 1.7.1 Fabricator Qualifications

Minimum three years of experience designing, assembling, and installing partition assemblies similar to those specified in this section.

#### 1.7.2 Installer Certificate

Contractor to certify that installer of partition assemblies meets specified qualifications.

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#### 1.8 DELIVERY, STORAGE, AND HANDLING

Store products in manufacturer's unopened packaging until installation.

#### 1.9 WARRANTY

- a. See Section 01 78 23 OPERATIONS AND MAINTENANCE DATA for additional warranty requirements.
- b. Correct defective Work within a one year period after date of Substantial Completion.
- c. Provide five year manufacturer warranty against excessive degradation of metal finishes. Include provision for replacement of units with excessive fading, chalking, or flaking.

### PART 2 PRODUCTS

#### 2.1 SYSTEM DESCRIPTION

Framed Double-Glazed Interior Wall and Door Assemblies.

##### 2.1.1 Design Requirements

All products from a single manufacturer.

#### 2.2 FRAMED DOUBLE-GLAZED INTERIOR WALL AND DOOR ASSEMBLIES

##### 2.2.1 Framed Double-Glazed Interior Wall Assembly

Factory fabricated assemblies consisting of full-width and height glass panels fastened with low profile sidelite aluminum rail fittings on top and bottom edge of glass wall.

- a. Configuration: As indicated on drawings.
- b. Full Length Top and Bottom Sidelite Rails: 1-1/2 inch deep by width as required for STC rating, with 4-7/8 inch wall end caps.
- c. Sidelite Fittings, Clad Finish: bronze anodized.
- d. Glass Thickness: Double pane with air space, thickness as required for STC rating, tempered.
- e. Designed to withstand normal operation without damage, racking, sagging, or deflection.
- f. Coordinate wall and door assembly preparation and provide hardware as necessary for fully operable installation.
- g. Finished metal surfaces protected with strippable film.
- h. Factory assembled to greatest extent practical; may be disassembled to accommodate shipping constraints.
- i. Sound Transmission Class (STC) rating: 40 minimum.

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### 2.2.2 Pivoting Glass Doors

Full length dry glazed rail fittings.

- a. Door Configuration: As indicated on drawings.
- b. Full Length Top and Bottom Rails: 1-1/2 inch high.
- c. Glass Thickness: 1/2 inch, tempered.
- d. Sidelite Rails: Match door rail sightlines and finish.
- e. Aluminum Finish: bronze anodized.
- f. Door Hardware: Refer to Section 08 71 00 DOOR HARDWARE.
- g. Provide accessories as required for complete installation.

### 2.3 FITTINGS AND HARDWARE

Coordinate with additional requirements as specified in Section 08 7100.

### 2.4 MATERIALS

#### 2.4.1 Glass

Flat glass meeting requirements of ASTM C1036, Type I - Transparent Flat Glass, Class 2 - Tinted, Quality Q3, fully tempered in accordance with ASTM C1048, Kind FT, and as follows:

- a. Thickness: As indicated.
- b. Color: Grey tint; low iron.
- c. Prepare glazing panels for indicated fittings and hardware before tempering.
- d. Polish edges that will be exposed in finished work to bright flat polish.
- e. Temper glass materials horizontally; visible tong marks or tong mark distortions are not permitted.

#### 2.4.2 Aluminum Components

Conforming to ASTM B221/B221M, Alloy 6063, T5 Temper.

#### 2.4.3 Sealant

One-part silicone sealant, conforming to ASTM C920, clear.

### 2.5 FINISHES

#### 2.5.1 Class I Bronze Anodized Finish

AAMA 611 AA-M12C22A41 Bronze anodic coating not less than 0.7 mils thick.

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### PART 3 EXECUTION

#### 3.1 EXAMINATION

- a. Verify that field measurements are as indicated.
- b. Verify floor flatness of 1/8 inch in 10 feet, non-cumulative.
- c. Do not begin installation until supports and adjacent substrates have been properly prepared.
- d. If substrate preparation is the responsibility of another installer, notify Contracting Officer's Representative of unsatisfactory preparation before proceeding.

#### 3.2 PREPARATION

- a. Clean substrates thoroughly prior to installation.
- b. Prepare substrates using the methods recommended by the manufacturer for achieving acceptable result for the substrate under the project conditions.

#### 3.3 INSTALLATION

- a. Install in accordance with glazed interior wall and door assembly manufacturer's instructions.
- b. Fit and align glazed interior wall and door assembly level and plumb.

#### 3.4 ADJUSTING

- a. Adjust glazed interior wall and door assembly to operate smoothly from pivoting positions.
- b. Adjust swing door hardware for smooth operation.

#### 3.5 CLEANING

- a. Clean installed work to like-new condition.
- b. See Section 01 74 19 CONSTRUCTION WASTE MANAGEMENT AND DISPOSAL for additional requirements.

#### 3.6 CLOSEOUT ACTIVITIES

- a. See Section 01 78 23 OPERATIONS AND MAINTENANCE DATA CLOSEOUT SUBMITTALS for closeout submittals.
- b. Demonstrate operation of glazed interior wall and door assembly and identify potential operational problems.
- c. Provide operation and maintenance data for manufacturer-supplied operating hardware.

#### 3.7 PROTECTION

- a. Protect installed products until completion of project.

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- b. Touch-up, repair or replace damaged products before date of Substantial Completion.

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## SECTION 10 26 00

WALL AND DOOR PROTECTION  
 08/20

## PART 1 GENERAL

## 1.1 REFERENCES

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

## ASTM INTERNATIONAL (ASTM)

ASTM B221	(2020) Standard Specification for Aluminum and Aluminum-Alloy Extruded Bars, Rods, Wire, Profiles, and Tubes
ASTM D256	(2010; R 2018) Standard Test Methods for Determining the Izod Pendulum Impact Resistance of Plastics
ASTM D543	(2020) Standard Practices for Evaluating the Resistance of Plastics to Chemical Reagents
ASTM D635	(2018) Standard Test Method for Rate of Burning and/or Extent and Time of Burning of Plastics in a Horizontal Position
ASTM E84	(2020) Standard Test Method for Surface Burning Characteristics of Building Materials
ASTM G21	(2015; R 2021; E 2021) Standard Practice for Determining Resistance of Synthetic Polymeric Materials to Fungi

## CALIFORNIA DEPARTMENT OF PUBLIC HEALTH (CDPH)

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

GS-36	(2013) Adhesives for Commercial Use
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## SCIENTIFIC CERTIFICATION SYSTEMS (SCS)

SCS	SCS Global Services (SCS) Indoor Advantage
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## SOCIETY OF AUTOMOTIVE ENGINEERS INTERNATIONAL (SAE)

SAE J1545	(2005; R 2014) Instrumental Color
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 Detroit Arsenal, MI

Difference Measurement for Exterior  
 Finishes, Textiles and Colored Trim

#### SOUTH COAST AIR QUALITY MANAGEMENT DISTRICT (SCAQMD)

SCAQMD Rule 1168 (2017) Adhesive and Sealant Applications

#### U.S. GREEN BUILDING COUNCIL (USGBC)

LEED v4 BDC Ref Guide (2013; R 2020) USGBC LEED Reference Guide  
 for Building Design and Construction, v4

LEED v4.1 BDC Ref Guide (2023) LEED v4.1 Building Design and  
 Construction Reference Guide

#### UNDERWRITERS LABORATORIES (UL)

UL 2818 (2013) GREENGUARD Certification Program  
 For Chemical Emissions For Building  
 Materials, Finishes And Furnishings

### 1.2 SUSTAINABILITY REPORTING

Work of this section is intended to contribute to the achievement of, or compliance with, the requirements of the Guiding Principles Validation and LEED Prerequisites and attempted Credits. Refer to Section 01 33 29.00 06 SUSTAINABILITY REPORTING for specific documentation requirements and list of Prerequisites, attempted Credits and LEED version.

Comply with product, material content, performance criteria, activity, documentation, and other technical requirements as described in the LEED v4 BDC Ref Guide or LEED v4.1 BDC Ref Guide as applicable.

Collect, organize, and submit product data, drawings, diagrams, photos and cost information necessary to demonstrate compliance with LEED v4 BDC Ref Guide or LEED v4.1 BDC Ref Guide requirements as applicable.

Data collection shall commence with the notice to proceed and will only be deemed complete upon acceptance of the Final Sustainability Notebook and LEED Online submission by the Contracting Officer, the LEED Project Administrator, and the Green Building Certification Institute.

### 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

Corner Guards; G, AE

Wall Covering and Panels; G, AE

SD-03 Product Data



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Corner Guards; G, AE

Wall Covering and Panels; G, AE

Recycled content for aluminum component of corner guards; S

Environmental Product Declarations; S

Embodied Carbon Optimization Report/Action Plan; S

Extended Producer Responsibility; S

Recycled Content Materials; S

Local/Regional Materials; S

Material Ingredient Reporting; S

#### SD-04 Samples

Corner Guards; G, AE

Wall Covering and Panels; G, AESD-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

### 1.4 SUSTAINABLE DESIGN REQUIREMENTS

#### 1.4.1 Environmental Product Declarations

At a minimum, use materials or products with an Environmental Product Declaration in accordance with the LEED Implementation Plan. See Section 01 33 29.00 06 SUSTAINABILITY REPORTING for cumulative materials requirements and LEED Implementation Plan.

#### 1.4.2 Embodied Carbon Optimization Report/Action Plan

At a minimum, use materials or products with an Embodied Carbon Optimization Report/Action Plan in accordance with the LEED Implementation Plan. See Section 01 33 29.00 06 SUSTAINABILITY REPORTING for cumulative materials requirements and LEED Implementation Plan.

#### 1.4.3 Sourcing of Raw Materials

Provide products that meet one or more of the following categories:

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#### 1.4.3.1 Extended Producer Responsibility

At a minimum, use materials or products from manufacturers that participate in an extended producer responsibility program in accordance with the LEED Implementation Plan. Provide manufacturer letter verifying extended producer responsibility program is in place and that product is eligible. See Section 01 33 29.00 06 SUSTAINABILITY REPORTING for cumulative materials requirements and LEED Implementation Plan.

#### 1.4.3.2 Recycled Content Materials

At a minimum, use materials or products with recycled content in accordance with the LEED Implementation Plan. Provide manufacturers product literature identifying the percentage of recycled material incorporated within each product used. See Section 01 33 29.00 06 SUSTAINABILITY REPORTING for cumulative materials requirements and LEED Implementation Plan. If recycled content minimum is specified in this section, the greater of the two percentages governs.

#### 1.4.4 Material Ingredient Reporting

At a minimum, use materials or products with chemical inventory to at least 0.1% (1000 ppm) in accordance with the LEED Implementation Plan. Provide Health Product Declaration (HPD), Cradle to Cradle Certificate, Declare label, or other manufacturer's published content inventory in compliance with LEED v4.1 Material Ingredient Reporting credit. See Section 01 33 29.00 06 SUSTAINABILITY REPORTING for cumulative materials requirements and LEED Implementation Plan.

#### 1.4.5 Local/Regional Materials

Use materials or products extracted, harvested, or recovered, as well as manufactured, within a 100 mile radius from the project site, if available from a minimum of three sources. provide a letter from the manufacturer stating the extraction location, manufacturing location, and purchasing location of the products provided, referencing the project name and location specifically and distance to the project site. See Section 01 33 29.00 06 SUSTAINABILITY REPORTING for cumulative materials requirements and LEED Implementation Plan.

### 1.5 CERTIFICATIONS

#### 1.5.1 Indoor Air Quality

##### 1.5.1.1 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.

##### 1.5.1.2 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

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certification documentation from certification body. When product does not have certification, provide validation that product meets the indoor air quality product requirements cited herein.

#### 1.6 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.

#### 1.7 WARRANTY

Provide manufacturer's warranty to repair or replace defective materials and workmanship for a 1 year period of 5 years 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 acrylic vinyl conforming to the following:

##### 2.1.1.1 Minimum Impact Resistance

Minimum impact resistance must be 18 ft-lbs/sq. inch when tested in accordance with ASTM D256, (Izod impact, ft-lbs per sq inch notched).

##### 2.1.1.2 Fire Resistance Rating

Provide the following surface burning characteristics when tested and labeled in accordance with ASTM E84 by a qualified testing agency: maximum flame spread of 25 and a smoke developed rating of 450 or less. Provide material rated as self extinguishing when tested in accordance with ASTM D635. Provide resilient material used for protection on fire rated doors and frames listed by the qualified testing agency performing the tests. Provide resilient material installed on fire rated wood/steel door and frame assemblies tested on similar type assemblies. Test results

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of material tested on any other combination of door/frame assembly are not acceptable.

#### 2.1.1.3 Integral Color

Provide colored components having integral color and matched in accordance with SAE J1545 to within plus or minus 1.0 on the CIE-LCH scales.

#### 2.1.1.4 Chemical and Stain Resistance

Provide materials resistant to chemicals and stains reagents in accordance with ASTM D543.

#### 2.1.1.5 Fungal and Bacterial Resistance

Provide materials resistant to fungi and bacteria in accordance with ASTM G21, as applicable.

### 2.2 CORNER GUARDS

#### 2.2.1 Resilient Corner Guards

Provide surface mounted corner guards, radius formed to profile shown. Provide corner guards that are 4 feet high. Furnish mounting hardware, cushions, and base plates. Provide assembly consisting of a snap-on corner guard formed from high impact resistant resilient material, mounted on a continuous aluminum retainer. Extruded aluminum retainer conforms to ASTM B221, alloy 6063, temper T5 or T6. Provide aluminum components that contain a minimum of 35 percent recycled content. Provide data identifying percentage of recycled content for aluminum component of corner guards. Flush mounted type guards act as a stop for adjacent wall finish material. Furnish factory fabricated end closure caps for top and bottom of surface mounted corner guards. Provide flush mounted corner guards installed in fire rated wall that maintain the rating of the wall. Manufacturer to provide insulating materials that are an integral part of the corner guard system. Provide exposed metal portions of fire rated assemblies with a paintable surface.

### 2.3 WALL COVERING AND PANELS

Provide wall covering and panels consisting of high impact. 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 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 wall covering/panels.

### 2.4 TRIM, FASTENERS AND ANCHORS

Provide vinyl 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.

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#### 2.5.1 Resilient Material Finish

Provide resilient material finish of smooth 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; colors listed are not intended to limit the selection of equal colors from other manufacturers.

### PART 3 EXECUTION

#### 3.1 INSTALLATION

Do not install items that show visual evidence of biological growth. Install items on surfaces that are clean, smooth, and free of obstructions.

##### 3.1.1 Corner Guards and Wall Guards

- a. Mount guards as indicated and in accordance with manufacturer's written installation instructions.

##### 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.

## 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-AE

Submit product Schedule indicating types, quantities, sizes, and installation locations by room for each toilet accessory item required. Identify locations using room designations indicated on the drawings.

## SD-03 Product Data

Recycled content for stainless steel toilet accessories; S

Item AXXXX Dispenser/Disposal, Paper Towel, Recessed; G-AE

Item A5090 Disposal, Sanitary Napkin, SS, Surface Mounted; G-AE

Item A5109 Grab Bar, 1-1/4 inch Dia., SS, W/C Accessible; G-AE

Item A5135 Shelf, Utility W/ Mop/Broom Holders, SS, Surf Mntd; G-AE

Item A5150 Hook, Garment, Triple, Surface Mounted; G-AE

Item A5200 Dispenser, Toilet Tissue, SS, 2-Roll, Surface Mntd; G-AE

Submit catalog numbers, literature, data sheets, construction details, profiles, anchoring and mounting requirements, including cutouts in other work and substrate preparation, electrical characteristics, and other pertinent data for each toilet accessory item to evaluate function, materials, dimensions and

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appearance.

SD-07 Certificates

SD-10 Operation and Maintenance Data

Item AXXXX Dispenser/Disposal, Paper Towel, Recessed; G

Item A5090 Disposal, Sanitary Napkin, SS, Surface Mounted; G

Item A5109 Grab Bar, 1-1/4 inch Dia., SS, W/C Accessible; G

Item A5135 Shelf, Utility W/ Mop/Broom Holders, SS, Surf Mntd; G

Item A5150 Hook, Garment, Triple, Surface Mounted; G

Item A5200 Dispenser, Toilet Tissue, SS, 2-Roll, Surface Mntd; G

Submit Data Package 1 for each toilet accessory item , and Data Package 2 for each electrical toilet accessory item, in accordance with Section 01 78 23 OPERATIONS AND MAINTENANCE DATA.

### 1.3 DELIVERY, STORAGE, AND HANDLING

Wrap toilet accessories for shipment and storage, then deliver to the jobsite in manufacturer's original packaging, and store in a clean, dry area protected from construction damage and vandalism.

### 1.4 WARRANTY

Provide manufacturer's warranty to repair or replace defective materials and workmanship for a period of one year from date of final acceptance of the work..

## PART 2 PRODUCTS

### 2.1 ACCESSORY ITEMS

Provide toilet accessories where indicated in accordance with Contractor-provided product schedule. Conform to the requirements for accessory items specified herein which are based on MIL-STD-1691 Joint Schedule Numbers (JSN). Provide each accessory item complete with the necessary mounting plates of sturdy construction with corrosion resistant surface.

Provide stainless steel products listed herein manufactured from materials containing a minimum of 50 percent recycled content. Provide data identifying percentage of recycled content for stainless steel toilet accessories.

#### 2.1.1 Anchors and Fasteners

Provide corrosion-resistant anchors and fasteners capable of developing a restraining force commensurate with the strength of the accessory to be mounted and suited for use with the supporting construction. Provide oval heads exposed fasteners with finish to match the accessory. Provide fasteners proposed for use for each type of wall construction and mounting.

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### 2.1.2 Finishes

Except where noted otherwise, provide the following finishes on metal:

Metal	Finish
Stainless steel	No. 4 satin finish
Carbon steel, copper alloy, and brass	Chromium plated, bright

### 2.1.3 Item AXXXX Dispenser/Disposal, Paper Towel, Recessed

Recess mounted paper towel dispenser. Unit constructed of heavy gauge stainless steel with satin finish, all welded construction, have full length piano hinge and tumbler lock. Unit dispenses 600 C-fold or 800 multifold paper towels and be self-feeding until supply is depleted. Towel dispensing slot is snag-free. Unit is ADA compliant.

Approximate size: 17 inches wide by 54 inches high by 4 inches deep.

### 2.1.4 Item A5090 Disposal, Sanitary Napkin, SS, Surface Mounted

Surface mounted sanitary napkin receptacle. Unit made of stainless steel with satin finish and all welded construction. Unit has piano hinge attached at the top and an integral finger depression for opening. For use with disposable paper liners, available separately. Unit may be attached to wall or toilet partition.

Approximate size: 7 inches wide by 4 inches deep by 10 inches high.

### 2.1.5 Item A5109 Grab Bar, 1-1/4 Inch Diameter, SS, 2 Wall, W/C Accessible

Grab bar of 1-1/4 inch diameter satin finish stainless steel with peened gripping surface for use in toilet stall/room. Snap-on flange covers for concealed mounting are stainless steel and equipped with two screw holes for attachment to wall. Grab bars designed to meet and exceed ADA requirements for structural strength. Grab bars designed to withstand loads of 900 pounds when properly installed. Clearance from wall to grab bar is 1-1/2 inches to meet ADA and ANSI codes. Length as indicated in the Drawings.

### 2.1.6 Item A5135 Shelf, Utility W/ Mop/Broom Holders, SS, Surf Mounted

Surface mounted mop/broom holder with shelf made of 18 gauge stainless steel with all exposed surfaces in satin finish. Unit has shelf 8 inches deep with shelf support brackets of satin finish stainless steel welded to mounting base, and a minimum of 3 hooks/3 holders. Mop holders have spring-loaded rubber cams and hold mop or broom handle with a diameter between 5/8 inch and 1 inch.

Approximate size: 36 inches wide by 8 inches deep.

### 2.1.7 Item A5150 Hook, Garment, Triple, Surface Mounted

Surface mounted garment hook. Unit has three metal hooks with a backplate made of polished aluminum finished panel. For mounting directly on wall or to panel.



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Approximate maximum weight capacity: 35 pounds.

Approximate size: 18 inches wide by 4 inches high by 3/4 inch deep.

#### 2.1.8 Item A5200 Dispenser, Toilet Tissue, SS, 2-Roll, Surface Mounted

Concealed surface mounted, double roll, toilet tissue dispenser of stainless steel. Unit holds and dispenses two standard 5-1/4 inch diameter rolls of toilet tissue. Spindles are free-spinning for non-controlled delivery, chrome-plated plastic equipped with heavy-duty internal springs.

Approximate size: 7 inches diameter by 4 inches deep.

### PART 3 EXECUTION

#### 3.1 INSTALLATION

Do not install items that show visual evidence of biological growth. Provide the same finish for the surfaces of fastening devices exposed after installation as the attached accessory. Provide oval exposed screw heads. Install accessories at the location and height indicated. Protect exposed surfaces of accessories with strippable plastic or by other means until the installation is accepted. After acceptance of accessories, remove and dispose of strippable plastic protection. Coordinate accessory manufacturer's mounting details with other trades as their work progresses. 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  | (2018; ERTA 1-2 2018) Standard for<br>Portable Fire Extinguishers |
| NFPA 101 | (2021) Life Safety Code                                           |

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

- |                 |                                    |
|-----------------|------------------------------------|
| 29 CFR 1910.106 | Flammable Liquids                  |
| 29 CFR 1910.157 | (2003) Portable Fire Extinguishers |

#### UNDERWRITERS LABORATORIES (UL)

- |        |                                                     |
|--------|-----------------------------------------------------|
| UL 299 | (2012; May 2021) Dry Chemical Fire<br>Extinguishers |
|--------|-----------------------------------------------------|

##### 1.2 SUBMITTALS

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#### SD-02 Shop Drawings

- Fire Extinguishers; G, AE
- Accessories; G, AE
- Cabinets; G, AE
- Wall Brackets; G, AE
- Schedule; G

#### SD-03 Product Data

- Fire Extinguishers; G, AE

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Accessories; G, AE

Cabinets; G, AE

Wall Brackets; G, AE

Replacement Parts List; G

#### SD-04 Samples

Equipment Samples; G

#### SD-07 Certificates

Fire Extinguishers Certifications; G

Manufacturer's Warranty with Inspection Tag; G, AE

### 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 3 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.

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## 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, 29 CFR 1910.106 and 29 CFR 1910.157.

Provide stored-pressure water type fire extinguishers.

Provide dry chemical type fire extinguishers compliant with UL 299.

### 2.1.2 Material

Provide aluminum extinguisher shell.

### 2.1.3 Size

10 pounds extinguishers.

### 2.1.4 Accessories

Forged brass valve

Safety release

Pressure gage

## 2.2 EQUIPMENT

### 2.2.1 Cabinets

#### 2.2.1.1 Material

Provide corrosion-resistant steel cabinets.

#### 2.2.1.2 Type

Provide recessed type cabinets.

Provide semi-recessed cabinet for a 4 inch wall.

#### 2.2.1.3 Size

Dimension cabinets to accommodate the specified fire extinguishers.

### 2.2.2 Wall Brackets

Provide wall-hook fire extinguisher wall brackets.

Provide wall bracket and accessories as approved.

#### 2.2.2.1 Identification

Provide lettering complying with authorities having jurisdiction for letter style, size, spacing, and location. Locate as indicated by the

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drawings.

Identify bracket-mounted fire extinguishers with the words "FIRE  
EXTINGUISHER" in red letter decals applied to mounting surface.

Orientation: Vertical.

### PART 3 EXECUTION

#### 3.1 INSTALLATION

Install Fire Extinguishers where indicated on the drawings. Verify exact locations prior to installation.

Provide extinguishers which are fully charged and ready for operation upon installation. Provide extinguishers complete with Manufacturer's Warranty with Inspection Tag attached.

Install fire extinguishers in locations indicated and in compliance with requirements of authorities having jurisdiction.

Comply with the manufacturer's recommendations for all installations.

#### 3.2 PROTECTION

##### 3.2.1 Repairing

Remove and replace damaged and unacceptable portions of completed work with new work at no additional cost to the Government.

Submit replacement parts list indicating specified items replacement part, replacement cost, and name, address and contact for replacement parts distributor.

##### 3.2.2 Cleaning

Clean all surfaces of the work, and adjacent surfaces which are soiled as a result of the work. Remove from the site all construction equipment, tools, surplus materials and rubbish resulting from the work.

-- End of Section --

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## 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	(2021) 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
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ASTM B456	(2017) Standard Specification for Electrodeposited Coatings of Copper Plus Nickel Plus Chromium and Nickel Plus Chromium
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##### U.S. GENERAL SERVICES ADMINISTRATION (GSA)

FS AA-L-00486	(Rev J) Lockers, Clothing, Steel
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##### U.S. GREEN BUILDING COUNCIL (USGBC)

LEED v4 BDC Ref Guide	(2013; R 2020) USGBC LEED Reference Guide for Building Design and Construction, v4
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LEED v4.1 BDC Ref Guide	(2023) LEED v4.1 Building Design and Construction Reference Guide
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##### 1.2 SUSTAINABILITY REPORTING

Work of this section is intended to contribute to the achievement of, or compliance with, the requirements of the Guiding Principles Validation and LEED Prerequisites and attempted Credits. Refer to Section 01 33 29.00 06 SUSTAINABILITY REPORTING for specific documentation requirements and list of Prerequisites, attempted Credits and LEED version.

Comply with product, material content, performance criteria, activity, documentation, and other technical requirements as described in the LEED v4 BDC Ref Guide or LEED v4.1 BDC Ref Guide as applicable.

Collect, organize, and submit product data, drawings, diagrams, photos and cost information necessary to demonstrate compliance with LEED v4 BDC Ref Guide or LEED v4.1 BDC Ref Guide requirements as applicable.

Data collection shall commence with the notice to proceed and will only be deemed complete upon acceptance of the Final Sustainability Notebook and LEED Online submission by the Contracting Officer, the LEED Project

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Administrator, and the Green Building Certification Institute.

### 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

Types; G

Location; G

Installation

Numbering system

#### SD-03 Product Data

Material

Locking Devices

Handles

Finish

Locker components

Assembly instructions

Environmental Product Declarations; S

Embodied Carbon Optimization Report/Action Plan; S

Extended Producer Responsibility; S

Recycled Content Materials; S

Local/Regional Materials; S

Material Ingredient Reporting; S

#### SD-04 Samples

Color chips; G

### 1.4 SUSTAINABLE DESIGN REQUIREMENTS

#### 1.4.1 Environmental Product Declarations

At a minimum, use materials or products with an Environmental Product Declaration in accordance with the LEED Implementation Plan. See Section 01 33 29.00 06 SUSTAINABILITY REPORTING for cumulative materials requirements and LEED Implementation Plan.

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#### 1.4.2 Embodied Carbon Optimization Report/Action Plan

At a minimum, use materials or products with an Embodied Carbon Optimization Report/Action Plan in accordance with the LEED Implementation Plan. See Section 01 33 29.00 06 SUSTAINABILITY REPORTING for cumulative materials requirements and LEED Implementation Plan.

#### 1.4.3 Sourcing of Raw Materials

Provide products that meet one or more of the following categories:

##### 1.4.3.1 Extended Producer Responsibility

At a minimum, use materials or products from manufacturers that participate in an extended producer responsibility program in accordance with the LEED Implementation Plan. Provide manufacturer letter verifying extended producer responsibility program is in place and that product is eligible. See Section 01 33 29.00 06 SUSTAINABILITY REPORTING for cumulative materials requirements and LEED Implementation Plan.

##### 1.4.3.2 Recycled Content Materials

At a minimum, use materials or products with recycled content in accordance with the LEED Implementation Plan. Provide manufacturers product literature identifying the percentage of recycled material incorporated within each product used. See Section 01 33 29.00 06 SUSTAINABILITY REPORTING for cumulative materials requirements and LEED Implementation Plan. If recycled content minimum is specified in this section, the greater of the two percentages governs.

##### 1.4.4 Material Ingredient Reporting

At a minimum, use materials or products with chemical inventory to at least 0.1% (1000 ppm) in accordance with the LEED Implementation Plan. Provide Health Product Declaration (HPD), Cradle to Cradle Certificate, Declare label, or other manufacturer's published content inventory in compliance with LEED v4.1 Material Ingredient Reporting credit. See Section 01 33 29.00 06 SUSTAINABILITY REPORTING for cumulative materials requirements and LEED Implementation Plan.

##### 1.4.5 Local/Regional Materials

Use materials or products extracted, harvested, or recovered, as well as manufactured, within a 100 mile radius from the project site, if available from a minimum of three sources. provide a letter from the manufacturer stating the extraction location, manufacturing location, and purchasing location of the products provided, referencing the project name and location specifically and distance to the project site. See Section 01 33 29.00 06 SUSTAINABILITY REPORTING for cumulative materials requirements and LEED Implementation Plan.

#### 1.5 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.



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## 1.6 FIELD MEASUREMENTS

To ensure proper fits, make field measurements prior to the preparation of drawings and fabrication. Verify correct location.

## 1.7 QUALITY ASSURANCE

### 1.7.1 Color Chips

Provide a minimum of three color chips, not less than 3 inches square, of each color scheduled.

Government may request performance-characteristic tests on assembled lockers. Tests and results must conform to FS AA-L-00486. Lockers not conforming will be rejected.

## PART 2 PRODUCTS

### 2.1 TYPES

Locker must have the following type and size in the location and quantities indicated. Locker finish colors will be as scheduled.

#### 2.1.1 2 Tier Locker

2 Tier lockers must be as follows:

Type LK-1: 2-Tier locker 12 inches wide, 18 inches deep, and 72 inches high, attached to a 6-inch high base with closed base attachments

### 2.2 MATERIAL

#### 2.2.1 Steel Sheet

ASTM A1008/A1008M, commercial quality, minimized spangle material. Prepare material surfaces for powder coat paint finishing in accordance with FS AA-L-00486. Fabricate locker bodies from not less than 0.0239-inch thick steel sheet.

#### 2.2.2 Chromium Coating

Nickel and chromium electrodeposited on the specified base metal. Conform to ASTM B456, SC-3, as applicable to the base metal.

#### 2.2.3 Finish

FS AA-L-00486.

##### 2.2.3.1 Color

As selected.

### 2.3 COMPONENTS

#### 2.3.1 Built-In Locks

FS AA-L-00486. Provide locking devices as built-in key locks.

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### 2.3.2 Door Handles

FS AA-L-00486.

### 2.3.3 Doors

FS AA-L-00486, not less than 0.0598 inch thick steel sheet.

#### 2.3.3.1 Hinges

In addition to the requirements of FS AA-L-00486, provide 5-knuckle hinges, minimum 2 inches high. Fabricate knuckle hinges from not less than 0.0787 inch thick steel sheet. A full height piano hinge may be provided if standard with the manufacturer. Weld or bolt hinges to the door frame. Weld, bolt, or rivet hinges to the door.

#### 2.3.3.2 Latching Mechanisms

FS AA-L-00486.

### 2.3.4 Latch Strikes

FS AA-L-00486. Fabricate from not less than 0.0787 inch thick steel sheet, except latch strike may be continuous from top to bottom and fabricated as part of the door framing.

### 2.3.5 Silencers

FS AA-L-00486.

### 2.3.6 Back and Side Panels, Tops, and Bottoms.

FS AA-L-00486, not less than 0.0474 inch thick steel sheet.

### 2.3.7 Shelves

FS AA-L-00486. Fabricate from not less than 0.0598 inch thick steel sheet.

### 2.3.8 Base Panels

FS AA-L-00486.

### 2.3.9 Legs

FS AA-L-00486.

### 2.3.10 Number Plates

FS AA-L-00486. Aluminum. Provide consecutive numbers from 1 to 100.

### 2.3.11 Fastening Devices

Provide bolts, nuts, and rivets as specified in FS AA-L-00486.

## PART 3 EXECUTION

### 3.1 ASSEMBLY AND INSTALLATION

Assemble lockers according to the locker manufacturer's instructions.

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Align lockers horizontally and vertically. Secure lockers to wall and base with screws as indicated. Bolt adjacent lockers together. Adjust doors to operate freely without sticking or binding and to ensure they close tightly.

### 3.2 NUMBERING SYSTEM

Install number plates on lockers consecutively .

### 3.3 FIELD QUALITY CONTROL

#### 3.3.1 Testing

Government may request performance-characteristic tests on assembled lockers in accordance with FS AA-L-00486. Lockers not conforming will be rejected.

#### 3.3.2 Repairing

Remove and replace damaged and unacceptable portions of completed work with new.

#### 3.3.3 Cleaning

Clean surfaces of the work, and adjacent surfaces soiled as a result of the work, in an approved manner. Remove equipment, surplus materials, and rubbish from the site.

-- End of Section --

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## SECTION 12 24 13

ROLLER WINDOW SHADES  
 08/20

## PART 1 GENERAL

## 1.1 REFERENCES

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

## AMERICAN NATIONAL STANDARDS INSTITUTE (ANSI)

ANSI/WCMA A100.1 (2018) American National Standard for  
 Safety of Window Covering Products

## ASTM INTERNATIONAL (ASTM)

ASTM G21 (2015; R 2021; E 2021) Standard Practice  
 for Determining Resistance of Synthetic  
 Polymeric Materials to Fungi

## 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 701 (2019) Standard Methods of Fire Tests for  
 Flame Propagation of Textiles and Films

## SCIENTIFIC CERTIFICATION SYSTEMS (SCS)

SCS SCS Global Services (SCS) Indoor Advantage

## U.S. GREEN BUILDING COUNCIL (USGBC)

LEED v4 BDC Ref Guide (2013; R 2020) USGBC LEED Reference Guide  
 for Building Design and Construction, v4

LEED v4.1 BDC Ref Guide (2023) LEED v4.1 Building Design and  
 Construction Reference Guide

## UNDERWRITERS LABORATORIES (UL)

UL 325 (2017; Reprint Feb 2020) UL Standard for  
 Safety Door, Drapery, Gate, Louver, and  
 Window Operators and Systems

UL 2818 (2013) GREENGUARD Certification Program  
 For Chemical Emissions For Building  
 Materials, Finishes And Furnishings

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## 1.2 SUSTAINABILITY REPORTING

Work of this section is intended to contribute to the achievement of, or compliance with, the requirements of the Guiding Principles Validation and LEED Prerequisites and attempted Credits. Refer to Section 01 33 29.00 06 SUSTAINABILITY REPORTING for specific documentation requirements and list of Prerequisites, attempted Credits and LEED version.

Comply with product, material content, performance criteria, activity, documentation, and other technical requirements as described in the LEED v4 BDC Ref Guide or LEED v4.1 BDC Ref Guide as applicable.

Collect, organize, and submit product data, drawings, diagrams, photos and cost information necessary to demonstrate compliance with LEED v4 BDC Ref Guide or LEED v4.1 BDC Ref Guide requirements as applicable.

Data collection shall commence with the notice to proceed and will only be deemed complete upon acceptance of the Final Sustainability Notebook and LEED Online submission by the Contracting Officer, the LEED Project Administrator, and the Green Building Certification Institute.

## 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

Detailed Drawings; G

Location Schedule; G

### SD-03 Product Data

Window Shades; G

Recycled Content for various fiber components; S

Environmental Product Declarations; S

Embodied Carbon Optimization Report/Action Plan; S

Extended Producer Responsibility; S

Local/Regional Materials; S

Material Ingredient Reporting; S

### SD-04 Samples

Window Shades; G

### SD-06 Test Reports

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Flammability Requirements; G

SD-07 Certificates

Indoor Air Quality for roller window shades; S

Qualifications

SD-10 Operation and Maintenance Data

Window Shades, Data Package 1; G

SD-11 Closeout Submittals

Submit Data Package 1 for roller window shades, and Data Package 2 for electrical operators, in accordance with Section 01 78 23 OPERATIONS AND MAINTENANCE DATA.

#### 1.4 SUSTAINABLE DESIGN REQUIREMENTS

##### 1.4.1 Environmental Product Declarations

At a minimum, use materials or products with an Environmental Product Declaration in accordance with the LEED Implementation Plan. See Section 01 33 29.00 06 SUSTAINABILITY REPORTING for cumulative materials requirements and LEED Implementation Plan.

##### 1.4.2 Embodied Carbon Optimization Report/Action Plan

At a minimum, use materials or products with an Embodied Carbon Optimization Report/Action Plan in accordance with the LEED Implementation Plan. See Section 01 33 29.00 06 SUSTAINABILITY REPORTING for cumulative materials requirements and LEED Implementation Plan.

##### 1.4.3 Sourcing of Raw Materials

Provide products that meet one or more of the following categories:

###### 1.4.3.1 Extended Producer Responsibility

At a minimum, use materials or products from manufacturers that participate in an extended producer responsibility program in accordance with the LEED Implementation Plan. Provide manufacturer letter verifying extended producer responsibility program is in place and that product is eligible. See Section 01 33 29.00 06 SUSTAINABILITY REPORTING for cumulative materials requirements and LEED Implementation Plan.

###### 1.4.3.2 Recycled Content Materials

At a minimum, use materials or products with recycled content in accordance with the LEED Implementation Plan. Provide manufacturers product literature identifying the percentage of recycled material incorporated within each product used. See Section 01 33 29.00 06 SUSTAINABILITY REPORTING for cumulative materials requirements and LEED Implementation Plan. If recycled content minimum is specified in this section, the greater of the two percentages governs.

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#### 1.4.4 Material Ingredient Reporting

At a minimum, use materials or products with chemical inventory to at least 0.1% (1000 ppm) in accordance with the LEED Implementation Plan. Provide Health Product Declaration (HPD), Cradle to Cradle Certificate, Declare label, or other manufacturer's published content inventory in compliance with LEED v4.1 Material Ingredient Reporting credit. See Section 01 33 29.00 06 SUSTAINABILITY REPORTING for cumulative materials requirements and LEED Implementation Plan.

#### 1.4.5 Local/Regional Materials

Use materials or products extracted, harvested, or recovered, as well as manufactured, within a 100 mile radius from the project site, if available from a minimum of three sources. provide a letter from the manufacturer stating the extraction location, manufacturing location, and purchasing location of the products provided, referencing the project name and location specifically and distance to the project site. See Section 01 33 29.00 06 SUSTAINABILITY REPORTING for cumulative materials requirements and LEED Implementation Plan.

### 1.5 CERTIFICATES

#### 1.5.1 Indoor Air Quality Certifications

##### 1.5.1.1 Roller Window Shades

Provide products certified to meet indoor air quality requirements by UL 2818 (Greenguard) Gold, SCS Global Services Indoor Advantage Gold or provide validation by other third-party program that products meet the requirements of this paragraph. Provide current product certification documentation from certification body.

### 1.6 QUALITY ASSURANCE

#### 1.6.1 Qualifications

##### 1.6.1.1 Installer's Qualifications

Installer trained and certified by the manufacturer with a minimum of ten years of experience in installing products comparable to those specified in this section.

#### 1.6.2 Flammability Requirements

Passes in accordance with NFPA 701 small and large-scale vertical burn. Materials tested are identical to products proposed for use.

#### 1.6.3 Electrical Requirements

NFPA Article 100 listed and labeled in accordance with UL 325 or other testing agency acceptable to authorities having jurisdiction, marked for intended use, and tested as a system. Individual testing of components is not acceptable in lieu of system testing.

#### 1.6.4 Anti-Microbial Requirements

'No Growth' per ASTM G21 results for fungi ATCC9642, ATCC 9644, ATCC9645.

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#### 1.7 DELIVERY, STORAGE, AND HANDLING

Deliver components to the jobsite in the manufacturer's original packaging with the brand or company name, item identification, and project reference clearly marked. Store components in a dry location that is adequately ventilated and free from dust, water, or other contaminants and has easy access for inspection and handling. Store materials flat in a clean dry area with temperature maintained above 50 degrees F. Do not open containers until needed for installation unless verification inspection is required. Handle and store shades in accordance with manufacturer's recommendations.

#### 1.8 WARRANTY

Provide manufacturer's warranty to repair or replace defective materials and workmanship for a period of 10 years from date of final acceptance of the work.

### PART 2 PRODUCTS

#### 2.1 WINDOW SHADES

Submit drawings showing plans, elevations, sections, product details, installation details, operational clearances, wiring diagrams and relationship to work. Submit a location schedule showing location, size and quantity of shades. Include the use of same room designations as indicated on the drawings.

Provide product data composed of catalog cuts, brochures, and operating and maintenance instructions on each product to be used. Include styles, profiles and features.

Furnish samples of each type and color of roller shade fabric and roller shade channel. Provide shade material minimum 6 by 6 inches in size. Mark face of material to indicate interior faces.

Mock up: Install shade in area designated by Contracting Officer. Do not proceed with remaining work until the Contracting Officer approves workmanship and operation. Rework mock up as required to produce acceptable work. The approved shade can be used in the installation.

Submit fire resistance data, flame spread and smoke contribution data.

Provide roller tube that operates smoothly and of sufficient diameter and thickness to prevent excessive deflection. Provide brackets that are appropriate for inside mount. Provide shade cloth meeting the performance described in NFPA 701, small scale test. Treat steel features for corrosion resistance.

Provide Various Fiber Components with a minimum of 60 percent recycled content. Provide data identifying percentage of recycled content for various fiber components.

Provide roller window shades used on the interior of the building (defined as inside of the weatherproofing system) that meets emissions requirements of CDPH SECTION 01350 (limit requirements for either office or classroom spaces regardless of space type). Provide certification of indoor air quality for roller window shades.



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#### 2.1.1 Manufacturer's Qualifications

Obtain roller shades through one source from a single manufacturer with a minimum of twenty years of experience and minimum of three projects of similar scope and size in manufacturing products comparable to those specified in this section. Furnish manual and motorized shades produced by the same manufacturer to provide matching appearance.

#### 2.1.2 Manually Operated Shades with Single Rollers

##### 2.1.2.1 Chain-and-Clutch Operating Mechanisms

Provide continuous-loop bead chain and clutch that stops shade movement when bead chain is released; shade to be permanently adjusted and lubricated.

##### 2.1.2.2 Bead Chains

Provide bead chain from #10 stainless steel rated to 90 lb. minimum breaking strength with pull chain tensioning device complying with ANSI/WCMA A100.1

- a. Loop Length: Full length of roller shade.
- b. Limit Stops: Allows shade to stop when chain is released. Provide limit stops to prevent shade from being raised or lowered too far.
- c. Chain-Retainer Type: Chain tensioner, jamb mounted.

##### 2.1.2.3 Rollers

Provide corrosion-resistant steel or extruded-aluminum tubes of diameters and wall thicknesses required to accommodate operating mechanisms and weights and widths of shade bands indicated without deflection. Provide with permanently lubricated drive-end assemblies and idle-end assemblies designed to facilitate removal of shade cloth for service.

- a. Roller Drive-End Location: Right side of interior face of shade.
- b. Direction of Shade cloth Roll: Regular, from back (exterior face) of roller.
- c. Shade cloth-to-Roller Attachment: Manufacturer's standard method. Adhesive attachment is not acceptable.

##### 2.1.2.4 Mounting Hardware

Provide corrosion resistant brackets or endcaps compatible with roller assembly, operating mechanism, installation accessories, and mounting location and conditions indicated. Provide hardware that allows for field adjustment or removal of shade roller tube and other operable hardware component without removal of brackets and end or center supports.

##### 2.1.2.5 Shade Cloth

- a. Shade Material: Light-filtering fabric: Openness 3 percent.
- b. Shade Cloth Bottom (Hem) Bar: Steel or extruded aluminum. Provide shade bar enclosed in sealed pocket of shade band material.

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#### 2.1.2.6 Installation Accessories

- a. Front Fascia: L-shaped aluminum extrusion to conceal shade roller and hardware that snaps onto end caps without requiring exposed fasteners of any kind. Fascia can be mounted continuously across two or more shade bands. Provide manufacturers standard height fascia as required to conceal roller and shade band assembly when shade is fully open.
- b. Exposed Headbox: Rectangular, extruded-aluminum enclosure including front fascia, top and back covers, endcaps, and removable bottom closure. Provide manufacturers standard height fascia as required to conceal roller and shade band assembly when shade is fully open.
- c. Endcaps: Extruded aluminum with universal design suitable for mounting to window mullions. Provide size compatible with roller size. Provide end cap covers matching fascia/headbox finish.

#### 2.2 COLOR

Provide color, pattern and texture for metal trim and shade fabric as indicated; colors listed are not intended to limit the selection of equal colors from other manufacturers.

### PART 3 EXECUTION

#### 3.1 FIELD MEASUREMENTS

After becoming familiar with details of the work, verify all dimensions in the field, and advise the Contracting Officer of any discrepancy before performing the work.

#### 3.2 INSTALLATION

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

Provide roller window shades, complete with necessary brackets, fittings, and hardware on o as indicated on drawings.

Perform installation in accordance with the approved detailed drawings and manufacturer's installation instructions. Install units level, plumb, secure, and at proper height and location relative to window units. Provide and install supplementary or miscellaneous items in total, including clips, brackets, or anchorages incidental to or necessary for a sound, secure, and complete installation. Do not start installation until completion of room painting and finishing operations.

#### 3.3 CLEAN-UP

Upon completion of the installation, clean window treatments and exposed components as recommended by manufacturer. Adjust window treatment for form and appearance and proper operating condition. Repair or replace damaged units as directed by the Contracting Officer. Isolate metal parts from direct contact with concrete, mortar, or dissimilar metals. Ensure shades installed in recessed pockets can be removed without disturbing the pocket. The entire shade, when retracted, is contained inside the

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pocket. For shades installed outside the jambs and mullions, overlap each jamb and mullion 0.75 inch or more when the jamb and mullion sizes permit. Include all hardware, brackets, anchors, fasteners, and accessories necessary for a complete, finished installation.

-- End of Section --

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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 (2013) 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 D6866 (2022) Standard Test Methods for  
 Determining the Biobased Content of Solid,  
 Liquid, and Gaseous Samples Using  
 Radiocarbon Analysis

ASTM E 1537 (2016) Standard Test Method for Fire  
 Testing of Upholstered Furniture

ASTM E84 (2020) Standard Test Method for Surface  
 Burning Characteristics of Building  
 Materials

BIFMA INTERNATIONAL (BIFMA)

ANSI/BIFMA e3-2014e (2014) Furniture Sustainability Standard

ANSI/BIFMA e3-2019 (2019) Furniture Sustainability Standard

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

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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

FOREST STEWARDSHIP COUNCIL (FSC)

FSC STD 01 001	(2015) Principles and Criteria for Forest Stewardship
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NATIONAL FIRE PROTECTION ASSOCIATION (NFPA)

NFPA 101	(2021) Life Safety Code
NFPA 260	(2013) Standard Methods of Tests and Classification System for Cigarette Ignition Resistance of Components of Upholstered Furniture
NFPA 265	(2019) Standard Methods of Fire Tests for Evaluating Room Fire Growth Contribution of Textile or Expanded Vinyl Wall Coverings on Full Height Panels and Walls

STATE OF CALIFORNIA DEPARTMENT OF CONSUMER AFFAIRS, BUREAU OF  
ELECTRICAL AND APPLIANCE REPAIR, HOME FURNISHINGS AND THERMAL  
INSULATION (BEARHFTI)

TB 117-2013	(2013) Requirements, Test Procedure and Apparatus for Testing the Smolder Resistance of Materials Used in Upholstered Furniture
TB 133	(1991) Flammability Test Procedure for Seating Furniture in Public Occupancies

U.S. GREEN BUILDING COUNCIL (USGBC)

LEED v4 BDC Ref Guide	(2013; R 2020) USGBC LEED Reference Guide for Building Design and Construction, v4
LEED v4.1 BDC Ref Guide	(2023) LEED v4.1 Building Design and Construction Reference Guide

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

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

UL 723	(2018) UL Standard for Safety Test for Surface Burning Characteristics of
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## Building Materials

### 1.2 SUSTAINABILITY REPORTING

Work of this section is intended to contribute to the achievement of, or compliance with, the requirements of the Guiding Principles Validation and LEED Prerequisites and attempted Credits. Refer to Section 01 33 29.00 06 SUSTAINABILITY REPORTING for specific documentation requirements and list of Prerequisites, attempted Credits and LEED version.

Comply with product, material content, performance criteria, activity, documentation, and other technical requirements as described in the LEED v4 BDC Ref Guide or LEED v4.1 BDC Ref Guide as applicable.

Collect, organize, and submit product data, drawings, diagrams, photos and cost information necessary to demonstrate compliance with LEED v4 BDC Ref Guide or LEED v4.1 BDC Ref Guide requirements as applicable.

Data collection shall commence with the notice to proceed and will only be deemed complete upon acceptance of the Final Sustainability Notebook and LEED Online submission by the Contracting Officer, the LEED Project Administrator, and the Green Building Certification Institute.

### 1.3 SUBMITTALS

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

#### SD-01 Preconstruction Submittals

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

Energy Efficient Equipment; S

Environmental Product Declarations; S

Embodied Carbon Optimization Report/Action Plan; S

Extended Producer Responsibility; S

Bio-Based Materials; S

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Local/Regional Materials; S

Material Ingredient Reporting; S

Certified Wood; S

Recycled Content Materials; S

#### 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

Indoor Air Quality For Furniture; S

#### SD-10 Operation and Maintenance Data

Furniture, Data Package 1; G

#### SD-11 Closeout Submittals

### 1.4 SUSTAINABLE DESIGN REQUIREMENTS

#### 1.4.1 Energy Efficient Equipment

Coordinate requirement for energy efficient equipment, such as appliances and lighting, and provide documentation in accordance with Section 01 33 29.00 06 SUSTAINABILITY REPORTING paragraph ENERGY EFFICIENT EQUIPMENT.

#### 1.4.2 Environmental Product Declarations

At a minimum, use materials or products with an Environmental Product Declaration in accordance with the LEED Implementation Plan. See Section 01 33 29.00 06 SUSTAINABILITY REPORTING for cumulative materials requirements and LEED Implementation Plan.

#### 1.4.3 Embodied Carbon Optimization Report/Action Plan

At a minimum, use materials or products with an Embodied Carbon Optimization Report/Action Plan in accordance with the LEED Implementation Plan. See Section 01 33 29.00 06 SUSTAINABILITY REPORTING for cumulative materials requirements and LEED Implementation Plan.

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#### 1.4.4 Sourcing of Raw Materials

Provide products that meet one or more of the following categories:

##### 1.4.4.1 Extended Producer Responsibility

At a minimum, use materials or products from manufacturers that participate in an extended producer responsibility program in accordance with the LEED Implementation Plan. Provide manufacturer letter verifying extended producer responsibility program is in place and that product is eligible. See Section 01 33 29.00 06 SUSTAINABILITY REPORTING for cumulative materials requirements and LEED Implementation Plan.

##### 1.4.4.2 Bio-Based Materials

At a minimum, use materials or products with bio-based content in accordance with the LEED Implementation Plan. Provide manufacturer signed letter confirming ASTM D6866 test method was conducted validating bio-based material weight within product, type of bio-based material used within product, and confirmation raw material was legally harvested. See Section 01 33 29.00 06 SUSTAINABILITY REPORTING for cumulative materials requirements and LEED Implementation Plan. If bio-based content minimum is specified in this section, the greater of the two percentages governs.

##### 1.4.4.3 Certified Wood

Use FSC-certified wood where available from a minimum of three sources. See Section 01 33 29.00 06 SUSTAINABILITY REPORTING for cumulative materials requirements and LEED Implementation Plan. Indicate compliance with FSC STD 01 001 and identify certifying organization. Submit FSC certification numbers; identify each certified products on a line-item basis. Submit copies of invoices for all wood products bearing the FSC certification numbers for certified wood products as part of the closeout submittal.

##### 1.4.4.4 Recycled Content Materials

At a minimum, use materials or products with recycled content in accordance with the LEED Implementation Plan. Provide manufacturers product literature identifying the percentage of recycled material incorporated within each product used. See Section 01 33 29.00 06 SUSTAINABILITY REPORTING for cumulative materials requirements and LEED Implementation Plan. If recycled content minimum is specified in this section, the greater of the two percentages governs.

##### 1.4.5 Material Ingredient Reporting

At a minimum, use materials or products with chemical inventory to at least 0.1% (1000 ppm) in accordance with the LEED Implementation Plan. Provide Health Product Declaration (HPD), Cradle to Cradle Certificate, Declare label, or other manufacturer's published content inventory in compliance with LEED v4.1 Material Ingredient Reporting credit. See Section 01 33 29.00 06 SUSTAINABILITY REPORTING for cumulative materials requirements and LEED Implementation Plan.

##### 1.4.6 Local/Regional Materials

Use materials or products extracted, harvested, or recovered, as well as manufactured, within a 100 mile radius from the project site, if available



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from a minimum of three sources. provide a letter from the manufacturer stating the extraction location, manufacturing location, and purchasing location of the products provided, referencing the project name and location specifically and distance to the project site. See Section 01 33 29.00 06 SUSTAINABILITY REPORTING for cumulative materials requirements and LEED Implementation Plan.

#### 1.5 FURNITURE PURCHASE

U.S. Army Engineering and Support Center, Huntsville will 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.

#### 1.6 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.

##### 1.6.1 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.

##### 1.6.2 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.

##### 1.6.3 Furniture Requirements

The furniture provided must comply with the drawings, specifications, and the requirements identified in the FF&E Package Attachment.

##### 1.6.4 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.

#### 1.7 AUTHORIZED DEALER, CERTIFIED FURNITURE INSTALLERS, LICENSED ELECTRICIAN AND CERTIFIED TELECOMMUNICATIONS INSTALLER

When required by the furniture manufacturer, furniture must be installed by an authorized dealer and a certified furniture installation crew must be used on the project. All furniture requiring hardwiring must be completed by a licensed electrician. Communications installers must be Building Industry Consulting Services International (BICSI) Registered Cabling Installers, Technician Level or have a minimum of 3 years

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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.

#### 1.8 DELIVERY, STORAGE AND HANDLING

##### 1.8.1 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.

##### 1.8.2 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.

##### 1.8.3 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.

##### 1.8.4 Furniture Staging Area

Coordinate location of the furniture staging area with the Contracting Officer.

#### 1.9 WARRANTY

Provide manufacturer performance guarantees or warranties for single-shift service and include parts, labor and transportation as follows, unless otherwise noted:

- a. Systems Furniture - 12 year minimum
- b. Desks and Workstations - 12 year minimum
- c. Filing and Storage - 12 year minimum
- d. Seating
  - (1) Seating, unless otherwise noted - 10 year minimum
  - (2) 24/7 Seating (multiple shift use) - 10 year minimum
  - (3) Seating Mechanisms and Pneumatic Cylinders - 10 year minimum

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(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 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.

### 2.2 FURNITURE REQUIREMENTS

Use the FF&E Package Attachment in conjunction with the drawings and specifications for the furniture requirements. Provide furniture from manufacturer's standard product as shown in the most current published price list or amendment. Furniture provided must be part of current line as indicated with no intent to discontinue within two years. Provide furniture that is intended for commercial use not residential. Submit product data for all furniture items, to include catalog cuts, brochures, product information, and other necessary literature to indicate compliance with specifications. Provide product data for all similar types of items together as a group, such as desks/workstations, seating, storage and tables.. Submit each grouping of similar type items in a single submittal.

When applicable, include GSA schedule information to confirm that items are available on GSA schedule. Tag product data sheets with applicable furniture item code and name. Submit data for all product style options for selection when options are available. This applies to but is not limited to furniture items that have options such as edge details, hardware options, and grommet colors. Submit manufacturer's certification stating that furniture meets the specifications.

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Provide furniture used on the interior of the building (defined as inside of the weatherproofing system) that meets emissions requirements of ANSI/BIFMA e3-2014e or ANSI/BIFMA e3-2019 FURNITURE SUSTAINABILITY STANDARD, Section 7.6.1 (for half credit by cost) or 7.6.2 (for full credit by cost) or 7.6.2 and 7.6.3 (for one and one quarter credit by cost). Provide certification of indoor air quality for furniture.

#### 2.2.1 Construction

- a. Provide furniture that complies with the following testing requirements:

- (1) ANSI/BIFMA

- (a) Office Seating - ANSI/BIFMA X5.1
    - (b) Vertical Files - ANSI/BIFMA X5.3
    - (d) Desk Products - ANSI/BIFMA X5.5
    - (e) Panel Systems - ANSI/BIFMA X5.6
    - (f) Storage - ANSI/BIFMA X5.9

- (2) Flammability

- (a) Systems furniture and workstation panel components must meet requirements for flame spread and smoke development as specified by NFPA 101 except as follows. Conduct testing in accordance with either ASTM E84 or UL 723 on the entire assembled panel of the worst case (most combustible) combination of fabric and interior construction. In addition, fabric must meet the requirements of NFPA 265. Panel flame spread shall not exceed 25 for Class A , and panel smoke development shall not exceed 450 for Class A.

- (b) Upholstered furniture must comply with TB 117-2013 or NFPA 260 TB 133 or ASTM E 1537.

- 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.

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#### 2.2.2 Locks and Keying

- a. All drawers and doors, including but not limited to overhead storage cabinets, storage towers, supply cabinets, storage cabinets, desk and workstation pedestals, and filing cabinets must be lockable.
- b. Key each desk and workstation in an office differently and key locks within each desk and workstation alike.
- c. Furniture storage components in private offices must be keyed alike. Key each private office differently.
- d. Provide field changeable lock cylinders in desks and workstations with a minimum of 100 different key options. Number keys and lock cylinders for ease of replacement or clearly label locks with a key number, except for those manufacturers who have removable format locks.
- e. Drawers within a pedestal must be lockable either by a central lock that controls all pedestals under one work surface or an individual keyed lock in each pedestal.
- f. Central file and storage units which are grouped together but are not a part of a workstation must be keyed differently unless otherwise specified.
- g. Provide two keys for each workstation when components are keyed alike. Also provide two keys for each miscellaneous item such as filing cabinets, supply cabinets, storage cabinets, and similar type furniture items.
- h. Provide three copies of each master key to the Contracting Officer.
- i. Leave keys in locks .

#### 2.2.3 Receptacle Bodies and Device Cover Plates

Provide furniture panel faceplates and receptacle body types as specified in 12 59 00 SYSTEMS FURNITURE .

#### 2.2.4 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.

#### 2.2.5 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.

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#### 2.2.5.1 Fabric

- a. Fabric must be from manufacturer's standard line.
- b. Provide a mid grade fabric. Example: manufacturer available grades 1 through 4 (even number of grades), provide grade 3; manufacturer available grades A through D (even number of grades), provide grade C; manufacturer available grades A through E (odd number of grades), provide grade C (middle grade).
- c. Provide a topical or inherent soil retardant treatment where indicated.
- d. Fabric for seating must comply with a minimum of 55,000 double rubs unless otherwise noted. Perform double rub testing in accordance with the ASTM D4157 Wyzenbeek Method.
- e. Provide vinyl, polypropylene or similar type fabric for seating only if allowed in FF&E Package Attachment.
- f. Pattern:
  - (1) Provide patterned upholstery fabric to help hide soiling. Pattern is defined as follows:
    - (a) Solid Color: textured, 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.
- g. See FF&E Package Attachment for additional information.

#### 2.2.5.2 Finishes

Provide furniture finishes as listed below unless otherwise noted:

- a. Finishes must be able to be cleaned with ordinary household cleaning solutions. Wood finishes must be able to be cleaned with damp cloth as directed by the manufacturer.
- b. The finish of steel surfaces must be the manufacturer's most durable finish such as factory powder coat or baked enamel.
- c. Grommet colors must be compatible and coordinated with desk, workstation, and table finish colors.
- d. Finishes must be neutral in color.
- e. Plastic laminate worksurfaces and table tops must be neutral in color and must have a pattern to help hide soiling.
- f. See FF&E Package Attachment for additional information.

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## 2.3 FURNITURE LAYOUT

Provide furniture layout as indicated.

## PART 3 EXECUTION

### 3.1 BUILDING EXAMINATION

Become familiar with details of the work, inspect all areas and conditions under which furniture is to be installed, and coordinate scheduling of dedicated elevators and docks. Notify the Contracting Officer in writing of any conditions detrimental to the proper and timely completion of the installation. Work will proceed only when conditions have been corrected.

### 3.2 BUILDING PROTECTION

Protect building surfaces to prevent soiling and damage during delivery and installation. Any soiling and damage that occurs to the building during the installation of furniture must be cleaned and repaired, or replaced to its original condition and must be approved by the Contracting Officer.

### 3.3 INSTALLATION

#### 3.3.1 Installation Drawings

Installation drawings must include furniture layout, critical dimensions and locations of electrical and communications. Furniture layouts shall reflect field verified conditions. Drawings must be at 1/4 inch = 1 foot scale, unless otherwise specified. Provide typical plans and isometrics/elevations of desks and workstations at a scale of 1/2 inch = 1 foot. When applicable, provide desk and workstation electrical and communications locations. When applicable include controlled-circuit identification for each furniture receptacle and coordinate with the building electrical system circuits in accordance with ASHRAE 90.1 - IP. Critical dimensions include, but are not limited to clearances and aisle widths. Drawings must include layout for furniture systems workstations for coordination purposes. Label furniture with furniture item code identified in this specification. Submit grommet, power and communication units, and wire management locations.

#### 3.3.2 Furniture Installation Procedures

Complete installation in accordance with manufacturer's installation instructions, assembly manuals, warranty requirements and approved installation drawings. Also comply with the following requirements:

- a. Use material handling equipment with rubber wheels.
- b. Furniture and components must be installed level, plumb, square, and with proper alignment with adjoining furniture.
- c. Match keys to locks and check locking mechanisms.
- d. Check drawers, doors, lighting, and other operable items and mechanisms for proper operation.
- e. Remove all protective wrapping tape, residue, and related type items.

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- 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

Installation of Information/Technology (IT) wiring, cables and face plates/boxes in the furniture will be completed by others.

### 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



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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 SOCIETY OF HEATING, REFRIGERATING AND AIR-CONDITIONING  
 ENGINEERS (ASHRAE)

ASHRAE 90.1 - IP (2013) Energy Standard for Buildings  
 Except Low-Rise Residential Buildings

## ASTM INTERNATIONAL (ASTM)

ASTM E84 (2020) Standard Test Method for Surface  
 Burning Characteristics of Building  
 Materials

## BIFMA INTERNATIONAL (BIFMA)

ANSI/BIFMA e3-2014e (2014) Furniture Sustainability Standard

ANSI/BIFMA e3-2019 (2019) Furniture Sustainability Standard

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

## NATIONAL ELECTRICAL MANUFACTURERS ASSOCIATION (NEMA)

NEMA WD 1 (1999; R 2020) Standard for General Color  
 Requirements for Wiring Devices

NEMA WD 6 (2016) Wiring Devices Dimensions  
 Specifications

## NATIONAL FIRE PROTECTION ASSOCIATION (NFPA)

NFPA 70 (2020; ERTA 20-1 2020; ERTA 20-2 2020; TIA  
 20-1; TIA 20-2; TIA 20-3; TIA 20-4)  
 National Electrical Code

NFPA 101 (2021) Life Safety Code

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NFPA 265 (2019) Standard Methods of Fire Tests for  
 Evaluating Room Fire Growth Contribution  
 of Textile or Expanded Vinyl Wall  
 Coverings on Full Height Panels and Walls

#### SCIENTIFIC CERTIFICATION SYSTEMS (SCS)

SCS SCS Global Services (SCS) Indoor Advantage

#### TELECOMMUNICATIONS INDUSTRY ASSOCIATION (TIA)

TIA-568.2 (2018d) Balanced Twisted-Pair  
 Telecommunications Cabling and Components  
 Standards

TIA-569 (2019e) Telecommunications Pathways and  
 Spaces

#### U.S. DEPARTMENT OF ENERGY (DOE)

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

#### U.S. GREEN BUILDING COUNCIL (USGBC)

LEED v4 BDC Ref Guide (2013; R 2020) USGBC LEED Reference Guide  
 for Building Design and Construction, v4

LEED v4.1 BDC Ref Guide (2023) LEED v4.1 Building Design and  
 Construction Reference Guide

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

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

#### UNDERWRITERS LABORATORIES (UL)

UL 723 (2018) UL Standard for Safety Test for  
 Surface Burning Characteristics of  
 Building Materials

UL 1286 (2008; Reprint Apr 2021) UL Standard for  
 Safety Office Furnishings

UL 2818 (2013) GREENGUARD Certification Program  
 For Chemical Emissions For Building  
 Materials, Finishes And Furnishings

## 1.2 SUSTAINABILITY REPORTING

Work of this section is intended to contribute to the achievement of, or  
 compliance with, the requirements of the Guiding Principles Validation and  
 LEED Prerequisites and attempted Credits. Refer to Section 01 33 29.00 06  
 SUSTAINABILITY REPORTING for specific documentation requirements and list  
 of Prerequisites, attempted Credits and LEED version.

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Comply with product, material content, performance criteria, activity, documentation, and other technical requirements as described in the LEED v4 BDC Ref Guide or LEED v4.1 BDC Ref Guide as applicable.

Collect, organize, and submit product data, drawings, diagrams, photos and cost information necessary to demonstrate compliance with LEED v4 BDC Ref Guide or LEED v4.1 BDC Ref Guide requirements as applicable.

Data collection shall commence with the notice to proceed and will only be deemed complete upon acceptance of the Final Sustainability Notebook and LEED Online submission by the Contracting Officer, the LEED Project Administrator, and the Green Building Certification Institute.

### 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

Warranty; G

Workstations

Power and Communications

Communications

Recycled Content for system furniture components; S

Energy Star Label for Task Lighting; S

Environmental Product Declarations; S

Embodied Carbon Optimization Report/Action Plan; S

Extended Producer Responsibility; S

Local/Regional Materials; S

Material Ingredient Reporting; S

#### SD-04 Samples

Workstations; G

Mock-up; G

Samples

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SD-06 Test Reports

Selected Components; G

Fire Safety; G

Electrical System; G

SD-07 Certificates

Workstations

Indoor Air Quality For Office Furniture Systems And Seating; S

SD-10 Operation and Maintenance Data

Assembly Manuals; G

Maintenance Manuals; G

Cleaning; G

Electrical System; G

Maintenance Agreements

Installation; G

1.4 SUSTAINABLE DESIGN REQUIREMENTS

1.4.1 Environmental Product Declarations

At a minimum, use materials or products with an Environmental Product Declaration in accordance with the LEED Implementation Plan. See Section 01 33 29.00 06 SUSTAINABILITY REPORTING for cumulative materials requirements and LEED Implementation Plan.

1.4.2 Embodied Carbon Optimization Report/Action Plan

At a minimum, use materials or products with an Embodied Carbon Optimization Report/Action Plan in accordance with the LEED Implementation Plan. See Section 01 33 29.00 06 SUSTAINABILITY REPORTING for cumulative materials requirements and LEED Implementation Plan.

1.4.3 Sourcing of Raw Materials

Provide products that meet one or more of the following categories:

1.4.3.1 Extended Producer Responsibility

At a minimum, use materials or products from manufacturers that participate in an extended producer responsibility program in accordance with the LEED Implementation Plan. Provide manufacturer letter verifying extended producer responsibility program is in place and that product is eligible. See Section 01 33 29.00 06 SUSTAINABILITY REPORTING for cumulative materials requirements and LEED Implementation Plan.

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#### 1.4.3.2 Recycled Content Materials

At a minimum, use materials or products with recycled content in accordance with the LEED Implementation Plan. Provide manufacturers product literature identifying the percentage of recycled material incorporated within each product used. See Section 01 33 29.00 06 SUSTAINABILITY REPORTING for cumulative materials requirements and LEED Implementation Plan. If recycled content minimum is specified in this section, the greater of the two percentages governs.

#### 1.4.4 Material Ingredient Reporting

At a minimum, use materials or products with chemical inventory to at least 0.1% (1000 ppm) in accordance with the LEED Implementation Plan. Provide Health Product Declaration (HPD), Cradle to Cradle Certificate, Declare label, or other manufacturer's published content inventory in compliance with LEED v4.1 Material Ingredient Reporting credit. See Section 01 33 29.00 06 SUSTAINABILITY REPORTING for cumulative materials requirements and LEED Implementation Plan.

#### 1.4.5 Local/Regional Materials

Use materials or products extracted, harvested, or recovered, as well as manufactured, within a 100 mile radius from the project site, if available from a minimum of three sources. provide a letter from the manufacturer stating the extraction location, manufacturing location, and purchasing location of the products provided, referencing the project name and location specifically and distance to the project site. See Section 01 33 29.00 06 SUSTAINABILITY REPORTING for cumulative materials requirements and LEED Implementation Plan.

### 1.5 CERTIFICATIONS

#### 1.5.1 Indoor Air Quality Certifications

##### 1.5.1.1 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.

### 1.6 QUALITY ASSURANCE

#### 1.6.1 General Safety

Provide workstation products free of rough or sharp edges. Provide desk-based workstation components with an option for a positive, integral locking device that secures components to the base units.

#### 1.6.2 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.

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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.

#### 1.6.3 Electrical System

Task lights are required to be UL listed and installation of task lighting must meet the requirements of NFPA 70. The electrical system must meet the requirements of UL 1286. Submit three sets of electrical system manuals describing the functions, configuration, and maintenance of the electrical system (power , communications ). This material may be included in the Assembly or Maintenance manuals at the Contractor's option.

#### 1.6.4 Detail Drawings

Submit detail drawings showing communications, electronic data processing (EDP) and local area network (LAN); locations may be provided as a separate submittal from remaining workstation drawings. Provide drawing requirements, which are the furniture manufacturer's responsibility, as a single submittal. Provide electronic drawings to the user for future re-configuration in the software package requested by the user. Include in the electronic drawings all modifications made during installation. As a minimum, submit the following:

- a. Overall reference drawings: Drawings showing workstation locations and overall plan view within each floor in a scale of 1/8 inch = 1 foot. Layouts must reflect field verified conditions and clearly illustrate the overall space planning concept and intent.
- b. Installation drawings: Drawings showing workstations, panels, components, and plan view within each floor. Identify workstations by workstation type; submit drawings showing the proposed workstation installation at a scale of 1/4 inch = 1 foot, unless otherwise specified. Installation drawings must reflect field verified conditions.
- c. Workstation elevations: Dimensioned workstation elevations showing each type of workstation with panel frame configurations and all components identified with manufacturer's catalog numbers. Draw elevations at 1/2 inch = 1 foot scale.
- d. Panel drawings: Panel drawings showing locations and critical dimensions from finished face of walls, columns, panels, including clearances and aisle widths. Key assemblies to a legend which includes width, height, configuration and composition of frame covers finishes and fabrics (if different selections exist within a project), power or nonpower, connectors and wall mount hardware. Coordinate panel placement with location of electrical, voice/data LAN, 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 (base feeds), activated power receptacles and other electrical components. Wiring configuration (circuiting, switching, internal and external connections) identified and a legend provided as applicable. Identify which receptacles in typical furniture configurations will be connected to controlled building power circuits as applicable to meet ASHRAE 90.1 - IP requirements. Coordinate with electrical drawings.

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- 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.

#### 1.7 DELIVERY, STORAGE, AND HANDLING

Deliver components to the jobsite in the manufacturer's original packaging with the brand, item identification, and project reference clearly marked. Remove furniture from packaging and store in an unoccupied, dry location that is ventilated. Storage shall be free from dirt and dust, water, and other contaminants, and in a manner that permits easy access for inspection and handling.

#### 1.8 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.

#### 1.9 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



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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 System Furniture Components used on the interior of the building (defined as inside of the weatherproofing system) that meets emissions requirements of ANSI/BIFMA e3-2014e or ANSI/BIFMA e3-2019 FURNITURE SUSTAINABILITY STANDARD, Section 7.6.1 (for half credit by cost) or 7.6.2 (for full credit by cost) or 7.6.2 and 7.6.3 (for one and one quarter credit by cost). 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

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tackboard).

- b. Workstation component finishes. Minimum 2-1/2 by 3 inches with label designating the manufacturer, material composition, thickness, color, and finish.

#### 2.2.3 Mock-up

Submit a Mock-up of an actual workstation reflecting approved finishes and fabrics. Locate the mock-up installation at approved off-site location. Do not order product for the project until the mock-up has been approved. Submit manufacturer's product and construction specifications which provide technical data for furniture system and components specified, including task lighting and illumination performance information. Include adequate information in the literature to verify that the proposed product meets the specification. Review of the mock-up may result in adjustments to the product, layout and finishes. The approved mock-up can be used in installation.

#### 2.2.4 Alternate Design

Manufacturers who are unable to provide workstations that conform exactly to the furniture layouts and typical workstation types shown in the contract drawings, may submit alternate designs for consideration by the Contracting Officer. Alternate designs must meet or exceed the following criteria. Alternate designs that are submitted but do not meet these criteria will be rejected. In the alternate design provide workstations and components of the same basic size and configuration shown, with only the sizes of the individual components within the workstation changed to meet the standard product of the manufacturer or site conditions.

##### 2.2.4.1 Component Requirements

Provide the types of components or elements as shown on the drawings and as specified in PART 2 PRODUCTS of this specification. Do not reduce the storage capacity, number of workstations accommodated, width of aisles, or workstation configuration.

##### 2.2.4.2 Wiring Configuration

Alternate configurations shall support the circuiting and connection capabilities identified under the provisions pertaining to power distribution of paragraph POWER AND COMMUNICATIONS. Generally any alternate will be acceptable which involves only a variation in size or quantity that exceeds the specified configuration.

#### 2.2.5 Performance Requirements

Panels, frames and frame covers, connection system, work surfaces, pedestals, shelf units, overhead door cabinets, lateral files, locks, accessories, and miscellaneous hardware must meet testing as specified. ISO 9001 certified manufacturers may perform in-house testing. Manufacturers not ISO 9001 qualified will be required to produce testing by an independent testing laboratory. Component specific requirements are listed in appropriate paragraphs.

##### 2.2.5.1 Selected Components

Workstation conformance to ANSI/BIFMA X5.5 and ANSI/BIFMA X5.6 is required

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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.

#### 2.2.6 Pattern and Color

Provide pattern and color of finishes and fabrics for panel systems, components, and trim in accordance with 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. Segments will be field removable from both sides of the panel. Provide capability for work surfaces to attach to the panels in 1 - 2 inch increments. Provide a spine wall system where electrical and data management will be easily accessible by removable wall covers that can be removed while workstation components are still attached. Cables must be laid in the system, not threaded through the frame. Provide a panel system that is available in a variety of nominal widths and heights as designated on the drawings. Measure heights from the finished floor to the top of the panel. Supply powered and nonpowered panels that are compatible in height. Coordinate panel heights with the HVAC and electrical designs. Minimum panel thickness is 3 inches thick. Submit three sets of Assembly Manuals describing assembly and reconfiguration procedures.

#### 2.3.2 Panel Finishes

Provide panels in the following options: tackable fabric, . Exposed panel trim to have a factory baked enamel or epoxy powder finish. Do not provide filler trim. Provide each fabric-faced panel with a seamless width of fabric stretched over the entire face of the panel. The fabric color throughout the installation must be consistent. Curved panels may use adhesives on curved sections. Attach the fabric securely and continuously along the entire perimeter of the panel and allow for easy removal and replacement in the field.

#### 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.

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### 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. Provide, as required, the continuation of electrical and communications wiring within workstations and from workstation to workstation. Filler posts must be level with the top rail.

### 2.4 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. 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 electrical control. Provide work surfaces as shown on the drawings and include hardware necessary to provide firm and rigid support.

#### 2.5.2 Finishes

Provide work surfaces with a finished top surface of high pressure plastic laminate and a smoothly finished underside. The work surface must not be damaged by ordinary household solvents, acids, alcohols, or salt solutions. Provide metal support brackets that match the color and finish of trim. Provide 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

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size specified.

#### 2.6.1 Construction

Provide pedestals and drawers of steel construction. Securely attach drawer faces to the drawer front.

#### 2.6.2 Finishes

Provide a factory baked enamel finish or powder coated for steel surfaces. Provide steel drawer fronts.

#### 2.6.3 Drawer Requirements

Pedestals must be field interchangeable from left to right, and right to left, and must retain the pedestal locking system capability. Design pedestals to protect wires from being damaged by drawer operation. Provide pedestals that are support work surfaces,. Drawers must stay securely closed when in the closed position and provide each drawer with a safety catch to prevent accidental removal when fully open. File drawers to be provided with full extension ball bearing drawer slides or rack and pinion suspension. File drawers to be provided with hanging folder frames or rails and capable of hanging side-to-side or front-to-back. Provide dividers with vertical files. Provide box drawers with pencil trays.

### 2.7 STORAGE

Provide storage units in the sizes and configurations shown on the drawings. Provide task lights under overhead cabinets and shelf units.

#### 2.7.1 Overhead Cabinet Construction

Provide metal construction overhead cabinets.

#### 2.7.2 Lateral File 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.

#### 2.7.3 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 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

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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.

#### 2.8.2 Monitor Arm

Provide monitor arm that allows 360 degree monitor rotation for portrait and landscape viewing, and 60 degree range of lateral and vertical monitor tilt for additional viewing adjustability. Provide monitor arm that supports monitors weighing 7 to 19 lbs. Provide dual monitor arm for 2 screens ..

#### 2.9 MISCELLANEOUS HARDWARE

Provide brackets, supports, hangers, clips, panel supported legs, connectors, adjustable feet, cover plates, stabilizers, and other miscellaneous hardware that contribute to a complete and operable furniture system.

#### 2.10 LOCKS AND KEYING

Provide overhead cabinets, vertical files, 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 both powered and nonpowered panels with base raceways capable of distributing power circuits, communication cables . Provide nonpowered bases that are capable of easy field conversion to powered base without requiring the panel to be dismantled or removed from the workstation. Provide panels able to support lay-in cabling and having a large capacity for power and data. Provide ample space for storing excess wires and fiber optic cables in the interior of the spine wall frame. Provide easy access to power and data systems in the spine wall without having to move return panels or components. Provide the ability for the spine wall system to supply power to a wall-attached panel system and/or an adjacent desk system. A termination center or utility closet may be utilized in the wall or at the end of a panel run. Provide copper wiring harnesses for the system and meet the requirements of UL 1286 and NFPA 70, Article 605. Provide conductors with 20 amp 90 degree C, #12 AWG wires (unless indicated otherwise) or the equivalent in the bus configuration. A single circuit must not serve more than four (4) cubicles or workstations under any circumstances. The label or listing of Underwriter's Laboratories, Inc. will be accepted as evidence that the material or equipment conforms to the applicable standards of that agency. In lieu of this label or listing, submit a statement from a nationally recognized, adequately equipped testing agency indicating that the items have been tested in

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accordance with required procedures of UL and that the materials and equipment comply with contract requirements. Electrical work not addressed in this section must conform to the requirements of Section 26 20 00 INTERIOR DISTRIBUTION SYSTEM.

#### 2.11.1 Panel Raceways

Provide panels that have hinged or removable covers that permit easy access to the raceway when required but are securely mounted and cannot be accidentally dislodged under normal conditions. Place raceways in locations such as the base, beltline, and below and above the beltline. The raceway must not extend past either panel face or frame cover by more than 1/2 inch. Provide metal or plastic covers which attach securely to the raceway as required and match the finish and color of the panel trim. Provide a minimum of 2 knockouts (doors) per side for power receptacles and communications jacks as indicated in raceways on panel frames. Provide other raceways that are flush with panel face.

#### 2.11.2 Power Distribution

Provide power distribution as indicated on the drawings. Provide an internal power and communications raceway and the capability of disconnecting and connecting external circuits to the electrified raceway in the panel. Capacity for at least twelve 4-pair category 6 cables is required for the communications receiving raceway. Power and communications wiring may share a common wireway if a metal divider is included to ensure electrical isolation. Provide doors or access openings for entry of communications cable. Provide the electrified power raceway for the 10-wire configuration indicated.

Unless otherwise indicated, allocate conductors of the 10-wire system as follows (4-4-2 independent neutrals, 2+2): the three-phase system will have two equipment grounds, four neutral, and four phase conductors; one neutral will be dedicated to each phase conductor; one ground conductor will be shared by two circuits, the other ground will be shared by the other two circuits.

##### 2.11.2.1 Receptacles

Provide power receptacles in the powered panels. Place devices at a density of three duplex receptacles per workstation and connected to the designated circuits. Unless otherwise indicated, receptacles must be 20 amp (NEMA 5-20R) commercial grade conforming to NEMA WD 1 and NEMA WD 6. Provide 10 percent spare devices of each type shown on these plans if receptacles are not interchangeable or will not permit field adjustment of phase and circuit selection. General use receptacles are required to be of the duplex configuration; unless otherwise indicated. Coordinate the color of receptacle bodies with the color of the panel trim. Furniture receptacles whose building power supply circuit is controlled by an occupancy sensor will be identified using the standard symbol shown in NFPA 70 Figure 406.3(E); each outlet on a multi-outlet receptacle shall be identified individually. 25% of receptacles in systems furniture that is located in open office areas shall be controlled by occupancy. Provide field applied identification of controlled receptacles that is permanent; stick-on or non-setting adhesives are not acceptable. Provide 5 percent spare devices for each configuration and type of receptacle. Provide a minimum of 5 receptacle removal tools for systems that require special tools for proper receptacle removal.

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#### 2.11.2.2 Power Cabling Variations

The paragraph Power Distribution has identified specific cabling configurations. Since universal conventions have not been established, variant configurations available from various manufacturers will be considered. Alternates shall allow the same circuiting, device connections, neutral and ground separation, and upstream feeder connections as shown on the plans. See paragraph ALTERNATE DESIGN. An example of an acceptable variation includes the use of a manufacturer's configuration which allocates individual conductors differently, but which has the same quantity of conductors and allows devices to be physically connected in the field as shown on the plans. It is not necessary that the manufacturer's labeling codes or terminology match the designations used on project plans or in the specifications; however, neutrals and grounds shall have insulation color coded per standard practice or be provided with tags, colored tape, colored ribbons or similar identification. (The reference to "dedicated" conductors in this specification pertains to circuit connections upstream and load connections downstream of panels; it is not necessary that manufacturer's designations correspond.)

#### 2.11.3 Electrical Connections

##### 2.11.3.1 Internal Connections

Utilize straight or flexible plug/receptacle connector assemblies for internal panel-to-panel power connections and provide the powered configurations shown on the drawings.

##### 2.11.3.2 Connections to Building Services

Supply external power and communications services to the panels via direct-wired entry modules. Extend wiring from building services to junction box assemblies in metal conduit or tubing. Provide wiring from junction boxes that is flexible liquid-tight conduit 6 foot maximum or in metal conduit or tubing. Do not use cord and plug assemblies for any portion of external links. External wiring must conform to Section 26 20 00 INTERIOR DISTRIBUTION SYSTEM.

##### 2.11.4 Wire Management

Provide wire management capability at all workstations and accommodate all cable types specified, including the applicable manufacturer required bending radius at corners. Design raceways and interfaces to the raceways to accommodate the bend radius as shown in TIA-569 for Category 6A communication wiring. Copper and fiber cabling shall meet the requirements of Section 27 10 00 BUILDING TELECOMMUNICATIONS CABLING SYSTEM. The capability may be accomplished by cable access cutouts (1 minimum per work surface), covered wire management troughs in vertical end panels, horizontal wiring troughs, internal midpanel (beltline) raceways, or rear gaps (between the back edge of the work surface and the facing support panel). Provide grommet kits or another suitable finish arrangement for all cable cutouts. Provide accessories for an externally mounted vertical and horizontal wire management and concealment system as recommended by the manufacturer. Supply horizontal wire managers for mounting under all work surfaces. Attach the wire managers either to the underside of the work surface or to the vertical panel without damaging the face. Exposed or loose wiring will not be acceptable. Wire managers must be prefinished and secure, conceal, and accommodate outlet cords as



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well as electrical and communications wiring. Wire channels are required to match color of panel trim, attach by means of clip-on attachment, and conceal wires routed vertically. Separate power wiring from communication wiring by use of separate raceways or by placement of channels in joint use troughs or wireways.

#### 2.11.5 Circuit Layout

Provide the circuit layout for workstations on the drawings. Connect devices to the designated circuits in the neutral, ground, and automatic control configurations indicated. Connections must be made to the building electrical distribution system as shown on the contract drawings and in accordance with Section 26 20 00 INTERIOR DISTRIBUTION SYSTEM.

#### 2.11.6 Task Lighting

Provide task lights with light emitting diode (LED) technology to include a built-in reflector and shielding device that prevents direct glare into an occupant's eyes when they are in a typical working position. Provide task light size and placement. It is required that lights be a standard component of the manufacturer's workstation products, and the ends of the task light length can not extend beyond the edges of the overhead cabinet. Enclose task light power cords within vertical wire cover or clips. Luminaires shall be UL approved for use in the configurations indicated on the drawings. Provide task lighting that is Energy Star labeled. Provide data identifying Energy Star label for task lighting.

##### 2.11.6.1 Luminaire Configuration

Provide luminaires and lamps as specified in Section 26 51 00 INTERIOR LIGHTING and modified herein. For undershelf or undercabinet lighting, provide luminaires that are light emitting diode (LED) type and have prismatic lenses, baffles, or other shielding device configured to minimize glare by shielding the lamp from view of the seated user. Provide task lights for each workstation with a minimum of 60 footcandles of light (horizontally measured) without veiling reflections, on the work surface directly below and a maximum of 20 inches from the luminaire. Easily removable diffusers, grilles, or other coverings are required to allow for cleaning and relamping. For LED-type task lighting, power consumption shall not exceed 8 watts per foot. Correlated Color Temperature (CCT) of task lighting shall match the CCT of the ambient room lighting. Provide an easily accessible on-off switch and one ballast or driver per luminaire. A variable intensity control is acceptable if the low setting is equivalent to "off" with zero energy consumption. Multiple level switching is also acceptable. For LED type technology, ganged luminaires or shared drivers are permitted for up to 4 continuous feet in length. A single driver designed for use with an individual LED housing of greater than 4 feet in length is allowed.

##### 2.11.6.2 Wiring

Provide each luminaire with a 6 foot minimum, factory installed, heavy duty electrical cordset with a grounded plug for luminaires that are mounted on the same wall as the receptacle. Provide luminaires mounted on non-powered wall with a 9 foot minimum, factory installed heavy duty electrical cordset with a grounded plug. Direct or hard wire connections are not acceptable. Unless otherwise indicated, conceal cord. Built-in cord concealment is required within panels or utilize field installed, manufacturer approved accessories. Cords may be extended through

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dedicated channels located at any point within panels or may be placed in vertical slots or in the space between panels if held in place by retainers and concealed by a cover plate. Vertical wire managers are required to be prefinished and cut to size and shall extend from the task light level down to the top of the work surface below the task light. Attach each manager to a panel vertical edge or connector strip without damage to the surfaces.

#### 2.11.6.3 Control Device

For furniture with automatically-controlled building supply power circuits, task lighting shall be connected to occupancy-sensor-controlled circuit. Provide task lighting with a manual ON/OFF switch.

#### 2.11.7 Communications

Communications wiring will be extended to, and installed in, the electrified panels as shown on the plans. Install communications jacks at designated locations. Communications work may be performed in conjunction with the installation of workstations or may be separately executed at the Contractor's option; however, equipment, materials, and installation must conform to the requirements of Section 27 10 00 BUILDING TELECOMMUNICATIONS CABLING SYSTEM, and properly coordinate all interfaces.

### 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 00 80 00.00 06 SPECIAL PROVISIONS. 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 21 13 13

WET PIPE SPRINKLER SYSTEMS, FIRE PROTECTION  
08/20

## PART 1 GENERAL

## 1.1 REFERENCES

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

## AMERICAN SOCIETY OF MECHANICAL ENGINEERS (ASME)

ASME B16.1	(2020) Gray Iron Pipe Flanges and Flanged Fittings Classes 25, 125, and 250
ASME B16.3	(2016) Malleable Iron Threaded Fittings, Classes 150 and 300
ASME B16.4	(2016) Standard for Gray Iron Threaded Fittings; Classes 125 and 250
ASME B16.18	(2018) Cast Copper Alloy Solder Joint Pressure Fittings
ASME B16.21	(2016) Nonmetallic Flat Gaskets for Pipe Flanges
ASME B16.22	(2018) Standard for Wrought Copper and Copper Alloy Solder Joint Pressure Fittings
ASME B16.26	(2018) Standard for Cast Copper Alloy Fittings for Flared Copper Tubes

## AMERICAN SOCIETY OF SANITARY ENGINEERING (ASSE)

ASSE 1013	(2021) Performance Requirements for Reduced Pressure Principle Backflow Prevention Assemblies
ASSE 1015	(2021) Performance Requirements for Double Check Backflow Prevention Assemblies

## AMERICAN WATER WORKS ASSOCIATION (AWWA)

AWWA C104/A21.4	(2016) Cement-Mortar Lining for Ductile-Iron Pipe and Fittings for Water
AWWA C110/A21.10	(2012) Ductile-Iron and Gray-Iron Fittings for Water
AWWA C111/A21.11	(2017) Rubber-Gasket Joints for Ductile-Iron Pressure Pipe and Fittings
AWWA C203	(2020) Coal-Tar Protective Coatings and

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# Linings for Steel Water Pipelines - Enamel and Tape - Hot-Applied

AWWA M14 (2015) Manual: Recommended Practice for  
 Backflow Prevention and Cross-Connection  
 Control

## ASTM INTERNATIONAL (ASTM)

ASTM A47/A47M (1999; R 2018; E 2018) Standard  
 Specification for Ferritic Malleable Iron  
 Castings

ASTM A53/A53M (2020) Standard Specification for Pipe,  
 Steel, Black and Hot-Dipped, Zinc-Coated,  
 Welded and Seamless

ASTM A135/A135M (2021) Standard Specification for  
 Electric-Resistance-Welded Steel Pipe

ASTM A153/A153M (2016a) Standard Specification for Zinc  
 Coating (Hot-Dip) on Iron and Steel  
 Hardware

ASTM A183 (2014; R 2020) Standard Specification for  
 Carbon Steel Track Bolts and Nuts

ASTM A536 (1984; R 2019; E 2019) Standard  
 Specification for Ductile Iron Castings

ASTM B62 (2017) Standard Specification for  
 Composition Bronze or Ounce Metal Castings

ASTM B75/B75M (2020) Standard Specification for Seamless  
 Copper Tube

ASTM B88 (2020) Standard Specification for Seamless  
 Copper Water Tube

ASTM F442/F442M (2020) Standard Specification for  
 Chlorinated Poly(Vinyl Chloride) (CPVC)  
 Plastic Pipe (SDR-PR)

## 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

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#### NATIONAL FIRE PROTECTION ASSOCIATION (NFPA)

NFPA 13	(2019; Errata 19-1; Errata 19-2; TIA 19-1; TIA 19-2; TIA 19-3; TIA 19-4; Errata 19-3; Errata 20-4; TIA 19-5; TIA 19-6) Standard for the Installation of Sprinkler Systems
NFPA 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 291	(2016) Recommended Practice for Fire Flow Testing and Marking of Hydrants
NFPA 1963	(2019) Standard for Fire Hose Connections

#### NATIONAL INSTITUTE FOR CERTIFICATION IN ENGINEERING TECHNOLOGIES (NICET)

NICET 1014-7	(2012) Program Detail Manual for Certification in the Field of Fire Protection Engineering Technology (Field Code 003) Subfield of Automatic Sprinkler System Layout
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#### UNDERWRITERS LABORATORIES (UL)

UL 199	(2020) UL Standard for Safety Automatic Sprinklers for Fire-Protection Service
UL 262	(2004; Reprint Oct 2011) Gate Valves for Fire-Protection Service
UL 312	(2010; Reprint Mar 2018) UL Standard for Safety Check Valves for Fire-Protection Service
UL 405	(2013; Bul. 2020) UL Standard for Safety Fire Department Connection Devices
UL 668	(2004; Reprint Jul 2016) UL Standard for Safety Hose Valves for Fire-Protection Service
UL 789	(2004; Reprint May 2017) UL Standard for Safety Indicator Posts for Fire-Protection Service
UL Fire Prot Dir	(2012) Fire Protection Equipment Directory

#### 1.2 SYSTEM DESCRIPTION

Provide wet pipe sprinkler areas indicated on the drawings. Except as modified herein, the system must meet the requirements of NFPA 13. Pipe

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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 10/13/2022 at near Bradly Dr. and resulted in a static pressure of 47 psi with a residual pressure of 39 psi while flowing 876 gpm. Perform a new fire hydrant flow test prior to shop drawing submittal in accordance with NFPA 291. Results must include hydrant elevations relative to the building and hydrant number/identifiers for the tested hydrants, including which were flowed, which had a gauge. This information must be presented in a tabular form if multiple hydrants were flowed. The results must be included with the hydraulic calculations. Hydraulic calculations must be based upon the Hazen-Williams formula with a "C" value noted in NFPA 13 for piping. Hydraulic calculations must be based on operation of the fire pump(s) provided in Section 21 30 00 FIRE PUMPS. The minimum residual pressure in a service lateral (lead-in) at the 150 percent of the fire pump rated flow must be 20 psi at the suction side of the fire pump.

#### 1.2.1.2 Hydraulic Calculations

- a. Water supply curves and system requirements must be plotted on semi-logarithmic graph ( $N^{1.85}$ ) paper so as to present a summary of the complete hydraulic calculation.
- b. Provide a summary sheet listing sprinklers in the design area and their respective hydraulic reference points, elevations, minimum discharge pressures and minimum flows. Elevations of hydraulic reference points (nodes) must be indicated.
- c. Documentation must identify each pipe individually and the nodes connected thereto. Indicate the diameter, length, flow, velocity, friction loss, number and type fittings, total friction loss in the pipe, equivalent pipe length and Hazen-Williams coefficient for each pipe.
- d. Where the sprinkler system is supplied by interconnected risers, the sprinkler system must be hydraulically calculated using the hydraulically most demanding single riser. The calculations must not assume the simultaneous use of more than one riser.
- e. All calculations must include the backflow preventer manufacturer's stated friction loss at the design flow or 8 psi for double check backflow preventer, whichever is greater.
- f. All calculations must be performed back to the actual location of the flow test, taking into account the direction of flow in the service main at the test location.
- g. For gridded systems, calculations must show peaking of demand area friction loss to verify that the hydraulically most demanding area is being used. A flow diagram indicating the quantity and direction of flows must be included.

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#### 1.2.1.3 Design Criteria

Hydraulically design the system to discharge a minimum density as indicated on the drawings. Hydraulic calculations must be in accordance with the Area/Density Method of NFPA 13. Add an allowance for exterior hose streams of 500 gpm to the sprinkler system demand at the point of connection to the existing water system.

#### 1.2.2 Sprinkler Coverage

Sprinklers must be uniformly spaced on branch lines. Provide coverage throughout 100 percent of the area noted on the Contract drawings. This includes, but is not limited to, telephone rooms, electrical equipment rooms (regardless of the fire resistance rating of the enclosure), boiler rooms, switchgear rooms, transformer rooms, attached electrical vaults and other electrical and mechanical spaces. Coverage per sprinkler must be in accordance with NFPA 13. Provide sprinklers below all obstructions in accordance with NFPA 13.

#### 1.2.3 Qualified Fire Protection Engineer (QFPE)

An individual who is a licensed professional engineer(P.E.) who has passed the fire protection engineering written examination administered by the National Council of Examiners for Engineering and Surveying (NCEES) and has relevant fire protection engineering experience. Services of the QFPE must include:

- a. Reviewing SD-02, SD-03, and SD-05 submittal packages for completeness and compliance with the provisions of this specification. Working (shop) drawings and calculations must be prepared by, or prepared under the immediate supervision of, the QFPE. The QFPE must affix their professional engineering stamp with signature to the shop drawings, calculations, and material data sheets, indicating approval prior to submitting the shop drawings to the DFPE.
- b. Provide a letter documenting that the SD-02, SD-03, and SD-05 submittal package has been reviewed and noting all outstanding comments.
- c. Performing in-progress construction surveillance prior to installation of ceilings (rough-in inspection).
- d. Witnessing pre-Government and final Government functional performance testing and performing a final installation review.
- e. Signing applicable certificates under SD-07.

#### 1.3 SUBMITTALS

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

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Shop drawings (SD-02), product data (SD-03) and calculations (SD-05) must be prepared by the designer and combined and submitted as one complete package. The QFPE must review the SD-02/SD-03/SD-05 submittal package for completeness and compliance with the Contract provisions prior to submission to the Government. The QFPE must provide a Letter of Confirmation that they have reviewed the submittal package for compliance with the contract provisions. This letter must include their professional engineer stamp and signature. Partial submittals and submittals not reviewed by the QFPE must be returned disapproved without review.

Submit the following in accordance with Section 01 33 00 SUBMITTAL PROCEDURES:

SD-01 Preconstruction Submittals

Qualified Fire Protection Engineer (QFPE); G, AE

Sprinkler System Designer; G, AE

Sprinkler System Installer; G, AE

SD-02 Shop Drawings

Shop Drawing; G, AE

SD-03 Product Data

Pipe; G, AE

Fittings; G, AE

Valves, including gate, check, butterfly, and globe; G, AE

Relief Valves; G, AE

Sprinklers ; G, AE

Pipe Hangers and Supports ; G, AE

Valve Supervisory (Tamper) Switch; G, AE

Fire Department Connection; G, AE

Backflow Prevention Assembly; G, AE

Air Vent; G, AE

Hose Valve; G, AE

Nameplates; G, AE

SD-05 Design Data

Hydraulic Calculations; G, AE

SD-06 Test Reports

Test Procedures; G, AE



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SD-07 Certificates

Verification of Compliant Installation; G, AE

Request for Government Final Test; G, AE

SD-10 Operation and Maintenance Data

Operating and Maintenance (O&M) Instructions; G, AE

Spare Parts Data; G, AE

SD-11 Closeout Submittals

As-built drawings

1.4 QUALITY ASSURANCE

1.4.1 Preconstruction Submittals

Within 36 days of contract award but no less than 14 days prior to commencing work on site, the prime Contractor must submit the following for review and approval. SD-02, SD-03 and SD-05 submittals received prior to the review and approval of the qualifications will be returned Disapproved Without Review.

1.4.1.1 Shop Drawing

\_\_\_3\_\_\_ 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

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room.

- g. Details of each type of riser assembly, pipe hanger, and restraint of underground water main at point-of-entry into the building, and electrical devices and interconnecting wiring. The dimension from the edge of vertical piping to the nearest adjacent wall(s) must be indicated on the drawings when vertical piping is located in stairs or other portions of the means of egress.
- h. Details of each type of pipe hanger and related components.
- i. Include fire pump curve with shop drawings and hydraulic calculations.

#### 1.4.1.2 Product Data

3 copies of annotated catalog data to show the specific model, type, and size of each item. Catalog cuts must also indicate the NRTL listing. The data must be highlighted to show model, size, options, and other pertinent information, that are intended for consideration. Data must be adequate to demonstrate compliance with all contract requirements. Product data for all equipment must be combined into a single submittal.

#### 1.4.1.3 Hydraulic Calculations

Calculations must be as outlined in NFPA 13 except that calculations must be performed by computer using software intended specifically for fire protection system design using the design data shown on the drawings. Calculations must include isometric diagram indicating hydraulic nodes and pipe segments. Include fire pump curve with submittal.

#### 1.4.1.4 Operating and Maintenance (O&M) Instructions

Submit in accordance with Section 01 78 23 OPERATION AND MAINTENANCE DATA as supplemented and modified by this specification section.

Provide six manuals and one pdf version on electronic media. The manuals must include the manufacturer's name, model number, parts list, list of parts and tools that should be kept in stock by the owner for routine maintenance, troubleshooting guide, and recommended service organization (including address and telephone number) for each item of equipment. Each service organization submitted must be capable of providing 4-hour on-site response to a service call on an emergency basis.

Submit spare parts data for each different item of material and equipment specified. The data must include a complete list of parts and supplies, and a list of parts recommended by the manufacturer to be replaced after 1-year and 3 years of service. Include a list of special tools and test equipment required for maintenance and testing of the products supplied.

#### 1.4.2 Qualifications

##### 1.4.2.1 Sprinkler System Designer

The sprinkler system designer must be certified as a Level III Technician by National Institute for Certification in Engineering Technologies (NICET) in the Water-Based Systems Layout subfield of Fire Protection Engineering Technology in accordance with NICET 1014-7.

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#### 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

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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 10 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 Gate Valve and Indicator Posts

Installation must comply with NFPA 24. Gate valves for use with indicator post must conform to UL 262. Indicator posts must conform to UL 789. Provide each indicator post with one coat of primer and two coats of red enamel paint.

#### 2.2.4 Buried Utility Warning and Identification Tape

Provide detectable aluminum foil plastic backed tape or detectable magnetic plastic tape manufactured specifically for warning and identification of buried piping. Tape must be detectable by an electronic detection instrument. Provide tape, 3 inches minimum width, color coded for the utility involved with warning and identification imprinted in bold block letters continuously and repeatedly over the entire tape length. Warning and identification must read "CAUTION BURIED WATER PIPING BELOW" or similar wording. Use permanent code and letter coloring unaffected by moisture and other substances contained in trench backfill material.

### 2.3 ABOVEGROUND PIPING COMPONENTS

#### 2.3.1 Steel Piping Components

##### 2.3.1.1 Steel Pipe

Except as modified herein, steel pipe must be black as permitted by NFPA 13 and conform to the applicable provisions of ASTM A53/A53M, ASTM A135/A135M or ASTM A153/A153M.

Steel pipe must be minimum Schedule 40 for sizes 2 inches and less; and minimum Schedule 10 for sizes larger than 2 inches. Steel piping with wall

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thickness less than Schedule 40 must not be threaded. Grooved pipe must be cut-grooved.

#### 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. Saddle tees using rubber gasketed fittings are permitted only when connecting to existing piping for additions or modifications. Saddle tees must use a connection method that completely wraps around the pipe. 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 Copper Tube

Copper tube must conform to ASTM B88, Types L and M.

#### 2.3.3 Copper Fittings and Joints

Cast copper alloy solder-joint pressure fittings must conform to ASME B16.18 and wrought copper and bronze solder-joint pressure fittings must conform to ASME B16.22 and ASTM B75/B75M. Cast copper alloy fittings for flared copper tube must conform to ASME B16.26 and ASTM B62. Brass or bronze adapters for brazed tubing may be used for connecting tubing to flanges and to threaded ends of valves and equipment.

#### 2.3.4 Plastic Pipe

Plastic pipe must be chlorinated polyvinyl chloride (CPVC) conforming to ASTM F442/F442M, 175 psi rating and listed for use in wet pipe sprinkler systems.

#### 2.3.5 Plastic Fittings

Plastic fittings must be chlorinated polyvinyl chloride (CPVC) and listed for use in wet pipe sprinkler systems.

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### 2.3.6 Pipe Hangers and Supports

Provide galvanized pipe hangers and supports in accordance with NFPA 13.

### 2.3.7 Valves

Provide valves of types approved for fire service. Valves must open by counterclockwise rotation.

#### 2.3.7.1 Control Valve

Manually operated sprinkler control/gate valve must be as indicated on the drawings and must be listed.

#### 2.3.7.2 Check Valves

Check valves must comply with UL 312. Check valves 4 inches and larger must be of the swing type, have a clear waterway and meet the requirements of MSS SP-71, for Type 3 or 4. Inspection plate must be provided on valves larger than 6 inches.

#### 2.3.7.3 Hose Valve

Valve must comply with UL 668.

### 2.3.8 Riser Check Valves

Provide riser check valve, pressure gauges and main drain.

## 2.4 ALARM INITIATING AND SUPERVISORY DEVICES

### 2.4.1 Valve Supervisory (Tamper) Switch

Switch must be integral to the control valve or suitable for mounting to the type of control valve to be supervised open. The switch must be tamper resistant and contain SPDT (Form C) contacts arranged to transfer upon removal of the housing cover or closure of the valve of more than two rotations of the valve stem.

## 2.5 BACKFLOW PREVENTION ASSEMBLY

Double-check valve assembly backflow preventer complying with ASSE 1013, ASSE 1015 and AWWA M14. Each check valve must have a drain. Backflow prevention assemblies must have current "Certificate of Approval from the Foundation for Cross-Connection Control and Hydraulic Research, FCCCHR List" and be listed for fire protection use. Listing of the specific make, model, design, and size in the FCCCHR List is acceptable as the required documentation.

### 2.5.1 Backflow Preventer Test Connection

Test connection must consist of a series of listed hose valves with 2 1/2-inch National Standard male hose threads with cap and chain.

## 2.6 FIRE DEPARTMENT CONNECTION

Fire department connection must be flush type with cast-brass body, matching wall escutcheon lettered "Auto Spkr" with a polished-brass

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finish. The connection must have individual self-closing clappers, caps with drip drains and chains. Female inlets must have 2 1/2-inch diameter American National Fire Hose Connection Screw Threads (NH) per NFPA 1963 . Comply with UL 405.

## 2.7 SPRINKLERS

Sprinklers must comply with UL 199 and NFPA 13. Sprinklers with internal O-rings are not acceptable. Sprinklers in high heat areas including attic spaces or in close proximity to unit heaters must have temperature classification in accordance with NFPA 13. Extended coverage sprinklers are permitted for loading docks, residential occupancies and high-piled storage applications only.

### 2.7.1 Pendent Sprinkler

Pendent sprinkler must be recessed quick-response type with nominal K-factor of as indicated on the drawings. Pendent sprinklers must have a white polyester finish. Assembly must include an integral escutcheon.

### 2.7.2 Upright Sprinkler

Upright sprinkler must be brass and have a nominal K-factor of as indicated on the drawings.

## 2.8 ACCESSORIES

### 2.8.1 Sprinkler Cabinet

Provide spare sprinklers in accordance with NFPA 13 and must be placed in a suitable metal or plastic cabinet of sufficient size to accommodate all the spare sprinklers and wrenches in designated locations. Spare sprinklers must be representative of, and in proportion to, the number of each type and temperature rating of the sprinklers installed as required by NFPA 13. At least one wrench of each type required must be provided.

### 2.8.2 Pendent Sprinkler Escutcheon

Escutcheon must be one-piece metallic type with a depth of less than 3/4-inch and suitable for installation on pendent sprinklers. The escutcheon must have a factory finish that matches the pendent sprinkler.

### 2.8.3 Pipe Escutcheon

Provide split hinge metal plates for piping entering walls, floors, and ceilings in exposed spaces. Provide polished stainless steel plates or chromium-plated finish on copper alloy plates in finished spaces. Provide paint finish on metal plates in unfinished spaces.

### 2.8.4 Sprinkler Guard

Listed guard must be a steel wire cage designed to encase the sprinkler and protect it from mechanical damage. Guards must be provided on sprinklers located within 7 feet of the floor.

### 2.8.5 Relief Valve

Relief valves must be listed and installed at the riser in accordance with NFPA 13.

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#### 2.8.6 Air Vent

Air vents must be of the automatic type and piped to drain to the building exterior.

#### 2.8.7 Identification Sign

Valve identification sign must be minimum 6 inches wide by 2 inches high with enamel baked finish on minimum 18 gage steel or 0.024-inch aluminum with red letters on a white background or white letters on red background. Wording of sign must include, but not be limited to "main drain", "auxiliary drain", "inspector's test", "alarm test", "alarm line", and similar wording as required to identify operational components. Where there is more than one sprinkler system, signage must include specific details as to the respective system.

### PART 3 EXECUTION

#### 3.1 VERIFYING ACTUAL FIELD CONDITIONS

Before commencing work, examine all adjoining work on which the contractor's work that is dependent for perfect workmanship according to the intent of this specification section, and report to the Contracting Officer's Representative a condition that prevents performance of first class work. No "waiver of responsibility" for incomplete, inadequate or defective adjoining work will be considered unless notice has been filed before submittal of a proposal.

#### 3.2 INSTALLATION

The installation must be in accordance with the applicable provisions of NFPA 13, NFPA 24 and publications referenced therein. Locate sprinklers in a consistent pattern with ceiling grid, lights, and air supply diffusers. Install sprinkler system over and under ducts, piping and platforms when such equipment can negatively affect or disrupt the sprinkler discharge pattern and coverage.

- a. Piping offsets, fittings, and other accessories required must be furnished to provide a complete installation and to eliminate interference with other construction.
- b. Wherever the contractor's work interconnects with work of other trades the Contractor must coordinate with other Contractors to insure all Contractors have the information necessary so that they may properly install all necessary connections and equipment. Identify all work items needing access (dampers and similar equipment) that are concealed above hung ceilings by permanent color coded pins/tabs in the ceiling directly below the item.
- c. Provide required supports and hangers for piping, conduit, and equipment so that loading will not exceed allowable loadings of structure. Submittal of a bid must be a deemed representation that the contractor submitting such bid has ascertained allowable loadings and has included in his estimates the costs associated in furnishing required supports.



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### 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 42 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 not 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.

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- 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 and 6 inches for copper tube.

#### 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

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or floor and be cut flush with each wall surface. Sleeves must provide required clearance between the pipe and the sleeve per NFPA 13. The space between the sleeve and the pipe must be firmly packed with mineral wool insulation.

- b. Where pipes and sleeves penetrate fire walls, fire partitions, or floors, pipes/sleeves must be firestopped in accordance with Section 07 84 00 FIRESTOPPING.
- c. In penetrations that are not fire-rated or not a floor penetration, the space between the sleeve and the pipe must be sealed at both ends with plastic waterproof cement that will dry to a firm but pliable mass or with a mechanically adjustable segmented elastomer seal.
- d. All penetrations through the boundary of rooms/areas identified as secure space area must meet ICS 705-1.

#### 3.4.9 Escutcheons

Escutcheons must be provided for pipe penetration in finished areas of ceilings, floors and walls. Escutcheons must be securely fastened to the pipe at surfaces through which piping passes.

#### 3.4.10 Inspector's Test Connection

Unless otherwise indicated, the test connection must consist of 1-inch pipe connected at the riser as a combination test and drain valve; a test valve located approximately 7 feet above the floor; a smooth bore brass outlet equivalent to the smallest orifice sprinkler used in the system; and a painted metal identification sign affixed to the valve with the words "Inspector's Test". All test connection piping must be inside of the building and penetrate the exterior wall at the location of the discharge orifice only. The discharge orifice must be located outside the building wall no more than 2 feet above finished grade, directed so as not to cause damage to adjacent construction or landscaping during full flow discharge, or to the sanitary sewer. Discharge to the exterior must not interfere with exiting from the facility. Water discharge or runoff must not cross the path of egress from the building. Do not discharge to the roof. Discharge to floor drains, janitor sinks or similar fixtures is not permitted.

Provide concrete splash blocks at all drain and inspector's test connection discharge locations if not discharging to a concrete surface. Splash blocks must be large enough to mitigate erosion and not become dislodged during a full flow of the drain. Ensure all discharged water drains away from the facility and does not cause property damage.

#### 3.4.11 Backflow Preventer

Locate within the building or in a heated enclosure in locations subject to freezing. For heated enclosures, provide a low temperature supervisory alarm connected to the facility fire alarm system. Heat trace is not permitted to be used.

Install backflow preventers so that the bottom of the assembly is a minimum of 6 inches above the finished floor/grade. Install horizontal backflow preventers so that the bottom of the assembly is no greater than 24 inches above the finished floor/grade. Install vertical backflow preventers so that the upper operating handwheel is no more than 6 feet

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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 the location indicated. Provide a concrete splash block at drain outlet. Discharge to the exterior must not interfere with exiting from the facility. Water discharge or runoff must not cross the path of egress from the building.
- b. Auxiliary drains must be provided as required by NFPA 13. Auxiliary drains are permitted to discharge to a floor drain if the drain is sized to accommodate full flow (min 40 gpm). Discharge to service sinks or similar plumbing fixtures is not permitted.

#### 3.4.13 Installation of Fire Department Connection

Connection must be mounted on the exterior wall approximately 3 feet above finished grade adjacent to and on the sprinkler system side of the backflow preventer. The piping between the connection and the check valve must be provided with an automatic drip in accordance with NFPA 13 and piped to drain to the outside or a floor drain within the same room.

#### 3.4.14 Identification Signs

Signs must be affixed to each control valve, inspector test valve, main drain, auxiliary drain, test valve, and similar valves as appropriate or as required by NFPA 13. Main drain test results must be etched into main drain identification sign. Hydraulic design data must be etched into the nameplates and permanently affixed to each sprinkler riser as specified in NFPA 13. Provide labeling on the surfaces of all feed and cross mains to show the pipe function (e.g., "Sprinkler System", "Fire Department Connection", "Standpipe") and normal valve position (e.g. "Normally Open", "Normally Closed"). For pipe sizes 4-inch and larger provide white painted stenciled letters and arrows, a minimum of 2 inches in height and visible from at least two sides when viewed from the floor. For pipe sizes less than 4-inch, provide white painted stenciled letters and arrows, a minimum of 0.75-inch in height and visible from the floor. Provide properly lettered and approved metal sign to elevator flow switch stating the circuits' voltage, and identify the switch as an "Elevator Power Shunt Flow Switch".

### 3.5 ELECTRICAL

Except as modified herein, electric equipment and wiring must be in accordance with Section 26 20 00 INTERIOR DISTRIBUTION SYSTEM.

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### 3.6 PAINTING

Color code mark piping red as specified in Section 09 90 00 PAINTS AND COATINGS.

### 3.7 FIELD QUALITY CONTROL

#### 3.7.1 Test Procedures

Submit detailed test procedures, prepared and signed by the NICET Level III or Fire Sprinkler Technician, and the representative of the installing company, and reviewed by the QFPE days prior to performing system tests. Detailed test procedures must list all components of the installed system. Test procedures must include sequence of testing, time estimate for each test, and sample test data forms. The test data forms must be in a check-off format (pass/fail with space to add applicable test data; similar to the forms in NFPA 13). The test procedures and accompanying test data forms must be used for the pre-Government testing and the Government final testing.

- a. Provide space to identify the date and time of each test. Provide space to identify the names and signatures of the individuals conducting and witnessing each test.

#### 3.7.2 Pre-Government Testing

##### 3.7.2.1 Verification of Compliant Installation

Conduct inspections and tests to ensure that equipment is functioning properly. Tests must meet the requirements of paragraph entitled "Minimum System Tests" and "System Acceptance" as noted in NFPA 13. The Contractor and QFPE must be in attendance at the pre-Government testing to make necessary adjustments. After inspection and testing is complete, provide a signed Verification of Compliant Installation letter by the QFPE that the installation is complete, compliant with the specification and fully operable. The letter must include the names and titles of the witnesses to the pre-Government tests. Provide all completion documentation as required by NFPA 13 and the test reports noted below.

- a. NFPA 13 Aboveground Material and Test Certificate
- b. NFPA 13 Underground Material and Test Certificate

##### 3.7.2.2 Request for Government Final Test

When the verification of compliant installation has been completed, submit a formal request for Government final test to the Contracting Officers Designated Representative (COR). Government final testing will not be scheduled until the COR has received copies of the request for Government final testing and Verification of Compliant Installation letter with all required reports. Government final testing will not be performed until after the connections to the building fire alarm system and installation fire alarm reporting system have been completed and tested to confirm communications are fully functional. Submit request for test at least 15 calendar days prior to the requested test date.

#### 3.7.3 Correction of Deficiencies

If equipment was found to be defective or non-compliant with contract

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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 COR. 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 Contracting Officer. At this time, all required tests noted in the paragraph "Minimum System Tests" must be repeated at their discretion.

### 3.8 MINIMUM SYSTEM TESTS

The system, including the underground water mains, and the aboveground piping and system components, must be tested to ensure that equipment and components function as intended. The underground and aboveground interior piping systems and attached appurtenances subjected to system working pressure must be tested in accordance with NFPA 13 and NFPA 24.

#### 3.8.1 Underground Piping

##### 3.8.1.1 Flushing

Underground piping must be flushed at a minimum of 10 fps in accordance with NFPA 20.

##### 3.8.1.2 Hydrostatic Test

New underground piping must be hydrostatically tested in accordance with NFPA 24.

#### 3.8.2 Aboveground Piping

##### 3.8.2.1 Hydrostatic Test

Aboveground piping must be hydrostatically tested in accordance with NFPA 13. There must be no drop in gauge pressure or visible leakage when the system is subjected to the hydrostatic test. The test pressure must be read from a gauge located at the low elevation point of the system or portion being tested.

##### 3.8.2.2 Backflow Prevention Assembly Forward Flow Test

Each backflow prevention assembly must be tested at system flow demand, including all applicable hose streams, as specified in NFPA 13. The Contractor must provide all equipment and instruments necessary to conduct a complete forward flow test, including 2.5-inch diameter hoses, playpipe nozzles or flow diffusers, calibrated pressure gauges, and pitot tube gauge. The Contractor must provide all necessary supports to safely secure hoses and nozzles during the test. At the system demand flow, the pressure readings and pressure drop (friction loss) across the assembly must be

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recorded. A metal placard must be provided on the backflow prevention assembly that lists the pressure readings both upstream and downstream of the assembly, total pressure drop, and the system test flow rate determined during the preliminary testing. The pressure drop must be compared to the manufacturer's data and the readings observed during the final inspections and tests.

### 3.8.3 Main Drain Flow Test

Following flushing of the underground piping, a main drain test must be made to verify the adequacy of the water supply. Static and residual pressures must be recorded on the certificate specified in paragraph SUBMITTALS.

### 3.9 SYSTEM ACCEPTANCE

Following acceptance of the system, as-built drawings and O&M manuals must be delivered to the Contracting Officer for review and acceptance. Submit six sets of detailed as-built drawings. The drawings must show the system as installed, including deviations from both the project drawings and the approved shop drawings. These drawings must be submitted within two weeks after the final acceptance test of the system. At least one set of as-built (marked-up) drawings must be provided at the time of, or prior to the final acceptance test.

- a. Provide one set of full size paper as-built drawings and schematics. The drawings must be prepared electronically and sized no less than the contract drawings. Furnish one set of CDs or DVDs containing software back-up and CAD based drawings in latest version of MicroStationAutoCAD, DXF and portable document formats of as-built drawings and schematics.
- b. Provide operating and maintenance (O&M) instructions.

### 3.10 ONSITE TRAINING

Conduct a training course for the responding fire department and operating and maintenance personnel as designated by the Contracting Officer. Training must be performed on two separate days (to accommodate different shifts of Fire Department personnel) for a period of 4hours 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 30 00

### FIRE PUMPS

04/08, CHG 1: 08/13

#### PART 1 GENERAL

##### 1.1 SUMMARY

Except as modified in this Section or on the drawings, install fire pumps in conformance with NFPA 20, NFPA 70, and NFPA 72. In the event of a conflict between specific provisions of this specification and applicable NFPA standards, this specification governs. Devices and equipment for fire protection service must be UL Fire Prot Dir listed or FM APP GUIDE approved. Interpret all reference to the authority having jurisdiction to mean the Contracting Officer.

##### 1.2 SEQUENCING

###### 1.2.1 Primary Fire Pump

Primary fire pump shall automatically operate when the pressure drops to 35 psi. The fire pump shall automatically stop operating when the system pressure reaches 120 psi and after the fire pump has operated for the minimum 10 minutes pump run time specified herein.

###### 1.2.2 Pressure Maintenance Pump

Pressure maintenance pump shall operate when the system pressure drops to 110 psi. Pump shall automatically stop when the system pressure reaches 120 psi and after the pump has operated for the minimum 10 Minutes pump run time specified herein.

##### 1.3 FIRE PUMP INSTALLATION RELATED SUBMITTALS

The Fire Protection Specialist shall prepare a list of the submittals, from the Contract Submittal Register, that relate to the successful installation of the fire pump(s), no later than 7 days after the approval of the Fire Protection Specialist and the Manufacturer's Representative. The submittals identified on this list shall be accompanied by a letter of approval signed and dated by the Fire Protection Specialist when submitted to the Government.

##### 1.4 REFERENCES

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

#### AMERICAN SOCIETY OF MECHANICAL ENGINEERS (ASME)

ASME B16.3 (2016) Malleable Iron Threaded Fittings, Classes 150 and 300

ASME B16.5 (2020) Pipe Flanges and Flanged Fittings NPS 1/2 Through NPS 24 Metric/Inch Standard



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ASME B16.18	(2018) Cast Copper Alloy Solder Joint Pressure Fittings
ASME B16.22	(2018) Standard for Wrought Copper and Copper Alloy Solder Joint Pressure Fittings
ASME B16.26	(2018) Standard for Cast Copper Alloy Fittings for Flared Copper Tubes
ASME B16.39	(2020) Standard for Malleable Iron Threaded Pipe Unions; Classes 150, 250, and 300
ASME B31.1	(2020) 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
AWWA C606	(2015) Grooved and Shouldered Joints

#### ASTM INTERNATIONAL (ASTM)

ASTM A47/A47M	(1999; R 2018; E 2018) Standard Specification for Ferritic Malleable Iron Castings
ASTM A53/A53M	(2020) 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	(2020) Standard Specification for Alloy-Steel and Stainless Steel Bolting Materials for High-Temperature Service and Other Special Purpose Applications
ASTM A194/A194M	(2020a) Standard Specification for Carbon Steel, Alloy Steel, and Stainless Steel Nuts for Bolts for High-Pressure or High-Temperature Service, or Both
ASTM A449	(2014; R 2020) Standard Specification for Hex Cap Screws, Bolts, and Studs, Steel, Heat Treated, 120/105/90 ksi Minimum Tensile Strength, General Use
ASTM A536	(1984; R 2019; E 2019) Standard Specification for Ductile Iron Castings

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ASTM A795/A795M	(2021) Standard Specification for Black and Hot-Dipped Zinc-Coated (Galvanized) Welded and Seamless Steel Pipe for Fire Protection Use
ASTM B42	(2020) Standard Specification for Seamless Copper Pipe, Standard Sizes
ASTM B62	(2017) Standard Specification for Composition Bronze or Ounce Metal Castings
ASTM B75/B75M	(2020) Standard Specification for Seamless Copper Tube
ASTM B88	(2020) Standard Specification for Seamless Copper Water Tube
ASTM B135/B135M	(2017) Standard Specification for Seamless Brass Tube
ASTM D2000	(2018) Standard Classification System for Rubber Products in Automotive Applications
ASTM D3308	(2012; R 2017) Standard Specification for PTFE Resin Skived Tape
ASTM F436	(2011) Hardened Steel Washers

#### FM GLOBAL (FM)

FM APP GUIDE	(updated on-line) Approval Guide <a href="http://www.approvalguide.com/">http://www.approvalguide.com/</a>
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#### NATIONAL ELECTRICAL MANUFACTURERS ASSOCIATION (NEMA)

NEMA MG 1	(2018) Motors and Generators
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#### NATIONAL FIRE PROTECTION ASSOCIATION (NFPA)

NFPA 20	(2018; ERTA 1 2018; TIA 18-1; TIA 18-2) Standard for the Installation of Stationary Pumps for Fire Protection
NFPA 70	(2020; ERTA 20-1 2020; ERTA 20-2 2020; TIA 20-1; TIA 20-2; TIA 20-3; TIA 20-4) National Electrical Code
NFPA 72	(2019; TIA 19-1; ERTA 1 2019; TIA 21-1; ERTA 1 2021) National Fire Alarm and Signaling Code
NFPA 1963	(2019) Standard for Fire Hose Connections

#### UNDERWRITERS LABORATORIES (UL)

UL 448	(2020) UL Standard for Safety Centrifugal Stationary Pumps for Fire-Protection Service
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UL 1247 (2007; Reprint Jun 2020) Diesel Engines  
for Driving Stationary Fire Pumps

UL Fire Prot Dir (2012) Fire Protection Equipment Directory

## 1.5 SUBMITTALS

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

### SD-01 Preconstruction Submittals

Fire Pump Installation Related Submittals; G, AE

Fire Protection Specialist; G, AE

No later than 14 days after the Notice to Proceed and prior to the submittal of the fire pump installation drawings

### SD-02 Shop Drawings

Installation Drawings; G, AE

3 copies

As-Built Drawings; G, AE

Piping Layout; G, AE

Pump Room; G, AE

### SD-03 Product Data

Catalog Data; G, AE

Spare Parts

Preliminary Tests

At least 14 days prior to the proposed date and time to begin Preliminary Tests

Field Tests; G, AE

At least 2 weeks before starting field tests

Manufacturer's Representative; G, AE

Field Training; G, AE

Army Final Acceptance Test

### SD-06 Test Reports

Preliminary Tests

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3 copies of the completed Preliminary Tests Reports, no later than 7 days after the completion of the Preliminary Tests.

Army Final Acceptance Test

#### SD-07 Certificates

Fire Protection Specialist

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, AE

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.

### 1.6 EXTRA MATERIALS

Submit Spare Parts data for each different item of equipment and material specified. The data shall include a complete list of parts and supplies, with current unit prices and source of supply, and a list of parts recommended by the manufacturer to be replaced after 1 year and 3 years of service. Include a list of special tools and test equipment required for maintenance and testing of the products supplied by the Contractor.

### 1.7 QUALITY ASSURANCE

#### 1.7.1 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.

#### 1.7.2 Qualifications of Welders

Submit certificates of each welder's qualifications prior to site welding; certifications shall not be more than one year old.

#### 1.7.3 Qualifications of Installer

Prior to installation, submit data for approval showing that the Contractor has successfully installed fire pumps and associated equipment

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of the same type and design as specified herein, or that he has a firm contractual agreement with a subcontractor having such required experience. The data shall include the names and locations of at least two installations where the Contractor, or the subcontractor referred to above, has installed such systems. Indicate the type and design of each system and certify that each system has performed satisfactorily in the manner intended for a period of not less than 18 months.

#### 1.7.4 Preliminary Test Certification

When preliminary tests have been completed and corrections made, submit a signed and dated certificate with a request for a formal inspection and tests.

#### 1.7.5 Final Test Certification

Concurrent with the Final Acceptance Test Report, submit certification by the Fire Protection Specialist that the fire pump installation is in accordance with the contract requirements, including signed approval of the Preliminary and Final Acceptance Test Reports.

#### 1.7.6 Manufacturer's Representative

Work specified in this section shall be performed under the supervision of and certified by a representative of the fire pump manufacturer. Submit the name and documentation of certification of the proposed Manufacturer's Representative, concurrent with submittal of the Fire Protection Specialist Qualifications. The Manufacturer's Representative shall be regularly engaged in the installation of the type and complexity of fire pump(s) specified in the Contract documents, and shall have served in a similar capacity for at least three systems that have performed in the manner intended for a period of not less than 6 months.

#### 1.8 DELIVERY, STORAGE, AND HANDLING

Protect all equipment delivered and placed in storage from the weather, excessive humidity and temperature variations, dirt and dust, or other contaminants. Additionally, all pipes shall be either capped or plugged until installed.

### PART 2 PRODUCTS

#### 2.1 MATERIALS AND EQUIPMENT

- a. Materials and equipment shall be standard products of a manufacturer regularly engaged in the manufacture of such products and shall essentially duplicate items that have been in satisfactory use for at least 2 years prior to bid opening.
- b. Submit manufacturer's catalog data included with the Fire Pump Installation Drawings for each separate piece of equipment proposed for use in the system. Catalog data shall indicate the name of the manufacturer of each item of equipment, with data annotated to indicate model to be provided. In addition, a complete equipment list that includes equipment description, model number and quantity shall be provided. Catalog data for material and equipment shall include, but not be limited to, the following:

- (1) Fire pumps, drivers and controllers including manufacturer's

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certified shop test characteristic curve for each pump. Shop test curve may be submitted after approval of catalog data but shall be submitted prior to the final tests.

- (2) Pressure maintenance pump and controller.
- (3) Piping components.
- (4) Valves, including gate, check, globe and relief valves.
- (5) Gauges.
- (6) Hose valve manifold test header and hose valves.
- (7) Flow meter.
- (8) Restrictive orifice union.
- (9) Associated devices and equipment.

- c. All equipment shall have a nameplate that identifies the manufacturer's name, address, type or style, model or serial number, contract number and accepted date; capacity or size; system in which installed and system which it controls and catalog number. Pumps and motors shall have standard nameplates securely affixed in a conspicuous place and easy to read. Fire pump shall have nameplates and markings in accordance with UL 448. Diesel driver shall have nameplate and markings in accordance with UL 1247. Electric motor nameplates shall provide the minimum information required by NFPA 70, Section 430-7.

## 2.2 FIRE PUMP

Fire pump shall be electric motor driven. Each pump capacity shall be rated at 1000 gpm with a rated net pressure of 65 psi. Fire pump shall furnish not less than 150 percent of rated flow capacity at not less than 65 percent of rated net pressure. Pump shall be centrifugal vertical in-line fire pump. The maximum rated pump speed shall be 1765 rpm when driving the pump at rated capacity. Pump shall be automatic start and automatic stop. Pump shall conform to the requirements of UL 448. Fire pump discharge and suction gauges shall be oil-filled type.

## 2.3 REQUIREMENTS FOR FIRE PROTECTION SERVICE

### 2.3.1 General Requirements

Materials and Equipment shall have been tested by Underwriters Laboratories, Inc. and listed in UL Fire Prot Dir or approved by Factory Mutual and listed in FM APP GUIDE. Where the terms "listed" or "approved" appear in this specification, such shall mean listed in UL Fire Prot Dir or FM APP GUIDE.

### 2.3.2 Alarms

Provide audible and visual alarms as required by NFPA 20 on the controller. Provide remote supervision as required by NFPA 20, in accordance with NFPA 72. Provide remote alarm devices located as indicated on the drawings. Alarm signal shall be activated upon the following conditions: electric motor controller has operated into a pump running

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condition, loss of electrical power to electric motor starter, and phase reversal on line side of motor starter. Exterior alarm devices shall be weatherproof type. Provide alarm silencing switch and red signal lamp, with signal lamp arranged to come on when switch is placed in OFF position.

## 2.4 ABOVEGROUND PIPING COMPONENTS

### 2.4.1 Pipe Sizes 2.5 inches and Larger

#### 2.4.1.1 Pipe

Piping shall be ASTM A53/A53M or ASTM A795/A795M, Weight Class STD (Standard), Schedule 40 (except for Schedule 30 for pipe sizes 8 inches and greater in diameter), Type E or Type S, Grade A; black steel pipe. Steel pipe shall be joined by means of flanges welded to the pipe or mechanical grooved joints only. Piping shall not be jointed by welding or weld fittings. Suction piping shall be galvanized on the inside in accordance with NFPA 20.

#### 2.4.1.2 Grooved Mechanical Joints and Fittings

Joints and fittings shall be designed for not less than 175 psi service and shall be the product of the same manufacturer. Fitting and coupling houses shall be malleable iron conforming to ASTM A47/A47M, Grade 32510; ductile iron conforming to ASTM A536, Grade 65-45-12. Gasket shall be the flush type that fills the entire cavity between the fitting and the pipe. Nuts and bolts shall be heat-treated steel conforming to ASTM A183 and shall be cadmium plated or zinc electroplated.

#### 2.4.1.3 Flanges

Flanges shall be ASME B16.5, Class 150 flanges. Flanges shall be provided at valves, connections to equipment, and where indicated.

#### 2.4.1.4 Gaskets

Gaskets shall be AWWA C111/A21.11, cloth inserted red rubber gaskets.

#### 2.4.1.5 Bolts

Bolts shall be ASTM A449, Type 1 or 2 or ASTM A193/A193M, Grade B7. Bolts shall extend no less than three full threads beyond the nut with bolts tightened to the required torque.

#### 2.4.1.6 Nuts

Nuts shall be ASTM A194/A194M, Grade 7 or ASTM A193/A193M, Grade 5.

#### 2.4.1.7 Washers

Washers shall meet the requirements of ASTM F436. Flat circular washers shall be provided under all bolt heads and nuts.

### 2.4.2 Piping Sizes 2 inches and Smaller

#### 2.4.2.1 Steel Pipe

Steel piping shall be ASTM A795/A795M, Weight Class STD (Standard), Schedule 40, Type E or Type S, Grade A, zinc-coated steel pipe with

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threaded end connections. Fittings shall be ASME B16.3 or ASME B16.39, Class 150, zinc-coated threaded fittings. Unions shall be ASME B16.39, Class 150, zinc-coated unions.

#### 2.4.2.2 Copper Tubing

Copper tubing shall be ASTM B88, Type L or K, soft annealed. Fittings shall be ASME B16.26, flared joint fittings. Pipe nipples shall be ASTM B42 copper pipe with threaded end connections.

#### 2.4.3 Pipe Hangers and Supports

Pipe hangers and support shall be UL listed UL Fire Prot Dir or FM approved FM APP GUIDE and shall be the adjustable type. Finish of rods, nuts, washers, hangers, and supports shall be zinc-plated after fabrication.

#### 2.4.4 Valves

Valves shall be UL listed UL Fire Prot Dir or FM approved FM APP GUIDE for fire protection service. Valves shall have flange or threaded end connections.

##### 2.4.4.1 Gate Valves and Control Valves

Gate valves and control valves shall be outside screw and yoke (O.S.&Y.) type which open by counterclockwise rotation. Butterfly-type control valves are permitted at the locations indicated on the drawings.

##### 2.4.4.2 Tamper Switch

The suction control valves, the discharge control valves, valves to test header and flow meter, and the by-pass control valves shall be equipped with valve tamper switches for monitoring by the fire alarm system.

##### 2.4.4.3 Check Valve

Check valve shall be clear open, swing type check valve with flange or threaded inspection plate.

#### 2.4.5 Hose Valve Manifold Test Header

Construct header of steel pipe. Provide ASME B16.5, Class 150 flanged inlet connection to hose valve manifold assembly. Provide approved bronze hose gate valve with 2.5 inch National Standard male hose threads with cap and chain; locate 3 feet above grade in the horizontal position for each test header outlet. Welding shall be metallic arc process in accordance with ASME B31.1.

#### 2.4.6 Pipe Sleeves

A pipe sleeve shall be provided at each location where piping passes entirely through walls, ceilings, roofs, and floors, including pipe entering buildings from the exterior. Secure sleeves in position and location during construction. Provide sleeves of sufficient length to pass through entire thickness of walls, ceilings, and floors. Provide one inch minimum clearance between exterior of piping or pipe insulation, and interior of sleeve or core-drilled hole. Firmly pack space with mineral wool insulation. Seal space at both ends of the sleeve or core-drilled



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hole with plastic waterproof cement which will dry to a firm but pliable mass, or provide a mechanically adjustable segmented elastomeric seal. In fire walls and fire floors, a fire seal shall be provided between the pipe and the sleeve in accordance with Section 07 84 00 FIRESTOPPING.

- a. Sleeves in Masonry and Concrete Walls, Ceilings, Roofs, and Floors: Provide hot-dip galvanized steel, ductile-iron, or cast-iron pipe sleeves. Core drilling of masonry and concrete may be provided in lieu of pipe sleeves provided that cavities in the core-drilled hole be completely grouted smooth.
- b. Sleeves in Other Than Masonry and Concrete Walls, Ceilings, Roofs, and Floors: Provide galvanized steel sheet pipe not less than 0.90 psf.

#### 2.4.7 Escutcheon Plates

Provide one-piece or split-hinge metal plates for piping entering floors, walls, and ceilings in exposed areas. Provide polished stainless steel or chromium-plated finish on copper alloy plates in finished spaces. Provide paint finish on plates in unfinished spaces. Plates shall be secured in place.

### 2.5 DISINFECTING MATERIALS

#### 2.5.1 Liquid Chlorine

Liquid chlorine shall conform to AWWA B301.

#### 2.5.2 Hypochlorites

Calcium hypochlorite and sodium hypochlorite shall conform to AWWA B300.

### 2.6 ELECTRIC MOTOR DRIVER

Motors, controllers, contactors, and disconnects shall be provided with their respective pieces of equipment, as specified herein and shall have electrical connections provided under Section 26 20 00 INTERIOR DISTRIBUTION SYSTEM. Controllers and contactors shall have a maximum of 120-volt control circuits, and auxiliary contacts for use with the controls furnished. When motors and equipment furnished are larger than sizes indicated, the cost of providing additional electrical service and related work shall be included under this section. Motor shall conform to NEMA MG 1 Design B type. Integral size motors shall be the premium efficiency type in accordance with NEMA MG 1. Motor horsepower shall be of sufficient size so that the nameplate horsepower rating will not be exceeded throughout the entire published pump characteristic curve. The motor and fire pump controller shall be fully compatible.

### 2.7 FIRE PUMP CONTROLLER

Controller shall be the automatic type and UL listed UL Fire Prot Dir or FM approved FM APP GUIDE for fire pump service. Pump shall be arranged for automatic start and stop, and manual push-button stop. Automatic stopping shall be accomplished only after all starting causes have returned to normal and after a minimum pump run time has elapsed. Controllers shall be completely terminally wired, ready for field connections, and mounted in a NEMA Type 2 drip-proof enclosure arranged so that controller current carrying parts will not be less than 12 inches above the floor. Controller shall be provided with voltage surge

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arresters installed in accordance with NFPA 20. Controller shall be equipped with a bourdon tube pressure switch or a solid state pressure switch with independent high and low adjustments, automatic starting relay actuated from normally closed contacts, visual alarm lamps and supervisory power light. Controller shall be equipped 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. The controller shall be factory-equipped with a heater operated by thermostat to prevent moisture in the cabinet.

#### 2.7.1 Controller for Electric Motor Driven Fire Pump

Controller shall be electronic soft startwye-delta, open circuit transition starting type. Controller shall be designed for 45.5 HP at 480 volts as indicated. Controller shall have a short circuit rating of 65k amps r.m.s. symmetrical at 480 volts a.c.. Controller shall monitor pump running, loss of a phase or line power, phase reversal and pump room temperature. Alarms shall be individually displayed in front of panel by lighting of visual lamps. Each lamp shall be labeled with rigid etched plastic labels. Controller shall be equipped with terminals for remote monitoring of pump running, pump power supply trouble (loss of power or phase and phase reversal), and pump room trouble (pump room temperature), and for remote start. Limited service fire pump controllers are not permitted, except for fire pumps driven by electric motors rated less than 15 hp. Controller shall be equipped with a 7-day electric pressure recorder with 24-hour spring wound back-up. The pressure recorder shall provide a readout of the system pressure from 0 to 15 hp, time, and date. Controller shall require the pumps to run for ten minutes for pumps with driver motors under 200 horsepower and for 15 minutes for pumps with motors 200 horsepower and greater, prior to automatic shutdown. The controller shall be equipped with an externally operable isolating switch which manually operates the motor circuit. Means shall be provided in the controller for measuring current for all motor circuit conductors.

#### 2.8 PRESSURE SENSING LINE

A completely separate pressure sensing line shall be provided for each fire pump and for the jockey pump. The sensing line shall be arranged in accordance with Figure A-7-5.2.1. of NFPA 20. The sensing line shall be 1/2 inchH58 brass tubing complying with ASTM B135/B135M. The sensing line shall be equipped with two restrictive orifice unions each. Restricted orifice unions shall be ground-face unions with brass restricted diaphragms drilled for a 3/32 inch. Restricted orifice unions shall be mounted in the horizontal position, not less than 5 feet apart on the sensing line. Two test connections shall be provided for each sensing line. Test connections shall consist of two brass 1/2 inch globe valves and 1/4 inch gauge connection tee arranged in accordance with NFPA 20. One of the test connections shall be equipped with a 0 to 300 psi water oil-filled gauge. Sensing line shall be connected to the pump discharge piping between the discharge piping control valve and the check valve.

#### 2.9 PRESSURE MAINTENANCE PUMP

##### 2.9.1 General

Pressure maintenance pump shall be electric motor driven, horizontal shaft centrifugal type with a rated discharge of 15 gpm at 100 psig. Pump shall draft from the suction supply side of the suction pipe gate valve of the fire pumpas indicated and shall discharge into the system at the

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downstream side of the pump discharge gate valve. An approved indicating gate valve of the outside screw and yoke (O.S.&Y.) type shall be provided in the maintenance pump discharge and suction piping. Oil-filled water pressure gauge and approved check valve in the maintenance pump discharge piping shall be provided. Check valve shall be swing type with removable inspection plate.

#### 2.9.2 Pressure Maintenance Pump Controller

Pressure maintenance pump controller shall be arranged for automatic and manual starting and stopping and equipped with a "manual-off-automatic" switch. The controller shall be completely prewired, ready for field connections, and wall-mounted in a NEMA Type 2 drip-proof enclosure. The controller shall be equipped with a bourdon tube pressure switch or a solid state pressure switch with independent high and low adjustments for automatic starting and stopping. A sensing line shall be provided connected to the pressure maintenance pump discharge piping between the control valve and the check valve. The sensing line shall conform to paragraph, PRESSURE SENSING LINE. The sensing line shall be completely separate from the fire pump sensing lines. An adjustable run timer shall be provided to prevent frequent starting and stopping of the pump motor. The run timer shall be set for 2 minutes.

#### 2.10 JOINTS AND FITTINGS FOR COPPER TUBE

Wrought copper and bronze solder-joint pressure fittings shall conform to ASME B16.22 and ASTM B75/B75M. Cast copper alloy solder-joint pressure fittings shall conform to ASME B16.18. Cast copper alloy fittings for flared copper tube shall conform to ASME B16.26 and ASTM B62. Brass or bronze adapters for brazed tubing may be used for connecting tubing to flanges and to threaded ends of valves and equipment. Extracted brazed tee joints produced with an acceptable tool and installed as recommended by the manufacturer may be used. Grooved mechanical joints and fittings shall be designed for not less than 125 psig service and shall be the product of the same manufacturer. Grooved fitting and mechanical coupling housing shall be ductile iron conforming to ASTM A536. Gaskets for use in grooved joints shall be molded synthetic polymer of pressure responsive design and shall conform to ASTM D2000 for circulating medium up to 239 degrees F. Grooved joints shall conform to AWWA C606. Coupling nuts and bolts for use in grooved joints shall be steel and shall conform to ASTM A183.

#### 2.11 PUMP BASE PLATE AND PAD

Provide a common base plate for each horizontal-shaft fire pump for mounting pump and driver unit. Construct the base plate of cast iron with raised lip tapped for drainage or welded steel shapes with suitable drainage. Provide each base plate for the horizontal fire pumps with a 1 inch galvanized steel drain line piped to the nearest floor drain. For vertical shaft pumps, pump head shall be provided with a cast-iron base plate and shall serve as the sole plate for mounting the discharge head assembly. Mount pump units and bases on a raised 6 inches reinforced concrete pad that is an integral part of the reinforced concrete floor.

#### 2.12 HOSE VALVE MANIFOLD TEST HEADER

Hose valve test header shall be connected by ASME B16.5, Class 150 flange inlet connection. Hose valves shall be UL listed UL Fire Prot Dir or FM approved FM APP GUIDE bronze hose gate valves with 2.5 inches American

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National Fire Hose Connection Screw Standard Threads (NH) in accordance with NFPA 1963. The number of valves shall be in accordance with NFPA 20. Each hose valve shall be equipped with a cap and chain, and located no more than 3 feet and no less than 2 feet above grade.

## 2.13 FLOW METER

Meter shall be UL listed UL Fire Prot Dir or FM approved FM APP GUIDE as flow meters for fire pump installation with direct flow readout device. Flow meter shall be capable of metering any waterflow quantities between 50 percent and 150 percent of the rated flow of the pumps. Arrange piping to permit flow meter to discharge to pump suction and to discharge through test header. The meter throttle valve and the meter control valves shall be O.S.&Y. valves. Provide automatic air release if flow meter piping between pump discharge and pump suction forms an inverted "U". Meter shall be of the venturi type.

## PART 3 EXECUTION

### 3.1 EXAMINATION

After becoming familiar with all details of the work, verify all dimensions in the field, and advise the Contracting Officer of any discrepancy before performing the work.

### 3.2 INSPECTION BY QUALIFIED FIRE PROTECTION ENGINEER

The Qualified Fire Protection Engineer shall periodically perform a thorough inspection of the fire pump installation, including visual observation of the pump while running, to assure that the installation conforms to the contract requirements. There shall be no excessive vibration, leaks (oil or water), unusual noises, overheating, or other potential problems. Inspection shall include piping and equipment clearance, access, supports, and guards. 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. Qualified Fire Protection Engineer shall witness the preliminary and final acceptance tests and, after completion of the inspections and a successful final acceptance test, shall sign test results and certify in writing that the installation the fire pump installation is in accordance with the contract requirements.

### 3.3 INSTALLATION

Equipment, materials, workmanship, fabrication, assembly, erection, installation, examination, inspection and testing shall be in accordance NFPA 20, except as modified herein. In addition, the fire pump and engine shall be installed in accordance with the written instructions of the manufacturer.

#### 3.3.1 Installation Drawings

Submit Fire Pump Installation Drawings consisting of a detailed plan view, detailed elevations and sections of the pump room, equipment and piping, drawn to a scale of not less than 1/2 inch = 1 foot. Drawings shall 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

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legend identifying all symbols, nomenclatures, and abbreviations.  
Indicate a complete piping and equipment layout including elevations  
and/or section views of the following:

- a. Fire pumps, controllers, piping, valves, and associated equipment.
- b. Sensing line for each pump including the pressure maintenance pump.
- c. Pipe hangers and sway bracing including support for diesel muffler and exhaust piping.
- 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.

### 3.3.2 Pump Room Configuration

Provide detail plan view of the pump room including elevations and sections showing the fire pumps, associated equipment, and piping. Submit working drawings on sheets not smaller than 24 by 36 inches; include data for the proper installation of each system. Show piping schematic of pumps, devices, valves, pipe, and fittings. Provide an isometric drawing of the fire pump and all associated piping. Show point to point electrical wiring diagrams. Show piping layout and sensing piping arrangement. Show engine fuel and cooling system. Include:

- a. Pumps, drivers, and controllers
- b. Hose valve manifold test header
- c. Circuit diagrams for pumps
- d. Wiring diagrams of each controller

### 3.3.3 Accessories

Tank supports, piping offsets, fittings, and any other accessories required shall be furnished as specified to provide a complete installation and to eliminate interference with other construction.

## 3.4 PIPE AND FITTINGS

Piping shall be inspected, tested and approved before burying, covering, or concealing. Fittings shall be provided for changes in direction of piping and for all connections. Changes in piping sizes shall be made using tapered reducing pipe fittings. Bushings shall not be used.

### 3.4.1 Cleaning of Piping

Interior and ends of piping shall be clean and free of any water or foreign material. Piping shall be kept clean during installation by means of plugs or other approved methods. When work is not in progress, open ends of the piping shall be securely closed so that no water or foreign matter will enter the pipes or fittings. Piping shall be inspected before placing in position.

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### 3.4.2 Threaded Connections

Jointing compound for pipe threads shall be polytetrafluoroethylene (PTFE) pipe thread tape conforming to ASTM D3308 and shall be applied to male threads only. Exposed ferrous pipe threads shall be provided 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

Additional hangers and supports shall be provided for concentrated loads in aboveground piping, such as for valves and risers.

#### 3.4.3.1 Vertical Piping

Piping shall be supported at each floor, at not more than 10 foot intervals.

#### 3.4.3.2 Horizontal Piping

Horizontal piping supports shall be spaced 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+
Copper Tube	6	7	8							
Steel Pipe	7	8	9	10	11	12	13	14	16	17

### 3.4.4 Grooved Mechanical Joint

Grooves shall be prepared according to the coupling manufacturer's instructions. Grooved fittings, couplings, and grooving tools shall be products of the same manufacturer. Pipe and groove dimensions shall comply with the tolerances specified by the coupling manufacturer. The diameter of grooves made in the field shall 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 shall be measured for each change in grooving tool setup to verify compliance with coupling manufacturer's tolerances. Grooved joints shall not be used 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

Electric motor and controls shall be in accordance with NFPA 20, NFPA 72 and NFPA 70, unless more stringent requirements are specified herein or are indicated on the drawings. Electrical wiring and associated equipment

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shall be provided in accordance with NFPA 20 and Section 26 20 00 INTERIOR DISTRIBUTION SYSTEM. Provide wiring in rigid metal conduit or intermediate metal conduit, except electrical metallic tubing conduit may be provided in dry locations not enclosed in concrete or where not subject to mechanical damage.

### 3.6 PIPE COLOR CODE MARKING

Color code marking of piping as specified in Section 09 90 00 PAINTS AND COATINGS.

### 3.7 FLUSHING

The fire pump suction and discharge piping shall be flushed at 150 percent of rated capacity of each pump. Where the pump installation consists of more than one pump, the flushing shall be 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. No underground piping shall be flushed by using the fire pumps. Flushing operations shall continue until water is clear, but not less than 10 minutes. Submit a signed and dated flushing certificate before requesting field testing.

### 3.8 FIELD TESTS

Submit system diagrams that show the layout of equipment, piping, and storage units, and typed condensed sequence of operation, wiring and control diagrams, and operation manuals explaining preventative maintenance procedures, methods of checking the system for normal, safe operation, and procedures for safely starting and stopping the system shall be framed under glass or laminated plastic. After approval, these items shall be posted where directed.

#### 3.8.1 Hydrostatic Test

Piping shall be hydrostatically tested 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 175 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 Fire Protection Specialist shall 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) shall 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 shall 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. Fire pumps, drivers and equipment shall be thoroughly inspected and tested to insure that the system is correct, complete, and ready for operation. Tests shall ensure that pumps are operating at rated capacity, pressure and speed. Tests shall 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

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signals, test of pump cooling, operational test of relief valves, and test of automatic power transfer, if provided. Pumps shall run without abnormal noise, vibration or heating. If any component or system was found to be defective, inoperative, or not in compliance with the contract requirements during the tests and inspection, the corrections shall be made and the entire preliminary test shall be repeated. Submit Preliminary Tests Reports, to include both the Contractor's Material and Test Certificate for Underground Piping and the Contractor's Material and Test Certificate for Aboveground Piping. All items in the Report shall be signed by the Fire Protection Specialist and the Manufacturer's Representative.

### 3.8.3 Army Final Acceptance Test

QFPE shall 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) shall 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. Notification shall be provided 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 than 7 days after the completion of the tests. All items in the reports shall be signed by the Fire Protection Specialist and the Manufacturer's Representative. Test reports in booklet form (each copy furnished in a properly labeled three ring binder) showing all field tests and measurements taken during the preliminary and final testing, and documentation that proves compliance with the specified performance criteria, upon completion of the installation and final testing of the installed system. Each test report shall indicate the final position of the controls and pressure switches. The test reports shall include the description of the hydrostatic test conducted on the piping and flushing of the suction and discharge piping. A copy of the manufacturer's certified pump curve for each fire pump shall be included in the report. Notification shall include a copy of the Contractor's Material & Test Certificates. Include the following in the final acceptance test:

#### 3.8.3.1 Flow Tests

Flow tests using the test header, hoses and playpipe nozzles shall be conducted. Flow tests shall be performed at churn (no flow), 75, 100, 125 and 150 percent capacity for each pump and at full capacity of the pump installation. Flow readings shall be taken from each nozzle by means of a calibrated pitot tube with gauge or other approved measuring equipment. Rpm, suction pressure and discharge pressure reading shall be taken as part of each flow test. Voltage and ampere readings shall be taken on each phase as part of each flow test for electric-motor driven pumps.

#### 3.8.3.2 Starting Tests

Pumps shall be tested for automatic starting and sequential starting. Setting of the pressure switches shall be tested when pumps are operated by pressure drop. Tests may be performed by operating the test connection on the pressure sensing lines. As a minimum, each pump shall be started automatically 10 times and manually 10 times, in accordance with NFPA 20. Tests of engine-driven pumps shall be divided equally between both set of batteries. The fire pumps shall be operated for a period of at least 10 minutes for each of the starts; except that electric motors over 200



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horsepower shall be operated for at least 15 minutes and shall not be started more than 2 times in 10 hours. Pressure settings that include automatic starting and stopping of the fire pump(s) shall be indicated on an etched plastic placard, attached to the corresponding pump controller.

#### 3.8.3.3 Alarms

All pump alarms, both local and remote, shall be tested. Supervisory alarms for diesel drivers shall be electrically tested for low oil pressure, high engine jacket coolant temperature, shutdown from overspeed, battery failure and battery charger failure.

#### 3.8.3.4 Miscellaneous

Valve tamper switches shall be tested. Pressure recorder operation relief valve settings, valve operations, operation and accuracy of meters and gauges, and other accessory devices shall be verified.

#### 3.8.3.5 Alternate Power Source

On installations with an alternate source of power and an automatic transfer switch, loss of primary power shall be simulated and transfer shall occur while the pump is operating at peak load. Transfer from normal to emergency source and retransfer from emergency to normal source shall not cause opening of overcurrent devices in either line. At least half of the manual and automatic starting operations listed shall be performed 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. Tests shall be conducted and repeated if necessary until the system has been demonstrated to comply with all contract requirements.

#### 3.8.3.7 Test Documentation

The Manufacturer's Representative shall supply a copy of the manufacturer's certified curve for each fire pump at the time of the test. The Fire Protection Specialist shall record all test results and plot curve of each pump performance during the test. Complete pump acceptance test data of each fire pump shall be recorded. The pump acceptance test data shall 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. All test data records shall be submitted 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 Government will 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

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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, each portion of the piping specified in this Section system to be disinfected shall be thoroughly flushed with potable water until all entrained dirt and other foreign materials have been removed before introducing chlorinating material.

### 3.9.1 Chlorination

The chlorinating material shall be hypochlorites or liquid chlorine. The chlorinating material shall be fed into the sprinkler piping at a constant rate of 50 parts per million (ppm). 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 shall be used. Chlorination application shall continue until the entire system is filled. The water shall remain in the system for a minimum of 24 hours. Each valve in the system shall be opened and closed several times to ensure its proper disinfection. Following the 24-hour period, no less than 25 ppm chlorine residual shall remain in the system.

### 3.9.2 Flushing

The system shall then be flushed 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

Samples shall be tested for total coliform organisms (coliform bacteria, fecal coliform, streptococcal, and other bacteria) in accordance with AWWA 10084. The testing method shall be either the multiple-tube fermentation technique or the membrane-filter technique. The disinfection shall be repeated 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. Hoses and nozzles used to conduct flow tests shall be in excellent condition and shall be safely anchored and secured 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 Field Training

The Fire Protection Specialist and the Manufacturer's Representative shall conduct a training course for operating and maintenance personnel as designated by the Contracting Officer. Submit the proposed schedule for

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field training at least 14 days prior to the start of related training. Training shall be provided for a period of 8 hours of normal working time and shall start after the fire pump installation is functionally complete and after the Final Acceptance Test. The field instruction shall cover all of the items contained in the approved Operating and Maintenance Instructions. Submit manuals listing step-by-step procedures required for system startup, operation, shutdown, and routine maintenance. The manuals shall include the manufacturer's name, model number, parts list, list of parts and tools that should be kept in stock by the owner for routine maintenance including the name of a local supplier, simplified wiring and controls diagrams, troubleshooting guide, and recommended service organization (including address and telephone number) for each item of equipment. Data Package 3 shall be submitted for fire pumps and drivers in accordance with Section 01 78 23 OPERATION AND MAINTENANCE DATA. Each service organization submitted shall be capable of providing 4 hour onsite response to a service call on an emergency basis.

### 3.11.2 As-Built Drawings

Submit As-Built Drawings, no later than 14 days after completion of the Final Tests. Update the Fire Pump Installation Drawings to reflect as-built conditions after all related work is completed and shall be 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 --

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## SECTION 22 00 00

### PLUMBING, GENERAL PURPOSE

**11/15, CHG 4: 05/21**

#### PART 1 GENERAL

##### 1.1 REFERENCES

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

#### AIR-CONDITIONING, HEATING AND REFRIGERATION INSTITUTE (AHRI)

AHRI 1010 (2002) Self-Contained, Mechanically Refrigerated Drinking-Water Coolers

#### AMERICAN NATIONAL STANDARDS INSTITUTE (ANSI)

ANSI Z21.10.1/CSA 4.1 (2019) Gas Water Heaters Vol. I, Storage Water Heaters with Input Ratings of 75,000 Btu Per Hour or Less

ANSI Z21.10.3/CSA 4.3 (2019) Gas-Fired Water Heaters Vol.III, Storage Water Heaters With Input Ratings Above 75,000 Btu Per Hour, Circulating and Instantaneous

ANSI Z21.22/CSA 4.4 (2015; R 2020) Relief Valves for Hot Water Supply Systems

#### AMERICAN SOCIETY OF MECHANICAL ENGINEERS (ASME)

ASME A112.1.2 (2012; R 2017) Air Gaps in Plumbing Systems (For Plumbing Fixtures and Water-Connected Receptors)

ASME A112.6.1M (1997; R 2017) Floor Affixed Supports for Off-the-Floor Plumbing Fixtures for Public Use

ASME A112.6.3 (2019) Standard for Floor and Trench Drains

ASME A112.6.4 (2003; R 2012) Roof, Deck and Balcony Drains

ASME A112.14.1 (2003; R 2017) Backwater Valves

ASME A112.19.2/CSA B45.1 (2018; ERTA 2018) Standard for Vitreous China Plumbing Fixtures and Hydraulic Requirements for Water Closets and Urinals

ASME A112.19.3/CSA B45.4 (2017; Errata 2017) Stainless Steel Plumbing Fixtures

ASME A112.36.2M (1991; R 2017) Cleanouts

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ASME B1.20.1	(2013; R 2018) Pipe Threads, General Purpose (Inch)
ASME B16.3	(2016) Malleable Iron Threaded Fittings, Classes 150 and 300
ASME B16.5	(2020) Pipe Flanges and Flanged Fittings NPS 1/2 Through NPS 24 Metric/Inch Standard
ASME B16.12	(2019) Cast Iron Threaded Drainage Fittings
ASME B16.15	(2018) Cast Copper Alloy Threaded Fittings Classes 125 and 250
ASME B16.18	(2018) Cast Copper Alloy Solder Joint Pressure Fittings
ASME B16.21	(2016) Nonmetallic Flat Gaskets for Pipe Flanges
ASME B16.22	(2018) Standard for Wrought Copper and Copper Alloy Solder Joint Pressure Fittings
ASME B16.23	(2011) Cast Copper Alloy Solder Joint Drainage Fittings - DWV
ASME B16.24	(2016) Cast Copper Alloy Pipe Flanges and Flanged Fittings: Classes 150, 300, 600, 900, 1500, and 2500
ASME B16.29	(2017) Wrought Copper and Wrought Copper Alloy Solder-Joint Drainage Fittings - DWV
ASME B16.34	(2021) Valves - Flanged, Threaded and Welding End
ASME B16.39	(2020) Standard for Malleable Iron Threaded Pipe Unions; Classes 150, 250, and 300
ASME B16.50	(2013) Wrought Copper and Copper Alloy Braze-Joint Pressure Fittings
ASME B16.51	(2013) Copper and Copper Alloy Press-Connect Pressure Fittings
ASME B31.1	(2020) Power Piping
ASME B31.5	(2020) Refrigeration Piping and Heat Transfer Components
ASME B40.100	(2013) Pressure Gauges and Gauge Attachments
ASME BPVC SEC IV	(2017) BPVC Section IV-Rules for Construction of Heating Boilers
ASME CSD-1	(2016) Control and Safety Devices for Automatically Fired Boilers

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#### AMERICAN SOCIETY OF SANITARY ENGINEERING (ASSE)

ASSE 1001	(2016) Performance Requirements for Atmospheric Type Vacuum Breakers
ASSE 1003	(2020) Performance Requirements for Water Pressure Reducing Valves for Domestic Water Distribution Systems - (ANSI approved 2010)
ASSE 1010	(2004) Performance Requirements for Water Hammer Arresters (ANSI approved 2004)
ASSE 1011	(2004; Errata 2004) Performance Requirements for Hose Connection Vacuum Breakers (ANSI approved 2004)
ASSE 1012	(2009) Performance Requirements for Backflow Preventer with an Intermediate Atmospheric Vent - (ANSI approved 2009)
ASSE 1013	(2021) Performance Requirements for Reduced Pressure Principle Backflow Prevention Assemblies
ASSE 1018	(2001; R 2021) Performance Requirements for Trap Seal Primer Valves - Potable Water Supplied (ANSI Approved 2002)
ASSE 1019	(2011; R 2016) Performance Requirements for Wall Hydrant with Backflow Protection and Freeze Resistance
ASSE 1020	(2020) Performance Requirements for Pressure Vacuum Breaker Assemblies

#### AMERICAN WATER WORKS ASSOCIATION (AWWA)

AWWA B300	(2018) Hypochlorites
AWWA B301	(2018) Liquid Chlorine
AWWA C203	(2020) Coal-Tar Protective Coatings and Linings for Steel Water Pipelines - Enamel and Tape - Hot-Applied
AWWA C606	(2015) Grooved and Shouldered Joints
AWWA C651	(2014) Standard for Disinfecting Water Mains
AWWA C652	(2019) Disinfection of Water-Storage Facilities
AWWA C700	(2020) Cold-Water Meters - Displacement Type, Metal Alloy Main Case
AWWA C701	(2019) Cold-Water Meters - Turbine Type

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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 A47/A47M	(1999; R 2018; E 2018) Standard Specification for Ferritic Malleable Iron Castings
ASTM A53/A53M	(2020) Standard Specification for Pipe, Steel, Black and Hot-Dipped, Zinc-Coated, Welded and Seamless
ASTM A74	(2021) Standard Specification for Cast Iron Soil Pipe and Fittings
ASTM A105/A105M	(2021) Standard Specification for Carbon Steel Forgings for Piping Applications
ASTM A183	(2014; R 2020) Standard Specification for Carbon Steel Track Bolts and Nuts
ASTM A193/A193M	(2020) Standard Specification for Alloy-Steel and Stainless Steel Bolting Materials for High-Temperature Service and Other Special Purpose Applications
ASTM A515/A515M	(2017) Standard Specification for Pressure Vessel Plates, Carbon Steel, for Intermediate- and Higher-Temperature Service
ASTM A516/A516M	(2017) Standard Specification for Pressure Vessel Plates, Carbon Steel, for Moderate- and Lower-Temperature Service
ASTM A536	(1984; R 2019; E 2019) Standard Specification for Ductile Iron Castings
ASTM A733	(2016) Standard Specification for Welded and Seamless Carbon Steel and Austenitic Stainless Steel Pipe Nipples
ASTM A888	(2021) Standard Specification for Hubless Cast Iron Soil Pipe and Fittings for Sanitary and Storm Drain, Waste, and Vent Piping Applications
ASTM B32	(2020) Standard Specification for Solder Metal
ASTM B42	(2020) Standard Specification for Seamless

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#### Copper Pipe, Standard Sizes

ASTM B75/B75M	(2020) Standard Specification for Seamless Copper Tube
ASTM B88	(2020) Standard Specification for Seamless Copper Water Tube
ASTM B88M	(2020) Standard Specification for Seamless Copper Water Tube (Metric)
ASTM B117	(2019) Standard Practice for Operating Salt Spray (Fog) Apparatus
ASTM B152/B152M	(2019) Standard Specification for Copper Sheet, Strip, Plate, and Rolled Bar
ASTM B306	(2020) Standard Specification for Copper Drainage Tube (DWV)
ASTM B370	(2012; R 2019) Standard Specification for Copper Sheet and Strip for Building Construction
ASTM B584	(2014) Standard Specification for Copper Alloy Sand Castings for General Applications
ASTM B813	(2016) Standard Specification for Liquid and Paste Fluxes for Soldering of Copper and Copper Alloy Tube
ASTM 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 D2000	(2018) Standard Classification System for Rubber Products in Automotive Applications
ASTM D2241	(2015) Standard Specification for Poly(Vinyl Chloride) (PVC) Pressure-Rated Pipe (SDR Series)
ASTM D2464	(2015) Standard Specification for Threaded Poly(Vinyl Chloride) (PVC) Plastic Pipe Fittings, Schedule 80
ASTM D2466	(2017) Standard Specification for



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	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 D2661	(2014; E 2018) Standard Specification for Acrylonitrile-Butadiene-Styrene (ABS) Schedule 40, Plastic Drain, Waste, and Vent Pipe and Fittings
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 D2822/D2822M	(2005; R 2011; E 2011) Standard Specification for Asphalt Roof Cement, Asbestos-Containing
ASTM D2846/D2846M	(2019) Standard Specification for Chlorinated Poly(Vinyl Chloride) (CPVC) Plastic Hot- and Cold-Water Distribution Systems
ASTM D2855	(2015) Standard Practice for Making Solvent-Cemented Joints with Poly(Vinyl Chloride) (PVC) Pipe and Fittings
ASTM D3122	(1995; R 2009) Solvent Cements for Styrene-Rubber (SR) Plastic Pipe and Fittings
ASTM D3138	(2004; R 2016) Standard Specification for Solvent Cements for Transition Joints Between Acrylonitrile-Butadiene-Styrene (ABS) and Poly(Vinyl Chloride) (PVC) Non-Pressure Piping Components
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

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ASTM F409	(2017) Standard Specification for Thermoplastic Accessible and Replaceable Plastic Tube and Tubular Fittings
ASTM F437	(2021) Standard Specification for Threaded Chlorinated Poly(Vinyl Chloride) (CPVC) Plastic Pipe Fittings, Schedule 80
ASTM F438	(2017) Standard Specification for Socket-Type Chlorinated Poly(Vinyl Chloride) (CPVC) Plastic Pipe Fittings, Schedule 40
ASTM F439	(2019) Standard Specification for Chlorinated Poly(Vinyl Chloride) (CPVC) Plastic Pipe Fittings, Schedule 80
ASTM F441/F441M	(2020) Standard Specification for Chlorinated Poly(Vinyl Chloride) (CPVC) Plastic Pipe, Schedules 40 and 80
ASTM F442/F442M	(2020) Standard Specification for Chlorinated Poly(Vinyl Chloride) (CPVC) Plastic Pipe (SDR-PR)
ASTM F477	(2014; R 2021) Standard Specification for Elastomeric Seals (Gaskets) for Joining Plastic Pipe
ASTM F493	(2020) Standard Specification for Solvent Cements for Chlorinated Poly (Vinyl Chloride) (CPVC) Plastic Pipe and Fittings
ASTM F628	(2012; E 2013; E 2016; E 2018) Standard Specification for Acrylonitrile-Butadiene-Styrene (ABS) Schedule 40 Plastic Drain, Waste, and Vent Pipe with a Cellular Core
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	(2021) 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
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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 ASSOCIATION OF PLUMBING AND MECHANICAL OFFICIALS  
 (IAPMO)

IAPMO PS 117 (2005b) Press Type Or Plain End Rub  
 Gasketed W/ Nail CU & CU Alloy Fittings 4  
 Install On CU Tubing

INTERNATIONAL CODE COUNCIL (ICC)

ICC A117.1 (2017) Standard And Commentary Accessible  
 and Usable Buildings and Facilities

ICC IPC (2018) International Plumbing Code

INTERNATIONAL SAFETY EQUIPMENT ASSOCIATION (ISEA)

ANSI/ISEA Z358.1 (2014) American National Standard for  
 Emergency Eyewash and Shower Equipment

MANUFACTURERS STANDARDIZATION SOCIETY OF THE VALVE AND FITTINGS  
 INDUSTRY (MSS)

MSS SP-25 (2018) Standard Marking System for Valves,  
 Fittings, Flanges and Unions

MSS SP-44 (2019) Steel Pipeline Flanges

MSS SP-58 (2018) Pipe Hangers and Supports -  
 Materials, Design and Manufacture,  
 Selection, Application, and Installation

MSS SP-67 (2017; Errata 1 2017) Butterfly Valves

MSS SP-70 (2011) Gray Iron Gate Valves, Flanged and  
 Threaded Ends

MSS SP-71 (2018) Gray Iron Swing Check Valves,  
 Flanged and Threaded Ends

MSS SP-72 (2010a) Ball Valves with Flanged or  
 Butt-Welding Ends for General Service

MSS SP-78 (2011) Cast Iron Plug Valves, Flanged and  
 Threaded Ends

MSS SP-80 (2019) Bronze Gate, Globe, Angle and Check  
 Valves

MSS SP-83 (2014) Class 3000 Steel Pipe Unions Socket  
 Welding and Threaded

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MSS SP-85 (2011) Gray Iron Globe & Angle Valves  
 Flanged and Threaded Ends

MSS SP-110 (2010) Ball Valves Threaded,  
 Socket-Welding, Solder Joint, Grooved and  
 Flared Ends

#### NACE INTERNATIONAL (NACE)

NACE SP0169 (2013) Control of External Corrosion on  
 Underground or Submerged Metallic Piping  
 Systems

#### NATIONAL ELECTRICAL MANUFACTURERS ASSOCIATION (NEMA)

NEMA 250 (2020) Enclosures for Electrical Equipment  
 (1000 Volts Maximum)

NEMA MG 1 (2018) Motors and Generators

NEMA MG 11 (1977; R 2012) Energy Management Guide for  
 Selection and Use of Single Phase Motors

#### NATIONAL FIRE PROTECTION ASSOCIATION (NFPA)

NFPA 54 (2021) National Fuel Gas Code

NFPA 90A (2021) Standard for the Installation of  
 Air Conditioning and Ventilating Systems

#### NSF INTERNATIONAL (NSF)

NSF 372 (2016) Drinking Water System Components -  
 Lead Content

NSF/ANSI 14 (2020) Plastics Piping System Components  
 and Related Materials

NSF/ANSI 61 (2020) Drinking Water System Components -  
 Health Effects

#### PLASTIC PIPE AND FITTINGS ASSOCIATION (PPFA)

PPFA Fire Man (2016) Firestopping: Plastic Pipe in Fire  
 Resistive Construction

#### PLUMBING AND DRAINAGE INSTITUTE (PDI)

PDI WH 201 (2010) Water Hammer Arresters Standard

#### SOCIETY OF AUTOMOTIVE ENGINEERS INTERNATIONAL (SAE)

SAE J1508 (2009) Hose Clamp Specifications

#### U.S. DEPARTMENT OF ENERGY (DOE)

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

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#### U.S. ENVIRONMENTAL PROTECTION AGENCY (EPA)

EPA SM 9223	(2004) Enzyme Substrate Coliform Test
PL 93-523	(1974; A 1999) Safe Drinking Water Act

#### U.S. GREEN BUILDING COUNCIL (USGBC)

LEED v4 BDC Ref Guide	(2013; R 2020) USGBC LEED Reference Guide for Building Design and Construction, v4
LEED v4.1 BDC Ref Guide	(2023) LEED v4.1 Building Design and Construction Reference Guide

#### 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

### 1.2 SUSTAINABILITY REPORTING

Work of this section is intended to contribute to the achievement of, or compliance with, the requirements of the Guiding Principles Validation and LEED Prerequisites and attempted Credits. Refer to Section 01 33 29.00 06 SUSTAINABILITY REPORTING for specific documentation requirements and list of Prerequisites, attempted Credits and LEED version.

Comply with product, material content, performance criteria, activity, documentation, and other technical requirements as described in the LEED v4 BDC Ref Guide or LEED v4.1 BDC Ref Guide as applicable.

Collect, organize, and submit product data, drawings, diagrams, photos and cost information necessary to demonstrate compliance with LEED v4 BDC Ref Guide or LEED v4.1 BDC Ref Guide requirements as applicable.

Data collection shall commence with the notice to proceed and will only be deemed complete upon acceptance of the Final Sustainability Notebook and LEED Online submission by the Contracting Officer, the LEED Project Administrator, and the Green Building Certification Institute.

### 1.3 SUBMITTALS

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

SD-02 Shop Drawings

Plumbing System; G

Detail drawings consisting of schedules, performance charts, instructions, diagrams, and other information to illustrate the

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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

Backflow Prevention Assemblies; G, AE

Fixtures; G, AE

List of installed fixtures with manufacturer, model, and flow rate.

Flush Valve Water Closets; G, AE

WaterSense Label for Flush Valve Water Closet; S, AE

Flush Valve Urinals; G, AE

WaterSense Label for Urinal; S, AE

Wall Hung Lavatories; G, AE

Countertop Lavatories; G, AE

WaterSense Label for Lavatory Faucet; S, AE

Kitchen Sinks; G, AE

Service Sinks; G, AE

Drinking-Water Coolers; G, AE

Water Heaters; G, AE

Energy Star Label for Gas Storage Water Heater; S, AE

Pumps; G, AE

#### 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.

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#### Test of Backflow Prevention Assemblies; G.

Certification of proper operation shall be as accomplished in accordance with state regulations by an individual certified by the state to perform such tests. If no state requirement exists, the Contractor shall have the manufacturer's representative test the device, to ensure the unit is properly installed and performing as intended. The Contractor shall provide written documentation of the tests performed and signed by the individual performing the tests.

#### SD-07 Certificates

##### Materials and Equipment

Where equipment is specified to conform to requirements of the ASME Boiler and Pressure Vessel Code, the design, fabrication, and installation shall conform to the code.

#### SD-10 Operation and Maintenance Data

##### Plumbing System; G

Submit in accordance with Section 01 78 23 OPERATION AND MAINTENANCE DATA.

### 1.4 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.

#### 1.4.1 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.

#### 1.4.2 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.

#### 1.4.3 Manufacturer's Nameplate

Each item of equipment shall have a nameplate bearing the manufacturer's

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name, address, model number, and serial number securely affixed in a conspicuous place; the nameplate of the distributing agent will not be acceptable.

#### 1.4.4 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.

##### 1.4.4.1 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."

##### 1.4.4.2 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.

#### 1.5 DELIVERY, STORAGE, AND HANDLING

Handle, store, and protect equipment and materials to prevent damage before and during installation in accordance with the manufacturer's recommendations, and as approved by the Contracting Officer. Replace damaged or defective items.

#### 1.6 PERFORMANCE REQUIREMENTS

#### 1.7 REGULATORY REQUIREMENTS

Unless otherwise required herein, plumbing work shall be in accordance with ICC IPC.

#### 1.8 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.

#### 1.9 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



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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.

#### 1.10 ACCESSIBILITY OF EQUIPMENT

Install all work so that parts requiring periodic inspection, operation, maintenance, and repair are readily accessible. Install concealed valves, expansion joints, controls, dampers, and equipment requiring access, in locations freely accessible through access doors.

### PART 2 PRODUCTS

#### 2.1 MATERIALS

Materials for various services shall be in accordance with TABLES I and II.

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 faucets, 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 floors. Plastic pipe shall not be installed in air plenums. .

##### 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

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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.
- d. 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.
- e. Brazing Material: Brazing material shall conform to AWS A5.8/A5.8M, BCuP-5.
- f. 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.
- g. Solder Material: Solder metal shall conform to ASTM B32.
- h. Solder Flux: Flux shall be liquid form, non-corrosive, and conform to ASTM B813, Standard Test 1.
- i. PTFE Tape: PTFE Tape, for use with Threaded Metal or Plastic Pipe.
- j. Rubber Gaskets for Cast-Iron Soil-Pipe and Fittings (hub and spigot type and hubless type): ASTM C564.
- k. Rubber Gaskets for Grooved Pipe: ASTM D2000, maximum temperature 230 degrees F.
- l. Flexible Elastomeric Seals: ASTM D3139, ASTM D3212 or ASTM F477.
- m. Bolts and Nuts for Grooved Pipe Couplings: Heat-treated carbon steel, ASTM A183.
- n. Solvent Cement for Transition Joints between ABS and PVC Nonpressure Piping Components: ASTM D3138.
- p. Plastic Solvent Cement for PVC Plastic Pipe: ASTM D2564 and ASTM D2855.
- q. Plastic Solvent Cement for CPVC Plastic Pipe: ASTM F493.
- r. 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.
- s. Plastic Solvent Cement for Styrene Rubber Plastic Pipe: ASTM D3122.
- t. Press fittings for Copper Pipe and Tube: Copper press fittings shall conform to the material and sizing requirements of ASME B16.51 and

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performance criteria of IAPMO PS 117. Sealing elements for copper press fittings shall be EPDM, FKM or HNBR. Sealing elements shall be factory installed or an alternative supplied fitting manufacturer. Sealing element shall be selected based on manufacturer's approved application guidelines.

u. 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 Arrestor: PDI WH 201. Water hammer arrester shall be diaphragm or piston type.
- b. Copper, Sheet and Strip for Building Construction: ASTM B370.
- c. Asphalt Roof Cement: ASTM D2822/D2822M.
- d. Hose Clamps: SAE J1508.
- e. Supports for Off-The-Floor Plumbing Fixtures: ASME A112.6.1M.
- f. Metallic Cleanouts: ASME A112.36.2M.
- g. Plumbing Fixture Setting Compound: A preformed flexible ring seal molded from hydrocarbon wax material. The seal material shall be nonvolatile nonasphaltic and contain germicide and provide watertight, gastight, odorproof and verminproof properties.
- h. Coal-Tar Protective Coatings and Linings for Steel Water Pipelines: AWWA C203.
- i. Hypochlorites: AWWA B300.
- j. Liquid Chlorine: AWWA B301.
- k. Gauges - Pressure and Vacuum Indicating Dial Type - Elastic Element: ASME B40.100.
- l. Thermometers: ASTM E1. Mercury shall not be used in thermometers.

#### 2.1.3 Pipe Insulation Material

Insulation shall be as specified in Section 23 07 00 THERMAL INSULATION FOR MECHANICAL SYSTEMS.

#### 2.2 PIPE HANGERS, INSERTS, AND SUPPORTS

Pipe hangers, inserts, and supports shall conform to MSS SP-58.

#### 2.3 VALVES

Valves shall be provided on supplies to equipment and fixtures. Valves 2-1/2 inches and smaller shall be bronze with threaded bodies for pipe and solder-type connections for tubing. Valves 3 inches and larger shall have flanged iron bodies and bronze trim. Pressure ratings shall be based upon the application. Grooved end valves may be provided if the manufacturer certifies that the valves meet the performance requirements of applicable

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MSS standard. Valves shall conform to the following standards:

Description	Standard
Butterfly Valves	MSS SP-67
Cast-Iron Gate Valves, Flanged and Threaded Ends	MSS SP-70
Cast-Iron Swing Check Valves, Flanged and Threaded Ends	MSS SP-71
Ball Valves with Flanged Butt-Welding Ends for General Service	MSS SP-72
Ball Valves Threaded, Socket-Welding, Solder Joint, Grooved and Flared Ends	MSS SP-110
Cast-Iron Plug Valves, Flanged and Threaded Ends	MSS SP-78
Bronze Gate, Globe, Angle, and Check Valves	MSS SP-80
Steel Valves, Socket Welding and Threaded Ends	ASME B16.34
Cast-Iron Globe and Angle Valves, Flanged and Threaded Ends	MSS SP-85
Backwater Valves	ASME A112.14.1
Vacuum Relief Valves	ANSI Z21.22/CSA 4.4
Water Pressure Reducing Valves	ASSE 1003
Water Heater Drain Valves	ASME BPVC SEC IV, Part HLW-810: Requirements for Potable-Water Heaters Bottom Drain Valve
Trap Seal Primer Valves	ASSE 1018
Temperature and Pressure Relief Valves for Hot Water Supply Systems	ANSI Z21.22/CSA 4.4

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Temperature and Pressure Relief Valves for Automatically Fired Hot Water Boilers	ASME CSD-1 Safety Code No., Part CW, Article 5
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### 2.3.1 Backwater Valves

Backwater valves shall be either separate from the floor drain or a combination floor drain, P-trap, and backwater valve, as shown. Valves shall have cast-iron bodies with cleanouts large enough to permit removal of interior parts. Valves shall be of the flap type, hinged or pivoted, with revolving disks. Hinge pivots, disks, and seats shall be nonferrous metal. Disks shall be slightly open in a no-flow no-backwater condition. Cleanouts shall extend to finished floor and be fitted with threaded countersunk plugs.

### 2.3.2 Wall Hydrants (Frostproof)

ASSE 1019 with vacuum-breaker backflow preventer shall have a nickel-brass or nickel-bronze wall plate or flange with nozzle and detachable key handle. A brass or bronze operating rod shall be provided within a galvanized iron casing of sufficient length to extend through the wall so that the valve is inside the building, and the portion of the hydrant between the outlet and valve is self-draining. A brass or bronze valve with coupling and union elbow having metal-to-metal seat shall be provided. Valve rod and seat washer shall be removable through the face of the hydrant. The hydrant shall have 3/4 inch exposed hose thread on spout and 3/4 inch male pipe thread on inlet.

### 2.3.3 Relief Valves

Water heaters and hot water storage tanks shall have a combination pressure and temperature (P&T) relief valve. The pressure relief element of a P&T relief valve shall have adequate capacity to prevent excessive pressure buildup in the system when the system is operating at the maximum rate of heat input. The temperature element of a P&T relief valve shall have a relieving capacity which is at least equal to the total input of the heaters when operating at their maximum capacity. Relief valves shall be rated according to ANSI Z21.22/CSA 4.4. Relief valves for systems where the maximum rate of heat input is less than 200,000 Btuh shall have 3/4 inch minimum inlets, and 3/4 inch outlets. Relief valves for systems where the maximum rate of heat input is greater than 200,000 Btuh shall have 1 inch minimum inlets, and 1 inch outlets. The discharge pipe from the relief valve shall be the size of the valve outlet.

### 2.3.4 Thermostatic Mixing Valves

Provide thermostatic mixing valve for lavatory faucets. Mixing valves, thermostatic type, pressure-balanced or combination thermostatic and pressure-balanced shall be line size and shall be constructed with rough or finish bodies either with or without plating. Each valve shall be constructed to control the mixing of hot and cold water and to deliver water at a desired temperature regardless of pressure or input temperature changes. The control element shall be of an approved type. The body shall be of heavy cast bronze, and interior parts shall be brass, bronze, corrosion-resisting steel or copper. The valve shall be equipped with necessary stops, check valves, unions, and sediment strainers on the

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inlets. Mixing valves shall maintain water temperature within 5 degrees F of any setting.

## 2.4 FIXTURES

Water closet replacements in major renovations may have a flush valve of up to 1.6 GPF to accommodate existing plumbing capacity. Fixtures for use by the physically handicapped shall be in accordance with ICC A117.1. 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, pop-up stoppers of lavatory waste drains shall be copper alloy with all visible surfaces chrome plated. Plastic in contact with hot water shall be suitable for 180 degrees F water temperature.

### 2.4.1 Lavatories

Vitreous china lavatories shall be provided with two integral molded lugs on the back-underside of the fixture and drilled for bolting to the wall in a manner similar to the hanger plate. Provide WaterSense labeled faucet with a maximum flow rate of 0.5 gpm at a flowing pressure of 60 psi. Water volume must be limited to 0.25 gal per metering cycle. Provide data identifying WaterSense label for lavatory faucet.

### 2.4.2 Automatic Controls

Flushing and faucet systems shall consist of solenoid-activated valves with light beam sensors. Flush valve for water closet shall include an override pushbutton. Flushing devices shall be provided as described in paragraph FIXTURES AND FIXTURE TRIMMINGS.

### 2.4.3 Flush Valve Water Closets

ASME A112.19.2/CSA B45.1, white vitreous china, siphon jet, elongated bowl, floor-mounted, wall outlet. Top of toilet seat height above floor shall be 14 to 15 inches, except 17 to 19 inches for wheelchair water closets. Provide wax bowl ring including plastic sleeve. Provide white solid plastic elongated open-front seat .

Water flushing volume of the water closet and flush valve combination shall not exceed 1.28 gallons per flush. Water closets must meet the EPA WaterSense product definition specified in [http://www.epa.gov/watersense/partners/product\\_program\\_specs.html](http://www.epa.gov/watersense/partners/product_program_specs.html) and must be EPA WaterSense labeled products. Provide data identifying WaterSense label for flush valve water closet.

Provide large diameter flush valve including angle control-stop valve, vacuum breaker, tail pieces, slip nuts, and wall plates; exposed to view components shall be chromium-plated or polished stainless steel. Flush

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valves shall be nonhold-open type. Mount flush valves not less than 11 inches above the fixture. Mounted height of flush valve shall not interfere with the hand rail in ADA stalls.

#### 2.4.4 Flush Valve Urinals

ASME A112.19.2/CSA B45.1, white vitreous china, ,wall-mounted, wall outlet, siphon jet, integral trap, and extended side shields. Provide urinal with the rim 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](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.

#### 2.4.5 Wall Hung Lavatories

ASME A112.19.2/CSA B45.1, white vitreous china, ,straight back type, minimum dimensions of 19 inches, wide by 17 inches front to rear, with supply openings for use with top mounted centerset faucets, and openings for concealed arm carrier installation. Provide aerator with faucet. Provide lavatory faucets and accessories meeting the flow rate and product requirements of the paragraph LAVATORIES. Provide ASME A112.6.1M concealed chair carriers with vertical steel pipe supports and concealed arms for the lavatory. Mount lavatory with the front rim 34 inches above floor and with 29 inches minimum clearance from bottom of the front rim to floor. Provide top mounted washerless centerset lavatory faucets.

#### 2.4.6 Countertop Lavatories

ASME A112.19.2/CSA B45.1, white vitreous china, ,self-rimming, minimum dimensions of 19 inches wide by 17 inches front to rear, with supply openings for use with top mounted centerset faucets. Furnish template and mounting kit by lavatory manufacturer. Provide aerator with faucet. Provide lavatory faucets and accessories meeting the flow rate and product requirements of the paragraph LAVATORIES. Mount counter with the top surface 34 inches above floor and with 29 inches minimum clearance from bottom of the counter face to floor.

#### 2.4.7 Kitchen Sinks

ASME A112.19.3/CSA B45.4, 20 gage stainless steel with integral mounting rim for flush installation, minimum dimensions of 33 inches wide by 21 inches front to rear, two compartments, with undersides fully sound deadened, with supply openings for use with top mounted washerless sink faucets with hose spray, and with 3.5 inch drain outlet. 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 separate 1.5 inch P-trap and drain piping to vertical vent piping from each compartment. Provide top mounted washerless sink faucets with hose spray.

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#### 2.4.8 Service Sinks

ASME A112.19.2/CSA B45.1, white vitreous china with integral back and wall hanger supports, minimum dimensions of 22 inches wide by 20 inches front to rear, with two supply openings in 10 inch high back. Provide floor supported wall outlet cast iron P-trap and stainless steel rim guards as recommended by service sink manufacturer. Provide back mounted washerless service sink faucets with vacuum breaker and 0.75 inch external hose threads.

#### 2.4.9 Drinking-Water Coolers

AHRI 1010 with more than a single thickness of metal between the potable water and the refrigerant in the heat exchanger, wall-hung, bubbler style, air-cooled condensing unit, 4.75 gph minimum capacity, stainless steel splash receptor and basin, bottle filler and stainless steel cabinet. Bubblers shall be controlled by push levers or push bars, front mounted or side mounted near the front edge of the cabinet. Bubbler spouts shall be mounted at maximum of 36 inches above floor and at front of unit basin. Spouts shall direct water flow at least 4 inches above unit basin and trajectory parallel or nearly parallel to the front of unit. Provide ASME A112.6.1M concealed steel pipe chair carriers.

#### 2.4.10 Wheelchair Drinking Water cooler

AHRI 1010, wall-mounted bubbler style with ASME A112.6.1M concealed chair carrier, air-cooled condensing unit, 4.75 gph minimum capacity, stainless steel splash receptor, and all stainless steel cabinet, with 27 inch minimum knee clearance from front bottom of unit to floor and 36 inch maximum spout height above floor and bottle filler. Bubblers shall also be controlled by push levers, by push bars, or touch pads one on each side or one on front and both sides of the cabinet. .

#### 2.4.11 Precast Terrazzo Mop Sinks

Terrazzo shall be made of marble chips cast in white portland cement to produce 3000 psi minimum compressive strength 7 days after casting. Provide floor or wall outlet copper alloy body drain cast integral with terrazzo, with polished stainless steel strainers.

#### 2.4.12 Emergency Eyewash and Shower

ANSI/ISEA Z358.1, floor supported free standing unit. Provide deluge shower head, stay-open ball valve operated by pull rod and ring or triangular handle. Provide eyewash and stay-open ball valve operated by foot treadle or push handle.

#### 2.4.13 Emergency Eye and Face Wash

ANSI/ISEA Z358.1, wall-mounted self-cleaning, nonclogging eye and face wash with quick opening, full-flow valves, stainless steel eye and face wash receptor. Unit shall deliver 3 gpm of aerated water at 30 psig flow pressure, with eye and face wash nozzles 33 to 45 inches above finished floor. Provide copper alloy control valves. Provide an air-gap with the lowest potable eye and face wash water outlet located above the overflow rim by not less than the International Plumbing Code minimum. Provide a pressure-compensated tempering valve, with leaving water temperature setpoint adjustable throughout the range 60 to 95 degrees F. Provide packaged, UL listed, alarm system; including an amber strobe lamp, horn



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with externally adjustable loudness and horn silencing switch, mounting hardware, and waterflow service within NEMA Type 3 or 4 enclosures and for explosion proof service within NEMA Type 7 or 9 enclosures.

## 2.5 BACKFLOW PREVENTERS

Backflow prevention devices must be approved by the State or local regulatory agencies. If there is no State or local regulatory agency requirements, the backflow prevention devices must be listed by the Foundation for Cross-Connection Control & Hydraulic Research, or any other approved testing laboratory having equivalent capabilities for both laboratory and field evaluation of backflow prevention devices and assemblies.

Reduced pressure principle assemblies, double check valve assemblies, atmospheric (nonpressure) type vacuum breakers, and pressure type vacuum breakers shall meet the above requirements.

Backflow preventers with intermediate atmospheric vent shall conform to ASSE 1012. Reduced pressure principle backflow preventers shall conform to ASSE 1013. Hose connection vacuum breakers shall conform to ASSE 1011. Pipe applied atmospheric type vacuum breakers shall conform to ASSE 1001. Pressure vacuum breaker assembly shall conform to ASSE 1020. Air gaps in plumbing systems shall conform to ASME A112.1.2.

## 2.6 DRAINS

### 2.6.1 Floor Drains

Floor and shower drains shall consist of a galvanized body, integral seepage pan, and adjustable perforated or slotted chromium-plated bronze, nickel-bronze, or nickel-brass strainer, consisting of grate and threaded collar. Floor drains shall be cast iron except where metallic waterproofing membrane is installed. Drains shall be of double drainage pattern for embedding in the floor construction. The seepage pan shall have weep holes or channels for drainage to the drainpipe. The strainer shall be adjustable to floor thickness. A clamping device for attaching flashing or waterproofing membrane to the seepage pan without damaging the flashing or waterproofing membrane shall be provided when required. Drains shall be provided with threaded connection. Between the drain outlet and waste pipe, a neoprene rubber gasket conforming to ASTM C564 may be installed, provided that the drain is specifically designed for the rubber gasket compression type joint. Floor drains shall conform to ASME A112.6.3. Provide drain with trap primer connection, trap primer, and connection piping. Primer shall meet ASSE 1018.

#### 2.6.1.1 Drains and Backwater Valves

Drains and backwater valves installed in connection with waterproofed floors or shower pans shall be equipped with bolted-type device to securely clamp flashing.

### 2.6.2 Area Drains

Area drains shall be plain pattern with polished stainless steel perforated or slotted grate and bottom outlet. The drain shall be circular or square with a 12 inch nominal overall width or diameter and 10 inch nominal overall depth. Drains shall be cast iron with manufacturer's standard coating. Grate shall be easily lifted out for cleaning. Outlet

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shall be suitable for inside caulked connection to drain pipe. Drains shall conform to ASME A112.6.3.

### 2.6.3 Roof Drains and Expansion Joints

Roof drains shall conform to ASME A112.6.4, with dome and integral flange, and shall have a device for making a watertight connection between roofing and flashing. The whole assembly shall be galvanized heavy pattern cast iron. For aggregate surface roofing, the drain shall be provided with a gravel stop. On roofs other than concrete construction, roof drains shall be complete with underdeck clamp, sump receiver, and an extension for the insulation thickness where applicable. A clamping device for attaching flashing or waterproofing membrane to the seepage pan without damaging the flashing or membrane shall be provided when required to suit the building construction. Strainer openings shall have a combined area equal to twice that of the drain outlet. The outlet shall be equipped to make a proper connection to threaded pipe of the same size as the downspout. An expansion joint of proper size to receive the conductor pipe shall be provided. The expansion joint shall consist of a heavy cast-iron housing, brass or bronze sleeve, brass or bronze fastening bolts and nuts, and gaskets or packing. The sleeve shall have a nominal thickness of not less than 0.134 inch. Gaskets and packing shall be close-cell neoprene, O-ring packing shall be close-cell neoprene of 70 durometer. Packing shall be held in place by a packing gland secured with bolts.

## 2.7 TRAPS

Unless otherwise specified, traps shall be plastic per ASTM F409 or copper-alloy adjustable tube type with slip joint inlet and swivel. Traps shall be without a cleanout. Tubes shall be copper alloy with walls not less than 0.032 inch thick within commercial tolerances, except on the outside of bends where the thickness may be reduced slightly in manufacture by usual commercial methods. Inlets shall have rubber washer and copper alloy nuts for slip joints above the discharge level. Swivel joints shall be below the discharge level and shall be of metal-to-metal or metal-to-plastic type as required for the application. Nuts shall have flats for wrench grip. Outlets shall have internal pipe thread, except that when required for the application, the outlets shall have sockets for solder-joint connections. The depth of the water seal shall be not less than 2 inches. The interior diameter shall be not more than 1/8 inch over or under the nominal size, and interior surfaces shall be reasonably smooth throughout. A copper alloy "P" trap assembly consisting of an adjustable "P" trap and threaded trap wall nipple with cast brass wall flange shall be provided for lavatories. The assembly shall be a standard manufactured unit and may have a rubber-gasketed swivel joint.

## 2.8 INTERCEPTORS

### 2.8.1 Oil Interceptor

Cast iron or welded steel, coated inside and outside with white acid resistant epoxy, with internal air relief bypass, bronze cleanout plug, double wall trap seal, removable combination pressure equalizing and flow diffusing baffle and sediment bucket, horizontal baffle, adjustable oil draw-off and vent connections on either side, gas and watertight gasketed nonskid cover, and flow control fitting.

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## 2.9 WATER HEATERS

Water heater types and capacities shall be as indicated. Each water heater shall have replaceable anodes. Each primary water heater shall have controls with an adjustable range that includes 90 to 160 degrees F. Each gas-fired water heater and booster water heater shall have controls with an adjustable range that includes 120 to 180 degrees F. Hot water systems utilizing recirculation systems shall be tied into building off-hour controls. The thermal efficiencies and standby heat losses shall conform to TABLE III in PART 3 of this Section for each type of water heater specified. The only exception is that storage water heaters and hot water storage tanks having more than 500 gallons storage capacity need not meet the standard loss requirement if the tank surface area is insulated to R-12.5 and if a standing light is not used. Plastic materials polyetherimide (PEI) and polyethersulfone (PES) are forbidden to be used for vent piping of combustion gases. A factory pre-charged expansion tank shall be installed on the cold water supply to each water heater. Expansion tanks shall be specifically designed for use on potable water systems and shall be rated for 200 degrees F water temperature and 150 psi working pressure.

### 2.9.1 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.

#### 2.9.1.1 Gas-Fired Type

Gas-fired water heaters shall conform to ANSI Z21.10.1/CSA 4.1 when input is 75,000 BTU per hour or less or ANSI Z21.10.3/CSA 4.3 for heaters with input greater than 75,000 BTU per hour. Provide Energy Star labeled gas storage water heater. Provide data identifying Energy Star label for gas storage water heater.

## 2.10 PUMPS

### 2.10.1 Circulating Pumps

Domestic hot water circulating pumps shall be electrically driven, single-stage, centrifugal, with mechanical seals, suitable for the intended service. Pump and motor shall be integrally mounted on a cast-iron or steel subbase, close-coupled with an overhung impeller, or supported by the piping on which it is installed. The shaft shall be one-piece, heat-treated, corrosion-resisting steel with impeller and smooth-surfaced housing of bronze.

Motor shall be totally enclosed, fan-cooled and shall have sufficient horsepower for the service required. Each pump motor shall be equipped with an across-the-line magnetic controller in a NEMA 250, Type 1 enclosure with "START-STOP" switch in cover.

Integral size motors shall be premium efficiency type in accordance with NEMA MG 1. Pump motors smaller than 1 hp Fractional horsepower pump motors shall have integral thermal overload protection in accordance with Section 26 20 00 INTERIOR DISTRIBUTION SYSTEM. Guards shall shield exposed moving parts.

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## 2.10.2 Flexible Connectors

Flexible connectors shall be provided at the suction and discharge of each pump that is 1 hp or larger. Connectors shall be constructed of neoprene, rubber, or braided bronze, with Class 150 standard flanges. Flexible connectors shall be line size and suitable for the pressure and temperature of the intended service.

## 2.11 DOMESTIC WATER SERVICE METER

Cold water meters 2 inches and smaller shall be positive displacement type conforming to AWWA C700. Cold water meters 2-1/2 inches and larger shall be turbine type conforming to AWWA C701. Meter register may be round or straight reading type, as provided by the local utility. Meter shall be provided with a pulse generator, remote readout register and all necessary wiring and accessories.

Meters must be connected to the base wide energy and utility monitoring and control system (if this system exists) using the installation's advanced metering protocols.

## 2.12 ELECTRICAL WORK

Provide electrical motor driven equipment specified complete with motors, motor starters, and controls as specified herein and in Section 26 20 00 INTERIOR DISTRIBUTION SYSTEM. Provide internal wiring for components of packaged equipment as an integral part of the equipment. Provide high efficiency type, single-phase, fractional-horsepower alternating-current motors, including motors that are part of a system, corresponding to the applications in accordance with NEMA MG 11. In addition to the requirements of Section 26 20 00 INTERIOR DISTRIBUTION SYSTEM, provide polyphase, squirrel-cage medium induction motors with continuous ratings, including motors that are part of a system, that meet the efficiency ratings for premium efficiency motors in accordance with NEMA MG 1. Provide motors in accordance with NEMA MG 1 and of sufficient size to drive the load at the specified capacity without exceeding the nameplate rating of the motor.

Motors shall be rated for continuous duty with the enclosure specified. Motor duty requirements shall allow for maximum frequency start-stop operation and minimum encountered interval between start and stop. Motor torque shall be capable of accelerating the connected load within 20 seconds with 80 percent of the rated voltage maintained at motor terminals during one starting period. Motor bearings shall be fitted with grease supply fittings and grease relief to outside of the enclosure.

Controllers and contactors shall have auxiliary contacts for use with the controls provided. Manual or automatic control and protective or signal devices required for the operation specified and any control wiring required for controls and devices specified, but not shown, shall be provided. For packaged equipment, the manufacturer shall provide controllers, including the required monitors and timed restart.

Power wiring and conduit for field installed equipment shall be provided under and conform to the requirements of Section 26 20 00 INTERIOR DISTRIBUTION SYSTEM.

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## 2.13 MISCELLANEOUS PIPING ITEMS

### 2.13.1 Escutcheon Plates

Provide one piece or split hinge metal plates for piping entering floors, walls, and ceilings in exposed spaces. Provide chromium-plated or copper alloy plates or polished stainless steel finish in finished spaces. Provide paint finish on plates in unfinished spaces.

### 2.13.2 Pipe Sleeves

Provide where piping passes entirely through walls, ceilings, roofs, and floors. Sleeves are not required where supply drain, waste, and vent (DWV) piping passes through concrete floor slabs located on grade, except where penetrating a membrane waterproof floor.

#### 2.13.2.1 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.

#### 2.13.2.2 Sleeves Not in Masonry and Concrete

Provide 26 gage galvanized steel sheet or PVC plastic pipe sleeves.

### 2.13.3 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.

### 2.13.4 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.

### 2.13.5 Labels

Provide labels for sensor operators at flush valves and faucets. Include the following information on each label:

- a. Identification of the sensor and its operation with graphic description.

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- b. Range of the sensor.
- c. Battery replacement schedule.

### PART 3 EXECUTION

#### 3.1 GENERAL INSTALLATION REQUIREMENTS

Piping located in air plenums shall conform to NFPA 90A requirements. Piping located in shafts that constitute air ducts or that enclose air ducts shall be noncombustible in accordance with NFPA 90A. Installation of plastic pipe where in compliance with NFPA may be installed in accordance with PPFA Fire Man. The plumbing system shall be installed complete with necessary fixtures, fittings, traps, valves, and accessories. Water and drainage piping shall be extended 5 feet outside the building, unless otherwise indicated. A ball valve and drain shall be installed on the water service line inside the building approximately 6 inches above the floor from point of entry. Piping shall be connected to the exterior service lines or capped or plugged if the exterior service is not in place. Sewer and water pipes shall be laid in separate trenches, except when otherwise shown. Exterior underground utilities shall be at least 12 inches below the average local frost depth or as indicated on the drawings. If trenches are closed or the pipes are otherwise covered before being connected to the service lines, the location of the end of each plumbing utility shall be marked with a stake or other acceptable means. Valves shall be installed with control no lower than the valve body.

##### 3.1.1 Water Pipe, Fittings, and Connections

###### 3.1.1.1 Utilities

The piping shall be extended to fixtures, outlets, and equipment. The hot-water and cold-water piping system shall be arranged and installed to permit draining. The supply line to each item of equipment or fixture, except faucets, flush valves, or other control valves which are supplied with integral stops, shall be equipped with a shutoff valve to enable isolation of the item for repair and maintenance without interfering with operation of other equipment or fixtures. Supply piping to fixtures, faucets, hydrants, shower heads, and flushing devices shall be anchored to prevent movement.

###### 3.1.1.2 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.

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#### 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 ball valve ahead of hose bibb. At other low points, 3/4 inch brass plugs or caps shall be provided. Disconnection of the supply piping at the fixture is an acceptable drain.

#### 3.1.1.6 Expansion and Contraction of Piping

Allowance shall be made throughout for expansion and contraction of water pipe. Each hot-water and hot-water circulation riser shall have expansion loops or other provisions such as offsets and changes in direction where indicated and required. Risers shall be securely anchored as required or where indicated to force expansion to loops. Branch connections from risers shall be made with ample swing or offset to avoid undue strain on fittings or short pipe lengths. Horizontal runs of pipe over 50 feet in length shall be anchored to the wall or the supporting construction about midway on the run to force expansion, evenly divided, toward the ends. Sufficient flexibility shall be provided on branch runouts from mains and risers to provide for expansion and contraction of piping. Flexibility shall be provided by installing one or more turns in the line so that piping will spring enough to allow for expansion without straining. If mechanical grooved pipe coupling systems are provided, the deviation from design requirements for expansion and contraction may be allowed pending approval of Contracting Officer.

#### 3.1.1.7 Commercial-Type Water Hammer Arresters

Commercial-type water hammer arresters shall be provided on hot- and cold-water supplies and shall be located as generally indicated, with precise location and sizing to be in accordance with PDI WH 201. Water hammer arresters, where concealed, shall be accessible by means of access doors or removable panels. Commercial-type water hammer arresters shall conform to ASSE 1010. Vertical capped pipe columns will not be permitted.

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### 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.
- d. Press connection. Copper press connections shall be made in **strict** accordance with the manufacturer's installation instructions for manufactured rated size. The joints shall be pressed using the tool(s) approved by the manufacturer **of that joint**. Minimum distance between fittings shall be in accordance with the manufacturer's requirements.

#### 3.1.2.5 Other Joint Methods

### 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



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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 Corrosion Protection for Buried Pipe and Fittings

Ductile iron, cast iron, and steel pipe, fittings, and joints shall have a protective coating. Coatings shall be selected, applied, and inspected in accordance with NACE SP0169 and as otherwise specified. The pipe shall be cleaned and the coating system applied prior to pipe tightness testing. Joints and fittings shall be cleaned and the coating system applied after pipe tightness testing. For tape coating systems, the tape shall conform to AWWA C203 and shall be applied with a 50 percent overlap. Primer utilized with tape type coating systems shall be as recommended by the tape manufacturer.

#### 3.1.5 Pipe Sleeves and Flashing

Pipe sleeves shall be furnished and set in their proper and permanent location.

##### 3.1.5.1 Sleeve Requirements

Unless indicated otherwise, provide pipe sleeves meeting the following requirements:

- a. Secure sleeves in position and location during construction. Provide sleeves of sufficient length to pass through entire thickness of walls, ceilings, roofs, and floors.
- b. A modular mechanical type sealing assembly may be installed in lieu of a waterproofing clamping flange and caulking and sealing of annular space between pipe and sleeve. The seals shall consist of interlocking synthetic rubber links shaped to continuously fill the annular space between the pipe and sleeve using galvanized steel bolts, nuts, and pressure plates. The links shall be loosely assembled with bolts to form a continuous rubber belt around the pipe with a pressure plate under each bolt head and each nut. After the seal assembly is properly positioned in the sleeve, tightening of the bolt shall cause the rubber sealing elements to expand and provide a watertight seal between the pipe and the sleeve. Each seal assembly shall be sized as recommended by the manufacturer to fit the pipe and sleeve involved.
- c. Sleeves shall not be installed in structural members, except where indicated or approved. Rectangular and square openings shall be as detailed. Each sleeve shall extend through its respective floor, or roof, and shall be cut flush with each surface, except for special circumstances. Pipe sleeves passing through floors in wet areas such as mechanical equipment rooms, lavatories, kitchens, and other plumbing fixture areas shall extend a minimum of 4 inches above the finished floor.
- d. Unless otherwise indicated, sleeves shall be of a size to provide a minimum of 1/4 inch clearance between bare pipe or insulation and

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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 masonry wall as specified above. Sealant selected for the earth side of the wall shall be compatible with dampproofing/waterproofing materials that are to be applied over the joint sealant. Pipe sleeves in fire-rated walls shall conform to the requirements in Section 07 84 00 FIRESTOPPING.

#### 3.1.5.2 Flashing Requirements

Pipes passing through roof shall be installed through a 16 ounce copper flashing, each within an integral skirt or flange. Flashing shall be suitably formed, and the skirt or flange shall extend not less than 8 inches from the pipe and shall be set over the roof or floor membrane in a solid coating of bituminous cement. The flashing shall extend up the pipe a minimum of 10 inches. For cleanouts, the flashing shall be turned down into the hub and caulked after placing the ferrule. Pipes passing through pitched roofs shall be flashed, using lead or copper flashing, with an adjustable integral flange of adequate size to extend not less than 8 inches from the pipe in all directions and lapped into the roofing to provide a watertight seal. The annular space between the flashing and the bare pipe or between the flashing and the metal-jacket-covered insulation shall be sealed as indicated. Flashing for dry vents shall be turned down into the pipe to form a waterproof joint. Pipes, up to and including 10 inches in diameter, passing through roof or floor waterproofing membrane may be installed through a cast-iron sleeve with caulking recess, anchor lugs, flashing-clamp device, and pressure ring with brass bolts. Flashing shield shall be fitted into the sleeve clamping device. Pipes passing through wall waterproofing membrane shall be sleeved as described above. A waterproofing clamping flange shall be installed.

#### 3.1.5.3 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

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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.

#### 3.1.5.4 Optional Counterflashing

Instead of turning the flashing down into a dry vent pipe, or caulking and sealing the annular space between the pipe and flashing or metal-jacket-covered insulation and flashing, counterflashing may be accomplished by utilizing the following:

- a. A standard roof coupling for threaded pipe up to 6 inches in diameter.
- b. A tack-welded or banded-metal rain shield around the pipe.

#### 3.1.5.5 Pipe Penetrations of Slab on Grade Floors

Where pipes, fixture drains, floor drains, cleanouts or similar items penetrate slab on grade floors, except at penetrations of floors with waterproofing membrane as specified in paragraphs FLASHING REQUIREMENTS and WATERPROOFING, a groove 1/4 to 1/2 inch wide by 1/4 to 3/8 inch deep 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.

#### 3.1.5.6 Pipe Penetrations

Provide sealants for all pipe penetrations. All pipe penetrations shall be sealed to prevent infiltration of air, insects, and vermin.

#### 3.1.6 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.

#### 3.1.7 Supports

##### 3.1.7.1 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.

##### 3.1.7.2 Pipe Hangers, Inserts, and Supports

Installation of pipe hangers, inserts and supports shall conform to MSS SP-58 except as modified herein.

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- 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

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or insulation, may freely rest on a steel plate.

(3) On pipe 4 inches and larger carrying medium less than 60 degrees F a Type 40 shield, attached to the pipe or insulation, may freely rest on a steel plate.

1. 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.

### 3.1.7.3 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.

### 3.1.8 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.

### 3.1.9 Pipe Cleanouts

Pipe cleanouts shall be the same size as the pipe except that cleanout plugs larger than 4 inches will not be required. A cleanout installed in connection with cast-iron soil pipe shall consist of a long-sweep 1/4 bend or one or two 1/8 bends extended to the place shown. An extra-heavy cast-brass or cast-iron ferrule with countersunk cast-brass head screw plug shall be caulked into the hub of the fitting and shall be flush with the floor. Cleanouts in connection with other pipe, where indicated, shall be T-pattern, 90-degree branch drainage fittings with cast-brass screw plugs, except plastic plugs shall be installed in plastic pipe. Plugs shall be the same size as the pipe up to and including 4 inches. Cleanout tee branches with screw plug shall be installed at the foot of

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soil and waste stacks, at the foot of interior downspouts, on each connection to building storm drain where interior downspouts are indicated, and on each building drain outside the building. Cleanout tee branches may be omitted on stacks in single story buildings with slab-on-grade construction or where less than 18 inches of crawl space is provided under the floor. Cleanouts on pipe concealed in partitions shall be provided with chromium plated bronze, nickel bronze, nickel brass or stainless steel flush type access cover plates. Round access covers shall be provided and secured to plugs with securing screw. Square access covers may be provided with matching frames, anchoring lugs and cover screws. Cleanouts in finished walls shall have access covers and frames installed flush with the finished wall. Cleanouts installed in finished floors subject to foot traffic shall be provided with a chrome-plated cast brass, nickel brass, or nickel bronze cover secured to the plug or cover frame and set flush with the finished floor. Heads of fastening screws shall not project above the cover surface. Where cleanouts are provided with adjustable heads, the heads shall be cast iron .

### 3.2 WATER HEATERS AND HOT WATER STORAGE TANKS

#### 3.2.1 Relief Valves

No valves shall be installed between a relief valve and its water heater or storage tank. The P&T relief valve shall be installed where the valve actuator comes in contact with the hottest water in the heater. Whenever possible, the relief valve shall be installed directly in a tapping in the tank or heater; otherwise, the P&T valve shall be installed in the hot-water outlet piping. A vacuum relief valve shall be provided on the cold water supply line to the hot-water storage tank or water heater and mounted above and within 6 inches above the top of the tank or water heater.

#### 3.2.2 Installation of Gas-Fired Water Heater

Installation shall conform to NFPA 54 for gas fired . Storage water heaters that are not equipped with integral heat traps and having vertical pipe risers shall be installed with heat traps directly on both the inlet and outlet. Circulating systems need not have heat traps installed. An acceptable heat trap may be a piping arrangement such as elbows connected so that the inlet and outlet piping make vertically upward runs of not less than 24 inches just before turning downward or directly horizontal into the water heater's inlet and outlet fittings. Commercially available heat traps, specifically designed by the manufacturer for the purpose of effectively restricting the natural tendency of hot water to rise through vertical inlet and outlet piping during standby periods may also be approved.

#### 3.2.3 Heat Traps

Piping to and from each water heater and hot water storage tank shall be routed horizontally and downward a minimum of 2 feet before turning in an upward direction.

#### 3.2.4 Connections to Water Heaters

Connections of metallic pipe to water heaters shall be made with dielectric unions or flanges.

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### 3.2.5 Expansion Tank

A pre-charged expansion tank shall be installed on the cold water supply between the water heater inlet and the cold water supply shut-off valve. The Contractor shall adjust the expansion tank air pressure, as recommended by the tank manufacturer, to match incoming water pressure.

### 3.3 FIXTURES AND FIXTURE TRIMMINGS

Polished chromium-plated pipe, valves, and fittings shall be provided where exposed to view. Angle stops, straight stops, stops integral with the faucets, or concealed type of lock-shield, and loose-key pattern stops for supplies with threaded, sweat or solvent weld inlets shall be furnished and installed with fixtures. Where connections between copper tubing and faucets are made by rubber compression fittings, a beading tool shall be used to mechanically deform the tubing above the compression fitting. Exposed traps and supply pipes for fixtures and equipment shall be connected to the rough piping systems at the wall, unless otherwise specified under the item. Floor and wall escutcheons shall be as specified. Drain lines and hot water lines of fixtures for handicapped personnel shall be insulated and do not require polished chrome finish. Plumbing fixtures and accessories shall be installed within the space shown.

#### 3.3.1 Fixture Connections

Where space limitations prohibit standard fittings in conjunction with the cast-iron floor flange, special short-radius fittings shall be provided. Connections between earthenware fixtures and flanges on soil pipe shall be made gastight and watertight with a closet-setting compound or neoprene gasket and seal. Use of natural rubber gaskets or putty will not be permitted. Fixtures with outlet flanges shall be set the proper distance from floor or wall to make a first-class joint with the closet-setting compound or gasket and fixture used.

#### 3.3.2 Flushometer Valves

Flushometer valves shall be secured to prevent movement by anchoring the long finished top spud connecting tube to wall adjacent to valve with approved metal bracket. Flushometer valves for water closets shall be installed 39 inches above the floor, except at water closets intended for use by the physically handicapped where flushometer valves shall be mounted at approximately 30 inches above the floor and arranged to avoid interference with grab bars. In addition, for water closets intended for handicap use, the flush valve handle shall be installed on the wide side of the enclosure. Bumpers for water closet seats shall be installed on the flushometer spud.

#### 3.3.3 Height of Fixture Rims Above Floor

Lavatories shall be mounted with rim 31 inches above finished floor. Wall-hung drinking fountains and water coolers shall be installed with rim 42 inches above floor. Wall-hung service sinks shall be mounted with rim 28 inches above the floor. Installation of fixtures for use by the physically handicapped shall be in accordance with ICC A117.1.

#### 3.3.4 Fixture Supports

Fixture supports for off-the-floor lavatories, urinals, water closets, and

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other fixtures of similar size, design, and use, shall be of the chair-carrier type. The carrier shall provide the necessary means of mounting the fixture, with a foot or feet to anchor the assembly to the floor slab. Adjustability shall be provided to locate the fixture at the desired height and in proper relation to the wall. Support plates, in lieu of chair carrier, shall be fastened to the wall structure only where it is not possible to anchor a floor-mounted chair carrier to the floor slab.

#### 3.3.4.1 Support for Solid Masonry Construction

Chair carrier shall be anchored to the floor slab. Where a floor-anchored chair carrier cannot be used, a suitable wall plate shall be imbedded in the masonry wall.

#### 3.3.4.2 Support for Concrete-Masonry Wall Construction

Chair carrier shall be anchored to floor slab. Where a floor-anchored chair carrier cannot be used, a suitable wall plate shall be fastened to the concrete wall using through bolts and a back-up plate.

#### 3.3.4.3 Support for Steel Stud Frame Partitions

Chair carrier shall be used. The anchor feet and tubular uprights shall be of the heavy duty design; and feet (bases) shall be steel and welded to a square or rectangular steel tube upright. Wall plates, in lieu of floor-anchored chair carriers, shall be used only if adjoining steel partition studs are suitably reinforced to support a wall plate bolted to these studs.

#### 3.3.4.4 Wall-Mounted Water Closet Gaskets

Where wall-mounted water closets are provided, reinforced wax, treated felt, or neoprene gaskets shall be provided. The type of gasket furnished shall be as recommended by the chair-carrier manufacturer.

#### 3.3.5 Backflow Prevention Devices

Plumbing fixtures, equipment, and pipe connections shall not cross connect or interconnect between a potable water supply and any source of nonpotable water. Backflow preventers shall be installed where indicated and in accordance with ICC IPC at all other locations necessary to preclude a cross-connect or interconnect between a potable water supply and any nonpotable substance. In addition backflow preventers shall be installed at all locations where the potable water outlet is below the flood level of the equipment, or where the potable water outlet will be located below the level of the nonpotable substance. Backflow preventers shall be located so that no part of the device will be submerged. Backflow preventers shall be of sufficient size to allow unrestricted flow of water to the equipment, and preclude the backflow of any nonpotable substance into the potable water system. Bypass piping shall not be provided around backflow preventers. Access shall be provided for maintenance and testing. Each device shall be a standard commercial unit.

#### 3.3.6 Access Panels

Access panels shall be provided for concealed valves and controls, or any item requiring inspection or maintenance. Access panels shall be of sufficient size and located so that the concealed items may be serviced,



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maintained, or replaced.

### 3.3.7 Traps

Each trap shall be placed as near the fixture as possible, and no fixture shall be double-trapped. Traps installed on cast-iron soil pipe shall be cast iron. Traps installed on steel pipe or copper tubing shall be recess-drainage pattern, or brass-tube type. Traps installed on plastic pipe may be plastic conforming to ASTM D3311. Traps for acid-resisting waste shall be of the same material as the pipe.

### 3.4 WATER METER REMOTE READOUT REGISTER

The remote readout register shall be mounted at the location indicated or as directed by the Contracting Officer.

### 3.5 IDENTIFICATION SYSTEMS

#### 3.5.1 Identification Tags

Identification tags made of brass, engraved laminated plastic, or engraved anodized aluminum, indicating service and valve number shall be installed on valves, except those valves installed on supplies at plumbing fixtures. Tags shall be 1-3/8 inch minimum diameter, and marking shall be stamped or engraved. Indentations shall be black, for reading clarity. Tags shall be attached to valves with No. 12 AWG, copper wire, chrome-plated beaded chain, or plastic straps designed for that purpose.

#### 3.5.2 Pipe Color Code Marking

Color code marking of piping shall be as specified in Section 09 90 00 PAINTS AND COATINGS.

#### 3.5.3 Color Coding Scheme for Locating Hidden Utility Components

Scheme shall be provided in buildings having suspended grid ceilings. The color coding scheme shall identify points of access for maintenance and operation of operable components which are not visible from the finished space and installed in the space directly above the suspended grid ceiling. The operable components shall include valves, dampers, switches, linkages and thermostats. The color coding scheme shall consist of a color code board and colored metal disks. Each colored metal disk shall be approximately 3/8 inch in diameter and secured to removable ceiling panels with fasteners. The fasteners shall be inserted into the ceiling panels so that the fasteners will be concealed from view. The fasteners shall be manually removable without tools and shall not separate from the ceiling panels when panels are dropped from ceiling height. Installation of colored metal disks shall follow completion of the finished surface on which the disks are to be fastened. The color code board shall have the approximate dimensions of 3 foot width, 30 inches height, and 1/2 inch thickness. The board shall be made of wood fiberboard and framed under glass or 1/16 inch transparent plastic cover. Unless otherwise directed, the color code symbols shall be approximately 3/4 inch in diameter and the related lettering in 1/2 inch high capital letters. The color code board shall be mounted and located in the mechanical or equipment room. The color code system shall be as indicated below:

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### 3.6 ESCUTCHEONS

Escutcheons shall be provided at finished surfaces where bare or insulated piping, exposed to view, passes through floors, walls, or ceilings, except in boiler, utility, or equipment rooms. Escutcheons shall be fastened securely to pipe or pipe covering and shall be satin-finish, corrosion-resisting steel, polished chromium-plated zinc alloy, or polished chromium-plated copper alloy. Escutcheons shall be either one-piece or split-pattern, held in place by internal spring tension or setscrew.

### 3.7 PAINTING

Painting of pipes, hangers, supports, and other iron work, either in concealed spaces or exposed spaces, is specified in Section 09 90 00 PAINTS AND COATINGS.

#### 3.7.1 Painting of New Equipment

New equipment painting shall be factory applied or shop applied, and shall be as specified herein, and provided under each individual section.

##### 3.7.1.1 Factory Painting Systems

Manufacturer's standard factory painting systems may be provided subject to certification that the factory painting system applied will withstand 125 hours in a salt-spray fog test, except that equipment located outdoors shall withstand 500 hours in a salt-spray fog test. Salt-spray fog test shall be in accordance with ASTM B117, and for that test the acceptance criteria shall be as follows: immediately after completion of the test, the paint shall show no signs of blistering, wrinkling, or cracking, and no loss of adhesion; and the specimen shall show no signs of rust creepage beyond 0.125 inch on either side of the scratch mark.

The film thickness of the factory painting system applied on the equipment shall not be less than the film thickness used on the test specimen. If manufacturer's standard factory painting system is being proposed for use on surfaces subject to temperatures above 120 degrees F, the factory painting system shall be designed for the temperature service.

##### 3.7.1.2 Shop Painting Systems for Metal Surfaces

Clean, pretreat, prime and paint metal surfaces; except aluminum surfaces need not be painted. Apply coatings to clean dry surfaces. Clean the surfaces to remove dust, dirt, rust, oil and grease by wire brushing and solvent degreasing prior to application of paint, except metal surfaces subject to temperatures in excess of 120 degrees F shall be cleaned to bare metal.

Where more than one coat of paint is specified, apply the second coat after the preceding coat is thoroughly dry. Lightly sand damaged painting and retouch before applying the succeeding coat. Color of finish coat shall be aluminum or light gray.

- a. Temperatures Less Than 120 Degrees F: Immediately after cleaning, the metal surfaces subject to temperatures less than 120 degrees F shall receive one coat of pretreatment primer applied to a minimum dry film thickness of 0.3 mil, one coat of primer applied to a minimum dry film thickness of one mil; and two coats of enamel applied to a minimum dry

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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.

### 3.8 TESTS, FLUSHING AND DISINFECTION

#### 3.8.1 Plumbing System

The following tests shall be performed on the plumbing system in accordance with ICC IPC, except that the drainage and vent system final test shall include the smoke test. The Contractor has the option to perform a peppermint test in lieu of the smoke test. If a peppermint test is chosen, the Contractor must submit a testing procedure and reasons for choosing this option in lieu of the smoke test to the Contracting Officer for approval.

- a. Drainage and Vent Systems Test. The final test shall include a smoke test.
- b. Building Sewers Tests.
- c. Water Supply Systems Tests.

##### 3.8.1.1 Test of Backflow Prevention Assemblies

Backflow prevention assembly shall be tested using gauges specifically designed for the testing of backflow prevention assemblies.

Backflow prevention assembly test gauges shall be tested annually for accuracy in accordance with the requirements of State or local regulatory agencies. If there is no State or local regulatory agency requirements, gauges shall be tested annually for accuracy in accordance with the requirements of University of Southern California's Foundation of Cross Connection Control and Hydraulic Research or the American Water Works Association Manual of Cross Connection (Manual M-14), or any other approved testing laboratory having equivalent capabilities for both laboratory and field evaluation of backflow prevention assembly test gauges. Report form for each assembly shall include, as a minimum, the following:

Data on Device	Data on Testing Firm
Type of Assembly	Name
Manufacturer	Address
Model Number	Certified Tester
Serial Number	Certified Tester No.
Size	Date of Test

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Location	
Test Pressure Readings	Serial Number and Test Data of Gauges

If the unit fails to meet specified requirements, the unit shall be repaired and retested.

### 3.8.2 Defective Work

If inspection or test shows defects, such defective work or material shall be replaced or repaired as necessary and inspection and tests shall be repeated. Repairs to piping shall be made with new materials. Caulking of screwed joints or holes will not be acceptable.

### 3.8.3 System Flushing

#### 3.8.3.1 During Flushing

Before operational tests or disinfection, potable water piping system shall be flushed with potable water. Sufficient water shall be used to produce a water velocity that is capable of entraining and removing debris in all portions of the piping system. This requires simultaneous operation of all fixtures on a common branch or main in order to produce a flushing velocity of approximately 4 fps through all portions of the piping system. In the event that this is impossible due to size of system, the Contracting Officer (or the designated representative) shall specify the number of fixtures to be operated during flushing. Contractor shall provide adequate personnel to monitor the flushing operation and to ensure that drain lines are unobstructed in order to prevent flooding of the facility. Contractor shall be responsible for any flood damage resulting from flushing of the system. Flushing shall be continued until entrained dirt and other foreign materials have been removed and until discharge water shows no discoloration. All faucets and drinking water fountains, to include any device considered as an end point device by NSF/ANSI 61, Section 9, shall be flushed a minimum of 0.25 gallons per 24 hour period, ten times over a 14 day period.

#### 3.8.3.2 After Flushing

System shall be drained at low points. Strainer screens shall be removed, cleaned, and replaced. After flushing and cleaning, systems shall be prepared for testing by immediately filling water piping with clean, fresh potable water. Any stoppage, discoloration, or other damage to the finish, furnishings, or parts of the building due to the Contractor's failure to properly clean the piping system shall be repaired by the Contractor. When the system flushing is complete, the hot-water system shall be adjusted for uniform circulation. Flushing devices and automatic control systems shall be adjusted for proper operation according to manufacturer's instructions. Flow rates on fixtures must not exceed those stated in PART 2 of this Section. Unless more stringent local requirements exist, lead levels shall not exceed limits established by 40 CFR 141.80 (c)(1). The water supply to the building shall be tested separately to ensure that any lead contamination found during potable water system testing is due to work being performed inside the building.

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#### 3.8.4 Operational Test

Upon completion of flushing and prior to disinfection procedures, the Contractor shall subject the plumbing system to operating tests to demonstrate satisfactory installation, connections, adjustments, and functional and operational efficiency. Such operating tests shall cover a period of not less than 8 hours for each system and shall include the following information in a report with conclusion as to the adequacy of the system:

- a. Time, date, and duration of test.
- b. Water pressures at the most remote and the highest fixtures.
- c. Operation of each fixture and fixture trim.
- d. Operation of each valve, hydrant, and faucet.
- e. Pump suction and discharge pressures.
- f. Temperature of each domestic hot-water supply.
- g. Operation of each floor and roof drain by flooding with water.
- h. Operation of each vacuum breaker and backflow preventer.
- i. Complete operation of each water pressure booster system, including pump start pressure and stop pressure.

#### 3.8.5 Disinfection

After all system components are provided and operational tests are complete, the entire domestic hot- and cold-water distribution system shall be disinfected. Before introducing disinfecting chlorination material, entire system shall be flushed with potable water until any entrained dirt and other foreign materials have been removed.

Water chlorination procedure shall be in accordance with AWWA C651 and AWWA C652 as modified and supplemented by this specification. The chlorinating material shall be hypochlorites or liquid chlorine. The chlorinating material shall be fed into the water piping system at a constant rate at a concentration of at least 50 parts per million (ppm). Feed a properly adjusted hypochlorite solution injected into the system with a hypochlorinator, or inject liquid chlorine into the system through a solution-feed chlorinator and booster pump until the entire system is completely filled.

Test the chlorine residual level in the water at 6 hour intervals for a continuous period of 24 hours. If at the end of a 6 hour interval, the chlorine residual has dropped to less than 25 ppm, flush the piping including tanks with potable water, and repeat the above chlorination procedures. During the chlorination period, each valve and faucet shall be opened and closed several times.

After the second 24 hour period, verify that no less than 25 ppm chlorine residual remains in the treated system. The 24 hour chlorination procedure must be repeated until no less than 25 ppm chlorine residual remains in the treated system.

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Upon the specified verification, the system including tanks shall then be flushed with potable water until the residual chlorine level is reduced to less than one part per million. During the flushing period, each valve and faucet shall be opened and closed several times.

Take additional samples of water in disinfected containers, for bacterial examination, at locations specified by the Contracting Officer. Test these samples for total coliform organisms (coliform bacteria, fecal coliform, streptococcal, and other bacteria) in accordance with EPA SM 9223. The testing method used shall be EPA approved for drinking water systems and shall comply with applicable local and state requirements.

Disinfection shall be repeated until bacterial tests indicate the absence of coliform organisms (zero mean coliform density per 100 milliliters) in the samples for at least 2 full days. The system will not be accepted until satisfactory bacteriological results have been obtained.

### 3.9 POSTED INSTRUCTIONS

Framed instructions under glass or in laminated plastic, including wiring and control diagrams showing the complete layout of the entire system, shall be posted where directed. Condensed operating instructions explaining preventive maintenance procedures, methods of checking the system for normal safe operation, and procedures for safely starting and stopping the system shall be prepared in typed form, framed as specified above for the wiring and control diagrams and posted beside the diagrams. The framed instructions shall be posted before acceptance testing of the systems.

### 3.10 PERFORMANCE OF WATER HEATING EQUIPMENT

Standard rating condition terms are as follows:

EF = Energy factor, minimum overall efficiency.

ET = Minimum thermal efficiency with 70 degrees F delta T.

SL = Standby loss is maximum (Btu/h) based on a 70 degrees F temperature difference between stored water and ambient requirements.

V = Rated volume in gallons

Q = Nameplate input rate in kW (Btu/h)

#### 3.10.1 Storage Water Heaters

##### 3.10.1.1 Gas

- a. Storage capacity of 50 gallons or less shall have a minimum energy factor (EF) of 0.67 or higher per FEMP requirements.
- b. Storage capacity of 20 gallons - or more and input rating of 75,000 Btu/h or less: minimum EF shall be 0.62 - 0.0019V per 10 CFR 430.
- c. Rating of less than 22980 W: (75,000 Btu/h) ET shall be 80 percent; maximum SL shall be  $(Q/800+110 \times (V^{1/2}))$ , per ANSI Z21.10.3/CSA 4.3

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### 3.11 TABLES

TABLE I								
PIPE AND FITTING MATERIALS FOR DRAINAGE, WASTE, VENT AND CONDENSATE DRAIN PIPING SYSTEMS								
Item #	Pipe and Fitting Materials	SERVICE A	SERVICE B	SERVICE C	SERVICE D	SERVICE E	SERVICE F	SERVICE G
1	Cast iron soil pipe and fittings, hub and spigot, ASTM A74 with compression gaskets. Pipe and fittings shall be marked with the CISPI trademark.	X	X	X	X	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	X		
3	Cast iron drainage fittings, threaded, ASME B16.12 for use with Item 10	X		X	X			
6	Ductile iron grooved joint fittings for ferrous pipe ASTM A536 and ASTM A47/A47M for use with Item 5	X	X		X	X		
7	Bronze sand casting grooved joint pressure fittings for non-ferrous pipe ASTM B584, for use with Item 5	X	X		X	X		

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TABLE I								
PIPE AND FITTING MATERIALS FOR DRAINAGE, WASTE, VENT AND CONDENSATE DRAIN PIPING SYSTEMS								
Item #	Pipe and Fitting Materials	SERVICE A	SERVICE B	SERVICE C	SERVICE D	SERVICE E	SERVICE F	SERVICE G
8	Wrought copper grooved joint pressure fittings for non-ferrous pipe ASTM B75/B75M C12200, ASTM B152/B152M, C11000, ASME B16.22 ASME B16.22 for use with Item 5	X	X					
9	Malleable-iron threaded fittings, galvanized ASME B16.3 for use with Item 10				X	X		
10	Steel pipe, seamless galvanized, ASTM A53/A53M, Type S, Grade B	X			X	X		
12	Bronzed flanged fittings, ASME B16.24 for use with Items 11 and 14				X	X		X
13	Cast copper alloy solder joint pressure fittings, ASME B16.18 for use with Item 14				X	X		X
14	Seamless copper pipe, ASTM B42						X	X
15	Cast bronze threaded fittings, ASME B16.15				X	X		
16	Copper drainage tube, (DWV), ASTM B306	X*	X	X*	X	X		X



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TABLE I								
PIPE AND FITTING MATERIALS FOR DRAINAGE, WASTE, VENT AND CONDENSATE DRAIN PIPING SYSTEMS								
Item #	Pipe and Fitting Materials	SERVICE A	SERVICE B	SERVICE C	SERVICE D	SERVICE E	SERVICE F	SERVICE G
17	Wrought copper and wrought alloy solder-joint drainage fittings. ASME B16.29	X	X	X	X	X		X
18	Cast copper alloy solder joint drainage fittings, DWV, ASME B16.23	X	X	X	X	X		X
19	Acrylonitrile-Butadiene (ABS) plastic drain, waste, and vent pipe and fittings ASTM D2661, ASTM F628	X	X	X	X	X	X	
20	Polyvinyl Chloride plastic drain, waste and vent pipe and fittings, ASTM D2665, ASTM F891, (Sch 40) ASTM F1760	X	X	X	X	X	X	X
SERVICE:  A - Underground Building Soil, Waste and Storm Drain B - Aboveground Soil, Waste, Drain In Buildings C - Underground Vent D - Aboveground Vent E - Interior Rainwater Conductors Aboveground F - Corrosive Waste And Vent Above And Belowground G - Condensate Drain Aboveground  * - Hard Temper								

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TABLE II					
PIPE AND FITTING MATERIALS FOR PRESSURE PIPING SYSTEMS					
Item #	Pipe and Fitting Materials	SERVICE A	SERVICE B	SERVICE C	SERVICE D
1	Malleable-iron threaded fittings:				
	a. Galvanized, ASME B16.3 for use with Item 4a	X	X	X	X
	b. Same as "a" but not galvanized for use with Item 4b			X	
3	Ductile iron grooved joint fittings for ferrous pipe ASTM A536 and ASTM A47/A47M, for use with Item 2	X	X	X	
4	Steel pipe:				
	a. Seamless, galvanized, ASTM A53/A53M, Type S, Grade B	X	X	X	X
	b. Seamless, black, ASTM A53/A53M, Type S, Grade B			X	
6	Bronze flanged fittings, ASME B16.24 for use with Items 5 and 7	X	X		X
7	Seamless copper pipe, ASTM B42	X	X		X
8	Seamless copper water tube, ASTM B88, ASTM B88M	X**	X**	X**	X***
9	Cast bronze threaded fittings, ASME B16.15 for use with Items 5 and 7	X	X		X
10	Wrought copper and bronze solder-joint pressure fittings, ASME B16.22 for use with Items 5, 7 and 8	X	X	X	X
11	Cast copper alloy solder-joint pressure fittings, ASME B16.18 for use with Item 8	X	X	X	X

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TABLE II					
PIPE AND FITTING MATERIALS FOR PRESSURE PIPING SYSTEMS					
Item #	Pipe and Fitting Materials	SERVICE A	SERVICE B	SERVICE C	SERVICE D
12	Bronze and sand castings grooved joint pressure fittings for non-ferrous pipe ASTM B584, for use with Item 2	X	X	X	
19	Chlorinated polyvinyl chloride (CPVC) plastic hot and cold water distribution system, ASTM D2846/D2846M	X	X		X
20	Chlorinated polyvinyl chloride (CPVC) plastic pipe, Schedule 40 and 80, ASTM F441/F441M	X	X		X
21	Chlorinated polyvinyl chloride (CPVC) plastic pipe (SDR-PR) ASTM F442/F442M	X	X		X
22	Threaded chlorinated polyvinyl chloride (chloride CPVC) plastic pipe fittings, Schedule 80, ASTM F437, for use with Items 20, and 21	X	X		X
23	Socket-type chlorinated polyvinyl chloride (CPVC) plastic pipe fittings, Schedule 40, ASTM F438 for use with Items 20, 21, and 22	X	X		X
24	Socket-type chlorinated polyvinyl chloride (CPVC) plastic pipe fittings Schedule 80, ASTM F439 for use with Items 20, 21, and 22	X	X		X
25	Polyvinyl chloride (PVC) plastic pipe, Schedules 40, 80, and 120, ASTM D1785	X			X
26	Polyvinyl chloride (PVC) pressure-rated pipe (SDR Series), ASTM D2241	X			X

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TABLE II					
PIPE AND FITTING MATERIALS FOR PRESSURE PIPING SYSTEMS					
Item #	Pipe and Fitting Materials	SERVICE A	SERVICE B	SERVICE C	SERVICE D
27	Polyvinyl chloride (PVC) plastic pipe fittings, Schedule 40, ASTM D2466	X			X
28	Socket-type polyvinyl chloride (PVC) plastic pipe fittings, schedule 80, ASTM D2467 for use with Items 26 and 27	X			X
29	Threaded polyvinyl chloride (PVC) plastic pipe fittings, schedule 80, ASTM D2464	X			X
30	Joints for IPS PVC pipe using solvent cement, ASTM D2672	X			X
32	Steel pipeline flanges, MSS SP-44	X	X		
33	Fittings: brass or bronze; ASME B16.15 and ASME B16.18 ASTM B828	X	X		
34	Carbon steel pipe unions, socket-welding and threaded, MSS SP-83	X	X	X	
35	Malleable-iron threaded pipe unions ASME B16.39	X	X		
36	Nipples, pipe threaded ASTM A733	X	X	X	

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TABLE II					
PIPE AND FITTING MATERIALS FOR PRESSURE PIPING SYSTEMS					
Item #	Pipe and Fitting Materials	SERVICE A	SERVICE B	SERVICE C	SERVICE D
	SERVICE: A - Cold Water Service Aboveground B - Hot and Cold Water Distribution 180 degrees F Maximum Aboveground C - Compressed Air Lubricated D - Cold Water Service Belowground Indicated types are minimum wall thicknesses. ** - Type L - Hard *** - Type K - Hard temper with brazed joints only or type K-soft temper without joints in or under floors **** - In or under slab floors only brazed joints				

TABLE III				
STANDARD RATING CONDITIONS AND MINIMUM PERFORMANCE RATINGS FOR WATER HEATING EQUIPMENT				
FUEL	STORAGE CAPACITY GALLONS	INPUT RATING	TEST PROCEDURE	REQUIRED PERFORMANCE
A. STORAGE WATER HEATERS				
Gas	50 max.		10 CFR 430	EF = 0.67
Gas	20 min.	75,000 Btu/h max.	10 CFR 430	EF = 80-0.0019V min.
Gas	1,000 (Btu/h)/gal max.	75,000 Btu/h	ANSI Z21.10.3/CS	ET = 80 percent min. SL = 1.3+38/V max.
TERMS:  EF = Energy factor, minimum overall efficiency. ET = Minimum thermal efficiency with 70 degrees F delta T. SL = Standby loss is maximum Btu/h based on a 70 degree F temperature difference between stored water and ambient requirements. V = Rated storage volume in gallons Q = Nameplate input rate in Btu/h				

-- End of Section --

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## SECTION 23 05 93.00 06

TESTING, ADJUSTING, AND BALANCING (TAB) OF HVAC  
08/16

## PART 1 GENERAL

## 1.1 REFERENCES

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

## ASSOCIATED AIR BALANCE COUNCIL (AABC)

AABC MN-1 (2002; 6th ed) National Standards for  
Total System Balance

## NATIONAL ENVIRONMENTAL BALANCING BUREAU (NEBB)

NEBB PROCEDURAL STANDARDS (2005) Procedural Standards for Testing,  
Adjusting and Balancing (TAB) of  
Environmental Systems

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

SMACNA 1780 (2002) HVAC Systems - Testing, Adjusting  
and Balancing, 3rd Edition

SMACNA 1972 CD (2012) HVAC Air Duct Leakage Test Manual -  
2nd Edition

## 1.2 SUBMITTALS

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

## SD-02 Shop Drawings

TAB Schematic Drawings and Report Forms; G

Submit TAB Schematic Drawings and Report Forms no later than 21 calendar days prior to the start of TAB field work. Submit three hard copies and an electronic copy.

## SD-03 Product Data

TAB Related HVAC Submittals

Submit an electronic copy of a list of the TAB Related HVAC Submittals, no later than 7 calendar days after the approval of the TAB Specialist.

Duct Air Leakage Test Procedures; G

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Submit Duct Air Leakage Test Procedures no later than 21 calendar days prior to the start of duct air leakage tests. Submit three hardcopies and one electronic copy.

TAB Procedures; G

Submit TAB Procedures concurrent with the TAB Schematic Drawings and Report Forms. Submit three hard copies and an electronic copy.

Calibrations; G

Submit Calibration concurrent with the TAB Schematic Drawings and Report Forms. Submit three hard copies and an electronic copy.

Duct Air Leakage Tests

Submit proposed date and time to begin the Duct Air Leakage Tests, no later than 7 calendar days prior to the start of the Systems Readiness Check.

Systems Readiness Check

Submit proposed date and time to begin the Systems Readiness Check, no later than 7 calendar days prior to the start of the Systems Readiness Check.

TAB Field Work; G

Submit proposed date and time to begin TAB field work concurrent with the Systems Readiness Check Report.

TAB Verification; G

Submit proposed date and time to begin the TAB Verification, concurrent with the Draft TAB Report.

SD-06 Test Reports

Design Review Report; G

Submit the Design Review Report no later than 14 calendar days after approval of the TAB Firm and the TAB Specialist. Submit one hard copy and an electronic copy.

Draft Duct Air Leakage Test Report; G

Submit the one hardcopy and an electronic copy of the Draft Duct Air Leakage Test Report no later than 7 calendar days after completion of duct air leakage testing.

Final Duct Air Leakage Test Report; G, AE

Submit three hardcopies and an electronic copy of the Final Duct Air Leakage Test Report no later than 7 calendar days after completion of duct air leakage acceptance test.

Systems Readiness Check Report; G

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Submit the Systems Readiness Check Report at least 14 calendar days prior to the start of TAB Field Work. Submit three hard copies and an electronic copy.

Draft TAB Report; G

Submit completed Draft TAB Report electronically no later than 7 calendar days after completion of all TAB field work. Submit one hard copy and an electronic copy.

Final TAB Report; G, AE

Submit three hard copies and an electronic copy of the Final TAB Reports no later than 7 calendar days after successful completion of TAB Verification. Submit three hard copies and an electronic copy.

#### SD-07 Certificates

TAB Firm; G

Submit certification of the proposed TAB Firm's qualifications by either AABC, NEBB, or TABB to perform the duties specified herein and in other related Sections, no later than 21 calendar days after the Notice to Proceed. The documentation shall include the date that the Certification was initially granted and the date that the current Certification expires. Submit three hard copies and one electronic copy.

TAB Specialist; G

Submit certification of the proposed TAB Specialist's qualifications by either AABC, NEBB, or TABB to perform the duties specified herein and in other related Sections, no later than 21 calendar days after the Notice to Proceed. The documentation shall include the date that the Certification was initially granted and the date that the current Certification expires. Submit three hard copies and an electronic copy.

#### 1.3 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.	SMACNA's Procedures



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#### SIMILAR TERMS

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

#### 1.3.1 Work Description

Perform Duct Air Leakage Testing (DALT) and Testing, Adjusting, and Balancing (TAB) of the new heating, ventilation, and cooling (HVAC) air and water distribution systems.

Conduct Duct Air Leakage Testing in compliance with the requirements specified in SMACNA 1972 CD, except as supplemented and modified by this section.

#### 1.4 TAB STANDARD

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, i.e. AABC MN-1, NEBB PROCEDURAL STANDARDS, or SMACNA 1780 as supplemented and modified by this specification section. Comply with all recommendations and suggested practices contained in the TAB procedural standards. Use the provisions of the TAB Standard, including checklists, report forms, etc., as nearly as practical, to satisfy the Contract requirements. The TAB Standard shall be used 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 mandatory.

#### 1.5 QUALIFICATIONS

##### 1.5.1 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 TAB of environmental systems and building systems commissioning.

The certification must be maintained for the entire duration of duties specified herein. If, for any reason, the firm loses subject certification during this period, immediately notify the Contracting

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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 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 is 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 subcontractor of the prime Contractor and shall be financially and corporately independent of the mechanical subcontractor, and shall report to and be paid by the prime Contractor.

#### 1.5.2 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 is invalid if the TAB Specialist loses its certification prior to Contract completion and must be performed by the approved successor.

#### 1.6 TAB SPECIALIST RESPONSIBILITIES

All TAB work specified herein and in related sections must be performed under the direct guidance of the TAB Specialist. The TAB specialist is required to be onsite on a daily basis to direct TAB efforts. The TAB Specialist shall participate in the commissioning process specified in LRL Section 01 46 00.00 06 TOTAL BUILDING COMMISSIONING (CONTRACTOR CxA).

#### PART 2 PRODUCTS (Not Applicable)

#### PART 3 EXECUTION

##### 3.1 DESIGN REVIEW

The TAB Specialist must review the Contract Plans and Specifications and identify, in a Design Review Report, any deficiencies that would prevent the effective and accurate TAB of the system. In the Design Review Report, the TAB Specialist shall individually list each deficiency and the corresponding proposed corrective action necessary for proper system operation. State that no deficiencies are evident if that is the case.

##### 3.2 TAB RELATED HVAC SUBMITTALS

The TAB Specialist must prepare a list of the submittals from the Contract Submittal Register that relate to the successful accomplishment of all HVAC TAB. Accompany the submittals identified on this list shall be accompanied by a letter certifying that submitted equipment will allow proper testing, adjusting, and balancing of the HVAC systems. The letter must be signed and dated by the TAB Specialist when submitted to the

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Government. The TAB Specialist must also ensure that the location and details of ports, terminals, connections, etc., necessary to perform TAB are identified on the submittals.

### 3.3 TAB SCHEMATIC DRAWINGS AND REPORT FORMS

Provide TAB Schematic Drawings showing each system component, including balancing devices, for each system. Include the following on TAB Schematic Drawings:

- a. Location of all air terminal devices including supply, return, exhaust, and transfer devices.
- b. A unique number or mark for each piece of equipment or terminal cross-referenced to the report forms and procedures.
- c. Locations of air balancing dampers.
- d. Air quantities at each air terminal.
- e. Air quantities and temperatures in air handling unit schedules.
- f. Intended location of all traverse, static pressure readings, and other testing points with a keying scheme cross-referenced to the TAB report forms and procedures.

Provide TAB Report Forms intended for use in preparing the TAB Report. Include the following information in the TAB Report Forms:

- a. Design data obtained from contract drawings, specifications, and approved submittals.
- b. Notations detailing additional data to be obtained from the contract site by the TAB Specialist.
- c. Designate the actual data to be measured.
- d. Identifiers for each measured item and piece of equipment or terminal cross-referenced from TAB Schematic Drawings.
- e. Provide a list of the types of instruments, and the measuring range of each, which are anticipated to be used. By means of a keying scheme, specify on each TAB report form submitted, which instruments will be used for measuring each item. If selection of which instrument to use will 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.

### 3.4 TAB Procedures

Provide step by step procedures for each measurement required during TAB. Provide a separate section for each system. Include measures to ensure that each system performs as specified in all operating modes, interactions with other components (such as exhaust fans, relief vents, etc.) and systems, and with all seasonal operating differences, diversity, simulated loads, and pressure relationships required.

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### 3.5 Calibrations

Provide a list of each instrument to be used during TAB, stating calibration requirements required or recommended by both the TAB Standard and the instrument manufacturer and the actual calibration history of the instrument, submitted with the TAB Procedures. The calibration history shall include dates calibrated, the qualifications of the calibration laboratory, and the calibration procedures used.

### 3.6 Duct Air Leakage Tests

#### 3.6.1 Duct Air Leakage Test Procedures

The TAB Specialist must prepare and provide step by step procedures for duct air leakage testing. Procedures must comply with SMACNA 1972 CD. Perform duct air leakage tests for ductwork over 3-inch water gauge static pressure. Despite specification of SMACNA 1972 CD to the contrary, duct air leakage tests must be performed for ductwork with a construction class of 3-inch water gauge static pressure and below if indicated on the drawings. Use the duct class, seal class, leakage class, and the leak test pressure data indicated on the drawings or as specified. Include a list of each instrument to be used during duct air leakage testing, stating the calibration requirements required or recommended by both the TAB standard and the instrument manufacturer and the actual calibration history of the instrument. The calibration history shall include dates calibrated, the qualifications of the calibration laboratory, and the calibration procedures used.

#### 3.6.2 Ductwork to be Leakage Tested

The Contracting Officer's Representative will randomly select section of each completed duct system for testing by the TAB Firm. Coordinate scheduling of selection of duct sections for duct air leakage tests with the Contracting Officer's Representative. The sections selected will not exceed 20 percent of the total measured linear footage of the duct systems indicated as subject to duct air leakage testing. Sections of duct systems subject to duct air leakage testing 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 the entire system to be duct air leakage tested instead of disassembling that system in order to test only the 20 percent portion.

#### 3.6.3 Duct Air Leakage Testing

The TAB Specialist must perform duct air leakage test on each system as selected by the Contracting Officer's Representative only after Duct Air Leakage Test Procedures have been submitted and approved. Complete duct air leakage test work within 48 hours after the particular ductwork was selected for testing by the Contracting Officer's Representative. Comply with approved Duct Air Leakage Test Procedures and SMACNA 1972 CD. Provide all instruments, consumables, and personnel required to accomplish the Duct Air Leakage field work. Calibrate and maintain instruments in accordance with manufacturer's written procedures. It is the contractor's responsibility to provide and install test ports as necessary for the duct air leakage tests. If the required conditions cannot be met during testing due to design or installation deficiencies, immediately notify the Contracting Officer's representative and provide written notice describing the deficiency and recommended corrections. The Contractor is responsible for correction of installation deficiencies.

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#### 3.6.4 Draft Duct Air Leakage Test Report

Following completion of the duct air leakage test work, prepare a Draft Duct Air Leakage Test Report using report forms shown in SMACNA 1972 CD. The TAB Specialist must furnish the data required by the report forms. Include a marked duct shop drawing identifying 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 Specialist must certify the report. Include all calculations prepared in determining the duct surface of area of each duct test section. Include calibration curve for each of the test orifices used for testing. List instruments actually used to measure the data including the instruments unique identification number, calibration date, and calibration expiration date.

#### 3.6.5 Duct Air Leakage Acceptance Test

In the presence of the Contracting Officer's Representative, verify, through retesting, 50 percent of the test data reported in the Draft Duct Air Leakage Test Report. If any data in the Draft Duct Air Leakage Test Report is out-of-tolerance, perform acceptance testing on one additional duct section in the presence of the Contracting Officer's Representative. 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 1972 CD for an indicated duct construction class and sealant class, terminate data checking for that section. The associated draft report data will be disapproved. Make the necessary corrections and prepare a revised Draft Duct Air Leakage Test Report. Reschedule acceptance testing of the revised report data with the Contracting Officer's Representative.

At the sole discretion of the Government and with written concurrence from the Contracting Officer, the Contracting Officer's Representative may witness 100 percent of the Duct Air Leakage Tests in order to eliminate the requirement for Duct Air Leakage Acceptance Testing. In such a case, the Draft Duct Air Leakage Test Report serves as the Final Duct Air Leakage Test Report.

#### 3.6.6 Final Duct Air Leakage Test Report

After successful completion of all duct air leakage acceptance testing, submit the Final Duct Air Leakage Test Report. Include all information from the Draft Duct Air Leakage Test Report updated to include final test data.

#### 3.7 Systems Readiness Check

The TAB Specialist must inspect each system to ensure that it is complete, including installation and operation of controls, and that all aspects of the facility that have any bearing on the HVAC systems, including installation of ceilings, walls, windows, doors, and partitions, are complete in accordance with the applicable TAB standard and to the extent that TAB results will not be affected by any detail or touch-up work remaining. The TAB Specialist must also verify completion of all items necessary to perform TAB such as ductwork and piping ports, terminals, connections, etc. Provide a Systems Readiness Check Report, signed by the TAB Specialist, that certifies that all work necessary to perform TAB field work has been completed and includes checklists used to verify completion.

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### 3.8 TESTING, ADJUSTING, AND BALANCING

#### 3.8.1 Preliminary Procedures

Begin testing, adjusting, and balancing field work only after TAB Schematic Drawings and Report Forms, TAB Procedures, the Final Duct Air Leakage Test Report,, and the Systems Readiness Check Report have been submitted and approved. It is the responsibility of the contractor to provide and install test ports as necessary for the TAB field work.

#### 3.8.2 TAB Field Work

Test, adjust, and balance the HVAC systems until measured air and water flow rates are within plus or minus 10 percent of the design flow rates as specified or indicated on the contract documents. Test, adjust, and balance outdoor air supply flow to plus 10% and minus 0% percent and exhaust flow to plus 0% and minus 10% of design flow rates specified or indicated on the contract documents. Adjust balancing valves, dampers, and sheaves and change out fan sheaves and fan impellers as necessary to obtain the specified or indicated air and water flow rates. Comply with the requirements of the TAB Standard except as supplemented and modified by this section. Where possible, use "industry standard" adjusting and balancing techniques which would result in the greatest energy savings, such as adjusting the speed of a fan instead of throttling the flow. Provide all instruments and consumables required to accomplish the TAB work. Calibrate and maintain instruments in accordance with manufacturer's written procedures. If the design flow rates cannot be attained due to design or installation deficiencies, immediately notify the Contracting Officer's representative and provide written notice describing the deficiency and recommended corrections. The Contractor is responsible for correction of installation deficiencies.

##### 3.8.2.1 Units with Coils

Perform and report heating and cooling performance capacity tests for DX coils for the purpose of verifying that the coils meet the indicated design capacity. Determine entering and leaving wet and dry bulb temperatures by single point measurement for units with capacities up to and including 7.5 tons or 90,000 Btu. Determine entering and leaving wet and dry bulb temperatures by the average of multiple readings, in accordance with AABC MN-4, procedure "Coil Capacity Testing" for units over 7.5 tons or 90,000 Btu. Submit part-load data from the coil manufacturer converting test conditions to design conditions to verify coils meet intended design capacity in accordance with AABC MN-4, Procedure Coil Capacity Testing, Actual Capacity vs. Design Capacity. Record the outdoor and indoor ambient dry and wet bulb temperature ranges within which the report data was recorded; record temperatures and the beginning and end of data taking.

##### 3.8.2.2 Refrigeration Equipment

Measure and report data as indicated in NEBB Form TAB 15-83, NEBB PROCEDURAL STANDARDS, including refrigeration operational data for equipment using refrigerant such as compressors, condensers, condensing units, evaporators, and chillers. Record outdoor ambient dry and wet bulb temperature ranges within which the report data was recorded.

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### 3.9 TAB Report

#### 3.9.1 Draft TAB Report

Provide a Draft TAB Report demonstrating successful completion of the TAB field work using the approved TAB Report Forms. Include a separate section for each system. Include a copy of the approved TAB Schematic Drawings and TAB Related Submittals such as pump curves and fan curves. Mark, on the performance curves and tables, the operating points measured during successful TAB field work and the theoretical operating points listed in the approved submittals. Note any deficiencies outside of normal adjustments and balancing during TAB field work including a description of the corrective action performed to bring the measurement into the specified tolerance. If the TAB Specialist determines during TAB field work that any contract requirements cannot be met, include a written description of the deficiency and the corresponding proposed corrective action necessary for proper system operation.

#### 3.9.2 Final TAB Report

Provide a Final TAB Report following TAB Verification. The Final TAB Report includes all information from the Draft TAB Report, updated to show results from any rework performed following successful TAB Verification. Include data recorded and any changes or differences from the Draft TAB Report discovered during TAB Verification. All items in the TAB Report shall be signed by the TAB Specialist and shall bear the seal of the Professional Society or National Association used as the TAB Standard.

### 3.10 TAB Verification

Begin TAB Verification only after submission and approval of the Draft TAB Report. The TAB Specialist must recheck ten percent of the measurements listed in the Draft Tab Report. The measurements selected for verification and the individuals that witness the verification will be selected by the Contracting Officer's Representative (COR). The measurements will be recorded in the same manner as required for the TAB Report. If over 20 percent of the measurements selected by the COR for verification fall outside of plus to minus 10 percent of the Draft TAB Report data, the COR will select an additional ten percent for verification. If over 20 percent of the total tested (including both test groups) fall outside plus to minus 10 percent of the Draft TAB Report data, the TAB Report shall be considered invalid and all contract TAB field work shall be repeated beginning with the Systems Readiness Check. Correct all items outside of the required tolerance.

The Contractor shall be responsible for all necessary insulation repair following completion of TAB Verification.

### 3.11 Marking of Setting

Following approval of TAB Verification Report, the setting of all HVAC adjustment devices including valves, splitters, and dampers shall be permanently marked by the TAB Specialist so that adjustment can be restored if disturbed at any time. Marking shall be visible following completion or repair of insulation.

### 3.12 Identification of Test Ports

The TAB Specialist shall permanently and legibly identify the location

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points of duct test ports. If the ductwork has exterior insulation, the identification shall be made on the exterior side of the insulation. All penetrations through ductwork and ductwork insulation shall be sealed to prevent air leakage or to maintain integrity of vapor barrier.

-- End of Section --



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## SECTION 23 07 00

THERMAL INSULATION FOR MECHANICAL SYSTEMS  
02/13, CHG 7: 05/20

## PART 1 GENERAL

## 1.1 REFERENCES

The publications listed below form a part of this specification to the extent referenced. The publications are referred to within the text by the basic designation only. At the discretion of the Government, the manufacturer of any material supplied will be required to furnish test reports pertaining to any of the tests necessary to assure compliance with the standard or standards referenced in this specification.

## ASTM INTERNATIONAL (ASTM)

ASTM A167	(2011) Standard Specification for Stainless and Heat-Resisting Chromium-Nickel Steel Plate, Sheet, and Strip
ASTM A240/A240M	(2020a) Standard Specification for Chromium and Chromium-Nickel Stainless Steel Plate, Sheet, and Strip for Pressure Vessels and for General Applications
ASTM A580/A580M	(2018) Standard Specification for Stainless Steel Wire
ASTM B209	(2014) Standard Specification for Aluminum and Aluminum-Alloy Sheet and Plate
ASTM C195	(2007; R 2013) Standard Specification for Mineral Fiber Thermal Insulating Cement
ASTM C450	(2008) Standard Practice for Fabrication of Thermal Insulating Fitting Covers for NPS Piping, and Vessel Lagging
ASTM C518	(2021) Standard Test Method for Steady-State Thermal Transmission Properties by Means of the Heat Flow Meter Apparatus
ASTM C534/C534M	(2020a) Standard Specification for Preformed Flexible Elastomeric Cellular Thermal Insulation in Sheet and Tubular Form
ASTM C547	(2019) Standard Specification for Mineral Fiber Pipe Insulation
ASTM C647	(2008; R 2013) Properties and Tests of Mastics and Coating Finishes for Thermal Insulation

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ASTM C755	(2019b) Standard Practice for Selection of Water Vapor Retarders for Thermal Insulation
ASTM C795	(2008; R 2018) Standard Specification for Thermal Insulation for Use in Contact with Austenitic Stainless Steel
ASTM C916	(2020) Standard Specification for Adhesives for Duct Thermal Insulation
ASTM C920	(2018) Standard Specification for Elastomeric Joint Sealants
ASTM C921	(2010) Standard Practice for Determining the Properties of Jacketing Materials for Thermal Insulation
ASTM C1136	(2021) Standard Specification for Flexible, Low Permeance Vapor Retarders for Thermal Insulation
ASTM C1710	(2011) Standard Guide for Installation of Flexible Closed Cell Preformed Insulation in Tube and Sheet Form
ASTM D882	(2012) Tensile Properties of Thin Plastic Sheeting
ASTM D2863	(2019) Standard Test Method for Measuring the Minimum Oxygen Concentration to Support Candle-Like Combustion of Plastics (Oxygen Index)
ASTM D5590	(2000; R 2010; E 2012) Standard Test Method for Determining the Resistance of Paint Films and Related Coatings to Fungal Defacement by Accelerated Four-Week Agar Plate Assay
ASTM E84	(2020) Standard Test Method for Surface Burning Characteristics of Building Materials
ASTM E96/E96M	(2016) Standard Test Methods for Water Vapor Transmission of Materials
ASTM E2231	(2019) Standard Practice for Specimen Preparation and Mounting of Pipe and Duct Insulation Materials to Assess Surface Burning Characteristics

CALIFORNIA DEPARTMENT OF PUBLIC HEALTH (CDPH)

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

FM APP GUIDE (updated on-line) Approval Guide  
<http://www.approvalguide.com/>

GREEN SEAL (GS)

GS-36 (2013) Adhesives for Commercial Use

MANUFACTURERS STANDARDIZATION SOCIETY OF THE VALVE AND FITTINGS  
 INDUSTRY (MSS)

MSS SP-58 (2018) Pipe Hangers and Supports -  
 Materials, Design and Manufacture,  
 Selection, Application, and Installation

MIDWEST INSULATION CONTRACTORS ASSOCIATION (MICA)

MICA Insulation Stds (8th Ed) National Commercial & Industrial  
 Insulation Standards

NATIONAL FIRE PROTECTION ASSOCIATION (NFPA)

NFPA 90A (2021) Standard for the Installation of  
 Air Conditioning and Ventilating Systems

NFPA 90B (2021) Standard for the Installation of  
 Warm Air Heating and Air Conditioning  
 Systems

SCIENTIFIC CERTIFICATION SYSTEMS (SCS)

SCS SCS Global Services (SCS) Indoor Advantage

SOUTH COAST AIR QUALITY MANAGEMENT DISTRICT (SCAQMD)

SCAQMD Rule 1168 (2017) Adhesive and Sealant Applications

TECHNICAL ASSOCIATION OF THE PULP AND PAPER INDUSTRY (TAPPI)

TAPPI T403 OM (2015) Bursting Strength of Paper

U.S. DEPARTMENT OF DEFENSE (DOD)

MIL-A-3316 (1987; Rev C; Am 2 1990) Adhesives,  
 Fire-Resistant, Thermal Insulation

MIL-A-24179 (1969; Rev A; Am 2 1980; Notice 1 1987;  
 Notice 2 2020) Adhesive, Flexible  
 Unicellular-Plastic Thermal Insulation

MIL-PRF-19565 (1988; Rev C) Coating Compounds, Thermal  
 Insulation, Fire- and Water-Resistant,  
 Vapor-Barrier

U.S. GREEN BUILDING COUNCIL (USGBC)

LEED v4 BDC Ref Guide (2013; R 2020) USGBC LEED Reference Guide

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for Building Design and Construction, v4

LEED v4.1 BDC Ref Guide (2023) LEED v4.1 Building Design and  
 Construction Reference Guide

#### UNDERWRITERS LABORATORIES (UL)

UL 94 (2013; Reprint May 2021) UL Standard for  
 Safety Tests for Flammability of Plastic  
 Materials for Parts in Devices and  
 Appliances

UL 723 (2018) UL Standard for Safety Test for  
 Surface Burning Characteristics of  
 Building Materials

UL 2818 (2013) GREENGUARD Certification Program  
 For Chemical Emissions For Building  
 Materials, Finishes And Furnishings

### 1.2 SUSTAINABILITY REPORTING

Work of this section is intended to contribute to the achievement of, or compliance with, the requirements of the Guiding Principles Validation and LEED Prerequisites and attempted Credits. Refer to Section 01 33 29.00 06 SUSTAINABILITY REPORTING for specific documentation requirements and list of Prerequisites, attempted Credits and LEED version.

Comply with product, material content, performance criteria, activity, documentation, and other technical requirements as described in the LEED v4 BDC Ref Guide or LEED v4.1 BDC Ref Guide as applicable.

Collect, organize, and submit product data, drawings, diagrams, photos and cost information necessary to demonstrate compliance with LEED v4 BDC Ref Guide or LEED v4.1 BDC Ref Guide requirements as applicable.

Data collection shall commence with the notice to proceed and will only be deemed complete upon acceptance of the Final Sustainability Notebook and LEED Online submission by the Contracting Officer, the LEED Project Administrator, and the Green Building Certification Institute.

### 1.3 SYSTEM DESCRIPTION

#### 1.3.1 General

Provide field-applied insulation and accessories on mechanical systems as specified herein; factory-applied insulation is specified under the piping, duct or equipment to be insulated. Field applied insulation materials required for use on Government-furnished items as listed in the SPECIAL CONTRACT REQUIREMENTS shall be furnished and installed by the Contractor.

### 1.4 SUBMITTALS

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

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Submit the three SD types, SD-02 Shop Drawings, SD-03 Product Data, and SD-08 Manufacturer's Instructions at the same time for each system.

#### SD-02 Shop Drawings

MICA Plates; G

Pipe Insulation Systems and Associated Accessories

Duct Insulation Systems and Associated Accessories

Recycled content for insulation materials; S, AE

Environmental Product Declarations; S

Embodied Carbon Optimization Report/Action Plan; S

Extended Producer Responsibility; S

Local/Regional Materials; S

Material Ingredient Reporting; S

#### SD-03 Product Data

Pipe Insulation Systems; G

Duct Insulation Systems; G

#### SD-07 Certificates

Indoor air quality for adhesives; S, AE

#### SD-08 Manufacturer's Instructions

Pipe Insulation Systems; G

Duct Insulation Systems; G

### 1.5 SUSTAINABLE DESIGN REQUIREMENTS

#### 1.5.1 Environmental Product Declarations

At a minimum, use materials or products with an Environmental Product Declaration in accordance with the LEED Implementation Plan. See Section 01 33 29.00 06 SUSTAINABILITY REPORTING for cumulative materials requirements and LEED Implementation Plan.

#### 1.5.2 Embodied Carbon Optimization Report/Action Plan

At a minimum, use materials or products with an Embodied Carbon Optimization Report/Action Plan in accordance with the LEED Implementation Plan. See Section 01 33 29.00 06 SUSTAINABILITY REPORTING for cumulative materials requirements and LEED Implementation Plan.

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### 1.5.3 Sourcing of Raw Materials

Provide products that meet one or more of the following categories:

#### 1.5.3.1 Extended Producer Responsibility

At a minimum, use materials or products from manufacturers that participate in an extended producer responsibility program in accordance with the LEED Implementation Plan. Provide manufacturer letter verifying extended producer responsibility program is in place and that product is eligible. See Section 01 33 29.00 06 SUSTAINABILITY REPORTING for cumulative materials requirements and LEED Implementation Plan.

#### 1.5.3.2 Recycled Content Materials

At a minimum, use materials or products with recycled content in accordance with the LEED Implementation Plan. Provide manufacturers product literature identifying the percentage of recycled material incorporated within each product used. See Section 01 33 29.00 06 SUSTAINABILITY REPORTING for cumulative materials requirements and LEED Implementation Plan. If recycled content minimum is specified in this section, the greater of the two percentages governs.

#### 1.5.4 Material Ingredient Reporting

At a minimum, use materials or products with chemical inventory to at least 0.1% (1000 ppm) in accordance with the LEED Implementation Plan. Provide Health Product Declaration (HPD), Cradle to Cradle Certificate, Declare label, or other manufacturer's published content inventory in compliance with LEED v4.1 Material Ingredient Reporting credit. See Section 01 33 29.00 06 SUSTAINABILITY REPORTING for cumulative materials requirements and LEED Implementation Plan.

#### 1.5.5 Local/Regional Materials

Use materials or products extracted, harvested, or recovered, as well as manufactured, within a 100 mile radius from the project site, if available from a minimum of three sources. provide a letter from the manufacturer stating the extraction location, manufacturing location, and purchasing location of the products provided, referencing the project name and location specifically and distance to the project site. See Section 01 33 29.00 06 SUSTAINABILITY REPORTING for cumulative materials requirements and LEED Implementation Plan.

### 1.6 CERTIFICATIONS

#### 1.6.1 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.

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## 1.7 QUALITY ASSURANCE

### 1.7.1 Installer Qualification

Qualified installers shall have successfully completed three or more similar type jobs within the last 5 years.

## 1.8 DELIVERY, STORAGE, AND HANDLING

Materials shall be delivered in the manufacturer's unopened containers. Materials delivered and placed in storage shall be provided with protection from weather, humidity, dirt, dust and other contaminants. The Contracting Officer may reject insulation material and supplies that become dirty, dusty, wet, or contaminated by some other means. Packages or standard containers of insulation, jacket material, cements, adhesives, and coatings delivered for use, and samples required for approval shall have manufacturer's stamp or label attached giving the name of the manufacturer and brand, and a description of the material, date codes, and approximate shelf life (if applicable). Insulation packages and containers shall be asbestos free.

## PART 2 PRODUCTS

### 2.1 STANDARD PRODUCTS

Provide materials which are the standard products of manufacturers regularly engaged in the manufacture of such products and that essentially duplicate items that have been in satisfactory use for at least 2 years prior to bid opening. Submit a complete list of materials, including manufacturer's descriptive technical literature, performance data, catalog cuts, and installation instructions. The product number, k-value, thickness and furnished accessories including adhesives, sealants and jackets for each mechanical system requiring insulation shall be included. The product data must be copyrighted, have an identifying or publication number, and shall have been published prior to the issuance date of this solicitation. Materials furnished under this section shall be submitted together in a booklet and in conjunction with the MICA plates booklet (SD-02). Annotate the product data to indicate which MICA plate is applicable.

#### 2.1.1 Insulation System

Provide insulation systems in accordance with the approved MICA National Insulation Standards plates as supplemented by this specification. Provide field-applied insulation for heating, ventilating, and cooling (HVAC) air distribution systems and piping systems that are located within, on, under, and adjacent to buildings; and for plumbing systems. Provide CFC and HCFC free insulation.

#### 2.1.2 Surface Burning Characteristics

Unless otherwise specified, insulation must have a maximum flame spread index of 25 and a maximum smoke developed index of 50 when tested in accordance with ASTM E84. Flame spread, and smoke developed indexes, shall be determined by ASTM E84 or UL 723. Test insulation in the same density and installed thickness as the material to be used in the actual construction. Prepare and mount test specimens according to ASTM E2231.

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## 2.2 MATERIALS

Provide insulation that meets or exceeds the requirements of ASHRAE 90.1. Insulation exterior shall be cleanable, grease resistant, non-flaking and non-peeling. Materials shall be compatible and shall not contribute to corrosion, soften, or otherwise attack surfaces to which applied in either wet or dry state. Materials to be used on stainless steel surfaces shall meet ASTM C795 requirements. Calcium silicate shall not be used on chilled or cold water systems. Materials shall be asbestos free. Provide product recognized under UL 94 (if containing plastic) and listed in FM APP GUIDE.

### 2.2.1 Adhesives

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

#### 2.2.1.1 Acoustical Lining Insulation Adhesive

Adhesive shall be a nonflammable, fire-resistant adhesive conforming to ASTM C916, Type I.

#### 2.2.1.2 Mineral Fiber Insulation Cement

Cement shall be in accordance with ASTM C195.

#### 2.2.1.3 Lagging Adhesive

Lagging is the material used for thermal insulation, especially around a cylindrical object. This may include the insulation as well as the cloth/material covering the insulation. To resist mold/mildew, lagging adhesive shall meet ASTM D5590 with 0 growth rating. Lagging adhesives shall be nonflammable and fire-resistant and shall have a maximum flame spread index of 25 and a maximum smoke developed index of 50 when tested in accordance with ASTM E84. Adhesive shall be MIL-A-3316, Class 1, pigmented white and be suitable for bonding fibrous glass cloth to faced and unfaced fibrous glass insulation board; for bonding cotton brattice cloth to faced and unfaced fibrous glass insulation board; for sealing edges of and bonding glass tape to joints of fibrous glass board; for bonding lagging cloth to thermal insulation; or Class 2 for attaching fibrous glass insulation to metal surfaces. Lagging adhesives shall be applied in strict accordance with the manufacturer's recommendations for pipe and duct insulation.

#### 2.2.1.4 Contact Adhesive

Adhesives may be any of, but not limited to, the neoprene based, rubber based, or elastomeric type that have a maximum flame spread index of 25 and a maximum smoke developed index of 50 when tested in accordance with ASTM E84. The adhesive shall not adversely affect, initially or in



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service, the insulation to which it is applied, nor shall it cause any corrosive effect on metal to which it is applied. Any solvent dispersing medium or volatile component of the adhesive shall have no objectionable odor and shall not contain any benzene or carbon tetrachloride. The dried adhesive shall not emit nauseous, irritating, or toxic volatile matters or aerosols when the adhesive is heated to any temperature up to 212 degrees F. The dried adhesive shall be nonflammable and fire resistant. Flexible Elastomeric Adhesive: Comply with MIL-A-24179, Type II, Class I. Provide product listed in FM APP GUIDE.

#### 2.2.2 Caulking

ASTM C920, Type S, Grade NS, Class 25, Use A.

#### 2.2.3 Corner Angles

Nominal 0.016 inch aluminum 1 by 1 inch with factory applied kraft backing. Aluminum shall be ASTM B209, Alloy 3003, 3105, or 5005.

#### 2.2.4 Fittings

Fabricated Fittings are the prefabricated fittings for flexible elastomeric pipe insulation systems in accordance with ASTM C1710. Together with the flexible elastomeric tubes, they provide complete system integrity for retarding heat gain and controlling condensation drip from chilled-water and refrigeration systems. Flexible elastomeric, fabricated fittings provide thermal protection (0.25 k) and condensation resistance (0.05 Water Vapor Transmission factor). For satisfactory performance, properly installed protective vapor retarder/barriers and vapor stops shall be used on high relative humidity and below ambient temperature applications to reduce movement of moisture through or around the insulation to the colder interior surface.

#### 2.2.5 Finishing Cement

ASTM C450: Mineral fiber hydraulic-setting thermal insulating and finishing cement. All cements that may come in contact with Austenitic stainless steel must comply with ASTM C795.

#### 2.2.6 Fibrous Glass Cloth and Glass Tape

Fibrous glass cloth, with 20X20 maximum mesh size, and glass tape shall have maximum flame spread index of 25 and a maximum smoke developed index of 50 when tested in accordance with ASTM E84. Tape shall be 4 inch wide rolls. Class 3 tape shall be 4.5 ounces/square yard. Elastomeric Foam Tape: Black vapor-retarder foam tape with acrylic adhesive containing an anti-microbial additive.

#### 2.2.7 Staples

Outward clinching type monel .

#### 2.2.8 Jackets

##### 2.2.8.1 Aluminum Jackets

Aluminum jackets shall be corrugated, embossed or smooth sheet, 0.016 inch nominal thickness; ASTM B209, Temper H14, Temper H16, Alloy 3003, 5005, or 3105. Corrugated aluminum jacket shall not be used outdoors. Aluminum

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jacket securing bands shall be Type 304 stainless steel, 0.015 inch thick, 1/2 inch wide for pipe under 12 inch diameter and 3/4 inch wide for pipe over 12 inch and larger diameter. Aluminum jacket circumferential seam bands shall be 2 by 0.016 inch aluminum matching jacket material. Bands for insulation below ground shall be 3/4 by 0.020 inch thick stainless steel, or fiberglass reinforced tape. The jacket may, at the option of the Contractor, be provided with a factory fabricated Pittsburgh or "Z" type longitudinal joint. When the "Z" joint is used, the bands at the circumferential joints shall be designed by the manufacturer to seal the joints and hold the jacket in place.

#### 2.2.8.2 Polyvinyl Chloride (PVC) Jackets

Polyvinyl chloride (PVC) jacket and fitting covers shall have high impact strength, ultraviolet (UV) resistant rating or treatment and moderate chemical resistance with minimum thickness 0.030 inch.

#### 2.2.8.3 Vapor Barrier/Weatherproofing Jacket

Vapor barrier/weatherproofing jacket shall be laminated self-adhesive, greater than 3 plies standard grade, silver, white, black and embossed or greater than 8 ply (minimum 2.9 mils adhesive); with 0.0000 permeability when tested in accordance with ASTM E96/E96M, using the water transmission rate test method; heavy duty, white or natural; and UV resistant. Flexible Elastomeric exterior foam with factory applied, UV Jacket made with a cold weather acrylic adhesive. Construction of laminate designed to provide UV resistance, high puncture, tear resistance and excellent Water Vapor Transmission (WVT) rate.

#### 2.2.8.4 Vapor Barrier/Vapor Retarder

Apply the following criteria to determine which system is required.

- a. On ducts, piping and equipment operating below 95 degrees F or located outside shall be equipped with a vapor barrier.
- b. Ducts, pipes and equipment that are located inside and that always operate above 95 degrees F shall be installed with a vapor retarder where required as stated in paragraph VAPOR RETARDER REQUIRED.

#### 2.2.9 Vapor Retarder Required

ASTM C921, Type I, minimum puncture resistance 50 Beach units on all surfaces except concealed ductwork, where a minimum puncture resistance of 25 Beach units is acceptable. Minimum tensile strength, 35 pounds/inch width. ASTM C921, Type II, minimum puncture resistance 25 Beach units, tensile strength minimum 20 pounds/inch width. Jackets used on insulation exposed in finished areas shall have white finish suitable for painting without sizing. Based on the application, insulation materials that require manufacturer or fabricator applied pipe insulation jackets are cellular glass, when all joints are sealed with a vapor barrier mastic, and mineral fiber. All non-metallic jackets shall have a maximum flame spread index of 25 and a maximum smoke developed index of 50 when tested in accordance with ASTM E84. Flexible elastomerics require (in addition to vapor barrier skin) vapor retarder jacketing for high relative humidity and below ambient temperature applications.

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#### 2.2.9.1 White Vapor Retarder All Service Jacket (ASJ)

ASJ is for use on hot/cold pipes, ducts, or equipment indoors or outdoors if covered by a suitable protective jacket. The product shall meet all physical property and performance requirements of ASTM C1136, Type I, except the burst strength shall be a minimum of 85 psi. ASTM D2863 Limited Oxygen Index (LOI) shall be a minimum of 31.

In addition, neither the outer exposed surface nor the inner-most surface contacting the insulation shall be paper or other moisture-sensitive material. The outer exposed surface shall be white and have an emittance of not less than 0.80. The outer exposed surface shall be paintable.

#### 2.2.9.2 Vapor Retarder/Vapor Barrier Mastic Coatings

##### 2.2.9.2.1 Vapor Barrier

The vapor barrier shall be self adhesive (minimum 2 mils adhesive, 3 mils embossed) greater than 3 plies standard grade, silver, white, black and embossed white jacket for use on hot/cold pipes. Permeability shall be less than 0.02 when tested in accordance with ASTM E96/E96M. Products shall meet UL 723 or ASTM E84 flame and smoke requirements and shall be UV resistant.

##### 2.2.9.2.2 Vapor Retarder

The vapor retarder coating shall be fire and water resistant and appropriately selected for either outdoor or indoor service. Color shall be white. The water vapor permeance of the compound shall be in accordance with ASTM C755, Section 7.2.2, Table 2, for insulation type and service conditions. The coating shall be nonflammable, fire resistant type. To resist mold/mildew, coating shall meet ASTM D5590 with 0 growth rating. Coating shall meet MIL-PRF-19565 Type II (if selected for indoor service) and be Qualified Products Database listed. All other application and service properties shall be determined pursuant to ASTM C647.

#### 2.2.9.3 Laminated Film Vapor Retarder

ASTM C1136, Type I, maximum moisture vapor transmission 0.02 perms, minimum puncture resistance 50 Beach units on all surfaces except concealed ductwork; where Type II, maximum moisture vapor transmission 0.02 perms, a minimum puncture resistance of 25 Beach units is acceptable. Vapor retarder shall have a maximum flame spread index of 25 and a maximum smoke developed index of 50 when tested in accordance with ASTM E84. Flexible Elastomeric exterior foam with factory applied UV Jacket. Construction of laminate designed to provide UV resistance, high puncture, tear resistance and an excellent WVT rate.

#### 2.2.9.4 Polyvinylidene Chloride (PVDC) Film Vapor Retarder

The PVDC film vapor retarder shall have a maximum moisture vapor transmission of 0.02 perms, minimum puncture resistance of 150 Beach units, a minimum tensile strength in any direction of 30 lb/inch when tested in accordance with ASTM D882, and a maximum flame spread index of 25 and a maximum smoke developed index of 50 when tested in accordance with ASTM E84.

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#### 2.2.9.5 Polyvinylidene Chloride Vapor Retarder Adhesive Tape

Requirements must meet the same as specified for Laminated Film Vapor Retarder above.

#### 2.2.9.6 Vapor Barrier/Weather Barrier

The vapor barrier shall be greater than 3 ply self adhesive laminate -white vapor barrier jacket- superior performance (less than 0.0000 permeability when tested in accordance with ASTM E96/E96M). Vapor barrier shall meet UL 723 or ASTM E84 25 flame and 50 smoke requirements; and UV resistant. Minimum burst strength 185 psi in accordance with TAPPI T403 OM . Tensile strength 68 lb/inch width (PSTC-1000). Tape shall be as specified for laminated film vapor barrier above.

#### 2.2.10 Vapor Retarder Not Required

ASTM C921, Type II, Class D, minimum puncture resistance 50 Beach units on all surfaces except ductwork, where Type IV, maximum moisture vapor transmission 0.10, a minimum puncture resistance of 25 Beach units is acceptable. Jacket shall have a maximum flame spread index of 25 and a maximum smoke developed index of 50 when tested in accordance with ASTM E84.

#### 2.2.11 Wire

Soft annealed ASTM A580/A580M Type 302, 304 or 316 stainless steel, 16 or 18 gauge.

#### 2.2.12 Insulation Bands

Insulation bands shall be 1/2 inch wide; 26 gauge stainless steel.

#### 2.2.13 Sealants

Sealants shall be chosen from the butyl polymer type, the styrene-butadiene rubber type, or the butyl type of sealants. Sealants shall have a maximum permeance of 0.02 perms based on Procedure B for ASTM E96/E96M, and a maximum flame spread index of 25 and a maximum smoke developed index of 50 when tested in accordance with ASTM E84.

### 2.3 PIPE INSULATION SYSTEMS

Conform insulation materials to Table 1 and minimum insulation thickness as listed in Table 2 and meet or exceed the requirements of ASHRAE 90.1. Limit pipe insulation materials to those listed herein and meeting the following requirements:

#### 2.3.1 Recycled Materials

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

Rock Wool: 75 percent slag of weight  
Fiberglass: 20 percent glass cullet  
Rigid Foam: 9 percent recovered material  
Phenolic Rigid Foam: 9 percent recovered material

Provide data identifying percentage of recycled content for insulation materials.

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### 2.3.2 Aboveground Cold Pipeline ( -30 to 60 deg. F)

Insulation for outdoor, indoor, exposed or concealed applications, shall be as follows:

#### 2.3.2.1 Flexible Elastomeric Cellular Insulation

Closed-cell, foam- or expanded-rubber materials containing anti-microbial additive, complying with ASTM C534/C534M, Grade 1, Type I or II. Type I, Grade 1 for tubular materials. Type II, Grade 1, for sheet materials. Type I and II shall have vapor retarder/vapor barrier skin on one or both sides of the insulation, and require an additional exterior vapor retarder covering for high relative humidity and below ambient temperature applications.

### 2.3.3 Aboveground Hot Pipeline (Above 60 deg. F)

Insulation for outdoor, indoor, exposed or concealed applications shall meet the following requirements. Supply the insulation with manufacturer's recommended factory-applied jacket/vapor barrier.

#### 2.3.3.1 Mineral Fiber

ASTM C547, Types I, II or III, supply the insulation with manufacturer's recommended factory-applied jacket.

#### 2.3.3.2 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 Jackets

#### 2.4.1.1 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.

#### 2.4.1.2 Vapor Barrier/Weatherproofing Jacket

Vapor barrier/weatherproofing jacket shall be laminated self-adhesive (minimum 2 mils adhesive, 3 mils embossed) less than 0.0000 permeability, (greater than 3 ply, standard grade, silver, white, black and embossed or greater than 8 ply (minimum 2.9 mils adhesive), heavy duty white or natural).

## PART 3 EXECUTION

### 3.1 APPLICATION - GENERAL

Insulation shall only be applied to unheated and uncooled piping and equipment. Flexible elastomeric cellular insulation shall not be

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compressed at joists, studs, columns, ducts, hangers, etc. The insulation shall not pull apart after a one hour period; any insulation found to pull apart after one hour, shall be replaced.

### 3.1.1 Installation

Except as otherwise specified, material shall be installed in accordance with the manufacturer's written instructions. Insulation materials shall not be applied until tests and heat tracing specified in other sections of this specification are completed. Material such as rust, scale, dirt and moisture shall be removed from surfaces to receive insulation. Insulation shall be kept clean and dry. Insulation shall not be removed from its shipping containers until the day it is ready to use and shall be returned to like containers or equally protected from dirt and moisture at the end of each workday. Insulation that becomes dirty shall be thoroughly cleaned prior to use. If insulation becomes wet or if cleaning does not restore the surfaces to like new condition, the insulation will be rejected, and shall be immediately removed from the jobsite. Joints shall be staggered on multi layer insulation. Mineral fiber thermal insulating cement shall be mixed with demineralized water when used on stainless steel surfaces. Insulation, jacketing and accessories shall be installed in accordance with MICA Insulation Stds plates except where modified herein or on the drawings.

### 3.1.2 Firestopping

Where pipes and ducts pass through fire walls, fire partitions, above grade floors, and fire rated chase walls, the penetration shall be sealed with fire stopping materials as specified in Section 07 84 00 FIRESTOPPING. The protection of ducts at point of passage through firewalls must be in accordance with NFPA 90A and/or NFPA 90B. All other penetrations, such as piping, conduit, and wiring, through firewalls must be protected with a material or system of the same hourly rating that is listed by UL, FM, or a NRTL.

### 3.1.3 Painting and Finishing

Painting shall be as specified in Section 09 90 00 PAINTS AND COATINGS.

### 3.1.4 Installation of Flexible Elastomeric Cellular Insulation

Install flexible elastomeric cellular insulation with seams and joints sealed with rubberized contact adhesive. Flexible elastomeric cellular insulation shall not be used on surfaces greater than 220 degrees F. Stagger seams when applying multiple layers of insulation. Protect insulation exposed to weather and not shown to have vapor barrier weatherproof jacketing with two coats of UV resistant finish or PVC or metal jacketing as recommended by the manufacturer after the adhesive is dry and cured.

#### 3.1.4.1 Adhesive Application

Apply a brush coating of adhesive to both butt ends to be joined and to both slit surfaces to be sealed. Allow the adhesive to set until dry to touch but tacky under slight pressure before joining the surfaces. Insulation seals at seams and joints shall not be capable of being pulled apart one hour after application. Insulation that can be pulled apart one hour after installation shall be replaced.

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#### 3.1.4.2 Adhesive Safety Precautions

Use natural cross-ventilation, local (mechanical) pickup, and/or general area (mechanical) ventilation to prevent an accumulation of solvent vapors, keeping in mind the ventilation pattern must remove any heavier-than-air solvent vapors from lower levels of the workspaces. Gloves and spectacle-type safety glasses are recommended in accordance with safe installation practices.

#### 3.1.5 Welding

No welding shall be done on piping, duct or without written approval of the Contracting Officer. The capacitor discharge welding process may be used for securing metal fasteners to duct.

#### 3.1.6 Pipes/Ducts That Require Insulation

Insulation is required on all pipes, ducts, or except for omitted items as specified.

### 3.2 PIPE INSULATION SYSTEMS INSTALLATION

Install pipe insulation systems in accordance with the approved MICA Insulation Stds plates as supplemented by the manufacturer's published installation instructions.

#### 3.2.1 Pipe Insulation

##### 3.2.1.1 General

Pipe insulation shall be installed on aboveground hot and cold pipeline systems as specified below to form a continuous thermal retarder/barrier, including straight runs, fittings and appurtenances unless specified otherwise. Installation shall be with full length units of insulation and using a single cut piece to complete a run. Cut pieces or scraps abutting each other shall not be used. Pipe insulation shall be omitted on the following:

- a. Pipe used solely for fire protection.
- b. Chromium plated pipe to plumbing fixtures. However, fixtures for use by the physically handicapped shall have the hot water supply and drain, including the trap, insulated where exposed.
- c. Sanitary drain lines.
- d. Air chambers.
- e. Adjacent insulation.
- f. ASME stamps.
- g. Access plates of fan housings.
- h. Cleanouts or handholes.

##### 3.2.1.2 Pipes Passing Through Walls, Roofs, and Floors

Pipe insulation shall be continuous through the sleeve.

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Provide an aluminum jacket or vapor barrier/weatherproofing self adhesive jacket (minimum 2 mils adhesive, 3 mils embossed) less than 0.0000 permeability, greater than 3 ply standard grade, silver, white, black and embossed with factory applied moisture retarder over the insulation wherever penetrations require sealing.

#### 3.2.1.2.1 Penetrate Interior Walls

The aluminum jacket or vapor barrier/weatherproofing - self adhesive jacket (minimum 2 mils adhesive, 3 mils embossed) less than 0.0000 permeability, greater than 3 plies standard grade, silver, white, black and embossed shall extend 2 inches beyond either side of the wall and shall be secured on each end with a band.

#### 3.2.1.2.2 Penetrating Floors

Extend the aluminum jacket from a point below the backup material to a point 10 inches above the floor with one band at the floor and one not more than 1 inch from the end of the aluminum jacket.

#### 3.2.1.2.3 Penetrating Waterproofed Floors

Extend the aluminum jacket from below the backup material to a point 2 inches above the flashing with a band 1 inch from the end of the aluminum jacket.

#### 3.2.1.2.4 Penetrating Exterior Walls

Continue the aluminum jacket required for pipe exposed to weather through the sleeve to a point 2 inches beyond the interior surface of the wall.

#### 3.2.1.2.5 Penetrating Roofs

Insulate pipe as required for interior service to a point flush with the top of the flashing and sealed with flashing sealant. Tightly butt the insulation for exterior application to the top of flashing and interior insulation. Extend the exterior aluminum jacket 2 inches down beyond the end of the insulation to form a counter flashing. Seal the flashing and counter flashing underneath with metal jacketing/flashing sealant.

#### 3.2.1.2.6 Hot Water Pipes Supplying Lavatories or Other Similar Heated Service

Terminate the insulation on the backside of the finished wall. Protect the insulation termination with two coats of vapor barrier coating with a minimum total thickness of 1/16 inch applied with glass tape embedded between coats (if applicable). Extend the coating out onto the insulation 2 inches and seal the end of the insulation. Overlap glass tape seams 1 inch. Caulk the annular space between the pipe and wall penetration with approved fire stop material. Cover the pipe and wall penetration with a properly sized (well fitting) escutcheon plate. The escutcheon plate shall overlap the wall penetration at least 3/8 inches.

#### 3.2.1.2.7 Domestic Cold Water Pipes Supplying Lavatories or Other Similar Cooling Service

Terminate the insulation on the finished side of the wall (i.e., insulation must cover the pipe throughout the wall penetration). Protect



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the insulation with two coats of weather barrier mastic (breather emulsion type weatherproof mastic impermeable to water and permeable to air) with a minimum total thickness of 1/16 inch. Extend the mastic out onto the insulation 2 inches and shall seal the end of the insulation. The annular space between the outer surface of the pipe insulation and caulk the wall penetration with an approved fire stop material having vapor retarder properties. Cover the pipe and wall penetration with a properly sized (well fitting) escutcheon plate. The escutcheon plate shall overlap the wall penetration by at least 3/8 inches.

### 3.2.1.3 Pipes Passing Through Hangers

Insulation, whether hot or cold application, shall be continuous through hangers. All horizontal pipes 2 inches and smaller shall be supported on hangers with the addition of a Type 40 protection shield to protect the insulation in accordance with MSS SP-58. Whenever insulation shows signs of being compressed, or when the insulation or jacket shows visible signs of distortion at or near the support shield, insulation inserts as specified below for piping larger than 2 inches shall be installed, or factory insulated hangers (designed with a load bearing core) can be used.

#### 3.2.1.3.1 Horizontal Pipes Larger Than 2 Inches at 60 Degrees F and Above

Supported on hangers in accordance with MSS SP-58, and Section 22 00 00 PLUMBING, GENERAL PURPOSE.

#### 3.2.1.3.2 Horizontal Pipes Larger Than 2 Inches and Below 60 Degrees F

Supported on hangers with the addition of a Type 40 protection shield in accordance with MSS SP-58. An insulation insert of cellular glass, prefabricated insulation pipe hangers, or perlite above 80 degrees F shall be installed above each shield. The insert shall cover not less than the bottom 180-degree arc of the pipe. Inserts shall be the same thickness as the insulation, and shall extend 2 inches on each end beyond the protection shield. When insulation inserts are required in accordance with the above, and the insulation thickness is less than 1 inch, wooden or cork dowels or blocks may be installed between the pipe and the shield to prevent the weight of the pipe from crushing the insulation, as an option to installing insulation inserts. The insulation jacket shall be continuous over the wooden dowel, wooden block, or insulation insert.

#### 3.2.1.3.3 Vertical Pipes

Supported with either Type 8 or Type 42 riser clamps with the addition of two Type 40 protection shields in accordance with MSS SP-58 covering the 360-degree arc of the insulation. An insulation insert of cellular glass or calcium silicate shall be installed between each shield and the pipe. The insert shall cover the 360-degree arc of the pipe. Inserts shall be the same thickness as the insulation, and shall extend 2 inches on each end beyond the protection shield. When insulation inserts are required in accordance with the above, and the insulation thickness is less than 1 inch, wooden or cork dowels or blocks may be installed between the pipe and the shield to prevent the hanger from crushing the insulation, as an option instead of installing insulation inserts. The insulation jacket shall be continuous over the wooden dowel, wooden block, or insulation insert. The vertical weight of the pipe shall be supported with hangers located in a horizontal section of the pipe. When the pipe riser is longer than 30 feet, the weight of the pipe shall be additionally supported with hangers in the vertical run of the pipe that are directly clamped to the pipe,

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penetrating the pipe insulation. These hangers shall be insulated and the insulation jacket sealed as indicated herein for anchors in a similar service.

#### 3.2.1.3.4 Inserts

Covered with a jacket material of the same appearance and quality as the adjoining pipe insulation jacket, overlap the adjoining pipe jacket 1-1/2 inches, and seal as required for the pipe jacket. The jacket material used to cover inserts in flexible elastomeric cellular insulation shall conform to ASTM C1136, Type 1, and is allowed to be of a different material than the adjoining insulation material.

#### 3.2.1.4 Flexible Elastomeric Cellular Pipe Insulation

Flexible elastomeric cellular pipe insulation shall be tubular form for pipe sizes 6 inches and less. Grade 1, Type II sheet insulation used on pipes larger than 6 inches shall not be stretched around the pipe. On pipes larger than 12 inches, the insulation shall be adhered directly to the pipe on the lower 1/3 of the pipe. Seams shall be staggered when applying multiple layers of insulation. Sweat fittings shall be insulated with miter-cut pieces the same size as on adjacent piping. Screwed fittings shall be insulated with sleeved fitting covers fabricated from miter-cut pieces and shall be overlapped and sealed to the adjacent pipe insulation. Type II requires an additional exterior vapor retarder/barrier covering for high relative humidity and below ambient temperature applications.

#### 3.2.1.5 Pipes in high abuse areas.

In high abuse areas such as janitor closets and traffic areas in equipment rooms, kitchens, and mechanical rooms, welded PVC, aluminum or flexible laminate cladding (comprised of elastomeric, plastic or metal foil laminate) laminated self-adhesive (minimum 2 mils adhesive, 3 mils embossed) vapor barrier/weatherproofing jacket, - less than 0.0000 permeability; (greater than 3 ply, standard grade, silver, white, black and embossed) aluminum jackets shall be utilized. Pipe insulation to the 6 foot level shall be protected.

#### 3.2.1.6 Pipe Insulation Material and Thickness

Pipe insulation materials must be as listed in Table 1 and must meet or exceed the requirements of ASHRAE 90.1.

TABLE 1					
Insulation Material for Piping					
Service					
	Material	Specification	Type	Class	VR/VB Req'd

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TABLE 1					
Insulation Material for Piping					
Service					
	Material	Specification	Type	Class	VR/VB Req'd
Cold Domestic Water Piping, Makeup Water & Drinking Fountain Drain Piping					
	Flexible Elastomeric Cellular	ASTM C534/C534M	I		No
Hot Domestic Water Supply & Recirculating Piping (Max 200 F)					
	Mineral Fiber	ASTM C547	I	1	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
Horizontal Roof Drain Leaders (Including Underside of Roof Drain Fittings)					
	Flexible Elastomeric Cellular	ASTM C534/C534M	I		No
Condensate Drain Located Inside Building					
	Flexible Elastomeric Cellular	ASTM C534/C534M	I		No
Note: VR/VB = Vapor Retarder/Vapor Barrier					

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Piping Insulation Thickness (inch) Do not use integral wicking material in Chilled water applications exposed to outdoor ambient conditions in climatic zones 1 through 4.						
Service						
	Material	Tube And Pipe Size (inch)				
		<1	1-<1.5	1.5-<4	4-<8	> or = >8
Cold Domestic Water Piping, Makeup Water & Drinking Fountain Drain Piping						
	Flexible Elastomeric Cellular	1	1	1	N/A	N/A
Hot Domestic Water Supply & Recirculating Piping (Max 200 F)						
	Mineral Fiber	1	1	1	1.5	1.5
	Flexible Elastomeric Cellular	1	1	1	N/A	N/A
Refrigerant Suction Piping (35 degrees F nominal)						
	Flexible Elastomeric Cellular	1	1	1	N/A	N/A
Exposed Lavatory Drains, Exposed Domestic Water Piping & Drains to Areas for Handicapped Personnel						
	Flexible Elastomeric Cellular	0.5	0.5	0.5	0.5	0.5
Horizontal Roof Drain Leaders (Including Underside of Roof Drain Fittings)						
	Flexible Elastomeric Cellular	1	1	1	N/A	N/A
Condensate Drain Located Inside Building						
	Flexible Elastomeric Cellular	1	1	1	N/A	N/A

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### 3.2.2 Aboveground Cold Pipelines

The following cold pipelines for minus 30 to plus 60 degrees F, shall be insulated in accordance with Table 2 except those piping listed in subparagraph Pipe Insulation in PART 3 as to be omitted. This includes but is not limited to the following:

- a. Make-up water.
- b. Horizontal and vertical portions of interior roof drains.
- c. Refrigerant suction lines.  
water
- f. Air conditioner condensate drains.
- h. Exposed lavatory drains and domestic water lines serving plumbing fixtures for handicap persons.
- i. Domestic cold and chilled drinking water.

#### 3.2.2.1 Insulation Material and Thickness

Insulation thickness for cold pipelines shall be determined using Table 2.

#### 3.2.2.2 Factory or Field applied Jacket

Insulation shall be covered with a factory applied vapor retarder jacket/vapor barrier or seal welded PVC jacket or greater than 3 ply laminated self-adhesive (minimum 2 mils adhesive, 3 mils embossed) vapor barrier/weatherproofing jacket - less than 0.0000 permeability, standard grade, silver, white, black and embossed for use with Mineral Fiber, Cellular Glass, and Phenolic Foam Insulated Pipe. Insulation inside the building, to be protected with an aluminum jacket or greater than 3ply vapor barrier/weatherproofing self-adhesive (minimum 2 mils adhesive, 3 mils embossed) product, less than 0.0000 permeability, standard grade, Embossed Silver, White & Black, shall have the insulation and vapor retarder jacket installed as specified herein. The aluminum jacket or greater than 3ply vapor barrier/weatherproofing self-adhesive (minimum 2 mils adhesive, 3 mils embossed) product, less than 0.0000 permeability, standard grade, embossed silver, White & Black, shall be installed as specified for piping exposed to weather, except sealing of the laps of the aluminum jacket is not required. In high abuse areas such as janitor closets and traffic areas in equipment rooms, kitchens, and mechanical rooms, aluminum jackets or greater than 3ply vapor barrier/weatherproofing self-adhesive (minimum 2 mils adhesive, 3 mils embossed) product, less than 0.0000 permeability, standard grade, embossed silver, white & black, shall be provided for pipe insulation to the 6 ft level.

#### 3.2.2.3 Installing Insulation for Straight Runs Hot and Cold Pipe

Apply insulation to the pipe with tight butt joints. Seal all butted joints and ends with joint sealant and seal with a vapor retarder coating, greater than 3 ply laminate jacket - less than 0.0000 perm adhesive tape or PVDC adhesive tape.

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#### 3.2.2.3.1 Longitudinal Laps of the Jacket Material

Overlap not less than 1-1/2 inches. Provide butt strips 3 inches wide for circumferential joints.

#### 3.2.2.3.2 Laps and Butt Strips

Secure with adhesive and staple on 4 inch centers if not factory self-sealing. If staples are used, seal in accordance with paragraph STAPLES below. Note that staples are not required with cellular glass systems.

#### 3.2.2.3.3 Factory Self-Sealing Lap Systems

May be used when the ambient temperature is between 40 and 120 degrees F during installation. Install the lap system in accordance with manufacturer's recommendations. Use a stapler only if specifically recommended by the manufacturer. Where gaps occur, replace the section or repair the gap by applying adhesive under the lap and then stapling.

#### 3.2.2.3.4 Staples

Coat all staples, including those used to repair factory self-seal lap systems, with a vapor retarder coating or PVDC adhesive tape or greater than 3 ply laminate jacket - 0.0000 perm adhesive tape. Coat all seams, except those on factory self-seal systems, with vapor retarder coating or PVDC adhesive tape or greater than 3 ply laminate jacket - less than 0.0000 perm adhesive tape.

#### 3.2.2.3.5 Breaks and Punctures in the Jacket Material

Patch by wrapping a strip of jacket material around the pipe and secure it with adhesive, staple, and coat with vapor retarder coating or PVDC adhesive tape or greater than 3 ply laminate jacket - less than 0.0000 perm adhesive tape. Extend the patch not less than 1-1/2 inches past the break.

#### 3.2.2.3.6 Penetrations Such as Thermometers

Fill the voids in the insulation and seal with vapor retarder coating or PVDC adhesive tape or greater than 3 ply laminate jacket - less than 0.0000 perm adhesive tape.

#### 3.2.2.3.7 Flexible Elastomeric Cellular Pipe Insulation

Install by slitting the tubular sections and applying them onto the piping or tubing. Alternately, whenever possible slide un-slit sections over the open ends of piping or tubing. Secure all seams and butt joints and seal with adhesive. When using self seal products only the butt joints shall be secured with adhesive. Push insulation on the pipe, never pulled. Stretching of insulation may result in open seams and joints. Clean cut all edges. Rough or jagged edges of the insulation are not be permitted. Use proper tools such as sharp knives. Do not stretch Grade 1, Type II sheet insulation around the pipe when used on pipe larger than 6 inches. On pipes larger than 12 inches, adhere sheet insulation directly to the pipe on the lower 1/3 of the pipe.

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#### 3.2.2.4 Insulation for Fittings and Accessories

- a. Pipe insulation shall be tightly butted to the insulation of the fittings and accessories. The butted joints and ends shall be sealed with joint sealant and sealed with a vapor retarder coating or PVDC adhesive tape or greater than 3 ply laminate jacket - less than 0.0000 perm adhesive tape.
- b. Precut or preformed insulation shall be placed around all fittings and accessories and shall conform to MICA plates except as modified herein: 5 for anchors; 10, 11, and 13 for fittings; 14 for valves; and 17 for flanges and unions. Insulation shall be the same insulation as the pipe insulation, including same density, thickness, and thermal conductivity. Where precut/preformed is unavailable, rigid preformed pipe insulation sections may be segmented into the shape required. Insulation of the same thickness and conductivity as the adjoining pipe insulation shall be used. If nesting size insulation is used, the insulation shall be overlapped 2 inches or one pipe diameter. Elbows insulated using segments shall conform to MICA Tables 12.20 "Mitered Insulation Elbow". Submit a booklet containing completed MICA Insulation Stds plates detailing each insulating system for each pipe, duct, insulating system, after approval of materials and prior to applying insulation.
  - (1) The MICA plates shall detail the materials to be installed and the specific insulation application. Submit all MICA plates required showing the entire insulating system, including plates required to show insulation penetrations, vessel bottom and top heads, legs, and skirt insulation as applicable. The MICA plates shall present all variations of insulation systems including locations, materials, vaporproofing, jackets and insulation accessories.
  - (2) If the Contractor elects to submit detailed drawings instead of edited MICA Plates, the detail drawings shall be technically equivalent to the edited MICA Plate submittal.
- c. Upon completion of insulation installation on flanges, unions, valves, anchors, fittings and accessories, terminations, seams, joints and insulation not protected by factory vapor retarder jackets or PVC fitting covers shall be protected with PVDC or greater than 3 ply laminate jacket - less than 0.0000 perm adhesive tape or two coats of vapor retarder coating with a minimum total thickness of 1/16 inch, applied with glass tape embedded between coats. Tape seams shall overlap 1 inch. The coating shall extend out onto the adjoining pipe insulation 2 inches. Fabricated insulation with a factory vapor retarder jacket shall be protected with either greater than 3 ply laminate jacket - less than 0.0000 perm adhesive tape, standard grade, silver, white, black and embossed or PVDC adhesive tape or two coats of vapor retarder coating with a minimum thickness of 1/16 inch and with a 2 inch wide glass tape embedded between coats. Where fitting insulation butts to pipe insulation, the joints shall be sealed with a vapor retarder coating and a 4 inch wide ASJ tape which matches the jacket of the pipe insulation.
- d. Anchors attached directly to the pipe shall be insulated for a sufficient distance to prevent condensation but not less than 6 inches from the insulation surface.

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- e. Insulation shall be marked showing the location of unions, strainers, and check valves.

#### 3.2.2.5 Optional PVC Fitting Covers

At the option of the Contractor, premolded, one or two piece PVC fitting covers may be used in lieu of the vapor retarder and embedded glass tape. Factory precut or premolded insulation segments shall be used under the fitting covers for elbows. Insulation segments shall be the same insulation as the pipe insulation including same density, thickness, and thermal conductivity. The covers shall be secured by PVC vapor retarder tape, adhesive, seal welding or with tacks made for securing PVC covers. Seams in the cover, and tacks and laps to adjoining pipe insulation jacket, shall be sealed with vapor retarder tape to ensure that the assembly has a continuous vapor seal.

#### 3.2.3 Aboveground Hot Pipelines

##### 3.2.3.1 General Requirements

All hot pipe lines above 60 degrees F, except those piping listed in subparagraph Pipe Insulation in PART 3 as to be omitted, shall be insulated in accordance with Table 2. This includes but is not limited to the following:

- a. Domestic hot water supply & re-circulating system.

Insulation shall be covered, in accordance with manufacturer's recommendations, with a factory applied Type I jacket or field applied aluminum where required or seal welded PVC.

##### 3.2.3.2 Insulation for Fittings and Accessories

Pipe insulation shall be tightly butted to the insulation of the fittings and accessories. The butted joints and ends shall be sealed with joint sealant. Insulation shall be marked showing the location of unions, strainers, check valves and other components that would otherwise be hidden from view by the insulation.

##### 3.2.3.2.1 Precut or Preformed

Place precut or preformed insulation around all fittings and accessories. Insulation shall be the same insulation as the pipe insulation, including same density, thickness, and thermal conductivity.

##### 3.2.3.2.2 Rigid Preformed

Where precut/preformed is unavailable, rigid preformed pipe insulation sections may be segmented into the shape required. Insulation of the same thickness and conductivity as the adjoining pipe insulation shall be used. If nesting size insulation is used, the insulation shall be overlapped 2 inches or one pipe diameter. Elbows insulated using segments shall conform to MICA Tables 12.20 "Mitered Insulation Elbow".



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### 3.2.4 Piping Exposed to Weather

Piping exposed to weather shall be insulated and jacketed as specified for the applicable service inside the building. After this procedure, a laminated self-adhesive (minimum 2 mils adhesive, 3 mils embossed) vapor barrier/weatherproofing jacket - less than 0.0000 permeability (greater than 3 ply, standard grade, silver, white, black and embossed aluminum jacket, stainless steel or PVC jacket shall be applied.

PVC jacketing requires no factory-applied jacket beneath it, however an all service jacket shall be applied if factory applied jacketing is not furnished. Flexible elastomeric cellular insulation exposed to weather shall be treated in accordance with paragraph INSTALLATION OF FLEXIBLE ELASTOMERIC CELLULAR INSULATION in PART 3.

#### 3.2.4.1 Aluminum Jacket

The jacket for hot piping may be factory applied. The jacket shall overlap not less than 2 inches at longitudinal and circumferential joints and shall be secured with bands at not more than 12 inch centers. Longitudinal joints shall be overlapped down to shed water and located at 4 or 8 o'clock positions. Joints on piping 60 degrees F and below shall be sealed with metal jacketing/flashing sealant while overlapping to prevent moisture penetration. Where jacketing on piping 60 degrees F and below abuts an un-insulated surface, joints shall be caulked to prevent moisture penetration. Joints on piping above 60 degrees F shall be sealed with a moisture retarder.

#### 3.2.4.2 Insulation for Fittings

Flanges, unions, valves, fittings, and accessories shall be insulated and finished as specified for the applicable service. Two coats of breather emulsion type weatherproof mastic (impermeable to water, permeable to air) recommended by the insulation manufacturer shall be applied with glass tape embedded between coats. Tape overlaps shall be not less than 1 inch and the adjoining aluminum jacket not less than 2 inches. Factory preformed aluminum jackets may be used in lieu of the above. Molded PVC fitting covers shall be provided when PVC jackets are used for straight runs of pipe. PVC fitting covers shall have adhesive welded joints and shall be weatherproof laminated self-adhesive (minimum 2 mils adhesive, 3 mils embossed) vapor barrier/weatherproofing jacket - less than 0.0000 permeability, (greater than 3 ply, standard grade, silver, white, black and embossed, and UV resistant.

#### 3.2.4.3 PVC Jacket

PVC jacket shall be ultraviolet resistant and adhesive welded weather tight with manufacturer's recommended adhesive. Installation shall include provision for thermal expansion.

#### 3.2.4.4 Stainless Steel Jackets

ASTM A167 or ASTM A240/A240M; Type 304, minimum thickness of 33 gauge (0.010 inch), smooth surface with factory-applied polyethylene and kraft paper moisture barrier on inside surface. Provide stainless steel bands, minimum width of 1/2 inch.

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### 3.3 DUCT INSULATION SYSTEMS INSTALLATION

Install duct insulation systems in accordance with the approved MICA Insulation Std's 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.

Except for oven hood exhaust duct insulation, corner angles shall be installed on external corners of insulation on ductwork in exposed finished spaces before covering with jacket. Air conditioned spaces shall be defined as those spaces directly supplied with cooled conditioned air (or provided with a cooling device such as a fan-coil unit) and heated conditioned air (or provided with a heating device such as a unit heater, radiator or convector).

#### 3.3.1 Duct Insulation Minimum Thickness

Table 3				
Minimum Duct Insulation				
	Cooling		Heating	
Duct Location	Annual Cooling Degree Days Base 65 F	Insulation R-Value (h sf F)/Btu	Annual Heating Degree Days Base 65 F	Insulation R-Value (h sf F)/Btu
Exterior of Building	< 500	3.3	< 1500	3.3
	500 - 1150	5.0	1500 - 4500	5.0
	1151 - 2000	6.5	4501 - 7500	6.5
	>2000	8.0	>7500	8.0
	Temperature Difference	Insulation R-Value (h sf F)/Btu	Temperature Difference	Insulation R-Value (h sf F)/Btu
Inside building envelope or in unconditioned spaces	<15	None required	<15	None required
	15 <TD <40	3.3	15 <TD <40	3.3
	40 <TD	5.0	40 <TD	5.0

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Table 3		
Minimum Duct Insulation		
	Cooling	Heating
<p>These R-values do not include the film resistances. 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 ducts are designed to convey both heated and cooled air, duct insulation shall be as required by the most restrictive condition. Where exterior walls are used as plenum walls, wall insulation shall be as 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 3.3 (h sf F)/Btu. Unconditioned spaces include crawlspaces and attics.</p>		

Duct insulation minimum thickness in accordance with Table 4.

Table 4 - Minimum Duct Insulation (inches)	
Cold Air Ducts	2.0
Relief Ducts	1.5
Fresh Air Intake Ducts	1.5
Warm Air Ducts	2.0
Relief Ducts	1.5
Fresh Air Intake Ducts	1.5

### 3.3.2 Insulation and Vapor Retarder/Vapor Barrier for Cold Air Duct

Insulation and vapor retarder/vapor barrier shall be provided for the following cold air ducts and associated equipment.

- a. Supply ducts.
- b. Return air ducts.
- c. Relief ducts.
- d. Flexible run-outs (field-insulated).
- e. Plenums.

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- f. Duct-mounted coil casings.
- g. Coil headers and return bends.
- h. Coil casings.
- i. Fresh air intake ducts.
- j. Filter boxes.
- o. Combustion air intake ducts.

Insulation for rectangular ducts shall be flexible type where concealed, minimum density 3/4 pcf, and rigid type where exposed, minimum density 3 pcf. Insulation for both concealed or exposed round/oval ducts shall be flexible type, minimum density 3/4 pcf or a semi rigid board, minimum density 3 pcf, formed or fabricated to a tight fit, edges beveled and joints tightly butted and staggered. Insulation for all exposed ducts shall be provided with either a white, paint-able, factory-applied Type I jacket or a field applied vapor retarder/vapor barrier jacket coating finish as specified, the total field applied dry film thickness shall be approximately 1/16 inch. Insulation on all concealed duct shall be provided with a factory-applied Type I or II vapor retarder/vapor barrier jacket. Duct insulation shall be continuous through sleeves and prepared openings except firewall penetrations. Duct insulation terminating at fire dampers, shall be continuous over the damper collar and retaining angle of fire dampers, which are exposed to unconditioned air and which may be prone to condensate formation. Duct insulation and vapor retarder/vapor barrier shall cover the collar, neck, and any un-insulated surfaces of diffusers, registers and grills. Vapor retarder/vapor barrier materials shall be applied to form a complete unbroken vapor seal over the insulation. Sheet Metal Duct shall be sealed in accordance with Section 23 30 00 HVAC AIR DISTRIBUTION.

#### 3.3.2.1 Installation on Concealed Duct

- a. For rectangular, oval or round ducts, flexible insulation shall be attached by applying adhesive around the entire perimeter of the duct in 6 inch wide strips on 12 inch centers.
- b. For rectangular and oval ducts, 24 inches and larger insulation shall be additionally secured to bottom of ducts by the use of mechanical fasteners. Fasteners shall be spaced on 16 inch centers and not more than 16 inches from duct corners.
- c. For rectangular, oval and round ducts, mechanical fasteners shall be provided on sides of duct risers for all duct sizes. Fasteners shall be spaced on 16 inch centers and not more than 16 inches from duct corners.
- d. Insulation shall be impaled on the mechanical fasteners (self stick pins) where used and shall be pressed thoroughly into the adhesive. Care shall be taken to ensure vapor retarder/vapor barrier jacket joints overlap 2 inches. The insulation shall not be compressed to a thickness less than that specified. Insulation shall be carried over standing seams and trapeze-type duct hangers.
- e. Where mechanical fasteners are used, self-locking washers shall be

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installed and the pin trimmed and bent over.

- f. Jacket overlaps shall be secured with staples and tape as necessary to ensure a secure seal. Staples, tape and seams shall be coated with a brush coat of vapor retarder coating or PVDC adhesive tape or greater than 3 ply laminate (minimum 2 mils adhesive, 3 mils embossed) - less than 0.0000 perm adhesive tape.
- g. Breaks in the jacket material shall be covered with patches of the same material as the vapor retarder jacket. The patches shall extend not less than 2 inches beyond the break or penetration in all directions and shall be secured with tape and staples. Staples and tape joints shall be sealed with a brush coat of vapor retarder coating or PVDC adhesive tape or greater than 3 ply laminate (minimum 2 mils adhesive, 3 mils embossed) - less than 0.0000 perm adhesive tape.
- h. At jacket penetrations such as hangers, thermometers, and damper operating rods, voids in the insulation shall be filled and the penetration sealed with a brush coat of vapor retarder coating or PVDC adhesive tape greater than 3 ply laminate (minimum 2 mils adhesive, 3 mils embossed) - less than 0.0000 perm adhesive tape.
- i. Insulation terminations and pin punctures shall be sealed and flashed with a reinforced vapor retarder coating finish or tape with a brush coat of vapor retarder coating.. The coating shall overlap the adjoining insulation and un-insulated surface 2 inches. Pin puncture coatings shall extend 2 inches from the puncture in all directions.
- j. Where insulation standoff brackets occur, insulation shall be extended under the bracket and the jacket terminated at the bracket.

#### 3.3.2.2 Installation on Exposed Duct Work

- a. For rectangular ducts, rigid insulation shall be secured to the duct by mechanical fasteners on all four sides of the duct, spaced not more than 12 inches apart and not more than 3 inches from the edges of the insulation joints. A minimum of two rows of fasteners shall be provided for each side of duct 12 inches and larger. One row shall be provided for each side of duct less than 12 inches. Mechanical fasteners shall be as corrosion resistant as G60 coated galvanized steel, and shall indefinitely sustain a 50 lb tensile dead load test perpendicular to the duct wall.
- b. Form duct insulation with minimum jacket seams. Fasten each piece of rigid insulation to the duct using mechanical fasteners. When the height of projections is less than the insulation thickness, insulation shall be brought up to standing seams, reinforcing, and other vertical projections and shall not be carried over. Vapor retarder/barrier jacket shall be continuous across seams, reinforcing, and projections. When height of projections is greater than the insulation thickness, insulation and jacket shall be carried over. Apply insulation with joints tightly butted. Neatly bevel insulation around name plates and access plates and doors.
- c. Impale insulation on the fasteners; self-locking washers shall be installed and the pin trimmed and bent over.
- d. Seal joints in the insulation jacket with a 4 inch wide strip of

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tape. Seal taped seams with a brush coat of vapor retarder coating.

- e. Breaks and ribs or standing seam penetrations in the jacket material shall be covered with a patch of the same material as the jacket. Patches shall extend not less than 2 inches beyond the break or penetration and shall be secured with tape and stapled. Staples and joints shall be sealed with a brush coat of vapor retarder coating.
- f. At jacket penetrations such as hangers, thermometers, and damper operating rods, the voids in the insulation shall be filled and the penetrations sealed with a flashing sealant.
- g. Insulation terminations and pin punctures shall be sealed and flashed with a reinforced vapor retarder coating finish. The coating shall overlap the adjoining insulation and un-insulated surface 2 inches. Pin puncture coatings shall extend 2 inches from the puncture in all directions.
- h. Oval and round ducts, flexible type, shall be insulated with factory Type I jacket insulation with minimum density of 3/4 pcf, attached as in accordance with MICA standards.

### 3.3.3 Insulation for Warm Air Duct

Insulation and vapor barrier shall be provided for the following warm air ducts and associated equipment:.

- a. Supply ducts.
- b. Return air ducts.
- c. Relief air ducts
- d. Flexible run-outs (field insulated).
- e. Plenums.
- f. Duct-mounted coil casings.
- g. Coil-headers and return bends.
- h. Coil casings.
- i. Fresh air intake ducts.
- j. Filter boxes.
- o. Exhaust ducts passing through concealed spaces exhausting conditioned air.

Insulation for rectangular ducts shall be flexible type where concealed, and rigid type where exposed. Insulation on exposed ducts shall be provided with a white, paint-able, factory-applied Type II jacket, or finished with adhesive finish. Flexible type insulation shall be used for round ducts, with a factory-applied Type II jacket. Insulation on concealed duct shall be provided with a factory-applied Type II jacket. Adhesive finish where indicated to be used shall be accomplished by applying two coats of adhesive with a layer of glass cloth embedded

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between the coats. The total dry film thickness shall be approximately 1/16 inch. Duct insulation shall be continuous through sleeves and prepared openings. Duct insulation shall terminate at fire dampers and flexible connections.

#### 3.3.3.1 Installation on Concealed Duct

- a. For rectangular, oval and round ducts, insulation shall be attached by applying adhesive around the entire perimeter of the duct in 6 inch wide strips on 12 inch centers.
- b. For rectangular and oval ducts 24 inches and larger, insulation shall be secured to the bottom of ducts by the use of mechanical fasteners. Fasteners shall be spaced on 18 inch centers and not more than 18 inches from duct corner.
- c. For rectangular, oval and round ducts, mechanical fasteners shall be provided on sides of duct risers for all duct sizes. Fasteners shall be spaced on 18 inch centers and not more than 18 inches from duct corners.
- d. The insulation shall be impaled on the mechanical fasteners where used. The insulation shall not be compressed to a thickness less than that specified. Insulation shall be carried over standing seams and trapeze-type hangers.
- e. Self-locking washers shall be installed where mechanical fasteners are used and the pin trimmed and bent over.
- f. Insulation jacket shall overlap not less than 2 inches at joints and the lap shall be secured and stapled on 4 inch centers.

#### 3.3.3.2 Installation on Exposed Duct

- a. For rectangular ducts, the rigid insulation shall be secured to the duct by the use of mechanical fasteners on all four sides of the duct, spaced not more than 16 inches apart and not more than 6 inches from the edges of the insulation joints. A minimum of two rows of fasteners shall be provided for each side of duct 12 inches and larger and a minimum of one row for each side of duct less than 12 inches.
- b. Duct insulation with factory-applied jacket shall be formed with minimum jacket seams, and each piece of rigid insulation shall be fastened to the duct using mechanical fasteners. When the height of projection is less than the insulation thickness, insulation shall be brought up to standing seams, reinforcing, and other vertical projections and shall not be carried over the projection. Jacket shall be continuous across seams, reinforcing, and projections. Where the height of projections is greater than the insulation thickness, insulation and jacket shall be carried over the projection.
- c. Insulation shall be impaled on the fasteners; self-locking washers shall be installed and pin trimmed and bent over.
- d. Joints on jacketed insulation shall be sealed with a 4 inch wide strip of tape and brushed with vapor retarder coating.
- e. Breaks and penetrations in the jacket material shall be covered with a patch of the same material as the jacket. Patches shall extend not

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less than 2 inches beyond the break or penetration and shall be secured with adhesive and stapled.

- f. Insulation terminations and pin punctures shall be sealed with tape and brushed with vapor retarder coating.
- g. Oval and round ducts, flexible type, shall be insulated with factory Type I jacket insulation, minimum density of 3/4 pcf attached by staples spaced not more than 16 inches and not more than 6 inches from the degrees of joints. Joints shall be sealed in accordance with item "d." above.

#### 3.3.4 Ducts Handling Air for Dual Purpose

For air handling ducts for dual purpose below and above 60 degrees F, ducts shall be insulated as specified for cold air duct.

#### 3.3.5 Duct Test Holes

After duct systems have been tested, adjusted, and balanced, breaks in the insulation and jacket shall be repaired in accordance with the applicable section of this specification for the type of duct insulation to be repaired.

-- End of Section --



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## SECTION 23 08 00.00 20

### COMMISSIONING OF MECHANICAL AND PLUMBING SYSTEMS

**02/21, CHG 1: 05/21**

#### PART 1 GENERAL

Total Building Commissioning (TBCx) is a systematic, quality-focused process for enhancing the delivery of a project that focuses on verifying and documenting that all of the commissioned systems and assemblies are planned, designed, installed, tested, operated, and maintained to meet the project requirements. The purpose is to reduce the cost and performance risks associated with delivering facilities projects, and to increase value to owners, occupants, and users.

#### 1.1 DEFINITIONS

Commissioning Process (Cx) - a quality-focused process for enhancing the delivery of a project. Refer to ASHRAE 202 for a comprehensive description of the commissioning process.

Commissioning Provider (CxP)- The entity who leads, plans, and coordinates the Commissioning Team. The terms Commissioning Provider, Commissioning Firm, Lead Commissioning Specialist, Commissioning Specialist, and Commissioning Authority (CA or CxA) when used by sustainable Third Party Certification (TPC) programs, are interchangeable.

Commissioning Authority - The Government retains the authority for oversight and assurance of the entire commissioning process, and final approval of all commissioning deliverables.

#### 1.2 SEQUENCING AND SCHEDULING

Complete the following prior to starting Functional Performance Tests of mechanical systems:

- a. All equipment and systems completed, cleaned, flushed, disinfected, calibrated, tested, and operate in accordance with contract documents and construction plans and specifications
- b. Final DALT Report submitted and approved in accordance with Section 23 05 93.00 06 TESTING, ADJUSTING, AND BALANCING FOR HVAC
- c. Performance Verification Tests of the controls systems have been completed and the Performance Verification Test Report has been submitted and approved in accordance with Section 23 09 00 INSTRUMENTATION AND CONTROL FOR HVAC.
- d. The Certificate of Readiness submitted and approved in accordance with Section TOTAL BUILDING COMMISSIONING
- e. Pre-final Testing, Adjusting, and Balancing Report submitted in accordance with Section 23 05 93.00 06 TESTING, ADJUSTING, AND BALANCING FOR HVAC
- f. Air Leakage Test Reports and Diagnostic Test Reports submitted and approved in accordance with Section 07 05 23 PRESSURE TESTING AN AIR BARRIER SYSTEM FOR AIR TIGHTNESS

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- g. Tests, Flushing, and Disinfection in accordance with Section 22 00 00  
PLUMBING, GENERAL PURPOSE

### 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

Test Equipment; G, DO

SD-06 Test Reports

Pipe Flushing, Testing, And Water Treatment Reports; G, DO

Seasonal Test Report; G, DO

Full-Load Test Report; G, DO

### 1.4 ACCESSIBILITY REQUIREMENTS

Equipment, systems, and devices for commissioned systems must be accessible. Make necessary modifications if systems and devices are not accessible for inspections and testing.

Assist commissioning team in testing by removing equipment covers, opening access panels, and other required activities that assist with visual oversight. Furnish ladders, flashlights, meters, gauges, or other inspection equipment as necessary.

### 1.5 COORDINATION

Refer to Section 01 46 00.00 06 TOTAL BUILDING COMMISSIONING for requirements pertaining to coordination during the commissioning process. Coordinate with the Commissioning Provider in accordance with Section 01 46 00.00 06 and in accordance with the Commissioning Plan to schedule inspections as required to support the commissioning process. Furnish additional information requested by the Commissioning Provider. Coordinate scheduling of Functional Performance Testing with the commissioning team. Upload plans, reports, notes, and other documentation to the Commissioning Provider's web-based commissioning software, or as specified in the commissioning plan, as it is completed.

### 1.6 PIPE FLUSHING, TESTING, AND WATER TREATMENT REPORTS

Test requirements are specified in Division 22 and 23 piping Sections. Prepare a pipe system cleaning, flushing, and hydrostatic testing log. Provide cleaning, flushing, testing, and water treatment log and final reports.

Include the following in the pipe system cleaning, flushing, and hydrostatic testing log:

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- a. Minimum flushing water velocity.
- b. Water treatment reports.
- c. Tracking checklist for managing and ensuring that all pipe sections have been cleaned, flushed, hydrostatically tested, and chemically treated.

#### 1.7 CERTIFICATE OF READINESS DOCUMENTATION

Submit Certificate of Readiness documentation in accordance with Section 01 46 00.00 06 TOTAL BUILDING COMMISSIONING for all equipment and systems including start-up reports; completed Pre-Functional Checklists; Testing, Adjusting, and Balancing (TAB) Report; HVAC Controls Start-Up Reports. Do not schedule Functional Performance Tests for the system until the Certificate of Readiness for that system receives approval by the Contracting Officer. The Mechanical, Electrical, Controls, and TAB subcontractor representatives must sign and date the Certificate of Readiness.

### PART 2 PRODUCTS

#### 2.1 TEST EQUIPMENT

Provide all testing equipment required to perform testing for the systems to be commissioned, except for equipment specific to and used by TAB as required by Section 23 05 93.00 06 TESTING, ADJUSTING, AND BALANCING FOR HVAC. Provide a sufficient quantity of two-way radios for each subcontractor. Submit list of Test Equipment and instrumentation to be used for testing including equipment/instrument identification number, equipment application or planned use, manufacturer, make, model, and serial number, and calibration history with certificates. Also list special equipment and proprietary tools specific to a piece of equipment required for testing.

##### 2.1.1 Proprietary Equipment

Provide manufacturer's proprietary test equipment and software required by any equipment manufacturer for programming and/or start-up, whether specified or not. Provide manufacturer test equipment, demonstrate its use, and assist in the commissioning process as needed. Provide data logging equipment and software required to test equipment.

##### 2.1.2 Calibration and Accuracy

Comply with equipment manufacturer's test equipment calibration procedures and intervals. Recalibrate test instruments immediately after instruments have been repaired resulting from being dropped or damaged. Affix calibration tags to test instruments. Furnish calibration records to Contracting Officer upon request.

Provide all testing equipment of sufficient quality and accuracy to test and/or measure system performance with the tolerances specified. Unless otherwise noted, the following minimum requirements apply: Provide temperature sensors and digital thermometers with a certified calibration within the past year to an accuracy of 0.5 degrees F and a resolution of plus or minus 0.1 degrees F. Provide pressure sensors with an accuracy of plus or minus 2.0 percent of the value range being measured (not full range of meter) and calibrated within the last year.

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### PART 3 EXECUTION

#### 3.1 MEETINGS

Attend all meetings in accordance with Section 01 46 00.00 06 TOTAL BUILDING COMMISSIONING.

Provide timely updates on construction schedule changes so Commissioning Provider has scheduling information needed to execute commissioning process efficiently. Notify Contracting Officer of anticipated construction delays to commissioning activities not yet performed or not yet scheduled.

#### 3.2 PREFUNCTIONAL CHECKS

Complete and sign Pre-Functional Checklists using the Commissioning Provider's web-based commissioning software, or as specified by the commissioning plan. Provide manufacturer's installation manual for each type of unit. Perform all work in accordance with the manufacturer's published diagrams, recommendations, and equipment warranty requirements.

#### 3.3 STARTUP AND INITIAL CHECKOUT

Document start-up and initial testing procedures including:

- a. Startup tests and factory testing reports.
- b. Manufacturer's representative start-up, operating, troubleshooting and maintenance procedures.
- c. Additional documentation necessary for third party certification programs.
- d. Perform and clearly document system operational checks and quality control checks as they are completed, and providing a copy to the commissioning team.
- e. Correct deficiencies and sign the Certificate of Readiness for each system before functional performance testing

#### 3.4 COMMISSIONING TESTING

Conduct Functional Performance Testing in accordance with Section 01 46 00.00 06 TOTAL BUILDING COMMISSIONING and requirements in this section. Prior to Functional Performance Testing, complete all prerequisites in accordance with paragraph SEQUENCING AND SCHEDULING.

##### 3.4.1 Preparation

Put equipment and systems into operation and continue operation during each working day of commissioning, as required. Verify temperature and pressure taps in accordance with Contract Documents. Provide a pressure/temperature plug at each water sensor which is an input point to control system.

Perform minor adjustments to equipment and systems during Functional Performance Tests as deemed necessary by the commissioning team. Where calibrated DDC sensors cannot be used to record test data, provide measuring instruments, logging devices, and data acquisition equipment to

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record data for the complete range of test data for the required test period.

#### 3.4.2 Test Setup

Perform each test under conditions that simulate actual conditions as close as is practically possible. Provide all necessary materials and system modifications to produce the necessary flows, pressures, temperatures, and other conditions necessary to execute the test according to the specified conditions. At completion of the test, return the affected building equipment and systems to their pre-test condition.

#### 3.4.3 Manufacturer's Representative

Provide a factory trained representative authorized by the equipment manufacturer to perform Functional Performance Testing for the following equipment:

Rooftop Units

Dedicated Outside Air Unit (DOAS)

CRAC Units

Ensure the test representative reviews, approves, and signs the completed field test report. Include person's name with signatures.

#### 3.4.4 Sample Strategy

Perform Functional Performance Tests using the sample strategy described in Section 01 46 00.00 06 TOTAL BUILDING COMMISSIONING. Prepare and complete a Functional Performance Test for each item of equipment or system to be tested. During testing, Government representatives may select the specific equipment or system to be tested for sample sizes less than 100 percent.

#### 3.4.5 Simulating Conditions

Functional performance testing is conducted by simulating conditions at control devices to initiate a control system response. Before testing, calibrate all sensors, transducers and devices. Over-writing control input values through the control system is not acceptable unless approved by the Contracting Officer. Specific examples of simulating conditions are provided below. Do not simulate conditions when damage to the system or building may result.

- a. When varying static pressures inside ductwork cannot be simulated within the duct, and where a sensor signals the controls system to initiate sequences at various duct static pressures, it is acceptable to simulate the various pressures with a Pneumatic Squeeze-Bulb Type Signaling Device with gauge temporarily attached to the sensing tube leading to the transmitter. It is not acceptable to reset the various set-points, nor to simulate an electric analog signal (unless approved as noted above).
- b. Dirty filter pressure drops can be simulated by partially blocking filter face.
- c. Freeze-stat safeties can be simulated by packing portion of sensor

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with ice.

- d. High outside air temperatures can be simulated with a hair blower.
- e. Raising entering cooling coil temperatures by activating a heating/preheat coil can be used to simulate entering cooling coil conditions.
- f. Do not use signal generators to simulate sensor signals unless approved by the Contracting Officer, as noted above, for special cases.
- g. Control set points can be altered. For example, to see the air conditioning compressor lockout work at an outside air temperature below 55 degrees F, when the outside air temperature is above 55 degrees F, temporarily change the lockout set point to be 0 degrees F above the current outside air temperature. Caution: Set points are not to be raised or lowered to a point to cause damage to the components, systems, or the building structure and/or contents.
- h. Test duct mounted smoke detectors in accordance with the manufacturer's recommendations. Perform the tests with air system at minimum airflow condition.
- i. Test current sensing relays used for fan and pump status signals to control system to indicate unit failure and run status by resetting the set point on the relay to simulate a lost belt or unit failure while the unit is running. Confirm that the failure alarm was generated and received at the control system. After the test is conducted, return the set point to its original set-point or a set-point as indicated by the Contracting Officer.

#### 3.4.6 Duct Air Leakage Test (DALT) Report Review

The Mechanical System Technical Commissioning Specialist must review the pre-final TAB Report required by Section 23 05 93.00 06 TESTING, ADJUSTING, AND BALANCING FOR HVAC. Identify any deficiencies to the Contracting Officer's Representative and the Contractor's Quality Control Personnel and include in the issues log. All deficiencies must be resolved prior to DALT Report approval.

#### 3.4.7 Duct Air Leakage Test (DALT) Report Verification

The Mechanical System Technical Commissioning Specialist must witness the DALT Field Acceptance Testing specified by Section 23 05 93.00 06 TESTING, ADJUSTING, AND BALANCING FOR HVAC and identify any deficiencies to the Contracting Officer's Representative and the Contractor's Quality Control Personnel and include in the issues log. All deficiencies must be resolved prior to DALT Report approval.

#### 3.4.8 Testing, Adjusting, and Balancing (TAB) Report Review

The Mechanical System Technical Commissioning Specialist must review the pre-final TAB Report required by Section 23 05 93.00 06 TESTING, ADJUSTING, AND BALANCING FOR HVAC and identify any deficiencies to the Contracting Officer's Representative and the Contractor's Quality Control Personnel and include in the issues log. All deficiencies must be resolved prior to TAB Report approval.

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#### 3.4.9 Testing, Adjusting, and Balancing (TAB) Report Verification

The Mechanical System Technical Commissioning Specialist must witness the TAB Field Acceptance Testing specified by Section 23 05 93.00 06 TESTING, ADJUSTING, AND BALANCING FOR HVAC and identify any deficiencies to the Contracting Officer's Representative and the Contractor's Quality Control Personnel and include in the issues log. All deficiencies must be resolved prior to TAB Report approval.

#### 3.4.10 HVAC Controls Test Procedures, Reports, and Trends Review

The Mechanical System Technical Commissioning Specialist must review the Start-Up Testing Report, PVT Procedures and PVT Reports including endurance testing trend submittals required by Section 23 05 93.00 06 INSTRUMENTATION AND CONTROL FOR HVAC and Section 25 10 10 UTILITY MONITORING AND CONTROL SYSTEM (UMCS) FRONT END AND INTEGRATION. The Mechanical System Technical Commissioning Specialist must review each submittal and identify any deficiencies to the Contracting Officer's Representative and the Contractor's Quality Control Personnel and include in the issues log. All deficiencies must be resolved prior to final acceptance.

### 3.5 RETESTING REQUIREMENTS

Abort tests if any deficiency prevents successful completion of the test or if any required commissioning team member is not present for the test. Re-test only after all deficiencies identified during the original tests have been corrected.

If sequence of operation in any of Functional Performance Tests fails, the Government's costs for witnessing further demonstration of that test procedure may be assigned to the Contractor as a deduct to their contracted price, including salary, travel costs, and per diem for Government commissioning team members. Correct deficiencies as identified by the commissioning team and retest the systems to be commissioned.

### 3.6 SYSTEM ACCEPTANCE

Systems may be partially accepted prior to seasonal testing if they comply with all construction contract and accepted design requirements that can be tested during initial Functional Performance Tests. All test procedures must be successful completed prior to full systems acceptance.

### 3.7 SEASONAL TESTS

Perform Initial Functional Performance Tests as soon as all contract work is completed, but prior to facility turnover, regardless of the season.

In addition to the Initial Functional Performance Tests, perform Functional Performance Tests of HVAC systems during season of maximum heating and cooling as defined by Section 23 05 93.00 06 TESTING, ADJUSTING, AND BALANCING FOR HVAC. Schedule Seasonal Functional Performance Tests in coordination with the Contracting Officer. Submit Seasonal Test Report within 14 days of test completion.

Execute seasonal functional performance testing, witnessed by the Contracting Officer. Correct deficiencies and make adjustments to O&M manuals and as-built drawings for applicable issues identified in any seasonal testing.

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### 3.8 FULL-LOAD TESTS

Perform Initial Functional Performance Tests as soon as all contract work is completed, but prior to facility turnover. In addition to the Initial Functional Performance Tests, perform Functional Performance Tests of HVAC systems under full-load conditions. Develop and implement means of artificial loading to demonstrate the ability of the process cooling systems to handle peak process loads. Schedule Full-Load Functional Performance Tests in coordination with the Contracting Officer. Submit Full-Load Test Report within 14 days of test completion.

Execute full-load functional performance testing, witnessed by the Contracting Officer. Correct deficiencies and make adjustments to O&M manuals and as-built drawings for applicable issues identified in any full load testing.

### 3.9 TRAINING

The Mechanical Systems Technical Commissioning Specialist must review the training plan required by Section 00 80 00.00 06 SPECIAL PROVISIONS and identify any deficiencies to the Contracting Officer's Representative and the Contractor's Quality Control Personnel.

Coordinate, schedule, and document all required training. At a minimum, include the following items in the training report for commissioned systems:

- a. Complete commissioning documentation
- b. Complete O&M data
- c. Complete Training
- d. Purpose of equipment.
- e. Principle of how the equipment works.
- f. Important parts and assemblies.
- g. How the equipment achieves its purpose and necessary operating conditions.
- h. Most likely failure modes, causes and corrections.
- i. On site demonstration.
- j. Provide updates to O&M manuals based on field modifications.
- k. Provide training of the post-occupancy operations and maintenance staff.

-- 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 specified in Section 25 10 10 UTILITY MONITORING AND CONTROL (UMCS) FRONT END AND INTEGRATION, suitable for the control of the heating, ventilating and air conditioning (HVAC) and other building-level systems as indicated and shown and in accordance with Section 23 09 13 INSTRUMENTATION AND CONTROL DEVICES FOR HVAC, Section 23 09 23.02 BACNET DIRECT DIGITAL CONTROL FOR HVAC AND OTHER BUILDING CONTROL SYSTEMS for BACnet or Niagara BACnet systems, and other referenced Sections.

##### 1.1.1 Proprietary Systems

###### 1.1.1.1 Proprietary Systems Exempted From Open Protocol Requirements

The following systems are specifically exempted from the open protocol requirements of Section 23 09 23.02 BACNET DIRECT DIGITAL CONTROL FOR HVAC AND OTHER BUILDING CONTROL SYSTEMS:

- a. A simple split (DX) system consisting of a single indoor unit and a single outdoor unit from the same manufacturer.

###### 1.1.1.2 Implementation of Proprietary Systems

For proprietary systems exempted from open protocol requirements, a proprietary network and DDC hardware communicating via proprietary protocol are permitted. For these systems a building control network meeting the requirements of Section 23 09 23.02 BACNET DIRECT DIGITAL CONTROL FOR HVAC AND OTHER BUILDING CONTROL SYSTEMS must also be provided, along with a gateway or interface to connect the proprietary system to the open building control network.

The proprietary system gateway or interface must provide the required functionality as shown on the points schedule. Scheduling, alarming, trending, overrides, network inputs, network outputs and other protocol related requirements must be met on the open protocol control system as specified in Section 23 09 23.02 BACNET DIRECT DIGITAL CONTROL FOR HVAC AND OTHER BUILDING CONTROL SYSTEMS.

##### 1.1.2 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.

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- c. Control sequences reside in DDC hardware in the building. The building control network is not dependent upon connection to a Utility Monitoring and Control System (UMCS) Front End or to any other system for performance of control sequences. To the greatest extent practical, the hardware performs control sequences without reliance on the building network.
- d. The hardware is installed such that individual control equipment can be replaced by similar control equipment from other equipment manufacturers with no loss of system functionality.
- e. All necessary documentation, configuration information, programming tools, programs, drivers, and other software are licensed to and otherwise remain with the Government such that the Government or their agents are able to perform repair, replacement, upgrades, and expansions of the system without subsequent or future dependence on the Contractor, Vendor or Manufacturer.
- f. Sufficient documentation and data, including rights to documentation and data, are provided such that the Government or their agents can execute work to perform repair, replacement, upgrades, and expansions of the system without subsequent or future dependence on the Contractor, Vendor or Manufacturer.
- g. Hardware is installed and configured such that the Government or their agents are able to perform repair, replacement, and upgrades of individual hardware without further interaction with the Contractor, Vendor or Manufacturer.
- 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="\*\*"

#### 1.1.1.3 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.

#### 1.1.1.4 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.

#### 1.1.1.5 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

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to be performed, arrange such work accordingly, and provide all work necessary to meet such conditions.

## 1.2 RELATED SECTIONS

Related work specified elsewhere:

- a. Section 23 09 23.02 BACNET DIRECT DIGITAL CONTROL FOR HVAC AND OTHER BUILDING CONTROL SYSTEMS for BACnet systems with or without Niagara Framework.
- b. Section 23 09 13 INSTRUMENTATION AND CONTROL DEVICES FOR HVAC
- d. Section 25 08 10 UTILITY MONITORING AND CONTROL SYSTEMS TESTING
- e. Section 25 10 10 UTILITY MONITORING AND CONTROL SYSTEMS (UMCS) FRONT END AND INTEGRATION
- f. Section 25 05 11.01 CYBERSECURITY FOR FACILITY-RELATED CONTROL SYSTEMS
- g. Section 01 46 00.00 06 TOTAL BUILDING COMMISSIONING

## 1.3 REFERENCES

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

AMERICAN SOCIETY OF HEATING, REFRIGERATING AND AIR-CONDITIONING ENGINEERS (ASHRAE)

ASHRAE 135	(2020; Errata 2021) BACnet-A Data Communication Protocol for Building Automation and Control Networks
ASHRAE FUN IP	(2017) Fundamentals Handbook, I-P Edition

INSTITUTE OF ELECTRICAL AND ELECTRONICS ENGINEERS (IEEE)

IEEE C62.41	(1991; R 1995) Recommended Practice on Surge Voltages in Low-Voltage AC Power Circuits
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NATIONAL ELECTRICAL MANUFACTURERS ASSOCIATION (NEMA)

NEMA 250	(2020) Enclosures for Electrical Equipment (1000 Volts Maximum)
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NATIONAL FIRE PROTECTION ASSOCIATION (NFPA)

NFPA 70	(2020; ERTA 20-1 2020; ERTA 20-2 2020; TIA 20-1; TIA 20-2; TIA 20-3; TIA 20-4) National Electrical Code
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NFPA 90A	(2021) Standard for the Installation of Air Conditioning and Ventilating Systems
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#### TRIDIUM, INC (TRIDIUM)

Niagara Framework	(2012) NiagaraAX User's Guide
Tridium Open NiCS	(2005) Understanding the NiagaraAX Compatibility Statement (NiCS)

#### UNDERWRITERS LABORATORIES (UL)

UL 5085-3	(2006; Reprint Nov 20121) Low Voltage Transformers - Part 3: Class 2 and Class 3 Transformers
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### 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

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controller types (B-AAC, B-ASC etc.) a B-BC device is required to support the server ("B") side of the ReadProperty and WriteProperty services, but unlike the other controller types it is also required to support the client ("A") side of these services. Communication between controllers requires that one of them support the client side and the other support the server side, so a B-BC is often used when communication between controllers is needed.

#### 1.4.6 BACnet Broadcast Management Device (BBMD) (BACnet)

A communications device, typically combined with a BACnet router. A BBMD forwards BACnet broadcast messages to BACnet/IP devices and other BBMDs connected to the same BACnet/IP network. Each IP subnet that is part of a BACnet/IP network must have at least one BBMD. Note there are additional restrictions when multiple BBMDs share an IP subnet.

#### 1.4.7 BACnet/IP (BACnet)

An extension of BACnet, Annex J, defines the use of a reserved UDP socket to transmit BACnet messages over IP networks. A BACnet/IP network is a collection of one or more IP subnets that share the same BACnet network number. See also paragraph BACNET BROADCAST MANAGEMENT DEVICE.

#### 1.4.8 BACnet Internetwork (BACnet)

Two or more BACnet networks, connected with BACnet routers. In a BACnet Internetwork, there exists only one message path between devices.

#### 1.4.9 BACnet Interoperability Building Blocks (BIBBs) (BACnet)

A BIBB is a collection of one or more ASHRAE 135 Services intended to define a higher level of interoperability. BIBBs are combined to build the BACnet functional requirements for a device in a specification. Some BIBBs define additional requirements (beyond requiring support for specific services) in order to achieve a level of interoperability. For example, the BIBB DS-V-A (Data Sharing-View-A), which would typically be used by a front-end, not only requires the client to support the ReadProperty Service, but also provides a list of data types (Object / Properties) which the client must be able to interpret and display for the user.

In the BIBB shorthand notation, -A is the client side and -B is the server side.

The following is a list of some BIBBs used by this or referenced Sections:	
DS-COV-A	Data Sharing-Change of Value (A side)
DS-COV-B	Data Sharing-Change of Value (B side)
NM-RC-B	Network Management-Router Configuration (B side)
DS-RP-A	Data Sharing-Read Property (A side)
DS-RP-B	Data Sharing-Read Property (B side)
DS-RPM-A	Data Sharing-Read Property Multiple (A Side)

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The following is a list of some BIBBs used by this or referenced Sections:	
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.

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#### 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

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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



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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

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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

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#### 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).

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#### 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.

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#### 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 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.

- 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

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indicates the earliest the activity may begin.

- c. Abbreviations: In TABLE II the abbreviation AAO is used for 'after approval of' and 'ACO' is used for 'after completion of'.

TABLE II. PROJECT SEQUENCING			
ITEM #	TYPE	DESCRIPTION	SEQUENCING (START OF ACTIVITY OR DEADLINE FOR
1	S	Existing Conditions Report	
2	S	DDC Contractor Design Drawings	
3	S	Manufacturer's Product Data	
4	S	Pre-construction QC Checklist	
5	E	Install Building Control System	AAO #1 thru #4
6	E	Start-Up and Start-Up Testing	ACO #5
7	S	Post-Construction QC Checklist	ACO #6
8	S	Programming Software Configuration Software  Niagara Framework Engineering Tool Niagara Framework Wizards	ACO #6
9	S	Draft As-Built Drawings	ACO #6
10	S	Start-Up Testing Report	ACO #6
11	S	PVT Procedures	before schedule start of #12 and AAO #10
12	E	Execute PVT	AAO #9 and #11
13	S	PVT Report	ACO #12
14	S	Controller Application Programs Controller Configuration Settings  Niagara Framework Supervisory Gateway Backups	AAO #13
15	S	Final As-Built Drawings	AAO #13
16	S	O&M Instructions	AAO #15
17	S	Training Documentation	AAO #10 and before scheduled start of #18

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TABLE II. PROJECT SEQUENCING			
ITEM #	TYPE	DESCRIPTION	SEQUENCING (START OF ACTIVITY OR DEADLINE FOR
18	E	Training	AAO #16 and #17
19	S	Closeout QC Checklist	ACO #18

#### 1.6 SUBMITTALS

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

##### SD-02 Shop Drawings

DDC Contractor Design Drawings; G, AE

Draft As-Built Drawings; G

Final As-Built Drawings; G, AE

##### SD-03 Product Data

Programming Software; G

Controller Application Programs; G

Configuration Software; G

Controller Configuration Settings; G

Manufacturer's Product Data; G

Niagara Framework Supervisory Gateway Backups; G

Niagara Framework Engineering Tool; 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, AE

##### SD-10 Operation and Maintenance Data

Operation and Maintenance (O&M) Instructions; G

Training Documentation; G

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#### SD-11 Closeout Submittals

Enclosure Keys; G

Password Summary Report; G

Closeout Quality Control (QC) Checklist; G

#### 1.7 DATA PACKAGE AND SUBMITTAL REQUIREMENTS

Technical data packages consisting of technical data and computer software (meaning technical data which relates to computer software) which are specifically identified in this project and which may be defined/required in other specifications must be delivered strictly in accordance with the CONTRACT CLAUSES and in accordance with the Contract Data Requirements List, DD Form 1423. Data delivered must be identified by reference to the particular specification paragraph against which it is furnished. All submittals not specified as technical data packages are considered 'shop drawings' under the Federal Acquisition Regulation Supplement (FARS) and must contain no proprietary information and be delivered with unrestricted rights.

#### 1.8 SOFTWARE FOR DDC HARDWARE AND GATEWAYS

Provide all software related to the programming and configuration of DDC Hardware and Gateways as indicated. License all Software to the project site. The term "controller" as used in these requirements means both DDC Hardware and Gateways.

##### 1.8.1 Configuration Software

For each type of controller, provide the configuration tool software in accordance with Section 23 09 23.02 BACNET DIRECT DIGITAL CONTROL FOR HVAC AND OTHER BUILDING CONTROL SYSTEMS. Submit hard copies of the software user manuals for each software with the software submittal.

Submit Configuration Software on CD-ROM as a Technical Data Package. Submit 2 hard copies of the software user manual for each piece of software.

##### 1.8.2 Controller Configuration Settings

For each controller, provide copies of the installed configuration settings as source code compatible with the configuration tool software for that controller in accordance with Section 23 09 23.02 BACNET DIRECT DIGITAL CONTROL FOR HVAC AND OTHER BUILDING CONTROL SYSTEMS.

Submit Controller Configuration Settings on CD-ROM as a Technical Data Package. Include on the CD-ROM a list or table of contents clearly indicating which files are associated with each device. Submit 2 copies of the Controller Configuration Settings CD-ROM.

##### 1.8.3 Programming Software

For each type of programmable controller, provide the programming software in accordance with Section 23 09 23.02 BACNET DIRECT DIGITAL CONTROL FOR HVAC AND OTHER BUILDING CONTROL SYSTEMS. Submit hard copies of software user manuals for each software with the software submittal.



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Submit Programming Software on CD-ROM as a Technical Data Package.  
Submit 2 hard copies of the software user manual for each piece of software.

#### 1.8.4 Controller Application Programs

For each programmable controller, provide copies of the application program as source code compatible with the programming software for that controller in accordance with Section 23 09 23.02 BACNET DIRECT DIGITAL CONTROL FOR HVAC AND OTHER BUILDING CONTROL SYSTEMS.

Submit Controller Application Programs on CD-ROM as a Technical Data Package. Include on the CD-ROM a list or table of contents clearly indicating which application program is associated with each device. Submit 2 copies of the Controller Application Programs CD-ROM.

#### 1.8.5 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 2 hard copies of the software user manual for the Niagara Framework Engineering Tool.

### 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 four copies of the Pre-Construction QC Checklist.

#### 1.9.2 Post-Construction Quality Control (QC) Checklist

Complete items indicated as Post-Construction QC Checklist items in the QC

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Checklist. Submit four copies of the Post-Construction QC Checklist.

### 1.9.3 Closeout Quality Control (QC) Checklist

Complete items indicated as Closeout QC Checklist items in the QC Checklist. Submit four copies of the Closeout QC Checklist.

## PART 2 PRODUCTS

Provide products meeting the requirements of Section 23 09 13 INSTRUMENTATION AND CONTROL DEVICES FOR HVAC, Section 23 09 23.02 BACNET DIRECT DIGITAL CONTROL FOR HVAC AND OTHER BUILDING CONTROL SYSTEMS for BACnet or Niagara BACnet systems, other referenced Sections, and this Section.

### 2.1 GENERAL PRODUCT REQUIREMENTS

Units of the same type of equipment must be products of a single manufacturer. Each major component of equipment must have the manufacturer's name and address, and the model and serial number in a conspicuous place. Materials and equipment must be standard products of a manufacturer regularly engaged in the manufacturing of these and similar products. The standard products must have been in a satisfactory commercial or industrial use for two years prior to use on this project. The two year use must include applications of equipment and materials under similar circumstances and of similar size. DDC Hardware not meeting the two-year field service requirement is acceptable provided it has been successfully used by the Contractor in a minimum of two previous projects. The equipment items must be supported by a service organization. Items of the same type and purpose must be identical, including equipment, assemblies, parts and components.

### 2.2 PRODUCT DATA

Provide manufacturer's product data sheets documenting compliance with product specifications for each product provided under Section 23 09 13 INSTRUMENTATION AND CONTROL DEVICES FOR HVAC, Section 23 09 23.02 BACNET DIRECT DIGITAL CONTROL FOR HVAC AND OTHER BUILDING CONTROL SYSTEMS, or this Section. Provide product data for all products in a single indexed compendium, organized by product type.

For all BACnet hardware: for each manufacturer, model and version (revision) of DDC Hardware provide the Protocol Implementation Conformance Statement (PICS) in accordance with Section 23 09 23.02 BACNET DIRECT DIGITAL CONTROL FOR HVAC AND OTHER BUILDING CONTROL SYSTEMS.

Submit Manufacturer's Product Data on CD-ROM.

### 2.3 OPERATION ENVIRONMENT

Unless otherwise specified, provide products rated for continuous operation under the following conditions:

- a. Pressure: Pressure conditions normally encountered in the installed location.
- b. Vibration: Vibration conditions normally encountered in the installed location.

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c. Temperature:

- (1) Products installed indoors: Ambient temperatures in the range of 32 to 112 degrees F and temperature conditions outside this range normally encountered at the installed location.
- (2) Products installed outdoors or in unconditioned indoor spaces: Ambient temperatures in the range of -35 to +151 degrees F and temperature conditions outside this range normally encountered at the installed location.

- d. Humidity: 10 to 95 percent relative humidity, noncondensing and humidity conditions outside this range normally encountered at the installed location.

## 2.4 WIRELESS CAPABILITY

For products incorporating any wireless capability (including but not limited to radio frequency (RF), infrared and optical), provide products for which wireless capability can be permanently disabled at the device. Optical and infrared capabilities may be disabled via a permanently affixed opaque cover plate.

## 2.5 ENCLOSURES

Enclosures supplied as an integral (pre-packaged) part of another product are acceptable. Provide two Enclosure Keys for each lockable enclosure on a single ring per enclosure with a tag identifying the enclosure the keys operate. Provide enclosures meeting the following minimum requirements:

### 2.5.1 Outdoors

For enclosures located outdoors, provide enclosures meeting NEMA 250 Type 4 requirements.

### 2.5.2 Mechanical and Electrical Rooms

For enclosures located in mechanical or electrical rooms, provide enclosures meeting NEMA 250 Type 4 requirements.

### 2.5.3 Other Locations

For enclosures in other locations including but not limited to occupied spaces, above ceilings, and in plenum returns, provide enclosures meeting NEMA 250 Type 1 requirements.

## 2.6 WIRE AND CABLE

Provide wire and cable meeting the requirements of NFPA 70 and NFPA 90A in addition to the requirements of this specification and referenced specifications.

### 2.6.1 Terminal Blocks

For terminal blocks which are not integral to other equipment, provide terminal blocks which are insulated, modular, feed-through, clamp style with recessed captive screw-type clamping mechanism, suitable for DIN rail mounting, and which have enclosed sides or end plates and partition plates for separation.

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### 2.6.2 Control Wiring for Binary Signals

For Control Wiring for Binary Signals, provide 18 AWG copper or thicker wire rated for 300-volt service.

### 2.6.3 Control Wiring for Analog Signals

For Control Wiring for Analog Signals, provide 18 AWG or thicker, copper, single- or multiple-twisted wire meeting the following requirements:

- a. minimum 2 inch lay of twist
- b. 100 percent shielded pairs
- c. at least 300-volt insulation
- d. each pair has a 20 AWG tinned-copper drain wire and individual overall pair insulation
- e. cables have an overall aluminum-polyester or tinned-copper cable-shield tape, overall 20 AWG tinned-copper cable drain wire, and overall cable insulation.

### 2.6.4 Power Wiring for Control Devices

For 24-volt circuits, provide insulated copper 18 AWG or thicker wire rated for 300 VAC service. For 120-volt circuits, provide 14 AWG or thicker stranded copper wire rated for 600-volt service.

### 2.6.5 Transformers

Provide UL 5085-3 approved transformers. Select transformers sized so that the connected load is no greater than 80 percent of the transformer rated capacity.

## PART 3 EXECUTION

### 3.1 INSTALLATION

Fully install and test the control system in accordance Section 23 09 13 INSTRUMENTATION AND CONTROL DEVICES FOR HVAC, Section 23 09 23.02 BACNET DIRECT DIGITAL CONTROL FOR HVAC AND OTHER BUILDING CONTROL SYSTEMS for BACnet 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 manner that provides clearance for control system maintenance by maintaining access space required to calibrate, remove, repair, or replace control system devices. Install control system such that it does not interfere with the clearance requirements for mechanical and electrical system maintenance.

#### 3.1.2 Penetrations in Building Exterior

Make all penetrations through and mounting holes in the building exterior watertight.

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### 3.1.3 Device Mounting Criteria

Install devices in accordance with the manufacturer's recommendations and as indicated and shown. Provide a weathershield for all devices installed outdoors. Provide clearance for control system maintenance by maintaining access space required to calibrate, remove, repair, or replace control system devices. Provide clearance for mechanical and electrical system maintenance; do not not interfere with the clearance requirements for mechanical and electrical system maintenance.

### 3.1.4 Labels and Tags

Key all labels and tags to the unique identifiers shown on the As-Built drawings. For labels exterior to protective enclosures provide engraved plastic labels mechanically attached to the enclosure or DDC Hardware. Labels inside protective enclosures may be attached using adhesive, but must not be hand written. For tags, provide plastic or metal tags mechanically attached directly to each device or attached by a metal chain or wire.

- a. Label all Enclosures and DDC Hardware.
- b. Tag Airflow measurement arrays (AFMA) with flow rate range for signal output range, duct size, and pitot tube AFMA flow coefficient.
- c. Tag duct static pressure taps at the location of the pressure tap

### 3.1.5 Surge Protection

#### 3.1.5.1 Power-Line Surge Protection

Protect equipment connected to AC circuits to withstand power-line surges in accordance with IEEE C62.41. Do not use fuses for surge protection.

#### 3.1.5.2 Surge Protection for Transmitter and Control Wiring

Protect DDC hardware against or provided DDC hardware capable of withstanding surges induced on control and transmitter wiring installed outdoors and as shown. Protect equipment against the following two waveforms:

- a. A waveform with a 10-microsecond rise time, a 1000-microsecond decay time and a peak current of 60 amps.
- b. A waveform with an 8-microsecond rise time, a 20-microsecond decay time and a peak current of 500 amperes.

### 3.1.6 Basic Cybersecurity Requirements

#### 3.1.6.1 Passwords

For all devices with a password, change the password from the default password. Do not use the same password for more than one device. Coordinate selection of passwords with the Controls Shop. Provide a Password Summary Report documenting the password for each device and describing the procedure to change the password for each device.

Provide two hardcopies of the Password Summary Report, each copy in its own sealed envelope.

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### 3.1.6.2 Wireless Capability

Unless otherwise indicated, disable wireless capability (including but not limited to radio frequency (RF), infrared and optical) for all devices with wireless capability. Optical and infrared capabilities may be disabled via a permanently affixed opaque cover plate. Password protecting a wireless connections does not meet this requirement; the wireless capability must be disabled.

### 3.1.6.3 IP Network Physical Security

Install all IP Network media in conduit. Install all IP devices including but not limited to IP-enabled DDC hardware and IP Network Hardware in lockable enclosures.

## 3.2 DRAWINGS AND CALCULATIONS

Provide drawings in the form and arrangement indicated and shown. Use the same abbreviations, symbols, nomenclature and identifiers shown. Assign a unique identifier as shown to each control system element on a drawing. When packaging drawings, group schedules by system. When space allows, it is permissible to include multiple schedules for the same system on a single sheet. Except for drawings covering all systems, do not put information for different systems on the same sheet.

Submit hardcopy drawings on ISO A1 34 by 22 inches or A3 17 by 11 inches sheets, and electronic drawings in PDF and in AutoCAD or Autodesk Revit 2013 format. In addition, submit electronic drawings in editable Excel format for all drawings that are tabular, including but not limited to the Point Schedule and Equipment Schedule.

- a. Submit DDC Contractor Design Drawings consisting of each drawing indicated with pre-construction information depicting the intended control system design and plans. Submit DDC Contractor Design Drawings as a single complete package: 2 hard copies and 2 copies on CD-ROM.
- b. Submit Draft As-Built Drawings consisting of each drawing indicated updated with as-built data for the system prior to PVT. Submit Draft As-Built Drawings as a single complete package: 2 hard copies and 2 copies on CD-ROM.
- c. Submit Final As-Built Drawings consisting of each drawing indicated updated with all final as-built data. Final As-Built Drawings as a single complete package: 2 hard copies and 2 copies on CD-ROM.

### 3.2.1 Sample Drawings

Sample drawings in electronic format are available at the Whole Building Design Guide page for this section:

<http://www.wbdg.org/ffc/dod/unified-facilities-guide-specifications-ufgs/ufgs-23-09-00>

These drawings may prove useful in demonstrating expected drawing formatting and example content and are provided for illustrative purposes only. Note that these drawings do not meet the content requirements of this Section and must be completed to meet project requirements.

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### 3.2.2 Drawing Index and Legend

Provide an HVAC Control System Drawing Index showing the name and number of the building, military site, State or other similar designation, and Country. In the Drawing Index, list all Contractor Design Drawings, including the drawing number, sheet number, drawing title, and computer filename when used. In the Design Drawing Legend, show and describe all symbols, abbreviations and acronyms used on the Design Drawings. Provide a single Index and Legend for the entire drawing package.

### 3.2.3 Thermostat and Occupancy Sensor Schedule

Provide a thermostat and occupancy sensor schedule containing each thermostat's unique identifier, room identifier and control features and functions as shown. Provide a single thermostat and occupancy sensor schedule for the entire project.

### 3.2.4 Valve Schedule

Provide a valve schedule containing each valve's unique identifier, size, flow coefficient Kv (Cv), pressure drop at specified flow rate, spring range, positive positioner range, actuator size, close-off pressure to torque data, dimensions, and access and clearance requirements data. In the valve schedule include actuator selection data supported by calculations of the force required to move and seal the valve, access and clearance requirements. Provide a single valve schedule for the entire project.

### 3.2.5 Damper Schedule

Provide a damper schedule containing each damper's unique identifier, type (opposed or parallel blade), nominal and actual sizes, orientation of axis and frame, direction of blade rotation, actuator size and spring ranges, operation rate, positive positioner range, location of actuators and damper end switches, arrangement of sections in multi-section dampers, and methods of connecting dampers, actuators, and linkages. Include the AMCA 511 maximum leakage rate at the operating static-pressure differential for each damper in the Damper Schedule. Provide a single damper schedule for the entire project.

### 3.2.6 Project Summary Equipment Schedule

Provide a project summary equipment schedule containing the manufacturer, model number, part number and descriptive name for each control device, hardware and component provided under this specification. Provide a single project equipment schedule for the entire project.

### 3.2.7 Equipment Schedule

Provide system equipment schedules containing the unique identifier, manufacturer, model number, part number and descriptive name for each control device, hardware and component provided under this specification. Provide a separate equipment schedule for each HVAC system.

### 3.2.8 Occupancy Schedule

Provide an occupancy schedule drawing containing the same fields as the occupancy schedule Contract Drawing with Contractor updated information. Provide a single occupancy schedule for the entire project.

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### 3.2.9 DDC Hardware Schedule

Provide a single DDC Hardware Schedule for the entire project and including following information for each device.

#### 3.2.9.1 DDC Hardware Identifier

The Unique DDC Hardware Identifier for the device.

#### 3.2.9.2 HVAC System

The system "name" used to identify a specific system (the name used on the system schematic drawing for that system).

#### 3.2.9.3 BACnet Device Information

##### 3.2.9.3.1 Device Object Identifier

The Device Object Identifier: The Object\_Identifier of the Device Object

##### 3.2.9.3.2 Network Number

The Network Number for the device.

##### 3.2.9.3.3 MAC Address

The MAC Address for the device

##### 3.2.9.3.4 BTL Listing

The BTL Listing of the device. If the device is listed under multiple BTL Profiles, indicate the profile that matches the use and configuration of the device as installed.

##### 3.2.9.3.5 Proprietary Services Information

If the device uses non-standard ASHRAE 135 services as defined and permitted in Section 23 09 23.02 BACNET DIRECT DIGITAL CONTROL FOR HVAC AND OTHER BUILDING CONTROL SYSTEMS, indicate that the device uses non-standard services and include a description of all non-standard services used. Describe usage and content such that a device from another vendor can interoperate with the device using the non-standard service. Provide descriptions with sufficient detail to allow a device from a different manufacturer to be programmed to both read and write the non-standard service request:

- a. read: interpret the data contained in the non-standard service and;
- b. write: given similar data, generate the appropriate non-standard service request.

##### 3.2.9.3.6 Alarming Information

Indicate whether the device is used for alarm generation, and which types of alarm generation the device implements: intrinsic, local algorithmic, remote algorithmic.



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#### 3.2.9.3.7 Scheduling Information

Indicate whether the device is used for scheduling.

#### 3.2.9.3.8 Trending Information

Indicate whether the device is used for trending, and indicate if the device is used to trend local values, remote values, or both.

#### 3.2.9.4 Niagara Station ID

The Niagara Station ID for each Niagara Framework Supervisory Gateway

#### 3.2.10 Points Schedule

Provide a Points Schedule in tabular form for each HVAC system, with the indicated columns and with each row representing a hardware point, network point or configuration point in the system.

- a. When a Points Schedule was included in the Contract Drawing package, use the same fields as the Contract Drawing with updated information in addition to the indicated fields.
- b. When Point Schedules are included in the contract package, items requiring contractor verification or input have been shown in angle brackets ("<" and ">"), such as <\_\_\_\_> for a required entry or <value> for a value requiring confirmation. Complete all items in brackets as well as any blank cells. Do not modify values which are not in brackets without approval.

Points Schedule Columns must include:

##### 3.2.10.1 Point Name

The abbreviated name for the point using the indicated naming convention.

##### 3.2.10.2 Description

A brief functional description of the point such as "Supply Air Temperature".

##### 3.2.10.3 DDC Hardware Identifier

The Unique DDC Hardware Identifier shown on the DDC Hardware Schedule and used across all drawings for the DDC Hardware containing the point.

##### 3.2.10.4 Settings

The value and units of any setpoints, configured setpoints, configuration parameters, and settings related to each point.

##### 3.2.10.5 Range

The range of values, including units, associated with the point, including but not limited to a zone temperature setpoint adjustment range, a sensor measurement range, occupancy values for an occupancy input, or the status of a safety.

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#### 3.2.10.6 Input or Output (I/O) Type

The type of input or output signal associated with the point. Use the following abbreviations for entries in this column:

- a. AI: The value comes from a hardware (physical) Analog Input
- b. AO: The value is output as a hardware (physical) Analog Output
- c. BI: The value comes from a hardware (physical) Binary Input
- d. BO: The value is output as a hardware (physical) Binary Output
- e. PULSE: The value comes from a hardware (physical) Pulse Accumulator Input
- f. NET-IN: The value is provided from the network (generally from another device). Use this entry only when the value is received from another device as part of scheduling or as part of a sequence of operation, not when the value is received on the network for supervisory functions such as trending, alarming, override or display at a user interface.
- g. NET-OUT: The value is provided to another controller over the network. Use this entry only when the value is transmitted to another device as part of scheduling or as part of a sequence of operation, not when the value is transmitted on the network for supervisory functions such as trending, alarming, override or display at a user interface.

#### 3.2.10.7 Object and Property Information

The Object Type and Instance Number for the Object associated with the point. If the value of the point is not in the Present\_Value Property, then also provide the Property ID for the Property containing the value of the point. Any point that is displayed at the front end or on an LDP, is trended, is used by another device on the network, or has an alarm condition must be documented here.

#### 3.2.10.8 Niagara Station ID

The Niagara Station ID of the Niagara Framework Supervisory Gateway the point is mapped into.

#### 3.2.10.9 Network Data Exchange Information (Gets Data From, Sends Data To)

Provide the DDC Hardware Identifier of other DDC Hardware the point is shared with.

#### 3.2.10.10 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.

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#### 3.2.10.11 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.)

#### 3.2.10.12 Configuration Information

Indicate the means of configuration associated with each point. For points in a Niagara Framework Supervisory Gateway, indicate the point within the Niagara Framework Supervisory Gateway used to configure the value. For other points:

- a. For Operator Configurable Points indicate BACnet Object and Property information (Name, Type, Identifiers) containing the configurable value. Indicate whether the property is writable always, or only when Out\_Of\_Service is TRUE.
- b. For Configurable Points indicate the BACnet Object and Property information as for Operator Configurable points, or identification of the configurable settings from within the engineering software for the device or identification of the hardware settings on the device.

#### 3.2.11 Riser Diagram

The Riser Diagram of the Building Control Network may be in tabular form, and must show all DDC Hardware and all Network Hardware, including network terminators. For each item, provide the unique identifier, common descriptive name, physical sequential order (previous and next device on the network), room identifier and location within room. A single riser diagram must be submitted for the entire system.

#### 3.2.12 Control System Schematics

Provide control system schematics in the same form as the control system schematic Contract Drawing with Contractor updated information. Provide a control system schematic for each HVAC system.

#### 3.2.13 Sequences of Operation

Provide HVAC control system sequence of operation in the same format as the Contract Drawings. Within these drawings, refer to devices by their unique identifiers. Submit sequences of operation for each HVAC system

#### 3.2.14 Controller, Motor Starter and Relay Wiring Diagram

Provide controller wiring diagrams as functional wiring diagrams which show the interconnection of conductors and cables to each controller and to the identified terminals of input and output devices, starters and package equipment. Show necessary jumpers and ground connections and the labels of all conductors. Identify sources of power required for control systems and for packaged equipment control systems back to the panel board circuit breaker number, controller enclosures, magnetic starter, or packaged equipment control circuit. Show each power supply and transformer not integral to a controller, starter, or packaged equipment. Show the connected volt-ampere load and the power supply volt-ampere rating. Provide wiring diagrams for each HVAC system.

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### 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.

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#### 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 4 copies of the PVT Procedures. The PVT Procedures may be submitted as a Technical Data Package.

##### 3.5.1.1 Sensor Accuracy Checks

Include a one-point accuracy check of each sensor in the PVT procedures.

##### 3.5.1.2 Endurance Test

Include a one-week endurance test as part of the PVT during which the system is operated continuously.

Use the building control system 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

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calibration, and the results of the latest calibration

### 3.5.2 PVT Execution

Demonstrate compliance of the control system with the contract documents. Using test plans and procedures approved by the Government, software capable of reading and writing COV Notification Subscriptions, Notification Class Recipient List Properties, event enrollments, demonstrate all physical and functional requirements of the project. Show, step-by-step, the actions and results demonstrating that the control systems perform in accordance with the sequences of operation. Do not start the performance verification test until after receipt of written permission by the Government, based on Government approval of the PVT Plan and Draft As-Built and completion of balancing. UNLESS GOVERNMENT WITNESSING OF A TEST IS SPECIFICALLY WAIVED BY THE GOVERNMENT, PERFORM ALL TESTS WITH A GOVERNMENT WITNESS. Do not conduct tests during scheduled seasonal off periods of base heating and cooling systems. If the system experiences any failures during the endurance test portion of the PVT, repair the system repeat the endurance test portion of the PVT until the system operates continuously and without failure for the specified endurance test period.

### 3.5.3 PVT Report

Prepare and submit a PVT report documenting all tests performed during the PVT and their results. Include all tests in the PVT procedures and any additional tests performed during PVT. Document test failures and repairs conducted with the test results.

Submit four copies of the PVT Report. The PVT Report may be submitted as a Technical Data Package.

## 3.6 OPERATION AND MAINTENANCE (O&M) INSTRUCTIONS

Provide HVAC control System Operation and Maintenance Instructions which include:

- a. "Data Package 3" as indicated in Section 01 78 23 OPERATION AND MAINTENANCE DATA for each piece of control equipment.
- b. "Data Package 4" as described in Section 01 78 23 OPERATION AND MAINTENANCE DATA for all air compressors.
- c. HVAC control system sequences of operation formatted as indicated.
- d. Procedures for the HVAC system start-up, operation and shut-down including the manufacturer's supplied procedures for each piece of equipment, and procedures for the overall HVAC system.
- e. As-built HVAC control system detail drawings formatted as indicated.
- f. Routine maintenance checklist. Provide the routine maintenance checklist arranged in a columnar format, where the first column lists all installed devices, the second column states the maintenance activity or that no maintenance required, the third column states the frequency of the maintenance activity, and the fourth column is used for additional comments or reference.

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- 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

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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 00 80 00.00 06 SPECIAL PROVISIONS.

#### 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 4 operating staff members designated by the Government in the maintenance and operation of the system, including



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specified hardware and software. Conduct 32 hours of training at the project site within 30 days after successful completion of the performance verification test. The Government reserves the right to make audio and visual recordings (using Government supplied equipment) of the training sessions for later use. Provide audiovisual equipment and other training materials and supplies required to conduct training. A training day is defined as 8 hours of classroom instruction, including two 15 minute breaks and excluding lunchtime, Monday through Friday, during the daytime shift in effect at the training facility.

#### 3.8.1 Training Documentation

Prepare training documentation consisting of:

- a. Course Attendee List: Develop the list of course attendees in coordination with and signed by the Controls shop supervisor.
- b. Training Manuals: Provide training manuals which include an agenda, defined objectives for each lesson, and a detailed description of the subject matter for each lesson. When presenting portions of the course material by audiovisuals, deliver copies of those audiovisuals as a part of the printed training manuals.

#### 3.8.2 Training Course Content

For guidance in planning the required instruction, assume that attendees will have a high school education, and are familiar with HVAC systems. During the training course, cover all of the material contained in the Operating and Maintenance Instructions, the layout and location of each controller enclosure, the layout of one of each type of equipment and the locations of each, the location of each control device external to the panels, the location of the compressed air station, preventive maintenance, troubleshooting, diagnostics, calibration, adjustment, commissioning, tuning, and repair procedures. Typical systems and similar systems may be treated as a group, with instruction on the physical layout of one such system. Present the results of the performance verification test and the Start-Up Testing Report as benchmarks of HVAC control system performance by which to measure operation and maintenance effectiveness.

#### 3.8.3 Training Documentation Submittal Requirements

Submit hardcopy training manuals and all training materials on CD-ROM. Provide one hardcopy manual for each trainee on the Course Attendee List and 2 additional copies for archive at the project site. Provide 2 copies of the Course Attendee List with the archival copies. Training Documentation may be submitted as a Technical Data Package.

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## APPENDIX A

<u>QC CHECKLIST FOR NIAGARA FRAMEWORK BASED BACNET SYSTEMS</u>		
<p>This checklist is not all-inclusive of the requirements of this specification and should not be interpreted as such.</p> <p>Instructions: Initial each item in the space provided ( ____ ) verifying that the requirement has been met.</p>		
<p>This checklist is for (circle one:)</p> <p>Pre-Construction QC Checklist Submittal</p> <p>Post-Construction QC Checklist Submittal</p> <p>Close-out QC Checklist Submittal</p>		
Items verified for Pre-Construction, Post-Construction and Closeout QC Checklist Submittals:		
1	All DDC Hardware is numbered on Control System Schematic Drawings.	____
2	Signal lines on Control System Schematic are labeled with the signal type.	____
3	Local Display Panel (LDP) Locations are shown on Control System Schematic drawings.	____
Items verified for Post-Construction and Closeout QC Checklist Submittals:		
4	All sequences are performed as specified using DDC Hardware.	____
5	Training schedule and course attendee list has been developed and coordinated with shops and submitted.	____
Items verified for Closeout QC Checklist Submittal:		
6	Final As-built Drawings, including all Points Schedule drawings, accurately represent the final installed system.	____
7	Programming software has been submitted for all programmable controllers.	____
8	All software has been licensed to the Government.	
9	O&M Instructions have been completed and submitted.	____
10	Training course has been completed.	____

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<u>QC CHECKLIST FOR NIAGARA FRAMEWORK BASED BACNET SYSTEMS</u>		
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 Intrinsic Alarming as indicated.	____
15	All Properties indicated as required to be Writable are Writable and Overrides have been provided as indicated	____
<div style="border-bottom: 1px solid black; height: 20px; width: 100%;"></div>		
<div style="display: flex; justify-content: space-between;"> <div style="width: 45%;">(QC Representative Signature)</div> <div style="width: 45%;">(Date)</div> </div>		

-- 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

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### 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<br>Dampers for Rating          |
| AMCA 511   | (2010; R 2016) Certified Ratings Program<br>for Air Control Devices |

#### AMERICAN NATIONAL STANDARDS INSTITUTE (ANSI)

- |            |                                                                        |
|------------|------------------------------------------------------------------------|
| ANSI C12.1 | (2014; Errata 2016) Electric Meters - Code<br>for Electricity Metering |
|------------|------------------------------------------------------------------------|

#### INSTITUTE OF ELECTRICAL AND ELECTRONICS ENGINEERS (IEEE)

- |          |                                                                                                                           |
|----------|---------------------------------------------------------------------------------------------------------------------------|
| IEEE 142 | (2007; Errata 2014) Recommended Practice<br>for Grounding of Industrial and Commercial<br>Power Systems - IEEE Green Book |
|----------|---------------------------------------------------------------------------------------------------------------------------|

#### NATIONAL ELECTRICAL MANUFACTURERS ASSOCIATION (NEMA)

- |                  |                                                                           |
|------------------|---------------------------------------------------------------------------|
| ANSI C12.20      | (2015; E 2018) Electricity Meters - 0.1,<br>0.2, and 0.5 Accuracy Classes |
| NEMA/ANSI C12.10 | (2011; R 2021) Physical Aspects of<br>Watt-hour Meters - Safety Standard  |

#### NATIONAL FIRE PROTECTION ASSOCIATION (NFPA)

- |          |                                                                                                               |
|----------|---------------------------------------------------------------------------------------------------------------|
| NFPA 70  | (2020; ERTA 20-1 2020; ERTA 20-2 2020; TIA<br>20-1; TIA 20-2; TIA 20-3; TIA 20-4)<br>National Electrical Code |
| NFPA 90A | (2021) Standard for the Installation of<br>Air Conditioning and Ventilating Systems                           |

#### UNDERWRITERS LABORATORIES (UL)

- |           |                                                                                                    |
|-----------|----------------------------------------------------------------------------------------------------|
| UL 555    | (2006; Reprint Aug 2016) UL Standard for<br>Safety Fire Dampers                                    |
| UL 555S   | (2014; Reprint Oct 2020) UL Standard for<br>Safety Smoke Dampers                                   |
| UL 5085-3 | (2006; Reprint Nov 2012) Low Voltage<br>Transformers - Part 3: Class 2 and Class 3<br>Transformers |

### 1.4 SUBMITTALS

Submittal requirements are specified in Section 23 09 00 INSTRUMENTATION AND CONTROL FOR HVAC.

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## 1.5 DELIVERY AND STORAGE

Store and protect products from the weather, humidity, and temperature variations, dirt and dust, and other contaminants, within the storage condition limits published by the equipment manufacturer.

## 1.6 INPUT MEASUREMENT ACCURACY

Select, install and configure sensors, transmitters and DDC Hardware such that the maximum error of the measured value at the input of the DDC hardware is less than the maximum allowable error specified for the sensor or instrumentation.

## PART 2 PRODUCTS

### 2.1 EQUIPMENT

#### 2.1.1 General Requirements

All products used to meet this specification must meet the indicated requirements, but not all products specified here will be required by every project. All products must meet the requirements both Section 23 09 00 INSTRUMENTATION AND CONTROL FOR HVAC and this Section.

#### 2.1.2 Operation Environment Requirements

Unless otherwise specified, provide products rated for continuous operation under the following conditions:

##### 2.1.2.1 Pressure

Pressure conditions normally encountered in the installed location.

##### 2.1.2.2 Vibration

Vibration conditions normally encountered in the installed location.

##### 2.1.2.3 Temperature

- a. Products installed indoors: Ambient temperatures in the range of 32 to 112 degrees F and temperature conditions outside this range normally encountered at the installed location.
- b. Products installed outdoors or in unconditioned indoor spaces: Ambient temperatures in the range of -35 to +151 degrees F and temperature conditions outside this range normally encountered at the installed location.

##### 2.1.2.4 Humidity

10 to 95 percent relative humidity, non-condensing and also humidity conditions outside this range normally encountered at the installed location.

### 2.2 WEATHERSHIELDS

Provide weathershields constructed of galvanized steel painted white, unpainted aluminum, aluminum painted white, or white PVC.

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## 2.3 WIRE AND CABLE

Provide wire and cable meeting the requirements of NFPA 70 and NFPA 90A in addition to the requirements of this specification and referenced specifications.

### 2.3.1 Terminal Blocks

For terminal blocks which are not integral to other equipment, provide terminal blocks which are insulated, modular, feed-through, clamp style with recessed captive screw-type clamping mechanism, suitable for DIN rail mounting, and which have enclosed sides or end plates and partition plates for separation.

### 2.3.2 Control Wiring for Binary Signals

For Control Wiring for Binary Signals, provide 18 AWG copper or thicker wire rated for 300-volt service.

### 2.3.3 Control Wiring for Analog Signals

For Control Wiring for Analog Signals, provide 18 AWG or thicker, copper, single- or multiple-twisted wire meeting the following requirements:

- a. minimum 2 inch lay of twist
- b. 100 percent shielded pairs
- c. at least 300-volt insulation
- d. each pair has a 20 AWG tinned-copper drain wire and individual overall pair insulation
- e. cables have an overall aluminum-polyester or tinned-copper cable-shield tape, overall 20 AWG tinned-copper cable drain wire, and overall cable insulation.

### 2.3.4 Power Wiring for Control Devices

For 24-volt circuits, provide insulated copper 18 AWG or thicker wire rated for 300 VAC service. For 120-volt circuits, provide 14 AWG or thicker stranded copper wire rated for 600-volt service.

### 2.3.5 Transformers

Provide UL 5085-3 approved transformers. Select transformers sized so that the connected load is no greater than 80 percent of the transformer rated capacity.

## 2.4 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

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constructed of 0.06 inch minimum thickness are acceptable provided the corners are reinforced.

- a. Flat blades must be made rigid by folding the edges. Blade-operating linkages must be within the frame so that blade-connecting devices within the same damper section must not be located directly in the air stream.
- b. Damper axles must be 1/2 inch minimum, plated steel rods supported in the damper frame by stainless steel or bronze bearings. Blades mounted vertically must be supported by thrust bearings.
- c. Provide dampers which do not exceed a pressure drop through the damper of 0.04 inches water gauge at 1000 ft/min in the wide-open position. Provide dampers with frames not less than 2 inch in width. Provide dampers which have been tested in accordance with AMCA 500-D.

#### 2.4.2 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 2000 ft/min air velocity.

##### 2.4.3.2 Mechanical Rooms and Other Utility Space Ventilation Dampers

Provide utility space ventilation dampers as indicated. Unless otherwise indicated provide AMCA 511 class 3 dampers. Provide dampers rated at not less than 1500 ft/min air velocity.

##### 2.4.3.3 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



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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 mA<sub>dc</sub>, 0-10 V<sub>dc</sub> 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 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.

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#### 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

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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 0.085 inch water gauge at an airflow of 2,000 fpm. AFMA construction must be suitable for operation at airflows of up to 5000 fpm over a temperature range of 40 to 120 degrees F.

#### 2.5.6.1.3 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 Pitot Tube AFMA

Each Pitot Tube AFMA must contain an array of velocity sensing elements. The velocity sensing elements must be of the multiple pitot tube type with averaging manifolds. The sensing elements must be distributed across the duct cross section in the quantity and pattern specified or recommended by the published installation instructions of the AFMA manufacturer.

- a. Pitot Tube AFMAs for use in airflows over 600 fpm must have an accuracy of plus or minus 5 percent over a range of 500 to 2500 fpm.
- b. Pitot Tube AFMAs for use in airflows under 600 fpm must have an accuracy of plus or minus 5 percent over a range of 125 to 2500 fpm.

#### 2.5.6.1.5 Electronic AFMA

Each electronic AFMA must consist of an array of velocity sensing elements of the resistance temperature detector (RTD) or thermistor type. The sensing elements must be distributed across the duct cross section in the quantity and pattern specified or recommended by the published application data of the AFMA manufacturer. Electronic AFMAs must have an accuracy of plus or minus 5 percent over a range of 125 to 5,000 fpm and the output

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must be temperature compensated over a range of 32 to 212 degrees F.

#### 2.5.6.1.6 Fan Inlet Measurement Devices

Fan inlet measurement devices cannot be used unless indicated on the drawings or schedules.

#### 2.5.6.2 Flow Switch

Flow switch must have a repetitive accuracy of plus or minus 10 percent of actual flow setting. Switch actuation must be adjustable over the operating flow range, and must be sized for the application such that the setpoint is between 25 percent and 75 percent of the full range.. The switch must have Form C snap-action contacts, rated for the application. The flow switch must have non flexible paddle with magnetically actuated contacts and be rated for service at a pressure greater than the installed conditions. Flow switch for use in sewage system must be rated for use in corrosive environments encountered.

#### 2.5.6.3 Gas Flow Meter

Gas flow meter must be diaphragm or bellows type (gas positive displacement meters) for flows up to 2500 SCFH and axial flow turbine type for flows above 2500 SCFH, designed specifically for natural gas supply metering, and rated for the pressure, temperature, and flow rates of the installation. Meter must have a minimum turndown ratio of 10 to 1 with an accuracy of plus or minus 1 percent of actual flow rate. The meter index must include a direct reading mechanical totalizing register and electrical impulse dry contact output for remote monitoring. The electrical impulse dry contact output must not require field adjustment or calibration. The electrical impulse dry contact output must have a minimum resolution of 100 cubic feet of gas per pulse and must not exceed 15 pulses per second at the design flow.

#### 2.5.7 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 0.5 percent of full scale. The device must have a means for calibration. Current transducers for variable frequency applications must be rated for variable frequency operation.

##### 2.5.7.2 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.

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#### 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.

#### 2.5.7.4 Energy Metering

##### 2.5.7.4.1 Watt or Watthour Transducers

Watt transducers must measure voltage and current and must output kW or kWh or both kW and kWh as indicated. kW outputs must have an accuracy of plus or minus 0.5 percent over a power factor range of 0.1 to 1. kWh outputs must have an accuracy of plus or minus 0.5 percent over a power factor range of 0.1 to 1.

##### 2.5.7.4.2 Watthour Revenue Meter (with and without Demand Register)

All Watthour revenue meters must measure voltage and current and must be in accordance with ANSI C12.1 with an ANSI C12.20 Accuracy class of 0.5 and must have pulse initiators for remote monitoring of Watthour consumption. Pulse initiators must consist of form C contacts with a current rating not to exceed two amperes and voltage not to exceed 500 V, with combinations of VA not to exceed 100 VA, and a life rating of one billion operations. Meter sockets must be in accordance with NEMA/ANSI C12.10. Watthour revenue meters with demand registers must output instantaneous demand in addition to the pulse initiators.

#### 2.5.8 Vibration Switch

Vibration switch must be solid state, enclosed in a NEMA 250 Type 4 or Type 4X housing with sealed wire entry. Unit must have two independent sets of Form C switch contacts with one set to shutdown equipment upon excessive vibration and a second set for monitoring alarm level vibration. The vibration sensing range must be a true rms reading, suitable for the application. The unit must include either displacement response for low speed or velocity response for high speed application. The frequency range must be at least 3 Hz to 500 Hz. Contact time delay must be 3 seconds. The unit must have independent start-up and running delay on each switch contact. Alarm limits must be adjustable and setpoint accuracy must be plus or minus 10 percent of setting with repeatability of plus or minus 2 percent.

#### 2.5.9 Temperature Switch

##### 2.5.9.1 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.

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#### 2.5.10 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 OUTPUT DEVICES

#### 2.6.1 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. 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.

##### 2.6.1.1 Valve Actuators

Valve actuators must provide shutoff pressures and torques as indicated on the Valve Schedule.

##### 2.6.1.2 Damper Actuators

Damper actuators must provide the torque necessary per damper manufacturer's instructions to modulate the dampers smoothly over its full range of operation and torque must be at least 6 inch-pounds/1 square foot of damper area for opposed blade dampers and 9 inch-pounds/1 square foot of damper area for parallel blade dampers.

##### 2.6.1.3 Electric Actuators

Each actuator must have distinct markings indicating the full-open and full-closed position. Each actuator must deliver the torque required for continuous uniform motion and must have internal end switches to limit the travel, or be capable of withstanding continuous stalling without damage. Actuators must function properly within 85 to 110 percent of rated line voltage. Provide actuators with hardened steel running shafts and gears of steel or copper alloy. Fiber or reinforced nylon gears may be used for

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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.

#### 2.6.2 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.

#### 2.7 USER INPUT DEVICES

User Input Devices, including potentiometers, switches and momentary contact push-buttons. Potentiometers must be of the thumb wheel or sliding bar type. Momentary Contact Push-Buttons may include an adjustable timer for their output. User input devices must be labeled for their function.

#### 2.8 MULTIFUNCTION DEVICES

Multifunction devices are products which combine the functions of multiple sensor, user input or output devices into a single product. Unless otherwise specified, the multifunction device must meet all requirements of each component device. Where the requirements for the component devices conflict, the multifunction device must meet the most stringent of the requirements.

##### 2.8.1 Current Sensing Relay Command Switch

The Current Sensing Relay portion must meet all requirements of the Current Sensing Relay input device. The Command Switch portion must meet all requirements of the Relay output device except that it must have at least one normally-open (NO) contact.

Current Sensing Relays used for Variable Frequency Drives must be rated

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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.

## 2.8.2 Space Sensor Module

Space Sensor Modules must be multifunction devices incorporating a temperature sensor and one or more of the following as specified and indicated on the Space Sensor Module Schedule:

- a. A temperature indicating device.
- b. A User Input Device which must adjust a temperature setpoint output.
- c. A User Input Momentary Contact Button and an output to the control system indicating zone occupancy.
- d. A three position User Input Switch labeled to indicate heating, cooling and off positions ('HEAT-COOL-OFF' switch) and providing corresponding outputs to the control system.
- e. A two position User Input Switch labeled with 'AUTO' and 'ON' positions and providing corresponding output to the control system..
- f. A multi-position User Input Switch with 'OFF' and at least two fan speed positions and providing corresponding outputs to the control system.

Space Sensor Modules cannot contain mercury (Hg).

## PART 3 EXECUTION

### 3.1 INSTALLATION

#### 3.1.1 General Installation Requirements

Perform the installation under the supervision of competent technicians regularly employed in the installation of DDC systems.

##### 3.1.1.1 Device Mounting Criteria

All devices must be installed in accordance with manufacturer's recommendations and as specified and indicated. Control devices to be installed in piping and ductwork must be provided with required gaskets, flanges, thermal compounds, insulation, piping, fittings, and manual valves for shutoff, equalization, purging, and calibration. Strap-on temperature sensing elements must not be used except as specified. Spare thermowells must be installed adjacent to each thermowell containing a sensor and as indicated. Devices located outdoors must have a weathershield.

##### 3.1.1.2 Labels and Tags

Match labels and tags to the unique identifiers indicated on the As-Built drawings. Label all enclosures and instrumentation. Tag all sensors and actuators in mechanical rooms. Tag airflow measurement arrays to show flow rate range for signal output range, duct size, and pitot tube AFMA



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flow coefficient. Tag duct static pressure taps at the location of the pressure tap. Provide plastic or metal tags, mechanically attached directly to each device or attached by a metal chain or wire. Labels exterior to protective enclosures must be engraved plastic and mechanically attached to the enclosure or instrumentation. Labels inside protective enclosures may be attached using adhesive, but must not be hand written.

### 3.1.2 Weathershield

Provide weathershields for sensors located outdoors. Install weathershields such that they prevent the sun from directly striking the sensor and prevent rain from directly striking or dripping onto the sensor. Install weather shields with adequate ventilation so that the sensing element responds to the ambient conditions of the surroundings. When installing weathershields near outside air intake ducts, install them such that normal outside air flow does not cause rainwater to strike the sensor.

### 3.1.3 Room Instrument Mounting

Mount room instruments, including but not limited to wall mounted non-adjustable space sensor modules and sensors located in occupied spaces, 48 inches above the floor unless otherwise indicated. Install adjustable devices to be ADA compliant unless otherwise indicated on the Room Sensor Schedule:

- a. Space Sensor Modules for Fan Coil Units may be either unit or wall mounted but not mounted on an exterior wall.
- b. Wall mount all other Space Sensor Modules.

### 3.1.4 Indication Devices Installed in Piping and Liquid Systems

Provide snubbers for gauges in piping systems subject to pulsation. For gauges for steam service use pigtail fittings with cock. Install thermometers and temperature sensing elements in liquid systems in thermowells. Provide spare Pressure/Temperature Ports (Pete's Plug) for all temperature and pressure sensing elements installed in liquid systems for calibration/testing.

### 3.1.5 Switches

#### 3.1.5.1 Temperature Limit Switch

Provide a temperature limit switch (freezestat) to sense the temperature at the location indicated. Provide a sufficient number of temperature limit switches (freezestats) to provide complete coverage of the duct section but no less than 1 foot in length per square foot of cross sectional area. Install manual reset limit switches in approved, accessible locations where they can be reset easily. Install temperature limit switch (freezestat) sensing elements in a side-to-side (not top-to-bottom) serpentine pattern with the relay section at the highest point and in accordance with the manufacturer's installation instructions.

#### 3.1.5.2 Hand-Off Auto Switches

Wire safety controls such as smoke detectors and freeze protection thermostats to protect the equipment during both hand and auto operation.

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### 3.1.6 Temperature Sensors

Install temperature sensors in locations that are accessible and provide a good representation of sensed media. Installations in dead spaces are not acceptable. Calibrate and install sensors according to manufacturer's instructions. Select sensors only for intended application as designated or recommended by manufacturer.

#### 3.1.6.1 Room Temperature Sensors

Mount the sensors on interior walls to sense the average room temperature at the locations indicated. Avoid locations near heat sources such as copy machines or locations by supply air outlet drafts. Mount the center of all user-adjustable sensors 48 inches above the floor to meet ADA requirements. Non user-adjustable sensors can be mounted as indicated in paragraph ROOM INSTRUMENT MOUNTING.

#### 3.1.6.2 Duct Temperature Sensors

##### 3.1.6.2.1 Probe Type

Place tip of the sensor in the middle of the airstream or in accordance with manufacturer's recommendations or instructions. Provide a gasket between the sensor housing and the duct wall. Seal the duct penetration air tight. When installed in insulated duct, provide enclosure or stand off fitting to accommodate the thickness of duct insulation to allow for maintenance or replacement of the sensor and wiring terminations. Seal the duct insulation penetration vapor tight.

##### 3.1.6.2.2 Averaging Type

Weave the sensing element in a serpentine fashion from side to side perpendicular to the flow, across the duct or air handler cross-section, using durable non-metal supports in accordance with manufacturer's installation instructions. Avoid tight radius bends or kinking of the sensing element. Prevent contact between the sensing element and the duct or air handler internals. Provide a duct access door at the sensor location. The access door must be hinged on the side, factory insulated, have cam type locks, and be as large as the duct will permit, maximum 18 by 18 inches. For sensors inside air handlers, the sensors must be fully accessible through the air handler's access doors without removing any of the air handler's internals.

#### 3.1.6.3 Outside Air Temperature Sensors

Provide outside air temperature sensors on the building's north side with a protective weather shade that does not inhibit free air flow across the sensing element, and protects the sensor from snow, ice, and rain. Location must not be near exhaust hoods and other areas such that it is not influenced by radiation or convection sources which may affect the reading. Provide a shield to shade the sensor from direct sunlight.

### 3.1.7 Air Flow Measurement Arrays (AFMA)

Locate Outside Air AFMAs downstream from the Outside Air filters.

Install AFMAs with the manufacturer's recommended minimum distances between upstream and downstream disturbances. Airflow straighteners may

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be used to reduce minimum distances as recommended by the AFMA manufacturer.

### 3.1.8 Duct Static Pressure Sensors

Locate the duct static pressure sensing tap at 75 percent of the distance between the first and last air terminal units . If the transmitter output is a 0-10Vdc signal, locate the transmitter in the same enclosure as the air handling unit (AHU) controller for the AHU serving the terminal units. If a remote duct static pressure sensor is to be used, run the signal wire back to the controller for the air handling unit.

### 3.1.9 Relative Humidity Sensors

Install relative humidity sensors in supply air ducts at least 10 feet downstream of humidity injection elements.

### 3.1.10 Meters

#### 3.1.10.1 Flowmeters

Install flowmeters to ensure minimum straight unobstructed piping for at least 10 pipe diameters upstream and at least 5 pipe diameters downstream of the flowmeter, and in accordance with the manufacturer's installation instructions.

#### 3.1.10.2 Energy Meters

Locate energy meters as indicated. Connect each meter output to the DDC system, to measure both instantaneous demand/energy and other variables as indicated.

### 3.1.11 Dampers

#### 3.1.11.1 Damper Actuators

Provide spring return actuators which fail to a position that protects the served equipment and space on all control dampers related to freeze protection or force protection. For all outside, makeup and relief dampers provide dampers which fail closed. Terminal fan coil units, terminal VAV units, convectors, and unit heaters may be non-spring return unless indicated otherwise. Do not mount actuators in the air stream. Do not connect multiple actuators to a common drive shaft. Install actuators so that their action seal the damper to the extent required to maintain leakage at or below the specified rate and so that they move the blades smoothly throughout the full range of motion.

#### 3.1.11.2 Damper Installation

Install dampers straight and true, level in all planes, and square in all dimensions. Dampers must move freely without undue stress due to twisting, racking (parallelogramming), bowing, or other installation error. External linkages must operate smoothly over the entire range of motion, without deformation or slipping of any connecting rods, joints or brackets that will prevent a return to it's normal position. Blades must close completely and leakage must not exceed that specified at the rated static pressure. Provide structural support for multi-section dampers. Acceptable methods of structural support include but are not limited to U-channel, angle iron, corner angles and bolts, bent galvanized steel

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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

Install control circuit wiring not in raceways in a neat and safe manner. Wiring must not use the suspended ceiling system (including tiles, frames or hangers) for support. Where conduit or raceways are required, control circuit wiring must not run in the same conduit/raceway as power wiring over 50 volts. Run all circuits over 50 volts in conduit, metallic tubing, covered metal raceways, or armored cable.

-- End of Section --

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## SECTION 23 09 23.02

### BACNET DIRECT DIGITAL CONTROL FOR HVAC AND OTHER BUILDING CONTROL SYSTEMS 02/19, CHG 1: 02/20

#### PART 1 GENERAL

##### 1.1 SUMMARY

Provide a complete Direct Digital Control (DDC) system, except for the front end which is specified in Section 25 10 10 UTILITY MONITORING AND CONTROL (UMCS) FRONT END AND INTEGRATION, suitable for the control of the heating, ventilating and air conditioning (HVAC) and other building-level systems as specified and shown and in accordance with Section 23 09 00 INSTRUMENTATION AND CONTROL FOR HVAC.

##### 1.1.1 System Requirements

Provide a system meeting the requirements of both Section 23 09 00 INSTRUMENTATION AND CONTROL FOR HVAC and this Section and with the following characteristics:

- a. Except for Gateways, the control system must be an open implementation of BACnet technology using ASHRAE 135 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.
- b. Install and configure control hardware to provide ASHRAE 135 Objects and Properties or Niagara Framework Objects as indicated and as needed to meet the requirements of this specification.
- c. 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.
- d. Use Niagara Framework either AX or Version 4.0 or later.

##### 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.

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## 1.2 REFERENCES

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

AMERICAN SOCIETY OF HEATING, REFRIGERATING AND AIR-CONDITIONING ENGINEERS (ASHRAE)

ASHRAE 135 (2020; Errata 2021) BACnet—A Data Communication Protocol for Building Automation and Control Networks

BACNET INTERNATIONAL (BTL)

BTL Guide (v.49; 2017) BACnet Testing Laboratory Implementation Guidelines

INSTITUTE OF ELECTRICAL AND ELECTRONICS ENGINEERS (IEEE)

IEEE 802.3 (2018) Ethernet

TELECOMMUNICATIONS INDUSTRY ASSOCIATION (TIA)

TIA-485 (1998a; R 2012) Electrical Characteristics of Generators and Receivers for Use in Balanced Digital Multipoint Systems

TRIDIUM, INC (TRIDIUM)

Niagara Framework (2012) NiagaraAX User's Guide

Tridium Open NiCS (2005) 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) Standard for Energy Management Equipment

## 1.3 DEFINITIONS

For definitions related to this section, see Section 23 09 00 INSTRUMENTATION AND CONTROL FOR HVAC.

## 1.4 SUBMITTALS

Submittal requirements related to this Section are specified in Section 23 09 00 INSTRUMENTATION AND CONTROL FOR HVAC.

## PART 2 PRODUCTS

All products used to meet this specification must meet the indicated requirements, but not all products specified here will be required by every project. All products must meet the requirements both Section

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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 Ethernet Switch

Ethernet Switches must be managed switches and must autoconfigure between 10,100 and 1000 megabits per second (MBPS).

## 2.2 CONTROL NETWORK WIRING

- a. BACnet MS/TP communications wiring must be in accordance with ASHRAE 135. The wiring must use shielded, three wire (twisted-pair with reference) cable with characteristic impedance between 100 and 120 ohms. Distributed capacitance between conductors must be less than 30 pF per foot.
- b. Building Control Network Backbone IP Network must use Ethernet media. Ethernet cables must be CAT-5e at a minimum and meet all requirements of IEEE 802.3 .

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## 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



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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.
- 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

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application programs (all software that is not common to every controller of the same manufacturer and model) as source code compatible with the supplied programming software in accordance with Section 23 09 00 INSTRUMENTATION AND CONTROL FOR HVAC. The submitted application program must be the complete application necessary for controller to function as installed and be sufficient to allow replacement of the installed controller with another controller of the same type.

### 2.3.2 Hardware Input-Output (I/O) Functions

DDC Hardware incorporating hardware input-output (I/O) functions must meet the following requirements:

#### 2.3.2.1 Analog Inputs

DC Hardware analog inputs (AIs) must be implemented using ASHRAE 135 Analog Input Objects and perform analog to digital (A-to-D) conversion with a minimum resolution of 8 bits plus sign or better as needed to meet the accuracy requirements specified in Section 23 09 00. Signal conditioning including transient rejection must be provided for each analog input. Analog inputs must be capable of being individually calibrated for zero and span. Calibration via software scaling performed as part of point configuration is acceptable. The AI must incorporate common mode noise rejection of at least 50 dB from 0 to 100 Hz for differential inputs, and normal mode noise rejection of at least 20 dB at 60 Hz from a source impedance of 10,000 ohms.

#### 2.3.2.2 Analog Outputs

DDC Hardware analog outputs (AOs) must be implemented using ASHRAE 135 Analog Output Objects and perform digital to analog (D-to-A) conversion with a minimum resolution of 8 bits plus sign, and output a signal with a range of 4-20 mA<sub>dc</sub> or 0-10 V<sub>dc</sub>. 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

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be provided on all output lines to limit transients to 50 Vac. Minimum contact rating must be 0.5 amperes at 24 Vac.

#### 2.3.2.4.2 Triac Outputs

Triac outputs must provide at least 180 V of isolation. Minimum contact rating must be 0.5 amperes at 24 Vac.

#### 2.3.2.5 Pulse Accumulator

DDC Hardware pulse accumulators must be implemented using either an ASHRAE 135 Accumulator Object or an ASHRAE 135 Analog Value Object where the Present\_Value is the totalized pulse count. Pulse accumulators must accept contact closures, ignore transients less than 5 msec duration, protect against transients of 50 VAC, and accept rates of at least 20 pulses per second.

#### 2.3.2.6 ASHRAE 135 Objects for Hardware Inputs and Outputs

The requirements for use of ASHRAE 135 objects for hardware input and outputs includes devices where the hardware sensor or actuator is integral to the controller (e.g. a VAV box with integral damper actuator, a smart sensor, a VFD, etc.)

#### 2.3.3 Local Display Panel (LDP)

The Local Display Panels (LDPs) must be DDC Hardware with a display and navigation buttons or a touch screen display, and must provide display and adjustment of Niagara Framework points or ASHRAE 135 Properties as indicated on the Points Schedule and as specified. LDPs must be either BTL Listed as a B-OD, B-OWS, B-AWS, or be an integral part of another piece of DDC Hardware listed as a B-BC. For LDPs listed as B-OWS or B-AWS, the hardware must be BTL listed and the product must come factory installed with all applications necessary for the device to function as an LDP.

The adjustment of values using display and navigation buttons must be password protected.

#### 2.3.4 Expansion Modules and Tethered Hardware

A single piece of DDC Hardware may consist of a base unit and also:

- a. An unlimited number of hardware expansion modules, where the individual hardware expansion modules are designed to directly connect, both mechanically and electrically, to the base unit hardware. The expansion modules must be commercially available as an optional add-on to the base unit.
- b. A single piece of hardware connected (tethered) to a base unit by a single cable where the cable carries a proprietary protocol between the base unit and tethered hardware. The tethered hardware must not contain control logic and be commercially available as an optional add-on to the base unit as a single package.

Note that this restriction on tethered hardware does not apply to sensors or actuators using standard binary or analog signals (not a communications protocol); sensors or actuators using standard binary or analog signals are not considered part of the DDC Hardware.

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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 Alarm Generation Hardware

Non-Niagara Framework DDC Hardware used for alarm generation must meet the following requirements:

- a. Device must support the AE-N-I-B BIBB
- b. The Recipient\_List Property must be Writable for all Notification Class Objects used for alarm generation.
- c. For all Objects implementing Intrinsic Alarming, the following Properties must be Writable:
  - (1) Time\_Delay
  - (2) High\_Limit
  - (3) Low\_Limit
  - (4) Deadband
  - (5) Event\_Enable
  - (6) If the issue date of this project specification is after 1 January 2016, Time\_Delay\_Normal must be writable.
- d. It is preferred, but not required, that devices support the DM-OCD-B BIBB on all Notification Class Objects. It is also preferred, but not required that devices supporting the DM-OCD-B BIBB accept any valid value as an initial value for properties of Notification Class Objects.

#### 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

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- (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) One 10/100 Mbps Ethernet Port
  - (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.

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## PART 3 EXECUTION

### 3.1 CONTROL SYSTEM INSTALLATION

#### 3.1.1 Niagara Framework Engineering Tool

The project site currently has the Niagara Framework Engineering Tool. If this software is not adequate for programming the Niagara Framework Supervisory Gateways provided under this project, 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.

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. When the FPOC location is a room number, provide sufficient additional media to ensure that the Building Control Network (BCN) IP Backbone can be extended to any location in the room.

Use UDP port 0xBAC0 for all BACnet traffic on the IP network. (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, or between multiple buildings.
- d. For 18 AWG cable, use segments with a maximum length of 4000 ft. When using greater distances or different wire gauges comply with the electrical specifications of TIA-485.

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- 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

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Control Shop .

- b. Coordinate device IP addresses with installation.

#### 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 Controls Shop 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. For LDPs using WriteProperty to commandable objects to implement an override, write values with priority 9.



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### 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 or natural gas flows in cubic feet per minute (CFM)
- c. Water in gallons per minute (GPM)
- d. Steam flow in pounds per hour (pph)
- e. Differential Air pressures in inches of water column (IWC)
- f. Water, steam, and natural gas pressures in PSI
- g. Enthalpy in BTU/lb
- h. Heating and cooling energy in MBTU (1MBTU = 1,000,000 BTU)
- i. Cooling load in tons (1 ton = 12,000 BTU/hour)
- j. Heating load in MBTU/hour (1MBTU = 1,000,000 BTU)
- k. Electrical Power: kilowatts (kW)
- l. Electrical Energy: kilowatt-hours (kWh)

### 3.1.3.10 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.

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#### 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 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

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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 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.

Provide a separate schedule for each AHU including it's associated Terminal Units and for each stand-alone Terminal Unit (those not dependent upon AHU service).

##### 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

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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:

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(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. 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 Trending

Perform all trending using a Niagara Framework Supervisory Gateway using Niagara Framework History Extensions and Niagara Framework History Service exclusively.

#### 3.1.4.5 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

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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 11 20

### FACILITY GAS PIPING 05/20

#### PART 1 GENERAL

##### 1.1 SUMMARY

This specification section applies to gas piping installed within buildings incidental underground piping under building, above ground steel piping and corrugated stainless steel tubing (CSST) both outside (up to 5 feet beyond exterior walls) and within buildings in compliance with NFPA 54 /AGA Z223.1, "National Fuel Gas Code" , "Fuel Gas Piping".

##### 1.2 REFERENCES

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

#### AMERICAN GAS ASSOCIATION (AGA)

AGA ANSI B109.1	(2000) Diaphragm Type Gas Displacement Meters (Under 500 cubic ft./hour Capacity)
AGA ANSI B109.2	(2000) Diaphragm Type Gas Displacement Meters (500 cubic ft./hour Capacity and Over)
AGA ANSI B109.4	(2016) Self-Operated Diaphragm-Type Natural Gas Service Regulators for Nominal Pipe Size 1¼ inches (32 mm) and Smaller with Outlet Pressures of 2 psig (13.8 kPa) and Less
AGA XR0603	(2006; 8th Ed) AGA Plastic Pipe Manual for Gas Service
AGA Z223.1	(2012) National Fuel Gas Code

#### AMERICAN NATIONAL STANDARDS INSTITUTE (ANSI)

ANSI Z21.15/CSA 9.1	(2009; Addenda A 2012, Addenda B 2013; R 2019) Manually Operated Gas Valves for Appliances, Appliance Connector Valves and Hose End Valves
ANSI Z21.18/CSA 6.3	(2007; R 2017) Gas Appliance Pressure Regulators
ANSI Z21.21/CSA 6.5	(2019) Automatic Valves for Gas Appliances
ANSI Z21.24/CSA 6.10	(2015; R 2020) Connectors for Gas Appliances
ANSI Z21.41/CSA 6.9	(2014; R 2019) Quick-Disconnect Devices

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ANSI Z21.69/CSA 6.16	(2015; R 2020) Connectors for Movable Gas Appliances
ANSI Z21.78/CSA 6.20	(2010; R 2020) Standard Specification for Combination Gas Controls for Gas Appliances
ANSI Z21.80/CSA 6.22	(2019) Line Pressure Regulators
ANSI Z21.93/CSA 6.30	(2017) Excess Flow Valves for Natural Gas and Propane Gas with Pressures up to 5 psig

AMERICAN PETROLEUM INSTITUTE (API)

API RP 2009	(2002; R 2007; 7th Ed) Safe Welding, Cutting, and Hot Work Practices in Refineries, Gasoline Plants, and Petrochemical Plants
API Spec 6D	(June 2018, 4th Ed; Errata 1 July 2018; Errata 2 August 2018) Specification for Pipeline and Piping Valves
API Std 598	(2009) Valve Inspecting and Testing
API Std 607	(2016) Fire Test for Quarter-turn Valves and Valves Equipped with Non-metallic Seats

AMERICAN SOCIETY OF CIVIL ENGINEERS (ASCE)

ASCE 25-16	(2016) Earthquake-Activated Automatic Gas Shutoff Devices
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AMERICAN SOCIETY OF MECHANICAL ENGINEERS (ASME)

ASME A13.1	(2020) Scheme for the Identification of Piping Systems
ASME B1.1	(2003; R 2018) Unified Inch Screw Threads (UN and UNR Thread Form)
ASME B1.20.1	(2013; R 2018) Pipe Threads, General Purpose (Inch)
ASME B16.1	(2020) Gray Iron Pipe Flanges and Flanged Fittings Classes 25, 125, and 250
ASME B16.3	(2016) Malleable Iron Threaded Fittings, Classes 150 and 300
ASME B16.5	(2020) Pipe Flanges and Flanged Fittings NPS 1/2 Through NPS 24 Metric/Inch Standard
ASME B16.9	(2018) Factory-Made Wrought Buttwelding Fittings
ASME B16.11	(2016) Forged Fittings, Socket-Welding and Threaded



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ASME B16.21	(2016) Nonmetallic Flat Gaskets for Pipe Flanges
ASME B16.33	(2012; R 2017) Manually Operated Metallic Gas Valves for Use in Gas Piping Systems Up to 125 psi, (Sizes NPS 1/2 - NPS 2)
ASME B18.2.1	(2012; Errata 2013) Square and Hex Bolts and Screws (Inch Series)
ASME B18.2.2	(2015) Nuts for General Applications: Machine Screw Nuts, Hex, Square, Hex Flange, and Coupling Nuts (Inch Series)
ASME B31.8	(2018; Supplement 2018) Gas Transmission and Distribution Piping Systems
ASME B31.9	(2020) Building Services Piping
ASME B36.10M	(2015; Errata 2016) Welded and Seamless Wrought Steel Pipe
ASME BPVC SEC IX	(2017; Errata 2018) BPVC Section IX-Welding, Brazing and Fusing Qualifications

#### AMERICAN WELDING SOCIETY (AWS)

AWS A5.8/A5.8M	(2019) Specification for Filler Metals for Brazing and Braze Welding
AWS WHB-2.9	(2004) Welding Handbook; Volume 2, Welding Processes, Part 1

#### ASTM INTERNATIONAL (ASTM)

ASTM 01.01	(2019) Steel - Piping, Tubing, Fittings
ASTM A105/A105M	(2021) Standard Specification for Carbon Steel Forgings for Piping Applications
ASTM A181/A181M	(2014; R 2020) Standard Specification for Carbon Steel Forgings, for General-Purpose Piping
ASTM A193/A193M	(2020) Standard Specification for Alloy-Steel and Stainless Steel Bolting Materials for High-Temperature Service and Other Special Purpose Applications
ASTM A194/A194M	(2020a) Standard Specification for Carbon Steel, Alloy Steel, and Stainless Steel Nuts for Bolts for High-Pressure or High-Temperature Service, or Both
ASTM A513/A513M	(2020a) Standard Specification for Electric-Resistance-Welded Carbon and Alloy Steel Mechanical Tubing

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ASTM B88 (2020) Standard Specification for Seamless  
 Copper Water Tube

ASTM B280 (2020) Standard Specification for Seamless  
 Copper Tube for Air Conditioning and  
 Refrigeration Field Service

ASTM F2015 (2000; R 2013) Standard Specification for  
 Lap Joint Flange Pipe End Applications

CSA GROUP (CSA)

ANSI LC 1/CSA 6.26 (2019) Fuel Gas Piping Systems Using  
 Corrugated Stainless Steel Tubing (CSST)

CGA 3.11-M88 (2015) Lever Operated Pressure Lubricated  
 Plug Type Gas Shut-Off Valves

FM GLOBAL (FM)

FM APP GUIDE (updated on-line) Approval Guide  
<http://www.approvalguide.com/>

MANUFACTURERS STANDARDIZATION SOCIETY OF THE VALVE AND FITTINGS  
 INDUSTRY (MSS)

MSS SP-25 (2018) Standard Marking System for Valves,  
 Fittings, Flanges and Unions

MSS SP-58 (2018) Pipe Hangers and Supports -  
 Materials, Design and Manufacture,  
 Selection, Application, and Installation

NATIONAL FIRE PROTECTION ASSOCIATION (NFPA)

NFPA 54 (2021) National Fuel Gas Code

NFPA 58 (2020; TIA 20-1; TIA 20-2; TIA 20-3)  
 Liquefied Petroleum Gas Code

NFPA 70 (2020; ERTA 20-1 2020; ERTA 20-2 2020; TIA  
 20-1; TIA 20-2; TIA 20-3; TIA 20-4)  
 National Electrical Code

U.S. DEPARTMENT OF DEFENSE (DOD)

MIL-STD-101 (2014; Rev C) Color Code for Pipelines and  
 for Compressed Gas Cylinders

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

49 CFR 192 Transportation of Natural and Other Gas by  
 Pipeline: Minimum Federal Safety Standards

UNDERWRITERS LABORATORIES (UL)

UL FLAMMABLE & COMBUSTIBLE (2012) Flammable and Combustible Liquids  
 and Gases Equipment Directory

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### 1.3 SYSTEM DESCRIPTION

The gas piping system includes natural gas piping and appurtenances from point of connection with supply system, as indicated, to gas operated equipment within the facility. Submit operation and maintenance data in accordance with Section 01 78 23 OPERATION AND MAINTENANCE DATA, in three separate packages.

#### 1.3.1 Gas Facility System and Equipment Operation

Include shop drawings showing piping layout, locations of system valves, gas line markers; step-by-step procedures for system start up, operation and shutdown (index system components and equipment to the system drawings); isolation procedures including valve operation to shutdown or isolate each section of the system (index valves to the system maps and provide separate procedures for normal operation and emergency shutdown if required to be different). Submit Data package No. 4.

#### 1.3.2 Gas Facility System Maintenance

Include maintenance procedures and frequency for system and equipment; identification of pipe materials and manufacturer by locations, pipe repair procedures, and jointing procedures at transitions to other piping material or material from a different manufacturer. Submit Data Package No.4.

#### 1.3.3 Gas Facility Equipment Maintenance

Include identification of valves, shut-offs, disconnects, and other equipment by materials, manufacturer, vendor identification and location; maintenance procedures and recommended tool kits for valves and equipment; recommended repair methods (i.e., field repair, factory repair, or replacement) for each valve and piece of equipment; and preventive maintenance procedures, possible failure modes and troubleshooting guide. Submit Data Package No. 3.

### 1.4 SUBMITTALS

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

#### SD-02 Shop Drawings

Gas Piping System; G

#### SD-03 Product Data

Pipe and Fittings; G

Gas Equipment Connectors; G

Gas Piping System; G

Pipe Coating Materials; G

Pressure Regulators; G

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Risers; G

Transition Fittings; G

Valves; G

Warning and Identification Tape; G

#### SD-06 Test Reports

Testing; G

Pressure Tests; G

Test with Gas; G

#### SD-07 Certificates

Welders Procedures and Qualifications; G

Assigned Number, Letter, or Symbol; G

#### SD-08 Manufacturer's Instructions

PE Pipe and Fittings; G

Pipe Coating Materials; G

#### SD-10 Operation and Maintenance Data

Gas Facility System and Equipment Operation; G

Gas Facility System Maintenance; G

Gas Facility Equipment Maintenance; G

### 1.5 QUALITY ASSURANCE

Submit manufacturer's descriptive data and installation instructions for approval for compression-type mechanical joints used in joining dissimilar materials and for insulating joints. Mark all valves, flanges and fittings in accordance with MSS SP-25.

#### 1.5.1 Welding Qualifications

- a. Weld piping in accordance with qualified procedures using performance qualified welders and welding operators in accordance with API RP 2009, ASME BPVC SEC IX, and ASME B31.9. Welding procedures qualified by others, and welders and welding operators qualified by another employer may be accepted as permitted by ASME B31.9. Notify the Contracting Officer at least 24 hours in advance of tests, and perform at the work site if practicable.
- b. Submit a certified copy of welders procedures and qualifications metal and PE in conformance with ASME B31.9 for each welder and welding operator. Submit the assigned number, letter, or symbol that will be used in identifying the work of each welder to the Contracting Officer.  
Weld all structural members in conformance with AWS A5.8/A5.8M, and

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AWS WHB-2.9.

#### 1.5.2 Jointing Thermoplastic and Fiberglass Piping

Perform all jointing of piping using qualified joiners and qualified procedures in accordance with AGA XR0603. Furnish the Contracting Officer with a copy of qualified procedures and list of and identification symbols of qualified joiners. Submit manufacturer's installation instructions and manufacturer's visual joint appearance chart, including all PE pipe and fittings.

#### 1.5.3 Shop Drawings

Submit drawings for complete Gas Piping System, within 30 days of contract award, showing location, size and all branches of pipeline; location of all required shutoff valves; and instructions necessary for the installation of gas equipment connectors and supports.

### 1.6 DELIVERY, STORAGE, AND HANDLING

#### 1.6.1 Plastic Pipe

Handle, transport, and store plastic pipe and fittings carefully. Plug or cap pipe and fittings ends during transportation or storage to minimize dirt and moisture entry. Do not subject piping to abrasion or concentrated external loads. Discard PE pipe sections and fittings that have been damaged.

#### 1.6.2 CSST Tubing

Handle, transport and store CSST tubing on the wooden spool or shipping container provided by the manufacturer. Insure tubing ends are capped during transportation and storage to minimize dirt and moisture entry. Discard any tubing segment and fitting that has been damaged.

## PART 2 PRODUCTS

### 2.1 MATERIALS AND EQUIPMENT

Provide materials and equipment which are the standard products of a manufacturer regularly engaged in the manufacture of the products and that essentially duplicate items that have been in satisfactory use for at least 2 years prior to bid opening. Asbestos or products containing asbestos are not allowed. Submit catalog data and installation instructions for pipe, valves, all related system components, pipe coating materials and application procedures. Conform to NFPA 54 and with requirements specified herein. Provide supply piping to appliances or equipment at least as large as the inlets thereof.

### 2.2 GAS PIPING SYSTEM AND FITTINGS

#### 2.2.1 Steel Pipe, Joints, and Fittings

Provide steel pipe conforming to ASME B36.10M; and malleable-iron threaded fittings conforming to ASME B16.1 and ASME B16.3. Provide steel pipe flanges and flanged fittings, including bolts, nuts, and bolt pattern in accordance with ASME B16.5 and ASTM A105/A105M. Provide wrought steel butt welding fittings conforming to ASME B16.9. Provide socket welding and threaded forged steel fittings conforming to ASME B16.11 and

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ASTM A181/A181M, Class 60.

#### 2.2.2 Copper Tubing, Joints and Fittings

Provide copper tubing conforming to ASTM B88, Type K or L, or ASTM B280, with tubing joints made up with tubing fittings recommended by the tubing manufacturer. Provide copper and copper alloy press fittings, with sealing elements of Hydrogenated Nitrile Butadiene Rubber (HNBR), factory installed, or an alternative supplied by the fitting manufacturer. Press fittings are not a permitted connection fitting for natural and LP gas on Army and Navy projects.

#### 2.2.3 Steel Tubing, Joints and Fittings

Provide steel tubing conforming to ASTM 01.01, and ASTM A513/A513M, with tubing joints made up with gas tubing fittings recommended by the tubing manufacturer.

#### 2.2.4 Corrugated Stainless Steel Tubing, Fittings and Accessories

Provide corrugated stainless steel tubing conforming to ANSI LC 1/CSA 6.26 (austenitic stainless steel of series 300) with tubing joints made with special mechanical fittings as supplied by the tubing manufacturer.

##### 2.2.4.1 Tubing

Austenitic stainless alloy of series 300 with polyethylene jacket/coating in accordance with ANSI LC 1/CSA 6.26 for sizes 3/8-inch through 2-inch

##### 2.2.4.2 Mechanical Fittings

Copper alloy with one end matched to the corrugated tubing and one end with NPT threads in accordance with ASME B1.20.1

##### 2.2.4.3 Striker Plates

Hardened steel designed to protect tubing from mechanical damage in accordance with ANSI LC 1/CSA 6.26

##### 2.2.4.4 Manifolds

Malleable iron, steel or copper alloy with threaded connections/ports in accordance with ASME B1.20.1

#### 2.2.5 Sealants for Steel Pipe Threaded Joints

Provide joint sealing compound as listed in UL FLAMMABLE & COMBUSTIBLE, Class 20 or less. For taping, use tetrafluoroethylene tape conforming to UL FLAMMABLE & COMBUSTIBLE.

#### 2.2.6 Warning and Identification

Provide pipe flow markings, warning and identification tape, and metal tags as required.

#### 2.2.7 Flange Gaskets

Provide gaskets of nonasbestos compressed material in accordance with ASME B16.21, 1/16 inch thickness, full face or self-centering flat ring

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type, containing aramid fibers bonded with styrene butadiene rubber (SBR) or nitrile butadiene rubber (NBR) suitable for a maximum 600 degree F service, to be used for hydrocarbon service.

#### 2.2.8 Pipe Threads

Provide pipe threads conforming to ASME B1.20.1.

#### 2.2.9 Escutcheons

Provide chromium-plated steel or chromium-plated brass escutcheons, either one piece or split pattern, held in place by internal spring tension or set screw.

#### 2.2.10 Gas Transition Fittings

- a. Provide steel to plastic (PE) designed for steel-to-plastic with tapping tee or sleeve conforming to AGA XR0603 requirements for transitions fittings.. Coat or wrap exposed steel pipe with heavy plastic coating.
- c. Provide lever operated pressure lubricated plug type gas shut-off valve conforming to CGA 3.11-M88.

#### 2.2.11 Insulating Pipe Joints

##### 2.2.11.1 Insulating Joint Material

Provide insulating joint material between flanged or threaded metallic pipe systems where shown to control galvanic or electrical action.

##### 2.2.11.2 Threaded Pipe Joints

Provide threaded pipe joints of steel body nut type dielectric unions with insulating gaskets.

##### 2.2.11.3 Flanged Pipe Joints

Provide joints for flanged pipe consisting of full face sandwich-type flange insulating gasket of the dielectric type, insulating sleeves for flange bolts, and insulating washers for flange nuts. Provide lap joint flange pipe ends conforming to ASTM F2015.

#### 2.2.12 Flexible Connectors

- a. Provide flexible connectors for connecting gas utilization equipment to building gas piping conforming to ANSI Z21.24/CSA 6.10 or ANSI Z21.41/CSA 6.9 for quick disconnect devices, and flexible connectors for movable food service equipment conforming to ANSI Z21.69/CSA 6.16. Provide combination gas controls for gas appliances conforming to ANSI Z21.78/CSA 6.20.
- b. Do not install the flexible connector through the appliance cabinet face. Provide rigid metallic pipe and fittings to extend the final connection beyond the cabinet, except when appliance is provided with an external connection point.

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## 2.3 VALVES

Provide lockable shutoff or service isolation valves conforming to the following:

### 2.3.1 Valves 2 Inches and Smaller

Provide valves 2 inches and smaller conforming to ASME B16.33 of materials and manufacture compatible with system materials used.

### 2.3.2 Valves 2-1/2 Inches and Larger

Provide valves 2-1/2 inches and larger of carbon steel conforming to API Spec 6D, Class 150.

## 2.4 RISERS

Provide manufacturer's standard riser, transition from plastic to steel pipe with 7 to 12 mil thick epoxy coating. Use swaged gas-tight construction with O-ring seals, metal insert, and protective sleeve. Provide wall-mounted riser supports .

## 2.5 PIPE HANGERS AND SUPPORTS

Provide pipe hangers and supports conforming to MSS SP-58.

## 2.6 LINE AND APPLIANCE REGULATORS AND SHUTOFF VALVES

Provide regulators conforming to ANSI Z21.18/CSA 6.3 for appliances , and ANSI Z21.80/CSA 6.22 for line pressure regulators. Provide shutoff valves conforming to ANSI Z21.15/CSA 9.1 for manually controlled gas shutoff valves and ANSI Z21.21/CSA 6.5 for automatic shutoff valves for gas appliances.

## 2.7 NATURAL GAS SERVICE

### 2.7.1 Service Regulators

- a. Provide ferrous bodied pressure regulators for individual service lines, capable of reducing distribution line pressure to pressures required for users. Provide service regulators conforming to AGA ANSI B109.4 CGA-6.18-M95 with full capacity internal relief and overpressure shutoff. Set pressure relief at a lower pressure than would cause unsafe operation of any connected user.
- b. Adjust regulators for liquified petroleum gas to 2.5 to 3 kPa 10 to 12 inches of water column, with pressure relief set at 4 kPa 16 inches of water column.
- c. Provide regulator(s) having a single port with orifice diameter no greater than that recommended by the manufacturer for the maximum gas flow rate at the regulator inlet pressure. Provide regulator valve vent of resilient materials designed to withstand flow conditions when pressed against the valve port, capable of regulating downstream pressure within limits of accuracy and limiting the buildup of pressure under no-flow conditions to 50 percent or less of the discharge pressure maintained under flow conditions. Provide a self-contained service regulator, and pipe not exceeding exceed 2 inch size.



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## 2.7.2 Gas Meter

AGA ANSI B109.1 pipe mounted, diaphragm or bellowstyle, enamel-coated steel case. Provided with a strainer immediately upstream. Provide diaphragm-type meter conforming to AGA ANSI B109.1 for required flow rates less than 500 cfh, or AGA ANSI B109.2, for flow rates 500 cfh and above as required by local gas utility supplier. Provide combined odometer-type register totalizer index, UV-resistant index cover, water escape hole in housing, and means for sealing against tampering. Provide temperature-compensated type meters sized for the required volumetric flow rate and suitable for accurately measuring and handling gas at pressures, temperatures, and flow rates indicated. Provide meters with over-pressure protection as specified in 49 CFR 192 and ASME B31.8. Provide meters that are tamper-proof with frost protection. Provide meters with a pulse switch initiator capable of operating up to speeds of 500 maximum pulses per minute with no false pulses and requiring no field adjustments. Provide not less than one pulse per 100 cubic feet of gas. Minimum service life must be 30,000,000 cycles.

### 2.7.2.1 Utility Monitoring and Control System (UMCS) / Energy Monitoring and Control (EMCS) or Automatic Meter Reading Interfaces

Provide gas meters capable of interfacing the output signal, equivalent to volumetric flow rate, with the existing UMCS / EMCS for data gathering in units of cubic meters cubic feet. Provide meters that do not require power to function and deliver data. Output signal must be either a voltage or amperage signal that can be converted to volumetric flow by using an appropriate scaling factor.

### 2.7.2.2 Measurement Configuration

For buildings that already have a gas meter with a pulse output, ensure that the pulse output is connected to a data gathering device (i.e. electric meter). For buildings where a natural gas meter already exists but does not have a pulse output, add a pulse kit to the existing meter and tie the output to a data gathering device. If the existing gas meter will not accept a pulse kit or if no meter exists a new natural gas meter must be installed, also requiring a pulse output to a data gathering device. Ensure the pulse frequency and electronic characteristics are compatible with the existing data gathering device, if any.

## 2.8 AUTOMATIC GAS SHUT-OFF

Provide low pressure automatic gas shutoff or excess flow valve (EFV) downstream of the point of delivery after the meter/regulator conforming to ANSI Z21.93/CSA 6.30 and UL listed or CSA listed or International Association of Plumbing and Mechanical Officials (IAPMO) listed. The EFV may be either a bypass (automatic reset) or a non-bypass type (manual reset).

## 2.9 BOLTING (BOLTS AND NUTS)

Stainless steel bolting; ASTM A193/A193M, Grade B8M or B8MA, Type 316, for bolts; and ASTM A194/A194M, Grade 8M, Type 316, for nuts. Dimensions of bolts, studs, and nuts must conform with ASME B18.2.1 and ASME B18.2.2 with coarse threads conforming to ASME B1.1, with Class 2A fit for bolts and studs and Class 2B fit for nuts. Bolts or bolt-studs must extend through the nuts and may have reduced shanks of a diameter not less than

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the diameter at root of threads. Bolts must have American Standard regular square or heavy hexagon heads; nuts must be American Standard heavy semifinished hexagonal.

## 2.10 GASKETS

Fluorinated elastomer, compatible with flange faces.

## 2.11 IDENTIFICATION FOR ABOVEGROUND PIPING

MIL-STD-101 for legends and type and size of characters. For pipes 3/4 inch od and larger, provide printed legends to identify contents of pipes and arrows to show direction of flow. Color code label backgrounds to signify levels of hazard. Make labels of plastic sheet with pressure-sensitive adhesive suitable for the intended application. For pipes smaller than 3/4 inch od, provide brass identification tags 1 1/2 inches in diameter with legends in depressed black-filled characters.

# PART 3 EXECUTION

## 3.1 EXAMINATION

After becoming familiar with all details of the work, verify all dimensions in the field, and advise the Contracting Officer of any discrepancy or areas of conflict before performing the work.

## 3.2 EXCAVATION AND BACKFILLING

Provide required excavation, backfilling, and compaction as specified in Section 31 00 00.00 06 EARTHWORK.

## 3.3 GAS PIPING SYSTEM

Provide a gas piping system from the point of delivery, defined as the outlet of the shutoff valve, as specified under "Gas Service" within this specification, to the connections to each gas utilization device that is in compliance with NFPA 54..

### 3.3.1 Protection and Cleaning of Materials and Components

Protect equipment, pipe, and tube openings by closing with caps or plugs during installation. At the completion of all work, thoroughly clean the entire system.

### 3.3.2 Workmanship and Defects

Piping, tubing and fittings must be clear and free of cutting burrs and defects in structure or threading and must be thoroughly brushed and chip-and scale-blown. Repair of defects in piping, tubing or fittings is not allowed; replace defective items when found.

## 3.4 PROTECTIVE COVERING

### 3.4.1 Underground Metallic Pipe

Protect buried metallic piping and tubing from corrosion by either: (1) applying protective coatings (1) encasement in a water tight plastic conduit; or (2) encasement in a protective system designed and listed by the manufacturer for this application. When dissimilar metals are joined

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underground, use gastight insulating fittings.

### 3.4.2 Aboveground Metallic Piping Systems

#### 3.4.2.1 Ferrous Surfaces

Touch up shop primed surfaces with ferrous metal primer. Solvent clean surfaces that have not been shop primed. Mechanically clean surfaces that contain loose rust, loose mill scale and other foreign substances by power wire brushing and prime with ferrous metal primer. Finish primed surfaces with two coats of exterior oil paint or vinyl paint.

#### 3.4.2.2 Nonferrous Surfaces

Except for aluminum alloy pipe, do not paint nonferrous surfaces. Paint surfaces of aluminum alloy pipe and fittings to protect against external corrosion where they contact masonry, plaster, insulation, or are subject to repeated wettings by such liquids as water, detergents or sewage. Solvent-clean the surfaces and treat with vinyl type wash coat. Apply a first coat of aluminum paint and a second coat of alkyd gloss enamel or silicone alkyd copolymer enamel.

### 3.5 INSTALLATION

Install the gas system in conformance with the manufacturer's recommendations and applicable provisions of NFPA 54 and AGA XR0603, and as indicated. Perform all pipe cutting without damage to the pipe, with an approved type of mechanical cutter, unless otherwise authorized. Use wheel cutters where practicable. On steel pipe 6 inches and larger, an approved gas cutting and beveling machine may be used. Cut thermoplastic and fiberglass pipe in accordance with AGA XR0603.

#### 3.5.1 Metallic Piping Installation

Bury underground piping a minimum of 18 inches below grade. Make changes in direction of piping with fittings only; mitering or notching pipe to form elbows and tees or other similar type construction is not permitted. Branch connection may be made with either tees or forged branch outlet fittings. Provide branch outlet fittings which are forged, flared for improvement of flow where attached to the run, and reinforced against external strains. Do not use aluminum alloy pipe in exterior locations or underground.

#### 3.5.2 Metallic Tubing Installation

Install metallic tubing using gas tubing fittings approved by the tubing manufacturer. CSST gas piping systems must be installed by contractors who have completed the manufacturer's training program as indicated on a certification card. Make branch connections with tees. Prepare all tubing ends with tools designed for that purpose. Do not use aluminum alloy tubing in exterior locations or underground. Maintain electrical continuity of gas piping system in accordance with NFPA 54, paragraph entitled 'Electrical Bonding and Grounding'.

#### 3.5.3 Thermoplastic and Fiberglass Piping, Tubing, and Fittings

Installation of thermoplastic and fiberglass piping, tubing, and fittings is permitted only outside and underground. Bury piping a minimum of 18 inches below grade. Install the piping to avoid excessive stresses due to

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thermal contraction, and use only where indicated. Installations must be made using qualified procedures, by qualified installers, and in compliance with AGA XR0603 and NFPA 54 , and must be inspected by a qualified inspector.

#### 3.5.4 Connections Between Metallic and Plastic Piping

Connections between metallic and plastic piping are only allowed outside, underground, and with approved transition fittings.

#### 3.5.5 Concealed Piping in Buildings

Do not use combinations of fittings ( unions, tubing fittings, running threads, right- and left-hand couplings, bushings, and swing joints) to conceal piping within buildings.

##### 3.5.5.1 Piping and Tubing in Partitions

Locate concealed piping and tubing in hollow, rather than solid, partitions. Protect tubing passing through walls or partitions against physical damage both during and after construction, and provide appropriate safety markings and labels. Provide protection of concealed pipe and tubing in accordance with ANSI LC 1/CSA 6.26.

#### 3.5.6 Aboveground Piping

Run aboveground piping as straight as practicable along the alignment and elevation indicated, with a minimum of joints, and separately supported from other piping system and equipment. Install exposed horizontal piping no farther than 6 inches from nearest parallel wall and at an elevation which prevents standing, sitting, or placement of objects on the piping.

#### 3.5.7 Final Gas Connections

Unless otherwise specified, make final connections with rigid metallic pipe and fittings. Provide accessible gas shutoff valve and coupling for each gas equipment item.

#### 3.5.8 Seismic Requirements

Support and brace piping and attached valves to resist seismic loads in conformance with ASCE 25-16. CSST tubing and fittings that are seismically qualified in accordance with the FM APP GUIDE: Flexible Piping Systems for Flammable Gases must meet the seismic requirements in accordance with the manufacturer's installation instructions.

### 3.6 PIPE JOINTS

Design and install pipe joints to effectively sustain the longitudinal pull-out forces caused by contraction of the piping or superimposed loads.

#### 3.6.1 Threaded Metallic Joints

Provide threaded joints in metallic pipe with tapered threads evenly cut and made with UL approved graphite joint sealing compound for gas service or tetrafluoroethylene tape applied to the male threads only. Threaded joints up to 1-1/2 inches in diameter may be made with approved tetrafluoroethylene tape. Threaded joints up to 2 inches in diameter may be made with approved joint sealing compound. After cutting and before

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threading, ream pipe and remove all burrs. Caulking of threaded joints to stop or prevent leaks is not permitted.

### 3.6.2 Welded Metallic Joints

Conform beveling, alignment, heat treatment, and inspection of welds to NFPA 54. Remove weld defects and make repairs to the weld, or remove the weld joints entirely and reweld. After filler metal has been removed from its original package, protect and store so that its characteristics or welding properties are not affected adversely. Do not use electrodes that have been wetted or have lost any of their coating.

### 3.6.3 Flared Metallic Tubing Joints

Make flared joints in metallic tubing with special tools recommended by the tubing manufacturer. Use flared joints only in systems constructed from nonferrous pipe and tubing, when experience or tests have demonstrated that the joint is suitable for the conditions, and when adequate provisions are made in the design to prevent separation of the joints. Do not use metallic ball sleeve compression-type tubing fittings for tubing joints.

### 3.6.4 Solder or Brazed Joints

Make all joints in metallic tubing and fittings with materials and procedures recommended by the tubing supplier. Braze joints with material having a melting point above 1000 degrees F, containing no phosphorous.

### 3.6.5 Joining Thermoplastic or Fiberglass to Metallic Piping or Tubing

When compression type mechanical joints are used, provide gasket material in the fittings compatible with the plastic piping and with the gas in the system. Use an internal tubular rigid stiffener in conjunction with the fitting, flush with end of the pipe or tubing, extending at least to the outside end of the compression fitting when installed. Remove all rough or sharp edges from stiffener. Do not force fit stiffener in the plastic. Split tubular stiffeners are not allowed.

### 3.6.6 Press Connections

Make press connections in accordance with manufacturer's installation instructions using tools approved by the manufacturer. Fully insert the tubing into the fitting and then mark at the shoulder of the fitting. Check the fitting alignment against the mark on the tubing to assure the tubing is fully inserted before the joint is pressed.

## 3.7 PIPE SLEEVES

Provide pipes passing through concrete or masonry walls or concrete floors or roofs with pipe sleeves fitted into place at the time of construction. Do not install sleeves in structural members except where indicated or approved. Make all rectangular and square openings as detailed. Extend each sleeve through its respective wall, floor or roof, and cut flush with each surface, except in mechanical room floors not located on grade where clamping flanges or riser pipe clamps are used. Extend sleeves in mechanical room floors above grade at least 4 inches above finish floor. Unless otherwise indicated, use sleeves large enough to provide a minimum clearance of 1/4 inch all around the pipe. Provide steel pipe for sleeves in bearing walls, waterproofing membrane floors, and wet areas. Provide

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sleeves in nonbearing walls, floors, or ceilings of steel pipe, galvanized sheet metal with lock-type longitudinal seam, or moisture-resistant fiber or plastic. For penetrations of fire walls, fire partitions and floors which are not on grade, seal the annular space between the pipe and sleeve with fire-stopping material and sealant that meet the requirement of Section 07 84 00 FIRESTOPPING.

### 3.8 PIPES PENETRATING WATERPROOFING MEMBRANES

Install pipes penetrating waterproofing membranes as specified in Section 22 00 00 PLUMBING, GENERAL PURPOSE.

### 3.9 FIRE SEAL

Fire seal all penetrations of fire rated partitions, walls and floors in accordance with Section 07 84 00 FIRESTOPPING.

### 3.10 ESCUTCHEONS

Provide escutcheons for all finished surfaces where gas piping passes through floors, walls, or ceilings except in boiler, utility, or equipment rooms.

### 3.11 SPECIAL REQUIREMENTS

Provide drips, grading of the lines, freeze protection, and branch outlet locations as shown and conforming to the requirements of NFPA 54.

### 3.12 BUILDING STRUCTURE

Do not weaken any building structure by the installation of any gas piping. Do not cut or notch beams, joists or columns. Attach piping supports to metal decking. Do not attach supports to the underside of concrete filled floors or concrete roof decks unless approved by the Contracting Officer.

### 3.13 PIPING SYSTEM SUPPORTS

Support gas piping systems in buildings with pipe hooks, metal pipe straps, bands or hangers suitable for the size of piping or tubing. Do not support any gas piping system by other piping. Conform spacing of supports in gas piping and tubing installations to the requirements of NFPA 54. Conform the selection and application of supports in gas piping and tubing installations to the requirements of MSS SP-58. In the support of multiple pipe runs on a common base member, use a clip or clamp where each pipe crosses the base support member. Spacing of the base support members is not to exceed the hanger and support spacing required for any of the individual pipes in the multiple pipe run. Rigidly connect the clips or clamps to the common base member. Provide a clearance of 1/8 inch between the pipe and clip or clamp for all piping which may be subjected to thermal expansion.

### 3.14 ELECTRICAL BONDING AND GROUNDING

Provide a gas piping system within the building that is electrically continuous and bonded to a grounding electrode as required by NFPA 54, NFPA 58, and NFPA 70.

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### 3.15 SHUTOFF VALVE

Install the main gas shutoff valve controlling the gas piping system to be easily accessible for operation, as indicated, protected from physical damage, and marked with a metal tag to clearly identify the piping system controlled. Install valves approximately at locations indicated. Orient stems vertically, with operators on top, or horizontally. Provide stop valve on service branch at connection to main and shut-off valve on riser outside of building.

### 3.16 LINE AND APPLIANCE PRESSURE REGULATORS

Install line pressure regulators and appliance regulators in accordance with the manufacturer's requirements and in accordance with NFPA 54. Install each regulator in an accessible location and install shutoff valves ahead of each line and appliance regulator to allow for maintenance. Where vent limiting devices are not included in the regulators, install a vent pipe to the exterior of the building. Terminate all service regulator vents and relief vents in the outside air in rain and insect resistant fittings. Locate the open end of the vent where gas can escape freely into the atmosphere, away from any openings into the building and above areas subject to flooding.

### 3.17 GAS SERVICE INSTALLATION

Installations must be in accordance with 49 CFR 192 and ASME B31.8. Contractor must submit and use only tested and approved work procedures. Contractor must use only welders and jointers who have been recently qualified by training and test for joining and installing the gas pipe material used on this job. The finished product must be inspected by a person qualified to inspect joints made by the particular procedures used to make joints.

#### 3.17.1 Service Line

Install service line, branch connection to the main, and riser in accordance with 49 CFR 192 and ASME B31.8. Provide a minimum of 18 inches cover or encase the service line so that it is protected. Install service line so that no undue stress is applied to the pipe, connection, or riser. Install approved riser and terminate with an approved isolation valve, EFV and automatic shutoff device. After laying of pipe and testing, backfill the trench in accordance with Section 31 00 00.00 06 EARTHWORK.

Where steel pipe is used as service line, install corrosion prevention coating and cathodic protect for the steel service line. Where connected to an existing cathodically protected steel pipe, ensure electrical continuity from the riser to the branch connection to the main. Install a dielectric fitting on the riser to prevent electrical continuity to the above ground piping.

Where plastic pipe is used as the service line, make joints in accordance with procedures qualified by test. Personnel joining plastic pipe must be qualified by making a satisfactory specimen joint that passes the required inspection and test listed in 49 CFR 192.285. Inspection must be made by inspectors qualified in evaluating joints made under the specific joining procedure, as required by 49 CFR 192.287.

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### 3.17.2 Service Regulator

Install service regulator in accordance with 49 CFR 192 and ASME B31.8 and this specification ensuring that the customer's piping is protected from over pressurization should the service regulator fail. A 3/8 inch tapped fitting equipped with a plug must be provided on both sides of the service regulator for installation of pressure gauges for adjusting the regulator. For inside installations, route the regulator vent pipe through the exterior wall to the atmosphere, and seal building penetrations for service line and vent. Terminate the regulator vent so that it is protected from precipitation and insect intrusion, so that it is not submerged during floods, and so that gas escaping will not create a hazard or enter the building through openings.

### 3.17.3 Gas Meter

Install shutoff valve, meter set assembly, and service regulator on the service line inside the building, a minimum of 3 feet from any potential ignition source, 18 inches above the finished floor on the riser. An insulating joint (dielectric connection) must be installed on the inlet side of the meter set assembly and service regulator and must be constructed to prevent flow of electrical current.

## 3.18 TESTING

Submit test procedures and reports in booklet form tabulating test and measurements performed; dated after award of this contract, and stating the Contractor's name and address, the project name and location, and a list of the specific requirements which are being certified. Test entire gas piping system to ensure that it is gastight prior to putting into service. Prior to testing, purge the system, clean, and clear all foreign material. Test each joint with an approved gas detector, soap and water, or an equivalent nonflammable solution. Inspect and test each valve in conformance with API Std 598 and API Std 607. Complete testing before any work is covered, enclosed, or concealed, and perform with due regard for the safety of employees and the public during the test. Install bulkheads, anchorage and bracing suitably designed to resist test pressures if necessary, and as directed and or approved by the Contracting Officer. Do not use oxygen as a testing medium.

### 3.18.1 Pressure Tests

Submit test procedures and reports in booklet form tabulating test and measurements performed; dated after award of this contract, and stating the Contractor's name and address, the project name and location, and a list of the specific requirements which are being certified. Before appliances are connected, test by filling the piping systems with air or an inert gas to withstand a minimum pressure of 3 pounds gauge for a period of not less than 10 minutes as specified in NFPA 54 without showing any drop in pressure. Do not use Oxygen for test. Measure pressure with a mercury manometer, slope gauge, or an equivalent device calibrated to be read in increments of not greater than 0.1 pound. Isolate the source of pressure before the pressure tests are made.

### 3.18.2 Test With Gas

Before turning on gas under pressure into any piping, close all openings from which gas can escape. Immediately after turning on the gas, check the piping system for leakage by using a laboratory-certified gas meter,



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an appliance orifice, a manometer, or equivalent device. Conform all testing to the requirements of NFPA 54. If leakage is recorded, shut off the gas supply, repair the leak, and repeat the tests until all leaks have been stopped.

#### 3.18.3 Purging

After testing is completed, and before connecting any appliances, fully purge all gas piping. Do not purge piping into the combustion chamber of an appliance. Do not purge the open end of piping systems into confined spaces or areas where there are ignition sources unless the safety precautions recommended in NFPA 54 are followed.

#### 3.18.4 Labor, Materials and Equipment

Furnish all labor, materials and equipment necessary for conducting the testing and purging.

#### 3.19 PIPE COLOR CODE MARKING

Provide color code marking of piping as specified in Section 09 90 00 PAINTS AND COATINGS, conforming to ASME A13.1.

-- End of Section --

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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	(2015) Method of Testing Capacity of Thermostatic Refrigerant Expansion Valves
ASHRAE 90.1 - IP	(2013) Energy Standard for Buildings Except Low-Rise Residential Buildings

## AMERICAN SOCIETY OF MECHANICAL ENGINEERS (ASME)

ASME B1.20.1	(2013; R 2018) Pipe Threads, General Purpose (Inch)
ASME B16.3	(2016) Malleable Iron Threaded Fittings, Classes 150 and 300
ASME B16.5	(2020) Pipe Flanges and Flanged Fittings NPS 1/2 Through NPS 24 Metric/Inch Standard
ASME B16.9	(2018) Factory-Made Wrought Butt welding

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#### Fittings

ASME B16.11	(2016) Forged Fittings, Socket-Welding and Threaded
ASME B16.21	(2016) Nonmetallic Flat Gaskets for Pipe Flanges
ASME B16.22	(2018) Standard for Wrought Copper and Copper Alloy Solder Joint Pressure Fittings
ASME B16.26	(2018) Standard for Cast Copper Alloy Fittings for Flared Copper Tubes
ASME B31.1	(2020) Power Piping
ASME B31.5	(2020) Refrigeration Piping and Heat Transfer Components
ASME B31.9	(2020) Building Services Piping
ASME B40.100	(2013) Pressure Gauges and Gauge Attachments
ASME BPVC SEC IX	(2017; Errata 2018) BPVC Section IX-Welding, Brazing and Fusing Qualifications

#### AMERICAN WELDING SOCIETY (AWS)

AWS A5.8/A5.8M	(2019) Specification for Filler Metals for Brazing and Braze Welding
AWS 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) Structural Welding Code - Steel
AWS Z49.1	(2012) Safety in Welding and Cutting and Allied Processes

#### ASTM INTERNATIONAL (ASTM)

ASTM A53/A53M	(2020) Standard Specification for Pipe, Steel, Black and Hot-Dipped, Zinc-Coated, Welded and Seamless
ASTM A193/A193M	(2020) Standard Specification for Alloy-Steel and Stainless Steel Bolting Materials for High-Temperature Service and Other Special Purpose Applications
ASTM A653/A653M	(2020) Standard Specification for Steel Sheet, Zinc-Coated (Galvanized) or Zinc-Iron Alloy-Coated (Galvannealed) by the Hot-Dip Process

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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	(2020) Standard Test Method for Surface Burning Characteristics of Building Materials

MANUFACTURERS STANDARDIZATION SOCIETY OF THE VALVE AND FITTINGS  
 INDUSTRY (MSS)

MSS SP-58	(2018) Pipe Hangers and Supports - Materials, Design and Manufacture, Selection, Application, and Installation
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U.S. DEPARTMENT OF DEFENSE (DOD)

UFC 3-301-01	(2019) Structural Engineering
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## 1.2 SUBMITTALS

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

### SD-02 Shop Drawings

Refrigerant Piping System; G

### SD-03 Product Data

Refrigerant Piping System

Spare Parts

Qualifications

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Refrigerant Piping Tests

Verification of Dimensions

SD-06 Test Reports

Refrigerant Piping Tests

SD-07 Certificates

Service Organization

SD-10 Operation and Maintenance Data

Maintenance; G

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

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the requirements of Section 01 78 23 OPERATION AND MAINTENANCE DATA and as specified herein.

#### 1.5.2 Extra Materials

Submit spare parts data for each different item of equipment specified, after approval of detail drawings and not later than 2 months prior to the date of contract completion. Include a complete list of parts and supplies, with current unit prices and source of supply, a recommended spare parts list for 1 year of operation, and a list of the parts recommended by the manufacturer to be replaced on a routine basis in the data.

### PART 2 PRODUCTS

#### 2.1 STANDARD COMMERCIAL PRODUCTS

- a. Provide materials and equipment which are standard products of a manufacturer regularly engaged in the manufacturing of such products, that are of a similar material, design and workmanship and that have been in satisfactory commercial or industrial use for 2 years prior to bid opening.
- b. The 2 year use must include applications of equipment and materials under similar circumstances and of similar size. The 2 years' experience must be satisfactorily completed by a product which has been sold or is offered for sale on the commercial market through advertisements, manufacturer's catalogs, or brochures. Products having less than a 2-year field service record will be acceptable if a certified record of satisfactory field operation, for not less than 6000 hours exclusive of the manufacturer's factory tests, can be shown.
- c. Products must be supported by a service organization. System components must be environmentally suitable for the indicated locations. Submit a certified list of qualified permanent service organizations for support of the equipment which includes their addresses and qualifications. The service organizations must be reasonably convenient to the equipment installation and be able to render satisfactory service to the equipment on a regular and emergency basis during the warranty period of the contract.
- d. Exposed equipment moving parts, parts that produce high operating temperature, parts which may be electrically energized, and parts that may be a hazard to operating personnel must be insulated, fully enclosed, guarded, or fitted with other types of safety devices. Install safety devices so that proper operation of equipment is not impaired. Welding and cutting safety requirements must be in accordance with AWS Z49.1.
- e. Provide the manufacturer's standard catalog data, at least 5 weeks prior to the purchase or installation of a particular component. Highlight the data to show information such as, but not limited to, material, size, options, performance charts, and curves in adequate detail to demonstrate compliance with contract requirements. Include the manufacturer's recommended installation instructions and procedures in the data provided. Provide data for the following components as a minimum:

- (1) Piping and Fittings

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- (2) Valves
- (3) Piping Accessories
- (4) Pipe Hangers, Inserts, and Supports

## 2.2 ELECTRICAL WORK

Electrical equipment and wiring must be in accordance with Section 26 20 00 INTERIOR DISTRIBUTION SYSTEM. Field wiring must be in accordance with manufacturer's instructions.

## 2.3 REFRIGERANT PIPING SYSTEM

Provide refrigerant piping, valves, fittings, and accessories in accordance with ASHRAE 15 & 34 and ASME B31.5, except as specified herein. Refrigerant piping, valves, fittings, and accessories must be compatible with the fluids used and capable of withstanding the pressures and temperatures of the service. Refrigerant piping, valves, and accessories used for refrigerant service must be cleaned, dehydrated, and sealed (capped or plugged) prior to shipment from the manufacturer's plant. Submit drawings, at least 5 weeks prior to beginning construction, provided in adequate detail to demonstrate compliance with contract requirements. Drawings must consist of:

- a. Piping layouts which identify all valves and fittings.
- b. Plans and elevations which identify clearances required for maintenance and operation.

## 2.4 PIPE, FITTINGS AND END CONNECTIONS (JOINTS)

### 2.4.1 Steel Pipe

Steel pipe for refrigerant service must conform to ASTM A53/A53M, Schedule 40, Type E or S, Grades A or B. Do not use Type F pipe.

#### 2.4.1.1 Welded Fittings and Connections

Butt-welded fittings must conform to ASME B16.9. Socket-welded fittings must conform to ASME B16.11. Identify welded fittings with the appropriate grade and marking symbol. Welded valves and pipe connections (both butt-welds and socket-welds types) must conform to ASME B31.9.

#### 2.4.1.2 Threaded Fittings and Connections

Threaded fitting must conform to ASME B16.3. Threaded valves and pipe connections must conform to ASME B1.20.1.

#### 2.4.1.3 Flanged Fittings and Connections

Flanges must conform to ASME B16.5, Class 150. Gaskets must be non-asbestos compressed material in accordance with ASME B16.21, 1/16 inch thickness, full face or self-centering flat ring type. Gaskets must contain aramid fibers bonded with styrene butadiene rubber (SBR) or nitrile butadiene rubber (NBR). Bolts, nuts, and bolt patterns must conform to ASME B16.5. Bolts must be high or intermediate strength material conforming to ASTM A193/A193M.

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#### 2.4.2 Copper Tubing

Provide copper tubing conforming to ASTM B280 annealed or hard drawn as required. Copper tubing must bear the product identification markings in accordance with ASTM B280, "ACR" must be present on copper tubing. Copper tubing must be soft annealed where bending is required and hard drawn where no bending is required. Soft annealed copper tubing must not be used in sizes larger than 1-3/8 inches. Joints must be brazed except that joints on lines 7/8 inch and smaller may be flared. Cast copper alloy fittings for flared copper tube must conform to ASME B16.26 and ASTM B62. Wrought copper and bronze solder-joint pressure fittings must conform to ASME B16.22 and ASTM B75/B75M. Joints and fittings for brazed joint must be wrought-copper or forged-brass sweat fittings. Cast sweat-type joints and fittings are not allowed for brazed joints. Brass or bronze adapters for brazed tubing may be used for connecting tubing to flanges and to threaded ends of valves and equipment.

#### 2.4.3 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.

#### 2.4.4 Brazing Filler Metal

Filler metal must conform to AWS A5.8/A5.8M, Type BAg-5 with AWS Type FB3-A or Type FB3-C flux, except Type BCuP-3, BCuP-4, or BCuP-5 may be used for brazing copper-to-copper joints. BAlSi-4 with AWS Type FB1-A flux may be used when joining copper piping to aluminum components.

#### 2.4.5 Brazing Flux

Brazing flux must conform to AWS A5.31/A5.31M, Type FB3-A or Type FB3-C when using Type BAg-5 filler metal. Type FB1-A is to be used with Type BAlSi-4 filler metal.

#### 2.4.6 Press Fittings

Press fittings are not acceptable for use in refrigerant piping systems.

### 2.5 VALVES

Valves must be designed, manufactured, and tested specifically for refrigerant service. The valve material and all internal components must be compatible with the specific refrigerant and lubricant used. Valve bodies must be of brass, bronze, steel, or ductile iron construction. Valves 1 inch and smaller must have brazed 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.



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#### 2.5.1 Refrigerant Stop Valves

Valve must be the globe or full-port ball type with a back-seating stem especially packed for refrigerant service. Valve packing must be replaceable under line pressure. Provide valve with a handwheel or wrench operator and a seal cap. Valve must be the straight or angle pattern design as indicated.

#### 2.5.2 Check Valves

Valve must be the swing or lift type as required to provide positive shutoff at the differential pressure indicated. Valve must be provided with resilient seat.

#### 2.5.3 Liquid Solenoid Valves

Provide valves that comply with AHRI 760 I-P and are suitable for continuous duty with applied voltages 15 percent under and 5 percent over nominal rated voltage at maximum and minimum encountered pressure and temperature service conditions. Valves must be direct-acting or pilot-operating type, packless, except that packed stem, seal capped, manual lifting provisions must be furnished. Provide solenoid coils that are moisture-proof, UL approved, totally encapsulated or encapsulated and metal jacketed as required. Valves must have safe working pressure of 610 psi and a maximum operating pressure differential of at least 200 psi at 85 percent rated voltage. Valves must have an operating pressure differential suitable for the refrigerant used.

#### 2.5.4 Expansion Valves

Provide valve conforming to AHRI 750 I-P and ASHRAE 17. Valve must be the diaphragm and spring-loaded type with internal or external equalizers, and bulb and capillary tubing. Provide valve with an external superheat adjustment along with a seal cap. Internal equalizers may be utilized where flowing refrigerant pressure drop between outlet of the valve and inlet to the evaporator coil is negligible and pressure drop across the evaporator is less than the pressure difference corresponding to 2 degrees F of saturated suction temperature at evaporator conditions. Bulb charge must be determined by the manufacturer for the application and such that liquid will remain in the bulb at all operating conditions. Do not use gas limited liquid charged valves and other valve devices for limiting evaporator pressure without a distributor or discharge tube or effective means to prevent loss of control when bulb becomes warmer than valve body. Pilot-operated valves must have a characterized plug to provide required modulating control. A de-energized solenoid valve may be used in the pilot line to close the main valve in lieu of a solenoid valve in the main liquid line. Provide an isolatable pressure gauge in the pilot line, at the main valve. Automatic pressure reducing or constant pressure regulating expansion valves may be used only where indicated or for constant evaporator loads.

#### 2.5.5 Electronic Expansion Valves

Valve must conform to AHRI 1370 I-P and ASHRAE 17. The valve must prevent the return of liquid to the compressor in the event of power loss or low superheat.

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#### 2.5.6 Safety Relief Valves

Valve must be the two-way type, unless indicated otherwise. Valve must bear the ASME code symbol. Valve capacity must be certified by the National Board of Boiler and Pressure Vessel Inspectors. Valve must be of an automatically reseating design after activation.

#### 2.5.7 Evaporator Pressure Regulators, Direct-Acting

Valve must include a diaphragm/spring assembly, external pressure adjustment with seal cap, and pressure gauge port. Valve must maintain a constant inlet pressure by balancing inlet pressure on diaphragm against an adjustable spring load. Pressure drop at system design load must not exceed the pressure difference corresponding to a 2 degrees F change in saturated refrigerant temperature at evaporator operating suction temperature. Spring must be selected for indicated maximum allowable suction pressure range.

#### 2.5.8 Refrigerant Access Valves

Provide refrigerant access valves and hose connections in accordance with AHRI 720.

### 2.6 PIPING ACCESSORIES

#### 2.6.1 Filter Driers

Driers must conform to AHRI 710 I-P. Sizes 5/8 inch and larger must be the full flow, replaceable core type. Sizes 1/2 inch and smaller must be the sealed type. Cores must be of suitable desiccant that will not plug, cake, dust, channel, or break down, and must remove water, acid, and foreign material from the refrigerant. Construct filter driers so that none of the desiccant will pass into the refrigerant lines. Minimum bursting pressure must be 1,500 psi.

#### 2.6.2 Sight Glass and Liquid Level Indicator

##### 2.6.2.1 Assembly and Components

Assembly must be pressure- and temperature-rated and constructed of materials suitable for the service. Glass must be borosilicate type. Ferrous components subject to condensation must be electro-galvanized.

##### 2.6.2.2 Gauge Glass

Gauge glass must include top and bottom isolation valves fitted with automatic checks, and packing followers; red-line or green-line gauge glass; elastomer or polymer packing to suit the service; and gauge glass guard.

##### 2.6.2.3 Bull's-Eye and Inline Sight Glass Reflex Lens

Provide bull's-eye and inline sight glass reflex lens for dead-end liquid service. For pipe line mounting, provide two plain lenses in one body suitable for backlighted viewing.

##### 2.6.2.4 Moisture Indicator

Indicator must be a self-reversible action, moisture reactive, color

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changing media. Indicator must be furnished with full-color-printing tag containing color, moisture, and temperature criteria. Unless otherwise indicated, the moisture indicator must be an integral part of each corresponding sight glass.

#### 2.6.3 Vibration Dampeners

Dampeners must be of the all-metallic bellows and woven-wire type.

#### 2.6.4 Flexible Pipe Connectors

Connector must be a composite of interior corrugated phosphor bronze or Type 300 Series stainless steel, as required for fluid service, with exterior reinforcement of bronze, stainless steel or monel wire braid. Assembly must be constructed with a safety factor of not less than 4 at 300 degrees F. Unless otherwise indicated, the length of a flexible connector must be as recommended by the manufacturer for the service intended.

#### 2.6.5 Strainers

Strainers used in refrigerant service must have brass or cast-iron body, Y-or angle-pattern, cleanable, not less than 60-mesh noncorroding screen of an area to provide net free area not less than ten times the pipe diameter with pressure rating compatible with the refrigerant service. Screens must be stainless steel or monel and reinforced spring-loaded where necessary for bypass-proof construction.

#### 2.6.6 Pressure and Vacuum Gauges

Provide gauges conforming to ASME B40.100 with throttling type needle valve or a pulsation dampener and shut-off valve. Gauge must be a minimum of 3-1/2 inches in diameter with a range from 0 psig to approximately 1.5 times the maximum system working pressure. Select each gauge range so that at normal operating pressure, the needle is within the middle-third of the range.

#### 2.6.7 Temperature Gauges

Provide industrial duty type temperature gauges for the required temperature range. Gauges must have Fahrenheit scale in 2 degrees graduations scale (black numbers) on a white face. The pointer must be adjustable. Provide rigid stem type temperature gauges in thermowells located within 5 feet of the finished floor. Provide universal adjustable angle type or remote element type temperature gauges in thermowells located 5 to 7 feet above the finished floor. Provide remote element type temperature gauges in thermowells located 7 feet above the finished floor.

##### 2.6.7.1 Stem Cased-Glass

Provide stem cased-glass case composed of polished stainless steel or cast aluminum, 9 inches long, with clear acrylic lens, and non-mercury filled glass tube with indicating-fluid column.

##### 2.6.7.2 Bimetallic Dial

Provide bimetallic dial type case that is greater than 3-1/2 inches, stainless steel, and hermetically sealed with clear acrylic lens. Bimetallic element must be silicone dampened and unit fitted with external calibrator adjustment. Accuracy must be one percent of dial range.

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#### 2.6.7.3 Liquid-, Solid-, and Vapor-Filled Dial

Provide liquid-, solid-, and vapor-filled dial type cases that are greater than 3-1/2 inches, stainless steel or cast aluminum with clear acrylic lens. Fill must be nonmercury, suitable for encountered cross-ambients, and connecting capillary tubing must be double-braided bronze.

#### 2.6.7.4 Thermowell

Thermowell must be identical size, 1/2 or 3/4 inch NPT connection, brass or stainless steel. Where test wells are indicated, provide captive plug-fitted type 1/2 inch NPT connection suitable for use with either engraved stem or standard separable socket thermometer or thermostat. Mercury must not be used in thermometers. Extended neck thermowells must be of sufficient length to clear insulation thickness by 1 inch.

#### 2.6.8 Pipe Hangers, Inserts, and Supports

Provide pipe hangers, inserts, guides, and supports conforming to MSS SP-58.

#### 2.6.9 Escutcheons

Escutcheons must be chromium-plated iron or chromium-plated brass, either one piece or split pattern, held in place by internal spring tension or set screws.

### 2.7 FABRICATION

#### 2.7.1 Factory Coating

Unless otherwise specified, equipment and component items, when fabricated from ferrous metal, must be factory finished with the manufacturer's standard finish, except that items located outside of buildings must have weather resistant finishes that will withstand 125 hours exposure to the salt spray test specified in ASTM B117 using a 5 percent sodium chloride solution. Immediately after completion of the test, the specimen must show no signs of blistering, wrinkling, cracking, or loss of adhesion and no sign of rust creepage beyond 1/8 inch on either side of the scratch mark. Cut edges of galvanized surfaces where hot-dip galvanized sheet steel is used must be coated with a zinc-rich coating conforming to ASTM D520, Type I.

#### 2.7.2 Factory Applied Insulation

Factory installed insulation must be in accordance with ASHRAE 90.1 - IP. Refrigerant suction lines between the cooler and each compressor must be insulated with not less than 1/2 inch thick unicellular plastic foam. Factory insulated items installed outdoors are not required to be fire-rated. As a minimum, factory insulated items installed indoors must have a flame spread index no higher than 25 and a smoke developed index no higher than 50. Factory insulated items (no jacket) installed indoors and which are located in air plenums, in ceiling spaces, and in attic spaces must have a flame spread index no higher than 25 and a smoke developed index no higher than 50. Flame spread and smoke developed indexes must be determined by ASTM E84. Test insulation in the same density and installed thickness as the material to be used in the actual construction. Test material supplied by a manufacturer with a jacket as a composite material. Provide jackets, facings, and adhesives that have a flame

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spread index less than 25 and a smoke developed index less than 50 when tested in accordance with ASTM E84.

### PART 3 EXECUTION

#### 3.1 EXAMINATION

After becoming familiar with all details of the work, perform a verification of dimensions in the field. Submit a letter, at least 2 weeks prior to beginning construction, including the date the site was visited, conformation of existing conditions, and any discrepancies found before performing any work.

#### 3.2 INSTALLATION

Pipe and fitting installation must conform to the requirements of ASME B31.1. Cut pipe accurately to measurements established at the jobsite, and work into place without springing or forcing, completely clearing all windows, doors, and other openings. Cutting or other weakening of the building structure to facilitate piping installation is not permitted without written approval. Cut pipe or tubing square, remove by reaming, and permit free expansion and contraction without causing damage to the building structure, pipe, joints, or hangers.

##### 3.2.1 Directional Changes

Make changes in direction with fittings, except that bending of pipe 4 inches and smaller is permitted, provided a pipe bender is used and wide weep bends are formed. Mitering or notching pipe or other similar construction to form elbows or tees is not permitted. The centerline radius of bends must not be less than 6 diameters of the pipe. Bent pipe showing kinks, wrinkles, flattening, or other malformations will not be accepted.

##### 3.2.2 Functional Requirements

Install piping sloped at 1/2 inch/10 feet of pipe in the direction of flow to ensure adequate oil drainage. Properly cap or plug open ends of refrigerant lines or equipment during installation to keep moisture, dirt, or other foreign material out of the system. Piping must remain capped until installation. Equipment piping must be in accordance with the equipment manufacturer's recommendations and the contract drawings. Equipment and piping arrangements must fit into space allotted and allow adequate acceptable clearances for installation, replacement, entry, servicing, and maintenance.

##### 3.2.3 Fittings and End Connections

###### 3.2.3.1 Threaded Connections

Make threaded connections with tapered threads and make tight with PTFE tape complying with ASTM D3308 or equivalent thread-joint compound applied to the male threads only. Do not show more than three threads after the joint is made.

###### 3.2.3.2 Brazed Connections

Perform brazing in accordance with AWS BRH, except as modified herein. During brazing, fill the pipe and fittings with a pressure regulated inert

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gas, such as nitrogen, to prevent the formation of scale. Before brazing copper joints, clean both the outside of the tube and the inside of the fitting with a wire fitting brush until the entire joint surface is bright and clean. Do not use brazing flux on copper-to-copper connections. Remove surplus brazing material at all joints. Make steel tubing joints in accordance with the manufacturer's recommendations. Paint joints in steel tubing with the same material as the baked-on coating within 8 hours after joints are made. Protect tubing against oxidation during brazing by continuous purging of the inside of the piping using nitrogen. Support piping prior to brazing and do not spring or force.

#### 3.2.3.3 Welded Connections

Fusion-weld joints in steel refrigerant piping. 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

#### 3.2.3.4 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.

#### 3.2.3.5 Flanged Connections

When steel refrigerant piping is used, provide union or flange joints in each line immediately preceding the connection to each piece of equipment requiring maintenance, such as compressors, coils, chillers, control valves, and other similar items. 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.

#### 3.2.4 Valves

##### 3.2.4.1 General

Install refrigerant stop valves on each side of each piece of equipment such as compressors condensers, evaporators, receivers, and other similar items in multiple-unit installation, to provide partial system isolation as required for maintenance or repair. Install stop valves with stems horizontal unless otherwise indicated. Install ball valves must be installed with stems positioned to facilitate operation and maintenance. Isolating valves for pressure gauges and switches must be external to thermal insulation. Safety switches must not be fitted with isolation valves. Filter dryers having access ports may be considered a point of isolation. Purge valves must be provided at all points of systems where accumulated non-condensable gases would prevent proper system operation. Valves must be furnished to match line size, unless otherwise indicated or approved.

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#### 3.2.4.2 Expansion Valves

Install expansion valves with the thermostatic expansion valve bulb located on top of the suction line when the suction line is less than 2-1/8 inches in diameter and at the 4 o'clock or 8 o'clock position on lines larger than 2-1/8 inches. Fasten the bulb securely with two clamps. Insulate the bulb. Install the bulb in a horizontal portion of the suction line, if possible, with the pigtail on the bottom. If the bulb must be installed in a vertical line, the bulb tubing must be facing up.

#### 3.2.4.3 Valve Identification

Tag each system valve, including those which are part of a factory assembly. Tags must be in alphanumeric sequence, progressing in direction of fluid flow. Tags must be embossed, engraved, or stamped plastic or nonferrous metal of various shapes, sized approximately 1-3/8 inch diameter, or equivalent dimension, substantially attached to a component or immediately adjacent thereto. Attach tags with nonferrous, heavy duty, bead or link chain, 14 gauge annealed wire, nylon cable bands or as approved. Reference tag numbers in Operation and Maintenance Manuals and system diagrams.

#### 3.2.5 Vibration Dampers

Provide vibration damper in the suction and discharge lines on spring mounted compressors. Install vibration dampers parallel with the shaft of the compressor and anchor firmly at the upstream end on the suction line and the downstream end in the discharge line.

#### 3.2.6 Strainers

Provide strainers immediately ahead of solenoid valves and expansion devices. Strainers may be an integral part of an expansion valve.

#### 3.2.7 Filter Dryer

Provide a liquid line filter dryer on each refrigerant circuit located such that all liquid refrigerant passes through a filter dryer. Size dryers in accordance with the manufacturer's recommendations for the system in which it is installed. Install dryers such that it can be isolated from the system, the isolated portion of the system evacuated, and the filter dryer replaced. Install dryers in the horizontal position except replaceable core filter dryers may be installed in the vertical position with the access flange on the bottom.

#### 3.2.8 Sight Glass

Install a moisture indicating sight glass in all refrigerant circuits downstream of all filter dryers and where indicated. Provide full line size sight glasses.

#### 3.2.9 Discharge Line Oil Separator

Provide discharge line oil separator in the discharge line from each compressor. Connect the oil return line to the compressor as recommended by the compressor manufacturer.

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### 3.2.10 Accumulator

Provide accumulators in the suction line to each compressor.

### 3.2.11 Flexible Pipe Connectors

Install connectors perpendicular to line of motion being isolated. Fit piping for equipment with bidirectional motion with two flexible connectors, in perpendicular planes. Install reinforced elastomer flexible connectors in accordance with manufacturer's instructions. Provide piping guides and restraints related to flexible connectors as required.

### 3.2.12 Temperature Gauges

Locate temperature gauges specifically on, but not limited to the following: the sensing element of each automatic temperature control device where a thermometer is not an integral part thereof. Thermowells for insertion thermometers and thermostats must extend beyond thermal insulation surface not less than 1 inch.

### 3.2.13 Pipe Hangers, Inserts, and Supports

Pipe hangers, inserts, and supports must conform to MSS SP-58, except as modified herein. Do not use pipe hanger types 5, 12, and 26. Fabricate hangers used to support piping 2 inches and larger to permit adequate adjustment after erection while still supporting the load. Support piping subjected to vertical movement, when operating temperatures exceed ambient temperatures, by variable spring hangers and supports or by constant support hangers.

#### 3.2.13.1 Hangers

Do not use Type 3 on insulated piping. Type 24 may be used only on trapeze hanger systems or on fabricated frames.

#### 3.2.13.2 Inserts

Secure Type 18 inserts to concrete forms before concrete is placed. Continuous inserts which allow more adjustments may be used if they otherwise meet the requirements for Type 18 inserts.

#### 3.2.13.3 C-Clamps

Torque Type 19 and 23 C-clamps in accordance with MSS SP-58 and have both locknuts and retaining devices, furnished by the manufacturer. Field-fabricated C-clamp bodies or retaining devices are not acceptable.

#### 3.2.13.4 Angle Attachments

Furnish Type 20 attachments used on angles and channels with an added malleable-iron heel plate or adapter.

#### 3.2.13.5 Saddles and Shields

Where Type 39 saddle or Type 40 shield are permitted for a particular pipe attachment application, the Type 39 saddle, connected to the pipe, must be used on all pipe 4 inches and larger when the temperature of the medium is 60 degrees F or higher. Use Type 40 shields on all piping less than 4



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inches and all piping 4 inches and larger carrying medium less than 60 degrees F. Use a high-density insulation insert of cellular glass under the Type 40 shield for piping 2 inches and larger.

#### 3.2.13.6 Horizontal Pipe Supports

Space horizontal pipe supports as specified in MSS SP-58 and install a support no more than 1 foot from the pipe fitting joint at each change in direction of the piping. Space pipe supports no more than 5 feet apart at valves. Pipe hanger loads suspended from steel joist with hanger loads between panel points in excess of 50 pounds must have the excess hanger loads suspended from panel points.

#### 3.2.13.7 Vertical Pipe Supports

Support vertical pipe at each floor, except at slab-on-grade, and at intervals of not more than 15 feet not more than 8 feet from end of risers, and at vent terminations.

#### 3.2.13.8 Pipe Guides

Provide Type 35 guides using, steel, reinforced polytetrafluoroethylene (PTFE) or graphite slides where required to allow longitudinal pipe movement. Provide lateral restraints as required. Provide slide materials that are suitable for the system operating temperatures, atmospheric conditions, and bearing loads encountered.

#### 3.2.13.9 Steel Slides

Where steel slides do not require provisions for restraint of lateral movement, an alternate guide method may be used. On piping 4 inches and larger, use a Type 39 saddle. On piping under 4 inches, a Type 40 protection shield may be attached to the pipe or insulation and freely rest on a steel slide plate.

#### 3.2.13.10 High Temperature Guides with Cradles

Where there are high system temperatures and welding to piping is not desirable, the Type 35 guide must include a pipe cradle, welded to the guide structure and strapped securely to the pipe. Separate the pipe from the slide material by at least 4 inches, or by an amount adequate for the insulation, whichever is greater.

#### 3.2.13.11 Multiple Pipe Runs

In the support of multiple pipe runs on a common base member, use a clip or clamp where each pipe crosses the base support member. Spacing of the base support members must not exceed the hanger and support spacing required for an individual pipe in the multiple pipe run.

#### 3.2.13.12 Seismic Requirements

Support and brace piping and attached valves to resist seismic loads as specified under UFC 3-301-01. Provide structural steel required for reinforcement to properly support piping, headers, and equipment but not shown under this section. Specify material used for support under Section 05 12 00 STRUCTURAL STEEL.

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### 3.2.13.13 Structural Attachments

Attachment to building structure concrete and masonry must be by cast-in concrete inserts, built-in anchors, or masonry anchor devices. Inserts and anchors must be applied with a safety factor not less than 5. Do not attach supports to metal decking. Construct masonry anchors for overhead applications of ferrous materials only. Provide structural steel brackets required to support piping, headers, and equipment, but not shown, under this section. Specify material used for support under Section 05 12 00 STRUCTURAL STEEL.

### 3.2.14 Pipe Alignment Guides

Provide pipe alignment guides where indicated for expansion loops, offsets, and bends and as recommended by the manufacturer for expansion joints, not to exceed 5 feet on each side of each expansion joint, and in lines 4 inches or smaller not more than 2 feet on each side of the joint.

### 3.2.15 Pipe Anchors

Provide anchors wherever necessary or indicated to localize expansion or to prevent undue strain on piping. Provide anchors consisting of heavy steel collars with lugs and bolts for clamping and attaching anchor braces, unless otherwise indicated. Install anchor braces in the most effective manner to secure the desired results using turnbuckles where required. Do not attach supports, anchors, or stays where they will injure the structure or adjacent construction during installation or by the weight of expansion of the pipeline. Where pipe and conduit penetrations of vapor barrier sealed surfaces occur, immediately anchor these items adjacent to each penetrated surface, to provide essentially zero movement within penetration seal. Submit detailed drawings of pipe anchors for approval before installation.

### 3.2.16 Building Surface Penetrations

Do not install sleeves in structural members except where indicated or approved. Provide galvanized sheet metal sleeves in non-load bearing surfaces conforming to ASTM A653/A653M, Coating Class G-90, 20 gauge. Provide uncoated carbon steel pipe sleeves in load bearing surfaces conforming to ASTM A53/A53M, Schedule 30. Apply sealants to moisture and oil-free surfaces and elastomers to not less than 1/2 inch depth. Do not install sleeves in structural members.

#### 3.2.16.1 General Service Areas

Extend each sleeve through its respective wall, floor, or roof, and cut flush with each surface. Provide pipes passing through concrete or masonry wall or concrete floors or roofs with pipe sleeves fitted into place at the time of construction. Provide sleeves that allow a minimum of 1/4 inch all-around clearance between bare pipe and sleeves or between jacketed-insulation and sleeves. Except in pipe chases or interior walls, seal the annular space between pipe and sleeve or between jacket over-insulation and sleeve in accordance with Section 07 92 00 JOINT SEALANTS.

#### 3.2.16.2 Waterproof Penetrations

Install pipes passing through roof or floor waterproofing membrane through a 17 ounce copper sleeve, or a 0.032 inch thick aluminum sleeve, each

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within an integral skirt or flange. Form flashing sleeve, and extend skirt or flange greater than 8 inches from the pipe and set over the roof or floor membrane in a troweled coating of bituminous cement. Extend the flashing sleeve up the pipe a minimum of 2 inches above the roof or floor penetration. Seal the annular space between the flashing sleeve and the bare pipe or between the flashing sleeve and the metal-jacket-covered insulation as indicated. Seal penetrations by either one of the following methods.

#### 3.2.16.2.1 Waterproofing Clamping Flange

Pipes up to and including 10 inches in diameter passing through roof or floor waterproofing membrane may be installed through a cast iron sleeve with caulking recess, anchor lugs, flashing clamp device, and pressure ring with brass bolts. Clamp waterproofing membrane into place and place sealant in the caulking recess.

#### 3.2.16.2.2 Modular Mechanical Type Sealing Assembly

In lieu of a waterproofing clamping flange and caulking and sealing of annular space between pipe and sleeve or conduit and sleeve, a modular mechanical type sealing assembly may be installed. Provide seals consisting of interlocking synthetic rubber links shaped to continuously fill the annular space between the pipe/conduit and sleeve with corrosion protected carbon steel bolts, nuts, and pressure plates. Loosely assemble links with bolts to form a continuous rubber belt around the pipe with a pressure plate under each bolt head and each nut. After the seal assembly is properly positioned in the sleeve, tighten the bolt to cause the rubber sealing elements to expand and provide a watertight seal between the pipe/conduit and the sleeve. Size each seal assembly as recommended by the manufacturer to fit the pipe/conduit and sleeve involved. The Contractor electing to use the modular mechanical type seals must provide sleeves of the proper diameters.

#### 3.2.16.3 Fire-Rated Penetrations

Seal penetration of fire-rated walls, partitions, and floors as specified in Section 07 84 00 FIRESTOPPING.

#### 3.2.16.4 Escutcheons

Provide escutcheons for finished surfaces where exposed piping, bare or insulated, pass through floors, walls, or ceilings, except in boiler, utility, or equipment rooms. Where sleeves project slightly from floors, use special deep-type escutcheons. Secure escutcheon to pipe or pipe covering.

#### 3.2.17 Access Panels

Provide access panels for all concealed valves, vents, controls, and items requiring inspection or maintenance. Provide access panels of sufficient size and locate so that the concealed items may be serviced and maintained or completely removed and replaced. Provide access panels as specified in Section 08 31 00 ACCESS DOORS AND PANELS.

#### 3.2.18 Field Applied Insulation

Field installed insulation is specified in Section 23 07 00 THERMAL INSULATION FOR MECHANICAL SYSTEMS, except as defined differently herein.

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### 3.2.19 Field Painting

Painting required for surfaces not otherwise specified, and finish painting of items only primed at the factory are specified in Section 09 90 00 PAINTS AND COATINGS.

#### 3.2.19.1 Color Coding

Color coding for piping identification is specified in Section 09 90 00 PAINTS AND COATINGS.

#### 3.2.19.2 Color Coding Scheme

Provide a color coding scheme for locating hidden piping in accordance with Section 22 00 00 PLUMBING, GENERAL PURPOSE.

### 3.2.20 Identification Tags

Provide identification tags made of brass, engraved laminated plastic or engraved anodized aluminum indicating service and item number on all valves and dampers. Tags must be 1-3/8 inch minimum diameter and marking must be stamped or engraved. Indentations must be black for reading clarity. Attach tags to valves with No. 12 AWG copper wire, chrome-plated beaded chain or plastic straps designed for that purpose.

### 3.3 CLEANING AND ADJUSTING

Clean uncontaminated system(s) by evacuation and purging procedures currently recommended by refrigerant and refrigerant equipment manufacturers, and as specified herein, to remove small amounts of air and moisture. Systems containing moderate amounts of air, moisture, contaminated refrigerant, or any foreign matter are considered contaminated systems. Restore contaminated systems to clean condition including disassembly, component replacement, evacuation, flushing, purging, and re-charging, using currently approved refrigerant and refrigeration manufacturer's procedures. Restore contaminated systems at no additional cost to the Government as determined by the Contracting Officer. Do not use water in any procedure or test.

### 3.4 TRAINING COURSE

- a. Submit a schedule, at least 2 weeks prior to the date of the proposed training course, which identifies the date, time, and location for the training. Conduct a training course for 4 members of the operating staff as designated by the Contracting Officer. The training period must consist of a total 8 hours of normal working time and start after the system is functionally completed but prior to final acceptance tests.
- b. Cover all of the items contained in the approved operation and maintenance manuals as well as demonstrations of routine maintenance operations in the field posted instructions..
- c. Submit 6 complete copies of an operation manual in bound 8 1/2 by 11 inch booklets listing step-by-step procedures required for system startup, operation, abnormal shutdown, emergency shutdown, and normal shutdown at least 4 weeks prior to the first training course. Include the manufacturer's name, model number, and parts list in the

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booklets. Include the manufacturer's name, model number, service manual, and a brief description of all equipment and their basic operating features in the manuals.

- d. Submit 6 complete copies of maintenance manual in bound 8 1/2 x 11 inch booklets listing routine maintenance procedures, possible breakdowns and repairs, and a trouble shooting guide. Include piping layouts and simplified wiring and control diagrams of the system as installed in the manuals.

### 3.5 REFRIGERANT PIPING TESTS

After all components of the refrigerant system have been installed and connected, subject the entire refrigeration system to pneumatic, evacuation, and startup tests as described herein. Submit a schedule, at least 2 weeks prior to the start of related testing, for each test. Identify the proposed date, time, and location for each test. Conduct tests in the presence of the Contracting Officer. Water and electricity required for the tests will be furnished by the Government. Provide all material, equipment, instruments, and personnel required for the test. Provide the services of a qualified technician, as required, to perform all tests and procedures indicated herein. Coordinate field tests with Section 23 05 93.00 06 TESTING, ADJUSTING, AND BALANCING (TAB) OF HVAC. Submit 6 copies of the tests report in bound 8 1/2 by 11 inch booklets documenting all phases of the tests performed. Include initial test summaries, all repairs/adjustments made, and the final test results in the report.

#### 3.5.1 Preliminary Procedures

Prior to pneumatic testing, isolate equipment which has been factory tested and refrigerant charged as well as equipment which could be damaged or cause personnel injury by imposed test pressure, positive or negative, from the test pressure, or remove from the system. Remove safety relief valves and rupture discs that are not part of factory sealed systems, and cap or plug openings.

#### 3.5.2 Pneumatic Test

Provide pressure control and excess pressure protection at the source of test pressure. Valves must be wide open, except those leading to the atmosphere. Test gas must be dry nitrogen, with minus 70 degree F dewpoint and less than 5 ppm oil. Apply test pressure in two stages before any refrigerant pipe is insulated or covered. In accordance with ASME B31.5, a preliminary test not to exceed 25 psi must be applied as a means of locating major leaks. Every joint being tested must be coated with a thick soap or color indicating solution. The second stage test pressure must be at least 110 percent of the design pressure, but cannot exceed 130 percent of the design pressure of any component in the system. For large systems that are not completely visible, the pressure in the system must be gradually increased to one-half of the test pressure after which the pressure must be increased in steps of one-tenth of the test pressure, until the required test pressure has been reached. The test pressure must be continuously maintained for at least 24 hours, after which it can be reduced to the leak test pressure. A correction factor of 0.3 psi will be allowed for each degree F change between test space initial and final ambient temperature, plus for increase and minus for a decrease. The leak test pressure must be the design pressure, or a pressure specified in the engineering design. To repair leaks, the joint

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must be taken apart, thoroughly cleaned, and reconstructed as a new joint. Joints repaired by caulking, re-melting, or back-welding/brazing are not acceptable. Following repair, the entire system must be retested using the pneumatic tests described above. Reassemble the entire system once the pneumatic tests are satisfactorily completed.

### 3.5.3 Evacuation Test

Following satisfactory completion of the pneumatic tests, relieve the pressure and evacuate the entire system to an absolute pressure of 300 micrometers. During evacuation of the system, the ambient temperature must be higher than 35 degrees F. Do not evacuate no more than one system at one time by one vacuum pump. Once the desired vacuum has been reached, close the vacuum line and allow the system to stand for 1 hour. If the pressure rises over 500 micrometers after the 1 hour period, evacuate the system again down to 300 micrometers and let set for another 1 hour period. Do not charge the system until a vacuum of at least 500 micrometers is maintained for a period of 1 hour without the assistance of a vacuum line. If during the testing the pressure rises above 500 micrometers, continue to repeat the evacuation procedures until all residual moisture has been removed. During evacuation, record pressures by a thermocouple-type, electronic-type, or a calibrated-micrometer type gauge.

### 3.5.4 System Charging and Startup Test

Following satisfactory completion of the evacuation tests, charge the system with the required amount of refrigerant by raising pressure to normal operating pressure and in accordance with manufacturer's procedures. Following charging, the system must operate with high-side and low-side pressures and corresponding refrigerant temperatures, at design or improved values. Test the entire system tested for leaks. Test fluorocarbon systems with halide torch or electronic leak detectors.

### 3.5.5 Refrigerant Leakage

If a refrigerant leak is discovered after the system has been charged, the leaking portion of the system must be immediately isolated from the remainder of the system and the refrigerant pumped into the system receiver or other suitable container. The refrigerant must not be discharged into the atmosphere.

### 3.5.6 Contractor's Responsibility

At all times during the installation and testing of the refrigeration system, take steps to prevent the release of refrigerants into the atmosphere. The steps must include, but not be limited to, procedures which will minimize the release of refrigerants to the atmosphere and the use of refrigerant recovery devices to remove refrigerant from the system and store the refrigerant for reuse or reclaim. At no time will the allowable leak rate exceed the leak rates allowed in Section 608 of the Clean Air Act: 30 percent of the full charge per year for industrial refrigeration, 20 percent of the full charge per year for commercial refrigeration, and 10 percent of the full charge per year for comfort cooling. Any system leaks within the first year must be repaired in accordance with the requirements herein at no cost to the Government including material, labor, and refrigerant if the leak is the result of defective equipment, material, or installation.

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-- End of Section --

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## SECTION 23 30 00

HVAC AIR DISTRIBUTION  
 05/20

## PART 1 GENERAL

## 1.1 REFERENCES

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

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

AMCA 201	(2002; R 2011) Fans and Systems
AMCA 210	(2016) Laboratory Methods of Testing Fans for Aerodynamic Performance Rating
AMCA 300	(2014) Reverberant Room Method for Sound Testing of Fans
AMCA 301	(2014) Methods for Calculating Fan Sound Ratings from Laboratory Test Data
AMCA 500-D	(2018) Laboratory Methods of Testing Dampers for Rating

## AIR-CONDITIONING, HEATING AND REFRIGERATION INSTITUTE (AHRI)

AHRI 260 I-P	(2012) Sound Rating of Ducted Air Moving and Conditioning Equipment
AHRI 350	(2015) Sound Rating of Non-Ducted Indoor Air-Conditioning Equipment
AHRI 410	(2001; Addendum 1 2002; Addendum 2 2005; Addendum 3 2011) Forced-Circulation Air-Cooling and Air-Heating Coils
AHRI 430	(2009) Central-Station Air-Handling Units
AHRI 880 I-P	(2011) Performance Rating of Air Terminals
AHRI 885	(2008; Addendum 2011) Procedure for Estimating Occupied Space Sound Levels in the Application of Air Terminals and Air Outlets
AHRI Guideline D	(1996) Application and Installation of Central Station Air-Handling Units

## AMERICAN BEARING MANUFACTURERS ASSOCIATION (ABMA)

ABMA 9	(2015) Load Ratings and Fatigue Life for Ball Bearings
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ABMA 11 (2014) Load Ratings and Fatigue Life for  
 Roller Bearings

AMERICAN SOCIETY OF HEATING, REFRIGERATING AND AIR-CONDITIONING  
 ENGINEERS (ASHRAE)

ASHRAE 52.2 (2017) Method of Testing General  
 Ventilation Air-Cleaning Devices for  
 Removal Efficiency by Particle Size

ASHRAE 62.1 (2010) Ventilation for Acceptable Indoor  
 Air Quality

ASHRAE 68 (1997) Laboratory Method of Testing to  
 Determine the Sound Power In a Duct

ASHRAE 70 (2006; R 2021) Method of Testing the  
 Performance of Air Outlets and Inlets

ASHRAE 84 (2020; Errata 2021) Method of Testing  
 Air-to-Air Heat/Energy Exchangers

ASHRAE 90.1 - IP (2013) Energy Standard for Buildings  
 Except Low-Rise Residential Buildings

AMERICAN SOCIETY OF MECHANICAL ENGINEERS (ASME)

ASME A13.1 (2020) Scheme for the Identification of  
 Piping Systems

ASTM INTERNATIONAL (ASTM)

ASTM A53/A53M (2020) Standard Specification for Pipe,  
 Steel, Black and Hot-Dipped, Zinc-Coated,  
 Welded and Seamless

ASTM A123/A123M (2017) Standard Specification for Zinc  
 (Hot-Dip Galvanized) Coatings on Iron and  
 Steel Products

ASTM A167 (2011) Standard Specification for  
 Stainless and Heat-Resisting  
 Chromium-Nickel Steel Plate, Sheet, and  
 Strip

ASTM A924/A924M (2020) Standard Specification for General  
 Requirements for Steel Sheet,  
 Metallic-Coated by the Hot-Dip Process

ASTM B117 (2019) Standard Practice for Operating  
 Salt Spray (Fog) Apparatus

ASTM B280 (2020) Standard Specification for Seamless  
 Copper Tube for Air Conditioning and  
 Refrigeration Field Service

ASTM B766 (1986; R 2015) Standard Specification for  
 Electrodeposited Coatings of Cadmium

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ASTM C553	(2013; R 2019) Standard Specification for Mineral Fiber Blanket Thermal Insulation for Commercial and Industrial Applications
ASTM C1071	(2019) Standard Specification for Fibrous Glass Duct Lining Insulation (Thermal and Sound Absorbing Material)
ASTM D520	(2000; R 2011) Zinc Dust Pigment
ASTM D1654	(2008; R 2016; E 2017) Standard Test Method for Evaluation of Painted or Coated Specimens Subjected to Corrosive Environments
ASTM D3359	(2017) Standard Test Methods for Rating Adhesion by Tape Test
ASTM E2016	(2020) Standard Specification for Industrial Woven Wire Cloth

#### CALIFORNIA DEPARTMENT OF PUBLIC HEALTH (CDPH)

CDPH SECTION 01350	(2010; Version 1.1) Standard Method for the Testing and Evaluation of Volatile Organic Chemical Emissions from Indoor Sources using Environmental Chambers
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#### NATIONAL ELECTRICAL MANUFACTURERS ASSOCIATION (NEMA)

NEMA MG 1	(2018) Motors and Generators
NEMA MG 10	(2017) Energy Management Guide for Selection and Use of Fixed Frequency Medium AC Squirrel-Cage Polyphase Induction Motors
NEMA MG 11	(1977; R 2012) Energy Management Guide for Selection and Use of Single Phase Motors

#### NATIONAL FIRE PROTECTION ASSOCIATION (NFPA)

NFPA 70	(2020; ERTA 20-1 2020; ERTA 20-2 2020; TIA 20-1; TIA 20-2; TIA 20-3; TIA 20-4) National Electrical Code
NFPA 90A	(2021) Standard for the Installation of Air Conditioning and Ventilating Systems
NFPA 701	(2019) Standard Methods of Fire Tests for Flame Propagation of Textiles and Films

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

SMACNA 1819	(2002) Fire, Smoke and Radiation Damper Installation Guide for HVAC Systems, 5th Edition
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SMACNA 1966	(2005) HVAC Duct Construction Standards Metal and Flexible, 3rd Edition
SMACNA 1972 CD	(2012) HVAC Air Duct Leakage Test Manual - 2nd Edition
SMACNA 1981	(2008) Seismic Restraint Manual Guidelines for Mechanical Systems, 3rd Edition

SOUTH COAST AIR QUALITY MANAGEMENT DISTRICT (SCAQMD)

SCAQMD Rule 1168	(2017) Adhesive and Sealant Applications
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U.S. DEPARTMENT OF DEFENSE (DOD)

UFC 4-010-01	(2018; with Change 1, 2020) DoD Minimum Antiterrorism Standards for Buildings
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U.S. NATIONAL ARCHIVES AND RECORDS ADMINISTRATION (NARA)

40 CFR 82	Protection of Stratospheric Ozone
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UNDERWRITERS LABORATORIES (UL)

UL 6	(2007; Reprint Sep 2019) UL Standard for Safety Electrical Rigid Metal Conduit-Steel
UL 181	(2013; Reprint Apr 2017) UL Standard for Safety Factory-Made Air Ducts and Air Connectors
UL 555	(2006; Reprint Aug 2016) UL Standard for Safety Fire Dampers
UL 586	(2009; Reprint Dec 2017) UL Standard for Safety High-Efficiency Particulate, Air Filter Units
UL 705	(2017; Reprint Aug 2021) UL Standard for Safety Power Ventilators
UL 900	(2015) Standard for Air Filter Units
UL 1995	(2015) UL Standard for Safety Heating and Cooling Equipment
UL Bld Mat Dir	(updated continuously online) Building Materials Directory
UL Electrical Construction	(2012) Electrical Construction Equipment Directory
UL Fire Resistance	(2014) Fire Resistance Directory

## 1.2 SYSTEM DESCRIPTION

Furnish ductwork, piping offsets, fittings, and accessories as required to provide a complete installation. Coordinate the work of the different

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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 equipment schedules. Identify similar services with different temperatures or pressures. Label and arrow piping in accordance with the following:

- a. Each point of entry and exit of pipe passing through walls.
- b. Each change in direction, i.e., elbows, tees.
- c. In congested or hidden areas and at all access panels at each point required to clarify service or indicated hazard.
- d. In long straight runs, locate labels at distances within eyesight of each other not to exceed 75 feet. All labels must be visible and legible from the primary service and operating area.

For Bare or Insulated Pipes	
for Outside Diameters of	Lettering
1/2 thru 1-3/8 inch	1/2 inch
1-1/2 thru 2-3/8 inch	3/4 inch
2-1/2 inch and larger	1-1/4 inch

#### 1.2.3 Color Coding

Color coding of all piping systems must be in accordance with ASME A13.1 .

#### 1.3 SUBMITTALS

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

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SD-02 Shop Drawings

Detail Drawings; G

SD-03 Product Data

Insulated Nonmetallic Flexible Duct Runouts

Duct Connectors

Duct Access Doors; G

Fire Dampers; G, AE

Manual Balancing Dampers; G

Diffusers; G, AE

Registers and Grilles; G, AE

Louvers; G, AE

Centrifugal Fans; G, AE

Centrifugal Type Power Roof Ventilators Air Handling Units; G

Variable Volume, Single Duct Terminal Units; G, AE

Reheat Units; G, AE

Unit Ventilators; G, AE

Energy Recovery Devices; G, AE

Test Procedures

Indoor Air Quality for Duct Sealants; S, AE

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

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Operation and Maintenance Manuals; G

Fire Dampers; G

Manual Balancing Dampers; G

Centrifugal Fans; G

Air Handling Units; G

Variable Volume, Single Duct Terminal Units; G

Reheat Units; G

Unit Ventilators; G

Energy Recovery Devices; G

SD-11 Closeout Submittals

Indoor Air Quality During Construction; S, AE

#### 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.

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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 93.00 06 Testing, Adjusting and Balancing (TAB) of 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,

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manufacturers' catalogs, or brochures. Products having less than a 2-year field service record are acceptable if a certified record of satisfactory field operation, for not less than 6000 hours exclusive of the manufacturer's factory tests, can be shown. Provide equipment items that are supported by a service organization. In product categories covered by ENERGY STAR or the Federal Energy Management Program, provide equipment that is listed on the ENERGY STAR Qualified Products List or that meets or exceeds the FEMP-designated Efficiency Requirements.

## 2.2 IDENTIFICATION PLATES

In addition to standard manufacturer's identification plates, provide engraved laminated phenolic identification plates for each piece of mechanical equipment. Identification plates are to designate the function of the equipment. Submit designation with the shop drawings. Provide identification plates that are layers, black-white-black, engraved to show white letters on black background. Letters must be upper case. Identification plates that are 1-1/2-inches high and smaller must be 1/16-inch thick, with engraved lettering 1/8-inch high; identification plates larger than 1-1/2-inches high must be 1/8-inch thick, with engraved lettering of suitable height. Identification plates 1-1/2-inches high and larger must have beveled edges. Install identification plates using a compatible adhesive.

## 2.3 EQUIPMENT GUARDS AND ACCESS

Fully enclose or guard belts, pulleys, chains, gears, couplings, projecting setscrews, keys, and other rotating parts exposed to personnel contact according to OSHA requirements. Properly guard or cover with insulation of a type specified, high temperature equipment and piping exposed to contact by personnel or where it creates a potential fire hazard. The requirements for catwalks, operating platforms, ladders, and guardrails are specified in Section 08 31 00 ACCESS DOORS AND PANELS.

## 2.4 ELECTRICAL WORK

- a. Provide motors, controllers, integral disconnects, contactors, and controls with their respective pieces of equipment, except controllers indicated as part of motor control centers. Provide electrical equipment, including motors and wiring, as specified in Section 26 20 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.



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- d. Provide motors in accordance with NEMA MG 1 and of sufficient size to drive the load at the specified capacity without exceeding the nameplate rating of the motor. Provide motors rated for continuous duty with the enclosure specified. Provide motor duty that allows for maximum frequency start-stop operation and minimum encountered interval between start and stop. Provide motor torque capable of accelerating the connected load within 20 seconds with 80 percent of the rated voltage maintained at motor terminals during one starting period. Provide motor starters complete with thermal overload protection and other necessary appurtenances. Fit motor bearings with grease supply fittings and grease relief to outside of the enclosure.
- e. Where two-speed or variable-speed motors are indicated, solid-state variable-speed controllers are allowed to accomplish the same function. Use solid-state variable-speed controllers for motors rated 10 hp or less and adjustable frequency drives for larger motors. Provide variable frequency drives for motors as specified in Section 26 29 23 ADJUSTABLE SPEED DRIVE SYSTEMS UNDER 600 VOLTS.

## 2.5 ANCHOR BOLTS

Provide anchor bolts for equipment placed on concrete equipment pads or on concrete slabs. Bolts to be of the size and number recommended by the equipment manufacturer and located by means of suitable templates. Installation of anchor bolts must not degrade the surrounding concrete.

## 2.6 SEISMIC ANCHORAGE

Anchor equipment in accordance with applicable seismic criteria for the area and as defined in SMACNA 1981

## 2.7 PAINTING

Paint equipment units in accordance with approved equipment manufacturer's standards unless specified otherwise. Field retouch only if approved. Otherwise, return equipment to the factory for refinishing.

## 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 .

- b. Provide radius type elbows with a centerline radius of 1.5 times the width or diameter of the duct where space permits. Otherwise, elbows having a minimum radius equal to the width or diameter of the duct or square elbows with factory fabricated turning vanes are allowed.
- c. Provide ductwork that meets the requirements of Seal Class A. Provide ductwork in VAV systems upstream of the VAV boxes that meets the requirements of Seal Class A.

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- 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 Insulated Nonmetallic Flexible Duct Runouts

Use flexible duct runouts only where indicated. Runout length is indicated on the drawings, and is not to exceed 5 feet. Provide runouts that are preinsulated, factory fabricated, and that comply with NFPA 90A and UL 181. Provide either field or factory applied vapor barrier. Provide not less than 20 ounce glass fabric duct connectors coated on both sides with neoprene. Where coil induction or high velocity units are supplied with vertical air inlets, use a streamlined, vaned and mitered elbow transition piece for connection to the flexible duct or hose. Provide a die-stamped elbow and not a flexible connector as the last elbow to these units other than the vertical air inlet type. Insulated flexible connectors are allowed as runouts. Provide insulated material and vapor barrier that conform to the requirements of Section 23 07 00 THERMAL INSULATION FOR MECHANICAL SYSTEMS. Do not expose the insulation material surface to the air stream.

#### 2.9.1.2 General Service Duct Connectors

Provide a flexible duct connector approximately 6 inches in width where sheet metal connections are made to fans or where ducts of dissimilar metals are connected. For round/oval ducts, secure the flexible material by stainless steel or zinc-coated, iron clinch-type draw bands. For rectangular ducts, install the flexible material locked to metal collars using normal duct construction methods. Provide a composite connector system that complies with NFPA 701 and is classified as "flame-retardent fabrics" in UL Bld Mat Dir.

#### 2.9.1.3 High Temperature Service Duct Connections

Provide material that is approximately 3/32 inch thick, 35 to 40-ounce per square yard weight, plain weave fibrous glass cloth with, nickel/chrome wire reinforcement for service in excess of 1200 degrees F.

#### 2.9.2 Duct Access Doors

Provide hinged access doors conforming to SMACNA 1966 in ductwork and

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plenums where indicated and at all air flow measuring primaries, automatic dampers, fire dampers, coils, thermostats, and other apparatus requiring service and inspection in the duct system. Provide access doors upstream and downstream of air flow measuring primaries and heating and cooling coils. Provide doors that are a minimum 15 by 18 inches, unless otherwise shown. Where duct size does not accommodate this size door, make the doors as large as practicable. Equip doors 24 by 24 inches or larger with fasteners operable from inside and outside the duct. Use insulated type doors in insulated ducts.

#### 2.9.3 Fire Dampers

Use 1.5 hour rated fire dampers unless otherwise indicated. Provide fire dampers that conform to the requirements of NFPA 90A and UL 555. Perform the fire damper test as outlined in NFPA 90A. Provide a pressure relief door upstream of the fire damper. If the ductwork connected to the fire damper is to be insulated then provide a factory installed pressure relief damper. Provide automatic operating fire dampers with a dynamic rating suitable for the maximum air velocity and pressure differential to which it is subjected. Provide fire dampers approved for the specific application, and install according to their listing. Equip fire dampers with a steel sleeve or adequately sized frame installed in such a manner that disruption of the attached ductwork, if any, does not impair the operation of the damper. Equip sleeves or frames with perimeter mounting angles attached on both sides of the wall or floor opening. Construct ductwork in fire-rated floor-ceiling or roof-ceiling assembly systems with air ducts that pierce the ceiling of the assemblies in conformance with UL Fire Resistance. Provide curtain type with damper blades out of the air stream fire dampers. Install dampers that do not reduce the duct or the air transfer opening cross-sectional area. Install dampers so that the centerline of the damper depth or thickness is located in the centerline of the wall, partition or floor slab depth or thickness. Unless otherwise indicated, comply with the installation details given in SMACNA 1819 and in manufacturer's instructions for fire dampers. Perform acceptance testing of fire dampers according to paragraph Fire Damper Acceptance Test and NFPA 90A.

#### 2.9.4 Manual Balancing Dampers

Furnish manual balancing dampers with accessible operating mechanisms. Use chromium plated operators (with all exposed edges rounded) in finished portions of the building. Provide manual volume control dampers that are operated by locking-type quadrant operators. Install dampers that are 2 gauges heavier than the duct in which installed. Unless otherwise indicated, provide opposed blade type multileaf dampers with maximum blade width of 12 inches. Provide access doors or panels for all concealed damper operators and locking setscrews. Provide stand-off mounting brackets, bases, or adapters not less than the thickness of the insulation when the locking-type quadrant operators for dampers are installed on ducts to be thermally insulated, to provide clearance between the duct surface and the operator. Provide stand-off mounting items that are integral with the operator or standard accessory of the damper manufacturer.

#### 2.9.5 Air Supply And Exhaust Air Dampers

Provide outdoor air supply and exhaust air dampers that have a maximum leakage rate when tested in accordance with AMCA 500-D as required by ASHRAE 90.1 - IP and UFC 4-010-01. The maximum damper leakage at 1.0 inch

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w.g. for motorized dampers is 3 cfm per square foot of damper area.

## 2.9.6 Plenums and Casings for Field-Fabricated Units

### 2.9.6.1 Plenum and Casings

Fabricate and erect plenums and casings as shown in SMACNA 1966, as applicable. Construct system casing of not less than 16 gauge galvanized sheet steel. Furnish cooling coil drain pans with 1 inch threaded outlet to collect condensation from the cooling coils. Fabricate drain pans from not lighter than 16 gauge steel, galvanized after fabrication or of 18 gauge corrosion-resisting sheet steel conforming to ASTM A167, Type 304, welded and stiffened. Thermally insulate drain pans exposed to the atmosphere to prevent condensation. Coat insulation with a flame resistant waterproofing material. Provide separate drain pans for each vertical coil section, and a separate drain line for each pan. Size pans to ensure capture of entrained moisture on the downstream-air side of the coil. Seal openings in the casing, such as for piping connections, to prevent air leakage. Size the water seal for the drain to maintain a pressure of at least 2 inch water gauge greater than the maximum negative pressure in the coil space.

### 2.9.6.2 Casing

Terminate casings at the curb line and bolt each to the curb using galvanized angle, as indicated in SMACNA 1966.

### 2.9.6.3 Access Doors

Provide access doors in each section of the casing. Weld doorframes in place, gasket each door with neoprene, hinge with minimum of two brass hinges, and fasten with a minimum of two brass tension fasteners operable from inside and outside of the casing. Where possible, make doors 36 by 18 inches and locate them 18 inches above the floor. Where the space available does not accommodate doors of this size, use doors as large as the space accommodates. Swing doors so that fan suction or pressure holds doors in closed position, airtight. Provide a push-button station, located inside the casing, to stop the supply.

### 2.9.6.4 Factory-Fabricated Insulated Sheet Metal Panels

Factory-fabricated components are allowed for field-assembled units, provided all requirements specified for field-fabricated plenums and casings are met. Provide panels of modular design, pretested for structural strength, thermal control, condensation control, and acoustical control. Seal and insulate panel joints. Provide and gasket access doors to prevent air leakage. Provide panel construction that is not less than 20 gauge galvanized sheet steel, assembled with fasteners treated against corrosion. Provide standard length panels that deflect not more than 1/2 inch under operation. Construct details, including joint sealing, not specifically covered, as indicated in SMACNA 1966. Construct the plenums and casings to withstand the specified internal pressure of the air systems.

### 2.9.6.5 Duct Liner

Unless otherwise specified, duct liner is not permitted.

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#### 2.9.7 Diffusers, Registers, and Grilles

Provide factory-fabricated units of steel that distribute the specified quantity of air evenly over space intended without causing noticeable drafts, air movement faster than 50 fpm in occupied zone, or dead spots anywhere in the conditioned area. Provide outlets for diffusion, spread, throw, and noise level as required for specified performance. Certify performance according to ASHRAE 70. Provide sound rated and certified inlets and outlets according to ASHRAE 70. Provide sound power level as indicated. Provide diffusers and registers with volume damper with accessible operator, unless otherwise indicated; or if standard with the manufacturer, an automatically controlled device is acceptable. Provide opposed blade type volume dampers for all diffusers and registers, except linear slot diffusers. Provide linear slot diffusers with round or elliptical balancing dampers. Where the inlet and outlet openings are located less than 7 feet above the floor, protect them by a grille or screen according to NFPA 90A.

##### 2.9.7.1 Diffusers

Provide diffuser types indicated. Furnish ceiling mounted units with anti-smudge devices, unless the diffuser unit minimizes ceiling smudging through design features. Provide diffusers with air deflectors of the type indicated. Provide air handling troffers or combination light and ceiling diffusers conforming to the requirements of UL Electrical Construction for the interchangeable use as cooled or heated air supply diffusers or return air units. Install ceiling mounted units with rims tight against ceiling. Provide sponge rubber gaskets between ceiling and surface mounted diffusers for air leakage control. Provide suitable trim for flush mounted diffusers. For connecting the duct to diffuser, provide duct collar that is airtight and does not interfere with volume controller. Provide return or exhaust units that are similar to supply diffusers.

##### 2.9.7.2 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. Locate return and exhaust registers 6 inches above the floor unless otherwise indicated. Achieve four-way directional control by a grille face which can be rotated in 4 positions or by adjustment of horizontal and vertical vanes. Provide grilles as specified for registers, without volume control damper.

##### 2.9.8 Louvers

Provide louvers for installation in exterior walls that are associated with the air supply and distribution system as specified in Section 08 91 00 METAL WALL 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.

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## 2.10 AIR SYSTEMS EQUIPMENT

### 2.10.1 Fans

Test and rate fans according to AMCA 210. Calculate system effect on air moving devices in accordance with AMCA 201 where installed ductwork differs from that indicated on drawings. Install air moving devices to minimize fan system effect. Where system effect is unavoidable, determine the most effective way to accommodate the inefficiencies caused by system effect on the installed air moving device. The sound power level of the fans must not exceed 85 dBA when tested according to AMCA 300 and rated in accordance with AMCA 301. Provide all fans with an AMCA seal. Connect fans to the motors either directly or indirectly with V-belt drive. Use V-belt drives designed for not less than 150 percent of the connected driving capacity. Provide variable pitch motor sheaves for 15 hp and below, and fixed pitch as defined by AHRI Guideline D (A fixed-pitch sheave is provided on both the fan shaft and the motor shaft. This is a non-adjustable speed drive.). Select variable pitch sheaves to drive the fan at a speed which can produce the specified capacity when set at the approximate midpoint of the sheave adjustment. When fixed pitch sheaves are furnished, provide a replaceable sheave when needed to achieve system air balance. Provide motors for V-belt drives with adjustable rails or bases. Provide removable metal guards for all exposed V-belt drives, and provide speed-test openings at the center of all rotating shafts. Provide fans with personnel screens or guards on both suction and supply ends, except that the screens need not be provided, unless otherwise indicated, where ducts are connected to the fan. Provide fan and motor assemblies with vibration-isolation supports or mountings as indicated. Use vibration-isolation units that are standard products with published loading ratings. Select each fan to produce the capacity required at the fan static pressure indicated. Provide sound power level as indicated. Obtain the sound power level values according to AMCA 300. Provide standard AMCA arrangement, rotation, and discharge as indicated. Provide power ventilators that conform to UL 705 and have a UL label.

#### 2.10.1.1 Centrifugal Fans

Provide fully enclosed, single-width single-inlet, or double-width double-inlet centrifugal fans, with AMCA Pressure Class I, II, or III as required or indicated for the design system pressure. Provide impeller wheels that are rigidly constructed and accurately balanced both statically and dynamically. Provide forward curved or backward-inclined airfoil design fan blades in wheel sizes up to 30 inches. Provide backward-inclined airfoil design fan blades for wheels over 30 inches in diameter. Provide fan wheels over 36 inches in diameter with overhung pulleys and a bearing on each side of the wheel. Provide fan wheels 36 inches or less in diameter that have one or more extra long bearings between the fan wheel and the drive. Provide sleeve type, self-aligning and self-oiling bearings with oil reservoirs, or precision self-aligning roller or ball-type with accessible grease fittings or permanently lubricated type. Connect grease fittings to tubing for serviceability from a single accessible point. Provide L50 rated bearing life at not less than 200,000 hours as defined by ABMA 9 and ABMA 11. Provide steel, accurately finished fan shafts, with key seats and keys for impeller hubs and fan pulleys. Provide fan outlets of ample proportions, designed for the attachment of angles and bolts for attaching flexible connections. Provide Unless otherwise indicated, provide motors that do not exceed 1800 rpm and have open dripproof enclosures. Provide type motor starters with

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general-purpose enclosure.

#### 2.10.1.2 Centrifugal Type Power Roof Ventilators

Provide direct or V-belt driven centrifugal type fans with backward inclined, non-overloading wheel. Provide hinged or removable and weatherproof motor compartment housing, constructed of heavy gauge aluminum. Provide fans with birdscreen, disconnect switch, motorized dampers, roof curb, and . Provide dripproof type motor enclosure. Provide centrifugal type kitchen exhaust fans according to UL 705, fitted with V-belt drive, round hood, and windband upblast discharge configuration, integral residue trough and collection device, with motor and power transmission components located in outside positively air ventilated compartment. Use only lubricated bearings.

#### 2.10.2 Coils

Provide fin-and-tube type coils constructed of seamless copper tubes and aluminum or copper fins mechanically bonded or soldered to the tubes. Provide copper tube wall thickness that is a minimum of 0.020 inches.. Provide aluminum fins that are 0.0055 inch minimum thickness. Provide copper fins that are 0.0045 inch minimum thickness. Provide casing and tube support sheets that are not lighter than 16 gauge galvanized steel, formed to provide structural strength. When required, provide multiple tube supports to prevent tube sag. Mount coils for counterflow service. Rate and certify coils to meet the requirements of AHRI 410.

##### 2.10.2.1 Direct-Expansion Coils

Provide suitable direct-expansion coils for the refrigerant involved. Provide refrigerant piping that conforms to ASTM B280 and clean, dehydrate and seal. Provide seamless copper tubing suction headers or seamless or resistance welded steel tube suction headers with copper connections. Provide supply headers that consist of a distributor which distributes the refrigerant through seamless copper tubing equally to all circuits in the coil. Provide circuited tubes to ensure minimum pressure drop and maximum heat transfer. Provide circuiting that permits refrigerant flow from inlet to suction outlet without causing oil slugging or restricting refrigerant flow in coil. Provide field installed coils which are completely dehydrated and sealed at the factory upon completion of pressure tests. Pressure test coils in accordance with UL 1995.

#### 2.10.3 Air Filters

List air filters according to requirements of UL 900, except list high efficiency particulate air filters of 99.97 percent efficiency by the DOP Test method under the Label Service to meet the requirements of UL 586.

##### 2.10.3.1 Extended Surface Pleated Panel Filters

Provide 2 inch depth, sectional, disposable type filters of the size indicated with a MERV of 8 when tested according to ASHRAE 52.2. Provide initial resistance at 500 fpm that does not exceed 0.36 inches water gauge. Provide UL Class 2 filters, and nonwoven cotton and synthetic fiber mat media. Attach a wire support grid bonded to the media to a moisture resistant fiberboard frame. Bond all four edges of the filter media to the inside of the frame to prevent air bypass and increase rigidity.

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#### 2.10.3.2 Cartridge Type Filters

Provide 12 inch depth, sectional, replaceable dry media type filters of the size indicated with a MERV of 13 when tested according to ASHRAE 52.2. Provide initial resistance at 500 fpm that does not exceed 0.56 inches, water gauge. Provide UL class 1 filters, and pleated microglass paper media with corrugated aluminum separators, sealed inside the filter cell to form a totally rigid filter assembly. Fluctuations in filter face velocity or turbulent airflow have no effect on filter integrity or performance. Install each filter with an extended surface pleated media panel filter as a prefilter in a factory preassembled side access housing, or a factory-made sectional frame bank, as indicated.

#### 2.10.3.3 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 taps with integral compression fittings, two molded plastic vent valves, two 5 foot minimum lengths of 1/4 inch diameter aluminum tubing, and all hardware and accessories for gauge mounting.

### 2.11 AIR HANDLING UNITS

#### 2.11.1 Factory-Fabricated Air Handling Units

Provide single-zone draw-through type or multizone draw-through type units as indicated. Units must include fans, coils, airtight insulated casing, prefilters, secondary filter sections, adjustable V-belt drives, belt guards for externally mounted motors, access sections where indicated, combination sectional filter-mixing box, vibration-isolators, and appurtenances required for specified operation. Provide vibration isolators as indicated. Physical dimensions of each air handling unit must be suitable to fit space allotted to the unit with the capacity indicated. Provide air handling unit that is rated in accordance with AHRI 430 and AHRI certified for cooling.

##### 2.11.1.1 Casings

Provide the following:

- a. Casing sections 2 inch double wall type, constructed of a minimum 18 gauge galvanized steel, or 18 gauge corrosion-resisting sheet steel conforming to ASTM A167, Type 304. Inner casing of double-wall units that are a minimum 20 gauge solid galvanized steel or corrosion-resisting sheet steel conforming to ASTM A167, Type 304. Design and construct casing with an integral insulated structural



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galvanized steel frame such that exterior panels are non-load bearing.

- b. Individually removable exterior panels with standard tools. Removal must not affect the structural integrity of the unit. Furnish casings with access sections, according to paragraph AIR HANDLING UNITS, inspection doors, and access doors, all capable of opening a minimum of 90 degrees, as indicated.
- c. Insulated, fully gasketed, double-wall type inspection and access doors, of a minimum 18 gauge outer and 20 gauge inner panels made of either galvanized steel or corrosion-resisting sheet steel conforming to ASTM A167, Type 304. Provide rigid doors with heavy duty hinges and latches. Inspection doors must be a minimum 12 inches wide by 12 inches high. Access doors must be a minimum 24 inches wide, the full height of the unit casing or a minimum of 6 foot, whichever is less. Install a minimum 8 by 8 inches sealed glass window suitable for the intended application, in all access doors.
- d. Double-wall insulated type drain pan (thickness equal to exterior casing) constructed of 16 gauge galvanized steel, conforming to ASHRAE 62.1. Construct drain pans water tight, treated to prevent corrosion, and designed for positive condensate drainage. When 2 or more cooling coils are used, with one stacked above the other, condensate from the upper coils must not flow across the face of lower coils. Provide intermediate drain pans or condensate collection channels and downspouts, as required to carry condensate to the unit drain pan out of the air stream and without moisture carryover. Construct drain pan to allow for easy visual inspection, including underneath the coil without removal of the coil and to allow complete and easy physical cleaning of the pan underneath the coil without removal of the coil. Provide coils that are individually removable from the casing.
- e. Casing insulation that conforms to NFPA 90A. Insulate single-wall casing sections handling conditioned air with not less than 1 inch thick, 1-1/2 pound density coated fibrous glass material having a thermal conductivity not greater than 0.23 Btu/hr-sf-F. Insulate double-wall casing sections handling conditioned air with not less than 2 inches of the same insulation specified for single-wall casings. Foil-faced insulation is not an acceptable substitute for use with double wall casing. Seal double wall insulation completely by inner and outer panels.
- f. Factory applied fibrous glass insulation that conforms to ASTM C1071, except that the minimum thickness and density requirements do not apply, and that meets the requirements of NFPA 90A. Make air handling unit casing insulation uniform over the entire casing. Foil-faced insulation is not an acceptable substitute for use on double-wall access doors and inspections doors 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 inspection door, in the fan and coil sections. Plus additional inspection doors, access doors and access sections.

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#### 2.11.1.2 Heating and Cooling Coils

Provide coils as specified in paragraph AIR SYSTEMS EQUIPMENT.

#### 2.11.1.3 Air Filters

Provide air filters as specified in paragraph AIR SYSTEMS EQUIPMENT for types and thickness indicated.

#### 2.11.1.4 Fans

Provide the following:

- a. Fans that are double-inlet, centrifugal type with each fan in a separate scroll. Dynamically balance fans and shafts prior to installation into air handling unit, then after it has been installed in the air handling unit, statically and dynamically balance the entire fan assembly. Mount fans on steel shafts, accurately ground and finished.
- b. Fan bearings that are sealed against dust and dirt and are precision self-aligning ball or roller type, with L50 rated bearing life at not less than 200,000 hours as defined by ABMA 9 and ABMA 11. Provide bearings that are permanently lubricated or lubricated type with lubrication fittings readily accessible at the drive side of the unit. Support bearings by structural shapes, or die formed sheet structural members, or support plates securely attached to the unit casing. Do not fasten bearings directly to the unit sheet metal casing. Furnish fans and scrolls with coating indicated.
- c. Fans that are driven by a unit-mounted, or a floor-mounted motor connected to fans by V-belt drive complete with belt guard for externally mounted motors. Furnish belt guards that are the three-sided enclosed type with solid or expanded metal face. Design belt drives for not less than a 1.3 service factor based on motor nameplate rating.
- d. Motor sheaves that are variable pitch for 25 hp and below and fixed pitch above 25 hp as defined by AHRI Guideline D. Where fixed sheaves are required, the use of variable pitch sheaves is allowed during air balance, but replace them with an appropriate fixed sheave after air balance is completed. Select variable pitch sheaves to drive the fan at a speed that produces the specified capacity when set at the approximate midpoint of the sheave adjustment. Furnish motors for V-belt drives with adjustable bases, and with opensplashproof enclosures.
- e. Motor starters of magnetic type with general-purpose enclosure. Select unit fan or fans to produce the required capacity at the fan static pressure with sound power level as indicated. Obtain the sound power level values according to AMCA 300, ASHRAE 68, or AHRI 260 I-P.

#### 2.11.1.5 Access Sections and Filter/Mixing Boxes

Provide access sections where indicated and furnish with access doors as shown. Construct access sections and filter/mixing boxes in a manner identical to the remainder of the unit casing and equip with access doors. Design mixing boxes to minimize air stratification and to promote thorough mixing of the air streams.

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## 2.12 TERMINAL UNITS

### 2.12.1 Variable Air Volume (VAV) Terminal Units

- a. Provide VAV terminal units that are the type, size, and capacity shown, mounted in the ceiling or wall cavity, plus units that are suitable for single or dual duct system applications. Provide actuators and controls as specified in paragraph SUPPLEMENTAL COMPONENTS/SERVICES, subparagraph CONTROLS.
- b. Provide unit enclosures that are constructed of galvanized steel not lighter than 22 gauge or aluminum sheet not lighter than 18 gauge. Provide single or multiple discharge outlets as required. Units with flow limiters are not acceptable. Provide unit air volume that is factory preset and readily field adjustable without special tools. Provide reheat coils as indicated.
- c. Attach a flow chart to each unit. Base acoustic performance of the terminal units upon units tested according to AHRI 880 I-P with the calculations prepared in accordance with AHRI 885. Provide sound power level as indicated. Show discharge sound power for minimum and 1-1/2 inches water gauge inlet static pressure. Provide acoustical lining according to NFPA 90A.

#### 2.12.1.1 Variable Volume, Single Duct Terminal Units

Provide variable volume, single duct, terminal units with a calibrated air volume sensing device, air valve or damper, actuator, and accessory relays. Provide units that control air volume to within plus or minus 5 percent of each air set point volume as determined by the thermostat with variations in inlet pressures from 3/4 to 6 inch water gauge. Provide units with an internal resistance not exceeding 0.4 inch water gauge at maximum flow range. Provide external differential pressure taps separate from the control pressure taps for air flow measurement with a 0 to 1 inch water gauge range.

#### 2.12.1.2 Reheat Units

##### 2.12.1.2.1 Electric Resistance Heaters

Provide the duct-mounting type 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 the fan is running.

## 2.12.2 Unit Ventilators

Provide unit ventilators that include an enclosure, galvanized casing, resistance heating coil assembly, fan assembly, fan drive, motor, motor controller, and sound power level as indicated. Obtain sound power level data or values for these units according to test procedures based on AHRI 350. Sound power values apply to units provided with factory fabricated cabinet enclosures and standard grilles, when handling standard flow for which the unit air capacity is rated. Secure each unit to the building structure. Provide the unit ventilators with capacity

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indicated. Provide automatic valves and controls as specified in paragraph SUPPLEMENTAL COMPONENTS/SERVICES, subparagraph CONTROLS. Make the sequence of control any one of the standard ANSI cycles specified in paragraph CONTROLS.

#### 2.12.2.1 Enclosures

Fabricate enclosures from not lighter than 16 gauge galvanized steel, reinforced and braced, or all welded framework with panels to provide equivalent strength. Provide casing that is acoustically and thermally insulated internally with not less than 1/2 inch thick dual density fibrous glass insulation. Make the exposed side a high density, erosion-proof material suitable for use in air streams with velocities up to 4500 fpm. Fasten the insulation with waterproof, fire-resistant adhesive. Design front panel for easy removal by one person. Provide discharge grilles that have adjustable grilles or grilles with adjustable vanes and properly distribute air throughout the conditioned space. Provide return grilles that are removable where front panel does not provide access to interior components. Plastic discharge or return grilles are not acceptable. Furnish removable panels or access doors for all piping and control compartments. Provide fan switch that is key operated or accessible through a locked access panel. Install gaskets at the back and bottom of the unit for effective air seal, as required.

#### 2.12.2.2 Electric Resistance Heating Elements

Provide electric resistance heating elements that are of the sheathed, finned, tubular type, or of the open resistance type designed for direct exposure to the air stream. Provide heating element electrical characteristics as indicated. Where fan motor or control voltage is lower than required for the electric-resistance heating element, install a fused factory mounted and wired transformer.

#### 2.12.2.3 Fans

Provide fans that meet the requirements as specified in paragraph AIR SYSTEMS EQUIPMENT. Provide galvanized steel or aluminum, multiblade, centrifugal type fans, dynamically and statically balanced. Equip fan housings with resilient mounted, self-aligning permanently lubricated ball bearings, sleeve bearings, or combination ball and sleeve bearings, capable of not less than 2000 hours of operation on one oiling. Provide direct-connected fans.

#### 2.12.2.4 Motors

Provide permanent split-capacitor type motors with built-in thermal overload protection and automatic reset. Mount motor on a resilient mounting, isolated from the casing and suitable for operation on electric service available. Provide a manually operated motor switch that provides for 2 or 3 speeds and off, mounted on an identified plate inside the unit below or behind an access door. In lieu of speed control, provide a solid state variable speed controller having minimum speed reduction of 50 percent.

#### 2.12.2.5 Outside Air Intakes

Provide the manufacturer's standard design outside air intakes furnished with 1/2 inch mesh bird screen or louvers on 1/2 inch centers.

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## 2.13 ENERGY RECOVERY DEVICES

### 2.13.1 Rotary Wheel

Provide unit that is a factory fabricated and tested assembly for air-to-air energy recovery by transfer of sensible heat from exhaust air to supply air stream, with device performance according to ASHRAE 84 and that delivers an energy transfer effectiveness of not less than 70 percent with cross-contamination not in excess of 0.1 percent of exhaust airflow rate at system design differential pressure, including purging sector if provided with wheel. Provide exchange media that is chemically inert, moisture-resistant, fire-retardant, laminated, nonmetallic material which complies with NFPA 90A. Isolate exhaust and supply streams by seals which are static, field adjustable, and replaceable. Equip chain drive mechanisms with ratcheting torque limiter or slip-clutch protective device. Fabricate enclosure from galvanized steel and include provisions for maintenance access. Provide recovery control and rotation failure provisions as indicated.

## 2.14 FACTORY PAINTING

Factory paint new equipment, which are not of galvanized construction. Paint with a corrosion resisting paint finish according to ASTM A123/A123M or ASTM A924/A924M. Clean, phosphatize and coat internal and external ferrous metal surfaces with a paint finish which has been tested according to ASTM B117, ASTM D1654, and ASTM D3359. Submit evidence of satisfactory paint performance for a minimum of 125 hours for units to be installed indoors and 500 hours for units to be installed outdoors. Provide rating of failure at the scribe mark that is not less than 6, average creepage not greater than 1/8 inch. Provide rating of the inscribed area that is not less than 10, no failure. On units constructed of galvanized steel that have been welded, provide a final shop docket of zinc-rich protective paint on exterior surfaces of welds or welds that have burned through from the interior according to ASTM D520 Type I.

Field paint factory painting that has been damaged prior to acceptance by the Contracting Officer in compliance with the requirements of paragraph FIELD PAINTING OF MECHANICAL EQUIPMENT.

## 2.15 SUPPLEMENTAL COMPONENTS/SERVICES

### 2.15.1 Refrigerant Piping

The requirements for refrigerant piping are specified in Section 23 23 00 REFRIGERANT PIPING.

### 2.15.2 Condensate Drain Lines

Provide and install condensate drainage for each item of equipment that generates condensate in accordance with Section 22 00 00 PLUMBING, GENERAL PURPOSE and 23 64 26 CHILLED, CHILLED-HOT, AND CONDENSER WATER PIPING SYSTEMS except as modified herein.

### 2.15.3 Backflow Preventers

The requirements for backflow preventers are specified in Section 22 00 00 PLUMBING, GENERAL PURPOSE.

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#### 2.15.4 Insulation

The requirements for shop and field applied insulation are specified in Section 23 07 00 THERMAL INSULATION FOR MECHANICAL SYSTEMS.

#### 2.15.5 Controls

The requirements for controls are specified in Section 23 05 93.00 06 TESTING, ADJUSTING, AND BALANCING (TAB) OF HVAC and Section 23 09 00 INSTRUMENTATION AND CONTROL FOR HVAC.

### PART 3 EXECUTION

#### 3.1 EXAMINATION

After becoming familiar with all details of the work, verify all dimensions in the field, and advise the Contracting Officer of any discrepancy before performing the work.

#### 3.2 INSTALLATION

- a. Install materials and equipment in accordance with the requirements of the contract drawings and approved manufacturer's installation instructions. Accomplish installation by workers skilled in this type of work. Perform installation so that there is no degradation of the designed fire ratings of walls, partitions, ceilings, and floors.
- b. No installation is permitted to block or otherwise impede access to any existing machine or system. Install all hinged doors to swing open a minimum of 120 degrees. Provide an area in front of all access doors that clears a minimum of 3 feet. In front of all access doors to electrical circuits, clear the area the minimum distance to energized circuits as specified in OSHA Standards, part 1910.333 (Electrical-Safety Related work practices) and an additional 3 feet.
- c. Except as otherwise indicated, install emergency switches and alarms in conspicuous locations. Mount all indicators, to include gauges, meters, and alarms in order to be easily visible by people in the area.

##### 3.2.1 Condensate Drain Lines

Provide water seals in the condensate drain from all units. Provide a depth of each seal of 2 inches plus the number of inches, measured in water gauge, of the total static pressure rating of the unit to which the drain is connected. Provide water seals that are constructed of 2 tees and an appropriate U-bend with the open end of each tee plugged. Provide pipe cap or plug cleanouts where indicated. Connect drains indicated to connect to the sanitary waste system using an indirect waste fitting. Insulate air conditioner drain lines as specified in Section 23 07 00 THERMAL INSULATION FOR MECHANICAL SYSTEMS.

##### 3.2.2 Equipment and Installation

Provide frames and supports for tanks, compressors, pumps, valves, air handling units, fans, coils, dampers, and other similar items requiring supports. Floor mount or ceiling hang air handling units as indicated. Anchor and fasten as detailed. Set floor-mounted equipment on not less than 6 inch concrete pads or curbs doweled in place unless otherwise indicated. Make concrete foundations heavy enough to minimize the

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intensity of the vibrations transmitted to the piping, duct work and the surrounding structure, as recommended in writing by the equipment manufacturer. In lieu of a concrete pad foundation, build a concrete pedestal block with isolators placed between the pedestal block and the floor. Make the concrete foundation or concrete pedestal block a mass not less than three times the weight of the components to be supported. Provide the lines connected to the pump mounted on pedestal blocks with flexible connectors. Submit foundation drawings as specified in paragraph DETAIL DRAWINGS. Provide concrete for foundations as specified in Section 03 30 00 CAST-IN-PLACE CONCRETE.

### 3.2.3 Access Panels

Install access panels for concealed valves, vents, controls, dampers, and items requiring inspection or maintenance of sufficient size, and locate them so that the concealed items are easily serviced and maintained or completely removed and replaced. Provide access panels as specified in Section 08 31 00 ACCESS DOORS AND PANELS.

### 3.2.4 Flexible Duct

Install pre-insulated flexible duct in accordance with the latest printed instructions of the manufacturer to ensure a vapor tight joint. Provide hangers, when required to suspend the duct, of the type recommended by the duct manufacturer and set at the intervals recommended.

### 3.2.5 Metal Ductwork

Install according to SMACNA 1966 unless otherwise indicated. Install duct supports for sheet metal ductwork according to SMACNA 1966, unless otherwise specified. Do not use friction beam clamps indicated in SMACNA 1966. Anchor risers on high velocity ducts in the center of the vertical run to allow ends of riser to move due to thermal expansion. Erect supports on the risers that allow free vertical movement of the duct. Attach supports only to structural framing members and concrete slabs. Do not anchor supports to metal decking unless a means is provided and approved for preventing the anchor from puncturing the metal decking. Where supports are required between structural framing members, provide suitable intermediate metal framing. Where C-clamps are used, provide retainer clips.

### 3.2.6 Dust Control

To prevent the accumulation of dust, debris and foreign material during construction, perform temporary dust control protection. Protect the distribution system (supply and return) with temporary seal-offs at all inlets and outlets at the end of each day's work. Keep temporary protection in place until system is ready for startup.

### 3.2.7 Insulation

Provide thickness and application of insulation materials for ductwork, piping, and equipment according to Section 23 07 00 THERMAL INSULATION FOR MECHANICAL SYSTEMS. Externally insulate outdoor air intake ducts and plenums up to the point where the outdoor air reaches the conditioning unit.

### 3.2.8 Duct Test Holes

Provide holes with closures or threaded holes with plugs in ducts and

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plenums as indicated or where necessary for the use of pitot tube in balancing the air system. Plug insulated duct at the duct surface, patched over with insulation and then marked to indicate location of test hole if needed for future use.

### 3.2.9 Power Roof Ventilator Mounting

Provide foamed 1/2 inch thick, closed-cell, flexible elastomer insulation to cover width of roof curb mounting flange. Where wood nailers are used, predrill holes for fasteners.

### 3.2.10 Power Transmission Components Adjustment

Test V-belts and sheaves for proper alignment and tension prior to operation and after 72 hours of operation at final speed. Uniformly load belts on drive side to prevent bouncing. Make alignment of direct driven couplings to within 50 percent of manufacturer's maximum allowable range of misalignment.

### 3.3 EQUIPMENT PADS

Provide equipment pads to the dimensions shown or, if not shown, to conform to the shape of each piece of equipment served with a minimum 3-inch margin around the equipment and supports. Allow equipment bases and foundations, when constructed of concrete or grout, to cure a minimum of 28 calendar days before being loaded.

### 3.4 CUTTING AND PATCHING

Install work in such a manner and at such time that a minimum of cutting and patching of the building structure is required. Make holes in exposed locations, in or through existing floors, by drilling and smooth by sanding. Use of a jackhammer is permitted only where specifically approved. Make holes through masonry walls to accommodate sleeves with an iron pipe masonry core saw.

### 3.5 CLEANING

Thoroughly clean surfaces of piping and equipment that have become covered with dirt, plaster, or other material during handling and construction before such surfaces are prepared for final finish painting or are enclosed within the building structure. Before final acceptance, clean mechanical equipment, including piping, ducting, and fixtures, and free from dirt, grease, and finger marks. When the work area is in an occupied space such as office, laboratory or warehouse protect all furniture and equipment from dirt and debris. Incorporate housekeeping for field construction work which leaves all furniture and equipment in the affected area free of construction generated dust and debris; and, all floor surfaces vacuum-swept clean.

### 3.6 PENETRATIONS

Provide sleeves and prepared openings for duct mains, branches, and other penetrating items, and install during the construction of the surface to be penetrated. Cut sleeves flush with each surface. Place sleeves for round duct 15 inches and smaller. Build framed, prepared openings for round duct larger than 15 inches and square, rectangular or oval ducts. Sleeves and framed openings are also required where grilles, registers, and diffusers are installed at the openings. Provide one inch clearance



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between penetrating and penetrated surfaces except at grilles, registers, and diffusers. Pack spaces between sleeve or opening and duct or duct insulation with mineral fiber conforming with ASTM C553, Type 1, Class B-2.

### 3.6.1 Sleeves

Fabricate sleeves, except as otherwise specified or indicated, from 20 gaugethick 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.

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### 3.7.1 Temperatures less than 120 degrees F

Immediately after cleaning, apply one coat of pretreatment primer applied to a minimum dry film thickness of 0.3 mil, one coat of primer applied to a minimum dry film thickness of one mil; and two coats of enamel applied to a minimum dry film thickness of one mil per coat to metal surfaces subject to temperatures less than 120 degrees F.

### 3.7.2 Temperatures between 120 and 400 degrees F

Apply two coats of 400 degrees F heat-resisting enamel applied to a total minimum thickness of two mils to metal surfaces subject to temperatures between 120 and 400 degrees F.

### 3.7.3 Finish Painting

The requirements for finish painting of items only primed at the factory, and surfaces not specifically noted otherwise, are specified in Section 09 90 00 PAINTS AND COATINGS.

### 3.7.4 Color Coding Scheme for Locating Hidden Utility Components

Use scheme in buildings having suspended grid ceilings. Provide color coding scheme that identifies points of access for maintenance and operation of components and equipment that are not visible from the finished space and are accessible from the ceiling grid, consisting of a color code board and colored metal disks. Make each colored metal disk approximately 3/8 inch diameter and secure to removable ceiling panels with fasteners. Insert each fastener into the ceiling panel so as to be concealed from view. Provide fasteners that are manually removable without the use of tools and that do not separate from the ceiling panels when the panels are dropped from ceiling height. Make installation of colored metal disks follow completion of the finished surface on which the disks are to be fastened. Provide color code board that is approximately 3 foot wide, 30 inches high, and 1/2 inches thick. Make the board of wood fiberboard and frame under glass or 1/16 inch transparent plastic cover. Make the color code symbols approximately 3/4 inch in diameter and the related lettering in 1/2 inch high capital letters.

## 3.8 IDENTIFICATION SYSTEMS

Provide identification tags made of brass, engraved laminated plastic, or engraved anodized aluminum, indicating service and item number on all valves and dampers. Provide tags that are 1-3/8 inch minimum diameter with stamped or engraved markings. Make indentations black for reading clarity. Attach tags to valves with No. 12 AWG 0.0808-inch diameter corrosion-resistant steel wire, copper wire, chrome-plated beaded chain or plastic straps designed for that purpose.

## 3.9 DUCTWORK LEAK TEST

Perform ductwork leak test for the entire air distribution and exhaust system, including fans, coils, Provide test procedure, apparatus, and report that conform to SMACNA 1972 CD. Complete ductwork leak test with satisfactory results prior to applying insulation to ductwork exterior or concealing ductwork.

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### 3.10 DAMPER ACCEPTANCE TEST

Submit the proposed schedule, at least 2 weeks prior to the start of test. Operate all fire dampers and smoke dampers under normal operating conditions, prior to the occupancy of a building to determine that they function properly. Test each fire damper equipped with fusible link by having the fusible link cut in place. Test dynamic fire dampers with the air handling and distribution system running. Reset all fire dampers with the fusible links replaced after acceptance testing. To ensure optimum operation and performance, install the damper so it is square and free from racking.

### 3.11 TESTING, ADJUSTING, AND BALANCING

The requirements for testing, adjusting, and balancing are specified in Section 23 05 93.00 06 TESTING, ADJUSTING AND BALANCING (TAB) 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 93.00 06 Testing, Adjusting and Balancing (TAB) OF 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, unit ventilators, 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 contractually complete.

### 3.14 OPERATION AND MAINTENANCE

#### 3.14.1 Operation and Maintenance Manuals

Submit six manuals at least 2 weeks prior to field training. Submit data complying with the requirements specified in Section 01 78 23 OPERATION AND MAINTENANCE DATA. Submit Data Package 3 for the items/units listed under SD-10 Operation and Maintenance Data

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### 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 --

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## SECTION 23 35 16.17 10

## MECHANICAL ENGINE EXHAUST SYSTEMS

05/20

## PART 1 GENERAL

## 1.1 REFERENCES

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

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

AMCA 210 (2016) Laboratory Methods of Testing Fans  
 for Aerodynamic Performance Rating

AMCA 300 (2014) Reverberant Room Method for Sound  
 Testing of Fans

## AIR-CONDITIONING, HEATING AND REFRIGERATION INSTITUTE (AHRI)

AHRI Guideline D (1996) Application and Installation of  
 Central Station Air-Handling Units

## AMERICAN BEARING MANUFACTURERS ASSOCIATION (ABMA)

ABMA 9 (2015) Load Ratings and Fatigue Life for  
 Ball Bearings

ABMA 11 (2014) Load Ratings and Fatigue Life for  
 Roller Bearings

## AMERICAN SOCIETY OF MECHANICAL ENGINEERS (ASME)

ASME B16.21 (2021) Nonmetallic Flat Gaskets for Pipe  
 Flanges

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

## ASTM INTERNATIONAL (ASTM)

ASTM A36/A36M (2019) Standard Specification for Carbon  
 Structural Steel

ASTM A53/A53M (2022) Standard Specification for Pipe,  
 Steel, Black and Hot-Dipped, Zinc-Coated,  
 Welded and Seamless

ASTM A167 (2011) Standard Specification for

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Stainless and Heat-Resisting  
 Chromium-Nickel Steel Plate, Sheet, and  
 Strip

ASTM A193/A193M	(2020) Standard Specification for Alloy-Steel and Stainless Steel Bolting Materials for High-Temperature Service and Other Special Purpose Applications
ASTM A307	(2021) Standard Specification for Carbon Steel Bolts, Studs, and Threaded Rod 60 000 PSI Tensile Strength
ASTM A924/A924M	(2022) Standard Specification for General Requirements for Steel Sheet, Metallic-Coated by the Hot-Dip Process
ASTM A1011/A1011M	(2018a) Standard Specification for Steel Sheet and Strip, Hot-Rolled, Carbon, Structural, High-Strength Low-Alloy, High-Strength Low-Alloy with Improved Formability, and Ultra-High Strength
ASTM B32	(2020) Standard Specification for Solder Metal
ASTM B117	(2019) Standard Practice for Operating Salt Spray (Fog) Apparatus
ASTM E2016	(2022) Standard Specification for Industrial Woven Wire Cloth

#### NATIONAL ELECTRICAL MANUFACTURERS ASSOCIATION (NEMA)

NEMA MG 1	(2021) Motors and Generators
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#### SHEET METAL AND AIR CONDITIONING CONTRACTORS' NATIONAL ASSOCIATION (SMACNA)

SMACNA 1520	(1999) Round Industrial Duct Construction Standards, 3rd Edition
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### 1.2 SYSTEM DESCRIPTION

Construct, complete and operational, an exhaust system as specified herein. Provide adequate air exhaust quantities and velocities. Properly size all duct for pressure loss and adequate velocity including locating intakes, ductwork size, layout, equipment and controls. Base construction of the exhaust system on the referenced publications, and other provisions as specified herein. Furnish ductwork offsets, fittings, and any other accessories required, as specified, to provide a complete exhaust system installation and to eliminate interference with other construction. Provide controls as specified in Section 23 09 00 INSTRUMENTATION AND CONTROL FOR HVAC.

### 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

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Contractor Quality Control approval. Submit the following in accordance with Section 01 33 00 SUBMITTAL PROCEDURES:

SD-02 Shop Drawings

Detail Drawings; G

Exhaust System Installation; G

SD-03 Product Data

Related Submittals

Ductwork Components; G

Materials and Equipment

Spare Parts

Field Instructions

Final Acceptance Tests

Onsite Training; G

Exhaust System Specialist; G

SD-06 Test Reports

Final Acceptance Tests

SD-07 Certificates

Inspection; G

SD-10 Operation and Maintenance Data

Exhaust System

Operation and Maintenance Manuals

1.4 QUALITY ASSURANCE

1.4.1 Detail Drawings

Submit 3 copies of the Exhaust System Drawings, no later than 21 days prior to the start of exhaust system installation. Include a complete list of equipment and materials, including manufacturer's descriptive and technical literature, performance charts and curves, catalog cuts, installation instructions, complete duct, wiring, and schematic diagrams and any other details to demonstrate that the system has been coordinated and will properly function as a unit. Also show proposed layout and anchorage of equipment and appurtenances, and equipment in relation to other parts of the work including clearances required for maintenance and operation.

1.4.2 Exhaust System Specialist

Submit the name and documentation of certification of the proposed Exhaust

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System Specialists, no later than 14 days after the Notice to Proceed and prior to the submittal of the exhaust system drawings and hydraulic calculations. Prepare a list of the submittals from the Contract Submittal Register that relate to the successful installation of the exhaust systems(s). Submit the list no later than 7 days after the approval of the Exhaust System Specialist. The related submittals identified on this list must be accompanied by a letter of approval signed and dated by the Exhaust System Specialist when submitted to the Government. The Exhaust System Specialist must be regularly engaged in the installation of the type and complexity of system specified in the Contract documents, and will 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.

#### 1.5 DELIVERY, STORAGE, AND HANDLING

House all equipment delivered and placed in storage in a manner to preclude any damage from the weather, humidity and temperature variations, dirt and dust, or other contaminants. Additionally, cap or plug all ductwork, flexible connections and pipes until installed.

#### 1.6 EXTRA MATERIALS

Submit spare parts data for each 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.

### PART 2 PRODUCTS

#### 2.1 STANDARD PRODUCTS

- a. Provide materials and equipment which are standard products of a manufacturer regularly engaged in the manufacture of the product and that essentially duplicate items that have been in satisfactory use for at least 2 years prior to bid opening. Submit manufacturer's catalog data included with the Exhaust System Drawings for all items specified herein. Highlight data to show model, size, options, etc., that are intended for consideration. Demonstrate compliance with all contract requirements. In addition, provide a complete equipment list that includes equipment description, model number and quantity.
- b. Where an integrated, packaged exhaust system is furnished, all items will be the product of the system manufacturer. System component parts may be by other manufacturers. Provide equipment by a service organization that is capable of responding to service calls within four hours .
- c. Asbestos and asbestos-containing products are not acceptable.

#### 2.2 NAMEPLATES

Furnish a nameplate that identifies the manufacturer's name, address, type or style, model or serial number, and catalog number on all equipment.



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### 2.3 EQUIPMENT GUARDS AND ACCESS

Fully enclose or guard belts, pulleys, chains, gears, couplings, projecting setscrews, keys, and other rotating parts exposed to personnel contact according to OSHA requirements. Properly guard or cover high temperature equipment and piping exposed to contact by personnel or where it creates a potential fire hazard with insulation of a type specified.

### 2.4 DUCTWORK COMPONENTS

#### 2.4.1 General

Provide duct constructed of galvanized sheets of the minimum gauge thickness for ducts as required in SMACNA 1520. Construct and seal ducts in accordance with SMACNA 1520 for a negative pressure of 6 inch water gauge static pressure. Unless otherwise approved, provide ducts that are round with longitudinal lock seam and conform to the dimensions indicated. Provide ducts that are straight and smooth on the inside with airtight joints. Where ducts with crimped ends are used to make up joints, the joints must have crimp and bead. The bead must provide a rigid stop for the mating open end to seat against. Steel spiral wound duct is not acceptable.

#### 2.4.2 Fittings

Furnish reducing fittings that have a minimum of 1 inch increase in diameter per 8 inches in length. Elbows that have a centerline radius less than 1.5 times the diameter are not permitted. Stub branches into mains at main expansion points at an angle of not more than 30 degrees with the centerline of the main duct in the direction of air flow, unless otherwise indicated or approved. Where riser ducts with single or multiple inlets are indicated, connect the riser duct into the bottom of the main duct at an angle as specified for branches. Where flexible connections connect to the main duct, brace the duct branch takeoff or stub with approved metal straps or members.

#### 2.4.3 Cleanout

Provide cleanout on the end of the main ductwork opposite the end of the fan suction connection. Size the cleanout opening to the approximate inside area of the duct. Provide removable airtight caps or flange type covers of minimum gauge thickness as the main duct. Provide other cleanout openings where indicated.

#### 2.4.4 Apparatus Connections

Where sheet metal connections are made to fan suction and discharge, or where ducts of dissimilar metals are connected, install an approved noncombustible flexible connection approximately 6 inches and securely fasten by zinc-coated steel clinch-type draw bands for round ducts. For rectangular ducts, install the flexible connections locked to metal collars using normal duct construction methods.

#### 2.4.5 Duct Test Holes

Provide test holes with covers where indicated, directed, or where necessary in ducts and plenums for using Pitot tubes for taking air measurements to balance the air systems.

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#### 2.4.6 Duct Sleeves and Framed Openings

Provide duct sleeves for all round ducts 15 inch diameter or less passing through floors, walls, ceilings, or roofs. Provide sleeves in non-load bearing walls fabricated of 20 gauge steel sheets conforming to ASTM A924/A924M. Provide sleeves in load-bearing walls fabricated of standard-weight galvanized steel pipe conforming to ASTM A53/A53M. Install round ducts larger than 15 inch diameter and all square and rectangular ducts passing through floors, walls, ceilings, or roofs through framed openings. Furnish structural steel members for framed openings conforming to ASTM A36/A36M. Provide 1 inch clearance between the duct and the opening. Provide closure collars of galvanized steel no less than 4 inches wide on each side of walls or floors where sleeves or framed openings are provided. Fabricate collars for round ducts 15 inch diameter or less from 20 gauge galvanized steel. Fabricate collars for round, square or rectangular ducts with minimum dimension over 15 inches from 18 gauge galvanized steel.

### 2.5 EXHAUST HOSE SYSTEM

#### 2.5.1 Tailpipe Adapters

Provide tapered-cone adapters with spring clips or other suitable devices for exhaust pipe attachment. The adapter must fit 4 inch nominal diameter exhaust pipe.

#### 2.5.2 Flexible Exhaust Hose

Flexible exhaust hose must be approved heat-resistant wire reinforced glass fiber and silicone tubing. Provide wye connectors where shown. Provide flexible tubing inside diameter and length as shown. Connect the tubing to the bottom of the ductwork. Provide a flanged connection where the flexible tubing and overhead ductwork are joined. The flanged connection must consist of steel flanges not less than 0.078 inch thick, 1/8 inch gasket. Provide gasket suitable for the system design temperature shown, in accordance with ASME B16.21, full face or self-centering flat ring type. It must contain aramid fibers bonded with styrene butadiene rubber (SBR) or nitrile butadiene rubber (NBR). Size or design the flange to suit the hose as approved.

#### 2.5.3 Exhaust Hose Suspension System

Suspend the flexible tubing overhead when not in use; allowing it to be lowered to the operating level, when required. Furnish the suspension system complete with cable, and operating mechanism. The suspension system must be counter-weighted type or manually operated balancer type with safety ratchet lock or automatic brake having slip resistant hand grip.

### 2.6 DAMPERS

Provide dampers of the type indicated and install where shown. Provide circular disk dampers with quadrant locking device or blast gate type. Damper blades less than 16 gauge thickness of stainless steel are not permitted. Provide blast gate dampers consisting of two piece construction with adjustable sliding gate and setscrew.

### 2.7 MATERIALS

Provide materials conforming to the following requirements.

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#### 2.7.1 Screen

ASTM E2016, type and class as required for the application.

#### 2.7.2 Iron and Steel Sheets

##### 2.7.2.1 Galvanized Iron and Steel

ASTM A924/A924M, Coating Designation G90.

##### 2.7.2.2 Uncoated Steel

ASTM A1011/A1011M, condition, and type best suited to intended use.

##### 2.7.2.3 Stainless Steel

ASTM A167, Type 304.

#### 2.7.3 Steel Structural Shapes

ASTM A36/A36M.

#### 2.7.4 Solder Silver

AWS A5.8/A5.8M, brazing alloy; grade to suit application.

#### 2.7.5 Solder

ASTM B32, composition to suit application.

#### 2.7.6 Bolts and Nuts

Furnish bolts and nuts, except as required for high temperature exhaust applications, in accordance with ASTM A307. Use bolts and nuts for exhaust applications where the temperature of the bolt may rise above 400 degrees F or use as flange bolts in corrosion resistant material in accordance with ASTM A193/A193M Class 2. Mark the bolt head to identify the manufacturer and the standard with which the bolt complies in accordance with ASTM A307 or ASTM A193/A193M as applicable.

### 2.8 ELECTRICAL WORK

Provide specified electrical motor-driven equipment complete with motor, motor starter, and controls. Unless otherwise specified, provide electric equipment, including wiring and motor efficiencies, according to Section 26 20 00 INTERIOR DISTRIBUTION SYSTEM. Provide electrical characteristics and enclosure type as shown. Unless otherwise indicated, motors of 1 hp and above must be high efficiency type. Provide motor starters complete with thermal overload protection and other appurtenances necessary. Provide each motor according to NEMA MG 1 and of sufficient size to drive the equipment at the specified capacity without exceeding the nameplate rating of the motor. Manual or automatic control and protective or signal devices required for the operation specified, and any control wiring required for controls and devices, but not shown, must be provided. Where two-speed or variable-speed motors are indicated, solid-state variable-speed controller may be provided to accomplish the same function. Utilize solid-state variable-speed controllers for motors rated 10 hp or less. Use adjustable frequency drives for larger motors.

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## 2.9 AIR MOVING DEVICES

### 2.9.1 General

Test and rate fans in accordance with the standards of AMCA 210, Type "D" Ducted Inlet, Ducted Outlet Configuration. Where V-belt drives are used, design such drives for no less than 150 percent of the connected driving capacity, and adjust motor sheaves to provide no less than an overall 20 percent speed variation. Select sheaves to drive the fan at such speed as to 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 fans with personnel screens or guards on both suction and supply ends except where ducts or dampers are connected to the fan. Provide fans and motors with vibration isolation supports or mountings. Vibration isolation units must be standard products with published load ratings, and must be single rubber-in-shear, neoprene coated fiberglass, double rubber-in-shear springs, or springs under inertia base. Select each fan to produce the capacity required at the fan total pressure indicated. Provide standard AMCA arrangements unless otherwise indicated and provide the rotation and discharge as indicated. Provide fans with nonoverloading characteristics. Construct fan housing with no less than 16 gauge thick steel. Construct fan impellers to meet AMCA Spark Resistance "B" Classification and accurately balance both statically and dynamically when installed in the assembled fan unit. Coat impeller and housing in the air stream with neoprene, epoxy, phenolic resins, or otherwise be suitable to resist the corrosive gases and temperatures produced. Fans must be free of objectionable vibration or noise. Certified performance curves indicating that the fan supplied will operate in its most efficient operating range will be provided. In addition, furnish "sound power" ratings with each fan. Select each fan to produce the capacity required at the fan total pressure indicated. Provide weather hoods, flashing, and bird screens where indicated.

### 2.9.2 Fans

Provide sound power level as indicated and obtain values according to AMCA 300. Indicate Standard AMCA arrangement, rotation, and discharge. Test and rate fans according to AMCA 210. Select each fan to produce the capacity required at the fan static pressure indicated. Fans may be connected to the motors either directly or indirectly with V-belt drive. Design V-belt drives for no less than 150 percent of the connected driving capacity. Provide variable pitch motor sheaves for 15 hp and below and fixed pitch as defined by AHRI Guideline D. Select variable pitch sheaves to drive the fan at a speed which will produce the specified capacity when set at the approximate midpoint of the sheave adjustment. When fixed pitch sheaves are furnished, provide a replaceable sheave when needed to achieve system air balance.

#### 2.9.2.1 Protective Devices

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. Vibration-isolation units must be standard products with published loading

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ratings.

#### 2.9.2.2 Centrifugal Fans

Centrifugal fans must be fully enclosed, single-width single-inlet, or double-width double-inlet, AMCA Pressure Class I, II, or III as required or indicated for the design system pressure. Provide rigidly constructed impellar wheels, accurately balance both statically and dynamically. Fan blades may be forward curved, backward-inclined or airfoil design in wheel sizes up to 30 inches. Fan blades for wheels over 30 inches in diameter must be backward-inclined or airfoil design. These fans must be suitable for the temperatures encountered. Provide fan shaft with a heat slinger to dissipate heat buildup along the shaft. Supply an access (service) door to facilitate maintenance with these fans. Fan wheels over 36 inches in diameter must have overhung pulleys and a bearing on each side of the wheel. Indirect drive fan wheels 36 inches or less in diameter may have one or more extra long bearings between the fan wheel and the drive. Provide bearings that are sleeve type, self-aligning and self-oiling with oil reservoirs, or precision self-aligning roller or ball-type with accessible grease fittings or permanently lubricated type. Connect grease fittings to tubing and service from a single accessible point. Bearing life must be L50 rated at not less than 200,000 hours as defined by ABMA 9 and ABMA 11. Provide steel fan shafts, accurately finish, and provide key seats and keys for impeller hubs and fan pulleys. Provide each fan outlet of ample proportions and design for the attachment of angles and bolts for attaching flexible connections. Provide motors, unless otherwise indicated, that do not exceed 1800 rpm and have open dripproof enclosures. Provide motor starters that are magnetic type with general-purpose enclosure.

#### 2.9.3 In-Line Centrifugal Fans

Provide in-line centrifugal fans consisting of welded tubular casings, centrifugal backward inclined blades, stationary discharge conversion vanes, internal and external belt guards, and adjustable motor mounts. Air must enter and leave the fan axially. Inlets must be streamline with conversion vanes to eliminate turbulence and discharge air flow smoothly. Enclose fan bearings and drive shafts and isolate from air stream. Provide fan bearings that are sealed against dust and dirt and permanently lubricated or lubricative type with grease lines extending to the exterior of the housing. Bearing life must be L50 rated at not less than 200,000 hours as defined by ABMA 9 and ABMA 11. Provide motors that have open dripproof enclosure. Provide motor starters that are magnetic across-the-line with general-purpose enclosure.

#### 2.10 FACTORY COATING

Provide factory finished equipment and component items, when fabricated from ferrous metal as defined by ASTM (or similar) standard, with the manufacturers standard finish except provide weather-resistant finishes that will withstand 500 hours exposure to the salt spray test specified in ASTM B117 to items located outside of building.

### 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

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discrepancy before performing the work.

### 3.2 INSTALLATION

Install work as shown and according to the manufacturer's diagrams and recommendations.

### 3.3 INSPECTION

The Exhaust System Specialist must (1) Inspect the exhaust system periodically during the installation. (2) Witness the final tests, and sign approval of the test results. (3) Certify in writing that the system has been installed in accordance with the contract requirements. Bring any discrepancy to the attention of the Contracting Officer in writing, no later than three working days after the discrepancy is discovered.

### 3.4 EXHAUST SYSTEM INSTALLATION

#### 3.4.1 General Requirements

Perform welding and brazing conforming to ASME BPVC SEC IX. Install horizontal sections of the main duct with the longitudinal lock seam on the top. Seal slip joints in accordance with SMACNA 1520. Support and anchor riser duct to the structure as indicated. Attach main duct to the structural members of the building as recommended by SMACNA 1520.

#### 3.4.2 Building Surface Penetrations

Utilize sleeves or framed openings where duct penetrates building surfaces. Penetrations must be sealed, and fireproofed in accordance with Section 07 84 00 FIRESTOPPING. Pack the space between the sleeve or framed opening and the duct with mineral wool or other approved material. Install closure collars around the duct on both sides of the penetrated surface. Collars must fit tight against the building surfaces and snugly around the duct.

### 3.5 PIPE COLOR CODE MARKING

Provide color code marking of piping as specified in Section 09 90 00 PAINTS AND COATINGS.

### 3.6 ONSITE TRAINING

Submit proposed Onsite Training schedule, at least 14 days prior to the start of related training 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 must start after the system is functionally completed but prior to final acceptance tests. The field instructions must cover all of the items contained in the approved operation and maintenance manuals, as well as demonstrations of routine maintenance operations. Submit 6 manuals listing step-by-step procedures required for system startup, operation, shutdown, and routine maintenance, at least 14 days prior to on-site training. Include the manufacturer's name, model number, 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. Each service organization submitted must be capable of providing 4 hour on-site response to a service call on an emergency basis.

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Notify the Contracting Officer at least 14 days prior to date of proposed conduction of the training course.

### 3.7 FINAL ACCEPTANCE TESTS

Balance each exhaust system and inlet to produce the indicated air quantities within 10 percent at the conditions shown. Set control devices to control at the points indicated or directed. Lubricate bearings, and check the speed, direction or rotation of each fan. Check the running current of each motor. Upon completion, and prior to acceptance of the installation, test the exhaust system at operating conditions to demonstrate satisfactory functional and operating efficiency.

- a. Operating tests must cover a period of not less than 2 hours for each system, and conduct all tests in the presence of the Contracting Officer. If tests do not demonstrate satisfactory operation of the exhaust system, correct deficiencies and retest. Provide all instruments, facilities, and labor required to properly conduct the tests. The electricity required for testing will be furnished by the Government.
- b. Submit 3 copies of the completed Final Acceptance Tests Reports, no later than 7 days after the completion of the Tests. Sign all items in the Final Acceptance Report. Submit proposed diagrams, instructions, and other sheets, concurrent with the Final Acceptance Test Procedures. Post framed instructions under glass or in laminated plastic where directed, including wiring and control diagrams showing the complete layout of the entire system. Prepare 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 in typed form, frame as specified above for the wiring and control diagrams and post beside the diagrams. Post the framed instructions before acceptance testing of the systems.
- c. Submit proposed procedures for Final Acceptance Tests, no later than 14 days prior to the proposed start of the tests.
- d. Submit proposed date and time to begin Final Acceptance Tests, with the Final Acceptance Test Procedures. Provide notification at least 14 days prior to the proposed start of the test.

-- End of Section --

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## 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 700	(2016) Specifications for Fluorocarbon Refrigerants
ANSI/AHRI 210/240	(2008; Add 1 2011; Add 2 2012) Performance Rating of Unitary Air-Conditioning & Air-Source Heat Pump Equipment
ANSI/AHRI 460	(2005) Performance Rating of Remote Mechanical-Draft Air-Cooled Refrigerant Condensers
ANSI/AHRI 495	(2005) Performance Rating of Refrigerant Liquid Receivers

## AMERICAN SOCIETY OF HEATING, REFRIGERATING AND AIR-CONDITIONING ENGINEERS (ASHRAE)

ANSI/ASHRAE 15 & 34	(2013) ANSI/ASHRAE Standard 15-Safety Standard for Refrigeration Systems and ANSI/ASHRAE Standard 34-Designation and Safety Classification of Refrigerants
ASHRAE 15 & 34	(2013) ASHRAE Standard 34-2016 Safety Standard for Refrigeration Systems/ASHRAE Standard 34-2016 Designation and Safety Classification of Refrigerants-ASHRAE Standard 34-2016
ASHRAE 52.2	(2017) Method of Testing General Ventilation Air-Cleaning Devices for Removal Efficiency by Particle Size
ASHRAE 55	(2010) Thermal Environmental Conditions for Human Occupancy
ASHRAE 62.1	(2010) Ventilation for Acceptable Indoor Air Quality
ASHRAE 90.1 - IP	(2013) Energy Standard for Buildings Except Low-Rise Residential Buildings



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#### AMERICAN SOCIETY OF MECHANICAL ENGINEERS (ASME)

ASME BPVC SEC IX	(2017; Errata 2018) BPVC Section IX-Welding, Brazing and Fusing Qualifications
ASME BPVC SEC VIII D1	(2019) BPVC Section VIII-Rules for Construction of Pressure Vessels Division 1

#### AMERICAN WELDING SOCIETY (AWS)

AWS Z49.1	(2012) Safety in Welding and Cutting and Allied Processes
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#### ASTM INTERNATIONAL (ASTM)

ASTM B117	(2019) Standard Practice for Operating Salt Spray (Fog) Apparatus
ASTM C1071	(2019) Standard Specification for Fibrous Glass Duct Lining Insulation (Thermal and Sound Absorbing Material)
ASTM D520	(2000; R 2011) Zinc Dust Pigment
ASTM E84	(2020) Standard Test Method for Surface Burning Characteristics of Building Materials

#### NATIONAL ELECTRICAL MANUFACTURERS ASSOCIATION (NEMA)

NEMA MG 1	(2018) Motors and Generators
NEMA MG 2	(2014) Safety Standard for Construction and Guide for Selection, Installation and Use of Electric Motors and Generators

#### NATIONAL FIRE PROTECTION ASSOCIATION (NFPA)

NFPA 70	(2020; ERTA 20-1 2020; ERTA 20-2 2020; TIA 20-1; TIA 20-2; TIA 20-3; TIA 20-4) National Electrical Code
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#### UNDERWRITERS LABORATORIES (UL)

UL 207	(2009; Reprint Jan 2020) Refrigerant-Containing Components and Accessories, Nonelectrical
UL 586	(2009; Reprint Dec 2017) UL Standard for Safety High-Efficiency Particulate, Air Filter Units
UL 900	(2015) Standard for Air Filter Units
UL 1995	(2015) UL Standard for Safety Heating and Cooling Equipment

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## 1.2 SUBMITTALS

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

### SD-03 Product Data

Spare Parts

Posted Instructions

System Performance Tests

Training; G

Inventory

Supplied Products

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

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required to have concrete foundations.

- e. Details, if piping and equipment are to be supported other than as indicated, which include loadings and type of frames, brackets, stanchions, or other supports.
- f. Automatic temperature control diagrams and control sequences.
- g. Installation details which includes the amount of factory set superheat and corresponding refrigerant pressure/temperature.
- h. Equipment schedules

#### 1.4 DELIVERY, STORAGE, AND HANDLING

Protect stored items from the weather, humidity and temperature variations, dirt and dust, or other contaminants. Properly protect and care for all material both before and during installation. Submit an inventory of all the stored items. Replace any materials found to be damaged, at no additional cost to the Government. During installation, cap piping and similar openings capped to keep out dirt and other foreign matter.

#### 1.5 ENVIRONMENTAL REQUIREMENTS

For proper Indoor Environmental Quality, maintain pressure within the building as indicated. Ventilation must meet or exceed ASHRAE 62.1 and all published addenda. Meet or exceed filter media efficiency as tested in accordance with ASHRAE 52.2. Thermal comfort must meet or exceed ASHRAE 55.

#### 1.6 WARRANTY

Provide equipment with the Manufacturer's Standard Warranty.

### PART 2 PRODUCTS

#### 2.1 ENERGY EFFICIENCY REQUIREMENTS

42 USC 8259b requires the procurement of energy efficient products in product categories covered by the Energy Star program or the Federal Energy Management Program for designated products. A list of covered product categories is available from the Federal Energy Management Web site at <http://energy.gov/eere/femp/covered-product-categories>. A list of qualified light commercial products is available at <http://www.energystar.gov/productfinder/product/certified-light-commercial-hvac/result>

Submit Material, Equipment, and Fixtures List of all supplied products within a covered product category, including manufacturer's catalog numbers, specification and drawing reference number, warranty information, fabrication site, and energy performance data. For product categories covered by the Energy Star program, submit documentation that the product is Energy Star-qualified. For product categories covered by the Federal Energy Management Program, submit documentation that the product meets or exceeds FEMP-designated efficiency requirements.

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## 2.2 MATERIALS

Provide Manufacturer's standard catalog data, at least 5 weeks prior to the purchase or installation of a particular component, highlighted to show material, size, options, performance charts and curves, etc. in adequate detail to demonstrate compliance with contract requirements. Data includes manufacturer's recommended installation instructions and procedures. If vibration isolation is specified for a unit, include vibration isolator literature containing catalog cuts and certification that the isolation characteristics of the isolators provided meet the manufacturer's recommendations. Submit data for each specified component. Minimum efficiency requirements must be in accordance with ASHRAE 90.1 - IP.

### 2.2.1 Standard Products

Provide materials and equipment that are standard products of a manufacturer regularly engaged in the manufacturing of such products, which are of a similar material, design and workmanship. The standard products must have been in satisfactory commercial or industrial use for 2 years prior to bid opening. The 2 year use includes applications of equipment and materials under similar circumstances and of similar size. The 2 years' experience must be satisfactorily completed by a product which has been sold or is offered for sale on the commercial market through advertisements, manufacturer's catalogs, or brochures. Products having less than a 2 year field service record will be acceptable if a certified record of satisfactory field operation, for not less than 6000 hours exclusive of the manufacturer's factory tests, can be shown. Products must be supported by a service organization. Ensure system components are environmentally suitable for the indicated geographic locations.

### 2.2.2 Product Sustainability Criteria

#### 2.2.2.1 Energy Efficient Equipment

Provide equipment meeting the efficiency requirements as stated within this section and provide documentation in conformance with Section 01 33 29.00 06 SUSTAINABILITY REPORTING paragraph ENERGY EFFICIENT EQUIPMENT.

#### 2.2.2.2 Electrical Equipment / Motors

Provide electrical equipment, motors, motor efficiencies, and wiring which are in accordance with Section 26 20 00 INTERIOR DISTRIBUTION SYSTEM. Electrical motor driven equipment specified must be provided complete with motors, motor starters, and controls. Electrical characteristics must be as shown, and unless otherwise indicated, all motors of 1 horsepower and above with open, dripproof, totally enclosed, or explosion proof fan cooled enclosures, must be the premium efficiency type in accordance with NEMA MG 1. Field wiring must be in accordance with manufacturer's instructions. Each motor must conform to NEMA MG 1 and NEMA MG 2 and be of sufficient size to drive the equipment at the specified capacity without exceeding the nameplate rating of the motor. Motors must be continuous duty with the enclosure specified. Motor starters must be provided complete with thermal overload protection and other appurtenances necessary for the motor control indicated. Motors must be furnished with a magnetic across-the-line or reduced voltage type starter as required by the manufacturer. Motor duty requirements must allow for maximum frequency start-stop operation and minimum encountered interval between

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start and stop. Motors must be sized for the applicable loads. Motor torque must be capable of accelerating the connected load within 20 seconds with 80 percent of the rated voltage maintained at motor terminals during one starting period. Motor bearings must be fitted with grease supply fittings and grease relief to outside of enclosure. Manual or automatic control and protective or signal devices required for the operation specified and any control wiring required for controls and devices specified, but not shown, must be provided.

#### 2.2.2.3 Ozone Depleting Substances

Unitary air conditioning equipment must not use CFC-based refrigerants. Refrigerant may be an approved alternative refrigerant in accordance with EPA's Significant New Alternative Policy (SNAP) listing. Provide documentation in conformance with Section 01 33 29.00 06 SUSTAINABILITY REPORTING paragraph OZONE DEPLETING SUBSTANCES.

#### 2.2.3 Nameplates

Major equipment including compressors, condensers, receivers, heat exchanges, fans, and motors must have the manufacturer's name, address, type or style, model or serial number, and catalog number on a plate secured to the item of equipment. Plates must be durable and legible throughout equipment life and made of anodized aluminum. Fix plates in prominent locations with nonferrous screws or bolts.

#### 2.2.4 Safety Devices

Exposed moving parts, parts that produce high operating temperature, parts which may be electrically energized, and parts that may be a hazard to operating personnel must be insulated, fully enclosed, guarded, or fitted with other types of safety devices. Safety devices must be installed so that proper operation of equipment is not impaired. Welding and cutting safety requirements must be in accordance with AWS Z49.1.

### 2.3 EQUIPMENT

#### 2.3.1 Mini-Split-System Air Conditioners Heat Pumps

##### 2.3.1.1 Small-Capacity Split-System Air-Conditioners

Provide an air-cooled, split system which employs a remote condensing 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 galvanized steel cabinet construction. The remote unit must be as specified in paragraph CONDENSING UNIT. Provide double-width, double inlet, forward curved backward inclined, or airfoil blade, centrifugal scroll type evaporator or supply fans. Provide the manufacturer's standard condenser or outdoor fans for the unit specified and may be propeller type. Fan and condenser motors must have open drip proof enclosures. Design unit to operate at outdoor ambient temperatures up to 115 degrees F.

##### 2.3.1.1.1 Energy Efficiency

Provide unit with an Energy Star label.

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#### 2.3.1.1.2 Air-to-Refrigerant Coil

Provide condensing coils with copper or aluminum tubes of 3/8 inch minimum diameter with copper or aluminum fins that are mechanically bonded or soldered to the tubes. Casing must be galvanized steel. Avoid contact of dissimilar metals. Test coils in accordance with ASHRAE 15 & 34 at the factory and ensure suitability for the working pressure of the installed system. Dehydrate and seal each coil testing and prior to evaluation and charging.

#### 2.3.1.1.3 Compressor

Provide direct drive scroll type compressor. Provide compressor with internal over temperature and pressure protector; sump heater; oil pump; high pressure and low pressure controls; and liquid line dryer.

#### 2.3.1.1.4 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. Provide refrigerant charging valves. Provide filter-drier in liquid line to prevent freeze-up in event of loss of water flow during heating cycle.

#### 2.3.1.1.5 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.

#### 2.3.1.1.6 Condensing Coil

Provide coils with copper or aluminum tubes of 3/8 inch minimum diameter with copper or aluminum fins that are mechanically bonded or soldered to the tubes. Provide galvanized steel or aluminum casing. Avoid contact of dissimilar metals. Test coils in accordance with ANSI/ASHRAE 15 & 34 at the factory and ensure suitability for the working pressure of the installed system. Dehydrate and seal each coil after testing and prior to evaluation and charging. Provide separate expansion devices for each compressor circuit.

#### 2.3.1.1.7 Remote Condenser or Condensing Unit

Fit each remote condenser coil fitted with a manual isolation valve and an access valve on the coil side. Saturated refrigerant condensing temperature must not exceed 120 degrees F at 104 degrees F ambient. Provide unit with low ambient condenser controls to ensure proper operation in an ambient temperature of 20 degrees F. Provide fan and cabinet construction as specified in paragraph UNITARY EQUIPMENT

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ACCESSORIES. Fan and condenser motors must have opendrip proof enclosures. Condensing unit must have controls to initiate a refrigerant pump down cycle at system shut down on each refrigerant circuit.

#### 2.3.1.1.7.1 Air-Cooled Condenser

Provide Unit in accordance with ANSI/AHRI 460 and conform to the requirements of UL 1995. Provide factory fabricated, tested, packaged, and self-contained unit; complete with casing, propeller type fans, heat rejection coils, connecting piping and wiring, and all necessary accessories.

#### 2.3.1.1.8 Primary/Supplemental Heat

Provide heating unit with internal thermal insulation having a fire hazard rating not to exceed 25 for flame spread and 50 for smoke developed as determined by ASTM E84.

##### 2.3.1.1.8.1 Electric Heating

Provide electric duct heater in accordance with UL 1995 and NFPA 70. Coil must be completely assembled, unit-mounted, and integral to the unit. Provide coil with nickel chromium elements and a maximum density of 40 watts per square inch. Provide coil with automatic reset high limit control operating through heater backup contactors. Provide coil casing and support brackets of galvanized steel. Mount coil to eliminate noise from expansion and contraction and be completely accessible for service. Construct electric heater of heavy-duty nickel chromium elements. Achieve staging through the unit control processor. Each heater must have automatically reset high limit control. Heaters must be individually fused from the factory and comply with NEC requirements. Power assemblies must provide single point connection. Electric heat modules must be listed and labeled by a national recognized testing laboratory acceptable to authorities having jurisdiction. Electric heater controls must confirm the supply fan is operating before electric elements are energized. Operate electric heater in 2 stages when outdoor ambient is too low to maintain space thermostat setting with compressor operation.

##### 2.3.1.1.9 Air Filters

Provide filters of the panel type that are capable of filtering the entire air supply. Mount filter(s) integral within the unit and make accessible by hinged access panel(s). 1 inch MERV 8, provide throwaway filter on all units below 6 Tons.

Provide filter rack that can be converted to 2.0 inch capability. Filters must have an average dust spot efficiency of 25-35 percent and an average arrestance of 90 percent when tested in accordance with ASHRAE 52.2. Provide UL Class 1 filters.

##### 2.3.1.1.10 Fans

Provide direct driven, statically and dynamically balanced, centrifugal or propeller type fans. Design the outdoor fan so that condensate will evaporate without drip, splash, or spray on building exterior. Provide indoor fan with a minimum two-speed motor with built-in overload protection. Fan motors must be the inherently protected, permanent split-capacitor type.

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## 2.4 COMPONENTS

### 2.4.1 Refrigerant and Oil

Refrigerant must be one of the fluorocarbon gases. Refrigerants must have number designations and safety classifications in accordance with ASHRAE 15 & 34. Refrigerants must meet the requirements of AHRI 700 as a minimum. Provide a complete charge of refrigerant for the installed system as recommended by the manufacturer. Lubricating oil must be of a type and grade recommended by the manufacturer for each compressor. Where color leak indicator dye is incorporated, charge must be in accordance with manufacturer's recommendation.

### 2.4.2 Fans

Fan wheel shafts must be supported by either maintenance-accessible lubricated antifriction block-type bearings, or permanently lubricated ball bearings. Unit fans must be selected to produce the cfm required at the fan total pressure. Motor starters, if applicable, must be magnetic across-the-line type with a nondripproof enclosure. Thermal overload protection must be of the manual or automatic-reset type. Fan wheels or propellers must be constructed of aluminum or galvanized steel. Centrifugal fan wheel housings must be of galvanized steel, and both centrifugal and propeller fan casings must be constructed of aluminum or galvanized steel. Steel elements of fans, except fan shafts, must be hot-dipped galvanized after fabrication or fabricated of mill galvanized steel. Mill-galvanized steel surfaces and edges damaged or cut during fabrication by forming, punching, drilling, welding, or cutting must be recoated with an approved zinc-rich compound. Fan wheels or propellers must be statically and dynamically balanced. Direct-drive fan motors must be of the multiple-speed variety. Belt-driven fans must have adjustable sheaves to provide not less than 30 percent fan-speed adjustment. The sheave size must be selected so that the fan speed at the approximate midpoint of the sheave adjustment will produce the specified air quantity. Centrifugal scroll-type fans must be provided with streamlined orifice inlet and V-belt drive. Each drive will be independent of any other drive. Propeller fans must be direct-drive drive type with fixed pitch blades. V-belt driven fans must be mounted on a corrosion protected drive shaft supported by either maintenance-accessible lubricated antifriction block-type bearings, or permanently lubricated ball bearings. Each drive will be independent of any other drive. Drive bearings must be protected with water slingers or shields. V-belt drives must be fitted with guards where exposed to contact by personnel and fixed pitch sheaves.

### 2.4.3 Primary/Supplemental Heating

#### 2.4.3.1 Electric Heating Coil

Coil must be an electric duct heater in accordance with UL 1995 and NFPA 70. Coil must be duct- or unit-mounted. Coil must be of the nickel chromium resistor, single stage, strip type. Coil must be provided with a built-in or surface-mounted high-limit thermostat interlocked electrically so that the coil cannot be energized unless the fan is energized. Coil casing and support brackets must be of galvanized steel or aluminum. Coil must be mounted to eliminate noise from expansion and contraction and be completely accessible for service. Supplemental Electric Resistance Heating controls must be provided to prevent operation when the heating load can be met by the primary source.



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#### 2.4.4 Air Filters

Provide filters to filter outside air and return air and locate inside filter box . Provide replaceable (throw-away) type. Filters must conform to UL 900, Class 1 . Polyurethane filters cannot be used on units with multiframe filters.

Air filters must be listed in accordance with requirements of UL 900, except high efficiency particulate air filters of 99.97 percent efficiency by the DOP Test Method must be as listed under the label service and must meet the requirements of UL 586.

##### 2.4.4.1 Extended Surface Pleated Panel Filters

Filters must be 2 inch depth sectional type of the size indicated and must have an average efficiency of 25 to 30 percent when tested in accordance with ASHRAE 52.2. Initial resistance at 500 feet/minute must not exceed 0.36 inches water gauge. Filters must be UL Class 2. Media must be nonwoven cotton and synthetic fiber mat. A wire support grid bonded to the media must be attached to a moisture resistant fiberboard frame. Four edges of the filter media must be bonded to the inside of the frame to prevent air bypass and increase rigidity.

#### 2.4.5 Coil Frost Protection

Provide each circuit with a manufacturer's standard coil frost protection system. The coil frost protection system must use a temperature sensor in the suction line of the compressor to shut the compressor off when coil frosting occurs. Use timers to prevent the compressor from rapid cycling.

#### 2.4.6 Pressure Vessels

Pressure vessels must conform to ASME BPVC SEC VIII D1 or UL 207, as applicable for maximum and minimum pressure or temperature encountered. Where referenced publications do not apply, test pressure components at 1-1/2 times design working pressure. Refrigerant wetted carbon steel surfaces must be pickled or abrasive blasted free of mill scale, cleaned, dried, charged, and sealed.

##### 2.4.6.1 Liquid Receiver

A liquid receiver must be provided when a system's condenser or compressor does not contain a refrigerant storage capacity of at least 20 percent in excess of a fully charged system. Receiver must be designed, filled, and rated in accordance with the recommendations of ANSI/AHRI 495, except as modified herein. Receiver must be fitted to include an inlet connection; an outlet drop pipe with oil seal and oil drain where necessary; two bull's-eye liquid level sight glass in same vertical plane, 90 degrees apart and perpendicular to axis of receiver or external gauge glass with metal guard and automatic stop valves; and purge, charge, equalizing, pressurizing, plugged drain and service valves on the inlet and outlet connections. Receiver must be provided with a relief valve of capacity and setting in accordance with ASHRAE 15 & 34.

##### 2.4.6.2 Oil Separator

Separator must be the high efficiency type and be provided with removable flanged head for ease in removing float assembly and removable screen

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cartridge assembly. Pressure drop through a separator must not exceed 10 psi during the removal of hot gas entrained oil. Connections to compressor must be as recommended by the compressor manufacturer. Separator must be provided with an oil float valve assembly or needle valve and orifice assembly, drain line shutoff valve, sight glass, filter for removal of all particulate sized 10 microns and larger, and strainer.

#### 2.4.6.3 Oil Reservoir

Reservoir capacity must equal one charge of all connected compressors. Reservoir must be provided with an external liquid gauge glass, plugged drain, and isolation valves. Vent piping between the reservoir and the suction header must be provided with a 5 psi pressure differential relief valve. Reservoir must be provided with the manufacturer's standard filter on the oil return line to the oil level regulators.

#### 2.4.7 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.

##### 2.4.7.1 Indoor Cabinet

Indoor cabinets must be suitable for the specified indoor service and enclose all unit components.

##### 2.4.7.2 Outdoor Cabinet

Outdoor cabinets must be suitable for outdoor service with a weathertight, insulated and corrosion-protected structure. Cabinets constructed exclusively for indoor service which have been modified for outdoor service are not acceptable.

#### 2.4.8 Refrigerant Piping

Provide refrigerant piping in accordance with Section 23 23 00 REFRIGERANT PIPING.

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#### 2.4.9 Condensate Drain Piping

provide condensate drain piping in accordance with Section 22 00 00  
PLUMBING, GENERAL PURPOSE.

#### 2.4.10 Ductwork

Provide ductwork in accordance with Section 23 30 00 HVAC AIR DISTRIBUTION.

#### 2.4.11 Temperature Controls

Temperature controls shall be in accordance with Section 23 09 23.02  
BACnet DIRECT DIGITAL CONTROL FOR HVAC AND OTHER BUILDING CONTROL SYSTEMS.

### 2.5 UNITARY EQUIPMENT ACCESSORIES AND MISCELLANEOUS EQUIPMENT

### 2.6 FINISHES

#### 2.6.1 Equipment and Components Factory Coating

Unless otherwise specified, equipment and component items, when fabricated from ferrous metal, must be factory finished with the manufacturer's standard finish, except that items located outside of buildings must have weather resistant finishes that will withstand 500 hours exposure to the salt spray test specified in ASTM B117 using a 5 percent sodium chloride solution. Immediately after completion of the test, the specimen must show no signs of blistering, wrinkling, cracking, or loss of adhesion and no sign of rust creepage beyond 1/8 inch on either side of the scratch mark. Cut edges of galvanized surfaces where hot-dip galvanized sheet steel is used must be coated with a zinc-rich coating conforming to ASTM D520, Type I.

Where stipulated in equipment specifications of this section, coat finned tube coils of the affected equipment as specified below. Apply coating at the premises of a company specializing in such work. Degrease and prepare for coating in accordance with the coating applicator's procedures for the type of metals involved. Completed coating must show no evidence of softening, blistering, cracking, crazing, flaking, loss of adhesion, or "bridging" between the fins.

#### 2.6.2 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

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than 25 and a smoke developed index no higher than 50 when tested in accordance with ASTM E84.

## 2.7 TESTS, INSPECTIONS, AND VERIFICATIONS

All manufactured units must be inspected and tested, and documentation provided to demonstrate that each unit is in compliance with ANSI/AHRI and UL requirements and that the minimum efficiency requirements of ASHRAE 90.1 - IP have been met.

## PART 3 EXECUTION

### 3.1 EXAMINATION

After becoming familiar with all details of the work, perform Verification of Dimensions in the field, and advise the Contracting Officer of any discrepancy before performing any work.

### 3.2 INSTALLATION

Perform work in accordance with the manufacturer's published diagrams, recommendations, and equipment warranty requirements. Where equipment is specified to conform to the requirements of ASME BPVC SEC VIII D and ASME BPVC SEC IX, the design, fabrication, and installation of the system must conform to ASME BPVC SEC VIII D1 and ASME BPVC SEC IX.

#### 3.2.1 Equipment

Provide refrigeration equipment conforming to ASHRAE 15 & 34. Provide necessary supports for all equipment, appurtenances, and pipe as required, including frames or supports for compressors, pumps, cooling towers, condensers, and similar items. Isolate compressors from the building structure. If mechanical vibration isolators are not provided, provide vibration absorbing foundations. Each foundation must include isolation units consisting of machine and floor or foundation fastenings, together with intermediate isolation material. Other floor-mounted equipment must be set on not less than a 6 inch concrete pad doweled in place. Concrete foundations for floor mounted pumps must have a mass equivalent to three times the weight of the components, pump, base plate, and motor to be supported. In lieu of concrete pad foundation, concrete pedestal block with isolators placed between the pedestal block and the floor may be provided. Concrete pedestal block must be of mass not less than three times the combined pump, motor, and base weights. Isolators must be selected and sized based on load-bearing requirements and the lowest frequency of vibration to be isolated. Isolators must limit vibration to 10-20 percent at lowest equipment rpm. Provide lines connected to pumps mounted on pedestal blocks with flexible connectors. Provide foundation drawings, bolt-setting information, and foundation bolts prior to concrete foundation construction for all equipment indicated or required to have concrete foundations. Concrete for foundations must be as specified in Section 03 30 00 CAST-IN-PLACE CONCRETE. Equipment must be properly leveled, aligned, and secured in place in accordance with manufacturer's instructions.

#### 3.2.2 Mechanical Room Ventilation

Provide mechanical ventilation systems in accordance with Section 23 30 00 HVAC AIR DISTRIBUTION.

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### 3.2.3 Field Applied Insulation

Apply field applied insulation as specified in Section 23 07 00 THERMAL INSULATION FOR MECHANICAL SYSTEMS, except as defined differently herein.

### 3.2.4 Field Painting

Painting required for surfaces not otherwise specified, and finish painting of items only primed at the factory are specified 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 93.00 06 TESTING, ADJUSTING, AND BALANCING (TAB) OF HVAC.

## 3.4 TRAINING

Conduct a training course for the operating staff as designated by the Contracting Officer. The training period must consist of a total 8 hours of normal working time and start after the system is functionally completed but prior to final acceptance tests.

- a. Submit a schedule, at least 2 weeks prior to the date of the proposed training course, which identifies the date, time, and location for the training.
- b. Submit the field posted instructions, at least 2 weeks prior to construction completion, including equipment layout, wiring and control diagrams, piping, valves and control sequences, and typed condensed operation instructions. The condensed operation instructions must include preventative maintenance procedures, methods of checking the system for normal and safe operation, and procedures for safely starting and stopping the system. The posted instructions must be framed under glass or laminated plastic and be posted where indicated by the Contracting Officer.
- c. The posted instructions must cover all of the items contained in the approved operation and maintenance manuals as well as demonstrations of routine maintenance operations. Submit 6 complete copies of an operation manual in bound 8-1/2 by 11 inch booklets listing step-by-step procedures required for system startup, operation, abnormal shutdown, emergency shutdown, and normal shutdown at least 4 weeks prior to the first training course. The booklets must include the manufacturer's name, model number, and parts list. The manuals must include the manufacturer's name, model number, service manual, and a brief description of all equipment and their basic operating features.

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- d. Submit 6 complete copies of maintenance manual in bound 8-1/2 by 11 inch booklets listing routine maintenance procedures, possible breakdowns and repairs, and a trouble shooting guide. The manuals must include piping and equipment layouts and simplified wiring and control diagrams of the system as installed.

### 3.5 REFRIGERANT TESTS, CHARGING, AND START-UP

Split-system refrigerant piping systems must be tested and charged as specified in Section 23 23 00 REFRIGERANT PIPING. Packaged refrigerant systems which are factory charged must be checked for refrigerant and oil capacity to verify proper refrigerant levels in accordance with manufacturer's recommendations. Following charging, packaged systems must be tested for leaks with a halide torch or an electronic leak detector. Submit 6 copies of each test containing the information described below in bound 8-1/2 by 11 inch booklets. Individual reports must be submitted for the refrigerant system tests.

- a. The date the tests were performed.
- b. A list of equipment used, with calibration certifications.
- c. Initial test summaries.
- d. Repairs/adjustments performed.
- e. Final test results.

#### 3.5.1 Refrigerant Leakage

If a refrigerant leak is discovered after the system has been charged, the leaking portion of the system must immediately be isolated from the remainder of the system and the refrigerant pumped into the system receiver or other suitable container. Under no circumstances must the refrigerant be discharged into the atmosphere.

#### 3.5.2 Contractor's Responsibility

Take steps, at all times during the installation and testing of the refrigeration system, to prevent the release of refrigerants into the atmosphere. The steps must include, but not be limited to, procedures which will minimize the release of refrigerants to the atmosphere and the use of refrigerant recovery devices to remove refrigerant from the system and store the refrigerant for reuse or reclaim. At no time must more than 3 ounces of refrigerant be released to the atmosphere in any one occurrence. Any system leaks within the first year must be repaired in accordance with the requirements herein at no cost to the Government including material, labor, and refrigerant if the leak is the result of defective equipment, material, or installation.

### 3.6 SYSTEM PERFORMANCE TESTS

Before each refrigeration system is accepted, conduct tests to demonstrate the general operating characteristics of all equipment by a registered professional engineer or an approved manufacturer's start-up representative experienced in system start-up and testing, at such times as directed. Six copies of the report provided in bound 8-1/2 by 11 inch booklets. The report must document compliance with the specified performance criteria upon completion and testing of the system. The report must indicate the number of days covered by the tests and any conclusions as to the adequacy of the system.

For equipment providing heating and cooling the system performance tests

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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 93.00 06 TESTING, ADJUSTING, AND BALANCING (TAB) OF HVAC. Submit 6 copies of the report provided in bound 8-1/2 by 11 inch booklets. The report must document compliance with the specified performance criteria upon completion and testing of the system. The report must indicate the number of days covered by the tests and any conclusions as to the adequacy of the system. Submit the report including the following information (where values are taken at least three different times at outside dry-bulb temperatures that are at least 5 degrees F apart):
  - (1) Date and outside weather conditions.
  - (2) The load on the system based on the following:
    - (a) The refrigerant used in the system.
    - (b) Condensing temperature and pressure.
    - (c) Suction temperature and pressure.
    - (d) Ambient, condensing and coolant temperatures.
    - (e) Running current, voltage and proper phase sequence for each phase of all motors.
  - (3) The actual on-site setting of operating and safety controls.
  - (4) Thermostatic expansion valve superheat - value as determined by field test.
  - (5) Subcooling.
  - (6) High and low refrigerant temperature switch set-points
  - (7) Low oil pressure switch set-point.
  - (8) Defrost system timer and thermostat set-points.
  - (9) Moisture content.
  - (10) Capacity control set-points.

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(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 contract completion. Include in the data a complete list of parts and supplies, with current unit prices and source of supply, a recommended spare parts list for 1 year of operation, and a list of the parts recommended by the manufacturer to be replaced on a routine basis.

#### 3.7.2 Maintenance Service

Submit a certified list of qualified permanent service organizations, which includes their addresses and qualifications, for support of the equipment. The service organizations must be reasonably convenient to the equipment installation and be able to render satisfactory service to the equipment on a regular and emergency basis during the warranty period of the contract.

-- End of Section --



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## SECTION 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
ANSI/AHRI 520	(2004) Performance Rating of Positive Displacement Condensing Units

#### AMERICAN SOCIETY OF HEATING, REFRIGERATING AND AIR-CONDITIONING ENGINEERS (ASHRAE)

ANSI/ASHRAE 15 & 34	(2013) ANSI/ASHRAE Standard 15-Safety Standard for Refrigeration Systems and ANSI/ASHRAE Standard 34-Designation and Safety Classification of Refrigerants
ASHRAE 52.2	(2017) Method of Testing General Ventilation Air-Cleaning Devices for Removal Efficiency by Particle Size
ASHRAE 62.1	(2010) Ventilation for Acceptable Indoor Air Quality
ASHRAE 90.1 - IP	(2013) Energy Standard for Buildings Except Low-Rise Residential Buildings
ASHRAE 127	(2020) Method of Testing for Rating Computer and Data Processing Room Unitary Air-Conditioners

#### AMERICAN SOCIETY OF MECHANICAL ENGINEERS (ASME)

ASME B31.1	(2020) Power Piping
ASME B31.5	(2020) Refrigeration Piping and Heat Transfer Components

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#### 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	(2014) Standard Test Method for Determining Fungi Resistance of Insulation Materials and Facings
ASTM D5864	(2011) Standard Test Method for Determining Aerobic Aquatic Biodegradation of Lubricants or Their Components
ASTM D6081	(1998; R 2014) Aquatic Toxicity Testing of Lubricants: Sample Preparation and Results Interpretation
ASTM 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
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#### NATIONAL FIRE PROTECTION ASSOCIATION (NFPA)

NFPA 70	(2020; ERTA 20-1 2020; ERTA 20-2 2020; TIA 20-1; TIA 20-2; TIA 20-3; TIA 20-4) National Electrical Code
NFPA 90A	(2021) Standard for the Installation of Air Conditioning and Ventilating Systems

#### U.S. ARMY CORPS OF ENGINEERS (USACE)

EM 1110-2-1424	(2016) Engineering and Design -- Lubricants and Hydraulic Fluids
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#### U.S. GREEN BUILDING COUNCIL (USGBC)

LEED v4 BDC Ref Guide	(2013; R 2020) USGBC LEED Reference Guide for Building Design and Construction, v4
LEED v4.1 BDC Ref Guide	(2023) LEED v4.1 Building Design and Construction Reference Guide

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

40 CFR 82	Protection of Stratospheric Ozone
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#### UNDERWRITERS LABORATORIES (UL)

UL 181	(2013; Reprint Apr 2017) UL Standard for
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## 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 SUSTAINABILITY REPORTING

Work of this section is intended to contribute to the achievement of, or compliance with, the requirements of the Guiding Principles Validation and LEED Prerequisites and attempted Credits. Refer to Section 01 33 29.00 06 SUSTAINABILITY REPORTING for specific documentation requirements and list of Prerequisites, attempted Credits and LEED version.

Comply with product, material content, performance criteria, activity, documentation, and other technical requirements as described in the LEED v4 BDC Ref Guide or LEED v4.1 BDC Ref Guide as applicable.

Collect, organize, and submit product data, drawings, diagrams, photos and cost information necessary to demonstrate compliance with LEED v4 BDC Ref Guide or LEED v4.1 BDC Ref Guide requirements as applicable.

Data collection shall commence with the notice to proceed and will only be deemed complete upon acceptance of the Final Sustainability Notebook and LEED Online submission by the Contracting Officer, the LEED Project Administrator, and the Green Building Certification Institute.

### 1.4 SUBMITTALS

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

#### SD-03 Product Data

Computer Room Air Conditioner; G, AE

Small Computer Room Air Conditioners; G, AE

Space Temperature Control System Drawings; G

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Filters

Refrigerants; S, AE

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

1.5 REFRIGERANTS

Refrigerants must have an Ozone Depletion Potential (ODP) no greater than 0.0. CFC-based refrigerants are prohibited. HCFCs and Halons are not permitted. Provide SDS sheets for all refrigerants.

1.6 QUALIFICATIONS

1.6.1 Ozone Depleting Substances Technician Certification

All technicians working on equipment that contain ozone depleting refrigerants must be certified as a Section 608 Technician to meet requirements in 40 CFR 82, Subpart F. Provide copies of technician certifications to the Contracting Officer at least 14 calendar days prior to work on any equipment containing these refrigerants.

1.7 QUALIFICATIONS

1.7.1 Material and Equipment Qualifications

Provide materials and equipment that are standard products of manufacturers regularly engaged in the manufacture of such products,

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which are of a similar material, design, and workmanship. Standard products must have been in satisfactory commercial or industrial use for two years prior to bid opening. The two-year use must include applications of equipment and materials under similar circumstances and of similar size. The product must have been for sale on the commercial market through advertisements, manufacturers' catalogs, or brochures during the two-year period.

#### 1.7.2 Alternative Equipment Qualifications

Products having less than a two-year field service record will be acceptable if a certified record of satisfactory field operation for not less than 6000 hours, exclusive of the manufacturer's factory or laboratory tests, can be shown.

#### 1.7.3 Service Support

The equipment items must be supported by service organizations. Submit a certified list of qualified permanent service organizations for support of the equipment which includes their addresses and qualifications. These service organizations must be reasonably convenient to the equipment installation and able to render satisfactory service to the equipment on a regular and emergency basis during the warranty period of the contract.

#### 1.7.4 Manufacturer's Nameplate

For each item of equipment, provide a nameplate bearing the manufacturer's name, address, model number, and serial number securely affixed in a conspicuous place; the nameplate of the distributing agent will not be acceptable.

#### 1.7.5 Modification of References

In each of the publications referred to herein, consider the advisory provisions to be mandatory, as though the word, "must" had been substituted for "should" wherever it appears. Interpret references in these publications to the "authority having jurisdiction", or words of similar meaning, to mean the Contracting Officer.

##### 1.7.5.1 Definitions

For the International Code Council (ICC) Codes referenced in the contract documents, advisory provisions must be considered mandatory, the word "should" is interpreted as "must." Reference to the "code official" must be interpreted to mean the "Contracting Officer." For Navy owned property, references to the "owner" must be interpreted to mean the "Contracting Officer." For leased facilities, references to the "owner" must be interpreted to mean the "lessor." References to the "permit holder" must be interpreted to mean the "Contractor."

##### 1.7.5.2 Administrative Interpretations

For ICC Codes referenced in the contract documents, the provisions of Chapter 1, "Administrator," do not apply. These administrative requirements are covered by the applicable Federal Acquisition Regulations (FAR) included in this contract and by the authority granted to the Officer in Charge of Construction to administer the construction of this project. References in the ICC Codes to sections of Chapter 1, must be applied appropriately by the Contracting Officer as authorized by his

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administrative cognizance and the FAR.

## 1.8 PROJECT REQUIREMENTS

### 1.8.1 Verification of Dimensions

Become familiar with the details of the work, verify all dimensions in the field, and provide adequate clearance for all connections and service access. Notify the Contracting Officer of any discrepancy before performing any work.

### 1.8.2 Energy Efficiency

Provide equipment with minimum efficiencies as required by ASHRAE 90.1 - IP.

## 1.9 DELIVERY, STORAGE, AND HANDLING

Handle, store, and protect equipment and materials to prevent damage before and during installation in accordance with the manufacturer's recommendations, and as approved by the Contracting Officer. Replace damaged or defective items.

## PART 2 PRODUCTS

### 2.1 COMPUTER ROOM AIR CONDITIONER (CRAC)

Provide complete working CRACs, designed, factory assembled. Equipment must be listed in UL Elec Equip Dir or ETL DLP for computer room application. CRACs must include room cabinet and frame, fan section, filter section, cooling coil, compressor, controls, and, interconnecting piping internal to the CRAC. Provide units rated in accordance with AHRI 1360.

#### 2.1.1 Unit Airflow Configuration

#### 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.

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Provide double deflection supply and return grilles integral to unit.  
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.

Compressors located in CRAC interior cabinets must be either wrapped in a sound absorbing insulating blanket or enclosed in its' own sound absorbing insulated mini-cabinet inside of the larger CRAC interior cabinet.

Fans and compressors located in the CRAC interior cabinet must be provided with vibration isolators between their respective support frames and the cabinet framing.

#### 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, backward curved, plenum/plug type fan wheel. The fan must be statically and dynamically balanced. The fan must have self-aligning, permanently lubricated ball bearings with a minimum life span of 100,000 hours. Assess potential effects of lubricant on aquatic organisms in accordance with ASTM D6081 and submit aquatic toxicity reports. Assess biodegradation in accordance with ASTM D5864. In accordance with EM 1110-2-1424 Chapter 8, aquatic toxicity shall exceed 1,000 ppm at LL50 and biodegradation shall exceed 60 percent conversion of carbon to carbon dioxide in 28 days.

##### 2.1.3.2 Motor and Drive

Provide fan wheel directly coupled to motor shaft.

Provide 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 or copper 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

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expansion valve with external equalizer. Provide double-sloped condensate drain pan of minimum 22 gage Type 304 stainless steel with nonferrous connections, and internal trap,

#### 2.1.1.5 Filters

Provide UL listed 2 inches thick deep pleated fiberglass throwaway type filters. Provide filtration media with a Minimum Efficiency Reporting Value (MERV) of 8 as determined by ASHRAE 52.2. Provide one complete spare filter bank set per unit for installation prior to final acceptance testing covered in Part 3 of this section.

#### 2.1.1.6 Compressor

Provide compressor that is direct drive, 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 compressor 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.

##### 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 reversible-flow type filter-drier in each liquid line.

#### 2.1.1.7 Condenser

Provide condenser circuit pre-piped with start-up and head pressure controls to maintain system operation at ambient temperatures down to 0 degrees F.

Provide 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.

##### 2.1.7.1 Air-cooled Condenser

Provide remote air-cooled condenser arranged for horizontal air discharge, designed and manufactured specifically for permanent outdoor installation. Condenser performance must be rated in accordance with ANSI/AHRI 460. Condenser must have head pressure control to allow unit operation down to 0 degrees F .

##### 2.1.7.1.1 Condenser Fans

Provide direct-driven propeller fans with factory balanced aluminum blades and equipped with fan guards. Provide electronically commutated fan motors with drip proof enclosures.



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#### 2.1.7.1.2 Condenser Coils

Air-cooled condenser coils must be seamless copper tubes with plate type aluminum or copper fins or all aluminum microchannel type. 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.

#### 2.1.7.1.3 Unit Casing

Provide air-cooled condenser casings and mounting legs manufactured from aluminum or galvanized steel with manufacturer's standard corrosion-resistant finish.

### 2.2 SMALL COMPUTER ROOM AIR CONDITIONERS

Provide complete working CRACs, designed and factory assembled. Equipment must be listed in UL Elec Equip Dir or ETL DLP for computer room application. CRACs must have a minimum sensible coefficient of performance in accordance with ASHRAE 127. CRACs must include room cabinet and frame, fan, filter, cooling coil, compressor, condenser, controls, and, interconnecting piping internal to the CRAC. Provide units rated in accordance with AHRI 1360. Provide all refrigerant piping in accordance with Section 23 23 00 REFRIGERANT PIPING.

#### 2.2.1 System Configuration

Split System Air Cooled: Provide an indoor unit for ducted concealed application, an outdoor condensing unit, and interconnecting refrigerant piping. Unit must consist of a direct expansion system evaporator and an outdoor, air cooled condensing unit.

#### 2.2.2 Cooling Coil Cabinet Construction

Provide cabinet and chassis constructed of heavy gauge galvanized steel with all service access from a single side of the unit. Mounting brackets must be integral to the cabinet. Internal cabinet insulation must meet ASHRAE 62.1 requirements for Mold Growth, Humidity & Erosion, tested per UL 181 and ASTM C1338 standards.

#### 2.2.3 Air Distribution Components

Provide direct-drive fan assembly equipped with double-inlet blower, self-aligning ball bearings and lifetime lubrication. Fan motor must be permanent-split capacitor, high-efficiency type, equipped with two speeds for airflow modulation. The microprocessor controller must use the lower fan speed for precise dehumidification control. Fan speed must also be user selectable from the wall controller. System must be suitable for supply and return air plenum or ducted supply and return air distribution. Provide filter rack designed to accept 4 inch thick filters. Provide pleated filters with a MERV 8 rating in accordance with ASHRAE 52.2.

#### 2.2.4 Direct Expansion System Evaporator Components

The evaporator section must include evaporator coil, thermostatic expansion valve and filter drier. The evaporator coil must be constructed of copper tubes and aluminum fins. Provide an externally equalized

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thermostatic expansion valve to control refrigerant flow. The refrigerant piping must be spun-closed and filled with a nitrogen holding charge. Evaporator and condensing unit must be field piped using copper lines, brazed, evacuated and field charged with R-407C refrigerant. The evaporator unit can be coupled directly with the condensing unit or mounted remote to the condensing unit. The coil assembly must be mounted in a condensate drain pan with an internally trapped drain line. The evaporator drain pan must include a factory-installed float switch to shut down the evaporator upon high water condition.

#### 2.2.5 Outdoor, Air-Cooled Condensing Unit

Provide condensing unit rated in accordance with ANSI/AHRI 520 and designed for permanent outdoor installation. Provide removable panels for access to all components. Condensing unit components must include condenser coil, direct drive propeller fan, scroll compressor, high-pressure switch, refrigerant receiver, head pressure control valve, hot gas bypass system, and liquid line solenoid valve. Unit casing and chassis must be constructed of heavy gauge galvanized steel.

Provide hot gas bypass to reduce compressor cycling and improve operation under low-load conditions. The hot gas bypass must be completely contained in the condensing unit. Field installed third refrigerant line is not acceptable. Hot gas bypass must be automatically deactivated upon a call for dehumidification. Provide a high pressure switch to protect the unit from abnormal refrigerant pressure conditions and deactivate the compressor and annunciate an alarm at the wall controller. The blower must continue to circulate air. The wall controller must be used to manually restart the compressor function after the automatic pressure switch resets. Three high head pressure alarms in a rolling 12-hour period must lock out the manual restart feature until power is cycled to the evaporator unit. A pressure balancing valve must be factory installed to reduce the chance of high pressure cut-out due to excessive refrigerant migration to the receiver due to changing outdoor temperatures during off-cycles. The refrigerant piping must be spun-closed and filled with a nitrogen holding charge. Evaporator and condensing unit must be field piped using copper lines, brazed, evacuated and field charged with R-407C refrigerant. Condensing unit must be designed for 95 degrees F ambient and be capable of operation to 0 degrees F. The condensing coil must be constructed of copper tubes and aluminum fins.

#### 2.2.6 Controls

Provide remote mounted color touchscreen display for each unit. Provide remote mounted temperature sensor for each unit. Controls must be organized by menus with minimum menu selection of: Alarms, Event Log, Graphics, and Status Overview. The Graphics menu must display a minimum of the following: zone temperature, zone setpoints, fan status. Controls must include a control system interface. 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.

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 and UMCS defined in Section 25 10 10 UTILITY MONITORING AND CONTROL SYSTEM (UMCS) FRONT END AND INTEGRATION. Refer to controls drawings for minimum points required to interface with the HVAC control system.

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## 2.3 INSTRUMENTATION AND CONTROLS

All controls provided under this section must comply with the requirements of Section 25 05 11.01 CYBERSECURITY FOR FACILITY-RELATED CONTROL SYSTEMS.

### 2.3.1 Unit Level Controls

Provide factory installed components and wiring to control a unit's basic functions and space ambient conditions 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. Unit controls must comply with the requirements of Section 25 05 11.01 CYBERSECURITY FOR FACILITY-RELATED CONTROL SYSTEMS.

#### 2.3.1.1 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, humidifier problems, and leak detection. Provide field accessible local audible alarm with silence pushbutton. Provide push-to-test lamps or all-lamp test pushbutton.

#### 2.3.1.2 Factory Wired Components

Provide factory wired discharge air temperature sensor. Sensors must meet the requirements of Section 23 09 13 INSTRUMENTATION AND CONTROL DEVICES FOR HVAC.

### 2.3.2 Integration to HVAC control system and Basewide Utility Monitoring and Control System (UMCS)

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 and UMCS.

## 2.4 FACTORY PAINTING SYSTEMS

Provide manufacturer's standard factory painting. Certify that the factory painting system applied will withstand 125 hours in a salt-spray fog test, except that equipment located outdoors must withstand 500 hours in a salt-spray fog test. Salt-spray fog test must be in accordance with ASTM B117, and for that test the acceptance criteria must be as follows: immediately after completion of the test, the paint must show no signs of blistering, wrinkling, or cracking, and no loss of adhesion; and the

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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 at least 65,000 amp Short Circuit Current Rating (SCCR).

### 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 FIRE PROTECTION DEVICES

The requirements for duct smoke detectors are specified in Section 23 09 00 INSTRUMENTATION AND CONTROL FOR HVAC.

## 2.8 SOURCE QUALITY CONTROL

Provide factory test plan, factory test schedule, factory test and factory test report on .

### 2.8.1 Manufacturer's Factory Test Plans

For each CRAC, submit a factory test plan which when followed during factory testing shall verify that the performance scheduled on the drawings is met by the produced CRAC models.

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The manufacturer shall perform factory tests on the actual CRAC produced for this project. The test reports shall document the performance tests conducted on the factory assembled computer room air conditioning units. Performance testing on the individual computer room air conditioning unit components, not factory assembled, is not acceptable.

Submit the required test plans for review and approval to the Contracting Officer at least 90 calendar days before scheduled factory test date.

#### 2.8.1.1 Test Procedure

Indicate in each test plan the factory acceptance test procedures. Procedures shall be structured to test all modes of operation to confirm that the controls are performing in accordance with the intended sequence of control.

Controllers shall be verified to be properly calibrated and have the proper set point to provide stable control of their respective equipment.

Include in each test plan a detailed step-by-step procedure for testing automatic controls provided by the manufacturer.

#### 2.8.1.2 Performance Variables

Each test plan shall list performance variables that are required to be measured or tested as part of the field test. Include in the performance variables list the performance indicated on the equipment schedules on the contract design drawings.

Manufacturer must provide with each test procedure a description of acceptable performance results that shall be verified. Manufacturer shall identify the acceptable limits or tolerances within which each tested performance variable shall acceptably operate.

#### 2.8.1.3 Test Configuration

Plans shall indicate that tests are to be performed for a minimum of four continuous hours. 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 CRAC and particular conditions which exist with this contract. Generic or general preprinted test procedures are not acceptable.

#### 2.8.1.4 Tested Variables

Plans shall provide for air side testing which includes verification of the airflow, total static pressure; fan drive motor KW, amperage and RPM; and fan RPM. Provide entering air temperatures equal to those indicated on the CRAC schedules.

#### 2.8.1.5 Thermal Testing

Plans shall provide thermal testing utilizing with temperatures equal to those indicated on the CRAC schedules. Thermal testing shall verify CRAC heating, sensible cooling, total cooling, and humidifying performance scheduled on the contract drawings.

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#### 2.8.1.6 Specialized Components

Include procedures for field testing and field adjusting specialized components, such as hot gas bypass control valves, or pressure valves.

#### 2.8.1.7 Factory Tests Reporting Forms

Each test plan shall include the required test reporting forms to be completed by the Contractor's testing representatives. Submit factory test reports, referencing each tested CRAC serial number, and receive approval before delivery of CRAC to the project site.

#### 2.8.2 Factory Tests

Conduct the factory testing in compliance with the Contracting Officer approved manufacturer's field test plan, and in accordance with additional field testing requirements specified herein. Record the required data using the test reporting forms approved of the approved field test plan. Conduct the test for each CRAC for the continuous test period in the approved test plan. A CRAC shutdown before the continuous test period is completed shall result in the test period being started again and run for the required duration.

#### 2.8.3 Deficiency Resolution

The test requirements shall be acceptably met; deficiencies identified during the tests shall be corrected in compliance with the manufacturer's recommendations and corrections tested as specified in the paragraph FACTORY TEST PLANS.

#### 2.8.4 Factory Test Reports

Use the test reporting forms approved in the factory test plan. Final test report forms shall be typed including data entries and remarks. Completed test report forms for each CRAC shall be reviewed, approved, and signed by the Manufacturer's test director.

### PART 3 EXECUTION

#### 3.1 INSTALLATION

##### 3.1.1 CRAC System

Installation of each CRAC system including equipment, materials, installation, workmanship, fabrication, assembly, erection, examination, inspection, and testing, must be in accordance with ASME B31.1, ASME B31.5, NFPA 70, as modified and supplemented by the requirements of this section and the CRAC manufacturer's written installation instructions.

Install all work so that parts requiring periodic inspection, operation, maintenance, and repair are readily accessible. Install concealed valves, expansion joints, controls, dampers, and equipment requiring access, in locations freely accessible through access doors.

##### 3.1.2 Installation Instructions

Provide a manufacturer's installation manual for each type of CRAC.

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### 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 steam, fuel, water, electricity, instruments, connecting devices, and personnel for tests. Flush and clean piping before placing in operation. Clean equipment, piping, strainers, and ducts. Prior to commencement of field testing, remove all filters and provide new filters. Perform and document that proper Indoor Air Quality During Construction procedures have been followed; this includes providing documentation showing that after construction ends, and prior to occupancy, new filters were provided.

## 3.3 FIELD TESTING

Provide field test plan, field test schedule, field test and field test report on each of the CRAC. Field test each CRAC for Contracting Officer acceptance in accordance with the CRAC manufacturer's approved field test plan.

### 3.3.1 Manufacturer's Field Test Plans

Submit field test plans developed by the manufacturer for each CRAC; submit the field test plans at least 90 calendar days prior to planned date of the field test. Field test plans developed by the installing Contractor, or the equipment sales agency furnishing the CRAC, will not be acceptable.

The Contracting Officer will review and approve the field test plan for each of the listed CRACs prior to commencement of field testing of the equipment. The approved field test plans must be followed for the field tests of the CRAC and test reporting.

#### 3.3.1.1 Coordinated Testing

Indicate in each field test plan when work required by this section requires coordination with test work required by other specification sections. Provide test procedures for the simultaneous or integrated testing of: CRAC controls which interlock and interface with controls factory prewired; and external controls for the CRAC provided under Section 23 09 00 INSTRUMENTATION AND CONTROL FOR HVAC.

#### 3.3.1.2 Prerequisite Testing

Each CRAC for which performance testing is dependent upon the completion of the work covered by Section 23 05 93.00 06 TESTING, ADJUSTING AND BALANCING (TAB) OF 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.

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#### 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 CRAC and particular conditions which exist with this contract. Generic or general preprinted test procedures are not acceptable.

#### 3.3.1.6 Tested Variables

Plans must provide for air side testing which includes verification of the airflow, total static pressure; fan drive motor KW, amperage and RPM; and fan RPM. Provide entering air temperatures equal to those indicated on the CRAC schedules.

#### 3.3.1.7 Thermal Testing

Plans must provide thermal testing utilizing with temperatures equal to those indicated on the CRAC schedules. Thermal testing must verify CRAC heating, sensible cooling, total cooling, and humidifying performance scheduled on the contract drawings.

#### 3.3.1.8 Specialized Components

Include procedures for field testing and field adjusting specialized components, such as hot gas bypass control valves, or pressure valves.

#### 3.3.1.9 Field Test Reporting Forms

Each test plan must include the required test reporting forms to be completed by the Contractor's testing representatives.



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### 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.

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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 --