



**NAVFAC PACIFIC**

WORK ORDER NO: 1569648

**SPECIFICATIONS - VOLUME 2 of 3**

For

**FY19 MCON Project P-946  
Corrosion Control Hangar & Parking Facility**

At the

**Marine Corps Base Hawaii, Kaneohe, Hi**

**PREPARED BY:**

**JACOBS®**

Jacobs Government Services Company  
777 Main Street  
Fort Worth, Texas 76102 USA

A/E Contract No. N62742-17-D-0003

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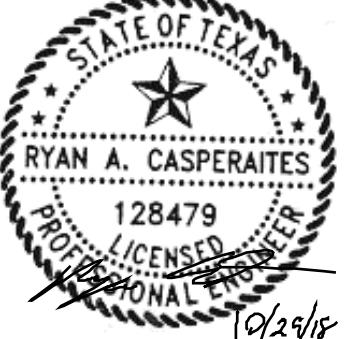
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**SEALS PAGE FOR WFXO6300  
FY19 MCON PROJECT P-946  
CORROSION CONTROL HANGAR & PARKING FACILITY  
MARINE CORPS BASE HAWAII, KANEOHE, HI**

**FINAL DESIGN SUBMITTAL**

**A/E CONTRACT No. N62742-17-D-0003  
ePROJECTS WORK ORDER NO. 1569648**

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SECTION 03 23 00

STRESSED TENDON REINFORCING  
05/16

PART 1 GENERAL

1.1 LUMP SUM PRICES

1.1.1 Steel Stressing Tendons and Accessories for Prestressed Concrete

1.1.1.1 Payment

Payment will constitute full compensation for furnishing all plant, labor, materials and equipment and performing all operations necessary for steel stressing tendons and accessories for prestressed concrete.

1.1.1.2 Unit of Measure

Unit of measure: lump sum.

1.2 REFERENCES

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

AMERICAN CONCRETE INSTITUTE INTERNATIONAL (ACI)

ACI 318 (2014; Errata 1-2 2014; Errata 3-5 2015; Errata 6 2016; Errata 7-9 2017) Building Code Requirements for Structural Concrete (ACI 318-14) and Commentary (ACI 318R-14)

ACI SP-66 (2004) ACI Detailing Manual

ASTM INTERNATIONAL (ASTM)

ASTM A416/A416M (2017) Standard Specification for Low-Relaxation, Seven-Wire for Prestressed Concrete

ASTM A421/A421M (2015) Standard Specification for Uncoated Stress-Relieved Steel Wire for Prestressed Concrete

ASTM A722/A722M (2015) Standard Specification for Uncoated High-Strength Steel Bar for Prestressing Concrete

ASTM C109/C109M (2016a) Standard Test Method for Compressive Strength of Hydraulic Cement Mortars (Using 2-in. or (50-mm) Cube Specimens)

POST-TENSIONING INSTITUTE (PTI)

PTI M10.3	(2000) Field Procedures Manual for Unbonded Single Strand Tendons
PTI M50.3	(2012) Guide Specification for Grouted Post-Tensioning
PTI M55.1	(2012; ERTA 2012; Addendum 1 2013) Specification for Grouting of Post-Tensioned Structures
PTI-CRT-20 G1-1015	(2015) Manual for Certification of Plants Producing Unbonded Single Strand Tendons

1.3 SUBMITTALS

Government approval is required for submittals with a "G" designation; submittals not having a "G" designation are for information only. When used, a designation following the "G" designation identifies the office that will review the submittal for the Government. Submittals with an "S" are for inclusion in the Sustainability eNotebook, in conformance to Section 01 33 29 SUSTAINABILITY REPORTING. Submit the following in accordance with Section 01 33 00 SUBMITTAL PROCEDURES:

SD-02 Shop Drawings

Installation Drawings; G

Procedures for Grouting Operations

SD-03 Product Data

Prestressing Method and Equipment; G

Materials Disposition Records

Prestressing Operations Records

SD-06 Test Reports

Stressing Tendons and Accessories

SD-07 Certificates

Tendon Installer Qualifications

SD-11 Closeout Submittals

Recycled Content for Steel; S

1.4 QUALITY ASSURANCE

1.4.1 Tendon Installer Qualifications

1.4.1.1 Unbonded Tendons

Installation crew must have at least two PTI Level 2 certified installers and all other personnel must be PTI Level 1 certified installers. Submit

PTI certifications.

#### 1.4.1.2 Bonded Tendons

The direct supervisor of the Post-Tensioning operations must be certified as PTI Level 2 Bonded PT Field Specialist. The foreman of each installation and stressing crew must be certified as PTI Level 2 Bonded PT Field Specialist. The foreman of each grouting crew must be certified as PTI Level 2 PT Field Specialist and ASBI Certified Grouting Technician. At least 25 percent of each crew must be certified in PTI Level 1 Bonded PT-Field Installation. Submit PTI certifications.

#### 1.4.2 Installation Drawings

Submit detailed installation drawings for stressing tendons and accessories approved prior to commencing the work and showing the type and size of stressing tendons and anchorages, tendon profiles, erection methods, sequence of stressing and stressing calculations.

#### 1.4.3 PTI Certified Plants

Fabrication plant must be certified by PTI-CRT-20 G1-1015.

### 1.5 DELIVERY, STORAGE, AND HANDLING

Deliver materials suitably wrapped, packaged or covered at the factory to prevent being affected by dirt, water and rust. Protect materials against abrasion or damage during shipment and handling. Place materials stored at the site above the ground on elevated, covered platforms.

## PART 2 PRODUCTS

### 2.1 MATERIALS

Stressing tendons and accessories must conform to the requirements of ACI 318 except as specified. Submit certified materials test reports for all required materials tests; note the specific standards followed in the performance of tests, show that materials comply with the applicable specifications for each material shipment, and identified with specific lots prior to use of materials in the work.

#### 2.1.1 Material Sustainability Criteria

For products in this section, where applicable and to extent allowed by performance criteria, provide and document the following in accordance with Section 01 33 29 SUSTAINABILITY REQUIREMENTS:

- a. Minimum 75 percent recycled content for steel.

#### 2.1.2 Stressing Tendons

Stressing tendons must be clean and free of loose rust, scale and pitting. Permanently protect unbonded tendons from corrosion with an approved applied coating.

##### 2.1.2.1 Seven-Wire Stress-Relieved Strand and Strand Assemblies

Seven-wire stress-relieved strand and strand assemblies must conform to ASTM A416/A416M, Grade 1860 (270), strand diameter as indicated. Strand

assemblies may be field assembled with anchor fittings positively attached to strands for bonded tendons only.

#### 2.1.2.2 Stress-Relieved Wire and Wire Assemblies

Stress-relieved wire and wire assemblies must conform to ASTM A421/A421M, Type BA or WA, wire diameter as shown. Wire assemblies must be shop assembled with anchor fittings positively attached to wires.

#### 2.1.2.3 High-Strength Steel Bars

High-strength steel bars must conform to ASTM A722/A722M, Type I or II, Grade 1035 (150) meeting all supplementary requirements.

### 2.1.3 Accessories

#### 2.1.3.1 Ducts

Provide tendon ducts of galvanized sheet steel or plastic, capable of transmitting forces from grout to the surrounding concrete, flexible enough to conform to the tendon profile and strong enough to maintain their shape without deforming, sagging, or collapsing during concrete placement and vibration. The inside diameter of the ducts must be large enough to provide an internal area at least two and a half times the gross area of multiple wire, bar or strand assemblies and must be at least 1/2-inch larger than the diameter of a single wire, bar or strand placed in the ducts. Design ducts for watertight connections with all fittings.

#### 2.1.3.2 Tendon Sheathing

Tendon sheathing must have a minimum thickness of 0.050 inch for polyethylene or polypropylene with a minimum density of 0.034 lb/in<sup>3</sup>. The sheathing must be continuous over the length of the tendon to provide watertight encapsulation of strand and between anchorages to prevent intrusion of cement paste or loss of coating for a non-encapsulated system.

#### 2.1.3.3 Tendon Coating

For unbonded tendons provide a compound with friction-reducing, moisture-displacing, and corrosion-inhibiting properties that is chemically stable and nonreactive with prestressing steel, nonprestressed reinforcement, sheathing material and concrete. The compound must have a minimum coating weight of 2.5 lb for 0.5 inch diameter strand per 100 feet of strand. Completely fill the annular space between the strand and sheathing over the entire tendon length with the tendon coating.

#### 2.1.3.4 Anchorages and Couplers

Anchorages and couplers must be metal of proven corrosion resistance and compatible with the stressing tendons, capable of developing 95 percent of the actual breaking strength of the strands. Anchorages must be the button-head, wedge, nut and thread, grip nut, thread-bar, threaded plate or other approved type and must be provided with bearing plates bars, rings, bells or other positive-attaching anchor fittings. Provide couplers with housings long enough to permit the necessary movements and fittings which allow complete grouting of all components. Bar couplers must meet the requirements of ASTM A722/A722M and develop 100 percent of

the minimum bar ultimate tensile strength.

#### 2.1.3.5 Grout

Grout for grouting post-tensioned tendons must be a Class A, B, C, or D in accordance with PTI M55.1. The minimum 7-day compressive strength of 2-inch grout cubes, molded, cured and tested in accordance with ASTM C109/C109M must be 3000 psi.

#### 2.1.3.6 Encapsulation System

Watertight encapsulation of prestressing strand consisting of the following:

##### 2.1.3.6.1 Wedge-Cavity Caps

Attached to anchorages with a positive mechanical connection and completely filled with tendon coating.

##### 2.1.3.6.1.1 Caps for Fixed- and Stressing-End Anchorage Devices

Designed to provide watertight encapsulation of wedge cavity. Sized to allow required extension of strand past the wedges. Attach cap for fixed-end anchorage device in fabricating plant.

##### 2.1.3.6.1.2 Caps at Intermediate Anchorages

Open to allow passage of strand.

##### 2.1.3.6.2 Sleeves

Attached to anchorage device with positive mechanical connection; overlapped a minimum of 4 inches with sheathing and completely filled with tendon coating.

#### 2.1.3.7 Nonprestressed Steel Bars

Provide reinforcing bars in accordance with 03 30 00 CAST-IN-PLACE CONCRETE. Coordinate placement of nonprestressed steel reinforcement with installation of tendons.

#### 2.1.3.8 Pocket Formers

Pocket formers must be capable of completely sealing wedge cavity and be sized to provide the required cover of the anchorage and allow access for cutting strand tail.

#### 2.1.3.9 Sheathing Repair Tape

Repair tape must be elastic, self-adhesive, moisture proof tape with a minimum width of 2 inches, in contrasting color to tendon sheathing. Repair tape must be nonreactive with the sheathing, coating, or prestressing steel.

## 2.2 TESTS, INSPECTIONS, AND VERIFICATIONS

Perform required material tests on stressing tendons and accessories by an approved laboratory to demonstrate that the materials are in conformance with the specifications. These tests are at the Contractor's expense.

## PART 3 EXECUTION

### 3.1 INSTALLATION

Install or place stressing tendons and accessories as specified and as shown on contract and approved installation drawings. Installation details of stressing tendons and accessories not specified or shown must be in accordance with ACI SP-66, ACI 318 and PTI M10.3. Maintain a minimum radius of curvature of 480-strand diameters for lateral deviations to avoid openings, ducts, and embedded items. Limit tendon bundles to five tendons. Maintain a minimum of 12 inches between center of adjacent bundles. Welding must not be performed near or adjacent to stressing tendons. Do not install stressing tendons until all welding has been completed on supports or any part which might be in contact with the tendons. Securely support unbonded tendons at regular intervals not to exceed 48 inches. Grouted tendons must meet protection level 2 per PTI M50.3. Place nonprestressed steel bars in accordance with 03 30 00 CAST-IN-PLACE CONCRETE.

#### 3.1.1 Anchorages

Set anchorages in a plane normal to the axis of the tendons such that uniform bearing on the concrete is assured. Do not switch fixed- and stressing-end anchorage locations from that shown on the approved installation drawings. Use positive connecting anchorages rather than gripping types for anchoring embedded ends of tendons. Permanently protect anchorages and anchor fittings against corrosion. Recess parallel wire anchorage wedges or cores within the members.

#### 3.1.2 Stressing Tendons and Ducts for Grouted Post-Tensioned Systems

Remove protective coverings and wrappings, closely inspect each stressing tendon to see that nicks, scoring, pits or other damage does not exist, and closely inspect high strength steel bars to assure that they are not bent and that threaded ends are in satisfactory condition immediately prior to installation. Strand, wire and bar tendons must be shop or field assembled as required and positively attached to anchorages. Anchor type WA wire assemblies only with wedge type anchorages. Assemble stressing tendons and ducts to required shapes and dimensions and place them where indicated on drawings within specified tolerances and adequately supported. Securely support ducts to be grouted at regular intervals not exceeding 48 inches for round galvanized metal duct and steel pipes, 24 inches for round plastic ducts and flat ducts with strand preinstalled and 12 inches for flat ducts with strand preinstalled and grout openings and vents must be securely anchored to ducts and to either the forms or reinforcing steel to prevent displacement during concrete placing. The ends of ducts must be effectively protected to prevent entry of water, concrete, grout or debris. Wires of parallel-wire assemblies must not be spliced. Steel bar tendons may be joined by couplers where shown or approved. Strands to be spliced must have the same lay or direction of twist and the ends must be cut by shears or abrasive grinders. No more than one strand may be spliced in any one member where single strand tensioning is employed. Strand splices must be capable of developing the full ultimate strength of the strand. Check for slippage of the splice and correct for differential slippage. Where multiple strand tensioning is used, not more than 10 percent of the strands in any member may be spliced.



### 3.1.3 Sheathing Inspection and Repair

Inspect sheathing for damage after installing tendons. Repair damaged areas by restoring tendon coating and repairing or replacing tendon sheathing. Follow tape repair procedures in PTI M10.3.

### 3.1.4 Prestressing Method and Equipment

Submit descriptions of the proposed prestressing methods and equipment approved prior to the start of prestressing operations and indicating the manufacturer of all prestressing equipment, including tensioning jacks, stress measurement gages, dynamometers and load cells or other devices for measuring stressing loads. Descriptions must include certified calibration records for each set of jacking equipment and testing curves for stress measurement gages which show that the gages have been calibrated for the jacks for which they are to be used.

### 3.1.5 Tensioning Tendons

Tension stressing tendons as specified and indicated. Determine the stress induced in the tendons by any method of tensioning independently by both (1) measurement of tendon elongation and (2) direct measurement of force using a pressure gauge or load cell. If the results of these two measurements do not check each other and the theoretical values are not within 7 percent, carefully check the operation and determine and correct the source of error before proceeding further. Concrete cylinder tests must indicate a breaking strength of at least 4000 psi before transfer of stress to ensure that the concrete strength is adequate for the requirements of the anchorages or for transfer through bond as well as meet camber or deflection requirements. The final prestress load in each unit after seating must be as indicated. Take safety measures to prevent accidental injury caused by failure of a stressing tendon or tendon component. Protect the exposed ends of stressing tendons and anchorages from damage during stressing operations to prevent failure.

#### 3.1.5.1 Post-Tensioning

Do not perform tensioning until the concrete has reached the required strength at transfer of stress. Measure the force corresponding to the initial tension by a dynamometer or other approved method as a starting point in determining final elongation. The units must be tensioned until the proper elongations and jacking pressures are attained and reconciled within the limits stated above.

### 3.1.6 Grouting Post-Tensioned Tendons

At least four weeks prior to the start of construction submit written procedures for grouting operations for approval. Perform grouting between each tendon and its enclosing duct within 7 days after completion of the tensioning operation. Do not perform grouting if air temperature below 45 degrees F is anticipated within 48 hours after grouting unless an approved method of temperature control is used. Mix the grout in a mechanical mixer of a type that will produce uniformly and thoroughly mixed grout. First, place water in the mixer followed by cement and admixture. Continuously agitate grout until it is pumped. Discard grout that has not been used within 30 minutes of the first addition of water to ensure the flowability of the grout. Just before grouting, blow the ducts clear by compressed air. With the grout vent open at one end of duct, apply grout continuously under moderate pressure at the other end until all entrapped

air is forced out as indicated by a uniform flow of grout from the discharge vent. Close the injection point by an approved means to prevent any loss of grout. For a period of at least 3 days after grouting the tendons, the prestressed members must not have equipment or other loads placed on them. A longer period may be required, depending upon the method of curing and magnitude of imposed stresses.

### 3.1.7 Accuracy of Stress and Elongation Measurement

#### 3.1.7.1 Stress Measurement

Hydraulic gauges, dynamometers, load cells or other devices for measuring stressing load must have an accuracy of reading within two percent for stress measurement. Gauges are required to have been calibrated for the jacks for which they are used within a period not exceeding six months. Perform recalibration at any time that a gaging system shows indication of erratic results in the opinion of the Contracting Officer. Gauges must indicate loads directly in pounds or be accompanied by a chart which converts dial readings into pounds.

#### 3.1.7.2 Elongation Measurement

After the initial force has been applied to a tendon, establish reference points for measuring elongation due to additional tensioning forces. They must be located according to the method of tensioning and type of equipment. The system used must be capable of measuring the true elongation plus or minus 1/16-inch.

### 3.1.8 Prestressing Operations Records

Compile and submit complete prestressing operations records showing the manufacturer, identification and description of materials and equipment including prestressing tendons and jacking and load measuring equipment; location of prestressing tendons; initial design tensioning loads, final design tensioning loads and actual tensioning loads for tendons; dates tensioning loads applied; and theoretical and actual elongations for tendons before completion of the contract.

### 3.1.9 Tendon Finishing

Do not cut strand tails or cover anchorages until stressing records have been reviewed and approved. Cut strand tail between 1/2 and 3/4 inch from wedges as soon as possible after approval of elongations. Do not damage tendon or concrete during removal of strand tail. Acceptable methods of cutting strand tail include oxyacetylene flame, abrasive wheel, hydraulic shears or plasma cutting. Patch stressing pocket within one day of cutting strand tail. Clean inside surface of pocket to remove laitance or tendon coating before installing patch material. Finish patch material flush with adjacent concrete.

## 3.2 INSPECTION

The Contractor's facilities must be open for inspection by the Contracting Officer at any time.

## 3.3 MATERIALS DISPOSITION RECORDS

Compile accurate materials disposition records, identifying all materials incorporated into the work and showing the disposition of specific lots of

approved tested materials. Submit records which identify the incorporation of approved materials into the work before completion of the contract.

-- End of Section --



SECTION 03 30 00

CAST-IN-PLACE CONCRETE

05/14

PART 1 GENERAL

1.1 REFERENCES

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

AMERICAN CONCRETE INSTITUTE INTERNATIONAL (ACI)

ACI 117	(2010; Errata 2011) Specifications for Tolerances for Concrete Construction and Materials and Commentary
ACI 121R	(2008) Guide for Concrete Construction Quality Systems in Conformance with ISO 9001
ACI 201.2R	(2016) Guide to Durable Concrete
ACI 211.1	(1991; R 2009) Standard Practice for Selecting Proportions for Normal, Heavyweight and Mass Concrete
ACI 301	(2016) Specifications for Structural Concrete
ACI 302.1R	(2015) Guide for Concrete Floor and Slab Construction
ACI 304.2R	(1996; R 2008) Placing Concrete by Pumping Methods
ACI 304R	(2000; R 2009) Guide for Measuring, Mixing, Transporting, and Placing Concrete
ACI 305R	(2010) Guide to Hot Weather Concreting
ACI 306R	(2016) Guide to Cold Weather Concreting
ACI 308.1	(2011) Specification for Curing Concrete
ACI 318	(2014; Errata 1-2 2014; Errata 3-5 2015; Errata 6 2016; Errata 7-9 2017) Building Code Requirements for Structural Concrete (ACI 318-14) and Commentary (ACI 318R-14)
ACI 347	(2004; Errata 2008; Errata 2012) Guide to Formwork for Concrete
ACI SP-15	(2011) Field Reference Manual: Standard Specifications for Structural Concrete ACI 301-05 with Selected ACI References

ACI SP-2 (2007; Abstract: 10th Edition) ACI Manual  
of Concrete Inspection

ACI SP-66 (2004) ACI Detailing Manual

AMERICAN HARDBOARD ASSOCIATION (AHA)

AHA A135.4 (1995; R 2004) Basic Hardboard

AMERICAN WELDING SOCIETY (AWS)

AWS D1.4/D1.4M (2011) Structural Welding Code -  
Reinforcing Steel

ASTM INTERNATIONAL (ASTM)

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

ASTM A36/A36M (2014) Standard Specification for Carbon  
Structural Steel

ASTM A53/A53M (2012) Standard Specification for Pipe,  
Steel, Black and Hot-Dipped, Zinc-Coated,  
Welded and Seamless

ASTM A615/A615M (2016) Standard Specification for Deformed  
and Plain Carbon-Steel Bars for Concrete  
Reinforcement

ASTM A706/A706M (2016) Standard Specification for  
Low-Alloy Steel Deformed and Plain Bars  
for Concrete Reinforcement

ASTM C1017/C1017M (2013; E 2015) Standard Specification for  
Chemical Admixtures for Use in Producing  
Flowing Concrete

ASTM C1077 (2016) Standard Practice for Laboratories  
Testing Concrete and Concrete Aggregates  
for Use in Construction and Criteria for  
Laboratory Evaluation

ASTM C1107/C1107M (2014a) Standard Specification for  
Packaged Dry, Hydraulic-Cement Grout  
(Nonshrink)

ASTM C1157/C1157M (2017) Standard Performance Specification  
for Hydraulic Cement

ASTM C1240 (2014) Standard Specification for Silica  
Fume Used in Cementitious Mixtures

ASTM C1260 (2014) Standard Test Method for Potential  
Alkali Reactivity of Aggregates  
(Mortar-Bar Method)

ASTM C143/C143M	(2015) Standard Test Method for Slump of Hydraulic-Cement Concrete
ASTM C150/C150M	(2017) Standard Specification for Portland Cement
ASTM C1567	(2013) Standard Test Method for Potential Alkali-Silica Reactivity of Combinations of Cementitious Materials and Aggregate (Accelerated Mortar-Bar Method)
ASTM C1602/C1602M	(2012) Standard Specification for Mixing Water Used in Production of Hydraulic Cement Concrete
ASTM C172/C172M	(2014a) Standard Practice for Sampling Freshly Mixed Concrete
ASTM C173/C173M	(2016) Standard Test Method for Air Content of Freshly Mixed Concrete by the Volumetric Method
ASTM C192/C192M	(2016a) Standard Practice for Making and Curing Concrete Test Specimens in the Laboratory
ASTM C231/C231M	(2017a) Standard Test Method for Air Content of Freshly Mixed Concrete by the Pressure Method
ASTM C260/C260M	(2010a; R 2016) Standard Specification for Air-Entraining Admixtures for Concrete
ASTM C295/C295M	(2012) Petrographic Examination of Aggregates for Concrete
ASTM C31/C31M	(2017) Standard Practice for Making and Curing Concrete Test Specimens in the Field
ASTM C311/C311M	(2013) Sampling and Testing Fly Ash or Natural Pozzolans for Use as a Mineral Admixture in Portland-Cement Concrete
ASTM C33/C33M	(2016) Standard Specification for Concrete Aggregates
ASTM C39/C39M	(2017b) Standard Test Method for Compressive Strength of Cylindrical Concrete Specimens
ASTM C42/C42M	(2013) Standard Test Method for Obtaining and Testing Drilled Cores and Sawed Beams of Concrete
ASTM C494/C494M	(2017) Standard Specification for Chemical Admixtures for Concrete
ASTM C595/C595M	(2017) Standard Specification for Blended

Hydraulic Cements

ASTM C618	(2012a) Standard Specification for Coal Fly Ash and Raw or Calcined Natural Pozzolan for Use in Concrete
ASTM C78/C78M	(2016) Standard Test Method for Flexural Strength of Concrete (Using Simple Beam with Third-Point Loading)
ASTM C920	(2018) Standard Specification for Elastomeric Joint Sealants
ASTM C94/C94M	(2017a) Standard Specification for Ready-Mixed Concrete
ASTM C989/C989M	(2017) Standard Specification for Slag Cement for Use in Concrete and Mortars
ASTM D1751	(2004; E 2013; R 2013) Standard Specification for Preformed Expansion Joint Filler for Concrete Paving and Structural Construction (Nonextruding and Resilient Bituminous Types)
ASTM D1752	(2004a; R 2013) Standard Specification for Preformed Sponge Rubber Cork and Recycled PVC Expansion
ASTM D2628	(1991; R 2011) Standard Specification for Preformed Polychloroprene Elastomeric Joint Seals for Concrete Pavements
ASTM D2835	(1989; R 2017) Standard Specification for Lubricant for Installation of Preformed Compression Seals in Concrete Pavements
ASTM D412	(2016) Standard Test Methods for Vulcanized Rubber and Thermoplastic Elastomers - Tension
ASTM D471	(2016a) Standard Test Method for Rubber Property - Effect of Liquids
ASTM D5759	(2012) Characterization of Coal Fly Ash and Clean Coal Combustion Fly Ash for Potential Uses
ASTM D6690	(2015) Standard Specification for Joint and Crack Sealants, Hot Applied, for Concrete and Asphalt Pavements
ASTM E1643	(2011; R 2017) Standard Practice for Selection, Design, Installation, and Inspection of Water Vapor Retarders Used in Contact with Earth or Granular Fill Under Concrete Slabs
ASTM E1745	(2017) Standard Specification for Water



Vapor Retarders Used in Contact with Soil  
or Granular Fill under Concrete Slabs

ASTM E1993/E1993M (1998; R 2013; E 2013) Standard  
Specification for Bituminous Water Vapor  
Retarders Used in Contact with Soil or  
Granular Fill Under Concrete Slabs

ASTM E329 (2014a) Standard Specification for  
Agencies Engaged in the Testing and/or  
Inspection of Materials Used in  
Construction

ASTM E96/E96M (2016) Standard Test Methods for Water  
Vapor Transmission of Materials

CONCRETE REINFORCING STEEL INSTITUTE (CRSI)

CRSI 10MSP (2009; 28th Ed) Manual of Standard Practice

FOREST STEWARDSHIP COUNCIL (FSC)

FSC STD 01 001 (2000) Principles and Criteria for Forest  
Stewardship

NATIONAL INSTITUTE OF STANDARDS AND TECHNOLOGY (NIST)

NIST PS 1 (2009) DOC Voluntary Product Standard PS  
1-07, Structural Plywood

U.S. ARMY CORPS OF ENGINEERS (USACE)

COE CRD-C 513 (1974) Corps of Engineers Specifications  
for Rubber Waterstops

COE CRD-C 572 (1974) Corps of Engineers Specifications  
for Polyvinylchloride Waterstops

U.S. GREEN BUILDING COUNCIL (USGBC)

LEED NC (2009) Leadership in Energy and  
Environmental Design(tm) New Construction  
Rating System

1.2 DEFINITIONS

- a. "Cementitious material" as used herein must include all portland cement, pozzolan, fly ash, ground granulated blast-furnace slag, and silica fume.
- b. "Exposed to public view" means situated so that it can be seen from eye level from a public location after completion of the building. A public location is accessible to persons not responsible for operation or maintenance of the building.
- c. "Chemical admixtures" are materials in the form of powder or fluids that are added to the concrete to give it certain characteristics not obtainable with plain concrete mixes.

- d. "Supplementary cementing materials" (SCM) include coal fly ash, silica fume, granulated blast-furnace slag, natural or calcined pozzolans, and ultra-fine coal ash when used in such proportions to replace the portland cement that result in improvement to sustainability and durability and reduced cost.
- e. "Design strength" (f'c) is the specified compressive strength of concrete at time(s) specified in this section to meet structural design criteria.
- f. "Mass Concrete" is any concrete system that approaches a maximum temperature of 158 degrees F within the first 72 hours of placement. In addition, it includes all concrete elements with a section thickness of 3 feet or more regardless of temperature.
- g. "Mixture proportioning" is the process of designing concrete mixture proportions to enable it to meet the strength, service life and constructability requirements of the project while minimizing the initial and life-cycle cost.
- h. "Mixture proportions" are the masses or volumes of individual ingredients used to make a unit measure (cubic meter or cubic yard) of concrete.
- i. "Pozzolan" is a siliceous or siliceous and aluminous material, which in itself possesses little or no cementitious value but will, in finely divided form and in the presence of moisture, chemically react with calcium hydroxide at ordinary temperatures to form compounds possessing cementitious properties.
- j. "Workability (or consistence)" is the ability of a fresh (plastic) concrete mix to fill the form/mould properly with the desired work (vibration) and without reducing the concrete's quality. Workability depends on water content, chemical admixtures, aggregate (shape and size distribution), cementitious content and age (level of hydration).

### 1.3 SUBMITTALS

Government approval is required for submittals with a "G" designation; submittals not having a "G" designation are for information only. When used, a designation following the "G" designation identifies the office that will review the submittal for the Government. Submittals with an "S" are for inclusion in the Sustainability eNotebook, in conformance to Section 01 33 29 SUSTAINABILITY REPORTING. Submit the following in accordance with Section 01 33 00 SUBMITTAL PROCEDURES:

#### SD-01 Preconstruction Submittals

Concrete Curing Plan

Quality Control Plan; G

Quality Control Personnel Certifications; G

Quality Control Organizational Chart

Laboratory Accreditation; G

Form Removal Schedule; G

SD-02 Shop Drawings

Formwork

Reinforcing Steel; G

SD-03 Product Data

Joint Sealants; (LEED NC)

Joint Filler; (LEED NC)

Materials for Forms

Cementitious Materials; (LEED NC)

Vapor Retarder

Concrete Curing Materials

Reinforcement; (LEED NC)

Admixtures

Mechanical Reinforcing Bar Connectors

Waterstops

Local/Regional Materials; (LEED NC)

Biodegradable Form Release Agent

Pumping Concrete

Finishing Plan

SD-04 Samples

Slab Finish Sample

Surface Finish Sample

SD-05 Design Data

Concrete Mix Design; G

Formwork Calculations

SD-06 Test Reports

Concrete Mix Design; G

Fly Ash

Pozzolan

Ground Granulated Blast-Furnace Slag

Aggregates

Compressive Strength Tests; G

Air Content

Slump Tests

Water

#### SD-07 Certificates

Reinforcing Bars

Welder Qualifications

Silica Fume Manufacturer's Representative

VOC Content for Form Release Agents, Curing Compounds, and  
Concrete Penetrating Sealers

Safety Data Sheets

Forest Stewardship Council (FSC) Certification

Field Testing Technician and Testing Agency

#### SD-08 Manufacturer's Instructions

Curing Compound

### 1.4 MODIFICATION OF REFERENCES

Accomplish work in accordance with ACI publications except as modified herein. Consider the advisory or recommended provisions to be mandatory. Interpret reference to the "Building Official," the "Structural Engineer," and the "Architect/Engineer" to mean the Contracting Officer.

### 1.5 QUALITY ASSURANCE

#### 1.5.1 Design Data

##### 1.5.1.1 Formwork Calculations

ACI 347. Include design calculations indicating arrangement of forms, sizes and grades of supports (lumber), panels, and related components. Furnish drawings and calculations of shoring and re-shoring methods proposed for floor and roof slabs, spandrel beams, and other horizontal concrete members. Calculations must indicate concrete pressure with both live and dead loads, along with material types.

##### 1.5.1.2 Concrete Mix Design

Sixty days minimum prior to concrete placement, submit a mix design for each strength and type of concrete. Submit a complete list of materials including type; brand; source and amount of cement, complementary cementitious materials, , and admixtures; and applicable reference specifications. Submit mill test and all other test for cement, complementary cementitious materials, aggregates, and admixtures.

Provide documentation of maximum nominal aggregate size, gradation analysis, percentage retained and passing sieve, and a graph of percentage retained verses sieve size. Provide mix proportion data using at least three different water-cementitious material ratios for each type of mixture, which produce a range of strength encompassing those required for each type of concrete required. If source material changes, resubmit mix proportion data using revised source material. Provide only materials that have been proven by trial mix studies to meet the requirements of this specification, unless otherwise approved in writing by the Contracting Officer. Indicate clearly in the submittal where each mix design is used when more than one mix design is submitted. Resubmit data on concrete components if the qualities or source of components changes. For previously approved concrete mix designs used within the past twelve months, the previous mix design may be re-submitted without further trial batch testing if accompanied by material test data conducted within the last six months. Obtain mix design approval from the contracting officer prior to concrete placement.

#### 1.5.2 Shop Drawings

##### 1.5.2.1 Formwork

Drawings showing details of formwork including, but not limited to; joints, supports, studding and shoring, and sequence of form and shoring removal. Indicate placement schedule, construction, location and method of forming control joints. Include locations of inserts, conduit, sleeves and other embedded items. Reproductions of contract drawings are unacceptable. Submit form removal schedule indicating element and minimum length of time for form removal.

Design, fabricate, erect, support, brace, and maintain formwork so that it is capable of supporting without failure all vertical and lateral loads that may reasonably be anticipated to be applied to the formwork.

##### 1.5.2.2 Reinforcing Steel

ACI SP-66. Indicate bending diagrams, assembly diagrams, splicing and laps of bars, shapes, dimensions, and details of bar reinforcing, accessories, and concrete cover. Do not scale dimensions from structural drawings to determine lengths of reinforcing bars. Reproductions of contract drawings are unacceptable.

#### 1.5.3 Control Submittals

##### 1.5.3.1 Concrete Curing Plan

Submit proposed materials, methods and duration for curing concrete elements in accordance with ACI 308.1.

##### 1.5.3.2 Pumping Concrete

Submit proposed materials and methods for pumping concrete. Submittal must include mix designs, pumping equipment including type of pump and size and material for pipe, and maximum length and height concrete is to be pumped.

##### 1.5.3.3 Silica Fume Manufacturer's Representative

The manufacturer's representative must be present at mix plant to ensure

proper mix, including high range water reducer, and batching methods during the first 3 days of concrete mix preparation and placement. After which the manufacturer's representative must designate a representative at the concrete producer's plant to ensure the concrete mix procedures meet the silica fume manufacturer's recommendations.

#### 1.5.3.4 Finishing Plan

Submit proposed material and procedures to be used in obtaining the finish for the slab on grade and suspended floors. Include qualification of person to be used for obtaining floor tolerance measurement, description of measuring equipment to be used, and a sketch showing lines and locations the measuring equipment will follow.

#### 1.5.3.5 VOC Content for form release agents, curing compounds, and concrete penetrating sealers

Submit certification for the form release agent, curing compounds, and concrete penetrating sealers that indicate the VOC content of each product.

#### 1.5.3.6 Safety Data Sheets

Submit Safety Data Sheets (SDS) for all materials that are regulated for hazardous health effects. SDS must be readily accessible during each work shift to employees when they are at the construction site.

#### 1.5.4 Test Reports

##### 1.5.4.1 Fly Ash and Pozzolan

Submit test results in accordance with ASTM C618 for fly ash and pozzolan. Submit test results performed within 6 months of submittal date.

##### 1.5.4.2 Ground Granulated Blast-Furnace Slag

Submit test results in accordance with ASTM C989/C989M for ground granulated blast-furnace slag. Submit test results performed within 6 months of submittal date.

##### 1.5.4.3 Aggregates

ASTM C1260 for potential alkali-silica reactions, ASTM C295/C295M for petrographic analysis.

#### 1.5.5 Field Samples

##### 1.5.5.1 Slab Finish Sample

Install minimum of 10 foot by 10 foot slab. Slab finish sample must not be part of the final project. Finish as required by specification.

##### 1.5.5.2 Surface Finish Samples

Provide a minimum of three sample concrete panels for each finish for each mix design, 3 feet by 3 feet, 3 inches thick. Use the approved concrete mix design(s). Provide sample panels on-site at locations directed. Once approved, each set of panels must be representative of each of the finishes specified and of the workmanship and finish(es) required. Do not remove or destroy samples until directed by the Contracting Officer.

#### 1.5.6 Quality Control Plan

Develop and submit for approval a concrete quality control program in accordance with the guidelines of ACI 121R and as specified herein. The plan must include approved laboratories. Provide direct oversight for the concrete qualification program inclusive of associated sampling and testing. All quality control reports must be provided to the Contracting Officer, Quality Manager and Concrete Supplier. Maintain a copy of ACI SP-15 and CRSI 10MSP at project site.

#### 1.5.7 Quality Control Personnel Certifications

The Contractor must submit for approval the responsibilities of the various quality control personnel, including the names and qualifications of the individuals in those positions and a quality control organizational chart defining the quality control hierarchy and the responsibility of the various positions. Quality control personnel must be employed by the Contractor.

Submit American Concrete Institute certification for the following:

- a. CQC personnel responsible for inspection of concrete operations.
- b. Lead Foreman or Journeyman of the Concrete Placing, Finishing, and Curing Crews.
- c. Field Testing Technicians: ACI Concrete Field Testing Technician, Grade I.

##### 1.5.7.1 Quality Manager Qualifications

The quality manager must hold a current license as a professional engineer in a U.S. state or territory with experience on at least five (5) similar projects. Evidence of extraordinary proven experience may be considered by the Contracting Officer as sufficient to act as the Quality Manager.

##### 1.5.7.2 Field Testing Technician and Testing Agency

Submit data on qualifications of proposed testing agency and technicians for approval by the Contracting Officer prior to performing testing on concrete.

- a. Work on concrete under this contract must be performed by an ACI Concrete Field Testing Technician Grade 1 qualified in accordance with ACI SP-2 or equivalent. Equivalent certification programs must include requirements for written and performance examinations as stipulated in ACI SP-2.
- b. Testing agencies that perform testing services on reinforcing steel must meet the requirements of ASTM E329.
- c. Testing agencies that perform testing services on concrete materials must meet the requirements of ASTM C1077.

#### 1.5.8 Laboratory Qualifications for Concrete Qualification Testing

The concrete testing laboratory must have the necessary equipment and experience to accomplish required testing. The laboratory must meet the

requirements of ASTM C1077 and be Cement and Concrete Reference Laboratory (CCRL) inspected.

#### 1.5.9 Laboratory Accreditation

Laboratory and testing facilities must be provided by and at the expense of the Contractor. The laboratories performing the tests must be accredited in accordance with ASTM C1077, including ASTM C78/C78M and ASTM C1260. The accreditation must be current and must include the required test methods, as specified. Furthermore, the testing must comply with the following requirements:

- a. Aggregate Testing and Mix Proportioning: Aggregate testing and mixture proportioning studies must be performed by an accredited laboratory and under the direction of a registered professional engineer in a U.S. state or territory competent in concrete materials who is competent in concrete materials and must sign all reports and designs.
- b. Acceptance Testing: Furnish all materials, labor, and facilities required for molding, curing, testing, and protecting test specimens at the site and in the laboratory. Furnish and maintain boxes or other facilities suitable for storing and curing the specimens at the site while in the mold within the temperature range stipulated by ASTM C31/C31M.
- c. Contractor Quality Control: All sampling and testing must be performed by an approved, onsite, independent, accredited laboratory.

#### 1.6 ENVIRONMENTAL REQUIREMENTS

Provide space ventilation according to manufacturer recommendations, at a minimum, during and following installation of concrete curing compound and sealer. Maintain one of the following ventilation conditions during the curing period or for 72 hours after installation:

- a. Supply 100 percent outside air 24 hours a day.
- b. Supply airflow at a rate of 6 air changes per hour, when outside temperatures are between 55 degrees F and 84 degrees F and humidity is between 30 percent and 60 percent.
- c. Supply airflow at a rate of 1.5 air changes per hour, when outside air conditions are not within the range stipulated above.

##### 1.6.1 Submittals for Environmental Performance

- a. Provide data indication the percentage of post-industrial pozzolan (fly ash, blast furnace slag) cement substitution as a percentage of the full product composite by weight.
- b. Provide data indicating the percentage of post-industrial and post-consumer recycled content aggregate.
- c. Provide product data indicating the percentage of post-consumer recycled steel content in each type of steel reinforcement as a percentage of the full product composite by weight.
- d. Provide product data stating the location where all products were manufactured



- e. For projects using FSC certified formwork, provide chain-of-custody documentation for all certified wood products.
- f. For projects using reusable formwork, provide data showing how formwork is reused.
- g. Provide SDS product information data showing that form release agents meet any environmental performance goals such as using vegetable and soy based products.
- h. Provide SDS product information data showing that concrete adhesives meet any environmental performance goals including low emitting, low volatile organic compound products.

## 1.7 SUSTAINABLE DESIGN REQUIREMENTS

### 1.7.1 Local/Regional Materials

Use materials or products extracted, harvested, or recovered, as well as manufactured, within a 500 mile radius from the project site, if available from a minimum of three sources. Submit documentation indicating distance between manufacturing facility and the project site. Indicate distance of raw material origin from the project site. Indicate relative dollar value of local/regional materials to total dollar value of products included in project.

### 1.7.2 Forest Stewardship Council (FSC) Certification

Use FSC-certified wood where specified. Provide letter of certification signed by lumber supplier. Indicate compliance with FSC STD 01 001 and identify certifying organization. Submit FSC certification numbers; identify each certified product on a line-item basis. Submit copies of invoices bearing the FSC certification numbers.

## 1.8 QUALIFICATIONS FOR WELDING WORK

Welding procedures must be in accordance with AWS D1.4/D1.4M.

Verify that Welder qualifications are in accordance with AWS D1.4/D1.4M or under an equivalent qualification test approved in advance. Welders are permitted to do only the type of welding for which each is specifically qualified.

## PART 2 PRODUCTS

### 2.1 MATERIALS FOR FORMS

Provide wood, plywood, plastic, carton, or steel. Use plywood or steel forms where a smooth form finish is required.

#### 2.1.1 Wood Forms

Use lumber as specified in Section 06 10 00 ROUGH CARPENTRY and as follows. Provide lumber that is square edged or tongue-and-groove boards, free of raised grain, knotholes, or other surface defects. Provide plywood that complies with NIST PS 1, B-B concrete form panels or better or AHA A135.4, hardboard for smooth form lining.

2.1.1.1 Concrete Form Plywood (Standard Rough)

Provide plywood that conforms to NIST PS 1, B-B, concrete form, not less than 5/8-inch thick.

2.1.1.2 Overlaid Concrete Form Plywood (Standard Smooth)

Provide plywood that conforms to NIST PS 1, B-B, high density form overlay, not less than 5/8-inch thick.

2.1.2 Plastic Forms

Plastic lumber as specified in Section 06 10 00 ROUGH CARPENTRY. Provide plastic forms that contain a minimum of 50 percent post-consumer recycled content, or a minimum of 50 percent post-industrial recycled content.

2.1.3 Steel Forms

Provide steel form surfaces that do not contain irregularities, dents, or sags.

2.2 FORM TIES AND ACCESSORIES

Provide a form tie system that does not leave mild steel after break-off or removal any closer than 2 inches from the exposed surface. Do not use wire alone. Form ties and accessories must not reduce the effective cover of the reinforcement.

2.2.1 Waterstops

2.2.1.1 PVC Waterstop

Polyvinylchloride waterstops must conform to COE CRD-C 572.

2.2.1.2 Rubber Waterstop

Rubber waterstops must conform to COE CRD-C 513.

2.2.1.3 Thermoplastic Elastomeric Rubber Waterstop

Thermoplastic elastomeric rubber waterstops must conform to ASTM D471.

2.2.1.4 Hydrophilic Waterstop

Swellable strip type compound of polymer modified chloroprene rubber that swells upon contact with water must conform to ASTM D412 as follows: Tensile strength 420 psi minimum; ultimate elongation 600 percent minimum. Hardness must be 50 minimum on the type A durometer and the volumetric expansion ratio in distilled water at 70 degrees F must be 3 to 1 minimum.

2.2.2 Dovetail Anchor Slot

Preformed metal slot approximately 1 inch by 1 inch of not less than 22 gage galvanized steel cast in concrete. Coordinate actual size and throat opening with dovetail anchors and provide with removable filler material.

## 2.3 CONCRETE MIX DESIGN

### 2.3.1 Contractor-Furnished Mix Design

ACI 211.1, ACI 301, and ACI 318 and ACI 304.2R except as otherwise specified. Indicate the compressive strength ( $f'_c$ ) of the concrete for each portion of the structure(s) as specified below. Where faster set time is required, use Type III cement before using calcium chloride with approval from the contracting officer.

#### 2.3.1.1 Footings

Proportion normal-weight concrete mixture as follows:

- a. Minimum Compressive Strength: As indicated on the Structural Drawings.
- b. Maximum Water-Cementitious Materials Ratio: 0.45.
- c. Slump Limit: 4 inches, plus or minus 1 inch.
- d. Air Content: Not required.

#### 2.3.1.2 Slab-on-Grade

Proportion normal-weight concrete mixture as follows:

- a. Minimum Compressive Strength: As indicated on the Structural Drawings.
- b. Maximum Water-Cementitious Materials Ratio: 0.45.
- c. Slump Limit: 4 inches for concrete with verified slump of 2 to 4 inches before adding high-range water-reducing admixture or plasticizing admixture, plus or minus 1 inch.
- d. Air Content: Not required.

#### 2.3.1.3 Suspended Slabs

Proportion normal-weight concrete mixture as follows:

- a. Minimum Compressive Strength: As indicated on the Structural Drawings.
- b. Maximum Water-Cementitious Materials Ratio: 0.45.
- c. Slump Limit: 4 inches for concrete with verified slump of 2 to 4 inches before adding high-range water-reducing admixture or plasticizing admixture, plus or minus 1 inch.
- d. Air Content: Not required.

#### 2.3.1.4 Building Frame Members

Proportion normal-weight concrete mixture as follows:

- a. Minimum Compressive Strength: As indicated on the Structural Drawings.
- b. Maximum Water-Cementitious Materials Ratio: 0.45.
- c. Slump Limit: 4 inches for concrete with verified slump of 2 to 4

inches before adding high-range water-reducing admixture or plasticizing admixture, plus or minus 1 inch.

- d. Air Content: Not required.

#### 2.3.1.5 Building Walls

Proportion normal-weight concrete mixture as follows:

- a. Minimum Compressive Strength: As indicated on the Structural Drawings.
- b. Maximum Water-Cementitious Materials Ratio: 0.45.
- c. Slump Limit: 4 inches for concrete with verified slump of 2 to 4 inches before adding high-range water-reducing admixture or plasticizing admixture, plus or minus 1 inch.
- d. Air Content: Not required.

Maximum slump may be increased 1 inch for methods of consolidation other than vibration. Provide air entrainment using air-entraining admixture.

#### 2.3.1.6 Mix Proportions for Normal Weight Concrete

Trial design batches, mixture proportioning studies, and testing requirements for various classes and types of concrete specified are the responsibility of the Contractor. Base mixture proportions on compressive strength as determined by test specimens fabricated in accordance with ASTM C192/C192M and tested in accordance with ASTM C39/C39M. Samples of all materials used in mixture proportioning studies must be representative of those proposed for use in the project and must be accompanied by the manufacturer's or producer's test report indicating compliance with these specifications. Base trial mixtures having proportions, consistencies, and air content suitable for the work on methodology described in ACI 211.1. In the trial mixture, use at least three different water-cementitious material ratios for each type of mixture, which must produce a range of strength encompassing those required for each class and type of concrete required on the project. The maximum water-cementitious material ratio allowed must be based on equivalent water-cementitious material ratio calculations as determined by the conversion from the weight ratio of water to cement plus pozzolan by weight equivalency method. Design laboratory trial mixture for maximum permitted slump and air content. Each combination of material proposed for use must have separate trial mixture, except for accelerator or retarder use can be provided without separate trial mixture. Report the temperature of concrete in each trial batch. For each water-cementitious material ratio, at least three test cylinders for each test age must be made and cured in accordance with ASTM C192/C192M and tested in accordance with ASTM C39/C39M for 7 and 28 days. From these results, plot a curve showing the relationship between water-cementitious material ratio and strength for each set of trial mix studies. In addition, plot a curve showing the relationship between 7 and 28 day strengths.

#### 2.3.1.7 Required Average Strength of Mix Design

The selected mixture must produce an average compressive strength exceeding the specified strength by the amount indicated in ACI 301, but may not exceed the specified strength at the same age by more than 20 percent. When a concrete production facility has a record of at least 15

consecutive tests, the standard deviation must be calculated and the required average compressive strength must be determined in accordance with ACI 301.

### 2.3.2 Ready-Mix Concrete

Provide concrete that meets the requirements of ASTM C94/C94M.

Ready-mixed concrete manufacturer must provide duplicate delivery tickets with each load of concrete delivered. Provide delivery tickets with the following information in addition to that required by ASTM C94/C94M:

Type and brand cement

Cement and complementary cementitious materials content in 94-pound bags per cubic yard of concrete

Maximum size of aggregate

Amount and brand name of admixtures

Total water content expressed by water cementitious material ratio

### 2.3.3 Concrete Curing Materials

Provide concrete curing material in accordance with ACI 301 Section 5 and ACI 308.1 Section 2. Submit product data for concrete curing compounds. Submit manufacturers instructions for placement of curing compound.

## 2.4 MATERIALS

### 2.4.1 Cementitious Materials

For exposed concrete, use one manufacturer and one source for each type of cement, ground slag, fly ash, and pozzolan.

#### 2.4.1.1 Fly Ash

Not allowed at hangar slab on grade.

ASTM C618, Class F, except that the maximum allowable loss on ignition must not exceed 3 percent. Class F fly ash for use in mitigating Alkali-Silica Reactivity must have a Calcium Oxide (CaO) content of less than 8 percent and a total equivalent alkali content less than 1.5 percent.

Add with cement. Fly ash content must be a minimum of 15 percent by weight of cementitious material, provided the fly ash does not reduce the amount of cement in the concrete mix below the minimum requirements of local building codes. Where the use of fly ash cannot meet the minimum level, provide the maximum amount of fly ash permittable that meets the code requirements for cement content. Report the chemical analysis of the fly ash in accordance with ASTM C311/C311M. Evaluate and classify fly ash in accordance with ASTM D5759.

#### 2.4.1.2 Raw or Calcined Natural Pozzolan

Natural pozzolan must be raw or calcined and conform to ASTM C618, Class N, including the optional requirements for uniformity and effectiveness in controlling Alkali-Silica reaction and must have an ignition loss not

exceeding 3 percent. Class N pozzolan for use in mitigating Alkali-Silica Reactivity must have a Calcium Oxide (CaO) content of less than 13 percent and total equivalent alkali content less than 3 percent.

#### 2.4.1.3 Ultra Fine Fly Ash and Ultra Fine Pozzolan

Ultra Fine Fly Ash (UFFA) and Ultra Fine Pozzolan (UFP) must conform to ASTM C618, Class F or N, and the following additional requirements:

- a. The strength activity index at 28 days of age must be at least 95 percent of the control specimens.
- b. The average particle size must not exceed 6 microns.
- c. The sum of SiO<sub>2</sub> + Al<sub>2</sub>O<sub>3</sub> + Fe<sub>2</sub>O<sub>3</sub> must be greater than 77 percent.

#### 2.4.1.4 Ground Granulated Blast-Furnace Slag

ASTM C989/C989M, Grade 100. Slag content must be a minimum of 25 percent by weight of cementitious material.

#### 2.4.1.5 Silica Fume

Silica fume must conform to ASTM C1240, including the optional limits on reactivity with cement alkalis. Silica fume may be furnished as a dry, densified material or as slurry. Proper mixing is essential to accomplish proper distribution of the silica fume and avoid agglomerated silica fume which can react with the alkali in the cement resulting in premature and extensive concrete damage. Supervision at the batch plant, finishing, and curing is essential. Provide at the Contractor's expense the services of a manufacturer's technical representative, experienced in mixing, proportioning, placement procedures, and curing of concrete containing silica fume. This representative must be present on the project prior to and during at least the first 4 days of concrete production and placement using silica fume. A High Range Water Reducer (HRWR) must be used with silica fume.

#### 2.4.1.6 Portland Cement

Provide cement that conforms to ASTM C150/C150M, Type II, low alkali with tri-calcium aluminates (C3A) content less than 10 percent and a maximum cement-alkali content of 0.80 percent Na<sub>2</sub>O<sub>e</sub> (sodium oxide) equivalent. Use one brand and type of cement for formed concrete having exposed-to-view finished surfaces.

For portland cement manufactured in a kiln fueled by hazardous waste, maintain a record of source for each batch. Supplier must certify that no hazardous waste is used in the fuel mix or raw materials.

#### 2.4.1.7 Blended Cements

Blended cement must conform to ASTM C595/C595M and ASTM C1157/C1157M, Type IP or IS, including the optional requirement for mortar expansion and sulfate soundness and consist of a mixture of ASTM C150/C150M Type I, or Type II cement and a complementary cementing material. The slag added to the Type IS blend must be ASTM C989/C989M ground granulated blast-furnace slag. The pozzolan added to the Type IP blend must be ASTM C618 Class F and must be interground with the cement clinker. The manufacturer must state in writing that the amount of pozzolan in the finished cement will not vary more than plus or minus 5 mass percent of the finished cement

from lot-to-lot or within a lot. The percentage and type of mineral admixture used in the blend must not change from that submitted for the aggregate evaluation and mixture proportioning.

#### 2.4.2 Water

Water must comply with the requirements of ASTM C1602/C1602M. Minimize the amount of water in the mix. Improve workability by adjusting the grading rather than by adding water. Water must be potable; free from injurious amounts of oils, acids, alkalis, salts, organic materials, or other substances deleterious to concrete. Submit test report showing water complies with ASTM C1602/C1602M.

#### 2.4.3 Aggregates

ASTM C33/C33M, except as modified herein. Furnish aggregates for exposed concrete surfaces from one source. Provide aggregates that do not contain any substance which may be deleteriously reactive with the alkalis in the cement. Submit test report showing compliance with ASTM C33/C33M.

Fine and coarse aggregates must show expansions less than 0.08 percent at 28 days after casting when testing in accordance with ASTM C1260. Should the test data indicate an expansion of 0.08 percent or greater, reject the aggregate(s) or perform additional testing using ASTM C1567 using the Contractor's proposed mix design. In this case, include the mix design low alkali portland cement and one of the following supplementary cementitious materials:

1. GGBF slag at a minimum of 40 percent of total cementitious
2. Fly ash or natural pozzolan at a minimum of total cementitious of
  - a. 30 percent if (SiO<sub>2</sub> plus Al<sub>2</sub>O<sub>3</sub> plus Fe<sub>2</sub>O<sub>3</sub>) is 65 percent or more,
  - b. 25 percent if (SiO<sub>2</sub> plus Al<sub>2</sub>O<sub>3</sub> plus Fe<sub>2</sub>O<sub>3</sub>) is 70 percent or more,
  - c. 20 percent if (SiO<sub>2</sub> plus Al<sub>2</sub>O<sub>3</sub> plus Fe<sub>2</sub>O<sub>3</sub>) is 80 percent or more,
  - d. 15 percent if (SiO<sub>2</sub> plus Al<sub>2</sub>O<sub>3</sub> plus Fe<sub>2</sub>O<sub>3</sub>) is 90 percent or more.
3. Silica fume at a minimum of 7 percent of total cementitious.

If a combination of these materials is chosen, the minimum amount must be a linear combination of the minimum amounts above. Include these materials in sufficient proportion to show less than 0.08 percent expansion at 28 days after casting when tested in accordance with ASTM C1567.

Aggregates must not possess properties or constituents that are known to have specific unfavorable effects in concrete when tested in accordance with ASTM C295/C295M.

##### 2.4.3.1 Aggregates/Combined Aggregate Gradation (Floor Slabs Only)

ASTM C33/C33M, uniformly graded and as follows: Nominal maximum aggregate size of 1 inch. A combined sieve analysis must indicate a well graded aggregate from coarsest to finest with not more than 18 percent and not less than 8 percent retained on an individual sieve, except that less than 8 percent may be retained on coarsest sieve and on No. 50 (0.3mm) sieve, and less than 8 percent may be retained on sieves finer than No. 50 (0.3mm). Provide sand that is at least 50 percent natural sand.

#### 2.4.4 Nonshrink Grout

ASTM C1107/C1107M.

#### 2.4.5 Admixtures

ASTM C494/C494M: Type A, water reducing; Type B, retarding; Type C, accelerating; Type D, water-reducing and retarding; and Type E, water-reducing and accelerating admixture. Do not use calcium chloride admixtures. Submit product data for admixtures used in concrete.

##### 2.4.5.1 Air-Entraining

ASTM C260/C260M.

##### 2.4.5.2 High Range Water Reducer (HRWR) (Superplasticizers)

ASTM C494/C494M, Type F and ASTM C1017/C1017M. Silica fume and HRWR must come from the same manufacturer.

#### 2.4.6 Vapor Retarder

ASTM E1745 Class C polyethylene sheeting, minimum 15 mil thickness or ASTM E1993/E1993M bituminous membrane or other equivalent material with a maximum permeance rating of 0.01 perms per ASTM E96/E96M.

Consider plastic vapor retarders and adhesives with a high recycled content, low toxicity low VOC (Volatile Organic Compounds) levels.

#### 2.4.7 Expansion/Contraction Joint Filler

ASTM D1751 or ASTM D1752 Type I or II. Material must be 1/2 inch thick, unless otherwise indicated.

#### 2.4.8 Joint Sealants

Submit manufacturer's product data, indicating VOC content.

##### 2.4.8.1 Horizontal Surfaces, 3 Percent Slope, Maximum

ASTM D6690 or ASTM C920, Type M, Class 25, Use T.

##### 2.4.8.2 Vertical Surfaces Greater Than 3 Percent Slope

ASTM C920, Type M, Grade NS, Class 25, Use T ..

##### 2.4.8.3 Preformed Polychloroprene Elastomeric Type

ASTM D2628.

##### 2.4.8.4 Lubricant for Preformed Compression Seals

ASTM D2835.

#### 2.4.9 Biodegradable Form Release Agent

Provide form release agent that is colorless, biodegradable, , with a low (maximum of 55 grams/liter (g/l)) VOC content. A minimum of 85 percent of the total product must be biobased material. Provide product that does



not bond with, stain, or adversely affect concrete surfaces and does not impair subsequent treatments of concrete surfaces. Provide form release agent that does not contain diesel fuel, petroleum-based lubricating oils, waxes, or kerosene. Submit documentation indicating type of biobased material in product and biobased content. Indicate relative dollar value of biobased content products to total dollar value of products included in project.

## 2.5 REINFORCEMENT

### 2.5.1 Reinforcing Bars

ACI 301 unless otherwise specified. Use deformed steel. ASTM A615/A615M with the bars marked A, Grade 60. Submit documentation indicating percentage of post-industrial and post-consumer recycled content per unit of product. Indicate relative dollar value of recycled content products to total dollar value of products included in project. Submit mill certificates for reinforcing bars.

#### 2.5.1.1 Weldable Reinforcing Bars

Provide weldable reinforcing bars that conform to ASTM A706/A706M and ASTM A615/A615M and Supplement S1, Grade 60, except that the maximum carbon content must be 0.55 percent.

#### 2.5.2 Mechanical Reinforcing Bar Connectors

ACI 301. Provide 125 percent minimum yield strength of the reinforcement bar.

#### 2.5.3 Wire

##### 2.5.3.1 Welded Wire Reinforcement

ASTM A1064/A1064M. Provide wire reinforcement that contains a minimum of 100 percent recycled content. Provide flat sheets of welded wire reinforcement for slabs and toppings.

##### 2.5.3.2 Steel Wire

Wire must conform to ASTM A1064/A1064M.

#### 2.5.4 Reinforcing Bar Supports

Supports include bolsters, chairs, spacers, and other devices necessary for proper spacing, supporting, and fastening reinforcing bars and welded wire reinforcement in place.

Provide wire bar type supports of coated or non-corrodible material conforming to ACI SP-66 and CRSI 10MSP.

Legs of supports in contact with formwork must be hot-dip galvanized, or plastic coated after fabrication, or stainless-steel bar supports.

##### 2.5.5 Dowels for Load Transfer in Floors

Provide greased dowels for load transfer in floors of the type, design, weight, and dimensions indicated. Provide dowel bars that are plain-billet steel conforming to ASTM A615/A615M, Grade 40. Provide dowel

pipe that is steel conforming to ASTM A53/A53M.

Plate dowels must conform to ASTM A36/A36M, and must be of size and spacing indicated. Plate dowel system must minimize shrinkage restraint by using a tapered shape or by having compressible material on the vertical faces with a thin bond breaker on the top and bottom dowel surfaces.

## PART 3 EXECUTION

### 3.1 EXAMINATION

Do not begin installation until substrates have been properly constructed; verify that substrates are level.

If substrate preparation is the responsibility of another installer, notify Contracting Officer of unsatisfactory preparation before processing.

Check field dimensions before beginning installation. If dimensions vary too much from design dimensions for proper installation, notify Contracting Officer and wait for instructions before beginning installation.

### 3.2 PREPARATION

Determine quantity of concrete needed and minimize the production of excess concrete. Designate locations or uses for potential excess concrete before the concrete is poured.

#### 3.2.1 General

Surfaces against which concrete is to be placed must be free of debris, loose material, standing water, snow, ice, and other deleterious substances before start of concrete placing.

Remove standing water without washing over freshly deposited concrete. Divert flow of water through side drains provided for such purpose.

#### 3.2.2 Subgrade Under Foundations and Footings

When subgrade material is semiporous and dry, sprinkle subgrade surface with water as required to eliminate suction at the time concrete is deposited, or seal subgrade surface by covering surface with specified vapor retarder. When subgrade material is porous, seal subgrade surface by covering surface with specified vapor retarder.

#### 3.2.3 Subgrade Under Slabs on Ground

Before construction of slabs on ground, have underground work on pipes and conduits completed and approved.

Previously constructed subgrade or fill must be cleaned of foreign materials.

Finish surface of capillary water barrier under interior slabs on ground must not show deviation in excess of 1/4 inch when tested with a 10-foot straightedge parallel with and at right angles to building lines.

Finished surface of subgrade or fill under exterior slabs on ground must

not be more than 0.02-foot above or 0.10-foot below elevation indicated.

#### 3.2.4 Edge Forms and Screed Strips for Slabs

Set edge forms or bulkheads and intermediate screed strips for slabs to obtain indicated elevations and contours in finished slab surface and must be strong enough to support vibrating bridge screeds or roller pipe screeds if nature of specified slab finish requires use of such equipment. Align concrete surface to elevation of screed strips by use of strike-off templates or approved compacting-type screeds.

#### 3.2.5 Reinforcement and Other Embedded Items

Secure reinforcement, joint materials, and other embedded materials in position, inspected, and approved before start of concrete placing.

### 3.3 FORMS

Provide forms, shoring, and scaffolding for concrete placement in accordance with ACI 301 Section 2 and 5 and ACI 347. Set forms mortar-tight and true to line and grade. Chamfer above grade exposed joints, edges, and external corners of concrete 0.75 inch unless otherwise indicated. Provide formwork with clean-out openings to permit inspection and removal of debris.

#### 3.3.1 Coating

Before concrete placement, coat the contact surfaces of forms with a form release agent.

#### 3.3.2 Reshoring

Reshore concrete elements in accordance with ACI 301 Section 2.

#### 3.3.3 Reuse

Reuse forms providing the structural integrity of concrete and the aesthetics of exposed concrete are not compromised. Wood forms must not be clogged with paste and must be capable of absorbing high water-cementitious material ratio paste.

#### 3.3.4 Forms for Standard Rough Form Finish

Provide formwork in accordance with ACI 301 Section 5 with a surface finish, SF-1.0, for formed surfaces that are to be concealed by other construction.

#### 3.3.5 Forms for Standard Smooth Form Finish

Provide formwork in accordance with ACI 301 Section 5 with a surface finish, SF-3.0, for formed surfaces that are exposed to view.

#### 3.3.6 Form Ties

Provide ties in accordance with ACI 301 section 2.

#### 3.3.7 Tolerances for Form Construction

Construct formwork to ensure that after removal of forms and prior to

patching and finishing of formed surfaces, provide concrete surfaces in accordance with tolerances specified in ACI 301 Section 5 and ACI 117.

### 3.3.8 Removal of Forms and Supports

After placing concrete, removal of forms must be in accordance with ACI 301 Section 2 except as modified by approved form removal schedule.

## 3.4 WATERSTOP INSTALLATION AND SPLICES

Provide waterstops in construction joints as indicated.

Install waterstops to form a continuous diaphragm in each joint. Make adequate provisions to support and protect waterstops during progress of work. Protect waterstops protruding from joints from damage.

### 3.4.1 PVC Waterstop

Make splices by heat sealing the adjacent waterstop edges together using a thermoplastic splicing iron utilizing a non-stick surface specifically designed for waterstop welding. Reform waterstops at splices with a remolding iron with ribs or corrugations to match the pattern of the waterstop. The spliced area, when cooled, must show no signs of separation, holes, or other imperfections when bent by hand in as sharp an angle as possible.

### 3.4.2 Rubber Waterstop

Rubber waterstops must be spliced using cold bond adhesive as recommended by the manufacturer.

### 3.4.3 Thermoplastic Elastomeric Rubber Waterstop

Fittings must be shop made using a machine specifically designed to mechanically weld the waterstop. A portable power saw must be used to miter or straight cut the ends to be joined to ensure good alignment and contact between joined surfaces. Maintain continuity of the characteristic features of the cross section of the waterstop (for example ribs, tabular center axis, and protrusions) across the splice.

### 3.4.4 Hydrophilic Waterstop

Miter cut ends to be joined with sharp knife or shears. The ends must be adhered with adhesive.

## 3.5 PLACING REINFORCEMENT AND MISCELLANEOUS MATERIALS

ACI 301 and ACI SP-66. Provide bars, welded wire reinforcement, wire ties, supports, and other devices necessary to install and secure reinforcement. Reinforcement must not have rust, scale, oil, grease, clay, or foreign substances that would reduce the bond. Rusting of reinforcement is a basis of rejection if the effective cross-sectional area or the nominal weight per unit length has been reduced. Remove loose rust prior to placing steel. Tack welding is prohibited.

### 3.5.1 General

Provide details of reinforcement that are in accordance with ACI 301 and ACI SP-66 and as specified.

### 3.5.2 Vapor Retarder

Install in accordance with ASTM E1643. Provide beneath the on-grade concrete floor slab. Use the greatest widths and lengths practicable to eliminate joints wherever possible. Lap joints a minimum of 12 inches and tape. Remove torn, punctured, or damaged vapor retarder material and provide with new vapor retarder prior to placing concrete. Concrete placement must not damage vapor retarder. Place a 2 inch layer of clean concrete sand on vapor retarder before placing concrete.

### 3.5.3 Reinforcement Supports

Support reinforcement in accordance with ACI 301 Section 3. Supports for coated or galvanized bars must also be coated with electrically compatible material for a distance of at least 2 inches beyond the point of contact with the bars.

### 3.5.4 Splicing

As indicated. For splices not indicated ACI 301. Do not splice at points of maximum stress. Overlap welded wire reinforcement the spacing of the cross wires, plus 2 inches.

### 3.5.5 Future Bonding

Plug exposed, threaded, mechanical reinforcement bar connectors with a greased bolt. Provide bolt threads that match the connector. Countersink the connector in the concrete. Caulk the depression after the bolt is installed.

### 3.5.6 Setting Miscellaneous Material

Place and secure anchors and bolts, pipe sleeves, conduits, and other such items in position before concrete placement and support against displacement. Plumb anchor bolts and check location and elevation. Temporarily fill voids in sleeves with readily removable material to prevent the entry of concrete.

### 3.5.7 Fabrication

Shop fabricate reinforcing bars to conform to shapes and dimensions indicated for reinforcement, and as follows:

- a. Provide fabrication tolerances that are in accordance with ACI 318 and ACI SP-66.
- b. Provide hooks and bends that are in accordance with ACI 318 and ACI SP-66.

Reinforcement must be bent cold to shapes as indicated. Bending must be done in the shop. Rebending of a reinforcing bar that has been bent incorrectly is not be permitted. Bending must be in accordance with standard approved practice and by approved machine methods.

Tolerance on nominally square-cut, reinforcing bar ends must be in accordance with ACI SP-66.

Deliver reinforcing bars bundled, tagged, and marked. Tags must be metal

with bar size, length, mark, and other information pressed in by machine. Marks must correspond with those used on the placing drawings.

Do not use reinforcement that has any of the following defects:

- a. Bar lengths, depths, and bends beyond specified fabrication tolerances
- b. Bends or kinks not indicated on drawings or approved shop drawings
- c. Bars with reduced cross-section due to rusting or other cause

Replace defective reinforcement with new reinforcement having required shape, form, and cross-section area.

### 3.5.8 Placing Reinforcement

Place reinforcement in accordance with ACI 301 and ACI SP-66.

For slabs on grade (over earth or over capillary water barrier) and for footing reinforcement, support bars or welded wire reinforcement on precast concrete blocks, spaced at intervals required by size of reinforcement, to keep reinforcement the minimum height specified above the underside of slab or footing.

For slabs other than on grade, supports for which any portion is less than 1 inch from concrete surfaces that are exposed to view or to be painted must be of precast concrete units, plastic-coated steel, or stainless steel protected bar supports. Precast concrete units must be wedge shaped, not larger than 3-1/2 by 3-1/2 inches, and of thickness equal to that indicated for concrete protection of reinforcement. Provide precast units that have cast-in galvanized tie wire hooked for anchorage and blend with concrete surfaces after finishing is completed.

Provide reinforcement that is supported and secured together to prevent displacement by construction loads or by placing of wet concrete, and as follows:

Provide supports for reinforcing bars that are sufficient in number and have sufficient strength to carry the reinforcement they support, and in accordance with ACI 318, ACI SP-66 and CRSI 10MSP. Do not use supports to support runways for concrete conveying equipment and similar construction loads.

- a. Equip supports on ground and similar surfaces with sand-plates.
- b. Support welded wire reinforcement as required for reinforcing bars.
- c. Secure reinforcements to supports by means of tie wire. Wire must be black, soft iron wire, not less than 16 gage.
- d. Reinforcement must be accurately placed, securely tied at intersections, and held in position during placing of concrete by spacers, chairs, or other approved supports. Point wire-tie ends away from the form. Unless otherwise indicated, numbers, type, and spacing of supports must conform to ACI SP-66.

Bending of reinforcing bars partially embedded in concrete is permitted only as specified in ACI SP-66 and ACI 318.

### 3.5.9 Spacing of Reinforcing Bars

Spacing must be as indicated. If not indicated, spacing must be in accordance with the ACI 318 and ACI SP-66.

Reinforcing bars may be relocated to avoid interference with other reinforcement, or with conduit, pipe, or other embedded items. If any reinforcing bar is moved a distance exceeding one bar diameter or specified placing tolerance, resulting rearrangement of reinforcement is subject to preapproval by the Contracting Officer.

### 3.5.10 Concrete Protection for Reinforcement

Concrete protection must be in accordance with the ACI 318, ACI 201.2R, and ACI SP-66.

### 3.5.11 Welding

Welding must be in accordance with AWS D1.4/D1.4M.

## 3.6 BATCHING, MEASURING, MIXING, AND TRANSPORTING CONCRETE

ASTM C94/C94M, ACI 301, ACI 302.1R and ACI 304R, except as modified herein. Batching equipment must be such that the concrete ingredients are consistently measured within the following tolerances: 1 percent for cement and water, 2 percent for aggregate, and 3 percent for admixtures. Furnish mandatory batch ticket information for each load of ready mix concrete.

### 3.6.1 Measuring

Make measurements at intervals as specified in paragraphs SAMPLING and TESTING.

### 3.6.2 Mixing

ASTM C94/C94M, ACI 301 and ACI 304R. Machine mix concrete. Begin mixing within 30 minutes after the cement has been added to the aggregates. Place concrete within 90 minutes of either addition of mixing water to cement and aggregates or addition of cement to aggregates if the air temperature is less than 84 degrees F. Reduce mixing time and place concrete within 60 minutes if the air temperature is greater than 84 degrees F except as follows: if set retarding admixture is used and slump requirements can be met, limit for placing concrete may remain at 90 minutes. Additional water may be added, provided that both the specified maximum slump and water-cementitious material ratio are not exceeded and the required concrete strength is still met. When additional water is added, an additional 30 revolutions of the mixer at mixing speed is required. If the entrained air content falls below the specified limit, add a sufficient quantity of admixture to bring the entrained air content within the specified limits. Dissolve admixtures in the mixing water and mix in the drum to uniformly distribute the admixture throughout the batch. Do not reconstitute concrete that has begun to solidify.

### 3.6.3 Transporting

Transport concrete from the mixer to the forms as rapidly as practicable. Prevent segregation or loss of ingredients. Clean transporting equipment thoroughly before each batch. Do not use aluminum pipe or chutes. Remove

concrete which has segregated in transporting and dispose of as directed.

### 3.7 PLACING CONCRETE

Place concrete in accordance with ACI 301 Section 5.

#### 3.7.1 Pumping

ACI 304R and ACI 304.2R. Pumping must not result in separation or loss of materials nor cause interruptions sufficient to permit loss of plasticity between successive increments. Loss of slump in pumping equipment must not exceed 2 inches at discharge/placement. Do not convey concrete through pipe made of aluminum or aluminum alloy. Avoid rapid changes in pipe sizes. Limit maximum size of coarse aggregate to 33 percent of the diameter of the pipe. Limit maximum size of well rounded aggregate to 40 percent of the pipe diameter. Take samples for testing at both the point of delivery to the pump and at the discharge end.

#### 3.7.2 Hot Weather

Maintain required concrete temperature using Figure 4.2 in ACI 305R to prevent the evaporation rate from exceeding 0.2 pound of water per square foot of exposed concrete per hour. Cool ingredients before mixing or use other suitable means to control concrete temperature and prevent rapid drying of newly placed concrete. Shade the fresh concrete as soon as possible after placing. Start curing when the surface of the fresh concrete is sufficiently hard to permit curing without damage. Provide water hoses, pipes, spraying equipment, and water hauling equipment, where job site is remote to water source, to maintain a moist concrete surface throughout the curing period. Provide burlap cover or other suitable, permeable material with fog spray or continuous wetting of the concrete when weather conditions prevent the use of either liquid membrane curing compound or impervious sheets. For vertical surfaces, protect forms from direct sunlight and add water to top of structure once concrete is set.

#### 3.7.3 Bonding

Surfaces of set concrete at joints, must be roughened and cleaned of laitance, coatings, loose particles, and foreign matter. Roughen surfaces in a manner that exposes the aggregate uniformly and does not leave laitance, loosened particles of aggregate, nor damaged concrete at the surface.

Obtain bonding of fresh concrete that has set as follows:

- a. At joints between footings and walls or columns, between walls or columns and the beams or slabs they support, and elsewhere unless otherwise specified; roughened and cleaned surface of set concrete must be dampened, but not saturated, immediately prior to placing of fresh concrete.
- b. At joints in exposed-to-view work; at vertical joints in walls; at joints near midpoint of span in girders, beams, supported slabs, other structural members; in work designed to contain liquids; the roughened and cleaned surface of set concrete must be dampened but not saturated and covered with a cement grout coating.
- c. Provide cement grout that consists of equal parts of portland cement and fine aggregate by weight with not more than 6 gallons of water per



sack of cement. Apply cement grout with a stiff broom or brush to a minimum thickness of 1/16 inch. Deposit fresh concrete before cement grout has attained its initial set.

### 3.8 WASTE MANAGEMENT

Provide as specified in the Waste Management Plan and as follows.

#### 3.8.1 Mixing Equipment

Before concrete pours, designate Contractor-owned site meeting environmental standards for cleaning out concrete mixing trucks. Minimize water used to wash equipment.

#### 3.8.2 Hardened, Cured Waste Concrete

Crush and reuse hardened, cured waste concrete as fill or as a base course for pavement. 3.8.3 Reinforcing Steel

Collect reinforcing steel and place in designated area for recycling.

#### 3.8.4 Other Waste

Identify concrete manufacturer's or supplier's policy for collection or return of construction waste, unused material, deconstruction waste, and/or packaging material. Institute deconstruction and construction waste separation and recycling for use in manufacturer's programs. When such a program is not available, seek local recyclers to reclaim the materials.

### 3.9 SURFACE FINISHES EXCEPT FLOOR, SLAB, AND PAVEMENT FINISHES

#### 3.9.1 Defects

Repair surface defects in accordance with ACI 301 Section 5.

#### 3.9.2 Not Against Forms (Top of Walls)

Surfaces not otherwise specified must be finished with wood floats to even surfaces. Finish must match adjacent finishes.

#### 3.9.3 Formed Surfaces

##### 3.9.3.1 Tolerances

ACI 117 and as indicated.

##### 3.9.3.2 As-Cast Rough Form

Provide for surfaces not exposed to public view a surface finish SF-1.0. Patch holes and defects in accordance with ACI 301.

##### 3.9.3.3 Standard Smooth Finish

Provide for surfaces exposed to public view a surface finish SF-3.0. Patch holes and defects in accordance with ACI 301.

### 3.10 FLOOR, SLAB, AND PAVEMENT FINISHES AND MISCELLANEOUS CONSTRUCTION

ACI 301 and ACI 302.1R, unless otherwise specified. Slope floors

uniformly to drains where drains are provided. Depress the concrete base slab where indicated. Steel trowel and fine-broom finish concrete slabs that are to receive quarry tile, ceramic tile, or paver tile. Where straightedge measurements are specified, Contractor must provide straightedge.

### 3.10.1 Finish

Place, consolidate, and immediately strike off concrete to obtain proper contour, grade, and elevation before bleedwater appears. Permit concrete to attain a set sufficient for floating and supporting the weight of the finisher and equipment. If bleedwater is present prior to floating the surface, drag the excess water off or remove by absorption with porous materials. Do not use dry cement to absorb bleedwater.

#### 3.10.1.1 Scratched

Use for surfaces intended to receive bonded applied cementitious applications. Finish concrete in accordance with ACI 301 Section 5 for a scratched finish.

#### 3.10.1.2 Floated

Use for surfaces to receive waterproofing membranes, and exterior slabs where not otherwise specified. Finish concrete in accordance with ACI 301 Section 5 for a floated finish.

#### 3.10.1.3 Concrete Containing Silica Fume

Finish using magnesium floats or darbies. Finish using techniques demonstrated in the sample installation.

#### 3.10.1.4 Steel Troweled

Use for floors intended as walking surfaces and for reception of floor coverings. Finish concrete in accordance with ACI 301 Section 5 for a steel troweled finish.

#### 3.10.1.5 Broomed

Use on surfaces of exterior walks, platforms, patios, and ramps, unless otherwise indicated. Finish concrete in accordance with ACI 301 Section 5 for a broomed finish.

#### 3.10.1.6 Pavement

Screed the concrete with a template advanced with a combined longitudinal and crosswise motion. Maintain a slight surplus of concrete ahead of the template. After screeding, float the concrete longitudinally. Use a straightedge to check slope and flatness; correct and refloat as necessary. Obtain final finish by belting. Lay belt flat on the concrete surface and advance with a sawing motion; continue until a uniform but gritty nonslip surface is obtained. Drag a strip of clean, wet burlap from 3 to 10 feet wide and 2 feet longer than the pavement width across the slab. Produce a fine, granular, sandy textured surface without disfiguring marks. Round edges and joints with an edger having a radius of 1/8 inch.

### 3.10.2 Pits and Trenches

Place bottoms and walls monolithically or provide waterstops and keys.

### 3.10.3 Splash Blocks

Provide at outlets of downspouts emptying at grade. Splash blocks may be precast concrete, and must be 24 inches long, 12 inches wide and 4 inches thick, unless otherwise indicated, with smooth-finished countersunk dishes sloped to drain away from the building.

## 3.11 JOINTS

### 3.11.1 Construction Joints

Make and locate joints not indicated so as not to impair strength and appearance of the structure, as approved. Joints must be perpendicular to main reinforcement. Reinforcement must be continued and developed across construction joints. Locate construction joints as follows:

#### 3.11.1.1 Maximum Allowable Construction Joint Spacing

- a. In walls at not more than 60 feet in any horizontal direction.
- b. In slabs on ground, so as to divide slab into areas not in excess of 1,200 square feet.

#### 3.11.1.2 Construction Joints for Constructability Purposes

- a. In walls, at top of footing; at top of slabs on ground; at top and bottom of door and window openings or where required to conform to architectural details; and at underside of deepest beam or girder framing into wall.
- b. In columns or piers, at top of footing; at top of slabs on ground; and at underside of deepest beam or girder framing into column or pier.
- c. Near midpoint of spans for supported slabs, beams, and girders unless a beam intersects a girder at the center, in which case construction joints in girder must offset a distance equal to twice the width of the beam. Make transfer of shear through construction joint by use of inclined reinforcement.

Provide keyways at least 1-1/2-inches deep in construction joints in walls and slabs and between walls and footings; approved bulkheads may be used for slabs.

### 3.11.2 Isolation Joints in Slabs on Ground

Provide joints at points of contact between slabs on ground and vertical surfaces, such as column pedestals, foundation walls, grade beams, and elsewhere as indicated.

Fill joints with premolded joint filler strips 1/2 inch thick, extending full slab depth. Install filler strips at proper level below finish floor elevation with a slightly tapered, dress-and-oiled wood strip temporarily secured to top of filler strip to form a groove not less than 3/4 inch in depth where joint is sealed with sealing compound and not less than 1/4 inch in depth where joint sealing is not required. Remove wood strip

after concrete has set. Contractor must clean groove of foreign matter and loose particles after surface has dried.

### 3.11.3 Contraction Joints in Slabs on Ground

Provide joints to form panels as indicated.

Under and on exact line of each control joint, cut 50 percent of welded wire reinforcement before placing concrete.

Sawcut contraction joints into slab on ground in accordance with ACI 301 Section 5.

Sawcutting will be limited to within 12 hours after set and at 1/4 slab depth.

### 3.11.4 Sealing Joints in Slabs on Ground

Contraction and control joints which are to receive finish flooring material must be sealed with joint sealing compound after concrete curing period. Slightly underfill groove with joint sealing compound to prevent extrusion of compound. Remove excess material as soon after sealing as possible.

Sealed groove must be left ready to receive filling material that is provided as part of finish floor covering work.

## 3.12 CONCRETE FLOOR TOPPING

### 3.12.1 Standard Floor Topping

Provide topping for treads and platforms of metal steel stairs and elsewhere as indicated.

#### Preparations Prior to Placing

When topping is placed on a green concrete base slab, screed surface of base slab to a level not more than 1-1/2 inches nor less than 1 inch below required finish surface. Remove water and laitance from surface of base slab before placing topping mixture. As soon as water ceases to rise to surface of base slab, place topping.

When topping is placed on a hardened concrete base slab, remove dirt, loose material, oil, grease, asphalt, paint, and other contaminants from base slab surface, leaving a clean surface. Prior to placing topping mixture, 2-1/2-inches minimum, slab surface must be dampened and left free of standing water. Immediately before topping mixture is placed, broom a coat of neat cement grout onto surface of slab. Do not allow cement grout to set or dry before topping is placed.

When topping is placed on a metal surface, such as metal pans for steel stairs, remove dirt, loose material, oil, grease, asphalt, paint, and other contaminants from metal surface.

#### Placing

Spread standard topping mixture evenly on previously prepared base slab or metal surface, brought to correct level with a straightedge, and struck off. Topping must be consolidated, floated, checked for trueness of

surface, and refloated as specified for float finish.

#### Finishing

Give trowel finish standard floor topping surfaces.

Give other finishes standard floor topping surfaces as indicated.

### 3.13 CURING AND PROTECTION

ACI 301 Section 5, unless otherwise specified. Begin curing immediately following form removal. Avoid damage to concrete from vibration created by blasting, pile driving, movement of equipment in the vicinity, disturbance of formwork or protruding reinforcement, and any other activity resulting in ground vibrations. Protect concrete from injurious action by sun, rain, flowing water, frost, mechanical injury, tire marks, and oil stains. Do not allow concrete to dry out from time of placement until the expiration of the specified curing period. Do not use membrane-forming compound on surfaces where appearance would be objectionable, on any surface to be painted, where coverings are to be bonded to the concrete, or on concrete to which other concrete is to be bonded. If forms are removed prior to the expiration of the curing period, provide another curing procedure specified herein for the remaining portion of the curing period. Provide moist curing for those areas receiving liquid chemical sealer-hardener or epoxy coating. Allow curing compound/sealer installations to cure prior to the installation of materials that adsorb VOCs.

#### 3.13.1 Curing Periods

ACI 301 Section 5, except 10 days for retaining walls, pavement or chimneys. Begin curing immediately after placement. Protect concrete from premature drying, excessively hot temperatures, and mechanical injury; and maintain minimal moisture loss at a relatively constant temperature for the period necessary for hydration of the cement and hardening of the concrete. The materials and methods of curing are subject to approval by the Contracting Officer.

#### 3.13.2 Curing Formed Surfaces

Accomplish curing of formed surfaces, including undersurfaces of girders, beams, supported slabs, and other similar surfaces by moist curing with forms in place for full curing period or until forms are removed. If forms are removed before end of curing period, accomplish final curing of formed surfaces by any of the curing methods specified above, as applicable.

#### 3.13.3 Curing Unformed Surfaces

Accomplish initial curing of unformed surfaces, such as monolithic slabs, floor topping, and other flat surfaces, by membrane curing.

Unless otherwise specified, accomplish final curing of unformed surfaces by any of curing methods specified, as applicable.

#### 3.13.4 Temperature of Concrete During Curing

When temperature of atmosphere is 41 degrees F and below, maintain temperature of concrete at not less than 55 degrees F throughout concrete

curing period or 45 degrees F when the curing period is measured by maturity. When necessary, make arrangements before start of concrete placing for heating, covering, insulation, or housing as required to maintain specified temperature and moisture conditions for concrete during curing period.

When the temperature of atmosphere is 80 degrees F and above or during other climatic conditions which cause too rapid drying of concrete, make arrangements before start of concrete placing for installation of wind breaks, of shading, and for fog spraying, wet sprinkling, or moisture-retaining covering of light color as required to protect concrete during curing period.

Changes in temperature of concrete must be uniform and not exceed 37 degrees F in any 1 hour nor 80 degrees F in any 24-hour period.

### 3.13.5 Protection from Mechanical Injury

During curing period, protect concrete from damaging mechanical disturbances, particularly load stresses, heavy shock, and excessive vibration and from damage caused by rain or running water.

### 3.13.6 Protection After Curing

Protect finished concrete surfaces from damage by construction operations.

## 3.14 FIELD QUALITY CONTROL

### 3.14.1 Sampling

ASTM C172/C172M. Collect samples of fresh concrete to perform tests specified. ASTM C31/C31M for making test specimens.

### 3.14.2 Testing

#### 3.14.2.1 Slump Tests

ASTM C143/C143M. Take concrete samples during concrete placement/discharge. The maximum slump may be increased as specified with the addition of an approved admixture provided that the water-cementitious material ratio is not exceeded. Perform tests at commencement of concrete placement, when test cylinders are made, and for each batch (minimum) or every 20 cubic yards (maximum) of concrete.

#### 3.14.2.2 Temperature Tests

Test the concrete delivered and the concrete in the forms. Perform tests in hot or cold weather conditions (below 50 degrees F and above 80 degrees F) for each batch (minimum) or every 20 cubic yards (maximum) of concrete, until the specified temperature is obtained, and whenever test cylinders and slump tests are made.

#### 3.14.2.3 Compressive Strength Tests

ASTM C39/C39M. Make six 6 inch by 12 inch test cylinders for each set of tests in accordance with ASTM C31/C31M, ASTM C172/C172M and applicable requirements of ACI 305R and ACI 306R. Take precautions to prevent evaporation and loss of water from the specimen. Test two cylinders at 7 days, two cylinders at 28 days, two cylinders at 56 days and hold two

cylinder in reserve. Take samples for strength tests of each mix design for concrete placed each day not less than once a day, nor less than once for each 100 cubic yards of concrete for the first 500 cubic yards, then every 500 cubic yards thereafter, nor less than once for each 5400 square feet of surface area for slabs or walls. For the entire project, take no less than five sets of samples and perform strength tests for each mix design of concrete placed. Each strength test result must be the average of two cylinders from the same concrete sample tested at 28 days. Concrete compressive tests must meet the requirements of ACI 318 Section 5.6. Retest locations represented by erratic core strengths. Where retest does not meet concrete compressive strength requirements submit a mitigation or remediation plan for review and approval by the contracting officer. Repair core holes with nonshrink grout. Match color and finish of adjacent concrete.

#### 3.14.2.4 Air Content

ASTM C173/C173M or ASTM C231/C231M for normal weight concrete . Test air-entrained concrete for air content at the same frequency as specified for slump tests.

#### 3.14.2.5 Strength of Concrete Structure

The strength of the concrete structure will be considered to be deficient if any of the following conditions are identified:

- a. Failure to meet compressive strength tests as evaluated
- b. Reinforcement not conforming to requirements specified
- c. Concrete which differs from required dimensions or location in such a manner as to reduce strength
- d. Concrete curing and protection of concrete against extremes of temperature during curing, not conforming to requirements specified
- e. Concrete subjected to damaging mechanical disturbances, particularly load stresses, heavy shock, and excessive vibration
- f. Poor workmanship likely to result in deficient strength

Where the strength of the concrete structure is considered deficient submit a mitigation or remediation plan for review and approval by the contracting officer.

#### 3.14.2.6 Non-Conforming Materials

Factors that indicate that there are non-conforming materials include (but not limited to) excessive compressive strength, inadequate compressive strength, excessive slump, excessive voids and honeycombing, concrete delivery records that indicate excessive time between mixing and placement, or excessive water was added to the mixture during delivery and placement. Any of these indicators alone are sufficient reason for the Contracting Officer to request additional sampling and testing.

Investigations into non-conforming materials must be conducted at the Contractor's expense. The Contractor must be responsible for the investigation and must make written recommendations to adequately mitigate or remediate the non-conforming material. The Contracting Officer may

accept, accept with reduced payment, require mitigation, or require removal and replacement of non-conforming material at no additional cost to the Government.

#### 3.14.2.7 Testing Concrete Structure for Strength

When there is evidence that strength of concrete structure in place does not meet specification requirements or there are non-conforming materials, make cores drilled from hardened concrete for compressive strength determination in accordance with ASTM C42/C42M, and as follows:

- a. Take at least three representative cores from each member or area of concrete-in-place that is considered potentially deficient. Location of cores will be determined by the Contracting Officer.
- b. Test cores after moisture conditioning in accordance with ASTM C42/C42M if concrete they represent is more than superficially wet under service.
- c. Air dry cores, (60 to 80 degrees F with relative humidity less than 60 percent) for 7 days before test and test dry if concrete they represent is dry under service conditions.
- d. Strength of cores from each member or area are considered satisfactory if their average is equal to or greater than 85 percent of the 28-day design compressive strength of the class of concrete.

Fill core holes solid with patching mortar and finished to match adjacent concrete surfaces.

Correct concrete work that is found inadequate by core tests in a manner approved by the Contracting Officer.

#### 3.15 REPAIR, REHABILITATION AND REMOVAL

Before the Contracting Officer accepts the structure the Contractor must inspect the structure for cracks, damage and substandard concrete placements that may adversely affect the service life of the structure. A report documenting these defects must be prepared which includes recommendations for repair, removal or remediation must be submitted to the Contracting Officer for approval before any corrective work is accomplished.

##### 3.15.1 Repair of Weak Surfaces

Weak surfaces are defined as mortar-rich, rain-damaged, uncured, or containing exposed voids or deleterious materials. Concrete surfaces with weak surfaces less than 1/4 inch thick must be diamond ground to remove the weak surface. Surfaces containing weak surfaces greater than 1/4 inch thick must be removed and replaced or mitigated in a manner acceptable to the Contracting Officer.

##### 3.15.2 Failure of Quality Assurance Test Results

Proposed mitigation efforts by the Contractor must be approved by the Contracting Officer prior to proceeding.

-- End of Section --



SECTION 03 45 00

PRECAST ARCHITECTURAL CONCRETE

05/16

PART 1 GENERAL

1.1 REFERENCES

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

AMERICAN ASSOCIATION OF STATE HIGHWAY AND TRANSPORTATION OFFICIALS  
(AASHTO)

AASHTO M 251 (2006; R 2011) Standard Specification for  
Plain and Laminated Elastomeric Bridge  
Bearings

AMERICAN CONCRETE INSTITUTE INTERNATIONAL (ACI)

ACI 211.1 (1991; R 2009) Standard Practice for  
Selecting Proportions for Normal,  
Heavyweight and Mass Concrete

ACI 211.2 (1998; R 2004) Standard Practice for  
Selecting Proportions for Structural  
Lightweight Concrete

ACI 214R (2011) Evaluation of Strength Test Results  
of Concrete

ACI 301 (2016) Specifications for Structural  
Concrete

ACI 304R (2000; R 2009) Guide for Measuring,  
Mixing, Transporting, and Placing Concrete

ACI 305R (2010) Guide to Hot Weather Concreting

ACI 306.1 (1990; R 2002) Standard Specification for  
Cold Weather Concreting

ACI 318 (2014; Errata 1-2 2014; Errata 3-5 2015;  
Errata 6 2016; Errata 7-9 2017) Building  
Code Requirements for Structural Concrete  
(ACI 318-14) and Commentary (ACI 318R-14)

ACI SP-66 (2004) ACI Detailing Manual

AMERICAN HARDBOARD ASSOCIATION (AHA)

AHA A135.4 (1995; R 2004) Basic Hardboard

AMERICAN SOCIETY OF CIVIL ENGINEERS (ASCE)

ASCE 7 (2017) Minimum Design Loads for Buildings

and Other Structures

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

ASHRAE 90.1 - IP (2013) Energy Standard for Buildings  
Except Low-Rise Residential Buildings

AMERICAN WELDING SOCIETY (AWS)

AWS D1.1/D1.1M (2015; Errata 1 2015; Errata 2 2016)  
Structural Welding Code - Steel

ASME INTERNATIONAL (ASME)

ASME B18.21.1 (2009; R 2016) Washers: Helical  
Spring-Lock, Tooth Lock, and Plain Washers  
(Inch Series)

ASTM INTERNATIONAL (ASTM)

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

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

ASTM A27/A27M (2017) Standard Specification for Steel  
Castings, Carbon, for General Application

ASTM A283/A283M (2013) Standard Specification for Low and  
Intermediate Tensile Strength Carbon Steel  
Plates

ASTM A36/A36M (2014) Standard Specification for Carbon  
Structural Steel

ASTM A416/A416M (2017) Standard Specification for  
Low-Relaxation, Seven-Wire for  
Prestressed Concrete

ASTM A449 (2014) Standard Specification for Hex Cap  
Screws, Bolts, and Studs, Steel, Heat  
Treated, 120/105/90 ksi Minimum Tensile  
Strength, General Use

ASTM A47/A47M (1999; R 2014) Standard Specification for  
Ferritic Malleable Iron Castings

ASTM A563 (2015) Standard Specification for Carbon  
and Alloy Steel Nuts

ASTM A615/A615M (2016) Standard Specification for Deformed  
and Plain Carbon-Steel Bars for Concrete  
Reinforcement

ASTM C1107/C1107M	(2014a) Standard Specification for Packaged Dry, Hydraulic-Cement Grout (Nonshrink)
ASTM C1218/C1218M	(2017) Standard Test Method for Water-Soluble Chloride in Mortar and Concrete
ASTM C1240	(2014) Standard Specification for Silica Fume Used in Cementitious Mixtures
ASTM C143/C143M	(2015) Standard Test Method for Slump of Hydraulic-Cement Concrete
ASTM C150/C150M	(2017) Standard Specification for Portland Cement
ASTM C1602/C1602M	(2012) Standard Specification for Mixing Water Used in Production of Hydraulic Cement Concrete
ASTM C172/C172M	(2014a) Standard Practice for Sampling Freshly Mixed Concrete
ASTM C231/C231M	(2017a) Standard Test Method for Air Content of Freshly Mixed Concrete by the Pressure Method
ASTM C260/C260M	(2010a; R 2016) Standard Specification for Air-Entraining Admixtures for Concrete
ASTM C31/C31M	(2017) Standard Practice for Making and Curing Concrete Test Specimens in the Field
ASTM C311/C311M	(2013) Sampling and Testing Fly Ash or Natural Pozzolans for Use as a Mineral Admixture in Portland-Cement Concrete
ASTM C33/C33M	(2016) Standard Specification for Concrete Aggregates
ASTM C39/C39M	(2017b) Standard Test Method for Compressive Strength of Cylindrical Concrete Specimens
ASTM C42/C42M	(2013) Standard Test Method for Obtaining and Testing Drilled Cores and Sawed Beams of Concrete
ASTM C494/C494M	(2017) Standard Specification for Chemical Admixtures for Concrete
ASTM C618	(2012a) Standard Specification for Coal Fly Ash and Raw or Calcined Natural Pozzolan for Use in Concrete
ASTM C78/C78M	(2016) Standard Test Method for Flexural Strength of Concrete (Using Simple Beam with Third-Point Loading)

ASTM C94/C94M	(2017a) Standard Specification for Ready-Mixed Concrete
ASTM C989/C989M	(2017) Standard Specification for Slag Cement for Use in Concrete and Mortars
ASTM D1056	(2014) Standard Specification for Flexible Cellular Materials - Sponge or Expanded Rubber
ASTM D1149	(2007; R 2012) Standard Test Method for Rubber Deterioration - Surface Ozone Cracking in a Chamber
ASTM D2240	(2015) Standard Test Method for Rubber Property - Durometer Hardness
ASTM D5759	(2012) Characterization of Coal Fly Ash and Clean Coal Combustion Fly Ash for Potential Uses
ASTM D635	(2014) Standard Test Method for Rate of Burning and/or Extent and Time of Burning of Self-Supporting Plastics in a Horizontal Position
ASTM D746	(2014) Standard Test Method for Brittleness Temperature of Plastics and Elastomers by Impact

PRECAST/PRESTRESSED CONCRETE INSTITUTE (PCI)

PCI MNL-117	(2013) Manual for Quality Control for Plants and Production of Architectural Precast Concrete Products, 3rd Edition
PCI MNL-122	(2007) Architectural Precast Concrete, 3rd Edition

1.2 SUBMITTALS

Government approval is required for submittals with a "G" designation; submittals not having a "G" designation are for information only. When used, a designation following the "G" designation identifies the office that will review the submittal for the Government. Submittals with an "S" are for inclusion in the Sustainability eNotebook, in conformance with Section 01 33 29 SUSTAINABILITY REPORTING. Submit the following in accordance with Section 01 33 00 SUBMITTAL PROCEDURES:

SD-01 Preconstruction Submittals

Pre-Installation Meeting

SD-02 Shop Drawings

Precast Drawings; G

SD-03 Product Data

Cast-In Embedded Items And Connectors; G

Connection Devices; G

Admixtures

Gasket

Bearing Pads

SD-04 Samples

Concrete Wall Panel Surface Finish; G

Mock-up

Full Size Sample Wall Panel

SD-05 Design Data

Design Calculations; G

Contractor-Furnished Mix Design; G

Concrete Mix Design for Repair of Surface Defects; G

Thermal Calculations; G

SD-06 Test Reports

Strength Tests; G

Slump

Air Content

Test for Concrete Materials

Water

Testing Precast Units for Strength

SD-07 Certificates

Manufacturer's Qualifications; G

Fabricator Quality Certifications

Erector Certification

Erector's Post Audit Declaration

SD-08 Manufacturer's Instructions

Installation; G

Cleaning; G

SD-11 Closeout Submittals

Concrete Batch Ticket Information; G

Recycled Content for Fly Ash and Pozzolan; S

Recycled Content for Ground Iron Blast-Furnace Slag; S

Recycled Content for Silica Fume; S

1.3 MODIFICATION OF REFERENCES

In the referenced ACI and PCI publications, consider the advisory provisions to be mandatory. Interpret reference to the "Building Official," the "Structural Engineer," and the "Architect/Engineer" to mean the Contracting Officer.

1.4 GENERAL REQUIREMENTS

Precast concrete units must be designed and fabricated by an experienced and certified precast concrete manufacturer. The manufacturer needs to have been regularly and continuously engaged in the manufacture of precast concrete work similar to that indicated on the drawings for at least 3 years. The Contractor must submit a statement detailing the Manufacturer's Qualifications. Coordinate precast work with the work of other trades.

1.5 DESIGN

1.5.1 Standards and Loads

Precast unit design must conform to ASCE 7, ACI 318 and PCI MNL-122. Indicate design loads for precast concrete on the drawings. A differential temperature of 192 degrees F, between interior and exterior faces of the units, must be considered in the design. Stresses due to restrained volume change caused by shrinkage and temperature differential, handling, transportation and erection must be accounted for in the design.

1.5.2 Connections

Connection of units to other members, or to other units must be of the type and configuration indicated. The design and sizing of connections for all design loads will be completed by the Contractor.

1.5.3 Concrete Proportion

Base the selection of proportions for concrete on the methodology presented in ACI 211.1 for normal weight concrete and ACI 211.2 for lightweight concrete. Develop the concrete proportion using the same type and brand of cement, the same type and gradation of aggregates, and the same type and brand of admixture that will be used in the manufacture of precast concrete units for the project. Do not use calcium chloride in precast concrete and admixtures containing chloride ions, nitrates, or other substances that are corrosive will not be used in prestressed concrete.

1.5.4 Design Calculations

Calculations for design of members, connections and embedments not shown

must be made by a registered professional engineer experienced in the design of precast architectural concrete. Calculation will include the analysis of member for lifting stresses and the sizing of the lifting inserts. Submit calculations for review and approval prior to fabrication, signed and sealed by the registered design professional who prepared the design.

#### 1.5.5 Thermal Calculations

Submit thermal calculations prepared and sealed by a registered professional engineer for review complying with ASHRAE 90.1 - IP, for the steady state thermal resistance for the precast concrete wall panels. Thermal calculations must demonstrate the thermal conductivity of all components, the spacing of all connectors, the percent area of the wall that is solid concrete, and the thermal resistance of all components.

#### 1.6 DELIVERY, STORAGE, AND HANDLING

Deliver packaged materials, except for wall panels, to the project site in the original, unbroken packages or containers, each bearing a label clearly identifying manufacturer's name, brand name, weight or volume, and other pertinent information. Store packaged materials, and materials in containers, in a weathertight and dry place until ready for use.

Store products in manufacturer's unopened packaging in dry storage area, with ambient temperature between 30 degrees F and 120 degrees F, until installation.

#### 1.7 STORAGE AND INSPECTION AT MANUFACTURER'S PLANT

Protect precast units temporarily stored at the manufacturer's plant from damage in accordance with PCI MNL-117 and PCI MNL-122. Immediately prior to shipment to the jobsite, all precast concrete units must be inspected for quality to insure all precast units conform to the requirements specified. Inspection for quality will include, but will not be limited to, the following elements: color, texture, dimensional tolerances, chipping, cracking, staining, warping and honeycombing. Replace or repair all defective precast concrete units as approved.

#### 1.8 PLANT INSPECTION

Precast units must be inspected by the QC representative prior to being transported to the job site. The Contractor is to give notice 14 days prior to the time the units will be available for plant inspection. Neither the exercise nor waiver of inspection at the plant will affect the Government's right to enforce contractual provisions after units are transported or erected.

##### 1.8.1 Fabricator Quality Certifications

Plants must be certified by the PCI Plant Certification Program for Group A, Category A1, or Architectural Precast Association (APA) certification or National Precast Concrete Association (NPCA). When plants are not currently enrolled in one of the three certification programs listed above then they must provide a product quality control system in accordance with PCI MNL-117 and perform concrete and aggregate quality control testing using an approved, independent commercial testing laboratory.

## 1.9 ERECTOR CERTIFICATION

Erector with erecting organization and all erecting crews certified and designated by PCI's Certificate of Compliance to erect Category A (Architectural Systems) for non-load-bearing members.

## 1.10 ERECTOR QUALIFICATIONS

A precast erector that is not certified by PCI who retains a PCI-Certified Field Auditor, at the erector's expense, to conduct a field audit of a project in the same category as this project prior to start of precast concrete erection and must submit the Erector's Post Audit Declaration to be considered qualified.

## 1.11 CONCRETE SAMPLING AND TESTING

### 1.11.1 Test for Concrete Materials

Sample and test concrete materials proposed for use in the work in accordance with PCI MNL-117.

Submit reports for each material sampled and tested prior to the start of work. Reports must contain the project name and number, date, name of Contractor, name of precast unit manufacturer, name of concrete testing service, source of concrete aggregates, generic name of aggregate, and values specified.

### 1.11.2 Quality Control Testing During Fabrication

Sample and test concrete for quality control during fabrication as follows:

<u>REQUIREMENT</u>	<u>TEST METHOD</u>	<u>NUMBER OF TESTS</u>
Sampling fresh concrete	ASTM C172/C172M except modified for slump per ASTM C94/C94M	As required for each test
Slump test	ASTM C143/C143M	One for each concrete load at point of discharge and one for each set of compressive strength tests
Air Content by pressure method	ASTM C231/C231M	One for each set of compressive strength tests



<u>REQUIREMENT</u>	<u>TEST METHOD</u>	<u>NUMBER OF TESTS</u>
Compressive test specimens	ASTM C31/C31M	One set of six specimens for each Compressive Strength test, one set per day or for every 20 cubic yards of concrete placed, whichever is greater.

Compression test specimens may be either standard 6 by 12 inch cylinders or 4-inch cubes. Cubes may be molded individually or cut from slabs. Preparation and testing of cube specimens must be as nearly consistent with the test methods specified as possible, with the exception that the concrete will be placed in a single layer.

Curing of compression test specimens must be the same as the curing method used for the precast concrete wall panels until panels are stripped of forms and then standard moist cure will continue.

<u>REQUIREMENT</u>	<u>TEST METHOD</u>	<u>NUMBER OF TESTS</u>
Concrete temperature		Each time a set of compression test specimens is made
Compressive strength tests	ASTM C39/C39M	One set of facing strength tests mix and one set of backing mix for every ten panels or fraction thereof cast in any one day; two specimens in each set tested at 7 calendar days; three specimens in each set tested at 28 calendar days, and one specimen in each set retained in reserve for testing if required

Evaluate compression test results at 28 days in accordance with ACI 214R using a coefficient of variation of 20 percent. Evaluate the strength of concrete by averaging the test results (two specimens) of standard cylinders tested at 28 days. Not more than 20 percent of the individual tests can have an average compressive strength less than the specified ultimate compressive strength. Submit test reports on the same day that tests are made.

Reports for Compressive Strength tests need to contain the project name and number, date of concrete placement, name of Contractor, name of precast concrete wall panel manufacturer, name of concrete testing service, panel identification letter and number, use of concrete mixture

(facing or backing), design compressive strength at 28 calendar days, concrete-mix proportions and materials, and compressive breaking strength and type of break.

If 4-inch cubes are used for compressive strength specimens, average strength of the cubes at any test age must be multiplied by the factor of 0.8 to arrive at an estimate of the corresponding 6 by 12 inch cylinder strength. Report both of these values .

#### 1.12 QUALITY ASSURANCE

##### 1.12.1 Precast Drawings

Submit precast drawings with the following information:

- a. Precast dimensions, cross-section, and edge details; location, size, and type of reinforcement, including reinforcement necessary for safe handling and erection of precast units and other embedded items. Comply with ACI SP-66.
- b. Layout, dimensions, and identification of each precast unit, corresponding to installation sequence.
- c. Setting drawings, instructions, and directions for installation of concrete inserts.
- d. Location and details of anchorage devices and lifting devices embedded in panels, and connection details to building framing system.
- e. Location of embedded brick work including joint locations, joint widths, brick coursing, brick coursing alignment across panel joints and reveal and false-joint locations and dimensions.

##### 1.12.2 Concrete Wall Panel Surface Finish Sample

Submit a concrete wall panel sample 12 inches by 12 inches by approximately 1 1/2 inches in thickness, to illustrate quality, color, and texture of both exposed-to-view surface finish and finish of panel surfaces that will be concealed by other construction. Obtain approval prior to submission of sample panels.

After approval of the surface, Contractor must provide one full size sample Wall Panel. Approved sample may be used in construction when properly identified.

##### 1.12.3 Required Records

ASTM C94/C94M. Submit mandatory batch ticket information for each load of ready-mixed concrete.

##### 1.12.4 Mock-Up

Provide mock-up to establish that proposed materials and construction techniques provide acceptable visual effect. Materials used for mock-up should be those proposed for actual construction. Include all anchors, connections, flashing and joint fillers. Apply specified products to determine acceptability of appearance and optimum coverage rate required for application

Provide mock-up sections of building and structures which typify the most difficult areas to build.

1. Finish areas designated by Contracting Officer.
2. Apply water repellent in accordance with manufacturer's instructions.
3. After materials have cured, water test surface to determine that sufficient water repellent has been applied.
4. Do not proceed with remaining work until workmanship, color, and detail are approved by Contracting Officer.
5. Modify mock-up area as required to produce acceptable work.

Job Mock Up Panel: Minimum 4 feet by 4 feet

1. Incorporate edge, and reveal detail as shown on drawings.
3. Show clean, pressure washed concrete surface.
4. Utilize full range of color of concrete mortar joints.
5. Maintain Mock Up for comparison with finished work.

After approval by Contracting Officer, transport mock-up to job-site and erect where directed by Contracting Officer.

#### 1.12.5 Pre-Installation Meeting

Hold a meeting at the job site with representative of the manufacturer and all other trades that may be effected by work of this section. Notify the Contracting Officer at least 3 days in advance of the time of the meeting.

#### 1.13 TOLERANCES

Dimensions of the finished panel, at the time of erection in the structure, must conform to the tolerances for precast, non-prestressed elements in PCI MNL-117, unless otherwise specified by the Architect.

### PART 2 PRODUCTS

#### 2.1 CONCRETE

##### 2.1.1 Contractor-Furnished Mix Design

ACI 211.1 and ACI 301. The Contractor must submit the mix design report giving the maximum nominal coarse aggregate size, the proportions of all ingredients and the type and amount of any admixtures that will be used in the manufacture of each strength and type of concrete, a minimum of sixty days prior to commencing operations. Provide mix proportion data using at least three different water-cementitious material ratios for each type of mixture, which produce a range of strength encompassing those required for each type of concrete required. Plot a curve for each concrete mixture, showing the relationships between water-cementitious material ratios and compressive strengths. Maximum permissible water-cementitious material ratio must be that value not exceeding the maximum water-cementitious material ratio specified, indicated by the curve to produce a design minimum laboratory compressive strength at 28 calendar days not less than that specified. The mix design report is to contain the project name and number, date, name of Contractor, name of precast concrete wall panel manufacturer, name of concrete testing service, use of concrete mixture (facing or backing), source of concrete aggregates for each mixture. Submit certified copies of laboratory test reports, including mill tests

and all other test data, for portland cement, blended cement, pozzolan, ground granulated blast furnace slag, silica fume, and aggregates. The statement must be accompanied by test results from an approved testing laboratory, certifying that the proportions selected will produce concrete of the properties required. Make no substitutions without additional tests to verify that the concrete properties are satisfactory. Concrete must have a 28-day compressive strength of 4000 psi. Air content of plastic concrete must be between 4 and 6 percent air by volume.

If, the compressive strength falls below that specified, adjust the mix proportions and water content and make necessary changes in the temperature, moisture, and curing procedures to secure the specified strength. Notify the Contracting Officer of all changes.

#### 2.1.2 Exposed-to-View Facing Mixture

Provide aggregates for exposed-to-view facing mixture; white, gray, or buff portland cement or a blend of two or more portland cements; air-entraining admixture; and water. Provide exact proportions of facing mixture to produce concrete having the specified properties and capable of obtaining the approved surface color and finish.

#### 2.1.3 Backing Mixture

Provide the approved mix design.

### 2.2 MATERIALS

#### 2.2.1 Material Sustainability Criteria

For products in this section, where applicable and to extent allowed by performance criteria, provide and document the following in accordance with Section 01 33 29 SUSTAINABILITY REQUIREMENTS:

- a. Recycled content for fly ash and pozzolan
- b. Recycled content for Ground Iron Blast-Furnace Slag
- c. Recycled content for Silica Fume

#### 2.2.2 Fine Aggregates

ASTM C33/C33M. The optional method of reducing the No. 50 and No. 100 sieve aggregates does not apply. The restriction to use only fine aggregates that do not contain any materials that are deleteriously reactive with alkalis in cement does apply.

#### 2.2.3 Coarse Aggregate

ASTM C33/C33M, Size No. 57 , Class 5S. The restriction to use only coarse aggregates that do not contain any materials that are deleteriously reactive with alkalis in cement does apply. Aggregate must not contain slag or crushed concrete.

#### 2.2.4 Cementitious Materials

For exposed concrete, use one manufacturer and one source for each type of cement, ground slag, fly ash, and pozzolan.

##### 2.2.4.1 Fly Ash

ASTM C618, Class F, except that the maximum allowable loss on ignition

must not exceed 3 percent. Class F fly ash for use in mitigating Alkali-Silica Reactivity must have a Calcium Oxide (CaO) content of less than 8 percent and a total equivalent alkali content less than 1.5 percent.

Add with cement. Fly ash content must be a minimum of 15 percent by weight of cementitious material, provided the fly ash does not reduce the amount of cement in the concrete mix below the minimum requirements of local building codes. Where the use of fly ash cannot meet the minimum level, provide the maximum fly ash of 25 percent by weight of cementitious material. Report the chemical analysis of the fly ash in accordance with ASTM C311/C311M. Evaluate and classify fly ash in accordance with ASTM D5759.

#### 2.2.4.2 Raw or Calcined Natural Pozzolan

Natural pozzolan must be raw or calcined and conform to ASTM C618, Class N, including the optional requirements for uniformity and effectiveness in controlling Alkali-Silica reaction and must have an ignition loss not exceeding 3 percent. Class N pozzolan for use in mitigating Alkali-Silica Reactivity must have a Calcium Oxide (CaO) content of less than 13 percent and total equivalent alkali content less than 3 percent.

#### 2.2.4.3 Ultra Fine Fly Ash and Ultra Fine Pozzolan

Ultra Fine Fly Ash (UFFA) and Ultra Fine Pozzolan (UFP) must conform to ASTM C618, Class F or N, and the following additional requirements:

- a. The strength activity index at 28 days of age must be at least 95 percent of the control specimens.
- b. The average particle size must not exceed 6 microns.
- c. The sum of  $\text{SiO}_2 + \text{Al}_2\text{O}_3 + \text{Fe}_2\text{O}_3$  must be greater than 77 percent.

#### 2.2.4.4 Ground Granulated Blast-Furnace Slag

ASTM C989/C989M, Grade 100. Slag content must be a minimum of 25 percent by weight of cementitious material.

#### 2.2.4.5 Silica Fume

Silica fume must conform to ASTM C1240, including the optional limits on reactivity with cement alkalis. Silica fume may be furnished as a dry, densified material or as slurry. Proper mixing is essential to accomplish proper distribution of the silica fume and avoid agglomerated silica fume which can react with the alkali in the cement resulting in premature and extensive concrete damage. Supervision at the batch plant, finishing, and curing is essential. Provide at the Contractor's expense the services of a manufacturer's technical representative, experienced in mixing, proportioning, placement procedures, and curing of concrete containing silica fume. This representative must be present on the project prior to and during at least the first 4 days of concrete production and placement using silica fume. A High Range Water Reducer (HRWR) must be used with silica fume.

#### 2.2.4.6 Portland Cement

Provide cement that conforms to ASTM C150/C150M, Type I, with tri-calcium aluminates (C3A) content less than 10 percent and a maximum cement-alkali

content of 0.80 percent Na<sub>2</sub>O<sub>e</sub> (sodium oxide) equivalent. Use one brand and type of cement for formed concrete having exposed-to-view finished surfaces.

#### 2.2.5 Admixtures

ASTM C260/C260M for air-entraining admixtures. Other admixtures: ASTM C494/C494M. Certify that admixtures are free of chlorides.

#### 2.2.6 Water

Water must comply with the requirements of ASTM C1602/C1602M. Minimize the amount of water in the mix. Improve workability by adjusting the grading rather than by adding water. Water must be potable; free from injurious amounts of oils, acids, alkalis, salts, organic materials, or other substances deleterious to concrete. Submit test report showing water complies with ASTM C1602/C1602M.

#### 2.2.7 Reinforcement

All exposed steel must be phosphate treated, primed, and coated to prevent rust.

##### 2.2.7.1 Reinforcing Bars

ACI 301 unless otherwise specified. ASTM A615/A615M, Grade 60.

##### 2.2.7.2 Welded Wire Reinforcement

ASTM A1064/A1064M.

##### 2.2.7.3 Supports for Concrete Reinforcement

Include bolsters, chairs, spacers, and other devices necessary for proper spacing, supporting, and fastening in place in accordance with PCI MNL-117.

#### 2.2.8 Prestressing Strands

Prestressing strands need to conform to ASTM A416/A416M Grade 270.

#### 2.2.9 Tie Wire

Tie wire must be soft monel or 18-8 stainless steel.

#### 2.2.10 Plates, Angles, Anchors and Embedment

ASTM A36/A36M, ferrous metal plate connectors for attachment to the structural framing using manufacturer standard construction procedures. Headed studs will use 60,000 psi steel with construction conforming to AWS D1.1/D1.1M, Type B. Deformed bar anchors must conform to ASTM A1064/A1064M. Coat steel items, other than stainless, with a rust-inhibiting paint or provide hot-dip galvanized after fabrication in accordance with ASTM A153/A153M.

Furnish and install anchors, inserts, lifting devices, and other accessories which are to be embedded in the precast units in accordance with the approved detail drawings. Embedded items must be accurately positioned in their designed location, and have sufficient anchorage and embedment to satisfy design requirements.

#### 2.2.11 Form Release Agent

Release agent must be manufacturer's standard non-staining type.

#### 2.2.12 Grout

Packaged, nonmetallic, noncorrosive, nonstaining grout containing selected silica sands, portland cement, shrinkage-compensating agents, plasticizing and water-reducing agents, complying with ASTM C1107/C1107M, Grade A for drypack and Grades B and C for flowable grout and of consistency suitable for application within a 30-minute working time. Water-soluble chloride ion content less than 0.06 percent by weight of cement when tested according to ASTM C1218/C1218M.

### 2.3 CAST-IN EMBEDDED ITEMS AND CONNECTORS

#### 2.3.1 Inserts

##### 2.3.1.1 Threaded-Type Concrete Inserts

ASTM A47/A47M, Grade 32510 or 35018, or may be medium strength cast steel conforming to ASTM A27/A27M, Grade U-60-30. Provide galvanized ferrous casting having enlarged base with two nailing lugs minimum length less than the thickness of panel less 3/4 inch, and internally threaded to receive 3/4 inch diameter machine bolt. Ferrous castings must be ferritic malleable iron. Provide inserts hot-dip galvanized after fabrication in accordance with ASTM A153/A153M.

##### 2.3.1.2 Wedge-Type Concrete Inserts

Provide galvanized, box-type ferrous castings with integral anchor loop at back of box to accept 3/4 inch diameter bolts having special wedge-shaped head. Provide inserts hot-dip galvanized after fabrication in accordance with ASTM A153/A153M.

##### 2.3.1.3 Slotted-Type Concrete Inserts

Provide pressed steel plate, welded construction, box type with slot to receive 3/4 inch diameter square head bolt, and provide lateral adjustment of bolt. Length of insert body, less anchorage lugs, must be 4 1/2 inches minimum. Provide insert with knockout cover. Steel plate must be 1/8 inch minimum thickness, ASTM A283/A283M, Grade C. Provide inserts hot-dip galvanized after fabrication in accordance with ASTM A153/A153M.

#### 2.3.2 Connection Devices

##### 2.3.2.1 Clip Angles

ASTM A36/A36M steel, galvanized after fabrication in accordance with ASTM A153/A153M.

##### 2.3.2.2 Ferrous Casting Clamps

ASTM A47/A47M, Grade 32510 or Grade 35018 malleable iron or cast steel, or ASTM A27/A27M, Grade 60-30, cast steel casting, hot-dip galvanized in accordance with ASTM A153/A153M.

#### 2.3.2.3 Threaded Fasteners

Provide galvanized machine bolts, washers and, when required, nuts.

- a. Bolts: ASTM A449, 3/4 inch diameter machine bolts with hexagon head.
- b. Washers: ASME B18.21.1, medium or heavy lock-spring washers.
- c. Nuts: ASTM A563, Grade C, heavy, hexagon-type nuts.
- d. Square Nuts: ASTM A563, Grade A, plain, square-type nuts where required for slotted-type concrete inserts.

#### 2.4 PRECAST ELEMENT FABRICATION

##### 2.4.1 Formwork and Fabrication Tolerances

Provide forms and form-facing materials of wood, metal, plastic, or other approved material to produce concrete having the specified finish. Construct forms mortar-tight and of sufficient strength to withstand all pressures due to concrete placing operations and temperature changes. Brace and stiffen against deformation. Provide form liners where required to produce indicated finish. Provide dimensional tolerances per PCI MNL-117.

##### 2.4.2 Reinforcement

ACI 301. Place reinforcing bars and welded wire reinforcement. Secure in position with tie wires, bar supports, and spacers.

##### 2.4.3 Preparation for Placing Concrete

Remove hardened concrete, excess form parting compound, standing water, ice, snow, or other deleterious substances from form interiors and reinforcement before concrete placement. Secure reinforcement and embedded items.

##### 2.4.4 Concrete Mixing and Conveying

###### 2.4.4.1 Batch Plant, Mixer, Mixing, and Measuring of Materials

ASTM C94/C94M.

###### 2.4.4.2 Conveying

Prevent segregation and loss of materials.

##### 2.4.5 Concrete Placing

ACI 304R. Deposit concrete in the forms continuously or in layers of such thickness that no concrete will be placed on concrete which has hardened sufficiently to cause formation of seams or planes of weakness within the precast concrete units. Place concrete at a constant temperature of between 50 and 90 degrees F throughout fabrication of each unit. Make temperature of forms or molds the same as or close to the concrete temperature. For hot or cold weather, use methods recommended by ACI 305R and ACI 306.1. Vibrate and consolidate concrete to prevent segregation and to produce a high-density concrete free of honeycomb and rock



pockets. When specified, the exposed-to-view facing mixture is required to be a minimum thickness of 3/4 inches. Place backing mixture before facing mixture attains initial set.

#### 2.4.6 Identification Markings

Permanently mark each precast unit to indicate pick-up points, location, orientation in the building, and date of casting. Identification markings need to correlate with approved detail drawings. Do not locate in exposed-to-view finished surfaces.

#### 2.4.7 Finishing

##### 2.4.7.1 Unformed Concealed Surfaces (Standard Smooth Finish)

Provide a trowel finish. Level surface with a straightedge, and strike off. After surface water has disappeared, float and trowel surface. Provide smooth finished surface, free of trowel marks, and uniform in texture and appearance.

##### 2.4.7.2 Smooth, Exposed-to-View Surfaces

Provide a standard smooth finish to all exposed-to-view surfaces of panels, unless otherwise indicated. Provide a concrete surface having the texture imparted by a steel form or other approved smooth surfaces form-facing material.

##### 2.4.7.3 Other Surfaces

Surfaces of precast units not exposed to view or not otherwise indicated to be finished are to be finished in accordance with ACI 301 for a Surface Finish of 1.0.

#### 2.4.8 Curing

Provide moist or steam curing or curing compound. Do not remove precast units from forms; prevent moisture loss and maintain 50 degrees F minimum for at least 24 hours after finishing. Maintain precast units in a surface damp condition at 50 degrees F minimum until concrete has attained 75 percent minimum of the design compressive strength..

#### 2.4.9 Repair of Surface Defects

Cut out defective areas to solid concrete, with edges of cuts perpendicular to the surface of the concrete, and clean thoroughly. Dampen area to be patched and brush-coat with nonshrink grout or bonding agent. Patch the surface in accordance with procedures previously submitted by the Contractor and approved by the Contracting Officer. Where exposed to view, the patches, when dry, needs to be indistinguishable from the surrounding surfaces.

##### 2.4.9.1 Smooth, Concealed Surfaces

Acceptable defective area will be limited to holes left by rods and other temporary inserts, and to honeycomb or rock pockets of 1/4 inch diameter maximum. Remove fins and other projections on the surfaces.

#### 2.4.9.2 Exposed-to-View Surfaces

The combined area of acceptable defective areas must not exceed 0.2 percent of the exposed-to-view surface area and will be limited to holes of 1/4 inch diameter maximum.

#### 2.4.10 Stripping

Do not remove precast concrete units from forms until units develop sufficient strength to safely strip the formwork and to remove the precast concrete units from the forms to prevent damage to the units from overstress or chipping.

#### 2.4.11 Built-In Anchorage Devices

Accurately position and securely anchor all anchorage devices. Openings in anchorage devices must be filled temporarily to prevent entry of concrete.

#### 2.4.12 Lifting Devices

Lifting devices must be provided, and designed for a safety factor of 4, which includes 100 percent impact. Do not use brittle material.

#### 2.4.13 Finishing for Formed Surfaces

Upon removal of forms, repair and patch defective areas. Where the finished surface will be exposed to view, the combined area of defective areas must not exceed 0.2 percent of the surface and will be limited to honeycomb or rock pockets not deep enough to expose the reinforcement. Where the finished surface will be concealed by other construction, defective areas are limited to holes left by the rods and other temporary inserts and honeycomb or rock pockets not deep enough to expose the reinforcement. Defective areas must be cut out to solid concrete, cleaned, and patched with grout. Where concrete surface will be exposed to view, the patches, when dry, must be indistinguishable from the surrounding surfaces.

### 2.5 JOINT MATERIALS

Gasket must be elastomeric material, premolded to cross section indicated.

Material must be a vulcanized closed-cell expanded chloroprene conforming to ASTM D1056, Grade No. 2A2, with the following additional properties:

Brittleness temperature will be minus 40 degrees F when tested in accordance with ASTM D746.

Flammability resistance needs to be self-extinguishing when tested in accordance with ASTM D635.

Resistance to ozone must be "no cracks" after exposure of a sample, at 20 percent elongation, to an ozone concentration of 100 parts per million of air by volume in air for 100 hours at 104 degrees F when tested in accordance with ASTM D1149.

### 2.6 BEARING PADS

Submit product data for all bearing pads being used.

#### 2.6.1 Elastomeric

AASHTO M 251, for plain neoprene bearings.

#### 2.6.2 Hardboard (Interior Only)

AHA A135.4, class as specified by the precast manufacturer.

#### 2.6.3 Random-Oriented, Fiber-Reinforced Elastomeric Pads

Preformed, randomly oriented synthetic fibers set in elastomer. Surface hardness of 70 to 90 Shore A durometer according to ASTM D2240. Capable of supporting a compressive stress of 3000 psi with no cracking, splitting or delaminating in the internal portion of the pad.

#### 2.6.4 Cotton-Duck-Fabric-Reinforced Elastomeric Pads

Preformed, horizontally layered cotton-duck fabric bonded to an elastomer. Surface hardness of 80 to 100 Shore A durometer according to ASTM D2240. Conforming to Division II, Section 18.10.2 of AASHTO LRFD Bridge Design Specifications or Military Specification MIL-C-882E.

#### 2.6.5 Frictionless Pads

Polytetrafluoroethylene (PTFE), glass-fiber reinforced, bonded to stainless or mild-steel plates, or random-oriented, fiber-reinforced elastomeric pads, of type required for in-service stress.

#### 2.6.6 Sub Title

Multimonomer, nonleaching, plastic strip capable of supporting loads with no visible overall expansion.

### PART 3 EXECUTION

#### 3.1 PREPARATION

Deliver anchorage devices to the site in time to be installed before the start of concrete placing or during steel erection. Contractor must provide setting drawings, instructions, and directions for the installation of anchorage devices.

#### 3.2 EXAMINATION

Do not begin installation until supporting structures have been properly prepared.

Verify that all parts of the supporting structure are complete and ready to receive the precast units and that site conditions are conducive to proper installation.

If support structure is the responsibility of another installer, notify Contracting Officer of unsatisfactory preparation before proceeding.

#### 3.3 INSTALLATION

Install precast concrete units and accessories in accordance with approved detail drawings and descriptive data, and as specified below.

### 3.3.1 Building Framing System

Provide supporting members, including anchorage items attached to or embedded in building structural elements, prior to placement of precast units.

### 3.3.2 Concrete Strength at Time of Precast Unit Installation

Do not install precast units until concrete has attained the minimum laboratory compressive strength at 28 calendar days specified.

Do not install precast units before 28 calendar days from the date of casting unless approval has been obtained to make one compressive strength test, ASTM C39/C39M, and one flexural strength test using simple beam with third-point loading, ASTM C78/C78M, on field cured concrete test specimens, ASTM C31/C31M, for each individual precast unit to determine the strength of the concrete.

### 3.3.3 Erection

rect precast units in accordance with the detail drawings and without damage to other units or to adjacent members. Set units true to alignment and level, with joints properly spaced and aligned both vertically and horizontally. Erection tolerances must be in accordance with the requirements of PCI MNL-117 and PCI MNL-122. As units are being erected, shims and wedges will be placed as required to maintain correct alignment. After final attachment, grout precast units as shown. After erection, clean and touch-up welds and abraded surfaces of steel with a zinc-rich paint. Welds must be made by a certified welder in accordance with the manufacturer's erection drawings. Finish pickup points, boxouts, inserts, and similar items to match adjacent areas after erection. Erection of precast units must be supervised and performed by workmen skilled in this type of work. Welding and the qualifications of welders must be in accordance with AWS D1.1/D1.1M.

### 3.3.4 Erection Tolerances

Erect architectural precast concrete units level, plumb, square and in alignment without exceeding the noncumulative erection tolerances of PCI MNL-117, Appendix I.

### 3.3.5 Joints

Joint widths between precast units will be as specified unless otherwise indicated.

#### 3.3.5.1 Joint Sealing

Joint sealing will be as specified in Section 07 92 00 JOINT SEALANTS.

### 3.3.6 Protection

Protect exposed-to-view facing from staining and other damage from subsequent operations. Do not allow laitance to penetrate, stain, or harden on exposed surfaces.

### 3.4 DEFECTIVE WORK

Repair precast concrete units damaged during erection as soon after occurrence as possible or replaced, as directed, using approved procedures. All repairs to precast concrete units must match the adjacent surfaces in color and texture, as approved. Unless otherwise approved, repair procedures will conform to PCI MNL-117.

### 3.5 JOINTS AND GASKETS

Joints between precast units must be the width indicated and within limits of installation tolerances.

Install gaskets in joints as indicated, continuous throughout the joint length, and compressed at least 25 percent by volume.

### 3.6 INSPECTION AND ACCEPTANCE PROVISIONS

#### 3.6.1 Dimensional Tolerances

Precast units having dimensions outside the limits for fabrication tolerances will be rejected.

#### 3.6.2 Surface Finish Requirements

Precast units will be rejected for the following surface finish deficiencies:

Exposed-to-view surfaces that do not match the color, aggregate size and distribution, and texture of the approved sample

Exposed-to-view surfaces that contain defects that affect the appearance of the finish, such as cracks, spalls, honeycomb, rock pockets, or stains and discoloration of aggregate or matrix that cannot be removed by cleaning

Concealed surfaces that contain cracks in excess of 0.01 inch wide, cracks that penetrate to the reinforcement regardless of width, honeycomb, rock pockets, and spalls except minor breakage at corners and edges

#### 3.6.3 Strength of Precast Units

Strength of precast concrete units will be considered potentially deficient if the units fail to comply with the requirements that control the strength of the units, including the following conditions:

Failure to meet compressive strength tests

Reinforcement not conforming to the requirements specified

Concrete curing and protection of precast units against extremes of temperature during curing not conforming to the requirements specified

Precast units damaged during handling and erection

#### 3.6.4 Testing Precast Units for Strength

When there is evidence that the strength of precast concrete units does

not meet specification requirements, cores drilled from hardened concrete for compressive strength determination must be made in accordance with ASTM C42/C42M and as follows:

Take at least three representative cores from the precast-concrete units that are considered potentially deficient.

Test cores with the saturated surface dry.

Strength of cores will be considered satisfactory if their average is equal to or greater than 90 percent of the 28-day design compressive strength of 6 by 12 inch cylinders.

Submit test reports on the same day that tests are made. Reports must contain the project name and number, date, name of contractor, name of precast concrete wall units manufacturer, name of concrete-testing service, identification letter and number of units represented by core tests, nominal maximum size of aggregate, design compressive strength of concrete at 28 calendar days, compressive breaking strength and type of break, length of core test specimen before capping, compressive strength after correcting for length diameter ratio, direction of application of the load on the core test specimen with respect to the horizontal plane of the concrete as placed, and the moisture condition of the core test specimen at time of testing.

If the results of the core tests are unsatisfactory or if core tests are impractical to obtain, a static load tests of a precast unit will be evaluated in accordance with ACI 318.

Replace precast units used for core tests or static load tests with units that meet the requirements of this section.

### 3.7 SAMPLING AND TESTING

#### 3.7.1 Rejection

Precast units in place may be rejected for any one of the following product defects or installation deficiencies remaining after repairs and cleaning have been accomplished. "Visible" means visible to a person with normal eyesight when viewed from a distance of 20 feet in broad daylight.

- a. Nonconformance to specified tolerances.
- b. Air voids (bugholes or blowholes) larger than 3/8 inch diameter.
- c. Visible casting lines.
- d. Visible from joints.
- e. Visible irregularities.
- f. Visible stains on precast unit surfaces.
- g. Visible differences between precast unit and approved sample.
- h. Visible non-uniformity of textures or color.
- i. Visible areas of backup concrete bleeding through the facing concrete.

- j. Visible foreign material embedded in the face.
- k. Visible repairs.
- l. Visible reinforcement shadow lines.
- m. Visible cracks.
- n. Precast units that are damaged during construction operations.

### 3.7.2 Field Quality Control

Perform field inspection of precast unit connections. Notify the Contracting Officer in writing of defective welds, bolts, nuts and washers within 7 working days of the date of inspection. All defective connections or welds are to be removed and re-welded or repaired as required by the Contracting Officer.

#### 3.7.2.1 Welded Connection Visual Inspection

AWS D1.1/D1.1M, furnish the services of AWS-certified welding inspector for erection inspections. Welding inspector must visually inspect all welds and identify all defective welds.

### 3.8 CLEANING

Clean exposed-to-view surfaces of precast units thoroughly with detergent and water; use a brush to remove foreign matter. Remove stains that remain after washing in accordance with recommendations of the precast manufacturer. Surfaces must be clean and uniform in color. Include precast concrete wall panel manufacturer's written recommendations for installation and cleaning.

-- End of Section --





SECTION 03 53 14.00 20

LIGHT REFLECTIVE NONFERROUS METALLIC AGGREGATE FLOOR SYSTEM  
**02/10**

PART 1 GENERAL

1.1 REFERENCES

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

AMERICAN CONCRETE INSTITUTE INTERNATIONAL (ACI)

ACI 305R	(2010) Guide to Hot Weather Concreting
ACI 308.1	(2011) Specification for Curing Concrete
ACI 308R	(2016) Guide to Curing Concrete

ASTM INTERNATIONAL (ASTM)

ASTM C1315	(2011) Standard Specification for Liquid Membrane-Forming Compounds Having Special Properties for Curing and Sealing Concrete
ASTM C309	(2011) Standard Specification for Liquid Membrane-Forming Compounds for Curing Concrete
ASTM C779/C779M	(2012) Abrasion Resistance of Horizontal Concrete Surfaces
ASTM C944/C944M	(2012) Standard Test Method for Abrasion Resistance of Concrete or Mortar Surfaces by the Rotating-Cutter Method

1.2 SUBMITTALS

Government approval is required for submittals with a "G" designation; submittals not having a "G" designation are for information only. When used, a designation following the "G" designation identifies the office that will review the submittal for the Government. Submittals with an "S" are for inclusion in the Sustainability eNotebook, in conformance to Section 01 33 29 SUSTAINABILITY REPORTING. Submit the following in accordance with Section 01 33 00 SUBMITTAL PROCEDURES:

SD-03 Product Data

Non-oxidizing metallic aggregate surface hardener; G

SD-04 Samples

Sample installation

Material sample

SD-07 Certificates

Statement of alternates; G

1.2.1 Sample Installation

A minimum of 100 square feet of the hangar floor slab shall be finished in a location as directed by the Contracting Officer. Color, texture and installation procedures are of prime importance. After approval by the Contracting Officer, the Contractor shall maintain the same controls and procedures throughout the installation process. Before acceptance, all work will be compared to the sample area.

1.2.2 Material Sample

Samples of materials, color, and finish type shall be submitted to the Contracting Officer for approval.

1.2.3 Alternates

Submittals for an alternate product shall contain the following from an independent laboratory. Unit weight, abrasion resistance test in accordance with ASTM C944/C944M and ASTM C779/C779M. Any product submitted, whose warranty contains a disclaimer limiting liability to the purchase price of the material, will be disqualified.

1.3 DELIVERY AND STORAGE

Product shall be delivered in sealed moisture resistant packages. Protect packages from damage. Store in an enclosed area. Contractor shall replace damaged packages with new packages. Manufacturer's information regarding date of manufacture, shelf life and date of purchase shall be provided no later than the date delivered on site. Products shall be identifiable by lot numbers.

1.4 WARRANTY

The manufacturer shall provide a standard warranty stating that the material is free of defects and that when used by competent persons in accordance with current published recommendations, the product will perform as specified herein. The manufacturer's standard warranty shall not contain any disclaimers, limiting their responsibility to the purchase price of the material. The manufacturer shall state in the warranty that they shall be willing to contribute to replacing defective materials, as determined by accepted test methods.

1.5 QUALITY CONTROL

The Contractor shall hold a meeting to review the detailed requirements for the floor, including the concrete mix design, placing techniques, finishing techniques including surface levelness, floor hardener application procedures, curing and the equipment required for these procedures.

The pre-slab meeting agenda shall be prepared by the Contractor and submitted to the attendees at least one week in advance of the meeting.

All parties involved in the floor system installation shall be required to attend. The Architect-Engineer's representative and the manufacturer's

technical representative shall be present at the conference. The Contractor shall notify both at least 10 days prior to the scheduled date of the conference.

Minutes of the meeting shall be recorded, typed and printed by the Contractor and distributed by him to all parties concerned within five days of the meeting.

## PART 2 PRODUCTS

### 2.1 CONCRETE

Concrete materials shall be as specified in Section 03 30 00 CAST-IN-PLACE CONCRETE, in addition to items required by this section and the following:

The concrete mix, including admixtures and plasticizers, shall be in strict compliance with the aggregate surface hardener manufacturer's recommendations and shall be approved by the Contracting Officer and the manufacturer's technical representative prior to the placement of concrete.

### 2.2 NON-FERROUS, NON-OXIDIZING METALLIC AGGREGATE, DRY-SHAKE SURFACE HARDENER

The surface hardener system shall consist of specially processed, non-ferrous, malleable, non-oxidizing, metallic aggregates, specially graded cementitious binder, plasticizer, and water-reducing admixtures, formulated and processed under the stringent quality control of the manufacturer. "Lumiplate" as manufactured by ChemRex, a subsidiary of Master Builder Technologies and "Diamond Plate" as manufactured by The Euclid Chemical Company comply with these specifications. The hardener shall be proportioned and sealed in standard moisture-resistant bags. The manufacturer shall guarantee their aggregate to be free of rust, corrosive materials, oil, petroleum, or other water-base materials, when delivered. The manufacturer shall replace any material found to contain any such materials, or any other material which is deemed unsatisfactory. The manufacturer shall provide a full-time technical representative, qualified in designing and adjusting concrete mixes, to assist in the application of the aggregate surface hardener system.

### 2.3 SURFACE EVAPORATION RETARDANT

A mono molecular surface evaporation retardant film, as recommended by ACI 305R and ACI 308R, shall be provided for use under drying conditions, due to high concrete and/or ambient temperatures, low humidity, high winds, and so forth. This includes work in heated interiors during cold weather, to aid in the maintaining of concrete moisture during the early placement stages of plastic concrete. Retarder shall be certified by the manufacturer to be compatible with the surface hardener and shall be provided in accordance with the manufacturer's recommendations.

### 2.4 CURING AND SEALING

Curing and sealing materials and procedures shall be as recommended by the manufacturer of the aggregate surface hardener system and shall comply with ASTM C309 or ASTM C1315.

### PART 3 EXECUTION

#### 3.1 CONCRETE PLACEMENT

For concrete placement, refer to Section 03 30 00 CAST-IN-PLACE CONCRETE in addition to items required by this section and the following:

- a. Maximum slump shall be 5 inches, when peak ambient temperatures are anticipated to be in excess of 65 degrees Fahrenheit, and shall be no greater than 4 inches, when such temperatures are below 85 degrees Fahrenheit. Water reducing admixtures can be used to aid in workability without affecting dry shake hardener.
- b. Maximum total air content shall not exceed 3 percent.
- c. Calcium chloride or set accelerating admixtures, containing calcium chloride, shall not be used.
- d. Water-reducing admixture shall be used. Provider must certify that the water reducer will not contribute to or cause increased air content.

Place base slab between screed points to minimize handling. Move concrete into place with square-tapped shovels; do not use rakes. Vibrators, when used, shall be inserted and withdrawn vertically. Concrete shall be struck to the specified level. Concrete shall be further leveled and consolidated with wood bull float or wood darby. This shall be completed before free moisture rises to the surface (bleeding). Floating shall begin adjacent to columns, forms, and walls

##### 3.1.1 Application of Surface Hardener

Apply first shake to floated concrete adjacent to forms, entry ways, columns and walls, where moisture will be lost first. Apply two-thirds of the specified total shake immediately following the floating of total area. Material shall be applied at a minimum rate of 2 pounds per square foot of slab. Bleed water shall not be present during or following the application of this shake. Distribute Evenly. DO NOT THROW THE SHAKE. Wood bull floats can be used as soon as the shake has absorbed moisture (indicated by the darkening of the surface). Float just sufficiently to bring moisture from base slab through the shake. Finishing machines with float blades shall be used to "open" the surface, prior to the application of the remaining one-third of the total specified shake, and shall be used to incorporate this second shake. Surface shall be further compacted by a second mechanical floating, if time and setting characteristics of the concrete will allow, without removing of the cement surface paste from the metallic aggregate system. AT NO TIME SHALL WATER BE ADDED TO THE SURFACE. As surface further stiffens, indicated by loss of sheen, it shall be hand or mechanically troweled with blades relatively flat. Trowel blades should be run as slowly as possible, to achieve the desired finish. Excessive trowel blade speed will "burn" or darken the floor surface resulting in a possible loss of the desired even surface color. All marks and pinholes shall be removed in the raised trowel operation. DO NOT OVER FINISH. Do not burnish trowel. Type or texture of surface shall conform to job mock-up.

##### 3.1.2 Field Service

During the initial periods of installation, manufacturer of surface

hardener shall provide, at no cost, the service of a trained, full-time employee of the manufacturer, to aid in securing the proper use of all prescribed floor finish products. A minimum of 21 days notice shall be given by the Contractor, to the manufacturer, to arrange a "pre-job conference, related to application procedures, and a minimum of 7 days notice shall be given, prior to installation of the product. At discretion of the Contracting Officer, the manufacturer shall videotape pre-job conference and random placement of surface hardener. Video tape shall be supplied by the Contractor. Original video tape shall be delivered to the Contracting Officer, upon completion of the finish operations.

### 3.1.3 Curing and Protection (Water Based Wax Emulsion)

Refer to ACI 308.1. Floors, finished with the non-rusting, metallic-aggregate surface hardener, shall be cured as recommended by the manufacturer of the surface hardener. When high efficiency membrane curing compound is recommended, apply the membrane curing compound immediately after the floor surface has hardened sufficiently, so surface will not be marred by the application. Compound shall be applied uniformly, over the entire surface, to meet the required moisture retention of ASTM C1315, at a maximum rate of 250 square feet per gallon. When dry, the coating shall be protected from droppings of plaster, paint, dirt, and other debris, by a covering of scuff-proof building paper. Adequate provision shall be made for maintaining the concrete temperature at 50 degrees Fahrenheit, or above during the curing period. Floor shall remain covered and be kept free of traffic and loads for at least 10 days after completion. At the direction of the Contracting Officer, the curing compound shall be removed between 2 and 4 weeks after placement.

### 3.2 Cleaning and Surface Preparation

After the aggregate surface hardener system has cured for 28 days, the Contractor shall clean and buff the floor surfaces in accordance with the manufacturer's recommendations. The cleaning and surface preparation shall be performed to remove projections that permit soil and foreign bodies to embed into the floor and to permit easier cleaning of a less porous, more densified concrete surface.

-- End of Section --



SECTION 03 62 16

METALLIC NON-SHRINK GROUTING

02/18

PART 1 GENERAL

1.1 REFERENCES

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

AMERICAN CONCRETE INSTITUTE INTERNATIONAL (ACI)

ACI 211.5R	(2014) Guide for Submittal of Concrete Proportions
ACI 214R	(2011) Evaluation of Strength Test Results of Concrete
ACI 311.4R	(2005) Guide for Concrete Inspection
ACI MCP SET	(2017) Manual of Concrete Practice

ASTM INTERNATIONAL (ASTM)

ASTM C1107/C1107M	(2014a) Standard Specification for Packaged Dry, Hydraulic-Cement Grout (Nonshrink)
ASTM C150/C150M	(2017) Standard Specification for Portland Cement
ASTM C33/C33M	(2016) Standard Specification for Concrete Aggregates

1.2 SUBMITTALS

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SD-01 Preconstruction Submittals

Grout Placement and Inspection Reports; G

SD-04 Samples

Aggregates; G

Expansive Admixtures; G

SD-06 Test Reports

Expansion; G

Compressive Strength; G

Grout Placement and Inspection Reports; G

Expansive Grout; G

Portland Cement; G

#### SD-07 Certificates

Portland Cement; G

Expansive Admixtures; G

Expansive Grout; G

Aggregates; G

### 1.3 QUALITY CONTROL

#### 1.3.1 Grout Placement Plan and Inspection Reports

Provide examples of grout placement and inspection reports in accordance with ACI 214R, ACI 211.5R, ACI 311.4R and ACI MCP SET. Show details of proposed methods of application, with written instructions from the manufacturer for the use of expansive admixture at least 45 calendar days before the start of expansive concrete operations.

Include a copy of records of inspections and tests, as well as the records of corrective action taken. Include descriptions of preparation of cavities for placement of grout; and proper mixing, placement, and curing of grout with methods of preventing discoloration.

### PART 2 PRODUCTS

#### 2.1 MATERIALS

##### 2.1.1 Portland Cement

Provide portland cement grout conforming to ASTM C150/C150M for Cement, Type I.

##### 2.1.2 Aggregates

Submit samples conforming to ASTM C33/C33M for aggregates and the gradation as directed.

##### 2.1.3 Water

Provide potable water.

##### 2.1.4 Expansive Admixtures

Use admixture consisting of an oxidizable metallic aggregate.

Submit samples to the Contracting Officer before commencement of work for



review and acceptance.

#### 2.1.5 Expansive Grout

Provide Type A grout containing an oxidizable metallic aggregate and an oxidation-promoting ingredient. Conform to the manufacturer's printed instructions.

### PART 3 EXECUTION

#### 3.1 PREPARATION

Prepare cavities for grouting by cleaning away foreign matter, laitance, dirt, grease, or oil. Clean all contact surfaces of concrete and masonry no less than 24 hours before grout application.

##### 3.1.1 Mixing

Mix grout ingredients for both cementitious grout and epoxy grout in accordance with the manufacturer's written mixing instructions and recommendations.

Mix grout materials in proper mechanical mixers.

Mix grout as close to the work area as possible.

#### 3.2 APPLICATION

##### 3.2.1 Placing Grout

Place grout in accordance with the manufacturer's written installation instructions and recommendations. Do not use grout that has begun to set or if more than 1 hour has elapsed after initial mixing.

Fill blind cavities by pressure injection under controlled venting. Start injection and continue with the vent open until waste grout is expelled through the vent with the same consistency. Then block the vent for pressurization to 60 psi. Use lower pressures when damage to construction may result.

#### 3.3 FIELD QUALITY CONTROL

Provide testing and submit test reports in accordance with ASTM C1107/C1107M for the expansive grout to meet the following performance requirements:

Expansion: 28 calendar days - Percent maximum: 0.3

- Percent minimum: 0.0

Compressive Strength: 6,000 psi

#### 3.4 PROTECTION

Protect freshly placed grout from premature drying and excessive cold or hot temperatures. Comply with manufacturer's requirements for cold-weather and hot-weather protection during curing.

-- End of Section --



SECTION 04 20 00

UNIT MASONRY  
11/15

PART 1 GENERAL

1.1 REFERENCES

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

AMERICAN CONCRETE INSTITUTE INTERNATIONAL (ACI)

ACI 216.1 (2014) Code Requirements for Determining  
Fire Resistance of Concrete and Masonry  
Construction Assemblies

ACI SP-66 (2004) ACI Detailing Manual

ASTM INTERNATIONAL (ASTM)

ASTM A1008/A1008M (2016) Standard Specification for Steel,  
Sheet, Cold-Rolled, Carbon, Structural,  
High-Strength Low-Alloy, High-Strength  
Low-Alloy with Improved Formability,  
Solution Hardened, and Bake Hardenable

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

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

ASTM A167 (2011) Standard Specification for  
Stainless and Heat-Resisting  
Chromium-Nickel Steel Plate, Sheet, and  
Strip

ASTM A185/A185M (2007) Standard Specification for Steel  
Welded Wire Reinforcement, Plain, for  
Concrete

ASTM A615/A615M (2016) Standard Specification for Deformed  
and Plain Carbon-Steel Bars for Concrete  
Reinforcement

ASTM A641/A641M (2009a; R 2014) Standard Specification for  
Zinc-Coated (Galvanized) Carbon Steel Wire

ASTM A653/A653M (2017) Standard Specification for Steel  
Sheet, Zinc-Coated (Galvanized) or  
Zinc-Iron Alloy-Coated (Galvannealed) by

the Hot-Dip Process

ASTM A951/A951M	(2011) Standard Specification for Steel Wire for Masonry Joint Reinforcement
ASTM A996/A996M	(2016) Standard Specification for Rail-Steel and Axle-Steel Deformed Bars for Concrete Reinforcement
ASTM B370	(2012) Standard Specification for Copper Sheet and Strip for Building Construction
ASTM C1019	(2014) Standard Test Method for Sampling and Testing Grout
ASTM C1384	(2012a) Standard Specification for Admixtures for Masonry Mortars
ASTM C1611/C1611M	(2014) Standard Test Method for Slump Flow of Self-Consolidating Concrete
ASTM C207	(2006; R 2011) Standard Specification for Hydrated Lime for Masonry Purposes
ASTM C270	(2014a) Standard Specification for Mortar for Unit Masonry
ASTM C476	(2016) Standard Specification for Grout for Masonry
ASTM C494/C494M	(2017) Standard Specification for Chemical Admixtures for Concrete
ASTM C641	(2017) Standard Test Method for Iron Staining Materials in Lightweight Concrete Aggregates
ASTM C780	(2017) Standard Test Method for Preconstruction and Construction Evaluation of Mortars for Plain and Reinforced Unit Masonry
ASTM C90	(2016) Standard Specification for Loadbearing Concrete Masonry Units
ASTM D2000	(2012; R 2017) Standard Classification System for Rubber Products in Automotive Applications
ASTM D2287	(2012) Nonrigid Vinyl Chloride Polymer and Copolymer Molding and Extrusion Compounds
ASTM E514/E514M	(2014a) Standard Test Method for Water Penetration and Leakage Through Masonry

THE MASONRY SOCIETY (TMS)

TMS MSJC	(2011) Masonry Standard Joint Committee's (MSJC) Book - Building Code Requirements
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and Specification for Masonry Structures,  
Containing TMS 402/ACI 530/ASCE 5, TMS  
602/ACI 530.1/ASCE 6, and Companion  
Commentaries

## 1.2 SUBMITTALS

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### SD-02 Shop Drawings

Cut CMU Drawings  
Reinforcement Detail Drawings; G

### SD-03 Product Data

Hot Weather Procedures  
Cold Weather Procedures  
Cementitious Materials; S

### SD-04 Samples

Mock-Up Panel; G  
Concrete Masonry Units (CMU)  
Admixtures for Masonry Mortar; G  
Anchors, Ties, and Bar Positioners  
Joint Reinforcement

### SD-05 Design Data

Masonry Compressive Strength; G  
Fire-Rated Concrete Masonry Units  
Bracing Calculations; G

### SD-06 Test Reports

Fire-Rated Concrete Masonry Units  
Field Testing of Mortar  
Field Testing of Grout  
Single-Wythe Masonry Wall Water Penetration Test

### SD-07 Certificates

Special Masonry Inspector Qualifications  
Concrete Masonry Units (CMU); G  
Cementitious Materials; G  
Admixtures for Masonry Mortar  
Admixtures for Grout  
Anchors, Ties, and Bar Positioners; G  
Joint Reinforcement; G

### SD-08 Manufacturer's Instructions

Admixtures for Masonry Mortar  
Admixtures for Grout

SD-10 Operation and Maintenance Data

Take-Back Program

SD-11 Closeout Submittals

Recycled Content of Cement; S

### 1.3 QUALITY ASSURANCE

#### 1.3.1 Masonry Mock-Up Panels

##### 1.3.1.1 Mock-Up Panel Location

After material samples are approved and prior to starting masonry work, construct a mock-up panel for each type and color of masonry required. At least 48 hours prior to constructing the panel or panels, submit written notification to the Contracting Officer. Do not build-in mock-up panels as part of the structure; locate mock-up panels where directed. Construct portable mock-up panels or locate in an area where they will not be disrupted during construction.

##### 1.3.1.2 Mock-Up Panel Configuration

Construct mock-up panels L-shaped or otherwise configured to represent all of the wall elements. Construct panels of the size necessary to demonstrate the acceptable level of workmanship for each type of masonry represented on the project. Provide a straight panel or a leg of an L-shaped panel of minimum size 8 feet long by 4 feet high.

##### 1.3.1.3 Mock-Up Panel Composition

Show full color range, texture, and bond pattern of the masonry work. Demonstrate mortar joint tooling; grouting of reinforced vertical cores, collar joints, bond beams, and lintels; positioning, securing, and lapping of reinforcing steel; positioning and lapping of joint reinforcement (including prefabricated corners); and cleaning of masonry work during the construction of the panels. Also include installation or application procedures for anchors, wall ties, CMU control joints, brick expansion joints, insulation, flashing, brick soldier, row lock courses and weeps. Include a masonry bonded corner and installation of electrical boxes and conduit. When the panel represents reinforced masonry, include a 2 by 2 foot opening placed at least 2 feet above the panel base and 2 feet away from all free edges, corners, and control joints. Provide required reinforcing around this opening as well as at wall corners and control joints.

##### 1.3.1.4 Mock-Up Panel Purpose

The completed panels is used as the standard of workmanship for the type of masonry represented. Do not commence masonry work until the mock-up panel for that type of masonry construction has been completed and approved. Protect panels from the weather and construction operations until the masonry work has been completed and approved. Perform cleaning procedures on the mockup and obtain approval of the Contracting Officer prior to cleaning the building. After completion of the work, completely

remove the mock-up panels, including all foundation concrete, from the construction site.

#### 1.3.2 Special Masonry Inspector Qualifications

Refer to Section 01 45 35 SPECIAL INSPECTIONS for qualifications and responsibilities of the masonry special inspector.

#### 1.4 DELIVERY, STORAGE, AND HANDLING

Deliver, store, handle, and protect material to avoid chipping, breakage, and contact with soil or contaminating material. Store and prepare materials in already disturbed areas to minimize project site disturbance and size of project site.

##### 1.4.1 Masonry Units

Cover and protect masonry units from precipitation. Conform to handling and storage requirements of TMS MSJC.

##### 1.4.2 Reinforcement, Anchors, and Ties

Store steel reinforcing bars, coated anchors, ties, and joint reinforcement above the ground. Maintain steel reinforcing bars and uncoated ties free of loose mill scale and loose rust.

##### 1.4.3 Cementitious Materials, Sand and Aggregates

Deliver cementitious and other packaged materials in unopened containers, plainly marked and labeled with manufacturers' names and brands. Store cementitious material in dry, weathertight enclosures or completely cover. Handle cementitious materials in a manner that will prevent the inclusion of foreign materials and damage by water or dampness. Store sand and aggregates in a manner to prevent contamination and segregation.

#### 1.5 PROJECT/SITE CONDITIONS

Conform to TMS MSJC for hot and cold weather masonry erection.

##### 1.5.1 Hot Weather Procedures

When ambient air temperature exceeds 100 degrees F, or exceeds 90 degrees F and the wind velocity is greater than 8 mph, comply with TMS MSJC Article 1.8 D for: preparation prior to conducting masonry work; construction while masonry work is in progress; and protection for newly completed masonry.

##### 1.5.2 Cold Weather Procedures

When ambient temperature is below 40 degrees F, comply with TMS MSJC Article 1.8 C for: preparation prior to conducting masonry work; construction while masonry work is in progress; and protection for newly completed masonry.

## PART 2 PRODUCTS

### 2.1 SYSTEM DESCRIPTION

#### 2.1.1 Performance - Verify Masonry Compressive Strength

Verify specified compressive strength of masonry using the "Prism Test Method" of TMS MSJC when the "Unit Strength Method" cannot be used. Submit test results.

### 2.2 MANUFACTURED UNITS

#### 2.2.1 General Requirements

Do not change the source of materials, which will affect the appearance of the finished work, after the work has started except with Contracting Officer's approval. Submit test reports from an approved independent laboratory. Certify test reports on a previously tested material as the same materials as that proposed for use in this project. Submit certificates of compliance stating that the materials meet the specified requirements.

#### 2.2.2 Concrete Units

##### 2.2.2.1 Aggregates

Test lightweight aggregates, and blends of lightweight and heavier aggregates in proportions used in producing the units, for stain-producing iron compounds in accordance with ASTM C641, visual classification method. Do not incorporate aggregates for which the iron stain deposited on the filter paper exceeds the "light stain" classification.

##### 2.2.2.2 Concrete Masonry Units (CMU)

###### 2.2.2.2.1 Recycled Content

Provide units with a minimum of 5 percent post-consumer recycled content, or a minimum of 20 percent post-industrial recycled content, based on mass, cost, or volume.

###### 2.2.2.2.2 Size

Units to be modular in size and shall include closer, jamb and bond BM. units and special shapes and sizes to complete the work as indicated.

###### 2.2.2.2.3 Surfaces

Provide units with exposed surfaces that are smooth and of uniform texture.

###### 2.2.2.2.4 Weather Exposure

Provide concrete masonry units with water-repellant admixture added during manufacture where units will be exposed to weather..

###### 2.2.2.2.5 Unit Types

- a. Hollow Load-Bearing Units: ASTM C90, lightweight or normal weight. Provide load-bearing units for exterior walls, foundation walls, load-bearing walls, and shear walls.



#### 2.2.2.2.6 Jamb Units

Provide jamb units of the shapes and sizes to conform with wall units. Solid units may be incorporated in the masonry work where necessary to fill out at corners, gable slopes, and elsewhere as approved.

Provide sash jamb units with a 3/4 by 3/4 inch groove near the center at end of each unit.

#### 2.2.2.3 Fire-Rated Concrete Masonry Units

For indicated fire-rated construction, provide concrete masonry units of minimum equivalent thickness for the fire rating indicated and the corresponding type of aggregates indicated in TABLE I. Units containing more than one of the aggregates listed in TABLE I will be rated by linear interpolation based on the percent by dry-rodded volume of each aggregate used in manufacturing the units.

TABLE I FIRE-RATED CONCRETE MASONRY UNITS							
Aggregate Type	Minimum Equivalent Thickness for Fire-Resistance Rating, inch						
	1/2 hour	3/4 hour	1 hour	1-1/2 hour	2 hours	3 hours	4 hours
Calcareous or siliceous gravel (other than limestone)	2.0	2.4	2.8	3.6	4.2	5.3	6.2
Limestone, cinders, or air-cooled slag	1.9	2.3	2.7	3.4	4.0	5.0	5.9
Expanded clay, expanded shale, or expanded slate	1.8	2.2	2.6	3.3	3.6	4.4	5.1
Expanded slag or pumice	1.5	1.9	2.1	2.7	3.2	4.0	4.7

Determine equivalent thickness in accordance with ACI 216.1.

### 2.3 EQUIPMENT

#### 2.3.1 Vibrators

Maintain at least one spare vibrator on site at all times.

#### 2.3.2 Grout Pumps

Pumping through aluminum tubes is not permitted.

## 2.4 MATERIALS

### 2.4.1 Mortar Materials

#### 2.4.1.1 Cementitious Materials

Provide cementitious materials that conform to those permitted by ASTM C270.

#### 2.4.1.2 Hydrated Lime and Alternates

Provide lime that conforms to one of the materials permitted by ASTM C207 for use in combination with portland cement, hydraulic cement, and blended hydraulic cement. Do not use lime in combination with masonry cement or mortar cement.

#### 2.4.1.3 Admixtures for Masonry Mortar

In cold weather, use a non-chloride based accelerating admixture that conforms to ASTM C1384, unless Type III portland cement is used in the mortar.

#### 2.4.1.4 Aggregate and Water

Provide aggregate (sand) and water that conform to materials permitted by ASTM C270.

### 2.4.2 Grout and Ready-Mix Grout Materials

#### 2.4.2.1 Cementitious Materials for Grout

Provide cementitious materials that conform to those permitted by ASTM C476.

#### 2.4.2.2 Admixtures for Grout

Water-reducing admixtures that conform to ASTM C494/C494M Type F or G and viscosity-modifying admixtures that conform to ASTM C494/C494M Type S are permitted for use in grout. Other admixtures require approval by the Contracting Officer.

In cold weather, a non-chloride based accelerating admixture may be used subject to approval by the Contracting Officer; use accelerating admixture that is non-corrosive and conforms to ASTM C494/C494M, Type C.

#### 2.4.2.3 Aggregate and Water

Provide fine and coarse aggregates and water that conform to materials permitted by ASTM C476.

## 2.5 MORTAR AND GROUT MIXES

### 2.5.1 Mortar Mix

- a. Provide mortar Type S unless specified otherwise herein.
- b. Use ASTM C270 Type S cement-lime mortar or mortar cement mortar for seismic-force-resisting elements indicated.
- c. For field-batched mortar, measure component materials by volume. Use measuring boxes for materials that do not come in packages, such as

sand, for consistent batching. Mix cementitious materials and aggregates between 3 and 5 minutes in a mechanical batch mixer with a sufficient amount of water to produce a workable consistency. Do not hand mix mortar unless approved by the Contracting Officer. Maintain workability of mortar by remixing or retempering. Discard mortar that has begun to stiffen or is not used within 2-1/2 hours after initial mixing.

- d. For preblended mortar, follow manufacturer's mixing instructions.

#### 2.5.2 Grout and Ready Mix Grout Mix

Use grout that conforms to ASTM C476, fine coarse. Use conventional grout with a slump between 8 and 11 inches. Use self-consolidating grout with slump flow of 24 to 30 inches and a visual stability index (VSI) not greater than 1. Provide minimum grout strength of 2000 psi in 28 days, as tested in accordance with ASTM C1019. Do not change proportions and do not use materials with different physical or chemical characteristics in grout for the work unless additional evidence is furnished that grout meets the specified requirements. Use ready-mixed grout that conforms to ASTM C476.

### 2.6 ACCESSORIES

#### 2.6.1 Grout Barriers

Grout barriers for vertical cores that consist of fine mesh wire, fiberglass, or expanded metal.

#### 2.6.2 Anchors, Ties, and Bar Positioners

##### 2.6.2.1 General

- a. Fabricate anchors and ties without drips or crimps. Size anchors and ties to provide a minimum of 5/8 inch mortar cover from each face of masonry.
- b. Fabricate steel wire anchors and ties shall from wire conforming to ASTM A1064/A1064M and hot-dip galvanize in accordance with ASTM A153/A153M.
- c. Fabricate joint reinforcement in conformance with ASTM A951/A951M. Hot dip galvanize joint reinforcement in exterior walls and in interior walls exposed to moist environment in conformance with ASTM A153/A153M. Galvanize joint reinforcement in other interior walls in conformance with ASTM A641/A641M; coordinate with paragraph JOINT REINFORCEMENT below.
- d. Fabricate sheet metal anchors and ties in conformance with ASTM A1008/A1008M. Hot dip galvanize sheet metal anchors and ties in exterior walls and in interior walls exposed to moist environment in compliance with ASTM A153/A153M Class B. Galvanize sheet metal anchors and ties in other interior walls in compliance with ASTM A653/A653M, Coating Designation G60.
- e. Submit two anchors, ties and bar positioners of each type used, as samples.

#### 2.6.2.2 Wire Mesh Anchors

Provide wire mesh anchors of 1/4 inch mesh galvanized hardware cloth, conforming to ASTM A185/A185M, with length not less than 12 inches, at intersections of interior non-bearing masonry walls.

#### 2.6.2.3 Dovetail Anchors

Provide dovetail anchors of 3/16 inch diameter steel wire, triangular shaped, and attached to a 12 gauge or heavier steel dovetail section. Use these anchors to connect the exterior masonry wythe as it passes over the face of concrete columns, beams, or walls. Fill cells immediately above and below these anchors unless solid units are used.

#### 2.6.2.4 Adjustable Anchors

##### 2.6.2.4.1 Anchorage to Structural Steel

Provide hot-dip galvanized adjustable anchors for connecting masonry walls to the structural steel frame as detailed on the drawings. Provide zinc-rich paint for touching up paint after welding galvanized anchors to structural steel.

#### 2.6.2.5 Bar Positioners

Factory-fabricate bar positioners, used to prevent displacement of reinforcing bars during the course of construction, from 9 gauge steel wire or equivalent, and hot-dip galvanized.

#### 2.6.3 Joint Reinforcement

Factory fabricate joint reinforcement in conformance with ASTM A951/A951M, welded construction. Provide ladder type joint reinforcement, having one longitudinal wire in the mortar bed of each face shell for hollow units and one wire for solid units and with all wires a minimum of 9 gauge. Size joint reinforcement to provide a minimum of 5/8 inch cover from each face. Space crosswires not more than 16 inches. Provide joint reinforcement for straight runs in flat sections not less than 10 feet long. Provide joint reinforcement with factory formed corners and intersections. If approved for use, joint reinforcement may be furnished with adjustable wall tie features. Submit one piece of each type used, including corner and wall intersection pieces, showing at least two cross wires.

#### 2.6.4 Reinforcing Steel Bars

Reinforcing steel bars and rods shall conform to ASTM A615/A615M or ASTM A996/A996M, Grade 60.

#### 2.6.5 Concrete Masonry Control Joint Keys

Provide control joint keys of a factory fabricated solid section of natural or synthetic rubber (or combination thereof) conforming to ASTM D2000 M2AA-805 with a minimum durometer hardness of 80 or polyvinyl chloride conforming to ASTM D2287 Type PVC 654-4 with a minimum durometer hardness of 85. Form the control joint key with a solid shear section not less than 5/8 inch thick and 3/8 inch thick flanges, with a tolerance of plus or minus 1/16 inch, to fit neatly, but without forcing, in masonry unit jamb sash grooves.

## 2.6.6 Through Wall Flashing and Weeps

### 2.6.6.1 Coated-Copper Flashing

Provide 7 ounce, electrolytic copper sheet, uniformly coated on both sides with acidproof, alkaliproof, asphalt impregnated kraft paper or polyethylene sheets.

### 2.6.6.2 Copper or Stainless Steel Flashing

Provide copper sheet, complying with ASTM B370, minimum 16 ounce weight; or stainless steel, ASTM A167, Type 304 or 316, 0.015 inch thick, No. 2D finish. Where indicated, provide with factory-fabricated deformations that mechanically bond flashing against horizontal movement in all directions, where deformations consist of dimples, diagonal corrugations, or a combination of dimples and transverse corrugations.

### 2.6.6.3 Reinforced Membrane Flashing

Provide polyester film core with a reinforcing fiberglass scrim bonded to one side. Provide membrane that is impervious to moisture, flexible, is not affected by caustic alkalis, and after being exposed for not less than 1/2 hour to a temperature of 32 degrees F, shows no cracking when, at that temperature, it is bent 180 degrees over a 1/16 inch diameter mandrel and then bent at the same point over the same size mandrel in the opposite direction 360 degrees.

### 2.6.6.4 Weep Ventilators

Provide weep ventilators that are prefabricated from stainless steel or plastic. Provide inserts with grill or louver-type openings designed to allow the passage of moisture from cavities and to prevent the entrance of insects, and with a rectangular closure strip to prevent mortar droppings from clogging the opening. Provide ventilators with compressible flanges to fit in a standard 3/8 inch wide mortar joint and with height equal to the nominal height of the unit.

### 2.6.6.5 Metal Drip Edge

Provide stainless steel drip edge, 15-mil thick, hemmed edges, with down-turned drip at the outside edge and upturned dam at the inside edge for use with membrane flashings.

## PART 3 EXECUTION

### 3.1 EXAMINATION

Prior to start of work, verify the applicable conditions as set forth in TMS MSJC, inspection.

### 3.2 PREPARATION

#### 3.2.1 Stains

Protect exposed surfaces from mortar and other stains. When mortar joints are tooled, remove mortar from exposed surfaces with fiber brushes and wooden paddles. Protect base of walls from splash stains by covering adjacent ground with sand, sawdust, or polyethylene.

### 3.2.2 Loads

Do not apply uniform loads for at least 12 hours or concentrated loads for at least 72 hours after masonry is constructed. Provide temporary bracing as required.

### 3.2.3 Concrete Surfaces

Where masonry is to be placed, clean concrete of laitance, dust, dirt, oil, organic matter, or other foreign materials and slightly roughen to provide a surface texture with a depth of at least 1/8 inch. Sandblast, if necessary, to remove laitance from pores and to expose the aggregate.

### 3.2.4 Bracing

Provide bracing and scaffolding necessary for masonry work. Design bracing to resist wind pressure as required by OSHA and local codes and submit bracing calculations, sealed by a registered professional engineer. Do not remove bracing in less than 10 days.

## 3.3 ERECTION

### 3.3.1 General

- a. Coordinate masonry work with the work of other trades to accommodate built-in items and to avoid cutting and patching. Lay masonry units in running bond pattern. Adjust each unit to its final position while mortar is still soft and has plastic consistency.
- b. Remove and clean units that have been disturbed after the mortar has stiffened, and relay with fresh mortar. Keep air spaces, cavities, chases, expansion joints, and spaces to be grouted free from mortar and other debris. Select units to be used in exposed masonry surfaces from those having the least amount of chipped edges or other imperfections detracting from the appearance of the finished work.
- c. When necessary to temporarily discontinue the work, step (rack) back the masonry for joining when work resumes. Toothing may be used only when specifically approved by the Contracting Officer. Before resuming work, remove loose mortar and thoroughly clean the exposed joint. Cover the top of walls subjected to rain or snow with nonstaining waterproof covering or membrane when work is not in process. Extend the covering a minimum of 610 mm 2 feet down on each side of the wall and hold securely in place.
- d. Ensure that units being laid and surfaces to receive units are free of water film and frost. Lay solid units in a nonfurrowed full bed of mortar. Shove units into place so that the vertical joints are tight. Completely fill vertical joints between solid units with mortar, except where indicated at control, expansion, and isolation joints. Place hollow units so that mortar extends to the depth of the face shell at heads and beds, unless otherwise indicated. Mortar will be permitted to protrude up to 1/2 inch into the space or cells to be grouted. Provide means to prevent mortar from dropping into the space below or clean grout spaces prior to grouting.

### 3.3.1.1 Jointing

Tool mortar joints when the mortar is thumbprint hard. Tool horizontal joints after tooling vertical joints. Brush mortar joints to remove loose and excess mortar.

#### 3.3.1.1.1 Tooled Joints

Tool mortar joints in exposed exterior and interior masonry surfaces concave, using a jointer that is slightly larger than the joint width so that complete contact is made along the edges of the unit. Perform tooling so that the mortar is compressed and the joint surface is sealed. Use a jointer of sufficient length to obtain a straight and true mortar joint.

#### 3.3.1.1.2 Door and Window Frame Joints

On the exposed interior side of exterior frames, joints between frames and abutting masonry walls shall be raked to a depth of 3/8 inch. On the exterior side of exterior frames, joints between frames and abutting masonry walls shall be raked to a depth of 3/8 inch.

#### 3.3.1.1.3 Joint Widths

- a. Provide 3/8 inch wide mortar joints in concrete masonry, except for prefaced concrete masonry units.
- b. Maintain mortar joint widths within tolerances permitted by TMS MSJC

### 3.3.1.2 Cutting and Fitting

Use full units of the proper size wherever possible, in lieu of cut units. Locate cut units where they would have the least impact on the architectural aesthetic goals of the facility. Perform cutting and fitting, including that required to accommodate the work of others, by masonry mechanics using power masonry saws. Concrete masonry units may be wet or dry cut. Before being placed in the work, dry wet-cut units to the same surface-dry appearance as uncut units being laid in the wall. Provide cut edges that are clean, true and sharp.

- a. Carefully make openings in the masonry so that wall plates, cover plates or escutcheons required by the installation will completely conceal the openings and will have bottoms parallel with the masonry bed joints. Provide reinforced masonry lintels above openings over 12 inches wide for pipes, ducts, cable trays, and other wall penetrations, unless steel sleeves are used.
- b. Do not reduce masonry units in size by more than one-third in height and one-half in length. Do not locate cut products at ends of walls, corners, and other openings.

### 3.3.1.3 Unfinished Work

Rack back unfinished work for joining with new work. Toothing may be resorted to only when specifically approved by the Contracting Officer. Remove loose mortar and thoroughly clean the exposed joints before laying new work.

#### 3.3.1.4 Control Joints

Provide control joints in concrete masonry as indicated. Construct by using sash jamb units with control joint key in accordance with the details shown on the Drawings. Form a continuous vertical joint at control joint locations, including through bond beams, by utilizing half blocks in alternating courses on each side of the joint. Interrupt the control joint key in courses containing continuous bond beam reinforcement. Interrupt the horizontal reinforcement and grout in bond beams at the control joint except in bond beams at the floor and roof diaphragms.

#### 3.3.2 Reinforced, Single Wythe Concrete Masonry Units Walls

##### 3.3.2.1 Concrete Masonry Unit Placement

- a. Fully bed units used to form piers, pilasters, columns, starting courses on footings, solid foundation walls, lintels, and beams, and where cells are to be filled with grout in mortar under both face shells and webs. Provide mortar beds under both face shells for other units. Mortar head joints for a distance in from the face of the unit not less than the thickness of the face shell.
- b. Solidly grout foundation walls below grade.
- c. Submit drawings showing elevations of walls exposed to view and indicating the location of all cut CMU products.

##### 3.3.2.2 Preparation for Reinforcement

Lay units in such a manner as to preserve the unobstructed vertical continuity of cores to be grouted. Remove mortar protrusions extending 1/2 inch or more into cells before placing grout. Position reinforcing bars accurately as indicated before placing grout. Where vertical reinforcement occurs, fill cores solid with grout in accordance with paragraph PLACING GROUT in this Section.

#### 3.3.3 ANCHORAGE

##### 3.3.3.1 Anchorage to Structural Steel

Masonry shall be anchored to vertical structural steel framing with adjustable steel wire anchors spaced not over 16 inches on centers vertically, and if applicable, not over 24 inches on centers horizontally.

##### 3.3.3.2 Anchorage at Intersecting Walls

Provide wire mesh anchors at maximum 16 inches spacing at intersections of interior non-bearing masonry walls.

#### 3.3.4 Lintels

##### 3.3.4.1 Masonry Lintels

Construct masonry lintels with lintel units filled solid with grout in all courses and reinforced with a minimum of two No. 4 bars in the bottom course unless otherwise indicated. Extend lintel reinforcement beyond each side of masonry opening 40 bar diameters or 24 inches, whichever is greater. Support reinforcing bars in place prior to grouting and locate



1/2 inch above the bottom inside surface of the lintel unit.

### 3.3.5 Sills and Copings

Set sills and copings in a full bed of mortar with faces plumb and true. Slope sills and copings to drain water. Mechanically anchor copings and sills longer than 4 feet as indicated.

## 3.4 INSTALLATION

### 3.4.1 Bar Reinforcement Installation

#### 3.4.1.1 Preparation

Submit detail drawings showing bar splice locations. Identify bent bars on a bending diagram and reference and locate such bars on the drawings. Show wall dimensions, bar clearances, and wall openings. Utilize bending details that conform to the requirements of ACI SP-66. No approval will be given to the shop drawings until the Contractor certifies that all openings, including those for mechanical and electrical service, are shown. If, during construction, additional masonry openings are required, resubmit the approved shop drawings with the additional openings shown along with the proposed changes. Clearly highlight location of these additional openings. Provide wall elevation drawings with minimum scale of 1/4 inch per foot. Submit drawings including plans, elevations, and details of wall reinforcement; details of reinforcing bars at corners and wall intersections; offsets; tops, bottoms, and ends of walls; control and expansion joints; lintels; and wall openings.

Clean reinforcement of loose, flaky rust, scale, grease, mortar, grout, and other coatings that might destroy or reduce its bond prior to placing grout. Do not use bars with kinks or bends not shown on the approved shop drawings. Place reinforcement prior to grouting. Unless otherwise indicated, extend vertical wall reinforcement to within 2 inches of tops of walls.

#### 3.4.1.2 Positioning Bars

- a. Accurately place vertical bars within the cells at the positions indicated on the drawings. A minimum clearance of 1/2 inch shall be maintained between the bars and masonry units. Provide minimum clearance between parallel bars of 1/2 inch between the bars and masonry units for coarse grout and a minimum clearance of 1/4 inch between the bars and masonry units for fine grout. Provide minimum clearance between parallel bars of 1 inch or one diameter of the reinforcement, whichever is greater. Vertical reinforcement may be held in place using bar positioners located near the ends of each bar and at intermediate intervals of not more than 192 diameters of the reinforcement or by other means to prevent displacement beyond permitted tolerances. As masonry work progresses, secure vertical reinforcement to prevent displacement beyond allowable tolerances.
- b. Wire column and pilaster lateral ties in position around the vertical reinforcing bars. Place lateral ties in contact with the vertical reinforcement and do not place in horizontal mortar bed joints.
- c. Position horizontal reinforcing bars as indicated. Stagger splices in adjacent horizontal bars, unless otherwise indicated.

- d. Form splices by lapping bars as indicated. Do not cut, bend or eliminate reinforcing bars. Foundation dowel bars may be field-bent when permitted by TMS MSJC.

#### 3.4.1.3 Splices of Bar Reinforcement

Lap splice reinforcing bars as indicated. When used, provide welded or mechanical connections that develop at least 125 percent of the specified yield strength of the reinforcement.

#### 3.4.2 Placing Grout

##### 3.4.2.1 General

Fill cells containing reinforcing bars with grout. Solidly grout hollow masonry units in walls or partitions supporting plumbing, heating, or other mechanical fixtures, voids at door and window jambs, and other indicated spaces. Solidly grout cells under lintel bearings on each side of openings for full height of openings. Solidly grout walls below grade, lintels, and bond beams. Units other than open end units may require grouting each course to preclude voids in the units.

Discard site-mixed grout that is not placed within 1-1/2 hours after water is first added to the batch or when the specified slump is not met without adding water after initial mixing. Discard ready-mixed grout that does not meet the specified slump without adding water other than water that was added at the time of initial discharge. Allow sufficient time between grout lifts to preclude displacement or cracking of face shells of masonry units. Provide a grout shear key between lifts when grouting is delayed and the lower lift loses plasticity. If blowouts, flowouts, misalignment, or cracking of face shells should occur during construction, tear down the wall and rebuild.

##### 3.4.2.2 Horizontal Grout Barriers

Embed horizontal grout barriers in mortar below cells of hollow units receiving grout.

##### 3.4.2.3 Grout Holes and Cleanouts

###### 3.4.2.3.1 Grout Holes

Provide grouting holes in slabs, spandrel beams, and other in-place overhead construction. Locate holes over vertical reinforcing bars or as required to facilitate grout fill in bond beams. Provide additional openings spaced not more than 16 inches on centers where grouting of hollow unit masonry is indicated. Form such openings not less than 4 inches in diameter or 3 by 4 inches in horizontal dimensions. Upon completion of grouting operations, plug and finish grouting holes to match surrounding surfaces.

###### 3.4.2.3.2 Cleanouts for Hollow Unit Masonry Construction

For hollow masonry units, provide cleanout holes at the bottom of every grout pour in cores containing vertical reinforcement when the height of the grout pour exceeds 5 feet 4 inches. Where all cells are to be grouted, construct cleanout courses using bond beam units in an inverted position to permit cleaning of all cells. Provide cleanout holes at a maximum spacing of 32 inches where all cells are to be filled with grout.

Establish a new series of cleanouts if grouting operations are stopped for more than 4 hours. Provide cleanouts not less than 3 by 3 inch by cutting openings in one face shell. Manufacturer's standard cutout units may be used at the Contractor's option. Do not cleanout holes until masonry work, reinforcement, and final cleaning of the grout spaces have been completed and inspected. For walls which will be exposed to view, close cleanout holes in an approved manner to match surrounding masonry.

#### 3.4.2.4 Grout Placement

A grout pour is the total height of masonry to be grouted prior to erection of additional masonry. A grout lift is an increment of grout placement within a grout pour. A grout pour is filled by one or more lifts of grout.

- a. Lay masonry to the top of a pour permitted by TMS MSJC Table 7, based on the size of the grout space and the type of grout. Prior to grouting, remove masonry protrusions that extend 1/2 inch or more into cells or spaces to be grouted. Provide grout holes and cleanouts in accordance with paragraph GROUT HOLES AND CLEANOUTS above when the grout pour height exceeds 5 feet 4 inches. Hold reinforcement, bolts, and embedded connections rigidly in position before grouting is started. Do not prewet concrete masonry units.
- b. Place grout using a hand bucket, concrete hopper, or grout pump to fill the grout space without segregation of aggregate. Operate grout pumps to produce a continuous stream of grout without air pockets, segregation, or contamination.
- c. If the masonry has cured at least 4 hours, grout slump is maintained between 10 to 11 inches, and no intermediate reinforced bond beams are placed between the top and bottom of the pour height, place conventional grout in lifts not exceeding 12 feet 8 inches. For the same curing and slump conditions but with intermediate bond beams, limit conventional grout lift to the bottom of the lowest bond beam that is more than 5 feet 4 inches above the bottom of the lift, but do not exceed 12 feet 8 inches. If masonry has not cured at least 4 hours or grout slump is not maintained between 10 to 11 inches, place conventional grout in lifts not exceeding 5 feet 4 inches.
- d. Consolidate conventional grout lift and reconsolidate after initial settlement before placing next lift. For grout pours that are 12 inches or less in height, consolidate and reconsolidate grout by mechanical vibration or puddling. For grout pours that are greater than 12 inches in height, consolidate and reconsolidate grout by mechanical vibration. Apply vibrators at uniformly spaced points not further apart than the visible effectiveness of the machine. Limit duration of vibration to time necessary to produce satisfactory consolidation without causing segregation. If previous lift is not permitted to set, dip vibrator into previous lift. Do not insert vibrators into lower lifts that are in a semi-solidified state. If lower lift sets prior to placement of subsequent lift, form a grout key by terminating grout a minimum of 1-1/2 inch below a mortar joint. Vibrate each vertical cell containing reinforcement in partially grouted masonry. Do not form grout keys within beams.
- e. If the masonry has cured 4 hours, place self-consolidating grout (SCG) in lifts not exceeding the pour height. If masonry has not cured for

at least 4 hours, place SCG in lifts not exceeding 5 feet 4 inches. Do not mechanically consolidate self-consolidating grout. Place self-consolidating grout in accordance with manufacturer's recommendations.

- f. Upon completion of each day's grouting, remove waste materials and debris from the equipment, and dispose of outside the masonry.

### 3.4.3 Joint Reinforcement Installation

Install joint reinforcement at 16 inches on center unless otherwise indicated. Lap joint reinforcement not less than 12 inches. Install prefabricated sections at corners and wall intersections. Place the longitudinal wires of joint reinforcement in mortar beds to provide not less than 5/8 inch cover to either face of the unit.

### 3.4.4 Bond Beams

Reinforce and grout bond beams as indicated and as described in paragraphs above. Install grout barriers under bond beam units to retain the grout as required, unless wall is fully grouted or solid bottom units are used. For high lift grouting in partially grouted masonry, provide grout retaining material on the top of bond beams to prevent upward flow of grout. Ensure that reinforcement is continuous, including around corners, except through control joints or expansion joints, unless otherwise indicated.

### 3.4.5 Flashing and Weeps

Install through-wall flashing at obstructions in the cavity and where indicated on Drawings. Ensure continuity of the flashing at laps and inside and outside corners by splicing in a manner approved by the flashing manufacturer. Ensure that the top edge of the flashing is sealed by turning the flashing 1/2 inch into the mortar bed joint of backup masonry. Terminate the horizontal leg of the flashing terminating the fabric flashing 1/2 inch short of the outside face of masonry and adhering the flashing to a sheet metal drip edge. Provide sealant below the drip edge of through-wall flashing.

Wherever through-wall flashing occurs, provide weep holes to drain flashing to exterior at acceptable locations as indicated. Provide weeps of weep ventilators. Locate weeps not more than 24 inches on centers in mortar joints of the exterior wythe directly on the horizontal leg of through-wall flashing over foundations, bond beams, and any other horizontal interruptions of the cavity. Place weep holes perfectly horizontal or slightly canted downward to encourage water drainage outward and not inward. Other methods may be used for providing weeps when spacing is reduced to 16 inches on center and approved by the Contracting Officer. Maintain weeps free of mortar and other obstructions.

## 3.5 APPLICATION

### 3.5.1 Interface with Other Products

#### 3.5.1.1 Built-In Items

Fill spaces around built-in items with mortar. Point openings around flush-mount electrical outlet boxes in wet locations with mortar. Embed anchors, ties, wall plugs, accessories, flashing, pipe sleeves and other

items required to be built-in as the masonry work progresses. Fully embed anchors, ties and joint reinforcement in the mortar. Fill cells receiving anchor bolts and cells of the first course below bearing plates with grout, unless otherwise indicated.

#### 3.5.1.2 Door and Window Frame Joints

On the exposed interior and exterior sides of exterior frames, rake joints between frames and abutting masonry walls to a depth of 3/8 inch.

#### 3.5.2 Tolerances

Lay masonry plumb, true to line, with courses level within the tolerances of TMS MSJC, Article 3.3 F.

### 3.6 FIELD QUALITY CONTROL

#### 3.6.1 Tests

##### 3.6.1.1 Field Testing of Mortar

Prepare and test mortar samples for mortar aggregate ratio in accordance with ASTM C780 Appendix A4. Prepare and test mortar compressive strength specimens in accordance with ASTM C780 Appendix A6.

##### 3.6.1.2 Field Testing of Grout

- a. Perform grout testing at the following frequency: For each required grout property to be evaluated, provide a minimum of three specimens.
- b. Sample and test conventional and self-consolidating grout for compressive strength and temperature in accordance with ASTM C1019.
- c. Evaluate slump in conventional grout in accordance with ASTM C1019.
- d. Evaluate slump flow and visual stability index of self-consolidating grout in accordance with ASTM C1611/C1611M.

##### 3.6.1.3 Single-Wythe Masonry Wall Water Penetration Test

Prior to start of field construction of the single-wythe concrete masonry wall, perform masonry wall water penetration test on mock-up wall assemblies consisting of the identical design, materials, mix, and construction methods as the actual wall construction and in accordance with ASTM E514/E514M. Prepare a minimum of three specimens and cure for minimum 28 days prior to testing. Construct panels by the same methods, processes, and applications to be used on the project's construction site. Spray test for 6 hours on each specimen. If water is visible on back of test panels during the test and areas of dampness on the backside of the test panels do not exceed 25 percent of the wall area, the panels will be considered to have passed. Dampness is defined as any area of surface darkening or discoloration due to moisture penetration or accumulation below the observed surface.

Construct additional test panels for each failed test performed until three test panels pass the test. Factors that can affect test performance include materials, mixing, and quality of application and workmanship. Materials, mixing, and methods adjustments may be necessary in order to provide construction that passes the water penetration test. Document and

record the test specimen construction materials and application and provide written test report in accordance with ASTM E514/E514M, supplemented by a detailed discussion of the specifics of test panel construction, application methods and processes used, quality of construction, and any variances or deviations that may have occurred between test panels during test panel construction. For failed test panels, identify in the supplemental report the variances, deficiencies or flaws that contributed to test panel failure and itemize the precautions to be taken in field construction of the masonry wall to prevent similar deficiencies and assure the wall construction replicates test panel conditions that pass the water penetration test. Submit the complete, certified test report, including supplemental report, to the Contracting Officer prior to start of single-wythe concrete masonry wall construction. Significant changes to materials, proportions, or construction techniques from those used in the passing water penetration test are grounds for performing new tests, at the discretion of the Contracting Officer.

### 3.7 POINTING AND CLEANING

After mortar joints have attained their initial set, but prior to hardening, completely remove mortar and grout daubs and splashings from masonry-unit surfaces that will be exposed or painted. Before completion of the work, rake out defects in joints of masonry to be exposed or painted, fill with mortar, and tool to match existing joints. Immediately after grout work is completed, remove scum and stains that have percolated through the masonry work using a low pressure stream of water and a stiff bristled brush. Do not clean masonry surfaces, other than removing excess surface mortar, until mortar in joints has hardened. Leave masonry surfaces clean, free of mortar daubs, dirt, stain, and discoloration, including scum from cleaning operations, and with tight mortar joints throughout. Do not use metal tools and metal brushes for cleaning.

#### 3.7.1 Dry-Brushing Concrete Masonry

Dry brush exposed concrete masonry surfaces at the end of each day's work and after any required pointing, using stiff-fiber bristled brushes.

### 3.8 CLOSE-OUT TAKE-BACK PROGRAM

Collect information from manufacturer for take-back program options. Set aside masonry units, full and partial scrap packaging to be returned to manufacturer for recycling into new product. When such a service is not available, seek local recyclers to reclaim the materials. Submit documentation that includes contact information, summary of procedures, and the limitations and conditions applicable to the project. Indicate manufacturer's commitment to reclaim materials for recycling and/or reuse.

### 3.9 PROTECTION

Protect facing materials against staining. Cover top of walls with nonstaining waterproof covering or membrane to protect from moisture intrusion when work is not in progress. Continue covering the top of the unfinished walls until the wall is waterproofed with a complete roof or parapet system. Extend covering a minimum of 2 feet down on each side of the wall and hold securely in place. Before starting or resuming work, clean top surface of masonry in place of loose mortar and foreign material.

-- End of Section --

SECTION 05 05 23.16

STRUCTURAL WELDING  
05/14

PART 1 GENERAL

1.1 REFERENCES

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

AMERICAN INSTITUTE OF STEEL CONSTRUCTION (AISC)

AISC 360 (2016) Specification for Structural Steel Buildings

AMERICAN SOCIETY FOR NONDESTRUCTIVE TESTING (ASNT)

ANSI/ASNT CP-189 (2016) ASNT Standard for Qualification and Certification of Nondestructive Testing Personnel (ANSI/ASNT CP-105-2006)

AMERICAN WELDING SOCIETY (AWS)

AWS A2.4 (2012) Standard Symbols for Welding, Brazing and Nondestructive Examination

AWS D1.1/D1.1M (2015; Errata 1 2015; Errata 2 2016) Structural Welding Code - Steel

AWS D1.3/D1.3M (2008; Errata 2008) Structural Welding Code - Sheet Steel

AWS D1.4/D1.4M (2011) Structural Welding Code - Reinforcing Steel

AWS D1.8/D1.8M (2009) Structural Welding Code—Seismic Supplement

AWS D14.4/D14.4M (2012) Specification for Welded Joints for Machinery and Equipment

AWS Z49.1 (2012) Safety in Welding and Cutting and Allied Processes

ASTM INTERNATIONAL (ASTM)

ASTM E165/E165M (2012) Standard Practice for Liquid Penetrant Examination for General Industry

ASTM E709 (2015) Standard Guide for Magnetic Particle Examination

## 1.2 SUBMITTALS

Government approval is required for submittals with a "G" designation; submittals not having a "G" designation are for information only. When used, a designation following the "G" designation identifies the office that will review the submittal for the Government. Submittals with an "S" are for inclusion in the Sustainability eNotebook, in conformance to Section 01 33 29 SUSTAINABILITY REPORTING. Submit the following in accordance with Section 01 33 00 SUBMITTAL PROCEDURES:

### SD-01 Preconstruction Submittals

Welding Quality Assurance Plan

### SD-03 Product Data

Welding Procedure Qualifications; G  
Welder, Welding Operator, and Tacker Qualification  
Inspector Qualification  
Previous Qualifications  
Pre-Qualified Procedures  
Welding Electrodes and Rods

### SD-06 Test Reports

Nondestructive Testing

### SD-07 Certificates

Certified Welding Procedure Specifications (WPS)  
Certified Brazing Procedure Specifications (BPS)  
Certified Procedure Qualification Records (PQR)  
Certified Welder Performance Qualifications (WPQ)  
Certified Brazer Performance Qualifications (BPQ)

## 1.3 QUALITY ASSURANCE

Except for pre-qualified (in accordance with AWS D1.1/D1.1M) and previously qualified procedures, each Contractor performing welding must record in detail and qualify the welding procedure specification for any welding procedure followed in the fabrication of weldments. Conform welding procedure qualifications to AWS D1.1/D1.1M, AWS D1.8/D1.8M and to the specifications in this section. Submit for approval copies of the welding procedure specification and the results of the procedure qualification test records for each type of welding which requires procedure qualification and the welder, welding operator, or tacker qualification test records.. Approval of any procedure, however, does not relieve the Contractor of the sole responsibility for producing a finished structure meeting all the specified requirements. Submit this information on the forms in Annex M of AWS D1.1/D1.1M. Individually identify and clearly reference on the detail drawings and erection drawings all welding procedure specifications, or suitably key them to the contract drawings. In case of conflict between this specification and AWS D1.1/D1.1M, this specification governs.

### 1.3.1 General Requirements

Fabricate work in an AISC Certified Fabrication Plant, Category Std .  
Work must be erected by an AISC Certified Erector, Category ASCE .



a. For Structural Projects, provide documentation of the following:

- (1) Component Thickness 1/8 inch and greater: Qualification documents (WPS, PQR, and WPQ) in accordance with AWS D1.1/D1.1M and AWS D1.8/D1.8M.
- (2) Component Thickness Less than 1/8 inch: Qualification documents (WPS, PQR, and WPQ) in accordance with AWS D1.3/D1.3M.
- (3) Reinforcing Steel: Qualification documents (WPS, PWR, and WPQ) in accordance with AWS D1.4/D1.4M.

b. For other applications, provide documentation of the following:

- (1) Submit two copies of the Certified Welding Procedure Specifications (WPS), Certified Brazing Procedure Specifications (BPS) and Certified Procedure Qualification Records (PQR) to the Contracting Officer for approval .
- (2) Submit two copies of the Certified Welder Performance Qualifications (WPQ) and Certified Brazier Performance Qualifications (BPQ) to the Contracting Officer for approval within fifteen calendar days prior to any employee welding on the project material.
- (3) Machinery: Qualification documents (WPS, PQR, and WPQ) in accordance with AWS D14.4/D14.4M.

### 1.3.2 Previous Qualifications

Welding procedures previously qualified by test may be accepted for this contract without re-qualification, upon receipt of the test results, if the following conditions are met:

- a. Testing was performed by an approved testing laboratory, technical consultant, or the Contractor's approved quality control organization.
- b. The qualified welding procedure conforms to the requirements of this specification and is applicable to welding conditions encountered under this contract.
- c. The welder, welding operator, and tacker qualification tests conform to the requirements of this specification and are applicable to welding conditions encountered under this contract.

### 1.3.3 Pre-qualified Procedures

No pre-qualified welding procedures are allowed. Qualify the welding procedures and welders by tests prescribed in the applicable code or specification notwithstanding the fact the code or specification may allow pre-qualified procedures.

### 1.3.4 Retests

If welding procedure fails to meet the requirements of AWS D1.1/D1.1M, revise and re-qualify the procedure specification, or at the Contractor's option, welding procedure may be retested in accordance with AWS D1.1/D1.1M. If the welding procedure is qualified through retesting, submit all test

results, including those of test welds that failed to meet the requirements, with the welding procedure.

#### 1.3.5 Welder, Welding Operator, and Tacker Qualification

Each welder, welding operator, and tacker assigned to work on this contract must be qualified in accordance with the applicable requirements of AWS D1.1/D1.1M, AWS D1.8/D1.8M and as specified in this section. Welders, welding operators, and tackers who make acceptable procedure qualification test welds will be considered qualified for the welding procedure used.

##### 1.3.5.1 Previous Personnel Qualifications

At the discretion of the Contracting Officer, welders, welding operators, and tackers qualified by test within the previous 6 months may be accepted for this contract without re-qualification if all the following conditions are met:

- a. Copies of the welding procedure specifications, the procedure qualification test records, and the welder, welding operator, and tacker qualification test records are submitted and approved in accordance with the specified requirements for detail drawings.
- b. Testing was performed by an approved testing laboratory, technical consultant, or the Contractor's approved quality control organization.
- c. The previously qualified welding procedure conforms to the requirements of this specification and is applicable to welding conditions encountered under this contract.
- d. The welder, welding operator, and tacker qualification tests conform to the requirements of this specification and are applicable to welding conditions encountered under this contract.

##### 1.3.5.2 Certificates

Before assigning any welder, welding operator, or tacker to work under this contract, submit the names of the welders, welding operators, and tackers to be employed, and certification that each individual is qualified as specified. State in the certification the type of welding and positions for which the welder, welding operator, or tacker is qualified, the code and procedure under which the individual is qualified, the date qualified, and the name of the firm and person certifying the qualification tests. Keep the certification current, on file, and furnish 3 copies.

##### 1.3.5.3 Renewal of Qualification

Re-qualification of a welder or welding operator is required under any of the following conditions:

- a. It has been more than 6 months since the welder or welding operator has used the specific welding process for which he is qualified.
- b. There is specific reason to question the welder or welding operator's ability to make welds that meet the requirements of these specifications.

- c. The welder or welding operator was qualified by an employer other than those firms performing work under this contract, and a qualification test has not been taken within the past 12 months. Submit as evidence of conformance all records showing periods of employment, name of employer where welder, or welding operator, was last employed, and the process for which qualified.
- d. A tacker who passes the qualification test is considered eligible to perform tack welding indefinitely in the positions and with the processes for which he/she is qualified, unless there is some specific reason to question the tacker's ability. In such a case, the tacker is required to pass the prescribed tack welding test.

#### 1.3.6 Inspector Qualification

Submit inspector qualifications that are in accordance with AWS D1.1/D1.1M and AWS D1.8/D1.8M. Qualify all nondestructive testing personnel in accordance with the requirements of ANSI/ASNT CP-189 for Levels I or II in the applicable nondestructive testing method. The inspector may be supported by assistant welding inspectors who are not qualified to AWS D1.1/D1.1M, and assistant inspectors may perform specific inspection functions under the supervision of the qualified inspector, as allowed by AWS D1.1/D1.1M.

#### 1.3.7 Symbols and Safety

Use symbols in accordance with AWS A2.4, unless otherwise indicated. Follow safe welding practices and safety precautions during welding in conformance with AWS Z49.1.

### PART 2 PRODUCTS

#### 2.1 SYSTEM DESCRIPTION

Conform the design of welded connections to AISC 360, unless otherwise indicated or specified. Material with welds will not be accepted unless the welding is specified or indicated on the drawings or otherwise approved. Perform welding as specified in this section, except where additional requirements are shown on the drawings or are specified in other sections. Do not commence welding until welding procedures, inspectors, nondestructive testing personnel, welders, welding operators, and tackers have been qualified and the submittals approved by the Contracting Officer. Perform all testing at or near the work site. Maintain records of the test results obtained in welding procedure, welder, welding operator, and tacker performance qualifications.

##### 2.1.1 Pre-erection Conference

Hold a pre-erection conference prior to the start of the field welding, to bring all affected parties together and to gain a naturally clear understanding of the project and the Welding Procedure Specifications (WPS) (submitted for all welding, including welding done using pre-qualified procedures). Mandatory attendance is required by all Contractor's welding production and inspection personnel and appropriate Government personnel. Include as items for discussion: responsibilities of various parties; welding procedures and processes to be followed; welding sequence (both within a joint and joint sequence within the building); inspection requirements and procedures, both visual and nondestructive testing; welding schedule; and other items deemed necessary

by the attendees.

## 2.2 WELDING EQUIPMENT AND MATERIALS

Provide all welding equipment, welding electrodes and rods, welding wire, and fluxes capable of producing satisfactory welds when used by a qualified welder or welding operator performing qualified welding procedures. Provide welding equipment and materials that comply with the applicable requirements of AWS D1.1/D1.1M and AWS D1.8/D1.8M. Submit product data on welding electrodes and rods.

## PART 3 EXECUTION

### 3.1 WELDING OPERATIONS

#### 3.1.1 Requirements

Conform workmanship and techniques for welded construction to the requirements of AWS D1.1/D1.1M, AWS D1.8/D1.8M and AISC 360. When AWS D1.1/D1.1M, AWS D1.8/D1.8M and the AISC 360 specification conflict, the requirements of AWS D1.1/D1.1M, AWS D1.8/D1.8M govern.

#### 3.1.2 Identification

Identify all welds in one of the following ways:

- a. Submit written records to indicate the location of welds made by each welder, welding operator, or tacker.
- b. Identify all work performed by each welder, welding operator, or tacker with an assigned number, letter, or symbol to identify welds made by that individual. The Contracting Officer may require welders, welding operators, and tackers to apply their symbol next to the weld by means of rubber stamp, felt-tipped marker with waterproof ink, or other methods that do not cause an indentation in the metal. Place the identification mark for seam welds adjacent to the weld at 3 foot intervals. Identification with die stamps or electric etchers is not allowed.

### 3.2 QUALITY CONTROL

Perform testing using an approved inspection or testing laboratory or technical consultant; or if approved, the Contractor's inspection and testing personnel may be used instead of the commercial inspection or testing laboratory or technical consultant. Perform visual and ultrasonic, magnetic particle, and liquid penetrant inspections to determine conformance with paragraph STANDARDS OF ACCEPTANCE. Conform procedures and techniques for inspection with applicable requirements of AWS D1.1/D1.1M, AWS D1.8/D1.8M, ASTM E165/E165M, and ASTM E709. Submit a Welding Quality Assurance Plan and records of tests and inspections.

### 3.3 STANDARDS OF ACCEPTANCE

Conform dimensional tolerances for welded construction, details of welds, and quality of welds with the applicable requirements of AWS D1.1/D1.1M, AWS D1.8/D1.8M and the contract drawings. Perform nondestructive testing by visual inspection and ultrasonic, magnetic particle, or dye penetrant methods. The minimum extent of nondestructive testing must be random 100 percent of welds or joints, as indicated on the drawings. Submit all

records of nondestructive testing.

### 3.3.1 Nondestructive Testing

The welding is subject to inspection and tests in the mill, shop, and field. Inspection and tests in the mill or shop do not relieve the Contractor of the responsibility to furnish weldments of satisfactory quality. When materials or workmanship do not conform to the specification requirements, the Government reserves the right to reject material or workmanship or both at any time before final acceptance of the structure containing the weldment. Any indication of a defect is regarded as a defect, unless re-evaluation by nondestructive methods or by surface conditioning shows that no unacceptable defect is present. Submit all records of nondestructive testing in accordance with paragraph STANDARDS OF ACCEPTANCE.

### 3.3.2 Destructive Tests

Make all repairs when metallographic specimens are removed from any part of a structure. Employ only qualified welders or welding operators, and use the proper joints and welding procedures, including peening or heat treatment if required, to develop the full strength of the members and joints cut and to relieve residual stress.

### 3.4 GOVERNMENT INSPECTION AND TESTING

In addition to the inspection and tests performed by the Contractor for quality control, the Government will perform inspection and testing for acceptance to the extent determined by the Contracting Officer. The costs of such inspection and testing will be borne by the Contractor if unsatisfactory welds are discovered, or by the Government if the welds are satisfactory. The work may be performed by the Government's own forces or under a separate contract for inspection and testing. The Government reserves the right to perform supplemental nondestructive and destructive tests to determine compliance with paragraph STANDARDS OF ACCEPTANCE.

### 3.5 CORRECTIONS AND REPAIRS

If inspection or testing indicates defects in the weld joints, repair defective welds using a qualified welder or welding operator as applicable. Conduct corrections in accordance with the requirements of AWS D1.1/D1.1M, AWS D1.8/D1.8M and the specifications. Repair all defects in accordance with the approved procedures. Repair defects discovered between passes before additional weld material is deposited. Wherever a defect is removed and repair by welding is not required, blend the affected area into the surrounding surface to eliminate sharp notches, crevices, or corners. After a defect is thought to have been removed, and before re-welding, examine the area by suitable methods to ensure that the defect has been eliminated. Repaired welds must meet the inspection requirements for the original welds.

-- End of Section --



SECTION 05 12 00

STRUCTURAL STEEL

05/14

PART 1 GENERAL

1.1 REFERENCES

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

AMERICAN ASSOCIATION OF STATE HIGHWAY AND TRANSPORTATION OFFICIALS  
(AASHTO)

AASHTO HB-17 (2002; Errata 2003; Errata 2005, 17th  
Edition) Standard Specifications for  
Highway Bridges

AMERICAN INSTITUTE OF STEEL CONSTRUCTION (AISC)

AISC 303 (2016) Code of Standard Practice for Steel  
Buildings and Bridges

AISC 325 (2017) Steel Construction Manual

AISC 326 (2009) Detailing for Steel Construction

AISC 341 (2016) Seismic Provisions for Structural  
Steel Buildings

AISC 360 (2016) Specification for Structural Steel  
Buildings

AISC DESIGN GUIDE 10 (1997) Erection Bracing of Low-Rise  
Structural Steel Buildings

AMERICAN WELDING SOCIETY (AWS)

AWS A2.4 (2012) Standard Symbols for Welding,  
Brazing and Nondestructive Examination

AWS D1.1/D1.1M (2015; Errata 1 2015; Errata 2 2016)  
Structural Welding Code - Steel

AWS D1.8/D1.8M (2009) Structural Welding Code—Seismic  
Supplement

ASME INTERNATIONAL (ASME)

ASME B46.1 (2009) Surface Texture, Surface Roughness,  
Waviness and Lay

ASTM INTERNATIONAL (ASTM)

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

ASTM A1085	(2013) Standard Specification for Cold-Formed Welded Carbon Steel Hollow Structural Sections (HSS)
ASTM A123/A123M	(2017) Standard Specification for Zinc (Hot-Dip Galvanized) Coatings on Iron and Steel Products
ASTM A143/A143M	(2007; R 2014) Standard Practice for Safeguarding Against Embrittlement of Hot-Dip Galvanized Structural Steel Products and Procedure for Detecting Embrittlement
ASTM A276/A276M	(2017) Standard Specification for Stainless Steel Bars and Shapes
ASTM A307	(2014; E 2017) Standard Specification for Carbon Steel Bolts, Studs, and Threaded Rod 60 000 PSI Tensile Strength
ASTM A325	(2014) Standard Specification for Structural Bolts, Steel, Heat Treated, 120/105 ksi Minimum Tensile Strength
ASTM A36/A36M	(2014) Standard Specification for Carbon Structural Steel
ASTM A490	(2014a) Standard Specification for Structural Bolts, Alloy Steel, Heat Treated, 150 ksi Minimum Tensile Strength
ASTM A53/A53M	(2012) Standard Specification for Pipe, Steel, Black and Hot-Dipped, Zinc-Coated, Welded and Seamless
ASTM A563	(2015) Standard Specification for Carbon and Alloy Steel Nuts
ASTM A563M	(2007; R 2013) Standard Specification for Carbon and Alloy Steel Nuts (Metric)
ASTM A6/A6M	(2017) Standard Specification for General Requirements for Rolled Structural Steel Bars, Plates, Shapes, and Sheet Piling
ASTM A668/A668M	(2017) Standard Specification for Steel Forgings, Carbon and Alloy, for General Industrial Use
ASTM A780/A780M	(2009; R 2015) Standard Practice for Repair of Damaged and Uncoated Areas of Hot-Dip Galvanized Coatings
ASTM A992/A992M	(2011) Standard Specification for Structural Steel Shapes
ASTM B695	(2004; R 2016) Standard Specification for



Coatings of Zinc Mechanically Deposited on  
Iron and Steel

ASTM C1107/C1107M	(2014a) Standard Specification for Packaged Dry, Hydraulic-Cement Grout (Nonshrink)
ASTM C827/C827M	(2016) Standard Test Method for Change in Height at Early Ages of Cylindrical Specimens of Cementitious Mixtures
ASTM F1554	(2015; E 2016; E 2017) Standard Specification for Anchor Bolts, Steel, 36, 55, and 105-ksi Yield Strength
ASTM F1852	(2014) Standard Specification for "Twist Off" Type Tension Control Structural Bolt/Nut/Washer Assemblies, Steel, Heat Treated, 120/105 ksi Minimum Tensile Strength
ASTM F2329	(2013) Zinc Coating, Hot-Dip, Requirements for Application to Carbon and Alloy Steel Bolts, Screws, Washers, Nuts, and Special Threaded Fasteners
ASTM F436	(2011) Hardened Steel Washers
ASTM F844	(2007a; R 2013) Washers, Steel, Plain (Flat), Unhardened for General Use
ASTM F959/F959M	(2017) Standard Specification for Compressible-Washer-Type Direct Tension Indicators for Use with Structural Fasteners, Inch and Metric Series

SOCIETY FOR PROTECTIVE COATINGS (SSPC)

SSPC PA 1	(2016) Shop, Field, and Maintenance Coating of Metals
SSPC Paint 20	(2002; E 2004) Zinc-Rich Primers (Type I, Inorganic, and Type II, Organic)
SSPC Paint 29	(2002; E 2004) Zinc Dust Sacrificial Primer, Performance-Based
SSPC SP 3	(1982; E 2004) Power Tool Cleaning
SSPC SP 6/NACE No.3	(2007) Commercial Blast Cleaning

U.S. DEPARTMENT OF DEFENSE (DOD)

UFC 3-301-01	(2013; with Change 3) Structural Engineering
UFC 3-310-04	(2013; with Change 1) Seismic Design for Buildings

## 1.2 SUBMITTALS

Government approval is required for submittals with a "G" designation; submittals not having a "G" designation are for information only. When used, a designation following the "G" designation identifies the office that will review the submittal for the Government. Submittals with an "S" are for inclusion in the Sustainability eNotebook, in conformance to Section 01 33 29 SUSTAINABILITY REPORTING. Submit the following in accordance with Section 01 33 00 SUBMITTAL PROCEDURES:

### SD-01 Preconstruction Submittals

Erection Drawings; G

### SD-02 Shop Drawings

Fabrication Drawings Including Description of Connections; G

### SD-03 Product Data

Shop Primer

Welding Electrodes and Rods

Direct Tension Indicator Washers

Non-Shrink Grout

Tension Control Bolts

### SD-06 Test Reports

Class B Coating

Bolts, Nuts, and Washers

Weld Inspection Reports

Direct Tension Indicator Washer Inspection Reports

Bolt Testing Reports

Embrittlement Test Reports

### SD-07 Certificates

Steel

Bolts, Nuts, and Washers

Galvanizing

Pins and Rollers

AISC Fabrication Plant Quality Certification

AISC Erector Quality Certification

Welding Procedures and Qualifications

## Welding Electrodes and Rods

### 1.3 AISC QUALITY CERTIFICATION

Work must be fabricated in an AISC Certified Fabrication Plant, Category Std . Submit AISC fabrication plant quality certification.

Work must be erected by an AISC Certified Erector, Category CSE. Submit AISC erector quality certification.

### 1.4 SEISMIC PROVISIONS

The structural steel system must be provided in accordance with AISC 341, Chapter J as amended by UFC 3-310-04.

### 1.5 QUALITY ASSURANCE

#### 1.5.1 Preconstruction Submittals

##### 1.5.1.1 Erection Drawings

Submit for record purposes. Indicate the sequence of erection, temporary shoring and bracing. The erection drawings must conform to AISC 303. Erection drawings must be reviewed, stamped and sealed by a registered professional engineer.

#### 1.5.2 Fabrication Drawing Requirements

Submit fabrication drawings for approval prior to fabrication. Prepare in accordance with AISC 326 and AISC 325. Fabrication drawings must not be reproductions of contract drawings. Sign and seal fabrication drawings by a registered professional engineer. Include complete information for the fabrication and erection of the structure's components, including the location, type, and size of bolts, welds, member sizes and lengths, connection details, blocks, copes, and cuts. Use AWS A2.4 standard welding symbols. Shoring and temporary bracing must be designed and sealed by a registered professional engineer and submitted for record purposes, with calculations, as part of the drawings. Any deviations from the details shown on the contract drawings must be clearly highlighted on the fabrication drawings. Explain the reasons for any deviations from the contract drawings.

#### 1.5.3 Certifications

##### 1.5.3.1 Welding Procedures and Qualifications

Prior to welding, submit certification for each welder stating the type of welding and positions qualified for, the code and procedure qualified under, date qualified, and the firm and individual certifying the qualification tests. If the qualification date of the welding operator is more than one-year old, the welding operator's qualification certificate must be accompanied by a current certificate by the welder attesting to the fact that he has been engaged in welding since the date of certification, with no break in welding service greater than 6 months.

Conform to all requirements specified in AWS D1.1/D1.1M and AWS D1.8/D1.8M.

## PART 2 PRODUCTS

### 2.1 SYSTEM DESCRIPTION

Provide the structural steel system, including galvanizing, complete and ready for use. Structural steel systems including design, materials, installation, workmanship, fabrication, assembly, erection, inspection, quality control, and testing must be provided in accordance with AISC 360, AISC 341, UFC 3-301-01 and UFC 3-310-04 except as modified in this contract.

### 2.2 STEEL

#### 2.2.1 Structural Steel

Wide flange and WT shapes, ASTM A992/A992M. Angles, Channels and Plates, ASTM A36/A36M.

#### 2.2.2 Structural Steel Tubing

ASTM A1085, Grade B.

#### 2.2.3 Steel Pipe

ASTM A53/A53M, Type S, Grade B, weight class STD.

### 2.3 BOLTS, NUTS, AND WASHERS

Submit the certified manufacturer's mill reports which clearly show the applicable ASTM mechanical and chemical requirements together with the actual test results for the supplied fasteners.

#### 2.3.1 Common Grade Bolts

##### 2.3.1.1 Bolts

ASTM A307, Grade A. The bolt heads and the nuts of the supplied fasteners must be marked with the manufacturer's identification mark, the strength grade and type specified by ASTM specifications.

##### 2.3.1.2 Nuts

ASTM A563M, Grade A, heavy hex style.

##### 2.3.1.3 Washers

ASTM F844.

#### 2.3.2 High-Strength Bolts

##### 2.3.2.1 Bolts

ASTM A325, Type 1 ASTM A490, Type 1 or 2.

##### 2.3.2.2 Nuts

ASTM A563, Grade and Style as specified in the applicable ASTM bolt standard.

#### 2.3.2.3 Direct Tension Indicator Washers

ASTM F959/F959M. Provide ASTM B695, Class 50, Type 1 galvanizing.

#### 2.3.2.4 Washers

ASTM F436, plain carbon steel.

#### 2.3.3 Tension Control Bolts

ASTM F1852, Type 1, heavy-hex head assemblies consisting of steel structural bolts with splined ends, heavy-hex carbon steel nuts, and hardened carbon steel washers. Assembly finish must be plain or mechanically deposited zinc coating when exposed to weather.

#### 2.3.4 Foundation Anchorage

##### 2.3.4.1 Anchor Rods

ASTM F1554 Gr 55, weldable.

##### 2.3.4.2 Anchor Nuts

ASTM A563, Grade A, hex style.

##### 2.3.4.3 Anchor Washers

ASTM F844. Type 304 conforming to ASTM A276/A276M.

##### 2.3.4.4 Anchor Plate Washers

ASTM A36/A36M Type 304 conforming to ASTM A276/A276M.

#### 2.4 STRUCTURAL STEEL ACCESSORIES

##### 2.4.1 Welding Electrodes and Rods

AWS D1.1/D1.1M and AWS D1.8/D1.8M.

##### 2.4.2 Non-Shrink Grout

ASTM C1107/C1107M, with no ASTM C827/C827M shrinkage. Grout must be nonmetallic.

##### 2.4.3 Pins and Rollers

ASTM A668/A668M, Class C, D, F, or G; ASTM A108, Grades 1016 to 1030. Provide as specified in AASHTO HB-17, Division II, Sections 10.26 and 10.27, except provide pins in lengths to extend a minimum of 0.25 inch beyond the outside faces of the connected parts.

#### 2.5 GALVANIZING

ASTM F2329 for threaded parts or ASTM A123/A123M for structural steel members, as applicable, unless specified otherwise galvanize after fabrication where practicable.

## 2.6 FABRICATION

Fabrication must be in accordance with the applicable provisions of AISC 325. Fabrication and assembly must be done in the shop to the greatest extent possible. Punch, subpunch and ream, or drill bolt and pin holes perpendicular to the surface of the member.

Compression joints depending on contact bearing must have a surface roughness not in excess of 500 micro inch as determined by ASME B46.1, and ends must be square within the tolerances for milled ends specified in ASTM A6/A6M.

Shop splices of members between field splices will be permitted only where indicated on the Contract Drawings. Splices not indicated require the approval of the Contracting Officer.

Do not splice truss top and bottom chords except as approved by the Contracting Officer. Chord splices must occur at panel joints at approximately the third point of the span. The center of gravity lines of truss members must intersect at panel points unless otherwise approved by the Contracting Officer. When the center of gravity lines do not intersect at a panel point, provisions must be made for the stresses due to eccentricity. Camber of trusses must be 1/8 inch in 10 feet unless otherwise indicated.

### 2.6.1 Markings

Prior to erection, members must be identified by a painted erection mark. Connecting parts assembled in the shop for reaming holes in field connections must be match marked with scratch and notch marks. Do not locate erection markings on areas to be welded. Do not locate match markings in areas that will decrease member strength or cause stress concentrations. Affix embossed tags to hot-dipped galvanized members.

### 2.6.2 Shop Primer

SSPC Paint 20 or SSPC Paint 29, (zinc rich primer). Shop prime structural steel, except as modified herein, in accordance with SSPC PA 1. Do not prime steel surfaces embedded in concrete, galvanized surfaces, or surfaces within 0.5 inch of the toe of the welds prior to welding (except surfaces on which metal decking is to be welded). If flash rusting occurs, re-clean the surface prior to application of primer.

Slip critical surfaces must be primed with a Class B coating in accordance with AISC 325. Submit test report for Class B coating.

Prior to assembly, prime surfaces which will be concealed or inaccessible after assembly. Do not apply primer in foggy or rainy weather; when the ambient temperature is below 45 degrees F or over 95 degrees F; or when the primer may be exposed to temperatures below 40 degrees F within 48 hours after application, unless approved otherwise by the Contracting Officer. Repair damaged primed surfaces with an additional coat of primer.

#### 2.6.2.1 Cleaning

SSPC SP 6/NACE No.3, except steel exposed in spaces above ceilings, attic spaces, furred spaces, and chases that will be hidden to view in finished construction may be cleaned to SSPC SP 3 when recommended by the shop primer manufacturer. Maintain steel surfaces free from rust, dirt, oil,

grease, and other contaminants through final assembly.

### 2.6.3 Surface Finishes

ASME B46.1 maximum surface roughness of 125 for pin, pinholes, and sliding bearings, unless indicated otherwise.

### 2.7 DRAINAGE HOLES

Adequate drainage holes must be drilled to eliminate water traps. Hole diameter must be 1/2 inch and location must be indicated on the detail drawings. Hole size and location must not affect the structural integrity.

## PART 3 EXECUTION

### 3.1 ERECTION

- a. Erection of structural steel, except as indicated in item b. below, must be in accordance with the applicable provisions of AISC 325.
- b. For low-rise structural steel buildings (60 feet tall or less and a maximum of 2 stories), the structure must be erected in accordance with AISC DESIGN GUIDE 10.

After final positioning of steel members, provide full bearing under base plates and bearing plates using nonshrink grout. Place nonshrink grout in accordance with the manufacturer's instructions.

#### 3.1.1 STORAGE

Material must be stored out of contact with the ground in such manner and location as will minimize deterioration.

### 3.2 CONNECTIONS

Except as modified in this section, connections not detailed must be designed in accordance with AISC 360. Build connections into existing work. Do not tighten anchor bolts set in concrete with impact torque wrenches. Holes must not be cut or enlarged by burning. Bolts, nuts, and washers must be clean of dirt and rust, and lubricated immediately prior to installation.

#### 3.2.1 Common Grade Bolts

ASTM A307 bolts must be tightened to a "snug tight" fit. "Snug tight" is the tightness that exists when plies in a joint are in firm contact. If firm contact of joint plies cannot be obtained with a few impacts of an impact wrench, or the full effort of a man using a spud wrench, contact the Contracting Officer for further instructions.

#### 3.2.2 High-Strength Bolts

Provide direct tension indicator washers in all ASTM A325 and ASTM A490 bolted connections. Bolts must be installed in connection holes and initially brought to a snug tight fit. After the initial tightening procedure, bolts must then be fully tensioned, progressing from the most rigid part of a connection to the free edges.

#### 3.2.2.1 Installation of Direct Tension Indicator Washers (DTIW)

Where possible, the DTIW must be installed under the bolt head and the nut must be tightened. If the DTIW is installed adjacent to the turned element, provide a flat washer between the DTIW and nut when the nut is turned for tightening, and between the DTIW and bolt head when the bolt head is turned for tightening. In addition to the DTIW, provide flat washers under both the bolt head and nut when ASTM A490 bolts are used.

#### 3.2.3 Tension Control Bolts

Bolts must be installed in connection holes and initially brought to a snug tight fit. After the initial tightening procedure, bolts must then be fully tensioned, progressing from the most rigid part of a connection to the free edges.

#### 3.3 GAS CUTTING

Use of gas-cutting torch in the field for correcting fabrication errors will not be permitted on any major member in the structural framing. Use of a gas cutting torch will be permitted on minor members not under stress only after approval has been obtained from the Contracting Officer.

#### 3.4 WELDING

Welding must be in accordance with AWS D1.1/D1.1M and AWS D1.8/D1.8M. Grind exposed welds smooth as indicated. Provide AWS D1.1/D1.1M qualified welders, welding operators, and tackers.

Develop and submit the Welding Procedure Specifications (WPS) for all welding, including welding done using prequalified procedures. Prequalified procedures may be submitted for information only; however, procedures that are not prequalified must be submitted for approval.

##### 3.4.1 Removal of Temporary Welds, Run-Off Plates, and Backing Strips

Remove only from finished areas. Remove backing strips from bottom flange of moment connections, backgouge the root pass to sound weld metal and reinforce with a 5/16 inch fillet weld minimum.

#### 3.5 SHOP PRIMER REPAIR

Repair shop primer in accordance with the paint manufacturer's recommendation for surfaces damaged by handling, transporting, cutting, welding, or bolting.

##### 3.5.1 Field Priming

Steel exposed to the weather, or located in building areas without HVAC for control of relative humidity must be field primed. After erection, the field bolt heads and nuts, field welds, and any abrasions in the shop coat must be cleaned and primed with paint of the same quality as that used for the shop coat.

#### 3.6 GALVANIZING REPAIR

Repair damage to galvanized coatings using ASTM A780/A780M zinc rich paint for galvanizing damaged by handling, transporting, cutting, welding, or bolting. Do not heat surfaces to which repair paint has been applied.



### 3.7 FIELD QUALITY CONTROL

Perform field tests, and provide labor, equipment, and incidentals required for testing. The Contracting Officer must be notified in writing of defective welds, bolts, nuts, and washers within 7 working days of the date of the inspection.

#### 3.7.1 Welds

##### 3.7.1.1 Visual Inspection

AWS D1.1/D1.1M. Furnish the services of AWS-certified welding inspectors for fabrication and erection inspection and testing and verification inspections.

Inspection by the Government will include proper preparation, size, gaging location, and acceptability of welds; identification marking; operation and current characteristics of welding sets in use.

Inspect proper preparation, size, gaging location, and acceptability of welds; identification marking; operation and current characteristics of welding sets in use.

##### 3.7.1.2 Nondestructive Testing

Nondestructive testing must be in accordance with AWS D1.1/D1.1M and AWS D1.8/D1.8M. Test locations must be selected by the Contracting Officer. If more than 20 percent of welds made by a welder contain defects identified by testing, then all welds made by that welder must be tested by ultrasonic testing, as approved by the Contracting Officer. When all welds made by an individual welder are required to be tested, magnetic particle testing must be used only in areas inaccessible to ultrasonic testing. Retest defective areas after repair. Submit weld inspection reports.

Testing frequency: Provide the following types and number of tests:

<u>Test Type</u>	<u>Number of Tests</u>
Ultrasonic	100%
Magnetic Particle	100%
Dye Penetrant	100%

#### 3.7.2 Direct Tension Indicator Washers

##### 3.7.2.1 Direct Tension Indicator Washer Compression

Direct tension indicator washers must be tested in place to verify that they have been compressed sufficiently to provide the 0.015 inch gap when the direct tension indicator washer is placed under the bolt head and the nut is tightened, and to provide the 0.005 inch gap when the direct tension indicator washer is placed under the turned element, as required by ASTM F959/F959M. Submit direct tension indicator washer inspection reports.

### 3.7.2.2 Direct Tension Indicator Gaps

In addition to the above testing, an independent testing agency as approved by the Contracting Officer, must test in place the direct tension indicator gaps on 20 percent of the installed direct tension indicator washers to verify that the ASTM F959/F959M direct tension indicator gaps have been achieved. If more than 10 percent of the direct tension indicators tested have not been compressed sufficiently to provide the average gaps required by ASTM F959/F959M, then all in place direct tension indicator washers shall be tested to verify that the ASTM F959/F959M direct tension indicator gaps have been achieved. Test locations must be selected by the Contracting Officer.

### 3.7.3 High-Strength Bolts

#### 3.7.3.1 Testing Bolt, Nut, and Washer Assemblies

Test a minimum of 3 bolt, nut, and washer assemblies from each mill certificate batch in a tension measuring device at the job site prior to the beginning of bolting start-up. Demonstrate that the bolts and nuts, when used together, can develop tension not less than the provisions specified in AISC 360, depending on bolt size and grade. The bolt tension must be developed by tightening the nut. A representative of the manufacturer or supplier must be present to ensure that the fasteners are properly used, and to demonstrate that the fastener assemblies supplied satisfy the specified requirements. Submit bolt testing reports.

#### 3.7.3.2 Inspection

Inspection procedures must be in accordance with AISC 360. Confirm and report to the Contracting Officer that the materials meet the project specification and that they are properly stored. Confirm that the faying surfaces have been properly prepared before the connections are assembled. Observe the specified job site testing and calibration, and confirm that the procedure to be used provides the required tension. Monitor the work to ensure the testing procedures are routinely followed on joints that are specified to be fully tensioned.

Inspection by the Government will include calibration of torque wrenches for high-strength bolts.

Inspect calibration of torque wrenches for high-strength bolts.

#### 3.7.3.3 Testing

The Government has the option to perform nondestructive tests on 5 percent of the installed bolts to verify compliance with pre-load bolt tension requirements. Provide the required access for the Government to perform the tests. The nondestructive testing will be done in-place using an ultrasonic measuring device or any other device capable of determining in-place pre-load bolt tension. The test locations must be selected by the Contracting Officer. If more than 10 percent of the bolts tested contain defects identified by testing, then all bolts used from the batch from which the tested bolts were taken, must be tested at the Contractor's expense. Retest new bolts after installation at the Contractor's expense.

#### 3.7.4 Testing for Embrittlement

ASTM A143/A143M for steel products hot-dip galvanized after fabrication.

Submit embrittlement test reports.

-- End of Section --



SECTION 05 21 00

STEEL JOIST FRAMING  
05/15

PART 1 GENERAL

1.1 REFERENCES

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

AMERICAN WELDING SOCIETY (AWS)

AWS D1.1/D1.1M (2015; Errata 1 2015; Errata 2 2016)  
Structural Welding Code - Steel

ASTM INTERNATIONAL (ASTM)

ASTM A36/A36M (2014) Standard Specification for Carbon  
Structural Steel

INTERNATIONAL CODE COUNCIL (ICC)

ICC IBC (2017) International Building Code

SOCIETY FOR PROTECTIVE COATINGS (SSPC)

SSPC PA 1 (2016) Shop, Field, and Maintenance  
Coating of Metals

SSPC Paint 15 (1999; E 2004) Steel Joist Shop Primer

SSPC SP 2 (1982; E 2000; E 2004) Hand Tool Cleaning

STEEL JOIST INSTITUTE (SJI)

SJI LOAD TABLES (2010; Errata 1 2011; Errata 2 2012) 42nd  
Edition Catalog of Standard Specifications  
Load Tables and Weight Tables for Steel  
Joists and Joist Girders

SJI MANUAL (2009) 80 Years of Open Web Steel Joist  
Construction

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

29 CFR 1926 Safety and Health Regulations for  
Construction

1.2 SUBMITTALS

Government approval is required for submittals with a "G" designation; submittals not having a "G" designation are for information only. When used, a designation following the "G" designation identifies the office that will review the submittal for the Government. Submittals with an "S"

are for inclusion in the Sustainability eNotebook, in conformance to Section 01 33 29 SUSTAINABILITY REPORTING. Submit the following in accordance with Section 01 33 00 SUBMITTAL PROCEDURES:

SD-01 Preconstruction Submittals

Welder Qualification

SD-02 Shop Drawings

Steel Joist Framing; G

SD-05 Design Data

Design Calculations; G

SD-06 Test Reports

Erection Inspection  
Welding Inspections

SD-07 Certificates

Certification of Compliance

SD-11 Closeout Submittals

Recycled Content of Steel Products; S

1.3 QUALITY ASSURANCE

Perform all work in compliance with the requirements set forth in 29 CFR 1926.

1.3.1 Drawing Requirements

Submit drawings of steel joist framing including fabrication, specifications for shop painting, and identification markings of joists . Show joist type and size, layout in plan, all applicable loads, deflection criteria, and erection details including methods of anchoring, framing at openings, type, size, and location and connections for and spacing of bridging, requirements for field welding, and details of accessories as applicable. Show profiles for nonstandard joist configurations.

1.3.2 Certification of Compliance

Prior to construction commencement, submit certification for welder qualification, in compliance with AWS D1.1/D1.1M, welding operation, and tacker, stating the type of welding and positions qualified for, the code and procedure qualified under, date qualified, and the firm and individual certifying the qualification tests. Submit certification of compliance for the following:

- a. SJI MANUAL
- b. Steel Joist Institute Member Fabricator
- c. Statement from steel joist manufacturer, that work was performed in accordance with approved construction documents and with SJI standard

specifications, in accordance with ICC IBC Section 1704.2.5.2.

#### 1.4 DELIVERY, STORAGE, AND HANDLING

Handle, transport, and store joists in a manner to prevent damage affecting their structural integrity. Verify piece count of all joist products upon delivery and inspect all joists products for damage. Report any damage to the joist supplier. Store all items off the ground in a well drained location protected from the weather and easily accessible for inspection and handling. Store joists with top chord down and with joists in a vertical position. Store deep joists horizontally if they were shipped on their sides.

### PART 2 PRODUCTS

#### 2.1 SYSTEM DESCRIPTION

Designate steel joists on the drawings in accordance with the standard designations of the Steel Joist Institute. Joists of other standard designations or joists with properties other than those shown may be substituted for the joists designated provided the structural properties are equal to or greater than those of the joists shown and provided all other specified requirements are met.

#### 2.2 STEEL JOISTS

Provide steel joists conforming to SJI LOAD TABLES. Design joists designated K, KCS, LH and DLH to support the loads given in the applicable standard load tables of SJI LOAD TABLES. Submit design calculations for special steel joists, net uplift loads, non-SJI standard details, and field splices. Include cover letter signed and sealed by the joist manufacturer's registered design professional.

##### 2.2.1 Steel Joist Camber

Camber joists according to SJI LOAD TABLES.

##### 2.2.2 Special Steel Joists

Provide special joists and connections capable of withstanding the design loads indicated with a live-load deflection less than  $L/360$  for roof joists.

##### 2.2.3 Steel Joist Substitutes and Outriggers

Provide joist substitutes and outriggers conforming to SJI LOAD TABLES with steel angle or channel members.

#### 2.3 RECYCLED CONTENT

Provide products with an average recycled content of steel products of postconsumer recycled content plus one half of preconsumer recycled content not less than 25 percent.

#### 2.4 ACCESSORIES AND FITTINGS

##### 2.4.1 Bridging

Provide bridging of material, size, and type required by SJI LOAD TABLES for type of joist, chord size, spacing and span. Furnish additional

erection bridging if required for stability.

#### 2.4.2 Bearing Plates

Fabricate steel bearing plats from ASTM A36/A36M steel of size and thickness indicated.

#### 2.4.3 Ceiling Extensions

Furnish ceiling extensions, either bottom-chord elements or a separate extension unit of enough strength to support ceiling construction. Extend ends to within 1/2 inch of finished wall surface unless otherwise indicated.

### 2.5 SHOP PAINTING

SSPC Paint 15. Shop prime joists, except as modified herein, in accordance with SSPC PA 1. Clean joists in accordance with SSPC SP 2 before priming. If flash rusting occurs, re-clean the surface prior to application of primer. For joists which require finish painting under Section 09 90 00 PAINTS AND COATINGS, the primer paint must be compatible with the finish paint.

## PART 3 EXECUTION

### 3.1 ERECTION

Install joists in conformance with SJI LOAD TABLES for the joist series indicated. Handle and set joists avoiding damage to the members. Place the "tag end" of joists as shown on the joists placement plans. Ensure that square-end joists are erected right side up. Distribute temporary loads so that joist capacity is not exceeded. Remove damaged joists from the site, except when field repair is approved and such repairs are satisfactorily made in accordance with the manufacturer's recommendations. Do not repair, field modify, or alter any joists without specific written instructions from the Designer of Record and/or joist manufacturer.

Install and connect bridging concurrently with joist erection, before construction loads are applied. Do not apply loads to bridging. Anchor ends of bridging lines at top and bottom chords if terminating at walls or beams. Do not cut away vertical leg of bridging where bridging makes an elevation transition; weld a separate piece of bridging at the transition. Perform all welding in accordance with AWS D1.1/D1.1M.

### 3.2 BEARING PLATES

Provide bearing plates to accept full bearing after the supporting members have been plumbed and properly positioned, but prior to placing superimposed loads. The area under the plate must be damp-packed solidly with bedding mortar, except where nonshrink grout is indicated on the drawings. Provide bedding mortar and grout as specified in Section 03 30 00 CAST-IN-PLACE CONCRETE.

### 3.3 PAINTING

#### 3.3.1 Touch-Up Painting

After erection of joists , touch-up connections and areas of abraded shop



coat with paint of the same type used for the shop coat.

### 3.3.2 Field Painting

Paint joists requiring a finish coat in conformance with the requirements of Section 09 90 00 PAINTS AND COATINGS.

### 3.4 VISUAL INSPECTIONS

Perform the following visual inspections:

- a. Verify that all joists are spaced properly.
- b. Verify that there is sufficient joist bearing on steel beams, concrete, and masonry.
- c. Verify all bridging lines are properly spaced and anchored.
- d. Verify that damage has not occurred to the joists during erection.
- e. Verify the joists are aligned vertically and there is no lateral sweep in the joists.
- f. Where concentrated loads are present on the joists verify that they are located in accordance with the joists placement plan.
- g. Verify welding of bridging and joist seats in accordance with AWS D1.1/D1.1M, Section 6. Perform erection inspection and field welding inspections with AWS certified welding inspectors.
- h. Verify proper bolting of diagonal bridging and joist seats where the bolts are snug-tight.

-- End of Section --



SECTION 05 30 00

STEEL DECKS

05/15

PART 1 GENERAL

1.1 REFERENCES

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

AMERICAN IRON AND STEEL INSTITUTE (AISI)

AISI D100 (1991; R 2008) Cold-Formed Steel Design Manual

AMERICAN WELDING SOCIETY (AWS)

AWS D1.1/D1.1M (2015; Errata 1 2015; Errata 2 2016) Structural Welding Code - Steel

AWS D1.3/D1.3M (2008; Errata 2008) Structural Welding Code - Sheet Steel

ASTM INTERNATIONAL (ASTM)

ASTM A1008/A1008M (2016) 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 A123/A123M (2017) Standard Specification for Zinc (Hot-Dip Galvanized) Coatings on Iron and Steel Products

ASTM A36/A36M (2014) Standard Specification for Carbon Structural Steel

ASTM A653/A653M (2017) Standard Specification for Steel Sheet, Zinc-Coated (Galvanized) or Zinc-Iron Alloy-Coated (Galvannealed) by the Hot-Dip Process

ASTM A780/A780M (2009; R 2015) Standard Practice for Repair of Damaged and Uncoated Areas of Hot-Dip Galvanized Coatings

ASTM A792/A792M (2010) Standard Specification for Steel Sheet, 55% Aluminum-Zinc Alloy-Coated by the Hot-Dip Process

ASTM D1056 (2014) Standard Specification for Flexible Cellular Materials - Sponge or Expanded Rubber

ASTM D1149 (2007; R 2012) Standard Test Method for Rubber Deterioration - Surface Ozone Cracking in a Chamber

ASTM D746 (2014) Standard Test Method for Brittleness Temperature of Plastics and Elastomers by Impact

ASTM E84 (2018) Standard Test Method for Surface Burning Characteristics of Building Materials

FM GLOBAL (FM)

FM APP GUIDE (updated on-line) Approval Guide  
<http://www.approvalguide.com/>

FM DS 1-28R (1998) Data Sheet: Roof Systems

SOCIETY FOR PROTECTIVE COATINGS (SSPC)

SSPC Paint 20 (2002; E 2004) Zinc-Rich Primers (Type I, Inorganic, and Type II, Organic)

STEEL DECK INSTITUTE (SDI)

ANSI/SDI C (2011; Int 1 2012; Errata 1 2012) Standard for Composite Steel Floor Deck - Slabs

ANSI/SDI NC (2010) Standard for Non-Composite Steel Floor Deck

ANSI/SDI QA/QC (2011) Standard for Quality Control and Quality Assurance for Installation of Steel Deck

SDI DDMO3 (2004; Errata 2006; Add 2006) Diaphragm Design Manual; 3rd Edition

SDI DDP (1987; R 2000) Deck Damage and Penetrations

SDI MOC2 (2006) Manual of Construction with Steel Deck

U.S. DEPARTMENT OF DEFENSE (DOD)

UFC 3-301-01 (2013; with Change 3) Structural Engineering

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

29 CFR 1926 Safety and Health Regulations for Construction

UNDERWRITERS LABORATORIES (UL)

UL 580 (2006; Reprint Oct 2013) Tests for Uplift Resistance of Roof Assemblies

UL Fire Resistance

(2014) Fire Resistance Directory

## 1.2 SUBMITTALS

Government approval is required for submittals with a "G" designation; submittals not having a "G" designation are for information only. When used, a designation following the "G" designation identifies the office that will review the submittal for the Government. Submittals with an "S" are for inclusion in the Sustainability eNotebook, in conformance to Section 01 33 29, SUSTAINABILITY REPORTING. Submit the following in accordance with Section 01 33 00 SUBMITTAL PROCEDURES:

### SD-02 Shop Drawings

Fabrication Drawings; G

### SD-03 Product Data

Accessories

Deck Units

Galvanizing Repair Paint

Touch-Up Paint

Welding Equipment

Welding Rods and Accessories

### SD-04 Samples

Metal Roof Deck Units

Flexible Closure Strips

### SD-05 Design Data

Deck Units; G

### SD-07 Certificates

Powder-Actuated Tool Operator

Welder Qualifications

Welding Procedures

Fire Safety

Wind Storm Resistance

Manufacturer's Certificate

### SD-11 Closeout Submittals

Recycled Content of Steel Products; S

### 1.3 QUALITY ASSURANCE

#### 1.3.1 Deck Units

Furnish deck units and accessory products from a manufacturer regularly engaged in manufacture of steel decking. Provide manufacturer's certificates attesting that the decking material meets the specified requirements.

#### 1.3.2 Certification of Powder-Actuated Tool Operator

Provide manufacturer's certificate attesting that the operators are authorized to use the low velocity powder-actuated tool.

#### 1.3.3 Qualifications for Welding Work

Follow Welding Procedures of AWS D1.3/D1.3M for sheet steel and AWS D1.1/D1.1M for stud welding. Submit qualified Welder Qualifications in accordance with AWS D1.3/D1.3M for sheet steel and AWS D1.1/D1.1M for stud welding, or under an equivalent approved qualification test. Perform tests on test pieces in positions and with clearances equivalent to those actually encountered. Test specimens shall be made in the presence of Contracting Officer and shall be tested by an approved testing laboratory at the Contractor's expense. If a test weld fails to meet requirements, perform an immediate retest of two test welds until each test weld passes. Failure in the immediate retest will require the welder be retested after further practice or training, performing a complete set of test welds.

Submit manufacturer's catalog data for Welding Equipment and Welding Rods and Accessories.

#### 1.3.4 Regulatory Requirements

##### 1.3.4.1 Fire Safety

Test roof deck as a part of a roof deck construction assembly of the type used for this project, listing as fire classified in the UL Fire Resistance, or listing as Class I construction in the FM APP GUIDE, and so labeled.

##### 1.3.4.2 Wind Storm Resistance

Provide roof construction assembly capable of withstanding a nominal uplift pressure of 90 pounds per square foot when tested in accordance with the uplift pressure test described in the FM DS 1-28R or as described in UL 580 and in general compliance with UFC 3-301-01.

##### 1.3.5 Fabrication Drawings

Show type and location of units, location and sequence of connections, bearing on supports, methods of anchoring, attachment of accessories, adjusting plate details, cant strips, ridge and valley plates, metal closure strips, size and location of holes to be cut and reinforcement to be provided, the manufacturer's erection instructions and other pertinent details.

### 1.4 DELIVERY, STORAGE, AND HANDLING

Deliver deck units to the site in a dry and undamaged condition. Store

and handle steel deck in a manner to protect it from corrosion, deformation, and other types of damage. Do not use decking for storage or as working platform until units have been fastened into position. Exercise care not to damage material or overload decking during construction. The maximum uniform distributed storage load must not exceed the design live load. Stack decking on platforms or pallets and cover with weathertight ventilated covering. Elevate one end during storage to provide drainage. Maintain deck finish at all times to prevent formation of rust. Repair deck finish using touch-up paint. Replace damaged material.

## 1.5 DESIGN REQUIREMENTS FOR ROOF DECKS

### 1.5.1 Properties of Sections

Properties of metal roof deck sections must comply with engineering design width as limited by the provisions of AISI D100.

## PART 2 PRODUCTS

### 2.1 DECK UNITS

Submit manufacturer's design calculations, or applicable published literature for the structural properties of the proposed deck units.

Recycled content of steel products: provide products with an average recycled content of steel products so postconsumer recycled content plus one half of preconsumer recycled content not less than 25 percent.

#### 2.1.1 Roof Deck

Conform to ASTM A792/A792M or ASTM A1008/A1008M for deck used in conjunction with insulation and built-up roofing. Fabricate roof deck units of 0.0295 inch design thickness or thicker steel the steel design thickness required by the design drawings and galvanized. Furnish sample of Metal Roof Deck Units used to illustrate actual cross section dimensions and configurations.

#### 2.1.2 Form Deck

Conform to ASTM A653/A653M or ASTM A1008/A1008M for deck used as formwork for concrete. Fabricate form deck of 0.015 inch design thickness or thicker steel. the steel design thickness required by the design drawings.

Provide sufficient welds, forming the steel sheets into the cellular floor deck unit, to develop the full horizontal shear at the plane where the steel sheets are joined.

Use panels of maximum possible lengths to minimize end laps. Fabricate deck units in lengths to span 3 or more supports with flush, telescoped, or nested 2 inch laps at ends, and interlocking, or nested side laps, unless otherwise indicated.

#### 2.1.3 Length of Deck Units

Provide deck units of sufficient length to span three or more spacings where possible.

#### 2.1.4 Shop Priming

Shop prime accessories and deck at the factory after coating. Clean surfaces in accordance with the manufacturer's standard procedure followed by a spray, dip or roller coat of rust-inhibitive primer, oven cured.

#### 2.1.5 Touch-Up Paint

Provide a high zinc-dust content paint for regalvanizing welds in galvanized steel conforming to ASTM A780/A780M.

Provide touch-up paint for shop-painted units , and touch-up paint for zinc-coated units of an approved galvanizing repair paint with a high-zinc dust content . Touch-up welds with paint conforming to SSPC Paint 20 in accordance with ASTM A780/A780M. Maintain finish of deck units and accessories by using touch-up paint whenever necessary to prevent the formation of rust.

### 2.2 ACCESSORIES

Provide accessories of same material as deck, unless specified otherwise. Provide manufacturer's standard type accessories, as specified.

#### 2.2.1 Adjusting Plates

Provide adjusting plates, or segments of deck units, of same thickness and configuration as deck units in locations too narrow to accommodate full size units. Provide factory cut plates of predetermined size where possible.

#### 2.2.2 End Closures

Fabricated of sheet metal by the deck manufacturer. Provide end closures minimum 0.0295 inch thick to close open ends at exposed edges of floors, parapets, end walls, eaves, and openings through deck.

#### 2.2.3 Partition Closures

Provide closures for closing voids above interior walls and partitions that are perpendicular to the direction of the configurations.

#### 2.2.4 Flexible Closure Strips for Roof Decks

Provide strips made of vulcanized, closed-cell, synthetic rubber material specified and premolded to the configuration required to provide tight-fitting closures at open ends and sides of steel roof decking.

Conforming to ASTM D1056, Grade 2A1, with the following additional properties:

Brittleness temperature of minus 40 degrees F when tested in accordance with ASTM D746.

Flammability resistance with a flame spread rating of less than 25 when tested in accordance with ASTM E84.

Resistance to ozone must be "no cracks" after exposure of a sample kept under a surface tensile strain of 25 percent to an ozone concentration of 100 parts per million of air by volume in air for 100



hours at 104 degrees F and tested in accordance with ASTM D1149.

Provide a elastomeric type adhesive as recommended by the manufacturer of the flexible closure strips.

#### 2.2.5 Closure Plates for Composite Deck

Support and retain concrete at each floor level. Provide edge closures at all edges of the slab of sufficient strength and stiffness to support the wet concrete. Provide metal closures for all openings in composite steel deck 1/4 inch and over.

#### 2.2.6 Sheet Metal Collar

Where deck is cut for passage of pipes, ducts, columns, etc., and deck is to remain exposed, provide a neatly cut sheet metal collar to cover edges of deck. Do not cut deck until after installation of supplemental supports.

#### 2.2.7 Cover Plates

Sheet metal to close panel edge and end conditions, and where panels change direction or butt. Polyethylene-coated, self-adhesive, 2 inch wide joint tape may be provided in lieu of cover plates on flat-surfaced decking butt joints.

Fabricate cover plates for abutting floor deck units from the specified structural-quality steel sheets not less than nominal 18 gage thick before galvanizing. Provide 6 inch wide cover plates and form to match the contour of the floor deck units.

#### 2.2.8 Roof Sump Pans

Sump pans must be provided for roof drains and must be minimum 0.075 inch thick steel, flat type. Shape sump pans to meet roof slope by the supplier or by a sheet metal specialist. Provide bearing flanges of sump pans to overlap steel deck a minimum of 3 inch. Shape, size, and reinforce the opening in bottom of the sump pan to receive roof drain.

#### 2.2.9 Column Closures

Sheet metal, minimum 0.0358 inch thick or metal rib lath.

#### 2.2.10 Access Hole Covers

Sheet metal, minimum 0.0474 inch thick.

#### 2.2.11 Hanger

Provide clips or loops for utility systems and suspended ceilings of one or more of the following types:

- a. Lip tabs or integral tabs where noncellular decking or flat plate of cellular section is 0.0474 inch thick or more, and a structural concrete fill is used over deck.
- b. Slots or holes punched in decking for installation of pigtails.
- c. Tabs driven from top side of decking and arranged so as not to pierce

electrical cells.

d. Decking manufacturer's standard as approved by the Contracting Officer.

#### 2.2.12 Cant Strips for Roof Decks

Fabricate cant strips from the specified commercial-quality steel sheets not less than nominal 0.0358 inch thick before galvanizing. Bend strips to form a 45-degree cant not less than 5 inches wide, with top and bottom flanges a minimum 3 inches wide. Length of strips 10 feet.

#### 2.2.13 Ridge and Valley Plates for Roof Decks

Fabricate plates from the specified structural-quality steel sheets, not less than nominal 0.0358 inch thick before galvanizing. Provide plates of minimum 4-1/2 inches wide and bent to provide tight fitting closures at ridges and valleys. Provide a minimum length of ridge and valley plates of 10 feet.

#### 2.2.14 Metal Closure Strips for Roof Decks

Fabricate strips from the specified commercial-quality steel sheets not less than nominal 0.0358 inch thick before galvanizing. Provide strips from the configuration required to provide tight-fitting closures at open ends and sides of steel roof decking.

#### 2.2.15 Galvanized Steel Angles for Roof Decks

Provide hot-rolled carbon steel angles conforming to ASTM A36/A36M, and hot-dip galvanized in accordance with ASTM A123/A123M.

#### 2.2.16 Miscellaneous Accessories

Furnish the manufacturer's standard accessories to complete the deck installation. Furnish metal accessories of the same material as the deck and with the minimum design thickness as follows: saddles, 0.0474 inch welding washers, 0.0598 inch other metal accessories, 0.0358 inch unless otherwise indicated.

### PART 3 EXECUTION

#### 3.1 EXAMINATION

Prior to installation of decking units and accessories, examine worksite to verify that as-built structure will permit installation of decking system without modification.

#### 3.2 INSTALLATION

Install steel deck units in accordance with 29 CFR 1926, Subpart R - Steel Erection, ANSI/SDI QA/QC, ANSI/SDI C and approved shop drawings. Place units on structural supports, properly adjusted, leveled, and aligned at right angles to supports before permanently securing in place. Damaged deck and accessories including material which is permanently stained or contaminated, deformed, or with burned holes shall not be installed. Extend deck units over three or more supports unless absolutely impractical. Report inaccuracies in alignment or leveling to the Contracting Officer and make necessary corrections before permanently anchoring deck units. Locate deck ends over supports only. Lap 2 inch deck ends. Do not use unanchored deck units as a work or storage

platform. Permanently anchor units placed by the end of each working day. Do not support suspended ceilings, light fixtures, ducts, utilities, or other loads by steel deck unless indicated. Distribute loads by appropriate means to prevent damage. Prepare shoring in position before concrete placement begins in composite or form deck.

### 3.2.1 Attachment

Immediately after placement and alignment, and after correcting inaccuracies, permanently fasten steel deck units to structural supports and to adjacent deck units by welding with normal 5/8 inch diameter puddle welds, fastened with screws, powder-actuated fasteners, or pneumatically driven fasteners as indicated on the design drawings and in accordance with manufacturer's recommended procedure. Clamp or weight deck units to provide firm contact between deck units and structural supports while performing welding or fastening. Anchoring the deck to structural supports with powder-actuated fasteners or pneumatically driven fasteners is prohibited. Attachment of adjacent deck units by button-punching is prohibited.

#### 3.2.1.1 Welding

Perform welding in accordance with AWS D1.3/D1.3M using methods and electrodes recommended by the manufacturers of the base metal alloys being used. Ensure only operators previously qualified by tests prescribed in AWS D1.3/D1.3M make welds. Immediately recertify, or replace qualified welders, that are producing unsatisfactory welding. Conform to the recommendations of the Steel Deck Institute and the steel deck manufacturer for location, size, and spacing of fastening. Do not use welding washers at the connections of the deck to supports. Do not use welding washers at sidelaps. Holes and similar defects will not be acceptable. Attach all partial or segments of deck units to structural supports in accordance with Section 2.5 of SDI DDMO3. Immediately clean welds by chipping and wire brushing. Heavily coat welds, cut edges and damaged portions of coated finish with zinc-dust paint conforming to ASTM A780/A780M .

#### 3.2.1.2 Mechanical Fastening

Anchor deck to structural supports and adjoining units with mechanical fasteners. Drive the powder-actuated fasteners with a low-velocity piston tool by an operator authorized by the manufacturer of the powder-actuated tool. Drive pneumatically fasteners with a low-velocity fastening tool and comply with the manufacturer's recommendations. Drive screws to properly clamp desk to supporting steel.

#### 3.2.1.3 Sidelap Fastening

Lock sidelaps between adjacent floor deck units together by welding or screws as indicated.

### 3.2.2 Openings

Cut or drill all holes and openings required and be coordinated with the drawings, specifications, and other trades. Frame and reinforce openings through the deck in conformance with SDI DDP. Reinforce sheet at least 12 inch wider and longer than the opening and be fastened to the steel deck at each corner of the sheet and at a maximum of 6 inch on center. Reinforce holes and openings larger than 12 inch by steel channels or angles installed perpendicular to the steel joists and supported by the

adjacent steel joists. Install steel channels or angles perpendicular to the deck ribs and fasten to the channels or angles perpendicular to the steel joists. Deck manufacturer shall approve holes or openings larger than 6 inch in diameter prior to drilling or cutting. Openings must not interfere with seismic members such as chords and drag struts.

### 3.2.3 Deck Damage

SDI MOC2, for repair of deck damage.

### 3.2.4 Touch-Up Paint

#### 3.2.4.1 Roof Deck

After roof decking installation, wire brush, clean, and touchup paint the scarred areas on top and bottom surfaces of metal roof decking. The scarred areas include welds, weld scars, bruises, and rust spots. Touchup galvanized surfaces with galvanizing repair paint. Touchup painted surfaces with repair paint of painted surfaces.

#### 3.2.4.2 Floor Deck

For floor decking installation, wire brush, clean, and touchup paint the scarred areas on the top and bottom surfaces of the metal floor decking and on the surface of supporting steel members. Include welds, weld scars, bruises, and rust spots for scarred areas. Touched up the galvanized surfaces with galvanizing repair paint. Touch up the painted surfaces with paint for the repair of painted surfaces.

### 3.2.5 Accessory Installation

#### 3.2.5.1 Adjusting Plates

Provide in locations too narrow to accommodate full-size deck units and install as shown on shop drawings.

#### 3.2.5.2 End Closures

Provide end closure to close open ends of cells at columns, walls, and openings in deck.

#### 3.2.5.3 Closures Above Partitions

Provide for closing voids between cells over partitions that are perpendicular to direction of cells. Provide a one-piece closure strip for partitions 4 inch nominal or less in thickness and two-piece closure strips for wider partitions. Provide sheet metal closures above fire-rated partitions at both sides of partition with space between filled with fiberglass insulation. Provide flexible rubber closures above acoustic-rated partitions at both sides of partition with space between filled with blanket insulation.

#### 3.2.5.4 Cover Plates

Provide metal cover plates, or joint tape, at joints between cellular decking sheets to be used as electrical raceways. Where concrete leakage would be a problem, provide metal cover plates, or joint tape, at joints between decking sheets, cellular or noncellular, to be covered with concrete fill.

#### 3.2.5.5 Column Closures

Provide for spaces between floor decking and columns which penetrate the deck. Field cut closure plate to fit column in the field and tack weld to decking and columns.

#### 3.2.5.6 Access Hole Covers

Provide access whole covers to seal holes cut in decking to facilitate welding of the deck to structural supports.

#### 3.2.5.7 Hangers

Provide as indicated to support utility system and suspended ceilings. Space devices as indicated .

#### 3.2.6 Concrete Work

Prior to placement of concrete, inspect installed decking to ensure that there has been no permanent deflection or other damage to decking. Replace decking which has been damaged or permanently deflected as approved by the Contracting Officer. Place concrete on metal deck in accordance with Construction Practice of ANSI/SDI C or ANSI/SDI NC.

#### 3.3 ROOF SUMP PANS

Place sump pans over openings in roof decking and fusion welded to top surface of roof decking. Do not exceed spacing of welds of 12 inch with not less than one weld at each corner. Field cut opening in the bottom of each roof sump pan to receive the roof drain as part of the work of this section.

#### 3.4 CANT STRIPS FOR ROOF DECKS

Provide strips to be fusion welded to surface of roof decking, secured to wood nailers by galvanized screws or to steel framing by galvanized self-tapping screws or welds. Do not exceed spacing of welds and fasteners of 12 inches. Lap end joints a minimum 3 inches and secure with galvanized sheet metal screws spaced a maximum 4 inches on center.

#### 3.5 RIDGE AND VALLEY PLATES FOR ROOF DECKS

Provide plates to be fusion welded to top surface of roof decking. Lap end joints a minimum 3 inches. For valley plates, provide endlaps to be in the direction of water flow.

#### 3.6 CLOSURE STRIPS FOR ROOF DECKS

Provide closure strips at open, uncovered ends and edges of the roof decking and in voids between roof decking and top of walls and partitions where indicated. Install closure strips in position in a manner to provide a weathertight installation.

#### 3.7 ROOF INSULATION SUPPORT FOR ROOF DECKS

Provide metal closure strips for support of roof insulation where rib openings in top surface of metal roof decking occur adjacent to edges and openings. Weld metal closure strips in position.

### 3.8 CLEANING AND PROTECTION FOR ROOF DECKS

Upon completion of the deck, sweep surfaces clean and prepare for installation of the roofing.

### 3.9 FIELD QUALITY CONTROL

#### 3.9.1 Headed Stud Inspection

In addition to visual inspection, test and inspect shop-welded shear connectors according to requirements in AWS D1.1/D1.1M for stud welding and as follows:

- a. Perform bend tests if visual inspections reveal either a less-than-continuous 360-degree flash or welding repairs to any shear connector.
- b. Conduct tests according to requirements in AWS D1.1/D1.1M on additional shear connectors if weld fracture occurs on shear connectors already tested.

#### 3.9.2 Deck Weld Inspection

Visual inspect welds in accordance with AWS D1.3/D1.3M.

#### 3.9.3 Decks Not Receiving Concrete

Inspect the decking top surface for distortion after installation. For roof decks not receiving concrete, verify distortion by placing a straight edge across three adjacent top flanges. The maximum allowable gap between the straight edge and the top flanges should not exceed manufacturing and construction tolerances of supporting members. When gap is more than the allowable, provide corrective measures or replacement. Reinspect decking after performing corrective measures or replacement.

-- End of Section --

SECTION 05 40 00

COLD-FORMED METAL FRAMING

05/15

PART 1 GENERAL

1.1 REFERENCES

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

AMERICAN CONCRETE INSTITUTE INTERNATIONAL (ACI)

ACI 318 (2014; Errata 1-2 2014; Errata 3-5 2015; Errata 6 2016; Errata 7-9 2017) Building Code Requirements for Structural Concrete (ACI 318-14) and Commentary (ACI 318R-14)

AMERICAN IRON AND STEEL INSTITUTE (AISI)

AISI S100 (2012) North American Specification for the Design of Cold-Formed Steel Structural Members

AISI S110 (2007; Suppl 1; Reaffirmed 2012) Standard for Seismic Design of Cold-Formed Steel Structural Systems - Special Bolted Moment Frames

AISI S200 (2007) North American Standard for Cold-Formed Steel Framing - General Provision

AISI S201 (2007) North American Standard for Cold-Formed Steel Framing - Product Data

AISI S202 (2011) Code of Standard Practice for Cold-formed Steel Structural Framing

AISI S211 (2007) North American Standard for Cold-Formed Steel Framing - Wall Stud Design

AISI S212 (2007) North American Standard for Cold-Formed Steel Framing - Header Design

AISI S213 (2007; Suppl 1 2009) North American Standard for Cold-Formed Steel Framing - Lateral Design

AISI S214 (2012) North American Standard for Cold-Formed Steel Framing - Truss Design

AMERICAN WELDING SOCIETY (AWS)

AWS D1.1/D1.1M (2015; Errata 1 2015; Errata 2 2016)

Structural Welding Code - Steel

AWS D1.3/D1.3M (2008; Errata 2008) Structural Welding  
Code - Sheet Steel

ASTM INTERNATIONAL (ASTM)

ASTM A1003/A1003M (2015) Standard Specification for Steel  
Sheet, Carbon, Metallic- and  
Nonmetallic-Coated for Cold-Formed Framing  
Members

ASTM A123/A123M (2017) Standard Specification for Zinc  
(Hot-Dip Galvanized) Coatings on Iron and  
Steel Products

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

ASTM A307 (2014; E 2017) Standard Specification for  
Carbon Steel Bolts, Studs, and Threaded  
Rod 60 000 PSI Tensile Strength

ASTM A370 (2016) Standard Test Methods and  
Definitions for Mechanical Testing of  
Steel Products

ASTM A653/A653M (2017) Standard Specification for Steel  
Sheet, Zinc-Coated (Galvanized) or  
Zinc-Iron Alloy-Coated (Galvannealed) by  
the Hot-Dip Process

ASTM C1007 (2011a) Standard Specification for  
Installation of Load Bearing (Transverse  
and Axial) Steel Studs and Related  
Accessories

ASTM C1513 (2013) Standard Specification for Steel  
Tapping Screws for Cold-Formed Steel  
Framing Connections

ASTM C955 (2017) Standard Specification for  
Cold-Formed Steel Structural Framing  
Members

ASTM E119 (2016a) Standard Test Methods for Fire  
Tests of Building Construction and  
Materials

ASTM E329 (2014a) Standard Specification for  
Agencies Engaged in the Testing and/or  
Inspection of Materials Used in  
Construction

ASTM E488/E488M (2015) Standard Test Methods for Strength  
of Anchors in Concrete and Masonry Elements

ASTM F1554 (2015; E 2016; E 2017) Standard



Specification for Anchor Bolts, Steel, 36,  
55, and 105-ksi Yield Strength

ASTM F1941

(2010) Standard Specification for  
Electrodeposited Coatings on Threaded  
Fasteners (Unified Inch Screw Threads  
(UN/UNR))

ASTM F2329

(2013) Zinc Coating, Hot-Dip, Requirements  
for Application to Carbon and Alloy Steel  
Bolts, Screws, Washers, Nuts, and Special  
Threaded Fasteners

INTERNATIONAL CODE COUNCIL (ICC)

ICC IBC

(2017) International Building Code

U.S. DEPARTMENT OF DEFENSE (DOD)

UFC 3-301-01

(2013; with Change 3) Structural  
Engineering

## 1.2 SUBMITTALS

Government approval is required for submittals with a "G" designation; submittals not having a "G" designation are for information only. When used, a designation following the "G" designation identifies the office that will review the submittal for the Government. Submittals with an "S" are for inclusion in the Sustainability eNotebook, in conformance to Section 01 33 29, SUSTAINABILITY REPORTING. Submit the following in accordance with Section 01 33 00 SUBMITTAL PROCEDURES:

SD-02 Shop Drawings

Framing Components; G

SD-03 Product Data

Steel Studs, Joists, Tracks, Bracing, Bridging and Accessories

SD-05 Design Data

Metal Framing Calculations; G

SD-07 Certificates

Load-Bearing Cold-Formed Metal Framing

Welds

SD-11 Closeout Submittals

Recycled Content of Steel Products; S

## 1.3 DELIVERY, STORAGE, AND HANDLING

Steel framing and related accessories shall be stored and handled in accordance with the AISI S202, "Code of Standard Practice for Cold-Formed Steel Structural Framing".

#### 1.4 LOAD-BEARING COLD-FORMED METAL FRAMING

Include top and bottom tracks, bracing, fastenings, and other accessories necessary for complete installation. Framing members shall have the structural properties indicated. Where physical structural properties are not indicated, they shall be as necessary to withstand all imposed loads. Design framing in accordance with AISI S100.

Submit mill certificates or test reports from independent testing agency, qualified in accordance with ASTM E329, showing that the steel sheet used in the manufacture of each cold-formed component complies with the minimum yield strengths and uncoated steel thickness specified. Test reports shall be based on the results of three coupon tests in accordance with ASTM A370.

#### 1.5 MAXIMUM DEFLECTION

Deflections of structural members shall not exceed the more restrictive of the limitations of ICC IBC and UFC 3-301-01.

#### 1.6 QUALITY ASSURANCE

- a. Engineering Responsibility: Preparation of Shop Drawings, design calculations, and other structural data by a registered professional engineer.
- b. Testing Agency Qualifications: An independent testing agency, acceptable to authorities having jurisdiction, qualified according to ASTM E329 for testing indicated.
- c. Product Tests: Mill certificates or data from a qualified independent testing agency indicating steel sheet complies with requirements, including base-metal thickness, yield strength, tensile strength, total elongation, chemical requirements, and metallic-coating thickness.
- d. Welding Qualifications: Qualify procedures and personnel according to the following:
  - (1) AWS D1.1/D1.1M, "Structural Welding Code - Steel".
  - (2) AWS D1.3/D1.3M, "Structural Welding Code - Sheet Steel".
- e. Fire-Test-Response Characteristics: Where indicated, provide cold-formed metal framing identical to that of assemblies tested for fire resistance per ASTM E119 by, and displaying a classification label from, a testing and inspecting agency acceptable to authorities having jurisdiction.
- f. AISI Specifications and Standards: Comply with:
  - (1) AISI S100, "North American Specification for the Design of Cold-Formed Steel Structural Members".
  - (2) AISI S110, "Standard for Seismic Design of Cold-Formed Steel Structural Systems - Special Bolted Moment Frames".
  - (3) AISI S200, "North American Standard for Cold-Formed Steel Framing

- General Provision".
- (4) AISI S201, "North American Standard for Cold-Formed Steel Framing - Product Data".
- (5) AISI S202, "Code of Standard Practice for Cold-Formed Steel Structural Framing".
- (6) AISI S211, "North American Standard for Cold-Formed Steel Framing - Wall Stud Design".
- (7) AISI S212, "North American Standard for Cold-Formed Steel Framing - Header Design".
- (8) AISI S213, "North American Standard for Cold-Formed Steel Framing - Lateral Design".
- (9) AISI S214, "North American Standard for Cold-Formed Steel Framing - Truss Design".

#### 1.6.1 Drawing Requirements

Submit framing components to show sizes, thicknesses, layout, material designations, methods of installation, and accessories including the following:

- a. Cross sections, plans, and/or elevations showing component types and locations for each framing application; including shop coatings and material thicknesses for each framing component.
- b. Connection details showing fastener type, quantity, location, and other information to assure proper installation.
- c. Drawings depicting panel configuration, dimensions, components, locations, and construction sequence if the Contractor elects to install prefabricated/prefinished frames.

Sign and seal fabrication drawings by a registered professional engineer.

#### 1.6.2 Design Data Required

Submit metal framing calculations with design criteria and structural loading to verify sizes, thickness, and spacing of members and connections signed and sealed by a registered professional engineer. Show methods and practices used in installation.

## PART 2 PRODUCTS

### 2.1 STEEL STUDS, JOISTS, TRACKS, BRACING, BRIDGING AND ACCESSORIES

Framing components shall comply with ASTM C955 and the following.

- a. Recycled Content of Steel Products: Provide products with an average recycled content of steel products so postconsumer recycled content plus one half of preconsumer recycled content not less than 25 percent.
- b. Steel Sheet: ASTM A1003/A1003M, Structural Grade, Type H, metallic coated, of grade and coating weight as follows:

- (1) Grade: As required by structural performance.
  - (2) Coating: G90 (Z275).
  - c. Steel Studs: Manufacturer's standard C-shaped steel studs, of web depths indicated, punched, with stiffened flanges, and as follows:
    - (1) Minimum Base-Metal Thickness: 0.0329 inch.
    - (2) Flange Width: 1-5/8 inches.
  - d. Steel Track: Manufacturer's standard U-shaped steel track, of web depths indicated, unpunched, with straight flanges, and as follows:
    - (1) Minimum Base-Metal Thickness: 0.0329 inch.
    - (2) Flange Width: 1-1/4 inches.
- 2.1.1 Studs and Joists of 54 mils (0.054 Inch) and Heavier
- Galvanized steel, ASTM A653/A653M and ASTM A1003/A1003M, SS Grade 50, G90.
- 2.1.2 Studs and Joists of 43 mils (0.043 Inch) and Lighter
- Studs and Joists of 43 mils (0.043 Inch) and Lighter, Track, and Accessories (All thicknesses): Galvanized steel, ASTM A653/A653M and ASTM A1003/A1003M, SS, Grade 33 33,000 psi G60.
- 2.1.3 Sizes, Thickness, Section Modulus, and Other Structural Properties
- Size and thickness as required.
- 2.2 MARKINGS
- Studs and track shall have product markings stamped on the web of the section. The markings shall be repeated throughout the length of the member at a maximum spacing of 4 feet on center and shall be legible and easily read. The product marking shall include the following:
- a. An ICC number.
  - b. Manufacturer's identification.
  - c. Minimum delivered uncoated steel thickness.
  - d. Protective coating designator.
  - e. Minimum yield strength.
- 2.3 CONNECTIONS
- 2.3.1 Steel-To-Concrete Connections
- a. Anchor Rods: ASTM F1554, Grade 55; galvanized per ASTM A153/A153M.
  - b. Post-Installed Concrete Anchors: Adhesive or expansion anchors fabricated from corrosion-resistant materials with allowable load capacities in accordance with ICC-ES AC193 and ACI 318 greater than or equal to the design load as determined by testing per ASTM E488/E488M

conducted by a qualified testing agency.

- c. Power-Actuated Fasteners: Fabricated from corrosion-resistant materials with allowable load capacities in accordance with ICC-ES AC 70 greater than or equal to the design load as determined by testing per ASTM E1190 conducted by a qualified testing agency

#### 2.3.2 Steel-To-Steel Connections

- a. Screws: ASTM C1513, corrosion-resistant-coated, self-drilling, self-tapping steel screws of the type and size indicated. Provide low-profile head beneath sheathing and manufacturer's standard elsewhere. Electroplated to a minimum of 5 micron zinc coating per ASTM F1941 or hot-dipped galvanized per ASTM A123/A123M or ASTM A153/A153M.
- b. Bolts: ASTM A307 coated by hot-dip process per ASTM F2329 or zinc-coated by mechanical-deposition process per ASTM B695, Class 55.
- c. Welding Electrodes: Comply with AWS standards.

#### 2.4 PLASTIC GROMMETS

Supply plastic grommets for stud webs as recommended by stud manufacturer, to protect electrical wires and plumbing piping. Prevent metal-to-metal contact between wiring/piping and studs.

#### 2.5 SEALER GASKET

Closed-cell neoprene foam, 1/4-inch thick, selected from manufacturer's standard widths to match width of bottom track on concrete slab or foundation.

### PART 3 EXECUTION

#### 3.1 TRUSS FABRICATION

- a. Fabricate cold-formed steel trusses and accessories plumb, square, and true to line, and with connections securely fastened, according to referenced AISI's specifications and standards, manufacturer's written instructions, and requirements in this Section.
- b. Truss must be fabricated either on site or off site prior to erection.
- c. Fabricate trusses using jigs or templates.
- d. Splices can only occur at joints.
- e. Cut truss members by sawing or shearing: do not torch cut.
- f. Fasten cold-formed steel truss members by welding, screw fastening, clinch fastening, pneumatic pin fastening, or riveting as standard with fabricator.
- g. Fasten other materials to cold-formed steel trusses by welding, bolting, pneumatic pin fastening, or screw fastening, according to Shop Drawings.
- h. Reinforce, stiffen, and brace trusses to withstand handling, delivery,

and erection stresses. Lift fabricated trusses to prevent damage or permanent distortion.

### 3.2 FASTENING

Fasten framing members together by welding or by using self-drilling, self-tapping screws. Electrodes and screw connections shall be as required and indicated in the design calculations.

#### 3.2.1 Welds

All welding shall be performed in accordance with AWS D1.3/D1.3M, as modified by AISI S100. All welders, welding operations, and welding procedures shall be qualified according to AWS D1.3/D1.3M. Submit certified copies of welder qualifications test records showing qualification in accordance with AWS D1.3/D1.3M. All welds shall be cleaned and coated with rust inhibitive galvanizing paint. Do not field weld materials lighter than 43 mils.

#### 3.2.2 Screws

Screws shall be of the self-drilling self-tapping type, size, and location as required. Screw penetration through joined materials shall not be less than three exposed threads. Minimum spacings and edge distances for screws shall be as specified in AISI S100. Screws covered by sheathing materials shall have low profile heads.

#### 3.2.3 Anchors

Anchors shall be of the type, size, and location as required.

#### 3.2.4 Powder-Actuated Fasteners

Powder-actuated fasteners shall be of the type, size, and location as required.

### 3.3 INSTALLATION

Install cold-formed framing in accordance with ASTM C1007 and AISI S200.

Install cold-formed steel framing according to AISI S202 and to manufacturer's written instructions unless more stringent requirements are indicated.

#### 3.3.1 Tracks

Provide accurately aligned runners at top and bottom of studs. Install sealer gasket under bottom of track on concrete slab or foundation. Anchor tracks as indicated in design calculations. Butt weld joints in tracks or splice with stud inserts. Fasteners shall be at least 3 inches from the edge of concrete slabs.

#### 3.3.2 Studs

Cut studs square and set with firm bearing against webs of top and bottom tracks. Position studs vertically in tracks and space as indicated in design. Do not splice studs. Provide at least two studs at jambs of doors and other openings 2 feet wide or larger. Provide jack studs over openings, as necessary, to maintain indicated stud spacing. Provide

tripled studs at corners, positioned to receive interior and exterior finishes. Fasten studs to top and bottom tracks by welding or screwing both flanges to the tracks. Framed wall openings shall include headers and supporting components as shown on the drawings. Headers shall be installed in all openings that are larger than the stud spacing in a wall. In curtain wall construction, provide for vertical movement where studs connect to the structural frame. Provide horizontal bracing in accordance with the design calculations and AISI S100. Bracing shall be not less than the following:

<u>LOAD</u>	<u>HEIGHT</u>	<u>BRACING</u>
Wind load only	Up to 10 feet	One row at mid-height
	Over 10 feet	Rows 5'-0" o.c. maximum
Axial load	Up to 10 feet	Two rows at 1/3 points
	Over 10 feet	Rows 3'-4" o.c. maximum

### 3.3.3 Joists and Trusses

- a. Provide a stud directly under each joist or truss. The maximum spacing of studs as indicated shall be maintained.
- b. Install, bridge, and brace cold-formed steel trusses according to AISI S200, AISI S214, AISI's "Code of Standard Practice for Cold-Formed Steel Structural Framing," and manufacturer's written instructions unless more stringent requirements are indicated.
- c. Install temporary bracing and supports. Maintain braces and supports in place, undisturbed, until entire integrated supporting structure has been completed and permanent connections to framing are secured.
- d. Do not alter, cut, or remove framing members or connections of trusses.

### 3.3.4 Erection Tolerances

- a. Framing members which will be covered by finishes such as wallboard, plaster, or ceramic tile set in a mortar setting bed, shall be within the following limits:
  - (1) Layout of walls and partitions: 1/4 inch from intended position;
  - (2) Plates and runners: 1/4 inch in 8 feet from a straight line;
  - (3) Studs: 1/4 inch in 8 feet out of plumb, not cumulative; and
  - (4) Face of framing members: 1/4 inch in 8 feet from a true plane.
- b. Framing members which will be covered by ceramic tile set in dry-set

mortar, latex-portland cement mortar, or organic adhesive shall be within the following limits:

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

-- End of Section --



SECTION 05 50 13

MISCELLANEOUS METAL FABRICATIONS  
**05/17**

PART 1 GENERAL

1.1 REFERENCES

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

ALUMINUM ASSOCIATION (AA)

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

AMERICAN SOCIETY OF SAFETY ENGINEERS (ASSE/SAFE)

ASSE/SAFE A10.3 (2013) Operations - Safety Requirements  
for Powder Actuated Fastening Systems

AMERICAN WELDING SOCIETY (AWS)

AWS D1.1/D1.1M (2015; Errata 1 2015; Errata 2 2016)  
Structural Welding Code - Steel

ASME INTERNATIONAL (ASME)

ASME B18.2.1 (2012; Errata 2013) Square and Hex Bolts  
and Screws (Inch Series)

ASME B18.2.2 (2015) Nuts for General Applications:  
Machine Screw Nuts, Hex, Square, Hex  
Flange, and Coupling Nuts (Inch Series)

ASME B18.21.1 (2009; R 2016) Washers: Helical  
Spring-Lock, Tooth Lock, and Plain Washers  
(Inch Series)

ASME B18.21.2M (1999; R 2014) Lock Washers (Metric Series)

ASME B18.22M (1981; R 2017) Metric Plain Washers

ASME B18.6.2 (1998; R 2010) Slotted Head Cap Screws,  
Square Head Set Screws, and Slotted  
Headless Set Screws: Inch Series

ASME B18.6.3 (2013; R 2017) Machine Screws, Tapping  
Screws, and Machine Drive Screws (Inch  
Series)

ASTM INTERNATIONAL (ASTM)

ASTM A123/A123M (2017) Standard Specification for Zinc  
(Hot-Dip Galvanized) Coatings on Iron and  
Steel Products

ASTM A153/A153M	(2016) Standard Specification for Zinc Coating (Hot-Dip) on Iron and Steel Hardware
ASTM A307	(2014; E 2017) Standard Specification for Carbon Steel Bolts, Studs, and Threaded Rod 60 000 PSI Tensile Strength
ASTM A36/A36M	(2014) Standard Specification for Carbon Structural Steel
ASTM A467/A467M	(2007; R 2012) Standard Specification for Machine Coil Chain
ASTM A47/A47M	(1999; R 2014) Standard Specification for Ferritic Malleable Iron Castings
ASTM A475	(2003; R 2014) Standard Specification for Zinc-Coated Steel Wire Strand
ASTM A500/A500M	(2013) Standard Specification for Cold-Formed Welded and Seamless Carbon Steel Structural Tubing in Rounds and Shapes
ASTM A53/A53M	(2012) Standard Specification for Pipe, Steel, Black and Hot-Dipped, Zinc-Coated, Welded and Seamless
ASTM A653/A653M	(2017) Standard Specification for Steel Sheet, Zinc-Coated (Galvanized) or Zinc-Iron Alloy-Coated (Galvannealed) by the Hot-Dip Process
ASTM A666	(2015) Standard Specification for Annealed or Cold-Worked Austenitic Stainless Steel Sheet, Strip, Plate and Flat Bar
ASTM A780/A780M	(2009; R 2015) Standard Practice for Repair of Damaged and Uncoated Areas of Hot-Dip Galvanized Coatings
ASTM A786/A786M	(2015a) Standard Specification for Hot-Rolled Carbon, Low-Alloy, High-Strength Low-Alloy, and Alloy Steel Floor Plates
ASTM A924/A924M	(2017a) Standard Specification for General Requirements for Steel Sheet, Metallic-Coated by the Hot-Dip Process
ASTM B108/B108M	(2015) Standard Specification for Aluminum-Alloy Permanent Mold Castings
ASTM B209M	(2014) Standard Specification for Aluminum and Aluminum-Alloy Sheet and Plate (Metric)
ASTM B221	(2014) Standard Specification for Aluminum

and Aluminum-Alloy Extruded Bars, Rods,  
Wire, Profiles, and Tubes

ASTM C1513 (2013) Standard Specification for Steel  
Tapping Screws for Cold-Formed Steel  
Framing Connections

ASTM D1187/D1187M (1997; E 2011; R 2011) Asphalt-Base  
Emulsions for Use as Protective Coatings  
for Metal

MASTER PAINTERS INSTITUTE (MPI)

MPI 79 (2012) Primer, Alkyd, Anti-Corrosive for  
Metal

NATIONAL ASSOCIATION OF ARCHITECTURAL METAL MANUFACTURERS (NAAMM)

NAAMM MBG 531 (2009) Metal Bar Grating Manual

NAAMM MBG 532 (2009) Heavy Duty Metal Bar Grating Manual

SOCIETY FOR PROTECTIVE COATINGS (SSPC)

SSPC SP 3 (1982; E 2004) Power Tool Cleaning

SSPC SP 6/NACE No.3 (2007) Commercial Blast Cleaning

U.S. ARMY CORPS OF ENGINEERS (USACE)

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

## 1.2 SUBMITTALS

Government approval is required for submittals with a "G" designation; submittals not having a "G" designation are for information only. When used, a designation following the "G" designation identifies the office that will review the submittal for the Government. Submittals with an "S" are for inclusion in the Sustainability eNotebook, in conformance with Section 01 33 29 SUSTAINABILITY REPORTING. Submit the following in accordance with Section 01 33 00 SUBMITTAL PROCEDURES:

### SD-02 Shop Drawings

Cover Plates and Frames, Installation Drawings; G

Expansion Joint Covers, Installation Drawings; G

Elevator Pit Gratings and Frame, Installation Drawings; G

Floor Gratings, Installation Drawings; G

Bollards/Pipe Guards

Embedded Angles and Plates, Installation Drawings

Structural Steel Security Gates and Frames, Installation Drawings;  
G

Roof Hatches, Installation Drawings; G

SD-03 Product Data

Corner Guards

Cover Plates and Frames; G

Expansion Joint Covers; G

Elevator Pit Gratings and Frame; G

Floor Gratings; G

Floor Access Hatch

Roof Hatches; G

Each Downspout Terminations Type; G

SD-04 Samples

Expansion Joint Covers

SD-07 Certificates

Certificates of Compliance; G

Certified Mill Test Reports for Chemistry and Mechanical  
Properties; G

SD-11 Closeout Submittals

Recycled Content; S

1.3 QUALIFICATION OF WELDERS

Qualify welders in accordance with AWS D1.1/D1.1M. Use procedures, materials, and equipment of the type required for the work.

1.4 DELIVERY, STORAGE, AND PROTECTION

Protect from corrosion, deformation, and other types of damage. Store items in an enclosed area free from contact with soil and weather. Remove and replace damaged items with new items.

PART 2 PRODUCTS

2.1 RECYCLED CONTENT

Provide products with recycled content and provide certificates of compliance in accordance with Section 01 33 29 SUSTAINABILITY REPORTING.

2.2 MATERIALS

Provide exposed fastenings of compatible materials (avoid contact of dissimilar metals). Coordinate color and finish with the material to which fastenings are applied. Submit the manufacturer's certified mill

reports which clearly show the applicable ASTM mechanical and chemical requirements together with the actual test results for the supplied materials.

#### 2.2.1 Structural Carbon Steel

Provide in accordance with ASTM A36/A36M.

#### 2.2.2 Structural Tubing

Provide in accordance with ASTM A500/A500M.

#### 2.2.3 Steel Pipe

Provide in accordance with ASTM A53/A53M, Type E or S, Grade B.

#### 2.2.4 Fittings for Steel Pipe

Provide standard malleable iron fittings in accordance with ASTM A47/A47M.

#### 2.2.5 Gratings

ca Provide metal bar type grating in accordance with NAAMM MBG 531.

#### 2.2.6 Floor Plates, Patterned

Provide floor plate in accordance with ASTM A786/A786M. Provide steel plate not less than 14 gage.

#### 2.2.7 Anchor Bolts

Provide in accordance with ASTM A307. Where exposed, provide anchor bolts of the same material, color, and finish as the metal to which they are applied.

##### 2.2.7.1 Expansion Anchors, Sleeve Anchors and Adhesive Anchors

Provide type and diameter as indicated. Minimum embedment shall be in accordance with the ICC ESR report for anchors.

##### 2.2.7.2 Lag Screws and Bolts

Provide in accordance with ASME B18.2.1, type and grade best suited for the purpose.

##### 2.2.7.3 Toggle Bolts

Provide in accordance with ASME B18.2.1.

##### 2.2.7.4 Bolts, Nuts, Studs and Rivets

Provide in accordance with ASME B18.2.2 or ASTM A307.

##### 2.2.7.5 Powder Actuated Fasteners

Follow safety provisions in accordance with ASSE/SAFE A10.3.

#### 2.2.7.6 Screws

Provide in accordance with ASME B18.2.1, ASME B18.6.2, ASME B18.6.3 and ASTM C1513.

#### 2.2.7.7 Washers

Provide plain washers in accordance with ASME B18.22M, ASME B18.21.1. Provide beveled washers for American Standard beams and channels, square or rectangular, tapered in thickness, and smooth. Provide lock washers in accordance with ASME B18.21.2M, ASME B18.21.1.

#### 2.2.8 Aluminum Alloy Products

Provide in accordance with ASTM B209M, for sheet plate, ASTM B221 for extrusions and ASTM B108/B108M for castings. Provide aluminum extrusions at least 1/8 inch thick and aluminum plate or sheet at least 0.050 inch thick.

### 2.3 FABRICATION FINISHES

#### 2.3.1 Galvanizing

Hot-dip galvanize items specified to be zinc-coated, after fabrication where practicable. Provide galvanizing in accordance with ASTM A123/A123M, ASTM A153/A153M, ASTM A653/A653M or ASTM A924/A924M, Z275 G90.

#### 2.3.2 Galvanize

Anchor bolts, grating fasteners, washers, and parts or devices necessary for proper installation, unless indicated otherwise.

#### 2.3.3 Repair of Zinc-Coated Surfaces

Repair damaged surfaces with galvanizing repair method and paint in accordance with ASTM A780/A780M or by application of stick or thick paste material specifically designed for repair of galvanizing, as approved by Contracting Officer. Clean areas to be repaired and remove slag from welds. Heat, surfaces to which stick or paste material will be applied. Heat to a temperature sufficient to melt the metals in the stick or paste. Spread molten material uniformly over surfaces to be coated and wipe off excess material.

#### 2.3.4 Shop Cleaning and Painting

##### 2.3.4.1 Surface Preparation

Blast clean surfaces in accordance with SSPC SP 6/NACE No.3. Surfaces that will be exposed in spaces above ceiling or in attic spaces, crawl spaces, furred spaces, and chases may be cleaned in accordance with SSPC SP 3 in lieu of being blast cleaned. Wash cleaned surfaces which become contaminated with rust, dirt, oil, grease, or other contaminants with solvents until thoroughly clean. Steel to be embedded in concrete must be free of dirt and grease prior to embed. Do not paint or galvanize bearing surfaces, including contact surfaces within slip critical joints. Shop coat these surfaces with rust prevention.

#### 2.3.4.2 Pretreatment, Priming and Painting

Apply pre-treatment, primer, and paint in accordance with manufacturer's printed instructions. On surfaces concealed in the finished construction or not accessible for finish painting, apply an additional prime coat to a minimum dry film thickness of 1.0 mil. Tint additional prime coat with a small amount of tinting pigment.

#### 2.3.5 Nonferrous Metal Surfaces

Protect by plating, anodic, or organic coatings.

#### 2.3.6 Aluminum Surfaces

##### 2.3.6.1 Surface Condition

Before finishes are applied, remove roll marks, scratches, rolled-in scratches, kinks, stains, pits, orange peel, die marks, structural streaks, and other defects which will affect uniform appearance of finished surfaces.

##### 2.3.6.2 Aluminum Finishes

Unexposed sheet, plate and extrusions may have mill finish as fabricated. Sandblast castings' finish, medium, AA DAF45. Unless otherwise specified, provide all other aluminum items with a clear anodized finish. Provide a coating thickness not less than that specified for protective and decorative type finishes for items used in interior locations or architectural Class I type finish for items used in exterior locations. Provide in accordance with AA DAF45. Provide a polished satin finish on items to be anodized.

#### 2.4 ACCESS DOORS AND PANELS

Provide flush type access doors and panels unless otherwise indicated. Fabricate frames for access doors of steel not lighter than 14 gage with welded joints and anchorage for securing into construction. Provide access doors with a minimum of 14 by 20 inches and of not lighter than 14 gage steel, with stiffened edges and welded attachments. Provide access doors hinged to frame and with a flush-face, turn-screw-operated latch. Provide exposed metal surfaces with a shop applied prime coat.

#### 2.5 EXPANSION JOINT COVERS

Provide expansion joint covers constructed of extruded aluminum with anodized satin aluminum finish for walls and ceilings and with standard mill finish for floor covers and exterior covers. Furnish plates, backup angles, expansion filler strip and anchors as indicated. Provide fire rating expansion joints as indicated on drawings. Exterior vertical wall expansion joints to be 3 inch silicone coated, acrylic impregnated compressible filler and exterior horizontal to be metal type expansion joint cover with the slip joint as shown on drawings.

#### 2.6 ELEVATOR PIT GRATINGS AND FRAME

Stainless Steel Grating: Metal bar type grating NAAMM MBG 531, bearing bars, cross bars, and connecting bars shall be Type 304, 304L alloy conforming to ASTM A666.

- a. Type of Grating: Welded
- b. Bearing Bar Size: 1-1/4 by 3/16 inches
- c. Cross Bar Spacing: 2 inches
- d. C-C Bearing Bars: 11/16 inches
- e. Loading and Spans: As indicated on drawings
- f. Type of Anchorage: Stainless steel saddle clip with 1/4 inch diameter stainless fasteners.
- g. NAAMM MBG 531, band edges of grating with bars of the same size as the bearing bars. Weld banding in accordance with the manufacturer's standard for trim unless otherwise indicated. Design tops of bearing bars, cross or intermediate bars to be in the same plane and match grating finish.
- h. Slip resistance requirements must exceed both wet and dry a static coefficient of friction of 0.6.
- i. Finish: Mill finish as fabricated.

#### 2.6.1 Grating Supports

As indicated on drawings.

- a. Finish: Hot-dip galvanize per ASTM A924/A924M, Z275 G90.

#### 2.7 CORNER GUARDS

For jambs and sills of openings and edges of platforms provide steel shapes and plates anchored in masonry or concrete with welded steel straps or end-weld stud anchors. Provide galvanized corner guards on exterior. Provide interior corner guards as indicated in Section 10 26 00 WALL AND DOOR PROTECTION.

#### 2.8 FLOOR GRATINGS

Design steel grating in accordance with NAAMM MBG 532 for bar type gratings, or in accordance with manufacturer's charts for plank grating.

#### 2.9 BOLLARDS/PIPE GUARDS

Provide 6 inch galvanized, prime coated, extra strong weight steel pipe in accordance with ASTM A53/A53M. Anchor posts in concrete as indicated and fill solidly with concrete with minimum compressive strength of 2500 psi.

#### 2.10 FLOOR ACCESS HATCH

Provide floor access door with lift assistance, automatic hold open arrears, the cover in open position, constructed of corrosion resistant material, heavy duty construction and positive latch mechanism.

- a. Size: 3'-0" by 3'-6".
- b. Cover: Diamond pattern tread plate reinforced for 150 PSF.



- c. Material: Cover and frame are 1/4-inch steel.
- d. Frame: Steel angle frame with strap anchors welded around the perimeter.
- e. Hinges: Cast steel cam-action hinges.
- f. Latch: Type 316 stainless steel slam cock.
- g. Lift Assistance: Torsion bars that pivot on cam-action hinges.
- h. Finish: Primer/paint.

#### 2.11 DOWNSPOUT TERMINATIONS

Provide galvanized cast iron downspout boot with cleanout access and manufacturer's standard cast iron strap. Downspout boot sized to accept downspout size as indicated on drawings.

#### 2.12 MISCELLANEOUS PLATES AND SHAPES

Provide items that do not form a part of the structural steel framework, such as lintels, sill angles, miscellaneous mountings and frames. Provide lintels fabricated from structural steel shapes over openings in masonry walls and partitions as required to support wall loads over openings. Provide with connections and fasteners or welds. Construct to have at least 8 in bearing on masonry at each end.

Provide angles and plates in accordance with ASTM A36/A36M, for embedment as indicated. Galvanize embedded items exposed to the elements in accordance with ASTM A123/A123M.

#### 2.13 SAFETY CHAINS

Construct safety chains of galvanized steel, straight link type, minimum 3/16 inch diameter, with a minimum of twelve links per one foot, and snap hooks on each end. Test safety chain in accordance with ASTM A467/A467M, Class CS. Provide boat type snap hooks. Provide galvanized 3/8 inch bolt with 3/4 inch eye diameter for attachment of chain, anchored as indicated. Supply two chains, 4 inches longer than the anchorage spacing, for each guarded area.

#### 2.14 STRUCTURAL STEEL SECURITY GATES AND FRAMES

Provide security steel tube gate frames, swing gates with steel tube frame and steel tube infills as detailed on drawings. Steel tube gate frames, provide jamb anchors at locations as indicated on drawings. Swing gates and steel tube infills shall be power coated for maintenance-free protection powder coat color shall be as indicated on drawings. Swing gate hardware shall include the following.

- a. 5/8 inches diameter galvanized steel head and foot bolts on inactive leaf.
- b. Hinged hasp and staple for pad lock welded to door frames.
- c. Hinges welded to steel tube jamb and steel tube gate frames with non-removable pins.

d. Finish for hardware to match gates and frames.

## 2.15 ROOF HATCHES (SCUTTLES)

Provide aluminum sheets not less than 14 gauge with 3 inch beaded flange, welded and ground at corners. Provide a minimum clear opening of 30 by 36 inches as indicated on Drawings. Insulate cover and curb with one inch thick rigid fiberboard insulation, covered and protected by aluminum sheet of not less than 26 gage. Provide with 12 inches high curb, formed with 3 inch mounting flanges with holes for securing to the roof deck.

## 2.16 GUY CABLES

Provide guy cables as pre-stretched, galvanized wire rope of sizes indicated. Provide wire rope in accordance with ASTM A475, high strength grade with Class A coating. Guys must have a factory attached clevis top-end fitting, a factory attached open-bridge strand socket bottom-end fitting, and must be complete with oval eye, threaded anchor rods. Provide hot-dip galvanized fittings and accessories.

## 2.17 WINDOW SUB-SILL

Provide window sub-sill of extruded aluminum alloy, finish to match window, of size(s) and design(s) indicated. Provide a minimum of two anchors per window section for securing sub-sill. Provide sills with protective coating for shipment, of two coats of a clear, colorless, methacrylate lacquer applied to all surfaces of the sills.

# PART 3 EXECUTION

## 3.1 GENERAL INSTALLATION REQUIREMENTS

Install items at locations indicated in accordance with manufacturer's instructions. Verify all field dimensions prior to fabrication. Include materials and parts necessary to complete each assembly, whether indicated or not. Miss-alignment and miss-sizing of holes for fasteners is cause for rejection. Conceal fastenings where practicable. Joints exposed to weather must be watertight.

## 3.2 WORKMANSHIP

Provide miscellaneous metalwork that is true and accurate in shape, size, and profile. Make angles and lines continuous and straight. Make curves consistent, smooth and unfaceted. Provide continuous welding along the entire area of contact except where tack welding is permitted. Do not tack weld exposed connections. Unless otherwise indicated and approved, provide a smooth finish on exposed surfaces. Provide countersunk rivets where exposed. Provide coped and mitered corner joints aligned flush and without gaps.

## 3.3 ANCHORAGE, FASTENINGS, AND CONNECTIONS

Provide anchorage as necessary, whether indicated or not, for fastening miscellaneous metal items securely in place. Include slotted inserts, expansion shields, powder-driven fasteners, toggle bolts (when approved for concrete), through bolts for masonry, headed shear studs, machine and carriage bolts for steel, through bolts, lag bolts, and screws for wood. Do not use wood plugs. Provide non-ferrous attachments for non-ferrous metal. Provide exposed fastenings of compatible materials (avoid contact

of dissimilar metals), that generally match in color and finish the surfaces to which they are applied. Conceal fastenings where practicable. Provide all fasteners flush with the surfaces they fasten, unless indicated otherwise. Test a minimum of 2 bolt, nut, and washer assemblies from each certified mill batch in a tension measuring device at the job site prior to the beginning of bolting start-up.

### 3.4 BUILT-IN WORK

Where necessary and not otherwise indicated, form built-in metal work for anchorage with concrete or masonry. Provide built-in metal work in ample time for securing in place as the work progresses.

### 3.5 WELDING

Perform welding, welding inspection, and corrective welding in accordance with AWS D1.1/D1.1M. Use continuous welds on all exposed connections. Grind visible welds smooth in the finished installation. Provide welded headed shear studs in accordance with AWS D1.1/D1.1M, Clause 7, except as otherwise specified. Provide in accordance with the safety requirements of EM 385-1-1.

### 3.6 DISSIMILAR METALS

Where dissimilar metals are in contact, protect surfaces with a coating in accordance with MPI 79 to prevent galvanic or corrosive action. Where aluminum is in contact with concrete, plaster, mortar, masonry, wood, or absorptive materials subject to wetting, protect in accordance with ASTM D1187/D1187M, asphalt-base emulsion. Clean surfaces with metal shavings from installation at the end of each work day.

### 3.7 PREPARATION

#### 3.7.1 Material Coatings and Surfaces

Remove rust preventive coating just prior to field erection, using a remover approved by the metal manufacturer. Surfaces, when assembled, must be free of rust, grease, dirt and other foreign matter.

#### 3.7.2 Environmental Conditions

Do not clean or paint surfaces when damp or exposed to foggy or rainy weather, when metallic surface temperature is less than minus 5 degrees F above the dew point of the surrounding air, or when surface temperature is below 45 degrees F or over 95 degrees F, unless approved by the Contracting Officer. Metal surfaces to be painted must be dry for a minimum of 48 hours prior to the application of primer or paint.

### 3.8 EXPANSION JOINT COVERS

Provide in accordance with manufacturer's written instructions and with seismic requirements indicated. Verify installation allows specified movement prior to completion of work

### 3.9 COVER PLATES AND FRAMES

Provide tops of cover plates and frames flush with finished surface. Test for trip hazards and adjust for any encountered lippage.

### 3.10 ROOF HATCH (SCUTTLES)

Construction and accessories as follows:

- a. Provide insulated cover and curb with mounting flanges for securing to roof deck. Provide curbs with integral metal cap flashing of the same gage and metal as the curb, fully welded and ground at corners for weather tightness.
- b. Provide hatches completely assembled, with pintle hinges, compression spring operators enclosed in telescopic tubes, positive snap latches with turn handles on inside and outside, and neoprene draft seals. Provide fasteners for padlocking from the inside. Provide covers with automatic hold-open arms complete with grip handle to permit one hand release. Cover action must be smooth through its entire range of motion with an operating pressure of approximately 30 pounds.

### 3.11 INSTALLATION OF BOLLARDS/PIPE GUARDS

Set bollards/pipe guards vertically in concrete piers. Fill hollow cores with concrete having a compressive strength of 3000 psi.

### 3.12 INSTALLATION OF DOWNSPOUT TERMINATIONS

Secure downspouts terminations to downspouts and substrate per manufacturer's instructions.

### 3.13 STRUCTURAL STEEL DOOR FRAMES

Secure door frames to the floor slab by means of angle clips and expansion bolts. Provide any necessary reinforcements and drill and tap frames as required for hardware. Clean metal shavings from finished surfaces at the end of each work day.

For freight elevator hoistway entrances, include a non-skid metal sill installed in accordance with the elevator manufacturer's written installation instructions.

### 3.14 INSTALLATION MISCELLANEOUS PLATES AND SHAPES

Provide lintels fabricated from structural steel shapes over openings in masonry walls and partitions as indicated and as required to support wall loads over openings. Construct to have at least 8 inches bearing on masonry at each end.

-- End of Section --

SECTION 05 51 00

METAL STAIRS

02/17

PART 1 GENERAL

Section 05 05 23.16 STRUCTURAL WELDING applies to work specified in this section.

1.1 REFERENCES

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

AMERICAN ASSOCIATION OF STATE HIGHWAY AND TRANSPORTATION OFFICIALS  
(AASHTO)

AASHTO M 314 (1990; R 2013) Standard Specification for  
Steel Anchor Bolts

AMERICAN INSTITUTE OF STEEL CONSTRUCTION (AISC)

AISC 360 (2016) Specification for Structural Steel  
Buildings

AMERICAN IRON AND STEEL INSTITUTE (AISI)

AISC/AISI 121 (2004) Standard Definitions for Use in the  
Design of Steel Structures

AMERICAN WELDING SOCIETY (AWS)

AWS D1.1/D1.1M (2015; Errata 1 2015; Errata 2 2016)  
Structural Welding Code - Steel

ASME INTERNATIONAL (ASME)

ASME B18.2.1 (2012; Errata 2013) Square and Hex Bolts  
and Screws (Inch Series)

ASME B18.21.1 (2009; R 2016) Washers: Helical  
Spring-Lock, Tooth Lock, and Plain Washers  
(Inch Series)

ASME B18.6.1 (2016) Wood Screws (Inch Series)

ASME B18.6.3 (2013; R 2017) Machine Screws, Tapping  
Screws, and Machine Drive Screws (Inch  
Series)

ASTM INTERNATIONAL (ASTM)

ASTM A1011/A1011M (2017) 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 A153/A153M	(2016) Standard Specification for Zinc Coating (Hot-Dip) on Iron and Steel Hardware
ASTM A27/A27M	(2017) Standard Specification for Steel Castings, Carbon, for General Application
ASTM A283/A283M	(2013) Standard Specification for Low and Intermediate Tensile Strength Carbon Steel Plates
ASTM A307	(2014; E 2017) Standard Specification for Carbon Steel Bolts, Studs, and Threaded Rod 60 000 PSI Tensile Strength
ASTM A325	(2014) Standard Specification for Structural Bolts, Steel, Heat Treated, 120/105 ksi Minimum Tensile Strength
ASTM A36/A36M	(2014) Standard Specification for Carbon Structural Steel
ASTM A449	(2014) Standard Specification for Hex Cap Screws, Bolts, and Studs, Steel, Heat Treated, 120/105/90 ksi Minimum Tensile Strength, General Use
ASTM A47/A47M	(1999; R 2014) Standard Specification for Ferritic Malleable Iron Castings
ASTM A48/A48M	(2003; R 2012) Standard Specification for Gray Iron Castings
ASTM A53/A53M	(2012) Standard Specification for Pipe, Steel, Black and Hot-Dipped, Zinc-Coated, Welded and Seamless
ASTM A568/A568M	(2017a) Standard Specification for Steel, Sheet, Carbon, Structural, and High-Strength, Low-Alloy, Hot-Rolled and Cold-Rolled, General Requirements for
ASTM A575	(1996; E 2013; R 2013) Standard Specification for Steel Bars, Carbon, Merchant Quality, M-Grades
ASTM A653/A653M	(2017) Standard Specification for Steel Sheet, Zinc-Coated (Galvanized) or Zinc-Iron Alloy-Coated (Galvannealed) by the Hot-Dip Process
ASTM A924/A924M	(2017a) Standard Specification for General Requirements for Steel Sheet, Metallic-Coated by the Hot-Dip Process
ASTM C514	(2004; R 2014) Standard Specification for Nails for the Application of Gypsum Board

ASTM C636/C636M	(2013) Standard Practice for Installation of Metal Ceiling Suspension Systems for Acoustical Tile and Lay-In Panels
ASTM E488/E488M	(2015) Standard Test Methods for Strength of Anchors in Concrete and Masonry Elements

NATIONAL FIRE PROTECTION ASSOCIATION (NFPA)

NFPA 101	(2018; TIA 18-1) Life Safety Code
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1.2 SUBMITTALS

Government approval is required for submittals with a "G" designation; submittals not having a "G" designation are for information only. When used, a designation following the "G" designation identifies the office that will review the submittal for the Government. Submittals with an "S" are for inclusion in the Sustainability eNotebook, in conformance to Section 01 33 29 SUSTAINABILITY REPORTING. Submit the following in accordance with Section 01 33 00 SUBMITTAL PROCEDURES:

SD-02 Shop Drawings

Iron and Steel Hardware

Steel Shapes, Plates, Bars, and Strips

Metal Stair System

SD-03 Product Data

Structural-Steel Plates, Shapes, and Bars

Hot-Rolled Carbon Steel Sheets and Strips

Hot-Rolled Carbon Steel Bars

Gray Iron Castings

Malleable Iron Castings

Concrete Inserts

Masonry Anchorage Devices

Protective Coating

Steel Pan Stairs

Steel Stairs; G

SD-07 Certificates

Welding Procedures

Welder Qualification

SD-08 Manufacturer's Instructions

Structural-Steel Plates, Shapes, and Bars; G

Hot-Rolled Carbon Steel Sheets and Strips; G

Hot-Rolled Carbon Steel Bars; G

Gray Iron Castings; G

Malleable Iron Castings; G

Protective Coating; G

Masonry Anchorage Devices; G

### 1.3 QUALITY CONTROL

#### 1.3.1 Qualifications for Welding Work

Submit welding procedures in accordance with AWS D1.1/D1.1M. Make test specimens in the presence of the Contracting Officer, and have the specimens tested by an approved testing laboratory at the Contractor's expense.

Certify welder qualification by tests in accordance with AWS D1.1/D1.1M, or under an equivalent approved qualification test. In addition, perform tests on test pieces in positions and with clearances equivalent to those actually encountered. If a test weld fails to meet requirements, ensure that two test welds are retested immediately and that each test weld is made and passes. Failure in the immediate retest requires that the welder be retested after further practice or training and a complete set of test welds be made.

## PART 2 PRODUCTS

### 2.1 SYSTEM DESCRIPTION

Submit complete and detailed fabrication drawings for all iron and steel hardware, and for all steel shapes, plates, bars, and strips used in accordance with the design specifications referenced in this section.

### 2.2 FABRICATION

Preassemble items in the shop to the greatest extent possible. Disassemble units only to the extent necessary for shipping and handling. Clearly mark units for reassembly and coordinated installation.

For the fabrication of work exposed to view, use only materials that are smooth and free of surface blemishes, including pitting, seam marks, roller marks, rolled trade names, and roughness. Remove blemishes by grinding, or by welding and grinding, before cleaning and treating surfaces and applying surface finishes, including zinc coatings.

#### 2.2.1 General Fabrication

Prepare and submit metal stair system shop drawings with detailed plans and elevations at scales not less than 1 inch to 1 foot and with details of sections and connections at scales not less than 3 inches to 1 foot. Also detail the placement drawings, diagrams, and templates for



installation of anchorages, including concrete inserts, anchor bolts, and miscellaneous metal items having integral anchorage devices.

Use materials of size and thicknesses indicated or, if not indicated, of the size and thickness necessary to produce a finished product that is strong enough and durable enough for its intended use. Work the materials to the dimensions indicated on approved detail drawings, using proven methods of fabrication and support. Use the type of materials indicated or specified for the various components of work.

Form exposed work true to line and level, with accurate angles and surfaces and with straight sharp edges. Ease exposed edges to a radius of approximately 1/32 inch, and bend metal corners to the smallest radius possible without causing grain separation or otherwise impairing the work.

Continuously weld corners and seams in accordance with the recommendations of AWS D1.1/D1.1M. Grind exposed welds smooth and flush to match and blend with adjoining surfaces.

Form exposed connections with hairline joints that are flush and smooth, using concealed fasteners wherever possible. Use exposed fasteners of the type indicated or, if not indicated, use Phillips flat-head (countersunk) screws or bolts.

Provide and coordinate anchorage of the type indicated for the supporting structure. Fabricate anchoring devices, and space them as indicated and as necessary to provide adequate support for the intended use of the work.

## 2.2.2 Steel Pan Stairs

### 2.2.2.1 General

Joining pieces by welding. Fabricate units so that bolts and other fastenings do not appear on finished surfaces. Make joints true and tight, and connections between parts lighttight. Grind continuous welds smooth where exposed.

Construct metal stair units to sizes and arrangements indicated to support a minimum live load of 100 pounds per square foot. Provide framing, hangers, columns, struts, clips, brackets, bearing plates, and other components as required for the support of stairs and platforms.

### 2.2.2.2 Stair Framing

Fabricate stringers of structural-steel channels, or plates, or a combination thereof as indicated. Provide closures for exposed ends of strings.

Construct platforms of structural-steel channel headers and miscellaneous framing members as indicated. Bolt headers to stringers and newels, and bolt framing members to stringers and headers.

### 2.2.2.3 Riser, Subtread, and Subplatform Metal Pans

Form metal pans of 0.1084-inch (12-gage) galvanized structural steel sheets, conforming to ASTM A653/A653M, Grade A, with zinc coating conforming to ASTM A653/A653M and ASTM A924/A924M. Shape the pans to the configuration indicated.

Construct risers and subread metal pans with steel angle supporting brackets, of the size indicated, welded to stringers. Secure metal pans to brackets with rivets or welds. Secure subplatform metal pans to platform frames with welds.

#### 2.2.2.4 Safety Nosings for Concrete Treads

Provide safety nosings of cast iron with cross-hatched abrasive surfaces, or extruded aluminum with abrasive inserts, at least 4 inches wide and 1/4 inch thick for metal-pan cement-filled treads extending the full length of the tread for stairs and for platforms and landings. Provide safety nosings with anchors embedded a minimum of 3/4 inch in the concrete and with tops flush with the top of the traffic surface.

#### 2.2.2.5 Safety Treads

ASTM A1011/A1011M, steel pan for concrete tread.

#### 2.2.2.6 Steel Framing for Concrete Stairs

When necessary, modify fabricated units to fit actual dimensions of the supporting structure. Join steel components by welding. Provide 14-gage steel risers unless otherwise indicated. Arrange components to receive finish materials as indicated.

#### 2.2.3 Protective Coating

Shop-prime steelwork as indicated in accordance with AISC/AISI 121 , except surfaces of steel encased in concrete; welded surfaces; high-strength, bolt-connected surfaces; and surfaces of crane rails.

### 2.3 COMPONENTS

#### 2.3.1 Steel Stairs

Provide steel stairs complete with stringers, metal-pan concrete-filled treads, treads, landings, columns, handrails, and necessary bolts and other fastenings. Shop-paint steel stairs and accessories.

##### 2.3.1.1 Design Loads

Design stairs to sustain a live load of not less than 300 pounds per square foot, or a concentrated load of 100 applied where it is most critical. Except for a commercial product, design and fabricate steel stairs to conform to AISC 360. Design fire stairs to conform to NFPA 101.

##### 2.3.1.2 Materials

Provide steel stairs of welded construction except that bolts may be used where welding is not practicable. Do not use screw or screw-type connections.

- a. Structural Steel: ASTM A36/A36M.
- b. Support metal pan for concrete fill on angle cleats welded to stringers or treads with integral cleats, welded or bolted to the stringer. Provide sheet-steel landings with angle stiffeners welded on. Close exposed ends.

- c. Before fabrication, obtain necessary field measurements and verify drawing dimensions.
- d. Clean metal surfaces free of mill scale, flake rust, and rust pitting before shop finishing. Weld permanent connections. Finish welds flush and smooth on surfaces that will be exposed after installation.

#### 2.3.2 Soffit Clips

Provide clips with holes for attaching metal furring for plastered soffits. Space the clips not more than 12 inches on center, and weld them to stair treads and platforms as required.

#### 2.3.3 Concrete Inserts

Threaded-type concrete inserts consisting of galvanized ferrous castings, internally threaded to receive 3/4-inch diameter machine bolts; either malleable iron conforming to ASTM A47/A47M or cast steel conforming to ASTM A27/A27M, and hot-dip-galvanized in accordance with ASTM A153/A153M.

#### 2.3.4 Masonry Anchorage Devices

Provide masonry anchorage devices consisting of expansion shields complying with AASHTO M 314, ASTM E488/E488M and ASTM C514 as follows:

- a. Lead expansion shields for machine screws and bolts 1/4 inch and smaller; head-out embedded-nut type, single unit class, Group I, Type 1, Class 1.

Use toggle bolts of the tumble-wing type, conforming to ASTM A325, ASTM A449, and ASTM C636/C636M, type, class, and style as required.

#### 2.3.5 Fasteners

Select galvanized zinc-coated fasteners conforming to ASTM A153/A153M for exterior applications or where the fasteners are built into exterior walls or floor systems. Select the fasteners for the type, grade, and class required for the installation of steel stair items:

- a. Standard/regular hexagon-head bolts and nuts, conforming to ASTM A307, Grade A.
- b. Square-head lag bolts conforming to ASME B18.2.1.
- c. Cadmium-plated steel machine screws, conforming to ASME B18.6.3.
- d. Flat-head carbon steel wood screws, conforming to ASME B18.6.1.
- e. Plain, round, general-assembly-grade, carbon steel washers, conforming to ASME B18.21.1.
- f. Helical-spring, carbon steel lockwashers, conforming to ASME B18.2.1.

### 2.4 MATERIALS

#### 2.4.1 Structural-Steel Plates, Shapes and Bars

Structural-size shapes and plates, conforming to ASTM A36/A36M, unless otherwise noted, except bent or cold-formed plates.

Steel plates - bent or cold-formed, conforming to ASTM A283/A283M, Grade C.

Steel bars and bar-size shapes, conforming to ASTM A36/A36M, unless otherwise noted for steel bars and bar-size shapes.

#### 2.4.2 Hot-Rolled Carbon Steel Bars

Provide the following:

- a. Hot-rolled carbon steel bars and bar-size shapes, conforming to ASTM A575, grade as selected by the fabricator.

#### 2.4.3 Hot-Rolled Carbon Steel Sheets and Strips

Provide the following:

- a. Hot-rolled carbon sheets and strips conforming to ASTM A568/A568M and ASTM A1011/A1011M, pickled and oiled.

#### 2.4.4 Gray Iron Castings

Provide the following:

- a. Gray iron castings conforming to ASTM A48/A48M, Class 30.

#### 2.4.5 Malleable Iron Castings

Provide the following:

- a. Malleable iron castings conforming to ASTM A47/A47M, grade as selected.

#### 2.4.6 Steel Pipe

Provide the following:

- a. Steel pipe conforming to ASTM A53/A53M, type as selected, Grade B; primed finish, unless galvanizing is required; standard weight (Schedule 40).

### PART 3 EXECUTION

#### 3.1 PREPARATION

Clean surfaces thoroughly before installation. Prepare surfaces using the methods recommended by the manufacturer for achieving the best result for the substrate under the project conditions. Examine materials upon arrival at site. Notify the carrier and manufacturer of any damage.

Protect installed products until completion of project. Touch up, repair or replace, damaged products before substantial completion

#### 3.2 INSTALLATION

Install in accordance with the manufacturer's instructions and approved submittals. Install in proper relationship with adjacent construction.

Install items at locations indicated, according to the manufacturer's instructions. Verify all measurements and take all field measurements

necessary before fabrication. Ensure that exposed fastenings are compatible with generally match the color and finish of, and harmonize with the material to which they are applied. Include materials and parts necessary to complete each item, even though such work is not definitely shown or specified. Poor matching of holes for fasteners is cause for rejection. Conceal fastenings where practicable. Select thickness of metal and details of assembly and supports that adequately strengthen and stiffen the construction.

#### 3.2.1 Field Preparation

Remove rust-preventive coating just before field erection, using a remover approved by the coating manufacturer. Provide surfaces, when assembled, free of rust, grease, dirt and other foreign matter.

#### 3.2.2 Field Welding

Comply with AWS D1.1/D1.1M in executing manual shielded-metal arc welding, (for appearance and quality of new welds) and in correcting existing welding.

#### 3.2.3 Safety Nosings

Completely embed nosing in concrete before the initial set of the concrete occurs and finish flush with the top of the concrete surface.

#### 3.2.4 Touchup Painting

Immediately after installation, clean all field welds, bolted connections, and abraded areas of the shop-painted material, and repaint exposed areas with the same paint used for shop painting. Apply paint by brush or spray to provide a minimum dry-film thickness of 2 mils.

-- End of Section --



SECTION 05 51 33

METAL LADDERS

02/16

PART 1 GENERAL

1.1 REFERENCES

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

AMERICAN LADDER INSTITUTE (ALI)

ALI A14.3 (2008) Standard for Fixed Ladders and  
Safety Requirements

AMERICAN WELDING SOCIETY (AWS)

AWS D1.1/D1.1M (2015; Errata 1 2015; Errata 2 2016)  
Structural Welding Code - Steel

ASTM INTERNATIONAL (ASTM)

ASTM A123/A123M (2017) Standard Specification for Zinc  
(Hot-Dip Galvanized) Coatings on Iron and  
Steel Products

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

ASTM A36/A36M (2014) Standard Specification for Carbon  
Structural Steel

ASTM A47/A47M (1999; R 2014) Standard Specification for  
Ferritic Malleable Iron Castings

ASTM A500/A500M (2013) Standard Specification for  
Cold-Formed Welded and Seamless Carbon  
Steel Structural Tubing in Rounds and  
Shapes

ASTM A53/A53M (2012) Standard Specification for Pipe,  
Steel, Black and Hot-Dipped, Zinc-Coated,  
Welded and Seamless

ASTM A653/A653M (2017) Standard Specification for Steel  
Sheet, Zinc-Coated (Galvanized) or  
Zinc-Iron Alloy-Coated (Galvannealed) by  
the Hot-Dip Process

ASTM A780/A780M (2009; R 2015) Standard Practice for  
Repair of Damaged and Uncoated Areas of  
Hot-Dip Galvanized Coatings

ASTM A924/A924M (2017a) Standard Specification for General

Requirements for Steel Sheet,  
Metallic-Coated by the Hot-Dip Process

MASTER PAINTERS INSTITUTE (MPI)

MPI 79 (2012) Primer, Alkyd, Anti-Corrosive for  
Metal

SOCIETY FOR PROTECTIVE COATINGS (SSPC)

SSPC SP 3 (1982; E 2004) Power Tool Cleaning

SSPC SP 6/NACE No.3 (2007) Commercial Blast Cleaning

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

29 CFR 1910.23 (Nov 2016) Ladders

29 CFR 1910.27 Scaffolds and Roope Descent Systems

1.2 SUBMITTALS

Government approval is required for submittals with a "G" designation; submittals not having a "G" designation are for information only. When used, a designation following the "G" designation identifies the office that will review the submittal for the Government. Submittals with an "S" are for inclusion in the Sustainability eNotebook, in conformance with Section 01 33 29 SUSTAINABILITY REPORTING. Submit the following in accordance with Section 01 33 00 SUBMITTAL PROCEDURES:

SD-02 Shop Drawings

Ladders, Installation Drawings

SD-03 Product Data

Ladders

Ladder Safety Devices (Climbing Ladder Fall Arrest Systems)

SD-07 Certificates

Fabricator Certification for Ladder Assembly

1.3 CERTIFICATES

Provide fabricator certification for ladder assembly stating that the ladder and associated components have been fabricated according to the requirements of 29 CFR 1910.27.

1.4 QUALIFICATION OF WELDERS

Qualify welders in accordance with AWS D1.1/D1.1M. Use procedures, materials, and equipment of the type required for the work.

1.5 DELIVERY, STORAGE, AND PROTECTION

Protect from corrosion, deformation, and other types of damage. Store items in an enclosed area free from contact with soil and weather. Remove



and replace damaged items with new items.

## PART 2 PRODUCTS

### 2.1 MATERIALS

#### 2.1.1 Structural Carbon Steel

ASTM A36/A36M.

#### 2.1.2 Structural Tubing

ASTM A500/A500M.

#### 2.1.3 Steel Pipe

ASTM A53/A53M, Type E or S, Grade B.

#### 2.1.4 Fittings for Steel Pipe

Standard malleable iron fittings ASTM A47/A47M.

### 2.2 FABRICATION FINISHES

#### 2.2.1 Galvanizing

Hot-dip galvanize items specified to be zinc-coated, after fabrication where practicable. Galvanizing: ASTM A123/A123M, ASTM A153/A153M, ASTM A653/A653M or ASTM A924/A924M, G90, as applicable.

#### 2.2.2 Galvanize

Anchor bolts, washers, and parts or devices necessary for proper installation, unless indicated otherwise.

#### 2.2.3 Repair of Zinc-Coated Surfaces

Repair damaged surfaces with galvanizing repair method and paint conforming to ASTM A780/A780M or by application of stick or thick paste material specifically designed for repair of galvanizing, as approved by Contracting Officer. Clean areas to be repaired and remove slag from welds. Heat surfaces to which stick or paste material is applied, with a torch to a temperature sufficient to melt the metallics in stick or paste; spread molten material uniformly over surfaces to be coated and wipe off excess material.

#### 2.2.4 Shop Cleaning and Painting

##### 2.2.4.1 Surface Preparation

Blast clean surfaces in accordance with SSPC SP 6/NACE No.3. Surfaces that will be exposed in spaces above ceiling or in attic spaces, crawl spaces, furred spaces, and chases may be cleaned in accordance with SSPC SP 3 in lieu of being blast cleaned. Wash cleaned surfaces which become contaminated with rust, dirt, oil, grease, or other contaminants with solvents until thoroughly clean.

#### 2.2.4.2 Pretreatment, Priming and Painting

Apply pretreatment, primer, and paint in accordance with manufacturer's printed instructions. On surfaces concealed in the finished construction or not accessible for finish painting, apply an additional prime coat to a minimum dry film thickness of 1.0 mil. Tint additional prime coat with a small amount of tinting pigment.

#### 2.2.5 Nonferrous Metal Surfaces

Protect by plating, anodic, or organic coatings.

#### 2.2.6 Aluminum Surfaces

##### 2.2.6.1 Surface Condition

Before finishes are applied, remove roll marks, scratches, rolled-in scratches, kinks, stains, pits, orange peel, die marks, structural streaks, and other defects which will affect uniform appearance of finished surfaces.

### 2.3 LADDERS

Fabricate vertical ladders conforming to 29 CFR 1910.23 and Section 5 of ALI A14.3. Use 2 1/2 by 3/8 inch steel flats for stringers and 3/4 inch diameter steel rods for rungs. Ladder rungs, must be spaced not less than 16 inches wide 12 inches apart, plug welded or shouldered and headed into stringers. Install ladders so that the maximum perpendicular distance from the centerline of the rungs, to the nearest finished wall surface will not be less than 7 inches. Provide heavy clip angles riveted or bolted to the stringer and drilled for not less than two 1/2 inch diameter expansion bolts as indicated. Provide intermediate clip angles not over 48 inches on centers. The top rung of the ladder must be level with the top of the access level, parapet or landing served by the ladder except for hatches or wells. Extend the side rails of through or side step ladders 42 inches above the access level. Provide ladder access protective swing gates at the top of access/egress level. The drawings must indicate ladder locations and details of critical dimensions and materials.

#### 2.3.1 Ladder Climbing System-Rail

Provide stainless steel rail and fall arrester system to be mounted to the rungs of the vertical steel ladders. The complete system to include stainless steel fall arresters, stainless steel vertical rails, rung clamps, rigid end stops, and foldable foot rest as recommended by manufacturer.

#### 2.3.2 Ladder Safety Devices (Climbing Ladder Fall Arrest Systems)

Conform to 29 CFR 1910.27, Section 7 of ALI A14.3 . Install ladder safety devices on ladders over 20 feet long or more. The ladder safety systems must meet the design requirement of the ladders which they serve. The ladder safety system must be capable of sustaining a minimum static load of 1,000 pounds.

## PART 3 EXECUTION

### 3.1 GENERAL INSTALLATION REQUIREMENTS

Install items at locations indicated, according to manufacturer's instructions. Verify all measurements and take all field measurements necessary before fabrication. Provide Exposed fastenings of compatible materials, generally matching in color and finish, and harmonize with the material to which fastenings are applied. Include materials and parts necessary to complete each item, even though such work is not definitely shown or specified. Poor matching of holes for fasteners will be cause for rejection. Conceal fastenings where practicable. Thickness of metal and details of assembly and supports must provide strength and stiffness. Formed joints exposed to the weather to exclude water. Items listed below require additional procedures.

### 3.2 WORKMANSHIP

Metalwork must be well formed to shape and size, with sharp lines and angles and true curves. Drilling and punching must produce clean true lines and surfaces. Continuously weld along the entire area of contact. Do not tack weld exposed connections of work in place. Grid smooth exposed welds. Provide smooth finish on exposed surfaces of work in place, unless otherwise approved. Where tight fits are required, mill joints. Cope or miter corner joints, well formed, and in true alignment. Install in accordance with manufacturer's installation instructions and approved drawings, cuts, and details.

### 3.3 ANCHORAGE, FASTENINGS, AND CONNECTIONS

Provide anchorage where necessary for fastening metal items securely in place. Include for anchorage not otherwise specified or indicated slotted inserts, expansion anchors, and powder-actuated fasteners, when approved for concrete; toggle bolts and through bolts for masonry; machine bolts, carriage bolts and powder-actuated threaded studs for steel; through bolts, lag bolts, and screws for wood. Do not use wood plugs in any material. Provide non-ferrous attachments for non-ferrous metal. Make exposed fastenings of compatible materials, generally matching in color and finish, to which fastenings are applied. Conceal fastenings where practicable.

### 3.4 WELDING

Perform welding, welding inspection, and corrective welding, in accordance with AWS D1.1/D1.1M. Use continuous welds on all exposed connections. Grind visible welds smooth in the finished installation.

### 3.5 FINISHES

#### 3.5.1 Dissimilar Materials

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

#### 3.5.2 Field Preparation

Remove rust preventive coating just prior to field erection, using a remover approved by the rust preventive manufacturer. Surfaces, when assembled, must be free of rust, grease, dirt and other foreign matter.

### 3.5.3 Environmental Conditions

Do not clean or paint surface when damp or exposed to foggy or rainy weather, when metallic surface temperature is less than 5 degrees F above the dew point of the surrounding air, or when surface temperature is below 45 degrees F or over 95 degrees F, unless approved by the Contracting Officer.

### 3.6 LADDERS

Secure to the adjacent construction with the clip angles attached to the stringer. Install intermediate clip angles not over 48 inches on center. Install brackets as required for securing of ladders welded or bolted to structural steel or built into the masonry or concrete. Ends of ladders must not rest upon finished roof or floor.

-- End of Section --

SECTION 05 52 00

METAL RAILINGS

08/15

PART 1 GENERAL

1.1 REFERENCES

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

AMERICAN ASSOCIATION OF STATE HIGHWAY AND TRANSPORTATION OFFICIALS  
(AASHTO)

AASHTO M 314 (1990; R 2013) Standard Specification for  
Steel Anchor Bolts

AMERICAN WELDING SOCIETY (AWS)

AWS D1.1/D1.1M (2015; Errata 1 2015; Errata 2 2016)  
Structural Welding Code - Steel

ASME INTERNATIONAL (ASME)

ASME B18.6.3 (2013; R 2017) Machine Screws, Tapping  
Screws, and Machine Drive Screws (Inch  
Series)

ASTM INTERNATIONAL (ASTM)

ASTM A123/A123M (2017) Standard Specification for Zinc  
(Hot-Dip Galvanized) Coatings on Iron and  
Steel Products

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

ASTM A27/A27M (2017) Standard Specification for Steel  
Castings, Carbon, for General Application

ASTM A283/A283M (2013) Standard Specification for Low and  
Intermediate Tensile Strength Carbon Steel  
Plates

ASTM A36/A36M (2014) Standard Specification for Carbon  
Structural Steel

ASTM A47/A47M (1999; R 2014) Standard Specification for  
Ferritic Malleable Iron Castings

ASTM A500/A500M (2013) Standard Specification for  
Cold-Formed Welded and Seamless Carbon  
Steel Structural Tubing in Rounds and  
Shapes

ASTM A53/A53M	(2012) Standard Specification for Pipe, Steel, Black and Hot-Dipped, Zinc-Coated, Welded and Seamless
ASTM A575	(1996; E 2013; R 2013) Standard Specification for Steel Bars, Carbon, Merchant Quality, M-Grades
ASTM C514	(2004; R 2014) Standard Specification for Nails for the Application of Gypsum Board
ASTM E488/E488M	(2015) Standard Test Methods for Strength of Anchors in Concrete and Masonry Elements

NATIONAL ASSOCIATION OF ARCHITECTURAL METAL MANUFACTURERS (NAAMM)

NAAMM AMP 521	(2001) Pipe Railing Manual
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1.2 ADMINISTRATIVE REQUIREMENTS

1.2.1 Pre-Installation Meetings

Within 30 days of Contract Award, submit fabrication drawings for the following items:

- a. Iron and Steel Hardware
- b. Steel Shapes, Plates, Bars and Strips
- c. Steel Railings and Handrails
- d. Anchorage and fastening systems

Submit manufacturer's catalog data, including two copies of manufacturers specifications, load tables, dimension diagrams, and anchor details for the following items:

- a. Structural steel plates, shapes, and bars
- b. Structural steel tubing
- c. Hot-Rolled carbon steel bars
- d. Concrete inserts
- e. Masonry anchorage devices
- f. Protective coating
- g. Steel railings and handrails
- h. Anchorage and fastening systems

1.3 SUBMITTALS

Government approval is required for submittals with a "G" designation; submittals not having a "G" designation are for information only. When used, a designation following the "G" designation identifies the office that will review the submittal for the Government. Submittals with an "S"

are for inclusion in the Sustainability eNotebook, in conformance to Section 01 33 29 SUSTAINABILITY REPORTING. Submit the following in accordance with Section 01 33 00 SUBMITTAL PROCEDURES:

SD-02 Shop Drawings

Fabrication Drawings; G

Iron and Steel Hardware

Steel Shapes, Plates, Bars and Strips

SD-03 Product Data

Structural Steel Plates, Shapes, and Bars; G

Structural Steel Tubing

Hot-Rolled Carbon Steel Bars; G

Concrete Inserts; G

Masonry Anchorage Devices; G

Protective Coating; G

Steel Railings and Handrails; G

Anchorage and Fastening Systems; G

SD-07 Certificates

Welding Procedures

Welder Qualification

SD-08 Manufacturer's Instructions

Installation Instructions; G

1.4 QUALITY CONTROL

1.4.1 Welding Procedures

Section 05 05 23.16 STRUCTURAL WELDING applies to work specified in this section.

Submit welding procedures testing in accordance with AWS D1.1/D1.1M made in the presence of the Contracting Officer and by an approved testing laboratory at the Contractor's expense.

1.4.2 Welder Qualification

Submit certified welder qualification by tests in accordance with AWS D1.1/D1.1M, or under an equivalent approved qualification test. In addition perform tests on test pieces in positions and with clearances equivalent to those actually encountered. If a test weld fails to meet requirements, make an immediate retest of two test welds and ensure each test weld passes. Failure in the immediate retest will require that the

welder be retested after further practice or training and make a complete set of test welds.

## PART 2 PRODUCTS

### 2.1 FABRICATION

Pre-assemble items in the shop to the greatest extent possible. Disassemble units only to the extent necessary for shipping and handling. Clearly mark units for reassembly and coordinated installation.

For the fabrication of work exposed to view, use only materials that are smooth and free of surface blemishes, including pitting, seam marks, roller marks, rolled trade names, and roughness. Remove blemishes by grinding, or by welding and grinding, prior to cleaning, treating, and application of surface finishes, including zinc coatings.

Provide railings and handrails detail plans and elevations at not less than 1-inch to 1-foot. Provide details of sections and connections at not less than 3-inches to 1-foot. Also detail setting drawings, diagrams, templates for installation of anchorages, including concrete inserts, anchor bolts, and miscellaneous metal items having integral anchors.

Use materials of size and thicknesses indicated or, if not indicated, of required size and thickness to produce adequate strength and durability in finished product for intended use. Work materials to dimensions indicated on approved detail drawings, using proven details of fabrication and support. Use type of materials indicated or specified for the various components of work.

Form exposed work true to line and level with accurate angles and surfaces and straight sharp edges. Ensure all exposed edges are eased to a radius of approximately 1/32-inch. Bend metal corners to the smallest radius possible without causing grain separation or otherwise impairing the work.

Weld corners and seams continuously and in accordance with the recommendations of AWS D1.1/D1.1M. Grind exposed welds smooth and flush to match and blend with adjoining surfaces.

Form exposed connections with hairline joints that are flush and smooth, using concealed fasteners wherever possible. Use exposed fasteners of the type indicated or, if not indicated, use Phillips flathead (countersunk) screws or bolts.

Provide anchorage of the type indicated and coordinated with the supporting structure. Fabricate anchoring devices and space as indicated and as required to provide adequate support for the intended use of the work.

Use hot-rolled steel bars for work fabricated from bar stock unless work is indicated or specified to be fabricated from cold-finished or cold-rolled stock.

#### 2.1.1 Steel Handrails

Fabricate joint posts, rail, and corners by one of the following methods:

- a. Flush-type rail fittings of commercial standard, welded and ground smooth with railing splice locks secured with 3/8 inch



hexagonal-recessed-head setscrews.

- b. Mitered and welded joints made by fitting post to top rail and intermediate rail to post, mitering corners, groove welding joints, and grinding smooth. Butt railing splices and reinforce them by a tight fitting interior sleeve not less than 6 inches long.
- c. Railings may be bent at corners in lieu of jointing, provided bends are made in suitable jigs and the pipe is not crushed.

#### 2.1.2 Protective Coating

Shop prime the steelwork as indicated in accordance with Section 09 90 00 PAINTS AND COATINGS except surfaces of steel that are:

- a. encased in concrete
- b. surfaces for welding
- c. high-strength bolt connected contact surfaces

Provide hot dipped galvanized steelwork as indicated in accordance with ASTM A123/A123M. Touch up abraded surfaces and cut ends of galvanized members with zinc-dust, zinc-oxide primer, or an approved galvanizing repair compound.

### 2.2 COMPONENTS

#### 2.2.1 Structural Steel Plates, Shapes And Bars

Provide structural-size shapes and plates, except plates to be bent or cold-formed, conforming to ASTM A36/A36M, unless otherwise noted.

Provide steel plates, to be bent or cold-formed, conforming to ASTM A283/A283M, Grade C.

Provide steel bars and bar-size shapes conforming to ASTM A36/A36M, unless otherwise noted.

#### 2.2.2 Structural Steel Tubing

Provide structural steel tubing, hot-formed, welded or seamless, conforming to ASTM A500/A500M, Grade B, unless otherwise noted.

#### 2.2.3 Hot-Rolled Carbon Steel Bars

Provide bars and bar-size shapes conforming to ASTM A575, grade as selected by the fabricator.

#### 2.2.4 Concrete Inserts

Provide threaded-type concrete inserts consisting of galvanized ferrous castings, internally threaded to receive 3/4-inch diameter machine bolts; either malleable iron conforming to ASTM A47/A47M or cast steel conforming to ASTM A27/A27M, hot-dip galvanized in accordance with ASTM A153/A153M.

#### 2.2.5 Masonry Anchorage Devices

Provide masonry anchorage devices consisting of expansion shields

complying with AASHTO M 314, ASTM E488/E488M and ASTM C514 as follows:

Provide lead expansion shields for machine screws and bolts 1/4-inch and smaller; head-out embedded nut type, single unit class, Group I, Type 1, Class 1.

#### 2.2.6 Fasteners

Provide galvanized zinc-coated fasteners in accordance with ASTM A153/A153M used for exterior applications or where built into exterior walls or floor systems. Select fasteners for the type, grade, and class required for the installation of steel stair items.

Provide cadmium-plated steel machine screws conforming to ASME B18.6.3.

#### 2.2.7 Steel Railings And Handrails

Design handrails to resist a concentrated load of 200 lbs in any direction at any point of the top of the rail or 50 lbs per foot applied horizontally to top of the rail, whichever is more severe. NAAMM AMP 521, provide the same size rail and post. Provide pipe collars of the same material and finish as the handrail and posts.

##### 2.2.7.1 Steel Handrails

Provide steel handrails, including inserts in concrete, steel pipe conforming to ASTM A53/A53M or structural tubing conforming to ASTM A500/A500M, Grade A or B of equivalent strength. Provide steel railings of 1-1/2 -inches nominal size, hot-dip galvanized and shop painted.

Provide kickplates between railing posts where indicated, and consist of 1/8-inch steel flat bars not less than 6-inches high. Secure kickplates as indicated.

### PART 3 EXECUTION

#### 3.1 PREPARATION

Adjust stair railings and handrails prior to securing in place to ensure proper matching at butting joints and correct alignment throughout their length. Space posts not more than 8-feet on center. Plumb posts in each direction. Secure posts and rail ends to building construction as follows:

- a. Anchor posts in concrete by means of pipe sleeves set and anchored into concrete. Provide sleeves of galvanized, standard weight, steel pipe, not less than 6-inches long, and having an inside diameter not less than 1/2-inch greater than the outside diameter of the inserted pipe post. Provide steel plate closure secured to the bottom of the sleeve, with closure width and length not less than 1-inch greater than the outside diameter of the sleeve. After posts have been inserted into sleeves, fill the annular space between post and sleeve with molten lead, sulfur, or a quick-setting hydraulic cement. Cover anchorage joint with a round steel flange welded to the post.
- b. Anchor posts to steel with steel oval flanges, angle type or floor type as required by conditions, welded to posts and bolted to the steel supporting members.
- c. Anchor rail ends into concrete and masonry with steel round flanges

welded to rail ends and anchored into the wall construction with lead expansion shields and bolts.

Secure handrails to walls by means of wall brackets and wall return fitting at handrail ends. Provide brackets of malleable iron castings, with not less than 3-inch projection from the finish wall surface to the center of the pipe drilled to receive one 3/8-inch bolt. Locate brackets not more than 60-inches on center. Provide wall return fittings of cast iron castings, flush-type, with the same projection as that specified for wall brackets. Secure wall brackets and wall return fittings to building construction as follows:

- a. For concrete and solid masonry anchorage, use bolt anchor expansion shields and lag bolts.
- b. For hollow masonry and stud partition anchorage, use toggle bolts having square heads.

Install toe boards and brackets where indicated. Make splices, where required, at expansion joints. Install removable sections as indicated.

### 3.2 INSTALLATION

Submit manufacturer's installation instructions for the following products to be used in the fabrication of steel stair railing and hand rail work:

- a. Structural steel plates, shapes, and bars
- b. Structural steel tubing
- c. Hot-Rolled carbon steel bars
- d. Protective coating
- e. Masonry anchorage devices
- f. Steel railings and handrails
- g. Anchorage and fastening systems

Provide complete, detailed fabrication and installation drawings for all iron and steel hardware, and for all steel shapes, plates, bars and strips used in accordance with the design specifications referenced in this section.

#### 3.2.1 Steel Handrail

Install in pipe sleeves embedded in concrete and filled with non-shrink grout or quick setting anchoring cement with anchorage covered with standard pipe collar pinned to post by means of base plates bolted to stringers or structural steel frame work. Secure rail ends by steel pipe flanges anchored by expansion shields and bolts. through-bolted to a back plate or by 1/4 inch lag bolts to studs or solid backing.

#### 3.2.2 Touchup Painting

Immediately after installation, clean field welds, bolted connections, abraded areas of the shop paint, and exposed areas painted with the paint used for shop painting. Apply paint by brush or spray to provide a

minimum dry-film thickness of 2-mils.

### 3.3 FIELD QUALITY CONTROL

#### 3.3.1 Field Welding

Ensure procedures of manual shielded metal arc welding, appearance and quality of welds made, and methods used in correcting welding work comply with AWS D1.1/D1.1M.

-- End of Section --

SECTION 06 10 00

ROUGH CARPENTRY

**08/16**

PART 1 GENERAL

1.1 REFERENCES

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

AMERICAN FOREST FOUNDATION (AFF)

ATFS STANDARDS (2015) American Tree Farm System Standards  
of Sustainability 2015-2020

AMERICAN LUMBER STANDARDS COMMITTEE (ALSC)

ALSC PS 20 (2015) American Softwood Lumber Standard

AMERICAN WOOD COUNCIL (AWC)

AWC NDS (2015) National Design Specification (NDS)  
for Wood Construction

AWC WFCM (2012) Wood Frame Construction Manual for  
One- and Two-Family Dwellings

AMERICAN WOOD PROTECTION ASSOCIATION (AWPA)

AWPA BOOK (2015) AWPA Book of Standards

AWPA M2 (2016) Standard for the Inspection of  
Preservative Treated Wood Products for  
Industrial Use

AWPA M6 (2013) Brands Used on Preservative Treated  
Materials

AWPA P5 (2015) Standard for Waterborne  
Preservatives

AWPA U1 (2017) Use Category System: User  
Specification for Treated Wood

APA - THE ENGINEERED WOOD ASSOCIATION (APA)

APA L870 (2010) Voluntary Product Standard, PS  
1-09, Structural Plywood

ASME INTERNATIONAL (ASME)

ASME B18.2.1 (2012; Errata 2013) Square and Hex Bolts  
and Screws (Inch Series)

ASME B18.2.2 (2015) Nuts for General Applications:

Machine Screw Nuts, Hex, Square, Hex  
Flange, and Coupling Nuts (Inch Series)

ASME B18.5.2.1M (2006; R 2011) Metric Round Head Short  
Square Neck Bolts

ASME B18.5.2.2M (1982; R 2010) Metric Round Head Square  
Neck Bolts

ASME B18.6.1 (2016) Wood Screws (Inch Series)

ASTM INTERNATIONAL (ASTM)

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

ASTM A307 (2014; E 2017) Standard Specification for  
Carbon Steel Bolts, Studs, and Threaded  
Rod 60 000 PSI Tensile Strength

ASTM F1667 (2017) Standard Specification for Driven  
Fasteners: Nails, Spikes, and Staples

ASTM F547 (2006; R 2012) Nails for Use with Wood and  
Wood-Base Materials

CSA GROUP (CSA)

CSA Z809-08 (R2013) Sustainable Forest Management

FOREST STEWARDSHIP COUNCIL (FSC)

FSC STD 01 001 (2000) Principles and Criteria for Forest  
Stewardship

INTERNATIONAL CODE COUNCIL (ICC)

ICC IBC (2017) International Building Code

PROGRAMME FOR ENDORSEMENT OF FOREST CERTIFICATION (PEFC)

PEFC ST 2002:2013 (2015) PEFC International Standard Chain  
of Custody of Forest Based Products  
Requirements

SUSTAINABLE FOREST INITIATIVE (SFI)

SFI 2015-2019 (2015) Standards, Rules for Label Use,  
Procedures and Guidance

U.S. GENERAL SERVICES ADMINISTRATION (GSA)

CID A-A-1923 (Rev A; Notice 2) Shield, Expansion (Lag,  
Machine and Externally Threaded Wedge Bolt  
Anchors)

CID A-A-1924 (Rev A; Notice 2) Shield, Expansion (Self  
Drilling Tubular Expansion Shell Bolt

Anchors

CID A-A-1925

(Rev A; Notice 2) Shield Expansion (Nail Anchors)

UNDERWRITERS LABORATORIES (UL)

UL 2818

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

1.2 SUBMITTALS

Government approval is required for submittals with a "G" designation; submittals not having a "G" designation are for information only. When used, a designation following the "G" designation identifies the office that will review the submittal for the Government. Submittals with an "S" are for inclusion in the Sustainability eNotebook, in conformance with Section 01 33 29 SUSTAINABILITY REPORTING. Submit the following in accordance with Section 01 33 00 SUBMITTAL PROCEDURES:

SD-06 Test Reports

Preservative-treated Lumber

SD-07 Certificates

Certificates of Grade

Certified Sustainably Harvested Wood; S

Preservative Treatment

Indoor Air Quality

1.3 DELIVERY AND STORAGE

Deliver materials to the site in an undamaged condition. Store materials off the ground to provide proper ventilation, with drainage to avoid standing water, and protection against ground moisture and dampness. Store materials with a moisture barrier at both the ground level and as a cover forming a well ventilated enclosure. Do not use materials that have visible moisture or biological growth. Remove defective and damaged materials and provide new materials. Store separated reusable wood waste convenient to cutting station and area of work.

1.4 GRADING AND MARKING

1.4.1 Lumber

Mark each piece of framing and board lumber or each bundle of small pieces of lumber with the grade mark of a recognized association or independent inspection agency. Such association or agency must be certified by the Board of Review, American Lumber Standards Committee, to grade the species used. Surfaces that are to be exposed to view must not bear grademarks, stamps, or any type of identifying mark. Hammer marking will be permitted on timbers when all surfaces will be exposed to view.

#### 1.4.2 Plywood

Mark each sheet with the mark of a recognized association or independent inspection agency that maintains continuing control over the quality of the plywood. The mark must identify the plywood by species group or span rating, exposure durability classification, grade, and compliance with APA L870. Surfaces that are to be exposed to view must not bear grademarks or other types of identifying marks.

#### 1.4.3 Preservative-Treated Lumber and Plywood

The Contractor is responsible for the quality of treated wood products. Each treated piece must be inspected in accordance with AWPA M2 and permanently marked or branded, by the producer, in accordance with AWPA M6. The Contractor must provide Contracting Officer's Representative (COR) with the inspection report of an approved independent inspection agency that offered products comply with applicable AWPA Standards. The appropriate Quality Mark on each piece will be accepted, in lieu of inspection reports, as evidence of compliance with applicable AWPA treatment standards.

#### 1.5 SIZES AND SURFACING

ALSC PS 20 for dressed sizes of yard and structural lumber. Lumber must be surfaced four sides. Size references, unless otherwise specified, are nominal sizes, and actual sizes must be within manufacturing tolerances allowed by the standard under which the product is produced. Other measurements are IP or SI standard.

#### 1.6 MOISTURE CONTENT

Air-dry or kiln-dry lumber. Kiln-dry treated lumber after treatment. Maximum moisture content of wood products must be as follows at the time of delivery to the job site:

- a. Framing lumber and board, 19 percent maximum
- b. Materials other than lumber; moisture content must be in accordance with standard under which the product is produced

#### 1.7 PRESERVATIVE TREATMENT

Treat wood products with waterborne wood preservatives conforming to AWPA P5. Pressure treatment of wood products must conform to the requirements of AWPA BOOK Use Category System Standards U1 and T1. Pressure-treated wood products must not contain arsenic, chromium, or other agents classified as carcinogenic, probably carcinogenic, or possibly carcinogenic to humans (compounds in Groups 1, 2A, or 2B) by the International Agency for Research on Cancer (IARC), Lyon, France. Pressure-treated wood products must not exceed the limits of the U.S. EPA's Toxic Characteristic Leaching Procedure (TCLP), and must not be classified as hazardous waste. Submit certification from treating plant stating chemicals and process used and net amount of preservatives retained are in conformance with specified standards. In accordance with AWPA U1 provide non-copper preservative treatment such as EL2, PTI or SBX, DOT for products in direct contact with sheet metal.

- a. 0.25 pcf intended for above ground use.



- b. 0.40 pcf intended for ground contact and fresh water use. 0.60 pcf intended for Ammoniacal Copper Quaternary Compound (ACQ)-treated foundations. 0.80 to 1.00 pcf intended for ACQ-treated pilings. All wood must be air or kiln dried after treatment. Specific treatments must be verified by the report of an approved independent inspection agency, or the AWPQ Quality Mark on each piece. Brush coat areas that are cut or drilled after treatment with either the same preservative used in the treatment or with a 2 percent copper naphthenate solution. All lumber and woodwork must be preservative treated. Plastic lumber must not be preservative treated. The following items must be preservative treated:

- (1) Wood framing, woodwork, and plywood up to and including the subflooring at the first-floor level of structures having crawl spaces when the bottoms of such items are 24 inches or less from the earth underneath.
- (4) Wood sills, soles, plates, furring, and sleepers that are less than 24 inches from the ground, furring and nailers that are set into or in contact with concrete or masonry.
- (5) Nailers for roof decks.

## 1.8 CERTIFICATIONS

### 1.8.1 Certified Wood Grades

Provide certificates of grade from the grading agency on graded but unmarked lumber or plywood attesting that materials meet the grade requirements specified herein.

### 1.8.2 Certified Sustainably Harvested Wood

Provide wood certified as sustainably harvested by FSC STD 01 001, ATFS STANDARDS, CSA Z809-08, SFI 2015-2019, or other third party program certified by PEFC ST 2002:2013. Provide a letter of Certification of Sustainably Harvested Wood signed by the wood supplier. Identify certifying organization and their third party program name and indicate compliance with chain-of-custody program requirements. Submit sustainable wood certification data; identify each certified product on a line item basis. Submit copies of invoices bearing certification numbers.

### 1.8.3 Indoor Air Quality Certifications

Submit required indoor air quality certifications in one submittal package.

#### 1.8.3.1 Adhesives and Sealants

Provide products certified to meet indoor air quality requirements by UL 2818.

## PART 2 PRODUCTS

### 2.1 PRODUCT SUSTAINABILITY CRITERIA

For products in this section, where applicable and to extent allowed by performance criteria, provide and document the following:

### 2.1.1 Certified Sustainably Harvested Wood

Certified sustainably harvested wood is identified for some products in this section; provide documentation in accordance with Section 01 33 29 SUSTAINABILITY REPORTING paragraph BIOBASED PRODUCTS. Other products listed in this section may be available as certified sustainably harvested wood; identify those products that meet project requirements for certified sustainably harvested wood, and provide documentation in accordance with Section 01 33 29 SUSTAINABILITY REPORTING paragraph BIOBASED PRODUCTS.

### 2.1.2 Reduce Volatile Organic Compounds (VOC) (Low-Emitting Materials) for Products

Reduced VOC content is identified for some products in this section; provide documentation in accordance with Section 01 33 29 SUSTAINABILITY REPORTING paragraph REDUCE VOLATILE ORGANIC COMPOUNDS (VOC) (LOW-EMITTING MATERIALS). Other products listed in this section may be available with reduced VOC content; identify those products that meet project requirements for reduced VOC content, and provide documentation in accordance with Section 01 33 29 SUSTAINABILITY REPORTING paragraph REDUCE VOLATILE ORGANIC COMPOUNDS (VOC) (LOW-EMITTING MATERIALS).

## 2.2 OTHER MATERIALS

### 2.2.1 Miscellaneous Wood Members

#### 2.2.1.1 Nonstress Graded Members

Members must include bridging, corner bracing, furring, grounds, and nailing strips. Members must be in accordance with TABLE I for the species used. Sizes must be as follows unless otherwise shown:

Member	Size inch
Blocking	2 x 4 or size as directed.
Furring	1 x 2
Nailing strips	1 x 3 or 1 x 4 when used as shingle base or interior finish, otherwise 2 inch stock.

#### 2.2.1.2 Blocking, furring and nailing strips

Blocking must be standard or number 2 grade.

## 2.3 ROUGH HARDWARE

Unless otherwise indicated or specified, rough hardware must be of the type and size necessary for the project requirements. Sizes, types, and spacing of fastenings of manufactured building materials UST be as recommended by the product manufacturer unless otherwise indicated or specified. Rough hardware embedded in or in contact with preservative treated wood, exterior masonry, or concrete walls or slabs must be hot-dip zinc-coated in accordance with ASTM A153/A153M.

### 2.3.1 Bolts, Nuts, Studs, and Rivets

ASME B18.2.1, ASME B18.5.2.1M, ASME B18.5.2.2M and ASME B18.2.2.

### 2.3.2 Anchor Bolts

ASTM A307, size as indicated, complete with nuts and washers.

### 2.3.3 Expansion Shields

CID A-A-1923, CID A-A-1924, and CID A-A-1925. Except as shown otherwise, maximum size of devices must be 3/8 inch.

### 2.3.4 Lag Screws and Lag Bolts

ASME B18.2.1.

### 2.3.5 Wood Screws

ASME B18.6.1.

### 2.3.6 Nails and Staples

ASTM F547, size and type best suited for purpose; staples must be as recommended by the manufacturer of the materials to be joined. In general, 8-penny or larger nails must be used for nailing through 1 inch thick lumber and for toe nailing 2 inch thick lumber; 16-penny or larger nails must be used for nailing through 2 inch thick lumber. Nails used with treated lumber and sheathing must be hot-dipped galvanized in accordance with ASTM A153/A153M. Nailing must be in accordance with the recommended nailing schedule contained in AWC WFCM. Where detailed nailing requirements are not specified, nail size and spacing must be sufficient to develop an adequate strength for the connection. The connection's strength must be verified against the nail capacity tables in AWC NDS. Reasonable judgment backed by experience must ensure that the designed connection will not cause the wood to split. If a load situation exceeds a reasonable limit for nails, a specialized connector must be used.

### 2.3.7 Wire Nails

ASTM F1667.

## PART 3 EXECUTION

### 3.1 INSTALLATION

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

Conform to AWC WFCM, unless otherwise indicated or specified. Fit framing lumber and other rough carpentry, set accurately to the required lines and levels, and secure in place in a rigid manner. Reinforce all members damaged by such cutting or boring by means of specially formed and approved sheet metal or bar steel shapes, or remove and provide new, as approved. Provide as necessary for the proper completion of the work all framing members not indicated or specified. Spiking and nailing not indicated or specified otherwise must be in accordance with the Nailing Schedule contained in ICC IBC; perform bolting in an approved manner. Spikes, nails, and bolts must be drawn up tight.

### 3.1.1 Sills

#### 3.1.1.1 Anchors in Masonry

Except where indicated otherwise, Embed anchor bolts not less than 15 inches in masonry unit walls and provide each with a nut and a 2 inch diameter washer at bottom end. Fully grout bolts with mortar.

#### 3.1.1.2 Anchors in Concrete

Except where indicated otherwise, Embed anchor bolts not less than 8 inches in poured concrete walls and provide each with a nut and a 2 inch diameter washer at bottom end. A bent end may be substituted for the nut and washer; bend must be not less than 90 degrees. Powder-actuated fasteners spaced 3 feet o.c. may be provided in lieu of bolts for single thickness plates on concrete.

### 3.2 MISCELLANEOUS

#### 3.2.1 Wood Roof Nailers, Edge Strips, Crickets, Curbs, and Cants

Provide sizes and configurations indicated or specified and anchored securely to continuous construction.

##### 3.2.1.1 Roof Nailing Strips

Provide roof nailing strips for roof decks as indicated and specified herein. Apply nailing strips in straight parallel rows in the direction and spacing indicated. Strips must be surface applied.

#### 3.2.2 Wood Blocking

Provide proper sizes and shapes at proper locations for the installation and attachment of wood and other finish materials, fixtures, equipment, and items indicated or specified.

#### 3.2.3 Wood Furring

Provide where shown and as necessary for facing materials specified. Except as shown otherwise, furring strips must be nominal one by 3, continuous, and spaced 16 inches o.c. Erect furring vertically or horizontally as necessary. Nail furring strips to masonry. Do not use wood plugs. Provide furring strips around openings, behind bases, and at angles and corners. Furring must be plumb, rigid, and level and must be shimmed as necessary to provide a true, even plane with surfaces suitable to receive the finish required.

#### 3.2.4 Temporary Closures

Provide with hinged doors and padlocks and install during construction at exterior doorways and other ground level openings that are not otherwise closed. Cover windows and other unprotected openings with polyethylene or other approved material, stretched on wood frames. Provide dustproof barrier partitions to isolate areas as directed.

#### 3.2.5 Temporary Centering, Bracing, and Shoring

Provide for the support and protection of masonry work during construction

as specified in Section 04 20 00. Forms and centering for cast-in-place concrete work are specified in Section 03 30 00 CAST-IN-PLACE CONCRETE.

### 3.3 WASTE MANAGEMENT OF WOOD PRODUCTS

In accordance with the Waste Management Plan and as specified. Separate and reuse scrap sheet materials larger than 2 square feet, framing members larger than 16 inches, and multiple offcuts of any size larger than 12 inches. Clearly separate damaged wood and other scrap lumber for acceptable alternative uses on site, including bracing, blocking, cripples, ties, and shims.

Separate treated, stained, painted, and contaminated wood and place in designated area for hazardous materials. Dispose of according to local regulations. Do not leave any wood, shavings, sawdust, or other wood waste buried in fill or on the ground. Prevent sawdust and wood shavings from entering the storm drainage system. Compost sawdust. Do not burn scrap lumber that has been pressure treated, or lumber that is less than one year old.

-- End of Section --



SECTION 06 20 00

FINISH CARPENTRY

08/16

PART 1 GENERAL

1.1 REFERENCES

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

AMERICAN HARDBOARD ASSOCIATION (AHA)

AHA A135.4 (1995; R 2004) Basic Hardboard

AMERICAN LUMBER STANDARDS COMMITTEE (ALSC)

ALSC PS 20 (2015) American Softwood Lumber Standard

AMERICAN WOOD PROTECTION ASSOCIATION (AWPA)

AWPA M4 (2015) Standard for the Care of  
Preservative-Treated Wood Products

AWPA U1 (2017) Use Category System: User  
Specification for Treated Wood

APA - THE ENGINEERED WOOD ASSOCIATION (APA)

APA L870 (2010) Voluntary Product Standard, PS  
1-09, Structural Plywood

ASME INTERNATIONAL (ASME)

ASME B18.2.1 (2012; Errata 2013) Square and Hex Bolts  
and Screws (Inch Series)

ASME B18.2.2 (2015) Nuts for General Applications:  
Machine Screw Nuts, Hex, Square, Hex  
Flange, and Coupling Nuts (Inch Series)

ASME B18.6.1 (2016) Wood Screws (Inch Series)

ASTM INTERNATIONAL (ASTM)

ASTM D2898 (2010; R 2017) Standard Practice for  
Accelerated Weathering of  
Fire-Retardant-Treated Wood for Fire  
Testing

ASTM F547 (2006; R 2012) Nails for Use with Wood and  
Wood-Base Materials

COMPOSITE PANEL ASSOCIATION (CPA)

CPA A208.1 (2016) Particleboard

HARDWOOD PLYWOOD AND VENEER ASSOCIATION (HPVA)

HPVA HP-1 (2016) American National Standard for  
Hardwood and Decorative Plywood

NATIONAL HARDWOOD LUMBER ASSOCIATION (NHLA)

NHLA Rules (2011) Rules for the Measurement &  
Inspection of Hardwood & Cypress

NORTHEASTERN LUMBER MANUFACTURERS ASSOCIATION (NELMA)

NELMA Grading Rules (2013) Standard Grading Rules for  
Northeastern Lumber

REDWOOD INSPECTION SERVICE (RIS) OF THE CALIFORNIA REDWOOD  
ASSOCIATION (CRA)

RIS Grade Use (1998) Redwood Lumber Grades and Uses

SOUTHERN PINE INSPECTION BUREAU (SPIB)

SPIB 1003 (2002) Standard Grading Rules for Southern  
Pine Lumber

WEST COAST LUMBER INSPECTION BUREAU (WCLIB)

WCLIB 17 (2004) Standard Grading Rules

WESTERN WOOD PRODUCTS ASSOCIATION (WWPA)

WWPA G-5 (2011) Western Lumber Grading Rules

WINDOW AND DOOR MANUFACTURERS ASSOCIATION (WDMA)

WDMA I.S.4 (2013) Preservative Treatment for Millwork

WOOD MOULDING AND MILLWORK PRODUCERS ASSOCIATION (WMPMA)

WMPMA WM 6 (1987) Industry Standard for Non-Pressure  
Treating of Wood Millwork

1.2 SUBMITTALS

Government approval is required for submittals with a "G" designation; submittals not having a "G" designation are for information only. When used, a designation following the "G" designation identifies the office that will review the submittal for the Government. Submittals with an "S" are for inclusion in the Sustainability eNotebook, in conformance with Section 01 33 29 SUSTAINABILITY REPORTING. Submit the following in accordance with Section 01 33 00 SUBMITTAL PROCEDURES:

SD-02 Shop Drawings

Detail Drawings Indicating All Wood Assemblies; G

SD-03 Product Data



Wood Products; G

Treated Wood Products; G

Hardware and Accessories; G

SD-04 Samples

Samples; G

SD-07 Certificates

Certificates of Grade; G

SD-11 Closeout Submittals

VOC Content for Softwood Plywood; S

VOC Content for Hardwood Plywood; S

Recycled Content for MDF/Particleboard; S

### 1.3 DETAIL DRAWINGS

Submit detail drawings indicating all wood assemblies proposed for use in the project. Indicate materials, species, grade, density, grain, finish details of construction, location of use in the project, finishes, types, method and arrangement of fasteners, and installation details. This includes all fabricated assemblies.

### 1.4 PRODUCT DATA

Submit Manufacturers printed data including proposed species, grade, density grain, and finish as applicable; sufficient to demonstrate compliance with this specification for each type of wood product specified. For treated wood products also provide documentation of environmentally safe preservatives for each type of wood product specified.

Provide Manufacturers printed data for hardware and all wood accessories including but not limited to edge banding, adhesives, and sealers.

### 1.5 SAMPLES

Samples indicating proposed species, grade, density grain, and finish for each type of wood product specified. Provide samples of sufficient size to show pattern and color ranges of proposed products.

### 1.6 DELIVERY, STORAGE, AND HANDLING

Deliver wood products to the jobsite in an undamaged condition. Stack materials to ensure ventilation and drainage. Protect against dampness before and after delivery. Store materials under cover in a well ventilated enclosure and protect against extreme changes in temperature and humidity. Keep materials wrapped and separated from off-gassing materials (such as drying paints and adhesives). Do not use materials that have visible moisture or biological growth. Do not store products in building until wet trade materials are dry and humidity of the space is within wood manufacturer's tolerance limits for storage.

## 1.7 QUALITY ASSURANCE

### 1.7.1 Certifications

#### 1.7.1.1 Certified Wood Grades

Provide certificates of grade from the grading agency on graded but unmarked lumber or plywood attesting that materials meet the grade requirements specified herein.

#### 1.7.2 Lumber

Identify each piece or each bundle of lumber, millwork, and trim by the grade mark of a recognized association or independent inspection agency certified by the Board of Review of the ALSC to grade the species.

#### 1.7.3 Plywood

Provide each sheet of plywood with the mark of a recognized association or independent inspection agency that maintains continuing control over the quality of the plywood. Marks must identify plywood by species group or span rating, exposure durability classification, grade, and compliance with APA L870.

#### 1.7.4 Hardboard

Provide materials marks or written documentation identifying the producer and the applicable standard.

#### 1.7.5 Pressure Treated Lumber and Plywood

Inspect each treated piece in accordance with AWP A U1.

#### 1.7.6 Non-Pressure Treated Woodwork and Millwork

Mark, stamp, or label to indicate compliance with WDMA I.S.4.

#### 1.7.7 Fire-Retardant Treated Lumber

Each piece must bear an Underwriters Laboratories fire resistance label or comparable label of another nationally recognized independent fire retardant materials testing laboratory.

## PART 2 PRODUCTS

### 2.1 WOOD PRODUCTS

#### 2.1.1 Sizes and Patterns of Wood Products

Provide yard and board lumber sizes in accordance with ALSC PS 20. Provide shaped lumber and millwork in the patterns indicated and in standard patterns of the association covering the species. Size references, unless otherwise specified, are nominal sizes. Provide actual sizes within manufacturing tolerances allowed by the applicable standard.

#### 2.1.2 Species and Grades

Provide in accordance with AWP A U1 Use Category System Tables unless otherwise specified herein.

### 2.1.3 Trim, Finish, and Frames

Provide species and grades listed in the table below for wood materials that must be painted. For materials that must be stained, have a natural, or a transparent finish, provide materials one grade higher than those listed in the table below. Provide trim, except window stools and aprons with hollow backs.

TABLE OF GRADES FOR WOOD TO RECEIVE PAINT FINISH		
Grading Rules	Species	Exterior and Interior Trim, Finish, and Frames
WWPA G-5 standard grading rules	Aspen, Douglas Fir-Larch, Douglas Fir South, Engelmann Spruce-Lodgepole Pine, Engelmann Spruce, Hem-Fir, Idaho White Pine, Lodgepole Pine, Mountain Hemlock, Mountain Hemlock-Hem-Fir, Ponderosa Pine-Sugar Pine, (Ponderosa Pine-Lodgepole Pine,) White Woods, (Western Woods,) Western Cedars, Western Hemlock	All Species: C & BTR. Select (Choice & BTR Idaho White Pine) or Superior Finish. Western Red Cedar may be graded C & BTR. Select or A & BTR in accordance with Special Western Red Cedar Rules.
WCLIB 17 standard grading rules	Douglas Fir-Larch, Hem-Fir, Mountain Hemlock, Sitka Spruce, Western Cedars, Western Hemlock	All Species: C & BTR VG, except A for Western Red Cedar
SPIB 1003 standard grading rules	Southern Pine	C & BTR
NHLA Rules	Cypress	C-Select
NELMA Grading Rules standard grading rules **	Balsam Fir, Eastern Hemlock-Tamarack, Eastern Spruce, Eastern White Pine, Northern Pine, Northern Pine, Northern White Cedar	All Species: C-Select except C & BTR for Eastern White Pine and Norway Pine
RIS Grade Use standard specifications	Redwood	Clear, Clear All Heart

TABLE OF GRADES FOR WOOD TO RECEIVE PAINT FINISH		
Grading Rules	Species	Exterior and Interior Trim, Finish, and Frames
NHLA Rules	Cypress	B Finish
	Red Gum, Soft Elm, Birch	Select or BTR (for interior use only)

Note: \*\*

<http://www.nelma.org/library/2013-standard-grading-rules-for-northeastern-lumber/>

#### 2.1.4 Utility Shelving

Provide utility shelving in a suitable species equal to or exceeding the requirements of No. 3 common white fir under WWPA G-5, 1 inch thick; or plywood, interior type, Grade A-B, 1/2 inch thick, any species group.

#### 2.1.5 Softwood Plywood

Provide in accordance with APA L870. When located on the interior of buildings, provide products with no added urea-formaldehyde resins. Provide data identifying VOC content for softwood plywood.

- Plywood for Soffits: Exterior type, B-B medium density overlay.
- Plywood for Shelving: Interior type, A-B Grade, any species group.
- Plywood for Countertops: Exterior type, A-C Grade.

#### 2.1.6 Hardwood Plywood

HPVA HP-1, Type II (Interior), Premium (A) Good (1) Backing (4) Grade, hardwood veneer core construction, lumber core construction, face veneers of 1/30 inch, of thickness indicated. When located on the interior of buildings, provide products with no added urea-formaldehyde resins. Provide data identifying VOC content for hardwood plywood.

#### 2.1.7 Hardboard

AHA A135.4, standard type, 1/4 inch thick.

#### 2.1.8 Medium Density Fiberboard (MDF) and Particleboard

CPA A208.1, Grade 1-M-2 or 2-M-2 or better.

Provide products with pre-consumer recycled content of 85 percent. Provide data identifying percentage of recycled content for MDF/particleboard.

#### 2.1.9 Wood Bumpers

As indicated on drawings, dressed to size indicated and with outer edges beveled.

## 2.2 MOISTURE CONTENT OF WOOD PRODUCTS

Air dry or kiln dry lumber. Kiln dry treated lumber after treatment. Maximum moisture content of wood products at time of delivery to the jobsite, and when installed, must be as follows:

- a. Interior Paneling: 12 percent.
- b. Interior Finish Lumber, Trim, and Millwork: 1-1/4 Inches Nominal or Less in Thickness: 12 percent on 85 percent of the pieces and 15 percent on remainder.
- c. Exterior Treated and Untreated Finish Lumber and Trim: 4 inches Nominal or Less in Thickness: 19 percent.
- d. Provide moisture content of other materials in accordance with the applicable standards.

## 2.3 PRESERVATIVE TREATMENT OF WOOD PRODUCTS

### 2.3.1 Non-Pressure Treatment

Treat woodwork and millwork, such as exterior trim, door trim, and window trim, in accordance with WDMA I.S.4, with either 2 percent copper naphenate, 3 percent zinc naphenate, or 1.8 percent copper-8-quinolinolate. Provide a liberal brush coat of preservative treatment to field cuts and holes.

### 2.3.2 Pressure Treatment

Treat lumber and plywood used on the exterior of buildings or in contact with masonry or concrete with a waterborne preservative listed in AWPA U1 (P series is included therein by reference) as applicable, and inspected in accordance with AWPA U1. Identify treatment on each piece of material by the quality mark of an agency accredited by the Board of Review of the American Lumber Standards Committee. Provide treated plywood to a reflection level as follows:

Preservative treat exterior wood moulding and millwork that will be within 18 inches of soil or in contact with water or concrete in accordance with WMMPA WM 6. Provide a field treatment in accordance with AWPA M4 of exposed areas of treated wood that have been cut or drilled. Items of all-heart material of cedar, cypress, or redwood do not require preservative treatment except when in direct contact with soil.

## 2.4 FIRE-RETARDANT TREATMENT

### 2.4.1 Wood Products

Pressure treat fire-retardant treated lumber and plywood in accordance with AWPA U1. Comply with material use as defined in AWPA U1 for Interior Type A and Exterior Type. Treatment and performance inspection must be conducted by a qualified independent testing agency that establishes performance ratings. Each piece or bundle of treated material must bear identification of the testing agency to indicate performance with such rating. Subject treated materials that will be exposed to rain wetting to an accelerated weathering technique in accordance with ASTM D2898, Method A, prior to being tested for compliance with AWPA U1.

## 2.5 HARDWARE AND ACCESSORIES

Provide sizes, types, and spacings of hardware and accessories as recommended in writing by the wood product manufacturer, except as otherwise specified.

### 2.5.1 Wood Screws

ASME B18.6.1.

### 2.5.2 Bolts, Nuts, Lag Screws, and Studs

ASME B18.2.1 and ASME B18.2.2.

### 2.5.3 Nails

Use nails of a size and type best suited for each application and in accordance with ASTM F547. Use hot-dipped galvanized or aluminum nails for exterior applications. For siding, provide nails of sufficient length to extend 1-1/2 inches into supports, including wood sheathing over framing. Where nailing is impractical, provide screws of a size and type best suited for each application.

## 2.6 FABRICATION

### 2.6.1 Quality Standards (QS)

#### 2.6.1.1 Grades

The terms "Premium," "Custom," and "Economy" refer to the quality grades defined in AWI AWS. Provide items not otherwise specified in a specific grade as "Custom" grade.

#### 2.6.1.2 Adhesives

Select adhesives for durability and permanent bonding. Address factors such as materials that must be bonded, expansion and contraction, bond strength, fire rating, moisture resistance, and manufacturer's recommendations.

## PART 3 EXECUTION

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

### 3.1 FINISH WORK

Apply primer to finish work before installing. Where practicable, shop assemble and finish millwork items. Construct joints tight and in a manner to conceal shrinkage but to avoid cupping, twisting and warping after installation. Miter trim and mouldings at exterior angles; cope at interior angles and at returns. Provide millwork and trim in maximum practical lengths. Fasten finish work with finish nails. Provide blind nailing where practicable. Set face nails for putty stopping.

#### 3.1.1 Interior Finish Work

After installation, sand exposed surfaces smooth. Provide window and door trim in single lengths.

### 3.1.2 Door Frames

Set plumb and square. Provide solid blocking at not more than 16 inches on center for each jamb. Position blocking to occur behind hinges and lock strikes. Double wedge frames and fasten with finish nails. Set nails for putty stopping.

### 3.1.3 Window Stools and Aprons

Provide stools with rabbets over window sills. Provide aprons with returns cut accurately to profile of member.

### 3.1.4 Bases

Provide flat member with a moulded top. Fasten base to framing or to grounds. Set one-piece wood base after finish flooring is in place.

## 3.2 SHELVING

Support 1 inch nominal thick wood shelf material or 3/4 or 23/32 inch thick plywood shelf material with end and intermediate supports arranged to prevent buckling and sagging. Provide hook strips 1 by 4 inches nominal and cleats 1 by 2 inches nominal. Provide cleats except where hook strips are specified or indicated. Where adjustable shelving is indicated, provide standards and brackets or shelf rests for each shelf. Anchor standards to wall at not more than 2 feet on center.

### 3.2.1 Storage Rooms

Unless otherwise indicated, provide storage rooms with shelves 11-1/4 inches wide, bottom shelf 18 inches above the floor, top shelf 18 inches below the ceiling, and intermediate shelves approximately 18 inches apart.

## 3.3 MISCELLANEOUS

### 3.3.1 Countertops

Conceal fastenings where practicable. Fit counters tight to adjoining surfaces and scribe where necessary. Provide scribed joints neat and flush. Provide counter sections in longest lengths practicable with a minimum number of joints. Where joints are necessary, provide tight joints drawn up with concealed type heavy pull-up bolts. Glue joints with water resistant glue and make rigid with screws, bolts, or other approved fastenings.

### 3.3.2 Cabinets

Provide cabinets level, plumb, true, and tight to adjacent walls. Secure cabinets to walls with concealed toggle bolts. Secure top to cabinet with concealed screws. Make cutouts for fixtures from templates supplied by fixture manufacturer. Locate cutouts for pipes so that edges of holes are covered by escutcheons after installation.

### 3.3.3 Wood Bumpers

Bore, countersink, and bolt wood bumpers in place where indicated.

### 3.4 MOULDING AND INTERIOR TRIM

Install mouldings and interior trim straight, plumb, level and with closely fitted joints. Provide exposed surfaces machine sanded at the shop. Cope returns and interior angles at moulded items and miter external corners. Shoulder intersections of flatwork to ease any inherent changes in plane. Provide window and door trim in single lengths. Blind nail to the extent practicable. Set and stop face nailing with a nonstaining putty to match the applied finish. Use screws for attachment to metal; set and stop screws in accordance with the same quality requirements for nails.

-- End of Section --



SECTION 06 41 16.00 10

PLASTIC-LAMINATE-CLAD ARCHITECTURAL CABINETS  
08/10

PART 1 GENERAL

1.1 REFERENCES

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

AMERICAN NATIONAL STANDARDS INSTITUTE (ANSI)

ANSI A161.2 (1998) Decorative Laminate Countertops,  
Performance Standards for Fabricated High  
Pressure

ARCHITECTURAL WOODWORK INSTITUTE (AWI)

AWI AWS (2nd Edition) Architectural Woodwork  
Standards

ASTM INTERNATIONAL (ASTM)

ASTM F547 (2006; R 2012) Nails for Use with Wood and  
Wood-Base Materials

BUILDERS HARDWARE MANUFACTURERS ASSOCIATION (BHMA)

ANSI/BHMA A156.9 (2015) Cabinet Hardware

COMPOSITE PANEL ASSOCIATION (CPA)

CPA A208.2 (2016) Medium Density Fiberboard (MDF) for  
Interior Applications

NATIONAL ELECTRICAL MANUFACTURERS ASSOCIATION (NEMA)

ANSI/NEMA LD 3 (2005) Standard for High-Pressure  
Decorative Laminates

SCIENTIFIC CERTIFICATION SYSTEMS (SCS)

SCS SCS Global Services (SCS)Indoor Advantage

U.S. GREEN BUILDING COUNCIL (USGBC)

LEED BD+C (2009; R 2010) Leadership in Energy and  
Environmental Design(tm) Building Design  
and Construction (LEED-NC)

UL ENVIRONMENT (ULE)

ULE Greenguard UL Greenguard Certification Program

WINDOW AND DOOR MANUFACTURERS ASSOCIATION (WDMA)

ANSI/WDMA I.S.1A

(2013) Interior Architectural Wood Flush  
Doors

1.2 SYSTEM DESCRIPTION

Work in this section includes laminate clad custom casework cabinets as shown on the drawings and as described in this specification. This Section includes high-pressure laminate surfacing and cabinet hardware. Comply with EPA requirements in accordance with Section 01 33 29 SUSTAINABILITY REPORTING.

1.3 SUSTAINABILITY REPORTING

Materials in this technical specification may contribute towards contract compliance with sustainability requirements. See Section 01 33 29 SUSTAINABILITY REPORTING for project LEED BD+C local/regional materials, low-emitting materials, recycled content, certified wood LEED documentation requirements.

1.4 SUBMITTALS

Government approval is required for submittals with a "G" designation; submittals not having a "G" designation are for information only. When used, a designation following the "G" designation identifies the office that will review the submittal for the Government. Submittals with an "S" are for inclusion in the Sustainability eNotebook, in conformance to Section 01 33 29 SUSTAINABILITY REPORTING. Submit the following in accordance with Section 01 33 00 SUBMITTAL PROCEDURES:

SD-02 Shop Drawings

Shop Drawings  
Installation

SD-03 Product Data

Wood Materials  
Certification

SD-04 Samples

Plastic Laminates  
Cabinet Hardware

SD-07 Certificates

Quality Assurance  
Laminate Clad Casework

SD-11 Closeout Submittals

LEED Documentation

## 1.5 QUALITY ASSURANCE

### 1.5.1 General Requirements

Unless otherwise noted on the drawings, all materials, construction methods, and fabrication shall conform to and comply with the premium grade quality standards as outlined in AWI AWS, Section for laminate clad cabinets. These standards shall apply in lieu of omissions or specific requirements in this specification. Contractors and their personnel engaged in the work shall be able to demonstrate successful experience with work of comparable extent, complexity and quality to that shown and specified. Submit a quality control statement which illustrates compliance with and understanding of AWI AWS requirements, in general, and the specific AWI AWS requirements provided in this specification. The quality control statement shall also certify a minimum of ten years Contractor's experience in laminate clad casework fabrication and construction. The quality control statement shall provide a list of a minimum of five successfully completed projects of a similar scope, size, and complexity.

### 1.5.2 Mock-ups

Prior to final approval of shop drawings, provide a full-size mock-up of a typical floor cabinet and wall cabinet, including all components and hardware necessary to illustrate a completed unit with a minimum of one door and one drawer assembly. The completed mock-up shall include countertops and back splashes where specified. The mock-up shall utilize specified finishes in the patterns and colors as indicated. Upon disapproval, rework or remake the mock-up until approval is secured. Remove rejected units from the jobsite. Approved mock-up may remain as part of the finished work. Submit shop drawings showing all fabricated casework items in plan view, elevations and cross-sections to accurately indicate materials used, details of construction, dimensions, methods of fastening and erection, and installation methods proposed. Shop drawing casework items shall be clearly cross-referenced to casework items located on the project drawings. Shop drawings shall include a color schedule of all casework items to include all countertop, exposed, and semi-exposed cabinet finishes to include finish material manufacturer, pattern, and color.

### 1.5.3 Sustainable Design Certification

Product shall be third party certified in accordance with ULE Greenguard Gold, SCS Scientific Certification Systems Indoor Advantage Gold or equal. Certification shall be performed annually and shall be current.

## 1.6 DELIVERY, STORAGE, AND HANDLING

Casework may be delivered knockdown or fully assembled. Deliver all units to the site in undamaged condition, stored off the ground in fully enclosed areas, and protected from damage. The storage area shall be well ventilated and not subject to extreme changes in temperature or humidity.

## 1.7 SEQUENCING AND SCHEDULING

Coordinate work with other trades. Units shall not be installed in any room or space until painting, and ceiling installation are complete within the room where the units are located. Floor cabinets shall be installed before finished flooring materials are installed.

## PART 2 PRODUCTS

### 2.1 WOOD MATERIALS

#### 2.1.1 Lumber

- a. All framing lumber shall be kiln-dried Grade III to dimensions as shown on the drawings. Frame front, where indicated on the drawings, shall be nominal 3/4 inch hardwood.

#### 2.1.2 Panel Products

##### 2.1.2.1 Medium Density Fiberboard

Medium density fiberboard (MDF) shall be an acceptable panel substrate where noted on the drawings. Medium density fiberboard shall meet the minimum standards listed in CPA A208.2.

### 2.2 SOLID POLYMER MATERIAL

Solid surfacing casework components shall conform to the requirements of Section 06 61 16 SOLID SURFACING FABRICATIONS.

### 2.3 HIGH PRESSURE DECORATIVE LAMINATE (HPDL)

All plastic laminates shall meet the requirements of ANSI/NEMA LD 3 and ANSI A161.2 for high-pressure decorative laminates. Design, colors, surface finish and texture, and locations shall be as indicated on the drawings. Submit two samples of each plastic laminate pattern and color. Samples shall be a minimum of 5 by 7 inches in size. Plastic laminate types and nominal minimum thicknesses for casework components shall be as indicated in the following paragraphs.

#### 2.3.1 Horizontal General Purpose Standard (HGS) Grade

Horizontal general purpose standard grade plastic laminate shall be 0.048 inches (plus or minus 0.005 inches) in thickness. This laminate grade is intended for horizontal surfaces where postforming is not required.

#### 2.3.2 Vertical General Purpose Standard (VGS) Grade

Vertical general purpose standard grade plastic laminate shall be 0.028 inches (plus or minus 0.004 inches) in thickness. This laminate grade is intended for exposed exterior vertical surfaces of casework components where postforming is not required.

#### 2.3.3 Horizontal General Purpose Postformable (HGP) Grade

Horizontal general purpose postformable grade plastic laminate shall be 0.042 inches (plus or minus 0.005 inches) in thickness. This laminate grade is intended for horizontal surfaces where post forming is required.

#### 2.3.4 Backing Sheet (BK) Grade

Undecorated backing sheet grade laminate is formulated specifically to be used on the backside of plastic laminated panel substrates to enhance dimensional stability of the substrate. Backing sheet thickness shall be 0.020 inches. Backing sheets shall be provided for all laminated casework

components where plastic laminate finish is applied to only one surface of the component substrate.

## 2.4 THERMOSET DECORATIVE OVERLAYS (MELAMINE)

Thermoset decorative overlays (melamine panels) shall be used for casework cabinet interior, drawer interior, and all semi-exposed surfaces.

## 2.5 EDGE BANDING

Edge banding for casework doors and drawer fronts shall be PVC vinyl and shall be 0.125 inch thick. Material width shall be as indicated on the drawings. Color and pattern shall match exposed door and drawer front laminate pattern and color.

## 2.6 CABINET HARDWARE

Submit one sample of each cabinet hardware item specified to include hinges, pulls, drawer glides, and shelf supporting system. All hardware shall conform to ANSI/BHMA A156.9, unless otherwise noted, and shall consist of the following components:

### 2.6.1 Door Hinges

Self-closing type, BHMA No. B01602.

### 2.6.2 Cabinet Pulls

Brushed stainless steel 4-inch tab pulls type, BHMA No. B52131.

### 2.6.3 Drawer Slide

Side mounted self-closing type, BHMA No. 05051 with full extension and a minimum 100 pound load capacity. Slides shall include an positive stop to avoid accidental drawer removal.

### 2.6.4 Adjustable Shelf Support System

Multiple holes with metal pin supports.

## 2.7 FASTENERS

Nails, screws, and other suitable fasteners shall be the size and type best suited for the purpose and shall conform to ASTM F547 where applicable.

## 2.8 ADHESIVES, CAULKS, AND SEALANTS

### 2.8.1 Adhesives

Adhesives shall be of a formula and type recommended by AWI. Adhesives shall be selected for their ability to provide a durable, permanent bond and shall take into consideration such factors as materials to be bonded, expansion and contraction, bond strength, and moisture resistance. Adhesives shall meet local regulations regarding VOC emissions and off-gassing.

#### 2.8.1.1 Wood Joinery

Adhesives used to bond wood members shall be a Type II for interior use urea-formaldehyde resin formula. Adhesives shall withstand a bond test as described in ANSI/WDMA I.S.1A.

#### 2.8.1.2 Laminate Adhesive

Adhesive used to join high-pressure decorative laminate to wood shall be adhesive consistent with AWI and laminate manufacturer's recommendations. PVC edgbanding shall be adhered using a polymer-based hot melt glue.

#### 2.8.2 Caulk

Caulk used to fill voids and joints between laminated components and between laminated components and adjacent surfaces shall be clear, 100 percent silicone.

#### 2.8.3 Sealant

Sealant shall be of a type and composition recommended by the substrate manufacturer to provide a moisture barrier at sink cutouts and all other locations where unfinished substrate edges may be subjected to moisture.

### 2.9 FABRICATION

Verify field measurements as indicated in the shop drawings before fabrication. Fabrication and assembly of components shall be accomplished at the shop site to the maximum extent possible. Construction and fabrication of cabinets and their components shall meet or exceed the requirements for AWI premium grade unless otherwise indicated in this specification. Cabinet style, in accordance with AWI AWS, Section 400-G descriptions, shall be reveal overlay.

#### 2.9.1 Base and Wall Cabinet Case Body

##### 2.9.1.1 Cabinet Components

Frame members shall be glued-together, kiln-dried hardwood lumber. Top corners, bottom corners, and cabinet bottoms shall be braced with either hardwood blocks or water-resistant glue and nailed in place metal or plastic corner braces. Cabinet components shall be constructed from the following materials and thicknesses:

##### 2.9.1.1.1 Body Members (Ends, Divisions, Bottoms, and Tops)

3/4 inch medium density fiberboard (MDF) panel product

##### 2.9.1.1.2 Face Frames and Rails

3/4 inch hardwood lumber

##### 2.9.1.1.3 Shelving

3/4 inch medium density fiberboard (MDF) panel product

##### 2.9.1.1.4 Cabinet Backs

1/4 inch medium density fiberboard (MDF) panel product

2.9.1.1.5 Drawer Sides, Backs, and Subfronts

1/2 inch hardwood lumber

2.9.1.1.6 Drawer Bottoms

1/4 inch medium density fiberboard (MDF) panel product

2.9.1.1.7 Door and Drawer Fronts

3/4-inch medium density fiberboard (MDF) panel product

2.9.1.2 Joinery Method for Case Body Members

2.9.1.2.1 Tops, Exposed Ends, and Bottoms

- a. Steel "European" assembly screws ( 1-1/2 inch from end, 5 inch on center, fasteners will not be visible on exposed parts).
- b. Doweled, glued under pressure (approx. 4 dowels per 12 inches of joint).
- c. Stop dado, glued under pressure, and either nailed, stapled or screwed (fasteners will not be visible on exposed parts).

2.9.1.2.2 Exposed End Corner and Face Frame Attachment

2.9.1.2.2.1 Mitered Joint

lock miter or spline or biscuit, glued under pressure (no visible fasteners)

2.9.1.2.2.2 Non-Mitered Joint (90 degree)

butt joint glued under pressure (no visible fasteners)

2.9.1.2.3 Cabinet Backs (Wall Hung Cabinets)

Wall hung cabinet backs must not be relied upon to support the full weight of the cabinet and its anticipated load for hanging/mounting purposes. Method of back joinery and hanging/mounting mechanisms should transfer the load to case body members. Fabrication method shall be:

2.9.1.2.3.1 Full Bound

Full bound, captured in grooves on cabinet sides, top, and bottom. Cabinet backs for floor standing cabinets shall be side bound, captured in grooves; glued and fastened to top and bottom.

2.9.1.2.3.2 Full Overlay

Full overlay, plant-on backs with minimum back thickness of 1/2 inch and minimum No. 12 plated (no case hardened) screws spaced a minimum 3 inches on center. Edge of back shall not be exposed on finished sides. Anchor strips are not required when so attached.

#### 2.9.1.2.4 Cabinet Backs (Floor Standing Cabinets)

##### 2.9.1.2.4.1 Side Bound

Side bound, captured in grooves; glued and fastened to top and bottom.

##### 2.9.1.2.4.2 Full Overlay

Full overlay, plant-on backs with minimum back thickness of 1/2 inch and minimum No. 12 plated (no case hardened) screws spaced a minimum 3 inches on center. Edge of back shall not be exposed on finished sides. Anchor strips are not required when so attached.

#### 2.9.1.2.5 Wall Anchor Strips

Wall Anchor Strips shall be required for all cabinets with backs less than 1/2 inch thick. Strips shall consist of minimum 1/2 inch thick lumber, minimum 2-1/2 inches width; securely attached to wall side of cabinet back - top and bottom for wall hung cabinets, top only for floor standing cabinets.

#### 2.9.2 Cabinet Floor Base

Floor cabinets shall be mounted on a base constructed of nominal 2 inch thick lumber. Base assembly components shall be treated lumber. Finished height for each cabinet base shall be not less than the full height of the installed, specified wall base as indicated on the drawings. Bottom edge of the cabinet door or drawer face shall be flush with top of base.

#### 2.9.3 Cabinet Door and Drawer Fronts

Door and drawer fronts shall be fabricated from 3/4 inch medium density fiberboard (MDF). All door and drawer front edges shall be surfaced with high pressure plastic laminate and PVC edgebanding, color and pattern to match exterior face laminate as indicated on the drawings.

#### 2.9.4 Drawer Assembly

##### 2.9.4.1 Drawer Components

Drawer components shall consist of a removable drawer front, sides, backs, and bottom. Drawer components shall be constructed of the following materials and thicknesses:

##### 2.9.4.1.1 Drawer Sides and Backs For Transparent Finish

1/2 inch thick solid hardwood lumber

##### 2.9.4.1.2 Drawer Sides and Back For Thermoset Decorative Overlay (Melamine) Finish

1/2 inch thick medium density particleboard or MDF fiberboard substrate

##### 2.9.4.1.3 Drawer Bottom

1/4 inch thick veneer core panel product for transparent or plastic laminate finish



#### 2.9.4.2 Drawer Assembly Joinery Method

- a. Multiple dovetail (all corners) or French dovetail front/dadoed back, glued under pressure.
- b. Doweled, glued under pressure.
- c. Lock shoulder, glued and pin nailed.
- d. Bottoms shall be set into sides, front, and back, 1/4 inch deep groove with a minimum 3/8 inch standing shoulder.

#### 2.9.5 Shelving

##### 2.9.5.1 General Requirements

Shelving shall be fabricated from 3/4 inch medium density fiberboard (MDF). All shelving top and bottom surfaces shall be finished with thermoset decorative overlay (melamine). Shelf edges shall be finished in a PVC edgebanding.

##### 2.9.5.2 Shelf Support System

The shelf support system shall be:

##### 2.9.5.2.1 Pin Hole Method

Drill holes on the interior surface of the cabinet side walls. Evenly space holes in two vertical columns. Space the holes in each column at 1 inch increments starting 6 inches from the cabinet interior bottom and extending to within 6 inches of the top interior surface of the cabinet. Drill holes to provide a level, stable surface when the shelf is resting on the shelf pins. Coordinate hole diameter with pin insert size to provide a firm, tight fit.

#### 2.9.6 Laminate Application

Laminate application to substrates shall follow the recommended procedures and instructions of the laminate manufacturer and ANSI/NEMA LD 3, using tools and devices specifically designed for laminate fabrication and application. Provide a balanced backer sheet (Grade BK) wherever only one surface of the component substrate requires a plastic laminate finish. Apply required grade of laminate in full uninterrupted sheets consistent with manufactured sizes using one piece for full length only, using adhesives specified herein or as recommended by the manufacturer. Fit corners and joints hairline. All laminate edges shall be machined flush, filed, sanded, or buffed to remove machine marks and eased (sharp corners removed). Clean up at easing shall be such that no overlap of the member eased is visible. Fabrication shall conform to ANSI A161.2. Laminate types and grades for component surfaces shall be as follows unless otherwise indicated on the drawings:

##### 2.9.6.1 Base/Wall Cabinet Case Body

- a. Exterior (exposed) surfaces to include exposed and semi-exposed face frame surfaces: HPDL Grade VGS .
- b. Interior (semi-exposed) surfaces to include interior back wall, bottom, and side walls: Thermoset Decorative Overlay (melamine).

#### 2.9.6.2 Adjustable Shelving

##### 2.9.6.2.1 Top and Bottom Surfaces

Thermoset Decorative Overlay (melamine)

##### 2.9.6.2.2 All Edges

PVC edgebanding

#### 2.9.6.3 Fixed Shelving

##### 2.9.6.3.1 Top and Bottom Surfaces

Thermoset Decorative Overlay (melamine)

##### 2.9.6.3.2 Exposed Edges

PVC edgebanding

#### 2.9.6.4 Door, Drawer Fronts, Access Panels

##### 2.9.6.4.1 Exterior (Exposed) and Interior (Semi-Exposed) Faces

HPDL Grade VGS

##### 2.9.6.4.2 Edges

PVC edgebanding

#### 2.9.6.5 Drawer Assembly

All interior and exterior surfaces: HPDL Grade CLS .

#### 2.9.6.6 Tolerances

Flushness, flatness, and joint tolerances of laminated surfaces shall meet the AWI AWS premium grade requirements.

#### 2.9.7 Finishing

##### 2.9.7.1 Filling

No fasteners shall be exposed on laminated surfaces. All nails, screws, and other fasteners in non-laminated cabinet components shall be countersunk and the holes filled with wood filler consistent in color with the wood species.

##### 2.9.7.2 Sanding

All surfaces requiring coatings shall be prepared by sanding with a grit and in a manner that scratches will not show in the final system.

### PART 3 EXECUTION

#### 3.1 INSTALLATION

Installation shall comply with applicable requirements for AWI AWS premium

quality standards. Countertops and fabricated assemblies shall be installed level, plumb, and true to line, in locations shown on the drawings. Cabinets and other laminate clad casework assemblies shall be attached and anchored securely to the floor and walls with mechanical fasteners that are appropriate for the wall and floor construction.

### 3.1.1 Anchoring Systems

#### 3.1.1.1 Floor

Base cabinets shall utilize a floor anchoring system. Anchoring and mechanical fasteners shall not be visible from the finished side of the casework assembly. Cabinet assemblies shall be attached to anchored bases without visible fasteners as indicated in the drawings. Where assembly abuts a wall surface, anchoring shall include a minimum 1/2 inch thick lumber or panel product hanging strip, minimum 2-1/2 inch width; securely attached to the top of the wall side of the cabinet back.

#### 3.1.1.2 Wall

Cabinet to be wall mounted shall utilize minimum 1/2 inch thick lumber or panel product hanging strips, minimum 2-1/2 inch width; securely attached to the wall side of the cabinet back, both top and bottom.

### 3.1.2 Hardware

Casework hardware shall be installed in types and locations as indicated on the drawings. Where fully concealed European-style hinges are specified to be used with particleboard or fiberboard doors, the use of plastic or synthetic insertion dowels shall be used to receive 3/16 inch "Euro screws". The use of wood screws without insertion dowels is prohibited.

### 3.1.3 Doors, Drawers and Removable Panels

The fitting of doors, drawers and removable panels shall be accomplished within target fitting tolerances for gaps and flushness in accordance with AWI AWS premium grade requirements.

### 3.1.4 Plumbing Fixtures

Install sinks, sink hardware, and other plumbing fixtures in locations as indicated on the drawings and in accordance with Section 22 00 00 PLUMBING, GENERAL PURPOSE.

-- End of Section --



SECTION 06 61 16

SOLID SURFACING FABRICATIONS  
08/10

PART 1 GENERAL

1.1 REFERENCES

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

ASTM INTERNATIONAL (ASTM)

ASTM D2583	(2013a) Indentation Hardness of Rigid Plastics by Means of a Barcol Impressor
ASTM D570	(1998; E 2010; R 2010) Standard Test Method for Water Absorption of Plastics
ASTM D638	(2014) Standard Test Method for Tensile Properties of Plastics
ASTM D696	(2016) Standard Test Method for Coefficient of Linear Thermal Expansion of Plastics Between -30 degrees C and 30 degrees C With a Vitreous Silica Dilatometer
ASTM E84	(2018) Standard Test Method for Surface Burning Characteristics of Building Materials
ASTM G21	(2015) Standard Practice for Determining Resistance of Synthetic Polymeric Materials to Fungi

CSA GROUP (CSA)

CSA B45.5-11/IAPMO Z124	(2011; Update 1 2012) Plastic Plumbing Fixtures - First Edition
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NATIONAL ELECTRICAL MANUFACTURERS ASSOCIATION (NEMA)

ANSI/NEMA LD 3	(2005) Standard for High-Pressure Decorative Laminates
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NSF INTERNATIONAL (NSF)

NSF/ANSI 51	(2012) Food Equipment Materials
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TILE COUNCIL OF NORTH AMERICA (TCNA)

TCNA Hdbk	(2013) Handbook for Ceramic, Glass, and Stone Tile Installation
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U.S. GREEN BUILDING COUNCIL (USGBC)

LEED BD+C

(2009; R 2010) Leadership in Energy and  
Environmental Design(tm) Building Design  
and Construction (LEED-NC)

1.2 SYSTEM DESCRIPTION

- a. Work under this section includes counter tops, vanity tops, backsplashes, window stools, shower thresholds, and other items utilizing solid polymer (solid surfacing) fabrication as shown on the drawings and as described in this specification. Do not change source of supply for materials after work has started, if the appearance of finished work would be affected.
- b. In most instances, installation of solid polymer fabricated components and assemblies will require strong, correctly located structural support provided by other trades. To provide a stable, sound, secure installation, close coordination is required between the solid polymer fabricator/installer and other trades to ensure that necessary structural wall support, cabinet counter top structural support, proper clearances, and other supporting components are provided for the installation of countertops, counter tops, vanity tops, backsplashes, window stools, shower thresholds, and all other solid polymer fabrications to the degree and extent recommended by the solid polymer manufacturer.
- c. Appropriate staging areas for solid polymer fabrications. Allow variation in component size and location of openings of plus or minus 1/8 inch.

1.3 SUSTAINABILITY REPORTING

Materials in this technical specification may contribute towards contract compliance with sustainability requirements. See Section 01 33 29 SUSTAINABILITY REPORTING for project LEED BD+C local/ regional materials recycled content and LEED documentation requirements.

1.4 SUBMITTALS

Government approval is required for submittals with a "G" designation; submittals not having a "G" designation are for information only. When used, a designation following the "G" designation identifies the office that will review the submittal for the Government. Submittals with an "S" are for inclusion in the Sustainability eNotebook, in conformance to Section 01 33 29 SUSTAINABILITY REPORTING. Submit the following in accordance with Section 01 33 00 SUBMITTAL PROCEDURES:

SD-02 Shop Drawings

Detail Drawings  
Installation

SD-03 Product Data

Solid Polymer Material  
Qualifications  
Fabrications

SD-04 Samples

Material; G  
Counter and Vanity Tops; G

SD-06 Test Reports

Solid Polymer Material

SD-07 Certificates

Fabrications  
Qualifications

SD-10 Operation and Maintenance Data

Clean-up

SD-11 Closeout Submittals

LEED Documentation

1.5 QUALITY ASSURANCE

1.5.1 Qualifications

To ensure warranty coverage, solid polymer fabricators shall be certified to fabricate by the solid polymer material manufacturer being utilized. Mark all fabrications with the fabricator's certification label affixed in an inconspicuous location. Fabricators shall have a minimum of 5 years of experience working with solid polymer materials. Submit solid polymer manufacturer's certification attesting to fabricator qualification approval.

1.5.2 Mock-ups

Submit Detail Drawings indicating locations, dimensions, component sizes, fabrication and joint details, attachment provisions, installation details, and coordination requirements with adjacent work. Prior to final approval of shop drawings, provide a full-size mock-up of a typical vanity top where multiple units are required. The mock-up shall include all solid polymer components required to provide a completed unit. The mock-up shall utilize finishes in patterns and colors indicated on the drawings. Should the mock-up not be approved, re-work or remake it until approval is secured. Remove rejected units from the jobsite. Approved mock-up may remain as part of the finished work.

1.6 DELIVERY, STORAGE, AND HANDLING

Do not deliver materials to project site until areas are ready for installation. Deliver components and materials to the site undamaged, in containers clearly marked and labeled with manufacturer's name. Materials shall be stored indoors and adequate precautions taken to prevent damage to finished surfaces. Provide protective coverings to prevent physical damage or staining following installation, for duration of project.

1.7 WARRANTY

Provide manufacturer's warranty of ten years against defects in materials,

excluding damages caused by physical or chemical abuse or excessive heat. Warranty shall provide for material and labor for replacement or repair of defective material for a period of ten years after component installation.

## PART 2 PRODUCTS

### 2.1 MATERIAL

Provide solid polymer material that is a homogeneous filled solid polymer; not coated, laminated or of a composite construction; meeting CSA B45.5-11/IAPMO Z124 requirements. Material shall have minimum physical and performance properties specified. Superficial damage to a depth of 0.01 inch shall be repairable by sanding or polishing. Material thickness shall be as indicated on the drawings. In no case shall material be less than 1/4 inch in thickness. Submit a minimum 4 by 4 inch sample of each color and pattern for approval. Samples shall indicate full range of color and pattern variation. Approved samples shall be retained as a standard for this work. Submit test report results from an independent testing laboratory attesting that the submitted solid polymer material meets or exceeds each of the specified performance requirements.

#### 2.1.1 Cast, 100 Percent Acrylic Polymer Solid Surfacing Material

Cast, 100 percent acrylic solid polymer material shall be composed of acrylic polymer, mineral fillers, and pigments and shall meet the following minimum performance requirements:

PROPERTY	REQUIREMENT (min. or max.)	TEST PROCEDURE
Tensile Strength	4000 psi (max.)	ASTM D638
Hardness	55-Barcol Impressor (min.)	ASTM D2583
Thermal Expansion	.000023 in/in/F (max.)	ASTM D696
Boiling Water Surface Resistance	No Change	ANSI/NEMA LD 3-3.05
High Temperature Resistance	No Change	ANSI/NEMA LD 3-3.06
Impact Resistance (Ball drop)		ANSI/NEMA LD 3-303
1/4 inch sheet	36 inches, 1/2 lb ball, no failure	
1/2 inch sheet	140 inches, 1/2 lb ball, no failure	
3/4 inch sheet	200 inches, 1/2 lb ball, no failure	
Mold & Mildew Growth	No growth	ASTM G21



PROPERTY	REQUIREMENT (min. or max.)	TEST PROCEDURE
Bacteria Growth	No growth	ASTM G21
Liquid Absorption (Weight in 24 hrs.)	0.1 percent max.	ASTM D570
Flammability		ASTM E84
Flame Spread	25 max.	
Smoke Developed	30 max.	
Sanitation	"Food Contact" approval	NSF/ANSI 51

### 2.1.2 Acrylic-modified Polymer Solid Surfacing Material

Cast, solid polymer material shall be composed of a formulation containing acrylic and polyester polymers, mineral fillers, and pigments. Acrylic polymer content shall be not less than 5 percent and not more than 10 percent in order to meet the following minimum performance requirements:

PROPERTY	REQUIREMENT (min. or max.)	TEST PROCEDURE
Tensile Strength	4100 psi (max.)	ASTM D638
Hardness	50-Barcol Impressor (min.)	ASTM D2583
Thermal Expansion	.000023 in/in/F (max.)	ASTM D696
Boiling Water Surface Resistance	No Change	ANSI/NEMA LD 3-3.05
High Temperature Resistance	No Change	ANSI/NEMA LD 3-3.06
Impact Resistance (Ball drop)		ANSI/NEMA LD 3-303
1/4 inch sheet	36 inches, 1/2 lb ball, no failure	
1/2 inch sheet	140 inches, 1/2 lb ball, no failure	
3/4 inch sheet	200 inches, 1/2 lb ball, no failure	
Mold & Mildew Growth	No growth	ASTM G21
Bacteria Growth	No growth	ASTM G21

PROPERTY	REQUIREMENT (min. or max.)	TEST PROCEDURE
Liquid Absorption (Weight in 24 hrs.)	0.6 percent max.	ASTM D570
Flammability		ASTM E84
Flame Spread	25 max.	
Smoke Developed	100 max.	
Sanitation	"Food Contact" approval	NSF/ANSI 51

### 2.1.3 Material Patterns and Colors

Patterns and colors for all solid polymer components and fabrications shall be those indicated on the project drawings . Pattern and color shall occur, and shall be consistent in appearance, throughout the entire depth (thickness) of the solid polymer material.

### 2.1.4 Surface Finish

Exposed finished surfaces and edges shall receive a uniform appearance. Exposed surface finish shall be as indicated on the drawings.

## 2.2 ACCESSORY PRODUCTS

Accessory products, as specified below, shall be manufactured by the solid polymer manufacturer or shall be products approved by the solid polymer manufacturer for use with the solid polymer materials being specified.

### 2.2.1 Seam Adhesive

Seam adhesive shall be a two-part adhesive kit to create permanent, inconspicuous, non-porous, hard seams and joints by chemical bond between solid polymer materials and components to create a monolithic appearance of the fabrication. Adhesive shall be approved by the solid polymer manufacturer. Adhesive shall be color-matched to the surfaces being bonded where solid-colored, solid polymer materials are being bonded together. The seam adhesive shall be clear or color matched where particulate patterned, solid polymer materials are being bonded together.

### 2.2.2 Panel Adhesive

Panel adhesive shall be neoprene based panel adhesive meeting TCNA Hdbk, Underwriter's Laboratories (UL) listed. Use this adhesive to bond solid polymer components to adjacent and underlying substrates.

### 2.2.3 Silicone Sealant

Sealant shall be a mildew-resistant, FDA and OSHA Nationally Recognized Testing Laboratory (NRTL) listed silicone sealant or caulk in a clear formulation. The silicone sealant shall be approved for use by the solid

polymer manufacturer. Use sealant to seal all expansion joints between solid polymer components and all joints between solid polymer components and other adjacent surfaces such as walls, floors, ceiling, and plumbing fixtures.

#### 2.2.4 Conductive Tape

Conductive tape shall be manufacturer's standard foil tape, 4 mils thick, applied around the edges of cut outs containing hot or cold appliances.

#### 2.2.5 Mounting Hardware

Provide mounting hardware, including sink/bowl clips, inserts and fasteners for attachment of undermount sinks and lavatories.

### 2.3 FABRICATIONS

Components shall be factory or shop fabricated to sizes and shapes indicated, to the greatest extent practical, in accordance with approved Shop Drawings and manufacturer's requirements. Provide factory cutouts for sinks, lavatories, and plumbing fixtures where indicated on the drawings. Contours and radii shall be routed to template, with edges smooth. Defective and inaccurate work will be rejected. Submit product data indicating product description, fabrication information, and compliance with specified performance requirements for solid polymer, joint adhesive, and sealants. Both the manufacturer of materials and the fabricator shall submit a detailed description of operations and processes in place that support efficient use of natural resources, energy efficiency, emissions of ozone depleting chemicals, management of water and operational waste, indoor environmental quality, and other production techniques supporting sustainable design and products.

#### 2.3.1 Joints and Seams

Form joints and seams between solid polymer components using manufacturer's approved seam adhesive. Joints shall be inconspicuous in appearance and without voids to create a monolithic appearance.

#### 2.3.2 Edge Finishing

Rout and finish component edges to a smooth, uniform appearance and finish. Edge shapes and treatments, including any inserts, shall be as detailed on the drawings. Rout all cutouts, then sand all edges smooth. Repair or reject defective or inaccurate work.

#### 2.3.3 Counter and Vanity Top Splashes

Fabricate backsplashes and end splashes from 1/2 inch thick solid surfacing material to be in conformance with dimensions and shapes as indicated on the drawings. Backsplashes and end splashes shall be provided for all counter tops and vanity tops at locations indicated on the drawings. Backsplashes shall be shop fabricated and be loose, to be field attached.

##### 2.3.3.1 End Splashes

End splashes shall be provided loose for installation at the jobsite after horizontal surfaces to which they are to be attached have been installed.

#### 2.3.4 Window Stools

Fabricate window stools from 1/2 inch thick solid surfacing, solid polymer material. Dimensions, edge shape, and other details shall be as indicated on the drawings .

#### 2.3.5 Counter and Vanity Tops

Fabricate all solid surfacing, solid polymer counter top and vanity top components from 1/2 inch thick material. Edge details, dimensions, locations, and quantities shall be as indicated on the Drawings. Counter tops shall be complete with 4 inch high loose backsplash at all locations where indicated on the drawings. Attach 2 inch wide reinforcing strip of polymer material under each horizontal counter top seam. Submit a minimum 1 foot wide by 6 inch deep, full size sample for each type of counter top shown on the project drawings. The sample shall include the edge profile and backsplash as detailed on the project drawings. Solid polymer material shall be of a pattern and color as indicated on the drawings. Sample shall include at least one seam. Approved sample shall be retained as standard for this work.

##### 2.3.5.1 Counter Top With Sink

- a. Stainless Steel or Vitreous China Sink. Countertops with sinks shall include cutouts to template as furnished by the sink manufacturer. Manufacturer's standard sink mounting hardware for stainless steel or vitreous china rimless installation shall be provided. Seam between sink and counter top shall be sealed with silicone sealant. Sink, faucet, and plumbing requirements shall be in accordance with Section 22 00 00 PLUMBING, GENERAL PURPOSE.

##### 2.3.5.2 Vanity Tops With Bowls

- a. Countertops with vitreous china bowls shall include cutouts to template as furnished by the sink manufacturer. Manufacturer's standard sink mounting hardware for vitreous china rimless installation shall be provided. Seam between sink and counter top shall be sealed with silicone sealant. Sink, faucet, and plumbing requirements shall be in accordance with Section 22 00 00 PLUMBING, GENERAL PURPOSE.

### PART 3 EXECUTION

#### 3.1 INSTALLATION

##### 3.1.1 Components

Install all components and fabricated units plumb, level, and rigid. Make field joints between solid polymer components using solid polymer manufacturer's approved seam adhesives, to provide a monolithic appearance with joints inconspicuous in the finished work. Attach metal or vitreous china sinks and lavatory bowls to counter tops using solid polymer manufacturer's recommended clear silicone sealant and mounting hardware. Plumbing connections to sinks and lavatories shall be made in accordance with Section 22 00 00 PLUMBING, GENERAL PURPOSE .

#### 3.1.1.1 Loose Counter Top Splashes

Mount loose splashes in the locations noted on the drawings. Loose splashes shall be adhered to the counter top with a color matched silicone sealant when the solid polymer components are solid colors. Use a clear silicone sealant to provide adhesion of particulate patterned solid polymer splashes to counter tops.

#### 3.1.2 Silicone Sealant

Use a clear, silicone sealant or caulk to seal all expansion joints between solid polymer components and all joints between solid polymer components and other adjacent surfaces such as walls, floors, ceiling, and plumbing fixtures. Sealant bead shall be smooth and uniform in appearance and shall be the minimum size necessary to bridge any gaps between the solid surfacing material and the adjacent surface. Bead shall be continuous and run the entire length of the joint being sealed.

#### 3.1.3 Plumbing

Make plumbing connections to sinks and lavatories in accordance with Section 22 00 00 PLUMBING, GENERAL PURPOSE .

#### 3.2 CLEAN-UP

Components shall be cleaned after installation and covered to protect against damage during completion of the remaining project items. Components damaged after installation by other trades will be repaired or replaced at the General Contractor's cost. Component supplier will provide a repair/replace cost estimate to the General Contractor who shall approve estimate before repairs are made. Submit a minimum of six copies of maintenance data indicating manufacturer's care, repair and cleaning instructions. Maintenance video shall be provided, if available. Maintenance kit for matte finishes shall be submitted.

-- End of Section --



SECTION 07 05 23

PRESSURE TESTING AN AIR BARRIER SYSTEM FOR AIR TIGHTNESS  
**05/14**

PART 1 GENERAL

1.1 SUMMARY

Employ an independent agency to conduct the pressure test on the building envelope in accordance with this specification section and ASTM E779.

1.2 REFERENCES

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

AMERICAN SOCIETY FOR NONDESTRUCTIVE TESTING (ASNT)

ANSI/ASNT CP-189	(2016) ASNT Standard for Qualification and Certification of Nondestructive Testing Personnel (ANSI/ASNT CP-105-2006)
ASNT CP-105	(2011) ASNT Standard Topical Outlines for Qualification of Nondestructive Testing Personnel - Item No. 2821
ASNT SNT-TC-1A	(2016) Recommended Practice for Personnel Qualification and Certification in Nondestructive Testing

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

ASHRAE RP-935	(1998) Protocol for Field Testing of Tall Buildings to Determine Envelope Air Leakage Rate
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ASTM INTERNATIONAL (ASTM)

ASTM E1186	(2017) Standard Practices for Air Leakage Site Detection in Building Envelopes and Air Barrier Systems
ASTM E1827	(2011; R 2017) Standard Test Methods for Determining Airtightness of Buildings Using an Orifice Blower Door
ASTM E779	(2010) Standard Test Method for Determining Air Leakage Rate by Fan Pressurization

INTERNATIONAL ORGANIZATION FOR STANDARDIZATION (ISO)

ISO 6781	(1983) Thermal Insulation - Qualitative Detection of Thermal Irregularities in
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## Building Envelopes - Infrared Method

### 1.3 DEFINITIONS

The following terms as they apply to this section:

#### 1.3.1 Air Barrier Envelope

The surface that separates the inside air from the outside air. The combination of air barrier assemblies and air barrier components, connected by air barrier accessories are designed to provide a continuous barrier to the movement of air through an environmental separator. A single building may have more than one air barrier envelope. The air barrier surface includes the top, bottom, and sides of the envelope. The term "air barrier envelope" is also known as "air barrier system" or simply "air barrier".

#### 1.3.2 Air Leakage Rate

How leaky, or conversely how air tight a building envelope is. The air leakage is normally described in terms of air flow rate for the surface area of the envelope at a defined differential pressure.

#### 1.3.3 Bias Pressure

Also known as zero flow pressure, baseline pressure, offset pressure or background pressure. With the envelope not artificially pressurized, bias is the differential pressure that always exists between the envelope that has been prepared (sealed) for the pressure test and the outdoors. Bias pressure is made up of two components, fixed static offset (usually due to stack effect or the HVAC system) and fluctuating pressure (usually due to wind or a moving elevator). Because of pressure fluctuations many bias pressure readings are recorded and averaged for use in the calculations.

#### 1.3.4 Blower Door

Commonly used term for an apparatus used to pressurize and depressurize the space within the building envelope and quantify air leakage through the envelope. The blower door typically includes a door fan and an air resistant fabric or a series of hard panels that extends to cover and seal the door opening between the fan shroud and door frame. The door fan is a calibrated fan capable of measuring air flow and is usually placed in the opening of an exterior door. With the air barrier otherwise sealed, air produced by the door fan pressurizes or de-pressurizes the envelope, depending on the fan's orientation.

#### 1.3.5 Environmental Separator

The parts of a building that separate the controlled interior environment from the uncontrolled exterior environment, or that separate spaces within a building that have dissimilar environments. The term "environmental separator" is also known as the "control layer".

#### 1.3.6 Pressure Test

A generic term for a test in which the envelope is either pressurized or de-pressurized with respect to the outdoors.



1.3.6.1 Negative Pressure Test (Depressurization Test)

A test wherein air inside the envelope is drawn to the outdoors. This places the envelope at a lower (negative) pressure with respect to the outdoors.

1.3.6.2 Positive Pressure Test (Pressurization Test)

A test wherein outdoor air is pushed into the envelope. This air movement places the envelope at a higher (positive) pressure with respect to the outdoors.

1.4 WORK PLAN

Submit the following not later than 120 calendar days after contract award, but before start of pressure testing work, steps to be taken by the lead pressure test technician to accomplish the required testing.

a. Memorandum of test procedure.

- (1) Proposed dates for conducting the pressure, thermographic and fog tests.
- (2) Submit detailed pressure test procedures prior to the test. Provide a plan view showing proposed locations (personnel doors or other similar openings) to install blower doors or flexible ducts (for trailer-mounted fans), if used.

b. Test equipment to be used.

c. Scaffolding, scissor lifts, power, electrical extension cords, duct tape, plastic sheeting and other Contractor's support equipment required to perform all tests.

d. Other Contractor's support personnel who will be on site for testing.

1.5 SUBMITTALS

Government approval is required for submittals with a "G" designation; submittals not having a "G" designation are for information only. When used, a designation following the "G" designation identifies the office that will review the submittal for the Government. Submittals with an "S" are for inclusion in the Sustainability eNotebook, in conformance to Section 01 33 29 SUSTAINABILITY REPORTING. Submit the following in accordance with Section 01 33 00 SUBMITTAL PROCEDURES:

SD-01 Preconstruction Submittals

Work Plan; G

SD-03 Product Data

Thermal Imaging Camera; G

SD-07 Certificates

Pressure Test Agency  
Thermographer Qualifications  
Test Instruments

Date Of Last Calibration

#### SD-06 Test Reports

Pressure Test Procedures; G  
Air Leakage Test Report; G  
Diagnostic Test Report; G

No later than 14 days after completion of the pressure test, submit 6 copies of an organized report bound in a durable 3-ring binder. The report is to contain a table of contents, an executive summary, an introduction, a results section and a discussion of the results. Submit the Air Leakage Test Report as described in paragraph AIR LEAKAGE TEST REPORT. Submit a diagnostic test report as described in paragraph LOCATING LEAKS BY DIAGNOSTIC TESTING. The diagnostic test report is to include the Thermographic Investigation Report and the Fog Test Report (if performed).

Submit field data and completed report forms found in the appendices. Use the sample forms, Test Agency Qualification Sheet, Air Leakage Test Form and Air Leakage Test Results Form to summarize the tests for the appropriate building envelope. Submit both electronically populated and field hand filled-in forms.

Report Data. Include in the report the following information for all tests:

- a. Date of Issue
- b. Project title and number
- c. Name, address, and telephone number of testing agency
- d. Dates and locations of samples and tests or inspections
- e. Names of individuals making the inspection or test
- f. Designation of the work and test method
- g. Identification of product and Specification Section
- h. Complete inspection or test data
- i. Test results and an interpretation of test results
- j. Comments or professional opinion on whether inspected or tested work complies with contract document requirements
- k. Recommendations on retesting

### 1.6 QUALITY ASSURANCE

#### 1.6.1 Modification of References

Perform all pressure and diagnostic tests according to the referenced publications listed in paragraph REFERENCES and as modified by this section. Consider the advisory or recommended provisions, of the referred references, as mandatory.

#### 1.6.2 Qualifications

##### 1.6.2.1 Pressure Test Agency

Submit, no later than 15 calendar days after contract award, information certifying that the pressure test agency is not affiliated with any other company participating in work on this contract. The work of the test agency is limited to pressure testing the building envelope, performing a

thermography test and fog test, and investigating, through various methods, the location of air leaks through the air barrier. See paragraph PRESSURE TEST AGENCY for additional requirements. For thermographer qualifications, see paragraph THERMOGRAPHER QUALIFICATIONS.

Use the sample TEST AGENCY QUALIFICATIONS SHEET form (Appendix C), to submit the following information.

- a. Verification of 2 years of experience as an agency in pressure testing commercial and/or industrial buildings.
- b. List of at least ten commercial/industrial facilities with building envelopes that the agency has tested within the past 2 years. Include building name, address, and name of prime construction contractor and contractor's point-of-contact information.
- c. Confirmation of 2 years of commercial and or industrial building pressure test experience for the lead pressure test technician and the thermographer in using the specified ASTM E779 testing standard. References from five Contracting Officers for facilities where the lead test technician has supervised commercial and or industrial building pressure tests in the last 2 years.
- d. Verification that the lead pressure test technician has been employed by a building pressure testing agency in the capacity of a lead pressure test technician for not less than 1 year.

#### 1.6.2.2 Thermographer Qualifications

To perform an infrared diagnostic evaluation, use a lead thermographer who has at least an active Level II Certification that is based on the requirements in ASNT CP-105 or ANSI/ASNT CP-189 and is in accordance with ASNT SNT-TC-1A. The course of study is to be specifically focused on infrared thermography for building science. The thermographer must have at least two years of building science thermography experience in IR testing commercial or industrial buildings. The thermographer must also have experience in building envelopes and building science in order to make effective recommendations to the contractor should the envelope require additional sealing. Submit the thermographer's certificate for approval. Submit a list of at least ten commercial/industrial buildings on which the thermographer has performed IR thermography in the past two years. The thermographer is to have a current active certification. Submit certification at least 60 days prior to thermography testing.

#### 1.6.3 Test Instruments And Date Of Last Calibration

Submit a signed and dated list of test instruments, their application, manufacturer, model, serial number, range of operation, accuracy and date of most recent calibration.

#### 1.7 CLIMATE CONDITIONS SUITABLE FOR A PRESSURE TEST

As the test date approaches, monitor the weather forecast for the test site. Avoid testing on days forecast to experience high winds, rain, or snow. Monitor weather forecasts prior to shipping pressure test equipment to the site. Preferred ambient weather test conditions as stated in ASTM E779 are 0 to 4 mph winds and an ambient temperature range of 41 - 95 degrees F. Based on current and forecast weather conditions, the Contracting Officer's representative is to grant final approval for

testing to occur.

#### 1.7.1 Rain

Rain can temporarily seal roof and wall assemblies so that they leak less than under no-rain conditions. Do not test during rain or if rain is anticipated during testing. If pneumatic hoses are installed and exposed to rain inspect the hose to insure rainwater has not migrated into the hose ends. Orient all exposed hose ends to keep them out of water puddles. Success in temporarily sealing outdoor ventilation components such as louvers and exhaust fans may also be compromised by rain. Don't seal roof-mounted ventilation components during times of potential lightning.

#### 1.7.2 Snow

Snow piled against a wall or on top of a roof can make a building envelope appear to be more airtight than it actually is. Snow may also impact thermography readings. Remove snow from around and on top of the building prior to testing.

#### 1.7.3 Wind

Because wind can skew pressure test results, test only on days and at times when winds are anticipated to be the calmest. Avoid pressure testing during gusty or high wind conditions.

### PART 2 PRODUCTS

#### 2.1 PRESSURE TEST EQUIPMENT

Depending on site conditions and size of the envelope, the test may be conducted using blower door equipment and/or trailer-mounted fans. The testing agency is to supply sufficient quantity of blower equipment that will produce a minimum of 75 Pa differential pressure between the envelope and outdoors using the test methods described herein. Supplying additional blower test equipment to provide additional airflow capacity or to act as a backup is highly recommended.

##### 2.1.1 Blower Door Fans and Trailer Mounted Fans

Each air flow measuring system including blower door fans and trailer mounted fans are to be calibrated within the last 3 years in accordance with ASTM E1827. Calibrated blower door fans and trailer mounted fans must measure accurately to within plus or minus 5 percent of the flow reading. Blower door equipment and trailer mounted fans are to be specifically designed to pressurize building envelopes. Each set of blower door equipment is to include fan(s), digital gage(s), door frame, door fabric or hard panels.

##### 2.1.2 Digital Gages as Test Instruments

Use only digital gages as measuring instruments in the pressure test; analog gages are not acceptable. The gauges must be accurate to within 1.0 percent of the pressure reading or 0.15 Pa, whichever is greater. Each gage is to have been calibrated within two years of the test. The calibration is to be checked against a National Institute of Standards and Technology (NIST, formerly National Bureau of Standards) traceable standard.

## 2.2 THERMAL IMAGING CAMERA REQUIREMENTS

The thermal imaging camera used in the thermography test must have a thermal sensitivity (Noise Equivalent Temperature Difference.) of +/- 0.18 degrees F at 86 degrees F or less. Ensure the camera's operating spectral range falls between 2 and 15 micrometers. Ensure the camera's IR image viewing screen resolution measures at least 240x180 pixels. Ensure the camera has a means of recording thermal images seen on the camera viewing screen. The camera is to display output as individual still frame images that also can be downloaded and inserted into an electronic Thermographic Investigation Report. Submit camera make and model, and catalog information that defines the camera thermal sensitivity for approval.

## PART 3 EXECUTION

### 3.1 PRESSURE TEST AGENCY

The test agency is to be an independent third party subcontractor, not an affiliated or subsidiary of the prime contractor, subcontractors or A/E firm. The agency is to be regularly engaged in pressure testing of commercial/industrial building envelopes. If using blower door or trailer-mounted fans, the lead test technician must have at least two years of experience in using such equipment in building envelope pressurization tests. Formal training using pressure test equipment is highly recommended. Technicians using the building's air handling system for pressure testing are to have tested at least five commercial/industrial buildings within the past two years with each building having over 50,000 square feet of floor area. Submit the name, address and floor areas of each of these five buildings for approval.

#### 3.1.1 Field Work

The lead pressure test technician and thermographer are to be present at the project site while testing is performed and is to be responsible for conducting, supervising, and managing of their respective test work. Management includes health and safety of test agency employees.

#### 3.1.2 Reporting Work

The lead pressure test technician is to prepare, sign, and date the test agenda, equipment list, and submit a certified Air Leakage Test Report. The thermographer is to prepare, sign, and date the test agenda, equipment list, and submit a certified Thermographic Investigation Report. The contractor is to prepare a final report that identifies improvements that were made to the envelope to reduce leaks, mitigate thermal bridging, eliminate moisture migration,, repair insulation voids discovered during diagnostic tests. Jointly submit all reports.

### 3.2 ENVELOPE SURFACE AREA CALCULATION

The architectural air barrier boundary includes the floor, walls, and ceiling. After construction of the air barrier envelope is complete, field measure the envelope to ensure the physical measurements match the design drawings and the air barrier envelope surface area calculations. If the measurements are not consistent with the defined air barrier boundary as indicated, re-calculate the envelope surface area and submit the envelope surface area calculation and results for review.

### 3.3 PREPARING THE BUILDING ENVELOPE FOR THE PRESSURE TEST

#### 3.3.1 Testing During Construction

The pressure test cannot be conducted until all components of the air barrier system have been installed. After all sealing as described herein has been completed, inspect the envelope to ensure it has been adequately prepared. During the pressure test, stop all ongoing construction within and neighboring the envelope which may impact the test or the air barrier integrity. The pressure test may be conducted before finishes that are not part of the air barrier envelope have been installed. For example, if suspended ceiling tile, interior gypsum board or cladding systems are not part of the air barrier the test can be conducted before they are installed. Recommend testing prior to installing the finished ceilings within the envelope and immediately surrounding it. The absence of finished ceilings allows for inspection and diagnostic testing of the roof/wall interface and for implementation of repairs to the air barrier, if necessary to comply with the maximum allowed leakage.

#### 3.3.2 Sealing The Air Barrier Envelope

Seal all penetrations through the air barrier. Unavoidable penetrations due to electrical boxes or conduit, plumbing, and other assemblies that are not air tight are to be made so by sealing the assembly and the interface between the assembly and the air barrier or by extending the air barrier over the assembly. Support the air barrier so as to withstand the maximum positive and negative air pressure to be placed on the building without displacement or damage, and transfer the load to the structure. Durably construct the air barrier to last the anticipated service life of the assembly and to withstand the maximum positive and negative pressures placed on it during pressure testing. Do not install lighting fixtures that are equipped with ventilation holes through the air barrier.

#### 3.3.3 Sealing Plumbing

Prime all plumbing traps located within the envelope full of water.

#### 3.3.4 Close and Lock Doors

Close and lock all doors and windows in the envelope perimeter. For doors not equipped with latching hardware, temporarily secure them in the closed position. Secure the doors in such a way that they remain fully closed even when the maximum anticipated differential air pressure produced during the test acts on them.

#### 3.3.5 Hold Excluded Building Areas at the Outdoor Pressure Level

Keep building areas immediately surrounding but excluded from the test envelope at the outdoor pressure level during the pressure test. Maintain these areas at the outdoor pressure level by propping exterior doors open, opening windows and de-energizing all air moving devices in or serving these areas.

#### 3.3.6 Maintain an Even Pressure within the Envelope

Ensure the pressure differences within the envelope are minimized by opening all internal air pathways including propping open all interior doors. Distribute test fans throughout the envelope as necessary to ensure the internal pressures are uniform (within 10 percent of the

average differential pressure). Ideally, do not install suspended ceilings until after all pressure tests have been completed. If, however the envelope includes finished suspended ceiling spaces, temporarily remove approximately 5 percent of all ceiling tiles or a minimum of 1 tile from each isolated suspended ceiling space, whichever comprises the greatest surface area. Temporarily remove additional ceiling tiles during testing to allow for inspection and diagnostic testing of the ceiling/wall interface.

### 3.3.7 Maintain Access to Mechanical and Electrical Rooms

Maintain access to mechanical rooms and electrical rooms associated with the envelope to allow for de-energizing ventilation equipment and resetting circuit breakers tripped by blower door equipment, if used.

### 3.3.8 Minimize Potential for Blowing Dust and Debris

Because high velocity air will be blown into and out of the envelope during the test, debris, including dust and litter, may become airborne. Airborne debris may become trapped or entangled in test equipment, thereby skewing test results. Ensure areas within and surrounding the envelope are free of dust, litter and construction materials that are easily airborne. If pressurizing existing, occupied areas, provide adequate notice to building occupants of blowing dust and debris, and general disruption of normal activities during the test.

### 3.3.9 De-energize Air Moving Devices

De-energize all air moving devices serving the envelope to keep air within the envelope as still as reasonably achievable. De-energize all fans that deliver air to, exhaust air from, or recirculate air within the envelope. Also de-energize all fans serving areas adjacent to but excluded from the envelope.

### 3.3.10 Installing Blower Door Equipment in a Door Opening

Where blower door fans are used, before installing blower door equipment, select a door opening that does not restrict air flow into and out of the envelope and has at least 5 feet clear distance in front of and behind the door opening. Disconnect the door actuator and secure the door open to prevent it from being drawn into the fan by fan pressure.

## 3.4 BUILDING ENVELOPE AIR TIGHTNESS REQUIREMENT

For each building envelope, perform two pressure tests; the Architectural Only test and the Architectural Plus HVAC System test. The purpose of the pressure (air leakage) test is to determine final compliance with the airtightness requirement by demonstrating the performance of the continuous air barrier. An effective air barrier envelope minimizes infiltration and exfiltration through unintended air paths (leaks). The tests may be performed in any desired order.

### 3.4.1 Architectural Only Test

The test envelope is the architectural air barrier boundary as defined on the contract drawings. This boundary includes connecting walls, roof and floor which comprise a complete, whole, and continuous three dimensional envelope. Perform both a positive pressure test and a negative pressure test on this envelope, unless otherwise directed.

#### 3.4.1.1 Test Goal

Input data from the test into the Air Leakage Rate by Fan Pressurization spreadsheet as described in paragraph CALCULATION PROGRAM via the Air Leakage Test Form. Compare output from the spreadsheet against the maximum allowable leakage defined in Section 07 27 10.00 10 BUILDING AIR BARRIER SYSTEM. The envelope passes the test if the leakage rate, as calculated using the spreadsheet, is equal to or lower than the Architectural Only leakage rate goal.

#### 3.4.1.2 Preparing The Envelope For The Pressure Test - Seal All Openings Through The Air Barrier

Temporarily close all perimeter windows, roof hatches and doors in the envelope perimeter except for those doors that are to remain open to accommodate blower door or trailer mounted fan test equipment installation. Seal, or isolate all other intentional openings, pathways and fenestrations through the architectural envelope prior to pressure testing. Follow the Recommended Test Envelope Conditions identified in ASTM E1827, Table 1, for the Closed Envelope condition. These openings may include boiler flues, fuel-burning water heater flues, fuel-burning kitchen equipment, clothes dryer vents, fireplaces, wall or ceiling grilles, diffusers etc. Before sealing flues, close their associated fuel valves and verify the associated pilot lights are extinguished. Prime all plumbing traps located within the envelope full of water. In lieu of applying tape and/or plastic, Typical temporary sealing materials include tape and sheet plastic or a self-adhesive grille wrap. Use and apply tape and plastic in a manner that does not deface or remove paint or mar the finish of permanent surfaces. Be especially aware of residue that remains from tape applied to stainless steel surfaces such as kitchen hoods or rollup doors. For painted surfaces, use tape types that do not remove finish paint when the tape is removed. If paint is removed from the finished surface, repaint to match existing surfaces. Secure dampers closed either manually or by using the building's HVAC system controls. Use the table below for further guidance in building preparation.

Building Component	Envelope Condition
Air handling units, duct fans	As found (open) or temporarily sealed as necessary
Dampers - intake, exhaust	Physically closed or closed using control power or temporarily sealed
Diffusers, registers, grilles within the envelope	Temporarily sealed
Doors, personnel type, at the envelope perimeter	Secured closed
Doors, personnel type, within the envelope	Secured (propped) open
Doors, roll-up type, at the envelope perimeter	Closed (no additional sealing)
Exhaust hoods	Closed* and temporarily sealed
Fireplace hearth	Temporarily sealed *



Building Component	Envelope Condition
Pilot light and associated fuel valve	Extinguished and closed, respectively
Vented combustion appliance	Temporarily sealed *
Vented combustion appliance exhaust flue	Off
Windows	Secured closed
* If the building component has an associated manual or automatic damper, consider securing the damper closed in lieu of temporarily sealing.	

### 3.4.2 Architectural Plus HVAC System Test

This test envelope includes the architectural air barrier boundary as defined on the contract drawings plus all HVAC supply, return and exhaust systems that penetrate and terminate within said architectural air barrier boundary and that extends outward from said boundary. All associated ductwork, intake and exhaust dampers, and air moving devices, including air handling units and fans, are included in this test envelope even if they are physically located outside of the architectural air barrier boundary. The boundary extends to and includes the low leakage intake and exhaust dampers. Perform both a positive pressure test and a negative pressure test on this envelope, unless otherwise indicated.

#### 3.4.2.1 Test Goal

Data from the test is to be input into the Air Leakage Rate by Fan Pressurization spreadsheet as described in paragraph CALCULATION PROGRAM via the Air Leakage Test Form. If both a positive and negative pressure tests were performed, both data sets are together to be input in the spreadsheet. Compare output from the spreadsheet against the leakage rate goal. The envelope passes the test if the leakage rate, as calculated using the spreadsheet, is equal to or lower than the Architectural Plus HVAC System leakage rate goal.

#### 3.4.2.2 Preparing the Building for the Pressure Test

In preparation of this test, de-energize all air moving devices within this envelope by putting their controls in the Unoccupied mode. This allows the building's HVAC controls to close all associated motorized intake, exhaust, and relief dampers. Make no other changes to the HVAC systems. Temporarily sealing diffusers, grilles, registers, kitchen hoods, exhaust hoods, fans, air handling units and all other HVAC system elements with tape and/or plastic sheeting or any other means is not allowed. Use the table below for further guidance in building preparation.

Building Component	Envelope Condition
Air handling units, duct fans	As found (open)

Building Component	Envelope Condition
Dampers - intake, exhaust	As found (no preparation)
Diffusers, registers, grilles within the envelope	As found (open)
Doors, personnel type, at the envelope perimeter	Secured closed
Doors, personnel type, within the envelope	Secured (propped) open
Doors, roll-up type, at the envelope perimeter	Closed (no preparation)
Exhaust hoods	Closed
Pilot light and associated fuel valve	Extinguished and closed, respectively
Vented combustion appliance	Off
Vented combustion appliance exhaust flue	As found (open)
Windows	Secured closed

### 3.5 CONDUCTING THE PRESSURE TEST

Notify the Contracting Officer at least 10 working days before conducting the pressure tests to provide the Government the opportunity to witness the tests and to monitor weather forecasts for conditions favorable for testing. Do not pressure test until verifying that the continuous air barrier is in place and installed without failures in accordance with installation instructions. During the pressure test periodically inspect temporarily sealed items to ensure they are still sealed. Seals on temporarily sealed items tend to release more readily at higher pressures. Test data obtained after temporarily sealed items become unsealed cannot be used as input into the calculation program. Follow the Envelope Pressure Test Procedures in the paragraphs below. Submit detailed pressure test procedures indicating the test apparatus, the test methods and procedures, and the analysis methods to be employed for the building envelope pressure (air tightness) test. Submit these procedures not later than 60 days after Notice to Proceed.

#### 3.5.1 Extend Pneumatic Tubes and Establish a Reference Differential Pressure

Confirm the various zones within the envelope have a relatively uniform interior pressure distribution by establishing a representative differential pressure between the envelope and the outdoors with blower door or trailer-mounted fans operating. The number of indoor pressure difference measurements (pneumatic hoses) required depends on the number of interior zones separated by bottle necks that could create significant pressure drops (e.g. doorways and stairwells). Extend at least four pneumatic hoses (differential pressure monitoring ports) to locations within the envelope that are physically opposite of each other. In multiple story buildings, extend hoses to multiple floors. Locate the hose ends away from the effects of air discharge from blower test equipment. Select one of the four (or more) interior hoses, one judged by the test agency to be the most unaffected by air velocity produced by

blower test equipment, to serve as the interior reference pressure port. Extend at least one additional pneumatic hose to the outdoors (outdoor pressure port). To the end of this hose manifold at least four hoses together and terminate each hose on a different side of the building. With the envelope sealed and the blowers energized, measure the differential pressure using the interior reference pressure port and the four outdoor pressure ports. Then measure and record the differential pressure by individually using each of the remaining three interior hoses. Ensure each reading is within plus or minus 10 percent of the reference reading. Thus at an average 75 Pa maximum pressure difference across the envelope, the difference between the highest and lowest interior pressure difference measurements should be 15 Pa or less. If this condition cannot be met, attempt to create additional air pathways within the envelope to minimize pressure differences within the envelope. If necessary, move the interior hose ends. See step 2.13 of the Air Leakage Test Form in Appendix A.

### 3.5.2 Bias Pressure Readings

With the fan pressurization equipment de-energized and the envelope sealed, obtain the differential pressure between the outdoors and the envelope. Record 12 bias pressure readings before the pressure test and 12 bias pressure readings after the pressure test. Each reading is the average of ten or more 1-second measurements. Include positive and negative signs for each reading. To help dampen bias pressures that significantly contribute to test pressure, reduce temperature differences between indoor and outdoor air. Temperature differences can be reduced by operating test fan equipment for a few minutes to replace most of the indoor air with outdoor air.

### 3.5.3 Testing in Both Positive and Negative Directions

The preferred method for testing a building envelope is to test in both the pressurized and depressurized directions. Testing in one direction is only allowed if opposite direction testing cannot logistically be performed due to test equipment limitations or restrictions. After obtaining the pre-test bias differential pressure readings, conduct the pressure test. Record the envelope pressures (in units of Pascals) from one interior pneumatic hose (monitoring port) and the outdoor pneumatic hose(s), averaged or manifolded, with corresponding flows (in units of cfm) for each fan. Record the flow rates at at least 10 to 12 positive and 10 to 12 negative building pressure readings. If conducting both positive and negative pressure tests the lowest allowable test pressure is 40 Pa and the highest test pressure is 85 Pa. Keep at least 25 Pa difference between the lowest and highest test pressure readings. Include the 75 Pa pressure value between the lowest and highest readings. The 10 to 12 readings in each direction are to be roughly evenly spaced along the range of pressures and flows. After testing is complete de-energize the equipment used to provide pressurization and obtain an additional 10 to 12 post-test bias pressure readings. None of the bias pressure readings are allowed to exceed 30 percent of the minimum test pressure. If these limits are exceeded the test fails and must be repeated.

### 3.5.4 Pressure Testing - Special Cases

#### 3.5.4.1 Pressure Testing a Tall or Large Building Envelope

Pressure testing the envelope of a tall or large building may be unworkable and unrealistic using blower door or trailer-mounted equipment. In this case, the test agency may define and pressure test

separate zones or floors within the envelope and sum the leakage of all of the zones to create an overall envelope leakage rate. Using this method, the test agency is to comply with the requirements of ASHRAE RP-935.

#### 3.5.4.2 Pressure Testing a Multiple Isolated Zoned Building

Pressure test each exterior corner zone plus at least an additional 20 percent (as measured by floor area) of remaining zones. The Contracting Officer is responsible for selecting which of these additional zones to test. If all zones pass the pressure test it is assumed that all untested zones also pass and no further testing is required. If, however, any zone fails to pass the test's leakage requirements, re-seal and re-test until it passes in accordance with paragraph FAILED PRESSURE TEST. Test an additional 20 percent of previously untested zones. If all tested zones pass, no further testing is needed. If any zone in this group fails the test re-seal and re-test the zone until it passes. Continue this process until all the tested zones pass. When testing a zone, the doors to all adjacent zones that share a common surface with the tested zone are to have their doors opened to the outdoors. The resulting leakage from the test zoned is that through all 6 surfaces (4 walls, roof and floor, for a rectangular shaped zone).

#### 3.5.5 Failed Pressure Test

If the pressure test fails to meet the established criteria, use diagnostic test methods described in paragraph LOCATING LEAKS BY DIAGNOSTIC TESTING to discover the leak locations. Provide additional permanent sealing measures to reduce or eliminate leak sources discovered during diagnostic testing. Retest (perform another pressure test) after sealing has been completed. Repeat this sequence of documenting test results in the test report, performing diagnostic tests, documenting recommendations for additional sealing measures in the test report, sealing leak locations per recommendations, and re-testing as necessary until the building envelope passes the pressure test and is in compliance with the performance requirements.

#### 3.5.6 Air Leakage Test Report

Report volumetric flow rates and corresponding differential pressures in cubic feet per minute (cfm) and Pascals (Pa), respectively, on the Air Leakage Test Form sample form found in Appendix A. Populate the accompanying spreadsheet file entitled Pressure Test Data Analysis with information obtained during the test. The spreadsheet uses equations found in ASTM E779 as a basis for calculating the envelope leakage rate. Other similar leakage rate calculation programs cannot be used or submitted for review. Submit a printout of the data input and output in the report. Should any air tightness (pressure) test fail, the pressure test report is to include data and results from all previous failed tests along with the final successful test data and results. Indicate if the resulting leakage rate did or did not meet the goal leakage requirement. Identify and document deficiencies in the building construction upon failure of a test to meet the specified maximum leakage rate.

Include the Test Agency Qualification Sheet, Air Leakage Test Form and Air Leakage Test Results Form in the written report. Document every test set-up condition with diagrams and photos to ensure the tests can be made repeatable. Document all pneumatic hose termination locations. Record in detail how the building envelope was prepared for the tests. Also describe in detail which building items were temporarily sealed. Include

photos of test equipment and sealing measures in the report. Include an electronic (pdf) version of all test reports on a CD. If the building envelope fails to meet the leakage rate goal, provide recommendations to further seal the envelope and document these recommendations in the test report.

### 3.6 LOCATING LEAKS BY DIAGNOSTIC TESTING

Use diagnostic test methods described herein to discover obvious leaks through the envelope. Perform diagnostic tests on the building envelope regardless of the envelope meeting or failing to meet the designated leakage rate goal. Use diagnostic test methods in accordance with ASTM E1186 and in conjunction with pressurization equipment as necessary. Use the thermography diagnostic test to establish a baseline for envelope leakage. Apply additional diagnostic tests (find, feel, fog or other tests) as necessary to further define leak locations and pathways discovered using thermography or to find additional leaks not readily detected by thermography. Using a variety of diagnostic tests may help locate leaks that would otherwise go undetected if only a single diagnostic test were used. Pay special attention to locating leaks at interfaces where there is a change in materials or a change in direction of like materials. These interfaces, at a minimum, include roof/wall, wall/wall, floor/wall, wall/window, wall/door, wall/louver, roof mounted equipment/roof curb interfaces and all utility penetrations (ducts, pipes, conduit, etc) through the envelope's architecture. Also use diagnostic tests to check for leakage between the air duct and duct damper, when the damper, under normal control power, is placed in the closed position. Should leaks be discovered during diagnostic tests, thoroughly document their exact locations on a floor plan so that sealing can be later applied, if required or as directed. If the envelope passes the leakage test, use the diagnostic test procedure described above to identify obvious leakage locations. Seal the leaks at the discretion of the COR based on the magnitude, location, potential for liquid moisture penetration or retention, potential for condensation, presence of daylight through an architectural surface or if the leakage location could potentially cause rapid deterioration or mold growth of, or in the building envelope materials and assemblies. Apply sealing measures after diagnostic testing is complete and all pressurization blowers are off. To verify that the applied sealing measures that are effective, re-test for leaks using the same diagnostic methods that discovered the leak. Reseal and retest until the envelope meets the leakage rate goal and all obvious leaks through the envelope are sealed.

#### 3.6.1 Find Test

Use visual observation to locate daylight and/or artificial light streaming from the opposite side of the envelope. Observe all interfaces identified above.

#### 3.6.2 Feel Test

Use the building's air handling system or blower door equipment to negatively pressurize the building envelope, to at least 25 Pa but no greater than 85 Pa, with respect to the outdoors. The larger the pressure difference, the easier discovering leaks by feeling them becomes. While inside the envelope, hand feel roof/wall, wall/wall, and floor/wall interfaces and utility penetrations (ducts, pipes, conduit, etc) for leaks and note the leak locations on a floor plan. The "Feel" test may also be used to check for leaks between the ductwork and ductwork damper. To do

this, positively pressurize the envelope and check for air movement from the envelope exterior.

### 3.6.3 Infrared Thermography Test

Avoid performing thermography tests just after pressure testing the building envelope (pressurizing and/or depressurizing the building envelope) as thermography readings may be inaccurate due to excessive air-wash. Perform thermography either before the pressure test or wait an appropriate amount of time after pressure test completion for the temperatures within the building envelope to stabilize before starting the thermography tests. Coordinate thermography examination with the pressure test agency and the test agency's pressurization equipment. The pressure test agency is to allow adequate time for the thermographer to perform a complete thermographic examination, as described hereinafter, of the envelope interior and exterior.

#### 3.6.3.1 Thermography Test Methods

Before thermographic testing, remove furniture, construction equipment, and all other obstructions both inside and outside the building as necessary to gain a clear field of view. In the Thermographic Investigation Report, document all areas where obstructions remain. For exterior thermal examination of the envelope, verify that no direct solar radiation has heated the envelope surfaces to be examined for a period of approximately 3 hours for frame construction and for approximately 8 hours for masonry veneer construction. Conduct exterior investigations after sunset, before sunrise, or on an overcast day when the influence of solar radiation can be determined to be minimal. Limit exterior examinations to times when the influence of solar radiation is minimal, such as after sunset or before sunrise or during an overcast day. Conduct thermal imaging tests only when wind speeds are less than 8 mph at the time of analysis and at the end of analysis. Document any variations in wind during the test. Document all variations of test conditions in the Thermographic Investigation Report. Test only when exterior surfaces are dry. Monitor and document ongoing test parameters, such as the temperatures inside and outside the air barrier envelope, wind speed, and differential pressure.

##### 3.6.3.1.1 Thermography Testing of the Air Barrier

Test the building envelope in accordance with ISO 6781, and ASTM E1186. Perform a complete thermographic inspection consisting of the full inspection of the interior and exterior of the complete air barrier envelope. Document envelope areas that are inaccessible for testing. Use infrared thermography technology in concert with standard pressurization methods (blower doors, trailer mounted fans and/or the building's own air handling systems) to locate leaks through the air barrier. Because thermography works best with at least a 18 degree F temperature difference between the envelope interior and the exterior, adjust the HVAC system, if possible, to create or enhance this temperature difference. The minimum allowable temperature difference is 3 degrees F. Maintain this temperature difference for at least 3 hours prior to the test. Use pressurization methods to establish a minimum of +20 Pa pressure difference with respect to the outdoors while using an infrared camera to view the envelope from outdoors. When viewing with the camera from inside the envelope, keep the envelope at a pressure differential of -20 Pa with respect to the outdoors using pressure testing equipment or the building's own air handling system.

#### 3.6.3.1.2 Thermography Testing of the Insulation Envelope to Find Insulation Voids (Qualitative Test)

After installation of the insulation envelope is complete, use thermography to identify anomalies (insulation voids) in this envelope. Test only when the temperature difference between inside and outside wall surfaces and as defined by the surface being imaged is a minimum of 18 degrees F or greater for a period of 4 hours before the test. Alternatively, the thermographer is to verify and document in the Thermographic Investigation Report that the imaging system is capable of providing satisfactory results with less temperature difference between inside and outside. Test during a time when there is no more than 0.05 inches differential pressure across the insulation envelope. Document the location of the voids on floor plans or wall sections.

#### 3.6.3.1.3 Thermography Testing of Thermal Bridging

Take sample thermal images of representative parts of the building envelope being examined and analyze to demonstrate the majority of areas with anomalies or identifiable thermal features. Also sample thermal bridges in parts of the building that have no apparent anomalies to demonstrate the correct functioning of building components.

#### 3.6.3.2 Thermography Test Results

Document the location of all leaks, anomalies, and unusual thermal features on a floor plan and/or elevation view and catalog them with a visible light picture for locating the defect for correction. The thermographer is to recommend corrective actions to eliminate the leaks, anomalies and unusual thermal features. Where leaks are found perform corrective sealing as necessary to achieve the whole envelope air leakage rate specified. After sealing, again use thermography in concert with standard pressurization methods to verify that the air leakage has been reduced. After these leaks have been permanently sealed note all actions taken on the drawings or in the Thermographic Investigation Report. Submit the drawings for approval as part of the Thermographic Investigation Report. Also include thermographic photos that show where leaks were discovered. Include thermograms using an imaging palette that clearly shows the observed thermal patterns indicating air leakage. The Contracting Officer's Representative is to witness all testing.

#### 3.6.4 Fog Test

Before using a theatrical fog generator, disable all building smoke detectors as they may alarm when fog is issued. Coordinate fog tests and the disabling of all smoke detectors with the Contracting Officer's representative and the local fire department as necessary. Use pressure test equipment or the buildings own air handling system to positively pressurize the building envelope to at least 25 Pa but not greater than 85 Pa over the outdoors. Using a theatrical fog generator within the envelope, direct fog at suspected leakage points such as at building interfaces. Test the following interfaces: roof/wall, wall/wall, floor/wall, wall/window, roof/ mounted mechanical equipment. From the vantage point immediately outside the envelope and opposite that of the interface being tested, observe the effect as the fog is issued. Detection may also be further enhanced by using a scented fog liquid or a fog liquid that produces a colored fog. Look for fog and smell for associated odor percolating through the interface. Also use smoke puffers

and smoke sticks as necessary to locate leaks at these and other interface locations. If the Architectural Plus HVAC System pressure test will be/was performed introduce fog into ductwork to check for leakage between ductwork and associated dampers. After fog testing has ended, reactivate the building smoke detectors and notify the Contracting Officer and local fire department that the test has ended. After sealing has been completed retest these areas using fog. Seal additional leaks that are found.

### 3.6.5 Diagnostic Test Report

Once the diagnostic tests have been completed and the leakage locations identified and sealed, document these procedures, locations and recommendations in the diagnostic test report. Submit plan and/or profile drawings that thoroughly identify leak locations. Describe in detail all leak locations so that the seal-up crew knows where to apply sealing measures. After sealing measures have been applied, describe the methods used along with applicable photos of the final sealed condition.

#### 3.6.5.1 Thermographic Investigation Report

Submit a report of each thermographic investigation identifying the thermal discontinuities in the thermal control layer. Indicate in the final report locations to which improvements for both the air control layer and the thermal control layer were made to reduce air leaks and correct discontinuities in the thermal control layer. Include in the report some selected radiometric images of suspected failure points in the air barrier envelope that indicate before and after conditions. Devote a chapter(s) of the Thermographic Investigation Report to identifying suspected points of thermal bridging, moisture migration through roofs and walls, and insulation voids. Indicate in the final report improvements that were made to the envelope to reduce air leaks, correct wet roof and wall areas, and repair insulation. Include the following items in the report:

- a. Brief description of the building construction
- b. Types of interior and exterior surface materials used in the building.
- c. Geographical orientation of the building with a description of the exterior surroundings including other buildings, vegetation, landscaping, and surface water drainage.
- d. Camera brand, model and serial number, and date of most recent calibration date; optional lenses with serial numbers (if applicable)
- e. Thermographer's and Government Inspector's names
- f. Date and time of tests
- g. Air temperature and humidity inside the air barrier envelope
- h. Outdoor air temperature and humidity
- i. General information for the last 12 hours on the solar radiation conditions in the geographic area where the test is being performed.
- j. Ambient conditions such as precipitation and wind direction and speed occurring with the last 24 hours, as applicable. Refer to specific requirements in each section of each thermographic inspection type for



requirements in each specific area.

- k. Documentation of those portions of the building envelop which were not within test conditions when the scan was performed and which portions were obstructed by adjacent structures, interior furnishings, intervening cavities or reflective surfaces.
- l. Other relevant information, which may have influenced test results.
- m. Drawings, sketches, floor plans and/or photographs detailing the locations in the buildings where thermograms were taken detailing possible irregularities in the components being tested.
- n. Thermal images taken during the inspection with their relative locations and written or voiced recorded explanations of the anomaly listed along with visual and reference images.
- o. An identification of the aspects or components of the building being examined.
- p. Explanations for the type and the extent of each construction defect observed during the inspection.
- q. Any results from additional measurements and investigations. Identify additional equipment used and support with type, model number, serial number and date of most recent calibrated.

#### 3.6.5.2 Fog Test Report

Document all turbulent air flow and dead air spaces within the envelope. Report fog behavior as it exits from and/or is entrained within the building. Include a floor plan in the report that documents the locations where fog passed through the envelope.

#### 3.7 CALCULATION PROGRAM

To calculate the envelope leakage rate and other required outputs, input the data obtained during the pressure tests as documented in the Air Leakage Test Form (Appendix A) into the Air Leakage Rate by Fan Pressurization Excel spreadsheet. This spreadsheet can be found at the following web site: <http://www.wbdg.org/FFC/NAVGRAPH/graphoc.pdf>.

#### 3.8 AFTER COMPLETION OF THE PRESSURE AND/OR DIAGNOSTIC TEST

After all pressure and/or diagnostic testing has been completed unseal all temporarily sealed items. Unless otherwise directed by the Contracting Officer, return all dampers, doors, and windows to their pre-test condition. Remove tape and plastic from all temporarily sealed openings, being careful not to deface painted surfaces. If paint is removed from finished surfaces, repaint to match existing surfaces. Unless otherwise directed by the Contracting Officer's representative, return fuel (gas) valves to their pre-test position and relight pilot lights. Return all fans and air handling units to pre-test conditions.

#### 3.9 REPAIR AND PROTECTION

Repair and protection is the Contractor's responsibility, regardless of the assignment of responsibility for testing, inspection, and similar services. Upon completion of inspection, testing, or sample taking and

similar services, repair damaged construction and restore substrates and finishes, protect construction exposed by or for quality control service activities, and protect repaired construction.

### 3.10 APPENDICES

The following forms are available for download as a MS Word file at <http://www.wbdg.org/FFC/NAVGRAPH/graphdoc.pdf>.

Appendix A - Air Leakage Test Form

Appendix B - Air Leakage Test Results Form

Appendix C - Test Agency Qualifications Sheet

-- End of Section --

SECTION 07 13 53

ELASTOMERIC SHEET WATERPROOFING  
02/16

PART 1 GENERAL

1.1 REFERENCES

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

ASTM INTERNATIONAL (ASTM)

ASTM C1305	(2008) Standard Test Method for Crack Bridging Ability of Liquid-Applied Waterproofing Membrane
ASTM D1004	(2013) Initial Tear Resistance of Plastic Film and Sheeting
ASTM D1149	(2007; R 2012) Standard Test Method for Rubber Deterioration - Surface Ozone Cracking in a Chamber
ASTM D1204	(2014) Linear Dimensional Changes of Nonrigid Thermoplastic Sheeting or Film at Elevated Temperature
ASTM D146/D146M	(2004; E 2012; R 2012) Sampling and Testing Bitumen-Saturated Felts and Woven Fabrics for Roofing and Waterproofing
ASTM D1876	(2008; R 2015; E 2015) Standard Test Method for Peel Resistance of Adhesives (T-Peel Test)
ASTM D2136	(2002; R 2012) Coated Fabrics - Low-Temperature Bend Test
ASTM D2240	(2015) Standard Test Method for Rubber Property - Durometer Hardness
ASTM D297	(2015) Rubber Products - Chemical Analysis
ASTM D3045	(1992; R 2010) Practice for Heat Aging of Plastics Without Load
ASTM D41/D41M	(2011; R 2016) Standard Specification for Asphalt Primer Used in Roofing, Dampproofing, and Waterproofing
ASTM D412	(2016) Standard Test Methods for Vulcanized Rubber and Thermoplastic Elastomers - Tension
ASTM D429	(2014) Rubber Property-Adhesion to Rigid

Substrates

ASTM D471	(2016a) Standard Test Method for Rubber Property - Effect of Liquids
ASTM D5385/D5385M	(1993; R 2014; E 2014) Standard Test Method for Hydrostatic Pressure Resistance of Waterproofing Membranes
ASTM D570	(1998; E 2010; R 2010) Standard Test Method for Water Absorption of Plastics
ASTM D573	(2004; R 2010) Standard Test Method for Rubber - Deterioration in an Air Oven
ASTM D624	(2000; R 2012) Tear Strength of Conventional Vulcanized Rubber and Thermoplastic Elastomers
ASTM D638	(2014) Standard Test Method for Tensile Properties of Plastics
ASTM D746	(2014) Standard Test Method for Brittleness Temperature of Plastics and Elastomers by Impact
ASTM D751	(2006; R 2011) Coated Fabrics
ASTM D903	(1998; R 2010) Peel or Stripping Strength of Adhesive Bonds
ASTM E154/E154M	(2008a; R 2013; E 2013) Water Vapor Retarders Used in Contact with Earth Under Concrete Slabs, on Walls, or as Ground Cover
ASTM E96/E96M	(2016) Standard Test Methods for Water Vapor Transmission of Materials

INTERNATIONAL CODE COUNCIL (ICC)

ICC IBC	(2017) International Building Code
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1.2 SUBMITTALS

Government approval is required for submittals with a "G" designation; submittals not having a "G" designation are for information only. When used, a designation following the "G" designation identifies the office that will review the submittal for the Government. Submittals with an "S" are for inclusion in the Sustainability eNotebook, in conformance with Section 01 33 29 SUSTAINABILITY REPORTING. Submit the following in accordance with Section 01 33 00 SUBMITTAL PROCEDURES:

SD-03 Product Data

Manufacturer's Standard Details; G

Elastomeric Waterproofing Sheet Material

Protection Board

Primers, Adhesives, and Mastics

SD-06 Test Reports

Elastomeric Waterproofing Sheet Material

Protective Covering

SD-07 Certificates

Elastomeric Waterproofing Sheet Material; G

Primers, Adhesives, and Mastics; G

Protective Coverings; G

Draft Special Warranties; G

Final Special Warranties; G

Certificates Of Compliance; G

SD-08 Manufacturer's Instructions

Primers, Adhesives, and Mastics

SD-11 Closeout Submittals

Certificates Of Compliance with sustainable requirements for items listed in SD-07; G

### 1.3 MANUFACTURER'S DETAILS

Submit manufacturer's standard details indicating methods of attachment and spacing, transition and termination details, and installation details. Include verification of existing conditions.

### 1.4 PRODUCT DATA

Include data for material descriptions, recommendations for product shelf life, requirements for protective coverings, and manufacturer's Safety Data Sheets (SDS) for primers, adhesives, and mastics.

### 1.5 CODE REQUIREMENTS

Provide membrane waterproofing system in accordance with ICC IBC Section 1805 Dampproofing and Waterproofing.

### 1.6 DELIVERY, STORAGE, HANDLING, IDENTIFICATION

Deliver and store materials in accordance with manufacturer's printed instructions, out of the weather, in manufacturer's original packaging with brand name and product identification clearly marked. Keep materials wrapped and separated from off-gassing materials (such as drying paints and adhesives). Do not use materials that have visible moisture or biological growth. Do not permit unidentified materials in the work area or in the project.

## 1.7 ENVIRONMENTAL CONDITIONS

Do not apply waterproofing during inclement weather or when there is ice, frost, surface moisture, or visible dampness on the surface to receive waterproofing for when ambient and surface temperatures are 40 degrees F or below. The restriction on the application of waterproofing materials when ambient and surface temperatures are below 40 degrees F will be waived if the Contractor devises a means, approved by the Contracting Officer in writing, of maintaining the surface and ambient temperatures above 40 degrees F.

## 1.8 SPECIAL WARRANTIES

### 1.8.1 Guarantee

Guarantee waterproofing membrane installation against failure due to leaks for a period of two years from the date of Beneficial Occupancy. Submit draft and final guarantees in accordance with Sections 01 78 23 OPERATION AND MAINTENANCE DATA.

### 1.8.2 Warranty

Provide manufacturer's material warranty for all system components for a period of ten years from the date of Beneficial Occupancy. Submit draft and final warranties in accordance with Sections 01 78 23 OPERATION AND MAINTENANCE DATA.

## PART 2 PRODUCTS

### 2.1 SUSTAINABILITY CRITERIA

Where allowed by performance criteria:

#### 2.1.1 Reduced Volatile Organic Compound (VOC) Content

Provide products with reduced VOC content and provide certificates of compliance in accordance with Section 01 33 29 SUSTAINABILITY REPORTING paragraph REDUCE VOLATILE ORGANIC COMPOUNDS.

#### 2.1.2 Recycled Content

Provide products with recycled content and provide certificates of compliance in accordance with Section 01 33 29 SUSTAINABILITY REPORTING paragraph RECYCLED CONTENT.

### 2.2 MATERIALS

Provide one of the types of elastomeric waterproofing sheet material and related primers, adhesives, and mastics as specified herein. Ensure compatibility of waterproofing materials with each other, and with materials on which they are applied. Provide materials that comply with applicable requirements cited below when tested in accordance with the referenced ASTM publications.

### 2.3 BUTYL RUBBER SHEETING

Not less than 60 mils minimum thickness.

### 2.3.1 Butyl Rubber Sheetting Performance Requirements

- a. Thickness Tolerance, ASTM D412: Plus or minus 10 percent.
- b. Specific Gravity, ASTM D297: 1.20, plus or minus 0.05.
- c. Tensile Strength, ASTM D412: 1200 psi minimum.
- d. Tensile Stress at 300 percent elongation, ASTM D412: 600 psi minimum.
- e. Elongation, ASTM D412: 300 percent minimum.
- f. Tear Resistance, Die C, ASTM D624: 150 pound force per inch (lbf/inch) minimum.
- g. Shore A Hardness, ASTM D2240: 5-second interval before reading; 60 plus or minus 10.
- h. Ozone Resistance, ASTM D1149: No cracks, 7 days - 50 pphm - 100 degrees F, 20 percent elongation.
- i. Heating Aging-Accelerated, ASTM D573: Tensile retention, 60 percent of minimum original elongation retention; 60 percent of minimum original requirement; 7 days, 240 degrees F.
- j. Butyl Identification, ASTM D471 REV A, Tricresyl Phosphate Immersion: Maximum volume swell 10 percent, 70 hrs, 212 degrees F.
- k. Low Temperature Flexibility, ASTM D746: No failure at minus 40 degrees F.
- l. Water Absorption, ASTM D471 REV A: Plus 1 percent maximum. 7 days, 158 degrees F.
- m. Exposure to Fungi and Bacteria in Soil, ASTM E154/E154M REV A, Minimum 16 Weeks: Unaffected.
- n. Water Vapor Transmission, 80 degrees F Permeance, ASTM E96/E96M, Procedure B or BW: 0.15 perms maximum.

### 2.3.2 Adhesive, Cement, and Tape for Use with Butyl Rubber

As recommended by the butyl rubber waterproofing membrane manufacturer.

### 2.4 THERMOPLASTIC MEMBRANE: POLYVINYL CHLORIDE (PVC)

Polyvinyl chloride (PVC) flexible sheets with non-woven fiberglass reinforcing not less than 60 mils minimum thickness.

#### 2.4.1 Thermoplastic Membrane Performance Requirements

- a. Overall thickness, ASTM D751: .059 inches minimum
- b. Tensile strength, ASTM D638: 1600 psi minimum
- c. Elongation at break, ASTM D638: 250 percent minimum
- d. Seam strength, ASTM D638: 90 percent minimum of tensile strength

- e. Retention of properties after heat aging, ASTM D3045
- f. Tensile strength, ASTM D638: 95 percent of original
- g. Elongation, ASTM D638: 95 percent of original
- h. Tear resistance, ASTM D1004: 17 lbf
- i. Low Temperature Bend, ASTM D2136: minus 40 degrees F
- j. Liner Dimensional Change, ASTM D1204: 0.002 percent
- k. Weight Change After Immersion in Water, ASTM D570: 2.0 percent maximum

#### 2.4.2 Adhesives

- a. Adhesive for thermoplastic flashings as recommended by manufacturer.
- b. Adhesive for Sub-Membrane Grid: 100 percent solids, two part urethane, with minimum tensile strength of 150 psi, in accordance with ASTM D412 and adhesion to concrete of 12 ply in accordance with ASTM D429 as recommended by manufacturer.

#### 2.4.3 Accessories

Securement Strip: 14 gauge stainless steel metal bar 1 inch wide, pre-punched 1 inch on center for securement.

### 2.5 COMPOSITE, SELF-ADHERING MEMBRANE SHEETING

Cold applied composite sheet consisting of rubberized asphalt and cross laminated, high density polyethylene film. Not less than 60 mils minimum thickness is required.

#### 2.5.1 Composite, Self-Adhering Sheeting Performance Requirements

- a. Tensile Strength ASTM D412, Die C: 250 psi minimum.
- b. Ultimate Elongation, ASTM D412, Die C: 200 percent minimum.
- c. Water Vapor Transmission, ASTM E96/E96M 80 degrees F Permeance, Procedure B: 0.1 perm maximum.
- d. Pliability degrees, ASTM D146/D146M: (180 degrees Bend Over 1 Inch Mandrel): No cracks at minus minus 25 degrees F.
- e. Provide test report data for crack bridging ability: Either in accordance with ASTM C1305 as modified for a dry film thickness specified by the manufacturer and conducted at low temperature; or in accordance with a cycling over crack test also conducted for the specified dry film thickness at low temperature. Using either test, verify crack bridging up to 1/4 inch without damage to the membrane system.
- f. Puncture Resistance, ASTM E154/E154M REV A: 40 lb minimum.
- g. Lap Adhesion at Minimum Application Temperature, ASTM D1876 Modified, 5 lbs/in..



- h. Peel Strength, ASTM D903: Modified 9 lbs/in.
- i. Resistance to Hydrostatic Head, ASTM D5385/D5385M: 231 ft of water.
- j. Water Absorption, ASTM D570: 0.1 percent maximum.

#### 2.5.2 Primers

Asphalt composition, ASTM D41/D41M, or synthetic polymer in solvent as recommended by the membrane manufacturer.

#### 2.5.3 Mastics

Polymer modified asphalt in suitable solvent of trowel grade consistency and as recommended by the membrane manufacturer.

#### 2.6 Protection Board

Provide protection board that is compatible with the waterproofing membrane. Use a minimum 1/2 inch thick fir bitumen impregnated board 1 inch for polystyrene 1/8 inch thick for vertical and 1/4 inch for horizontal premolded bituminous protection board as recommended by the manufacturer.

Three dimensional, high impact resistant polymeric grid with woven monofilament drainage fabric bonded to the grid.

### PART 3 EXECUTION

#### 3.1 VERIFICATION OF CONDITIONS

Before starting the work, verify surfaces that must be waterproofed are in satisfactory condition. Notify the Contracting Officer of defects or conditions anticipated to prevent a satisfactory application. Do not start application until defects and conditions have been corrected.

#### 3.2 SURFACE PREPARATION

Ensure surfaces to receive treatment are clean, dry, smooth, and free from deleterious materials and projections. Thoroughly wet holes, joints, cracks, and voids in concrete with water and fill with Portland cement mortar, strike flush, and permit to dry. Cut off high spots or grind smooth. Finish top surfaces of projecting concrete ledges below grade, except footings, to a steep bevel with Portland cement mortar. Sweep surfaces to receive covering before applying waterproofing to remove dust and foreign matter. Cure concrete by a method compatible with the waterproofing system.

#### 3.3 APPLICATION

##### 3.3.1 Building Envelope Requirements

Provide a continuous waterproofing system at all material and building transitions. Lap, wrap, fasten and seal products in accordance with manufacturer's printed instructions. Envelope assembly variations are not permitted without written approval from the Contracting Officer's Representative.

### 3.3.2 General Installation Requirements

Provide sheet waterproofing in accordance with manufacturer's printed installation instructions. Ensure the surface to receive membrane is clean, smooth and dry without surface irregularities; correct deficiencies prior to installation. Where indicated, mop continuous cant strips in place at vertical and horizontal corners before installing the waterproofing membrane. Do not use untreated wood or wood fiber cants. When using solvent welding liquid, avoid prolonged contact with skin and breathing of vapor and provide adequate ventilation. Carry waterproofing of horizontal surfaces up abutting vertical surfaces and adhere solid to the substrate. Avoid wrinkles and buckles in applying membrane and joint reinforcement.

#### 3.3.2.1 Non-Self-Adhering Membrane

Unroll membrane and allow to remain flat for at least one-half hour before application. Apply an asphalt concrete primer prior to application of asphaltic adhesive. Where solvent adhesive is applied, allow major portion of solvent to evaporate so that bonding adhesive does not stick to a dry finger touching it. Apply elastomeric waterproofing membrane in a full bed of adhesive at a uniform coverage rate in accordance with the membrane manufacturer's printed instructions. Where membrane on horizontal surfaces are to receive concrete fill, apply adhesive in 4 inch wide strips at 2 feet on center. Pull membrane tight without stretching. As soon as adhesive is fully set and dry, recheck lap splices. Where openings or fishmouths appear, reseal and reroll lap splices.

#### 3.3.2.2 Self-Adhering Membrane

Apply composite, self-adhering membrane on surfaces primed at a uniform coverage rate in accordance with membrane manufacturer's printed instructions. Remove release sheet and apply with tacky surface in contact with dried primer.

#### 3.3.3 Butyl Rubber

Lap sheets at sides and ends a minimum of 6 inches over the preceding sheet. Apply lap splicing cement over entire 6 inches splice area prior to application of sealant. Make sealant continuous along the entire length of the splice. Maintain a continuous bead of sealant at all membrane splices or as required by the manufacturer. Provide a tongue and groove cemented splice a minimum of 6 inches wide with factory made heat vulcanized seam of not less than 2 inches or as required by the manufacturer, when membrane is below water table.

#### 3.3.4 Thermoplastic Membrane (PVC)

Consult with membrane manufacturer prior to grid application. Install 12 inches wide sub-membrane containment grid as required by manufacturer. Provide the containment grid at intervals across the width and length of the substrate, at the base of all transitions, walls, curbs, penetrations, and at the perimeter of each deck/substrate section. Fully adhere strips to the deck in a full bedding of two-part urethane adhesive. Weld adjacent sheets in accordance with manufacturer's instructions. Hot-air weld all side and end lap joints. Provide lap area a minimum of 3 inch wide when machine welding, and a minimum of 4 inch wide when hand welding but not less than recommended by the manufacturer. Orient overlaps with the direction of flow of water.

### 3.4 COMPOSITE, SELF-ADHERING MEMBRANE

Lap sheets at edges and ends a minimum of 2-1/2 inches over the preceding sheet. Provide all side laps a minimum 2-1/2 inches and end laps 5 inches. Provide self-adhesive, mastic laps in accordance with manufacturer's recommendation. Roll or firmly press to adhere membrane to substrate. Cover corners and joints with two layers of reinforcement by first applying a 12 inch width of membrane centered along the axis. Flash drains and projections with a second ply of membrane for a distance of 6 inches from the drain or projection. Finish exposed, terminated edges of membrane on horizontal or vertical surfaces with a troweled bead of mastic. Apply mastic around edges of membrane, and drains and projections. Apply mastic at end of each work day.

### 3.5 FLASHING

Flash penetrations through membrane. Seal all penetrations where reinforcing bars penetrate a waterproofing membrane with the appropriate sealant or mastic flashing component. Embed elastomeric membrane in a heavy coat of adhesive, except for self-adhering membrane. Position continuous metal reglets horizontally on footing and vertically on intersecting and connecting walls, and as specified in Section 07 60 00 FLASHING AND SHEET METAL. Metal reglets are to receive exposed edges of membrane waterproofing. Secure membrane into reglets by lead wedges and fill with cement as recommended in writing by manufacturer of waterproofing materials. Counterflash upper edge of membrane waterproofing and protective covering as specified in Section 07 60 00 FLASHING AND SHEET METAL.

### 3.6 PROTECTIVE COVERING

After installation has been inspected and approved by the Contracting Officer, apply a protective covering to the membrane waterproofing prior to backfilling. Protect vertical membrane waterproofing with a 1/2 inch minimum thickness of asphalt plank; 1/2 inch minimum thickness of fiberboard; or 1/8 inch minimum thickness of compatible water resistant bitumen type protection board with edges abutting adjacent edges and exposed surfaces covered by a taping system recommended by manufacturer of protection board. Cover horizontal membrane waterproofing with similar protection board and Portland cement mortar not less than 3/4 inch thick; place uniformly and allow to set before installing subsequent construction.

-- End of Section --



SECTION 07 14 00

FLUID-APPLIED WATERPROOFING

02/12

PART 1 GENERAL

1.1 REFERENCES

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

ASTM INTERNATIONAL (ASTM)

ASTM C33/C33M	(2016) Standard Specification for Concrete Aggregates
ASTM C578	(2017a) Standard Specification for Rigid, Cellular Polystyrene Thermal Insulation
ASTM C836/C836M	(2015) High Solids Content, Cold Liquid-Applied Elastomeric Waterproofing Membrane for Use With Separate Wearing Course
ASTM D1056	(2014) Standard Specification for Flexible Cellular Materials - Sponge or Expanded Rubber
ASTM D1751	(2004; E 2013; R 2013) Standard Specification for Preformed Expansion Joint Filler for Concrete Paving and Structural Construction (Nonextruding and Resilient Bituminous Types)
ASTM D1752	(2004a; R 2013) Standard Specification for Preformed Sponge Rubber Cork and Recycled PVC Expansion

1.2 SUBMITTALS

Government approval is required for submittals with a "G" designation; submittals not having a "G" designation are for information only. When used, a designation following the "G" designation identifies the office that will review the submittal for the Government. Submittals with an "S" are for inclusion in the Sustainability eNotebook, in conformance to Section 01 33 29 SUSTAINABILITY REPORTING. Submit the following in accordance with Section 01 33 00 SUBMITTAL PROCEDURES:

SD-03 Product Data

Fluid-Applied Membrane

Membrane Primer

Elastomeric Sheet

Flexible Foam-Backed Elastomeric Sheet

Solvent

Moisture Meter

Protection Board

Bond Breaker

Submit material description and physical properties, application details, and recommendations regarding shelf life, application procedures, and precautions on flammability and toxicity.

#### SD-11 Closeout Submittals

Warranty

Information Card

Instructions To Government Personnel

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

### 1.3 PREWATERPROOFING CONFERENCE

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

### 1.4 DELIVERY, STORAGE, AND HANDLING

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

### 1.5 ENVIRONMENTAL CONDITIONS

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

the surface temperature of the substrate is maintained at a minimum of 40 degrees F for 24 hours prior to the application of the waterproofing, and remains above that temperature during the cure period recommended by the manufacturer.

## 1.6 WARRANTY

Provide roof system material and workmanship warranties meeting specified requirements. Provide revisions or amendment to standard membrane manufacturer warranty to comply with the specified requirements. Minimum manufacturer warranty shall have no dollar limit, cover full system water-tightness, and shall have a minimum duration of 20 years.

### 1.6.1 Continuance of Warranty

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

## PART 2 PRODUCTS

### 2.1 FLUID-APPLIED MEMBRANE

ASTM C836/C836M.

### 2.2 MEMBRANE PRIMER

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

### 2.3 SEALANT

As specified in Section 07 92 00 JOINT SEALANTS.

### 2.4 SEALANT PRIMER

As specified in Section 07 92 00 JOINT SEALANTS.

### 2.5 BACKING MATERIAL

Premolded, closed-cell, polyethylene, or polyurethane foam rod having a diameter 25 percent larger than joint width before being compressed into joint. Provide bond breaker of polyethylene film or other suitable material between backing material and sealant.

### 2.6 JOINT FILLER

As specified in Section 03 30 00 CAST-IN-PLACE CONCRETE, ASTM D1751 or ASTM D1752.

### 2.7 BOND BREAKER

As recommended by the fluid-applied membrane manufacturer. Bond breaker shall not interfere with the curing process or other performance properties of the fluid-applied membrane.

## 2.8 ELASTOMERIC SHEET

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

## 2.9 ELASTOMERIC SHEET ADHESIVE

As recommended by the elastomeric sheet manufacturer.

## 2.10 FLEXIBLE FOAM-BACKED ELASTOMERIC SHEET

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

## 2.11 PROTECTION BOARD

Premolded bitumen composition board, 1/8 inch minimum thickness or other composition board compatible with the fluid-applied membrane.

## 2.12 DRAINAGE COURSE AGGREGATE

ASTM C33/C33M, size No. 8.

## 2.13 INSULATION

Polystyrene foam conforming to ASTM C578, Class IV, thickness as required by indicated R-value.

# PART 3 EXECUTION

## 3.1 PREPARATION

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

### 3.1.1 Flashings

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

#### 3.1.1.1 Drains

Make drain flanges flush with surface of structural slab. Apply a full elastomeric sheet around the drain, with edges fully adhered to drain flange and to structural slab. Do not adhere elastomeric sheet over joint between drain and concrete slab. Do not plug drainage or weep holes. Cover elastomeric sheet with fluid-applied waterproofing during waterproofing application. Lap elastomeric sheet a minimum of 4 inches



onto concrete slab.

#### 3.1.1.2 Penetrations and Projections

Flash penetrations and projections through structural slab with an elastomeric sheet adhered to the concrete slab and the penetration. Leave elastomeric sheet unadhered for one inch over joint between penetration and concrete slab. Adhere elastomeric sheet a minimum of 4 inches onto horizontal deck.

#### 3.1.1.3 Walls and Vertical Surfaces

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

#### 3.1.2 Cracks and Joints

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

#### 3.1.3 Priming

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

### 3.2 SPECIAL PRECAUTIONS

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

### 3.3 APPLICATION

Over primed surfaces, provide a uniform, wet, monolithic coating of fluid-applied membrane, 60 mils thick, plus or minus 5 mils by following manufacturer's printed instructions. Apply material by trowel, squeegee, roller, brush, spray apparatus, or other method recommended by membrane manufacturer. Check wet film thickness as specified in paragraph entitled "Film Thickness" and adjust application rate as necessary to provide a uniform coating of the thickness specified. Where possible, mark off surface to be coated in equal units to facilitate proper coverage. At expansion joints, control joints, prepared cracks, flashing, and

terminations, carry membrane over preformed elastomeric sheet in a uniform 60 mil thick, plus or minus 5 mils, wet thickness to provide a monolithic coating. If membrane cures before next application, wipe previously applied membrane with a solvent to remove dirt and dust that could inhibit adhesion of overlapping membrane coat. Use solvent recommended by the membrane manufacturer, as approved.

### 3.3.1 Work Sequence

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

### 3.3.2 Protection Board

Protect fluid-applied membrane by placing protection board over membrane at a time recommended by the membrane manufacturer. Protect membrane application when protection board is not placed immediately. Butt protection boards together and do not overlap.

### 3.3.3 Drainage Course

Place drainage course where shown after flood tests are completed and concrete protection slab or wearing course is ready to be installed.

### 3.3.4 Insulation

Place insulation of thickness indicated, on top of drainage course just prior to placement of concrete protection slab.

## 3.4 FIELD QUALITY CONTROL

### 3.4.1 Moisture Test

Prior to application of fluid-applied waterproofing, measure moisture content of substrate with a moisture meter in the presence of the Contracting Officer. An acceptable device is the Delmhorst Moisture Meter, Model BD7/2E/CS, Type 21 E. Similar meters by other manufacturers, which are suitable for the purpose, may be used as approved by the Contracting Officer. Do not begin application until meter reading indicates "dry" range.

### 3.4.2 Film Thickness

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

### 3.4.3 Flood Test

After application and curing is complete, plug drains and fill waterproofed area with water to a depth of 2 inches. A minimum 48 hour cure time, or longer cure time if recommended by the membrane manufacturer, shall be required prior to flood testing. Allow water to stand 24 hours. Test watertightness by measuring water level at beginning and end of the 24 hour period. If water level falls, drain water, allow installation to dry, and inspect. Make repairs or replace as required and

repeat the test. Work shall not proceed before approval of repairs or replacement.

### 3.5 INSTRUCTIONS TO GOVERNMENT PERSONNEL

Furnish written and verbal instructions on proper maintenance procedures to designated Government personnel. Furnish instructions by a competent representative of the roof membrane manufacturer and include a minimum of 4 hours on maintenance and emergency repair of the membrane. Include a demonstration of membrane repair, and give sources of required special tools. Furnish information on safety requirements during maintenance and emergency repair operations.

### 3.6 INFORMATION CARD

For each roof application, furnish a minimum 8-1/2 inch by 11 inch information card for facility records and a card laminated in plastic and framed for interior display at roof access point, or a photoengraved 0.032 inch thick aluminum card for exterior display. Identify facility name and number; location; contract number; approximate roof area; detailed roof system description, including deck type, membrane, number of plies, method of application, manufacturer, insulation and cover board system and thickness; presence of tapered insulation for primary drainage, presence of vapor retarder; date of completion; installing contractor identification and contract information; membrane manufacturer warranty expiration, warranty reference number, and contact information. Install card at roof top or access location as directed by the Contracting Officer and provide a paper copy to the Contracting Officer.

FORM 1
FLUID-APPLIED WATERPROOFING SYSTEM COMPONENTS
1. Contract Number
2. Date Work Completed
3. Project Specification Designation
4. Substrate Material
5. Slope of Substrate
6. Drains Type/Manufacturer
7. Waterproofing
a. Membrane
b. Sealant
c. Elastomeric Sheet
d. Materials Manufacturer(s)
8. Protection Board
a. Type
b. Thickness
c. Manufacturer's Name
9. Drainage Course Material Graduation
10. Insulation
a. Type
b. Thickness
c. Manufacturer's Name
11. Protection Slab
a. Material
b. Thickness
c. Support

FORM 1	
FLUID-APPLIED WATERPROOFING SYSTEM COMPONENTS	
d. Joint System	
12. Wearing Course	
a. Type	
b. Slope	
c. Joint System	
d. Sealant/Gasket Type	
13. Wearing Surface Type	
Manufacturer's Name	
14. Warranty	
a. Manufacturer warranty expiration	
b. Warranty reference number	
15. Statement of Compliance or Exception	
Contractor's Signature	Date Signed
Inspector's Signature	Date Signed

-- End of Section --



SECTION 07 21 13

BOARD AND BLOCK INSULATION

02/16

PART 1 GENERAL

1.1 REFERENCES

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

ASTM INTERNATIONAL (ASTM)

ASTM C1289	(2017) Standard Specification for Faced Rigid Cellular Polyisocyanurate Thermal Insulation Board
ASTM C272/C272M	(2016) Standard Test Method for Water Absorption of Core Materials for Sandwich Constructions
ASTM C930	(2012) Potential Health and Safety Concerns Associated with Thermal Insulation Materials and Accessories
ASTM D1621	(2016) Standard Test Method for Compressive Properties of Rigid Cellular Plastics
ASTM D3833/D3833M	(1996; R 2011) Water Vapor Transmission of Pressure-Sensitive Tapes
ASTM E84	(2018) Standard Test Method for Surface Burning Characteristics of Building Materials
ASTM E96/E96M	(2016) Standard Test Methods for Water Vapor Transmission of Materials

INTERNATIONAL CODE COUNCIL (ICC)

ICC IBC	(2017) International Building Code
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U.S. NATIONAL ARCHIVES AND RECORDS ADMINISTRATION (NARA)

29 CFR 1910.134	Respiratory Protection
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1.2 SUBMITTALS

Government approval is required for submittals with a "G" designation; submittals not having a "G" designation are for information only. When used, a designation following the "G" designation identifies the office that will review the submittal for the Government. Submittals with an "S" are for inclusion in the Sustainability eNotebook, in conformance with Section 01 33 29 SUSTAINABILITY REPORTING. Submit the following in accordance with Section 01 33 00 SUBMITTAL PROCEDURES:

SD-03 Product Data

Manufacturer's Standard Details; G

Board Insulation

Pressure Sensitive Tape

Protection Board or Coatings

Accessories including sealants

SD-07 Certificates

Board Insulation; G

Protection Board or Coating; G

Draft Special Warranties; G

Final Special Warranties; G

SD-08 Manufacturer's Instructions

Board Insulation

Adhesive

1.3 MANUFACTURER'S DETAILS

Submit manufacturer's standard details indicating methods of attachment and spacing, transition and termination details, and installation details. Include verification of existing conditions.

1.4 PRODUCT DATA

Include data for material descriptions, recommendations for product shelf life, requirements for protection board or coatings, and precautions for flammability and toxicity. Include data to verify compatibility of sealants with insulation.

1.5 DELIVERY, STORAGE, AND HANDLING

1.5.1 Delivery

Deliver materials to the site in original sealed wrapping bearing manufacturer's name and brand designation, specification number, type, grade, R-value, and class. Store and handle to protect from damage. Do not allow insulation materials to become wet, soiled, crushed, or covered with ice or snow. Comply with manufacturer's recommendations for handling, storing, and protecting of materials before and during installation.

1.5.2 Storage

Inspect materials delivered to the site for damage and store out of weather in manufacturer's original packaging. Store only in dry locations, not subject to open flames or sparks, and easily accessible for



inspection and handling. Keep materials wrapped and separated from off-gassing materials (such as drying paints and adhesives). Do not use materials that have visible moisture or biological growth. Comply with manufacturer's recommendations for handling, storage, and protection of materials before and during installation.

## 1.6 SAFETY PRECAUTIONS

### 1.6.1 Respirators

Provide installers with dust/mist respirators, training in their use, and protective clothing, all approved by the National Institute for Occupational Safety and Health (NIOSH)/Mine Safety and Health Administration (MSHA) and in accordance with 29 CFR 1910.134.

### 1.6.2 Other Safety Considerations

Comply with the safety requirements of ASTM C930.

## 1.7 SPECIAL WARRANTIES

### 1.7.1 Guarantee

Guarantee insulation installation against failure due to ultraviolet light exposure for a period of three years from the date of Beneficial Occupancy. Submit draft and final guarantees in accordance with Sections 01 78 00 CLOSEOUT SUBMITTALS.

### 1.7.2 Warranty

Provide manufacturer's material warranty for all system components for a period of three years from the date of Beneficial Occupancy. Submit draft and final warranties in accordance with Sections 01 78 00 CLOSEOUT SUBMITTALS.

## PART 2 PRODUCTS

### 2.1 BOARD INSULATION

Provide thermal insulating materials as recommended by manufacturer for each type of application indicated. Provide insulation with the following physical properties and in accordance with the following standards:

- a. Faced Rigid Cellular Polyisocyanurate and Polyurethane Insulation:  
ASTM C1289 REV A

- (1) Type II Fibrous felt or glass fiber mat membrane on both major surfaces of the core foam.

#### 2.1.1 Thermal Resistance

Unless otherwise indicated, Roof R-20 Wall R-13 Floor R-20.

#### 2.1.2 Fire Protection Requirements

- a. Flame spread index of 75 or less when tested in accordance with ASTM E84.
- b. Smoke developed index of 150 or less when tested in accordance with

ASTM E84.

- c. Provide insulated assemblies in accordance ICC IBC Chapter Fire and Smoke Protection Features.

#### 2.1.3 Other Material Properties

Provide thermal insulating materials with the following properties:

- a. Compressive Resistance at Yield: Not less than 20 pounds per square inch (psi) when measured according to ASTM D1621.
- b. Water Vapor Permeance: Not more than 1.1 Perms or less when measured according to ASTM E96/E96M, desiccant method, in the thickness required to provide the specified thermal resistance, including facings, if any.
- c. Water Absorption: Not more than 1 percent by total immersion, by volume, when measured according to ASTM C272/C272M.

#### 2.1.4 Recycled Materials

Provide thermal insulation containing recycled materials to the extent practicable, provided that the material meets all other requirements of this section. The minimum required recycled material contents (by weight, not volume) are:

Phenolic Rigid Foam:	5 percent
Perlite Board:	75 percent post consumer paper

#### 2.1.5 Prohibited Materials

Do not provide materials containing asbestos.

#### 2.2 PRESSURE SENSITIVE TAPE

As recommended by manufacturer of vapor retarder(s). Match water vapor permeance rating for each vapor retarder specified. Provide tape in accordance with ASTM D3833/D3833M.

#### 2.3 PROTECTION BOARD OR COATING

As recommended by insulation manufacturer.

#### 2.4 ACCESSORIES

##### 2.4.1 Adhesive

As recommended by insulation manufacturer.

##### 2.4.2 Mechanical Fasteners

Corrosion resistant fasteners as recommended by the insulation manufacturer.

## PART 3 EXECUTION

### 3.1 EXISTING CONDITIONS

Prior to installation, ensure all areas that are in contact with the insulation are dry and free of projections that could cause voids, compressed insulation, or punctured vapor retarders. For foundation perimeter or under slab applications, check that subsurface fill is flat, smooth, dry, and well tamped. Do not proceed with installation if moisture or other conditions are present, and notify the Contracting Officer of such conditions. Do not proceed with the work until conditions have been corrected and verified to be dry.

### 3.2 PREPARATION

### 3.3 INSTALLATION

#### 3.3.1 Installation and Handling

Provide insulation in accordance with the manufacturer's printed installation instructions. Keep material dry and free of extraneous materials.

#### 3.3.2 Electrical Wiring

Do not install insulation in a manner that would enclose electrical wiring between two layers of insulation.

#### 3.3.3 Cold Climate Requirement

Place insulation on the outside of pipes.

#### 3.3.4 Continuity of Insulation

Butt tightly against adjoining boards, studs, rafters, joists, sill plates, headers and obstructions. Provide continuity and integrity of insulation at corners, wall to ceiling joint, roof, and floor. Avoid creating thermal bridges and voids. Provide and verify continuity of insulative barrier throughout the building enclosure.

#### 3.3.5 Coordination

Verify final installed insulation thicknesses comply with thicknesses indicated, R-values specified herein, and with the approved insulation submittal(s).

### 3.4 INSTALLATION ON WALLS

#### 3.4.1 Installation using Furring Strips

Install insulation, as recommended by insulation manufacturer.

#### 3.4.2 Installation on Masonry Walls

Apply board directly to masonry with adhesive or fasteners as recommended by the insulation manufacturer. Fit between obstructions without impaling board on ties or anchors. Apply in parallel courses with joints breaking midway over course below. Place boards in moderate contact with adjoining

insulation without forcing and without gaps. Cut and shape as required to fit around wall penetrations, projections or openings to accommodate conduit or other utilities. Seal around cutouts with sealant. Install insulation in wall cavities so that it leaves at least a nominal 1 inch air space outside of the insulation to allow for cavity drainage.

#### 3.4.3 Adhesive Attachment to Concrete and Masonry Walls

Apply adhesive to wall and completely cover wall with insulation.

- a. Use only full back method for pieces of 1 square foot or less.
- b. Butt all edges of insulation and seal edges with tape.

#### 3.4.4 Mechanical Attachment on Concrete and Masonry Walls

Cut insulation to cover walls. Apply adhesive to wall and set clip or other mechanical fastener in adhesive as recommended by manufacturer. After curing of adhesive, install insulation over fasteners and bend split prongs to provide a flush condition with the insulation. Butt all edges of insulation and seal with tape.

#### 3.4.5 Protection Board or Coating

Install protection board or coating in accordance with manufacturer's printed instructions. Install protection over all exterior exposed insulation and to 1 foot below grade.

### 3.5 INSTALLATION ON UNDERSIDE OF CONCRETE FLOOR SLAB

#### 3.5.1 Adhesively Bonded Systems

Apply adhesive to underside of slab and completely cover wall with insulation.

- a. As recommended by insulation manufacturer.
- b. Butt all edges of insulation and seal with tape.

### 3.6 PERIMETER AND UNDER SLAB INSULATION

Install perimeter thermal insulation where heated spaces are adjacent to exterior walls, slab edges in slab-on-grade, or floating slab construction.

#### 3.6.1 Manufacturer's Instructions

Layout insulation, tape edges, provide vapor retarder and other required accessories to protection against vermin, insects, and damage in accordance with manufacturer's printed instructions.

#### 3.6.2 Insulation on Vertical Surfaces

Provide thermal insulation on exterior of foundation walls and on edges of slabs-on-grade. Fasten insulation with mechanical fasteners.

#### 3.6.3 Insulation Under Slab

Provide insulation horizontally under slab on grade for a distance of 4 feet from the edge of slab. Turn insulation up at slab edge, and extend

full height of slab. Install insulation on top of vapor retarder and turn retarder up over the outside edge of insulation to top of slab.

#### 3.6.4 Protection of Insulation

Protect insulation from damage during construction and back filling by application of protection board or a coating. Do not leave installed vertical insulation unprotected overnight. Protect installed insulation from weather, including rain and ultraviolet light, from mechanical abuse, compression, and dislocation. Install protection over entire exposed exterior insulation board. Extend protection at least 1 foot below grade.

-- End of Section --



SECTION 07 21 16

MINERAL FIBER BLANKET INSULATION

11/11

PART 1 GENERAL

1.1 REFERENCES

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

ASTM INTERNATIONAL (ASTM)

ASTM C665	(2017) Standard Specification for Mineral-Fiber Blanket Thermal Insulation for Light Frame Construction and Manufactured Housing
ASTM C930	(2012) Potential Health and Safety Concerns Associated with Thermal Insulation Materials and Accessories
ASTM D3575	(2014) Flexible Cellular Materials Made From Olefin Polymers
ASTM D3833/D3833M	(1996; R 2011) Water Vapor Transmission of Pressure-Sensitive Tapes
ASTM D4397	(2016) Standard Specification for Polyethylene Sheeting for Construction, Industrial, and Agricultural Applications
ASTM E136	(2016) Behavior of Materials in a Vertical Tube Furnace at 750 Degrees C
ASTM E84	(2018) Standard Test Method for Surface Burning Characteristics of Building Materials
ASTM E96/E96M	(2016) Standard Test Methods for Water Vapor Transmission of Materials

NATIONAL FIRE PROTECTION ASSOCIATION (NFPA)

NFPA 31	(2016) Standard for the Installation of Oil-Burning Equipment
NFPA 54	(2015) National Fuel Gas Code
NFPA 70	(2017; ERTA 1-2 2017; TIA 17-1; TIA 17-2; TIA 17-3; TIA 17-4; TIA 17-5; TIA 17-6; TIA 17-7; TIA 17-8; TIA 17-9; TIA 17-10; TIA 17-11; TIA 17-12; TIA 17-13; TIA 17-14) National Electrical Code

TECHNICAL ASSOCIATION OF THE PULP AND PAPER INDUSTRY (TAPPI)

TAPPI T803 OM (2010) Puncture Test of Container Board

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

29 CFR 1910.134 Respiratory Protection

UL ENVIRONMENT (ULE)

ULE Greenguard UL Greenguard Certification Program

## 1.2 SUBMITTALS

Government approval is required for submittals with a "G" designation; submittals not having a "G" designation are for information only. When used, a designation following the "G" designation identifies the office that will review the submittal for the Government. Submittals with an "S" are for inclusion in the Sustainability eNotebook, in conformance to Section 01 33 29 SUSTAINABILITY REPORTING. Submit the following in accordance with Section 01 33 00 SUBMITTAL PROCEDURES:

### SD-03 Product Data

Blanket Insulation

Sill Sealer Insulation

Vapor Retarder

Pressure Sensitive Tape

Accessories

### SD-08 Manufacturer's Instructions

Insulation

### SD-11 Closeout Submittals

Recycled Content for Insulation Materials; S

Reduce Volatile Organic Compounds (VOC) for Insulation Materials; S

## 1.3 DELIVERY, STORAGE, AND HANDLING

### 1.3.1 Delivery

Deliver materials to site in original sealed wrapping bearing manufacturer's name and brand designation, specification number, type, grade, R-value, and class. Store and handle to protect from damage. Do not allow insulation materials to become wet, soiled, crushed, or covered with ice or snow. Comply with manufacturer's recommendations for handling, storing, and protecting of materials before and during installation.



### 1.3.2 Storage

Inspect materials delivered to the site for damage; unload and store out of weather in manufacturer's original packaging. Store only in dry locations, not subject to open flames or sparks, and easily accessible for inspection and handling.

## 1.4 SAFETY PRECAUTIONS

### 1.4.1 Respirators

Provide installers with dust/mist respirators, training in their use, and protective clothing, all approved by National Institute for Occupational Safety and Health (NIOSH)/Mine Safety and Health Administration (MSHA) in accordance with 29 CFR 1910.134.

### 1.4.2 Other Safety Concerns

Consider other safety concerns and measures as outlined in ASTM C930.

## PART 2 PRODUCTS

### 2.1 PRODUCT SUSTAINABILITY CRITERIA

For products in this section, where applicable and to extent allowed by performance criteria, provide and document the following:

#### 2.1.1 Recycled Content for Insulation Materials

Provide insulation materials meeting the recycled content requirements as stated within this section and provide documentation in accordance with Section 01 33 29 SUSTAINABILITY REPORTING paragraph RECYCLED CONTENT.

#### 2.1.2 Reduce Volatile Organic Compounds (VOC) for Insulation Materials

Provide insulation materials meeting the reduced VOC requirements as stated within this section and provide documentation in accordance with Section 01 33 29 SUSTAINABILITY REPORTING paragraph REDUCE VOLATILE ORGANIC COMPOUNDS.

### 2.2 BLANKET INSULATION

ASTM C665, Type I, blankets without membrane coverings and II, blankets with non-reflecting coverings and III, blankets with reflective coverings; Class A, membrane-faced surface with a flame spread of 25 or less.

#### 2.2.1 Thermal Resistance Value (R-VALUE)

The R-Value must be as indicated on drawings.

#### 2.2.2 Recycled Materials

Provide Thermal Insulation containing recycled materials to the extent practicable, provided the material meets all other requirements of this section. The minimum required recycled materials content by weight are:

Fiberglass: 20 to 25 percent glass cullet

### 2.2.3 Prohibited Materials

Do not provide asbestos-containing materials.

### 2.2.4 Reduced Volatile Organic Compounds (VOC) for Insulation Materials

ULE Greenguard Gold

### 2.3 SILL SEALER INSULATION

Provide polyethylene foam sill sealer 3.5 inches in width with the following characteristics:.

<u>Physical Properties</u>	<u>Test Method</u>	<u>Measurement</u>
Nominal Thickness	ASTM D3575	3/16 inch
Compressive Strength	ASTM D3575	1.2 psi
- Vertical Direction	Suffix D	
Tensile Strength	ASTM D3575	32 psi
	Suffix T	

### 2.4 BLOCKING

Wood, metal, unfaced mineral fiber blankets in accordance with ASTM C665, Type I, or other approved materials. Use only non-combustible materials meeting the requirements of ASTM E136 for blocking around chimneys and heat producing devices.

### 2.5 VAPOR RETARDER

- a. 6 mil thick polyethylene sheeting conforming to ASTM D4397 and having a water vapor permeance of 1 perm or less when tested in accordance with ASTM E96/E96M.

- b. Membrane with the following properties:

Water Vapor Permeance: ASTM E96/E96M: 1 perm  
Maximum Flame Spread: ASTM E84: 25  
Combustion Characteristics: Passing ASTM E136  
Puncture Resistance: TAPPI T803 OM: 15

### 2.6 PRESSURE SENSITIVE TAPE

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

### 2.7 ACCESSORIES

#### 2.7.1 Adhesive

As recommended by the insulation manufacturer.

Adhesives must follow the manufacturer's requirements for low pollutant emitting materials in achieving ULE Greenguard certification for their insulation products.

#### 2.7.2 Mechanical Fasteners

Corrosion resistant fasteners as recommended by the insulation manufacturer.

### PART 3 EXECUTION

#### 3.1 EXISTING CONDITIONS

Before installing insulation, ensure that areas that will be in contact with the insulation are dry and free of projections which could cause voids, compressed insulation, or punctured vapor retarders. If moisture or other conditions are found that do not allow the workmanlike installation of the insulation, do not proceed but notify Contracting Officer of such conditions.

#### 3.2 PREPARATION

##### 3.2.1 Blocking Around Heat Producing Devices

Install non-combustible blocking around heat producing devices to provide the following clearances:

- a. Recessed lighting fixtures, including wiring compartments, ballasts, and other heat producing devices, unless these are certified by the manufacturer for installation surrounded by insulation: 3 inches from outside face of fixtures and devices or as required by NFPA 70 and, if insulation is to be placed above fixture or device, 24 inches above fixture.
- b. Gas Fired Appliances: Clearances as required in NFPA 54.
- c. Oil Fired Appliances: Clearances as required in NFPA 31.

#### 3.3 INSTALLATION

##### 3.3.1 Insulation

Install and handle insulation in accordance with manufacturer's instructions. Keep material dry and free of extraneous materials. Any materials that show visual evidence of biological growth due to presence of moisture must not be installed on the building project. Ensure personal protective clothing and respiratory equipment is used as required. Observe safe work practices.

##### 3.3.1.1 Electrical wiring

Do not install insulation in a manner that would sandwich electrical wiring between two layers of insulation.

##### 3.3.1.2 Continuity of Insulation

Install blanket insulation to butt tightly against adjoining blankets and to studs, rafters, joists, sill plates, headers and any obstructions. Provide continuity and integrity of insulation at corners, wall to ceiling

joints, roof, and floor. Avoid creating thermal bridges.

#### 3.3.1.3 Installation at Bridging and Cross Bracing

Insulate at bridging and cross bracing by splitting blanket vertically at center and packing one half into each opening. Butt insulation at bridging and cross bracing; fill in bridged area with loose or scrap insulation.

#### 3.3.1.4 Insulation Blanket with Affixed Vapor Retarder

Locate vapor retarder as indicated. Do not install blankets with affixed vapor retarders unless so specified. Unless the insulation manufacturer's instructions specifically recommend not to staple the flanges of the vapor retarder facing, staple flanges of vapor retarder at 6 inch intervals flush with face or set in the side of truss, joist, or stud. Avoid gaps and bulges in insulation and "fishmouth" in vapor retarders. Overlap both flanges when using face method. Seal joints and edges of vapor retarder with pressure sensitive tape. Stuff pieces of insulation into small cracks between trusses, joists, studs and other framing, such as at attic access doors, door and window heads, jambs, and sills, band joists, and headers. Cover these insulated cracks with vapor retarder material and tape all joints with pressure sensitive tape to provide air and vapor tightness.

#### 3.3.1.5 Insulation without Affixed Vapor Retarder

Provide snug friction fit to hold insulation in place. Stuff pieces of insulation into cracks between trusses, joists, studs and other framing, such as at attic access doors, door and window heads, jambs, and sills, and headers.

#### 3.3.1.6 Sizing of Blankets

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

#### 3.3.1.7 Special Requirements for Ceilings

Place insulation under electrical wiring occurring across joists. Pack insulation into narrowly spaced framing.

#### 3.3.1.8 Installation of Sill Sealer

Size sill sealer insulation and place insulation over top of masonry or concrete perimeter walls or concrete perimeter floor slab on grade. Fasten sill plate over insulation.

#### 3.3.1.9 Access Panels and Doors

Affix blanket insulation to access panels greater than one square foot and access doors in insulated floors and ceilings. Use insulation with same R-Value as that for floor or ceiling.

-- End of Section --

SECTION 07 22 00

ROOF AND DECK INSULATION

02/16

PART 1 GENERAL

1.1 REFERENCES

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

ASTM INTERNATIONAL (ASTM)

ASTM C1177/C1177M	(2013) Standard Specification for Glass Mat Gypsum Substrate for Use as Sheathing
ASTM C1289	(2017) Standard Specification for Faced Rigid Cellular Polyisocyanurate Thermal Insulation Board
ASTM C208	(2012) Cellulosic Fiber Insulating Board
ASTM E84	(2018) Standard Test Method for Surface Burning Characteristics of Building Materials

FM GLOBAL (FM)

FM 4450	(1989) Approval Standard for Class 1 Insulated Steel Deck Roofs
FM APP GUIDE	(updated on-line) Approval Guide <a href="http://www.approvalguide.com/">http://www.approvalguide.com/</a>

INTERNATIONAL CODE COUNCIL (ICC)

ICC IBC	(2017) International Building Code
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SCIENTIFIC CERTIFICATION SYSTEMS (SCS)

SCS	SCS Global Services (SCS) Indoor Advantage
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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 SUBMITTALS

Government approval is required for submittals with a "G" designation; submittals not having a "G" designation are for information only. When used, a designation following the "G" designation identifies the office that will review the submittal for the Government. Submittals with an "S" are for inclusion in the Sustainability eNotebook, in conformance with Section 01 33 29 SUSTAINABILITY REPORTING. Submit the following in

accordance with Section 01 33 00 SUBMITTAL PROCEDURES:

SD-02 Shop Drawings

Insulation Board Layout and Attachment; G

Verification of Existing Conditions; G

SD-03 Product Data

Insulation; G

Cover Board; G

Fasteners; G

Sheathing Paper; G

SD-06 Test Reports

Flame Spread Rating; G

SD-07 Certificates

Volatile Organic Compounds (VOC) Content; G

Installer Qualifications; G

SD-08 Manufacturer's Instructions

Nails and Fasteners; G

Roof Insulation; G

SD-11 Closeout Submittals

Volatile Organic Compounds (VOC) Content; S

1.3 SHOP DRAWINGS

Submit insulation board layout and attachment indicating methods of attachment and spacing, transitions, tapered components, thicknesses of materials, and closure and termination conditions. Show locations of ridges, valleys, crickets, interface with, and slope to, roof drains. Base shop drawings on verified field measurements and include verification of existing conditions.

1.4 PRODUCT DATA

Include data for material descriptions, recommendations for product shelf life, requirements for cover board or coatings, and precautions for flammability and toxicity. Include data to verify compatibility of sealants with insulation.

1.5 MANUFACTURER'S INSTRUCTIONS

Include field of roof and perimeter attachment requirements.

Provide a complete description of installation sequencing for each phase

of the roofing system. Include weatherproofing procedures.

#### 1.6 QUALITY CONTROL

Provide certification of installer qualifications from the insulation manufacturer confirming the specific installer has the required qualifications for installing the specific roof insulation system(s) indicated.

#### 1.7 FM APPROVAL REQUIREMENTS

Provide fastening patterns in accordance with FM 1-90 for insulation on steel decks.

#### 1.8 FIRE PERFORMANCE REQUIREMENTS

##### 1.8.1 Insulation in Roof Systems

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

##### 1.8.2 Fire Resistance Ratings for Roofs

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

#### 1.9 CERTIFICATIONS

Provide products that are third party certified for low Volatile Organic Compounds (VOC) Content in accordance with UL 2818 Greenguard Gold, SCS Scientific Certification Systems Indoor Advantage Gold or approved equal. (<http://www.scsglobalservices.com/indoor-air-quality-certification>)

#### 1.10 DELIVERY, STORAGE, AND HANDLING

##### 1.10.1 Delivery

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

- a. Name of manufacturer
- b. Brand designation
- c. Specification number, type, and class, as applicable, where materials are covered by a referenced specification

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

##### 1.10.2 Storage and Handling

Store and handle materials in accordance with manufacturer's printed instructions. Protect from damage, exposure to open flame or other ignition sources, wetting, condensation, and moisture absorption. Keep materials wrapped and separated from off-gassing materials (such as drying

paints and adhesives). Do not use materials that have visible moisture or biological growth. Store in an enclosed building or trailer that provides a dry, adequately ventilated environment. Replace damaged material with new material.

#### 1.11 ENVIRONMENTAL CONDITIONS

Do not install roof insulation during inclement weather or when air temperature is below 40 degrees F and interior humidity is 45 percent or greater, or when there is visible ice, frost, or moisture on the roof deck.

### PART 2 PRODUCTS

#### 2.1 PRODUCT SUSTAINABILITY CRITERIA

Where allowed by performance criteria:

##### 2.1.1 Reduce Volatile Organic Compounds (VOC) Contents

Provide products with reduced VOC content and provide documentation in accordance with Section 01 33 29 SUSTAINABILITY REPORTING paragraph REDUCE VOLATILE ORGANIC COMPOUNDS.

##### 2.1.2 Recycled Content

Provide products with recycled content and provide documentation in accordance with Section 01 33 29 SUSTAINABILITY REPORTING paragraph RECYCLED CONTENT.

#### 2.2 INSULATION

##### 2.2.1 Insulation Types

Provide one of the following roof insulation materials. Provide roof insulation that is compatible with attachment methods for the specified insulation and roof membrane.

- a. Polyisocyanurate Board: Provide in accordance with ASTM C1289 REV A Type II, Class 1 fibrous glass reinforced face both sides, except minimum compressive strength of 20 pounds per square inch (psi).

ASTM C208 Type II, Grade 1 or 2, roof insulating board, treated with sizing, wax or bituminous impregnation. Limit bituminous impregnation to 4 percent by weight when used over steel decks. Maximum board size: 4 feet by 4 feet.

##### 2.2.2 Recycled Materials

Provide thermal insulation materials containing recycled content in accordance with paragraph PRODUCT SUSTAINABILITY CRITERIA. Unless specified otherwise, the minimum required recycled content for listed materials are:

Polyisocyanurate/polyurethane:	9 percent recovered material
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##### 2.2.3 Insulation Thickness

As necessary to provide the thermal resistance (R-value) indicated . Base



calculation on the R-value for aged insulation. For insulation over steel decks, satisfy both specified R-value and minimum thickness for width of rib opening recommended in insulation manufacturer's published literature.

#### 2.2.4 Tapered Roof Insulation

One layer of the tapered roof insulation assembly must be factory tapered to a slope of not less than one in 1/4 inch per foot. Factory fabricate mitered joints from two diagonally cut boards or one board shaped to provide required slopes.

#### 2.2.5 Cants and Tapered Edge Strips

Provide preformed cants and tapered edge strips of the same material as the roof insulation. Face of cant strips to incline at 45 degrees with a minimum vertical height of 4 inches.

### 2.3 COVER BOARD

For use as a overlayment, or cover board or adhesive-applied roofing membrane over roof insulation.

#### 2.3.1 Glass Mat Gypsum Roof Board

ASTM C1177/C1177M, 0 Flame Spread and 0 Smoke Developed when tested in accordance with ASTM E84, 1000 psi, Class A, non-combustible, 1/2 inch thick, 4 by 8 feet board size.

### 2.4 SHEATHING PAPER FOR WOOD DECKS

Rosin-sized building paper or unsaturated felt weighing not less than 5 pounds per 100 square feet.

### 2.5 FASTENERS

Provide flush-driven fasteners through flat round or hexagonal steel or plastic plates. Provide zinc-coated steel plates, flat round not less than 3 inch diameter, hexagonal not less than 28 gage. Provide high-density plastic plates, molded thermoplastic with smooth top surface, reinforcing ribs and not less than 3 inches in diameter. Fully recess fastener head into plastic plate after it is driven. Form plates to prevent dishing. Do not use bell or cup shaped plates. Provide fasteners in accordance with insulation manufacturer's recommendations for holding power when driven, or a minimum of 40 pounds each in steel deck, whichever is the higher minimum. Provide fasteners for steel or concrete decks in accordance with FM APP GUIDE (<http://www.approvalguide.com/>) for Class I roof deck construction, and spaced to withstand uplift pressure of 60 pounds per square foot.

#### 2.5.1 Fasteners for Steel Decks

Approved hardened penetrating fasteners or screws in accordance with FM 4450 and listed in FM APP GUIDE for Class I roof deck construction. Quantity and placement to withstand a minimum uplift pressure of 60 psf in accordance with FM APP GUIDE.

### 2.6 WOOD NAILERS

Pressure-preservative treated as specified in Section 06 10 00 ROUGH

CARPENTRY.

PART 3 EXECUTION

3.1 EXAMINATION AND PREPARATION

3.1.1 Surface Inspection

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

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

3.1.2 Surface Preparation

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

- a. Provide wood nailers of the same thickness as the insulation at eaves, edges, curbs, walls, and roof openings for securing of cant strips, gravel stops, gutters, and flashing flanges.
- b. Cover steel decks with a layer of insulation board of sufficient width to span the width of a deck rib opening, and in accordance with fire safety requirements. Secure with piercing or self-drilling, self-tapping fasteners of quantity and placement in accordance with FM APP GUIDE. Locate insulation joints parallel to ribs of deck on solid bearing surfaces only, not over open ribs.

3.2 INSULATION INSTALLATION

3.2.1 Special Precautions for Installation of Foam Insulation

3.2.1.1 Polyisocyanurate Insulation

Where polyisocyanurate foam board insulation is provided, install 1/2 inch thick wood fiberboard, glass mat gypsum roof board, or 3/4 inch thick expanded perlite board insulation over top surface of foam board insulation. Stagger joints of insulation with respect to foam board insulation below.

3.3 PROTECTION

3.3.1 Protection of Applied Insulation

Completely cover each day's installation of insulation with finished roofing on same day. Phased construction is not permitted. Protect open spaces between insulation and parapets or other walls and spaces at curbs, scuttles, and expansion joints, until permanent roofing and flashing are applied. Storing, walking, wheeling, or trucking directly on insulation or on roofed surfaces is not permitted. Provide smooth, clean board or plank walkways, runways, and platforms near supports, as necessary, to distribute weight in accordance with indicated live load limits of roof construction. Protect exposed edges of insulation with cutoffs at the end of each work day or whenever precipitation is imminent. Cutoffs must be

two layers of bituminous-saturated felt set in plastic bituminous cement or single ply set in roof cement. Fill all profile voids in cutoffs to prevent trapping moisture below the membrane. Remove cutoffs when work resumes.

### 3.3.2 Damaged Work and Materials

Restore work and materials that become damaged during construction to original condition or replace with new materials.

### 3.4 INSPECTION

Establish and maintain inspection procedures to assure compliance of the installed roof insulation with contract requirements. Remove, replace, correct in an approved manner, any work found not in compliance. Quality control must include, but is not limited to, the following:

- a. Observation of environmental conditions; number and skill level of insulation workers; start and end time of work.
- b. Verification of certification, listing or label compliance with FM Data Sheets. (  
<https://www.fmglobal.com/fmglobalregistration/Downloads.aspx>)
- c. Verification of proper storage and handling of insulation and vapor retarder materials before, during, and after installation.
- d. Inspection of vapor retarder application, including edge envelopes and mechanical fastening.
- e. Inspection of mechanical fasteners; type, number, length, and spacing.
- f. Coordination with other materials, cants, sleepers, and nailing strips.
- g. Inspection of insulation joint orientation and laps between layers, joint width and bearing of edges of insulation on deck.
- h. Installation of cutoffs and proper joining of work on subsequent days.
- i. Continuation of complete roofing system installation to cover insulation installed same day.
- j. Verification of required slope to each roof drain.

-- End of Section --



SECTION 07 27 10.00 10

BUILDING AIR BARRIER SYSTEM  
05/14

PART 1 GENERAL

1.1 SUMMARY

This Section specifies the construction and quality control of the installation of an air barrier system. Construct the air barrier system indicated, taking responsibility for the means, methods, and workmanship of the installation of the air barrier system. The air barrier must be contiguous and connected across all surfaces of the enclosed air barrier envelope indicated. The maximum leakage requirements of individual air barrier components and materials are specified in the other specification sections covering these items.

This section also defines the maximum allowable leakage of the final air barrier system. The workmanship must be adequate to meet the maximum allowable leakage requirements of this specification. Test the assembled air barrier system to demonstrate that the building envelope is properly sealed and insulated. Passing the air barrier system leakage test and thermography test will result in system acceptance. Conform air barrier system leakage and thermography testing and reporting to the requirements of Section 07 05 23 PRESSURE TESTING AN AIR BARRIER SYSTEM FOR AIR TIGHTNESS.

1.2 REFERENCES

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

ASTM INTERNATIONAL (ASTM)

ASTM D4541	(2017) Standard Test Method for Pull-Off Strength of Coatings Using Portable Adhesion Testers
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1.3 DEFINITIONS

The following terms as they apply to this section:

1.3.1 Air Barrier Accessory

Products designated to maintain air tightness between air barrier materials, air barrier assemblies and air barrier components, to fasten them to the structure of the building, or both (e.g., sealants, tapes, backer rods, transition membranes, fasteners, strapping, primers).

1.3.2 Air Barrier Assembly

The combination of air barrier materials and air barrier accessories that are designated and designed within the environmental separator to act as a continuous barrier to the movement of air through the environmental separator.

### 1.3.3 Air Barrier Component

Pre-manufactured elements such as windows, doors, dampers and service elements that are installed in the environmental separator.

### 1.3.4 Air Barrier Envelope

The combination of air barrier assemblies and air barrier components, connected by air barrier accessories that are designed to provide a continuous barrier to the movement of air through an environmental separator. There may be more than one air barrier envelope in a single building. Also known as Air Barrier System.

### 1.3.5 Air Barrier Material

A building material that is designed and constructed to provide the primary resistance to airflow through an air barrier assembly.

### 1.3.6 Air Barrier System

Same as AIR BARRIER ENVELOPE.

### 1.3.7 Air Leakage Rate

The rate of airflow (CFM) driven through a unit surface area (sq.ft.) of an assembly or system by a unit static pressure difference (Pa) across the assembly. (example: 0.25 CFM/sq.ft. @ 75 Pa)

### 1.3.8 Air Leakage

The total airflow (CFM) driven through the air barrier system by a unit static pressure difference (Pa) across the air barrier envelope. (example: 6500 CFM @ 75 Pa)

### 1.3.9 Air Permeance

The rate of airflow (CFM) through a unit area (sq.ft.) of a material driven by unit static pressure difference (Pa) across the material (example: 0.004 CFM/sq.ft. @ 75 Pa).

### 1.3.10 Environmental Separator

The parts of a building that separate the controlled interior environment from the uncontrolled exterior environment, or that separate spaces within a building that have dissimilar environments. Also known as the Control Layer.

## 1.4 PREPARATORY PHASE OR PRECONSTRUCTION CONFERENCE

Organize pre-construction conferences between the air barrier inspector and the sub-contractors involved in the construction of or penetration of the air barrier system to discuss where the work of each sub-contractor begins and ends, the sequence of installation, and each sub-contractor's responsibility to ensure airtight joints, junctures, penetrations and transitions between materials. Discuss the products, and assemblies of products specified in the different sections to be installed by the different sub-contractors.

## 1.5 SUBMITTALS

Government approval is required for submittals with a "G" designation; submittals not having a "G" designation are for information only. When used, a designation following the "G" designation identifies the office that will review the submittal for the Government. Submittals with an "S" are for inclusion in the Sustainability eNotebook, in conformance to Section 01 33 29 SUSTAINABILITY REPORTING. Submit the following in accordance with Section 01 33 00 SUBMITTAL PROCEDURES:

### SD-04 Samples

#### Mock-Up; G

Build one as specified prior to building construction.

### SD-06 Test Reports

#### Design Review Report; G

Two copies not later than 14 days after approval of the Air Barrier Inspector Qualifications.

#### Testing and Inspection

### SD-07 Certificates

#### Air Barrier Inspector

Two copies 30 days after Notice to Proceed.

## 1.6 AIR BARRIER ENVELOPE SURFACE AREA AND LEAKAGE REQUIREMENTS

The building air barrier systems must meet the following leakage requirements. The allowable leakage rate and the maximum leakage are at a differential test pressure of 75 Pa.

Air Barrier Envelope 1	
Surface Area	47,835 square feet
Architectural Only Test:	
Allowable leakage rate	0.25 CFM/sq.ft
Maximum leakage	total 11,958 CFM

## 1.7 AIR BARRIER INSPECTOR

Employ a designated Air Barrier Inspector on this project. The Air Barrier Inspector performs a Design Review, oversees quality control testing specified in these specifications, performs quality control air barrier inspection as specified, interfaces with the designer and product manufacturer's representatives to assure all installation requirements are

met, and coordinates efforts between all workers installing or penetrating the air barrier materials. Qualification for the Air Barrier Inspector are as follows:

- a. Training and certification as an Air Barrier Installer from the Air Barrier Association of America (ABAA) or other third party air barrier association.
- b. Experience coordinating and instructing personnel involved in the installation, joining, and sealing of air barrier materials and components.

#### 1.8 DESIGN REVIEW

Review the Contract Plans and Specifications and advise the Contracting Officer of any deficiencies that would prevent the construction of an effective air barrier system. Provide a Design Review Report individually listing each deficiency and the corresponding proposed corrective action necessary for proper air barrier system.

#### PART 2 PRODUCTS

Not Used

#### PART 3 EXECUTION

##### 3.1 QUALITY CONTROL

###### 3.1.1 Documentation and Reporting

Document the entire installation process on daily job site reports. These reports include information on the Installer, substrates, substrate preparation, products used, ambient and substrate temperature, the location of the air barrier installation, the results of the quality control procedures, and testing results.

###### 3.1.2 Construction Mock-Up

- a. Prepare a construction mock-up to demonstrate proper installation of the air barrier assemblies and components. Include air barrier system connections between floor and wall, wall and window, wall and roof. Also, include the sealing method between membrane joints at transitions from one material or component to another, at pipe or conduit penetrations of the wall and roof, and at duct penetration of the wall and roof. Work will not begin until the mock-up is satisfactory to the Contracting Officer.
- b. Size the mock-up to approximately 8 feet long by 8 feet high. The mock-up must be representative of primary exterior wall assemblies and glazing components including backup wall and typical penetrations as acceptable to the Contracting Officer. A corner of the actual building may be used as the mock-up.
- c. Mock-Up Tests for Adhesion: Test the mock-up of materials for adhesion in accordance with manufacturer's recommendations. Perform the test after the curing period recommended by the manufacturer. Record the mode of failure and the area which failed in accordance with ASTM D4541. When the air barrier material manufacturer has established a minimum adhesion level for the product on the particular



substrate, the inspection report must indicate whether this requirement has been met. Where the manufacturer has not declared a minimum adhesion value for their product/substrate combination, simply record the value.

### 3.1.3 Quality Control Testing And Inspection

Conduct the following tests and inspections as applicable in the presence of the Contracting Officer during installation of the air barrier system, and submit quality control reports as indicated below.

- a. Provide a Daily Report of Observations with a copy to the Contracting Officer.
- b. Inspect to assure continuity of the air barrier system throughout the building enclosure and that all gaps are covered, the covering is structurally sound, and all penetrations are sealed allowing for no infiltration or exfiltration through the air barrier system.
- c. Inspect to assure structural support of the air barrier system to withstand design air pressures.
- d. Inspect to assure masonry surfaces receiving air barrier materials are smooth, clean, and free of cavities, protrusions required by the manufacturer of the air barrier material.
- e. Inspect and test to assure site conditions for application temperature, and dryness of substrates are within guidelines.
- f. Inspect to assure substrate surfaces are properly primed if applicable and in accordance with manufacturer's instructions. Priming must extend at least 2 inches beyond the air barrier material to make it obvious that the primer was applied to the substrate before the air barrier material.
- g. Inspect to assure laps in materials are at least a 2-inch minimum, shingled in the correct direction or mastic applied in accordance with manufacturer's recommendations, and with no fishmouths.
- h. Inspect to assure that a roller has been used to enhance adhesion. Identify any defects such as fishmouths, wrinkles, areas of lost adhesion, and improper curing. Note the intended remedy for the deficiencies.
- i. Measure application thickness of liquid applied materials to assure that manufacturer's specifications for the specific substrate are met.
- j. Inspect to assure that the correct materials are installed for compatibility.
- k. Inspect to assure proper transitions for change in direction and structural support at gaps.
- l. Inspect to assure proper connection between assemblies (membrane and sealants) for cleaning, preparation and priming of surfaces, structural support, integrity and continuity of seal.
- m. Perform adhesion tests for fluid-applied and self-adhered air barrier membranes to assure that the manufacturer's specified adhesion

strength properties are met. Determine the bond strength of coatings to substrate in accordance with ASTM D4541.

- n. Provide cohesion tests for spray polyurethane foam (SPF). Perform the tests in accordance with the specification sections which specify these materials. Perform adhesion tests as follows: Using a coring tool remove a sample and determine the relative adhesion quality of the foam. If the foam is hard to remove and leaves small bits of foam on the substrate it is called cohesive foam failure and is considered the best adhesion. If the foam comes away from the substrate with some force but is clean, it is called a mechanical bond. If it comes away easily from the substrate, the adhesion is poor. Cohesive foam failure and a good mechanical bond are acceptable.
- o. Provide written test reports of all tests performed.

### 3.2 REPAIR AND PROTECTION

Upon completion of inspection, testing, sample removal and similar services, repair damaged construction and restore substrates, coatings and finishes. Protect construction exposed by or for quality control service activities, and protect repaired construction.

-- End of Section --

SECTION 07 27 19.01

SELF-ADHERING AIR BARRIERS

05/17

PART 1 GENERAL

1.1 REFERENCES

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

AIR BARRIER ASSOCIATION OF AMERICA (ABAA)

ABAA Accreditation

Accreditation

ABAA QAP

Quality Assurance Program

ASTM INTERNATIONAL (ASTM)

ASTM D146/D146M

(2004; E 2012; R 2012) Sampling and Testing Bitumen-Saturated Felts and Woven Fabrics for Roofing and Waterproofing

ASTM D1876

(2008; R 2015; E 2015) Standard Test Method for Peel Resistance of Adhesives (T-Peel Test)

ASTM D412

(2016) Standard Test Methods for Vulcanized Rubber and Thermoplastic Elastomers - Tension

ASTM D4263

(1983; R 2012) Indicating Moisture in Concrete by the Plastic Sheet Method

ASTM D4541

(2017) Standard Test Method for Pull-Off Strength of Coatings Using Portable Adhesion Testers

ASTM D570

(1998; E 2010; R 2010) Standard Test Method for Water Absorption of Plastics

ASTM D903

(1998; R 2010) Peel or Stripping Strength of Adhesive Bonds

ASTM E154/E154M

(2008a; R 2013; E 2013) Water Vapor Retarders Used in Contact with Earth Under Concrete Slabs, on Walls, or as Ground Cover

ASTM E2178

(2013) Standard Test Method for Air Permeance of Building Materials

ASTM E2357

(2017) Standard Test Method for Determining Air Leakage of Air Barrier Assemblies

ASTM E283	(2004; R 2012) 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 E84	(2018) Standard Test Method for Surface Burning Characteristics of Building Materials
ASTM E96/E96M	(2016) Standard Test Methods for Water Vapor Transmission of Materials

NATIONAL FIRE PROTECTION ASSOCIATION (NFPA)

NFPA 285	(2012) Standard Fire Test Method for Evaluation of Fire Propagation Characteristics of Exterior Non-Load-Bearing Wall Assemblies Containing Combustible Components
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1.2 RELATED REQUIREMENTS

Coordinate the requirements of Section 07 27 10.00 10 BUILDING AIR BARRIER SYSTEM, Section 07 05 23 PRESSURE TESTING AN AIR BARRIER SYSTEM FOR AIR TIGHTNESS and other building enclosure sections to provide a complete building air barrier system. Submit all materials, components, and assemblies of the air barrier system together as one complete submittal package.

1.3 SUBMITTALS

Government approval is required for submittals with a "G" designation; submittals not having a "G" designation are for information only. When used, a designation following the "G" designation identifies the office that will review the submittal for the Government. Submittals with an "S" are for inclusion in the Sustainability eNotebook, in conformance with Section 01 33 29 SUSTAINABILITY REPORTING. Submit the following in accordance with Section 01 33 00 SUBMITTAL PROCEDURES:

SD-01 Preconstruction Submittals

Qualifications of Manufacturer; G

Qualifications of Installer; G

SD-02 Shop Drawings

Self-adhering Air Barrier; G

SD-03 Product Data

Self-adhering Air Barrier; G

Primers, Adhesives, and Mastics; G

Safety Data Sheets; G

SD-04 Samples

Self-adhering Air Barrier Mockup; G

SD-06 Test Reports

Field Peel Adhesion Test; G

Flame Propagation of Wall Assemblies; G

Flame Spread and Smoke Developed Index Ratings; G

Site Inspections and Testing; G

SD-07 Certificates

Self-adhering Air Barrier; G

Qualifications of Manufacturer; G

Qualifications of Installer; G

SD-08 Manufacturer's Instructions

Self-adhering Air Barrier; G

Primers, Adhesives, and Mastics; G

SD-11 Closeout Submittals

Volatile Organic Compound (VOC) Content; S

1.4 MISCELLANEOUS REQUIREMENTS

For self-adhering air barrier provide the following:

1.4.1 Shop Drawings

Submit self-adhering air barrier shop drawings showing locations and extent of air barrier assemblies and details of all typical conditions, intersections with other building enclosure assemblies and materials, and membrane counterflashings. Show details for bridging of gaps in construction, treatment of inside and outside corners, expansion joints, methods of attachment of materials covering the self-adhered barrier without compromising the barrier. Indicate how miscellaneous penetrations such as conduit, pipes, electric boxes, brick ties, and similar items will be sealed.

1.4.2 Product Data

Submit manufacturer's technical data indicating compliance with performance and environmental requirements, manufacturer's printed instructions for evaluating, preparing, and treating substrates, temperature and other limitations of installation conditions, safety requirements for installation, and Safety Data Sheets. Indicate flame and smoke spread ratings for all products.

#### 1.4.3 Mockup

Provide a mockup of the self-adhering air barrier system specified. Apply product in an area designated by the Contracting Officer. Apply an area of not less than 54 square feet. Include all components specified as representative of the complete system. Notify the Contracting Officer a minimum of 48 hours prior to the test application. Select a test area representative of conditions to be covered including window or door openings, wall to ceiling transitions, flashings, and penetrations, as applicable.

#### 1.4.4 Test Reports

Submit test reports indicating that field peel-adhesion tests on all materials have been performed and the changes made, if required, in order to achieve successful and lasting adhesion. Submit test reports for flame propagation of wall assemblies tested in accordance with NFPA 285. Submit test reports for flame spread and smoke developed index ratings of barrier system materials tested in accordance with ASTM E84.

### 1.5 DELIVERY, STORAGE, AND HANDLING

#### 1.5.1 Delivery

Deliver and store materials in sufficient quantity to allow for uninterrupted flow of work. Inspect materials delivered to the site for damage and store out of weather. Deliver materials to the jobsite in their original unopened packages, clearly marked with the manufacturer's name, brand designation, description of contents, and shelf life of containerized materials. Store and handle to protect from damage.

#### 1.5.2 Storage

Inspect materials delivered to the site for damage; unload and store out of weather in manufacturer's original packaging. Store only in dry locations, not subject to open flames or sparks, and easily accessible for inspection and handling. Protect stored materials from direct sunlight. Keep materials sealed and separated from absorptive materials, such as wood and insulation.

### 1.6 FIELD PEEL ADHESION TEST

Perform a field peel-adhesion test on the construction mockup. Test the self-adhering air barrier for adhesion in accordance with ASTM D4541 using a Type II pull tester except use a disk that is 4 inches in diameter and cut through the membrane to separate the material attached to the dish from the surrounding material. Perform test after curing period in accordance with manufacturer's written recommendations. Record mode of failure and area which failed in accordance with ASTM D4541. Compare adhesion values with the manufacturer's established minimum values for the particular combination of material and substrate. Indicate on the inspection report whether the manufacturer's requirement has been met. Where the manufacturer has not declared a minimum adhesion value for their product and substrate combination, the inspector must record actual values.

### 1.7 AIR BARRIER TESTING

Perform air barrier testing in accordance with and Section 07 05 23

PRESSURE TESTING AN AIR BARRIER SYSTEM FOR AIR TIGHTNESS.

## 1.8 QUALITY ASSURANCE

### 1.8.1 Qualifications of Manufacturer

Submit documentation verifying that the manufacturer of the self-adhering air barrier is currently accredited by Air Barrier Association of America ( ABAA Accreditation <https://www.airbarrier.org/>).

### 1.8.2 Qualifications of Installer

Submit documentation verifying that installers of the self-adhering air barrier are currently certified in accordance with the ABAA QAP Quality Assurance Program (<https://www.airbarrier.org/qap/>).

## 1.9 PRECONSTRUCTION MEETING

Conduct a preconstruction meeting a minimum of two weeks prior to commencing work specified in this Section. Agenda must include, at a minimum, construction and testing of mockup, sequence of construction, coordination with substrate preparation, materials approved for use, compatibility of materials, coordination with installation of adjacent and covering materials, and details of construction. Attendance is required by representatives of related trades including covering materials, substrate materials, adjacent materials, and materials and components of the air barrier system.

## 1.10 ENVIRONMENTAL CONDITIONS

### 1.10.1 Temperature

Install air barrier within the range of ambient and substrate temperatures as recommended in writing by the air barrier manufacturer. Verify that the surface to receive self-adhering air barrier is dry for a minimum of 48 hours prior to the installation of the barrier. Do not apply air barrier to damp or wet substrates. Do not apply during inclement weather or when ice, frost, surface moisture, or visible dampness is present on surfaces to be covered, or when precipitation is imminent.

### 1.10.2 Exposure to Weather and Ultraviolet Light

Protect air barrier products from direct exposure to rain, snow, sunlight, mist, and other extreme weather conditions. Replace, at no additional cost to the government, barrier products that have been exposed to ultraviolet (sun)light longer than allowed by manufacturer's written requirements.

## PART 2 PRODUCTS

### 2.1 REDUCED VOLATILE ORGANIC COMPOUND (VOC) CONTENT

Provide products with reduced VOC content and provide documentation in accordance with Section 01 33 29 SUSTAINABILITY REPORTING.

### 2.2 SELF ADHERING AIR BARRIER

Provide minimum 0.040 inch thick self-adhering, vapor permeable, air barrier membrane consisting of a cross-laminated high density polyethylene

(HDPE) film, fully coated with rubberized asphalt adhesive. Provide membrane in rolls of various widths interleaved with disposable silicone release paper. Self-adhering air barrier must exhibit no visible water leakage when tested in accordance with ASTM E331 and must perform as a liquid water drainage plane flashed to discharge to the exterior any incidental condensation or water penetration. Use regular or low temperature formulation depending on site conditions, within temperature ranges specified by manufacturer.

#### 2.2.1 Physical Properties

- a. Air Permeance (ASTM E2178): Less than 0.004 CFM per sf at 1.57 psf.
- b. Air Leakage (ASTM E2357, ASTM E283): In accordance with Section 07 05 23 PRESSURE TESTING AN AIR BARRIER SYSTEM FOR AIR TIGHTNESS less than 0.004 CFM per sf at 1.57 psf at one inch.
- c. Tensile Strength (ASTM D412 die C modified): Not less than 400 psi.
- d. Tensile Elongation (ASTM D412 die C modified): Not less than 200 percent.
- e. Puncture Resistance (ASTM E154/E154M): Not less than 40 lbs.
- f. Pliability (ASTM D146/D146M): Unaffected at minus 25 degrees F, 0.063 inch mandrel.
- g. Lap Adhesion (ASTM D1876 modified): Not less than 4.0 lbs per inch.
- h. Peel Adhesion (ASTM D903): Not less than 5.0 lbs per inch.
- i. Water Vapor Permeance (Vapor Permeable Air Barrier) (ASTM E96/E96M, desiccant method B): greater than 10.0 perms.
- j. Water Absorption (ASTM D570): Not to exceed 0.12 percent by weight.
- k. Flame propagation of wall assemblies (NFPA 285): Pass
- l. Surface Burning Characteristics (ASTM E84):
  - (1) Flame Spread Index Rating not higher than 75.
  - (2) Smoke Developed Index Rating not higher than 150.

#### 2.3 PRIMERS, ADHESIVES, AND MASTICS

Provide primers, adhesives, mastics and other accessory materials as recommended in writing by the manufacturer of the self-adhering air barrier for adequate bonding to each type of substrate.

#### 2.4 SHEET METAL FLASHING

Provide as specified in Section 07 60 00 FLASHING AND SHEET METAL.

#### 2.5 JOINT SEALANTS

Provide as specified in Section 07 92 00 JOINT SEALANTS. Verify compatibility with adjacent products that are or will be in contact with one another.



## PART 3 EXECUTION

### 3.1 EXAMINATION

Before installing air barrier, examine substrates, areas, and conditions under which air barrier assemblies will be applied, with Installer present, for compliance with requirements. Ensure the following conditions are met:

- a. Surfaces are sound, dry, even, and free of oil, grease, dirt, excess mortar or other contaminants.
- b. Concrete surfaces are cured and dry, smooth without large voids, spalled areas or sharp protrusions.
- c. Verify substrate is visibly dry and free of moisture. Test for capillary moisture by plastic sheet method in accordance with ASTM D4263 and take suitable measures until substrate passes moisture test.
- d. Verify sealants used in sheathing are compatible with membrane proposed for use. Perform field peel adhesion test on materials to which sealants are adhered.

### 3.2 PREPARATION

Clean, prepare, and treat substrate in accordance with manufacturer's written instructions. Ensure clean, dust-free, and dry substrate for air barrier application.

- a. Prime masonry and concrete substrates with conditioning primer.
- b. Prime gypsum sheathing an adequate number of coats to achieve required bond, with adequate drying time between coats.
- c. Prime wood, metal, and painted substrates with primer.
- d. Prepare, treat, and seal vertical and horizontal surfaces at terminations and penetrations through air barrier and at protrusions.

### 3.3 INSTALLATION

#### 3.3.1 Installation of Self-adhering Air Barrier

Install materials in accordance with manufacturer's recommendations and the following:

- a. Apply primer at rate recommended by manufacturer prior to membrane installation. Allow primer to dry completely before membrane application. Apply as many coats as necessary for proper adhesion.
- b. When membrane is properly positioned, press into place and roll membrane with roller immediately after placement.
- c. Apply membrane sheets to shed water naturally without interception by a sheet edge, unless that edge is sealed with permanently flexible termination mastic.

- d. Position subsequent sheets of membrane applied above so that membrane overlaps the membrane sheet below by a minimum of 2-1/2 inches, unless greater overlap is recommended by manufacturer. Roll into place with roller.
- e. Make all side laps a minimum of 2-1/2 inches and all end laps a minimum of 5 inches, unless greater overlap is recommended by manufacturer. Roll seams with roller.
- f. Roll membrane to adhere to substrate. Cover corners and joints with two layers of reinforcement by first applying a 12 inch width of membrane centered along the axis. Flash drains and projections with a second ply of membrane for a distance of 6 inches from the drain or projection.
- g. Seal around all penetrations through the air barrier resulting from pipes, vents, conduit, electrical fixtures, structural members, or other construction passing through it. Seal with termination mastic, extruded silicone sealant, membrane counterflashing or other sealing methods in accordance with manufacturer's written recommendations.
- h. Continuously connect the air barrier between walls, roof, floor and below grade assemblies to form a continuous integrated air barrier system around the entire building enclosure. Extend the air barrier membrane into rough openings such as doors, windows, louvers, and other exterior penetrations. Seal edges of barrier at junctures with rough openings.
- i. At changes in substrate plane, provide transition material (e.g. bead of sealant, mastic, extruded silicone sealant, membrane counterflashing or other material recommended by manufacturer) under membrane to eliminate all sharp 90 degree inside corners and to make a smooth transition from one plane to another.
- j. Provide mechanically fastened non-corrosive metal sheet to span gaps in substrate plane and to make a smooth transition from one plane to the other. Continuously support membrane with substrate.
- k. At deflection and control joints, provide backup for the membrane to accommodate anticipated movement.
- l. At expansion and seismic joints provide transition to the joint assemblies.
- m. Apply a bead or trowel coat of mastic along membrane seams at reverse lapped seams, rough cuts, and as recommended by the manufacturer.
- n. At end of each working day, seal top edge of membrane to substrate with termination mastic.
- o. Do not allow materials to come in contact with chemically incompatible materials.
- p. Counterflash upper edge of thru-wall flashing and air barrier. Counter flashing and thru-wall flashing are specified in Section 07 60 00 FLASHING AND SHEET METAL.

### 3.4 FIELD QUALITY CONTROL

#### 3.4.1 Site Inspections and Testing

Provide site inspections and testing in accordance with ABAA protocol to verify conformance with the manufacturer's instructions, the ABAA QAP Quality Assurance Program (<https://www.airbarrier.org/qap/>), Section 07 05 23 PRESSURE TESTING AN AIR BARRIER SYSTEM FOR AIR TIGHTNESS, and this section.

- a. Conduct inspections and testing at 5, 50, and 95 percent completion of this scope of work. Forward written site inspections and testing reports to the Contracting Officer within five working days of the inspection and test being performed.
- b. If inspections reveal any defects, promptly remove and replace defective work at no additional expense to the Government.

### 3.5 FIELD PEEL ADHESION TEST

Conduct in accordance with test protocol indicated in Part 1, paragraph FIELD PEEL ADHESION TEST.

### 3.6 PROTECTION AND CLEANING

#### 3.6.1 Protection

##### 3.6.1.1 Adjacent Surfaces

Protect exposed adjacent surfaces that could be damaged by primers and adhesives associated with air barrier membrane. Provide protection during application and the remainder of construction in accordance with manufacturer's written instructions.

##### 3.6.1.2 The Air Barrier Assembly

Protect finished portions of the air barrier assembly from damage during ongoing application and throughout the remainder of the construction period in accordance with manufacturer's written instructions. Coordinate timing of installation of materials that will cover the air barrier membrane to ensure the exposure period does not exceed that recommended by the air barrier manufacturer's written installation instructions. Remove and replace, at no additional cost to the government, membrane products that exceed the manufacturer's allowed exposure limits.

#### 3.6.2 Cleaning

Clean spillage and soiling from adjacent construction using cleaning agents and procedures recommended by manufacturer of affected construction and as acceptable to the primary material manufacturer.

-- End of Section --



SECTION 07 27 26

FLUID-APPLIED MEMBRANE AIR BARRIERS

05/17

PART 1 GENERAL

1.1 REFERENCES

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

AIR BARRIER ASSOCIATION OF AMERICA (ABAA)

ABAA Accreditation

Accreditation

ABAA QAP

Quality Assurance Program

ASTM INTERNATIONAL (ASTM)

ASTM C836/C836M

(2015) High Solids Content, Cold  
Liquid-Applied Elastomeric Waterproofing  
Membrane for Use With Separate Wearing  
Course

ASTM D412

(2016) Standard Test Methods for  
Vulcanized Rubber and Thermoplastic  
Elastomers - Tension

ASTM D4263

(1983; R 2012) Indicating Moisture in  
Concrete by the Plastic Sheet Method

ASTM D4541

(2017) Standard Test Method for Pull-Off  
Strength of Coatings Using Portable  
Adhesion Testers

ASTM D5590

(2000; R 2010; E 2012) Standard Test  
Method for Determining the Resistance of  
Paint Films and Related Coatings to Fungal  
Defacement by Accelerated Four-Week Agar  
Plate Assay

ASTM E2178

(2013) Standard Test Method for Air  
Permeance of Building Materials

ASTM E2357

(2017) Standard Test Method for  
Determining Air Leakage of Air Barrier  
Assemblies

ASTM E283

(2004; R 2012) 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 E84 (2018) Standard Test Method for Surface  
Burning Characteristics of Building  
Materials

ASTM E96/E96M (2016) Standard Test Methods for Water  
Vapor Transmission of Materials

NATIONAL FIRE PROTECTION ASSOCIATION (NFPA)

NFPA 285 (2012) Standard Fire Test Method for  
Evaluation of Fire Propagation  
Characteristics of Exterior  
Non-Load-Bearing Wall Assemblies  
Containing Combustible Components

1.2 RELATED REQUIREMENTS

Coordinate the requirements of Section 07 27 10.00 10 BUILDING AIR BARRIER SYSTEM, Section 07 05 23 PRESSURE TESTING AN AIR BARRIER SYSTEM FOR AIR TIGHTNESS, and other building enclosure sections to provide a complete building air barrier system. Submit all materials, components and assemblies of the air barrier system together as one complete submittal package.

1.3 SUBMITTALS

Government approval is required for submittals with a "G" designation; submittals not having a "G" designation are for information only. When used, a designation following the "G" designation identifies the office that will review the submittal for the Government. Submittals with an "S" are for inclusion in the Sustainability eNotebook, in conformance with Section 01 33 29 SUSTAINABILITY REPORTING. Submit the following in accordance with Section 01 33 00 SUBMITTAL PROCEDURES:

SD-01 Preconstruction Submittals

Qualifications of Manufacturer; G

Qualifications of Installer; G

SD-02 Shop Drawings

Fluid-Applied Membrane Air Barrier; G

SD-03 Product Data

Fluid-Applied Membrane Air Barrier; G

Transition Membrane; G

Primers, Adhesives, and Mastics; G

Reinforcement; G

Safety Data Sheets; G

SD-04 Samples

Fluid-Applied Membrane Air Barrier Mockup; G

SD-06 Test Reports

Capillary Moisture Test; G

Field Peel Adhesion Test; G

Flame Propagation of Wall Assemblies; G

Flame Spread and Smoke Developed Index Ratings; G

Site Inspections Reports; G

SD-07 Certificates

Fluid-Applied Membrane Air Barrier; G

Transition Membrane; G

Qualifications of Manufacturer; G

Qualifications of Installer; G

SD-08 Manufacturer's Instructions

Fluid-Applied Membrane Air Barrier; G

Transition Membrane; G

Primers, Adhesives, and Mastics; G

SD-11 Closeout Submittals

Volatile Organic Compound (VOC) Content; S

1.4 MISCELLANEOUS REQUIREMENTS

For fluid-applied membrane air barriers provide the following:

1.4.1 Shop Drawings

Submit fluid-applied membrane air barrier shop drawings showing locations and extent of barrier assemblies, transition membranes, details of all typical conditions, intersections with other envelope assemblies and materials, and membrane counterflashings. Show details for bridging of gaps in construction, treatment of inside and outside corners, expansion joints, methods of attachment of materials covering the self-adhered barrier without compromising the barrier. Indicate how miscellaneous penetrations such as conduit, pipes, electric boxes, brick ties, and similar items will be sealed.

1.4.2 Product Data

Submit manufacturer's technical data indicating compliance with performance and environmental requirements, manufacturer's printed instructions for evaluating, preparing, and treating substrates, temperature and other limitations of installation conditions, safety

requirements for installation, and Safety Data Sheets. Indicate flame and smoke spread ratings for all products.

#### 1.4.3 Mockup

Provide a mockup of the fluid-applied membrane air barrier. Apply product in an area designated by the Contracting Officer. Apply an area of not less than 54 square feet. Include all components specified as representative of the complete system. Notify the Contracting Officer a minimum of 48 hours prior to the test application. Select a test area representative of conditions to be covered including window or door openings, wall to ceiling transitions, flashings, and penetrations, as applicable.

#### 1.4.4 Test Reports

Submit test reports indicating that capillary moisture tests and field peel adhesion tests on all substrate materials have been performed and the changes made, if required, in order to achieve successful and lasting adhesion. Submit test reports for flame propagation of wall assemblies tested in accordance with NFPA 285. Submit test reports for flame spread and smoke developed index ratings of barrier materials tested in accordance with ASTM E84.

### 1.5 DELIVERY, STORAGE, AND HANDLING

#### 1.5.1 Delivery

Deliver and store materials in sufficient quantity to allow for uninterrupted flow of work. Inspect materials delivered to the site for damage and store out of weather. Deliver materials to the jobsite in their original unopened packages, clearly marked with the manufacturer's name, brand designation, description of contents, and shelf life of containerized materials. Store and handle to protect from damage.

#### 1.5.2 Storage

Inspect materials delivered to the site for damage; unload and store out of weather in manufacturer's original packaging. Store only in dry locations, not subject to open flames or sparks, and easily accessible for inspection and handling. Protect stored materials from direct sunlight.

### 1.6 CAPILLARY MOISTURE TEST

Perform a capillary moisture test by plastic sheet method in accordance with ASTM D4263 on the construction mockup and substrate materials. Perform test after curing period as recommended by the air barrier manufacturer. Record mode of failure and area which failed in accordance with ASTM D4263. Once the air barrier material manufacturer has established a minimum adhesion or moisture level for the product on the particular substrate, indicate on the inspection report whether this requirement has been met. Where the manufacturer has not declared a minimum adhesion or moisture value for their product and substrate combination, the inspector must record actual values.

### 1.7 FIELD PEEL ADHESION TEST

Perform a field peel adhesion test on a construction mockup. Test the applied product for adhesion in accordance with manufacturer's



recommendations. Perform test after curing period recommended by the manufacturer. Record mode of failure and area which failed in accordance with ASTM D4541. When the manufacturer has established a minimum adhesion level for the product on the particular substrate, the inspection report must indicate whether this requirement has been met. Where the manufacturer has not declared a minimum adhesion value for their product/substrate combination, the inspector must record actual values.

#### 1.8 AIR BARRIER TESTING

Perform air barrier testing in accordance with Section 07 27 10.00 10 BUILDING AIR BARRIER SYSTEM Section 07 05 23 PRESSURE TESTING AN AIR BARRIER SYSTEM FOR AIR TIGHTNESS.

#### 1.9 QUALITY ASSURANCE

##### 1.9.1 Qualifications of Manufacturer

Submit documentation verifying that manufacturer of fluid-applied membrane air barrier is currently accredited by the Air Barrier Association of America (ABAA Accreditation <https://www.airbarrier.org/>).

##### 1.9.2 Qualifications of Installer

Submit documentation verifying that installers of the fluid-applied membrane air barrier are currently certified in accordance with the ABAA QAP Quality Assurance Program (<https://www.airbarrier.org/qap/>).

#### 1.10 PRECONSTRUCTION MEETING

Conduct a preconstruction meeting a minimum of two weeks prior to commencing work specified in this Section. Agenda must include, at a minimum, construction and testing of construction mock up, sequence of construction, coordination with substrate preparation, materials approved for use, compatibility of materials, coordination with installation of adjacent and covering materials, and details of construction. Attendance is required by representatives of related trades including covering materials, substrate materials, adjacent materials, and materials and components of the fluid-applied membrane air barrier.

#### 1.11 ENVIRONMENTAL CONDITIONS

##### 1.11.1 Temperature

Install fluid-applied membrane air barrier within the range of ambient and substrate temperatures as recommended in writing by the fluid-applied membrane air barrier manufacturer. Do not apply fluid-applied membrane air barrier to a damp or wet substrate. Do not apply during inclement weather or when ice, frost, surface moisture, or visible dampness is present on surfaces to be covered, or when precipitation is imminent.

##### 1.11.2 Exposure to Weather

Protect fluid-applied membrane air barrier products from direct exposure to rain, snow, sunlight, mist, and other extreme weather conditions. Replace, at no additional cost to the government, barrier products that have been exposed to ultraviolet (sun)light longer than allowed by manufacturer's written requirements.

## PART 2 PRODUCTS

### 2.1 REDUCED VOLATILE ORGANIC COMPOUND (VOC) CONTENT

Provide products with reduced VOC content and provide documentation in accordance with Section 01 33 29 SUSTAINABILITY REPORTING.

### 2.2 FLUID-APPLIED MEMBRANE AIR BARRIER

Provide a fluid-applied, vapor permeable, air barrier. This barrier must exhibit no visible water leakage when tested in accordance with ASTM E331 and must perform as a liquid water drainage plane with thru-wall flashing to discharge incidental condensation and water penetration to the exterior of the building enclosure. Provide products suitable for use within temperature ranges specified by manufacturer for the location of the project.

#### 2.2.1 Physical Properties

- a. Air Permeance (ASTM E2178): in accordance with Section 07 27 10.00 10 BUILDING AIR BARRIER SYSTEM.
- b. Air Leakage (ASTM E2357, ASTM E283): in accordance with Section 07 27 10.00 10 BUILDING AIR BARRIER SYSTEM.
- c. Water Vapor Permeance (Vapor Permeable Membrane) (ASTM E96/E96M, desiccant method A): Not more than 1.1 perms.
- d. Tensile Strength (ASTM D412): Not less than 138 psi.
- e. Elongation (ASTM D412): Not less than 300 percent.
- f. Low temperature Flexibility and Crack Bridging (ASTM C836/C836M): Pass at minus 15 degrees F.
- g. Solids by Volume: minimum 50 percent.
- h. Flame propagation of wall assemblies (NFPA 285): Pass
- i. Surface Burning Characteristics (ASTM E84):
  - (1) Flame Spread Index Rating not higher than 75 .
  - (2) Smoke Developed Index Rating not higher than 150 .
- j. Resistance to Mold, Mildew and Fungal Growth (ASTM D5590): 0, No growth.

### 2.3 PRIMERS, ADHESIVES, AND MASTICS

Provide primers, adhesives, mastics, sealants and other accessories as recommended by manufacturer of fluid-applied membrane air barrier for a complete installation.

### 2.4 TRANSITION MEMBRANE

Provide as specified in Section 07 27 19.01 SELF-ADHERING AIR BARRIERS.

## 2.5 SHEET METAL FLASHING

Provide as specified in Section 07 60 00 FLASHING AND SHEET METAL.

## 2.6 JOINT SEALANTS

Provide as specified in Section 07 92 00 JOINT SEALANTS.

## 2.7 REINFORCEMENT

Provide fiberglass mesh tape, or fluid-applied air barrier manufacturer's approved comparable equal product, reinforcement at seams, edges, projections and penetrations. Reinforce all joints exceeding 1/4 inch with fiberglass mesh.

# PART 3 EXECUTION

## 3.1 EXAMINATION

Before installing fluid-applied membrane air barrier, examine substrates, areas, and conditions under which fluid-applied membrane air barrier assemblies will be applied, with installer present, for compliance with requirements. Ensure the following conditions are met:

- a. Surfaces are sound, dry, even, and free of oil, grease, dirt, excess mortar or other contaminants detrimental to the adhesion of the membranes.
- b. Concrete and masonry surfaces are cured and dry, smooth without large voids, spalled areas or sharp protrusions. Do not proceed with installation until after minimum concrete curing period recommended by fluid-applied membrane air barrier manufacturer.
- c. Fill voids, gaps and spalled areas in substrate to provide an even plane. Strike masonry joints full flush.
- d. Verify substrate is visibly dry and free of moisture. Test for capillary moisture by plastic sheet method in accordance with ASTM D4263 and take suitable measures until substrate passes moisture test.
- e. Verify sealants used in substrates, and in joints between substrates, are compatible with fluid-applied membrane air barrier.

## 3.2 PREPARATION

Clean, prepare, and treat substrate in accordance with manufacturer's written instructions. Ensure clean, dust-free, and dry substrate for fluid-applied membrane air barrier application.

- a. Remove dust, dirt and other contaminants from joints and cracks before coating surfaces.
- b. Prepare, treat, and seal vertical and horizontal surfaces at terminations and penetrations through fluid-applied membrane air barrier.
- c. At changes in substrate plane, provide transition material (bead of sealant, mastic, extruded silicone sealant, membrane counterflashing

or other material recommended by manufacturer) under transition membrane to eliminate all sharp 90 degree inside corners and to make a smooth transition from one plane to another.

- d. Provide mechanically fastened non-corrosive metal sheet to span gaps in substrate plane and to make a smooth transition from one plane to the other. Continuously support membrane with substrate.
- e. For exterior sheathing substrates, ensure that exterior sheathing is stabilized, with corners and edges fastened with appropriate screws. Treat all joints in accordance with the air barrier manufacturer's instructions prior to application of air barrier material. Allow sufficient time for joint treatments to fully cure before application of transition membranes and fluid-applied membrane air barrier.
- f. For concrete and masonry substrates, fill all voids and holes, particularly in mortar joints, with non-shrinking grout.
- g. Mask off and cover adjacent surfaces to protect from spillage and overspray.

### 3.3 INSTALLATION

#### 3.3.1 Installation of Transition Membrane

Install transition membrane materials in accordance with the details on the drawings, Section 07 27 19.01 SELF-ADHERING AIR BARRIERS, and the following:

- a. Install transition membrane at all required locations prior to installation of the fluid-applied membrane air barrier.
- b. Verify transition membrane is fully adhered to substrate and that its surface is clean, dry and wrinkle free prior to installation of the fluid-applied membrane air barrier.
- c. Verify transition membrane completely covers all transition areas and will provide continuity of the finished fluid-applied membrane air barrier without gaps or cracks.

#### 3.3.2 Installation of Flashing

Counterflash upper edge of thru-wall flashing and fluid-applied air barrier. Counter flashing and thru-wall flashing are specified in Section 07 60 00 FLASHING AND SHEET METAL.

#### 3.3.3 Installation of Fluid-Applied Membrane Air Barrier

Install materials in accordance with manufacturer's recommendations and the following:

- a. Apply fluid-applied membrane air barrier in single or dual coat application by spray or roller. Apply fluid-applied membrane air barrier within manufacturer's recommended temperature range for application.
- b. Apply fluid-applied membrane air barrier at rate recommended by manufacturer to yield a wet film thickness of 90 mils.

- c. Apply fluid-applied membrane air barrier around all penetrations ensuring a complete and continuous air barrier. Lap fluid-applied membrane air barrier a minimum of 3 inch over transition membrane to seal leading edge.
- d. Seal membrane terminations, heads of mechanical fasteners, masonry tie fasteners, around penetrations, HVAC assemblies, plumbing and electrical assemblies, doors, windows, louvers, and other assemblies penetrating the fluid-applied membrane air barrier with a termination sealant recommended by the fluid-applied membrane air barrier manufacturer.
- e. Notify the Contracting Officer and Testing Agency upon completion of fluid-applied membrane air barrier installation. Air barrier materials and assemblies must remain exposed until tested and inspected by the ABAA.
- f. Do not allow materials to come in contact with chemically incompatible materials.

### 3.3.4 Installation of Reinforcement

Install reinforcement at projections, corners, joints, and penetrations where applicable.

## 3.4 FIELD QUALITY CONTROL

### 3.4.1 Site Inspections and Testing

Provide site inspections and testing in accordance with ABAA protocol to verify conformance with the manufacturer's instructions, the ABAA QAP Quality Assurance Program (<https://www.airbarrier.org/qap/>), Section 07 27 10.00 10 BUILDING AIR BARRIER SYSTEM, Section 07 05 23 PRESSURE TESTING AN AIR BARRIER SYSTEM FOR AIR TIGHTNESS, and this section.

- a. Conduct inspections and testing at 5, 50, and 95 percent completion of this scope of work. Forward written inspection reports to the Contracting Officer within five working days of the inspection and test being performed.
- b. If the inspections reveal any defects, promptly remove and replace defective work at no additional expense to the Government.

## 3.5 PROTECTION AND CLEANING

### 3.5.1 Protection

Protect fluid-applied membrane air barrier assemblies from damage during application and remainder of construction in accordance with manufacturer's written instructions.

Coordinate installation, testing, and inspection procedures to ensure exposure period does not exceed that recommended by the product manufacturer. Remove and replace, at no additional cost to the government, membrane products that exceed manufacturer's allowed exposure limits.

### 3.5.2 Cleaning of Adjacent Surfaces

Clean excess product from adjacent construction using cleaning agents and procedures as recommended in writing by the manufacturer of each type of affected construction and as acceptable to same.

### 3.6 CLEANUP OF SPILLS

Conduct cleanup of uncured product spillage in accordance with manufacturer's written safe handling instructions.

-- End of Section --

SECTION 07 27 36

SPRAY FOAM AIR BARRIERS

05/17

PART 1 GENERAL

1.1 REFERENCES

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

AIR BARRIER ASSOCIATION OF AMERICA (ABAA)

ABAA Accreditation

Accreditation

ABAA QAP

Quality Assurance Program

AMERICAN SOCIETY OF SAFETY ENGINEERS (ASSE/SAFE)

ASSE/SAFE Z88.2

(2015) American National Standard  
Practices for Respiratory Protection

ASSE/SAFE Z9.2

(2012) Fundamentals Governing the Design  
and Operation of Local Exhaust Ventilation  
Systems

ASTM INTERNATIONAL (ASTM)

ASTM C1029

(2015) Standard Specification for  
Spray-Applied Rigid Cellular Polyurethane  
Thermal Insulation

ASTM C1303/C1303M

(2015) Standard Test Method for Predicting  
Long-Term Thermal Resistance of  
Closed-Cell Foam Insulation

ASTM C1338

(2014) Standard Test Method for  
Determining Fungi Resistance of Insulation  
Materials and Facings

ASTM C518

(2017) Standard Test Method for  
Steady-State Thermal Transmission  
Properties by Means of the Heat Flow Meter  
Apparatus

ASTM D1621

(2016) Standard Test Method for  
Compressive Properties of Rigid Cellular  
Plastics

ASTM D1622

(2014) Apparent Density of Rigid Cellular  
Plastics

ASTM D1623

(2017) Standard Test Method for Tensile  
and Tensile Adhesion Properties of Rigid  
Cellular Plastics

ASTM D2126	(2009) Response of Rigid Cellular Plastics to Thermal and Humid Aging
ASTM D2842	(2012) Water Absorption of Rigid Cellular Plastics
ASTM D4541	(2017) Standard Test Method for Pull-Off Strength of Coatings Using Portable Adhesion Testers
ASTM D6226	(2010) Standard Test Method for Open Cell Content of Rigid Cellular Plastics
ASTM E2178	(2013) Standard Test Method for Air Permeance of Building Materials
ASTM E2357	(2017) Standard Test Method for Determining Air Leakage of Air Barrier Assemblies
ASTM E283	(2004; R 2012) Determining the Rate of Air Leakage Through Exterior Windows, Curtain Walls, and Doors Under Specified Pressure Differences Across the Specimen
ASTM E736	(2000; R 2011) Cohesion/Adhesion of Sprayed Fire-Resistive Materials Applied to Structural Members
ASTM E84	(2018) Standard Test Method for Surface Burning Characteristics of Building Materials
ASTM E96/E96M	(2016) Standard Test Methods for Water Vapor Transmission of Materials

ICC EVALUATION SERVICE, INC. (ICC-ES)

ICC-ES AC377	(2009) Acceptance Criteria for Spray-Applied Foam Plastic Insulation
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INTERNATIONAL CODE COUNCIL (ICC)

ICC IBC	(2017) International Building Code
ICC IECC	(2015) International Energy Conservation Code

INTERNATIONAL SAFETY EQUIPMENT ASSOCIATION (ISEA)

ANSI/ISEA Z87.1	(2015) Occupational and Educational Personal Eye and Face Protection Devices
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NATIONAL FIRE PROTECTION ASSOCIATION (NFPA)

NFPA 10	(2013) Standard for Portable Fire Extinguishers
NFPA 211	(2016) Standard for Chimneys, Fireplaces,



Vents, and Solid Fuel-Burning Appliances

NFPA 275	(2017) Standard Method of Fire Tests for the Evaluation of Thermal Barriers
NFPA 285	(2012) Standard Fire Test Method for Evaluation of Fire Propagation Characteristics of Exterior Non-Load-Bearing Wall Assemblies Containing Combustible Components
NFPA 31	(2016) Standard for the Installation of Oil-Burning Equipment
NFPA 54	(2015) National Fuel Gas Code
NFPA 70	(2017; ERTA 1-2 2017; TIA 17-1; TIA 17-2; TIA 17-3; TIA 17-4; TIA 17-5; TIA 17-6; TIA 17-7; TIA 17-8; TIA 17-9; TIA 17-10; TIA 17-11; TIA 17-12; TIA 17-13; TIA 17-14) National Electrical Code

SPRAY POLYURETHANE FOAM ALLIANCE (SPFA)

SPFA TechDocs	(2015) SPFA Technical Documents Library, four categories: General, Insulation, Roofing, Specialty
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U.S. DEPARTMENT OF DEFENSE (DOD)

UFC 3-600-01	(2016; with Change 1) Fire Protection Engineering for Facilities
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U.S. NATIONAL ARCHIVES AND RECORDS ADMINISTRATION (NARA)

29 CFR 1910.132	Personal Protective Equipment
29 CFR 1910.133	Eye and Face Protection
29 CFR 1910.134	Respiratory Protection

UNDERWRITERS LABORATORIES OF CANADA (ULC)

ULC S705.2	(2005) Standard for Thermal Insulation - Spray Applied Rigid Polyurethane Foam, Medium Density - Application
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1.2 RELATED REQUIREMENTS

Coordinate the requirements of Section 07 27 10.00 10 BUILDING AIR BARRIER SYSTEM, Section 07 05 23 PRESSURE TESTING AN AIR BARRIER SYSTEM FOR AIR TIGHTNESS, Section 07 27 19.01 SELF-ADHERING AIR BARRIERS, SECTION 07 27 26 FLUID-APPLIED MEMBRANE AIR BARRIERS, and other building envelope sections to provide a complete air barrier system. Submit all materials, components, and assemblies of the air barrier system together as one complete submittal package.

### 1.3 DEFINITIONS

#### 1.3.1 Long Term Thermal Resistance (LTTR)

The thermal resistance value of a closed cell foam insulation product measured using accelerated aging ASTM C1303/C1303M equivalent to the time-weighted average thermal resistance value over 15 years. Loss in thermal resistance is attributable to changes in cell gas composition caused by diffusion of air into and blowing agent out of the foam cells.

#### 1.3.2 SPFA TechDocs

Reformatted documents, named SPFA TechDocs (<http://www.sprayfoam.org/technical/spfa-technical-documents>), places each document in one of four categories for easy reference and identification: Roofing, Insulation, Specialty and General.

Spray Polyurethane Foam: Thermal and air/vapor barrier system consisting of sprayed polyurethane foam (SPF).

### 1.4 SUBMITTALS

Government approval is required for submittals with a "G" designation; submittals not having a "G" designation are for information only. When used, a designation following the "G" designation identifies the office that will review the submittal for the Government. Submittals with an "S" are for inclusion in the Sustainability eNotebook, in conformance with Section 01 33 29 SUSTAINABILITY REPORTING. Submit the following in accordance with Section 01 33 00 SUBMITTAL PROCEDURES:

#### SD-01 Preconstruction Submittals

Qualification of Manufacturer; G

Qualification of Installer; G

Quality Control Plan; G

Safety Plan; G

Fire Prevention Plan; G

Respirator Plan; G

#### SD-02 Shop Drawings

Spray Foam Air Barrier System

Foam Air Barrier System; G

Fire-Rated Assemblies; G

#### SD-03 Product Data

Closed Cell SPF; G

Transition Membrane; G

Primers, Adhesives, and Mastics; G

Sealants; G

Safety Data Sheets; G

Thermal Barrier Materials; G

Accessories; G

SD-04 Samples

Spray Foam Air Barrier Mockup; G

SD-06 Test Reports

Field Peel Adhesion Test; G

Thermographic Test; G

Air Barrier Test; G

Primers; G

Fire-Ratings Of Thermal Barrier Materials; G

Flame Spread And Smoke Developed Index Ratings Of SPF Products; G

Flame Propagation Of Wall Assemblies; G

Site Inspections Reports; G

SD-07 Certificates

Closed cell SPF; G

Qualification of Manufacturer; G

Qualification of Installer; G

Transition Membrane; G

SD-08 Manufacturer's Instructions

SPF Handling, Storage, and Spray Procedures; G

Substrate Preparation; G

Thermal Barrier; G

Ignition Barrier; G

Transition Membrane; G

Primers, Adhesives, and Mastics; G

SD-09 Manufacturer's Field Reports

Core Samples; G

Daily Work Record; G

Visual Inspection and Thermal Scanning; G

SD-11 Closeout Submittals

Volatile Organic Compound (VOC) Content; S

Recycled Content; S

## 1.5 MISCELLANEOUS REQUIREMENTS

For the spray foam air barrier system provide the following:

### 1.5.1 Shop Drawings

Submit spray foam air barrier shop drawings showing locations, detailing, and extent of spray foam air barrier assemblies. Provide details of all typical conditions, intersections with other envelope assemblies and materials, membrane counter-flashings. Provide details for fire-rated assemblies and indicate materials for thermal barriers. Show details for bridging of gaps in construction, treatment of inside and outside corners, expansion joints, methods of attachment of materials covering the SPF without compromising the barrier. Indicate how miscellaneous penetrations such as conduit, pipes, electric boxes, brick ties, and similar items will be sealed.

### 1.5.2 Product Data

Submit manufacturer's technical data indicating compliance with performance and environmental requirements, manufacturer's printed instructions for evaluating, preparing, and treating substrates, temperature and other limitations of installation conditions, safety requirements for installation, and Safety Data Sheets. Indicate flame and smoke spread ratings for all products. Submit thermal barrier literature including material description, physical properties, and fire-ratings.

### 1.5.3 Mockup

Provide a mockup of each foam system specified. Apply foam in an area designated by the Contracting Officer. Apply an area of not less than 50 square feet. Include all components specified for the finished assembly including primers, support components, expansion and contraction joints, thermal barriers, and other accessories as representative of the complete system. Isolate the area and protect workers as required by 29 CFR 1910.132, 29 CFR 1910.133 and 29 CFR 1910.134. Notify the Contracting Officer a minimum of 48 hours prior to the test application. Select a test area representative of conditions to be sprayed including window or door openings, wall to ceiling transitions, flashings, and penetrations, as applicable.

### 1.5.4 Test Reports

Submit test reports indicating that field peel adhesion tests on all materials have been performed and the changes made, if required, in order to achieve successful and lasting adhesion. Submit test reports for flame spread and smoke developed index ratings of SPF products tested in accordance with ASTM E84. Submit test reports for flame propagation of wall assemblies tested in accordance with NFPA 285. Submit test reports

for fire-ratings of thermal barrier materials tested in accordance with ASTM E84.

## 1.6 DELIVERY, STORAGE, AND HANDLING

### 1.6.1 Delivery

Deliver and store materials in sufficient quantity to allow for uninterrupted flow of work. Inspect materials delivered to the site for damage; unload and store out of weather. Deliver materials to the jobsite in their original unopened packages, clearly marked with the manufacturer's name, brand designation, description of contents, and shelf life of containerized materials. Store and handle to protect from damage. Submit SPF Handling, Storage, and Spray Procedures in accordance with submittal procedures.

### 1.6.2 Storage

Store materials in clean, dry areas, away from excessive heat, sparks, and open flame. Maintain temperatures in the storage area below the materials' flash point(s) and within limits recommended by the manufacturer's printed instructions. Provide ventilation in accordance with ASSE/SAFE Z9.2 to prevent build-up of flammable gases. Store MDI (A-side) drums in locations that limit the risk of contact with water, acids, caustics (such as lye), alcohols, and strong oxidizing and reducing agents.

### 1.6.3 Handling

Handle materials and containers safely and in accordance with manufacturer's recommendations. Store liquids in airtight containers and keep containers closed except when removing materials. Do not use equipment or containers containing remains of dissimilar materials. Do not expose foam component containers to direct sunlight. Do not use materials from containers with content temperatures in excess of 80 degrees F.

Containers exposed to long periods of cold may also exhibit separation and poor performance. Do not use materials exposed to temperature ranges outside of manufacturer's instructions for exposure limits.

Mark and remove from job site materials which have been exposed to moisture, that exceed shelf life limits, or that have been exposed to temperature extremes.

#### 1.6.3.1 Venting and Handling of Material Containers

Partially unscrew material container and drum caps to gradually vent the containers prior to opening. Do not inhale vapors. Decontaminate empty component containers by filling with water and allowing to stand for 48 hours with bung caps removed. Do not, under any circumstances seal, stop, or close containers which have been emptied of foam components.

## 1.7 FIELD PEEL ADHESION TEST

Perform a field peel adhesion test on the construction mockup. Test the SPF for adhesion in accordance with ASTM D4541 using a Type II pull tester except use a disk that is 4 inches in diameter and cut through the membrane to separate the material attached to the dish from the

surrounding material. Perform test after curing period in accordance with manufacturer's written recommendations. Record mode of failure and area which failed in accordance with ASTM D4541. Compare adhesion values with the manufacturer's established minimum values for the particular combination of material and substrate. Indicate on the inspection report whether the manufacturer's requirement has been met. Where the manufacturer has not declared a minimum adhesion value for their product and substrate combination, the inspector must record actual values.

#### 1.8 AIR BARRIER TESTING

Perform air barrier testing in accordance with Section 07 27 10.00 10 BUILDING AIR BARRIER SYSTEM and Section 07 05 23 PRESSURE TESTING AN AIR BARRIER SYSTEM FOR AIR TIGHTNESS.

#### 1.9 SAFETY PROVISIONS

##### 1.9.1 Fire Prevention

Provide a written fire prevention plan for the SPF application. Address specific fire hazards such as spontaneous combustion from exothermic heat build-up of SPF components during curing. Provide a continuous fire watch during mixing and spraying of SPF and for a minimum of two hours after completion of work at the end of each day. Maintain fire watch for additional time as required to ensure no potential ignition conditions exist.

##### 1.9.1.1 Fire Extinguishers

Furnish two fire extinguishers of minimum 15 pounds capacity each, in accordance with NFPA 10, in the immediate vicinity of the work. CAUTION: Do not discharge high pressure carbon dioxide extinguishers where explosive vapors exist since the discharge can cause a spark which will ignite the vapors.

##### 1.9.2 Respirator Plan

Provide a written respirator plan in accordance with OSHA regulations that protects installers during application and addresses separation of the area to prevent other workers from entering the work area during spraying.

##### 1.9.3 Isolation

Isolate the work area as recommended by spray foam manufacturer's written requirements. Prevent workers without respiratory, skin, and eye Personal Protective Equipment (PPE) or training from entering the work area or otherwise being exposed to off-gassing of the insulation in excess of permissible exposure limits.

##### 1.9.4 Respirators and Eye Protection

Respiratory protective devices (respirators) must meet the requirements of ASSE/SAFE Z88.2. Eye and face protective equipment must meet the requirements of ANSI/ISEA Z87.1. Additionally, sprayers and workers in the immediate vicinity of the spray must wear NIOSH-approved, full-face, supplied air respirators (SAR) operated in positive pressure or continuous flow mode. Workers not in the immediate vicinity of the sprayer must wear air purifying respirators (APR) with an organic gas / P100 particulate cartridge. Instruct personnel in the use of devices. Maintain such

equipment and inspect regularly. All workers are required to have undergone pulmonary function testing and fit testing and must provide certification that they have done so. Change APR cartridges in accordance with manufacturer's written recommendations.

#### 1.9.5 Clothing and Gloves

Sprayers and workers must wear protective clothing and gloves in accordance with OSHA requirements during materials application. Disposable coveralls must be worn and must cover all exposed skin. Sprayers and workers must wear fabric gloves coated with nitrile, neoprene, butyl or PVC.

#### 1.9.6 Additional Requirements

Require personnel to review the Health, Safety and Environmental Aspects of Spray Polyurethane Foam and Coverings published by the Spray Polyurethane Foam Alliance (SPFA). Verify compliance prior to allowing personnel on site for installation work. <http://www.sprayfoam.org>.

### 1.10 QUALITY ASSURANCE

#### 1.10.1 Qualification of Manufacturer

Submit documentation verifying that the manufacturer of the SPF is currently accredited by the Air Barrier Association of America (ABAA Accreditation <https://www.airbarrier.org/>) and by the Spray Polyurethane Foam Alliance (SPFA).

#### 1.10.2 Qualification of Installer

Submit documentation verifying that installers of the spray foam air barrier are currently certified by ABAA/BPQI (Building Performance Quality Institute) and by the Spray Polyurethane Foam Alliance (SPFA) Professional Certification Program (PCP). Installers must provide photo identification certification cards for inspection upon request.

#### 1.10.3 General Quality Requirements

Provide all products and installation in accordance with SPFA TechDocs requirements (<http://www.sprayfoam.org/technical/spfa-technical-documents>) and documented best practices.

### 1.11 PRECONSTRUCTION MEETING

Conduct a preconstruction meeting after approval of submittals and a minimum of two weeks prior to commencing work specified in this Section. Attendance is required by the Contracting Officer's designated personnel, Contractor, and representatives of related trades including covering materials, substrate materials, adjacent materials, and materials and components of the air/vapor/thermal barrier system. Agenda must include, at a minimum, the following items:

- a. Drawings, specifications and submittals related to the SPF work;
- b. Sequence of construction;
- c. Coordination with substrate preparation work and responsibility of repairing defects in substrates. Determine method of ensuring SPF

work does not begin until substrates have been inspected and accepted;

- d. Compatibility of materials;
- e. Construction and testing of construction mockup;
- f. Application of self-adhering air barrier transitions strips and primer as required for sealing the spray foam air barrier system at openings including but not limited to windows, doors and louvers;
- g. Spray foam air barrier system installation; including methods to be used to provide a continuous barrier at thru-wall flashing, penetrations, and covering of embed items;
- h. Quality control plan including methods of applying the product so that a consistent thickness across the face of the substrate is achieved.
- i. Procedures for SPF manufacturer's technical representative's onsite inspection and acceptance of substrates, contact info for the representative, frequency of visits, and distribution of copies of inspection reports. Determine where core samples will be taken and review procedures for daily documentation of SPF application.
- j. Property protection measures, including isolation of the work, and prevention of overspray and clean-up should overspray occur.
- k. Safety requirements, including review of PPE, fire prevention, safety plan, respirator plan, ventilation and separation of the work area, fall protection, and posting of warning signs. Provide a complete schedule and a detailed, written fire protection plan including temporary isolation of the product and the work area until permanent isolation or thermal barrier is in place.

#### 1.12 ENVIRONMENTAL CONDITIONS

##### 1.12.1 Temperature and Weather

Install SPF within the range of ambient and substrate surface temperatures in accordance with manufacturer's written instructions. Do not apply SPF to damp or wet substrates. Do not apply SPF during inclement weather or when ice, frost, surface moisture, or visible dampness is present on surfaces to be covered, or when precipitation is imminent. Do not apply SPF to exterior building surfaces when wind speeds exceed 25 miles per hour. Use moisture measuring methods and equipment to verify that the moisture conditions of substrate surfaces are in accordance with SPF manufacturer requirements prior to application. Substrate temperatures must be within limits recommended by the manufacturer's printed instructions.

##### 1.12.2 Conditions for Primers

Follow manufacturer's printed application and curing instructions. Do not apply primer when ambient temperature is below 40 degrees F or when ambient temperature is expected to fall below 35 degrees F for the duration of the drying or curing period.

##### 1.12.3 Temporary Ventilation

Provide temporary ventilation for work of this section in accordance with



manufacturer's written instructions and with OSHA requirements for this type of application.

### 1.13 FOAM SPRAY EQUIPMENT

#### 1.13.1 Applicator

Use an air purge foam spray gun.

#### 1.13.2 Equipment Calibration

Fully calibrate the foam metering equipment to monitor each liquid component to within 2 percent of the SPF manufacturer's required metering ratio. Calibrate spray equipment each day at the start of operations, after each restart if spraying operations have been terminated for more than one hour, whenever there is a change in fan pattern or pressure, whenever slow curing areas are noticed, whenever a change is made in hose length or working height, and after changeover between materials. Calibration consists of demonstrating that the equipment is adjusted to deliver components in proper mix and proportion. Conduct calibration tests on cardboard or plywood on a wall adjacent to the area to be sprayed.

#### 1.13.3 Metering Equipment Requirements

Use foam metering equipment capable of developing and maintaining the SPF manufacturer's required liquid component pressures and temperatures. Foam metering equipment must have gages for visual monitoring. Equipment must provide temperature control of foam components to within the temperature ranges recommended by the foam manufacturer's printed instructions.

#### 1.13.4 Moisture Protection

Protect surfaces of supply containers and tanks used to feed foam metering equipment from moisture.

#### 1.13.5 Compressed Air

Supply compressed air that is in contact with SPF during mixing or atomization through moisture traps that are continuously bled.

#### 1.13.6 Dispense Excess Materials

Do not deposit materials used for cleaning of equipment or materials dispensed for calibration purposes and establishment of spray gun pattern onto the ground. Dispense such materials into scrap containers or onto plastic film, or cardboard, and dispose of in accordance with safety requirements and jobsite regulations.

## PART 2 PRODUCTS

### 2.1 PRODUCT SUSTAINABILITY

#### 2.1.1 Reduced Volatile Organic Compound (VOC) Content

Provide products with reduced VOC content and provide documentation in accordance with Section 01 33 29 SUSTAINABILITY REPORTING.

### 2.1.2 Recycled Content

Provide products with recycled content and provide documentation in accordance with Section 01 33 29 SUSTAINABILITY REPORTING.

## 2.2 SPRAY FOAM AIR BARRIER

### 2.2.1 General

Provide a closed cell, sprayed in place, SPF that forms a continuous air /vapor/thermal barrier at the building enclosure. Provide in accordance with ASTM C1029, with the requirements of UFC 3-600-01, ICC IBC Chapter 26, ICC-ES AC308, and NFPA 285. In the event of a conflict, the most stringent requirement applies. Provide all system components necessary for a complete, code compliant installation, whether indicated or not, including material support components, expansion and contraction joints, thermal barrier materials, and accessories.

### 2.2.2 Physical Properties

Provide a closed cell product with the following characteristics:

- a. Density (ASTM D1622): 2.0 lb per cf, nominal
- b. Thermal Resistance (ASTM C518)
  - (1) Initial R-value per inch thickness: 7 sf degrees F h per Btu
  - (2) Aged R-value per inch thickness (180 days at 76 degrees F): 6.6 sf degrees F h per Btu
- c. Air Permeance (ASTM E2178): In accordance with Section 07 27 10.00 10 BUILDING AIR BARRIER SYSTEM.
- d. Air Leakage (ASTM E2357, ASTM E283): In accordance with Section 07 27 10.00 10 BUILDING AIR BARRIER SYSTEM and Section 07 05 23 PRESSURE TESTING AN AIR BARRIER SYSTEM FOR AIR TIGHTNESS.
- e. Compressive Strength (ASTM D1621): Minimum 28.3 psi
- f. Tensile Strength (ASTM D1623)
  - (1) Medium density: 15psi
  - (2) Roofing: 40 psi
- g. Water Vapor Permeance (ASTM E96/E96M, water method): less than 1.2 US perms at one inch thickness
- h. Vapor Retarder (ICC IBC, ICC IECC) Class III
- i. Surface Burning Characteristics (ASTM E84) 3 inch thickness:
  - (1) Flame Spread (FS) Index Rating less than 75.
  - (2) Smoke Developed (SD) Index Rating less than 150. SPF with an SD rating greater than 150 but less than 450 may be used when fully encapsulated. Approval of SPF product is contingent upon approval of encapsulation products and assemblies.

- j. Closed Cell Content (ASTM D6226): 90 percent
- k. Dimensional Stability (Humid Aging) (ASTM D2126): 15 percent at 28 days at 158 degrees F with 97 percent relative humidity.
- l. Water Absorption (ASTM D2842): Maximum 1.0 per volume
- m. Fungi Resistance (ASTM C1338): Pass, with no growth
- n. Recycled Content: Minimum 9 percent (pre- and post-consumer)

#### 2.2.3 Expansion and Contraction

Provide an assembly that allows for relative movement due to temperature, moisture, and air pressure changes. Provide expansion and contraction measures as required by the manufacturer's written recommendations.

#### 2.2.4 Fire-ratings, Flame Spread and Smoke Developed Index Ratings

Where fire-rated materials are indicated, provide products with the appropriate markings of a qualified testing agency. Submit fire-rating test reports. Submit flame spread (FS) and smoke developed (SD) index data. Where FS and SD values of foam products do not meet requirements, provide corresponding thermal barrier products or assemblies and verify complete encapsulation of the spray foam air barrier through product data or on shop drawings. Submit for approval in accordance with Section 01 33 00 SUBMITTAL PROCEDURES.

#### 2.2.5 Prohibited Materials

Products that contain hexabromocyclododecane (HBCD) flame retardants are prohibited. Products that contain hydrochlorofluorocarbons (HCFCs), chlorofluorocarbons (CFCs), or other high ozone depleting blowing agents, are prohibited. For a list of acceptable substitute foam blowing agents see <https://www.epa.gov/snap/foam-blowing-agents>.

#### 2.2.6 Thermal Barrier

Provide a thermal barrier in locations where SPF is exposed to the interior of the building, including attics and plenum spaces. Provide thermal barriers in accordance with ICC IBC Chapter 26 "Plastics," with ICC-ES AC377, ASTM E736, and NFPA 275.

- a. Building interior, fire-rated enclosures: At walls, ceilings and floors that are required to be fire-rated, separate the SPF from the occupied interior of a building with an ignition barrier consisting of 5/8 inch, Type X, fire-rated GWB in the number of layers corresponding to required ratings. Include all accessories as necessary for complete fire-rated assemblies.

#### 2.3 PRIMERS, ADHESIVES, AND MASTICS

Provide primers, adhesives, mastics and other accessory materials as recommended by spray foam manufacturer's printed literature.

#### 2.4 FLASHING

As specified in Section 07 60 00 FLASHING AND SHEET METAL.

## 2.5 JOINT SEALANTS

As specified in Section 07 92 00 JOINT SEALANTS. Verify compatibility with other system products.

## PART 3 EXECUTION

### 3.1 EXAMINATION

Before installing the spray foam air barrier and with the installer present, examine substrates, areas, and conditions under which SPF will be applied, for compliance with requirements. Ensure that surfaces are sound, dry, even, and free of oil, grease, dirt, excess mortar or other contaminants. Ensure that concrete surfaces are cured and dry, smooth without large voids, spalled areas or sharp protrusions. Correct defects that adversely affect the spray foam application or performance. Verify that work by other trades is in place and complete prior to application of spray foam.

### 3.2 PREPARATION

#### 3.2.1 Substrate Preparation

Clean, prepare, and treat substrate according to manufacturer's written instructions. Provide clean, dust-free, and dry substrate for spray foam application.

- a. Prepare surfaces by brushing, scrubbing, scraping, or grinding to remove loose mortar, dust, oil, grease, oxidation, mill scale and other contaminants which will affect adhesion of the SPF.
- b. Wipe down metal surfaces to remove release agents or other non-compatible coatings, using clean sponges or rags soaked in a solvent compatible with the SPF.

#### 3.2.2 Protection

Protect adjacent areas and surfaces from spray applied materials in accordance with the following:

- a. Mask and cover adjacent areas to protect from over spray.
- b. Ensure required foam stops and back up materials are in place to achieve a complete seal.
- c. Seal off ventilation equipment. Install temporary ducting and fans to provide required exhaust of spray fumes. Provide make-up air as required.
- d. Erect barriers, isolate area, and post warning signs to notify non-protected personnel of the requirement to avoid the spray area.

#### 3.2.3 Blocking Around Heat Producing Devices

Install non-combustible blocking around heat producing devices to provide the following clearances:

- a. Recessed light fixtures, including wiring compartments, ballasts, and

other heat producing devices, unless certified for installation surrounded by insulation: Minimum of 3 inches from outside face of fixtures and devices and in accordance with NFPA 70 and, if insulation is to be placed above fixture or device, 24 inches above fixture.

- b. Masonry enclosing a flue: a minimum of 2 inches from outside face of masonry. Masonry chimneys for medium and high heat operating appliances: Minimum clearances in accordance with NFPA 211.
- c. Vents and vent connectors used for venting products of combustion, flues, and chimneys other than masonry chimneys: Minimum clearances in accordance with NFPA 211.
- d. Gas Fired Appliances: Clearances in accordance with NFPA 54.
- e. Oil Fired Appliances: Clearances in accordance with NFPA 31. Blocking is not required if chimneys or flues are certified by the manufacturer for use in contact with insulating materials.

#### 3.2.4 Fire and Explosion Hazards

Prohibit open flames, sparks, welding, and smoking in the application area. Provide and maintain fire extinguishers of appropriate type, size and distance, as required by NFPA, in the application area. Mix batches in small enough quantities to avoid spontaneous combustion from exothermic heat build-up of SPF components during curing.

#### 3.2.5 Warning Signs

Post warning signs at ground level adjacent to the work area and a minimum of 150 feet from the application area stating the area is off limits to unauthorized persons and warning of potential hazards. Place clearly visible and legible warning sign at entrance to primary road leading to the project facility warning of presence of flammable materials, irritating fumes, and potential of overspray damage.

#### 3.2.6 Prime Substrate

Provide as recommended by the manufacturer for each substrate to be primed. Use primers at full strength. Do not dilute primers unless required and as recommended in writing by the manufacturer. Do not use cleaning solvents for thinning primers or other materials. Ensure that diluted primer(s) meet VOC requirements.

### 3.3 INSTALLATION

#### 3.3.1 Sequencing and Coordination

Sequence the work so as to prevent access to the work area by other trades during foam application and curing. Limit access of non-essential workers during application. Notify the Contracting Officer 24 hours in advance of spraying operations. Sequence spray foam work with other trades to permit continuous self-flashing of the spray foam air barrier. Ensure expansion and control joints are provided as detailed on the manufacturer's shop drawings to accommodate the expansion of each layer of the air/thermal envelope. Provide temporary fire protection of uncured foam, and isolate the work area, until foam application is isolated with a permanent thermal or ignition barrier.

### 3.3.2 Installation of Transition Membrane

Install transition membrane materials in accordance with the details on the drawings, Section 07 27 19.01 SELF-ADHERING AIR BARRIERS, and the following:

- a. Install transition membrane at all required locations prior to installation of the fluid-applied membrane air barrier.
- b. Verify transition membrane is fully adhered to substrate and that its surface is clean, dry and wrinkle free prior to installation of the fluid-applied membrane air barrier.
- c. Verify transition membrane completely covers all transition areas and will provide continuity of the finished SPF air barrier without gaps or cracks.

### 3.3.3 Installation of Spray Foam Air Barrier

Install materials in accordance with paragraph SAFETY PROVISIONS, in accordance with manufacturer's recommendations, ULC S705.2 Installation Standard, and in accordance with the following:

- a. Use spray equipment that complies with foam manufacturer's recommendations for the specific type of application, and as specified herein. Record equipment settings on the Daily Work Record. Each proportioned unit can supply only one spray gun.
- b. Apply only when surfaces and environmental conditions are within limits prescribed by the material manufacturer.
- c. Continuously connect the spray foam air barrier between walls, roof, floor, and below grade assemblies to form a continuous integrated air barrier system around the entire building enclosure. Extend the spray foam air barrier into rough openings such as doors, windows, louvers, and other exterior penetrations. Use self-adhering air barrier transition strips if necessary to achieve full extension and continuity of the barrier at these locations. Seal edges of barrier at junctures with rough openings.
- d. Install within manufacturer's tolerances, but not more than minus 1/4 inch or plus 1/2 inch.
- e. Sequence work so as to completely seal all penetrations resulting from pipes, vents, wires, conduit, electrical fixtures, structural members, or other construction. If penetrations through the spray foam air barrier are made after the initial SPF application, reapply in accordance with manufacturer's written instructions for such remedial work.
- f. Do not install SPF within 3 inches of heat emitting devices such as light fixtures and chimneys.
- g. Finished surface of SPF must be free of voids and embedded foreign objects.
- h. Remove masking materials and over spray from adjacent areas immediately after foam surface has hardened. Ensure cleaning methods do not damage work performed by other sections.

- i. Trim, as required, any excess thickness that would interfere with the application of cladding and covering system by other trades.
- j. Clean and restore surfaces soiled or damaged by work of other trades. Before cleaning and restoring damaged work, consult with other trades for appropriate and approved methods for cleaning and restoration to prevent further damage.
- k. Complete connections to other components and repair any gaps, holes or other damage using material approved by the manufacturer.
- l. Provide expansion joints in the SPF application aligned with expansion joints in the building enclosure, where substrate materials change, and in accordance with manufacturer's recommendations.
- m. Provide a continuous fire watch in accordance with paragraph SAFETY PROVISIONS.

### 3.4 FIELD QUALITY CONTROL

#### 3.4.1 General Site Inspections and Testing

Provide site inspections and testing in accordance with ABAA protocol to verify conformance with the manufacturer's instructions, the ABAA QAP Quality Assurance Program (<https://www.airbarrier.org/qap/>), Section 07 27 10.00 10 BUILDING AIR BARRIER SYSTEM, Section 07 05 23 PRESSURE TESTING AN AIR BARRIER SYSTEM FOR AIR TIGHTNESS, and this section.

- a. Conduct inspections and testing at 5, 50, and 95 percent of completion of this scope of work. Forward written inspection reports to the Contracting Officer within 5 working days of the inspection and test being performed.
- b. If inspections reveal any defects, promptly remove and replace defective work at no additional expense to the Government.

#### 3.4.2 Manufacturer Site Inspections

Manufacturer's technical representative must visit the site during the installation process to ensure the SPF and accessories are being applied in compliance with requirements. At a minimum, manufacturer's technical representative must be present at work startup and perform field inspection of the first day's completed application and at substantial completion, prior to demobilization. After each inspection, submit an inspection report signed by the manufacturer's technical representative, to the Contracting Officer within five working days. The inspection report must note overall quality of work, deficiencies, and recommended corrective actions in detail. Notify the Contracting Officer a minimum of two working days prior to site visits by manufacturer's technical representative.

#### 3.4.3 Contractor's Site Inspections

Establish and maintain an inspection procedure to ensure compliance of the foam installation with contract requirements. Conduct inspections and testing at 5, 50, and 95 percent completion of application. Forward written inspection reports to the Contracting Officer within five working days of the inspection and test being performed. Work not in compliance

must be promptly removed and replaced or corrected, in an approved manner, at no additional cost to the Government. Quality control must include, but is not limited to, the following:

- a. Observation of environmental conditions; number and skill level of insulation workers.
- b. Verification of certification, listing, or label.
- c. Verification of proper storage and handling of materials before, during, and after installation.
- d. Inspection of SPF, support structure, primer, expansion joints, thermal barrier, vapor retarder, and accessories.

#### 3.4.4 Field Peel Adhesion Test

Conduct in accordance with test protocol indicated in Part 1 paragraph FIELD PEEL ADHENSION TEST.

#### 3.4.5 Visual Inspection and Thermal Scanning

Following completion of installation, inspect the SPF surface or cavity using infrared (IR) scanning as specified in ASTM C1060 and ASTM C1153 . Where the IR inspection indicates construction inconsistencies including wet insulation, remove inconsistent portions of the assembly and replace insulation to correct thermal anomalies. Reinspect and document corrections to the satisfaction of the Contracting Officer.

##### 3.4.5.1 Thermographic Test Report

Include thermographs in color and a color temperature scale to define the temperature indicated by the various colors. Identify the high temperature reading, the outdoor air temperature, the building indoor air temperature, and the wind speed and direction. Note areas of compromise in the building enclosure, and note actions required and taken to correct those areas. Final thermography test report must demonstrate that the problem areas have been corrected. Submit the complete test and analysis.

#### 3.5 CORRECTION OF DEFICIENCIES

Upon completion of inspection, testing, or sample taking, repair damaged construction, restore substrates and finishes, and protect repaired construction. Deficiencies found during inspection must be corrected within 5 working days following notification.

#### 3.6 CLEANUP OF SPILLS

Conduct cleanup of uncured product spillage in accordance with paragraph SAFETY PROVISIONS and the manufacturer's written safe handling instructions. In the event of a conflict, the most stringent requirement governs.

#### 3.7 PROTECTION AND CLEANING

##### 3.7.1 Protection of Installed Work

Protect SPF installation from damage during application and remainder of construction period in accordance with manufacturer's written



instructions. Repair damaged areas to new condition.

### 3.7.2 Cleaning of Adjacent Surfaces

Clean overspray from adjacent construction using cleaning agents and procedures as recommended in writing by the manufacturer of each type of affected construction and as acceptable to same.

-- End of Section --



SECTION 07 41 63

FABRICATED ROOF PANEL ASSEMBLIES

11/16

PART 1 GENERAL

1.1 REFERENCES

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

AMERICAN INSTITUTE OF STEEL CONSTRUCTION (AISC)

AISC 341 (2016) Seismic Provisions for Structural Steel Buildings

AMERICAN IRON AND STEEL INSTITUTE (AISI)

AISI D100 (1991; R 2008) Cold-Formed Steel Design Manual

AMERICAN SOCIETY OF CIVIL ENGINEERS (ASCE)

ASCE 7 (2017) Minimum Design Loads for Buildings and Other Structures

AMERICAN WELDING SOCIETY (AWS)

AWS A5.1/A5.1M (2012) Specification for Carbon Steel Electrodes for Shielded Metal Arc Welding

AWS D1.1/D1.1M (2015; Errata 1 2015; Errata 2 2016) Structural Welding Code - Steel

ASTM INTERNATIONAL (ASTM)

ASTM A1008/A1008M (2016) 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 A123/A123M (2017) Standard Specification for Zinc (Hot-Dip Galvanized) Coatings on Iron and Steel Products

ASTM A36/A36M (2014) Standard Specification for Carbon Structural Steel

ASTM A463/A463M (2010; R 2015) Standard Specification for Steel Sheet, Aluminum-Coated, by the Hot-Dip Process

ASTM A653/A653M (2017) Standard Specification for Steel Sheet, Zinc-Coated (Galvanized) or Zinc-Iron Alloy-Coated (Galvannealed) by

the Hot-Dip Process

ASTM A755/A755M	(2016; E 2016) Standard Specification for Steel Sheet, Metallic Coated by the Hot-Dip Process and Prepainted by the Coil-Coating Process for Exterior Exposed Building Products
ASTM A780/A780M	(2009; R 2015) Standard Practice for Repair of Damaged and Uncoated Areas of Hot-Dip Galvanized Coatings
ASTM A792/A792M	(2010) Standard Specification for Steel Sheet, 55% Aluminum-Zinc Alloy-Coated by the Hot-Dip Process
ASTM B117	(2016) Standard Practice for Operating Salt Spray (Fog) Apparatus
ASTM B659	(1990; R 2014) Standard Guide for Measuring Thickness of Metallic and Inorganic Coatings
ASTM C920	(2018) Standard Specification for Elastomeric Joint Sealants
ASTM D1056	(2014) Standard Specification for Flexible Cellular Materials - Sponge or Expanded Rubber
ASTM D1308	(2013) Effect of Household Chemicals on Clear and Pigmented Organic Finishes
ASTM D1667	(2017) Standard Specification for Flexible Cellular Materials - Poly (Vinyl Chloride) Foam (Closed-Cell)
ASTM D2244	(2016) Standard Practice for Calculation of Color Tolerances and Color Differences from Instrumentally Measured Color Coordinates
ASTM D2247	(2015) Testing Water Resistance of Coatings in 100% Relative Humidity
ASTM D2794	(1993; R 2010) Resistance of Organic Coatings to the Effects of Rapid Deformation (Impact)
ASTM D3363	(2005; E 2011; R 2011; E 2012) Film Hardness by Pencil Test
ASTM D4214	(2007; R 2015) Standard Test Method for Evaluating the Degree of Chalking of Exterior Paint Films
ASTM D522/D522M	(2014) Mandrel Bend Test of Attached Organic Coatings

ASTM D523	(2014) Standard Test Method for Specular Gloss
ASTM D714	(2002; R 2017) Standard Test Method for Evaluating Degree of Blistering of Paints
ASTM D822	(2013) Filtered Open-Flame Carbon-Arc Exposures of Paint and Related Coatings
ASTM D968	(2017) Standard Test Methods for Abrasion Resistance of Organic Coatings by Falling Abrasive
ASTM E119	(2016a) Standard Test Methods for Fire Tests of Building Construction and Materials
ASTM E136	(2016) Behavior of Materials in a Vertical Tube Furnace at 750 Degrees C
ASTM E1592	(2005; R 2012) Structural Performance of Sheet Metal Roof and Siding Systems by Uniform Static Air Pressure Difference
ASTM E2140	(2001; R 2017) Standard Test Method for Water Penetration of Metal Roof Panel Systems by Static Water Pressure Head
ASTM E84	(2018) Standard Test Method for Surface Burning Characteristics of Building Materials
ASTM G152	(2013) Operating Open Flame Carbon Arc Light Apparatus for Exposure of Nonmetallic Materials
ASTM G153	(2013) Operating Enclosed Carbon Arc Light Apparatus for Exposure of Nonmetallic Materials

FM GLOBAL (FM)

FM 4474	(2014) Evaluating the Simulated Wind Uplift Resistance of Roof Assemblies Using Static Positive and/or Negative Differential Pressures
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METAL BUILDING MANUFACTURERS ASSOCIATION (MBMA)

MBMA RSDM	(2012) Metal Roofing Systems Design Manual
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NATIONAL ASSOCIATION OF ARCHITECTURAL METAL MANUFACTURERS (NAAMM)

NAAMM AMP 500	(2006) Metal Finishes Manual
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NATIONAL ROOFING CONTRACTORS ASSOCIATION (NRCA)

NRCA 0429	(2014) The NRCA Roofing Manual: Architectural Metal Flashing, Condensation
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and Air Leakage Control and Reroofing

NRCA RoofMan

(2017) The NRCA Roofing Manual

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

SMACNA 1793

(2012) Architectural Sheet Metal Manual,  
7th Edition

SOCIETY FOR PROTECTIVE COATINGS (SSPC)

SSPC PS 9.01

(1982; E 2004) Cold-Applied Asphalt Mastic  
Painting System with Extra-Thick Film

UNDERWRITERS LABORATORIES (UL)

UL 580

(2006; Reprint Oct 2013) Tests for Uplift  
Resistance of Roof Assemblies

## 1.2 DEFINITIONS

Fabricated Roof Panel Assembly: Metal roof and liner panels, attachment system components, miscellaneous metal framing, thermal insulation, and accessories shop-fabricated or field-assembled for a complete weathertight roofing system.

## 1.3 SUBMITTALS

Government approval is required for submittals with a "G" designation; submittals not having a "G" designation are for information only. When used, a designation following the "G" designation identifies the office that will review the submittal for the Government. Submittals with an "S" are for inclusion in the Sustainability eNotebook, in conformance to Section 01 33 29 SUSTAINABILITY REPORTING. Submit the following in accordance with Section 01 33 00 SUBMITTAL PROCEDURES:

### SD-01 Preconstruction Submittals

Qualification of Manufacturer; G

Qualification of Installer; G

Qualifications for Welding; G

On-Site Inspection and Acceptance Procedure; G

### SD-02 Shop Drawings

Roofing Panels; G

Flashing and Accessories; G

Gutter/Downspout Assembly; G

### SD-03 Product Data

Sustainable Acquisition; G.

Factory Color Finish; G

Sub-girts and Formed Shapes; G

Closure Materials; G

Insulation; G

Pressure-Sensitive Tape; G

Sealants and Caulking; G

Rated Wall Assembly; G

Galvanizing Repair Paint; G

Accessories; G

SD-04 Samples

Roofing Panels; G

Fasteners; G

Metal Closure Strips; G

Insulation; G

Manufacturer's Color Charts and Chips; G

SD-05 Design Data

Wind Design Analysis

Seismic Design Analysis

SD-06 Test Reports

Leakage Tests; G

Fire Rating Test Report; G

Coatings and Base Metals of Metal Roofing; G

Factory Finish and Color Performance Requirements; G

Wind Uplift Test Report; G

Seismic Test Report; G

SD-07 Certificates

Fasteners

Galvanizing Repair Paint

Safety Data Sheets

Coating Physical Properties:

SD-08 Manufacturer's Instructions

Installation of Roof Panel Assemblies

SD-11 Closeout Submittals

Warranty

Information Form and Placard; G

Application Instructions

1.4 QUALITY CONTROL

1.4.1 Preroofing Conference

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

a. The drawings and specifications:

- (1) Fabrication and installation drawings for the following items are to indicate completely dimensioned structural frame and erection layouts, openings in the roof, special framing details and construction details at corners, ridges, eaves, building intersections, curbs and flashing, location and type of mastic and metal filler strips, location and erection of flashing and gutter/downspout assembly.
- (2) Installation of roof panel assemblies
- (3) Roofing panels, submit sample 12 inches long by actual panel width
- (4) Flashing and accessories, submit sample 10 inches long of each type
- (5) Gutter/downspout assembly

Submit the manufacturer's color charts and chips, approximately 4 by 4 inches, showing the full range of colors, textures and patterns available for roof panels with the factory color finish.

Submit factory finish and color performance requirements verified by an independent testing agency.

Submit a wind design analysis from the manufacturer including wind speed, exposure category, coefficient, importance factor. Designate a type of facility, negative pressures for each zone, methods and requirements of attachment. Include a roof plan delineating dimensions and attachment patterns for each zone. Include a signed and sealed wind design analysis with a Licensed project engineer, in the geographic area where the construction will take place.

- (1) Wind Uplift Test Report
- (2) Seismic Design Analysis
- (3) Seismic Test Report



(4) Fire Rating Test Report

b. Qualifications including:

(1) Qualification of Manufacturer

(2) Qualification of Installer

(3) Qualifications for Welding

c. Submit an on-site inspection and acceptance procedure of the roofing substrate and pertinent structural details relating to the roofing system, including:

(1) Safety Data Sheets

(2) Sub-girts and Formed Shapes

(3) Closure Materials

(4) Insulation

(5) Pressure-Sensitive Tape

(6) Sealants and Caulking

(7) Rated Wall Assembly

(8) Galvanizing Repair Paint

(9) Accessories

Include detailed application instructions and standard manufacturer drawings altered as required by these specifications. Explicitly identify in writing the differences between the manufacturer's instructions and the specified requirements.

a. Safety requirements

b. Submit manufacturer's data indicating the percentage of recycle material in roofing panels to verify sustainable acquisition compliance.

#### 1.4.2 Manufacturer's Technical Representative

Ensure the representative has authorization from the manufacturer to approve field changes and is thoroughly familiar with the products and installations in the geographical area where construction will take place.

#### 1.4.3 Qualification of Manufacturer

Guarantee the metal roof panel system manufacturer possesses the following:

a. A minimum of five years of experience in manufacturing metal roof system and accessory products.

b. Engineering services of an authorized engineer; currently licensed in the geographical area where construction will take place, having a

minimum of four years of experience as an engineer knowledgeable in roof wind design analysis, protocols and procedures for the MBMA RSDM; ASCE 7, UL 580 and FM 4474 FM wind design guide for metal roof systems.

- c. Certified engineering calculations using the products submitted for wind uplift requirements in accordance with FM 4474 and ASCE 7.

#### 1.4.4 Qualification of Installation Contractor

Confirm that the installation contractor is approved and certified by the roofing panel manufacturer before installing the metal roofing system.

#### 1.4.5 Qualifications for Welding

Provide certification of welding procedures conforming to AWS A5.1/A5.1M and AWS D1.1/D1.1M

#### 1.4.6 Single-Source

Obtain each type of metal roof and liner panels, clips, closures and other accessories from the standard products of the single-source manufacturer to ensure these items operate as a complete system for the intended use.

### 1.5 DELIVERY, STORAGE, AND HANDLING

Deliver components, sheets, metal roof panels, and other manufactured items, handling them in a manner to prevent damage or deformation; package metal roof panels for protection during transportation and handling.

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

Stack metal roof panels on platforms or pallets, covered with a suitable weather-tight and ventilated covering; store metal roof panels to ensure dryness. Do not store metal roof panels in contact with other materials that might cause staining, denting, or other surface damage.

Protect the strippable protective covering on metal roof panels from exposure to sunlight and high humidity, except to extent necessary for the period of metal roof panel installation.

Protect foam-plastic insulation as follows:

- a. Do not expose the foam-plastic insulation to sunlight, except to extent necessary for period of installation and concealment.
- b. Protect the foam-plastic insulation against ignition at all times. Do not deliver foam-plastic insulation materials to the project site before installation time.

Complete installation and concealment of plastic materials as rapidly as possible.

### 1.6 PROJECT/SITE CONDITIONS

Weather Limitations: Proceed with installation only when existing and forecasted weather conditions permit metal roof panel work to be performed according to the manufacturer's written instructions and warranty requirements.

Field Measurements: Verify the actual dimensions of construction contiguous with metal roof panels by field measurements before fabrication.

#### 1.7 WARRANTY

Furnish the metal roof panel manufacturer's 20-year roof system materials and installation workmanship warranty, including flashing, insulation, components, trim, and accessories necessary for a watertight roof system construction. Issue the warranty directly to the Government, such that the warranty takes effect at the time of the Government's acceptance of the roof work. Provide a warranty with the following conditions:

- a. If within the warranty period, the metal roof system, as installed for its intended use in the normal climatic and environmental conditions of the facility, becomes nonwater-tight, shows evidence of moisture intrusion within the assembly, displaces, corrodes, perforates, separates at the seams, or shows evidence of excessive weathering due to defective materials or installation workmanship, the repair or replacement of the defective and damaged materials of the metal roof system and correction of defective workmanship is the responsibility of the metal roof panel manufacturer. All costs associated with the repair or replacement work are the responsibility of the metal roof panel manufacturer. Conform galvanized repairs to ASTM A780/A780M.
- b. If the manufacturer or the applicator approved by the manufacturer fail to perform the repairs within 24 hours of notification, emergency temporary repairs performed by others does not void the warranty.

##### 1.7.1 Metal Roof System Installer Warranty

Provide roof system installer warranty for a period of not less than five years that the roof system, as installed, is free from defects in installation workmanship, including the roof panel installation, flashing, insulation, accessories, attachments, and sheet metal installation integral to a complete watertight roof system assembly. Issue warranty directly to the Government. Issue a statement that correction of defective workmanship and replacement of damaged or affected materials is the responsibility of the metal roof system installer. Also state that all costs associated with the repair or replacement work are the responsibility of the installer.

##### 1.7.2 Continuance of Warranty

Approve and accomplish repair or replacement work that becomes necessary within the warranty period to restore the integrity of the roof system assembly and maintain the validity of the metal roof system manufacturer's warranty for the remainder of the manufacturer warranty period.

## PART 2 PRODUCTS

### 2.1 SYSTEM DESCRIPTION

#### 2.1.1 Conformance and Compatibility

Provide an entire roofing and flashing system in accordance with specified and indicated requirements, including wind resistance and seismic per AISC 341 requirements. Perform any work not specifically addressed, or any deviation from specified requirements in general accordance with

recommendations of the MBMA RSDM, NRCA RoofMan, the metal panel manufacturer's published recommendations and details, and compatible with surrounding components and construction. Submit any deviation from specified or indicated requirements to the Contracting Officer for approval before installation.

#### 2.1.2 Performance Requirements

- a. Hydrostatic-Head Resistance: No water penetration when tested according to ASTM E2140.
- b. Wind-Uplift Resistance: Provide roof panel assemblies that comply with the requirements of the roof systems and attachments in accordance with ASTM E1592 and UL 580. Ensure that uplifting force caused by wind action governs the design for panels. Ensure that roof systems and attachments are to resist the wind loads as determined by ASCE 7.
- c. Structural Performance: Provide roof panel assemblies capable of withstanding the effects of gravity loads and stresses within limits and under conditions indicated, based on testing according to ASTM E1592.
- d. Seismic Performance: Provide fabricated roof panel assemblies conforming to AISC 341 and the test data confirming compliance.

#### 2.1.3 Fire-Resistance

##### 2.1.3.1 Surface-Burning Characteristics

Provide metal roof panels having insulation core material with the following surface-burning characteristics as determined by testing identical products according to ASTM E84 by a qualified testing agency. Identify products with the appropriate markings of an applicable testing agency.

Flame-Spread Index: 25 or less.

Smoke-Developed Index: 450 or less.

##### 2.1.3.2 Fire-Resistance Ratings

Where indicated, provide metal roof panels identical to those of assemblies tested for fire resistance by a qualified testing agency in accordance with ASTM E119. Identify products with the appropriate markings of the applicable testing agency.

Indicate design designations from UL's "Fire Resistance Directory" or from the listings of another qualified testing agency. Combustion Characteristics: ASTM E136.

#### 2.2 FABRICATION

##### 2.2.1 Fabrication

Fabricate and finish metal roof panels and accessories at the factory to the greatest extent possible, using the manufacturer's standard procedures and processes to fulfill the indicated performance requirements. Comply with indicated profiles, and dimensional and structural requirements

conforming to AISI D100.

Provide a panel profile, including major ribs and intermediate stiffening ribs, if any, for the full length of panel.

Fabricate metal roof panel side laps with factory-installed captive gaskets or separator strips that provide a tight seal and prevent metal-to-metal contact, in a manner that will seal weather-tight and minimize noise from movements within the panel assembly.

Sheet Metal Accessories: Fabricate flashing and trim to comply with recommendations in SMACNA 1793 that apply to the design, dimensions, metal, and other characteristics of the item indicated.

Form exposed sheet metal accessories without excessive oil canning, buckling, and tool marks, and true to the line and levels indicated, with exposed edges folded back to form hems.

End Seams: Fabricate nonmoving seams with flat-lock seams. Form seams and seal with epoxy seam sealer. Rivet joints for additional strength.

Sealed Joints: Form nonexpansion but movable joints in metal to accommodate elastomeric sealant, compliant with SMACNA 1793.

Conceal fasteners and expansion provisions where possible. Exposed fasteners are not allowed on the faces of accessories exposed to view.

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

## 2.2.2 Sheet Metal Flashing and Trim

### 2.2.2.1 Fabrication, General

Custom-fabricate sheet metal flashing and trim to comply with the recommendations in SMACNA 1793 that apply to the design, dimensions, metal, and other characteristics of the items indicated. Shop-fabricate items where practicable. Obtain field measurements for an accurate fit before shop fabrication.

### 2.2.2.2 Roof Drainage Sheet Metal Fabrications

Fabricate gutters to the cross section indicated, with riveted and soldered joints, complete with end pieces, outlet tubes, and other special accessories as required. Fabricate in 96-inch long sections at a minimum. Fabricate expansion joints and accessories from the same metal as the gutters, unless otherwise indicated.

Fabricate circular downspouts complete with mitered elbows. Furnish with metal hangers, fabricated from the same material as the downspouts and anchors.

### 2.2.3 Finishes

Comply with NAAMM AMP 500 for recommendations for applying and designating finishes.

Appearance of Finished Work: Ensure that there are no noticeable variations in finish on the same piece. Variations in the appearance of adjoining components are acceptable if they are within the range of approved samples and are assembled or installed to minimize contrast.

## 2.3 COMPONENTS

### 2.3.1 Miscellaneous Metal Framing

#### 2.3.1.1 General

Provide cold-formed metallic-coated steel sheet conforming to AISI D100 and ASTM A653/A653M and specified in Section 05 40 00 COLD-FORMED METAL FRAMING unless otherwise indicated.

#### 2.3.1.2 Fasteners for Miscellaneous Metal Framing

Provide fasteners of a type, material, corrosion resistance, size, and sufficient length to penetrate the supporting member a minimum of 1 inch and possessing the other properties required to fasten miscellaneous metal framing members to substrates in accordance with the roof-panel manufacturer's and ASCE 7 requirements.

### 2.3.2 Fasteners

#### 2.3.2.1 General

Provide fasteners of a type, material, corrosion resistance, size, and sufficient length to penetrate the supporting member a minimum of 1 inch and possessing the other properties required to fasten miscellaneous metal framing members to substrates in accordance with the roof-panel manufacturer's and ASCE 7 requirements.

#### 2.3.2.2 Exposed Fasteners

Provide corrosion-resistant coated steel, aluminum, stainless steel, or nylon-capped, steel-compatible exposed fasteners, with the sheet panel or flashing. Provide exposed fasteners of a type and size recommended by the manufacturer to meet the performance requirements and design loads specified. Provide the manufacturer's standard fasteners for accessories. Provide an integral metal washer that matches the color of material the washer is attached to with a compressible sealing EPDM gasket approximately 3/32 inch thick.

#### 2.3.2.3 Screws

Provide corrosion-resistant coated steel, aluminum or stainless steel screws of the type and size recommended by the manufacturer to meet the performance requirements.

#### 2.3.2.4 Rivets

Provide closed-end rivets, made of corrosion-resistant coated steel, aluminum, or stainless steel where watertight connections are required.

#### 2.3.2.5 Attachment Clips

Provide clips fabricated from steel hot-dipped galvanized in accordance

with ASTM A653/A653M G 90 or Series 300 stainless steel. Ensure that the size, shape, thickness and capacity are as required to meet the insulation thickness and design load criteria specified.

## 2.4 MATERIALS

### 2.4.1 Steel Sheet

Provide roll-form steel roof and liner panels to the specified profile, with  $f_y$  equal to 80 ksi, 22 gauge and depth as indicated, conforming to ASTM A1008/A1008M, ASTM A36/A36M. Ensure the material is plumb and true, and within the tolerances listed:

- a. Galvanized/Galvannealed steel sheet conforming to ASTM A123/A123M, ASTM A653/A653M, ASTM A792/A792M, and AISI D100.
- b. Aluminum-Zinc Alloy-coated sheet steel in accordance with ASTM A463/A463M, ASTM A755/A755M, ASTM A792/A792M and AISI D100.
- c. Provide panels with thermal expansion and contraction consistent with the type of system specified.
  - (1) Profile: a 2 inch high standing seam, 16 inch coverage, with mechanical crimping or snap-together seams with concealed clips and fasteners.
  - (2) Provide smooth, flat surface texture.

### 2.4.2 Finish

Ensure all panels receive a factory-applied Kynar 500/Hylar 5000 finish consisting of a baked-on top-coat and a manufacturer's recommended prime coat with to the following:

- a. Metal Preparation: Prepare all metal surfaces for painting on a continuous process coil coating line by alkali cleaning, hot-water rinsing, application of chemical conversion coating, cold-water rinsing, sealing with acid rinse, and thorough drying.
- b. Prime Coating: Apply a base-coat of epoxy paint, specifically formulated to interact with the top-coat, to the prepared surfaces by roll-coating the paint to a dry film thickness of 0.20 mils plus 0.05 mils. Ensure that the prime coat is oven-cured before the application of finish coat is applied.
- c. Exterior Finish Coating: Apply the finish coating over the primer by roll-coating the finish coating to a dry film thickness of 0.80 plus 5 mils (3.80 plus 0.50 mils for Vinyl Plastisol) for a total dry-film thickness of 1.00 mils plus 0.10 mils (4.00 mils plus 0.10 mils for Vinyl Plastisol). Ensure that the finish coat is oven-cured.
- d. Interior Finish Coating: Apply a wash-coat on the reverse side over the primer by roll-coating to a dry-film thickness of 0.30 mils plus 0.05 mils for a total-dry film thickness of 0.50 mils plus 0.10 mils. Ensure that the wash-coat is oven-cured.
- e. Color: Ensure that the exterior finish is as chosen from the manufacturer's standard color chart.

f. Coating Physical Properties: Provide coating conforming to the industry and manufacturer's standard performance criteria as listed by the following certified test reports:

- (1) Chalking: ASTM D4214
- (2) Coating Thickness: ASTM B659
- (3) Color Change and Conformity: ASTM D2244
- (4) Weatherometer: ASTM G152, ASTM G153 and ASTM D822
- (5) Humidity: ASTM D2247 and ASTM D714
- (6) Salt Spray: ASTM B117
- (7) Chemical Pollution: ASTM D1308
- (8) Gloss at 60: ASTM D523
- (9) Pencil Hardness: ASTM D3363
- (10) Reverse Impact: ASTM D2794
- (11) Flexibility: ASTM D522/D522M
- (12) Abrasion: ASTM D968
- (13) Flame Spread: ASTM E84

## 2.5 ACCESSORIES

### 2.5.1 General

Provide only accessories which are compatible with the metal roof panels. Sheet metal flashing, trim, metal closure strips, caps and similar metal accessories can not be less than the minimum thickness specified for the roof panels. Submit a 10 inches long sample of each type. Ensure the exposed metal accessories and finishes match the panels furnished, except as otherwise indicated. Provide molded-foam rib, ridge and other closure strips which are non-absorbent closed-cell or solid-cell synthetic rubber or pre-molded neoprene to match the configuration of the panels.

### 2.5.2 Solar Hot Water Collector Mounting

Manufacturer to provide a compatible framing system for the collector mounting. Provide stainless steel clamps for the solar collector frame rail assembly attachment to the standing seam metal roof ribs.

### 2.5.3 Rubber Closure Strips

Provide closed-cell, expanded cellular rubber conforming to ASTM D1056 and ASTM D1667; extruded or molded to the configuration of the specified roof panel and in lengths supplied by the roof-panel manufacturer.

### 2.5.4 Metal Closure Strips

Provide factory fabricated steel closure strips of the same gauge , color,



finish and profile as the specified roof panel.

## 2.5.5 Joint Sealants

### 2.5.5.1 Sealants

Provide an approved gun-type sealant for use in hand- or air-pressure caulking guns at temperatures above 40 degrees F (or frostfree application at temperatures above 10 degrees F with minimum solid content of 85 percent of the total volume. Provide sealant that has a tough, durable, dry surface skin that permits it to remain soft and pliable underneath, providing a weather-tight joint. No migratory staining is permitted on painted or unpainted metal, stone, glass, vinyl, or wood.

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

- a. Shop-Applied Caulking: Use an approved gun-grade, non-sagging one-component polysulfide or silicone conforming to ASTM C920, Type II, with a curing time to ensure the sealant's plasticity at the time of field erection.
- b. Field Applied Caulking: Use an approved gun-grade, non-sagging one-component polysulfide or two-component polyurethane with an initial maximum Shore A durometer hardness of 25, conforming to ASTM C920, Type II. Match the color to the panel colors.
- c. Tape Sealant: Use a pressure-sensitive, 100 percent solid with a release paper backing, permanently elastic, non-sagging, non-toxic and non-staining as approved by the roof-panel manufacturer.

## PART 3 EXECUTION

### 3.1 EXAMINATION

The Contracting Officer may request verification and certification testing of coatings and base metals of metal roofing prior to installation. The following areas may be verified:

- a. Examine substrates, areas, and conditions, with the installer present, for compliance with the requirements for installation tolerances, metal roof panel supports, and other conditions affecting performance of the work.
- b. Examine primary and secondary roof framing to verify that rafters, purlins, angles, channels, and other structural panel support members and anchorages have been installed within alignment tolerances required by the metal roof-panel manufacturer, and as required for the geographical area where construction has taken place.
- c. Examine solid roof sheathing to verify that the sheathing joints are supported by framing or blocking and that the installation is within flatness tolerances required by the metal roof-panel manufacturer.
- d. Examine roughing-in for components and systems penetrating the metal roof panels to verify actual locations of penetrations relative to seam locations of metal roof panels before metal roof panel installation.

- e. Submit to the Contracting Officer a written report, endorsed by the installer, listing conditions detrimental to performance of the work.
- f. Proceed with the installation only after unsatisfactory conditions have been corrected.

### 3.2 PREPARATION

Clean substrates of substances harmful to insulation, remove projections capable of interfering with insulation attachment.

Install sub-purlins, eave angles, furring, and other miscellaneous roof-panel support members and anchorage according to the metal roof-panel manufacturer's written instructions.

### 3.3 INSTALLATION

#### 3.3.1 Workmanship

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

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

#### 3.3.2 Roof Panels

Provide metal roof panels of full length from eave to ridge or eave to wall as indicated, unless otherwise indicated or restricted by shipping limitations. Anchor metal roof panels and other components of the work in place, with provisions for thermal and structural movement in accordance with NRCA 0429.

- a. Steel Roof Panels: Use stainless-steel fasteners for exterior surfaces and galvanized steel fasteners for interior surfaces.
- b. Anchor Clips: Anchor metal roof panels and other components of the work securely in place. Use the manufacturer's approved fasteners according to the manufacturer's written instructions.
- c. Metal Protection: Where dissimilar metals will contact each other or corrosive substrates, protect against galvanic action by painting contact surfaces with bituminous coating conforming to SSPC PS 9.01, by applying rubberized-asphalt underlayment to each contact surface, or with another means to separate the metals and contact surface as recommended by metal roof-panel manufacturer.
- d. Joint Sealers: Install gaskets, joint fillers, and sealants where required for weatherproof performance of metal roof panel assemblies. Provide the types of gaskets, fillers, and sealants indicated; or if not indicated, provide types recommended by the metal roof

panel-manufacturer.

Erect the roofing system in accordance with the approved erection drawings, the printed instructions and the safety precautions of the manufacturer.

Do not overload, abuse, or subject sheets to undue impact. Do not apply bent, chipped, or defective sheets.

Erect sheets true and plumb and in exact alignment with the horizontal and vertical edges of the building, securely anchored, and with the indicated rake, eave, and curb overhang.

Allow for thermal movement of the roofing and movement of the building structure, and provide permanent freedom from noise caused by wind pressure.

Field cutting metal roof panels by torch is not permitted.

Lay roofing sheets with corrugations in the direction of the roof slope. End laps of exterior roofing cannot be less than 8 inches; the side laps of standard exterior corrugated sheets cannot be less than 2-1/2 corrugations.

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

### 3.3.3 Fasteners

Anchor metal roof panels and other components of the work in place using the manufacturer's approved fasteners according to the manufacturer's written instructions.

### 3.3.4 Flashing, Trim and Closure

#### 3.3.4.1 General Requirements

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

Install sheet metalwork to form weathertight construction without waves, warps, buckles, fastening stresses or distortion, and allow for expansion and contraction. Ensure sheet metal mechanics perform cutting, fitting, drilling, and other operations in connection with sheet metal work required to accommodate the work of other trades.

#### 3.3.4.2 Metal Flashing

Install metal flashing at building corners, rakes and eaves, junctions between metal siding and roofing, valleys and changes of slope or direction in metal roofing, and building expansion joints and gutters.

Provide exposed metal flashing that is the same material, color, and

finish as the specified metal roofing.

Fasten flashing at not more than 8 inches on-center for roofs, except where flashing are held in place by the same screws that secure covering sheets.

Furnish flashing in at least 8 foot lengths. Provide exposed flashing that has 1 inch locked and blind-soldered end joints, and expansion joints at intervals of not more than 16 feet.

Bed exposed flashing and flashing subject to rain penetration in the specified joint sealant.

To prevent electrolytic deterioration, isolate flashing that is in contact with dissimilar metals by means of the specified asphalt-mastic material.

Form drips to the profile indicated, with the edge folded back 1/2 inch to form a reinforced drip edge.

#### 3.3.4.3 Closures

Install metal closure strips at the open ends of corrugated or ribbed pattern roofs, and at the intersection of wall and roof unless open ends are concealed with formed eave flashing, at the rake of the metal roof unless the open end has a formed flashing member, and in other required areas.

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

#### 3.3.5 Information Form and Placard

For each roof, furnish a typewritten information card for facility records and a card laminated in plastic and framed for interior display at the roof access point, or a photoengraved 0.032 inch thick aluminum card for exterior display. Format the card as directed in paragraph FORM ONE.

Provide an information card 8 1/2 inches by 11 inches minimum, identifying the facility name and number, location, contract number, approximate roof area, detailed roof system description, including deck type, roof panel manufacturer and product name, type underlayment, date of completion, installing contractor identification and contact information; manufacturer warranty expiration, warranty reference number, and contact information. Install the card at interior roof top access point and provide a paper copy to the Contracting Officer.

### 3.4 FIELD QUALITY CONTROL

#### 3.4.1 Acceptance Provisions

##### 3.4.1.1 Erection Tolerances

Erect metal roofing straight and true with plumb vertical lines correctly lapped and secured in accordance with the manufacturer's written instructions. Do not vary horizontal lines more than 1/8 inch in 40 feet.

#### 3.4.1.2 Leakage Tests

Finished application of metal roofing is subject to inspection and test for leakage by the Contracting Officer, and architect/engineer. Conduct inspections and tests without cost to the Government.

Perform inspections and tests promptly after erection to permit correction of defects and the removal and replacement of defective materials.

#### 3.4.1.3 Repairs to Finish

Repair scratches, abrasions, and minor surface defects in the finish with the specified repair materials. Ensure repaired finished surfaces are uniform and free from variations of color and surface texture.

Immediately remove and replace repaired metal surfaces that are not acceptable to the project requirements with new material.

#### 3.4.1.4 Paint-Finish Metal Roofing

Test paint-finish metal roofing for color stability by the Contracting Officer during the manufacturer's specified guarantee period.

Remove and replace panels that have visual evidence of color changes, fading, or surface degradation, with new panels at no expense to the Government.

Replaced panels are subject to the specified tests for an additional year from the date of their installation.

#### 3.4.2 Manufacturer's Inspection

Ensure the manufacturer's technical representative visits the site a minimum of three times during the installation to review material installation practices and to verify the adequacy of work in place. Make inspections during the first 20 squares of roof panel installation, at mid-point of the installation, and at substantial completion, at a minimum. Additional inspections are required for each 100 squares of total roof area, with the exception that follow-up inspections of previously noted deficiencies or application errors are performed as requested by the Contracting Officer. After each inspection, submit a report, signed by the manufacturer's technical representative, to the Contracting Officer within 3 working days. Note in the report the overall quality of work, deficiencies, and any other concerns, and recommended corrective action.

#### 3.4.3 Repair of Finish Protection

Provide repair paint for color-finish enameled roofing that is compatible with the paint of the same formula and color as the specified finish furnished by the roofing manufacturer.

#### 3.5 ADJUSTING AND CLEANING

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

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

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

### 3.6 SCHEDULES

#### 3.6.1 Form One

FORM 1 - PREFORMED STEEL PANEL ROOFING SYSTEM AND COMPONENTS

1. Contract Number:
2. Building Number & Location:
3. NAVFAC Specification Number:
4. Deck/Substrate Type:
5. Slopes of Deck/Roof Structure:
6. Insulation Type & Thickness:
7. Insulation Manufacturer:
8. Vapor Retarder:      ( )Yes      ( )No
9. Vapor Retarder Type:
10. Preformed Steel Standing Seam Roofing Description:
  - a. Manufacturer (Name, Address, & Phone No.):
  - b. Product Name:
  - c. Width:
  - d. Gage:
  - e. Base Metal:
  - f. Method of Attachment:
11. Repair of Color Coating:
  - a. Coating Manufacturer (Name, Address & Phone No.):
  - b. Product Name:
  - c. Surface Preparation:
  - d. Recoating Formula:
  - e. Application Method:
12. Statement of Compliance or Exception: \_\_\_\_\_  
\_\_\_\_\_  
\_\_\_\_\_
13. Date Roof Completed:
14. Warranty Period: From \_\_\_\_\_ To \_\_\_\_\_
15. Roofing Contractor (Name & Address):
16. Prime Contractor (Name & Address):
  
- Contractor's Signature \_\_\_\_\_ Date:
  
- Inspector's Signature \_\_\_\_\_ Date:
  
- End of Section --





SECTION 07 42 13

METAL WALL PANELS

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.

ALUMINUM ASSOCIATION (AA)

AA ADM (2015) Aluminum Design Manual

AA ASD1 (2017; 2017 Errata 2017) Aluminum Standards and Data

AMERICAN ARCHITECTURAL MANUFACTURERS ASSOCIATION (AAMA)

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

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

AMERICAN INSTITUTE OF STEEL CONSTRUCTION (AISC)

AISC 341 (2016) Seismic Provisions for Structural Steel Buildings

AMERICAN IRON AND STEEL INSTITUTE (AISI)

AISI S100 (2012) North American Specification for the Design of Cold-Formed Steel Structural Members

AMERICAN SOCIETY OF CIVIL ENGINEERS (ASCE)

ASCE 7 (2017) Minimum Design Loads for Buildings and Other Structures

AMERICAN WELDING SOCIETY (AWS)

AWS A5.1/A5.1M (2012) Specification for Carbon Steel Electrodes for Shielded Metal Arc Welding

AWS D1.1/D1.1M (2015; Errata 1 2015; Errata 2 2016) Structural Welding Code - Steel

AWS D1.2/D1.2M (2014) Structural Welding Code - Aluminum

ASTM INTERNATIONAL (ASTM)

ASTM A1008/A1008M (2016) 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 A123/A123M	(2017) Standard Specification for Zinc (Hot-Dip Galvanized) Coatings on Iron and Steel Products
ASTM A36/A36M	(2014) Standard Specification for Carbon Structural Steel
ASTM A463/A463M	(2010; R 2015) Standard Specification for Steel Sheet, Aluminum-Coated, by the Hot-Dip Process
ASTM A606/A606M	(2009a) Standard Specification for Steel Sheet and Strip, High-Strength, Low-Alloy, Hot-Rolled and Cold-Rolled, with Improved Atmospheric Corrosion Resistance
ASTM A653/A653M	(2017) Standard Specification for Steel Sheet, Zinc-Coated (Galvanized) or Zinc-Iron Alloy-Coated (Galvannealed) by the Hot-Dip Process
ASTM B117	(2016) Standard Practice for Operating Salt Spray (Fog) Apparatus
ASTM B209	(2014) Standard Specification for Aluminum and Aluminum-Alloy Sheet and Plate
ASTM C920	(2018) Standard Specification for Elastomeric Joint Sealants
ASTM D1308	(2013) Effect of Household Chemicals on Clear and Pigmented Organic Finishes
ASTM D1654	(2008; R 2016; E 2017) Standard Test Method for Evaluation of Painted or Coated Specimens Subjected to Corrosive Environments
ASTM D2244	(2016) Standard Practice for Calculation of Color Tolerances and Color Differences from Instrumentally Measured Color Coordinates
ASTM D2247	(2015) Testing Water Resistance of Coatings in 100% Relative Humidity
ASTM D2794	(1993; R 2010) Resistance of Organic Coatings to the Effects of Rapid Deformation (Impact)
ASTM D3359	(2017) Standard Test Methods for Rating Adhesion by Tape Test
ASTM D3363	(2005; E 2011; R 2011; E 2012) Film

Hardness by Pencil Test

ASTM D4214	(2007; R 2015) Standard Test Method for Evaluating the Degree of Chalking of Exterior Paint Films
ASTM D4587	(2011) Standard Practice for Fluorescent UV-Condensation Exposures of Paint and Related Coatings
ASTM D522/D522M	(2014) Mandrel Bend Test of Attached Organic Coatings
ASTM D523	(2014) Standard Test Method for Specular Gloss
ASTM D5894	(2016) Standard Practice for Cyclic Salt Fog/UV Exposure of Painted Metal, (Alternating Exposures in a Fog/Dry Cabinet and a UV/Condensation Cabinet)
ASTM D610	(2008; R 2012) Evaluating Degree of Rusting on Painted Steel Surfaces
ASTM D714	(2002; R 2017) Standard Test Method for Evaluating Degree of Blistering of Paints
ASTM D822	(2013) Filtered Open-Flame Carbon-Arc Exposures of Paint and Related Coatings
ASTM D968	(2017) Standard Test Methods for Abrasion Resistance of Organic Coatings by Falling Abrasive
ASTM E1592	(2005; R 2012) Structural Performance of Sheet Metal Roof and Siding Systems by Uniform Static Air Pressure Difference
ASTM E283	(2004; R 2012) 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 E72	(2015) Conducting Strength Tests of Panels for Building Construction
ASTM E84	(2018) Standard Test Method for Surface Burning Characteristics of Building Materials
ASTM G152	(2013) Operating Open Flame Carbon Arc Light Apparatus for Exposure of Nonmetallic Materials

ASTM G153 (2013) Operating Enclosed Carbon Arc Light  
Apparatus for Exposure of Nonmetallic  
Materials

METAL BUILDING MANUFACTURERS ASSOCIATION (MBMA)

MBMA MBSM (2012) Metal Building Systems Manual

NATIONAL ASSOCIATION OF ARCHITECTURAL METAL MANUFACTURERS (NAAMM)

NAAMM AMP 500 (2006) Metal Finishes Manual

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

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

U.S. GREEN BUILDING COUNCIL (USGBC)

LEED NC (2009) Leadership in Energy and  
Environmental Design(tm) New Construction  
Rating System

UNDERWRITERS LABORATORIES (UL)

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

## 1.2 DEFINITIONS

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

## 1.3 DESCRIPTION OF WALL PANEL SYSTEM

Factory color finished, metal wall panel system with concealed fastening attachment. Panels to be flush-joint profile with a embossed raised flat pan.

### 1.3.1 Metal Wall Panel General Performance

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

ASTM A1008/A1008M  
ASTM A123/A123M  
ASTM A36/A36M  
ASTM A653/A653M  
ASTM A463/A463M for aluminum coated steel sheet  
ASTM A606/A606M  
ASTM D522/D522M for applied coatings  
UL Bld Mat Dir

### 1.3.2 Structural Performance

Maximum calculated fiber stress must not exceed the allowable value in the

AISI or AA manuals; a one third overstress for wind is allowed. Midspan deflection under maximum design loads is limited to  $L/180$ . Contract drawings show the design wind loads and the extent and general assembly details of the metal siding. Contractor must provide design for members and connections not shown on the drawings. Siding panels and accessories must be the products of the same manufacturer.

Provide metal wall panel assemblies complying with the load and stress requirements in accordance with ASTM E1592. Wind Load force due to wind action governs the design for panels.

Wall systems and attachments are to resist the wind loads as determined by ASTM E72 and ASCE 7 in the geographic area where the construction will take place, in pounds per square foot. Submit five copies of wind load tests and seismic tests to the Contracting Officer.

Provide metal wall panel assembly for seismic conditions complying with the applicable requirements of AISC 341.

#### 1.3.3 Air Infiltration

Air leakage must conform to the limits through the wall assembly area when tested according to ASTM E283.

#### 1.3.4 Water Penetration Under Static Pressure

No water penetration when tested according to ASTM E331.

#### 1.3.5 Water Penetration Under Dynamic Pressure

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

### 1.4 SUBMITTALS

Government approval is required for submittals with a "G" designation; submittals not having a "G" designation are for information only. When used, a designation following the "G" designation identifies the office that will review the submittal for the Government. Submittals with an "S" are for inclusion in the Sustainability eNotebook, in conformance to Section 01 33 29 SUSTAINABILITY REPORTING. Submit the following in accordance with Section 01 33 00 SUBMITTAL PROCEDURES:

#### SD-01 Preconstruction Submittals

Submit Documentation for the following items:

Qualification of Manufacturer; G  
Qualification of Installation Contractor; G  
Qualification of Welders; G  
Sample Warranty; G

#### SD-02 Shop Drawings

Installation Drawings; G

#### SD-03 Product Data

Recycled Content; (LEED NC)

Submit Manufacturer's data indicating percentage of recycle material in wall panels to verify sustainable acquisition compliance.

Submit Manufacturer's catalog data for the following items:

Wall Panels ; G

Factory Color Finish  
Closure Materials  
Sealants and Caulking  
Galvanizing Repair Paint  
Enamel Repair Paint  
Accessories

#### SD-04 Samples

Submit as required each of the following samples:

Wall Panels, 12 inches long by actual panel width; G  
Fasteners; G  
Metal Closure Strips, 10 inches long of each type; G  
Color chart and chips ; G

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

#### SD-05 Design Data

Wind load design analysis ; G

As applicable, submit the following wind load design analysis data, to include, but not limited to:

wind speed  
exposure category,co-efficient,importance factor  
type of facility  
negative pressures for each zone  
methods and requirements of attachment

#### SD-06 Test Reports

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

Leakage Tests; G  
Wind Load Tests; G  
Coating Tests; G  
Chalking Tests; G  
Seismic Tests; G

#### SD-07 Certificates

Submit certificates for the following items showing conformance with referenced standards contained in this section:

Coil Stock; G

Fasteners; G  
Galvanizing Repair Paint; G  
Enamel Repair Paint; G

SD-08 Manufacturer's Instructions

Include detailed application instructions and standard  
manufacturer drawings altered as required by these specifications.

Installation of Wall panels; G

SD-09 Manufacturer's Field Reports

Submit three bound copies of the Manufacturer's Field Reports; G

SD-11 Closeout Submittals

Warranty; G  
Maintenance Instructions; G

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

1.5 QUALITY ASSURANCE

1.5.1 Pre-Installation Conference

Upon notification of submittal receipt and approval by the Contracting Officer; and prior to the commencement of the work, the Contractor must attend a pre-installation conference to review the following:

- a. Drawings and Specifications.
- b. Qualification of Installer.
- c. Sustainable acquisition
- d. Approved Warranty
- e. Sample wall panels, 12 inches long by actual panel width
- f. Sample metal closure strips, 10 inches long of each type
- g. Color charts and chips
- h. Coatings and base metal tests, chalking tests
- i. Construction schedule, availability of materials, Installer's personnel, equipment and facilities required to progress with the work without delay.
- j. Methods and procedures related to installation of wall panels, including manufacturer's written instructions. Explicitly identify in writing, differences between manufacturer's instructions and the specified requirements.
- k. Support conditions for compliance with requirements, including alignment between and attachment to structural members.
- l. Flashing, special siding details, wall penetrations, openings, and

condition of other construction that will affect metal wall panels.

- m. Governing regulations and requirements for insurance, certificates, and tests and inspections if applicable.
- n. Temporary protection requirements for metal wall panel assembly during and after installation.
- o. Wall panel observation and repair procedures after metal wall panel installation. Provide detailed written instructions including copies of Safety Data Sheets for maintenance and repair materials, and manufacturer's maintenance instructions.

#### 1.5.1.1 Installation Drawings

Installation shop drawings for wall panels, flashing, accessories, and anchorage systems must indicate completely dimensioned structural frame and erection layouts, openings in the wall, special framing details, and construction details at corners, building intersections and flashing, location and type of mastic and metal filler strips.

#### 1.5.1.2 Wind Load Design Analysis

Wind design analysis must include wall plan delineating dimensions and attachment patterns for each zone. Wind design analysis must be prepared and sealed by Licensed Project Engineer in the geographic area where the construction will take place.

#### 1.5.2 Manufacturer's Technical Representative

The representative must have authorization from manufacturer to approve field changes and be thoroughly familiar with the products and installations in the geographical area where construction will take place.

#### 1.5.3 Qualification of Manufacturer

Certify that metal wall panel system manufacturer has a minimum of five (5) years experience in manufacturing metal wall system and accessory products.

Manufacturer must also provide engineering services by an authorized engineer; currently licensed in the geographical area where construction will take place, having a minimum of four (4) years experience as an engineer knowledgeable in wind load design analysis, protocols and procedures per MBMA MBSM, "Metal Building Systems Manual"; ASCE 7, and ASTM E1592 and seismic design conforming to AISC 341.

Provide certified engineering calculations, using the products submitted, for Wind load requirements in accordance with ASCE 7.

##### 1.5.3.1 Manufacturer's Certificates

Also provide the following certifications from the manufacturer:

Coil Stock  
Fasteners  
Galvanizing Repair Paint  
Enamel Repair Paint



Submit certification from coil stock manufacturer or supplier that the machinery used will form the provided coil stock without warping, waviness, or rippling that is not a part of the panel profile, and without damage, abrasion or marring of the finish coating.

Provide evidence that products used within this specification are manufactured in the United States.

#### 1.5.4 Certified Qualification of Installation Contractor

The installation contractor must be approved and certified by the metal wall panel manufacturer prior to beginning the installation of the metal wall panel system. Subcontracting by Certified Contractor for the metal wall panel work is not permitted.

##### 1.5.4.1 Qualifications for Welding Work

Qualification of welders and welding must conform to AWS A5.1/A5.1M, AWS D1.1/D1.1M for steel or AWS D1.2/D1.2M for aluminum.

#### 1.5.5 Single Source

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

##### 1.5.6

#### Manufacturer's Maintenance Instructions

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

#### 1.6 DELIVERY, HANDLING, AND STORAGE

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

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

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

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

#### 1.7 PROJECT CONDITIONS

##### 1.7.1 Field Measurements

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

#### 1.7.2 Weather Limitations

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

#### 1.8 WARRANTY

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

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

Furnish manufacturer's no-dollar-limit warranty for the metal wall panel system. The warranty period is to be no less than twenty (20) years from the date of Government acceptance of the work. The warranty is to be issued directly to the Government. The warranty is to provide that if within the warranty period the metal wall panel system shows evidence of corrosion, perforation, rupture or excess weathering due to deterioration of the wall panel system resulting from defective materials and correction of the defective workmanship is to be the responsibility of the metal wall panel system manufacturer. Repairs that become necessary because of defective materials and workmanship while metal wall panel system is under warranty are to be performed within 24 hours after notification, unless additional time is approved by the Contracting Officer. Failure to perform repairs within 24 hours of notification will constitute grounds for having emergency repairs performed by others and not void the warranty.

### PART 2 PRODUCTS

#### 2.1 FABRICATION

Unless approved otherwise, fabricate and finish metal wall panels and accessories at the factory to greatest extent possible, by manufacturer's standard procedures and processes and as necessary to fulfill indicated and specified performance requirements. Comply with indicated profiles and with dimensional and structural requirements. See section 01 33 29 LEED(tm) DOCUMENTATION for cumulative total recycled content requirements.

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

##### 2.1.1 Sheet Metal Accessories

Fabricate flashing and trim to comply with recommendations in SMACNA 1793 that apply to the design, dimensions, metal, and other characteristics of item indicated:

- a. Form exposed sheet metal accessories that are without excessive oil canning, buckling, and tool marks and that are true to line and levels indicated, with exposed edges folded back to form hems.
- b. End Seams: fabricate nonmoving end seams with flat-lock seams. Form seams and seal with epoxy seam sealer. Rivet joints for additional strength.

- c. Sealed Joints: form non-expansion but movable joints in metal to accommodate elastomeric sealant to comply with SMACNA 1793.
- d. Conceal fasteners and expansion provisions where possible. Exposed fasteners are not allowed on faces of accessories exposed to view.
- e. Fabricate cleats and attachment devices of size and metal thickness recommended by SMACNA 1793 or by metal wall panel manufacturer for application, but not less than thickness of metal being secured.

## 2.2 PANEL MATERIALS

### 2.2.1 Aluminum Sheet

Roll-form aluminum wall panels to the specified profile, with  $f_y = 30$  ksi, 18 and 20 gauge thickness and depth as indicated. Material must be plumb and true, and within the tolerances listed:

- a. Aluminum Sheet conforming to ASTM B209, AA ASD1 and AA ADM.
- b. Individual panels must be have continuous length to cover the entire length of any wall area with no joints or seams and formed without warping, waviness, or ripples that are not part of the panel profile and free of damage to the finish coating system.
- c. Provide panels with thermal expansion and contraction consistent with the type of system specified.

#### Panel Types as Follows:

##### Type 1: Exterior Wall Assembly

Flush-Joint Profile with raise flat pan. 18 gauge with embossed finish. Panel coverage 12 inches, panel height 1-1/2 inches.

#### Interior Depaint Bay Walls:

Type 2: Flush-Joint Profile w/raised flat pan. 18 gauge with smooth finish. Panel coverage 12 inches, panel height 1-1/2 inches.

Type 3: Exterior Wall Assembly. 1 inch reveal panel profile with raise flat pan, with concealed fasteners. 18 gauge with embossed finish. Panel coverage 12 inches, panel height 1-1/2 inches.

#### Interior Paint Bay Walls:

Embossed surface texture.

### 2.2.2 Factory Color Finish

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

All panels to receive fluoropolymer two-coat corrosion and abrasion resistant system: 3.0 mil primer with 0.8 mil to percent pvdf fluoropolymer color coat.

#### 2.2.2.1 Metal Preparation

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

#### 2.2.2.2 Prime Coating

Apply a base coat of epoxy paint, specifically formulated to interact with the top-coat, to the prepared surfaces by roll coating to a dry film thickness of 3.0 mils. Prime coat must be oven cured prior to application of finish coat.

#### 2.2.2.3 Exterior Finish Coating

Roll coat the finish coating over the primer by roll coating to dry film thickness of 0.80 mils. Oven-cure finish coat.

#### 2.2.2.4 Interior Finish Coating

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

#### 2.2.2.5 Color

Provide exterior finish color as indicated on drawings.

#### 2.2.2.6 Physical Properties

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

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

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

## 2.3 MISCELLANEOUS METAL FRAMING

Cold-formed metallic-coated steel sheet conforming to ASTM A653/A653M and specified in Section 05 40 00 COLD-FORMED METAL FRAMING unless otherwise indicated.

### 2.3.1 Fasteners for Miscellaneous Metal Framing

Type, material, corrosion resistance, size and sufficient length to penetrate the supporting member a minimum of 1 inch with other properties required to fasten miscellaneous metal framing members to supporting members and substrates in accordance with the wall panel manufacturer's and ASCE 7 requirements.

## 2.4 FASTENERS

### 2.4.1 General

#### 2.4.1.1 Hidden Fasteners

Provide corrosion resistant fasteners recommended by the manufacturer to meet the performance requirements and design loads.

#### 2.4.1.2 Screws

Screws to be corrosion resistant coated steel, aluminum and/or stainless steel being the type and size recommended by the manufacturer to meet the performance requirements.

#### 2.4.1.3 Rivets

Rivets to be closed-end type, corrosion resistant coated steel, aluminum or stainless steel where watertight connections are required.

#### 2.4.1.4 Attachment Clips

Fabricate clips from steel hot-dipped galvanized in accordance with ASTM A653/A653M, Z275 G 90 or Series 300 stainless steel. Size, shape, thickness and capacity as required meeting the insulation thickness and

design load criteria specified.

## 2.5 ACCESSORIES

### 2.5.1 General

All accessories must be compatible with the metal wall panels. Sheet metal flashing, trim, metal closure strips, caps and similar metal accessories must not be less than the minimum thickness specified for the wall panels. Exposed metal accessories/finishes to match the panels furnished, except as otherwise indicated. Molded foam rib, ridge and other closure strips must be non-absorbent closed-cell or solid-cell synthetic rubber or pre-molded neoprene to match configuration of the panels.

### 2.5.2 Joint Sealants

#### 2.5.2.1 Sealants and Caulking

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

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

#### 2.5.2.2 Shop-Applied

Sealant for shop-applied caulking must be non-curing butyl compliant with AAMA 800 to ensure the sealant's plasticity at the time of field erection.

#### 2.5.2.3 Field-Applied

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

## 2.6 SHEET METAL FLASHING AND TRIM

### 2.6.1 Fabrication

Shop fabricate sheet metal flashing and trim where practicable to comply with recommendations in SMACNA 1793 that apply to design, dimensions, metal, and other characteristics of item indicated. Obtain field measurements for accurate fit before shop fabrication.

Fabricate sheet metal flashing and trim without excessive oil canning, buckling, and tool marks and true to line and levels indicated, with exposed edges folded back to form hems.

## 2.7 REPAIR OF FINISH PROTECTION

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

## PART 3 EXECUTION

### 3.1 EXAMINATION

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

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

Examine solid wall sheathing to verify that sheathing joints are supported by framing or blocking and that installation is within flatness tolerances required by metal wall panel manufacturer.

Examine roughing-in for components and systems penetrating metal wall panels to verify actual locations of penetrations relative to seam locations of metal wall panels before metal wall panel installation.

Submit to the Contracting Officer a written report, endorsed by Installer, listing conditions detrimental to performance of the Work. Proceed with installation only after unsatisfactory conditions have been corrected.

### 3.2 PREPARATION

Clean substrates of substances harmful to insulation, including removing projections capable of interfering with insulation attachment. Miscellaneous framing installation, including sub-purlins, girts, angles, furring, and other miscellaneous wall panel support members and anchorage must be according to metal wall panel manufacturer's written instructions.

### 3.3 WALL PANEL INSTALLATION

Provide full length metal wall panels, from sill to eave as indicated, unless otherwise indicated or restricted by shipping limitations. Anchor metal wall panels and other components of the Work securely in place, with provisions for thermal and structural movement in accordance with MBMA MBSM.

Erect wall panel system in accordance with the approved erection drawings, the printed instructions and safety precautions of the manufacturer.

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

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

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

Field cutting metal wall panels by torch is not permitted.

### 3.3.1 Steel Wall Panels

Use stainless-steel fasteners for exterior surfaces and galvanized steel fasteners for interior surfaces.

### 3.3.2 Aluminum Wall Panels

Use aluminum or stainless-steel fasteners for exterior surfaces and aluminum or galvanized steel fasteners for interior surfaces.

### 3.3.3 Anchor Clips

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

### 3.3.4 Metal Protection

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

### 3.3.5 Joint Sealers

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

## 3.4 FASTENER INSTALLATION

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

## 3.5 FLASHING, TRIM AND CLOSURE INSTALLATION

### 3.5.1 General Requirements

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

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

### 3.5.2 Metal Flashing

Install exposed metal flashing at building corners, sills and eaves, junctions between metal siding and walling. Exposed metal flashing must be the same material, color, and finish as the specified metal wall panel.

Fasten flashing at a minimum of 8 inches on center, except where flashing



is held in place by the same screws that secure covering sheets.

Flashing is to be furnished in at least 8 foot lengths. Exposed flashing is to have 1 inch locked and blind-soldered end joints, and expansion joints at intervals of not more than 16 feet.

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

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

Form drips to the profile indicated, with the edge folded back 1/2 inch to form a reinforced drip edge.

### 3.5.3 Closures

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

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

## 3.6 WORKMANSHIP

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

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

## 3.7 ACCEPTANCE PROVISIONS

### 3.7.1 Erection Tolerances

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

### 3.7.2 Leakage Tests

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

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

materials.

### 3.7.3 Repairs to Finish

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

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

### 3.7.4 Paint-Finish Metal Siding

Paint-finish metal siding will be tested for color stability by the Contracting Officer during the manufacturer's specified guarantee period.

Panels that indicate color changes, fading, or surface degradation, determined by visual examination, must be removed and replaced with new panels at no expense to the Government.

New panels will be subject to the specified tests for an additional year from the date of their installation.

## 3.8 FIELD QUALITY CONTROL

### 3.8.1 Construction Monitoring

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

- a. Materials comply with the specified requirements.
- b. All materials are properly stored, handled and protected from damage. Damaged materials are removed from the site.
- c. Framing and substrates are in acceptable condition, in compliance with specification, prior to application of wall panels.
- d. Panels are installed without buckles, ripples, or waves and in uniform alignment and modulus.
- e. Side laps are formed, sealed, fastened or seam locked as required.
- f. The proper number, type, and spacing of attachment clips and fasteners are installed.
- g. Installer adheres to specified and detailed application parameters.
- h. Associated flashing and sheet metal are installed in a timely manner in accord with the specified requirements.

Provide five bound copies of Manufacturer's Field Reports to the Contracting Officer two weeks prior to project close-out.

## 3.9 CLEAN-UP AND DISPOSAL

Clean all exposed sheet metal work at completion of installation. Remove metal shavings, filings, nails, bolts, and wires from work area. Remove

grease and oil films, excess sealants, handling marks, contamination from steel wool, fittings and drilling debris and scrub the work clean. Exposed metal surfaces must be free of dents, creases, waves, scratch marks, solder or weld marks, and damage to the finish coating.

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

-- End of Section --



SECTION 07 42 16

INSULATED CORE METAL WALL PANELS

05/11

PART 1 GENERAL

1.1 SYSTEM DESCRIPTION

1.1.1 Insulated Core Metal Wall Panel System (MP-3)

Factory-foamed horizontal and vertical wall panel system consisting of exterior metal sheet with interior metal liner panel, bonded to factory foamed-in-place core in thermally-separated profile, with factory sealed tongue-and-groove and rainscreen-design pressure-equalized-chamber horizontal joint, and attached to supports using concealed fasteners.

- a. System is provided complete with through-tube supports and secondary metal framing.

1.2 REFERENCES

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

AMERICAN ARCHITECTURAL MANUFACTURERS ASSOCIATION (AAMA)

- |            |   |
|------------|---|
| AAMA 501.1 | (2017) Standard Test Method for Water Penetration of Windows, Curtain Walls and Doors Using Dynamic Pressure                        |
| AAMA 501.2 | (2003) Quality Assurance and Diagnostic Water Leakage Field Check of Installed Storefronts, Curtainwalls and Sloped Glazing Systems |
| AAMA 508   | (2005) Voluntary Test Method and Specifications for Pressure Equalized Rain Screen Wall Cladding Systems                            |
| AAMA 620   | (2002) Voluntary Specification For High Performance Organic Coatings On Coil Coated Architectural Aluminum Substrates               |

AMERICAN SOCIETY OF CIVIL ENGINEERS (ASCE)

- |           |  |
|-----------|--|
| ASCE 7-05 | (2010; Errata 2011; Supp 1 2013) Minimum Design Loads for Buildings and Other Structures |
|-----------|--|

ASTM INTERNATIONAL (ASTM)

- |                   |   |
|-------------------|---|
| ASTM A 653/A 653M | (2011) Standard Specification for Steel Sheet, Zinc-Coated (Galvanized) or Zinc-Iron Alloy-Coated (Galvannealed) by the Hot-Dip Process |
|-------------------|---|

ASTM A 755/A 755M	(2003; R 2008) Standard Specification for Steel Sheet, Metallic Coated by the Hot-Dip Process and Prepainted by the Coil-Coating Process for Exterior Exposed Building Products
ASTM B 209	(2007) Standard Specification for Aluminum and Aluminum-Alloy Sheet and Plate
ASTM C 1363	(2005) Standard Test Method for Thermal Performance of Building Materials and Envelope Assemblies by Means of a Hot Box Apparatus
ASTM C 209	(2007ae1) Standard Test Methods for Cellulosic Fiber Insulating Board
ASTM C 645	(2009a) Nonstructural Steel Framing Members
ASTM C 754	(2009a) Installation of Steel Framing Members to Receive Screw-Attached Gypsum Panel Products
ASTM D 3359	(2009e2) Measuring Adhesion by Tape Test
ASTM E 119	(2010b) Standard Test Methods for Fire Tests of Building Construction and Materials
ASTM E 1592	(2005) Structural Performance of Sheet Metal Roof and Siding Systems by Uniform Static Air Pressure Difference
ASTM E 1886	(2005) Standard Test Method for Performance of Exterior Windows, Curtain Walls, Doors, and Impact Protective Systems Impacted by Missile(s) and Exposed to Cyclic Pressure Differentials
ASTM E 1996	(2009) Standard Specification for Performance of Exterior Windows, Curtain Walls, Doors, and Impact Protective Systems Impacted by Windborne Debris in Hurricanes
ASTM E 283	(2004) Determining the Rate of Air Leakage Through Exterior Windows, Curtain Walls, and Doors Under Specified Pressure Differences Across the Specimen
ASTM E 329	(2009) Standard Specification for Agencies Engaged in Construction Inspection and/or Testing
ASTM E 331	(2000; R 2009) Water Penetration of Exterior Windows, Skylights, Doors, and Curtain Walls by Uniform Static Air Pressure Difference

ASTM E 72 (2005) Conducting Strength Tests of Panels  
for Building Construction

ASTM E 84 (2010b) Standard Test Method for Surface  
Burning Characteristics of Building  
Materials

NATIONAL FIRE PROTECTION ASSOCIATION (NFPA)

NFPA 285 (2012) Standard Fire Test Method for  
Evaluation of Fire Propagation  
Characteristics of Exterior  
Non-Load-Bearing Wall Assemblies  
Containing Combustible Components

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

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

U.S. GREEN BUILDING COUNCIL (USGBC)

LEED (2009) Leadership in Energy and  
Environmental Design(tm) Green Building  
Rating System for New Construction

UNDERWRITERS LABORATORIES (UL)

UL 1715 (1997) Fire Test of Interior Finish  
Material

UL 263 (2011; Reprint Mar 2018) Fire Tests of  
Building Construction and Materials

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

UL Fire Resistance (2014) Fire Resistance Directory

### 1.3 PERFORMANCE REQUIREMENTS

Provide metal wall panel system meeting performance requirements as  
determined by application of specified tests by a qualified testing agency  
on manufacturer's standard assemblies.

#### 1.3.1 Delegated Design

Engage a qualified engineer to provide design and engineering analysis of  
composite wall panel system including secondary framing based on Project  
performance requirements and design criteria.

#### 1.3.2 Air Infiltration

Maximum 0.06 cfm/sq. ft. air infiltration per ASTM E 283 at a  
static-air-pressure difference of 6.24 lbf/sq. ft., using minimum 10-by-10  
foot test panel that includes horizontal and vertical joints.

#### 1.3.3 Water Penetration, Static Pressure

No uncontrolled water penetration per ASTM E 331 at a minimum static differential pressure of 15 lbf/sq. ft., using minimum 10-by-10 foot test panel that includes horizontal and vertical joints.

#### 1.3.4 Water Penetration, Dynamic Pressure

No uncontrolled water penetration per AAMA 501.1 at a minimum static differential pressure of 15 lbf/sq. ft., using minimum 10-by-10 foot test panel that includes horizontal and vertical joints.

#### 1.3.5 System Performance

Horizontal joint design shall demonstrate pressure equalization in accordance with AAMA 508, which includes static and dynamic testing with imperfect air barriers. A third party test indicating successful passing of this test must be submitted prior to bid.

#### 1.3.6 Water Absorption

Maximum 1.0 percent absorption rate by volume when tested according to ASTM C 209.

#### 1.3.7 Structural Performance

Provide metal wall panel assemblies capable of withstanding the effects of indicated loads and stresses within limits and under conditions indicated, per ASTM E 72 and complying with the load and stress requirements in accordance with ASTM E 1592. Wind Load force due to wind action governs the design for panels. Submit wind load tests and seismic tests to the Contracting Officer.

##### 1.3.7.1 Wind Loads

Determine loads based on uniform pressure, importance factor, exposure category, and basic wind speed indicated on drawings.

##### 1.3.7.2 Limits of Deflection

Composite wall panel system shall withstand scheduled wind pressure with the following allowable deflection:

- a. Maximum allowable deflection limited to L/175 deflection of panel perimeter normal to plane of wall with no evidence of failure.

##### 1.3.7.3 Secondary Metal Framing

Design secondary metal framing according to AISI's "Standard for Cold-Formed Steel Framing - General Provisions." Provide minimum 3-inch-wide bearing surface for metal wall panels at the following locations:

- a. Vertical Panel System: At horizontal stack joints.

##### 1.3.7.4 Windborne-Debris-Impact-Resistance Performance

Pass missile-impact and cyclic-pressure tests per ASTM E 1886 and ASTM E 1996 for Wind Zone indicated on Drawings.



#### 1.3.7.5 Seismic Performance

Comply with ASCE 7-05 Section 9, "Earthquake Loads."

#### 1.3.8 Thermal Movements

Allow for thermal movements from variations in both ambient and internal temperatures. Accommodate movement of support structure caused by thermal expansion and contraction.

#### 1.3.9 Thermal Performance

Thermal-resistance (R) value indicated, per ASTM C 1363.

### 1.4 SUBMITTALS

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

#### SD-01 Preconstruction Submittals

Qualification of Manufacturer; G  
Qualification of Installer; G  
Qualification of Engineer; G

#### SD-02 Shop Drawings

Fabrication and installation drawings prepared by manufacturer or manufacturer's authorized dealer. Include full elevations showing openings and penetrations. Include details of each condition of installation and attachment. Provide details at a minimum scale 1-1/2-inch per foot of all required trim and extrusions needed for a complete installation. Include spacing, sizing, and material types of fasteners and connections to be used in completed assembly.

Wall Panel Assemblies; G  
Flashing and Accessories; G  
Anchorage Systems; G  
Closure Materials, including metal closure strips

Include data indicating compliance with performance requirements, prepared and signed by qualified professional engineer.

Indicate points of supporting structure that must coordinate with composite wall panel system installation.

#### SD-03 Product Data

Regional Materials; (LEED)

Documentation indicating distance between manufacturing facility and the project site, and distance of raw material origin from the project site. Indicate relative dollar value of local/regional materials to total dollar value of products included in the project.

Recycled Content; (LEED)

Manufacturer's descriptive data. Documentation indicating percentage of post-industrial and post-consumer recycled content per unit of product. Indicate relative dollar value of recycled content products to total dollar value of products included in project.

Submit manufacturer's catalog data for the following items:

Factory Color Finish; G  
Wall Panel Assemblies; G  
Flashing and Accessories; G  
Secondary Metal Framing; G  
Repair Paint; G  
Anchorage Systems; G  
Insulation; G  
Flashing Tape; G  
Fasteners; G

SD-04 Samples

Wall Panel Assemblies; G  
Sealants  
Gaskets

Samples for Initial Selection: For each product specified including sealants and gaskets. Submit manufacturer's color charts and chips showing full range of colors.

Samples for Verification: Provide 24-inch section of wall panel showing finishes, horizontal joinery, vertical joint return, injected core material, panel stiffener and anchoring details. Provide 12-inch long pieces of each extruded aluminum trim and gaskets.

SD-05 Design Data

Calculations; G  
Wind design analysis; G

SD-06 Test Reports

Wind load tests; G  
Seismic tests; G  
Rated Wall Assembly test data

Product test reports indicating compliance of products with requirements, from a qualified independent testing agency. Include spacing, sizing, and material types of fasteners and connections as used in tested assembly.

SD-07 Certificates

Submit certificates for the following items showing conformance with referenced standards contained in this section:

Fasteners

Repair Paint

Qualification of Manufacturer

Certify that the manufacturer of the metal wall panel system meets requirements specified under paragraph entitled "Qualification of Manufacturer."

Qualification of Installer

Certify that the applicator meets requirements specified under paragraph entitled "Qualification of Installation Contractor."

Submit the wall system assembly wind load and fire rating classification listings.

SD-08 Manufacturer's Instructions

Installation of Wall panels

SD-09 Manufacturer's Field Reports

Water-Spray Test; G  
Field Service Report; G

SD-11 Closeout Submittals

Warranty  
Instructions To:  
Government and/or Contractor Personnel  
Include copies of Material Safety Data Sheets for maintenance/repair materials.

## 1.5 QUALITY ASSURANCE

### 1.5.1 Qualification of Manufacturer

Metal wall panel system manufacturer must have a minimum of five (5) years experience in manufacturing metal wall system and accessory products.

### 1.5.2 Qualification of Engineer

Provide engineering services by an authorized engineer; currently licensed in the geographical area where construction will take place, having a minimum of four (4) years experience as an engineer knowledgeable in wind load design analysis, protocols and procedures for ASCE 7-05 and ASTM E 1592.

Provide certified engineering calculations using the products submitted for:

Wind load requirements in accordance with FM Wind Design Guide and ASCE 7-05.

### 1.5.3 Qualification of Installer

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

#### 1.5.4 Testing Agency Qualifications

Qualify in accordance with requirements of ASTM E 329.

#### 1.5.5 Adhesion Test

Prior to delivery of composite wall panel system, perform test on adhesives and sealants per ASTM D 3359. Test each adhesive and sealant utilizing specified panel finish.

- a. Preconstruction Field-Adhesion Testing: Before installing sealants, field test their adhesion to Project joint substrates as specified in Section 07 92 00 JOINT SEALANTS.

#### 1.5.6 Fire Performance Characteristics

Provide metal composite wall systems with the following fire-test characteristics determined by indicated test standard as applied by UL or other testing and inspection agency acceptable to authorities having jurisdiction.

- a. Surface-Burning Characteristics: Provide metal composite wall system panels with the following characteristics when tested per ASTM E 84.
  - (1) Flame spread index: 25 or less.
  - (2) Smoke developed index: 450 or less.
- b. Fire Performance of Insulated Wall: Class 1 wall panel per ANSI/FM 4880.
- c. Room Corner Test: NFPA 285 or UL 1715.
- d. Fire Resistance Ratings: Where indicated by design designations, provide metal wall panels tested per ASTM E 119; or UL 263, UL Fire Resistance, and UL Bld Mat Dir; by a testing and inspecting agency acceptable to authorities having jurisdiction..

### 1.6 ADMINISTRATIVE REQUIREMENTS

#### 1.6.1 Pre-Installation Conference

Conduct reinstallation meeting at site attended by Owner, Architect, manufacturer's technical representative, and other trade contractors, to review the following:

- a. Coordinate building framing in relation to composite wall panel system.
- b. Coordinate installation of building air and water barrier behind composite wall panel system.
- c. Coordinate window, door and louver, and other openings and penetrations of composite wall panel system.
- d. Review drawings, including Fabrication and Installation drawings, showing complete Wall Panel Assemblies, and specifications. Include review of submittal items as applicable for the following:

Flashing and accessories  
Anchorage systems  
Manufacturer's catalog data  
Factory Color Finish  
Insulation  
Closure Materials, including metal closure strips  
Flashing Tape  
Rated Wall Assembly test data  
Fasteners

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

- e. Finalize construction schedule and verify availability of materials, Installer's personnel, equipment, and facilities needed to make progress and avoid delays.
- f. Methods and procedures related to metal wall panel installation, including manufacturer's written instructions for Installation of Wall panels, and verification of wall system assembly wind load and fire rating classification listings.
- g. Support conditions for compliance with requirements, including alignment between and attachment to structural members. Provide details of wind design analysis including wind speed, exposure category, co-efficient, importance factor, designates type of facility, negative pressures for each zone, methods and requirements of attachment. Wind design analysis to include wall plan delineating dimensions and attachment patterns for each zone. Wind design analysis to be prepared and sealed by Licensed Project Engineer in the geographic area where the construction will take place.
- h. Flashing, special siding details, wall penetrations, openings, and condition of other construction that will affect metal wall panels.
- i. Governing regulations and requirements for insurance, certificates, tests and inspections if applicable. Include review of Sustainable Design Requirements, wall system assembly wind load, and fire rating classification. Safety plan review must include applicable Material Safety Data Sheets.
- j. Temporary protection requirements for metal wall panel assembly during and after installation.
- j. Wall panel observation and repair procedures after metal wall panel installation. Include review of sample repair paint.
- j. Sample Warranty.

#### 1.7 DELIVERY, HANDLING, AND STORAGE

Protect products of composite wall panel system during shipping, handling, and storage to prevent staining, denting, deterioration of components or other damage.

Deliver, unload, store, and erect composite wall panel system and accessory items without misshaping panels or exposing panels to surface damage from weather or construction operations.

## 1.8 WARRANTY

### 1.8.1 Special Manufacturer's Warranty

On manufacturer's standard form, in which manufacturer agrees to repair or replace metal wall panel assemblies that fail in materials and workmanship within two years from date of Substantial Completion.

### 1.8.2 Special Panel Finish Warranty

On manufacturer's standard form, in which manufacturer agrees to repair or replace wall panels that evidence deterioration of finish within 20 years from date of Substantial Completion.

## 1.9 SUSTAINABLE DESIGN REQUIREMENTS

### 1.9.1 Regional Materials

Use materials or products extracted, harvested, or recovered, as well as manufactured, within a 500 mile radius from the project site, if available from a minimum of three sources.

### 1.9.2 Recycled Content

Use materials with an average postconsumer recycled content plus one-half of preconsumer recycled content that is not less than 50 percent.

## PART 2 PRODUCTS

### 2.1 PANEL MATERIALS

#### 2.1.1 Aluminum Face Sheet

Smooth surface coil-coated, ASTM B 209, 5052-H32 alloy.

- a. Face Sheet Thickness: 0.040 thick.
- b. Surface: Smooth.
- c. Aluminum Products Recycled Content: Refer to Part 1 Article "Sustainable Design Requirements."

#### 2.1.2 Exposed Coil-Coated Finish

##### 2.1.2.1 Fluoropolymer Two-Coat Mica System

0.25-mil primer with 0.8-mil 70 percent PVDF fluoropolymer color coat providing a pearlescent appearance, AAMA 620.

##### 2.1.2.2 Color

As indicated.

#### 2.1.3 Metallic-Coated Steel Liner Sheet

Coil-coated, ASTM A 755/A 755M, 0.024 inch/24 gage thick.

- a. Zinc-Coated (Galvanized) Steel Sheet: ASTM A 653/A 653M, G90,

structural quality.

b. Surface: Smooth planked.

c. Interior Liner Panel Finish: 0.2 mil primer with 0.6 mil acrylic color coat.

#### 2.1.4 Exposed Trim and Fasteners

Match panel finish.

### 2.2 INSULATION FOR PANEL CORES

#### 2.2.1 Metal Panel Foamed-Insulation-Core

Urethane-modified isocyanurate, density 2.7 lb/cu. ft., minimum compressive strength 20 lb/sq. in., and containing no CFC or HCFC compounds.

### 2.3 FOAMED INSULATION-CORE METAL WALL PANELS

#### 2.3.1 Foamed-Insulation-Core Metal Wall Panels

Factory-foamed horizontal and vertical wall panel system consisting of an exterior metal face sheet with interior metal liner panel, bonded to factory foamed-in-place core in thermally-separated profile, with no glues or adhesives, and with factory sealed tongue-and-groove and rainscreen-design pressure-equalized-chamber horizontal joint, attached to supports using concealed fasteners.

#### 2.3.2 Panel Joinery

a. Vertical Panels: Double tongue-and-groove.

b. Horizontal Panels: Rainscreen design with pressure equalized chamber and vented weep holes.

c. Panel Ends: Trimless, with tab-under horizontal shelf.

#### 2.3.3 Panel Width

Custom widths indicated.

#### 2.3.4 Panel Profile

Segmented-faced in locations and sizes indicated.

a. Reveals: 1-3/16 inch deep by width indicated.

b. Segmented-faced Panels: As indicated.

#### 2.3.5 Panel Thickness:

2.0 inch, flat.

#### 2.3.6 Thermal-Resistance (R)

Value: 14.

## 2.4 METAL WALL PANEL ACCESSORIES

Provide complete metal wall panel assembly incorporating trim, copings, fasciae, parapet caps, soffits, sills, inside and outside corners, and miscellaneous flashings. Provide manufacturer's factory-formed clips, shims, flashings, gaskets, lap tapes, closure strips, and caps for a complete installation. Fabricate accessories in accordance with SMACNA 1793.

### 2.4.1 Formed Flashing and Trim

Match material, thickness, and color of metal wall panel face sheets.

### 2.4.2 Extrusion Trim

Provide manufacturer-provided extruded trim for the following locations and as indicated on Drawings:

- a. Base trim.
- b. Coping.
- c. Panel installation perimeter.
- d. Opening perimeters.

### 2.4.3 Vertical Seal Plate

Extruded aluminum seal plate with gasket seals and pressure-equalized vented drainage channel designed to transfer structural load to panel system substrate and to provide secondary vertical path for controlled moisture weeping.

### 2.4.4 Sealants

Type recommended by metal wall panel system manufacturer for application, meeting requirements of Section 07 92 00 JOINT SEALANTS.

### 2.4.5 Flashing Tape

4-inch wide self-adhering butyl flashing tape.

### 2.4.6 Panel Clips

Concealed stainless steel clip configured specifically for metal wall panel profile, engaging face and liner panel edge without compressing panel insulation.

### 2.4.7 Fasteners

Self-tapping screws, bolts, nuts, and other acceptable fasteners recommended by panel manufacturer. Where exposed fasteners cannot be avoided, supply corrosion-resistant fasteners with heads matching color of metal wall panels by means factory-applied coating.

## 2.5 Panel Support

The form insulation-core metal wall panels to be supported by paint booth structure. Reference Section 11 50 10.



#### 2.5.1 Size

As indicated on approved shop drawings.

### 2.6 SECONDARY METAL FRAMING

Miscellaneous Framing Components, General: Cold-formed metallic-coated steel sheet, ASTM C 645, Grade 50, with ASTM A 653/A 653M, G90 (Z180) hot-dip galvanized zinc coating.

#### 2.6.1 Subgirts

C- or Z- shaped sections, 0.064-inch minimum.

#### 2.6.2 Sill Channels

0.064-inch minimum.

#### 2.6.3 Hat Channels

0.040 inch minimum.

## PART 3 EXECUTION

### 3.1 EXAMINATION

Examine metal wall panel system substrate with Installer present. Inspect for erection tolerances and other conditions that would adversely affect installation of metal wall panels.

#### 3.1.1 Framing

Inspect framing that will support metal wall panels to determine if support components are installed as indicated on approved shop drawings. Confirm presence of acceptable framing members at recommended spacing to match installation requirements of metal wall panels.

#### 3.1.2 Wall Sheathing

Confirm that wall sheathing is within tolerances acceptable to metal wall panel system manufacturer.

a. Maximum deviations acceptable:

- (1) 1/4-inch in 20 feet vertically or horizontally from face plane of framing.
- (2) 1/2-inch maximum deviation from framing face plane on any building elevation.
- (3) 1/8-inch 5 feet.

#### 3.1.3 Openings

Verify that window, door, louver and other penetrations match layout on shop drawings.

#### 3.1.4 Air/Moisture Barriers

Confirm that work has been completed, inspected, and tested as required.

#### 3.1.5 Correction

Correct out-of-tolerance work and other deficient conditions prior to proceeding with metal wall panel system installation.

### 3.2 PREPARATION

Secondary Metal Framing: Install secondary metal framing components as indicated. Install secondary metal framing and other metal panel supports per ASTM C 754 and metal wall panel manufacturer's recommendations.

### 3.3 METAL WALL PANEL SYSTEM INSTALLATION

Install metal wall panel system in accordance with approved shop drawings and manufacturer's recommendations. Install metal wall panels in orientation, sizes, and locations indicated. Anchor metal wall panels and other components securely in place. Provide for thermal and structural movement.

- a. Attach panels to metal framing using recommended clips, screws, fasteners, sealants, and adhesives indicated on approved shop drawings.
  - (1) Fasteners for Steel Wall Panels: Stainless-steel for exterior locations and locations exposed to moisture; carbon steel for interior use only.
  - (2) Apply elastomeric sealant continuously between metal base channel (sill angle) and concrete, and elsewhere as indicated or, if not indicated, as approved by manufacturer.
  - (3) Do not field cut metal wall panels.
  - (4) Fasten metal wall panels to supports with concealed clips at each joint at location, spacing, and with fasteners recommended by manufacturer. Install clips to supports with self-tapping fasteners.
  - (5) Provide weatherproof escutcheons for pipe and conduit penetrating exterior walls.
  - (6) Horizontal Joinery: Working from base of installation to top connect upper panel to lower panel at dry seal joinery.
  - (7) Vertical Joinery: Provide reveal between vertical ends of panels as shown on shop drawings using hardware and gaskets furnished by manufacturer to form a weather tight seal between panels.
  - (8) Dissimilar Materials: Where elements of metal wall panel system will come into contact with dissimilar materials, treat faces and edges in contact with dissimilar materials as recommended by manufacturer.
- b. Joint Sealers: Install gaskets, joint fillers, and sealants where indicated and where required for weatherproof performance of metal wall panel assemblies.

- (1) Seal panel end utilizing 2 beads of non-curing butyl aligning with factory-applied seal in adjacent panel pocket; apply continuously without gaps to complete panel system air barrier.
- (2) Seal metal wall panel end laps to supports or back-up flashing sealant, full width of panel. Seal side joints where recommended by metal wall panel manufacturer. Do not install sealant in locations that will interfere with drainage of pressure-equalized panel chambers.
- (3) Prepare joints and apply sealants per requirements of Section 07 92 00 JOINT SEALANTS.

### 3.4 ACCESSORY INSTALLATION

Install metal wall panel accessories with positive anchorage to building and weather tight mounting and provide for thermal expansion. Coordinate installation with flashings and other components.

- a. Install related flashings and sheet metal trim per requirements of Section 07 60 00 FLASHING AND SHEET METAL.
- b. Install components required for a complete metal wall panel assembly, including trim, copings, corners, seam covers, flashings, sealants, gaskets, fillers, closure strips, and similar items.
- c. Comply with performance requirements and manufacturer's written installation instructions.
- d. Provide concealed fasteners except where noted on approved shop drawings.
- e. Set units true to line and level as indicated. Install work with laps, joints, and seams that will be permanently watertight and weather resistant.

### 3.5 FIELD QUALITY CONTROL

#### 3.5.1 Testing Agency

Owner will engage an independent testing and inspecting agency acceptable to Architect to perform field tests and inspections and to prepare field test reports.

#### 3.5.2 Water-Spray Test

After completing portion of metal wall panel assembly including accessories and trim, test 2-bay area selected by Architect for water penetration, according to AAMA 501.2.

#### 3.5.3 Manufacturer's Field Service

Engage a service representative authorized by metal wall panel manufacturer to inspect completed installation. Submit written field service report. Correct deficiencies noted in report.

### 3.6 CLEAN-UP AND PROTECTION

Remove temporary protective films. Clean finished surfaces as recommended by metal wall panel manufacturer. Clear weep holes and drainage channels of obstructions, dirt, and sealant. Maintain in a clean condition during construction.

Replace damaged panels and accessories that cannot be repaired by finish touch-up or minor repair.

-- End of Section --

SECTION 07 54 19  
POLYVINYL-CHLORIDE ROOFING  
**02/13**

PART 1 GENERAL

1.1 REFERENCES

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

AMERICAN SOCIETY OF CIVIL ENGINEERS (ASCE)

ASCE 7 (2017) Minimum Design Loads for Buildings and Other Structures

AMERICAN SOCIETY OF SAFETY ENGINEERS (ASSE/SAFE)

ASSE/SAFE A10.24 (2014) Roofing - Safety Requirements of Low-Sloped Roofs

ASTM INTERNATIONAL (ASTM)

ASTM D4434/D4434M (2015) Standard Specification for Poly(Vinyl Chloride) Sheet Roofing

ASTM D6754/D6754M (2010) Standard Specification for Ketone Ethylene Ester Based Sheet Roofing

ASTM E108 (2011) Fire Tests of Roof Coverings

FM GLOBAL (FM)

FM 4470 (2010) Single-Ply, Polymer-Modified Bitumen Sheet, Built-up Roof (BUR), and Liquid Applied Roof Assemblies for Use in Class 1 and Noncombustible Roof Deck Construction

FM APP GUIDE (updated on-line) Approval Guide  
<http://www.approvalguide.com/>

INTERNATIONAL CODE COUNCIL (ICC)

ICC IBC (2017) International Building Code

NATIONAL ROOFING CONTRACTORS ASSOCIATION (NRCA)

NRCA 3619 (2004) Quality Control Guidelines for Application of Polymer-Modified Bitumen Roofing

NRCA 3740 (2005) The NRCA Waterproofing Manual

U.S. GREEN BUILDING COUNCIL (USGBC)

LEED BD+C

(2009; R 2010) Leadership in Energy and  
Environmental Design(tm) Building Design  
and Construction (LEED-NC)

UNDERWRITERS LABORATORIES (UL)

UL 790

(2004; Reprint Jul 2014) Standard Test  
Methods for Fire Tests of Roof Coverings

1.2 SUMMARY

Adhered polyvinyl-chloride (PVC) roof membrane system applied over  
insulation, recovery board, and roof deck substrate.

1.3 ASSEMBLY REQUIREMENTS

Roofing membrane sheet widths shall be consistent with membrane attachment  
methods and wind uplift requirements, and shall be as large as practical.  
In order to minimize joints and 3-way overlaps, prefabricated sheets are  
not accepted. Provide membrane which is free of defects and foreign  
material. Coordinate flashing work to permit continuous roof-surfacing  
operations. Insulation shall be applied and weatherproofed on the same  
day.

1.3.1 Fire Resistance

Complete roof system assembly:

- a. Class A rated in accordance with ASTM E108, FM 4470, or UL 790; and
- b. Be listed as Class I roof deck construction in FM APP GUIDE.

FM or UL approved components of the roof covering assembly shall bear the  
appropriate FM or UL label.

1.3.2 Wind Uplift Resistance

The complete roof system assembly shall be rated and installed to resist  
wind loads as indicated on the Structural Drawings and validated by uplift  
resistance testing in accordance with Factory Mutual (FM) test  
procedures. Do not install non-rated systems, except as approved by the  
Contracting Officer. Submit Engineering calculations, signed, sealed, and  
dated by a Registered Engineer validating the wind resistance per ASCE 7.  
Base wind uplift measurements on a design wind speed in accordance with  
ASCE 7 and other applicable building code requirements.

1.3.3 Solar Reflectance Index (SRI)

SRI measures the roof's ability to reject solar heat, defined such that a  
standard black (reflectance 0.05, emittance 0.90) is 0 and a standard  
white (reflectance 0.80, emittance 0.90) is 100. Use roofing materials  
having minimum appropriate SRI for more than 75 percent of roof surface  
(low slope (less than 2:12) SRI greater than 78; high slope (greater than  
2:12) SRI greater than 29).

#### 1.4 SUSTAINABILITY REPORTING

Materials in this technical specification may contribute towards contract compliance with sustainability requirements. See Section 01 33 29 SUSTAINABILITY REPORTING for project LEED BD+C local/regional materials, low-emitting materials, recycled content, rapidly renewable materials and LEED documentation requirements.

#### 1.5 SUBMITTALS

Government approval is required for submittals with a "G" designation; submittals not having a "G" designation are for information only. When used, a designation following the "G" designation identifies the office that will review the submittal for the Government. Submittals with an "S" are for inclusion in the Sustainability Notebook, in conformance to Section 01 33 29 SUSTAINABILITY REPORTING. Submit the following in accordance with Section 01 33 00 SUBMITTAL PROCEDURES:

##### SD-02 Shop Drawings

Detail Drawings; G  
Roof Plan; G

##### SD-03 Product Data

PVC Roofing Membrane; G  
Bonding Adhesive  
Flashing  
Roof Insulation  
Information Card

##### SD-05 Design Data

Wind Uplift Resistance; G, AE

##### SD-07 Certificates

Qualification of Manufacturer  
Qualifications of Applicator  
Qualification of Engineer of Record  
Wind Uplift Resistance  
Fire Resistance classification  
Minimum Polymer Thickness  
Sample Certificate; G

##### SD-08 Manufacturer's Instructions

Membrane Flashing  
Cold Weather

##### SD-11 Closeout Submittals

LEED Documentation; S  
Warranty; G, AE  
Information Card; G, AE  
Instructions to Government Personnel; G, AE

## 1.6 QUALITY ASSURANCE

### 1.6.1 Qualification of Manufacturer

Polyvinyl-Chloride sheet roofing system manufacturer must have a minimum of 10 years experience in manufacturing PVC roofing products.

### 1.6.2 Qualifications of Applicator

Roofing system applicator must be approved, authorized, or licensed in writing by the PVC sheet roofing system manufacturer and have a minimum of five years experience as an approved, authorized, or licensed applicator with that manufacturer and be approved at a level capable of providing the specified warranty. Supply the names, locations and client contact information of five projects, within the previous three years, of similar size and scope that the applicator has constructed using the manufacturer's roofing products submitted for this project.

### 1.6.3 Qualifications of Photovoltaics (PV) Rooftop Applicator

The PV rooftop applicator must be approved, authorized, or certified by a Roof Integrated Solar Energy (RISE) Certified Solar Roofing Professional (CSRPF), and comply with applicable codes, standards, and regulatory requirements to maintain the weatherproofing abilities of both the integrated roof system and photovoltaic system.

### 1.6.4 Qualification of Engineer of Record

Engineer of Record must be currently licensed within the jurisdiction of the project.

Engineer of Record must be approved, authorized, and currently licensed, and have a minimum of five years experience as an approved Engineer for manufacturers of similar roof systems. Engineer of Record must supply the names and locations of five projects of similar size and scope for which he has provided engineering calculations using the manufacturer's products submitted for this project within the previous three years. Engineer of Record must provide certified engineering calculations for:

- a. ASCE 7, in accordance with ICC IBC.
- b. Seismic requirements per ICC IBC Chapter 16, Section 1613.

### 1.6.5 Conformance and Compatibility

The entire roofing and flashing system shall be in accordance with specified and indicated requirements, including fire and wind resistance.

### 1.6.6 Preroofing Conference

After approval of submittals and before performing roofing and insulation system installation work, hold a preroofing conference to review the following:

- a. Drawings, including roof plan, specifications and submittals related to the roof work.
- b. Roof system components installation;



- c. Procedure for the roof manufacturer's technical representative's onsite inspection and acceptance of the roofing substrate, and roofing substrate, the name of the manufacturer's technical representatives, the frequency of the onsite visits, distribution of copies of the inspection reports from the manufacturer's technical representative to roof manufacturer;
- d. Contractor's plan for coordination of the work of the various trades involved in providing the roofing system and other components secured to the roofing; and
- e. Quality control(NRCA 3619) plan for the roof system installation;
- f. Safety requirements.

Coordinate prerooting conference scheduling with the Contracting Officer. The conference shall be attended by the Contractor, the Contracting Officer's designated personnel, personnel directly responsible for the installation of roofing and insulation, flashing and sheet metal work, mechanical and electrical work, other trades interfacing with the roof work, designated safety personnel trained to enforce and copy with ASSE/SAFE A10.24, Fire Marshall, and a representative of the roofing materials manufacturer. Before beginning roofing work, provide a copy of meeting notes and action items to all attending parties. Note action items requiring resolution prior to start of roof work.

#### 1.7 DETAIL DRAWINGS

Submit roof plan depicting wind loads and boundaries of enhanced perimeter and corner attachments of roof system components, , spacing of perimeter, corner, and infield fasteners, as applicable. The drawing shall reflect the project roof plan of each roof level and conditions indicated. Submit bids with approved detail drawings and specifications approved and furnished by the PVC membrane manufacturer.

#### 1.8 DELIVERY, STORAGE, AND HANDLING

##### 1.8.1 Delivery

Deliver materials in the manufacturer's original, unopened containers and rolls with labels intact and legible. Mark and remove wet or damaged materials from the site. Where materials are covered by a referenced specification number, the container shall bear the specification number, type, class, and shelf life expiration date where applicable. Deliver materials in sufficient quantity to allow work to proceed without interruption.

##### 1.8.2 Storage

Protect materials against moisture absorption and contamination or other damage. Avoid crushing or crinkling of roll materials. Store roll materials on end on clean raised platforms or pallets one level high in dry locations with adequate ventilation, such as an enclosed building or closed trailer. Do not store roll materials in buildings under construction until concrete, mortar, and plaster work is finished and dry. Maintain roll materials at temperatures above 50 degrees F for 24 hours immediately before application. Do not store materials outdoors unless approved by the Contracting Officer. Completely cover felts stored outdoors, on and off roof, with waterproof canvas protective covering. Do

not use polyethylene sheet as a covering. Tie covering securely to pallets to make completely weatherproof. Provide sufficient ventilation to prevent condensation. Do not store more materials on roof than can be installed the same day and remove unused materials at end of each days work. Distribute materials temporarily stored on roof to stay within live load limits of the roof construction.

- a. Maintain a minimum distance of 35 foot for all stored flammable materials, including materials covered with shrink wraps, craft paper and/or tarps from all torch/welding applications.
- b. Immediately remove wet, contaminated or otherwise damaged or unsuitable materials from the site. Damaged materials may be marked by the Contracting Officer.

### 1.8.3 Handling

Prevent damage to edges and ends of roll materials. Do not install damaged materials in the work. Select and operate material handling equipment to prevent damage to materials or applied roofing.

## 1.9 ENVIRONMENTAL REQUIREMENTS

Do not install roofing system when air temperature is below 40 degrees F, during any form of precipitation, including fog, or when there is ice, frost, moisture, or any other visible dampness on the roof deck. Follow manufacturer's printed instructions for Cold Weather Installation.

### 1.10 SEQUENCING

Coordinate the work with other trades to ensure that components which are to be secured to or stripped into the roofing system are available and that permanent flashing and counterflashing in accordance with NRCA 3740, are installed as the work progresses. Ensure temporary protection measures are in place to preclude moisture intrusion or damage to installed materials. Application of roofing shall immediately follow application of insulation as a continuous operation. Coordinate roofing operations with insulation work so that all roof insulation applied each day is covered with roof membrane installation the same day.

### 1.11 WARRANTY

Provide roof system material and workmanship warranties. Provide revision or amendment to standard membrane manufacturer warranty as required to comply with the specified requirements. Minimum manufacturer warranty shall have no dollar limit, shall be warrantied to the designed wind load, cover full system water-tightness, and shall have a minimum duration of 20 years. Submit sample certificate.

#### 1.11.1 Roof Membrane Manufacturer Warranty

Furnish the roof membrane manufacturer's 20-year, no dollar limit roof system materials and installation workmanship warranty, including flashing, insulation, and accessories necessary for a watertight roof system construction. Provide warranty directly to the Government and commence warranty effective date at time of Government's acceptance of the roof work. The warranty must state that:

- a. If within the warranty period the roof system, as installed for its

intended use in the normal climatic and environmental conditions of the facility, becomes non-watertight, shows evidence of moisture intrusion within the assembly, splits, tears, cracks, delaminates, separates at the seams, or shows evidence of excessive weathering due to defective materials or installation workmanship, the repair or replacement of the defective and damaged materials of the roof system assembly and correction of defective workmanship are the responsibility of the roof membrane manufacturer. All costs associated with the repair or replacement work are the responsibility of the roof membrane manufacturer.

- b. When the manufacturer or his approved applicator fail to perform the repairs within 72 hours of notification, emergency temporary repairs performed by others does not void the warranty.

#### 1.11.2 Roofing System Installer Warranty

The roof system installer shall warrant for a minimum period of two years that the roof system, as installed, is free from defects in installation workmanship, to include the roof membrane, flashing, insulation, accessories, attachments, and sheet metal installation integral to a complete watertight roof system assembly. Write the warranty directly to the Government. The roof system installer is responsible for correction of defective workmanship and replacement of damaged or affected materials. The roof system installer is responsible for all costs associated with the repair or replacement work.

#### 1.11.3 Continuance of Warranty

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

### PART 2 PRODUCTS

#### 2.1 MATERIALS

##### 2.1.1 PVC Roof Membrane

Provide a minimum polymer thickness 0.072 inch reinforced PVC as specified herein. Provide PVC system capable of obtaining 20 year warranties and as listed in the applicable wind uplift and fire rating classification listings.

Submit Data as required by Section 07 22 00 ROOF AND DECK INSULATION together with requirements of this section. Data shall include written acceptance by the roof membrane manufacturer of the insulation and other products and accessories to be provided by and warranted under the full system guarantee of the roof membrane manufacturer.

- a. Coordinate with other specification sections related to the roof work. Furnish a combination of specified materials that comprise a roof system acceptable to the roof membrane manufacturer and meeting specified requirements. Provide materials free of defects and suitable for the service and climatic conditions of the installation. All warranted roof system components shall be sourced from the PVC roof membrane manufacturer, including but not limited to all

insulation, coverboards, accessories, adhesives and edge metal.

- b. For each roof, furnish a typewritten information card for facility records and a card laminated in plastic and framed for interior display at roof access point, or a photoengraved 0.032 inch thick aluminum card for exterior display. Card shall be 8 1/2 by 11 inches minimum. Information card shall identify facility name and number; location; contract number; approximate roof area; detailed roof system description, including deck type, membrane, number of plies, method of application, manufacturer, insulation and cover board system and thickness; presence of tapered insulation for primary drainage, presence of vapor retarder; date of completion; installing Contractor identification and contact information; membrane manufacturer warranty expiration, warranty reference number, and contact information. Install card at roof top or access location as directed by the Contracting Officer and provide a paper copy to the Contracting Officer.

#### 2.1.2 Bonding Adhesive

Provide PVC membrane manufacturer's low volatile organic compound (VOC) membrane adhesive, as supplied by roof membrane manufacturer, and recommended by the manufacturer's printed data for bonding of PVC membrane materials to acceptable insulation, wood, metal, concrete or other acceptable substrate materials. Bonding adhesive shall not be used to bond membrane materials to each other.

#### 2.1.3 Water Cutoff Mastic/Water Block

As supplied by the roof membrane manufacturer and recommended by the manufacturer's printed data.

#### 2.1.4 Membrane Flashing

Membrane flashing, including self-adhering membrane flashing, perimeter flashing, flashing around roof penetrations and prefabricated pipe seals, shall be minimum polymer thickness 0.072 inch reinforced PVC for 20year warranties, and shall be utilized as recommended and supplied by the roof membrane manufacturer or minimum 0.072 inch thick reinforced PVC roof membrane and flashing's for 20 year warranties. Submit certification from PVC membrane manufacturer that the proposed PVC membrane roofing product meets the minimum polymer thickness specified.

#### 2.1.5 Roof Insulation

Insulation system and facer material shall be compatible with membrane application specified and be approved and supplied by the PVC membrane roof manufacturer and as specified in Section 07 22 00 ROOF AND DECK INSULATION.

#### 2.1.6 Wood Products

As specified in Section 06 10 00 ROUGH CARPENTRY, except that fire retardant treated materials shall not be in contact with PVC membrane or PVC accessory products, unless approved by the membrane manufacturer and the Contracting Officer.

## 2.2 REINFORCED, PVC MEMBRANE

Reinforced polyvinyl chloride (PVC) membrane shall contain fibers or scrim, and shall comply with ASTM D4434/D4434M, Type III, or ASTM D6754/D6754M, and in all cases shall provide 0.072 inch minimum thickness for adhered application. Notwithstanding the ASTM standards referenced, reinforced PVC roof membranes provided under this section shall have the minimum, labeled thickness specified. PVC membrane thickness specified herein is exclusive of backing material on the bottom of fleece-backed membrane. Principal polymer used in manufacture of the membrane sheet shall be PVC. Width and length of PVC membrane roofing sheet shall be consistent with membrane attachment methods and wind uplift requirements, and shall be as large as practical. In order to minimize joints and 3-way overlaps, prefabricated sheets are not accepted. Maximum reinforced PVC membrane roofing sheet dimensions to be the maximum width obtainable from PVC membrane roof manufacturer in order to minimize seams in the field of the roof.

## PART 3 EXECUTION

### 3.1 EXAMINATION

Ensure that the following conditions exist prior to application of the roofing materials:

- a. Curbs, control joints, expansion joints, perimeter walls, roof penetrating components, and equipment supports are in place.
- b. Surfaces are rigid, clean, dry, smooth, and free from cracks, holes, and sharp changes in elevation.
- c. Substrate is sloped to provide positive drainage.
- d. Walls and vertical surfaces are constructed to receive counterflashing, and will permit mechanical fastening of the base flashing materials.
- e. Treated wood nailers are in place on non-nailable surfaces, to permit nailing of base flashing at minimum height of 8 inches above finished roofing surface.
- f. Pressure-preservative treated wood nailers are fastened in place at openings, and intersections with vertical surfaces for securing of membrane, edging strips, attachment flanges of sheet metal, and roof fixtures. Surface-applied nailers are the same thickness as the roof insulation.
- g. PVC materials are not in contact with fire retardant treated wood, except as approved by the PVC membrane roof manufacturer and Contracting Officer.
- h. Exposed nail heads in wood substrates are properly set. Warped and split boards have been replaced. There are no cracks or end joints 1/4 inch in width or greater. Joints in plywood substrates are taped or otherwise sealed to prevent air leakage from the underside.
- i. Insulation boards are installed smoothly and evenly, and are not broken, cracked, or curled. There are no gaps in insulation board joints exceeding 1/4 inch in width. Insulation is attached as

specified in Section 07 22 00 ROOF AND DECK INSULATION. Insulation is being roofed over on the same day the insulation is installed.

### 3.2 APPLICATION METHOD

Apply entire PVC membrane roofing utilizing adhered application method. Apply roofing materials as specified herein unless approved otherwise by the Contracting Officer.

#### 3.2.1 Special Precautions

- a. Do not dilute coatings or sealants unless specifically recommended by the material manufacturer's printed application instructions. Do not thin liquid materials or cleaners used for cleaning PVC sheet.
- b. Keep liquids in airtight containers, and keep containers closed except when removing materials.
- c. Use liquid components, including adhesives, within their shelf life period. Store adhesives at 60 to 80 degrees F prior to use. Avoid excessive adhesive application and adhesive spills, as they can be destructive to some thermoplastic sheets and insulations; follow adhesive manufacturer's printed application instructions. Mix and use liquid components in accordance with label directions and manufacturer's printed instructions.
- d. Provide clean, dry cloths or pads for applying membrane cleaners and cleaning of membrane.
- e. Do not use heat guns or open flame to expedite drying of adhesives or primers.
- f. Require workmen and others who walk on the membrane to wear clean, soft-soled shoes to avoid damage to roofing materials.
- g. Do not use equipment with sharp edges which could puncture the PVC membrane roofing sheet.
- h. Shut down air intakes and any related mechanical systems and seal open vents and air intakes when applying solvent-based materials in the area of the opening or intake. Coordinate shutdowns with the Contracting Officer.

#### 3.2.2 PVC Roofing Membrane

Provide a watertight roof membrane sheet free of contaminants and defects that might affect serviceability. Provide a uniform, straight, and flat edge. Only felt-backed membrane shall be placed directly on concrete deck or other hard surface which may otherwise damage the membrane, absent the felt backing. Membrane shall be overlapped a minimum of 3 inches at sides for adhered applications. Direction of laps shall allow water to flow over and not against the lap. Membrane joints shall be free of wrinkles and fishmouths. The entire length of hot-air-welded seams shall be probe-tested and corrected during the day of installation. Defective areas shall be re-welded. Wrinkles, fishmouths, or damaged areas shall be cut out and the area covered with membrane using a continuous hot-air-welded seam on all sides. Repairs shall be probe-tested for continuity. Hot-air-welded seams are to be accomplished in accordance with the PVC membrane roofing manufacturer's published requirements.

### 3.2.2.1 Nailing

Membrane shall be fastened to nailers in accordance with the membrane manufacturer's approved instructions. Unless otherwise specified, nails shall be staggered on 4 inch centers maximum; screws for sheet metal shall be staggered on 8 inch centers maximum; and a row of fasteners shall be at least 1/2 inch from edges of sheet metal.

### 3.2.2.2 Flashing

Roof edges, projections through the roof and changes in roof planes shall be flashed. The seam shall be sealed a minimum of 3 inches beyond the fasteners which attach the membrane to nailers. The installed flashing's shall be secured at the top of the flashing a maximum of 12 inches on centers under the counterflashing or cap. Where possible, prefabricated components shall be used for pipe seals and flashing accessories.

### 3.2.2.3 Cutoffs

If work is terminated prior to weatherproofing the entire roof, the membrane shall be sealed to the roof deck. Flutes in metal decking shall be sealed off along the cutoff edge. Membrane shall be pulled free or cut to expose the insulation when resuming work and cut insulation sheets used for fill-in shall be removed. Asphalt or coal-tar products shall not be used for sealing.

### 3.2.3 Adhered Membrane Application

Layout membrane and side lap adjoining sheets in accordance with membrane manufacturer's printed installation instructions. Allow for sufficient membrane to form proper membrane terminations. Remove dusting agents and dirt from membrane and substrate areas where bonding adhesives are to be applied. Apply specified adhesive evenly and continuously to substrate and underside of sheets at rates recommended by the roof membrane manufacturer's printed application instructions. When adhesive is spray applied, roll with a paint roller to ensure proper contact and coverage. Do not apply bonding adhesive to surfaces of membrane in seam or lap areas. Allow adhesive to flash off or dry to consistency prescribed by manufacturer before adhering sheets to the substrate. Roll each sheet into adhesive slowly and evenly to avoid wrinkles; broom or roll the membrane to remove air pockets and fishmouths and to ensure adequately uniform bonding of sheet to substrate. Form field hot-air-welded laps or seams as specified and ensure that hot-air welded dimension is at width required by the membrane manufacturer's installation instructions. Check all seams and continuous hot-air-weld of all seams and lap seals.

### 3.3 FLASHINGS

Provide flashings in the angles formed at walls and other vertical surfaces and where required to make the work watertight, except where metal flashings are indicated.

#### 3.3.1 General

Provide a one-ply flashing membrane, as specified for the system used, and install immediately after the roofing membrane is placed and prior to finish coating where a finish coating is required. Flashings must be stepped where vertical surfaces abut sloped roof surfaces. Provide sheet

metal reglet in which sheet metal cap flashings are installed of not more than 16 inch nor less than 8 inch above the roofing surfaces. Exposed joints and end laps of flashing membrane must be made and sealed in the manner required for roofing membrane.

### 3.3.2 Membrane Flashing

#### 3.3.2.1 Installation

Install flashing and flashing accessories as the roof membrane is installed. Apply flashing to cleaned surfaces and as recommended by the roof membrane manufacturer and as specified. Utilize cured PVC membrane flashing and prefabricated accessory flashings to the maximum extent recommended by the roof membrane manufacturer. Limit uncured flashing material to reinforcing inside and outside corners and angle changes in plane of membrane, and to flashing scuppers, pourable sealer pockets, and other formed penetrations or unusually shaped conditions as recommended by the roof membrane manufacturer where the use of cured material is impractical. Extend base flashing not less than 8 inch above roofing surface and as necessary to provide for seaming overlap on roof membrane as recommended by the roof membrane manufacturer.

#### 3.3.2.2 Sealing

Seal flashing membrane for a minimum of 3 inch on each side of fastening device used to anchor roof membrane to nailers. Completely adhere flashing sheets in place. Seam flashing membrane in the same manner as roof membrane, except as otherwise recommended by the membrane manufacturer's printed instructions and approved by the Contracting Officer. Reinforce all corners and angle transitions by applying uncured membrane to the area in accordance with roof membrane manufacturer recommendations. Mechanically fasten top edge of base flashing with manufacturer recommended termination bar fastened at maximum 12 inch on center. Install sheet metal flashing over the termination bar in the completed work. Mechanically fasten top edge of base flashing for all other terminations in a manner recommended by the roof membrane manufacturer. Apply membrane liner over top of exposed nailers and blocking and to overlap top edge of base flashing installation at curbs, parapet walls, expansion joints and as otherwise indicated to serve as waterproof lining under sheet metal flashing components.

### 3.4 CORRECTION OF DEFICIENCIES

Where any form of deficiency is found, additional measures must be taken as deemed necessary by the Contracting Officer to determine the extent of the deficiency and provide corrective action recommendations. Perform corrective action as directed by the Contracting Officer.

### 3.5 PROTECTION OF APPLIED ROOFING

At the end of the day's work and when precipitation is imminent, protect applied membrane roofing system from water intrusion.

#### 3.5.1 Temporary Flashing for Permanent Roofing

Provide temporary flashing at walls and other penetrations and terminations of roofing sheets until permanent flashings can be applied. Remove temporary flashing before applying permanent flashing.



### 3.6 FIELD QUALITY CONTROL

#### 3.6.1 Construction Monitoring

During progress of the roof work, make visual inspections as necessary to ensure compliance with specified parameters. Additionally, verify the following:

- a. Equipment is in working order. Metering devices are accurate.
- b. Materials are not installed in adverse weather conditions.
- c. Substrates are in acceptable condition, in compliance with specification, prior to application of subsequent materials.
  - (1) Nailers and blocking are provided where and as needed.
  - (2) Insulation substrate is smooth, properly secured to its substrate, and without excessive gaps prior to membrane application.
  - (3) The proper number, type, and spacing of fasteners are installed.
  - (4) Materials comply with the specified requirements.
  - (5) All materials are properly stored, handled and protected from moisture or other damages. Liquid components are properly mixed prior to application.
  - (6) Adhesives are applied uniformly to both mating surfaces and checked for proper set prior to bonding mating materials. Mechanical attachments are spaced as required, including additional fastening of membrane in corner and perimeter areas as required.
  - (7) Membrane is properly overlapped.
  - (8) Membrane seaming is as specified by PVC membrane manufacturer. All seams are checked at the end of each work day.
  - (9) Applied membrane is inspected and repaired as necessary prior to paver installation.
  - (10) Membrane is adhered without ridges, wrinkles, kinks, fishmouths.
  - (11) Installer adheres to specified and detailed application parameters.
  - (12) Associated flashing's and sheet metal are installed in a timely manner in accord with the specified requirements.
  - (13) Temporary protection measures are in place at the end of each work shift.

#### 3.6.2 Manufacturer's Inspection

Manufacturer's technical representative shall visit the site a minimum of once per week during the installation for purposes of reviewing materials installation practices and adequacy of work in place. Inspections shall occur during the first 20 squares of membrane installation, at mid-point

of the installation, and at substantial completion, at a minimum. Additional inspections need not exceed one for each 100 squares of total roof area with the exception that follow-up inspections of previously noted deficiencies or application errors shall be performed as requested by the Contracting Officer. After each inspection, a report, signed by the manufacturer's technical representative shall be submitted by the roofing Contractor to the Contracting Officer within 3 working days. The report shall note overall quality of work, deficiencies and any other concerns, and recommended corrective action.

### 3.7 CLEAN UP

Remove debris, scraps, containers and other rubbish and trash resulting from installation of the roofing system from job site each day.

### 3.8 INSTRUCTIONS TO GOVERNMENT PERSONNEL

Furnish written and verbal instructions on proper maintenance procedures to designated Government personnel. Furnish instructions by a competent representative of the roof membrane manufacturer and include a minimum of 4 hours on maintenance and emergency repair of the membrane. Include a demonstration of membrane repair, and give sources of required special tools. Furnish information on safety requirements during maintenance and emergency repair operations. Include copies of Material Safety Data Sheets for maintenance/repair materials.

-- End of Section --

SECTION 07 60 00

FLASHING AND SHEET METAL

05/17

PART 1 GENERAL

1.1 REFERENCES

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

AMERICAN WELDING SOCIETY (AWS)

AWS D1.2/D1.2M (2014) Structural Welding Code - Aluminum

ASTM INTERNATIONAL (ASTM)

ASTM A308/A308M (2010) Standard Specification for Steel Sheet, Terne (Lead-Tin Alloy) Coated by the Hot Dip Process

ASTM A480/A480M (2016) Standard Specification for General Requirements for Flat-Rolled Stainless and Heat-Resisting Steel Plate, Sheet, and Strip

ASTM A653/A653M (2017) 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 (2014) Standard Specification for Aluminum and Aluminum-Alloy Extruded Bars, Rods, Wire, Profiles, and Tubes

ASTM B32 (2008; R 2014) Standard Specification for Solder Metal

ASTM B69 (2013) Standard Specification for Rolled Zinc

ASTM D1784 (2011) Standard Specification for Rigid Poly(Vinyl Chloride) (PVC) Compounds and Chlorinated Poly(Vinyl Chloride) (CPVC) Compounds

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

ASTM D41/D41M (2011; R 2016) Standard Specification for Asphalt Primer Used in Roofing, Dampproofing, and Waterproofing

ASTM D4586/D4586M (2007; E 2012; R 2012) Asphalt Roof  
Cement, Asbestos-Free

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

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

SINGLE PLY ROOFING INDUSTRY (SPRI)

ANSI/SPRI RD-1 (2009) Performance Standard for Retrofit  
Drains

## 1.2 GENERAL REQUIREMENTS

Finished sheet metal assemblies must form a weathertight enclosure without waves, warps, buckles, fastening stresses or distortion, while allowing for expansion and contraction without damage to the system. The sheet metal installer is responsible for cutting, fitting, drilling, and other operations in connection with sheet metal modifications required to accommodate the work of other trades. Coordinate installation of sheet metal items used in conjunction with roofing with roofing work to permit continuous, uninterrupted roofing operations.

## 1.3 SUBMITTALS

Government approval is required for submittals with a "G" designation; submittals not having a "G" designation are for information only. When used, a designation following the "G" designation identifies the office that will review the submittal for the Government. Submittals with an "S" are for inclusion in the Sustainability eNotebook, in conformance with Section 01 33 29 SUSTAINABILITY REPORTING. Submit the following in accordance with Section 01 33 00 SUBMITTAL PROCEDURES:

### SD-02 Shop Drawings

Exposed Sheet Metal Coverings; G

Gutters; G

Downspouts; G

Expansion Joints; G

Gravel Stops and Fasciae

Splash Pans; G

Flashing for Roof Drains; G

Base Flashing; G

Counterflashing

Flashing at Roof Penetrations and Equipment Supports; G

Reglets

Copings; G

Drip Edges; G

Open Valley Flashing; G

Eave Flashing; G

SD-04 Samples

Finish Samples; G

SD-07 Certificates

Certificates of Compliance; G

SD-08 Manufacturer's Instructions

Instructions for Installation; G

Quality Control Plan; G

SD-10 Operation and Maintenance Data

Cleaning and Maintenance; G

SD-11 Closeout Submittals

Recycled Content; S

1.4 MISCELLANEOUS REQUIREMENTS

1.4.1 Product Data

Indicate thicknesses, dimensions, fastenings, anchoring methods, expansion joints, and other provisions necessary for thermal expansion and contraction. Scaled manufacturer's catalog data may be submitted for factory fabricated items.

1.4.2 Finish Samples

Submit two color charts and two finish sample chips from manufacturer's standard color and finish options for each type of finish indicated.

1.4.3 Operation and Maintenance Data

Submit detailed instructions for installation and quality control during installation, cleaning and maintenance, for each type of assembly indicated.

1.5 DELIVERY, HANDLING, AND STORAGE

Package and protect materials during shipment. Uncrate and inspect materials for damage, dampness, and wet-storage stains upon delivery to the job site. Remove from the site and replace damaged materials that cannot be restored to like-new condition. Handle sheet metal items to avoid damage to surfaces, edges, and ends. Store materials in dry, weather-tight, ventilated areas until installation.

## PART 2 PRODUCTS

### 2.1 RECYCLED CONTENT

Provide products with recycled content and provide certificates of compliance in accordance with Section 01 33 29 SUSTAINABILITY REPORTING.

### 2.2 MATERIALS

Do not use lead, lead-coated metal, or galvanized steel. Use any metal listed by SMACNA 1793 for a particular item, unless otherwise indicated. Provide materials, thicknesses, and configurations in accordance with SMACNA 1793 for each material. Different items need not be of the same metal, except that contact between dissimilar metals must be avoided.

Furnish sheet metal items in 8 to 10 foot lengths. Single pieces less than 8 feet long may be used to connect to factory-fabricated inside and outside corners, and at ends of runs. Factory fabricate corner pieces with minimum 12 inch legs. Provide accessories and other items essential to complete the sheet metal installation. Provide accessories made of the same or compatible materials as the items to which they are applied. Fabricate sheet metal items of the materials specified below and to the gage, thickness, or weight shown in Table I at the end of this section. Provide sheet metal items with mill finish unless specified otherwise. Where more than one material is listed for a particular item in Table I, each is acceptable and may be used, except as follows:

#### 2.2.1 Exposed Sheet Metal Items

Must be of the same material. Consider the following as exposed sheet metal: gutters, including hangers; downspouts; gravel stops and fasciae; cap, valley, steeped, base, and eave flashings and related accessories.

#### 2.2.2 Drainage

Do not use copper for an exposed item if drainage from that item will pass over exposed masonry, stonework or other metal surfaces. In addition to the metals listed in Table I, lead-coated copper may be used for such items.

#### 2.2.3 Lead Sheet

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

#### 2.2.4 Steel Sheet, Zinc-Coated (Galvanized)

Provide in accordance with ASTM A653/A653M.

#### 2.2.5 Zinc Sheet and Strip

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

#### 2.2.6 Stainless Steel

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

#### 2.2.7 Terne-Coated Steel

Provide in accordance with ASTM A308/A308M, a minimum of 14 by 20 inch with minimum of 40 pound coating per double base box. ASTM A308/A308M.

#### 2.2.8 Aluminum Alloy Sheet and Plate

Provide in accordance with ASTM B209 color to match adjacent surface material form alloy, and temper appropriate for use.

##### 2.2.8.1 Alclad

When fabricated of aluminum, fabricate the following items with Alclad 3003, Alclad 3004, or Alclad 3005, clad on both sides unless otherwise indicated.

- a. Gutters, downspouts, and hangers
- b. Gravel stops and fasciae
- c. Flashing

#### 2.2.9 Finishes

Provide exposed exterior sheet metal and aluminum with a baked on, factory applied color coating of polyvinylidene fluoride (PVF2) or approved equal fluorocarbon coating. Dry film thickness of coatings must be 0.8 to 1.3 mils and color to match adjacent surface material.

#### 2.2.10 Aluminum Alloy, Extruded Bars, Rods, Shapes, and Tubes

ASTM B221.

#### 2.2.11 Solder

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

#### 2.2.12 Reglets

##### 2.2.12.1 Polyvinyl Chloride Reglets

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

#### 2.2.13 Bituminous Plastic Cement

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

#### 2.2.14 Roofing Felt

Provide in accordance with ASTM D226/D226M Type I .

#### 2.2.15 Asphalt Primer

Provide in accordance with ASTM D41/D41M.

#### 2.2.16 Fasteners

Use the same metal as, or a metal compatible with the item fastened. Use

stainless steel fasteners to fasten dissimilar materials.

### PART 3 EXECUTION

#### 3.1 INSTALLATION

##### 3.1.1 Metal Roofing

##### 3.1.1.1 Standing-seam Method

Make standing seams parallel with slope of roof. Fabricate sheets into long lengths at shop by locking short dimensions together and thoroughly soldering joints thus formed. In applying metal, turn up one edge of course at each side seam at right angles 1.5 inch. Then install 2 by 3 inch cleats spaced 12 inches apart by fastening one end of each cleat to roof with two one inch long nails and folding roof end back over nail heads. Turn end adjoining turned-up side seam up over upstanding edge of course. Turn up adjoining edge of next course 1.75 inches and abutting upstanding edges locked, turned over, and flattened against one side of standing seam. Make standing seams straight, rounded neatly at the top edges, and stand about one inch above roof deck. All sheets must be same length, except as required to complete run or maintain pattern. Locate transverse joints of each panel half way between joints in adjacent sheets. Align joints of alternate sheets horizontally to produce uniform pattern, as shown in SMACNA 1793.

##### 3.1.2 Workmanship

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

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

##### 3.1.3 Nailing

Confine nailing of sheet metal generally to sheet metal having a maximum width of 18 inches. Confine nailing of flashing to one edge only. Space nails evenly not over 3 inch on center and approximately 1/2 inch from edge unless otherwise specified or indicated. Face nailing will not be permitted. Where sheet metal is applied to other than wood surfaces, include in shop drawings, the locations for sleepers and nailing strips required to secure the work.

##### 3.1.4 Cleats

Provide cleats for sheet metal 18 inches and over in width. Space cleats evenly not over 12 inches on center unless otherwise specified or indicated. Unless otherwise specified, provide cleats of 2 inches wide by 3 inches long and of the same material and thickness as the sheet metal being installed. Secure one end of the cleat with two nails and the cleat



folded back over the nailheads. Lock the other end into the seam. Where the fastening is to be made to concrete or masonry, use screws and drive in expansion shields set in concrete or masonry. Pre-tin cleats for soldered seams.

### 3.1.5 Bolts, Rivets, and Screws

Install bolts, rivets, and screws where indicated or required. Provide compatible washers where required to protect surface of sheet metal and to provide a watertight connection. Provide mechanically formed joints in aluminum sheets 0.040 inches or less in thickness.

### 3.1.6 Seams

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

#### 3.1.6.1 Flat-lock Seams

Finish not less than 3/4 inch wide.

#### 3.1.6.2 Lap Seams

Finish soldered seams not less than one inch wide. Overlap seams not soldered, not less than 3 inches.

#### 3.1.6.3 Loose-Lock Expansion Seams

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

#### 3.1.6.4 Standing Seams

Not less than one inch high, double locked without solder.

#### 3.1.6.5 Flat Seams

Make seams in the direction of the flow.

### 3.1.7 Soldering

Where soldering is specified, apply to copper, terne-coated stainless steel, zinc-coated steel, and stainless steel items. Pre-tin edges of sheet metal before soldering is begun. Seal the joints in aluminum sheets of 0.040 inch or less in thickness with specified sealants. Do not solder aluminum.

#### 3.1.7.1 Edges

Scrape or wire-brush the edges of lead-coated material to be soldered to produce a bright surface. Flux brush the seams in before soldering. Treat with soldering acid flux the edges of stainless steel to be pre-tinned. Seal the joints in aluminum sheets of 0.040 inch or less in thickness with specified sealants. Do not solder aluminum.

### 3.1.8 Welding and Mechanical Fastening

Use welding for aluminum of thickness greater than 0.040 inch. Aluminum

0.040 inch or less in thickness must be butted and the space backed with formed flashing plate; or lock joined, mechanically fastened, and filled with sealant as recommended by the aluminum manufacturer.

#### 3.1.8.1 Welding of Aluminum

Use welding of the inert gas, shield-arc type. For procedures, appearance and quality of welds, and the methods used in correcting welding work, conform to AWS D1.2/D1.2M.

#### 3.1.8.2 Mechanical Fastening of Aluminum

Use No. 12, aluminum alloy, sheet metal screws or other suitable aluminum alloy or stainless steel fasteners. Drive fasteners in holes made with a No. 26 drill in securing side laps, end laps, and flashings. Space fasteners 12 inches maximum on center. Where end lap fasteners are required to improve closure, locate the end lap fasteners not more than 2 inches from the end of the overlapping sheet.

#### 3.1.9 Protection from Contact with Dissimilar Materials

##### 3.1.9.1 Aluminum

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

##### 3.1.9.2 Metal Surfaces

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

##### 3.1.9.3 Wood or Other Absorptive Materials

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

#### 3.1.10 Expansion and Contraction

Provide expansion and contraction joints at not more than 32 foot intervals for aluminum and at not more than 40 foot intervals for other metals. Provide an additional joint where the distance between the last expansion joint and the end of the continuous run is more than half the required interval. Space joints evenly. Join extruded aluminum gravel stops and fasciae by expansion and contraction joints spaced not more than 12 feet apart.

#### 3.1.11 Base Flashing

Extend up vertical surfaces of the flashing not less than 8 inches and not less than 4 inches under the roof covering. Where finish wall coverings form a counterflashing, extend the vertical leg of the flashing up behind the applied wall covering not less than 6 inches. Overlap the flashing strips with the previously laid flashing not less than 3 inches. Fasten the strips at their upper edge to the deck. Horizontal flashing at

vertical surfaces must extend vertically above the roof surface and fastened at their upper edge to the deck a minimum of 6 inches on center with hex headed, galvanized shielded screws a minimum of 2 inch lap of any surface. Solder end laps and provide for expansion and contraction. Extend the metal flashing over crickets at the up-slope side of vertical surfaces extending through sloping roofs, the metal flashings. Extend the metal flashings onto the roof covering not less than 4.5 inches at the lower side of vertical surfaces extending through the roof decks. Install and fit the flashings so as to be completely weathertight. Provide factory-fabricated base flashing for interior and exterior corners. Do not use metal base flashing on built-up roofing.

#### 3.1.12 Counterflashing

Except where indicated or specified otherwise, insert counterflashing in reglets located from 9 to 10 inches above roof decks, extend down vertical surfaces over upturned vertical leg of base flashings not less than 3 inches. Fold the exposed edges of counterflashings 1/2 inch. Where stepped counterflashings are required, they may be installed in short lengths a minimum 8 inches by 8 inches or may be of the preformed single piece type. Provide end laps in counterflashings not less than 3 inches and make it weathertight with plastic cement. Do not make lengths of metal counterflashings exceed 10 feet. Form flashings to the required shapes before installation. Factory form corners not less than 12 inches from the angle. Secure the flashings in the reglets with lead wedges and space not more than 18 inches apart; on short runs, place wedges closer together. Fill caulked-type reglets or raked joints which receive counterflashing with caulking compound. Turn up the concealed edge of counterflashings built into masonry or concrete walls not less than 1/4 inch and extend not less than 2 inches into the walls. Install counterflashing to provide a spring action against base flashing. Extend down the counter flashing as close as practicable to the top of the cant strip. Factory form counter flashing to provide spring action against the base flashing.

#### 3.1.13 Metal Reglets

Keep temporary cores in place during installation. Ensure factory fabricated caulked type or friction type, reglets have a minimum opening of 1/4 inch and a minimum depth of 1-1/4 inch, when installed.

##### 3.1.13.1 Caulked Reglets

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

##### 3.1.13.2 Friction Reglets

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

#### 3.1.14 Polyvinyl Chloride Reglets for Temporary Construction

Rigid polyvinyl chloride reglets may be provided in lieu of metal reglets for temporary construction.

### 3.1.15 Gravel Stops and Fasciae

Prefabricate in the shapes and sizes indicated and in lengths not less than 8 feet. Extend flange at least 4 inches onto roofing. Provide prefabricated, mitered corners internal and external corners. Install gravel stops and fasciae after all plies of the roofing membrane have been applied, but before the flood coat of bitumen is applied. Prime roof flange of gravel stops and fasciae on both sides with an asphalt primer. After primer has dried, set flange on roofing membrane and strip-in. Nail flange securely to wood nailer with large-head, barbed-shank roofing nails 1.5 inch long spaced not more than 3 inches on center, in two staggered rows.

#### 3.1.15.1 Edge Strip

Hook the lower edge of fasciae at least 3/4 inch over a continuous strip of the same material bent outward at an angle not more than 45 degrees to form a drip. Nail hook strip to a wood nailer at 6 inches maximum on center. Where fastening is made to concrete or masonry, use screws spaced 12 inches on center driven in expansion shields set in the concrete or masonry. Where horizontal wood nailers are slotted to provide for insulation venting, install strips to prevent obstruction of vent slots. Where necessary, install strips over 1/16 inch thick compatible spacer or washers.

#### 3.1.15.2 Joints

Leave open the section ends of gravel stops and fasciae 1/4 inch and backed with a formed flashing plate, mechanically fastened in place and lapping each section end a minimum of 4 inches set laps in plastic cement. Face nailing will not be permitted. Install prefabricated aluminum gravel stops and fasciae in accordance with the manufacturer's printed instructions and details.

#### 3.1.16 Metal Drip Edges

Provide a metal drip edge, designed to allow water run-off to drip free of underlying construction, at eaves and rakes prior to the application of roofing shingles. Apply directly on the wood deck at the eaves and over the underlay along the rakes. Extend back from the edge of the deck not more than 3 inches and secure with compatible nails spaced not more than 10 inches on center along upper edge.

#### 3.1.17 Gutters

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

outlets. Fabricate hangers and fastenings from compatible metals.

### 3.1.18 Downspouts

Space supports for downspouts according to the manufacturer's recommendation for the masonry or steel substrate. Types, shapes and sizes are indicated. Provide complete including elbows and offsets. Provide downspouts in approximately 10 foot lengths. Provide end joints to telescope not less than 1/2 inch and lock longitudinal joints. Provide gutter outlets with wire ball strainers for each outlet. Provide strainers to fit tightly into outlets and be of the same material used for gutters. Keep downspouts not less than one inch away from walls. Fasten to the walls at top, bottom, and at an intermediate point not to exceed 5 feet on center with leader straps or concealed rack-and-pin type fasteners. Form straps and fasteners of metal compatible with the downspouts.

#### 3.1.18.1 Terminations

Neatly fit into the drainage connection the downspouts terminating in drainage lines and fill the joints with a portland cement mortar cap sloped away from the downspout. Provide downspouts terminating in splash blocks with elbow-type fittings. Provide splash pans as specified.

### 3.1.19 Flashing for Roof Drains

Provide a 30 inches square sheet indicated. Taper insulation to drain from 24 inches out. Set flashing on finished felts in a full bed of asphalt roof cement, ASTM D4586/D4586M. Heavily coat the drain flashing ring with asphalt roof cement. Clamp the roof membrane, flashing sheet, and stripping felt in the drain clamping ring. Secure clamps so that felts and drain flashing are free of wrinkles and folds. Retrofit roof drains must conform to ANSI/SPRI RD-1.

### 3.1.20 Splash Pans

Install splash pans lapped with horizontal roof flanges not less than 4 inches wide to form a continuous surface. Bend the rear flange of the pan to contour of can't strip and extend up 6 inches under the side wall covering or to height of base flashing under counterflashing. Bed the pans and roof flanges in plastic bituminous cement and strip-flash as specified.

### 3.1.21 Open Valley Flashing

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

### 3.1.22 Eave Flashing

One piece in width, applied in 8 to 10 foot lengths with expansion joints spaced as specified in paragraph EXPANSION AND CONTRACTION. Provide a 3/4 inch continuous fold in the upper edge of the sheet to engage cleats spaced not more than 10 inches on center. Locate the upper edge of flashing not less than 18 inches from the outside face of the building, measured along the roof slope. Fold lower edge of the flashing over and loose-lock into a continuous edge strip on the fascia. Where eave flashing intersects metal valley flashing, secure with one inch flat locked joints with cleats that are 10 inches on center.

### 3.1.23 Sheet Metal Covering on Flat, Sloped, or Curved Surfaces

Except as specified or indicated otherwise, cover and flash all minor flat, sloped, or curved surfaces such as crickets, bulkheads, dormers and small decks with metal sheets of the material used for flashing; maximum size of sheets, 16 by 18 inches. Fasten sheets to sheathing with metal cleats. Lock seams and solder. Lock aluminum seams as recommended by aluminum manufacturer. Provide an underlayment of roofing felt for all sheet metal covering.

### 3.1.24 Expansion Joints

Provide expansion joints for roofs, walls, and floors as indicated. Provide expansion joints in continuous sheet metal at 40 foot intervals for stainless steel and at 32 foot intervals for aluminum, aluminum gravel stops and fasciae which must have expansion joints at not more than 12 foot spacing. Provide evenly spaced joints. Provide an additional joint where the distance between the last expansion joint and the end of the continuous run is more than half the required interval spacing. Conform to the requirements of Table I.

#### 3.1.24.1 Roof Expansion Joints

Consist of curb with wood nailing members on each side of joint, bituminous base flashing, metal counterflashing, and metal joint cover. Bituminous base flashing is specified in Roofing Section. Provide counterflashing as specified in paragraph COUNTERFLASHING, except as follows: Provide counterflashing with vertical leg of suitable depth to enable forming into a horizontal continuous cleat. Secure the inner edge to the nailing member. Make the outer edge projection not less than one inch for flashing on one side of the expansion joint and be less than the width of the expansion joint plus one inch for flashing on the other side of the joint. Hook the expansion joint cover over the projecting outer edges of counterflashing. Provide roof joint with a joint cover of the width indicated. Hook and lock one edge of the joint cover over the shorter projecting flange of the continuous cleat, and the other edge hooked over and loose locked with the longer projecting flange. Joints are specified in Table II.

#### 3.1.24.2 Floor and Wall Expansion Joints

Provide U-shape with extended flanges for expansion joints in concrete and masonry walls and in floor slabs.

### 3.1.25 Flashing at Roof Penetrations and Equipment Supports

Provide metal flashing for all pipes, ducts, and conduits projecting

through the roof surface and for equipment supports, guy wire anchors, and similar items supported by or attached to the roof deck.

#### 3.1.1.26 Single Pipe Vents

See Table I, footnote (d). Set flange of sleeve in bituminous plastic cement and nail 3 inches on center. Bend the top of sleeve over and extend down into the vent pipe a minimum of 2 inches. For long runs or long rises above the deck, where it is impractical to cover the vent pipe with lead, use a two-piece formed metal housing. Set metal housing with a metal sleeve having a 4 inches roof flange in bituminous plastic cement and nailed 3 inches on center. Extend sleeve a minimum of 8 inches above the roof deck and lapped a minimum of 3 inches by a metal hood secured to the vent pipe by a draw band. Seal the area of hood in contact with vent pipe with an approved sealant.

#### 3.1.1.27 Stepped Flashing

Provide stepped flashing where sloping roofs surfaced with shingles abut vertical surfaces. Place separate pieces of base flashing in alternate shingle courses.

#### 3.1.1.28 Copings

Provide coping with locked and soldered seam. Terminate outer edges in edge strips. Install with sealed lap joints as indicated.

### 3.2 PAINTING

Touch ups in the field may be applied only after metal substrates have been cleaned and pretreated in accordance with manufacturer's written instructions and products.

Field-paint sheet metal for separation of dissimilar materials.

#### 3.2.1 Aluminum Surfaces

Clean with solvent and apply one coat of zinc-molybdate primer and one coat of aluminum paint.

### 3.3 CLEANING

Clean exposed sheet metal work at completion of installation. Remove grease and oil films, handling marks, contamination from steel wool, fittings and drilling debris, and scrub-clean. Free the exposed metal surfaces of dents, creases, waves, scratch marks, and solder or weld marks.

### 3.4 REPAIRS TO FINISH

Scratches, abrasions, and minor surface defects of finish may be repaired in accordance with the manufacturer's printed instructions and as approved. Repair damaged surfaces caused by scratches, blemishes, and variations of color and surface texture. Replace items which cannot be repaired.

### 3.5 FIELD QUALITY CONTROL

Establish and maintain a Quality Control Plan for sheet metal used in conjunction with roofing to assure compliance of the installed sheet

metalwork with the contract requirements. Remove work that is not in compliance with the contract and replace or correct. Include quality control, but not be limited to, the following:

- a. Observation of environmental conditions; number and skill level of sheet metal workers; condition of substrate.
- b. Verification that specified material is provided and installed.
- c. Inspection of sheet metalwork, for proper size(s) and thickness(es), fastening and joining, and proper installation.

### 3.5.1 Procedure

Submit for approval prior to start of roofing work. Include a checklist of points to be observed. Document the actual quality control observations and inspections. Furnish a copy of the documentation to the Contracting Officer at the end of each day.

TABLE I. SHEET METAL WEIGHTS, THICKNESSES, AND GAGES			
Sheet Metal Items	Aluminum, inch	Stainless Steel, inch	Zinc-Coated Steel, U.S. Std. Gage
Building Expansion Joints			
Cover	.032	.015	24
Covering on minor flat, pitched or curved surfaces	.040	.018	-
Downspouts and leaders	.032	.015	24
Downspout clips and anchors	.040 clip .125 anchor	-	-
Downspout straps, 2-inch	.060	.050	-
Conductor heads	.032	.015	-
Scupper lining	.032	.015	-
Strainers, wire diameter or gage	.144 diameter	.109 diameter	
Flashings:			



TABLE I. SHEET METAL WEIGHTS, THICKNESSES, AND GAGES			
Sheet Metal Items	Aluminum, inch	Stainless Steel, inch	Zinc-Coated Steel, U.S. Std. Gage
Base	.040	.018	24
Cap (Counter-flashing)	.032	.015	26
Eave	-	.015	24
Spandrel beam	-	.010	-
Coping	-	-	-
Gravel stops and fasciae:			
Extrusions	.075	-	-
Sheets, smooth	.050	.018	24
Edge strip	.050	.025	-
Gutters:			
Gutter section	.032	.015	24
Continuous cleat	.032	.015	24
Hangers, dimensions	1 inch by .080 inch (c)	1 inch by .037 inch	-
Joint Cover plates (See Table II)	.032	.015	24
Splash pans	.040	.018	-
(a) Brass.			
(b) May be lead weighing 4 pounds per square foot.			
(c) May be polyvinyl chloride.			

TABLE I. SHEET METAL WEIGHTS, THICKNESSES, AND GAGES			
Sheet Metal Items	Aluminum, inch	Stainless Steel, inch	Zinc-Coated Steel, U.S. Std. Gage
(d) 2.5 pound minimum lead sleeve with 4 inch flange. Where lead sleeve is impractical, refer to paragraph SINGLE PIPE VENTS for optional material.			

TABLE II. SHEET METAL JOINTS			
TYPE OF JOINT			
Item Designation	Copper, Terne-Coated Stainless Steel, Zinc-Coated Steel and Stainless Steel	Aluminum	Remarks
Joint cap for building expansion seam, cleated joint at roof	1.25 inch single lock, standing seam, cleated	1.25 inch single lock, standing	--
Flashings			
Base	One inch 3 inch lap for expansion joint	One inch flat locked, soldered; sealed; 3 inch lap for expansion joint	Aluminum manufacturer's recommended hard setting sealant for locked aluminum joints. Fill each metal expansion joint with a joint sealing compound.
Cap-in reglet	3 inch lap	3 inch lap	Seal groove with joint sealing compound.

TABLE II. SHEET METAL JOINTS			
TYPE OF JOINT			
Item Designation	Copper, Terne-Coated Stainless Steel, Zinc-Coated Steel and Stainless Steel	Aluminum	Remarks
Reglets	Butt joint	--	Seal reglet groove with joint sealing compound.
Eave	One inch flat locked, cleated. One inch loose locked, sealed expansion joint, cleated.	One inch flat locked, locked, cleated one inch loose locked, sealed expansion joints, cleated	Same as base flashing.
Stepped	3 inch lap	3 inch lap	--
Valley	6 inch lap cleated	6 inch lap cleated	--
Edge strip	Butt	Butt	--
Gravel stops:			
Extrusions	--	Butt with 1/2 inch space	Use sheet flashing beneath and a cover plate
Sheet, smooth	Butt with 1/4 inch space	Butt with 1/4 inch space	Use sheet flashing backup plate.
Sheet, corrugated	Butt with 1/4 inch space	Butt with 1/4 inch space	Use sheet flashing beneath and a cover plate or a combination unit
Gutters	1.5 inch lap, riveted and soldered	One inch flat locked riveted and sealed	Aluminum producers recommended hard setting sealant for locked aluminum joints.
(a) Provide a 3 inch lap elastomeric flashing with manufacturer's recommended sealant.			
(b) Seal Polyvinyl chloride reglet with manufacturer's recommended sealant.			

-- End of Section --

SECTION 07 81 00

SPRAY-APPLIED FIREPROOFING  
02/11

PART 1 GENERAL

1.1 REFERENCES

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

ASSOCIATION OF THE WALL AND CEILING INDUSTRY (AWCI)

AWCI TM 12-A (1997; 3rd Ed) Standard Practice for the Testing and Inspection of Field Applied Sprayed Fire-Resistive Materials; An Annotated Guide

ASTM INTERNATIONAL (ASTM)

ASTM E119 (2016a) Standard Test Methods for Fire Tests of Building Construction and Materials

ASTM E605/E605M (1993; R 2015; E 2015) Standard Test Methods for Thickness and Density of Sprayed Fire-Resistive Material (SFRM) Applied to Structural Members

ASTM E736 (2000; R 2011) Cohesion/Adhesion of Sprayed Fire-Resistive Materials Applied to Structural Members

ICC EVALUATION SERVICE, INC. (ICC-ES)

ICC-ES AC23 (2012; R 2016) Acceptance Criteria for Sprayed Fire-resistant Materials (SFRMs), Intumescent Fire-resistant Coatings and Mastic Fire-resistant Coatings Used to Protect Structural Steel Members

UNDERWRITERS LABORATORIES (UL)

UL 263 (2011; Reprint Mar 2018) Fire Tests of Building Construction and Materials

UL Fire Resistance (2014) Fire Resistance Directory

1.2 SYSTEM DESCRIPTION

1.2.1 General Requirements

Protect all structural steel, undersides of steel floors (if required) and steel roof decks (if required) with spray-applied fireproofing to a fire resistance hour-rating as indicated below, unless otherwise indicated.

### 1.2.2 Fire Resistance Rating

Fire resistance ratings shall be in accordance with the fire rated assemblies listed in UL Fire Resistance. Proposed materials not listed in UL Fire Resistance shall have fire resistance ratings at least equal to the UL Fire Resistance ratings as determined by an approved independent testing laboratory, based on tests specified in UL 263 or ASTM E119. Submit reports and test records, attesting that the fireproofing material conforms to the specified requirements. Each test report shall conform to the report requirements specified by the test method. For the underside of the decking use metal lath installed prior to the fireproofing material or Rigid Board Fireproofing Material as outlined in the UL Fire Resistance Directory Volume 1. Apply fireproofing to structural steel members, with the following hourly fire resistance rating and in accordance with the following UL design or approved equivalent. Use unrestrained fire resistance ratings, unless the architect/engineer has specified that the degree of thermal restraint of the construction meets or exceeds the degree of thermal restraint of the tested assembly. Performance tests shall be in accordance with ASTM E119.

Fire Rating Schedule		
Element	Hourly Rating	UL Design Reference
Columns supporting one floor	1 and 2 hour	X649
Floor decks	1 and 2 hour	D902
Floor beams	1 and 2 hour	N6-14

### 1.2.3 Evaluation Reports - ICC-ES Reports

Materials shall be evaluated in accordance with ICC-ES AC23. ICC-ES Reports shall be included as part of the Submittals below. The reports will identify the product as code compliant and having met the physical performance requirements outlined in paragraphs "Dry Density and Cohesion/Adhesion" through "Air Erosion".

### 1.3 SUBMITTALS

Government approval is required for submittals with a "G" designation; submittals not having a "G" designation are for information only. When used, a designation following the "G" designation identifies the office that will review the submittal for the Government. **For this specification, NAVFAC signifies the office that will review the submittal for the Government to be Pacific Division, .** Submittals with an "S" are for inclusion in the Sustainability eNotebook, in conformance to Section 01 33 29 SUSTAINABILITY REPORTING. Submit the following in accordance with Section 01 33 00 SUBMITTAL PROCEDURES:

SD-03 Product Data

Fireproofing Material

SD-04 Samples

Spray-Applied Intumescent Epoxy Coating System

SD-06 Test Reports

Fire Resistance Rating  
Field Tests; G  
Evaluation Reports

SD-07 Certificates

Installer Qualifications  
Surface Preparation Report  
Manufacturer's Inspection Report

1.4 QUALITY ASSURANCE

1.4.1 Installer Qualifications

Engage an experienced installer that is certified, licensed, or otherwise qualified by the spray-on fireproofing manufacturer as having the necessary experience, staff, and training to install the manufacturer's products in accordance with specified requirements. Submit manufacturer's certification that each listed installer is qualified and trained to install the specified fireproofing. Show evidence that each fireproofing installer has had a minimum of 3 years experience in installing the specified type of fireproofing. Each installer of fireproofing material shall be trained, have a minimum of 3 years experience and a minimum of three installations using fireproofing of the type specified. A manufacturer's willingness to sell its products to the Contractor or installer does not infer qualification of the buyer.

1.4.2 Pre-Installation Meeting

Hold a meeting with the installer, field testing agency, the manufacturer, subcontractors (whose employees come into contact with the fireproofing), and the Contracting Officer prior to the installation of any fireproofing material to review the substrates for acceptability, method of application, applied thickness, patching, repair, inspection and testing procedures.

1.5 DELIVERY, STORAGE, AND HANDLING

Deliver packaged material in the original unopened containers, marked to show the brand name, the manufacturer, and the UL markings. Keep fireproofing material dry until ready to be used, and store off the ground, under cover and away from damp surfaces. Damaged or opened containers will be rejected. Apply material with shelf-life prior to expiration of the shelf-life.

1.6 PROJECT/SITE CONDITIONS

1.6.1 Temperature

Maintain substrate and ambient air temperatures above 40 degrees F during application and for 24 hours before and after application. Maintain relative humidity within the limits recommended by the fireproofing manufacturer.

## 1.6.2 Ventilation

Provide adequate ventilation to properly dry the fireproofing after application. In enclosed areas, provide a minimum of 4 air exchanges per hour by forced air circulation.

## PART 2 PRODUCTS

### 2.1 SPRAY-APPLIED INTUMESCENT EPOXY COATING SYSTEM

Provide a two-component epoxy based intumescent fire protective coating that meets the following requirements.

- a. On curing it forms a flexible and tough epoxy barrier which transforms into a ceramic-like, insulating char to provide thermal protection of the substrate in the event of a fire.
- b. The coating system includes the manufacturer's required surface preparation, primer, and fire protective layer, and topcoat.
- c. The coating system protects the substrate from corrosion and retain its fire protection properties under aggressive chemical environments.
- d. Resistant to solvents, acids, alkalis, salts and abrasion while retaining its fire protective properties.

Provide a system that exhibits the following properties:

#### 2.1.1 Percent Solids by Weight

100 percent

#### 2.1.2 In Service Temperature Restrictions

Up to 150 degrees F

#### 2.1.3 Application Method

Air spray or specialized plural component airless equipment approved by the manufacture. Troweling can be used for small areas or touch-up work.

#### 2.1.4 Drying Time

Approximately 24 hours to achieve a Shore D hardness of 25.

#### 2.1.5 Shelf Life

Minimum shelf life under proper storage condition is 1 Year from date of manufacture.

#### 2.1.6 Pot Life

Approximately 40 minutes at 77 degrees F and 50 percent relative humidity. Pot life is not a factor when using specialized plural component airless spray equipment.

#### 2.1.7 Flash Point

Greater than 212 degrees F Pensky-Martens for each component.



## PART 3 EXECUTION

### 3.1 SURFACE PREPARATION

Thoroughly clean surfaces to be fireproofed of dirt, grease, oil, paint, primers, loose rust, rolling lubricant, mill scale or other contaminants that will interfere with the proper bonding of the sprayed fireproofing to the substrate. Test painted/primed steel substrates in accordance with ASTM E736, with specified sprayed fireproofing material, to provide the required fire-resistance rating; painted or primed steel surfaces may require a fireproofing bond test to determine if the paint formulation will impair proper adhesion. Certify the acceptability of surfaces to receive sprayed-applied fireproofing by inspection and submit a Surface Preparation Report accordingly. The statement shall list the structural members and the areas that have been inspected and certified. Overhead areas to be fireproofed shall be cleared of all obstructions interfering with the uniform application of the spray-applied fireproofing. Hardware such as support sleeves, inserts, clips, hanger attachment devices and the like shall be installed prior to the application of the fireproofing. Condition of the surfaces shall be acceptable to the manufacturer prior to application of spray-applied fireproofing. Applications listed for use on primed surfaces shall be in accordance with the manufacturer's recommendations and standards, and detailed in submittal item SD-03 Product Data.

### 3.2 PROTECTION

Cover surfaces not to receive spray-applied fireproofing to prevent contamination by splatter, rebound and overspray. Cover exterior openings in areas to receive spray-applied fireproofing prior to and during application of fireproofing with tarpaulins or other approved material. Clean surfaces not to receive fireproofing of fireproofing and sealer.

### 3.3 FIREPROOFING MATERIAL

Mix fireproofing material in accordance with the manufacturer's recommendations. Submit data identifying performance characteristics of fireproofing material. Data includes recommended application requirements and indicate thickness of fireproofing to be applied to achieve each required fire rating.

### 3.4 APPLICATION

#### 3.4.1 Application of Spray-Applied Intumescent Epoxy Coating System

Prepare surfaces and apply the spray-applied Intumescent epoxy coating system in accordance with the manufacturer's written recommendations.

### 3.5 MANUFACTURER'S SERVICES

#### 3.5.1 General

The manufacturer, or its representative, shall be onsite prior to, periodically during, and at completion of the application, to provide the specified inspections and certifications; and to ensure that preparations are adequate and that the material is applied according to manufacturer's recommendations and the contract requirements.

### 3.5.2 Manufacturer's Inspection

The manufacturer shall inspect the fireproofing work after the work is completed on each floor or area, including testing, repair and clean-up, and shall certify that the work complies with the manufacturer's criteria and recommendations. Before the sprayed material is covered, and after all of the fireproofing work is completed, including repair, testing, and clean-up; and after mechanical, electrical and other work in contact with fireproofing material has been completed, the manufacturer shall re-inspect the work and certify that the entire project complies with the manufacturer's criteria and recommendations. Obtain and submit the Manufacturer's Inspection Report and certifications of approval stating that the spray-applied fireproofing in the entire project complies with the manufacturer's criteria and recommendations.

### 3.6 FIELD TESTS

The applied fireproofing shall be tested by an approved independent testing laboratory to be selected by the A/E and paid for by the Contractor. Submit test reports documenting results of tests on the applied material in the project. Report shall include defects identified, repair procedures, and results of the retests when required. Perform the tests in approved locations: for density in accordance with ASTM E736, cohesion/adhesion in accordance with ASTM E736, and for thickness in accordance with ASTM E605/E605M. Determine densities in accordance with ASTM E605/E605M or Appendix A, "Alternate Method for Density Determination" of AWCI TM 12-A. Take density determinations at the flat portion of deck, beam bottom flange, beam web, column, and an equivalent area from the top of the lower beam flange. Areas showing a density less than specified will be rejected. A test sample shall be located every 10,000 square feet of floor area or two for each floor, whichever produces the greatest number of test areas. Any area showing less than minimum requirements shall be corrected. Proposed corrective measures, in writing, shall be approved before starting the corrective action. Corrected work shall be retested.

#### 3.6.1 Structural Components

Test each structural component type at floor and roof decks, beams, columns, joists, and trusses. Minimum average thickness shall be as required by UL Fire Resistance. Density and cohesion/adhesion shall be as specified.

#### 3.6.2 Repair

Additional fireproofing material may be added to provide proper thickness. Correct rejected areas of fireproofing to meet specified requirements by adding fireproofing material to provide the proper thickness, or by removing defects and respraying with new fireproofing material. Use same type of fireproofing material for repairs as originally applied or use patching materials recommended by the manufacturer. Retest and reinspect repaired areas. Apply fireproofing material to voids or damaged areas by hand-trowel, or by respraying.

#### 3.6.3 Visual Inspections

Inspections shall be made by the certified independent laboratory prior to closure of concealed areas. These inspections may be phased, but shall not occur less than 5 working days prior to the enclosure of the

fireproofing. Sprayed areas shall receive a final inspection. Fireproofed surfaces shall be inspected after mechanical, electrical, and other work in contact with fireproofing material has been completed and before sprayed material is covered. Any locations missing fireproofing shall be patched in accordance with the manufacturer's requirements.

#### 3.6.4 Patching

Patch and repair damaged fireproofing. The patching material shall be the same as that specified for that area.

#### 3.7 CLEANUP

Thoroughly clean surfaces not indicated to receive fireproofing of sprayed material within a 24 hour period after application.

-- End of Section --



SECTION 07 84 00

FIRESTOPPING  
05/10

PART 1 GENERAL

1.1 SUMMARY

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

- a. Through-penetrations include the annular space around pipes, tubes, conduit, wires, cables and vents.
- b. Construction joints include those used to accommodate expansion, contraction, wind, or seismic movement; firestopping material shall not interfere with the required movement of the joint.

Gaps requiring firestopping include gaps between the curtain wall and the floor slab and between the top of the fire-rated walls and the roof or floor deck above and at the intersection of shaft assemblies and adjoining fire resistance rated assemblies.

1.2 REFERENCES

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

ASTM INTERNATIONAL (ASTM)

ASTM E119	(2016a) Standard Test Methods for Fire Tests of Building Construction and Materials
ASTM E1399/E1399M	(1997; R 2017) Standard Test Method for Cyclic Movement and Measuring the Minimum and Maximum Joint Widths of Architectural Joint Systems
ASTM E1966	(2015) Fire-Resistive Joint Systems
ASTM E2174	(2014b) Standard Practice for On-Site Inspection of Installed Fire Stops
ASTM E2307	(2015a) Standard Test Method for Determining Fire Resistance of Perimeter Fire Barrier Systems Using Intermediate-Scale, Multi-story Test Apparatus
ASTM E2393	(2010a) Standard Practice for On-Site Inspection of Installed Fire Resistive

Joint Systems and Perimeter Fire Barriers

ASTM E699 (2009) Standard Practice for Evaluation of Agencies Involved in Testing, Quality Assurance, and Evaluating of Building Components

ASTM E814 (2013a; R 2017) Standard Test Method for Fire Tests of Penetration Firestop Systems

ASTM E84 (2018) Standard Test Method for Surface Burning Characteristics of Building Materials

FM GLOBAL (FM)

FM 4991 (2013) Approval of Firestop Contractors

FM APP GUIDE (updated on-line) Approval Guide  
<http://www.approvalguide.com/>

INTERNATIONAL CODE COUNCIL (ICC)

ICC IBC (2017) International Building Code

UNDERWRITERS LABORATORIES (UL)

UL 1479 (2015) Fire Tests of Through-Penetration Firestops

UL 2079 (2004; Reprint Dec 2014) Tests for Fire Resistance of Building Joint Systems

UL 723 (2008; Reprint Aug 2013) Test for Surface Burning Characteristics of Building Materials

UL Fire Resistance (2014) Fire Resistance Directory

### 1.3 SEQUENCING

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

### 1.4 SUBMITTALS

Government approval is required for submittals with a "G" designation; submittals not having a "G" designation are for information only. When used, a designation following the "G" designation identifies the office that will review the submittal for the Government. Submittals with an "S"

are for inclusion in the Sustainability eNotebook, in conformance to Section 01 33 29 SUSTAINABILITY REPORTING. Submit the following in accordance with Section 01 33 00 SUBMITTAL PROCEDURES:

SD-02 Shop Drawings

Firestopping System

SD-03 Product Data

Firestopping Materials; G

SD-06 Test Reports

Inspection; G

SD-07 Certificates

Inspector Qualifications

Firestopping Materials

Installer Qualifications

1.5 QUALITY ASSURANCE

1.5.1 Installer

Engage an experienced Installer who is:

- a. FM Research approved in accordance with FM 4991, operating as a UL Certified Firestop Contractor, or
- b. Certified, licensed, or otherwise qualified by the firestopping manufacturer as having the necessary staff, training, and a minimum of 3 years experience in the installation of manufacturer's products in accordance with specified requirements. Submit documentation of this experience. A manufacturer's willingness to sell its firestopping products to the Contractor or to an installer engaged by the Contractor does not in itself confer installer qualifications on the buyer. The Installer shall have been trained by a direct representative of the manufacturer (not distributor or agent) in the proper selection and installation procedures. The installer shall obtain from the manufacturer and submit written certification of training, and retain proof of certification for duration of firestop installation.

1.5.2 Inspector Qualifications

The inspector shall meet the criteria contained in ASTM E699 for agencies involved in quality assurance and shall have a minimum of two years experience in construction field inspections of firestopping systems, products, and assemblies. The inspector shall be completely independent of, and divested from, the installer, the manufacturer, and the supplier of any material or item being inspected. The inspector shall not be a competitor of the installer, the contractor, the manufacturer, or supplier of any material or item being inspected. Include in the qualifications submittal a notarized statement assuring compliance with the requirements stated herein.

## 1.6 DELIVERY, STORAGE, AND HANDLING

Deliver materials in the original unopened packages or containers showing name of the manufacturer and the brand name. Store materials off the ground, protected from damage and exposure to elements and temperatures in accordance with manufacturer requirements. Remove damaged or deteriorated materials from the site. Use materials within their indicated shelf life.

## PART 2 PRODUCTS

### 2.1 FIRESTOPPING SYSTEM

Submit detail drawings including manufacturer's descriptive data, typical details conforming to UL Fire Resistance or other details certified by another nationally recognized testing laboratory, installation instructions or UL listing details for a firestopping assembly in lieu of fire-test data or report. For those firestop applications for which no UL tested system is available through a manufacturer, a manufacturer's engineering judgment, derived from similar UL system designs or other tests, shall be submitted for review and approval prior to installation. Submittal must indicate the firestopping material to be provided for each type of application. When more than a total of 5 penetrations and/or construction joints are to receive firestopping, provide drawings that indicate location, "F" "T" and "L" ratings, and type of application.

Also, submit a written report indicating locations of and types of penetrations and types of firestopping used at each location; record type by UL list printed numbers.

### 2.2 FIRESTOPPING MATERIALS

Provide firestopping materials, supplied from a single domestic manufacturer, consisting of commercially manufactured, asbestos-free, nontoxic products FM APP GUIDE approved, or UL listed, for use with applicable construction and penetrating items, complying with the following minimum requirements:

#### 2.2.1 Fire Hazard Classification

Material shall have a flame spread of 25 or less, and a smoke developed rating of 50 or less, when tested in accordance with ASTM E84 or UL 723. Material shall be an approved firestopping material as listed in UL Fire Resistance or by a nationally recognized testing laboratory.

#### 2.2.2 Toxicity

Material shall be nontoxic and carcinogen free to humans at all stages of application or during fire conditions and shall not contain hazardous chemicals or require harmful chemicals to clean material or equipment.

#### 2.2.3 Fire Resistance Rating

Firestop systems shall be UL Fire Resistance listed or FM APP GUIDE approved with "F" rating at least equal to fire-rating of fire wall or floor in which penetrated openings are to be protected. Where required, firestop systems shall also have "T" rating at least equal to the fire-rated floor in which the openings are to be protected.



#### 2.2.3.1 Through-Penetrations

Firestopping materials for through-penetrations, as described in paragraph SUMMARY, shall provide "F", "T" and "L" fire resistance ratings in accordance with ASTM E814 or UL 1479. Fire resistance ratings shall be as follows:

##### 2.2.3.1.1 Penetrations of Fire Resistance Rated Walls and Partitions

F Rating = 1 or 2 hour Rating of wall or partition being penetrated.

##### 2.2.3.1.2 Penetrations of Fire Resistance Rated Floors, Floor-Ceiling Assemblies and the Ceiling Membrane of Roof-Ceiling Assemblies

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

##### 2.2.3.1.3 Penetrations of Fire and Smoke Resistance Rated Walls, Floors, Floor-Ceiling Assemblies, and the ceiling membrane of Roof-Ceiling Assemblies

F Rating = 1 hour, T Rating = 1 hour and L Rating = <10 cfm/sf Where L rating is required.

#### 2.2.3.2 Construction Joints and Gaps

Fire resistance ratings of construction joints, as described in paragraph SUMMARY, and gaps such as those between floor slabs and curtain walls shall be the same as the construction in which they occur. as follows: construction joints in walls, 1 hour; construction joints in floors, 1 hour; gaps between floor slabs and curtain walls, 1 hour; gaps between top of the walls and the bottom of roof and floor decks, 1 hour, and provide L rating of <5 cfm/lf where required. Construction joints and gaps shall be provided with firestopping materials and systems that have been tested in accordance with ASTM E119, ASTM E1966 or UL 2079 to meet the required fire resistance rating. Curtain wall joints shall be provided with firestopping materials and systems that have been tested in accordance with ASTM E2307 to meet the required fire resistance rating. Systems installed at construction joints shall meet the cycling requirements of ASTM E1399/E1399M or UL 2079. All joints at the intersection of the top of a fire resistance rated wall and the underside of a fire-rated floor, floor ceiling, or roof ceiling assembly shall provide a minimum class II movement capability.

#### 2.2.4 Material Certification

Submit certificates attesting that firestopping material complies with the specified requirements. For all intumescent firestop materials used in through penetration systems, manufacturer shall provide certification of compliance with UL 1479.

### PART 3 EXECUTION

#### 3.1 PREPARATION

Areas to receive firestopping must be free of dirt, grease, oil, or loose materials which may affect the fitting or fire resistance of the firestopping system. For cast-in-place firestop devices, formwork or

metal deck to receive device prior to concrete placement must be sound and capable of supporting device. Prepare surfaces as recommended by the manufacturer.

### 3.2 INSTALLATION

Completely fill void spaces with firestopping material regardless of geometric configuration, subject to tolerance established by the manufacturer. Firestopping systems for filling floor voids 4 inches or more in any direction must be capable of supporting the same load as the floor is designed to support or be protected by a permanent barrier to prevent loading or traffic in the firestopped area. Install firestopping in accordance with manufacturer's written instructions. Provide tested and listed firestop systems in the following locations, except in floor slabs on grade:

- a. Penetrations of duct, conduit, tubing, cable and pipe through floors and through fire-resistance rated walls, partitions, and ceiling-floor assemblies.
- b. Penetrations of vertical shafts such as pipe chases, elevator shafts, and utility chutes.
- c. Gaps at the intersection of floor slabs and curtain walls, including inside of hollow curtain walls at the floor slab.
- d. Gaps at perimeter of fire-resistance rated walls and partitions, such as between the top of the walls and the bottom of roof decks.
- e. Construction joints in floors and fire rated walls and partitions.
- f. Other locations where required to maintain fire resistance rating of the construction.

#### 3.2.1 Insulated Pipes and Ducts

Thermal insulation shall be cut and removed where pipes or ducts pass through firestopping, unless insulation meets requirements specified for firestopping. Replace thermal insulation with a material having equal thermal insulating and firestopping characteristics.

#### 3.2.2 Fire Dampers

Install and firestop fire dampers in accordance with Section 23 00 00 AIR SUPPLY, DISTRIBUTION, VENTILATION, AND EXHAUST SYSTEM. Firestop installed with fire damper must be tested and approved for use in fire damper system. Firestop installed with fire damper must be tested and approved for use in fire damper system.

#### 3.2.3 Data and Communication Cabling

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

##### 3.2.3.1 Re-Enterable Devices

Firestopping devices shall be pre-manufactured modular devices, containing built-in self-sealing intumescent inserts. Firestopping devices shall allow for cable moves, additions or changes without the need to remove or

replace any firestop materials. Devices must be capable of maintaining the fire resistance rating of the penetrated membrane at 0 percent to 100 percent visual fill of penetrants; while maintaining "L" rating of <10 cfm/sf measured at ambient temperature and 400 degrees F at 0 percent to 100 percent visual fill.

### 3.2.3.2 Re-Sealable Products

Provide firestopping pre-manufactured modular products, containing self-sealing intumescent inserts. Firestopping products shall allow for cable moves, additions or changes. Devices shall be capable of maintaining the fire resistance rating of the penetrated membrane at 0 percent to 100 percent visual fill of penetrants.

## 3.3 INSPECTION

For all projects, the firestopped areas shall not be covered or enclosed until inspection is complete and approved by the Contracting Officer. Inspect the applications initially to ensure adequate preparations (clean surfaces suitable for application, etc.) and periodically during the work to assure that the completed work has been accomplished according to the manufacturer's written instructions and the specified requirements. Submit written reports indicating locations of and types of penetrations and types of firestopping used at each location; type shall be recorded by UL listed printed numbers.

### 3.3.1 Inspection Standards

Inspect all firestopping in accordance to ASTM E2393 and ASTM E2174 for firestop inspection, and document inspection results to be submitted.

### 3.3.2 Inspection Reports

Submit inspection report stating that firestopping work has been inspected and found to be applied according to the manufacturer's recommendations and the specified requirements.

-- End of Section --



SECTION 07 92 00

JOINT SEALANTS

08/16

PART 1 GENERAL

1.1 REFERENCES

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

ASTM INTERNATIONAL (ASTM)

ASTM C1193	(2013) Standard Guide for Use of Joint Sealants
ASTM C1521	(2013) Standard Practice for Evaluating Adhesion of Installed Weatherproofing Sealant Joints
ASTM C509	(2006; R 2015) Elastomeric Cellular Preformed Gasket and Sealing Material
ASTM C734	(2015) Low-Temperature Flexibility of Latex Sealants After Artificial Weathering
ASTM C919	(2012; R 2017) Standard Practice for Use of Sealants in Acoustical Applications
ASTM C920	(2018) Standard Specification for Elastomeric Joint Sealants
ASTM D1056	(2014) Standard Specification for Flexible Cellular Materials - Sponge or Expanded Rubber
ASTM D217	(2017) Standard Test Methods for Cone Penetration of Lubricating Grease
ASTM E84	(2018) Standard Test Method for Surface Burning Characteristics of Building Materials

CALIFORNIA DEPARTMENT OF PUBLIC HEALTH (CDPH)

CDPH SECTION 01350	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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SOUTH COAST AIR QUALITY MANAGEMENT DISTRICT (SCAQMD)

SCAQMD Rule 1168 (1989; R 2005) Adhesive and Sealant  
Applications

UNDERWRITERS LABORATORIES (UL)

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

1.2 SUBMITTALS

Government approval is required for submittals with a "G" designation; submittals not having a "G" designation are for information only. When used, a designation following the "G" designation identifies the office that will review the submittal for the Government. Submittals with an "S" are for inclusion in the Sustainability eNotebook, in conformance with Section 01 33 29 SUSTAINABILITY REPORTING. Submit the following in accordance with Section 01 33 00 SUBMITTAL PROCEDURES:

SD-03 Product Data

Sealants

Primers

Bond Breakers

Backstops

SD-06 Test Reports

Field Adhesion; G

SD-07 Certificates

Indoor Air Quality; G

SD-11 Closeout Submittals

Indoor Air Quality For Interior Sealants; S

Indoor Air Quality For Interior Floor Joint Sealants; S

Indoor Air Quality For Interior Acoustical Sealants; S

1.3 PRODUCT DATA

Include storage requirements, shelf life, curing time, instructions for mixing and application, and accessories. Provide manufacturer's Safety Data Sheets (SDS) for each solvent, primer and sealant material proposed.

1.4 CERTIFICATIONS

1.4.1 Indoor Air Quality Certifications

Submit required indoor air quality certifications in one submittal package.

#### 1.4.1.1 Adhesives and Sealants

Provide products certified to meet indoor air quality requirements by UL 2818 (Greenguard) Gold, SCS Global Services Indoor Advantage Gold or provide validation by other third-party program that products meet the requirements of this paragraph. Sealants and non-aerosol adhesive products used on the interior of the building (defined as inside of the weatherproofing system) must meet either emissions requirements of CDPH SECTION 01350 (limit requirements for either office or classroom spaces regardless of space type) or VOC content requirements of SCAQMD Rule 1168. Provide current product certification documentation from certification body.

#### 1.5 ENVIRONMENTAL CONDITIONS

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

#### 1.6 DELIVERY AND STORAGE

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

#### 1.7 QUALITY ASSURANCE

##### 1.7.1 Compatibility with Substrate

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

##### 1.7.2 Joint Tolerance

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

##### 1.7.3 Mock-Up

Provide a mock-up of each type of sealant using materials, colors, and techniques approved for use on the project. Approved mock-ups may be incorporated into the Work.

##### 1.7.4 Adhesion

Provide in accordance with ASTM C1193 or ASTM C1521.

#### PART 2 PRODUCTS

##### 2.1 PRODUCT SUSTAINABILITY CRITERIA

For products in this section, where applicable and to extent allowed by performance criteria, provide and document the following:

### 2.1.1 Reduce Volatile Organic Compounds (VOC) (Low-Emitting Materials) for Products

Reduced VOC content is identified for some products in this section; provide documentation in accordance with Section 01 33 29 SUSTAINABILITY REPORTING paragraph REDUCE VOLATILE ORGANIC COMPOUNDS (VOC) (LOW-EMITTING MATERIALS). Other products listed in this section may be available with reduced VOC content; identify those products that meet project requirements for reduced VOC content, and provide documentation in accordance with Section 01 33 29 SUSTAINABILITY REPORTING paragraph REDUCE VOLATILE ORGANIC COMPOUNDS (VOC) (LOW-EMITTING MATERIALS).

## 2.2 SEALANTS

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

### 2.2.1 Interior Sealants

Provide ASTM C920, Type S or M, Grade NS, Class 12.5, Use NT. Provide certification of indoor air quality for interior sealants. Location(s) and color(s) of sealant for the following. Note, color "as selected" refers to manufacturer's full range of color options:

LOCATION	COLOR
a. Small voids between walls or partitions and adjacent lockers, casework, shelving, door frames, built-in or surface mounted equipment and fixtures, and similar items.	Match adjacent surface color
b. Perimeter of frames at doors, windows, and access panels which adjoin exposed interior concrete and masonry surfaces.	Match adjacent surface color
c. Joints of interior masonry walls and partitions which adjoin columns, pilasters, concrete walls, and exterior walls unless otherwise detailed.	Match adjacent surface color
d. Joints between edge members for acoustical tile and adjoining vertical surfaces.	Match adjacent surface color
e. Interior locations, not otherwise indicated or specified, where small voids exist between materials specified to be painted.	Match adjacent surface color
f. Joints between bathtubs and ceramic tile; joints between shower receptors and ceramic tile; joints formed where non-planar tile surfaces meet.	Match adjacent surface color
g. Joints formed between tile floors and tile base cove; joints between tile and dissimilar materials; joints occurring where substrates change.	Match adjacent surface color



LOCATION	COLOR
h. Behind escutcheon plates at valve pipe penetrations and showerheads in showers.	Match adjacent surface color

### 2.2.2 Exterior Sealants

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

LOCATION	COLOR
a. Joints and recesses formed where frames and subsills of windows, doors, louvers, and vents adjoin masonry, concrete, or metal frames. Use sealant at both exterior and interior surfaces of exterior wall penetrations.	Match adjacent surface color
b. Joints between new and existing exterior masonry walls.	Match adjacent surface color
c. Masonry joints where shelf angles occur.	Match adjacent surface color
d. Joints in wash surfaces of stonework.	Match adjacent surface color
e. Expansion and control joints.	Match adjacent surface color
f. Interior face of expansion joints in exterior concrete or masonry walls where metal expansion joint covers are not required.	Match adjacent surface color
g. Voids where items pass through exterior walls.	Match adjacent surface color
h. Metal reglets, where flashing is inserted into masonry joints, and where flashing is penetrated by coping dowels.	Match adjacent surface color
i. Metal-to-metal joints where sealant is indicated or specified.	Match adjacent surface color
j. Joints between ends of gravel stops, fasciae, copings, and adjacent walls.	Match adjacent surface color

### 2.2.3 Floor Joint Sealants

ASTM C920, Type S or M, Grade P, Class 25, Use T. Provide certification

of indoor air quality for interior floor joint sealants. Provide location(s) and color(s) of sealant as follows. Note, color "as selected" refers to manufacturer's full range of color options:

LOCATION	COLOR
a. Seats of metal thresholds for exterior doors.	Match adjacent surface color
b. Control and expansion joints in floors, slabs, ceramic tile, and walkways.	Match adjacent surface color

#### 2.2.4 Acoustical Sealants

Rubber or polymer based acoustical sealant in accordance with ASTM C919 to have a flame spread of 25 or less and a smoke developed rating of 50 or less when tested in accordance with ASTM E84. Provide non-staining acoustical sealant with a consistency of 250 to 310 when tested in accordance with ASTM D217. Acoustical sealant must remain flexible and adhesive after 500 hours of accelerated weathering as specified in ASTM C734. Provide certification of indoor air quality for interior acoustical sealants.

#### 2.2.5 Preformed Sealants

Provide preformed sealants of polybutylene or isoprene-butylene based pressure sensitive weather resistant tape or bead sealants capable of sealing out moisture, air and dust when installed as recommended by the manufacturer. At temperatures from minus 30 to plus 160 degrees F, sealants must be non-bleeding and have no loss of adhesion.

##### 2.2.5.1 Tape

Tape sealant: Provide cross section dimensions of 3/4 inches.

##### 2.2.5.2 Bead

Bead sealant: Provide cross section dimensions of 1/4 to 3/8 inches.

##### 2.2.5.3 Foam Strip

Provide foam strip of polyurethane foam with cross section dimensions of as indicated. Provide foam strip capable of sealing out moisture, air, and dust when installed and compressed in accordance with manufacturer's printed instructions. Service temperature must be minus 40 to plus 275 degrees F. Furnish untreated strips with adhesive to hold them in place. Do not allow adhesive to stain or bleed onto adjacent finishes. Saturate treated strips with butylene waterproofing or impregnate with asphalt.

#### 2.3 PRIMERS

Non-staining, quick drying type and consistency as recommended by the sealant manufacturer for the particular application. Provide primers for interior applications that meet the indoor air quality requirements of the paragraph SEALANTS above.

## 2.4 BOND BREAKERS

Type and consistency as recommended by the sealant manufacturer to prevent adhesion of the sealant to the backing or to the bottom of the joint. Provide bond breakers for interior applications that meet the indoor air quality requirements of the paragraph SEALANTS above.

## 2.5 BACKSTOPS

Provide glass fiber roving, neoprene, butyl, polyurethane, or polyethylene foams free from oil or other staining elements as recommended by sealant manufacturer. Provide 25 to 33 percent oversized backing for closed cell and 40 to 50 percent oversized backing for open cell material, unless otherwise indicated. Provide backstop material that is compatible with sealant. Do not use oakum, or other types of absorptive materials as backstops.

### 2.5.1 Rubber

Provide in accordance with ASTM D1056, Type 2, closed cell, Class A , Grade 2A3, round cross section for cellular rubber sponge backing.

### 2.5.2 Synthetic Rubber

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

### 2.5.3 Neoprene

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

### 2.5.4 Silicone Rubber Base

Provide in accordance with ASTM C920, from a single component, with solvent release, Non-sag, Type S, Grade NS, Class 25. Color as selected from manufacturer's full range of color choices.

## 2.6 CLEANING SOLVENTS

Provide type(s) recommended by the sealant manufacturer and in accordance with environmental requirements herein. Protect adjacent aluminum and bronze surfaces from solvents. Provide solvents for interior applications that meet the indoor air quality requirements of the paragraph SEALANTS above.

## PART 3 EXECUTION

### 3.1 FIELD QUALITY CONTROL

Perform a field adhesion test in accordance with manufacturer's instructions and ASTM C1193, Method A or ASTM C1521, Method A, Tail Procedure. Remove sealants that fail adhesion testing; clean substrates, reapply sealants, and re-test. Test sealants adjacent to failed sealants. Submit field adhesion test report indicating tests, locations, dates, results, and remedial actions taken.

### 3.2 SURFACE PREPARATION

Prepare surfaces according to manufacturer's printed installation instructions. Clean surfaces from dirt, frost, moisture, grease, oil, wax, lacquer, paint, or other foreign matter that would destroy or impair adhesion. Remove oil and grease with solvent; thoroughly remove solvents prior to sealant installation. Wipe surfaces dry with clean cloths. When resealing an existing joint, remove existing caulk or sealant prior to applying new sealant. For surface types not listed below, provide in accordance with sealant manufacturer's printed instructions for each specific surface.

#### 3.2.1 Steel Surfaces

Remove loose mill scale by sandblasting or, if sandblasting is impractical or would damage finished work, scraping and wire brushing. Remove protective coatings by sandblasting or using a residue free solvent. Remove resulting debris and solvent residue prior to sealant installation.

#### 3.2.2 Aluminum or Bronze Surfaces

Remove temporary protective coatings from surfaces that will be in contact with sealant. When masking tape is used as a protective coating, remove tape and any residual adhesive prior to sealant application. For removing protective coatings and final cleaning, use non-staining solvents recommended by the manufacturer of the item(s) containing aluminum or bronze surfaces.

#### 3.2.3 Concrete and Masonry Surfaces

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

#### 3.2.4 Wood Surfaces

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

#### 3.2.5 Removing Existing Hazardous Sealants

For sealants applied prior to 1979, or that have been tested and found to contain polychlorinated biphenyls (PCBs), remove and dispose of these sealants.

### 3.3 SEALANT PREPARATION

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

### 3.4 APPLICATION

#### 3.4.1 Joint Width-To-Depth Ratios

Acceptable Ratios:

JOINT WIDTH	JOINT DEPTH	
	Minimum	Maximum
For metal, glass, or other nonporous surfaces:		
1/4 inch (minimum)	1/4 inch	1/4 inch
over 1/4 inch	1/2 of width	Equal to width
For wood, concrete, masonry, stone, or :		
1/4 inch (minimum)	1/4 inch	1/4 inch
over 1/4 inch to 1/2 inch	1/4 inch	Equal to width
over 1/2 inch to 1 inch	1/2 inch	5/8 inch
Over 1 inch	prohibited	

Unacceptable Ratios: Where joints of acceptable width-to-depth ratios have not been provided, clean out joints to acceptable depths and grind or cut to acceptable widths without damage to the adjoining work. Grinding is prohibited at metal surfaces.

#### 3.4.2 Unacceptable Sealant Use

Do not install sealants in lieu of other required building enclosure weatherproofing components such as flashing, drainage components, and joint closure accessories, or to close gaps between walls, floors, roofs, windows, and doors, that exceed acceptable installation tolerances. Remove sealants that have been used in an unacceptable manner and correct building enclosure deficiencies to comply with contract documents requirements.

#### 3.4.3 Masking Tape

Place masking tape on the finished surface on one or both sides of joint cavities to protect adjacent finished surfaces from primer or sealant smears. Remove masking tape within 10 minutes of joint filling and tooling.

#### 3.4.4 Backstops

Provide backstops dry and free of tears or holes. Tightly pack the back or bottom of joint cavities with backstop material to provide joints in specified depths. Provide backstops where indicated and where backstops are not indicated but joint cavities exceed the acceptable maximum depths specified in JOINT WIDTH-TO-DEPTH RATIOS Table.

#### 3.4.5 Primer

Clean out loose particles from joints immediately prior to application of. Apply primer to joints in concrete masonry units, wood, and other porous surfaces in accordance with sealant manufacturer's printed instructions. Do not apply primer to exposed finished surfaces.

#### 3.4.6 Bond Breaker

Provide bond breakers to surfaces not intended to bond in accordance with, sealant manufacturer's printed instructions for each type of surface and sealant combination specified.

#### 3.4.7 Sealants

Provide sealants compatible with the material(s) to which they are applied. Do not use a sealant that has exceeded its shelf life or has jelled and cannot be discharged in a continuous flow from the sealant gun. Apply sealants in accordance with the manufacturer's printed instructions with a gun having a nozzle that fits the joint width. Work sealant into joints so as to fill the joints solidly without air pockets. Tool sealant after application to ensure adhesion. Apply sealant uniformly smooth and free of wrinkles. Upon completion of sealant application, roughen partially filled or unfilled joints, apply additional sealant, and tool smooth as specified. Apply sealer over sealants in accordance with the sealant manufacturer's printed instructions.

### 3.5 PROTECTION AND CLEANING

#### 3.5.1 Protection

Protect areas adjacent to joints from sealant smears. Masking tape may be used for this purpose if removed 5 to 10 minutes after the joint is filled and no residual tape marks remain.

#### 3.5.2 Final Cleaning

Upon completion of sealant application, remove remaining smears and stains and leave the work in a clean and neat condition.

- a. Masonry and Other Porous Surfaces: Immediately remove fresh sealant that has been smeared on adjacent masonry, rub clean with a solvent, and remove solvent residue, in accordance with sealant manufacturer's printed instructions. Allow excess sealant to cure for 24 hour then remove by wire brushing or sanding. Remove resulting debris.
- b. Metal and Other Non-Porous Surfaces: Remove excess sealant with a solvent moistened cloth. Remove solvent residue in accordance with solvent manufacturer's printed instructions.

-- End of Section --

SECTION 08 11 13

STEEL DOORS AND FRAMES

02/10

PART 1 GENERAL

1.1 REFERENCES

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

AMERICAN WELDING SOCIETY (AWS)

AWS D1.1/D1.1M (2015; Errata 1 2015; Errata 2 2016)  
Structural Welding Code - Steel

ASTM INTERNATIONAL (ASTM)

ASTM F2247 (2011; R 2017) Standard Test Method for  
Metal Doors Used in Blast Resistant  
Applications (Equivalent Static Load  
Method)

ASTM F2927 (2012) Standard Test Method for Door  
Systems Subject to Airblast Loadings

BUILDERS HARDWARE MANUFACTURERS ASSOCIATION (BHMA)

ANSI/BHMA A156.115 (2016) Hardware Preparation in Steel Doors  
and Steel Frames

NATIONAL FIRE PROTECTION ASSOCIATION (NFPA)

NFPA 105 (2016; TIA 16-1) Standard for Smoke Door  
Assemblies and Other Opening Protectives

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

NFPA 80 (2016; TIA 16-1) Standard for Fire Doors  
and Other Opening Protectives

STEEL DOOR INSTITUTE (SDI/DOOR)

SDI/DOOR 111 (2009) Recommended Selection and Usage  
Guide for Standard Steel Doors, Frames and  
Accessories

SDI/DOOR A250.11 (2001) Recommended Erection Instructions  
for Steel Frames

SDI/DOOR A250.3 (2007; R 2011) Test Procedure and  
Acceptance Criteria for Factory Applied  
Finish Painted Steel Surfaces for Steel  
Doors and Frames

SDI/DOOR A250.6 (2003; R2009) Recommended Practice for  
Hardware Reinforcing on Standard Steel  
Doors and Frames

SDI/DOOR A250.8 (2003; R2008) Recommended Specifications  
for Standard Steel Doors and Frames

UNDERWRITERS LABORATORIES (UL)

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

1.2 SUBMITTALS

Government approval is required for submittals with a "G" designation; submittals not having a "G" designation are for information only. When used, a designation following the "G" designation identifies the office that will review the submittal for the Government. Submittals with an "S" are for inclusion in the Sustainability eNotebook, in conformance to Section 01 33 29 SUSTAINABILITY REPORTING. Submit the following in accordance with Section 01 33 00 SUBMITTAL PROCEDURES:

SD-02 Shop Drawings

Doors

Frames

Accessories

Weatherstripping

Show elevations, construction details, metal gages, hardware provisions, method of glazing, and installation details.

Schedule of doors; G

Schedule of frames; G

Submit door and frame locations.

SD-03 Product Data

Doors

Frames

Accessories

Weatherstripping

Submit manufacturer's descriptive literature for doors, frames, and accessories. Include data and details on door construction, panel (internal) reinforcement, insulation, and door edge construction. When "custom hollow metal doors" are provided in lieu of "standard steel doors," provide additional details and data sufficient for comparison to SDI/DOOR A250.8 requirements.

SD-04 Samples



Factory-applied enamel finish; G

Where colors are not indicated, submit manufacturer's standard colors and patterns for selection.

#### SD-05 Design Data

Blast Calculations; G

Blast Report; G

#### SD-07 Certificates

Blast Consultant Qualifications; G

Blast Testing Agency Qualifications; G

### 1.3 DELIVERY, STORAGE, AND HANDLING

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

### 1.4 QUALITY ASSURANCE

#### 1.4.1 Blast Consultant Qualifications

Blast engineering consultant performing blast calculations shall be a licensed professional engineer, with formal training in Structural dynamics. Consultant shall have a minimum of 5 years of experience in providing qualified blast engineering services similar in design to that required for this project. "Qualified blast engineering services" is defined as "a minimum of three projects of similar value and scope that meet the satisfaction of the Owner and whose work has resulted in construction with a record of successful in-service performance for a period of at least 5 years".

#### 1.4.2 Blast Testing Agency Qualifications

If blast testing is performed in lieu of design/analysis calculations, Blast Testing Agency performing the testing shall employ licensed professional engineers with formal training in structural dynamics and shall be acceptable to the Contracting Officer. Blast testing agency shall have experience in providing blast testing services for projects of similar size and scope to the kind indicated, have experience in testing to the blast loads specified in "Design Blast Loads" portion of this specification section, and shall be familiar with the requirements of ASTM F2247 and/or with ASTM F2927.

## 1.5 BLAST PERFORMANCE REQUIREMENTS

### 1.5.1 Design Approach

#### 1.5.1.1 Unglazed Doors

Unglazed doors shall be designed using one of the following approaches.

- a. Provide unglazed doors that are tested to achieve a Door Damage Level Category III in accordance with ASTM F2247 or with ASTM F2927. The fasteners and anchorage methods used to attach the tested door assembly shall be representative of actual door installation.
- b. Unglazed door assemblies may be designed using a dynamic analysis.

#### 1.5.1.2 Glazed Doors

Glazed doors shall be designed using one of the following approaches.

- a. Provide glazed doors that are tested to achieve a Door Damage Level Category III and a Minimal Hazard Rating for glazing in accordance with ASTM F2927. The fasteners and anchorage methods used to attach the tested door assembly shall be representative of actual door installation. Unless included as part of the tested assembly, glazed sidelights and transoms around doors must meet the blast requirements of Section 08 81 00 GLAZING.
- b. Glazed door assemblies may be designed using a dynamic analysis.

### 1.5.2 Design Blast Loads

The following design blast load is a dynamic load to be used with an inelastic dynamic structural analysis method of the door assembly.

- a. Linearly decaying load function with peak pressure and impulse.

(1) All doors indicated: 8.36 psi and 38.12 psi-msec.

- b. Negative phase effects shall not be considered.

### 1.5.3 Blast Calculations

The submission of calculations and blast data is required from the contractor for review and approval. Requirements for the calculations and blast data are described in the paragraph entitled "Blast Report" of this specification.

### 1.5.4 Blast Report

Submit a blast report, including a summary narrative, structural design sketches, and structural design calculations, for each door assembly type and each building elevation required to resist blast loads, showing compliance with blast performance requirements for review and approval. Each blast resistant door assembly (including door size, glazing location, glazing thickness, glazing type, and PVB laminate thickness) shall be verified through analysis to meet or exceed the minimum required performance condition in response to the specified blast loads.

- a. Blast Report shall be prepared and submitted by a qualified blast

engineering consultant as defined in the paragraph entitled "Blast Consultant Qualifications" of this specification. The blast report shall be signed and sealed by a registered professional engineer.

- b. Blast engineering design calculations must be completed for all door assemblies if a dynamic analysis design approach is chosen. Test data may be submitted in addition to the engineering design calculations, although test data is not required. However, test data must be submitted if a tested door assembly design approach is chosen.

## 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. Undercut where indicated. Exterior doors shall have top edge closed flush and sealed to prevent water intrusion. Doors shall be 1-3/4 inch thick, unless otherwise indicated.

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

##### 2.1.1.1 Heavy Duty Doors

SDI/DOOR A250.8, Level 2, physical performance Level B, Model 2, with core construction as required by the manufacturer for interior doors, of size(s) and design(s) indicated. Where vertical stiffener cores are required, the space between the stiffeners shall be filled with mineral board insulation. Provide Level 2 for interior doors.

### 2.2 SOUND RATED STEEL DOORS

Doors shall have a Sound Transmission Class (STC) as indicated on the drawings.

### 2.3 ACCESSORIES

#### 2.3.1 Astragals

For interior pairs of fire rated and smoke control doors, provide stainless steel astragals complying with NFPA 80 for fire rated assemblies and NFPA 105 for smoke control assemblies.

#### 2.3.2 Moldings

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

### 2.4 STANDARD STEEL FRAMES

SDI/DOOR A250.8, Level 1, 2, and 3, except as otherwise specified. Form frames to sizes and shapes indicated, with welded corners. Provide steel frames for doors, unless otherwise indicated.

#### 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 Anchors

Provide anchors to secure the frame to adjoining construction. Provide steel anchors, zinc-coated or painted with rust-inhibitive paint, not lighter than 18 gage.

##### 2.4.2.1 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

##### 2.4.2.2 Floor Anchors

Provide floor anchors drilled for 3/8 inch anchor bolts at bottom of each jamb member. Where floor fill occurs, terminate bottom of frames at the indicated finished floor levels and support by adjustable extension clips resting on and anchored to the structural slabs.

#### 2.5 FIRE DOORS AND FRAMES

NFPA 80 and this specification. The requirements of NFPA 80 shall take precedence over details indicated or specified.

##### 2.5.1 Labels

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

##### 2.5.2 Astragal on Fire Doors

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

## 2.6 WEATHERSTRIPPING

As specified in Section 08 71 00 DOOR HARDWARE.

## 2.7 HARDWARE PREPARATION

Provide minimum hardware reinforcing gages as specified in SDI/DOOR A250.6. 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. Locate hardware in accordance with the requirements of SDI/DOOR A250.8, as applicable. 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 Factory-Primed Finish

All surfaces of doors and frames shall be thoroughly cleaned, chemically treated and factory primed with a rust inhibiting coating as specified in SDI/DOOR A250.8.

### 2.8.2 Factory-Applied Enamel Finish

Coatings shall meet test procedures and acceptance criteria in accordance with SDI/DOOR A250.3. After factory priming, apply two coats of low-gloss enamel to exposed surfaces. Separately bake or oven dry each coat. Drying time and temperature requirements shall be in accordance with the coating manufacturer's recommendations. Color(s) of finish coat shall be as indicated and shall match approved color sample(s).

## 2.9 FABRICATION AND WORKMANSHIP

Finished doors and frames shall be strong and rigid, neat in appearance, and free from defects, waves, scratches, cuts, dents, ridges, holes, warp, and buckle. Molded members shall be 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 shall be well formed and in true alignment. Conceal fastenings where practicable. On wraparound frames for masonry partitions, provide a throat opening 1/8 inch larger than the actual masonry thickness.

## 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. Backfill frames with mortar. Coat inside of frames with corrosion-inhibiting bituminous material. For frames in exterior walls, ensure that stops are filled with rigid insulation before grout is placed.

##### 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 Doors and Frames

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

#### 3.2 PROTECTION

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

#### 3.3 CLEANING

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

-- End of Section --

SECTION 08 22 20

FIBERGLASS REINFORCED PLASTIC (FRP) DOORS AND FRAMES  
05/15

PART 1 GENERAL

1.1 REFERENCES

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

AMERICAN SOCIETY OF CIVIL ENGINEERS (ASCE)

ASCE 7 (2017) Minimum Design Loads for Buildings  
and Other Structures

ASTM INTERNATIONAL (ASTM)

ASTM D2344/D2344M (2013) Standard Test Method for Short-Beam  
Strength of Polymer Matrix Composite  
Materials and Their Laminates

ASTM D256 (2010) Determining the Izod Pendulum  
Impact Resistance of Plastics

ASTM D638 (2014) Standard Test Method for Tensile  
Properties of Plastics

ASTM D695 (2010) Standard Test Method for  
Compressive Properties of Rigid Plastics

ASTM D696 (2016) Standard Test Method for  
Coefficient of Linear Thermal Expansion of  
Plastics Between -30 degrees C and 30  
degrees C With a Vitreous Silica  
Dilatometer

ASTM D790 (2010) Flexural Properties of Unreinforced  
and Reinforced Plastics and Electrical  
Insulating Materials

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

ASTM E2112 (2007) Standard Practice for Installation  
of Exterior Windows, Doors and Skylights

ASTM E283 (2004; R 2012) 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 E84	(2018) Standard Test Method for Surface Burning Characteristics of Building Materials
ASTM F2248	(2012) Standard Practice for Specifying an 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

INTERNATIONAL CODE COUNCIL (ICC)

ICC IBC	(2017) International Building Code
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NATIONAL FIRE PROTECTION ASSOCIATION (NFPA)

NFPA 241	(2013; Errata 2015) Standard for Safeguarding Construction, Alteration, and Demolition Operations
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U.S. NATIONAL ARCHIVES AND RECORDS ADMINISTRATION (NARA)

29 CFR 1910	Occupational Safety and Health Standards
29 CFR 1926	Safety and Health Regulations for Construction

1.2 ADMINISTRATIVE REQUIREMENTS

1.2.1 Pre-Installation Meeting

Within 30 days of Contract Award, the Contracting Officer will schedule a Pre-Installation meeting. For that meeting, submit the following for review and approval:

Shop Drawings

- a. Doors
- b. Frames
- c. Door Hardware Components and Accessories
- d. Weather-stripping

1.3 SUBMITTALS

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

SD-02 Shop Drawings

Doors



Frames; G

SD-03 Product Data

Doors

Calculations

Frames; G

SD-07 Certificates

ASTM Airblast Testing Certification Report; G

Warranty

#### 1.4 DELIVERY, STORAGE, AND HANDLING

##### 1.4.1 Delivery

Deliver FRP doors, frames, components and accessories in manufacturer's original unopened packaging. Mark and remove damaged materials from the project site. Where materials are covered by a referenced specification, label the package with the specification number, type, and class, as applicable. Deliver materials in sufficient quantity to allow work to proceed without interruption.

##### 1.4.2 Storage

Protect materials against moisture absorption and contamination or other damage.

Store all materials on clean raised platforms or pallets one level high in dry locations with adequate ventilation, such as an enclosed building or closed trailer.

Do not store materials in buildings under construction until concrete, mortar, and plaster work is finished and dry.

Do not store materials outdoors unless approved by the Contracting Officer. Completely cover materials stored outdoors, with waterproof canvas protective covering. Tie covering securely to pallets to ensure complete weatherproofing is met. Provide sufficient ventilation to prevent condensation. Do not use polyethylene sheet as a covering.

Do not store materials in contact with other materials that might cause staining, denting, or other surface damage.

##### 1.4.3 Handling

Prevent damage to corners, edges and ends of materials. Do not install damaged materials in the work. Select and operate material handling equipment to prevent damage to materials.

#### 1.5 WARRANTY

Submit sample material and workmanship warranties meeting specified requirements. Provide revision or amendment to standard manufacturer

warranty as required to comply with the specified requirements.

Furnish the manufacturer's 5 year no dollar limit for materials and installation, workmanship, and deterioration of factory-applied finishes within specified warranty period. Provide warranty directly to the Government and commence warranty effective date at time of Government's acceptance of the work.

## PART 2 PRODUCTS

### 2.1 SYSTEM DESCRIPTION

#### 2.1.1 Design Requirements

##### 2.1.1.1 Finish Surfaces

Ensure all finished surfaces of FRP items and fabrications are smooth, resin-rich, free of voids and without dry spots, cracks, and un-reinforced areas. Completely cover all glass fibers with resin to protect against their exposure due to wear or weathering. All stiles, rails, heads, jambs, and internal reinforcement are to be integrally pigmented yellow.

##### 2.1.1.2 Ultraviolet Protection

Provide documentation that all pultruded structural shapes are further protected from ultraviolet (UV) attack with:

- a. Integral UV inhibitors within the resin
- b. Synthetic surfacing veil to help produce a resin rich surface
- c. UV resistant coating for outdoor exposures.

##### 2.1.1.3 Flame Spread Rating

All FRP products to have a flame spread rating of 25 or less as per ASTM E84 Tunnel Test.

##### 2.1.1.4 Structural Properties

Meet minimum longitudinal structural properties with structural shapes in the door and frame system as follows:

Tensile Strength	ASTM D638	30,000 psi
Compressive Strength	ASTM D695	30,000 psi
Flexural Strength	ASTM D790	30,000 psi
Flexural Modulus	ASTM D790	1,600,000 psi
Short Beam Shear	ASTM D2344/D2344M	4,500 psi
Impact, Notched	ASTM D256	25 ft-lb/in

Tensile Strength	ASTM D638	30,000 psi
Thermal Expansion	ASTM D696	.000008 in/in/F
Fire Resistance	ASTM E84	Class I

#### 2.1.1.1.5 FRP Door and Frame

Provide complete swing-type FRP doors with frames of the size, design and location indicated, including but not limited to, framing members, subframes, molding, and accessories.

Provide complete door hardware schedule, design and location as specified in specification Section 08 71 00 DOOR HARDWARE.

##### a. FRP Doors

- (1) Doors shall be made of fiberglass reinforced plastic (FRP) using Class 1 premium resin. Doors shall be 1-3/4 inch thick and of flush construction, having no seams or cracks. All doors up to 48 by 96 inches shall have equal diagonal measurements. For consistency in the resin chemistry tailored for this application and to maintain the same physical properties throughout the structure, all fiberglass components including face plates, stiles and rails and frames must be fabricated by the same manufacturer. Components obtained through various outside sources for plant assembly will not be accepted.
- (2) Door plates shall be 0.125 inch thick minimum, molded in one continuous piece, starting with 25 mil gelcoat of the color specified, integrally molded with multiple layers of 1.5 ounces per square foot fiberglass mat and one layer of 18 ounce per square yard fiberglass woven roving. Each layer shall be individually laminated with resin as mentioned above. Door plate weight shall not be less than 0.97 lbs per square foot at a ratio of 30/70 glass to resin. Face plates manufactured using the pultrusion process will not be acceptable.
- (3) Stiles and rails shall be constructed with a matrix of at least three layers of 1.5 ounce per square foot of fiberglass mat. The stile and rail shall be molded in one continuous piece to a U-shaped configuration and to the exact dimensions of the door collar. In this manner there will be no miter joints and disparate materials used to form the one-piece stile and rail.
- (4) Core material to be polypropylene plastic honeycomb core with a non-woven polyester veil for unparalleled plate bonding, 180 PSI typical compression range.
- (5) Internal reinforcement shall be two layers of solid 3/8 by 1-1/2 inch FRP flat bar with a minimum hinge screw holding value of 1100 lbs per screw. Two vertical solid 3/8 by 1-1/2 inch by door length stiffeners shall be located per the manufacturers design discretion.
- (6) Finish of door frame shall be identical with 25 mil resin-rich gelcoat of the specified color integrally molded in at time of manufacture resulting in a smooth gloss surface that is dense and

non-porous. To achieve optimum surface characteristics, the gelcoat shall be cured within a temperature range of 120 to 170 degrees F creating an impermeable outer surface, uniform color throughout, and a permanent homogeneous bond with the resin/fiberglass substrate beneath. Only the highest quality gelcoat will be used to ensure enduring color and physical properties. Paint and/or post application of gelcoat result in poor mechanical fusion and will be deemed unacceptable for this application. The finish of the door and frame must be field repairable without compromising the integrity of the original uniform composite structure, function or physical strength.

(7) Door shall be certified to meet ASTM F2927.

b. FRP Frames

- (1) Frames (rated and non-rated) shall be fiberglass and manufactured using the resin transfer method creating one solid piece (no voids) with complete uniformity in color and size. Beginning with a minimum 25 mil gelcoat layer molded in and a minimum of two layers of continuous strand fiberglass mat saturated with resin, the frame will be of one-piece construction with molded stop. All frame profiles shall have a core material of 2 psf polyurethane foam.
- (2) Finish of frame shall be identical to the door with 25 mil resin-rich gelcoat of the specified color integrally molded in at time of manufacture. To achieve optimum surface characteristics, the gelcoat shall be cured within a temperature range of 120 to 170 degrees F creating an impermeable outer surface, uniform color throughout, and a permanent homogeneous bond with the resin/fiberglass substrate beneath. Only the highest quality gelcoat will be used to ensure enduring color and physical properties. Paint and/or post application of gelcoat and/or polyurethane will result in poor mechanical fusion and will be deemed unacceptable for this application. The finish of the door and frame must be field repairable without compromising the integrity of the original uniform composite structure, function or physical strength.
- (3) Jamb/header connection shall be mitered for tight fit. Optional seamless one piece frame construction as indicated on the project schedules and related details.
- (4) Internal reinforcement shall be continuous within the structure to allow for mounting of specified hardware. Reinforcing material shall be two layers of solid 3/8 inch FRP material with a minimum hinge screw holding value of 1000 lbs per screw. All reinforcing materials shall be completely encapsulated. Documented strength of frame screw holding value after third insert must be submitted. Dissimilar materials, such as steel, will be deemed unacceptable as reinforcement for hardware attachment.
- (5) Mortises for hardware shall be accurately machined by CNC to hold dimensions to +/- 0.010 inch in all three axis.
- (6) Hinge pockets shall be accurately machined by CNC to facilitate heavy duty hinges at all hinge locations, using shims when standard weight hinges are used.

(7) Frames shall be certified to meet ASTM F2927.

c. Hardware

(1) See Hardware Section 08 71 00 DOOR HARDWARE.

(2) The special nature of this material requires that all related hardware as specified must be furnished and installed by the door frame manufacturer to maintain product quality and function as well as to ensure sufficient support/reinforcement, precision tooling and proper sealing methods are provided.

## 2.2 PERFORMANCE REQUIREMENTS

### 2.2.1 Structural

Design exterior doors, frames and hardware to resist equivalent static design loads in accordance with ASTM F2927, with frame deflections not to exceed  $L/160$  of the unsupported member lengths. Use equivalent airblast design loads for connections of the door frame to the surrounding walls or hardware and associated connections, in accordance with ASTM F2248 and ASTM E1300. Design supporting elements and their connections based on their ultimate capacities. Provide calculations prepared by a Professional Engineer that substantiates compliance with these requirements, including insulation materials. Use frames that provide an equivalent level of performance. Provide framing members with shape and thickness sufficient to withstand the design wind load indicated with a deflection of not more than  $1/175$  times the length of the member and a safety factor of not less than 1.65. Provide glazing beads, moldings, and trim of not less than 0.050-inch nominal thickness.

Design doors and frames to withstand the specified design wind load acting normal to the plane of the entrance wall either inward or outward, in accordance with ASCE 7 and ICC IBC.

### 2.2.2 Air Infiltration

When tested in accordance with ASTM E283, air infiltration is not to exceed 0.06 cubic feet per minute per square foot of fixed area at a test pressure of 6.24 pounds per square foot 50 mile per hour wind.

### 2.2.3 Water Penetration

When tested in accordance with ASTM E331, no water penetration is allowed, at a pressure of 8 pounds per square foot of fixed area.

### 2.2.4 Provisions for Thermal Movement

Design doors and frames to provide for expansion and contraction of the component parts caused by an ambient temperature range of 0 to 100 degrees F causing buckling, opening of joints, overstressing of fasteners, or other harmful effects.

## PART 3 EXECUTION

### 3.1 INSTALLATION

Conform all work to the requirements of 29 CFR 1910, 29 CFR 1926, and

NFPA 241.

### 3.1.1 FRP Frame

Set FRP door frame plumb and true, aligned, and secured with the adjacent construction-in-place, in conformance with ASTM E2112. Anchor frame as specified and in accordance with the FRP door manufacturer's requirements.

#### Installation Tolerances

- a. Squareness: Plus or minus 1/16-inch, measure at the door rabbet on a line 90 degrees from the jamb perpendicular to the frame head.
- b. Alignment: Plus or minus 1/16-inch, measure at the jamb on a horizontal line parallel to the wall plane.
- c. Twist: Plus or minus 1/16-inch, measure at the opposite face corners of the jambs on parallel lines, and perpendicular to the wall plane.
- d. Plumb and True: Plus or minus 1/16-inch, measure at the jambs to the floor.

### 3.1.2 FRP Door

Fit and hang door in accordance with clearances specified below:

#### Clearance Tolerances

- a. Jambs and Head: Plus 1/8-inch or minus 1/16-inch.
- b. Pairs of Doors: Plus 1/8 inch or minus 1/16-inch.
- c. Bottom of Door and Top of Threshold: Maximum 3/8-inch.
- d. Bottom of Door and Top of finish floor (No Threshold: Maximum 3/4-inch.

## 3.2 ADJUSTING AND CLEANING

Check and re-adjust all operating hardware items immediately before final inspection. Leave work in complete and proper operating condition. Remove and replace defective work, including all FRP that is warped, bowed, or otherwise unacceptable to the Contracting Officer.

## 3.3 PROTECTION

Protect doors and frames from damage. Repair damaged doors and frames prior to final completion and acceptance of the project or replace with new, as directed by the Contracting Officer. Thoroughly clean all surfaces of the door and frame prior to final completion and acceptance of the project.

## 3.4 CLOSEOUT ACTIVITIES

### 3.4.1 Warranty

Submit approved Warranty made out to the Government, to the Contracting  
Officer no later than 10 days prior to final inspection,

-- End of Section --





SECTION 08 31 00

ACCESS DOORS AND PANELS

05/17

PART 1 GENERAL

1.1 REFERENCES

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

AMERICAN WELDING SOCIETY (AWS)

AWS D1.1/D1.1M (2015; Errata 1 2015; Errata 2 2016)  
Structural Welding Code - Steel

ASTM INTERNATIONAL (ASTM)

ASTM A1008/A1008M (2016) 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 A36/A36M (2014) Standard Specification for Carbon Structural Steel

ASTM A653/A653M (2017) 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 E119 (2016a) Standard Test Methods for Fire Tests of Building Construction and Materials

ASTM E1332 (2016) Standard Classification for Rating Outdoor-Indoor Sound Attenuation

ASTM E413 (2016) Classification for Rating Sound Insulation

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

MASTER PAINTERS INSTITUTE (MPI)

MPI 79 (2012) Primer, Alkyd, Anti-Corrosive for Metal

NATIONAL FIRE PROTECTION ASSOCIATION (NFPA)

NFPA 252	(2017) Standard Methods of Fire Tests of Door Assemblies
NFPA 288	(2017) Standard Methods of Fire Tests of Horizontal Fire Door Assemblies Installed in Horizontal Fire Resistance-Rated Assemblies
NFPA 80	(2016; TIA 16-1) Standard for Fire Doors and Other Opening Protectives

UNDERWRITERS LABORATORIES (UL)

UL 10B	(2008; Reprint Feb 2015) Fire Tests of Door Assemblies
UL 263	(2011; Reprint Mar 2018) Fire Tests of Building Construction and Materials

1.2 SUBMITTALS

Government approval is required for submittals with a "G" designation; submittals not having a "G" designation are for information only. When used, a designation following the "G" designation identifies the office that will review the submittal for the Government. Submittals with an "S" are for inclusion in the Sustainability eNotebook, in conformance with Section 01 33 29 SUSTAINABILITY REPORTING. Submit the following in accordance with Section 01 33 00 SUBMITTAL PROCEDURES:

SD-02 Shop Drawings

Access Doors And Panels; G

SD-03 Product Data

Access Doors And Panels; G

Hardware Including Locks and Keys; G

Accessories; G

Power Transfer Components; G

SD-04 Samples

Finishes; G

SD-06 Test Reports

Fire-rating(s) of Assemblies; G

Acoustical Ratings of Assemblies; G

SD-11 Closeout Submittals

Recycled Content; S

### 1.3 MISCELLANEOUS REQUIREMENTS

For access doors and panels provide the following:

#### 1.3.1 Shop Drawings

For field assembled access doors and panels, provide plans, elevations, sections, and details for each type of access door and panel assembly. Indicate frame, surface and edge construction, materials, and accessories. Indicate types of finished surfaces and details for panel edge conditions. Provide a door schedule with a unique number for each access door and panel, specific location in the project, location of hinges and hardware for each door. Indicate acoustical ratings of assemblies as sound transmission class (STC) ratings, and fire-rating(s) of assemblies and locations and power transfer components for electrified locks and alarms.

#### 1.3.2 Product Data

For shop assembled access doors and panels, provide literature indicating sizes, types, frame and edge construction, finishes, hardware, accessories such as gaskets, seals and weatherstripping, and location of each door and panel in the project. Indicate acoustical ratings of assemblies, fire-ratings of assemblies, and locations and power transfer components for electrified locks and alarms. Provide details of adjoining work for each condition indicated.

#### 1.3.3 Finish Samples

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

#### 1.3.4 Test Reports

Provide test reports for acoustical assemblies when tested in accordance with ASTM E90 and classified in accordance with ASTM E413 and ASTM E1332. Provide test reports for fire-rated assemblies when tested in accordance with NFPA 252 or UL 10B for fire-rated access door assemblies installed vertically and NFPA 288 for fire-rated access door assemblies installed horizontally.

### 1.4 PERFORMANCE REQUIREMENTS

#### 1.4.1 Structural Requirements

Provide floor access assemblies to support live loads indicated for floors. Deflection must not exceed 1/180 of span.

#### 1.4.2 Acoustical Requirements

Provide access panels with a minimum sound transmission class (STC) of as indicated on the Drawings. Provide gasketing in accordance with manufacturer's written recommendations.

#### 1.4.3 Fire-Rating Requirements

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

#### 1.4.4 Insulated Access Panels

Provide panels in a thickness as necessary to achieve a minimum R-value of as indicated on the Drawings. Provide gasketing as necessary for an airtight installation.

#### 1.4.5 Access Panels for Wet Areas

Provide panel assemblies that will be located in wet areas with corrosion resistant finishes and hardware and water resistant gasketing.

### 1.5 DELIVERY, STORAGE, AND PROTECTION

Protect from corrosion, deformation, and other types of damage. Store items in an enclosed area free from contact with soil and weather. Remove and replace damaged items with new items.

## PART 2 PRODUCTS

### 2.1 RECYCLED CONTENT

Provide products with recycled content and provide certificates of compliance in accordance with Section 01 33 29 SUSTAINABILITY REPORTING.

### 2.2 MATERIALS

#### 2.2.1 Steel Plates, Shapes, and Bars

Provide in accordance with ASTM A36/A36M.

#### 2.2.2 Sheet Steel

Provide cold rolled steel sheet substrate in accordance with ASTM A1008/A1008M, Commercial Steel (CS), exposed.

#### 2.2.3 Stainless Steel

Provide in accordance with ASTM A666, type 302 or 304.

#### 2.2.4 Metallic Coated Steel Sheet

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

#### 2.2.5 Hardware

Provide automatic closing devices. Provide latch releases operable from insides of doors. Provide anchors in accordance with applicable fire test parameters.

#### 2.2.6 Hinges

Provide concealed spring hinges, 175 degrees of opening, with removable hinge pins to allow removal of door panel from frame. Provide hinges of same steel as door and frame or in accordance with manufacturer's written recommendations. If providing non-continuous hinges, provide in numbers required to maintain alignment of door panel with frame. Provide coatings as necessary to permanently protect dissimilar metals from contact with one another; see Part 3 herein for more information.

#### 2.2.7 Locks

Provide cylinder lock, furnish two keys per lock and key all locks alike.

#### 2.2.8 Accessories

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

### 2.3 FABRICATION

#### 2.3.1 Thickness, Size, Edges

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

#### 2.3.2 Welding

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

### 2.4 ACCESS ASSEMBLY TYPES

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

#### 2.4.1 Recessed Doors

Provide recessed access doors. Depth of door panel recess must accommodate the installed thickness of the finish material of the wall assembly for a flush finished condition of the wall and the access panel face. Reinforce panel and frame to prevent sagging.

#### 2.4.2 Fire-rated Doors

##### 2.4.2.1 Door Construction

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

##### 2.4.2.2 Labels

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

##### 2.4.2.3 Door Panel and Frame

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

## 2.5 FINISHES

Provide steel frames and panel surfaces with a baked enamelProvide manufacturer's standard two coat finish system consisting of one coat primer and one thermoset topcoat. Provide dry film thickness in 2 mils minimum. Provide steel frame and panel surfaces with a shop applied prime coat. Field paint frames and panels to match wall and ceiling surfaces in which they occur. Provide exposed fastenings that approximately match the color and finish of the each material to which fastenings are applied.

## PART 3 EXECUTION

### 3.1 PREPARATION

Field verify all measurements prior to fabrication. Verify access door locations and sizes provide required maintenance access to installed building services components. Protect existing construction and completed work from damage during installation.

### 3.2 GENERAL INSTALLATION REQUIREMENTS

Install items at locations indicated, in accordance with manufacturer's written instructions. Include materials and parts as necessary for a complete installation of each item. Conceal fastenings where practicable. Poor matching of holes to fasteners is cause for rejection of the work.

### 3.3 ACCESS LOCATIONS

Install removable access panels directly below each valve, flow indicator, damper, air splitter or other utility requiring access that is located above ceilings, other than at acoustical panel ceilings, and that would otherwise not be accessible. Install access doors and panels permitting access to service valves, traps, dampers, cleanouts, and other mechanical, electrical and conveyor control items concealed in walls and partitions.

### 3.4 ACCESS LOCATIONS IN WET AREAS

When possible, avoid locating access panels in wet areas. When such locations cannot be avoided, provide moisture resistant assemblies as indicated in Part I herein.

### 3.5 RECESSED ACCESS DOORS

Install fire-rated access doors in fire-rated partitions and ceilings in accordance with NFPA 80.

### 3.6 FIELD PAINTING

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

### 3.7 DISSIMILAR MATERIALS

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

### 3.8 ADJUSTMENT

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

### 3.9 ENVIRONMENTAL CONDITIONS

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

-- End of Section --





SECTION 08 34 16

CORROSION CONTROL HANGAR DOORS

05/17

PART 1 GENERAL

1.1 REFERENCES

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

AMERICAN INSTITUTE OF STEEL CONSTRUCTION (AISC)

AISC 325 (2017) Steel Construction Manual

AISC 360 (2016) Specification for Structural Steel Buildings

AMERICAN IRON AND STEEL INSTITUTE (AISI)

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

AMERICAN LADDER INSTITUTE (ALI)

ALI A14.3 (2008) Standard for Fixed Ladders and Safety Requirements

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

ASHRAE 52.2 (2012) Method of Testing General Ventilation Air-Cleaning Devices for Removal Efficiency by Particle Size

AMERICAN WELDING SOCIETY (AWS)

AWS D1.1/D1.1M (2015; Errata 1 2015; Errata 2 2016)  
Structural Welding Code - Steel

ASTM INTERNATIONAL (ASTM)

ASTM A1008/A1008M (2016) 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 (2017) 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 A1018/A1018M (2016a) Standard Specification for Steel, Sheet and Strip, Heavy-Thickness Coils,

Hot-Rolled, Carbon, Commercial, Drawing,  
Structural, High-Strength Low-Alloy,  
High-Strength Low-Alloy with Improved  
Formability, and Ultra-High Strength

ASTM A123/A123M	(2017) Standard Specification for Zinc (Hot-Dip Galvanized) Coatings on Iron and Steel Products
ASTM A29/A29M	(2016) Standard Specification for General Requirements for Steel Bars, Carbon and Alloy, Hot-Wrought
ASTM A36/A36M	(2014) Standard Specification for Carbon Structural Steel
ASTM A519/A519M	(2017) Standard Specification for Seamless Carbon and Alloy Steel Mechanical Tubing
ASTM A653/A653M	(2017) Standard Specification for Steel Sheet, Zinc-Coated (Galvanized) or Zinc-Iron Alloy-Coated (Galvannealed) by the Hot-Dip Process
ASTM B103/B103M	(2015) Standard Specification for Phosphor Bronze Plate, Sheet, Strip, and Rolled Bar
ASTM B88	(2016) Standard Specification for Seamless Copper Water Tube
ASTM C920	(2018) Standard Specification for Elastomeric Joint Sealants
ASTM D4614	(2011) Standard Specification for Ethyl Acetate (All Grades)
ASTM D740	(2011) Methyl Ethyl Ketone
ASTM E84	(2018) Standard Test Method for Surface Burning Characteristics of Building Materials

INSTITUTE OF ELECTRICAL AND ELECTRONICS ENGINEERS (IEEE)

IEEE 519	(2014) Recommended Practices and Requirements for Harmonic Control in Electrical Power Systems
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NATIONAL ASSOCIATION OF ARCHITECTURAL METAL MANUFACTURERS (NAAMM)

NAAMM MBG 531	(2009) Metal Bar Grating Manual
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NATIONAL ELECTRICAL MANUFACTURERS ASSOCIATION (NEMA)

NEMA ICS 1	(2015) Standard for Industrial Control and Systems: General Requirements
NEMA ICS 2	(2000; R 2008; E 2010) Standard for Controllers, Contactors, and Overload

Relays Rated 600 V

NEMA ICS 4	(2015) Application Guideline for Terminal Blocks
NEMA ICS 6	(1993; R 2016) Industrial Control and Systems: Enclosures
NEMA MG 1	(2016; SUPP 2016) Motors and Generators

NATIONAL FIRE PROTECTION ASSOCIATION (NFPA)

NFPA 220	(2018) Standard on Types of Building Construction
NFPA 409	(2016; ERTA 2016) Standard on Aircraft Hangars
NFPA 70	(2017; ERTA 1-2 2017; TIA 17-1; TIA 17-2; TIA 17-3; TIA 17-4; TIA 17-5; TIA 17-6; TIA 17-7; TIA 17-8; TIA 17-9; TIA 17-10; TIA 17-11; TIA 17-12; TIA 17-13; TIA 17-14) National Electrical Code

SOCIETY OF AUTOMOTIVE ENGINEERS INTERNATIONAL (SAE)

SAE AMS-C-22542	(2012; Rev A; Stabilized (S) 2012) Cleaning Compound, High Pressure Cleaner, Liquid
SAE J514	(2012) Hydraulic Tube Fittings

U.S. DEPARTMENT OF DEFENSE (DOD)

MIL-D-16791	(1990; Rev G, Am 1 1993) Detergents, General Purpose (Liquid, Non-Ionic)
MIL-DTL-15021	(2014; Rev B) Hook, Snap Bolt, Swivel-Eye, and Rings
MIL-DTL-5541	(2006; Rev F) Chemical Conversion Coatings on Aluminum and Aluminum Alloys
MIL-R-24243	(1994; Rev E, Notice 1 2001; Notice 2 2006) Rivets, Blind, Nonstructural, Retained Mandrel, Open End, Domed Head, Aluminum Alloy, Carbon Steel, Corrosion Resistant Steel
MIL-T-81772	(1986; Rev B; Am 1 1991) Thinner, Aircraft Coating
UFC 1-200-01	(2013, with Change 3) General Building Requirements
UFC 3-301-01	(2013; with Change 3) Structural Engineering

U.S. GENERAL SERVICES ADMINISTRATION (GSA)

CID A-A-857	(Rev B, Notice 3) Thinner, Dope and Lacquer (Cellulose Nitrate)
FS RR-C-271	(Rev G) Chains and Attachments, Carbon And Alloy Steel

UNDERWRITERS LABORATORIES (UL)

UL 900	(2015) Standard for Air Filter Units
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1.2 RELATED REQUIREMENTS

Section 26 20 00 INTERIOR DISTRIBUTION SYSTEM, 03 30 00 CAST-IN-PLACE CONCRETE, 05 12 00 STRUCTURAL STEEL, 08 11 13 STEEL DOORS AND FRAMES, 08 71 00 DOOR HARDWARE, and 09 90 00 PAINTS AND COATINGS apply to this section with additions and modifications specified herein.

1.3 SUBMITTALS

Government approval is required for submittals with a "G" designation; submittals not having a "G" designation are for information only. When used, a designation following the "G" designation identifies the office that will review the submittal for the Government. Submittals with an "S" are for inclusion in the Sustainability eNotebook, in conformance with Section 01 33 29 SUSTAINABILITY REPORTING. Submit the following in accordance with Section 01 33 00 SUBMITTAL PROCEDURES:

SD-01 Preconstruction Submittals

Manufacturer's Qualifications; G

Installer's Qualifications; G

SD-02 Shop Drawings

Door Materials; G

SD-05 Design Data

Door Structure; G

SD-10 Operation and Maintenance Data

Lubrication; G

Air System; G

Electrical Equipment; G

1.3.1 Door Materials

Submit design drawings covering door structure, all operating devices, mechanical systems and "U" value

Show all details for construction, installation and operation; size, shapes and thickness of materials, joints and connections; reinforcing; hardware; mechanical devices; electrical devices; and all design and

detail data for work of other trades affected by hangar doors.

Submit the door manufacturer's complete schematic compressed air and wiring diagrams, field piping and wiring diagrams, and a complete physical location drawing showing the location of all pressure regulators, gauges, metering valves, lubricators, filter-dryers, interlocking valves and controls with the runs of pipe and conduit, pipe size and conduit size, wire number and wire size in each conduit, junction box location and full control mounting details

#### 1.3.2 Door Structure

Submit design calculations covering door structure, all operating devices, mechanical systems and "U" value. A Registered Professional Engineer shall prepare and sign structural calculations.

##### 1.3.2.1 Adjustable Frequency Motor Drive

IEEE 519.

#### 1.3.3 Operation and Maintenance Manuals

Drawings and instructions showing all lubrication points, proper lubricants, lubrication frequency schedule and complete operating instructions. Complete compressed air system schematic and electrical equipment wiring diagrams.

Furnish the above in duplicate to the Contracting Officer.

### 1.4 QUALITY ASSURANCE

#### 1.4.1 Manufacturer's Qualifications

Use a corrosion control hangar door product from a manufacturer who is regularly engaged in the design, fabrication, erection, and service of corrosion control hangar doors of type and size required for this project. The manufacturer shall have at least 5 years of similar corrosion control hangar door design experience. Similar doors must have comparable function and design including size, configuration, type of use, retractable or moving elements, safety features, controls, and other key engineering elements as the door being specified. It is acceptable to show that a series of similar doors collectively meet all comparable elements to the door being specified, although not necessarily individually. Manufacturer must submit written evidence on similar past door designs and installations listing the name, location, contact information of owners, installation dates, overall sizes, features, and other relevant information for experience and qualifications evaluation. Only manufacturers who can submit this evidence of actual installations where the products have proven practical, durable, and require a minimum of maintenance, will be qualified under this specification.

#### 1.4.2 Installer's Qualifications

Installation of the door(s) shall be supervised by a manufacturer's representative and shall be in accordance with approved shop drawings. Installers shall be skilled and experienced in the erection of corrosion control hangar doors of the type specified herein. Installers must submit written evidence of similar past door installations listing the name, locations, contacts information of owners, installation dates, overall

sizes, features, and other relevant information for experience and qualifications evaluation.

#### 1.4.3 Warranty

The door manufacturer shall provide a three-year warranty for all mechanical and electrical components against defects in material and workmanship beginning on the date of Project Acceptance.

### 1.5 DELIVERY AND STORAGE

Deliver materials which are not shop-installed in the doors in original packages, containers, boxes or crates bearing the manufacturer's name, brand and model number. Store all materials and equipment in dry locations with adequate ventilation, free from dust or water, and to permit 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.

### 1.6 DESIGN REQUIREMENTS

#### 1.6.1 Door Design and Components

The corrosion control hangar doors and components indicated in the construction documents are representative of a commercially-available door. Design and fabricate the door to fit within the space allocated and in accordance with the criteria specified herein. Design doors to operate properly without binding, interference, or damage to weather stripping or the adjacent structure. Door must be of limited combustible construction in accordance with NFPA 220 and NFPA 409.

Submit Calculations sealed by the door manufacturer's registered professional engineer for review.

##### 1.6.1.1 Steel Door Components

Design all supporting steel bracing and framing steel members in accordance with the specified loads and the requirements of AISC 325 and AISC 360. Design all cold formed steel in accordance with AISI SG03-3. Weld steel in accordance with the AWS D1.1/D1.1M Standards.

#### 1.6.2 Loads

Design the door for the loads in accordance with UFC 1-200-01, UFC 3-301-01 and all other applicable criteria.

##### 1.6.2.1 Wind Loads

In the closed position, design doors and all components to withstand the wind pressures indicated by the Engineer of Record. Design all door components to withstand both the highest positive and negative pressures based on actual tributary area from the wind load indicated in the Structural Drawings.

In addition, design doors and all components to be operational during wind events which cause a positive or negative load pressure on the surface of the door as indicated on the Structural Drawings.

### 1.6.3 Deflections

Design the differential deflection at the door seals to be less than 2 inches.

Design Doors as a system to withstand the upward and downward deflections of the door header structure.

### 1.6.4 Drive Mechanism

Design the drive mechanism so that when stopped at any point, the door automatically locks in place against wind speed indicated on Structural Drawings. Provide sufficient wheel traction to lock hangar doors when the track is wet. Design for the effect door sway and vibration will have on wheel traction as indicated on the Structural Drawings.

### 1.6.5 Door Seals

Use sealing system between door leaf and building, between door leaf and foundation, and between leaf, designed to provide an air tight closure with the building and the ventilation supply air plenum. Coordinate the design of the door seal system with the building architectural and structural details, and the mechanical ventilation systems. Use fully adjustable door seal system to permit initial setting during installation of the doors, and to permit future adjustments. Use door sealing system designed for ease of replacement and that incorporates commercially available components.

### 1.6.6 Electrical Requirements

Use electrical wiring and equipment conforming to NFPA 70. Use electric motor (460 V, 3-phase) as prime mover. All electrical devices and equipment located within hazards spaces (Class and Division) as defined by NFPA 70 Article 500 shall be rated for those spaces. Refer to hazardous area plans for boundary definitions.

## PART 2 PRODUCTS

### 2.1 MATERIALS

#### 2.1.1 Structural Steel

ASTM A36/A36M.

#### 2.1.2 Formed Steel

AISI SG03-3.

#### 2.1.3 Galvanized Steel

Hot dipped galvanized frames in accordance with ASTM A123/A123M.

#### 2.1.4 Sheet Steel

ASTM A1011/A1011M, hot-rolled sheet steel, commercial quality, or ASTM A1008/A1008M, cold-rolled steel sheet, commercial quality.

#### 2.1.1.5 Galvanized Sheet Steel

ASTM A653/A653M, coating designation G90 galvanized steel sheet, commercial quality.

#### 2.1.1.6 Exterior Covering

Perform the hangar door/plenums' exterior wall from siding panels over rigid insulation boards, assembled in accordance with the siding manufacturer's standard detail. Provide panels with factory finish equal to Kynar 500 PVDF fluoropolymer. Color as indicated on drawings.

##### 2.1.1.6.1 Liner Panels

Coated galvanized steel sheets conforming to ASTM A653/A653M, coating designation G90, with flush interior face, 1-7/8 inch panel depth and thickness to meet design loads and purlin spacing, but not less than 22 MFG STD gauge, with factory finish.

##### 2.1.1.6.2 Insulation

Permanently secure insulation materials in place between the face and liner panels. Design the doors to have an air-to-air "U" value not more than 0.05, a flame spread rating of 75 or less and a smoke-developed rating of 100 or less when tested in accordance with ASTM E84. Do not use cellular plastics.

##### 2.1.1.6.3 Accessories

Sheet metal flashings, trim molding, closure strips, caps, subgirts and other similar sheet metal accessories used in conjunction with the preformed panels shall be of the same material and finish as the panels. Metal shall be of a 20 gauge thickness not less than that used for the panels.

#### 2.1.1.7 Hardware

Provide hardware suitable for use on hangar doors and designed to accommodate actual dead loads plus wind loads specified herein.

##### 2.1.1.7.1 Pivots

Provide pivots with heavy duty thrust bearings sealed against dust and water, and with drip-type lubrication fittings requiring infrequent attention. They shall be of sufficient strength to resist all loads specified herein, with a factor of safety of 2. Provide for expansion and contraction over a temperature range of 80 degrees F. Design the top pivot to provide movement in the plane of the door to accommodate a differential settlement of 4 inches within the length of the track and between the track and the building. Design the top pivot to provide movement in the plane of the door in the closed position to accommodate a horizontal displacement of the building of vertical door alignment adjustments at the top and bottom pivot points. The bottom pivot point shall be self-aligning and installed in a cement case with removable weather tight cover, and shall be designed to resist axial and radial thrust loads.



#### 2.1.8 Weatherstripping

Rubber bulb seals shall be resistant to incidental contact with the following chemicals and solvents used in the facility:

MATERIAL	MILITARY OR FEDERAL SPECIFICATION
MEK	ASTM D740
Dope and Lacquer Thinner	CID A-A-857
Aircraft Coating Thinner	MIL-T-81772
High Pressure Cleaning Compound	SAE AMS-C-22542
Ethyl Acetate	ASTM D4614
Non-Ionic Detergent	MIL-D-16791
Conversion Coating	MIL-DTL-5541

#### 2.1.9 Fasteners

Hot dipped galvanized.

#### 2.1.10 Sealant

Single-component or multi-component elastomeric type conforming to ASTM C920, Type S or M, Grade NS, Class 12.5, Use NT. Provide a sealant that has been tested on the type(s) of substrate to which it will be applied.

#### 2.1.11 Personnel Emergency Pass Doors and Plenum Access Doors

Provide doors in each hangar door leaf for access to the air plenum for maintenance of the drive mechanism and lock pin mechanisms. Doors shall be exterior, hollow metal, flush type, insulated, with gasketed frame to provide an airtight seal. Doors shall conform to 08 11 13 STEEL DOORS AND FRAMES. Provide hardware conforming to 08 71 00 FINISH HARDWARE, as follows:

##### a. Personnel Pass Doors:

1-1/2 Pairs, Hinges	A5111 (Temp.) 5 by 4-1/2
1 Each Exit	Type 2, Function 01
1 Each Door Closer	C02061, Size IV
1 Each Kickplate	J102
1 Set Airtight Seals	As specified

##### b. Personnel Pass Doors:

1 Pair, Hinges	A5111 (Temp.) 5 by 4-1/2
1 Each Lockset	Series 1000, Grade 1, Function F04
1 Each Door Closer	C02011, Size 111
1 Set Airtight Seals	As specified

#### 2.1.12 Concrete and Non-Shrink Grout

Pour in place normal concrete having a strength of 3000 psi. Concrete and non-shrink grout shall conform to the requirements of 03 30 00 CAST-IN-PLACE CONCRETE.

#### 2.1.13 Filter Assembly

The filter system for the hangar doors shall consist of a replaceable media filter system in a permanent frame filter bank mounted in the door frame. The filter frame bank shall consist of universal modular frames, nominal 24 inch by 24 inch, fastened to each other to form an assembly. Fabricate frames from 16 gauge galvanized steel and include filter holding clips to permit easy removal of the filters without removal of the clips. Fasten frames to each other and to the supporting door frame by means of stainless steel break mandrel rivets (pop rivets) conforming to MIL-R-24243. Use replaceable filters of the extended surface type, nominal 24 inch by 24 inch by 2 inch deep, with a 30 percent efficiency when rated by ASHRAE 52.2. Filters shall meet the fire-resistant requirements of UL 900, Class 1. Use pleated type filters with a welded wire media support grid and nonflammable enclosing frame bonded to the filter media. Provide one complete set of replacement filters for each door leaf.

#### 2.1.14 Differential Pressure Switches

Provide each door leaf with a differential pressure switch to annunciate when the filters are dirty and require replacement. Provide 4 inch diaphragm operated differential pressure switches to activate a single pole double throw snap switch. Restrain motion of the diaphragm by a calibrated stainless steel spring adjustable through the full range. Transmit spring range the snap switch by means of a direct mechanical linkage. Switch shall be rated for a temperature range of minus 30 degrees F to 180 degrees F, and a pressure of 10 psig. The operating range shall be 1/2 to 2 inch water column with a maximum dead bank of 0.12 inches water column, and repetitive accuracy of 2 percent of range. Use U.L. listed switch mounted in an explosion-proof housing suitable for use in a Class 1, Division 1, Group D hazardous area. Use 1/8 inch NPT pressure sensing connection. Use 1/2 inch NPT electrical connection. Use switch rated 15 amps, 120 volt A.C., resistive load.

#### 2.1.15 Door Drive Mechanism

The drive wheel shall be driven by an electric worm gear motor through a double reduction chain and sprocket. The drive mechanism shall be capable of operating the door under the design loads specified herein. For areas classified as Class 1, Division 1, Group D hazardous areas, all moving parts exposed within the door plenum and the aircraft bay shall be non-sparking, except where protected by drive system sealed enclosure. Limit the acceleration of the door to reduce the potential hazard of the drive wheel sparking the rail. Incorporate machinery in the drive

mechanism to permit the door leaf to be operated manually by means of a tractor in the event of a power failure or motor drive failure. The drive mechanism shall be of the design indicated, or shall be of a comparable, previously-proven design for a similar type door which shall be approved by the CQC Representative.

#### 2.1.15.1 Worm Gear Motor

The gear motor shall consist of a multiple reduction helical worm gear reducer with an integrally mated A.C. motor and electric brake.

#### 2.1.15.2 Gear Reducer

The gear reducer shall be A.G.M.A. rated for the design torque with a service factor of 1.0. Use gear reducer housing of high strength cast aluminum or cast steel. The worm shall be machined of high strength leaded alloy steel carburized and hardened to 60-62 Rockwell C, tempered, honed and ground after hardening. The worm gear shall be cast bronze. The output shaft shall be high strength alloy steel. Bearings shall be either tapered or ball rollers on the work shaft and tapered rollers on the output shaft. Use dual lip spring-loaded seals to protect against leakage and foreign matter. Use gear reducer with a large oil reservoir for adequate splash lubrication for cool operation and an easily accessible oil fill, level and drain holes for maintaining proper oil level. The gear reducer shall have an adaptable base, machined for direct mounting to the support structure.

#### 2.1.15.3 Motor

Use integrally mated motor suitable for variable speed operation with input power from an adjustable frequency drive unit, constant torque, NEMA Design D, 3 phase, 60 hertz, 460 volt service, with Class B insulation, time and temperature rating 30 minutes 167 degrees F temperature rise over 104 degrees F ambient, 1.2 service factor and with sealed bearings. Include in motor an integrally mounted disc brake in an explosion-proof enclosure. Brake shall have a manual release with automatic reset. Extend shaft through brake for manual operation. Select motor for starting torque and not stall torque. Motor shall conform to NEMA MG 1 standard.

#### 2.1.15.4 Chain and Sprocket Drive

Accomplish double reduction chain and sprocket drive through a sprocket mounted on the output shaft of the gear motor, a sprocket mounted on the drive wheel shaft and an intermediate jack shaft with sprockets. Use single or double strand type sprockets to match the ANSI pitch chain with hardened steel teeth. Use sprockets designed to have a minimum of 40 percent tooth contact. Use jack shaft designed with a clutch mechanism to permit disengaging the gear motor drive from the drive wheel to permit manual operation of the door. Use jackshaft fabricated from high strength alloy steel and supported by two pillow blocks or flanged bearings. Use bearings designed for an L10 life of 20,000 hours, with self-aligning double row spherical bearings in a cast iron housing, a spring locking collar, spring loaded lip seals and grease fittings. Use manual clutch mechanism with a handle of sufficient length to facilitate manual operation and a latching device to assure positive engagement under normal operation when not mechanically retracted for manual operation. Fit the chain and sprocket drive system with an automatic oil lubricator readily accessible for inspection. Use roller chain of single or double strand

conforming to ANSI standards for dimensions. Use roller chain of heavy series type rated for occasional shock loading. Use press fit riveted type pins. Use press fit cotter pin type connecting pin.

#### 2.1.15.5 Drive Wheel Truck Assembly

Mount each drive wheel on a removable truck assembly, as indicated, to permit removal and servicing without dismantling the door.

#### 2.1.15.6 Shafting

Fit and weld wheels to a high strength steel tube shaft. Machine tube shaft from hot finished seamless carbon steel mechanical round tubing conforming to ASTM A519/A519M, and steel conforming to ASTM A1018/A1018M with a wall thickness as required by design. Machine tubing shaft to receive bearings so that the combination with the wheel shall be concentric with the bearings and support shaft within a tolerance of 0.002 inches. Run tube shaft on tapered roller bearings press fit into the ends of the tube. Ends of tube are supported by a high strength machined inner shaft mounted directly to the wheel truck. Machine inner shaft from medium carbon, high manganese, free machining, cold finished, Stress proof steel shafting, drawn, ground and polished with a tensile strength of 125,000 psi and a yield strength of 100,000 psi. Drill and tap inner shaft to accommodate lubrication tubing and to permit distribution of grease to both bearings.

#### 2.1.15.7 Tapered Roller Bearings

Use self-aligning, cylindrical bore, spherical roller type bearings, sized for the static and dynamic forces with an LB-10 minimum life rating of 20,000 hours. Use manufacturer's standard precision machined self-locking bearing nut for retaining the bearings on the shaft. Machine bearing sleeve for preloading the tapered roller bearings from Stress proof steel shafting used to support the wheels.

#### 2.1.15.8 Fabricated Truck

Use plate conforming to ASTM A36/A36M except as indicated and specified herein.

#### 2.1.15.9 Seals and Seal Housing

Fabricate seal housing as indicated for clearance fit to shaft and sleeve. Use double lip, spring loaded seal to retain bearing lubricating grease and protect the bearings from dirt.

#### 2.1.15.10 Bearing Lubrication Components

Use copper tubing the size indicated conforming to ASTM B88, Type L, for use with compression type fittings. Use brass fittings conforming to SAE J514 to connect tubing to shaft and to truck. Use male connector fitting for connection to shaft, male pipe end and flare tube end to receive tubing. Use "Triple-Lok" fittings as manufactured by Parker Hannafin, or approved equal. Provide alemite grease fitting to mate with bulkhead female pipe fitting.

#### 2.1.15.11 Door Drive Mechanism Enclosure

Design and fabricate drive mechanism enclosure to be readily removable to

facilitate inspection and maintenance of the mechanical drive components. Fabricate enclosure to airtight to maintain the integrity of the pressurized air plenum.

#### 2.1.16 Lock Pins

Equip leading edge of doors with top and bottom automatic lock pins designed to restrain the door in the full open or full closed positions, under the design operating wind forces. Assure that doors are properly aligned in the fully closed position with seals compressed. Use non-sparking lock pin mechanisms designed to accommodate thermal expansion and contraction of the doors, with sufficient range of action horizontally to seat under full wind load deflections (inward or outward). Seat bottom lock pins in special receptacles set in the concrete slab designed to accommodate the full travel of the pin, and designed to prevent dirt and water from accumulating inside. Lock pins designed for normal operating conditions with mechanism to manually release the pins in the event of a failure of the control system. Use lock pin mechanism of the design indicated, or of a comparable, previously proven design for a similar type door approved by the CQC Representative.

##### 2.1.16.1 Operating Mechanism

Use direct action double acting air cylinder operating mechanism for opening and closing the lock pins. Use cylinders sized to operate the lock pins when binding in the receivers under full wind loads or other combination of loads including thermal expansion and contraction of the doors, and settlement deflection of the doors with available 80 psig air. Use cylinder of corrosion-resistant construction suitable for industrial application and rated for 200 psig non-lubricated air service. Machine cylinder barrel head from high strength steel tubing, honed to a 10-15 micron-inch finish and hard chrome plated inside and outside. Fit head with easily externally removable precision machined high strength fine grained iron, bronze or aluminum rod bearing, incorporating seals and rod wiper to prevent dirt from entering cylinder. Use cylinders cushioned at both ends with built-in adjustable needle valves to allow adjustment of the cushion effect. Fit piston with double seals for minimum friction under varying dynamic pressures. Machine cylinder rod from high strength steel, 90,000 to 100,000 psi minimum yield, hard chrome plated, and sized for operating the pin with a factory safety of five based on yield strength. Pre-lubricate cylinder with a permanent type dry lubricant. LR2 Permanently Lubricated Air Cylinders or Universal "A-2" Series Heavy Duty Pre-Lubricated Pneumatic Cylinders as manufactured by Schrader Bellows of Akron, Ohio conform to this specification.

##### 2.1.16.2 Top Pin

Machine top pin cold drawn ASTM A29/A29M, Grade 1018 steel bar stock. Hard chrome plate top pin after machining. Machine pin bottom to mate with the clevis fitting on the air cylinder. Use two sets of bronze guide rollers to guide pin for the full stroke. Use bronze rollers designed to accommodate the maximum forces under the design loadings plus: forces due to temperature expansion and contraction of the door; forces due to settlement of the door; and other binding forces on the top pin when engaged in its receiver. Use top pin latching receiver assembly designed to accommodate the maximum pin loading and to mate with the 1/2 inch building truss plate provided for the lock mechanism. Use receiver assembly provided with a phosphor bronze liner sheet conforming to ASTM B103/B103M with a hard temper, minimum tensile strength of 80,000 psi

and Rockwell Hardness Number B86.

#### 2.1.16.3 Bottom Pin

Machine bottom pin from cold drawn ASTM A29/A29M, Grade 1018 steel cold finished round stock. Machine pin to thread to the cylinder rod. Guide pins at the bottom of door with UHMW supported in a fabricated steel bracket. Engage pin in sockets embedded on the floor. Use sockets with UHMW sleeves.

#### 2.1.17 Top Lock Pin Maintenance Platform

Provide a platform, as required, for maintenance of the top lock pin mechanism.

##### 2.1.17.1 Metal Grating

Platform metal grating shall conform to NAAMM MBG 531.

##### 2.1.17.2 Handrails

Fabricate handrails from standard-weight steel pipe, nominal inside diameter 1-1/2 inches. Use hot-dipped zinc-coated finished railing assemblies conforming to ASTM A123/A123M. Complete railing with standards, brackets, caps, plugs, toe guards and all other accessories and fastenings for complete job. Fabricate railings in one length for each run and securely anchor to the supporting structure. Conform railing to the requirements of Occupational Safety Health Act Article 1926.500.

##### 2.1.17.3 Jointing

Perform jointing of posts, rail and corners by fitting post to top rail and intermediate rail to post, mitering corners, groove welding joints and grinding smooth. Butt railing slices and reinforce with tight fitting interior sleeve not less than 6 inches in length. Railings may be bent at corners in lieu of jointing, provided bends are made in suitable jigs and that the pipe is not crushed. Weld posts welded directly to the steel platform structure.

##### 2.1.17.4 Ladders

Fabricate vertical ladders conforming to ALI A14.3 of 2-1/2 inches by 3/8 inches steel flats for strings and 3/4 inch diameter steel rods for rungs. Space rungs a maximum one foot apart, and plug weld or shoulder and head into strings. Hot dip galvanized ladder assemblies after fabrication in conformance to ASTM A123/A123M. Install ladder so that rungs are not less than 7 inches from the finished wall surface or other structural element. Secure ladder to adjacent construction with heavy clip angles welded to the string and secured to structure as indicated. Install intermediate clip angles not over 48 inches on centers. Install brackets as required for securing to ladders. Provide safety cage and spreaders as required.

##### 2.1.17.5 Safety Chains

Construct safety chains of 3/16 inch, zinc-coated, steel welded chain conforming to FS RR-C-271, Type 1, Group C, Class 4 with snap bolt hook with ring on both ends and eye bolt on both ends. Use swivel eye snap bolt hooks conforming to MIL-DTL-15021. Use galvanized eye bolts with 3/8

inch bolt and 3/4 inch eye diameter for attachment of chains. Supply two chains, 4 inches longer than the anchorage spacing, for each guarded area. Mount top chain 3 feet to 6 feet above the platform floor. Mount lower chain 2 feet to zero inches above the platform floor.

#### 2.1.17.6 Structural Framing

Provide additional structural framing welded to the tubular structure to accommodate the platform load.

#### 2.1.18 Electrical Equipment

Provide electric motors, wire and equipment specified under this section conforming to 26 20 00 INTERIOR DISTRIBUTION SYSTEM, NFPA 70 and NEMA ICS 1, NEMA ICS 2 and NEMA ICS 6. All electrical wiring entrances and equipment within the door and mounted on the door within the aircraft bay shall be constructed to NEMA ICS 6 standards. Use watertight, NEMA ICS 6, Type 4 enclosures for all electrical wiring and equipment on the exterior of the door.

##### 2.1.18.1 Plenum Lights

Provide LED lights within the door plenum to provide lighting for servicing the drive mechanism and the lock pin mechanisms. Light levels at each maintenance spaces shall be 5 footcandles. Use a switch mounted in the personnel access vestibule adjacent to the plenum access door for light control. Use weatherproof switch for plenum lights. Use 120 volts A.C. obtained from the door drive control transformer for circuit lighting.

##### 2.1.18.2 Controls

Use two joysticks as part of the controls for each door. Require that operator maintain constant contact with joystick for door drive motor to be engaged or energized. Locate a pushbutton on each side of the door at the "seeing" end with control configuration such that either of the two joysticks can maintain door movement. Locate joysticks such that the operator can "walk" the door to either the open or closed position and have view of the direction of travel while maintaining the hand activation of the joystick. Design door to automatically stop if the operator's hand is removed from the joystick. Include an audible and visual alarm to be activated when the door is in motion. Alarms shall have a distinct warning sound and visual display that is different than all other warning systems in the hangar bay.

Include proximity sensors and switches to detect "near end of travel" and "end of travel" in door and door apron. Include adjustable acceleration and deceleration ramping from zero to maximum speed and from maximum to zero speed in door motor drive. Include an automatic "soft start" with gradual acceleration to a pre-set maximum speed. Include capability to adjust maximum speed. Include automatic deceleration and a gradual stop when a "near end of travel" point is reached. Include automatic disengagement or de-energization when door "end of travel" is reached. Include capability of door motor drive reversing, such that the door can be powered open and powered close.

##### 2.1.18.3 Control Cabinet

House all applicable control components for the door in each control cabinet. Use factory installed and wired control cabinet components for

each door. Locate control cabinet on the exterior face of door and size for the electrical control equipment indicated and specified herein. Surface mount cabinet: NEMA ICS 6 Type 4 classification. Fabricate cabinet of 14 gauge steel minimum with all seams continuously welded. Use a 12-gauge back panel, for mounting equipment and devices, mounted on collar studs welded to the back face of the enclosure. Use heavy duty continuous hinged door constructed with rolled edge. Attach a neoprene gasket to doors with oil resistant adhesive and steel retaining strips. Provide stainless steel door clamps to hold the door securely closed. Punch holes in door to accept control switches and indicator lights as indicated. Include an exterior flange mounted NEMA ICS 6 Type 4 disconnect switch. Interlock the padlockable operating switch handle with the cabinet door so that the door can only be opened when the disconnect switch is open. Size the switch based on the voltage and electrical load in accordance with NFPA 70. Cabinets shall contain the following equipment.

- a. A microprocessor-based adjustable frequency motor drive unit (for each door) such that the door drive motor (460 volt, 3 phase) shall have variable speed capability. Make drive capable of reversing. Motor protection in compliance with NFPA 70, Article 430. Make drive capable of producing a controlled adjustable frequency/voltage output at suitable power levels to successfully operate the door drive mechanism.

Use UL listed adjustable frequency drive unit in compliance with IEEE 519. Use additional supplemental equipment as necessary to comply with IEEE 519. Submit a mathematical analysis by the drive vendor verifying compliance.

The adjustable frequency drive units shall have as a minimum the following features:

- (1) Ambient operating temperature range:
  - (a) 32 to 104 degrees F.
  - (b) Humidity 5-95", non-condensing.
- (2) Electrical:
  - (a) Input Voltage: 460 VAC  $\pm$  plus 10 percent, minus 5 percent. 3-phase.
  - (b) Input Frequency: 58-62 Hz.
  - (c) Output Voltage: 0-460 VAC, 3-phase.
  - (d) Output Frequency: 3 -60 Hz. The output shall be as a result of a sine coded pulse width modulated (PWM) output from the inverter section. Frequency regulation shall be  $\pm$  0.5 percent of maximum.
  - (e) Current ratings: continuous for 100 percent of drive rating, 120 percent for one minute.
  - (f) Electronic circuitry protection.
  - (g) Minimum .94 power factor.
- (3) Programmable functions:
  - (a) Acceleration rate.
  - (b) Deceleration rate.
  - (c) Voltage boost.
  - (d) Maximum frequency.
  - (e) Output current limit.
  - (f) Motor overload.
  - (g) Reduced volts per Hertz.



- (4) LED or digital display of the following:
  - (a) Overvoltage.
  - (b) Undervoltage.
  - (c) Ground fault.
  - (d) Instantaneous current.
  - (e) Overtemperature.
- b. Use control transformers rated 2 KVA 480-120 volts, 60 Hz.
- c. Use door mounted indicator lights, NEMA ICS 6, Type 4 transformer style, push-to-test type for operation up to 120 volts AC/DC. Use colored lens as indicated. Square D Type SK control units conform to this specification.
- d. Door mount push-button switches, NEMA ICS 6, Type 4, 4X momentary contact type for operation on 120 volts AC. Use black buttons, except use red for "off" and "open" buttons. Include extended guards for pushbuttons to protect against accidental operation.
- e. Use control relays rated at not less than 250 V, 60 Hz, 10 A contacts, 120 V, 60 Hz coils. Use plug in type, suitable for mounting to the back panel of the control cabinet with clamp type terminals. Furnish a minimum of one spare contact per relay. Use break coil relays rated for 600 V.
- f. Use programmable logic controller (PLC) to perform all control and timing of door operation. I/O no greater than 120 AC or DC. Use relay suitable for mounting to the back panel.
- g. Use Factory Mutual approved intrinsically safe barrier relays for hazard classification Class 1, Division 1, Group D. Suitable for use with a "close" pushbutton. Capable of switching a 120 V, 60 Hz, 5A load and withstanding 20 A inrush in one second. Use encapsulated, irreparable, and vibration resistant relay.
- h. Use solid-state pulsating type piezoelectric horns suitable for use at 120 V, 60 Hz. Produce a one-half second intermittent 3900 Hz tone of approximately 50 percent duty cycle. Minimum sound level 85 dB at 2 feet on axis. Suitable for door mounting with screw type terminals.
- i. Use barrier type terminal blocks made of thermosetting phenolic or nylon rated for 600 V, 20A with a maximum operating temperature of 250 degrees F. Use tabular screw blocks with pressure plate terminals. Locate marking strips on the top of the terminal block and center between the binding screws to permit full access to the binding screws with the marking strip in place.
- j. Use 120 V fuses, 1-1/4 inch, quick blow cartridge type in suitable fuse block for back panel mounting. Capable of handling 20 A continuous with screw or clamp type terminals.
- k. Fabricate nameplates from plastic laminate 3-ply engraving stock, minimum thickness 1/32 inch, dark blue with white core. Characters a minimum of 1/8 inch high, all capitals, gothic, unless noted otherwise. Engrave information; locate as indicated. Unless noted otherwise, determine nameplate length and height to fit legend and to present a neat and pleasing appearance. Engrave legend plates at pushbuttons and indicator lights engraved as indicated.

1. Provide cooling fans if necessary for proper cooling of cabinet components.

#### 2.1.18.4 Joysticks

On the control cabinet door and the interior face of the door, use bidirectional spring-return-to-center type joysticks with normally open contacts as indicated. Handle 3-3/4 inches long, threaded to accept a spherical phenolic knob. Comply with NEMA ICS 4, suitable for 120 volts 60 hertz operation. Install joystick on the interior face of the door in a NEMA ICS 6 Type 4 enclosure. As of publication, Cutler Hammer File E20 two position joysticks conform to this specification.

#### 2.1.18.5 Limit Switches

Use heavy duty type limit switches, mechanically actuated, in a NEMA ICS 6 Type 4 weathertight enclosure. Use contacts rated 10 amperes, 600 volts, DPDT. Use limit operable in ambient temperatures from minus 10 to 185 degrees F. Microswitch Type LCS and HDLS limit switches conform to this specification.

#### 2.1.18.6 Klaxon Horns

Use weatherproof, A.C. vibration type horns for annunciation of door movement suitable for operation on 120 volts 60 hertz. Use horns with adjustable volume, range of 78 to 128 db SPL measured on axis at 10 feet.

#### 2.1.18.7 Control Devices

On the door interior face use weathertight indicator lights and pushbutton suitable for use in 120 volt 60 hertz control circuit. Use NEMA ICS 6, Type 4, enclosures.

#### 2.1.18.8 Interconnecting Cable

Between each door and building interface junction box, use cable Type SO, UL listed, neoprene jacketed, 600 volt rated, of the number of conduits and gauge indicated. Use cable consisting of multiple stranded bare copper conductors, with a flexible heavy duty black neoprene jacket overall suitable for exterior installation to resist ozone, sunlight, moisture, oil and abrasion. Supply cable of sufficient length to accommodate the door swing.

#### 2.1.18.9 Conduit, Wire and Fittings

- a. Conduit: rigid hot dipped galvanized steel with thread connections.
- b. Within the control cabinet, use stranded copper wire type SIS. Minimum size power wiring: No.12 AWG. Minimum size control wiring: No.14 AWG. In conduit, use stranded copper wire Type THWN No.14 for control and No.12 for Power.
- c. Use watertight fittings for Type SO cable.
- d. In hazardous areas use flexible conduit suitable for installation in a Class 1, Division 1, Group D hazardous area.

#### 2.1.18.10 Rotating Beacons

Use rotating beacons rated 120 volts with 360 degree rotation, weatherproof, red dome, gasketed aluminum shock mount housing, suitable for 1 inch stanchion mounting.

### 2.2 FABRICATION

#### 2.2.1 Doors

Use door leaves fabricated from hot rolled sections or structural tubing in accordance with AISC 325 and AWS D1.1/D1.1M. Welded joints except where impractical. All joints shall develop 100 percent of the strength of the framing members. Prepare splices accurately to facilitate field assembly in accordance with standard practice. Use frames and framing members true to dimensions and square in all directions; no leaf shall be bowed, warped or out of line in the vertical or horizontal plane of the door opening by more than 1/8 inch in 20 feet. Provide bracing so that the completed leaf assembly will be adequately braced to withstand shipping, assembly and operational loads. Ground smooth exposed welds and welds which interfere with the installation of parts such as wall panels and cove sheets. Seal flat cover sheets with sealant and fasten to frame either by edge welding, plug welding or threaded fasteners on 12 inch centers. Prepare, prime, and coat structural framing and miscellaneous steel as specified in paragraph FINISHES. Seal joints in assembled door/plenum to provide an airtight plenum.

#### 2.2.2 Latches

Provide automatic latching devices at top and bottom of doors to take over positioning of the doors during closing, compress the seals, and anchor the door against full wind and seismic loads. Use devices with sufficient throw to allow for thermal expansion and contraction of the doors, and sufficient range of action horizontally to set under full wind deflection, inward or outward. Provide an automatic foot bolt to anchor the door in fully open position. seat bottom bolts in dust-proof strikes set in concrete pavement. Interlock latching devices with motors to prevent door operation unless the bolts are fully retracted.

#### 2.2.3 Tractor Pulls

Provide tractor pulls so that leaves can be towed by a tractor or similar equipment. The tractor pull shall be designed for a drive force to tow door of 5000 pounds whichever is greater. Minimum thickness steel plate shall 3/8 inch.

#### 2.2.4 Exterior Covering

Install exterior covering on the assembled door structure in accordance with the siding manufacturer's recommendation and approved shop drawings. Form and seal joints so that both sides of the covering are weathertight and the plenum is airtight.

#### 2.2.5 Weatherstripping

Install resilient bulb seals as required, to provide a weathertight seal around the perimeter of the door leaves and an airtight seal at the perimeter of the plenum opening mating surfaces with the supply ducts at the door head. Provide seals with molded or vulcanized corners.

Reinforce bottom seals with woven fabric. Install seals designed to allow for horizontal displacement of the building at the head of the door plus or minus 3 inches in the plane of the door in the closed position under seismic loading.

#### 2.2.6 Services

The door manufacturer shall provide all piping, wiring and devices in the door.

#### 2.2.7 Electrical

All manual and automatic control devices, control cabinets, light fixtures, door mounted interface junction boxes with cable and all conduit and wiring mounted on the doors and specified herein shall be provided under this section. Raceways and interconnect wiring within the aircraft bays will be provided under 26 20 00 INTERIOR DISTRIBUTION SYSTEM. Use color coded wiring, clearly labeled with identification numbers in accordance with approved shop drawings. Make individual wire identification at all terminations with wire numbers stamped on durable plastic heat-shrinkable sleeving, 3/4 inch minimum length. Neatly train and lace wiring within the cabinet or run in plastic wiring ducts. Make cable connections to boxes watertight cable clamps. Make conduit connections to motor and limit switches with liquid tight flexible conduit to permit servicing of equipment and of sufficient length to permit field adjustment. Secure conduit to the door structure. Provide conduits entering hazardous areas and areas with arcing devices with conduit seals in accordance with NFPA 70. Install conduit runs to permit easy access to junction boxes and not to interfere with the operation of the door or with servicing of components. Electrical installation shall conform to the requirements of 26 20 00 INTERIOR WIRING SYSTEMS, and NEMA ICS 1.

### 2.3 FINISHES

#### 2.3.1 Ferrous Metal

Clean, prepare, galvanize, and paint all exposed and non-exposed ferrous metal surfaces. Do not coat finished bearing surfaces. Alternate coating systems or products will not be considered. Prepare surface and apply coatings in the shop, following all temperature, humidity, and testing requirements. After installation of the door, prep and touch up surfaces damaged during assembly and installation of the door. Prep and coat unfinished ferrous metal accessories such as bolts and brackets.

#### 2.3.2 Factory-Finished Panels

All factory-finished ferrous metal panels to be exposed to the interior or exterior shall be galvanized G90 per ASTM A653/A653M and coated with a PVDF fluoropolymer equal to Kynar 500.

### 2.4 SINAGE

Provide a placard sign immediately adjacent to the controls explaining how to operate the door and indicating the following:

#### a. Notice

- (1) Doors must be closed and not operated when wind speeds above 60 mph are expected.

## PART 3 EXECUTION

### 3.1 GENERAL INSTALLATION REQUIREMENTS

The installation of the assemblies shall be performed by workmen skilled in this type of work in accordance with the approved shop erection drawings and procedures. Use erecting equipment suitable for the work and in fully operable condition. Report immediately to the CQC Representative if parts cannot be assembled or fitted properly as a result of errors in fabrication or of deformation due to handling or transportation. Obtain approval of the method of correction from the CQC Representative, and make correction in his presence. Use approved methods to straighten plates, angles or other structural shapes.

### 3.2 ERECTION

Assemble doors and accessories in accordance with approved shop drawings. Do not erect doors until the work of other trades in preparing the opening has been completed and the hangar roof is completed and under full dead load.

#### 3.2.1 Erection Procedure

Include in the erection procedure complete description of the material handling equipment and accessories and the methods which will be used to assure that individual assemblies will not twist, buckle, deform or otherwise be damaged during the handling and erection. Describe the method of alignment and leveling of the rails including equipment to be used. Describe the method of alignment of the door structure with respect to the pivots, locks and seals of the building.

##### 3.2.1.1 Templates

Furnish steel templates and installation instructions, including placing drawings, for setting the anchor bolts for the door rail and embedded lock pin receptacles. The manufacturer of the door shall ascertain that these items are properly set prior to the installation of the rails and the erection of the doors.

##### 3.2.1.2 Door Bottom Lock Pin Receivers

Locate lock pin receiver assemblies accurately and set to elevation indicated plus or minus 1/32 inch using the double nut method on the anchor bolts. Protect spring assembly during placement of concrete to prevent damage or entry of foreign matter.

##### 3.2.1.3 Door Leafs

Field erect door leafs in accordance with approved shop erection drawings after: the rails have been installed and checked for alignment and grade; the bottom pivot base assembly has been installed and checked for alignment and grade; and the lock pin receiver assemblies have been installed and checked for location and grade. First install lower assembly of each door leaf on the bottom pivot with the drive wheel on the rail. After checking for fit, erect and mate the upper assemblies to the lower assembly and the top pivot. Before installing the siding, concrete base fill, filter bank and seals, manually operate each door leaf through the total of 90 degrees of travel to check for final alignment, fit and

freedom of movement of the pivots with no binding. After confirmation of the proper movement of each door leaf, permanently locate all limit switches and secure. Place concrete fill, followed by the siding, flashing and seals. Make all electrical and compressed air connections with the building services. Commission and test the drive mechanism and lock pin mechanisms. Perform installation to assure that the equipment will function properly for its intended purpose in conformance with the requirements of the drawings and specifications. After installation has been completed, the Contractor shall perform such final adjustments, operational testing, and cleaning to assure conformance with the requirements specified herein.

#### 3.2.1.4 Compressed Air Tubing

Run tubing in maximum lengths possible without breaks or fittings. Install tubing runs and bends free of kinks, ripples or flattened surfaces. Align tubing with connectors before connections are made. Make appropriate union fittings for tubing connections to accessories and devices to permit removal of the item without removal of the tubing. Before final connection to the air system accessories and cylinders, clean and pressure test entire air piping system leaks.

#### 3.2.1.5 Electrical

Install and wire electrical power and control systems, including the motion annunciators (horn and light), and limit switches. Adjust location of each limit switch and set in proper position. Make watertight installation of electrical on the outside of doors. Make the SO power and control cables between the building interface junction boxes and the door of sufficient length to permit full travel of the doors without tangling or binding. All wiring within the building including the interface junction boxes on the building will be performed under 26 20 00 INTERIOR DISTRIBUTION SYSTEM.

#### 3.2.1.6 Touch-Up Coating

After installation of the door, the same installer that performed the initial coating prior to assembly and erection shall prep and touch up surfaces damaged during assembly and installation of the door as well as unfinished ferrous metal accessories.

### 3.3 FIELD INSPECTION AND TESTS

The Contractor Quality Control Representative shall perform all field inspections and tests specified herein at the Contractor's expense.

#### 3.3.1 Inspection General

Inspection shall continue during receipt and off-loading of door components and during erection. Make an inspection of the fabricated components prior to installation to determine conformance with the specifications and approved shop drawings. Correct or replace all rejected material to the satisfaction of the CQC Representative.

#### 3.3.2 Manufacturer's Field Engineer

The manufacturer of the hangar doors shall provide a qualified field engineer to supervise the installation and perform the inspection services specified hereinafter. The field engineer shall furnish duplicate copies

of his report to the Contractor Quality Control Representative within 24 hours following each inspection. The Contractor shall furnish a copy of the field inspection engineer's report to the CQC Representative within 48 hours and shall perform the following:

- a. Inspect doors during job site unloading, sub-assembly and prior to erection.
- b. Inspect installation of embedded items before pouring of fill concrete to ensure that the elevation and alignment indicated have been complied with tolerance.
- c. Recheck rails and other embedded items to verify the accuracy of dimensions.
- d. Provide recommendations for any necessary corrective action.
- e. Inspect final erection and assembly of door leafs for alignment and fit, and clearance between doors and building, and between door and leafs.
- f. Inspect setting of all seals in the closed position to assure an airtight installation.
- g. Inspect the positioning and fit of pivot assemblies.
- h. Inspect the mating of lock pins with receptacles.
- i. Inspect all fasteners to assure that all screws and bolts are properly secured to prevent loosening.
- j. Inspect all field welds in accordance with AWS D1.1/D1.1M.
- k. Check all drive assemblies and lock pins for smooth operation and that all lubrication has been accomplished.
- l. Check that final sealing provides an airtight plenum.
- m. Verify that all gear boxes and bearings have been lubricated.
- n. Supervise the testing, including the balancing of the air flow specified herein.

### 3.3.3 Operation

Install doors for smooth operation, providing indicated clearance and seal with the building. Door shall not bind or damage sealing mechanism while being opened or closed. Door shall be free of twists.

### 3.3.4 Tests

Upon completion of the installation, subject doors to operational tests. When all necessary corrections have been accomplished, advise the CQC Representative. CQC Representative will schedule a final inspection and test. Furnish all instruments, labor and materials required for test. The Manufacturer's field engineer shall be present to conduct the test. Test each door leaf for the full extent of its travel in both directions and check to assure that there is no conflict when both leafs are operated simultaneously. Power operate each door leaf through twenty cycles to

measure travel time. Test doors to demonstrate manual opening and closing, and unlocking without electric power. Demonstrate the distribution of the ventilation supply air through the diffuse and filter assemblies for uniformity of velocity.

#### 3.3.5 Corrections

Adjust doors failing to operate properly.

#### 3.4 PERSONNEL EQUIPMENT SYSTEMS ORIENTATION

Provide orientation and instruction of Government plant personnel in the operation and maintenance of the doors, mechanical drive system, locking systems and pivot system. Provide a factory trained representative to conduct formal classes at the facility for one eight-hour period during the final check-out and acceptance stages for the entire door system, after the receipt by the Government of approved operation and maintenance manuals.

-- End of Section --



SECTION 08 34 16.20

VERTICAL LIFT FABRIC DOORS

05/14

PART 1 GENERAL

1.1 REFERENCES

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

ALUMINUM ASSOCIATION (AA)

AA ADM (2015) Aluminum Design Manual

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

AMERICAN ARCHITECTURAL MANUFACTURERS ASSOCIATION (AAMA)

AAMA 2604 (2013) Voluntary Specification,  
Performance Requirements and Test  
Procedures for High Performance Organic  
Coatings on Aluminum Extrusions and Panels

AMERICAN INSTITUTE OF STEEL CONSTRUCTION (AISC)

AISC 325 (2017) Steel Construction Manual

AISC 360 (2016) Specification for Structural Steel  
Buildings

AMERICAN WELDING SOCIETY (AWS)

AWS A5.10/A5.10M (2017) Welding Consumables - Wire  
Electrodes, Wires and Rods for Welding of  
Aluminum and Aluminum-Alloys -  
Classification

AWS D1.1/D1.1M (2015; Errata 1 2015; Errata 2 2016)  
Structural Welding Code - Steel

AWS D1.2/D1.2M (2014) Structural Welding Code - Aluminum

ASTM INTERNATIONAL (ASTM)

ASTM A1023/A1023M (2015) Standard Specification for Stranded  
Carbon Steel Wire Ropes for General  
Purposes

ASTM A36/A36M (2014) Standard Specification for Carbon  
Structural Steel

ASTM A653/A653M (2017) Standard Specification for Steel  
Sheet, Zinc-Coated (Galvanized) or  
Zinc-Iron Alloy-Coated (Galvannealed) by

the Hot-Dip Process

ASTM A992/A992M	(2011) Standard Specification for Structural Steel Shapes
ASTM B209	(2014) Standard Specification for Aluminum and Aluminum-Alloy Sheet and Plate
ASTM B221	(2014) Standard Specification for Aluminum and Aluminum-Alloy Extruded Bars, Rods, Wire, Profiles, and Tubes
ASTM D2136	(2002; R 2012) Coated Fabrics - Low-Temperature Bend Test
ASTM E84	(2018) Standard Test Method for Surface Burning Characteristics of Building Materials

NATIONAL ASSOCIATION OF ARCHITECTURAL METAL MANUFACTURERS (NAAMM)

NAAMM AMP 500	(2006) Metal Finishes Manual
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NATIONAL ELECTRICAL MANUFACTURERS ASSOCIATION (NEMA)

NEMA AB 1	(2002) Molded-Case Circuit Breakers, Molded Case Switches, and Circuit-Breaker Enclosures
NEMA ICS 1	(2015) Standard for Industrial Control and Systems: General Requirements
NEMA ICS 2	(2000; R 2008; E 2010) Standard for Controllers, Contactors, and Overload Relays Rated 600 V
NEMA ICS 5	(2017) Industrial Control and Systems: Control Circuit and Pilot Devices
NEMA ICS 6	(1993; R 2016) Industrial Control and Systems: Enclosures
NEMA KS 1	(2013) Enclosed and Miscellaneous Distribution Equipment Switches (600 V Maximum)
NEMA MG 1	(2016; SUPP 2016) Motors and Generators

NATIONAL FIRE PROTECTION ASSOCIATION (NFPA)

NFPA 220	(2018) Standard on Types of Building Construction
NFPA 409	(2016; ERTA 2016) Standard on Aircraft Hangars
NFPA 70	(2017; ERTA 1-2 2017; TIA 17-1; TIA 17-2; TIA 17-3; TIA 17-4; TIA 17-5; TIA 17-6; TIA 17-7; TIA 17-8; TIA 17-9; TIA 17-10;

TIA 17-11; TIA 17-12; TIA 17-13; TIA  
17-14) National Electrical Code

NFPA 79 (2015) Electrical Standard for Industrial  
Machinery

U.S. DEPARTMENT OF DEFENSE (DOD)

UFC 1-200-01 (2013, with Change 3) General Building  
Requirements

UFC 3-301-01 (2013; with Change 3) Structural  
Engineering

UNDERWRITERS LABORATORIES (UL)

UL 1449 (2014; Reprint Jul 2017) UL Standard for  
Safety Surge Protective Devices

UL 248-1 (2011) Low Voltage Fuses - Part 1: General  
Requirements

UL 248-12 (2011) Low Voltage Fuses - Part 12: Class  
R Fuses

UL 489 (2016) UL Standard for Safety Molded-Case  
Circuit Breakers, Molded-Case Switches,  
and Circuit-Breaker Enclosures

UL 508 (1999; Reprint Oct 2013) Industrial  
Control Equipment

UL 98 (2016) UL Standard for Safety Enclosed and  
Dead-Front Switches

## 1.2 SUBMITTALS

Government approval is required for submittals with a "G" designation; submittals not having a "G" designation are for information only. When used, a designation following the "G" designation identifies the office that will review the submittal for the Government. Submittals with an "S" are for inclusion in the Sustainability eNotebook, in conformance to Section 01 33 29 SUSTAINABILITY REPORTING. Submit the following in accordance with Section 01 33 00.

### SD-01 Preconstruction Submittals

Manufacturer's Qualifications; G

Installer's Qualifications; G

### SD-02 Shop Drawings specific to this project, sealed by the Door Manufacturer's Registered Professional Engineer

Shop drawings of motors, all electrical control devices, and all electrical control panels, including schematic diagrams, dimensional drawings of control panels, details of control panel installations, internal wiring diagrams of control panels, and wiring diagrams indicating all external connections between

control panels and from control panels to remote control devices. Furnish list of materials for all control devices, both inside and remote from control panels including manufacturer's model number, electrical ratings, location, and quantity of each item furnished.

Door Design; G

Show all vertical lift fabric doors and components, including types, sizes, locations, fabric, supporting, bracing and framing steel and aluminum members, metal gages, fasteners, speed, hardware provisions, signage, installation details, and other details of construction. Include supporting brackets for motors, location of motors, and safety devices. Include personnel door, mullion pit and cover or retractable pin and strike if utilized. Provide details for the closure between bulkhead and doors. Include details for supporting and bracing the door assembly from the structure. Indicate finishes to be used.

#### SD-03 Product Data

Diagrams, performance curves and characteristic curves of equipment and systems.

Electric Operator; G

Drive unit system horsepower, belt type, and locations. Safety arrestor type, test reports, and brake system details.

Motors; G

Motor characteristics including horsepower, service factor, safety factor and standards compliance.

Doors; G

Controls; G

Controls characteristics including all electrical components and devices used in the control system, enclosures, safety devices, transformer size and voltage, and emergency power connection.

Door Fabric; G

Submit fabric panel samples for weight, strength and color approval.

Surge Protection Device (SPD) data for each incoming/outgoing power feeder and each control circuit; G

#### SD-05 Design Data

Calculations sealed by the Door Manufacturer's Registered Professional Engineer; G

Door Load Diagrams (Open/Closed positions); G

#### SD-06 Test Reports

Safety Arrestor Operation Test; G

Door Fabric: ASTM D2136; G

Door Fabric: ASTM E84; G

SD-07 Certificates

Manufacturer's Qualifications; G

Installers Qualifications; G

Welding Procedures and Qualifications; G

SD-09 Manufacturer's Field Reports

Acceptance Testing Procedure and Report; G

SD-10 Operation and Maintenance Data

Door Operation, Data Package 2; G

Submit in accordance with Section 01 78 23 OPERATION AND MAINTENANCE DATA. Including wiring diagrams and the complete manufacturer's instructions for operation and maintenance of the doors, door mullions where indicated, and accessories, including emergency operation, in the event of general building power failure to the doors.

Emergency and Routine Preventative Maintenance Plan; G

SD-11 Closeout Submittals

Acceptance Testing Procedure and Report; G

Manufacturer's Warranty; G

1.3 DESIGN REQUIREMENTS

1.3.1 Door Design and Components

The vertical lift fabric doors and components indicated in the construction documents are representative of a commercially-available door. Design and fabricate the door to fit within the space allocated and in accordance with the criteria specified herein. Door must operate properly without binding, interference, or damage to the adjacent structure. Door must be of limited combustible construction in accordance with NFPA 220 and NFPA 409.

1.3.1.1 Steel Door Components

All supporting, bracing and framing steel members must be designed by the door manufacturer's registered professional engineer for the specified loads according to the requirements of AISC 325 and AISC 360. Steel welding must be in accordance with the AWS D1.1/D1.1M Standards. Refer to Section 05 12 00 STRUCTURAL STEEL for requirements.

1.3.1.2 Aluminum Door Components

All supporting, bracing and framing aluminum members must be designed by

the door manufacturer's registered professional engineer for the specified loads according to the requirements of the Aluminum Association (AA ADM). Aluminum welding must be in accordance with AWS D1.2/D1.2M standards.

#### 1.3.2 Loads

The loads for the design of the door must be in accordance with UFC 1-200-01, UFC 3-301-01 and all other applicable criteria.

##### 1.3.2.1 Wind Loads

In the closed position, doors and all components must be designed to withstand the wind pressures as indicated by the Engineer of Record. All door components must be designed to withstand both the highest positive and negative pressures based on actual tributary area from the wind load indicated.

In addition, doors and all components must be designed to be operational during wind events which cause a positive or negative service load pressure of 15 psf on the surface of the door. Also the door mullions where indicated and jambs must be designed for an unbalanced positive or negative service load pressure of 15 psf load on the surface of a closed adjacent door with the other adjacent door being open.

Calculations sealed by the door manufacturer's registered professional engineer must be submitted for review.

##### 1.3.2.2 Other Loads

The door mullions where indicated must be of adequate strength to transmit the forces from design wind load, in addition to the other loads resulting from door operations or the door's action as a tributary element, with no detrimental effect on the operation of the door. The door manufacturer must submit the loads imposed upon the building structure by the vertical lift fabric door and its components.

#### 1.3.3 Door Speed

Door must open fully at a speed of 6 inches per second minimum under all design conditions. The door mullion when required must rotate with a cable retraction speed of 6 inches per second minimum.

#### 1.3.4 Door Weight

The door manufacturer must provide load diagrams of the door in the closed and open positions. Details must also be provided showing clearance and attachment requirements for coordination with the structural steel and miscellaneous steel shop drawings.

### 1.4 QUALITY ASSURANCE

#### 1.4.1 Manufacturer's Qualifications

Use a vertical lift fabric door product from a manufacturer who is regularly engaged in the design, fabrication, erection, and service of vertical lift fabric doors of type and size required for this project. The manufacturer must have at least 5 years of similar vertical lift fabric door design experience. Similar doors must have comparable function and design including size, configuration, type of use,

retractable or moving elements, safety features, controls, and other key engineering elements as the door being specified. It is acceptable to show that a series of similar doors collectively meet all comparable elements to the door being specified, although not necessarily individually. Manufacturer must submit written evidence on similar past door designs and installations listing the name, location, contact information of owners, installation dates, overall sizes, features, and other relevant information for experience and qualifications evaluation. Only manufacturers who can submit this evidence of actual installations where the products have proven practical, durable, and require a minimum of maintenance, will be qualified under this specification.

#### 1.4.2 Installer's Qualifications

Installation of the door(s) must be supervised by a manufacturer's representative and must be in accordance with approved shop drawings. Installers must be skilled and experienced in the erection of vertical lift fabric doors of the type specified herein. Installers must submit written evidence of similar past door installations listing the name, locations, contacts information of owners, installation dates, overall sizes, features, and other relevant information for experience and qualifications evaluation.

#### 1.4.3 Warranty

The door manufacturer must provide a three-year warranty for all mechanical and electrical components against defects in material and workmanship beginning on the date of Project Acceptance. The warranty for fabric must be ten years against defect in material.

##### 1.4.3.1 Maintenance and Repair Action Plan

The door manufacturer must provide an Emergency and Routine Preventative Maintenance Plan. In addition to Data Package SD-10 "Operation and Maintenance Data", provide a list of phone numbers and personnel contacts. Also provide a list of suggested spare parts materials and tools to be purchased by the Contracting Officer. Submit vertical lift fabric door manuals in accordance with Section 01 78 23 OPERATION AND MAINTENANCE DATA.

#### 1.4.4 Delivery, Storage and Handling

The door manufacturer must provide shipment of all materials required for door installation in protective packaging. Protect door and accessories from damage during delivery, storage, and handling. Mark all packaging clearly with manufacturer's brand name, door model and job site location. Store in dry location with adequate ventilation, and free from dust and water. Storage must permit easy access for inspection and handling. Remove damaged items that cannot be restored to like new condition or provide new items.

#### 1.5 WELDING PROCEDURES AND QUALIFICATIONS

Prior to welding, submit certification for each welder stating the type of welding and positions qualified for, the code and procedure qualified under, date qualified, and the firm and individual certifying the qualification tests.

Comply with applicable provisions of AWS D1.1/D1.1M for Steel.

Comply with applicable provisions of AWS D1.2/D1.2M for Aluminum.

## PART 2 PRODUCTS

### 2.1 MATERIALS

Materials must be selected based on durability, low maintenance, weather resistance and strength (permanent deformation from loading not allowed). Doors must comply with ASTM E84 for limited combustible construction.

#### 2.1.1 Steel Plate and Bars

ASTM A36/A36M

#### 2.1.2 Steel Sheet

ASTM A653/A653M

#### 2.1.3 Steel Shapes

ASTM A992/A992M

#### 2.1.4 Aluminum Extrusions

ASTM B221, Alloy 6063-T6, Alloy 6005-T5 or 6000 Series Aluminum

#### 2.1.5 Aluminum Sheets and Strips

ASTM B209, alloy and temper best suited for the purpose.

#### 2.1.6 Aluminum Welding Rods and Bare Electrodes

AWS A5.10/A5.10M.

#### 2.1.7 Door Fabric

The fabric material must be a one piece opaque heavy-duty vinyl coated polyester fabric weighing not less than 19 oz/square yard, capable of carrying 250 lb/in per panel. Fabric must be impervious and resistant to media, solvents, fuel, lubricants and other similar fluids commonly found in corrosion control hangars. It must be UV stabilized, self-extinguishing (0-75 flame spread), and suitable to withstand temperatures between plus 158 to minus 31 degrees F in compliance with ASTM D2136. Fabric color as indicated on drawings. The door fabric must be pulled tight between the intermediate beams when the door is fully closed and the wind locks engaged. The fabric must have been tested to meet the criteria of ASTM E84-94 (flame spread - Class A interior wall and ceiling finish) and ASTM D2136 (cold cracking, brittleness and temperature).

#### 2.1.8 Steel Cable and Wire Rope

ASTM A1023/A1023M.

### 2.2 DOORS

Doors must consist of hoist up fabric doors with intermediate aluminum beams or trusses. Fabric must be gathered above the head of the opening.



Maximum wind load deflection of steel structural members of the door must not exceed the member length divided by 120. Maximum wind load deflection of extruded aluminum members of the door must not exceed the member length divided by 30.

#### 2.2.1 Fabric Door Panels

The fabric must be attached to both sides of the intermediate beams, top beam, and bottom beam with self-tapping screws through corrosion resistant anodized or coated painted batten strips. Coated aluminum batten strips and PVC batten strip covers must be selected from the manufacturer's standard colors, which must offer a variety of options including colors to match the Standard Door Fabric color.

#### 2.2.2 Door Beams

The intermediate beams must be corrosion resistant, extruded aluminum and have a suitable depth dependent on the door width and the wind load requirements. They must be spaced 35 to 75 inches apart, dependent upon the wind load. At each end of the beams there must be a guide block of self-lubricating material or rollers that run along the guides. Built-up members meeting these requirements are acceptable. The intermediate door beams and guide block or rollers must be designed to carry the full design wind load without failure and being pulled from the door guides. The guide block or roller design must not put the intermediate beam into tension which would cause pulling forces on door jambs. Guide block material must be nylon, polyoxymethylene (POM), or Ultra High Molecular Weight (UHMW) polyethylene. Rollers must be galvanized steel with maintenance free, lifetime sealed ball-bearings in case-hardened steel races.

#### 2.2.3 Door Guides

The vertical guides must be an integral part of the door, made of extruded aluminum with a suitable depth and width dependent on the size of the intermediate beams and wind load requirements. The guides must be designed to provide weather sealing on the inside and outside faces. There must also be a space inside the guides for the nylon belt, polyester belt, or steel cable of the drive unit and safety arresters. The installer must provide jamb anchorage of size and type required for attachment of the guide rails as shown on the approved shop drawings. The jamb anchorage and door guides must be designed to carry the full design wind load without failure and without permanent deformation.

### 2.3 ELECTRIC OPERATORS

All electrical devices and equipment located within hazards spaces (Class and Division) as defined by NFPA 70 Article 500 shall be rated for those spaces. Refer to hazardous area plans for boundary definitions.

#### 2.3.1 Drive Units

Each door leaf must have a single or dual motor drive system with horsepower sized as appropriate for the weight of the door leaf. The gear motor must be equipped with a drum on which the nylon belt, polyester belt, or steel cables are wound. If a single motor drive is used, the belts and cables must be wound on the same drum. Cables must be wound on a grooved drum. The belts and cables must be attached to the bottom beam via the safety arresters. A hand crank device or other manual means must

be provided on the motor for manual operation of the door in the event of a power failure. The gear motor must be removable without disturbing limit switch adjustment. The drive units will be coordinated with the location of aircraft such that the drive units are accessible while aircraft are in the hangar.

#### 2.3.2 Belt/Cable System

A maximum of two belts/cables per door, running inside the door guides, must be used to transmit motive force to the door unit. Similarly, the quantity of sheaves used to guide the belts/cables must be minimized to reduce maintenance requirements and spare parts inventories. Belts/cables must be installed free of any kinks and the system design and sheave diameter must be such to prevent the occurrence of any kinks and abnormal stress in the operating belts/cables. Where belts/cables pass through openings of the building structure, the openings must be constructed so as to prevent abrasion, wear, or damage to the belts and cables. Sheave units must be provided in accessible locations that allow inspection and preventive maintenance. Sheaves must not be located in enclosed locations, which are not readily accessible for visual inspection.

#### 2.3.3 Safety Arresters

Each door leaf must be supplied with two safety arresters that automatically activate and support the door in case the door lifting system fails similar to a belt or cable breaking. A "Safety Arrestor Operation Test" must be performed on each set of safety arresters by an independent testing source to withstand at least 110 percent of the maximum door leaf weight.

The "Safety Arrestor Operation Test" must be deemed successful when it contains at least the minimum following criteria:

- a. Test door weight must be at least 110 percent of the specific project's door weight.
- b. Test must simulate the door lifting system abruptly disengaging similar to a belt or cable breaking.
- c. The Safety Arresters must automatically engage.
- d. The test door weight must be brought to rest after an initial downward movement (or drop) of not more than 12 inches and held firmly in this position.
- e. Damage from activation of the Safety Arrestors must be limited to localized replaceable components and not cause a system failure which would require repair or replacement of the entire VLFD or the structural door jambs.
- f. Independent testing source must submit documentation of successful "Safety Arrestor Operation Test".

#### 2.3.4 Slack Belt/Cable Breaker

A safety device must be used on all door leaf belts/cables that will send a slack belt/cable condition and cut power to the appropriate drive unit to prevent an unsafe condition.

### 2.3.5 Motors

NEMA MG 1, high-starting torque, reversible type with sufficient horsepower and torque output to move the door in either direction from any position. Motor must produce a door travel speed of not less than 6 inches per second without exceeding the rated capacity. Motors must operate on voltage of the characteristics indicated at not more than 1800 rpm. Motor enclosures must be drip-proof type or NEMA totally-enclosed, fan-cooled (TEFC) type. A hand crank must be supplied which fits the motor for manual operation of the door in the event of a power failure. Install motors in approved locations. Motors must have a minimum service factor of 1.2 at continuous duty under maximum full load. The design of the door motor and door drive gear box must each have a safety factor of 2.5. Motors must be provided in accordance with Section 26 20 00 INTERIOR DISTRIBUTION SYSTEM and requirement listed above.

### 2.3.6 Controls

Control equipment must conform to NEMA ICS 2. Control enclosures must be NEMA ICS 6, Type 9. The door electrical controls must comply with NEMA AB 1, NEMA ICS 2, NEMA ICS 5, and NEMA KS 1. The door electrical controls must comply with NEMA ICS 1, NEMA ICS 6, NFPA 70, NFPA 79, UL 98, UL 248-1, UL 248-12, UL 489, UL 508, and UL 1449. The door control components must all be UL listed.

Each Door Module must be provided with the following operators:

Master Control Panel (NEMA Type 9 enclosure)

- a. Remote Push Button Station - at opposite end of hangar door (NEMA Type 9 enclosure).
- b. Emergency Stop Buttons located outside at the end of each hangar bay.
- c. "Open" operator located on the exterior of each bay door keyed for use by Fire Department personnel to allow entry in the event of an emergency.

The door supplier must provide all conduit and control wiring between master, slave, emergency stop controls, proximity switches, limit switches, and each door motor drive unit. Power and controls wiring and conduit must be provided in accordance with Section 26 20 00 INTERIOR DISTRIBUTION SYSTEM.

#### 2.3.6.1 Control Panel Enclosures

Control panel enclosures must be NEMA ICS 6, Type 9. Each control panel must have an integral main power disconnect switch that is mechanically interlocked with the control panel door. Provide factory wired field wiring terminal strip in each control panel and instantaneous three-phase thermal overload relays. Provide each control panel enclosure including an internal motor starter or VFD with adequate integral ventilation (air conditioning if required) for operation in a 120 degree F ambient environment. Provide NEMA rated control relays. Provide main control panel with programmable logic controller.

Provide a three phase UL 1449 listed surge protection device (SPD) for the incoming power to each door control panel. Provide a UL 1449 listed surge suppression device (SPD) for each control circuit (limit switch, proximity

switch, motor, brake, solenoid, indicating light, and pushbutton) that is routed external from each door main control panel.

The control panel must contain devices to control the logic and sequence of door and mullion operation to ensure safe operation. The control panel must also contain interlocks to preclude personnel injury, including an interlock between the power supply system and use of the hand crank for manual operation of the door. Constant-pressure type, fully guarded, illuminated push buttons must be provided on the control panel for both up and down operations. Mushroom type emergency stop button must be provided on each control panel.

Back-up power hook up must be provided at the control panel to connect to a portable generator provided by the Base via a pin and sleeve female receptacle (coordinate with Base) and manual transfer switch provided on the main control panel.

#### 2.3.7 Limit Switches

Provide limit switches or proximity switches to automatically stop doors at the fully open and fully closed positions. Limit switches or proximity switch positions must be readily adjustable. Limit switches or proximity switches for the wind lock must be provided with indicator lights installed on the control panel for each door leaf. The indicator must notify the door operator that the wind locks are engaged for all door leaves.

The door installer must demonstrate the operability of all limit switches prior to Government occupancy.

#### 2.3.8 Door Control Alarms

Provide an audible alarm device on each door main control panel (minimum 100 dbA) that sounds 10 seconds before the door moves and continues to sound when the door is moving. Coordinate this audible signal such that it is clearly different from all of the other audible signals utilized in the hangar bay.

Provide a visual alarm device above each door main control panel (rotating beacon with 100 watt halogen lamp) that operates 10 seconds before the door moves and continues to operate when the door is moving. Coordinate the color of this visual signal such that it is clearly a different color than all of the other visual signals utilized in the hangar bay.

#### 2.3.9 Safety Device

Provide an intrinsically safe (suitable for a Class I Division 2 hazardous location) electric safety edge on the bottom of the edge of each door, continuous over the full length of the door. The safety edge must be located inside of a rubber cushioned bottom weather sealing edge (or boot) with sufficient vertical height (factoring in the time and distance that it takes to stop a closing door) that must prevent collision damage along the bottom edge of the door. The safety edge must be active when the door is closing, except it must be automatically de-activated the last (door length in inches/240) to allow for the L/240 deflection of the bottom beam which would prevent the door from stopping when only the middle of the door bottom beam (sagging with deflection) strikes the hangar floor before the ends of the door bottom beam reach the hangar floor, thus allowing the door to completely close along its entire length.

### 2.3.10 Control Transformers

Provide fused transformers inside of each Master Control Panel as necessary to reduce the voltage on the control circuits to 120 volts or less.

### 2.3.11 Electrical Components

NFPA 70. The door manufacturer must provide automatic control and safety devices, including failsafe battery powered wireless limit switches or hard-wired limit switches for mandoor interlocks. Cable reel type take-up devices must not be allowed. Control wiring must be in accordance with NFPA 70. The door supplier must provide conduit, wiring, and mounting of controls in accordance with Section 26 20 00 INTERIOR DISTRIBUTION SYSTEM.

### 2.3.12 User Interface with Diagnostics

The door manufacturer must supply a human machine interface (HMI) on the face of the Main Control Panel for multiple doors. The function of the diagnostic panel is to provide information on the status of electrical components in the door system. The HMI must consist of a large (8-10 inch diagonal measure) touch screen including a graphical representation of the door system to facilitate ease of use. The HMI must provide current door status including windlocks when applicable. A self diagnostic system must be included to provide detailed status information of a malfunction and provide guided trouble shooting and diagnostic features. The HMI must also provide a log for malfunctions and system alarms as well as provide detailed service monitoring and service history. Operation and configuration of the system must be controlled by multi-level password access to limit access to the system to qualified and authorized users. The HMI must include functionality for remote access to the system, by the manufacturer via both internet and cellular modem, to review malfunction logs, update settings, or assist in troubleshooting, should the user choose to allow such access.

## 2.4 HEADER BOX

Header boxes must be constructed of carbon steel and finished per the Section entitled, "Finishes".

## 2.5 BOTTOM BEAM

The bottom beam must be constructed of carbon steel and finished per the Section entitled, "Finishes". The bottom beam must be provided with a suitable width and depth to carry the load of the intermediate beams when the door is open, and to ensure full closing and a tight floor seal in heavy winds. A heavy-duty bottom rubber seal must be provided to form a tight seal with the floor. The bottom edge safety device must be integral with the bottom seal.

## 2.6 WIND LOCK

Each door leaf must have wind locks at each jamb, which activate and lock the bottom beam into place when the door reaches its closed position. This locking action must act to maintain a tight floor seal and intermediate beam stability under design wind conditions. A limit switch or a proximity switch, with indicator must be provided to notify the door operator that all wind locks are engaged properly. Switches located below

18 inches AFF must be compliant with NFPA 70, Class I, Division 2 hazardous environment.

## 2.7 OPERATION

### 2.7.1 Door Operation

The vertical lift fabric door must guide up and down in the weather sealed vertical guides attached to the structure. The door must operate by lifting the bottom beam upwards, thereby stacking the intermediate beams one on top of the other, with the fabric panel folding in pleats. The fabric panel must go over the top beam, covering both sides of the door, and must be attached to the intermediate beams by screws and batten strips. When the door is fully closed, the intermediate beams must hang between the two fabric door panels thus pulling the fabric tight. The tension created in the fabric panels must stabilize the intermediate beams. The safety arresters must be attached to each end of the bottom beam and must travel in the vertical guide tracks. The safety arresters must immediately stop the downward movement of the door in case of belt/cable failure.

### 2.7.2 Electrical Operation

When the door is completely opened it must stop on the primary top limit switch. In case of over travel, a secondary limit switch must stop the door to prevent damage. The drive unit must be stopped by the slack belt/cable breakers when the door is closed. The slack breakers must also stop the door in case of belt/cable rupture or if an obstruction should prevent the door from being closed. Weight or springs must activate the slack breakers. The control panel station(s) must be of the illuminated pushbutton type or touchscreen.

Door operation must be controlled by three buttons marked "OPEN", "CLOSE", and "STOP". The "OPEN" and "STOP" buttons must require only momentary pressure to operate. The "CLOSE" button must require constant pressure to maintain the closing motion of the door. When the door is in motion and the "STOP" button is pressed or the "CLOSE" button is released, the door must stop instantly and remain in the stop position; from the stop position, the door must be operated in either direction by the "OPEN" or "CLOSE" buttons. Removing the pressure from the "CLOSE" button must stop the motor drive and set the brake.

Two buttons marked "Horizontal Position and Vertical Position" must control the mullion operation. Both buttons must be controlled by constant pressure to open and to close. Removing the pressure from either button must stop the motor drive and set the brake. The electrical control panel must provide an interlock function to coordinate door leaf and mullion operation.

Pushbuttons must be illuminated by LEDs and utilize simple flashing/solid illumination schemes to inform the operator of door status (fully open, closed, in motion, etc.). In lieu of illuminated pushbuttons, a large touchscreen display must be provided to select desired door leaf/mullion to operate and inform user of current door status. Pushbuttons must be full-guarded to prevent accidental operation.

Multipart doors must utilize a human machine interface display (HMI) for door leaf/mullion operation. Upon selection, door operation must be controlled by three buttons marked UP, DOWN, and STOP. The UP and STOP

buttons must operate as indicated in the door operation controls section above.

When operating a mullion, controls must operate as described in the mullion operation controls above.

The main control panel must be equipped with backup method of controlling the door system should an HMI failure occur.

## 2.8 FINISHES

### 2.8.1 Ferrous Metal

Ferrous metal surfaces must be cleaned, prepared, galvanized, and paint. Follow coating system manufacturer's written instructions. All coating of ferrous metal must be shop-finished and the only necessary field painting should be touch-up painting and coating of any unfinished accessories such as bolts and brackets.

### 2.8.2 Aluminum

Batten strip surfaces must receive a high performance organic coating finish, AA-C12C42R1 per Aluminum Association Designation System, AA DAF45, fluoropolymer 2-coat coating system in accordance with NAAMM AMP 500 complying with AAMA 2604.

## 2.9 SIGNAGE

Provide a placard sign immediately adjacent to the control panel indicating the following:

#### Notice:

Vertical lift fabric doors must be closed and not operated when wind speeds above 60 mph are expected.

Vertical lift fabric doors must be transferred to back-up power for operation when commercial power is not available.

## PART 3 EXECUTION

### 3.1 PROTECTIVE COATINGS

#### 3.1.1 Cleaning

After fabrication, clean all metal surfaces thoroughly of all mill scale, rust, oil, grease and other foreign substances. Apply rust-preventive primer to all steel parts immediately after cleaning.

#### 3.1.2 Shop Painting

After cleaning, coat with primer all steel surfaces other than machine-finished parts. Keep paint off finished bearing surfaces. Before assembly, prime surfaces that will be inaccessible after assembly. Handle painted materials with care to avoid scraping and breaking the protective film. Ferrous metal surfaces that will be exposed after fabrication must be shop coated and touch-up painted in the field by the vertical lift fabric door installer per the Section entitled, "Finishes".

### 3.1.3 Metal Protection

Where aluminum will contact dissimilar metals, protect against galvanic action by painting contact surfaces with primer or by applying sealant or tape recommended by manufacturer for this purpose. Where aluminum will contact masonry or concrete, protect against corrosion by painting contact surfaces with bituminous coating.

## 3.2 ERECTION

Coordinate the erection of the doors with the work of other trades. Ensure that all steel support, bracing and framing members are furnished and accurately installed for the proper installation of the door hardware.

### 3.2.1 Assembly

Assemble and install the doors and accessories in accordance with the manufacturer's recommendations and installation manual. Secure guides to the walls plumb, level, and in-line. Anchor guides at spacing indicated on the manufacturer's installation drawings. Provide additional supports as necessary for attachment of guides, brackets, doors, and operation mechanisms. After erection is complete and before touch-up field painting is applied, thoroughly clean all abraded surfaces, field welds, and field bolts; coat per the Section entitled, "Finishes".

### 3.2.2 Cleaning

Clean both the interior and exterior of doors after erection.

### 3.2.3 Control Panel Installation

Locate each door main control panel indoors, adjacent to the door opening, and with an unobstructed line of sight for the entire door opening. All conduit entries must be into the bottom of the control panel. Contractor must mount master control panel and provide three phase power to the control panel.

## 3.3 ACCEPTANCE TESTING PROCEDURE AND REPORT

The door manufacturer must submit an Acceptance Testing Procedure for approval. After Government approval, the vertical lift fabric door manufacturer must perform the testing and submit a report of the results. The Acceptance testing must include all testing of the door and components performed by the door manufacturer and suppliers. The Acceptance testing will also include the following subparagraphs.

### 3.3.1 General

Upon completion of installation, including work by other trades, lubricate, adjust, and test doors to verify operation on accordance with manufacturer's product data. Manufacturer's authorized representative must make final adjustment. Adjust and re-test the doors until the entire installation is fully operational and acceptable. Acceptance testing must consist of operating each door and mullion (when included) open and closed (one cycle) ten times successfully and consecutively within a nine-hour time interval in accordance with manufacturer's recommended time interval between open/close cycles. Provide Contracting Officer's Representative an acceptance testing report of completed tests.



### 3.3.2 Safety Arresters

Perform a non-destructive demonstration of the safety arrester function by engaging the installed safety arresters on the guiderails at a height of 3 feet above closed position. Demonstration must be performed on all doors installed on Project in the presence of the COR.

### 3.3.3 Personnel Training

The door manufacturer must provide an 8-hour on-site training session for the door operating personnel and maintenance department. The training must outline door operation, troubleshooting and repair guidelines.

### 3.4 EXTRA MATERIALS

A door fabric patch kit must be supplied with approximately 45 square feet of fabric for each hangar door and all other materials required for door panel repair. Patch kit fabric color and associated materials must match door fabric color provided.

### 3.5 ELECTRICAL WORK

NFPA 70. Provide all conduit, wiring, and mounting of controls in accordance with Section 26 20 00 INTERIOR DISTRIBUTION SYSTEM.

-- End of Section --



SECTION 08 39 54

BLAST RESISTANT DOORS

08/09

PART 1 GENERAL

1.1 REFERENCES

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

AMERICAN BEARING MANUFACTURERS ASSOCIATION (ABMA)

ABMA 11 (2014) Load Ratings and Fatigue Life for  
Roller Bearings

ABMA 9 (2015) Load Ratings and Fatigue Life for  
Ball Bearings

AMERICAN INSTITUTE OF STEEL CONSTRUCTION (AISC)

AISC 325 (2017) Steel Construction Manual

AISC 360 (2016) Specification for Structural Steel  
Buildings

AMERICAN IRON AND STEEL INSTITUTE (AISI)

AISI S100 (2012) North American Specification for  
the Design of Cold-Formed Steel Structural  
Members

AMERICAN WELDING SOCIETY (AWS)

AWS A2.4 (2012) Standard Symbols for Welding,  
Brazing and Nondestructive Examination

AWS A5.4/A5.4M (2012) Specification for Stainless Steel  
Electrodes for Shielded Metal Arc Welding

AWS D1.1/D1.1M (2015; Errata 1 2015; Errata 2 2016)  
Structural Welding Code - Steel

AWS D1.3/D1.3M (2008; Errata 2008) Structural Welding  
Code - Sheet Steel

ASTM INTERNATIONAL (ASTM)

ASTM A242/A242M (2013) Standard Specification for  
High-Strength Low-Alloy Structural Steel

ASTM A307 (2014; E 2017) Standard Specification for  
Carbon Steel Bolts, Studs, and Threaded  
Rod 60 000 PSI Tensile Strength

ASTM A325	(2014) Standard Specification for Structural Bolts, Steel, Heat Treated, 120/105 ksi Minimum Tensile Strength
ASTM A354	(2017; E 2017) Standard Specification for Quenched and Tempered Alloy Steel Bolts, Studs, and Other Externally Threaded Fasteners
ASTM A36/A36M	(2014) Standard Specification for Carbon Structural Steel
ASTM A449	(2014) Standard Specification for Hex Cap Screws, Bolts, and Studs, Steel, Heat Treated, 120/105/90 ksi Minimum Tensile Strength, General Use
ASTM A490	(2014a) Standard Specification for Structural Bolts, Alloy Steel, Heat Treated, 150 ksi Minimum Tensile Strength
ASTM A500/A500M	(2013) Standard Specification for Cold-Formed Welded and Seamless Carbon Steel Structural Tubing in Rounds and Shapes
ASTM A501/A501M	(2014) Standard Specification for Hot-Formed Welded and Seamless Carbon Steel Structural Tubing
ASTM A514/A514M	(2014) Standard Specification for High-Yield-Strength, Quenched and Tempered Alloy Steel Plate, Suitable for Welding
ASTM A529/A529M	(2014) Standard Specification for High-Strength Carbon-Manganese Steel of Structural Quality
ASTM A534	(2017) Standard Specification for Carburizing Steels for Anti-Friction Bearings
ASTM A563	(2015) Standard Specification for Carbon and Alloy Steel Nuts
ASTM A572/A572M	(2015) Standard Specification for High-Strength Low-Alloy Columbium-Vanadium Structural Steel
ASTM A574	(2017) Standard Specification for Alloy Steel Socket-Head Cap Screws
ASTM A588/A588M	(2015) Standard Specification for High-Strength Low-Alloy Structural Steel with 50 ksi (345 MPa) Minimum Yield Point, with Atmospheric Corrosion Resistance
ASTM A606/A606M	(2009a) Standard Specification for Steel Sheet and Strip, High-Strength, Low-Alloy,

Hot-Rolled and Cold-Rolled, with Improved  
Atmospheric Corrosion Resistance

ASTM A618/A618M (2004; R 2010) Standard Specification for  
Hot-Formed Welded and Seamless  
High-Strength Low-Alloy Structural Tubing

ASTM A653/A653M (2017) Standard Specification for Steel  
Sheet, Zinc-Coated (Galvanized) or  
Zinc-Iron Alloy-Coated (Galvannealed) by  
the Hot-Dip Process

ASTM A780/A780M (2009; R 2015) Standard Practice for  
Repair of Damaged and Uncoated Areas of  
Hot-Dip Galvanized Coatings

ASTM A792/A792M (2010) Standard Specification for Steel  
Sheet, 55% Aluminum-Zinc Alloy-Coated by  
the Hot-Dip Process

ASTM E283 (2004; R 2012) Determining the Rate of Air  
Leakage Through Exterior Windows, Curtain  
Walls, and Doors Under Specified Pressure  
Differences Across the Specimen

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

ASTM F2247 (2011; R 2017) Standard Test Method for  
Metal Doors Used in Blast Resistant  
Applications (Equivalent Static Load  
Method)

ASTM F2927 (2012) Standard Test Method for Door  
Systems Subject to Airblast Loadings

ASTM F436 (2011) Hardened Steel Washers

ASTM F835 (2013) Alloy Steel Socket Button and Flat  
Countersunk Head Cap Screws

#### BUILDERS HARDWARE MANUFACTURERS ASSOCIATION (BHMA)

ANSI/BHMA A156.13 (2017) Mortise Locks & Latches Series 1000

ANSI/BHMA A156.3 (2014) Exit Devices

ANSI/BHMA A156.4 (2013) Door Controls - Closers

#### INTERNATIONAL ORGANIZATION FOR STANDARDIZATION (ISO)

ISO 898-1 (2013) Mechanical Properties of Fasteners  
Made of Carbon Steel and Alloy Steel –  
Part 1: Bolts, Screws and Studs with  
Specified Property Classes – Coarse Thread  
and Fine Pitch Thread

NATIONAL FIRE PROTECTION ASSOCIATION (NFPA)

NFPA 101	(2018; TIA 18-1) Life Safety Code
NFPA 252	(2017) Standard Methods of Fire Tests of Door Assemblies
NFPA 80	(2016; TIA 16-1) Standard for Fire Doors and Other Opening Protectives
NFPA 80A	(2017) Recommended Practice for Protection of Buildings from Exterior Fire Exposures

1.2 SYSTEM DESCRIPTION

Provide a blast resistant door which fits a Door Description as follows: Hollow metal doors shall be flush mounted in frames. Doors shall be the manually operated, side hinged, swinging type. Each door assembly shall include the door, frame, anchors, hardware, and accessories and shall be provided by a single manufacturer. Frames and anchors shall be capable of transferring blast and rebound reactions to the adjacent supporting structure. Resistance to blast shall be demonstrated either by design calculations or tests on prototype door assemblies.

1.2.1 Design Requirements

1.2.1.1 Static Material Strength

Obtain the static values for minimum yield strength (or yield point) and (ultimate) tensile strength for steel from the applicable material specification. For tensile strength specified in terms of a tensile strength range, the lowest tensile strength specified shall be selected for design. Structural steel having a minimum static yield strength (or yield point) less than 50 ksi shall be designed using an average yield strength computed as 1.1 times the minimum static yield strength or yield point. If the minimum static yield for structural steel exceeds 50 ksi, the expected yield strength used for design shall be equal to the minimum specified static yield strength or yield point without increase. Concrete used for design shall be computed by multiplying the specified. The expected yield stress for steel sheet and strip used in design shall be computed as 1.21 times the specified static yield point.

1.2.1.2 Dynamic Material Strength

Compute the dynamic material strength by applying a dynamic increase factor that accounts for the increase in material strength due to strain rate effects. The dynamic increase factor for structural steel in flexure shall be applied to the average yield strength and shall be 1.29, 1.19, and 1.09 for structural steel having a minimum yield strength (or yield point) of 36, 50, and 100 ksi, respectively. The dynamic increase factor for structural steel having a minimum yield strength (or yield point) between these values shall be obtained by interpolation. Optionally, for structural steel in these yield ranges, the dynamic increase factor shall be determined by a detailed analysis that accounts for the time to yield. The dynamic increase factor for structural steel having a minimum yield exceeding 100 ksi shall be 1.0. The dynamic increase factor for steel sheet and strip used in flexure shall be 1.1 applied to the average yield stress.

#### 1.2.1.3 Structural Member Design

Obtain structural steel section properties for rolled shapes from AISC 325, AISC 325, or steel manufacturers' catalogs. The plastic moment capacity for single plate sections and sections built up from plates and shapes shall be computed as the average of the elastic and plastic section modulus multiplied by the dynamic yield strength, unless otherwise approved. Shear, welds, local buckling, and web crippling of structural steel shall be designed in accordance with AISC 325, the plastic design provisions of AISC 360, or by other approved methods except that for blast design, the load factors and resistance factors shall be equal to 1.0 and the dynamic yield strength shall be substituted for the static yield stress. Hollow metal doors shall be designed in accordance with AISI S100 except that for blast design, the dynamic yield strength shall be substituted for the static yield point.

#### 1.2.1.4 Dynamic Analysis and Deformation

Design the door using an equivalent single degree of freedom or other approved dynamic analysis method. The maximum door deformation shall be selected by the door manufacturer except that the maximum deformation in flexure shall not exceed the deformation limits specified or indicated. The deformation of structural steel members having a minimum yield strength or yield point greater than 65 ksi shall not exceed the elastic deflection. Increased resistance due to strain hardening of structural steel in flexure can be used when the ductility ratio exceeds 10 or when otherwise approved. The ductility ratio for flexural members in hollow metal doors shall not exceed 1.0.

#### 1.2.1.5 Rebound Resistance

Rebound resistance shall be the specified or indicated percentage of the door resistance at initial peak response.

#### 1.2.2 Blast Effects

##### 1.2.2.1 Overpressure

The spatial distribution of overpressure shall be uniform unless otherwise specified or indicated. For overpressure specified or indicated without duration, the overpressure waveform shall have a zero rise time and infinite duration. For overpressure specified or indicated with duration only, the waveform shall be a triangle with a zero rise time.

##### 1.2.2.2 Overpressure Direction

For overpressure identified as seating and for overpressure directions not otherwise specified or indicated, the positive phase overpressure shall be in the direction that causes the door to seat toward the frame. For overpressure identified as unseating, the positive phase overpressure shall be in the direction that causes the door to unseat away from the frame.

##### 1.2.2.3 Fragment Resistance

For doors specified or indicated to resist fragments, design the door and the door and frame interface to prevent fragment perforation and the latches and latching mechanism shall be shielded from fragment damage. The fragment impact point shall be anywhere on the door and frame face

exposed to overpressure.

#### 1.2.3 Blast Door Operation

Measure the force required to set the door in motion from the 90-degree open position, and measure the force required to engage and release the latches at the latch handle with the door in the normal closed position.

#### 1.2.4 Other Submittals Requirements

The following shall be submitted:

- a. Detailed fabrication and assembly drawings for special doors or standard doors with appreciable modifications, indicating the door location and showing dimensions, materials, fabrication methods, hardware, and accessories in sufficient detail to enable the Contracting Officer to check compliance with contract documents. These drawings need not be submitted for standard doors for which manufacturer's catalog data is submitted. Weld symbols used shall conform to AWS A2.4.
- b. Data on standard blast doors consisting of catalog cuts, brochures, circulars, specifications, and product data that show complete dimensions and completely describe overpressure ratings, rebound ratings, doors, frames, anchors, hardware, and accessories. Manufacturer's instructions for installation and field testing.
- c. Detailed structural analysis and design calculations demonstrating resistance to blast when blast resistance is not demonstrated by prototype tests. Design calculations shall demonstrate adequacy under the blast effects specified or indicated. Include in the design calculations a sketch of the overpressure waveform; dimensioned sketches of blast resisting elements such as door members, frame members, latches, and hinges; section properties for blast resisting members including built-up sections; the standard under which steel is produced; static and dynamic material strength properties; the resistance, stiffness, mass, elastic natural period, and elastic deflection for flexural members; and the peak deflection, peak support rotation, and time to peak deflection for door members in flexure. Design calculations shall cover initial response, rebound, and all secondary items such as shear, welds, local buckling, web crippling, hinges, and latches.
- d. Steel mill reports covering the number, chemical composition, and tension properties for structural quality steels. When blast resistance is demonstrated by calculations, a certificate stating that the door assembly provided was manufactured using the same materials, dimensions, and tolerances shown in the calculations. When blast resistance is demonstrated by prototype testing, a certificate stating that door and frame provided was manufactured using the same materials, dimensions, and tolerances as the tested prototype and listing the hardware and frame anchors required to achieve blast resistance. Each certificate shall be signed by an official authorized to certify in behalf of the manufacturer and shall identify the door assembly and date of shipment or delivery to which the certificate applies.
- e. Information, for DOOR DESCRIPTION, bound in manual form consisting of manufacturer's safety precautions, preventative maintenance and



schedules, troubleshooting procedures, special tools, parts list, and spare parts data. All material shall be cross referenced to the door designations shown on the drawings.

### 1.3 SUBMITTALS

Government approval is required for submittals with a "G" designation; submittals not having a "G" designation are for information only. When used, a designation following the "G" designation identifies the office that will review the submittal for the Government. Submittals with an "S" are for inclusion in the Sustainability eNotebook, in conformance to Section 01 33 29 SUSTAINABILITY REPORTING. Submit the following in accordance with Section 01 33 00 SUBMITTAL PROCEDURES:

#### SD-02 Shop Drawings

Installation; G

#### SD-03 Product Data

Door Description; G  
Design Requirements; G  
Manufacturer's Field Service

#### SD-06 Test Reports

Tests  
Tests, Inspections, and Verifications  
Fire Rating Test and Inspection  
Prototype Static Test; G  
Prototype Blast Test; G

#### SD-07 Certificates

Materials  
Fire-Rated Door Assemblies  
Thermal Insulation  
Sound Rating Test

#### SD-10 Operation and Maintenance Data

Door Description; G

### 1.4 QUALITY ASSURANCE

Welders, welding operators, and weld inspectors shall be qualified in accordance with AWS D1.1/D1.1M except that welders performing arc welding of steel sheet and strip shall be qualified in accordance with AWS D1.3/D1.3M.

#### 1.4.1 Blast Consultant Qualifications

Blast engineering consultant performing blast calculations shall be a licensed professional engineer, with formal training in Structural dynamics. Consultant shall have a minimum of 5 years experience in providing qualified blast engineering services similar in design to that required for this project. "Qualified blast engineering services" is defined as "a minimum of three projects of similar size and scope that meet the satisfaction of the Owner and whose work has resulted in

construction with a record of successful in-service performance for a period of at least 5 years".

#### 1.4.2 Blast Testing Agency Qualifications

If blast testing is performed in lieu of design/analysis calculations, Blast Testing Agency performing the testing shall employ licensed professional engineers with formal training in structural dynamics and shall be acceptable to the Contracting Officer. Blast testing agency shall have experience in providing blast testing services for projects of similar size and scope to the kind indicated, have experience in testing to the blast loads specified in "Design Blast Loads" portion of this specification section, and shall be familiar with the requirements of ASTM F2247 and/or with ASTM F2927.

### 1.5 BLAST PERFORMANCE REQUIREMENTS

#### 1.5.1 Design Approach

##### 1.5.1.1 Unglazed Doors

Unglazed doors shall be designed using one of the following approaches.

- a. Provide unglazed doors that are tested to achieve a Door Damage Level Category III in accordance with ASTM F2247 or with ASTM F2927. The fasteners and anchorage methods used to attach the tested door assembly shall be representative of actual door installation.
- b. Unglazed door assemblies may be designed using a dynamic analysis.

##### 1.5.1.2 Glazed Doors

Glazed doors shall be designed using one of the following approaches.

- a. Provide glazed doors that are tested to achieve a Door Damage level Category III and a Minimal Hazard Rating for glazing in accordance with ASTM F2927. The fasteners and anchorage methods used to attach the tested door assembly shall be representative of actual door installation. Unless included as part of the tested assembly, glazed sidelights and transoms around doors must meet the blast requirements of Section 08 81 00 GLAZING.
- b. Glazed door assemblies may be designed using a dynamic analysis.

#### 1.5.2 Blast Calculations

The submission of calculations and blast data is required from the contractor for review and approval. Requirements for the calculations and blast data are described in the paragraph entitled "Blast Report" of this specification.

#### 1.5.3 Blast Report

Submit a blast report, including a summary narrative, structural design sketches, and structural design calculations, for each door assembly type and each building elevation required to resist blast loads, showing compliance with blast performance requirements for review and approval. Each blast resistant door assembly (including door size, glazing location, glazing thickness, glazing type, and PVG laminate thickness) shall be

verified through analysis to meet or exceed the minimum required performance condition in response to the specified blast loads.

- a. Blast Report shall be prepared and submitted by a qualified blast engineering consultant as defined in the paragraph entitled "Blast Consultant Qualifications" of this specification. The blast report shall be signed and sealed by a registered professional engineer.
- b. Blast engineering design calculations must be completed for all door assemblies if a dynamic analysis design approach is chosen. Test data may be submitted in addition to the engineering design calculations, although test data is not required. However, test data must be submitted if a tested door assembly design approach is chosen.

#### 1.6 DELIVERY, STORAGE, AND HANDLING

Store door assemblies, delivered and placed in storage, with protection from weather and dirt, dust, and contaminants.

#### 1.7 WARRANTY

Furnish manufacturer's written warranty covering the blast door assembly for 2 years after acceptance by the Government. Warranty shall provide for repair and replacement of the blast door assembly and individual hardware and accessory items in the event of malfunction due to defects in design, materials, and workmanship except that the warranty need not cover finishes provided by others.

### PART 2 PRODUCTS

#### 2.1 MATERIALS

Only structural quality steel materials, for which tension properties have been obtained, shall be used to resist blast except that commercial quality steel sheet and strip shall be permitted for prototype tested hollow metal doors. Select steel used in the door, door frame, and door frame anchors, and non stainless steel fasteners that resist blast, from the materials specified.

##### 2.1.1 Structural Tubing

Structural tubing shall conform to ASTM A500/A500M, ASTM A501/A501M, or ASTM A618/A618M.

##### 2.1.2 Structural Steel

Structural steel bars, plates, and shapes shall conform to ASTM A36/A36M, ASTM A242/A242M, ASTM A529/A529M, ASTM A572/A572M, or ASTM A588/A588M. Quenched and tempered steel plate shall conform to ASTM A514/A514M.

##### 2.1.3 Steel Sheet and Strip

Steel sheet and strip shall conform to ASTM A653/A653M, Type A, B, and C; ASTM A653/A653M; ASTM A606/A606M; or ASTM A792/A792M, Grades 33, 37, 40, and 50.

##### 2.1.4 Fasteners

Steel studs and bolts shall conform to ASTM A307, ASTM A325, ASTM A354,

ASTM A449, or ASTM A490 as applicable. Steel nuts shall conform to ASTM A563. Hardened circular, beveled, and clipped washers shall conform to ASTM F436. Steel hex cap screws shall conform to ISO 898-1. Steel socket-headed cap screws shall conform to ASTM A574. Steel button and flat-headed countersunk cap screws must conform to ASTM F835.

## 2.2 HARDWARE

### 2.2.1 Hinges

#### 2.2.1.1 General Requirements

Hinges shall be specially manufactured to support the door and to resist blast induced loading. The number of hinges shall be determined by the blast door manufacturer. Welds used in hinges shall be continuous. Attach hinges to the door and frame using mechanical fasteners, except that full surface hinges for doors with locks shall be attached to the door and frame by welding or approved tamper-resistant mechanical fasteners and hinges for doors with locks shall have approved nonremovable pins. Load ratings and fatigue life for ball and roller bearings shall be determined in accordance with ABMA 9 and ABMA 11 as applicable and, unless otherwise approved, the bearing steel shall conform to ASTM A534. Hinges shall be capable of operating for the minimum number of cycles specified without failure or excessive wear under the door service loads where one cycle consists of swinging the door back and forth between the normal closed position and the 90-degree open position, where failure or excessive wear means that the latches do not seat properly or the door does not swing smoothly due to hinge failure or wear, and where door service loads consist of the door weight plus any loads produced by hardware. Rolling bearings shall be factory grease lubricated and either sealed or provided with easily accessible lubrication fittings.

#### 2.2.1.2 Hinge Description

Hinge Type 1 shall be capable of smooth operation for a minimum of 250,000 cycles. This type of hinge shall be provided with structural quality steel pins and leafs and either rolling bearings in both the thrust and radial directions or hardened steel washer (disc) thrust bearings and rolling radial bearings except that rolling thrust bearings and metallic journal radial bearings shall be permitted for hollow metal doors when the specified overpressure is less than 3 psi.

### 2.2.2 Latching System

#### 2.2.2.1 Latching Points

The number of latching points shall be determined by the door manufacturer. For multiple latching points, latching points can be provided at the head, sill, and jambs.

#### 2.2.2.2 Latching System Operation

Latching systems shall be capable of operating for the same number of cycles specified for the door hinges where one latch operating cycle consists of engaging and releasing using the handle. Latches shall remain engaged until manually released and shall not release under blast loads or rebound. Self-latching latches shall provide self-activating engagement when the door is swung to the normal closed position. Handles shall release latches under a clockwise motion.

#### 2.2.2.3 Latching Mechanism

Latching mechanisms for hollow metal doors shall be mounted on the seating face of the door and safety covered. Latch handle axles shall be manufactured of hardened steel or stainless steel, and axles requiring lubrication shall be provided with easily accessible lubrication fittings.

#### 2.2.2.4 Safety Cover

Safety covers shall consist of steel housings that enclose the latching mechanism such that only the operating rods are exposed.

#### 2.2.2.5 Cover Plate

Cover plates for structural steel doors shall be manufactured of minimum 1/4 inch thick plate and shall enclose the entire latching mechanism.

#### 2.2.2.6 Latches

Latches (latch bolts) shall be manufactured of structural quality steel and the latch bolt throw shall not be less than 3/4 inch. Latch bolts shall be the sliding type in which the latch bolt slides into a matching strike in the door frame and floor.

#### 2.2.2.7 Handle

Handles for doors without locks shall be manufactured of steel castings, forgings, pipe, round tubing, bar, or plate and shall be one piece or have welded joints. Handles for doors with mortise lock and latch sets shall be manufactured of steel castings. Latch handles shall be firmly fastened to axles. Lever handles shall be perpendicular to the door edge when latches are engaged. Single lever handles shall be located at the stile opposite the hinges.

#### 2.2.3 Mortise Lock and Latch Set

Lever handles shall release latches using a torque not exceeding 27 lb-inch. Latches (latch bolts) shall be located at the stiles and operated from a single lever handle. Only one deadbolt shall be provided. The deadbolt shall be manufactured of structural quality steel and the deadbolt throw shall not be less than 1 inch. Mortise locks shall be provided with armored fronts. The function numbers for mortise locks shall be as defined in ANSI/BHMA A156.13.

#### 2.2.4 Keying

Keying shall conform to Section 08 71 00 DOOR HARDWARE.

#### 2.2.5 Exit Device

Latches (latch bolts) shall release by depressing the actuation bar using a force of not more than 15 lbf applied perpendicular to the door in the swing direction. The exit device shall conform to the finish test values specified in ANSI/BHMA A156.3 and shall be of stainless steel construction and plain design with straight, beveled, or smoothly rounded sides, corners, and edges. A touch bar may be provided in lieu of a conventional actuation bar (cross bar). The function numbers for exit devices shall be as defined in ANSI/BHMA A156.3.

#### 2.2.6 Straight Steel Bar Door Pull

Straight steel bar door pulls shall be manufactured of round steel bar. The type furnished shall be Type I: 1/2 inch diameter, 5 inch grip and 2-1/2 inch projection with 1/2 inch inside bend radiuses. Grip and projection dimensions are measured from the bar centerline. The pull shall be attached to the door by fillet welding all around.

#### 2.2.7 Door Stop

Door stops shall be designed to resist the impact of the door. The stop shall not scratch or scar the door finish when the door is opened against the stop.

#### 2.2.8 Surface Door Closer

The surface door closer shall conform to ANSI/BHMA A156.4. The size and grade shall be selected by the door manufacturer.

#### 2.2.9 Door Silencer

Rubber door silencers shall cushion the impact of the door against the frame so that steel-to-steel contact is not made during closing.

### 2.3 ACCESSORIES

#### 2.3.1 Nameplate

Each door assembly shall have a permanently affixed nameplate that displays the manufacturer's name, place and year of manufacture, and the applicable peak overpressure, impulse, and rebound rating.

### 2.4 FABRICATION

#### 2.4.1 Shop Assembly

Welding shall be in accordance with AWS D1.1/D1.1M except that arc welding of steel sheet and strip shall be in accordance with AWS D1.3/D1.3M. Stainless steel shall be welded using electrodes conforming to AWS A5.4/A5.4M. Structural steel doors shall be of welded construction. Fabricated steel shall be well-formed to shape and size, with sharp lines and angles. Intermediate and corner joints shall be coped or mitered. Exposed welds shall be dressed smooth. The stiles and top of built-up structural steel doors shall be closed using channel shapes or plates. When feasible, faceplates for structural steel doors shall be one piece. When one-piece faceplates are not feasible, plates shall be joined using full penetration groove weld butt joints or other approved welds. Hollow metal door frames shall be pressed steel or structural steel with welded joints. Steel frames or subframes installed in masonry walls shall be provided with adjustable anchors. Hollow metal doors shall be of unitized grid construction with welded grid junctions and shall have flat, one-piece face sheets spot welded to each face of the grid system. The edges of hollow metal doors shall be closed with seams continuously welded. Hollow metal doors shall be neat in appearance, free from warpage and buckle, and suitable reinforcing shall be provided for hardware.

#### 2.4.2 Mullion

Mullions for double doors shall be fabricated in the same manner specified for frames. Fixed mullions shall be welded to the frame. Removable mullions shall be attached to the frame with mechanical fasteners that are accessible for mullion removal or, in lieu of the removable mullion, an astragal shall be provided at the seating face of the inactive door leaf. Doors shall seat directly against the mullion, and the mullion or astragal shall be capable of transferring the door reactions to the frame.

#### 2.4.3 Thermal Insulation

The interior cells between the unitized grid shall be completely filled with thermal insulation material. The U value through the door (panel) shall not exceed 0.24 Btu per square foot per hour per degree F. Submit certification or test report for thermal insulated doors listing the type of hardware used to achieve the rating.

#### 2.4.4 Shop Finishing

Shop priming of steel surfaces shall conform to Section 09 90 00 PAINTS AND COATINGS, except that surfaces that will be embedded in concrete need not be primed and hollow metal doors shall be either dipped in primer after welding is completed, or exposed surfaces shall be primed and interior surfaces coated with an approved rust inhibitor.

#### 2.4.5 Clearance

The lateral clearance between hollow metal doors and frames shall not exceed 1/8 inch at the head and jambs and the clearance between the meeting edges of pairs of doors shall not exceed 1/4 inch. The clearance between the door bottom and threshold shall not exceed 3/4 inch.

### 2.5 BLAST DOOR ASSEMBLIES

#### 2.5.1 Door Metal

##### 2.5.1.1 Type

Type shall be hollow metal or double hollow metal door with a fixed mullion.

##### 2.5.1.2 Design Blast Loads

The following design blast load is a dynamic load to be used with an inelastic dynamic structural analysis method of the door assembly.

- a. Linearly decaying load function with peak pressure and impulse.

- (1) All doors indicated: 8.36 psi and 38.12 psi-msec.

- b. Negative phase effects shall not be considered.

##### 2.5.1.3 Rebound

Rebound resistance shall be 50 percent.

##### 2.5.1.4 Hardware

Mortise hinges shall be Type 1. Multiple latching points and a single

lever handle operated from the seating face with self-latching latch engagement and sliding latch bolts shall be provided. A door stop, surface door closer, door silencer shall be provided.

#### 2.5.1.5 Operating Forces

Operating forces shall conform to NFPA 101.

### 2.6 TESTS, INSPECTIONS, AND VERIFICATIONS

Submit shop and field operating test reports that include values for opening and closing forces and times, forces required to operate latches, and a description of all operating tests performed.

#### 2.6.1 Prototype Static Test

Static tests on prototype door assemblies shall demonstrate that the door will resist the blast overpressure. Static tests will be accepted only if the door and frame proposed are manufactured using the same materials, dimensions, and tolerances as those in the prototype static test and the static overpressure used in the test is at least two times the blast overpressure. Static test reports shall be supplemented with calculations that demonstrate rebound resistance when rebound is not tested.

#### 2.6.2 Prototype Blast Test

Blast tests on the prototype door assembly shall demonstrate that the door will resist the overpressure waveform. Blast tests will be accepted only if the door and frame proposed are manufactured using the same materials, dimensions, and tolerances as those in the prototype blast tests. The rise time of the test waveform shall be zero or subject to approval. For an overpressure with infinite duration, the overpressure used in the test shall be not less than that specified or indicated for a duration equal to at least five times the natural period of the door and the test report shall be supplemented with calculations that demonstrate the specified or indicated rebound resistance. For overpressure with finite duration, the overpressure waveform used in the test shall exceed the overpressure waveform in both peak overpressure and impulse and the blast test report shall be supplemented with calculations that demonstrate the specified or indicated rebound resistance when the positive phase waveform duration in the test exceeds the positive phase duration specified or indicated. Submit certified test reports demonstrating blast resistance. Include in the test reports the name and location of the testing agency or laboratory, a description of the testing apparatus, the date of the tests, a description of the door specimen tested, descriptions of loadings, the value of measured peak door deflection and peak permanent set and analysis and interpretation of test results.

#### 2.6.3 Shop Operating Test

Prior to shipment, each door assembly shall be fully erected in a supporting structure and tested for proper operation. Such testing shall include opening, closing, and operating all moving parts to ensure smooth operation and proper clearance, fit, and seating. Determine the operating forces and opening and closing times. Notify the Contracting Officer at least 7 calendar days prior to the start of testing and all doors shall be tested in the presence of the Contracting Officer. Prepare a test report and furnish three copies within 7 calendar days after testing.



#### 2.6.4 Air Leakage Test

Factory test each door assembly for which door seals or thermal insulation are specified for air leakage rate in accordance with ASTM E283. The rate of air leakage per unit length of crack shall not exceed 0.20 cfm using a pressure difference of 1.57 psf. Prototype tests can be substituted for door assembly tests when the prototype door, frame, and hardware tested are equivalent to that provided or when otherwise approved.

#### 2.6.5 Sound Rating Test

The sound transmission class (STC) rating shall be determined in accordance with ASTM E90.

#### 2.6.6 Fire Rating Test and Inspection

Fire-rated door assemblies shall bear the listing identification label of the UL, or other nationally recognized testing laboratory qualified to perform tests of fire door assemblies in accordance with NFPA 252 and having a listing for the tested assemblies. Doors exceeding the size for which listing label service is offered shall be inspected in accordance with NFPA 80, NFPA 80A, and NFPA 101. A letter may be submitted by the testing laboratory (in lieu of a UL listing for fire door assemblies) which identifies the submitted product by manufacturer and type or model and certifies that it has tested a sample assembly and issued a current listing. Submit certificate of inspection conforming to NFPA 80, NFPA 80A, and NFPA 101 for fire doors exceeding the size for which label service is available.

### PART 3 EXECUTION

#### 3.1 INSTALLATION

Install doors and frames in accordance with the manufacturer's written instructions. Pressed steel frames for hollow metal doors shall be fully grouted. Finish paint exposed surfaces in accordance with Section 09 90 00 PAINTS AND COATINGS. Repair galvanized surfaces damaged prior to final acceptance in accordance with ASTM A780/A780M to the same thickness as the original galvanizing.

#### 3.2 TESTS

After installation is completed, field test each door for operation, clearance, fit, and seating by operating the door and hardware through at least 10 operating cycles. Test door and hardware operation using the forces specified. Provide personnel and equipment required to perform field testing. Unless waived, perform all field tests in the presence of the Contracting Officer. After testing is completed, prepare test reports and furnish three copies.

#### 3.3 MANUFACTURER'S FIELD SERVICE

Perform installation and testing of door assemblies under the supervision of the door manufacturer's erection engineer. Upon completion of the work, and at a time designated by the Contracting Officer, provide the services of one engineer and other technical personnel, as required, for a period of not less than 4 hours to instruct Government personnel in the operation and maintenance of the blast doors and all other items furnished under this specification. Include in the instructions videotapes and use

of the operation and maintenance manual. Submit an instruction outline and procedure for approval prior to scheduling the instruction and information describing training to be provided, training aids to be used, and background data on the personnel conducting the training.

-- End of Section --

SECTION 08 41 13

ALUMINUM-FRAMED ENTRANCES AND STOREFRONTS

11/16

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.

ALUMINUM ASSOCIATION (AA)

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

AMERICAN ARCHITECTURAL MANUFACTURERS ASSOCIATION (AAMA)

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

AAMA 501 (2015) Methods of Test for Exterior Walls

AAMA 611 (2014) Voluntary Specification for  
Anodized Architectural Aluminum

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

AMERICAN CONCRETE INSTITUTE INTERNATIONAL (ACI)

ACI 318 (2014; Errata 1-2 2014; Errata 3-5 2015;  
Errata 6 2016; Errata 7-9 2017) Building  
Code Requirements for Structural Concrete  
(ACI 318-14) and Commentary (ACI 318R-14)

AMERICAN SOCIETY OF CIVIL ENGINEERS (ASCE)

ASCE 7 (2017) Minimum Design Loads for Buildings  
and Other Structures

ASTM INTERNATIONAL (ASTM)

ASTM B221 (2014) Standard Specification for Aluminum  
and Aluminum-Alloy Extruded Bars, Rods,  
Wire, Profiles, and Tubes

ASTM E1105 (2015) Standard Test Method for Field  
Determination of Water Penetration of  
Installed Exterior Windows, Skylights,  
Doors, and Curtain Walls, by Uniform or  
Cyclic Static Air Pressure Difference

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

ASTM E1424	(1991; R 2016) Standard Test Method for Determining the Rate of Air Leakage Through Exterior Windows, Curtain Walls, and Doors Under Specified Pressure and Temperature Differences Across the Specimen
ASTM E1886	(2013a) Standard Test Method for Performance of Exterior Windows, Curtain Walls, Doors, and Impact Protective Systems Impacted by Missile(s) and Exposed to Cyclic Pressure Differentials
ASTM E283	(2004; R 2012) Determining the Rate of Air Leakage Through Exterior Windows, Curtain Walls, and Doors Under Specified Pressure Differences Across the Specimen
ASTM E330/E330M	(2014) Structural Performance of Exterior Windows, Doors, Skylights and Curtain Walls by Uniform Static Air Pressure Difference
ASTM E331	(2000; R 2016) Standard Test Method for Water Penetration of Exterior Windows, Skylights, Doors, and Curtain Walls by Uniform Static Air Pressure Difference
ASTM E783	(2002; R 2010) Standard Test Method for Field Measurement of Air Leakage Through Installed Exterior Windows and Doors
ASTM F2248	(2012) Standard Practice for Specifying an Equivalent 3-Second Duration Design Loading for Blast Resistant Glazing Fabricated with Laminated Glass
ASTM F1642/F1642M	(2017) Standard Test Method for Glazing and Glazing Systems Subject to Airblast Loadings

BUILDERS HARDWARE MANUFACTURERS ASSOCIATION (BHMA)

ANSI/BHMA A156.10	(2017) Power Operated Pedestrian Doors
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INTERNATIONAL CODE COUNCIL (ICC)

ICC IBC	(2017) International Building Code
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U.S. GENERAL SERVICES ADMINISTRATION (GSA)

FS TT-P-645	(Rev C) Primer, Paint, Zinc-Molybdate, Alkyd Type
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UNDERWRITERS LABORATORIES (UL)

UL 325	(2017) UL Standard for Safety Door, Drapery, Gate, Louver, and Window Operators and Systems
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## 1.2 ADMINISTRATIVE REQUIREMENTS

### 1.2.1 Pre-Installation Meetings

Conduct a meeting before installation begins to verify the project requirements, substrate conditions, manufacturer's installation instructions, and manufacturer's warranty requirements.

Within 30 days of the Contract Award, submit the following for review and approval by the Contracting Officer:

- a. List of product installations
- b. Sample warranty
- c. Finish and color samples
- d. Manufacturer's catalog data

Concurrently submit certified test reports showing compliance with specified performance characteristics and UL 325 for the following:

- a. Wind Load (Resistance) in accordance with AAMA 501
- b. Deflection in accordance with ASTM F1642/F1642M
- c. Condensation Resistance and Thermal Transmittance Performance Requirements in accordance with AAMA 1503
- d. Water Infiltration in accordance with ASTM E331
- e. Structural Requirements in accordance with ASTM F1642/F1642M

### 1.3 SUBMITTALS

Government approval is required for submittals with a "G" designation; submittals not having a "G" designation are for information only. When used, a designation following the "G" designation identifies the office that will review the submittal for the Government. Submittals with an "S" are for inclusion in the Sustainability eNotebook, in conformance to Section 01 33 29 SUSTAINABILITY REPORTING. Submit the following in accordance with Section 01 33 00 SUBMITTAL PROCEDURES:

#### SD-01 Preconstruction Submittals

Sample Warranty

List of Product Installations

#### SD-02 Shop Drawings

Installation Drawings

Fabrication Drawings; G

#### SD-03 Product Data

Manufacturer's Catalog Data

Finish; G

SD-04 Samples

Finish and Color Samples

SD-05 Design Data

Blast Calculations; G

Blast Report; G

Blast Test Report; G

SD-06 Test Reports

Certified Test Reports

Deflection

Air Infiltration

Thermal Transmittance

Water Infiltration

SD-07 Certificates

Blast Consultant Qualifications; G

Blast Testing Agency Qualifications; G

SD-08 Manufacturer's Instructions

Manufacturer's Instructions

SD-11 Closeout Submittals

Manufacturer's Product Warranty

1.4 QUALITY CONTROL

1.4.1 Qualifications

1.4.1.1 Installer Qualifications

Provide documentation of the installer's experience in performing the work specified in this section.

Ensure that the installers have specialized in work similar to that required for this project, and that they are acceptable to product manufacturer.

1.4.1.2 Manufacturer Qualifications

Ensure that manufacturers meet the requirements specified in this section and project drawings.

Ensure that the manufacturer is capable of providing field service representation during construction, approving acceptable installers and approving application methods.

#### 1.4.1.2.1 List of Qualified Manufacturers

Subject to compliance with requirements, available manufacturers offering products that may be incorporated into the Work include, but are not limited to, the following:

- a. Wausau Window and Wall Systems.
- b. Norshield Security Products.
- c. Physical Security LLC.

#### 1.4.1.3 Blast Consultant Qualifications

Blast engineering consultant performing blast calculations shall be a licensed professional engineer, with formal training in structural dynamics. Consultant shall have a minimum of 5 years of experience in providing qualified blast engineering services similar in design to that required for this project. "Qualified blast engineering services" is defined as "a minimum of three projects of similar size and scope that meet the satisfaction of the Owner and whose work has resulted in construction with a record of successful in-service performance for a period of at least 5 years".

#### 1.4.1.4 Blast Testing Agency Qualifications

If blast testing is performed in lieu of design/analysis calculations, Blast Testing Agency performing the testing shall employ licensed professional engineers with formal training in structural dynamics and shall be acceptable to the Contracting Officer. Blast testing agency shall have experience in providing blast testing services for projects of similar size and scope to the kind indicated, have experience in testing to the blast loads specified in "Design Blast Loads" portion of this specification section, and shall be familiar with the requirements of ASTM F1642/F1642M and the requirements provided in the paragraph entitled "Blast Testing Alternate" of this specification.

#### 1.4.2 Single-Source Responsibility

When aluminum entrances are part of a building enclosure system, that includes storefront framing, windows, a curtain wall system, and related products, provide building enclosure system products from a single-source manufacturer.

Use a single source manufacturer with sole responsibility for providing design, structural engineering, and custom fabrication for door portal systems and for supplying components, materials, and products. Do not use products provided from numerous sources for assembly at the site. Ensure that the following work items and components are fabricated or supplied by a single source are:

- a. Door operating hardware to be installed on or within door portals as specified in Section 08 71 00 DOOR HARDWARE.
- b. Glass as specified in Section 08 81 00 GLAZING.

## 1.5 BLAST PERFORMANCE REQUIREMENTS

### 1.5.1 Blast Design Criteria

Provide aluminum-framed entrance and storefront assemblies consisting of framing, glazing, and anchorage systems that are designed for compliance with requirements indicated. Each type and size of blast resistant entrance and storefront assembly (included frame, mullions, anchorages, and all connections) shall be verified through analysis to meet the blast performance requirements.

The design, fabrication, and installation of blast resistant glazed entrance and storefront systems, attachments and anchorages shall withstand the design blast loads.

#### 1.5.1.1 Design Blast Loads

The following design blast load is a dynamic load to be used with an inelastic dynamic structural analysis method.

- a. Linearly decaying load function with peak pressure and impulse.
  - (1) All curtain wall systems indicated: 8.36 psi and 38.12 psi-msec.
- b. Negative phase effects shall not be considered.

#### 1.5.1.2 Design Approach

Entrance and storefront assemblies fabricated using laminated glass may be designed using one of the following approaches.

- a. Entrance and storefront assemblies may be designed using ASTM F2248 and ASTM E1300. This method results in a medium level of protection which is a higher level of protection than required. Also note that ASTM F2248 may only be used for a limited range of charge weights and standoff distances. For charge weights and standoffs outside of the range of ASTM F2248, window systems shall either be designed using a dynamic analysis or tested in accordance with ASTM F1642/F1642M.
- b. Entrance and storefront assemblies may be designed using a dynamic analysis.
- c. Entrance and storefront assemblies may be tested in accordance with ASTM F1642/F1642M. Testing shall include the entire entrance and storefront assembly including connections. The structural supporting material used in the test for fastener attachment shall be representative of the fielded application.

#### 1.5.1.3 Analysis

Design of mullions using inelastic dynamic structural analysis methods shall be designed using one of the following approaches:

- a. The specified blast load shall be applied to the window area and the resulting dynamic window edge reactions should be applied to the resisting mullion.
- b. The specified blast load acting on the window may be applied to the



tributary area of the mullion.

#### 1.5.1.4 Deformation Limitations

##### 1.5.1.4.1 Rotation

Rotation of mullions shall meet all of the following criteria:

- a. Over the full length of the mullion, rotations of mullion ends shall not exceed 6 degrees at design blast loading.

##### 1.5.1.4.2 Ductility

Ductility ratio of mullions shall not exceed 7 for aluminum at design blast loading. No ductility limit for steel.

#### 1.5.1.5 Anchorage and Connection Design Criteria

The entrance and storefront assemblies shall be designed, fabricated, and installed to resist the design blast loads specified in the paragraph entitled "Design Blast Loads" of this specification, within the limits and under the conditions below:

- a. Reaction Forces: Internal connections and anchorages to the supporting structure shall be engineered for the direct forces resulting from the window and curtain wall framing member analyses.
- b. Design anchorage and connections to resist the calculated reaction forces using the following procedures:
  - (1) Metal-to-metal connections: using the procedures outlined in the latest versions of the AISC Steel Construction Manual.
  - (2) Metal-to-Concrete: using the procedures outlined in the latest version of ACI 318 for anchorage to concrete.
  - (3) Load combination shall be in accordance with ASCE 7 for checking the capacity of a structure or structural element to withstand the effects of an extraordinary event.
- c. For anchorage and connections designed based on manufacturer supplied data, the design is to be based on the "Ultimate Capacity" value provided by manufacturer. A factor of safety of 1.0 shall be provided for ductile failure modes (ex: flexure) and 1.5 for brittle failure modes (ex: shear).
- d. Metal to metal connections shall be designed such that the weld material is stronger than the base material.

#### 1.5.1.6 Aluminum Framing Members

- a. Minimum aluminum yield strength shall be no less than 25,000 psi.
- b. Snap on elements or other aluminum extrusions that are not structurally connected together to act as a single composite member shall not be considered in determining the structural capacity of the mullion.
- c. The aluminum mullions shall be positively fastened to adequately

transfer the blast end reaction forces across the connection between adjacent framing members.

#### 1.5.1.7 Steel Framing Members

Minimum steel yield strength shall be 36,000 psi for steel bars and 46,000 psi for steel tubes used to reinforce the aluminum mullions of the windows. Alternatively, 50,000 psi steel bars may be used to reinforce jambs or mullions if necessary to meet required profile depths.

#### 1.5.1.8 Dynamic Enhancement Factor

A dynamic enhancement factor of 1.2 may be applied to the yield stress for steel members, to account for strain rate effects. Similarly, a dynamic enhancement factor no greater than 1.0 may be applied to the yield stress for aluminum.

#### 1.5.1.9 Composite Section Properties

Composite section properties of mullion components may only be used if calculations demonstrate strain compatibility across the interface.

- a. This requirement applies to the inner and outer components of thermally broken systems.

#### 1.5.1.10 Combined Section Properties

Combined section properties of mullion components may be used if calculations demonstrate deformation compatibility between the aluminum and steel components.

#### 1.5.1.11 Snap-on Elements

Snap-on elements or other architectural extrusions that do not have a positive connection to the main supporting element shall not be included in determining the mullion resistance or attachment capacity.

### 1.5.2 Blast Testing Alternate

In lieu of providing an inelastic dynamic structural analysis of the entrance and storefront assemblies, assemblies may be blast tested using an open-air arena test or shock-tube test. The blast test shall conform to the requirements of ASTM F1642/F1642M.

#### 1.5.2.1 Blast Test Loads

Blast test loads shall comply with the specified blast design loads. The applied impulse of the test load will be taken at the end of the linearly decaying portion of the pressure time history. Negative phase effects and build-up of impulse beyond the linearly decaying portion of the function shall not be considered.

#### 1.5.2.2 Glazing

Glazing shall meet the performance requirements provided in Section 08 81 00 GLAZING. The height of the bottom of the test window above the ground should be consistent with the actual field conditions.

#### 1.5.2.3 Test Window Attachment

The test entrance and storefront assembly shall be attached to the test frame with anchors identical to what will be used in the field. Where the supporting conditions are different from what is used in the blast test (i.e. connection geometry, anchor size, anchor spacing and/or substrate being attached to), supporting calculations shall be provided to verify the adequacy of connections. Anchorage design forces used to verify the adequacy of the connection in different support conditions shall be computed either based on the capacity of the anchors used in the test structure (full shear and tension capacity based on controlling failure mechanism) or on reactions calculated from a dynamic analysis which accounts for the full capacity of the window sections and glazing edge reactions.

#### 1.5.2.4 Test Acceptance Criteria

Per ASTM F1642/F1642M, three consecutive passing tests shall be performed in order to constitute an acceptable system. Although permanent deformation of the entrance and storefront framing system is permitted, the tested entrance and storefront assembly shall comply with the following criteria in the post-test evaluation.

- a. Frame members or pieces of members, architectural trim or cover pieces, fasteners and any other component of the window system may not fall greater than 3.3 feet from the plane of the window, consistent with a glazing Performance Condition 3a or Very Low Hazard Level.
- b. Local deformations in the frame itself may occur around connections and anchorages but no screws shall fail in shear or pull out from the supporting structure.
- c. The results of the blast test may be applied to entrance and storefront assemblies with the same tested dimensions (combined dimensional variance of the assembly opening of up to 20 percent maximum is acceptable), glazing make-up, framing system, internal connections, and anchorages.
- d. Where test data does not comply with the blast response criteria established in this section, is not complete, or does not match the assemblies or the design loading function required for this project, additional testing or supplemental engineering design calculations must be provided.
- e. Where connections or anchorages vary from what was tested, calculations shall be provided to clearly demonstrate the load path between the entrance and storefront assembly and the supporting structure, the magnitude of the forces being transferred, and calculations for the controlling failure mechanisms consistent with the anchorage and connection design criteria listed in this specification.

#### 1.5.3 Blast Calculations

The submission of calculations and blast data is required from the contractor for review and approval. Requirements for the calculations and blast data are described in the paragraph entitled "Blast Report" of this specification.

#### 1.5.4 Blast Report

Submit a blast report, including a summary narrative, structural design sketches, and structural design calculations, for each glass unit type and each building elevation required to resist blast loads, showing compliance with blast performance requirements for review and approval. Each blast resistant window unit or assembly (including window size, glazing thickness, glazing type, and PVB laminate thickness) shall be verified through analysis to meet or exceed the minimum required performance condition in response to the specified design blast loads.

- a. Blast Report shall be prepared and submitted by a qualified blast engineering consultant as defined in the paragraph entitled "Blast Consultant Qualifications" of this specification. The blast report shall be signed and sealed by a registered professional engineer.
- b. Blast engineering design calculations must be completed for all window units or assemblies. Test data alone will not be accepted. Test data may be submitted in addition to the engineering design calculations, although test data is not required.

#### 1.5.5 Blast Test Report

Blast test data and report must be submitted for review and approval for each entrance and storefront assembly for which blast test data will replace inelastic dynamic structural analysis of the entrance and storefront system. The report must show compliance with the blast performance requirements specified. Blast test report shall be prepared in accordance with ASTM F1642/F1642M. In addition, the blast test report should include but is not limited to the following:

- a. As-built shop drawings of tested configuration.
- b. Description of entrance and storefront assembly anchorages used to attach to the test frame.
- c. Detailed description and photographs of the post-test conditions of the window frame and connections.
- d. Detailed description and photographs of any region where severe deformations, damage, or failures to the window frame or connections are observed.

If supplementary calculations are required to demonstrate performance of varying entrance and storefront assembly conditions, submit calculations per the paragraph entitled "Blast Calculations" of this specification.

#### 1.5.6 Blast Analyses Standards

Comply with the applicable provisions and recommendations of the standards below. Where standards conflict, the more stringent requirements shall apply.

All building components requiring blast resistance for the project must meet requirements of Department of Defense (DoD) facilities and shall be designed using established methods and approaches for determining dynamic loads and dynamic structural response. Design and analysis approaches should be consistent with those in the technical manuals below:

- a. United Facilities Criteria UFC 4-010-01 "DoD Minimum Antiterrorism Standards for Buildings (February 9, 2012 with Change 1 dated October 1, 2013).
- b. Unified Facilities Criteria UFC 4-020-01 Security Engineering Facilities Planning Manual (September 11, 2008).

## 1.6 DELIVERY, STORAGE, AND HANDLING

### 1.6.1 Ordering

To avoid construction delays, comply with the manufacturer's lead-time requirements and instructions for ordering.

### 1.6.2 Packing, Shipping, Handling and Unloading

Deliver materials in the manufacturer's original, unopened, undamaged containers with identification labels intact.

### 1.6.3 Storage and Protection

Store materials in a way that protects them from exposure to harmful weather conditions. Avoid damaging the storefront material and components during handling. Protect storefront material against damage from elements, construction activities, and other hazards before, during, and after storefront installation.

Do not use adhesive papers or sprayed coatings that become firmly bonded when exposed to sunlight. Do not leave coating residue on surfaces.

## 1.7 PROJECT / SITE CONDITIONS

### 1.7.1 Field Measurements

Verify actual measurements or openings by taking field measurements before fabrication; record these measurements on shop drawings. To avoid construction delays, coordinate field measurements, and fabrication schedule with construction progress.

## 1.8 WARRANTY

Provide a written manufacturer's warranty, executed by a company official, warranting against defects in materials and products for 2 years from the date of shipment. Warrant that the door corner construction is for the life of the project. Provide a written installer's warranty, warranting work to be watertight and free from defective materials, defective workmanship, and glass breakage as a result of defective design, and agreeing to replace components that fail within 2 years.

The warranty states the following:

- a. Watertight and airtight system installation is completed within specified tolerances.
- b. The completed installation remains free of rattles, wind whistles and noise caused by thermal movement and wind pressure.
- c. System is structurally sound and free from distortion.

- d. Glass and glazing gaskets will not break or "pop" from frames as a result of design, wind load pressure, movement caused by expansion or contraction, or structural loading.
- e. Glazing sealants and gaskets remain free of abnormal deterioration or dislocation as a result of sunlight, weather, or oxidation.

Provide written warranty stating that the organic coating finish will not fade more than 10 percent or show chalking, yellowing, peeling, cracking, pitting, corroding or variations in color, or gloss deterioration beyond the manufacturer's descriptive standards for 10 years from the shipment date and agreeing to promptly correct defects.

Provide a written thermal integrity warranty for 10 years from ship date against thermal barrier system failure resulting from the following:

- a. Longitudinal and transverse thermal barrier shrinkage.
- b. Thermal barrier cracking.
- c. Structural failure of the thermal barrier material.
- d. Loss of adhesion or loss of prescribed edge pressure on glazing material, resulting in excessive air and water infiltration.

## PART 2 PRODUCTS

### 2.1 SYSTEM DESCRIPTION

Provide aluminum entrances, with glass and glazing, door hardware, and components.

Aluminum entrances include impact resistance entrances; medium stile, 3 1/2 inch vertical face dimension, 1 3/4 inch depth, for interior structural silicone glaze, for high-traffic/impact-resistant applications.:

#### 2.1.1 Design Requirements for Aluminum (Entrances and Components)

Provide a door portal system designed to withstand the following loads without breakage, loss, failure of seals, product deterioration, or other defects.

- a. Dead and Live Loads: Determined by ASCE 7 and calculated in accordance with applicable codes.
- b. Seismic Loads: Design and install the system to comply with the seismic requirements for the project location in accordance with Section 1613 of the International Building Code, ICC IBC.
- c. Wind Loads: Design and install the system so that the effects of wind load acting inward and outward normal to the plane of the wall are in accordance with ASTM E330/E330M.
- d. Thermal Loads And Movement:
  - (1) Ambient Temperature Range: 120 degrees F
  - (2) Material Surfaces Range: 180 degrees F

- e. Water and Air Resistance: Provide weatherstripping, exterior gaskets, sealants, and other accessories to resist water and air penetration.
- f. Impact-Protective Systems Provide an impact-protective system in accordance with ASTM E1886.

#### 2.1.1.1 Material Standard

ASTM B221; 6063-T5 alloy and tempered.

Provide door stile and rail face dimensions of the entrance doors as follows:

Vertical Stile	Top Rail	Bottom Rail
3-1/2 inches	3-1/2 inches	6-1/2 inches

Provide major portions of the door members at 0.125 inches nominal in thickness and glazing molding at 0.050 inches thick.

#### 2.1.1.2 Sealants

Provide either ethylene propylene diene monomer (EPDM) elastomeric extrusions or thermoplastic elastomer glazing gaskets. Structural silicone sealant is required.

Internal Sealants: Provide sealants that according to the manufacturer will remain permanently elastic, tacky, non-drying, non-migrating, and weather tight.

#### 2.1.1.3 Thermal Barrier

Use a rigid, structural thermal barrier to separate all exterior aluminum from interior aluminum. For purposes of this specification, a structural thermal barrier is defined as a system that transfers shear during bending and, therefore, promotes composite action between the exterior and interior extrusions. Do not use a nonstructural thermal barrier. Ensure that the thermal barrier provides a structural connection between the two sides of the door.

### 2.2 FABRICATION

Provide the following information when submitting fabrication drawings for custom fabrications:

- a. Indicate elevations, detailed design, dimensions, member profiles, joint locations, arrangement of units, and member connections.
- b. Show the following items:
  - (1) Details of special shapes.
  - (2) Reinforcing.
  - (3) Anchorage system.
  - (4) Interfacing with building construction.
  - (5) Provisions for expansion and contraction.

(6) Thermal breaks.

- c. Indicate typical glazing details, locations of various types and thickness of glass and internal sealant requirements as recommended by the sealant manufacturer.
- d. Clearly indicate locations of exposed fasteners and joints.
- e. Clearly show where and how the manufacturer's system deviates from Contract drawings and these specifications.

#### 2.2.1 Entrance System Fabrication

Provide door corner construction consisting of mechanical clip fastening, SIGMA deep penetration plug welds and 1 1/8 inch long fillet welds inside and outside all four corners. Provide a hook-in type exterior glazing stop with EPDM glazing gaskets reinforced with non-stretchable cord. Provide an interior glazing stop that is mechanically fastened to the door member and that incorporates a silicone-compatible spacer used with silicone sealant.

Accurately fit and secure joints and corners. Make joints hairline in appearance. Remove burrs and smooth edges. Prepare components with internal reinforcement for door hardware. Arrange fasteners and attachments so that they are concealed from view.

Separate dissimilar metals with protective coating or pre-formed separators in order to prevent contact and corrosion.

#### 2.2.2 Shop Assembly

Fabricate and assemble units with joints only at the intersection of aluminum members with hairline joints; rigidly secure these units, and seal them in accordance with the manufacturer's recommendations.

##### 2.2.2.1 Welding

Conceal welds on aluminum members in accordance with AWS recommendations or methods recommended by the manufacturer. Members showing welding bloom or discoloration on finish or material distortion will be rejected by the Contracting Officer.

#### 2.2.3 Finish

Before fabrication, clean the units and give them a AA-M-10-C22-A41 clear (natural) anodized finish in accordance with the requirements of the AA DAF45. The finish thickness is A42, 0.7 mil or greater.

- a. Clear Anodized; Conforming to AA-M12C22A31 and AAMA 611.

Select and edit the following items for the appropriate finish; delete types that do not apply.

- (1) Architectural Class II
- (2) Etched, medium matte
- (3) Clear anodic coating, 0.4 minimum thickness



#### 2.2.4 Fabrication Tolerance

Fabricate and assemble units with joints only at intersection of aluminum members with hairline joints; rigidly secure these units, and seal them in accordance with the manufacturer's recommendations.

Fabricate aluminum entrances in accordance with the entrance manufacturer's prescribed tolerances.

##### 2.2.4.1 Material Cuts

Square to 1/32 inch off square, over largest dimension; proportionate amount of 1/32 inch on the two dimensions.

##### 2.2.4.2 Maximum Offset at Consecutive Members

1/64 inch in alignment between two consecutive members in line, end to end.

##### 2.2.4.3 Maximum Offset at Glazing Pocket Corners

1/64 inch between framing members at glazing pocket corners.

##### 2.2.4.4 Joints

Between adjacent members in same assembly: Joints are hairline and square to the adjacent member.

##### 2.2.4.5 Variation

In squaring diagonals for doors and fabricated assemblies: 1/16 inch.

##### 2.2.4.6 Flatness

For doors and fabricated assemblies: plus/minus 1/16 inch of neutral plane.

#### 2.3 MATERIALS

##### 2.3.1 Sealants

Refer to Section 07 92 00 JOINT SEALANTS. Ensure that all sealants conform to AAMA 800.

##### 2.3.2 Glass

Refer to Section 08 81 00 GLAZING.

#### 2.4 ACCESSORIES

##### 2.4.1 Fasteners

Provide stainless steel fasteners in areas where the fasteners are exposed.

Use non-corrosive and compatible fasteners with components being fastened. Do not use exposed fasteners, except where unavoidable for application of hardware.

In areas where fasteners are not exposed, use aluminum, non-magnetic

stainless steel, or other materials warranted by the manufacturer.

For exposed locations, provide countersunk Phillips head screws when items with a matching finish are fastened. For concealed locations, provide the manufacturer's standard fasteners.

Provide nuts or washers that have been designed with a means to prevent disengagement; do not deform fastener threads.

#### 2.4.2 Perimeter Anchors

When steel anchors are used, provide insulation between steel material and aluminum material in order to prevent galvanic action.

##### 2.4.2.1 Inserts and Anchorage Devices

Provide manufacturer's standard formed or fabricated assemblies, steel or aluminum, of shapes, plates, bars, or tubes. Shop-coat steel assemblies after fabrication with an alkyd zinc chromate primer complying with FS TT-P-645.

#### 2.4.3 Standard Entrance Hardware

##### 2.4.3.1 Weatherstripping

Equip meeting stiles on pairs of doors with an adjustable astragal using wool pile with a polymeric fin.

Provide door weatherstripping on a single-acting offset pivot or butt-hung door and frame (single or pairs) consisting of a thermoplastic elastomer weatherstripping on a tubular shape with a semi-rigid polymeric backing.

Provide sill-sweep strips: Provide an EPDM blade gasket sweep strip in an aluminum extrusion applied to the interior exposed surface of the bottom rail with concealed fasteners. (Provide as necessary to meet specified performance tests.)

##### 2.4.3.2 Threshold

Provide an extruded aluminum threshold, one piece per door opening, with ribbed surface.

### PART 3 EXECUTION

#### 3.1 EXAMINATION

##### 3.1.1 Site Verification of Conditions

Verify that the condition of substrate previously installed under other sections is acceptable for product installation in accordance with the manufacturer's instructions.

Verify that openings are sized to receive the storefront system and that the sill plate is level in accordance with the manufacturer's acceptable tolerances.

#### 3.2 PREPARATION

Field-verify dimensions before fabricating components for the door portal

assembly.

Coordinate requirements for locations of blockouts for anchorage of door portal columns and other embedded components with Section 03 30 00 CAST-IN-PLACE CONCRETE.

Coordinate the erection of door portal with installation of surrounding glass wall and door assemblies. Ensure that the door portals can provide support and anchorage for assembly components.

Coordinate electrical requirements for to ensure proper power source, conduit, wiring, and boxes.

### 3.2.1 Adjacent Surfaces Protection

Protect adjacent work areas and finish surfaces from damage during product installation.

### 3.2.2 Aluminum Surface Protection

Protect aluminum surfaces from contact with lime, mortar, cement, acids, and other harmful contaminants.

## 3.3 INSTALLATION

Submit installation drawings for review and approval.

Install the entrance system in accordance with the manufacturer's instructions and the AAMA storefront and entrance guide specifications manual. Attach the entrance system to the structure, allowing it to be adjusted to accommodate construction tolerances and other irregularities. Provide alignment attachments and shims to permanently fasten the system to the building structure. Align the assembly so that it is plumb and level, and free of warp and twist. Maintain assembly dimensional tolerances aligning with adjacent work.

Set thresholds in a bed of mastic and secure the thresholds. Protect aluminum members in contact with masonry, steel, concrete, or dissimilar materials using nylon pads or a bituminous coating. Shim and brace the aluminum system before anchoring the system to the structure. Verify that weep holes are open, and the metal joints are sealed in accordance with the manufacturer's installation instructions. Seal metal-to-metal joints using a sealant recommended by the system manufacturer.

### 3.3.1 Tolerances

Ensure that tolerances for wall thickness and other cross-sectional dimensions of entrance members are nominal and in compliance with Aluminum Standards and Data, published by the Aluminum Association.

### 3.3.2 Adjusting

Adjust operating hardware for smooth operation, and as recommended by the manufacturer.

### 3.3.3 Related Products Installation Requirements

#### 3.3.3.1 Sealants (Perimeter)

Refer to Section 07 92 00 JOINT SEALANTS.

#### 3.3.3.2 Glass

Refer to Section 08 81 00 GLAZING.

### 3.4 FIELD QUALITY CONTROL

#### 3.4.1 Air Infiltration

Test air infiltration in accordance with ASTM E783

Submit certified test reports showing compliance with specified performance characteristics as follows:

- a. For single-acting offset pivot, butt hung, or continuous geared hinge entrances in the closed and locked position, test the specimen in accordance with ANSI/BHMA A156.10, and ASTM E283 at a pressure differential of 1.57 psf for pairs of doors; ensure that maximum infiltration for a pair of 7 foot by 8 foot entrance doors and frame is 1.2 cfm/square foot.
- b. Ensure the maximum allowable infiltration for a completed storefront system does not exceed 0.06 cfm/square foot when tested in accordance with ASTM E1424 at a differential static pressure of 6.24 psf.

#### 3.4.2 Wind Loads

Provide a completed storefront system capable of withstanding wind pressure loads, normal to the wall plane indicated, as follows:

##### a. Exterior Walls

(1) Positive and Negative Pressure: As shown on the Structural Drawings.

##### b. Interior Walls: pressure to meet the UFC requirements.

#### 3.4.3 Deflection

Submit certified test reports showing that the maximum allowable deflection in a member when tested in accordance with ASTM E330/E330M with allowable stress is L/175 or 3/4 inches maximum.

#### 3.4.4 Thermal Transmittance

Submit certified test reports showing compliance with specified performance characteristics as follows:

##### a. U-Value Requirements:

(1) Perform test in accordance with the AAMA 1503 procedure and on the configuration specified therein.

(2) Thermal Transmittance ("U" Value) maximum 0.51 BTU/hr/sf/deg F

(Storefront) and 0.99 BTU/hr/sf/deg F (Storefront Door) at 15 mph exterior wind.

#### 3.4.5 Water Infiltration

Submit certified test reports showing that the system is designed to provide no uncontrolled water when tested in accordance with ASTM E1105 at a static pressure of 8 psf.

### 3.5 ADJUSTING AND CLEANING

#### 3.5.1 Protection

Protect the installed product's finish surfaces from damage during construction. Protect the aluminum storefront system from damage from grinding and polishing compounds, plaster, lime, acid, cement, or other harmful contaminants.

#### 3.5.2 Cleaning

Repair or replace damaged installed products. Clean installed products in accordance with manufacturer's instructions before acceptance remove excess mastic, mastic smears, and other foreign materials. Remove construction debris from the project site and legally dispose of this debris.

### 3.6 WARRANTY

Submit three signed copies of the manufacturer's product warranty for the entrance system as follows:

- a. Warranty Period: Five years from Date of Substantial Completion of the project, provided that the Limited Warranty begins no later than six months from the date of shipment by the manufacturer. In addition, support welded door corner construction with a limited lifetime warranty for the life of the door under normal use.

Ensure that the Warranty's language is identical to the "As Approved" version of the sample warranty submitted to and returned from the Contracting Officer.

-- End of Section --



SECTION 08 51 13

ALUMINUM WINDOWS

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.

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 (2011; Update 1 2014) North American  
Fenestration Standard/Specification for  
Windows, Doors, and Skylights

ASTM INTERNATIONAL (ASTM)

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

ASTM F1642/F1642M (2017) Standard Test Method for Glazing  
and Glazing Systems Subject to Airblast  
Loadings

ASTM F2248 (2012) Standard Practice for Specifying an  
Equivalent 3-Second Duration Design  
Loading for Blast Resistant Glazing  
Fabricated with Laminated Glass

INTERNATIONAL WINDOW CLEANING ASSOCIATION (IWCA)

IWCA I-14.1 (2001) Window Cleaning Safety Standard

NATIONAL FENESTRATION RATING COUNCIL (NFRC)

NFRC 100 (2014) Procedure for Determining  
Fenestration Product U-Factors

NFRC 200 (2014) Procedure for Determining  
Fenestration Product Solar Heat Gain  
Coefficient and Visible Transmittance at  
Normal Incidence

1.2 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.

### 1.3 SUBMITTALS

Government approval is required for submittals with a "G" designation; submittals not having a "G" designation are for information only. When used, a designation following the "G" designation identifies the office that will review the submittal for the Government. Submittals with an "S" are for inclusion in the Sustainability eNotebook, in conformance to Section 01 33 29 SUSTAINABILITY REPORTING. Submit the following in accordance with Section 01 33 00 SUBMITTAL PROCEDURES:

#### SD-02 Shop Drawings

Windows; G

Fabrication Drawings

#### SD-03 Product Data

Windows; G

Hardware; G

Fasteners; G

Window Performance; G

Thermal-Barrier Windows; G

Mullions; G

Window Cleaners' Bolts; G

Weatherstripping; G

Accessories; G

Adhesives

Submit manufacturer's product data, indicating VOC content.

Thermal Performance; G

#### SD-04 Samples

Finish Sample

Window Sample

#### SD-05 Design Data

Structural Calculations for Deflection; G

Design Analysis; G



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 meets the minimum antiterrorism standards required by paragraph "Minimum Antiterrorism Performance", unless conformance is demonstrated by Standard Airblast Test results. 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. The window components and anchorage devices to the structure, as determined by the design analysis, must be reflected in the shop drawings.

#### SD-06 Test Reports

Minimum Condensation Resistance Factor

Standard Airblast Test; G

For Minimum Antiterrorism windows, in lieu of a Design Analysis, results of airblast testing, whether by arena test or shocktube, must be included in a test report, providing information in accordance with ASTM F1642/F1642M, as prepared by the independent testing agency performing the test. The test results must demonstrate the ability of each window proposed for use to withstand the airblast loading parameters and achieve the hazard level rating specified in paragraph "Standard Airblast Test Method".

#### 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

When not labeled, identify types in Operation and Maintenance Manual.

#### SD-11 Closeout Submittals

Recycled Content of Aluminum Windows; S

### 1.4 QUALITY ASSURANCE

#### 1.4.1 Shop Drawing Requirements

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, material and method of attaching subframes, stools, casings, sills, trim, installation details, and other related items.

#### 1.4.2 Sample Requirements

##### 1.4.2.1 Finish Sample Requirements

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

##### 1.4.2.2 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.

#### 1.4.3 Design Data Requirements

Submit calculations to substantiate compliance with deflection requirements and Minimum Antiterrorism Performance criteria. 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 meets the requirements of paragraph "Minimum Antiterrorism Performance Criteria". Calculations verifying the structural performance of each window proposed for use, under the given loads, must be prepared and signed by a registered professional engineer. Reflect the window components and anchorage devices to the structure, as determined by the design analysis, in the shop drawings.

#### 1.4.4 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, minimum condensation resistance factor (CRF), and for Minimum Antiterrorism windows, in lieu of a Design Analysis, results of a Standard Airblast Test.

#### 1.5 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.

#### 1.6 PROTECTION

Protect finished surfaces during shipping and handling using the manufacturer's standard method. Do not apply coatings or lacquers to surfaces to which caulking and glazing compounds must adhere.

#### 1.7 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.

#### 1.8 FIELD MEASUREMENTS

Take field measurements prior to preparation of the drawings and fabrication.

#### 1.9 PERFORMANCE REQUIREMENTS

##### 1.9.1 Wind Loading Design Pressure

Design window components, including mullions, hardware, and anchors, to withstand a wind-loading design pressure as shown on the Structural Drawings.

##### 1.9.2 Tests

Test windows proposed for use in accordance with AAMA/WDMA/CSA 101/I.S.2/A440 for the particular type and quality window specified.

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

#### 1.10 DRAWINGS

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

#### 1.11 WINDOW PERFORMANCE

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

##### 1.11.1 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.

#### 1.11.2 Minimum Antiterrorism Performance

Windows must meet the minimum antiterrorism performance as specified in the paragraphs below. Conformance to the performance requirements must be validated by one of the following methods.

##### 1.11.2.1 Computational Design Analysis Method

Window frames, mullions, and sashes must be designed to the criteria listed herein. Computational design analysis must include calculations verifying the structural performance of each window proposed for use, under the given static equivalent loads.

Aluminum window framing members must restrict deflections of the edges of glazing they support to  $L/60$  under two times (2X) the glazing resistance per the requirements of ASTM F2248 and ASTM E1300. Glazing to be designed to resist blast effects from explosive weight II at a standoff distance of 60 feet, for exterior windows (per Window Schedule indicated on the drawings).  $L$  denotes the length of the glazing supported edge. ( $L$  is to be based on edge length of glazing in frame and not on the distance between anchors that fasten frame to the structure.)

The glazing frame bite for the window frames must be in accordance with ASTM F2248.

Window frames must be anchored to the supporting structure with anchors designed to resist two times (2X) the glazing resistance in accordance with ASTM F2248 and ASTM E1300.

##### 1.11.2.2 Alternate Dynamic Design Analysis Method

As an alternative to the static equivalent load design approach described above, window framing members, anchors, and glazing may be designed using a dynamic analysis to prove the window system will provide performance equivalent to or better than a very low hazard rating in accordance with ASTM F1642/F1642M associated with the applicable low level of protection for the project.

##### 1.11.2.3 Standard Airblast Test Method

As an alternative to either of the Computational Design Analysis Methods, each Minimum Antiterrorism window type must be tested for evaluation of hazards generated from airblast loading in accordance with ASTM F1642/F1642M by an independent testing agency regularly engaged in blast testing. For proposed window systems that are of the same type as the tested system but of different size, the test results may be accepted provided the proposed window size is within the range from 25 percent smaller to 10 percent larger in area, than the tested window. Proposed windows of a size outside this range require testing to evaluate their hazard rating. Testing may be by shocktube or arena test. The test must be performed on the entire proposed window system, to include, but not be limited to, the glazing, its framing system, operating devices, and all anchorage devices. Anchorage of the window frame or subframe must replicate the method of installation to be used for the project. The

minimum airblast loading parameters for the test must be as follows: Peak positive pressure of 40 kPa and positive phase impulse of 285 kPa-msec. The hazard rating for the proposed window systems, as determined by the rating criteria of ASTM F1642/F1642M, must not exceed the "Very Low Hazard" rating (i.e. the "No Break", "No Hazard", "Minimal Hazard" and "Very Low Hazard" ratings are acceptable. "Low Hazard" and "High Hazard" ratings are unacceptable). Results of window systems previously tested by test protocols other than ASTM F1642/F1642M may be accepted provided the required loading, hazard level rating, and size limitations stated herein are met.

#### 1.11.3 Air Infiltration

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

#### 1.11.4 Water Penetration

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

#### 1.11.5 Thermal Performance

Non-residential aluminum windows (including frames and glass) must be certified by the National Fenestration Rating Council with a whole-window Solar Heat Gain Coefficient (SHGC) maximum of 0.25 determined according to NFRC 200 procedures and a U-factor maximum of 0.51 Btu/hr-ft<sup>2</sup>-F in accordance with NFRC 100.

#### 1.12 QUALIFICATION

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

#### 1.13 MOCK-UPS

Before fabrication, full-size mock-up of one window unit complete with glass and AAMA certification label for structural purposes and NFRC Temporary and Permanent Label for certification of thermal performance rating will be required for review of window construction and quality of hardware operation.

#### 1.14 WARRANTY

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

### PART 2 PRODUCTS

#### 2.1 PRODUCT SUSTAINABILITY CRITERIA

For products in this section, where applicable and to extent allowed by performance criteria, provide and document the following:

#### 2.1.1 Recycled content of Aluminum Windows

Provide aluminum window frames meeting the recycled content requirements as stated within this section and provide documentation in accordance with Section 01 33 29 SUSTAINABILITY REPORTING paragraph RECYCLED CONTENT.

### 2.2 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. 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.

#### 2.2.1 Fixed Windows (F)

Type F-CW.

#### 2.2.2 Glass and Glazing

Materials are specified in Section 08 81 00 GLAZING.

#### 2.2.3 Caulking and Sealing

Are specified in Section 07 92 00 JOINT SEALANTS.

#### 2.2.4 Weatherstripping

AAMA/WDMA/CSA 101/I.S.2/A440.

### 2.3 FABRICATION

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

#### 2.3.1 Provisions for Glazing

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

For minimum antiterrorism windows, attach glazing to its supporting frame using structural silicone sealant or adhesive glazing tape in accordance with ASTM F2248. Design sash for securing glass with metal beads, glazing clips, glazing channels, or glazing compound.

#### 2.3.2 Weatherstripping

Provide for ventilating sections of all windows to ensure a weather-tight seal meeting the infiltration requirements specified in AAMA/WDMA/CSA 101/I.S.2/A440. Provide easily replaceable factory-applied weatherstripping. Use molded vinyl, molded or molded-expanded neoprene or molded or expanded Ethylene Propylene Diene Terpolymer (EPDM) compression-type weatherstripping for compression contact surfaces. Use

treated woven pile or wool, or polypropylene or nylon pile bonded to nylon fabric and metal or plastic backing strip weatherstripping for sliding surfaces. Do not use neoprene or polyvinylchloride weatherstripping where exposed to direct sunlight.

#### 2.3.3 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.

#### 2.3.4 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.

#### 2.3.5 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.

#### 2.3.6 Combination Windows

Windows used in combination must be factory assembled of the same class and grade. Where factory assembly of individual windows into larger units is limited by transportation considerations, prefabricate, match mark, transport, and field assemble.

#### 2.3.7 Mullions and Transom Bars

Provide mullions between multiple window units to resist two times (2X) glazing resistance in accordance with ASTM F2248 and ASTM E1300. Provide mullions with a thermal break. Secure mullions and transom bars to adjoining construction and window units in such a manner as to permit expansion and contraction and to form a weathertight joint. Provide mullion covers on the interior and exterior to completely close exposed joints and recesses between window units and to present a neat appearance.

Provide special covers over structural support at mullions as indicated.

#### 2.3.8 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.

##### 2.3.8.1 Window Sunshades

Provide manufacturer's window sunshades which includes; extruded anodized aluminum airfoil blades, interlock outrigger, and fascia. Provide pre-final aluminum mounting brackets to secure sunshade to window system. Provide internal steel plate attachment in window framing for secure attachment of sunshade with mounting brackets.

Aluminum windows and sunshades to be provided by one source and

sunshades/mullion mounting be compatible to window system.

Color to match the aluminum window system.

#### 2.3.8.2 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.

#### 2.3.8.3 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.

#### 2.3.8.4 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.

#### 2.3.9 Finishes

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

##### 2.3.9.1 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-A41 integral color anodized. Color as indicated on drawings.

#### 2.4 THERMAL-BARRIER WINDOWS

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

Specify material and construction except as follows:

- a. Aluminum alloy must be 6063-T6.
- b. Frame construction, must be factory-assembled and factory-sealed inner and outer aluminum completely separated from metal-to-metal contact. Join assembly by a continuous, concealed, low conductance divider housed in an interlocking extrusion of the inner frame. Metal fasteners, straps, or anchors must not bridge the connection between the inner and outer frame.

#### 2.5 MULLIONS

Provide mullions between multiple-window units where indicated.



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

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

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

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

## 2.6 WINDOW CLEANERS' BOLTS

Provide window cleaners' bolts for all windows 7 feet or higher above finished grade, except for windows that can be removed and cleaned from the ground or from a lower roof level without the use of an extension ladder. Provide two bolts for each single window unit and each fixed glass unit. Locate bolts 44 inches above the window sill.

Window cleaners' bolts must be double-head type, AISI Series 300 corrosion-resistant steel, size and design complying with IWCA I-14.1. Contact side of the bolts must be ground to fit flat against window jambs. Bolts must be factory- or field-attached before windows are set. Reinforce backs of frames to receive bolts with 1/4 by 6-inch corrosion-resistant steel or aluminum plates bolted or welded to the frames at the factory. Special wall anchors must be provided on frames at the point of bolt attachment.

## PART 3 EXECUTION

### 3.1 INSTALLATION

#### 3.1.1 Method of Installation

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

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

#### 3.1.2 Dissimilar Materials

Where aluminum surfaces are in contact with, or fastened to masonry, concrete, wood, or dissimilar metals, except stainless steel or zinc,

protect the aluminum surface from dissimilar materials as recommended in the Appendix to AAMA/WDMA/CSA 101/I.S.2/A440. Do not coat surfaces in contact with sealants after installation with any type of protective material.

### 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.

## 3.2 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. Replace all stained, discolored, or abraded windows that cannot be restored to their original condition with new windows.

-- End of Section --

SECTION 08 71 00

DOOR HARDWARE  
**02/16**

PART 1 GENERAL

1.1 REFERENCES

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

ASTM INTERNATIONAL (ASTM)

ASTM E283 (2004; R 2012) Determining the Rate of Air Leakage Through Exterior Windows, Curtain Walls, and Doors Under Specified Pressure Differences Across the Specimen

ASTM F883 (2013) Padlocks

BUILDERS HARDWARE MANUFACTURERS ASSOCIATION (BHMA)

ANSI/BHMA A156.1 (2016) Butts and Hinges

ANSI/BHMA A156.13 (2017) Mortise Locks & Latches Series 1000

ANSI/BHMA A156.15 (2015) Release Devices Closer Holder, Electromagnetic and Electromechanical

ANSI/BHMA A156.16 (2013) Auxiliary Hardware

ANSI/BHMA A156.18 (2016) Materials and Finishes

ANSI/BHMA A156.21 (2014) Thresholds

ANSI/BHMA A156.22 (2017) Door Gasketing and Edge Seal Systems

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 A156.27 (2011) Power and Manual Operated Revolving Pedestrian Doors

ANSI/BHMA A156.3 (2014) Exit Devices

ANSI/BHMA A156.36 (2010) Auxiliary Locks

ANSI/BHMA A156.4 (2013) Door Controls - Closers

ANSI/BHMA A156.5 (2014) Cylinder and Input Devices for Locks

ANSI/BHMA A156.6 (2015) Architectural Door Trim

ANSI/BHMA A156.7 (2016) Template Hinge Dimensions  
ANSI/BHMA A156.8 (2015) Door Controls - Overhead Stops and Holders

NATIONAL FIRE PROTECTION ASSOCIATION (NFPA)

NFPA 101 (2018; TIA 18-1) Life Safety Code  
NFPA 252 (2017) Standard Methods of Fire Tests of Door Assemblies  
NFPA 70 (2017; ERTA 1-2 2017; TIA 17-1; TIA 17-2; TIA 17-3; TIA 17-4; TIA 17-5; TIA 17-6; TIA 17-7; TIA 17-8; TIA 17-9; TIA 17-10; TIA 17-11; TIA 17-12; TIA 17-13; TIA 17-14) National Electrical Code  
NFPA 72 (2016) National Fire Alarm and Signaling Code  
NFPA 80 (2016; TIA 16-1) Standard for Fire Doors and Other Opening Protectives

STEEL DOOR INSTITUTE (SDI/DOOR)

SDI/DOOR A250.8 (2003; R2008) Recommended Specifications for Standard Steel Doors and Frames

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

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

UNDERWRITERS LABORATORIES (UL)

UL 14C (2006; Reprint Jul 2017) UL Standard for Safety Swinging Hardware for Standard Tin-Clad Fire Doors Mounted Singly and in Pairs  
UL Bld Mat Dir (updated continuously online) Building Materials Directory

1.2 SUBMITTALS

Government approval is required for submittals with a "G" designation; submittals not having a "G" designation are for information only. When used, a designation following the "G" designation identifies the office that will review the submittal for the Government. Submittals with an "S" are for inclusion in the Sustainability eNotebook, in conformance with Section 01 33 29 SUSTAINABILITY REPORTING. Submit the following in accordance with Section 01 33 00 SUBMITTAL PROCEDURES:

SD-02 Shop Drawings

Manufacturer's Detail Drawings; G

Verification of Existing Conditions; G

Hardware Schedule

Keying System

SD-03 Product Data

Hardware Items

SD-08 Manufacturer's Instructions

Installation

SD-10 Operation and Maintenance Data

Hardware Schedule Items, Data Package 1

SD-11 Closeout Submittals

Key Bitting

### 1.3 SHOP DRAWINGS

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

### 1.4 PRODUCT DATA

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

### 1.5 HARDWARE SCHEDULE

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.

## 1.6 KEY BITTING CHART REQUIREMENTS

### 1.6.1 Requirements

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

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

## 1.7 QUALITY ASSURANCE

### 1.7.1 Hardware Manufacturers and Modifications

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

### 1.7.2 Key Shop Drawings Coordination Meeting

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

## 1.8 DELIVERY, STORAGE, AND HANDLING

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

## PART 2 PRODUCTS

### 2.1 TEMPLATE HARDWARE

Hardware applied to metal or to prefinished doors must be manufactured using a template. Provide templates to door and frame manufacturers in accordance with ANSI/BHMA A156.7 for template hinges. Coordinate hardware items to prevent interference with other hardware.

### 2.2 HARDWARE FOR FIRE DOORS AND EXIT DOORS

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

## 2.3 HARDWARE ITEMS

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

### 2.3.1 Hinges

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

### 2.3.2 Continuous Hinges

Where continuous hinges are required, provide in accordance with ANSI/BHMA A156.26. Anodized hinges after machining process. Provide lifetime warranty.

### 2.3.3 Locks and Latches

#### 2.3.3.1 Mortise Locks and Latches

Provide in accordance with ANSI/BHMA A156.13, Series 1000, Operational Grade 1, Security Grade 1. Provide solid one-piece stainless steel latchbolt. 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 concealed cylinders and provide trim items with straight, beveled, or smoothly rounded sides, corners, and edges. Provide lifetime warranty.

#### 2.3.3.2 Hospital Latches

Push-pull latch set similar and equal to ABH 6000, 2-3/4 inch throw, 2-3/4 inch backset. Cover approximately 2-1/2 by 5-1/2 inch, handle approximately 1-1/2 by 4-1/2 inch, projection approximately 2-1/2 inch, covers and handles of stainless steel, BHMA 630 finish, engraved "PUSH" and "PULL" on handles, push handle pointing up, pull handle pointing down.

#### 2.3.3.3 Auxiliary Locks

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

#### 2.3.3.4 Combination Locks

Heavy-duty, mechanical combination lockset with five push buttons, 3/4 inch deadlocking latch, 2-3/4 inch backset. Locks to operate by pressing two or more of the buttons in unison or individually in the proper sequence. Inside operates the latch. Provide a keyed removable core cylinder on the exterior to permit bypassing the combination.

### 2.3.4 Exit Devices

Provide in accordance with ANSI/BHMA A156.3, Grade 1. Provide adjustable strikes for rim type and vertical rod devices. Provide open back strikes

for pairs of doors with mortise and vertical rod devices. Provide "T" style stainless steel touch bars with ramped endcaps in the direction of egress.

#### 2.3.5 Cylinders and Cores

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

#### 2.3.6 Push Button Mechanisms

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

#### 2.3.7 Electrified Hardware

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

##### 2.3.7.1 Electric Strikes and Frame Mounted Actuators

###### 2.3.7.1.1 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.

###### 2.3.7.1.2 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.

###### 2.3.7.1.3 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.

###### 2.3.7.1.4 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.

###### 2.3.7.1.5 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.



#### 2.3.7.2 Card Readers and Keypad Access Control Hardware

Provide in accordance with ANSI/BHMA A156.5 and ANSI/BHMA A156.25, Grade 1 components. Provide devices that are tamper alarmed, tamper and vandal resistant, solid state, and do not contain electronics which could compromise the access control subsystem should the subsystem be attacked. Provide surface, semi-flush, pedestal, or weatherproof mountable devices as specified for each individual location. Provide proximity type card readers capable of reading Smart Card type access control cards. Coordinate access control hardware with corresponding devices and systems specified in Division 28 ELECTRONIC SECURITY SYSTEMS (ESS).

#### 2.3.7.3 Release Devices

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

#### 2.3.7.4 Delayed Egress Locking System

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

#### 2.3.7.5 Power and Manual Operated Revolving Pedestrian Doors

Provide in accordance with ANSI/BHMA A156.27, Grade 1.

#### 2.3.8 Keying System

Provide a master keying system an extension of the existing keying system. Existing locks were manufactured by BEST LOCK and have interchangeable cores. Provide construction interchangeable cores. Provide key cabinet as specified.

#### 2.3.9 Lock Trim

Provide cast, forged, construction and commercial plain design for lock trim with protected and concealed cylinder.

##### 2.3.9.1 Lever Handles

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

##### 2.3.10 Keys

Provide one file key, one duplicate key, and one working key for each key change and for each master keying system. Provide one additional working key for each lock of each keyed-alike group. Provide 2 grand master keys, 2 construction master keys, and 2 control keys for removable cores. Provide a quantity of key blanks equal to 20 percent of the total number of file keys. Stamp each key with appropriate key control symbol and "U.S. property - do not duplicate." Do not place room number on keys.

#### 2.3.11 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.

#### 2.3.12 Closers

Provide in accordance with ANSI/BHMA A156.4, Series C72000, Grade 1, cast iron with PT 4C and 1-1/2 inch minimum bore. Provide with brackets, arms, mounting devices, fasteners, full size covers, 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 lifetime warranty.

#### 2.3.13 Overhead Holders

Provide in accordance with ANSI/BHMA A156.8.

#### 2.3.14 Door Protection Plates

Provide in accordance with ANSI/BHMA A156.6.

##### 2.3.14.1 Sizes of Mop and Kick Plates

2 inch less than door width for single doors; 1 inch less than door width for pairs of doors. Provide 8 inch kick plates for flush doors. Provide a minimum 36 inch armor plates for flush doors. Provide 4 inch mop plates.

##### 2.3.14.2 Edge Guards

Stainless steel, of same height as armor plates. Apply to hinge stile, lock stile, and meeting stiles.

#### 2.3.15 Door Stops and Silencers

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

#### 2.3.16 Padlocks

Provide in accordance with ASTM F883.

#### 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 0.5 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 silicone rubber inserts. Provide clear anodized aluminum.

#### 2.3.19 Lightproofing and Soundproofing Gasketing

Provide in accordance with ANSI/BHMA A156.22. Provide adjustable doorstops at heads, jams and automatic door bottoms in accordance with the hardware set, of extruded aluminum, clear anodized, surface applied, with vinyl fin seals between plunger and housing. Provide doorstops with silicone rubber, or closed cell sponge gasket. Provide door bottoms with adjustable operating rod and silicone rubber. 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 finish. 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. Match exposed parts of concealed closers to lock and door trim. Match hardware finish for aluminum doors to the doors.

## 2.6 KEY CABINET AND CONTROL SYSTEM

Provide in accordance with ANSI/BHMA A156.5, Type required to yield a capacity (number of hooks) 50 percent greater than the number of key changes used for door locks.

## PART 3 EXECUTION

### 3.1 INSTALLATION

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

#### 3.1.1 Weatherstripping Installation

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

##### 3.1.1.1 Stop Applied Weatherstripping

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

#### 3.1.2 Lightproofing and 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.

### 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. Provide tin-clad fire doors in accordance with UL 14C.

### 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

SET #1 - Exterior, FRP

Doors: 150B, 150C, 151B, 151D, 151E

1	Continuous Hinge	662HD	628	ST	
1	Exit Device	2103 CD DS	630AM	PR	
1	Mortise Cylinder	1E-74 PATD	626	BE	
1	Rim Cylinder	12E-72 PATD	626	BE	
1	Flush Pull	1111C	630	TR	
1	Door Closer	QDC113	689	ST	
1	Weatherstrip	700 ES	NA		
1	Door Sweep	C627	NA		
1	Threshold	896 S	AL	NA	

SET #2 - Vestibule

Doors: 101B

1	Continuous Hinge	662HD	628	ST	
1	Power Transfer	PT100	689	AB	
1	Exit Device	ELR TS 2308 CD DS	630AM	PR	
2	Mortise Cylinder	1E-74 PATD	626	BE	
1	Card Reader	E-PLEX SMART	DO		
1	Power Supply	ELR151	PR		
1	Door Closer	QDC114	689	ST	
1	Kick Plate	K0050 8"	630	TR	
1	Gasketing	2525 B	NA		
1	Auto Door Bottom	4447 S	NA		

SET #3 - Specialty

Doors: 150A, 151A

1	Mortise Cylinder	1E-74 PATD	626	BE	
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SET #4 - Egress

Doors: 131A, 131B

3	Hinges	QH CB1900R 4 1/2 x 4 1/2	652	ST	
1	Exit Device	FL 2308	630AM	PR	
1	Mortise Cylinder	1E-74 PATD	626	BE	
1	Door Closer	QDC113	689	ST	
1	Kick Plate	K0050 8"	630	TR	
1	Gasketing	2525 B	NA		
1	Auto Door Bottom	4447 S	NA		

SET #5

Doors: 150E, 150F

3	Hinges	QH CB1900R 4 1/2 x 4 1/2	652	ST	
1	Exit Device	FL 2308	630AM	PR	
1	Electronic Exit Device Trim	EXBV-7EV14DV PATD	626AM	BE	
1	Mortise Cylinder	1E-74 PATD	626	BE	
1	Door Closer	QDC113	689	ST	
1	Kick Plate	K0050 8"	630	TR	
1	Gasketing	2525 B	NA		

1 Auto Door Bottom 4447 S NA

SET #6 - Exterior, Always Locked

Doors: 120A, 127A, 161A, 162A, 162B

1 Continuous Hinge 662HD 628 ST  
1 Lockset 45H-7D14N PATD 630AM BE  
1 Door Closer QDC113 DA 689 ST  
1 Door Position Switch 1078 CW SE  
1 Weatherstrip 700 ES NA  
1 Door Sweep C627 A NA  
1 Threshold 896 S AL NA

SET #7

Doors: 151C

3 Hinges QH CB1900R 4 1/2 x 4 1/2 652 ST  
1 Lockset 45H-7R14N PATD 630AM BE  
1 Door Closer QDC113 DA 689 ST  
1 Kick Plate K0050 8" 630 TR  
1 Gasketing 2525 B NA  
1 Auto Door Bottom 4447 S NA

SET #8 - Exterior, Pair, Always Locked

Doors: 121A, 122A, 126A, 116A, 119A

2 Continuous Hinge 662HD 628 ST  
1 Set Auto Flush Bolts 3820 X 3810 630 TR  
1 Lockset 45H-7D14N PATD 630AM BE  
2 Door Closer QDC114 DA 689 ST  
1 Dustproof Strike 3911 630 TR  
2 Door Position Switch 1078 CW SE  
1 Weatherstrip 700 ES NA  
2 Door Sweep C627 A NA  
1 Astragal NA  
1 Threshold 896 S AL NA

NOTE: At electrical rooms with more than 1200 amps of  
equipment, provide FL 2308 exit device as per NEC.

SET #9

Doors: 117A, 118A

1 Continuous Hinge 662HD 628 ST  
1 Lockset 45H-7R14N PATD 630AM BE  
1 Door Closer QDC113 DA 689 ST  
1 Armor Plate KA050 34" 630 TR  
2 Frame Guards FG4000 630 TR  
1 Mop Plate KM050 4" 630 TR  
1 Gasketing 2525 B NA  
1 Auto Door Bottom 4447 S NA

SET #10 - Pair

Doors: 119B

2	Continuous Hinge	662HD	628	ST	
1	Set Auto Flush Bolts	3820 X 3810	630	TR	
1	Lockset	45H-7R14N PATD	630AM	BE	
1	Coordinator	3094B2	600	TR	
2	Door Closer	QDC113 DA	689	ST	
2	Armor Plate	KA050 34"	630	TR	
2	Mop Plate	KM050 4"	630	TR	
1	Dustproof Strike	3911	630	TR	
1	Gasketing	2525 B	NA		
2	Auto Door Bottom	4448 S	NA		

SET #11 - Push Button

Doors: 123A, 150D

1	Continuous Hinge	662HD	628	ST	
1	Keypad Lock	45HZ-7DV14KP PATD	626AM	BE	
1	Door Closer	QDC113 DA	689	ST	
1	Armor Plate	KA050 34"	630	TR	
1	Mop Plate	KM050 4"	630	TR	
1	Gasketing	2525 B	NA		
1	Auto Door Bottom	4447 S	NA		

SET #12 - Always Locked

Doors: 106A, 136A

3	Hinges	QH CB1900R 4 1/2 x 4 1/2	652	ST	
1	Lockset	45H-7D14N PATD	630AM	BE	
1	Door Closer	QDC113	689	ST	
1	Gasketing	2525 B	NA		

NOTE: Provide FL 2308 exit device at 121B

SET #13 - Push Pull Latch

Doors: 110A, 110B, 113A, 113B, 114A

1	Continuous Hinge	662HD	628	ST	
1	Push/Pull Passage	6610J	630AM	AB	
1	Door Closer	QDC114 DA	689	ST	
1	Kick Plate	K0050 8"	630	TR	
1	Mop Plate	KM050 4"	630	TR	
3	Door Silencers	1229A	GREY	TR	

SET #14 - Push Pull Latch

Doors: 108A, 109A, 111A, 112A

1	Continuous Hinge	662HD	628	ST	
1	Push/Pull Passage	6610J	630AM	AB	
1	Door Closer	QDC113	689	ST	
1	Kick Plate	K0050 8"	630	TR	
1	Mop Plate	KM050 4"	630	TR	
1	Gasketing	2525 B	NA		

SET #15



Doors: 107A

3	Hinges	QH CB1900R 4 1/2 x 4 1/2	652	ST
1	Lockset	45H-7R14N PATD	630AM	BE
1	Door Closer	QDC111	689	ST
1	Kick Plate	K0050 8"	630	TR
1	Wall Bumper	1270CXSV	626	TR
1	Gasketing	2525 B	NA	

SET #16 - Office

Doors: 104A, 105A, 202A, 103A

3	Hinges	QH CB1900R 4 1/2 x 4 1/2	652	ST
1	Lockset	45H-7AB14N PATD	630AM	BE
1	Door Closer	QDC111	689	ST
1	Kick Plate	K0050 8"	630	TR
1	Wall Bumper	1270CXSV	626	TR
1	Coat Hook	802	626	RO
1	Gasketing	2525 B	NA	
1	Auto Door Bottom	4447 S	NA	

SET #17 - Exterior, FRP, Entry

Doors: 101A, 102A

1	Continuous Hinge	662HD	628	ST
1	Exit Device	2108 CD DS	630AM	PR
1	Electronic Exit Device Trim	EXBV-7EV14DV PATD	626AM	BE
1	Mortise Cylinder	1E-74 PATD	626	BE
1	Rim Cylinder	12E-72 PATD	626	BE
1	Door Closer	QDC113	689	ST
1	Weatherstrip	700 ES	NA	
1	Door Sweep	C627 A	NA	
1	Threshold	896 S	AL	NA

SET #18 - Passage

Doors: 231A

3	Hinges	QH CB1900R 4 1/2 x 4 1/2	652	ST
1	Passage Set	45H-0N14N	630AM	BE
1	Door Closer	QDC113	689	ST
1	Kick Plate	K0050 8"	630	TR
1	Gasketing	2525 B	NA	

-- End of Section --



SECTION 08 81 00

GLAZING

08/11

PART 1 GENERAL

1.1 REFERENCES

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

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 C1036 (2016) Standard Specification for Flat  
Glass

ASTM C1048 (2012; E 2012) Standard Specification for  
Heat-Treated Flat Glass - Kind HS, Kind FT  
Coated and Uncoated Glass

ASTM C1172 (2014) Standard Specification for  
Laminated Architectural Flat Glass

ASTM C509 (2006; R 2015) Elastomeric Cellular  
Preformed Gasket and Sealing Material

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

ASTM C920 (2018) Standard Specification for  
Elastomeric Joint Sealants

ASTM D2287 (2012) Nonrigid Vinyl Chloride Polymer and  
Copolymer Molding and Extrusion Compounds

ASTM D395 (2014) Standard Test Methods for Rubber  
Property - Compression Set

ASTM E119 (2016a) Standard Test Methods for Fire  
Tests of Building Construction and  
Materials

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

U.S. DEPARTMENT OF DEFENSE (DOD)

UFC 4-010-01 (2012; with Change 1) DoD Minimum  
Antiterrorism Standards for Buildings

GLASS ASSOCIATION OF NORTH AMERICA (GANA)

GANA Glazing Manual (2004) Glazing Manual

GANA Sealant Manual (2008) Sealant Manual

INSULATING GLASS MANUFACTURERS ALLIANCE (IGMA)

IGMA TB-3001 (2001) Guidelines for Sloped Glazing

IGMA TM-3000 (1990; R 2004) North American Glazing  
Guidelines for Sealed Insulating Glass  
Units for Commercial & Residential Use

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

16 CFR 1201 Safety Standard for Architectural Glazing  
Materials

1.2 SUBMITTALS

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

SD-02 Shop Drawings

Installation; G

Drawings showing complete details of the proposed setting methods, mullion details, edge blocking, size of openings, frame details, materials, and types and thickness of glass.

SD-03 Product Data

Blast Resistant Insulating Glass Units

Documentation for Energy Star qualifications.

Blast Resistant Laminated Glass

Fire/Safety Rated Glass

Tempered Glass

Glazing Accessories

Manufacturer's descriptive product data, handling and storage recommendations, installation instructions, and cleaning instructions.

SD-04 Samples

Blast Resistant Insulating Glass Units

Blast Resistant Laminated Glass

Fire/Safety Rated Glass

Tempered Glass

Glazing Tape

Sealant

Two 8 by 10 inch samples of each of the following: blast resistant insulated glass units, fire/safety rated glass and tempered glass.

#### SD-07 Certificates

Blast Resistant Insulating Glass Units

Blast Resistant Laminated Glass

Fire/Safety Rated Glass

Tempered Glass

Certificates stating that the glass meets the specified requirements. Labels or manufacturers marking affixed to the glass will be accepted in lieu of certificates.

#### SD-08 Manufacturer's Instructions

Setting and Sealing Materials

Glass Setting

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

### 1.3 SYSTEM DESCRIPTION

Fabricate and install watertight and airtight glazing systems to withstand thermal movement and wind loading without glass breakage, gasket failure, deterioration of glazing accessories, or defects in the work. Glazed panels must comply with the safety standards, in accordance with ANSI Z97.1, and comply with indicated blast/wind loading in accordance with ASTM E1300 and UFC 4-010-01 for blast loading.

### 1.4 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.

### 1.5 ENVIRONMENTAL REQUIREMENTS

Do not start glazing work until the outdoor temperature is above 40 degrees F and rising, unless procedures recommended by the glass manufacturer and approved by the Contracting Officer are made to warm the

glass and rabbet surfaces. Provide ventilation to prevent condensation of moisture on glazing work during installation. Do not perform glazing work during damp or rainy weather.

#### 1.6 DOD MINIMUM ANTITERRORISM STANDARDS

Exterior glazing shall meet the required DOD Minimum Antiterrorism Standards UFC 4-010-01.

#### 1.7 SUSTAINABLE DESIGN REQUIREMENTS

##### 1.7.1 Local/Regional Materials

Use materials or products extracted, harvested, or recovered, as well as manufactured, within a 500 mile radius from the project site, if available from a minimum of three sources.

#### 1.8 WARRANTY

##### 1.8.1 Warranty for Blast Resistant Insulating Glass Units

Warranty blast resistant 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

Type I, Class 1 (clear), Quality q5 (B). Provide for glazing openings not indicated or specified otherwise. Use double-strength sheet glass or 1/8 inch float glass for openings up to and including 15 square feet, 3/16 inch for glazing openings over 15 square feet but not over 30 square feet, and 1/4 inch for glazing openings over 30 square feet but not over 45 square feet.

##### 2.1.2 Blast Resistant Laminated Glass

ASTM C1172, Kind LA fabricated from two nominal 1/8 inch pieces of Type I, Class 1, Quality q3, flat annealed transparent glass conforming to ASTM C1036. Flat glass must be laminated together with a minimum of 0.030 inch thick, clear polyvinyl butyral interlayer, complying with UFC 4-010-01, with a total nominal thickness of 1/4 inch. Color shall be clear.

##### 2.1.3 Tempered Glass

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

#### 2.1.4 Fire/Safety Rated Glass

Fire/safety rated glass must be laminated Type I transparent flat type, Class 1-clear. Glass must have a 60 minute rating when tested in accordance with ASTM E119. Glass must be permanently labeled with appropriate markings.

### 2.2 BLAST RESISTANT INSULATING GLASS UNITS

#### 2.2.1 Blast Resistant Low Emissivity Insulating Glass

Exterior glass panes for Low-E insulating units must be Type I annealed flat glass, Class 2-tinted with anti-reflective low-emissivity coating on No. 2 surface, inside surface of exterior pane, plus 1/2 inch air space. Interior lite 1/4 inch clear plus 090 PVB plus 1/4 clear. Glass performance shall have a summer daytime U value maximum of 0.26 Btu/hr-ft<sup>2</sup>-F, Solar Heat Gain Coefficient (SHGC) maximum of 0.21. Color shall be solarbronze.

### 2.3 SETTING AND SEALING MATERIALS

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

#### 2.3.1 Sealants

Provide elastomeric sealants.

##### 2.3.1.1 Elastomeric Sealant

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

#### 2.3.2 Preformed Channels

Neoprene, vinyl, or rubber, as recommended by the glass manufacturer for the particular condition.

#### 2.3.3 Sealing Tapes

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

#### 2.3.4 Setting Blocks and Edge Blocks

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

recommended in writing by glass manufacturer. Block color must be black.

### 2.3.5 Glazing Gaskets

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

#### 2.3.5.1 Fixed Glazing Gaskets

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

#### 2.3.5.2 Wedge Glazing Gaskets

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

#### 2.3.5.3 Aluminum Framing Glazing Gaskets

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

### 2.3.6 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.

## PART 3 EXECUTION

### 3.1 PREPARATION

Preparation, unless otherwise specified or approved, must conform to applicable recommendations in the GANA Glazing Manual, GANA Sealant Manual, IGMA TB-3001, IGMA TM-3000, and manufacturer's recommendations. Determine the sizes to provide the required edge clearances by measuring the actual opening to receive the glass. Grind smooth in the shop glass edges that will be exposed in finish work. Leave labels in place until the installation is approved, except remove applied labels on heat-absorbing glass and on insulating glass units as soon as glass is installed. Securely fix movable items or keep in a closed and locked position until glazing compound has thoroughly set.

### 3.2 GLASS SETTING

Shop glaze or field glaze items to be glazed using glass of the quality and thickness specified or indicated. Glazing, unless otherwise specified or approved, must conform to applicable recommendations in the GANA Glazing Manual, GANA Sealant Manual, IGMA TB-3001, IGMA TM-3000, and



manufac, 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 Blast Resistant 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, 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 wa Remove and replace glass units which are broken, chipped, cracked, abraded, or otherwise damaged during construction activities with new units.

## 3.5 WASTE MANAGEMENT

Disposal and recycling of waste materials, including corrugated cardboard recycling, shall be in accordance with the Waste Management Plan. Upon removal, separate protective materials for reuse or recycle. Separate tempered glass for use as aggregate or nonstructural fill. Close and seal tightly all partly used sealant containers and store protected in well-ventilated, fire-safe area at moderate temperature.

-- End of Section --



SECTION 08 91 00

METAL WALL LOUVERS

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.

AIR MOVEMENT AND CONTROL ASSOCIATION INTERNATIONAL (AMCA)

AMCA 500-D (2012) Laboratory Methods of Testing  
Dampers for Rating

AMCA 511 (2010) 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 B221 (2014) Standard Specification for Aluminum  
and Aluminum-Alloy Extruded Bars, Rods,  
Wire, Profiles, and Tubes

1.2 SUBMITTALS

Government approval is required for submittals with a "G" designation; submittals not having a "G" designation are for information only. When used, a designation following the "G" designation identifies the office that will review the submittal for the Government. Submittals with an "S" are for inclusion in the Sustainability eNotebook, in conformance to Section 01 33 29 SUSTAINABILITY REPORTING. Submit the following in accordance with Section 01 33 00 SUBMITTAL PROCEDURES:

SD-02 Shop Drawings

Wall louvers

SD-03 Product Data

Metal Wall Louvers

SD-04 Samples

Wall louvers

Door louvers; G

1.3 DELIVERY, STORAGE, AND PROTECTION

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

1.4 DETAIL DRAWINGS

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

1.5 COLOR SAMPLES

Colors of finishes for wall louvers and door louvers shall 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 Extruded Aluminum

ASTM B221, alloy 6063-T5 or -T52.

2.2 METAL WALL LOUVERS

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

2.2.1 Extruded Aluminum Louvers

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

2.2.2 Mullions and Mullion Covers

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

2.2.3 Screens and Frames

For aluminum louvers, provide 1/2 inch square mesh, 14 or 16 gage aluminum or 1/4 inch square mesh, 16 gage aluminum bird screening. Mount screens in removable, rewirable frames of same material and finish as the louvers.

2.3 FASTENERS AND ACCESSORIES

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

## 2.4 FINISHES

### 2.4.1 Aluminum

Exposed aluminum surfaces shall be factory finished with an anodic coating. Color shall be as indicated.

#### 2.4.1.1 Anodic Coating

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

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

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

-- End of Section --



SECTION 09 22 00

SUPPORTS FOR PLASTER AND GYPSUM BOARD

02/10

PART 1 GENERAL

1.1 REFERENCES

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

ASTM INTERNATIONAL (ASTM)

ASTM A463/A463M	(2010; R 2015) Standard Specification for Steel Sheet, Aluminum-Coated, by the Hot-Dip Process
ASTM A653/A653M	(2017) 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	(2015) Installation of Steel Framing Members to Receive Screw-Attached Gypsum Panel Products

UNDERWRITERS LABORATORIES (UL)

UL Fire Resistance	(2014) Fire Resistance Directory
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1.2 SUBMITTALS

Government approval is required for submittals with a "G" designation; submittals not having a "G" designation are for information only. When used, a designation following the "G" designation identifies the office that will review the submittal for the Government. Submittals with an "S" are for inclusion in the Sustainability eNotebook, in conformance to Section 01 33 29 SUSTAINABILITY REPORTING. Submit the following in accordance with Section 01 33 00 SUBMITTAL PROCEDURES:

SD-02 Shop Drawings

Metal support systems

Submit for the erection of metal framing, furring, and ceiling suspension systems. Indicate materials, sizes, thicknesses, and fastenings.

1.3 DELIVERY, STORAGE, AND HANDLING

Deliver materials to the job site and store in ventilated dry locations. Storage area shall permit easy access for inspection and handling. If materials are stored outdoors, stack materials off the ground, supported

on a level platform, and fully protected from the weather. Handle materials carefully to prevent damage. Remove damaged items and provide new items.

## PART 2 PRODUCTS

### 2.1 MATERIALS

Provide steel materials for metal support systems with galvanized coating ASTM A653/A653M, G-60; aluminum coating ASTM A463/A463M, T1-25; or a 55-percent aluminum-zinc coating. Provide support systems and attachments per UFC 3-310-04, "Seismic Design for Buildings" in seismic zones.

#### 2.1.1 Materials for Attachment of Gypsum Wallboard

##### 2.1.1.1 Suspended and Furred Ceiling Systems

ASTM C645.

##### 2.1.1.2 Nonload-Bearing Wall Framing and Furring

ASTM C645, but not thinner than 0.0329 inch thickness. The ASTM certified third party testing statement for equivalent thicknesses shall not apply.

##### 2.1.1.3 Furring Structural Steel Columns

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

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

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

## PART 3 EXECUTION

### 3.1 INSTALLATION

#### 3.1.1 Systems for Attachment of Gypsum Wallboard

##### 3.1.1.1 Suspended and Furred Ceiling Systems

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

##### 3.1.1.2 Non-loadbearing Wall Framing and Furring

ASTM C754, except as indicated otherwise.

##### 3.1.1.3 Furring Structural Steel Columns

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



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

Install Z-furring channels vertically spaced not more than 24 inches o.c. Locate Z-furring channels at interior and exterior corners in accordance with manufacturer's printed erection instructions. Fasten furring channels to masonry 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 --



SECTION 09 29 00

GYPSUM BOARD

**08/16**

PART 1 GENERAL

1.1 REFERENCES

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

ASTM INTERNATIONAL (ASTM)

ASTM C1002	(2014) 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	(2014a) Standard Specification for Accessories for Gypsum Wallboard and Gypsum Veneer Base
ASTM C1177/C1177M	(2013) Standard Specification for Glass Mat Gypsum Substrate for Use as Sheathing
ASTM C1178/C1178M	(2013) Standard Specification for Glass Mat Water-Resistant Gypsum Backing Panel
ASTM C1396/C1396M	(2017) Standard Specification for Gypsum Board
ASTM C475/C475M	(2015) Joint Compound and Joint Tape for Finishing Gypsum Board
ASTM C514	(2004; R 2014) Standard Specification for Nails for the Application of Gypsum Board
ASTM C840	(2017) Standard Specification for Application and Finishing of Gypsum Board
ASTM C954	(2015) 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 D1149	(2007; R 2012) Standard Test Method for Rubber Deterioration - Surface Ozone Cracking in a Chamber
ASTM D226/D226M	(2017) Standard Specification for Asphalt-Saturated Organic Felt Used in Roofing and Waterproofing
ASTM D3273	(2016) Standard Test Method for Resistance

to Growth of Mold on the Surface of  
Interior Coatings in an Environmental  
Chamber

ASTM D412

(2016) Standard Test Methods for  
Vulcanized Rubber and Thermoplastic  
Elastomers - Tension

ASTM D624

(2000; R 2012) Tear Strength of  
Conventional Vulcanized Rubber and  
Thermoplastic Elastomers

CALIFORNIA DEPARTMENT OF PUBLIC HEALTH (CDPH)

CDPH SECTION 01350

Standard Method for the Testing and  
Evaluation of Volatile Organic Chemical  
Emissions from Indoor Sources using  
Environmental Chambers

FM GLOBAL (FM)

FM APP GUIDE

(updated on-line) Approval Guide  
<http://www.approvalguide.com/>

GREEN SEAL (GS)

GS-36

(2011) Commercial Adhesives

GYPSUM ASSOCIATION (GA)

GA 214

(2010) Recommended Levels of Gypsum Board  
Finish

GA 216

(2010) Application and Finishing of Gypsum  
Panel Products

GA 253

(2012) Application of Gypsum Sheathing

SCIENTIFIC CERTIFICATION SYSTEMS (SCS)

SCS

SCS Global Services (SCS) Indoor Advantage

SOUTH COAST AIR QUALITY MANAGEMENT DISTRICT (SCAQMD)

SCAQMD Rule 1168

(1989; R 2005) Adhesive and Sealant  
Applications

UNDERWRITERS LABORATORIES (UL)

UL 2818

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

UL Fire Resistance

(2014) Fire Resistance Directory

1.2 SUBMITTALS

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

used, a designation following the "G" designation identifies the office that will review the submittal for the Government. Submittals with an "S" are for inclusion in the Sustainability eNotebook, in conformance with Section 01 33 29 SUSTAINABILITY REPORTING. Submit the following in accordance with Section 01 33 00 SUBMITTAL PROCEDURES:

SD-03 Product Data

Glass Mat Water-Resistant Gypsum Tile Backing Board

Water-Resistant Gypsum Backing Board

Glass Mat Covered or Reinforced Gypsum Sheathing

Glass Mat Covered or Reinforced Gypsum Sheathing Sealant

Accessories

Submit for each type of gypsum board.

Certifications

Gypsum Board; S

SD-07 Certificates

Asbestos Free Materials

Certify that gypsum board types, gypsum backing board types, and joint treating materials do not contain asbestos.

Indoor Air Quality; G

SD-08 Manufacturer's Instructions

Safety Data Sheets

SD-10 Operation and Maintenance Data

Manufacturer Maintenance Instructions

SD-11 Closeout Submittals

Recycled Content for Gypsum Board; S

Recycled Content for Paper Facing and Gypsum Cores; S

Indoor Air Quality for Gypsum Board; S

VOC Content of Joint Compound; S

Indoor Air Quality for Non-aerosol Adhesives; S

Indoor Air Quality for Aerosol Adhesives; S

### 1.3 CERTIFICATIONS

#### 1.3.1 Indoor Air Quality Certifications

Submit required indoor air quality certifications in one submittal package.

##### 1.3.1.1 Ceiling and Wall Systems

Provide products certified to meet indoor air quality requirements by UL 2818 (Greenguard) Gold, SCS Global Services Indoor Advantage Gold or provide validation by other third-party program that products meet the requirements of this paragraph. Provide current product certification documentation from certification body. Gypsum wall board and panels must meet the emissions requirements of CDPH SECTION 01350 (limit requirements for either office or classroom spaces regardless of space type).

##### 1.3.1.2 Adhesives and Sealants

Provide products certified to meet indoor air quality requirements by UL 2818 (Greenguard) Gold, SCS Global Services Indoor Advantage Gold or provide validation by other third-party program that products meet the requirements of this paragraph. Sealants and non-aerosol adhesive products used on the interior of the building (defined as inside of the weatherproofing system) must meet either emissions requirements of CDPH SECTION 01350 (limit requirements for either office or classroom spaces regardless of space type) or VOC content requirements of SCAQMD Rule 1168. Aerosol adhesive products used on the interior of the building (defined as inside of the weatherproofing system) must meet either emissions requirements of CDPH SECTION 01350 (limit requirements for either office or classroom spaces regardless of space type) or VOC content requirements of GS-36. Provide current product certification documentation from certification body.

### 1.4 DELIVERY, STORAGE, AND HANDLING

#### 1.4.1 Delivery

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

#### 1.4.2 Storage

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

#### 1.4.3 Handling

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

## 1.5 QUALIFICATIONS

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

## 1.6 SCHEDULING

The gypsum wallboard must be taped, finished and primed before the installation of the highly-emitting materials.

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

## 1.7 ENVIRONMENTAL REQUIREMENTS

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

## 1.8 FIRE RESISTIVE CONSTRUCTION

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

## PART 2 PRODUCTS

### 2.1 PRODUCT SUSTAINABILITY CRITERIA

For products in this section, where applicable and to extent allowed by performance criteria, provide and document the following:

#### 2.1.1 Recycled Content for Gypsum Board Materials

Recycled content is identified for some products in this section; provide documentation in accordance with Section 01 33 29 SUSTAINABILITY REPORTING paragraph RECYCLED CONTENT. Other products listed in this section may be available with recycled content; identify those products that meet project requirements for recycled content, and provide documentation in accordance

with Section 01 33 29 SUSTAINABILITY REPORTING paragraph RECYCLED CONTENT.

#### 2.1.2 Reduce Volatile Organic Compounds (VOC) (LOW-EMITTING MATERIALS) for Products

Reduced VOC content is identified for some products in this section; provide documentation in accordance with Section 01 33 29 SUSTAINABILITY REPORTING paragraph REDUCE VOLATILE ORGANIC COMPOUNDS (VOC) (LOW-EMITTING MATERIALS). Other products listed in this section may be available with reduced VOC content; identify those products that meet project requirements for reduced VOC content, and provide documentation in accordance with Section 01 33 29 SUSTAINABILITY REPORTING paragraph REDUCE VOLATILE ORGANIC COMPOUNDS (VOC) (LOW-EMITTING MATERIALS).

### 2.2 MATERIALS

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

#### 2.2.1 Gypsum Board

ASTM C1396/C1396M. Gypsum board must contain a minimum of 10 percent post-consumer recycled content, or a minimum of 20 percent post-industrial recycled content. Provide data identifying percentage of recycled content for gypsum board. Paper facings must contain a minimum of 100 percent post-consumer recycled paper content. Gypsum cores must contain a minimum of 95 percent post-industrial recycled gypsum content. Provide data identifying percentage of recycled content for paper facing and gypsum cores. Provide certification of indoor air quality for gypsum board.

##### 2.2.1.1 Regular

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

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

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

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

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

#### 2.2.2 Regular Water-Resistant Gypsum Backing Board

ASTM C1396/C1396M

##### 2.2.2.1 Regular

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

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

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



### 2.2.3 Glass Mat Water-Resistant Gypsum Tile Backing Board

ASTM C1178/C1178M

#### 2.2.3.1 Regular

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

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

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

### 2.2.4 Glass Mat Covered or Reinforced Gypsum Sheathing

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

#### 2.2.4.1 Glass Mat Covered or Reinforced Gypsum Sheathing Sealant

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

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

### 2.2.5 Joint Treatment Materials

ASTM C475/C475M. Product must be low emitting VOC types with VOC limits not exceeding 50 g/L. Provide data identifying VOC content of joint compound. Use all purpose joint and texturing compound containing inert fillers and natural binders, including lime compound. Pre-mixed compounds must be free of antifreeze, vinyl adhesives, preservatives, biocides and other slow releasing compounds.

#### 2.2.5.1 Embedding Compound

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

#### 2.2.5.2 Finishing or Topping Compound

Specifically formulated and manufactured for use as a finishing compound.

#### 2.2.5.3 All-Purpose Compound

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

#### 2.2.5.4 Setting or Hardening Type Compound

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

#### 2.2.5.5 Joint Tape

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

#### 2.2.6 Fasteners

##### 2.2.6.1 Nails

ASTM C514.

##### 2.2.6.2 Screws

ASTM C1002, Type "G", Type "S" or Type "W" steel drill screws for fastening gypsum board to gypsum board, wood framing members and steel framing members less than 0.033 inch thick. ASTM C954 steel drill screws for fastening gypsum board to steel framing members 0.033 to 0.112 inch thick.

##### 2.2.6.3 Staples

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

<u>Length of Legs</u>	<u>Thickness of Gypsum Board</u>
1-1/8 inches	1/2 inch
1-1/4 inches	5/8 inch

#### 2.2.7 Adhesives

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

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

Not permitted.

#### 2.2.8 Shaftwall Liner Panel

ASTM C1396/C1396M. Conform to the UL Fire Resistance for the Design Numbers(s) indicated for shaftwall liner panels. Manufacture liner panel

for cavity shaftwall system, with water-resistant paper faces, bevel edges, single lengths to fit required conditions, 1 inch thick, by 24inch wide.

#### 2.2.9 Accessories

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

#### 2.2.10 Asphalt Impregnated Building Felt

Provide a 15 lb asphalt moisture barrier over glass mat covered or reinforced gypsum sheathing. Conforming to ASTM D226/D226M Type 1 (No. 15) for asphalt impregnated building felt.

#### 2.2.11 Water

Provide clean, fresh, and potable water.

### PART 3 EXECUTION

#### 3.1 EXAMINATION

##### 3.1.1 Framing and Furring

Verify that framing and furring are securely attached and of sizes and spacing to provide a suitable substrate to receive gypsum board. 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.

##### 3.1.2 Building Construction Materials

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

#### 3.2 APPLICATION OF GYPSUM BOARD

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

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

### 3.2.3 Glass Mat Covered or Fiber Reinforced Gypsum Sheathing

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

### 3.2.4 Control Joints

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

## 3.3 FINISHING OF GYPSUM BOARD

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

### 3.3.1 Uniform Surface

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

### 3.4 SEALING

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

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

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

### 3.5 FIRE-RESISTANT ASSEMBLIES

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

### 3.6 PATCHING

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

### 3.7 SHAFTWALL FRAMING

Install the shaftwall system in accordance with the system manufacturer's published instructions. Coordinate bucks, anchors, blocking and other items placed in or behind shaftwall framing with electrical and mechanical work. Patch or replace fireproofing materials which are damaged or removed during shaftwall construction.

-- End of Section --



SECTION 09 30 10

CERAMIC TILING  
08/17

PART 1 GENERAL

1.1 REFERENCES

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

AMERICAN NATIONAL STANDARDS INSTITUTE (ANSI)

ANSI A136.1 (2008) American National Standard  
Specifications for Organic Adhesives for  
Installation of Ceramic Tile

ANSI A137.1 (2012) 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 C1026 (2013) Standard Test Method for Measuring  
the Resistance of Ceramic Tile to  
Freeze-Thaw Cycling

ASTM C144 (2011) Standard Specification for  
Aggregate for Masonry Mortar

ASTM C150/C150M (2017) Standard Specification for Portland  
Cement

ASTM C206 (2014) Standard Specification for  
Finishing Hydrated Lime

ASTM C207 (2006; R 2011) Standard Specification for  
Hydrated Lime for Masonry Purposes

ASTM C333/C333M (2016) Standard Specification for Concrete  
Aggregates

ASTM C373 (2017) 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 (2004; R 2009) Breaking Strength of  
Ceramic Tile

ASTM C847 (2014a) Standard Specification for Metal  
Lath

CALIFORNIA DEPARTMENT OF PUBLIC HEALTH (CDPH)

CDPH SECTION 01350 Standard Method for the Testing and  
Evaluation of Volatile Organic Chemical  
Emissions from Indoor Sources using  
Environmental Chambers

GREEN SEAL (GS)

GS-36 (2011) Commercial Adhesives

SCIENTIFIC CERTIFICATION SYSTEMS (SCS)

SCS SCS Global Services (SCS) Indoor Advantage

SOUTH COAST AIR QUALITY MANAGEMENT DISTRICT (SCAQMD)

SCAQMD Rule 1168 (1989; R 2005) Adhesive and Sealant  
Applications

TILE COUNCIL OF NORTH AMERICA (TCNA)

TCNA Hdbk (2013) Handbook for Ceramic, Glass, and  
Stone Tile Installation

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

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

UNDERWRITERS LABORATORIES (UL)

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

## 1.2 SUBMITTALS

Government approval is required for submittals with a "G" designation; submittals not having a "G" designation are for information only. When used, a designation following the "G" designation identifies the office that will review the submittal for the Government. Submittals with an "S" are for inclusion in the Sustainability eNotebook, in conformance to Section 01 33 29 SUSTAINABILITY REPORTING. Submit the following in accordance with Section 01 33 00 SUBMITTAL PROCEDURES:

SD-02 Shop Drawings

Detail Drawings

SD-03 Product Data

Porcelain Tile; S



Glazed Wall Tile; S

Setting-Bed

Mortar, Grout, and Adhesive; S

Reinforcing Wire Fabric

SD-04 Samples

Tile; G

Accessories

Transition Strips

Grout

SD-07 Certificates

Indoor Air Quality

Mortar, Grout, and Adhesive; G

SD-08 Manufacturer's Instructions

Maintenance Instructions

SD-10 Operation and Maintenance Data

Installation

SD-11 Closeout Submittals

Recycled Content for Porcelain Tile; S

Recycled Content for Glazed Wall Tile; S

Indoor Air Quality for Adhesives; S

Indoor Air Quality for Sealants; S

1.3 CERTIFICATIONS

1.3.1 Indoor Air Quality Certifications

1.3.1.1 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.

1.4 QUALITY ASSURANCE

Provide installers having a minimum of two years experience with a company specializing in performing the type of work described. Each type and

color of tile to be provided from a single source. Each type and color of mortar, adhesive, and grout to be provided from the same source.

#### 1.5 DELIVERY, STORAGE, AND HANDLING

Ship tiles in sealed packages and clearly marked with the grade, type of tile, producer identification, and country of origin. Deliver materials to the project site in manufacturer's original unopened containers with seals unbroken and labels and hallmarks intact. Protect materials from weather, and store them under cover in accordance with manufacturer's printed instructions.

#### 1.6 ENVIRONMENTAL REQUIREMENTS

Do not perform ceramic tile work unless the substrate and ambient temperature is at least 50 degrees F and rising. Maintain temperature above 50 degrees F while the work is being performed and for at least 7 days after completion of the work. When temporary heaters are used, ventilate the area to the outside to avoid carbon dioxide damage to new tilework.

#### 1.7 WARRANTY

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

#### 1.8 EXTRA MATERIALS

Supply an extra 2 percent of each type tile used in clean and marked cartons.

### PART 2 PRODUCTS

#### 2.1 TILE

Provide tiles that comply with ANSI A137.1 and are standard grade tiles. Provide a minimum breaking strength of 125 lbs. for wall tile and 250 lbs. for floor tile in accordance with ASTM C648. Provide exterior building tile for cold climate projects that is approved by the manufacturer for exterior use when tested in accordance with ASTM C1026. Provide floor tiles with a wet dynamic coefficient of friction (DCOF) value of 0.42 or greater when tested in accordance with ANSI A137.1 requirements. For materials like tile, accessories, and transition strips submit samples of sufficient size to show color range, pattern, type and joints. Submit manufacturer's catalog data.

##### 2.1.1 Porcelain Tile

Provide porcelain tile, base and trim pieces with color extending uniformly through the body of the tile. 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) as indicated on the drawings and 3/8 inch thick. Provide a 0.50 percent maximum water absorption in accordance with ASTM C373.

Provide Porcelain Tiling Materials that contain a minimum of 10 percent recycled content. Provide data identifying percentage of recycled content for porcelain tile.

### 2.1.2 Glazed Wall Tile

Furnish glazed wall tile that has cushioned edges and trim with lead-free matte finish. Provide nominal tile size(s) as indicated on the drawings.

Provide Glazed Wall Tile Materials that contain a minimum of 3 percent recycled content. Provide data identifying percentage of recycled content for glazed wall tile.

### 2.1.3 Accessories

## 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.

## 2.3 WATER

Provide potable water.

## 2.4 MORTAR, GROUT, AND ADHESIVE

Provide non-aerosol adhesive products used on the interior of the building (defined as inside of the weatherproofing system) meeting either emissions requirements of CDPH SECTION 01350 (limit requirements for either office or classroom spaces regardless of space type) or VOC content requirements of SCAQMD Rule 1168. Provide aerosol adhesives used on the interior of the building meeting either emissions requirements of CDPH SECTION 01350 (limit requirements for either office or classroom spaces regardless of space type) or VOC content requirements of GS-36. For products located on the interior of the building (inside of the weatherproofing system),

provide certification or validation of indoor air quality for adhesives.

#### 2.4.1 Dry-Set Portland Cement Mortar

TCNA Hdbk.

#### 2.4.2 Latex-Portland Cement Mortar

TCNA Hdbk.

#### 2.4.3 Ceramic Tile Grout

TCNA Hdbk; petroleum-free and plastic-free dry-set grout.

#### 2.4.4 Organic Adhesive

TCNA Hdbk, Type I. Water-resistant. Comply with ANSI A136.1.

#### 2.4.5 Sealants

Comply with applicable regulations regarding toxic and hazardous materials and as specified. Grout sealant must 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 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. Provide transition strips that comply with 36 CFR 1191 requirements.

### 2.6 FINISHING AND EDGE-PROTECTION PROFILES

#### 2.6.1 Description

L-shaped profile with 1/8 inch wide top section and vertical wall section that together form the visible surface, integrated trapezoid-perforated anchoring leg, and integrated grout joint spacer.

#### 2.6.2 Anchoring Leg

- a. Provide with straight anchoring leg.
- b. Provide with special radius anchoring leg for radius applications.

#### 2.6.3 Material and Finish

Brushed chrome anodized aluminum.

## 2.7 MOVEMENT JOINTS

### 2.7.1 Description

Profile with integrated rigid, recycled PVC, trapezoid-perforated anchoring legs, connected by a 3/16 inch wide soft CPE movement zone that forms the visible surface.

- a. Color: To be closest match to grout color.
- b. Height: Height as required.

### 2.7.2 Description

Profile with integrated rigid, recycled PVC trapezoid-perforated anchoring legs, connected at a 90-degree angle by a 3/16 inch wide soft CPE movement zone that forms the visible surface.

- a. Color: To be closest match to grout color.
- b. Height: Height as required.

## 2.8 UNCOUPLING MEMBRANE

### 2.8.1 Description

1/8 inch thick, high-density polyethylene membrane with a grid structure of 1/2 by 1/2 inch square cavities, each cut back in a dovetail configuration, and a polypropylene anchoring fleece laminated to its underside. Conforms to definition for uncoupling membranes in the TCNA Handbook for Ceramic Tile Installation; and meets or exceeds the requirements of the "American national standard specifications for load bearing, bonded, waterproof membranes for thin-set ceramic tile and dimension stone installation A118.10," and is listed by cUPC®, and is evaluated by ICC-ES.

### 2.8.2 Waterproofing Seaming Membrane

Provide with seams and corners material 0.004 inch thick, polyethylene membrane, with polypropylene fleece laminated on both sides.

## 2.9 WATERPROOFING MEMBRANE

### 2.9.1 Description

0.008 inch thick, polyethylene membrane, with polypropylene fleece laminated on both sides, which meets or exceeds the requirements of the "American national standard specifications for load bearing, bonded, waterproof membranes for thin-set ceramic tile and dimension stone installation A118.10," and is listed by cUPC®, and is evaluated by ICC-ES.

### 2.9.2 Waterproofing Seaming Membrane

Provide seams and corners material 0.004 inch thick, polyethylene membrane, with polypropylene fleece laminated on both sides.

### 2.9.3 Waterproofing Accessories

- a. Mixing valve seals.

b. Pipe seals.

2.10 COLOR, TEXTURE, AND PATTERN

Provide color, pattern and texture in accordance with as indicated. Color listed is not intended to limit the selection of equal colors from other manufacturers.

PART 3 EXECUTION

3.1 PREPARATORY WORK AND WORKMANSHIP

Inspect surface to receive tile in conformance to the requirements of TCNA Hdbk for surface conditions for the type setting bed specified and for workmanship. Provide variations of tiled surfaces that fall within maximum values shown below:

TYPE	WALLS	FLOORS
Dry-Set Mortar	1/8 inch in 8 ft.	1/8 inch in 10 ft.
Organic Adhesives	1/8 inch in 8 ft.	1/16 inch in 3 ft.
Latex Portland Cement Mortar	1/8 inch in 8 ft.	1/8 inch in 10 ft.
Epoxy	1/8 inch in 8 ft.	1/8 inch in 10 ft.

3.2 GENERAL INSTALLATION REQUIREMENTS

Do not start tile work until roughing in for mechanical and electrical work has been completed and tested, and built-in items requiring membrane waterproofing have been installed and tested. Close space, in which tile is being set, to traffic and other work. Keep closed until tile is firmly set. Do not start floor tile installation in spaces requiring wall tile until after wall tile has been installed. Apply tile in colors and patterns indicated in the area shown on the drawings. Install tile with the respective surfaces in true even planes to the elevations and grades shown. Provide special shapes as required for sills, jambs, recesses, offsets, external corners, and other conditions to provide a complete and neatly finished installation. Solidly back tile bases and coves with mortar. Do not walk or work on newly tiled floors without using kneeling boards or equivalent protection of the tiled surface. Keep traffic off horizontal portland cement mortar installations for at least 72 hours. Keep all traffic off epoxy installed floors for at least 40 hours after grouting, and heavy traffic off for at least 7 days, unless otherwise specifically authorized by manufacturer. Dimension and draw detail drawings at a minimum scale of 1/4 inch = 1 foot. Include drawings of pattern at inside corners, outside corners, termination points and location of all equipment items such as thermostats, switch plates, mirrors and toilet accessories mounted on surface. Submit drawings showing ceramic tile pattern elevations. Submit manufacturer's preprinted installation instructions.

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

### 3.3 INSTALLATION OF WALL TILE

Install wall tile in accordance with the TCNA Hdbk, method W202E-17 and W244C-17 and with grout joints.

#### 3.3.1 Workable or Cured Mortar Bed

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

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

Use Latex-Portland Cement to install tile in accordance with TCNA Hdbk. Use Latex Portland Cement when installing porcelain ceramic tile.

#### 3.3.3 Organic Adhesive

Conform to TCNA Hdbk for the organic adhesive installation of ceramic tile.

#### 3.3.4 Ceramic Tile Grout

Prepare and install ceramic tile grout in accordance with TCNA Hdbk.

### 3.4 INSTALLATION OF FLOOR TILE

Install floor tile in accordance with TCNA Hdbk method F128-17 and with grout joints as recommended by the manufacturer for the type of tile. Install shower receptors in accordance with TCNA Hdbk method .

#### 3.4.1 Workable or Cured Mortar Bed

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

#### 3.4.2 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.

#### 3.4.3 Resinous Grout

When resinous grout is indicated, grout quarry tile with either furan or epoxy resin grout. 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 and 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.

#### 3.4.4 Ceramic Tile Grout

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

#### 3.4.5 Waterproofing

Shower pans are specified in Section 22 00 00 PLUMBING, GENERAL PURPOSE.

#### 3.4.6 Concrete Fill

Provide a 3500 psi concrete fill mix to dry as consistency as practicable. Compose concrete fill by volume of 1 part Portland cement to 3 parts fine aggregate to 4 parts coarse aggregate, and mix with water to as dry a consistency as practicable. Spread, tamp, and screed concrete fill to a true plane, and pitch to drains or levels as shown. Thoroughly damp concrete fill before applying setting-bed material. Reinforce concrete fill with one layer of reinforcement, with the uncut edges lapped the width of one mesh and the cut ends and edges lapped a minimum 2 inch. Tie laps together with 18 gauge wire every 10 inch along the finished edges and every 6 inch along the cut ends and edges. Provide reinforcement with support and secure in the centers of concrete fills. Provide a continuous mesh; except where expansion joints occur, cut mesh and discontinue across such joints. Provide reinforced concrete fill under the setting-bed where the distance between the under-floor surface and the finished tiles floor surface is a minimum of 2 inches, and of the same thickness that the mortar setting-bed over the concrete fill with the thickness required in the specified TCNA Hdbk method.

### 3.5 INSTALLATION OF 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 EXPANSION JOINTS

Form and seal joints as specified in Section 07 92 00 JOINT SEALANTS.

#### 3.6.1 Walls

Provide expansion joints at control joints in backing material. Wherever backing material changes, install an expansion joint to separate the different materials.

#### 3.6.2 Floors

Provide expansion joints over construction joints, control joints, and expansion joints in concrete slabs. Provide expansion joints where tile abuts restraining surfaces such as perimeter walls, curbs and columns and at intervals of 24 to 36 feet each way in large interior floor areas and 12 to 16 feet each way in large exterior areas or areas exposed to direct sunlight or moisture. Extend expansion joints through setting-beds and fill.



### 3.7 CLEANING AND PROTECTING

Upon completion, thoroughly clean tile surfaces in accordance with manufacturer's approved cleaning instructions. Do not use acid for cleaning glazed tile. Clean floor tile with resinous grout or with factory mixed grout in accordance with printed instructions of the grout manufacturer. After the grout has set, provide a protective coat of a noncorrosive soap or other approved method of protection for tile wall surfaces. Cover tiled floor areas with building paper before foot traffic is permitted over the finished tile floors. Provide board walkways on tiled floors that are to be continuously used as passageways by workmen. Replace damaged or defective tiles. Submit copy of manufacturer's printed maintenance instructions.

-- End of Section --



SECTION 09 51 00

ACOUSTICAL CEILINGS

08/17

PART 1 GENERAL

1.1 REFERENCES

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

ASTM INTERNATIONAL (ASTM)

ASTM A489	(2012) Standard Specification for Carbon Steel Lifting Eyes
ASTM A641/A641M	(2009a; R 2014) Standard Specification for Zinc-Coated (Galvanized) Carbon Steel Wire
ASTM C423	(2009a) Sound Absorption and Sound Absorption Coefficients by the Reverberation Room Method
ASTM C635/C635M	(2017) Standard Specification for Manufacture, Performance, and Testing of Metal Suspension Systems for Acoustical Tile and Lay-In Panel Ceilings
ASTM C636/C636M	(2013) Standard Practice for Installation of Metal Ceiling Suspension Systems for Acoustical Tile and Lay-In Panels
ASTM C834	(2017) Standard Specification for Latex Sealants
ASTM E1264	(2014) Acoustical Ceiling Products
ASTM E1414/E1414M	(2011a; E 2014) Airborne Sound Attenuation Between Rooms Sharing a Common Ceiling Plenum
ASTM E1477	(1998a; R 2017) Standard Test Method for Luminous Reflectance Factor of Acoustical Materials by Use of Integrating-Sphere Reflectometers
ASTM E795	(2016) Standard Practices for Mounting Test Specimens During Sound Absorption Tests

CALIFORNIA DEPARTMENT OF PUBLIC HEALTH (CDPH)

CDPH SECTION 01350	Standard Method for the Testing and Evaluation of Volatile Organic Chemical Emissions from Indoor Sources using
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Environmental Chambers

GREEN SEAL (GS)

GS-36

(2011) Commercial Adhesives

SOUTH COAST AIR QUALITY MANAGEMENT DISTRICT (SCAQMD)

SCAQMD Rule 1168

(1989; R 2005) Adhesive and Sealant  
Applications

1.2 SUBMITTALS

Government approval is required for submittals with a "G" designation; submittals not having a "G" designation are for information only. When used, a designation following the "G" designation identifies the office that will review the submittal for the Government. Submittals with an "S" are for inclusion in the Sustainability eNotebook, in conformance to Section 01 33 29 SUSTAINABILITY REPORTING. Submit the following in accordance with Section 01 33 00 SUBMITTAL PROCEDURES:

SD-02 Shop Drawings

Approved Detail Drawings

SD-04 Samples

Acoustical Units; G

SD-06 Test Reports

Ceiling Attenuation Class and Test

SD-11 Closeout Submittals

Recycled Content for Type XII Ceiling Tiles; S

Recycled Content for Suspension Systems; S

Indoor Air Quality for Type V Ceiling Tiles; S

Indoor Air Quality for Type XII Ceiling Tiles; S

Indoor Air Quality for Adhesives; S

Indoor Air Quality for Sealants; S

1.3 DELIVERY, STORAGE. AND HANDLING

Deliver materials to the site in the manufacturer's original unopened containers with brand name and type clearly marked. Carefully handle and store materials in dry, watertight enclosures. Immediately before installation, store acoustical units for not less than 24 hours at the same temperature and relative humidity as the space where they will be installed in order to assure proper temperature and moisture acclimation.

1.4 ENVIRONMENTAL REQUIREMENTS

Maintain a uniform temperature of not less than 60 degrees F nor more than

85 degrees F and a relative humidity of not more than 70 percent for 24 hours before, during, and 24 hours after installation of acoustical units.

#### 1.5 SCHEDULING

Complete and dry interior finish work such as plastering, concrete and terrazzo work before ceiling installation. Complete mechanical, electrical, and other work above the ceiling line; install and start operating heating, ventilating, and air conditioning systems in order to maintain temperature and humidity requirements.

#### 1.6 WARRANTY

Provide manufacturer's standard performance guarantees or warranties that extend beyond a one year period. Include an agreement to repair or replace acoustical panels that fail within the warranty period in the standard performance guarantee or warranty. Failures include, but are not limited to, sagging and warping of panels; rusting and manufacturers defects of grid system.

#### 1.7 EXTRA MATERIALS

Furnish spare tiles, from the same lot as those installed, of each color at the rate of 5 tiles for each 1000 tiles installed.

#### 1.8 OTHER SUBMITTAL REQUIREMENTS

Submit the following:

a. Manufacturer's catalog showing UL classification of fire-rated ceilings giving materials, construction details, types of floor and roof constructions to be protected, and UL design number and fire protection time rating for each required floor or roof construction and acoustic ceiling assembly.

b. Reports by an independent testing laboratory attesting that acoustical ceiling systems meet specified fire endurance and sound transmission requirements. Data attesting to conformance of the proposed system to Underwriters Laboratories requirements for the fire endurance rating listed in UL Fire Resistance may be submitted in lieu of test reports.

### PART 2 PRODUCTS

#### 2.1 SYSTEM DESCRIPTION

Provide sound controlling units mechanically mounted on a ceiling suspension system for acoustical treatment. The unit size, texture, finish, and color must be as specified. The Contractor has the option to substitute inch-pound (I-P) Recessed Light Fixtures (RLF) for metric RLF. If the Contractor opts to furnish I-P RLF, other ceiling elements like acoustical ceiling tiles, air diffusers, air registers and grills, must also be I-P products. Coordinate the whole ceiling system with other details, like the location of access panels and ceiling penetrations, etc, shown on the drawings. The Contractor is responsible for all associated labor and materials and for the final assembly and performance of the specified work and products if I-P products are used. The location and extent of acoustical treatment must be as shown on the approved detail drawings. Submit drawings showing suspension system, method of anchoring

and fastening, details, and reflected ceiling plan. Coordinate with paragraph RECLAMATION PROCEDURES for reclamation of mineral fiber acoustical ceiling panels to be removed from the job site.

#### 2.1.1.1 Ceiling Attenuation Class and Test

Provide a ceiling system with an attenuation class (CAC) of between 35 and 39 for when determined in accordance with ASTM E1414/E1414M. Provide fixture attenuators over light fixtures and other ceiling penetrations, and provide acoustical blanket insulation adjacent to partitions, as required to achieve the specified CAC. Provide test ceiling continuous at the partition and assembled in the suspension system in the same manner that the ceiling will be installed on the project.

#### 2.1.2 Ceiling Sound Absorption

Determine the Noise Reduction Coefficient (NRC) in accordance with ASTM C423 Test Method.

#### 2.1.3 Light Reflectance

Determine light reflectance factor in accordance with ASTM E1477 Test Method.

### 2.2 ACOUSTICAL UNITS

Submit two samples of each type of acoustical unit and each type of suspension grid tee section showing texture, finish, and color. Conform acoustical units to ASTM E1264, Class A, and the following requirements:

#### 2.2.1 Units for Exposed-Grid System

##### 2.2.1.1 Type

XII (fiberglass base with membrane-faced overlay). Provide Type XII Acoustical Ceiling Tiles containing a minimum of 25 percent recycled content. Provide data identifying percentage of recycled content for Type XII ceiling tiles. Provide certification of indoor air quality for Type XII Ceiling Tiles.

##### 2.2.1.2 Flame Spread

Class A, 25 or less

##### 2.2.1.3 Pattern

E

##### 2.2.1.4 Minimum NRC

0.75 in open office areas; 0.60 in conference rooms, executive offices, teleconferencing rooms, and other rooms as designated; 0.50 in all other rooms and areas when tested on mounting Type E-400 of ASTM E795.

##### 2.2.1.5 Minimum Light Reflectance Coefficient

LR-1, 0.75 or greater

2.2.1.6 Nominal Size

24 by 24 inch

2.2.1.7 Edge Detail

Square Tegular

2.2.1.8 Finish

Factory-applied standard finish .

2.2.1.9 Minimum CAC

40

2.2.2 Metal Faced Composition Units

2.2.2.1 Type

Type V (Steel facings with non-asbestos mineral composition absorbent backing). Provide certification of indoor air quality for Type V Ceiling Tiles.

2.2.2.2 Flame Spread

Class: A, flame spread 25 or less

2.2.2.3 Pattern

G

2.2.2.4 Minimum (NRC)

0.75 in open office areas. 0.60 in conference rooms, executive offices, teleconferencing rooms, and other rooms as designated. 0.50 in all other rooms and areas. Base the tested NRC value on Mounting Type E-400 of ASTM E795.

2.2.2.5 Minimum Light Reflectance Coefficient

LR-1, 0.75 or greater

2.2.2.6 Nominal Size

24 by 24 inch

2.2.2.7 Edge Detail

Square Tegular

2.2.2.8 Joint Detail

Trimmed and butted

2.2.3 Unit Acoustical Absorbers

Absorbers must be individually mounted sound absorbing plaques composed of glass fibers or non-asbestos mineral fibers and having a NRC range of not

less than 0.60 - 0.70 when tested in accordance with ASTM C423 and reported as a 4 frequency average.

## 2.3 SUSPENSION SYSTEM

Provide standard exposed-grid narrow width flange as shown on drawings suspension system conforming to ASTM C635/C635M for intermediate-duty systems . Provide surfaces exposed to view of aluminum or steel with a factory-applied white baked-enamel finish . Provide wall molding having a flange of not less than 2 inch. Provide standard corners. Suspended ceiling framing system must have the capability to support the finished ceiling, light fixtures, air diffusers, and accessories, as shown. Provide a suspension system with a maximum deflection of 1/360 of the span length. Conform seismic details to the guidance in ASTM C636 and ASTM E580/E580M.

Provide Suspension System containing a minimum of 15 percent recycled content. Provide data identifying percentage of recycled content for suspension systems.

## 2.4 HANGERS

Provide hangers and attachment capable of supporting a minimum 300 pound ultimate vertical load without failure of supporting material or attachment.

### 2.4.1 Wires

Conform wires to ASTM A641/A641M, Class 1, 0.08 inch (12 gauge) in diameter.

### 2.4.2 Eyebolts

Provide eyebolts of weldless, forged-carbon-steel, with a straight-shank in accordance with ASTM A489. Eyebolt size must be a minimum 1/4 inch, zinc coated.

### 2.4.3 Masonry Anchorage Devices

Comply with ASTM C636/C636M for anchorage devices for machine screws .

## 2.5 ACCESS PANELS

Provide access panels that match adjacent acoustical units, designed and equipped with suitable framing and fastenings for removal and replacement without damage. Size panel to be not less than 12 by 12 inch or more than 12 by 24 inch.

- a. Attach an identification plate of 0.032 inch thick aluminum, 3/4 inch in diameter, stamped with the letters "AP" and finished the same as the unit, near one corner on the face of each access panel.
- b. Identify ceiling access panel by a number utilizing white identification plates or plastic buttons with contrasting numerals. Provide plates or buttons of minimum 1 inch diameter and securely attached to one corner of each access unit. Provide a typewritten card framed under glass listing the code identification numbers and corresponding system descriptions listed above. Mount the framed card where directed and furnish a duplicate card to the Contracting



Officer. Code identification system is as follows:

- 1 Plumbing system
- 2 Heating system
- 3 Air conditioning duct system
- 4 Sprinkler system

## 2.6 ADHESIVE

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

## 2.7 FINISHES

Use manufacturer's standard textures, patterns and finishes as specified for acoustical units and suspension system members. Treat ceiling suspension system components to inhibit corrosion.

## 2.8 COLORS AND PATTERNS

Use colors and patterns for acoustical units and suspension system components as indicated on the drawings.

## 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) 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. For products located on the interior of the building (inside of the weatherproofing system), provide certification of indoor air quality for Sealants.

# PART 3 EXECUTION

## 3.1 INSTALLATION

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

Examine surfaces to receive directly attached acoustical units for unevenness, irregularities, and dampness that would affect quality and execution of the work. Rid areas, where acoustical units will be cemented, of oils, form residue, or other materials that reduce bonding capabilities of the adhesive. Complete and dry interior finish work such as plastering, concrete, and terrazzo work before installation. Complete

and approve mechanical, electrical, and other work above the ceiling line prior to the start of acoustical ceiling installation. Provide acoustical work complete with necessary fastenings, clips, and other accessories required for a complete installation. Do not expose mechanical fastenings in the finished work. Lay out hangers for each individual room or space. Provide hangers to support framing around beams, ducts, columns, grilles, and other penetrations through ceilings. Keep main runners and carrying channels clear of abutting walls and partitions. Provide at least two main runners for each ceiling span. Wherever required to bypass an object with the hanger wires, install a subsuspension system so that all hanger wires will be plumb.

### 3.1.1 Suspension System

Install suspension system in accordance with ASTM C636/C636M and as specified herein. Do not suspend hanger wires or other loads from underside of steel decking.

#### 3.1.1.1 Plumb Hangers

Install hangers plumb and not pressing against insulation covering ducts and pipes. Where lighting fixtures are supported from the suspended ceiling system, provide hangers at a minimum of four hangers per fixture and located not more than 6 inch from each corner of each fixture.

#### 3.1.1.2 Splayed Hangers

Where hangers must be splayed (sloped or slanted) around obstructions, offset the resulting horizontal force by bracing, countersplaying, or other acceptable means.

### 3.1.2 Wall Molding

Provide wall molding where ceilings abut vertical surfaces. Miter corners where wall moldings intersect or install corner caps. Secure wall molding not more than 3 inch from ends of each length and not more than 16 inch on centers between end fastenings. Provide wall molding springs at each acoustical unit in semi-exposed or concealed systems.

### 3.1.3 Acoustical Units

Install acoustical units in accordance with the approved installation instructions of the manufacturer. Ensure that edges of acoustical units are in close contact with metal supports, with each other, and in true alignment. Arrange acoustical units so that units less than one-half width are minimized. Hold units in exposed-grid system in place with manufacturer's standard hold-down clips, if units weigh less than 1 psf or if required for fire resistance rating.

### 3.1.4 Caulking

Seal all joints around pipes, ducts or electrical outlets penetrating the ceiling. Apply a continuous ribbon of acoustical sealant on vertical web of wall or edge moldings.

### 3.1.5 Adhesive Application

Wipe back of tile to remove accumulated dust. Daub acoustical units on back side with four equal daubs of adhesive. Apply daubs near corners of

tiles. Ensure that contact area of each daub is at least 2 inch diameter in final position. Press units into place, aligning joints and abutting units tight and uniform without differences in joint widths.

### 3.2 CEILING ACCESS PANELS

Locate ceiling access panels directly under the items which require access.

### 3.3 CLEANING

Following installation, clean dirty or discolored surfaces of acoustical units and leave them free from defects. Remove units that are damaged or improperly installed and provide new units as directed.

### 3.4 RECLAMATION PROCEDURES

Neatly stack ceiling tile, designated for recycling by the Contracting Officer, on 4 by 4 foot pallets not higher than 4 foot. Panels must be completely dry. Shrink wrap and symmetrically stack pallets on top of each other without falling over.

-- End of Section --



SECTION 09 54 23

LINEAR METAL CEILINGS

10/18

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 B209	(2014) Standard Specification for Aluminum and Aluminum-Alloy Sheet and Plate
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 E580/E580M	(2017) Standard Practice for Installation of Ceiling Suspension Systems for Acoustical Tile and Lay-in Panels in Areas Subject to Earthquake Ground Motions

NATIONAL ASSOCIATION OF ARCHITECTURAL METAL MANUFACTURERS (NAAMM)

NAAMM AMP 500	(2006) Metal Finishes Manual
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1.2 SUBMITTALS

Government approval is required for submittals with a "G" designation; submittals not having a "G" designation are for information only. When used, a designation following the "G" designation identifies the office that will review the submittal for the Government. Submittals with an "S" are for inclusion in the Sustainability Notebook, in conformance with Section 01 33 29 SUSTAINABILITY REPORTING. Submit the following in accordance with Section 01 33 00 SUBMITTAL PROCEDURES:

SD-02 Shop Drawings

Shop Drawings

SD-03 Product Data

Materials

Finishes

SD-04 Samples

Finishes

Color

SD-07 Certificates

Manufacturer Qualifications

Installer Qualifications

SD-11 Closeout Submittals

Recycled Content Of Metal Ceiling Products; S

### 1.3 QUALITY CONTROL

#### 1.3.1 Manufacturer Qualifications

Approval required for products of proposed manufacturer, to be based upon submission by certifying that:

- a. Manufacturer has provided linear metal ceiling systems and related accessories as one of its principal products for a minimum of three (3) years.
- b. Accessories required for linear metal ceiling systems are to be manufacturer's standard or other systems compatible with linear metal ceiling system manufacturer's material. Items are to be of materials and construction which provide desired functional service.
- c. Certificate stating that linear metal ceiling system material has been given specified thickness of anodizing or organic coating finish.

#### 1.3.2 Installer Qualifications

Approved in writing by manufacturer and having a minimum of three (3) years' experience in the installation of linear metal ceilings on projects of equivalent size.

#### 1.3.3 Seismic Design

Design braced frame grid system for seismic considerations under direct supervision of Professional Structural Engineer experienced in design of this work and licensed in the state where the work is located. Comply with ASTM E580/E580M for ceiling suspension systems requiring seismic restraint.

### 1.4 DELIVERY, STORAGE, AND HANDLING

#### 1.4.1 Materials

Deliver to site in manufacturer's original unopened containers with brand name and type clearly marked. Carefully handle and store in dry, watertight enclosures.

#### 1.4.2 Storage

Before installation, linear metal ceiling units are to be stored for not less than 48 hours at same temperature and relative humidity as space where they will be installed to assure temperature and moisture conditions

in accordance with manufacturer's recommendations.

## 1.5 ENVIRONMENTAL REQUIREMENTS

Uniform temperature of not less than 60 degrees F nor more than 80 degrees F and a relative humidity of not more than 70 percent are to be maintained for a period of 48 hours before, during, and for 48 hours after installation of linear metal ceiling units. After above period, room temperature is not permitted to fall below 55 degrees F.

## PART 2 PRODUCTS

### 2.1 SYSTEM DESCRIPTION

Unit size, texture, finish, and color as specified. This section includes the following:

- a. Metal grid ceiling system including trim.
- b. Decorative, linear, formed metal ceiling panels, mechanically mounted on a ceiling suspension system.
- c. Accessories: Closures, trim, edge molding and all other items required to provide complete installation.

#### 2.1.1 Shop Drawings

Submit shop drawings for the following:

- a. Submit complete composite fabrication, and installation shop drawings including associated components.
- b. Identify panel sections, trim, and other component parts, not included in manufacturer's product data, by name and material and showing design, construction, installation, and anchorage.
- c. Layout and installation details, including relation to adjacent work such as walls and bulkheads.
- d. Composite reflected ceiling plans, at 1:25 (1/4 inch) scale, showing location of all accessories. Indicate the following:
  - (1) Joint pattern.
  - (2) Ceiling suspension members.
  - (3) Method of attaching hangers to building structure.
  - (4) Ceiling-mounted items including light fixtures. Special moldings at walls, column penetrations, and other junctures with adjoining construction.
- e. Provisions for expansion and contraction.
- f. Anchors and reinforcements.

## 2.2 MATERIALS

### 2.2.1 Linear Metal Ceiling System, General

#### 2.2.1.1 Sheet Metal Characteristics

Form metal panels from sheet metal free from surface blemishes where exposed to view in finished unit. Do not use materials whose exposed surfaces exhibit pitting, seam marks, roller marks, stains, discolorations, or other imperfections.

#### 2.2.1.2 Fabrication

Die-form linear metal panels into units standard with manufacturer and finished as specified herein.

#### 2.2.1.3 Recycled Content of Metal Ceiling Products

Post-consumer content plus one-half of preconsumer content not less than 30 percent.

### 2.2.2 Accessories

Stabilizer bars, clips, splices, and as required for braced frame grid system.

### 2.2.3 Linear Metal Panels

#### 2.2.3.1 General

Formed to snap on and be securely retained on carriers without separate fasteners.

#### 2.2.3.2 Aluminum Panels

ASTM B209, roll-formed sheet, alloy 3005-H26, complying with following requirements:

- a. Minimum Nominal Thickness: 1 inch thickness with 4 inch module panel width.

### 2.2.4 Braced Frame Ceiling Systems, General

Provide manufacturer's standard compression seismic struts designed to accommodate seismic forces.

#### 2.2.4.1 Standard for Metal Braced Frame Systems

Provide manufacturer's standard types, structural classifications, and finishes indicated that comply with ASTM C635/C635M requirements.

#### 2.2.4.2 Anchors

Type as recommended by manufacturer. Size for five (5) times design load indicated in ASTM C635/C635M, Table 1, Direct Hung, unless otherwise indicated.



#### 2.2.5 Edge Moldings and Trim

Manufacturer's standard molding for edges and penetrations of ceiling.

### 2.3 FINISHES

Comply with NAAMM AMP 500. Protect mechanical finishes on exposed surfaces from damage by application of strippable, temporary protective covering before shipment. Submit pairs of samples of each specified color and finish on 12 inch long sections of extrusions or formed shapes for following:

- a. Linear metal panel.
- b. Each exposed molding and trim sections.
- c. Filler strips.
- d. End cap.

#### 2.3.1 Appearance of Finished Work

Variations in appearance of abutting or adjacent ceiling units are not acceptable. Noticeable variations in same piece are not acceptable.

#### 2.3.2 Aluminum Finishes

##### 2.3.2.1 Color

EX-1 to match adjacent wall finish as indicated on Drawings. Manufacturer's standard, organic coating. Where normal color variations are anticipated, include 2 units in set indicating extreme limits of color variations. Integrally colored anodized or prefinished aluminum sheet shall not be less than 8 by 10 inches.

## PART 3 EXECUTION

### 3.1 EXAMINATION

Conditions which may adversely affect linear metal ceiling system installation are to be corrected prior to commencement of linear metal ceiling system installation. Where linear metal ceiling system is installed adjacent to masonry, wash-down of adjacent masonry is to be completed prior to erection of ceiling system to prevent damage to material finish by cleaning materials.

#### 3.1.1 Ceiling Areas

Conform with details, dimensions and tolerances shown on approved linear metal ceiling system composite reflected ceiling plan shop drawings.

### 3.2 PREPARATION

Measure each ceiling area and establish layout of linear metal panel units to balance border widths at opposite edges of each ceiling. Avoid using units less than half wide at borders.

### 3.3 INSTALLATION

#### 3.3.1 Standard for Installation of Ceiling Suspension Systems

Comply with ASTM C636/C636M and ASTM E580/E580M as applicable to linear metal panel ceiling suspension system. The braced frame ceiling hangers from building structural members and as follows

- a. Secure hangers to structure, including intermediate framing members, by attaching to inserts, eye screws, or other devices that are secure and appropriate for structure to which hangers are attached as well as for type of hanger involved, and in a manner that will not cause them to deteriorate or fail because of age, corrosion, and elevated temperatures.

#### 3.3.2 Edge Moldings

Install edge moldings at edge of each linear metal ceiling area and at locations where edge of units would otherwise be exposed after completion of Work. Level moldings with ceiling suspension system to level tolerance of 1/8 inch in 12 feet.

#### 3.3.3 Joints

Align joints in adjacent courses to form uniform, straight joints parallel to room axis in both directions, unless otherwise indicated in construction documents.

#### 3.3.4 Panels with Butt Joints

Install panels with butt joints using internal concealed panel splices and in joint configurations shown on construction documents in reflected ceiling plan.

### 3.4 ADJUSTING AND CLEANING

Following installation, dirty or discolored surfaces of linear metal ceiling units are to be cleaned, in accordance with manufacturer's written recommendations, and left free from defects. Units that are damaged or improperly installed are to be removed and new units provided as directed.

### 3.5 PROTECTION

Protect linear metal ceiling systems from damage until final inspection and acceptance.

-- End of Section --

SECTION 09 65 00

RESILIENT FLOORING  
08/10

PART 1 GENERAL

1.1 REFERENCES

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

ASTM INTERNATIONAL (ASTM)

ASTM D4078	(2002; R 2015) Water Emulsion Floor Polish
ASTM E648	(2017) Standard Test Method for Critical Radiant Flux of Floor-Covering Systems Using a Radiant Heat Energy Source
ASTM F1482	(2015) Installation and Preparation of Panel Type Underlayments to Receive Resilient Flooring
ASTM F1700	(2013a) Solid Vinyl Floor Tile
ASTM F1861	(2016) Standard Specification for Resilient Wall Base
ASTM F1869	(2016) Standard Test Method for Measuring Moisture Vapor Emission Rate of Concrete Subfloor Using Anhydrous Calcium Chloride
ASTM F2169	(2015; E 2016) Standard Specification for Resilient Stair Treads
ASTM F2170	(2016a) Standard Test Method for Determining Relative Humidity in Concrete Floor Slabs in situ Probes
ASTM F710	(2011) Standard Practice for Preparing Concrete Floors to Receive Resilient Flooring

NATIONAL FIRE PROTECTION ASSOCIATION (NFPA)

NFPA 253	(2011) Standard Method of Test for Critical Radiant Flux of Floor Covering Systems Using a Radiant Heat Energy Source
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U.S. GREEN BUILDING COUNCIL (USGBC)

LEED BD+C	(2009; R 2010) Leadership in Energy and Environmental Design(tm) Building Design and Construction (LEED-NC)
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## 1.2 SYSTEM DESCRIPTION

### 1.2.1 Fire Resistance Requirements

Provide a critical radiant flux of not less than 0.45 watts per square centimeter (Class 1) for flooring in corridors and exits when tested in accordance with ASTM E648 or NFPA 253.

### 1.2.2 Other Submittal Requirements

The following shall be submitted in accordance with LEED BD+C:

- a. documentation indicating percentage of post-industrial and post-consumer recycled content per unit of product. Indicate relative dollar value of recycled content products to total dollar value of products included in project.
- b. documentation indicating distance between manufacturing facility and the project site. Indicate distance of raw material origin from the project site. Indicate relative dollar value of local/regional materials to total dollar value of products included in project.
- c. documentation indicating type of biobased material in product and biobased content. Indicate relative dollar value of biobased content products to total dollar value of products included in project.

## 1.3 SUSTAINABILITY REPORTING

Materials in this technical specification may contribute towards contract compliance with sustainability requirements. See Section 01 33 29 SUSTAINABILITY REPORTING for project LEED BD+C local/regional materials, low-emitting materials, recycled content, and rapidly renewable materials.

## 1.4 SUBMITTALS

Government approval is required for submittals with a "G" designation; submittals not having a "G" designation are for information only. When used, a designation following the "G" designation identifies the office that will review the submittal for the Government. Submittals with an "S" are for inclusion in the Sustainability eNotebook, in conformance to Section 01 33 29 SUSTAINABILITY REPORTING. Submit the following in accordance with Section 01 33 00 SUBMITTAL PROCEDURES:

### SD-02 Shop Drawings

Resilient Flooring and Accessories

### SD-03 Product Data

Resilient Flooring and Accessories  
Adhesives; S  
Luxury Vinyl Tile  
Wall Base  
Stair Treads, Risers and Stringers  
Local/Regional Materials

### SD-04 Samples

Resilient Flooring and Accessories; G

SD-06 Test Reports

Moisture, Alkalinity and Bond Tests

SD-08 Manufacturer's Instructions

Surface Preparation  
Installation

SD-10 Operation and Maintenance Data

Resilient Flooring and Accessories

1.5 DELIVERY, STORAGE, AND HANDLING

Deliver materials to the building site in original unopened containers bearing the manufacturer's name, style name, pattern color name and number, production run, project identification, and handling instructions. Store materials in a clean, dry, secure, and well-ventilated area free from strong contaminant sources and residues with ambient air temperature maintained above 68 degrees F and below 85 degrees F, stacked according to manufacturer's recommendations. Remove resilient flooring products from packaging to allow ventilation prior to installation. Protect materials from the direct flow of heat from hot-air registers, radiators and other heating fixtures and appliances. Observe ventilation and safety procedures specified in the MSDS. Do not store rubber surface products with materials that have a high capacity to adsorb volatile organic compound (VOC) emissions. Do not store exposed rubber surface materials in occupied spaces.

1.6 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.

1.7 SCHEDULING

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

1.8 WARRANTY

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

1.9 EXTRA MATERIALS

Provide extra flooring material of each color and pattern at the rate of 5 square feet for each 1000 square feet of sheet flooring installed. Provide extra wall base material composed of 20 linear feet of each type, color and pattern. Package all extra materials in original properly marked containers bearing the manufacturer's name, brand name, pattern color name and number, production run, and handling instructions. Provide

extra materials from the same lot as those installed. Leave extra stock at the site in location assigned by Contracting Officer.

## PART 2 PRODUCTS

### 2.1 LUXURY VINYL TILE TYPE A

Conform to ASTM F1700 Class III printed film with a minimum wear layer thickness 40 mil and minimum overall thickness 0.098 inch, Type A (smooth). Provide 18 inch square tile. Provide tile with a factory protective finish that enhances cleanability and durability.

### 2.2 WALL BASE

Conform to ASTM F1861, Type TS (vulcanized thermoset rubber). Provide 4 inch high and a minimum 1/8 inch thick wall base. Provide preformed corners in matching height, shape, and color.

### 2.3 STAIR TREADS, RISERS AND STRINGERS

Conform to ASTM F2169, Type TS (vulcanized thermoset rubber). Conform to ASTM F2169 for surface of treads Class 2 raised stud ribbed pattern. Provide square nosing. Provide either a one piece nosing/tread/riser or a two piece nosing/tread design with a matching coved riser.

### 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.

### 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.

### 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 floor patterns as specified on the. Provide flooring in any one continuous area or replacement of damaged flooring in continuous area from same production run with same shade and pattern. Submit scaled drawings indicating patterns (including location of patterns and colors) and dimensions. Submit manufacturer's descriptive data and three samples of each indicated color and type of flooring, base, mouldings, and accessories sized a

minimum 2-1/2 by 4 inch. Submit Data Package 1 in accordance with Section 01 78 23 OPERATION AND MAINTENANCE DATA.

### PART 3 EXECUTION

#### 3.1 EXAMINATION

Examine and verify that site conditions are in agreement with the design package. Report all conditions that will prevent a proper installation. Do not take any corrective action without written permission from the Government. Work will proceed only when conditions have been corrected and accepted by the installer. Submit manufacturer's printed installation instructions for all flooring materials and accessories, including preparation of substrate, seaming techniques, and recommended adhesives.

#### 3.2 SURFACE PREPARATION

Provide a smooth, true, level plane for surface preparation of the flooring, except where indicated as sloped. Floor to be flat to within 3/16 inch in 10 feet. Prepare subfloor in accordance with flooring manufacturer's recommended instructions. Prepare the surfaces of lightweight concrete slabs (as defined by the flooring manufacturer) as recommended by the flooring manufacturer. Comply with ASTM F710 for concrete subfloor preparation. Floor fills or toppings may be required as recommended by the flooring manufacturer. Install underlayments, when required by the flooring manufacturer, in accordance with manufacturer's recommended printed installation instructions. Comply with ASTM F1482 for panel type underlayments. Before any work under this section is begun, correct all defects such as rough or scaling concrete, chalk and dust, cracks, low spots, high spots, and uneven surfaces. Repair all damaged portions of concrete slabs as recommended by the flooring manufacturer. Remove concrete curing and sealer compounds from the slabs, other than the type that does not adversely affect adhesion. Remove paint, varnish, oils, release agents, sealers, waxes, and adhesives, as required by the flooring product in accordance with manufacturer's printed installation instructions.

#### 3.3 MOISTURE, ALKALINITY AND BOND TESTS

Determine the suitability of the concrete subfloor for receiving the resilient flooring with regard to moisture content and pH level by moisture and alkalinity tests. Conduct moisture testing in accordance with ASTM F1869 or ASTM F2170, unless otherwise recommended by the flooring manufacturer. Conduct alkalinity testing as recommended by the flooring manufacturer. Determine the compatibility of the resilient flooring adhesives to the concrete floors by a bond test in accordance with the flooring manufacturer's recommendations. Submit copy of test reports for moisture and alkalinity content of concrete slab, and bond test stating date of test, person conducting the test, and the area tested.

#### 3.4 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.

### 3.5 PLACING RUBBER TILE

Install rubber tile and accessories in accordance with manufacturer's printed installation instructions. Prepare and apply adhesives in accordance with manufacturer's printed directions. Provide square, symmetrical, tight, and even flooring lines and joints. Keep each floor in true, level plane, except where slope is indicated. Vary width of edge tiles as necessary to maintain full-size tiles, except where irregular-shaped rooms makes it impossible. Cut flooring to fit around, all permanent fixtures, built-in furniture and cabinets, pipes, and outlets. Cut, fit, and scribe flooring to walls and partitions after field flooring has been applied.

### 3.6 PLACING FEATURE STRIPS

Install feature strips in accordance with manufacturer's printed installation instructions. Prepare and apply adhesives in accordance with manufacturer's printed directions.

### 3.7 PLACING WALL BASE

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

### 3.8 PLACING STAIR TREADS

Secure and install stair treads in accordance with manufacturer's printed installation instructions. Cover the surface of treads the full width of the stairs. Provide equal length pieces butted together to cover the treads and risers for stairs wider than manufacturer's standard lengths.

### 3.9 CLEANING

Immediately upon completion of installation of flooring in a room or an area, dry/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/or finish in accordance with manufacturer's written instructions.

### 3.10 PROTECTION

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



-- End of Section --



SECTION 09 90 00

PAINTS AND COATINGS

05/11

PART 1 GENERAL

1.1 REFERENCES

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

AMERICAN CONFERENCE OF GOVERNMENTAL INDUSTRIAL HYGIENISTS (ACGIH)

ACGIH 0100 (2015; Suppl 2002-2016) Documentation of the Threshold Limit Values and Biological Exposure Indices

ASME INTERNATIONAL (ASME)

ASME A13.1 (2015) Scheme for the Identification of Piping Systems

ASTM INTERNATIONAL (ASTM)

ASTM D4263 (1983; R 2012) Indicating Moisture in Concrete by the Plastic Sheet Method

ASTM D523 (2014) Standard Test Method for Specular Gloss

ASTM D6386 (2016) Standard Practice for Preparation of Zinc (Hot-Dip Galvanized) Coated Iron and Steel Product and Hardware Surfaces for Painting

ASTM F1869 (2016) Standard Test Method for Measuring Moisture Vapor Emission Rate of Concrete Subfloor Using Anhydrous Calcium Chloride

MASTER PAINTERS INSTITUTE (MPI)

MPI 1 (Oct 2009) Aluminum Paint

MPI 10 (Oct 2009) Exterior Latex, Flat, MPI Gloss Level 1

MPI 101 (Oct 2009) Epoxy Anti-Corrosive Metal Primer

MPI 107 (Oct 2009) Rust Inhibitive Primer (Water-Based)

MPI 108 (Oct 2009) High Build Epoxy Coating, Low Gloss

MPI 11 (Oct 2009) Exterior Latex, Semi-Gloss, MPI

	Gloss Level 5
MPI 113	(Oct 2009) Exterior Pigmented Elastomeric Coating (Water Based)
MPI 116	(Oct 2009) Epoxy Block Filler
MPI 119	(Oct 2009) Exterior Latex, Gloss
MPI 134	(Oct 2009) Galvanized Primer (Waterbased)
MPI 138	(Oct 2009) Interior High Performance Latex, MPI Gloss Level 2
MPI 139	(Oct 2009) Interior High Performance Latex, MPI Gloss Level 3
MPI 140	(Oct 2009) Interior High Performance Latex, MPI Gloss Level 4
MPI 141	(Oct 2009) Interior High Performance Latex MPI Gloss Level 5
MPI 144	(Oct 2009) Institutional Low Odor / VOC Interior Latex, MPI Gloss Level 2
MPI 145	(Oct 2009) Institutional Low Odor / VOC Interior Latex, MPI Gloss Level 3
MPI 146	(Oct 2009) Institutional Low Odor/VOC Interior Latex, MPI Gloss Level 4
MPI 147	(May 2016) Institutional Low Odor / VOC Interior Latex, Semi-Gloss, MPI Gloss Level 5
MPI 151	(Oct 2009) Interior W.B. Light Industrial Coating, MPI Gloss Level 3
MPI 153	(Oct 2009) Interior W.B. Light Industrial Coating, Semi-Gloss, MPI Gloss Level 5
MPI 154	(Oct 2009) Interior W.B. Light Industrial Coating, Gloss, MPI Gloss Level 6
MPI 161	(Oct 2009) Exterior W.B. Light Industrial Coating, MPI Gloss Level 3
MPI 163	(Oct 2009) Exterior W.B. Light Industrial Coating, Semi-Gloss, MPI Gloss Level 5
MPI 164	(Oct 2009) Exterior W.B. Light Industrial Coating, Gloss, MPI Gloss Level 6
MPI 23	(Oct 2009) Surface Tolerant Metal Primer
MPI 26	(Oct 2009) Cementitious Galvanized Metal Primer

MPI 27	(Oct 2009) Exterior / Interior Alkyd Floor Enamel, Gloss
MPI 4	(Oct 2009) Interior/Exterior Latex Block Filler
MPI 42	(Oct 2009) Latex Stucco and Masonry Textured Coating
MPI 44	(Oct 2009) Interior Latex, MPI Gloss Level 2
MPI 47	(Oct 2009) Interior Alkyd, Semi-Gloss, MPI Gloss Level 5
MPI 48	(Oct 2009) Interior Alkyd, Gloss, MPI Gloss Level 6
MPI 49	(Oct 2009) Interior Alkyd, Flat, MPI Gloss Level 1
MPI 50	(Oct 2009) Interior Latex Primer Sealer
MPI 51	(Oct 2009) Interior Alkyd, Eggshell, MPI Gloss Level 2
MPI 52	(Oct 2009) Interior Latex, MPI Gloss Level 3
MPI 54	(Oct 2009) Interior Latex, Semi-Gloss, MPI Gloss Level 5
MPI 72	(Oct 2009) Polyurethane, Two Component, Pigmented, Gloss
MPI 77	(Oct 2009) Epoxy Gloss
MPI 79	(2012) Primer, Alkyd, Anti-Corrosive for Metal
MPI 8	(Oct 2009) Exterior Alkyd, Flat, MPI Gloss Level I
MPI 9	(Oct 2009) Exterior Alkyd, Gloss, MPI Gloss Level 6
MPI 94	(Oct 2009) Exterior Alkyd, Semi-Gloss, MPI Gloss Level 5
MPI 95	(Oct 2009) Quick Drying Primer for Aluminum

SCIENTIFIC CERTIFICATION SYSTEMS (SCS)

SCS SP-01	(2000) Environmentally Preferable Product Specification for Architectural and Anti-Corrosive Paints
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SOCIETY FOR PROTECTIVE COATINGS (SSPC)

SSPC 7/NACE No.4	(2007; E 2004) Brush-Off Blast Cleaning
SSPC PA 1	(2016) Shop, Field, and Maintenance Coating of Metals
SSPC PA Guide 3	(1982; E 1995) A Guide to Safety in Paint Application
SSPC QP 1	(2012; E 2012) Standard Procedure for Evaluating Painting Contractors (Field Application to Complex Industrial Structures)
SSPC SP 1	(2015) Solvent Cleaning
SSPC SP 10/NACE No. 2	(2007) Near-White Blast Cleaning
SSPC SP 12/NACE No.5	(2002) Surface Preparation and Cleaning of Metals by Waterjetting Prior to Recoating
SSPC SP 2	(1982; E 2000; E 2004) Hand Tool Cleaning
SSPC SP 3	(1982; E 2004) Power Tool Cleaning
SSPC SP 6/NACE No.3	(2007) Commercial 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

U.S. ARMY CORPS OF ENGINEERS (USACE)

EM 385-1-1	(2014) Safety and Health Requirements Manual
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U.S. ENVIRONMENTAL PROTECTION AGENCY (EPA)

EPA Method 24	(2000) Determination of Volatile Matter Content, Water Content, Density, Volume Solids, and Weight Solids of Surface Coatings
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U.S. GENERAL SERVICES ADMINISTRATION (GSA)

FED-STD-313	(2014; Rev E) Material Safety Data, Transportation Data and Disposal Data for Hazardous Materials Furnished to Government Activities
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U.S. NATIONAL ARCHIVES AND RECORDS ADMINISTRATION (NARA)

29 CFR 1910.1000

Air Contaminants

1.2 SUBMITTALS

Government approval is required for submittals with a "G" designation; submittals not having a "G" designation are for information only. When used, a designation following the "G" designation identifies the office that will review the submittal for the Government. Submittals with an "S" are for inclusion in the Sustainability eNotebook, in conformance to Section 01 33 29 SUSTAINABILITY REPORTING. Submit the following in accordance with Section 01 33 00 SUBMITTAL PROCEDURES:

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. All coats on a particular substrate must be from a single manufacturer. No variation from the MPI Approved Products List is acceptable.

Samples of specified materials may be taken and tested for compliance with specification requirements.

In keeping with the intent of Executive Order 13101, "Greening the Government through Waste Prevention, Recycling, and Federal Acquisition", products certified by SCS as meeting SCS SP-01 shall be given preferential consideration over registered products. Products that are registered shall be given preferential consideration over products not carrying any EPP designation.

SD-02 Shop Drawings

Piping identification

Submit color stencil codes

SD-03 Product Data

Local/Regional Materials; S

Submit documentation indicating distance between manufacturing facility and the project site. Indicate distance of raw material origin from the project site. Indicate relative dollar value of local/regional materials to total dollar value of products included in project.

Materials; S

Submit documentation indicating percentage of post-industrial and post-consumer recycled content per unit of product. Indicate relative dollar value of recycled content products to total dollar value of products included in project.

Coating

Manufacturer's Technical Data Sheets; S

Indicate VOC content.

SD-04 Samples

Color; G

Submit manufacturer's samples of paint colors. Cross reference color samples to color scheme as indicated.

Textured Wall Coating System; G

Sample Textured Wall Coating System Mock-Up; G

SD-07 Certificates

Applicator's qualifications

Qualification Testing laboratory for coatings

SD-08 Manufacturer's Instructions

Mixing

Detailed mixing instructions, minimum and maximum application temperature and humidity, potlife, and curing and drying times between coats.

Manufacturer's Safety Data Sheets

Submit manufacturer's Safety Data Sheets for coatings, solvents, and other potentially hazardous materials, as defined in FED-STD-313.

SD-10 Operation and Maintenance Data

Coatings:

Preprinted cleaning and maintenance instructions for all coating systems shall be provided.

SD-11 Closeout Submittals

Local/Regional Materials; S

LEED documentation relative to local/regional materials credit in accordance with LEED Reference Guide. Include in LEED Documentation Notebook.

Materials; S

LEED documentation relative to recycled content credit in accordance with LEED Reference Guide. Include in LEED Documentation Notebook.

LEED documentation relative to low emitting materials credit in accordance with LEED Reference Guide. Include in LEED Documentation Notebook.



### 1.3 APPLICATOR'S QUALIFICATIONS

#### 1.3.1 Contractor Qualification

Submit the name, address, telephone number, FAX number, and e-mail address of the contractor that will be performing all surface preparation and coating application. Submit evidence that key personnel have successfully performed surface preparation and application of coatings on a minimum of three similar projects within the past three years.

#### 1.3.2 SSPC QP 1 Certification

All contractors and subcontractors that perform surface preparation or coating application shall be certified by the Society for Protective Coatings (formerly Steel Structures Painting Council) (SSPC) to the requirements of SSPC QP 1 prior to contract award, and shall remain certified while accomplishing any surface preparation or coating application. The painting contractors and painting subcontractors must remain so certified for the duration of the project. If a contractor's or subcontractor's certification expires, the firm will not be allowed to perform any work until the certification is reissued. Requests for extension of time for any delay to the completion of the project due to an inactive certification will not be considered and liquidated damages will apply. Notify the Contracting Officer of any change in contractor certification status.

### 1.4 QUALITY ASSURANCE

#### 1.4.1 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 Procedures." Test each chosen product as specified in the paragraph "Testing Procedure." Products which do not conform, shall be removed from the job site and replaced with new products that conform to the referenced specification. Testing of replacement products that failed initial testing shall be at no cost to the Government.

##### 1.4.1.1 Sampling Procedure

The Contracting Officer will select paint at random from the products that have been delivered to the job site for sample testing. The Contractor shall provide one quart samples of the selected paint materials. The samples shall be taken in the presence of the Contracting Officer, and labeled, identifying each sample. Provide labels in accordance with the paragraph "Packaging, Labeling, and Storage" of this specification.

##### 1.4.1.2 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. The qualification testing lab report shall include the backup data and summary of the test results. The summary shall list all of the reference specification requirements and the result of each test. The summary shall clearly

indicate whether the tested paint meets each test requirement. Note that Qualification Testing may take 4 to 6 weeks to perform, due to the extent of testing required.

Submit name, address, telephone number, FAX number, and e-mail address of the independent third party laboratory selected to perform testing of coating samples for compliance with specification requirements. Submit documentation that laboratory is regularly engaged in testing of paint samples for conformance with specifications, and that employees performing testing are qualified. If the Contractor chooses MPI 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.

#### 1.4.2 Textured Wall Coating System

Three complete samples of each indicated type, pattern, and color of textured wall coating system applied to a panel of the same material as that on which the coating system will be applied in the work. Samples of wall coating systems shall be minimum 5 by 7 inches and of sufficient size to show pattern repeat and texture.

#### 1.4.3 Sample Textured Wall Coating System Mock-Up

After coating samples are approved, and prior to starting installation, a minimum 8 foot by 8 foot mock-up shall be provided for each substrate and for each color and type of textured wall coating, using the actual substrate materials. Once approved the mock-up samples shall be used as a standard of workmanship for installation within the facility. At least 48 hours prior to mock-up installation, the Contractor shall submit written notification to the Contracting Officer's Representative.

### 1.5 REGULATORY REQUIREMENTS

#### 1.5.1 Environmental Protection

In addition to requirements specified elsewhere for environmental protection, provide coating materials that conform to the restrictions of the local Air Pollution Control District and regional jurisdiction. Notify Contracting Officer of any paint specified herein which fails to conform.

#### 1.5.2 Lead Content

Do not use coatings having a lead content over 0.06 percent by weight of nonvolatile content.

#### 1.5.3 Chromate Content

Do not use coatings containing zinc-chromate or strontium-chromate.

#### 1.5.4 Asbestos Content

Materials shall not contain asbestos.

#### 1.5.5 Mercury Content

Materials shall not contain mercury or mercury compounds.

#### 1.5.6 Silica

Abrasive blast media shall not contain free crystalline silica.

#### 1.5.7 Human Carcinogens

Materials shall not contain ACGIH 0100 confirmed human carcinogens (A1) or suspected human carcinogens (A2).

### 1.6 PACKAGING, LABELING, AND STORAGE

Paints shall be 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. Pigmented paints shall be furnished in containers not larger than 5 gallons. Paints and thinners shall be stored in accordance with the manufacturer's written directions, and as a minimum, stored off the ground, under cover, with sufficient ventilation to prevent the buildup of flammable vapors, and at temperatures between 40 to 95 degrees F.

### 1.7 SAFETY AND HEALTH

Apply coating materials using safety methods and equipment in accordance with the following:

Work shall 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 GOVERNMENT SAFETY REQUIREMENTS and in Appendix A of EM 385-1-1. The Activity Hazard Analysis shall include analyses of the potential impact of painting operations on painting personnel and on others involved in and adjacent to the work zone.

#### 1.7.1 Safety Methods Used During Coating Application

Comply with the requirements of SSPC PA Guide 3.

#### 1.7.2 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.

### 1.8 ENVIRONMENTAL CONDITIONS

Comply, at minimum, with manufacturer recommendations for space ventilation during and after installation. Isolate area of application from rest of building when applying high-emission paints or coatings.

#### 1.8.1 Coatings

Do not apply coating when air or substrate conditions are:

- a. Less than 5 degrees F above dew point;
- b. Below 50 degrees F or over 95 degrees F, unless specifically pre-approved by the Contracting Officer and the product manufacturer. Under no circumstances shall application conditions exceed manufacturer recommendations.

#### 1.9 SUSTAINABLE DESIGN REQUIREMENTS

##### 1.9.1 Local/Regional Materials

Use materials or products extracted, harvested, or recovered, as well as manufactured, within a 500 mile radius from the project site, if available from a minimum of three sources. See Section 01 33 29 LEED(tm) DOCUMENTATION for cumulative total local material requirements. Paint and coating materials may be locally available.

##### 1.10 COLOR SELECTION

Colors of finish coats shall be as indicated. Where not indicated or specified, colors shall be selected by the Contracting Officer. 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 approximate colors indicated and the product conforms to specified requirements.

Tint each coat progressively darker to enable confirmation of the number of coats.

##### 1.11 LOCATION AND SURFACE TYPE TO BE PAINTED

###### 1.11.1 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.

###### 1.11.1.1 Exterior Painting

Includes new surfaces of the building and appurtenances. Also included are existing coated surfaces made bare by cleaning operations.

###### 1.11.1.2 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.

#### 1.11.2 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, brass, and lead except existing coated surfaces.
- e. Hardware, fittings, and other factory finished items.

#### 1.11.3 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.

#### 1.11.3.1 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. Clean the surfaces to remove dust, dirt, rust, and loose mill scale. Immediately after cleaning, provide the metal surfaces with one coat primer per schedules. Shield sprinkler heads with protective covering while painting is in progress. Upon completion of painting, remove protective covering from sprinkler heads. Remove sprinkler heads which have been painted and replace with new sprinkler heads. Provide primed surfaces with the following:

- a. Piping in Unfinished Areas: Provide primed surfaces with one coat of red alkyd gloss enamel applied to a minimum dry film thickness of 1.0 mil, spaces above suspended ceilings, crawl spaces, pipe chases, and spaces where walls or ceiling are not painted or not constructed of a prefinished material. In lieu of red enamel finish coat, provide piping with 2 inch wide red enamel bands or self-adhering red plastic bands spaced at maximum of 20 foot intervals.
- b. 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 applied to a minimum dry film thickness of 1.0 mil. Provide piping with 2 inch wide red enamel bands or self-adhering red plastic bands spaced at maximum of 20 foot intervals throughout the piping systems.

#### 1.11.4 Exterior Painting of Site Work Items

Field coat the following items:

##### New Surfaces

##### Existing Surfaces

- a. Exterior Metal, Ferrous and Non-Ferrous Surfaces

#### 1.11.5 Definitions and Abbreviations

##### 1.11.5.1 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.

##### 1.11.5.2 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 shall only be accomplished by MPI testing lab.

##### 1.11.5.3 Coating

A film or thin layer applied to a base material called a substrate. A coating may be a metal, alloy, paint, or solid/liquid suspensions on various substrates (metals, plastics, wood, paper, leather, cloth, etc.). They may be applied by electrolysis, vapor deposition, vacuum, or mechanical means such as brushing, spraying, calendaring, and roller coating. A coating may be applied for aesthetic or protective purposes or both. The term "coating" as used herein includes emulsions, enamels, stains, varnishes, sealers, epoxies, and other coatings, whether used as primer, intermediate, or finish coat. The terms paint and coating are used interchangeably.

##### 1.11.5.4 DFT or dft

Dry film thickness, the film thickness of the fully cured, dry paint or coating.

1.11.5.5 DSD

Degree of Surface Degradation, the MPI system of defining degree of surface degradation. Five (5) levels are generically defined under the Assessment sections in the MPI Maintenance Repainting Manual.

1.11.5.6 EPP

Environmentally Preferred Products, a standard for determining environmental preferability in support of Executive Order 13101.

1.11.5.7 EXT

MPI short term designation for an exterior coating system.

1.11.5.8 INT

MPI short term designation for an interior coating system.

1.11.5.9 micron / microns

The metric measurement for 0.001 mm or one/one-thousandth of a millimeter.

1.11.5.10 mil / mils

The English measurement for 0.001 in or one/one-thousandth of an inch, equal to 25.4 microns or 0.0254 mm.

1.11.5.11 mm

The metric measurement for millimeter, 0.001 meter or one/one-thousandth of a meter.

1.11.5.12 MPI Gloss Levels

MPI system of defining gloss. Seven (7) 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 degrees	Units at 85 degrees
G1	Matte or Flat	0 to 5	10 max
G2	Velvet	0 to 10	10 to 35
G3	Eggshell	10 to 25	10 to 35
G4	Satin	20 to 35	35 min
G5	Semi-Gloss	35 to 70	
G6	Gloss	70 to 85	
G7	High Gloss		

Gloss is tested in accordance with ASTM D523. Historically, the Government has used Flat (G1 / G2), Eggshell (G3), Semi-Gloss (G5), and Gloss (G6).

#### 1.11.5.13 MPI System Number

The MPI coating system number in each 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). The Division number follows the CSI Master Format.

#### 1.11.5.14 Paint

See Coating definition.

#### 1.11.5.15 REX

MPI short term designation for an exterior coating system used in repainting projects or over existing coating systems.

#### 1.11.5.16 RIN

MPI short term designation for an interior coating system used in repainting projects or over existing coating systems.

### PART 2 PRODUCTS

#### 2.1 MATERIALS

Conform to the coating specifications and standards referenced in PART 3. Submit manufacturer's technical data sheets for specified coatings and solvents. Minimum 20 percent post-consumer recycled content for the following light-colored paints and primers. Minimum 50 percent post-consumer recycled content for the following dark-colored paints and primers. All the following consolidated latex paints shall contain a minimum of 100 percent post-consumer recycled content. Comply with applicable regulations regarding toxic and hazardous materials.

### 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, workmen skilled in the trades involved shall reinstall removed items. Restore surfaces contaminated by coating materials, to original condition and repair damaged items.

#### 3.2 SURFACE PREPARATION

Remove dirt, splinters, loose particles, grease, oil, and other foreign matter and substances deleterious to coating performance as specified for each substrate before application of paint or surface treatments. Oil and grease shall be removed prior to mechanical cleaning. Cleaning shall be programmed so that dust and other contaminants will not fall on wet, newly painted surfaces. Exposed ferrous metals such as nail heads on or in contact with surfaces to be painted with water-thinned paints, shall be spot-primed with a suitable corrosion-inhibitive primer capable of preventing flash rusting and compatible with the coating specified for the adjacent areas.



### 3.3 PREPARATION OF METAL SURFACES

#### 3.3.1 New Ferrous Surfaces

- a. Ferrous Surfaces including Shop-coated Surfaces and Small Areas That Contain Rust, Mill Scale and Other Foreign Substances: Solvent clean or detergent wash in accordance with SSPC SP 1 to remove oil and grease. Where shop coat is missing or damaged, clean according to SSPC SP 2, 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 12/NACE No.5 WJ-4 may be used to remove loose coating and other loose materials. Use inhibitor as recommended by coating manufacturer to prevent premature rusting. Shop-coated ferrous surfaces shall be protected 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 12/NACE No.5 WJ-3.

#### 3.3.2 Final Ferrous Surface Condition:

For tool cleaned surfaces, the requirements are stated in SSPC SP 2 and SSPC SP 3. As a visual reference, cleaned surfaces shall be similar to photographs in SSPC VIS 3.

For abrasive blast cleaned surfaces, the requirements are stated in SSPC 7/NACE No.4, SSPC SP 6/NACE No.3, and SSPC SP 10/NACE No. 2. As a visual reference, cleaned surfaces shall be similar to photographs in SSPC VIS 1.

For waterjet cleaned surfaces, the requirements are stated in SSPC SP 12/NACE No.5. As a visual reference, cleaned surfaces shall be similar to photographs in SSPC VIS 4/NACE VIS 7.

#### 3.3.3 Galvanized Surfaces

- a. New Galvanized Surfaces With Only Dirt and Zinc Oxidation Products: Clean with solvent, steam, or non-alkaline detergent solution in accordance with SSPC SP 1. If the galvanized metal has been passivated or stabilized, the coating shall be completely removed by brush-off abrasive blast. New galvanized steel to be coated shall not be "passivated" or "stabilized" 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.

### 3.4 PREPARATION OF CONCRETE AND CEMENTITIOUS SURFACE

#### 3.4.1 Concrete and Masonry

- a. Curing: Concrete, stucco and masonry surfaces shall be allowed to cure at least 30 days before painting, except concrete slab on grade, which shall be allowed to cure 90 days before painting.
- b. Surface Cleaning: Remove the following deleterious substances.
  - (1) Dirt, 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, 1 quart 5 percent sodium hypochlorite solution and 3 quarts of warm water. Rinse thoroughly with fresh water.
  - (3) Paint and Loose Particles: Remove by wire brushing.
  - (4) Efflorescence: Remove by scraping or wire brushing followed by washing with a 5 to 10 percent by weight aqueous solution of hydrochloric (muriatic) acid. Do not allow acid to remain on the surface for more than five minutes before rinsing with fresh water. Do not acid clean more than 4 square feet of surface, per workman, at one time.
- c. Cosmetic Repair of Minor Defects: Repair or fill mortar joints and minor defects, including but not limited to spalls, in accordance with manufacturer's recommendations and prior to coating application.
- d. Allowable Moisture Content: Latex coatings may be applied to damp surfaces, but not to surfaces with droplets of water. Do not apply epoxies to damp vertical surfaces as determined by ASTM D4263 or horizontal surfaces that exceed 3 lbs of moisture per 1000 square feet in 24 hours as determined by ASTM F1869. In all cases follow manufacturers recommendations. Allow surfaces to cure a minimum of 30 days before painting.

#### 3.4.2 Gypsum Board

- a. Surface Cleaning: Gypsum board shall be 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 will be water-based.
- b. 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.
- c. Allowable Moisture Content: Latex coatings may be applied to damp surfaces, but not surfaces with droplets of water. Do not apply epoxies to damp surfaces as determined by ASTM D4263.

### 3.5 APPLICATION

#### 3.5.1 Coating Application

Painting practices shall comply with applicable federal, state and local laws enacted to insure 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.

At the time of application, paint shall show no signs of deterioration. Uniform suspension of pigments shall be maintained during application.

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. Rollers for applying paints and enamels shall be 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.

Paints, except water-thinned types, shall be applied only to surfaces that are completely free of moisture as determined by sight or touch.

Thoroughly work coating materials into joints, crevices, and open spaces. Special attention shall be given to insure that all edges, corners, crevices, welds, and rivets receive a film thickness equal to that of adjacent painted surfaces.

Each coat of paint shall be applied so dry film shall be of uniform thickness and free from runs, drops, ridges, waves, pinholes or other voids, laps, brush marks, and variations in color, texture, and finish. Hiding shall be complete.

Touch up damaged coatings before applying subsequent coats. Interior areas shall be broom clean and dust free before and during the application of coating material.

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. For piping in unfinished spaces, provide primed surfaces with one coat of red alkyd gloss enamel to a minimum dry film thickness of 1.0 mil. Unfinished spaces include, 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. For piping in finished areas, provide prime surfaces with two coats of paint to match adjacent surfaces, except provide valves and operating accessories with one coat of red alkyd gloss enamel. Upon completion of painting, remove protective covering from sprinkler heads.

- a. 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.
- b. 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. Each coat shall cover surface of preceding coat or surface completely, and there shall be a visually perceptible difference in shades of successive coats.

- c. Finished Surfaces: Provide finished surfaces free from runs, drops, ridges, waves, laps, brush marks, and variations in colors.
- d. Thermosetting Paints: Topcoats over thermosetting paints (epoxies and urethanes) should be applied within the overcoating window recommended by the manufacturer.

### 3.5.2 Mixing and Thinning of Paints

Reduce paints to proper consistency by adding fresh paint, except when thinning is mandatory to suit surface, temperature, weather conditions, application methods, or for the type of paint being used. Obtain written permission from the Contracting Officer to use thinners. The written permission shall include quantities and types of thinners to use.

When thinning is allowed, paints shall be thinned immediately prior to application with not more than 1 pint of suitable thinner per gallon. The use of thinner shall not relieve the Contractor from obtaining complete hiding, full film thickness, or required gloss. Thinning shall not cause the paint to exceed limits on volatile organic compounds. Paints of different manufacturers shall not be mixed.

### 3.5.3 Two-Component Systems

Two-component systems shall be mixed in accordance with manufacturer's instructions. Any thinning of the first coat to ensure proper penetration and sealing shall be as recommended by the manufacturer for each type of substrate.

### 3.5.4 Coating Systems

- a. Systems by Substrates: Apply coatings that conform to the respective specifications listed in the following Tables:

#### Table

Division 4. Exterior Concrete Masonry Units Paint Table  
Division 5. Exterior Metal, Ferrous and Non-Ferrous Paint Table  
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 surfaces which have not been specified, the same as surfaces having similar conditions of exposure.

### 3.6 COATING SYSTEMS FOR METAL

Apply coatings of Tables in Division 5 for Exterior and Interior.

- a. Apply specified ferrous metal primer 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, but shall be overcoated with the specified ferrous-metal primer prior to application of finish coats.
- f. Exposed Nails, Screws, Fasteners, and Miscellaneous Ferrous Surfaces. On surfaces to be coated with water thinned coatings, spot prime exposed nails and other ferrous metal with latex primer MPI 107.

### 3.7 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.

### 3.8 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.

### 3.9 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, local recyclers shall be sought after 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.

### 3.10 PAINT TABLES

All DFT's are minimum values. Use only materials with a GPS green check mark having a minimum MPI "Environmentally Friendly" E3 rating based on VOC (EPA Method 24) content levels. Use only interior paints and coatings that meet VOC requirements of LEED low emitting materials credit. Acceptable products are listed in the MPI Green Approved Products List, available at <http://www.specifygreen.com/APL/ProductIdxByMPInum.asp>.

#### 3.10.1 EXTERIOR PAINT TABLES

##### DIVISION 3: EXTERIOR CONCRETE PAINT TABLE

##### DIVISION 4: EXTERIOR CONCRETE MASONRY UNITS PAINT TABLE

#### A. New concrete masonry on uncoated surface:

##### 1. Latex

New; MPI EXT 4.2A-G1 (Flat) / Existing; MPI REX 4.2A-G1 (Flat)			
Block Filler:	Primer:	Intermediate:	Topcoat:
MPI 4	N/A	MPI 10	MPI 10
System DFT:	11 mils		

New; MPI EXT 4.2A-G5 (Semigloss) / Existing; MPI REX 4.2A-G5 (Semigloss)			
Block Filler:	Primer:	Intermediate:	Topcoat:
MPI 4	N/A	MPI 11	MPI 11
System DFT:	11 mils		

New; MPI EXT 4.2A-G6 (Gloss) / Existing; MPI REX 4.2A-G6 (Gloss)			
Block Filler:	Primer:	Intermediate:	Topcoat:
MPI 4	N/A	MPI 119	MPI 119
System DFT:	11 mils		

Topcoat: Coating to match adjacent surfaces.

#### B. New concrete masonry, textured system; on uncoated surface:

##### 1. Latex Aggregate

New; MPI EXT 4.2B-G1 (Flat) / Existing; MPI REX 4.2B-G1 (Flat)			
Primer:	Intermediate:	Topcoat:	
MPI 42	MPI 42	MPI 10	
System DFT:	Per Manufacturer		

New; MPI EXT 4.2B-G5 (Semigloss) / Existing; MPI REX 4.2B-G5 (Semigloss)			
Primer:	Intermediate:	Topcoat:	
MPI 42	MPI 42	MPI 11	
System DFT:	Per Manufacturer		

New; MPI EXT 4.2B-G6 (Gloss) / Existing; MPI REX 4.2B-G6 (Gloss)			
Primer:	Intermediate:	Topcoat:	
MPI 42	MPI 42	MPI 119	
System DFT:	Per Manufacturer		

Texture - Medium. Surface preparation and number of coats in accordance with manufacturer's instructions. Topcoat: Coating

DIVISION 4: EXTERIOR CONCRETE MASONRY UNITS PAINT TABLE  
to match adjacent surfaces.

C. New concrete masonry, elastomeric system; on uncoated  
surface:

1. Elastomeric Coating

New; MPI EXT 4.2D / Existing; MPI REX 4.2D

Primer:	Intermediate:	Topcoat:
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Per Manufacturer	MPI 113	MPI 113
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System DFT: 16 mils

Primer as recommended by manufacturer. Topcoat: Coating to match  
adjacent surfaces. Surface preparation and number of coats in  
accordance with manufacturer's instructions.

NOTE: Apply sufficient coats of MPI 113 to achieve a minimum dry film  
thickness of 16 mils.

DIVISION 5: EXTERIOR METAL, FERROUS AND NON-FERROUS PAINT TABLE

STEEL / FERROUS SURFACES

A. New Steel that has been hand or power tool cleaned to SSPC SP 2 or  
SSPC SP 3

1. Alkyd

New; MPI EXT 5.1Q-G5 (Semigloss) Existing; MPI REX 5.1D-G5

Primer:	Intermediate:	Topcoat:
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MPI 23	MPI 94	MPI 94
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System DFT: 5.25 mils

New; MPI EXT 5.1Q-G6 (Gloss) / Existing; MPI REX 5.1D-G6

Primer:	Intermediate:	Topcoat:
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MPI 23	MPI 9	MPI 9
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System DFT: 5.25 mils

B. New Steel that has been blast-cleaned to SSPC SP 6/NACE No.3:

2. Alkyd

New; MPI EXT 5.1D-G5 (Semigloss) / Existing; MPI REX 5.1D-G5

Primer:	Intermediate:	Topcoat:
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MPI 79	MPI 94	MPI 94
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System DFT: 5.25 mils

New; MPI EXT 5.1D-G6 (Gloss) / Existing; MPI REX 5.1D-G6

Primer:	Intermediate:	Topcoat:
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MPI 79	MPI 9	MPI 9
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System DFT: 5.25 mils

C. Existing steel that has been spot-blasted to SSPC SP 6/NACE No.3:

1. Surface previously coated with alkyd or latex:

Waterborne Light Industrial Coating

MPI REX 5.1C-G5 (Semigloss)

Spot Primer:	Intermediate:	Topcoat:
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MPI 79	MPI 163	MPI 163
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System DFT: 5 mils

STEEL / FERROUS SURFACES

MPI REX 5.1C-G6 (Gloss)

Spot Primer:	Intermediate:	Topcoat:
MPI 79	MPI 164	MPI 164
System DFT:	5 mils	

2. Surface previously coated with epoxy:

Waterborne Light Industrial

a. MPI REX 5.1L-G5 (Semigloss)

Spot Primer:	Intermediate:	Topcoat:
MPI 101	MPI 163	MPI 163
System DFT:	5 mils	

MPI REX 5.1L-G6 (Gloss)

Spot Primer:	Intermediate:	Topcoat:
MPI 101	MPI 164	MPI 164
System DFT:	5 mils	

Pigmented Polyurethane

b. MPI REX 5.1H-G6 (Gloss)

Spot Primer:	Intermediate:	Topcoat:
MPI 101	MPI 108	MPI 72
System DFT:	8.5 mils	

D. New steel blast cleaned to SSPC SP 10/NACE No. 2:

1. Waterborne Light Industrial

MPI EXT 5.1R-G5 (Semigloss)

Primer:	Intermediate:	Topcoat:
MPI 101	MPI 108	MPI 163
System DFT:	8.5 mils	

MPI EXT 5.1R-G6 (Gloss)

Primer:	Intermediate:	Topcoat:
MPI 101	MPI 108	MPI 164
System DFT:	8.5 mils	

2. Pigmented Polyurethane

MPI EXT 5.1J-G6 (Gloss)

Primer:	Intermediate:	Topcoat:
MPI 101	MPI 108	MPI 72
System DFT:	8.5 mils	

E. Metal floors (non-shop-primed surfaces or non-slip deck surfaces) with non-skid additive (NSA), load at manufacturer's recommendations.:

1. Alkyd Floor Enamel

MPI EXT 5.1S-G6 (Gloss)

Primer:	Intermediate:	Topcoat:
MPI 79	MPI 27	MPI 27 (plus NSA)
System DFT:	5.25 mils	

EXTERIOR GALVANIZED SURFACES

F. New Galvanized surfaces:

1. Cementitious primer / Latex



EXTERIOR GALVANIZED SURFACES

MPI EXT 5.3A-G1 (Flat)

Primer:	Intermediate:	Topcoat:
MPI 26	MPI 10	MPI 10
System DFT:	4.5 mils	

MPI EXT 5.3A-G5 (Semigloss)

Primer:	Intermediate:	Topcoat:
MPI 26	MPI 11	MPI 11
System DFT:	4.5 mils	

MPI EXT 5.3A-G6 (Gloss)

Primer:	Intermediate:	Topcoat:
MPI 26	MPI 119	MPI 119
System DFT:	4.5 mils	

2. Waterborne Primer / Latex

MPI EXT 5.3H-G1 (Flat)

Primer:	Intermediate:	Topcoat:
MPI 134	MPI 10	MPI 10
System DFT:	4.5 mils	

MPI EXT 5.3H-G5 (Semigloss)

Primer:	Intermediate:	Topcoat:
MPI 134	MPI 11	MPI 11
System DFT:	4.5 mils	

MPI EXT 5.3H-G6 (Gloss)

Primer:	Intermediate:	Topcoat:
MPI 134	MPI 119	MPI 119
System DFT:	4.5 mils	

3. Waterborne Primer / Waterborne Light Industrial Coating

MPI EXT 5.3J-G5 (Semigloss)

Primer:	Intermediate:	Topcoat:
MPI 134	MPI 163	MPI 163
System DFT:	4.5 mils	

MPI EXT 5.3J-G6 (Gloss)

Primer:	Intermediate:	Topcoat:
MPI 134	MPI 164	MPI 164
System DFT:	4.5 mils	

4. Epoxy Primer / Waterborne Light Industrial Coating

MPI EXT 5.3K-G5 (Semigloss)

Primer:	Intermediate:	Topcoat:
MPI 101	MPI 163	MPI 163
System DFT:	5 mils	

MPI EXT 5.3K-G6 (Gloss)

Primer:	Intermediate:	Topcoat:
MPI 101	MPI 164	MPI 164
System DFT:	5 mils	

5. Pigmented Polyurethane

MPI EXT 5.3L-G6 (Gloss)

Primer:	Intermediate:	Topcoat:
MPI 101	N/A	MPI 72
System DFT:	5 mils	

EXTERIOR GALVANIZED SURFACES

G. Galvanized surfaces with slight coating deterioration; little or no rusting:

1. Waterborne Light Industrial Coating  
MPI REX 5.3J-G5 (Semigloss)  
Primer: Intermediate: Topcoat:  
MPI 134 N/A MPI 163  
System DFT: 4.5 mils
2. Pigmented Polyurethane  
MPI REX 5.3D-G6 (Gloss)  
Primer: Intermediate: Topcoat:  
MPI 101 N/A MPI 72  
System DFT: 5 mils

H. Galvanized surfaces with severely deteriorated coating or rusting:

1. Waterborne Light Industrial Coating  
MPI REX 5.3L-G5 (Semigloss)  
Primer: Intermediate: Topcoat:  
MPI 101 MPI 108 MPI 163  
System DFT: 8.5 mils  
  
MPI REX 5.3L-G6 (Gloss)  
Primer: Intermediate: Topcoat:  
MPI 101 MPI 108 MPI 164  
System DFT: 8.5 mils
2. Pigmented Polyurethane  
MPI REX 5.3K-G6 (Gloss)  
Primer: Intermediate: Topcoat:  
MPI 101 MPI 108 MPI 72  
System DFT: 5 mils

EXTERIOR SURFACES, OTHER METALS (NON-FERROUS)

I. Aluminum, aluminum alloy and other miscellaneous non-ferrous metal items not otherwise specified except hot metal surfaces, roof surfaces, and new prefinished equipment. Match surrounding finish:

1. Alkyd  
MPI EXT 5.4F-G1 (Flat)  
Primer: Intermediate: Topcoat:  
MPI 95 MPI 8 MPI 8  
System DFT: 5 mils  
  
MPI EXT 5.4F-G5 (Semigloss)  
Primer: Intermediate: Topcoat:  
MPI 95 MPI 94 MPI 94  
System DFT: 5 mils  
  
MPI EXT 5.4F-G6 (Gloss)  
Primer: Intermediate: Topcoat:  
MPI 95 MPI 9 MPI 9  
System DFT: 5 mils
2. Waterborne Light Industrial Coating

EXTERIOR SURFACES, OTHER METALS (NON-FERROUS)

MPI EXT 5.4G-G3(Eggshell)  
Primer: Intermediate: Topcoat:  
MPI 95 MPI 161 MPI 161  
System DFT: 5 mils

MPI EXT 5.4G-G5(Semigloss)  
Primer: Intermediate: Topcoat:  
MPI 95 MPI 163 MPI 163  
System DFT: 5 mils

MPI EXT 5.4G-G6(Gloss)  
Primer: Intermediate: Topcoat:  
MPI 95 MPI 164 MPI 164  
System DFT: 5 mils

3.10.2 INTERIOR PAINT TABLES

DIVISION 4: INTERIOR CONCRETE MASONRY UNITS PAINT TABLE

A. New Concrete masonry:

1. High Performance Architectural Latex

MPI INT 4.2D-G2 (Flat)  
Filler Primer: Intermediate: Topcoat:  
MPI 4 N/A MPI 138 MPI 138  
System DFT: 11 mils

MPI INT 4.2D-G3 (Eggshell)  
Filler Primer: Intermediate: Topcoat:  
MPI 4 N/A MPI 139 MPI 139  
System DFT: 11 mils

MPI INT 4.2D-G4 (Satin)  
Filler Primer: Intermediate: Topcoat:  
MPI 4 N/A MPI 140 MPI 140  
System DFT: 11 mils

MPI INT 4.2D-G5 (Semigloss)  
Filler Primer: Intermediate: Topcoat:  
MPI 4 N/A MPI 141 MPI 141  
System DFT: 11 mils

Fill all holes in masonry surface

2. Institutional Low Odor / Low VOC Latex

New; MPI INT 4.2E-G2 (Flat)  
Filler Primer: Intermediate: Topcoat:  
MPI 4 N/A MPI 144 MPI 144  
System DFT: 4 mils

New; MPI INT 4.2E-G3 (Eggshell)  
Filler Primer: Intermediate: Topcoat:  
MPI 4 N/A MPI 145 MPI 145  
System DFT: 4 mils

New; MPI INT 4.2E-G4 (Satin)  
Filler Primer: Intermediate: Topcoat:  
MPI 4 N/A MPI 146 MPI 146

DIVISION 4: INTERIOR CONCRETE MASONRY UNITS PAINT TABLE

System DFT: 4 mils

New; MPI INT 4.2E-G5 (Semigloss)

Filler	Primer:	Intermediate:	Topcoat:
MPI 4	N/A	MPI 147	MPI 147

System DFT: 4 mils

B. Existing, previously painted Concrete masonry:

1. MPI RIN 4.2K-G4

Spot Primer:	Intermediate:	Topcoat:
MPI 50	MPI 140	MPI 140

System DFT: 4.5 mils

MPI RIN 4.2K-G5 (Semigloss)

Spot Primer:	Intermediate:	Topcoat:
MPI 50	MPI 141	MPI 141

System DFT: 4.5 mils

2. Institutional Low Odor / Low VOC Latex

Existing; MPI RIN 4.2L-G2 (Flat)

Spot Primer:	Intermediate:	Topcoat:
MPI 50	MPI 144	MPI 144

System DFT: 4 mils

MPI RIN 4.2L-G3 (Eggshell)

Spot Primer:	Intermediate:	Topcoat:
MPI 50	MPI 145	MPI 145

System DFT: 4 mils

MPI RIN 4.2L-G4 (Satin)

Spot Primer:	Intermediate:	Topcoat:
MPI 50	MPI 146	MPI 146

System DFT: 4 mils

MPI RIN 4.2L-G5 (Semigloss)

Spot Primer:	Intermediate:	Topcoat:
MPI 50	MPI 147	MPI 147

System DFT: 4 mils

C. New Concrete masonry units in toilets, restrooms, unless otherwise specified:

1. Waterborne Light Industrial Coating

MPI INT 4.2K-G3(Eggshell)

Filler:	Primer:	Intermediate:	Topcoat:
MPI 4	N/A	MPI 151	MPI 151

System DFT: 11 mils

MPI INT 4.2K-G5(Semigloss)

Filler:	Primer:	Intermediate:	Topcoat:
MPI 4	N/A	MPI 153	MPI 153

System DFT: 11 mils

MPI INT 4.2K-G6(Gloss)

Filler:	Primer:	Intermediate:	Topcoat:
MPI 4	N/A	MPI 154	MPI 154

System DFT: 11 mils

DIVISION 4: INTERIOR CONCRETE MASONRY UNITS PAINT TABLE

Fill all holes in masonry surface

2. Alkyd

MPI INT 4.2N-G3 (Eggshell)

Filler: Primer:

MPI 4 MPI 50

System DFT: 12 mils

Intermediate:

MPI 51

Topcoat:

MPI 51

MPI INT 4.2N-G5 (Semigloss)

Filler: Primer:

MPI 4 MPI 50

System DFT: 12 mils

Intermediate:

MPI 47

Topcoat:

MPI 47

MPI INT 4.2N-G6 (Gloss)

Filler: Primer:

MPI 4 MPI 50

System DFT: 12 mils

Intermediate:

MPI 48

Topcoat:

MPI 48

Fill all holes in masonry surface

3. Epoxy

MPI INT 4.2G-G6 (Gloss)

Filler: Primer:

MPI 116 N/A

System DFT: 10 mils

Intermediate:

MPI 77

Topcoat:

MPI 77

Fill all holes in masonry surface

DIVISION 5: INTERIOR METAL, FERROUS AND NON-FERROUS PAINT TABLE

INTERIOR STEEL / FERROUS SURFACES

A. 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:

1. High Performance Architectural Latex

MPI INT 5.1R-G2 (Flat)

Primer: Intermediate:

MPI 79 MPI 138

System DFT: 5 mils

Topcoat:

MPI 138

MPI INT 5.1R-G3 (Eggshell)

Primer: Intermediate:

MPI 79 MPI 139

System DFT: 5 mils

Topcoat:

MPI 139

MPI INT 5.1R-G5 (Semigloss)

Primer: Intermediate:

MPI 79 MPI 141

System DFT: 5 mils

Topcoat:

MPI 141

2. Alkyd

MPI INT 5.1E-G2 (Flat)

Primer: Intermediate:

Topcoat:

INTERIOR STEEL / FERROUS SURFACES

MPI 79	MPI 49	MPI 49
System DFT: 5.25 mils		
MPI INT 5.1E-G3 (Eggshell)		
Primer:	Intermediate:	Topcoat:
MPI 79	MPI 51	MPI 51
System DFT: 5.25 mils		
MPI INT 5.1E-G5 (Semigloss)		
Primer:	Intermediate:	Topcoat:
MPI 79	MPI 47	MPI 47
System DFT: 5.25 mils		
MPI INT 5.1E-G6 (Gloss)		
Primer:	Intermediate:	Topcoat:
MPI 79	MPI 48	MPI 48
System DFT: 5.25 mils		

B. Metal floors (non-shop-primed surfaces or non-slip deck surfaces) with non-skid additive (NSA), load at manufacturer's recommendations.:

1. Alkyd Floor Paint

MPI INT 5.1U-G6 (Gloss)		
Primer:	Intermediate:	Topcoat:
MPI 79	MPI 27	MPI 27 (plus NSA)
System DFT: 5.25 mils		

2. Epoxy

MPI INT 5.1L-G6 (Gloss)		
Primer:	Intermediate:	Topcoat:
MPI 101	MPI 77	MPI 77 (plus NSA)
System DFT: 5.25 mils		

C. Metal in toilets, restrooms, shower areas not otherwise specified except floors, hot metal surfaces, and new prefinished equipment:

1. Alkyd

MPI INT 5.1E-G3 (Eggshell)		
Primer:	Intermediate:	Topcoat:
MPI 79	MPI 51	MPI 51
System DFT: 5.25 mils		

MPI INT 5.1E-G5 (Semigloss)		
Primer:	Intermediate:	Topcoat:
MPI 79	MPI 47	MPI 47
System DFT: 5.25 mils		

MPI INT 5.1E-G6 (Gloss)		
Primer:	Intermediate:	Topcoat:
MPI 79	MPI 48	MPI 48
System DFT: 5.25 mils		

2. Alkyd

MPI INT 5.1T-G3 (Eggshell) For hand tool cleaning		
Primer:	Intermediate:	Topcoat:
MPI 23	MPI 51	MPI 51
System DFT: 5.25 mils		

INTERIOR STEEL / FERROUS SURFACES

MPI INT 5.1T-G5 (Semigloss)  
Primer: Intermediate: Topcoat:  
MPI 23 MPI 47 MPI 47  
System DFT: 5.25 mils

MPI INT 5.1T-G6 (Gloss)  
Primer: Intermediate: Topcoat:  
MPI 23 MPI 48 MPI 48  
System DFT: 5.25 mils

D. Ferrous metal in concealed damp spaces or in exposed areas having  
unpainted adjacent surfaces as follows:

1. Aluminum Paint

MPI INT 5.1M  
Primer: Intermediate: Topcoat:  
MPI 79 MPI 1 MPI 1  
System DFT: 4.25 mils

E. Miscellaneous non-ferrous metal items not otherwise specified except  
floors, hot metal surfaces, and new prefinished equipment. Match  
surrounding finish:

1. High Performance Architectural Latex

MPI INT 5.4F-G2 (Flat)  
Primer: Intermediate: Topcoat:  
MPI 95 MPI 138 MPI 138  
System DFT: 5 mils

MPI INT 5.4F-G3 (Eggshell)  
Primer: Intermediate: Topcoat:  
MPI 95 MPI 139 MPI 139  
System DFT: 5 mils

MPI INT 5.4F-G4 (Satin)  
Primer: Intermediate: Topcoat:  
MPI 95 MPI 140 MPI 140  
System DFT: 5 mils

MPI INT 5.4F-G5 (Semigloss)  
Primer: Intermediate: Topcoat:  
MPI 95 MPI 141 MPI 141  
System DFT: 5 mils

2. Alkyd

MPI INT 5.4J-G2 (Flat)  
Primer: Intermediate: Topcoat:  
MPI 95 MPI 49 MPI 49  
System DFT: 5 mils

MPI INT 5.4J-G3 (Eggshell)  
Primer: Intermediate: Topcoat:  
MPI 95 MPI 51 MPI 51  
System DFT: 5 mils

MPI INT 5.4J-G5 (Semigloss)

INTERIOR STEEL / FERROUS SURFACES

Primer:	Intermediate:	Topcoat:
MPI 95	MPI 47	MPI 47
System DFT:	5 mils	

MPI INT 5.4J-G6 (Gloss)

Primer:	Intermediate:	Topcoat:
MPI 95	MPI 48	MPI 48
System DFT:	5 mils	

DIVISION 9: INTERIOR, GYPSUM BOARD, TEXTURED SURFACES PAINT TABLE

A. New Wallboard not otherwise specified:

1. Latex

New; MPI INT 9.2A-G2 (Flat) / Existing; RIN 9.2A-G2 (Flat)

Primer:	Intermediate:	Topcoat:
MPI 50	MPI 44	MPI 44
System DFT:	4 mils	

New; MPI INT 9.2A-G3 (Eggshell) / Existing; RIN 9.2A-G3 (Eggshell)

Primer:	Intermediate:	Topcoat:
MPI 50	MPI 52	MPI 52
System DFT:	4 mils	

New; MPI INT 9.2A-G5 (Semigloss) / Existing; RIN 9.2A-G5 (Semigloss)

Primer:	Intermediate:	Topcoat:
MPI 50	MPI 54	MPI 54
System DFT:	4 mils	

2. High Performance Architectural Latex - High Traffic Areas

New; MPI INT 9.2B-G2 (Flat) / Existing; MPI RIN 9.2B-G2 (Flat)

Primer:	Intermediate:	Topcoat:
MPI 50	MPI 138	MPI 138
System DFT:	4 mils	

New; MPI INT 9.2B-G3 (Eggshell) / Existing; MPI RIN 9.2B-G3 (Eggshell)

Primer:	Intermediate:	Topcoat:
MPI 50	MPI 139	MPI 139
System DFT:	4 mils	

New; MPI INT 9.2B-G5 (Semigloss) / Existing; MPI RIN 9.2B-G5 (Semigloss)

Primer:	Intermediate:	Topcoat:
MPI 50	MPI 141	MPI 141
System DFT:	4 mils	

3. Institutional Low Odor / Low VOC Latex

New; MPI INT 9.2M-G2 (Flat) / Existing; MPI RIN 9.2M-G2 (Flat)

Primer:	Intermediate:	Topcoat:
MPI 50	MPI 144	MPI 144
System DFT:	4 mils	

New; MPI INT 9.2M-G3 (Eggshell) / Existing; MPI RIN 9.2M-G3 (Eggshell)

Primer:	Intermediate:	Topcoat:
MPI 50	MPI 145	MPI 145
System DFT:	4 mils	

New; MPI INT 9.2M-G4 (Satin) / Existing; MPI RIN 9.2M-G4 (Satin)



DIVISION 9: INTERIOR, GYPSUM BOARD, TEXTURED SURFACES PAINT TABLE

Primer:	Intermediate:	Topcoat:
MPI 50	MPI 146	MPI 146
System DFT:	4 mils	

New; MPI INT 9.2M-G5 (Semigloss) / Existing; MPI RIN 9.2M-G5 (Semigloss)

Primer:	Intermediate:	Topcoat:
MPI 50	MPI 147	MPI 147
System DFT:	4 mils	

B. New Wallboard in toilets, restrooms, shower areas, and other high humidity areas not otherwise specified.:

1. Waterborne Light Industrial Coating

New; MPI INT 9.2L-G5 (Semigloss) / Existing; MPI RIN 9.2L-G5 (Semigloss)

Primer:	Intermediate:	Topcoat:
MPI 50	MPI 153	MPI 153
System DFT:	4 mils	

2. Alkyd

New; MPI INT 9.2C-G5 (Semigloss) / Existing; MPI RIN 9.2C-G5 (Semigloss)

Primer:	Intermediate:	Topcoat:
MPI 50	MPI 47	MPI 47
System DFT:	4 mils	

3. Epoxy

New; MPI INT 9.2E-G6 (Gloss) / Existing; MPI RIN 9.2D-G6 (Gloss)

Primer:	Intermediate:	Topcoat:
MPI 50	MPI 77	MPI 77
System DFT:	4 mils	

-- End of Section --



SECTION 09 96 00

HIGH-PERFORMANCE COATINGS

**11/14**

PART 1 GENERAL

1.1 REFERENCES

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

MASTER PAINTERS INSTITUTE (MPI)

MPI ASM (2012) Architectural Painting  
Specification Manual

SOCIETY FOR PROTECTIVE COATINGS (SSPC)

SSPC 7/NACE No.4 (2007; E 2004) Brush-Off Blast Cleaning

1.2 SUBMITTALS

Government approval is required for submittals with a "G" designation; submittals not having a "G" designation are for information only. When used, a designation following the "G" designation identifies the office that will review the submittal for the Government. Submittals with an "S" are for inclusion in the Sustainability eNotebook, in conformance to Section 01 33 29 SUSTAINABILITY REPORTING. Submit the following in accordance with Section 01 33 00 SUBMITTAL PROCEDURES:

SD-01 Preconstruction Submittals

Equipment List

SD-03 Product Data

Polyurethane Coatings

SD-04 Samples

Color Chips; G

SD-07 Certificates

Polyurethane Coatings

Manufacturer's Printed Instructions; G

1.3 QUALITY CONTROL

Comply with Master Painters Institute (MPI) Standards indicated and listed in "MPI Approved Products List." Comply with the requirements in "MPI Architectural Painting Specification Manual" before any project is started.

Submit an equipment list consisting of a list of proposed equipment to be used in performance of construction work.

Submit three color chips 3-inch by 4-inch or manufacture's pull-down of each finish color and gloss as scheduled.

#### 1.4 DELIVERY, STORAGE, AND HANDLING

Deliver special coating materials to the project in their original containers bearing manufacturer's name, descriptive label, and coating formulations. Provide new and unopened containers.

Store special coating materials in tightly closed containers in a covered, well-ventilated area where they are not exposed to excessive heat, fumes, sparks, flame, or direct sunlight. Protect water-based coatings against freezing.

Store solvents, thinners, and equipment cleaners with the same care as the coating materials with ambient temperatures continuously maintained at a minimum 45 degrees F.

### PART 2 PRODUCTS

#### 2.1 PERFORMANCE REQUIREMENTS

Submit manufacturer's catalog data including manufacturer's name and identification. Include detailed data analysis of each special coating material required for the project, with all the coating constituents measured as percentages of the total weight of the coating. Also provide manufacturer's data concerning application, thinning, and average coverage per gallon

#### 2.2 MATERIALS

##### 2.2.1 Polyurethane Coatings

Ensure polyurethane coatings conform to MPI ASM for each substrate indicated.

Resins for finish coats are based on a two-part, prepolymer, catalytic-cured, polyurethane material. Apply catalytic-cured coatings with a total dry-film thickness of not less than 10 mils per coat. Indicate finish color and gloss on the schedules.

##### 2.2.1.1 Concrete Surface Coatings

Apply a Polyurethane, Clear, Two-Component Coating System in conformance with MPI ASM, No. 78. Ensure the prime coat fills surface pores with a total dry-film thickness of not less than 2 mils. Finish coats are polyurethane-based material as specified.

### PART 3 EXECUTION

#### 3.1 PREPARATION

##### 3.1.1 Surface Preparation

Protect adjacent materials and equipment against damage from spillage, dripping, and spatter of coating materials. Leave clean building materials and equipment with all damaged surfaces corrected. Provide "WET PAINT" signs to indicate newly painted surfaces.

Protect work of other trades against damage from coating operation. Correct damage by cleaning, repairing, replacing, and recoating, as approved by the Contracting Officer, and leave in an undamaged condition. At completion of construction activities of other trades, touch up and restore damaged or defaced coated surfaces.

Provide forced ventilation for interior spaces during application and drying of coatings to prevent the buildup of toxic or explosive concentrations of solvent vapors.

Provide fire extinguishers of the required quantity and correct type to combat flammable liquid fires.

Dispose of rags that are used to wipe up coating materials, solvents, and thinners by drenching with water and placing them in a covered metal container

### 3.1.2 Cleaning

At end of each workday, remove rubbish, empty cans, rags, and other discarded materials from Project site.

After completing coating application, clean spattered surfaces. Remove spattered coatings by washing, scraping, or other methods. Do not scratch or damage adjacent finished surfaces.

Clean application equipment promptly and thoroughly with a suitable solvent after each use and stored in a clean, covered, well-ventilated container.

### 3.1.3 Concrete Surfaces

Conform to MPI ASM for substrates indicated. Remove plates, machined surfaces, and similar items already in place that are not to be coated. Provide surface-applied protection before surface preparation and coating where removal is impractical or impossible. After completing coating operations, reinstall items that were removed.

Clean dirt, oil, grease, and incompatible paints from substrates to ensure bonding. Coordination of shop-applied prime coats with high-performance coatings is critical. Remove incompatible primers. Reprime substrate with compatible primers as required to produce coating systems indicated.

#### 3.1.3.1 Concrete Substrates

Remove release agents, curing compounds, efflorescence, and chalk. Maximum allowable moisture content of concrete is 12 percent. Measure moisture content with an electronic moisture meter.

Clean surfaces with pressurized water. Use pressure range of 1500 to 4000 psi at 6 inch to 12 inch.

Comply with SSPC 7/NACE No.4 (NACE No. 4), "Brush-Off Blast Cleaning" for abrasive cleaning.

### 3.1.4 Coating Material Preparation

Mix and prepare coating materials in accordance with the coating

manufacturer's printed instructions for applying the particular material and coat. Keep materials which are not in actual use in closed containers.

Coating materials that have been mixed with an automatic shaker are allowed to stand to let air bubbles escape, then given a final hand mixing before application. Stir materials so as to produce a mixture of uniform density. Stir at frequent intervals during application to prevent skinning. Do not stir film which may form on the surface of the material. Remove film and strain, if necessary.

#### 3.1.4.1 Thinning

Thinning is done in accordance with coating manufacturer's printed directions for the particular material and coat.

#### 3.1.4.2 Tinting

Ensure prime and intermediate coats of paint are slightly different tints from the finish coat to facilitate identification of each coat. Tinting is done by the coating manufacturer and clearly identified as to color and coat.

### 3.2 APPLICATION

Interior painting is not allowed until the building is enclosed and has thoroughly dried out. Painting is not allowed below 50 degrees F or above 95 degrees F. Apply paint in accordance with the coating manufacturer's recommendations, and as specified.

Ensure coating application is done by skilled applicators. Apply coatings to clean and properly prepared surfaces. Apply coatings with clean, high-quality application equipment. Allow sufficient time between coats to ensure complete drying and curing. Sand and dust surfaces between coatings, as required, to produce a surface free of visible defects. Lightly sand high gloss coatings and clear finishes between coats to ensure bond of following coats.

Apply coats to the surfaces in an even film. Cloudiness, spotting, holidays, laps, application marks, runs, sags, and other similar surface imperfections are not acceptable. Remove defective coating applications and re-coat as directed.

Ensure coating lines such as wainscots are sharp, true, and well-defined. Tape may be used to establish coating lines, providing tape is removed before ragging or sawtooth edges form.

Ensure surfaces, including edges, corners, crevices, welds, and other similar changes in surface plane, meet the dry-film thickness not less than specified.

#### 3.2.1 Brush Application

Use clean, proper size brushes for high-quality application of the specified coating materials. Brush out slow-dry coatings. Brush out quick-dry coatings only enough to spread out evenly.

#### 3.2.2 Roller Application

Use clean roller covers of the proper nap length, nap texture, and

material for high-quality application of the specified coating materials.

Ensure roller application is equivalent in all respects to the same coats applied by high-quality brush application.

### 3.2.3 Spray Application

Spray application equipment is limited to airless-spray equipment and electrostatic-spray equipment. Ensure equipment is clean and operated by workmen skilled in high quality application of coating materials.

Apply spray coatings as equivalent in all respects to the same coats applied by high quality brush application. Permit each spray coat to cure before the succeeding coat is applied. Do not double back with application equipment, for the purpose of building up film thickness of two coats in one operation.

Cover surfaces adjacent to sprayed areas to prevent damage from overspray, coating rebound, and spray drift.

## 3.3 FIELD QUALITY CONTROL

### 3.3.1 Field Test

Government may take dry-film tests from time to time on finished surfaces. Apply additional coatings to surfaces where there is less than the minimum specified dry-film thickness.

### 3.3.2 Repairing

Remove damaged and unacceptable portions of completed work and replace with new work to match adjacent surfaces at no additional cost to the Government.

-- End of Section --





SECTION 10 14 00.10

EXTERIOR SIGNAGE

08/17

PART 1 GENERAL

1.1 REFERENCES

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

AMERICAN WELDING SOCIETY (AWS)

AWS C1.1M/C1.1	(2012) Recommended Practices for Resistance Welding
AWS D1.1/D1.1M	(2015; Errata 1 2015; Errata 2 2016) Structural Welding Code - Steel

ASTM INTERNATIONAL (ASTM)

ASTM A123/A123M	(2017) Standard Specification for Zinc (Hot-Dip Galvanized) Coatings on Iron and Steel Products
ASTM A653/A653M	(2017) Standard Specification for Steel Sheet, Zinc-Coated (Galvanized) or Zinc-Iron Alloy-Coated (Galvannealed) by the Hot-Dip Process
ASTM A924/A924M	(2017a) Standard Specification for General Requirements for Steel Sheet, Metallic-Coated by the Hot-Dip Process
ASTM B108/B108M	(2015) Standard Specification for Aluminum-Alloy Permanent Mold Castings
ASTM B209	(2014) Standard Specification for Aluminum and Aluminum-Alloy Sheet and Plate
ASTM B221	(2014) Standard Specification for Aluminum and Aluminum-Alloy Extruded Bars, Rods, Wire, Profiles, and Tubes
ASTM B26/B26M	(2014; E 2015) Standard Specification for Aluminum-Alloy Sand Castings

NATIONAL ASSOCIATION OF ARCHITECTURAL METAL MANUFACTURERS (NAAMM)

NAAMM AMP 500	(2006) Metal Finishes Manual
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1.2 GENERAL REQUIREMENTS

All exterior signage must be provided by a single manufacturer. Exterior signage must be of the design, detail, sizes, types, and message content

shown on the drawings, must conform to the requirements specified, and must be provided at the locations indicated. Submit exterior signage schedule in electronic media with spread sheet format. Spread sheet must include sign location, sign type, and message. Signs must be complete with lettering, framing as detailed, and related components for a complete installation. Each sample must consist of a complete sign panel with letters and symbols. Samples may be installed in the work, provided each sample is identified and location recorded. Submit three color samples for each material requiring color and 12 inch square sample of sign face color sample.

#### 1.2.1 Wind Load Requirements

Exterior signage must be designed to withstand 145 mph windload. Submit design analysis and supporting calculations performed in support of specified signage.

#### 1.2.2 Character Proportions and Heights

Letters and numbers on indicated signs for handicapped-accessible buildings must have a width-to-height ratio between 3:5 and 1:1 and a stroke-width-to-height ratio between 1:5 and 1:10. Characters and numbers on indicated signs must be sized according to the viewing distance from which they are to be read. The minimum height is measured using an upper case letter "X". Lower case characters are permitted.

#### 1.3 SUBMITTALS

Government approval is required for submittals with a "G" designation; submittals not having a "G" designation are for information only. When used, a designation following the "G" designation identifies the office that will review the submittal for the Government. Submittals with an "S" are for inclusion in the Sustainability eNotebook, in conformance to Section 01 33 29 SUSTAINABILITY REPORTING. Submit the following in accordance with Section 01 33 00 SUBMITTAL PROCEDURES:

##### SD-02 Shop Drawings

Approved Detail Drawings; G

##### SD-03 Product Data

Installation

Exterior Signage; G

Wind Load Requirements

##### SD-04 Samples

Exterior Signage; G

##### SD-10 Operation and Maintenance Data

Protection and Cleaning

#### 1.4 QUALIFICATIONS

Signs, plaques, and dimensional letters must be the standard product of a

manufacturer regularly engaged in the manufacture of the products. Items of equipment must essentially duplicate equipment that has been in satisfactory use at least 2 years prior to bid opening.

#### 1.5 DELIVERY AND STORAGE

Materials must be wrapped for shipment and storage, delivered to the jobsite in manufacturer's original packaging, and stored in a clean, dry area in accordance with manufacturer's instructions.

#### 1.6 WARRANTY

Manufacturer's standard performance guarantees or warranties that extend beyond a one year period must be provided.

### PART 2 PRODUCTS

#### 2.1 DIMENSIONAL BUILDING LETTERS

##### 2.1.1 Fabrication

Letters must be fabricated from 0.063 inch aluminum sheet. Letters must be cleaned by chemical etching or cleaned ultrasonically in a special degreasing bath. Letters must be packaged for protection until installation.

##### 2.1.2 Typeface

Typeface must be helvetica medium .

##### 2.1.3 Size

Letter size must be as indicated.

##### 2.1.4 Finish

Baked enamel finish must be provided.

##### 2.1.5 Mounting

Threaded studs of number and size as recommended by manufacturer, must be used for concealed anchorage. Letters which project from the building line must have stud spacer sleeves. Letters, studs, and sleeves must be of the same material. Supply templates for mounting.

#### 2.2 ALUMINUM ALLOY PRODUCTS

Aluminum alloy products must conform to ASTM B209 for sheet or plate, ASTM B221 for extrusions and ASTM B26/B26M or ASTM B108/B108M for castings. Aluminum extrusions must be provided at least 1/8 inch thick and aluminum plate or sheet at least 16 gauge thick. Welding for aluminum products must conform to AWS C1.1M/C1.1.

#### 2.3 ORGANIC COATING

Clean, prime and give surfaces a semi-gloss baked enamel finish in accordance with NAAMM AMP 500, AMP 505, with total dry film thickness not less than 1.2 mils.

## 2.4 ANCHORS AND FASTENERS

Exposed anchor and fastener materials must be compatible with metal to which applied and must match in color and finish and must be non-rusting, non-corroding, and non-staining. Exposed fasteners must be tamper-proof.

## 2.5 SHOP FABRICATION AND MANUFACTURE

### 2.5.1 Factory Workmanship

Work must be assembled in the shop, as far as practical, ready for installation at the site. Work that cannot be shop assembled must be given a trial fit in the shop to ensure proper field assembly. Holes for bolts and screws must be drilled or punched. Drilling and punching must produce clean, true lines and surfaces. Welding to or on structural steel must be in accordance with AWS D1.1/D1.1M. Welding must be continuous along the entire area of contact. Exposed welds must be ground smooth. Exposed surfaces of work must have a smooth finish and exposed riveting must be flush. Fastenings must be concealed where practical. Items specified to be galvanized must be by hot-dip process after fabrication if practical. Galvanization must be in accordance with ASTM A123/A123M and ASTM A653/A653M, as applicable. Other metallic coatings of steel sheet must be in accordance with ASTM A924/A924M. Joints exposed to the weather must be formed to exclude water. Drainage and weep holes must be included as required to prevent condensation buildup.

### 2.5.2 Dissimilar Materials

Where dissimilar metals are in contact, or where aluminum is in contact with concrete, mortar, masonry, wet or pressure-treated wood, or absorptive materials subject to wetting, the surfaces must be protected with a coat of asphalt varnish or a coat of zinc-molybdate primer to prevent galvanic or corrosive action.

### 2.5.3 Shop Painting

Surfaces of miscellaneous metal work, except nonferrous metal, corrosion resisting steel, and zinc-coated work, must be given one coat of zinc-molybdate primer or an approved rust-resisting treatment and metallic primer in accordance with manufacturer's standard practice. Surfaces of items to be embedded in concrete must not be painted. Upon completion of work, damaged surfaces must be recoated.

## 2.6 COLOR, FINISH, AND CONTRAST

Color must be as indicated on the drawings. Color listed is not intended to limit the selection of equal colors from other manufacturers. For buildings required to be handicapped-accessible, the characters and background of signs must be eggshell, matte, or other non-glare finish. Characters and symbols must contrast with their background - either light characters on a dark background or dark characters on a light background.

## PART 3 EXECUTION

### 3.1 INSTALLATION

Signs, plaques, or dimensional letters must be installed in accordance with approved manufacturer's instructions at locations shown on the approved detail drawings; submit drawings showing elevations of each type

of sign; dimensions, details, and methods of mounting or anchoring; shape and thickness of materials; and details of construction. A schedule showing the location, each sign type, and message must be included. Signs must be installed plumb and true at mounting heights indicated, and by method shown or specified. Signs mounted on other surfaces must not be installed until finishes on such surfaces have been completed. Submit manufacturer's installation instructions and cleaning instructions.

#### 3.1.1 Anchorage

Anchorage and fastener materials must be in accordance with approved manufacturer's instructions for the indicated substrate. Anchorage not otherwise specified or indicated must include slotted inserts, expansion shields, and powder-driven fasteners when approved for concrete; toggle bolts and through bolts for masonry; machine carriage bolts for steel; lag bolts and screws for wood.

#### 3.1.2 Protection and Cleaning

The work must be protected against damage during construction. Hardware and electrical equipment must be adjusted for proper operation. Glass, frames, and other sign surfaces must be cleaned in accordance with manufacturer's instructions. After signs are completed and inspected, cover all project identification, directional, and other signs which may mislead the public. Covering must be maintained until instructed to be removed by the Contracting Officer or until the facility is to be opened for business. Submit six copies of maintenance instructions listing routine maintenance procedures, possible breakdowns and repairs, and troubleshooting guides. The instructions must include simplified diagrams for the equipment as installed. Signs must be cleaned, as required, at time of cover removal.

#### 3.2 FIELD PAINTED FINISH

Miscellaneous metals and frames must be field painted in accordance with Section 09 90 00 PAINTS AND COATINGS. Anodized metals, masonry, and glass must be protected from paint. Finish must be free of scratches or other blemishes.

-- End of Section --



SECTION 10 14 00.20

INTERIOR SIGNAGE  
08/17

PART 1 GENERAL

1.1 REFERENCES

The publications listed below form a part of this specification to the extent referenced. The publications are referred to 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 NATIONAL STANDARDS INSTITUTE (ANSI)

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

AMERICAN WELDING SOCIETY (AWS)

AWS D1.2/D1.2M (2014) Structural Welding Code - Aluminum

ASTM INTERNATIONAL (ASTM)

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

ASTM B221 (2014) Standard Specification for Aluminum  
and Aluminum-Alloy Extruded Bars, Rods,  
Wire, Profiles, and Tubes

INTERNATIONAL CODE COUNCIL (ICC)

ICC A117.1 COMM (2017) Standard And Commentary Accessible  
and Usable Buildings and Facilities

NATIONAL FIRE PROTECTION ASSOCIATION (NFPA)

NFPA 101 (2018; TIA 18-1) Life Safety Code

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

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

## 1.2 SUBMITTALS

Government approval is required for submittals with a "G" designation; submittals not having a "G" designation are for information only. When used, a designation following the "G" designation identifies the office that will review the submittal for the Government. Submittals with an "S" are for inclusion in the Sustainability eNotebook, in conformance to Section 01 33 29 SUSTAINABILITY REPORTING. Submit the following in accordance with Section 01 33 00 SUBMITTAL PROCEDURES:

### SD-02 Shop Drawings

Detail Drawings

### SD-03 Product Data

Installation

Warranty

### SD-04 Samples

Interior Signage; G

Software

### SD-10 Operation and Maintenance Data

Approved Manufacturer's Instructions

Protection and Cleaning

## 1.3 EXTRA MATERIALS

Provide 1 extra frame and extra stock of the following: 3 blank plates of each color and size. 3 changeable message strips. Provide 20 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.

## 1.4 QUALITY ASSURANCE

### 1.4.1 Samples

Submit interior signage samples of each of the following sign types showing typical quality, workmanship and color: Room identification Sign, Restroom Identification Sign, and Regulatory Sign. The samples may be installed in the work, provided each sample is identified and location recorded.

### 1.4.2 Detail Drawings

Submit detail drawings showing elevations of each type of sign, dimensions, details and methods of mounting or anchoring, mounting height, shape and thickness of materials, and details of construction. Include a schedule showing the location, each sign type, and message.



## 1.5 DELIVERY, STORAGE, AND HANDLING

Materials must be packaged to prevent damage and deterioration during shipment, handling, storage and installation. Product must be delivered to the jobsite in manufacturer's original packaging and stored in a clean, dry area in accordance with manufacturer's instructions.

## 1.6 WARRANTY

Warrant the interior signage for a period of 2 year against defective workmanship and material. Warranties must be signed by the authorized representative of the manufacturer. Submit warranty accompanied by the document authenticating the signer as an authorized representative of the guarantor. Guarantee that the signage products and the installation are free from any defects in material and workmanship from the date of delivery.

## PART 2 PRODUCTS

### 2.1 STANDARD PRODUCTS

Signs, plaques, directories, and dimensional letters must be the standard product of a manufacturer 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 letterforms and graphics true and clean.

### 2.2 ROOM IDENTIFICATION/DIRECTIONAL SIGNAGE SYSTEM

#### 2.2.1 Standard Room Signs

Signs must consist of acrylic plastic 0.080 inch thickness minimum conforming to ANSI Z97.1 and must conform to the following:

- a. Frames must be molded acrylic, flat 1/4 inch thick.
- b. End caps must be molded acrylic with square style corners.

#### 2.2.2 Changeable Message Strip Signs

Changeable message strip signs must be of same construction as standard room signs to include a clear sleeve that will accept a paper or plastic insert identifying changeable text. The insert must be prepared typeset message mounted on paper card stock. Provide paper and software for creating text and symbols for computers identified by owner for Owner production of paper inserts after project completion. Furnish one suction device to assist in removing face sheet.

#### 2.2.3 Type of Mounting For Signs

Provide extruded aluminum brackets for hanging, projecting, and double-sided signs. Mounting for framed, hanging, and projecting signs must be by mechanical fasteners. Surface mounted signs must be mounted with countersunk mounting holes in plaques and mounting screws fabricated from materials that are not corrosive to sign material and mounting surface.

## 2.2.4 Graphics

Signage graphics for modular signs must conform to the following:

### 2.2.4.1 Surface Applied Photopolymer

Integral graphics and Braille achieved by photomechanical stratification processes. Photopolymer used for ADA compliant graphics must be of the type that has a minimum durometer reading of 90. Tactile graphics must be raised 1/32 inch from the first surface of plaque by photomechanical stratification process.

## 2.2.5 Character Proportions and Heights

Letters and numbers on signs conform to 36 CFR 1191.

## 2.2.6 Tactile Letters, Symbols and Braille

Raised letters and numbers on signs must conform to 36 CFR 1191.

## 2.3 STAIR SIGNAGE

Provide signs on stairs serving three or more stories with special signage within the enclosure at each floor landing conforming to NFPA 101. Indicate the floor level, the terminus of the top and bottom of the stair enclosure, and the identification of the stair enclosure. Also, state the floor level of, and the direction to, exit discharge. Locate the signage inside the enclosure in a position that is visible when the door is in the open or closed position and install in conformance with 36 CFR 1191. The floor level designation must also be tactile in accordance with ICC A117.1 COMM.

## 2.4 BUILDING DIRECTORIES

Building directories must be lobby directories or floor directories, and must be provided with a changeable directory listing consisting of the areas, offices and personnel located within the facility. Dimensions, details, and materials of sign and message content must be as shown on the drawings.

### 2.4.1 Header Panel

Header panel must be acrylic with raised acrylic letters.

### 2.4.2 Non-Illuminated Unit

Directory must consist of a non-illuminated unit with machine or laser engraved copy in interchangeable acrylic, metal, or high-pressure plastic strips. Design of unit must be as shown in the drawings.

#### 2.4.2.1 Construction

Directory must consist of acrylic plastic 0.080 inch thickness minimum conforming to ANSI Z97.1. Frame must be molded acrylic, flat, 1/4 inch thick. End caps must be molded acrylic with square styled corners. Unit must be surface mounted. Unit must have a inch high header lettering as shown. Unit must have a inch face door frame with concealed hinges and locking system or other secure method. Door frame must .

## 2.5 ALUMINUM ALLOY PRODUCTS

Aluminum extrusions must be at least 1/8 inch thick, and aluminum plate or sheet must be at least 0.0508 inch thick. Extrusions must conform to ASTM B221; plate and sheet must conform to ASTM B209. Where anodic coatings are specified, alloy must conform to AA PK-1 alloy designation 514.0. Exposed anodized aluminum finishes must be as shown. Welding for aluminum products must conform to AWS D1.2/D1.2M.

## 2.6 ANODIC COATING

Anodized finish must conform to AA DAF45 as follows:

- a. Clear (natural) designation AA-M10-C22-A31, Architectural Class II 0.4 mil or thicker.

## 2.7 FABRICATION AND MANUFACTURE

### 2.7.1 Factory Workmanship

Holes for bolts and screws must be drilled or punched. Drilling and punching must produce clean, true lines and surfaces. Exposed surfaces of work must have a smooth finish and exposed riveting must be flush. Fastenings must be concealed where practicable.

### 2.7.2 Dissimilar Materials

Where dissimilar metals are in contact, the surfaces will be protected to prevent galvanic or corrosive action.

## 2.8 COLOR, FINISH, AND CONTRAST

Color must be as indicated. Finish of all signs must be eggshell, matte, or other non-glare finish as required in handicapped-accessible buildings.

## 2.9 TYPEFACE

As indicated.

## PART 3 EXECUTION

### 3.1 INSTALLATION

Signs must be installed plumb and true and in accordance with approved manufacturer's instructions at locations shown on the detail drawings. Submit six copies of operating instructions outlining the step-by-step procedures required for system operation. The instructions must 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. Each set must be permanently bound and must have a hard cover. The following identification must be inscribed on the covers: the words "OPERATING AND MAINTENANCE INSTRUCTIONS", name and location of the facility, name of the Contractor, and contract number. Mounting height and mounting location must conform to 36 CFR 1191. Required blocking must be installed. Do not install items that show visual evidence of biological growth.

### 3.1.1 Anchorage

Anchorage must be in accordance with approved manufacturer's instructions. Anchorage not otherwise specified or shown must include slotted inserts, expansion shields, and powder-driven fasteners when approved for concrete; toggle bolts and through bolts for masonry; machine carriage bolts for steel; lag bolts and screws for wood. Exposed anchor and fastener materials must be compatible with metal to which applied and must have matching color and finish.

- a. Signs mounted to painted gypsum board surfaces must be removable for painting maintenance.
- b. Mount signs mounted 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.

### 3.1.2 Protection and Cleaning

Protect the work against damage during construction. Hardware and electrical equipment must be adjusted for proper operation. Glass, frames, and other sign surfaces must be cleaned at completion of sign installation in accordance with the manufacturer's approved instructions and the requirements of Section 01 78 23 OPERATION AND MAINTENANCE DATA, Package 1. Submit six copies of maintenance instructions listing routine procedures, repairs, and guides.

-- End of Section --

SECTION 10 14 53

TRAFFIC SIGNAGE

02/15

PART 1 GENERAL

1.1 REFERENCES

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

AMERICAN ASSOCIATION OF STATE HIGHWAY AND TRANSPORTATION OFFICIALS  
(AASHTO)

AASHTO M 133	(2012; R 2016) Standard Specification for Preservatives and Pressure Treatment Processes for Timber
AASHTO M 168	(2007; R 2012) Standard Specification for Wood Products
AASHTO M 268	(2014) Standard Specification for Retroreflective Sheeting for Flat and Vertical Traffic Control Applications

AMERICAN WOOD PROTECTION ASSOCIATION (AWPA)

AWPA T1	(2017) Use Category System: Processing and Treatment Standard
AWPA U1	(2017) Use Category System: User Specification for Treated Wood

ASTM INTERNATIONAL (ASTM)

ASTM A1011/A1011M	(2017) 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 A123/A123M	(2017) Standard Specification for Zinc (Hot-Dip Galvanized) Coatings on Iron and Steel Products
ASTM A36/A36M	(2014) Standard Specification for Carbon Structural Steel
ASTM A499	(2015) Standard Specification for Steel Bars and Shapes, Carbon Rolled from "T" Rails
ASTM A500/A500M	(2013) Standard Specification for Cold-Formed Welded and Seamless Carbon Steel Structural Tubing in Rounds and Shapes

ASTM A563	(2015) Standard Specification for Carbon and Alloy Steel Nuts
ASTM A653/A653M	(2017) Standard Specification for Steel Sheet, Zinc-Coated (Galvanized) or Zinc-Iron Alloy-Coated (Galvannealed) by the Hot-Dip Process
ASTM A709/A709M	(2017) Standard Specification for Structural Steel for Bridges
ASTM B209	(2014) Standard Specification for Aluminum and Aluminum-Alloy Sheet and Plate
ASTM B221	(2014) Standard Specification for Aluminum and Aluminum-Alloy Extruded Bars, Rods, Wire, Profiles, and Tubes
ASTM C94/C94M	(2017a) Standard Specification for Ready-Mixed Concrete
ASTM D4956	(2013) Standard Specification for Retroreflective Sheeting for Traffic Control
ASTM F3125/F3125M	(2015a) Standard Specification for High Strength Structural Bolts, Steel and Alloy Steel, Heat Treated, 120 ksi (830 MPa) and 150 ksi (1040 MPa) Minimum Tensile Strength, Inch and Metric Dimensions
ASTM F436/F436M	(2016) Standard Specification for Hardened Steel Washers Inch and Metric Dimensions

U.S. FEDERAL HIGHWAY ADMINISTRATION (FHWA)

FHWA SHS	(2004; Supplement 2012) Standard Highway Signs
MUTCD	(2015) Manual on Uniform Traffic Control Devices

1.2 GENERAL

All signs must be in accordance with the MUTCD. Any signs not detailed on the drawings must be in accordance with the FHWA SHS.

1.3 SUBMITTALS

Government approval is required for submittals with a "G" designation; submittals not having a "G" designation are for Contractor Quality Control approval. Submittals with an "S" are for inclusion in the Sustainability eNotebook, in conformance to Section 01 33 29 SUSTAINABILITY REPORTING. Submit the following in accordance with Section 01 33 00 SUBMITTAL PROCEDURES:

SD-03 Product Data

Traffic Sign Posts

Traffic Sign Retroreflective Sheeting

SD-04 Samples

Flexible Posts

PART 2 PRODUCTS

2.1 TRAFFIC SIGN POSTS

2.1.1 Steel Flanged Channel Section (U-Shape)

Fabricate steel posts from steel conforming to ASTM A36/A36M or ASTM A499 and with a minimum yield strength of 30 ksi and a minimum tensile strength of 50 ksi. Punch or drill 5/16 to 3/8 inch diameter holes spaced at 1 or 2 inch centers along the centerline of the web prior to galvanizing for the entire length of the post. Galvanize posts after punching in accordance with ASTM A123/A123M.

2.1.2 Perforated Steel Tube

Fabricate steel posts from steel conforming to either ASTM A653/A653M, structural steel, Grade 50, Class 1, coating designation G90 or ASTM A1011/A1011M, structural steel, Grade 50, hot-dip galvanized after punching in accordance with ASTM A123/A123M. Prepunch holes approximately 7/16 inch in diameter spaced at approximately 1 inch centers along each side of the tube for the entire length of the post.

2.1.3 Steel Tube

Conform to ASTM A500/A500M, Grade B or C, and hot-dip galvanized in accordance with ASTM A123/A123M.

2.1.4 Structural Steel H Section

Conform to ASTM A709/A709M, Grade 50 or 50W. Galvanize posts, fuse plate and splice plate after fabrication in accordance with ASTM A123/A123M.

2.1.4.1 Slip Base, Fuse Plate and Splice Plate

Conform to ASTM A36/A36M, minimum yield strength 50,000 psi.

2.1.4.2 High-Strength Bolts, Nuts and Washers

High strength bolts must conform to ASTM F3125/F3125M. Nuts must conform to ASTM A563. Washers must conform to ASTM F436/F436M. High strength bolts, nuts and washers must be zinc coated.

2.1.5 Wood

Wood posts must be dry no. 1 grade Douglas fir, southern or Ponderosa pine, hemlock, spruce, or western larch conforming to AASHTO M 168. Treat the posts with water-borne preservative according to AASHTO M 133, AWPA T1 and AWPA U1.

## 2.2 FLAT ALUMINUM SIGN PANELS

Aluminum sign panels must conform to ASTM B209, alloy-temper 6061-T6 or 5052-H38. The blanks must be free from laminations, blisters, open seams, pits, holes, other defects that may affect their appearance or use. The thickness must be uniform and the blank commercially flat.

## 2.3 EXTRUDED ALUMINUM SIGN PANELS

Conform to ASTM B221, alloy 6063-T6. The maximum allowable deviation from flat on the face is 0.05 inches per foot.

## 2.4 TRAFFIC SIGN RETROREFLECTIVE SHEETING

All background sheeting applied to flat sheet and extruded panel signs must be in accordance with ASTM D4956, Type III, IV, VII, VIII, IX or XI retroreflective sheeting and must have Class 1, 3, or 4 adhesive backing. Retroreflective sheeting must be high intensity that is an unmetallized micro prismatic reflective material.

Retroreflective sheeting must have sufficient adhesion, strength and flexibility such that the sheeting can be handled, processed and applied according to the manufacturer's recommendations without appreciable stretching, tearing, cracking or other damage.

### 2.4.1 Legend and Border

Apply retroreflective sheeting as legend and border in accordance with ASTM D4956, Type IX, XI, or AASHTO M 268 Type C or D, Class 1. Retroreflective sheeting must be an unmetallized cube corner microprismatic reflective material. Retroreflective sheeting applied as legend and border for specific signing applications, without a datum mark on the surface of the sheeting, must be evaluated for rotational sensitivity in accordance with AASHTO M 268, Section 3.3.1 and fabricated in accordance with AASHTO M 268, Section 3.3.2.

### 2.4.2 Screen Printed Transparent Colored Areas

For screen printed transparent colored areas or transparent colored overlay films on white sheeting, the coefficient of retroreflection (RA) must be no less than 70 percent of the original values for the corresponding color.

### 2.4.3 Adhesive Performance

Adhesive performance for retroreflective sheeting must be in accordance with ASTM D4956. The sheeting surface must be in condition to be readily screen processed and compatible with transparent overlay films, plus recommended transparent and opaque screen process colors. Furnish manufacturer's information as to the type of solvent or solvents that may be used to clean the surface of the sheeting without detrimental loss of performance and durability.

## 2.5 LETTERS, NUMERALS, ARROWS, SYMBOLS, AND BORDERS

Apply letters, numerals, arrows, symbols, and borders on the retroreflective sheeting or opaque background of the sign using the direct or reverse screen process. Apply messages and borders of a color darker than the background to the paint or the retroreflective sheeting using the



direct process. Messages and borders must be of a color lighter than the sign background and applied using the reverse screen process. Use opaque or transparent colors, inks, and paints of the type and quality recommended by the retroreflective sheeting manufacturer in the screen process. Perform the screening in a manner that results in a uniform color and tone, with sharply defined edges of legends and borders and without blemishes on the sign background that will affect intended use. Air dry or bake the signs after screening according to the manufacturer's recommendations to provide a smooth hard finish. Reject any signs with blister's or other blemishes.

## 2.6 DELINEATOR POSTS

### 2.6.1 Steel Posts

Fabricate posts from steel conforming to ASTM A36/A36M or ASTM A499 and having a minimum yield strength of 30 ksi and a minimum tensile strength of 50 ksi. Galvanize posts after punching in accordance with ASTM A123/A123M.

### 2.6.2 Flexible Posts

Provide one-piece driveable flexible posts. Posts must be impact-resistant, integrally colored UV stabilized polymer or polycarbonate extrusion or fiberglass reinforced composite material. Other materials are subject to approval by the Contracting Officer's Representative. Include a retroreflective sheeting plate with each post as indicated.

## 2.7 DELINEATOR RETROREFLECTORS

### 2.7.1 Circular Prismatic Reflectors

Retroreflectors attached to steel posts must be a 3-inch minimum diameter acrylic plastic lens with prismatic optical elements and a smooth, clear, transparent face. Fabricate the back from similar material and fuse to the lens around the entire perimeter to form a homogeneous unit. Permanently seal the units against the intrusion of dust, water, or air. Mount the retroreflector unit in a housing fabricated from 0.063-inch aluminum alloy or similar, or from cold-rolled, hot dip, galvanized steel, having a thickness of 0.064 inches. Provide the indicated color.

### 2.7.2 Retroreflective Sheeting

A retroreflective sheeting plate must be applied to each flexible post by the post manufacturer and must be in accordance with ASTM D4956, Type III, IV, V, VII, VIII, IX or XI retroreflective sheeting. Retroreflective sheeting must be high intensity that is an unmetallized cube corner micro prismatic reflective material. Provide the size and color of the retroreflective sheeting plate as indicated.

## 2.8 HARDWARE

Bolts, nuts, post clips, lock and flat washers must be either aluminum alloy or commercial quality stainless steel, hot-dip galvanized or cadmium plated after fabrication. Provide fiber washers of commercial quality.

## 2.9 CONCRETE

ASTM C94/C94M, using 3/4 inch maximum aggregate, and having minimum

compressive strength of 3000 psi at 28 days.

### PART 3 EXECUTION

#### 3.1 SIGN POSTS

##### 3.1.1 Round Steel Tube

Sign posts consist of a base post and sign post. Drive steel sign base posts with a suitable driving head. Attach sign posts to base posts. Replace any base posts damaged during driving or otherwise at no additional cost to the Government.

##### 3.1.2 Structural Steel H Section Posts

Tighten all breakaway assembly bolts in a systematic manner to the prescribed torque indicated. Loosen each breakaway assembly bolt and re-tighten to the required torque in the same order as the initial tightening. Burr the threads at the nut using a center punch to prevent the nut from loosening. Tighten nuts on hinge plate bolts to the required minimum bolt tension values indicated.

##### 3.1.3 Wood

Drill holes in the post as indicated.

#### 3.2 SIGN PANELS

Clean, degrease and etch the face of metal panels using methods recommended by the retroreflective sheeting manufacturer. After cleaning and degreasing, apply retroreflective sheeting material to the sign panels as recommended by the manufacturer. Perform shearing, cutting and punching prior to preparing the blanks for application of reflective material. Do not field drill holes in any part of the panel. Use nylon washers recommended by the sign sheeting manufacturer between the bolt heads and sign faces on flat sheet aluminum signs. Replace any damaged sign panels at no additional cost to the Government.

#### 3.3 LOCATION AND POSITION OF SIGNS

Locate and erect all signs in accordance with the drawings and MUTCD. Vertically mount signs at right angles to the direction of, and facing, the traffic that they are intended to serve. Where mirror reflection from the sign face is encountered to such a degree as to reduce legibility, turn the sign slightly away from the road. Turn signs that are placed 30 feet or more from the pavement edge toward the road. On curved alignments, determine the angle of placement by the direction of approaching traffic rather than by the roadway edge at the point where the sign is located. Mounted signs must present a smooth flat surface varying no more than 3/8 inch from a 4-foot straightedge placed in any position on the face of the sign after erection. Mount signs on traffic signal posts with strap or clamp type sign supports. Each installed sign will be inspected by the Contracting Officer's representative prior to acceptance by the Government.

-- End of Section --

SECTION 10 21 13

TOILET COMPARTMENTS  
**08/17**

PART 1 GENERAL

1.1 REFERENCES

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

ASTM INTERNATIONAL (ASTM)

ASTM 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	(2015) Standard Specification for Alloy Steel Forgings for Pressure and High-Temperature Parts
ASTM A385/A385M	(2017) Standard Practice for Providing High-Quality Zinc Coatings (Hot-Dip)
ASTM A653/A653M	(2017) Standard Specification for Steel Sheet, Zinc-Coated (Galvanized) or Zinc-Iron Alloy-Coated (Galvannealed) by the Hot-Dip Process
ASTM B221	(2014) Standard Specification for Aluminum and Aluminum-Alloy Extruded Bars, Rods, Wire, Profiles, and Tubes
ASTM B36/B36M	(2013) Standard Specification for Brass Plate, Sheet, Strip, and Rolled Bar
ASTM B86	(2013) Standard Specification for Zinc and Zinc-Aluminum (ZA) Alloy Foundry and Die Castings
ASTM D6386	(2016) Standard Practice for Preparation of Zinc (Hot-Dip Galvanized) Coated Iron and Steel Product and Hardware Surfaces for Painting
ASTM D7611/D7611M	(2013; E 2014) Standard Practice for Coding Plastic Manufactured Articles for Resin Identification

CALIFORNIA DEPARTMENT OF PUBLIC HEALTH (CDPH)

CDPH SECTION 01350                      Standard Method for the Testing and  
Evaluation of Volatile Organic Chemical  
Emissions from Indoor Sources using  
Environmental Chambers

INTERNATIONAL CODE COUNCIL (ICC)

ICC A117.1 COMM                      (2017) Standard And Commentary Accessible  
and Usable Buildings and Facilities

SCIENTIFIC CERTIFICATION SYSTEMS (SCS)

SCS                                      SCS Global Services (SCS)Indoor Advantage

U.S. GENERAL SERVICES ADMINISTRATION (GSA)

CID A-A-60003                      (Basic) Partitions, Toilet, Complete

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

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

UNDERWRITERS LABORATORIES (UL)

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

1.2 SUBMITTALS

Government approval is required for submittals with a "G" designation;  
submittals not having a "G" designation are for information only. When  
used, a designation following the "G" designation identifies the office  
that will review the submittal for the Government. Submittals with an "S"  
are for inclusion in the Sustainability eNotebook, in conformance to  
Section 01 33 29 SUSTAINABILITY REPORTING. Submit the following in  
accordance with Section 01 33 00 SUBMITTAL PROCEDURES:

SD-02 Shop Drawings

Fabrication Drawings

Installation Drawings

SD-03 Product Data

Cleaning and Maintenance Instructions

Colors And Finishes

Galvanized Steel Sheet

Sound-Deadening Cores

Anchoring Devices and Fasteners

Hardware and Fittings

Brackets

Door Hardware

Toilet Enclosures

Urinal Screens

Pilaster Shoes

Finishes; G

SD-04 Samples

Colors and Finishes; G

Hardware and Fittings

Anchoring Devices and Fasteners

SD-07 Certificates

Warranty

Indoor Air Quality

SD-10 Operation and Maintenance Data

Plastic Identification

SD-11 Closeout Submittals

Recycled content for plastic, solid polyethylene partitions and  
screens; S

Indoor air quality for solid phenolic, black core partitions and  
screens; S

### 1.3 CERTIFICATIONS

#### 1.3.1 Indoor Air Quality

##### 1.3.1.1 Solid Phenolic Products

Provide products certified to meet indoor air quality requirements by UL 2818 (Greenguard) Gold, SCS Global Services Indoor Advantage Gold or provide certification or validation by other third-party program that products meet the requirements of this Section. Provide current product certification documentation from certification body.

### 1.4 REGULATORY REQUIREMENTS

Conform to ICC A117.1 COMM code for access for the handicapped operation of toilet compartment door and hardware.

## 1.5 DELIVERY, STORAGE, AND HANDLING

Deliver materials in the manufacturer's original unopened packages with the brand, item identification, and project reference clearly marked. Store components in a dry location that is adequately ventilated; free from dust, water, other contaminants, and damage during delivery, storage, and construction.

## 1.6 WARRANTY

Provide certification or warranties that toilet partitions will be free of defects in materials, fabrication, finish, and installation and will remain so for a period of not less than one year after completion and be free from delamination for a period of not less than 25 years.

## 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 metal toilet partitions and urinal screens consisting of fabrication and assembly details to be performed in the factory. Submit manufacturer's Cleaning and Maintenance Instructions with Fabrication Drawings for review.

#### 2.1.1 Plastic Identification

Verify that plastic products to be incorporated into the project are labeled in accordance with ASTM D7611/D7611M. Where products are not labeled, provide product data indicating polymeric information in the Operation and Maintenance Manual.

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

### 2.2 MATERIALS

#### 2.2.1 Galvanized Steel Sheet

Provide galvanized steel sheet cold-rolled, stretcher-level, commercial quality material, conforming to ASTM A653/A653M. Conform surface preparation of material for painting to ASTM D6386, Method A.

## 2.2.2 Sound-Deadening Cores

Provide sound deadening consisting of treated kraft paper honeycomb cores with a cell size of not more than 1 inch. Resin-material content must weigh not less than 11 percent of the finished core weight. Expanded cores must be faced on both sides with kraft paper.

## 2.2.3 Anchoring Devices and Fasteners

Provide steel anchoring devices and fasteners hot-dipped galvanized after fabrication, in conformance with ASTM A385/A385M and ASTM A123/A123M. Conceal all galvanized anchoring devices.

## 2.2.4 Brackets

Wall brackets must be two-ear panel brackets, T-style, 1-inch stock. Provide stirrup style panel-to-pilaster brackets.

## 2.2.5 Hardware and Fittings

### 2.2.5.1 General Requirements

Conform hardware for the toilet partition system to 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 latching devices and hinges for handicap compartments with 36 CFR 1191; provide stainless steel devices and hinges with door latches that operate without either tight grasping or twisting of the wrist of the operator. Submit three samples of each item, including anchoring devices and fasteners. Approved hardware samples may be installed in the work if properly identified.

Material	Conformance Standard
Cold-rolled sheet steel	ASTM A336/A336M, commercial quality
Zinc-base alloy	ASTM B86, Alloy AC41-A
Brass	ASTM B36/B36M, Alloy C26800
Aluminum	ASTM B221
Corrosion-resistant steel	ASTM A167, Type 304

### 2.2.5.2 Finishes

- a. Corrosion-resistant steel must have a No. 4 finish.
- b. Exposed fasteners must match the hardware and fittings.

## 2.2.6 Door Hardware

### 2.2.6.1 Hinges

Hinges must be adjustable to hold in-swinging doors open at any angle up to 90 degrees and outswinging doors to 10 degrees. Provide

self-lubricating hinges with the indicated swing. Hinges must have the following type of return movement:

- a. Gravity return movement

#### 2.2.6.2 Latch and Pull

Latch and pull must be a combination rubber-faced door strike and keeper equipped with emergency access.

#### 2.2.6.3 Coat Hooks

Coat hooks must be combination units with hooks and rubber tipped pins.

### 2.3 PARTITION PANELS AND DOORS

Fabricate partition panels and doors not less than 1 inch thick with face sheets not less than 0.0396 inch thick.

Provide solid polyethylene toilet partitions and screens with recycled content of 30 percent minimum. Provide data identifying percentage of recycled content for plastic, solid polyethylene partitions and screens.

Provide laminated plastic and solid phenolic toilet partitions and urinal screens to meet the emissions requirements of CDPH SECTION 01350 (limit requirements for either office or classroom spaces regardless of space type). Provide certification of indoor air quality for solid phenolic, black core partitions and screens.

#### 2.3.1 Toilet Enclosures

Provide and conform toilet enclosures to CID A-A-60003, Type I, Style A, floor supported. Furnish width, length, and height of toilet enclosures as shown. Finish surface of panels must be solid phenolic, black core Finish 4; water resistant; graffiti resistant; non-absorbent; with plastic laminate face sheets permanently fused to phenolic core; chamfered edges. Reinforce panels indicated to receive toilet paper holders or grab bars for mounting of the items required. Provide grab bars to withstand a bending stress, shear stress, shear force, and a tensile force induced by 250 lbf. Grab bars must not rotate within their fittings.

#### 2.3.2 Urinal Screens

Provide and conform urinal screens to CID A-A-60003, Type III, Style A, floor supported. Provide finish for surface of screens as solid phenolic, black core Finish 4; water resistant; graffiti resistant; non-absorbent; with plastic laminate face sheets permanently fused to phenolic core; chamfered edges. Furnish width and height of urinal screens as shown. Fabricate screens from the same types of panels and pilasters as the toilet partitions. Use corrosion-resistant steel fittings and fasteners.

### 2.4 FLOOR-ANCHORED PARTITIONS

Pilasters must be not less than 1-1/4 inch thick with face sheets not less than 0.0635 inch thick. Provide anchoring device at the bottom of the pilaster consisting of a steel bar not less than 1/2 by 7/8 inch welded to the reinforced face sheets and having not less than two 3/8 inch round anchorage devices for securing to the floor slab. Provide anchorage devices complete with threaded rods, expansion shields, lock washers, and



leveling-adjustment nuts. Trim piece at the floor must be 3 inch high and fabricated from not less than 0.030 inch thick corrosion-resistant steel.

## 2.5 PILASTER SHOES

Provide shoes at pilasters to conceal floor-mounted anchorage. Pilaster shoes must be stainless steel. See Section 01 33 29 SUSTAINABILITY REPORTING for cumulative total recycled content requirements. Height must be 3 inches.

## 2.6 HARDWARE

Provide hardware for the toilet partition system that conforms to 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: cast stainless steel pivot hinges, gravity type, adjustable for door close positioning; nylon bearings; stainless steel door latch; door strike and keeper with rubber bumper; and coat hook and bumper. Provide latching devices and hinges for handicap compartments complying with 36 CFR 1191 and stainless steel door latches that operate without either tight grasping or twisting of the wrist of the operator. Use stainless steel, tamper proof type screws and bolts. Wall mounting brackets must be continuous, full height, stainless steel, in accordance with toilet compartment manufacturer's instructions. Provide floor-mounted anchorage consisting of corrosion-resistant anchoring assemblies with threaded rods, lock washers, and leveling adjustment nuts at pilasters for structural connection to floor.

## 2.7 COLORS AND FINISHES

### 2.7.1 Colors

Provide manufacturer's standard color charts for color of finishes for toilet partition system components. Submit three samples showing a finished edge on two adjacent sides and core construction, each not less than 12-inch square

### 2.7.2 Finish No.4

Provide solid plastic fabricated of solid phenolic core with plastic laminate facing sheets formed under high pressure rendering a single component section not less than one inch thick. Provide exposed finish surfaces: smooth, waterproof, non-absorbent, and resistant to staining and marking with pens, pencils, or other writing devices. Solid plastic partitions must not show any sign of deterioration when immersed in the following chemicals and maintained at a temperature of 80 degrees F for a minimum of 30 days:

Acetic Acid (80 percent)	Hydrochloric Acid (40 percent)
Acetone	Hydrogen Peroxide (30 percent)
Ammonia (liquid)	Isopropyl Alcohol
Ammonia Phosphate	Lactic Acid (25 percent)

Bleach (12 percent)	Lime Sulfur
Borax	Nicotine
Brine	Potassium Bromide
Caustic Soda	Soaps
Chlorine Water	Sodium Bicarbonate
Citric Acid	Trisodium Phosphate
Copper Chloride	Urea; Urine
Core Oils	Vinegar

### 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 will adversely affect satisfactory execution of the work of this section. Do not proceed with work until unsatisfactory conditions have been corrected.

#### 3.2 INSTALLATION

Do not install items that show visual evidence of biological growth. Install partitions rigid, straight, plumb, and level, with the panels centered between the fixtures. Provide a panel clearance of not more than 1/2 inch and secure the panels to walls and pilasters with not less than two wall brackets attached near the top and bottom of the panel. Locate wall brackets so that holes for wall bolts occur in masonry or tile joints. Secure Panels to pilasters with brackets matching the wall brackets. Provide for adjustment due to minor floor variations. Locate head rail joints at pilaster center lines. Install adjacent components for consistency of line and plane. Equip each door with hinges, one door latch, and one coat hook and bumper. Align hardware to uniform clearance at vertical edges of doors.

- a. Secure panels to hollow plastered walls with toggle bolts using not less than 1/4-20 screws of the length required for the wall thickness. Toggle bolts must have 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. Toggle bolts must have 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 inch. Expansion shields must have a load-carrying strength of not less than 600 pounds per anchor.

- d. Submit Installation Drawings for metal toilet partitions and urinal screens showing plans, elevations, details of construction, hardware, reinforcing and blocking, fittings, mountings and escutcheons. Indicate on drawings the type of partition, location, mounting height, cutouts, and reinforcement required for toilet-room accessories.

### 3.3 FLOOR-ANCHORED PARTITIONS

Secure pilasters to the floor with the anchorage device specified. Make all leveling devices readily accessible for leveling, plumbing, and tightening the installation. Level tops of doors with tops of pilasters when doors are in a closed position. Expansion shields must have a minimum 2-inch penetration into the concrete slab.

### 3.4 FINAL ADJUSTMENT

After completion of the installation, make final adjustments to the pilaster-leveling devices, door hardware, and other working parts of the partition assembly. Doors must have a uniform vertical edge clearance of approximately 3/16 inch and must rest open at approximately 30 degrees when unlatched.

### 3.5 CLEANING

Baked enamel finish must be touched up with the same color of paint that was used for the finish. Clean all surfaces of the work, and adjacent surfaces soiled as a result of the work, in an approved manner compliant with the manufacturer's recommended cleaning and protection from damage procedures until accepted. Remove all equipment, tools, surplus materials, and work debris from the site.

-- End of Section --



SECTION 10 22 13

WIRE MESH PARTITIONS

08/16

PART 1 GENERAL

1.1 REFERENCES

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

AMERICAN IRON AND STEEL INSTITUTE (AISI)

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

ASTM INTERNATIONAL (ASTM)

ASTM A36/A36M (2014) Standard Specification for Carbon  
Structural Steel

1.2 SUBMITTALS

Government approval is required for submittals with a "G" designation; submittals not having a "G" designation are for information only. When used, a designation following the "G" designation identifies the office that will review the submittal for the Government. Submittals with an "S" are for inclusion in the Sustainability eNotebook, in conformance with Section 01 33 29 SUSTAINABILITY REPORTING. Submit the following in accordance with Section 01 33 00 SUBMITTAL PROCEDURES:

SD-02 Shop Drawings

Wire Mesh Partitions

Show layout, details, materials, dimensions, finishes, and all information necessary for fabrication and installation.

SD-03 Product Data

Wire Mesh Partitions

Submit for each type of partition, door, and window.

SD-11 Closeout Submittals

Recycled Content for Metal Post and Framing Materials; S

Recycled Content for Wire Materials; S

1.3 DELIVERY, STORAGE, AND HANDLING

Deliver materials in manufacturer's original, unopened containers or packaging with labels intact and legible. Deliver, store, and handle materials so as to prevent damage. Replace damaged or defective materials with new.

#### 1.4 DESCRIPTION OF WORK

Wire mesh partitions must be all wire type , heavy duty for extra heavy industrial use. Provide partitions complete with fasteners, capping bars, adjustable floor sockets, bracing, hardware, and other items necessary for a complete, useable, and rigid installation.

#### PART 2 PRODUCTS

##### 2.1 PRODUCT SUSTAINABILITY CRITERIA

For products in this section, where applicable and to extent allowed by performance criteria, provide and document the following:

###### 2.1.1 Recycled Content for Steel Materials

Recycled content is identified for some products in this section; provide documentation in accordance with Section 01 33 29 SUSTAINABILITY REPORTING paragraph RECYCLED CONTENT. Other products listed in this section may be available with recycled content; identify those products that meet project requirements for recycled content, and provide documentation in accordance with Section 01 33 29 SUSTAINABILITY REPORTING paragraph RECYCLED CONTENT.

##### 2.2 MATERIALS

Metal post and framing materials listed below must contain a minimum of 15 percent post-consumer recycled content and wire materials must contain a minimum of 50 percent post-industrial recycled content. Provide data identifying percentage of recycled content for metal post and framing materials. Also provide data identifying percentage of recycled content for wire materials.

###### 2.2.1 Steel Shapes, Plates, and Bars

ASTM A36/A36M.

###### 2.2.2 Cold-Formed Steel

AISI SG03-3.

###### 2.2.3 Wire Mesh

Carbon steel wire, woven diamond mesh, intermediate crimped.

###### 2.2.4 Floor Sockets

Cast or forged steel or ductile iron, adjustable, approximately 2-1/2 inches high.

##### 2.3 HEAVY DUTY PARTITIONS

###### 2.3.1 Wire Mesh

6 gage wire, 2 inch mesh.

###### 2.3.2 Panel Frames

1-1/2 by 3/4 by 1/8 inch steel channels.

### 2.3.3 Center Reinforcing Bar

One 1-1/2 by 3/4 by 1/8 inch channel with all wires woven through, or two 1-1/4 by 3/8 by 1/8 inch channels bolted together with mesh in between.

### 2.3.4 Capping Bar

Structural steel channel, 3 inch by 4.1 pounds.

### 2.3.5 Corner Posts

Structural steel angles, 1-3/4 by 1-3/4 by 1/8 inch.

### 2.3.6 Line Posts

Unless otherwise indicated, provide partitions with flat bar line posts bolted between vertical frame channels. Sizes of posts must be as follows:

Partition Height	Size of Posts
7 feet to 12 feet	2-1/2 by 5/16 inch
12 feet to 16 feet	3 by 5/16 inch or 2-1/2 by 3/8 inch
16 feet to 20 feet	3-1/2 by 5/16 inch

## 2.4 FABRICATION

### 2.4.1 Standard Panels

Wire must be woven into diamond mesh, intermediate crimped, and securely clinched to frames. Joints must be mortised and tenoned. Wire must be continuous at center reinforcing bars, either woven through a single channel or bolted between two channels. Panel vertical frames must have 3/8 inch bolt holes 18 inches o.c. for heavy duty partitions.

### 2.4.2 Finish

Thoroughly clean ferrous metal, treat with phosphate, and paint with enamel in the shop.

## PART 3 EXECUTION

### 3.1 INSTALLATION

#### 3.1.1 Wire Mesh Partitions

Install plumb, level, and true to line, within a tolerance of 1/8 inch in 10 feet or the height or run of the partition, if less than 10 feet. Anchor floor sockets to the floor with expansion bolts. Bolt vertical frames and posts together with 3/8 inch bolts 18 inches o.c. for heavy duty partitions. Secure top frames to a continuous capping bar with 1/4 inch diameter U bolts not more than 28 inches o.c.

#### 3.1.2 Bracing

Brace free standing partitions more than 20 feet in length, at intervals

not greater than 20 feet with a steel channel brace connected to the capping bar and anchored to the building wall or framing member or as indicated.

### 3.1.3 Touch-Up

Clean and paint scratches, abrasions, and other damage to shop painted surfaces to match the shop-applied finish.

-- End of Section --



SECTION 10 26 00

WALL AND DOOR PROTECTION  
**08/17**

PART 1 GENERAL

1.1 REFERENCES

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

ASTM INTERNATIONAL (ASTM)

ASTM B221	(2014) Standard Specification for Aluminum and Aluminum-Alloy Extruded Bars, Rods, Wire, Profiles, and Tubes
ASTM D256	(2010) Determining the Izod Pendulum Impact Resistance of Plastics
ASTM D543	(2014) Standard Practices for Evaluating the Resistance of Plastics to Chemical Reagents
ASTM D635	(2014) Standard Test Method for Rate of Burning and/or Extent and Time of Burning of Self-Supporting Plastics in a Horizontal Position
ASTM E84	(2018) Standard Test Method for Surface Burning Characteristics of Building Materials
ASTM G21	(2015) Standard Practice for Determining Resistance of Synthetic Polymeric Materials to Fungi

CALIFORNIA DEPARTMENT OF PUBLIC HEALTH (CDPH)

CDPH SECTION 01350	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	(2011) Commercial Adhesives
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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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Difference Measurement for Exterior  
Finishes, Textiles and Colored Trim

SOUTH COAST AIR QUALITY MANAGEMENT DISTRICT (SCAQMD)

SCAQMD Rule 1168

(1989; R 2005) Adhesive and Sealant  
Applications

UNDERWRITERS LABORATORIES (UL)

UL 2818

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

1.2 SUBMITTALS

Government approval is required for submittals with a "G" designation; submittals not having a "G" designation are for information only. When used, a designation following the "G" designation identifies the office that will review the submittal for the Government. Submittals with an "S" are for inclusion in the Sustainability eNotebook, in conformance to Section 01 33 29 SUSTAINABILITY REPORTING. Submit the following in accordance with Section 01 33 00 SUBMITTAL PROCEDURES:

SD-02 Shop Drawings

Corner Guards

Wall Covering/Panels

SD-03 Product Data

Corner Guards

Wall Covering/Panels

SD-04 Samples

Finish; G

SD-06 Test Reports

Corner Guards

Wall Covering/Panels

SD-07 Certificates

Corner Guards

Indoor Air Quality

SD-11 Closeout Submittals

Recycled content for aluminum component of corner guards; S

Indoor air quality for wall covering/panels; S

Indoor air quality for adhesives; S

### 1.3 CERTIFICATIONS

#### 1.3.1 Indoor Air Quality

##### 1.3.1.1 Wall Covering/Panels

Provide sheet and high impact resistant resilient materials certified to meet indoor air quality requirements by UL 2818 (Greenguard) Gold, SCS Global Services Indoor Advantage Gold or provide certification or validation by other third-party program that products meet the requirements of this section. Provide current product certification documentation from certification body.

##### 1.3.1.2 Adhesives and Sealants

Provide products certified to meet indoor air quality requirements by UL 2818 (Greenguard) Gold, SCS Global Services Indoor Advantage Gold or provide certification or validation by other third-party program that products meet the requirements of this section. Provide current product certification documentation from certification body.

#### 1.4 DELIVERY, STORAGE, AND HANDLING

Deliver materials to the project site in manufacturer's original unopened containers with seals unbroken and labels and trademarks intact. Keep materials dry, protected from weather and damage, and stored under cover. Materials must be stored at approximately 70 degrees F for at least 48 hours prior to installation.

#### 1.5 WARRANTY

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

## PART 2 PRODUCTS

### 2.1 STANDARD PRODUCTS

To the maximum extent possible, corner guards, door and door frame protectors, wall guards (bumper guards), wall panels and wall covering must be the standard products of a single manufacturer and must be furnished as detailed. Drawings show general configuration of products required, and items differing in minor details from those shown will be acceptable.

#### 2.1.1 Resilient Material

Provide resilient material consisting of high impact resistant extruded acrylic vinyl, polyvinyl chloride, or injection molded thermal plastic conforming to the following:

##### 2.1.1.1 Minimum Impact Resistance

Minimum impact resistance must be 18 ft-lbs/sq. inch when tested in accordance with ASTM D256, (Izod impact, ft-lbs per sq inch notched).

#### 2.1.1.2 Fire Rating

Fire rating must be Class 1 when tested in accordance with ASTM E84, having a maximum flame spread of 25 and a smoke developed rating of 450 or less. Material must be rated self extinguishing when tested in accordance with ASTM D635. Material must be labeled and tested by an approved nationally known testing laboratory. Resilient material used for protection on fire rated doors and frames must be listed by the testing laboratory performing the tests. Resilient material installed on fire rated wood/steel door and frame assemblies must have been tested on similar type assemblies. Test results of material tested on any other combination of door/frame assembly will not be acceptable.

#### 2.1.1.3 Integral Color

Colored components must have integral color and must be 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

Materials must be resistant to chemicals and stains reagents in accordance with ASTM D543.

#### 2.1.1.5 Fungal and Bacterial Resistance

Materials must be resistant to fungi and bacteria in accordance with ASTM G21, as applicable.

### 2.2 CORNER GUARDS

#### 2.2.1 Resilient Corner Guards

Corner guard units must be surface mounted type, radius formed to profile shown. Corner guards must extend from floor to height indicated on the drawings. Mounting hardware, cushions, and base plates must be furnished. Assembly must consist of a snap-on corner guard formed from high impact resistant resilient material, mounted on a continuous aluminum retainer. Extruded aluminum retainer must conform 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. Factory fabricated end closure caps must be furnished for top and bottom of surface mounted corner guards. Insulating materials that are an integral part of the corner guard system must be provided by the manufacturer of the corner guard system.

### 2.3 WALL COVERING/PANELS

Provide wall covering/panels consisting of high impact rigid acrylic vinyl or polyvinyl chloride resilient material. Panel sizes must be 4 by 8 feet. Submit fire rating and extinguishing test results for resilient material. Also submit statements attesting that the items comply with specified fire and safety code requirements. Provide wall covering material used on the interior of the building (defined as inside of the weatherproofing system) that meets either emissions requirements of CDPH SECTION 01350 (limit requirements for either office or classroom spaces regardless of space type) the VOC content requirements of SCAQMD Rule 1168, or VOC content requirements of GS-36. Provide certification of indoor air quality for

wall covering/panels.

#### 2.3.1 Rigid Vinyl Acrylic Wall Covering

Wall covering thickness must be 0.040 inch.

#### 2.4 TRIM, FASTENERS AND ANCHORS

Provide vinyl trim, fasteners and anchors for each specific installation as shown.

#### 2.5 FINISH

Submit three samples indicating color and texture of materials requiring color and finish.

##### 2.5.1 Resilient Material Finish

Finish for resilient material must be suede texture with colors in accordance with SAE J1545.

#### 2.6 ADHESIVES

Adhesive for resilient material must be 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

Color must be as indicated. Color listed is 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.

##### 3.1.1 Corner Guards and Wall Guards (Bumper Guards)

Material must be mounted at location indicated in accordance with manufacturer's recommendations.

-- End of Section --



SECTION 10 28 13

TOILET ACCESSORIES  
08/17

PART 1 GENERAL

1.1 REFERENCES

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

ASTM INTERNATIONAL (ASTM)

ASTM C1036 (2016) Standard Specification for Flat Glass

1.2 SUBMITTALS

Government approval is required for submittals with a "G" designation; submittals not having a "G" designation are for information only. When used, a designation following the "G" designation identifies the office that will review the submittal for the Government. Submittals with an "S" are for inclusion in the Sustainability eNotebook, in conformance to Section 01 33 29 SUSTAINABILITY REPORTING. Submit the following in accordance with Section 01 33 00 SUBMITTAL PROCEDURES:

SD-03 Product Data

Finishes; G

Accessory Items

SD-04 Samples

Finishes

Accessory Items

SD-07 Certificates

Accessory Items

SD-11 Closeout Submittals

Recycled content for stainless steel toilet accessories; S

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 standard performance guarantees or warranties that

extend beyond a 1 year period.

## PART 2 PRODUCTS

### 2.1 MANUFACTURED UNITS

Provide toilet accessories where indicated in accordance with paragraph SCHEDULE. Porcelain type, tile-wall accessories are specified in Section 09 30 10 CEMENT TILING, QUARRY TILING, AND PAVER TILING. 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 anchors and fasteners capable of developing a restraining force commensurate with the strength of the accessory to be mounted and suited for use with the supporting construction. Provide tamperproof design exposed fasteners with finish to match the accessory.

#### 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

### 2.2 ACCESSORY ITEMS

Conform to the requirements for accessory items specified below. Submit fasteners proposed for use for each type of wall construction, mounting, operation, and cleaning instructions and one sample of each other accessory proposed for use. Incorporate approved samples into the finished work, provided they are identified and their locations noted. Submit certificate for each type of accessory specified, attesting that the items meet the specified requirements.

#### 2.2.1 Grab Bar (GB-1 and GB-2)

Provide an 18 gauge, 1-1/4 inch grab bar OD Type 304 stainless steel. Provide form and length for grab bar as indicated. Provide concealed mounting flange. Provide grab with peened non-slip surface. Furnish installed bars capable of withstanding a 500 pound vertical load without coming loose from the fastenings and without obvious permanent deformation. Allow 1-1/2 inch space between wall and grab bar.

#### 2.2.2 Mirrors, Glass (MG-1)

Provide Type I transparent flat type, Class 1-clear glass for mirrors. Glazing Quality q1 1/4 inch thick conforming to ASTM C1036. Coat glass on one surface with silver coating, copper protective coating, and mirror



backing paint. Provide highly adhesive pure silver coating of a thickness which provides reflectivity of 83 percent or more of incident light when viewed through 1/4 inch thick glass, free of pinholes or other defects. Provide copper protective coating with pure bright reflective copper, homogeneous without sludge, pinholes or other defects, of proper thickness to prevent "adhesion pull" by mirror backing paint. Provide mirror backing paint with two coats of special scratch and abrasion-resistant paint and baked in uniform thickness to provide a protection for silver and copper coatings which will permit normal cutting and edge fabrication.

#### 2.2.3 Combination Paper Towel Dispenser/Waste Receptacle (PTDWR)

Provide semi-recessed dispenser/receptacle with a capacity of 600 sheets of C-fold, single-fold, or quarter-fold towel. Design waste receptacle to be locked in unit and removable for service. Provide tumbler key locking mechanism. Fabricate a minimum 0.03 inch stainless steel welded construction unit with all exposed surfaces having a satin finish. Provide waste receptacle that accepts reusable liner standard for unit manufacturer.

#### 2.2.4 Shower Curtain (SC)

Provide shower curtain, size to suit conditions. Provide anti-bacterial nylon/vinyl fabric curtain.

#### 2.2.5 Shower Curtain Rods (SCR)

Provide Type 304 stainless steel shower curtain rods 1-1/4 inch OD by 0.049 inch minimum straight to meet installation conditions.

#### 2.2.6 Soap Dispenser (SD)

Provide soap dispenser surface mounted, liquid type consisting of a vertical Type 304 stainless steel tank with holding capacity of 40 fluid ounces with a corrosion-resistant all-purpose valve that dispenses liquid soaps, lotions, detergents and antiseptic soaps.

#### 2.2.7 Surface Mounted Soap Dish (SD-2)

Provide surface-mounted soap dish shall be type-304 stainless steel with bright polished finish. Flange and support arm shall be 20 gauge and equipped with a concealed, 16 gauge mounting bracket that is secured to a concealed, 16 gauge wall plate with a stainless steel setscrew. Drawn, one-piece, seamless 20 gauge soap dish shall be welded to the support arm and shall have two drain holes and two soap-support ridges.

#### 2.2.8 Utility Shelf with Mop/Broom Holders and Rag Hooks (HDS-1)

Provide utility shelf with 4 mop/broom holders and rag hooks shall be type-304 stainless steel with all-welded construction; exposed surfaces shall have satin finish. Shelf shall be 18 Gauge 10 inches deep with 3/4 inch return edges, and shall have front edge hemmed for safety.

#### 2.2.9 Heavy-Duty Clothes Hook (CH-1)

Provide heavy-duty robe hook shall be one-piece brass casting with satin nickel-plated finish. Hook shall withstand 300 pounds downward pull when properly installed.

#### 2.2.10 Coat Hook with Bumper (CHB-1)

Coat hook shall be constructed of solid cast aluminum with matte finish. Unit shall be equipped with hard rubber bumpers.

#### 2.2.11 Surface-Mounted Door Bumper (DB-1)

Surface-mounted door bumper shall have base constructed of type-304 stainless steel with bright polished finish. Unit shall be equipped with black neoprene bumper.

#### 2.2.12 Folding Shower Seat (FSS-1)

Folding shower seat must have a frame constructed of type-304 satin finish stainless steel, 16-gauge, 1-1/4 inch square tubing, and 18-gauge, 1 inch diameter seamless tubing. Seat must be constructed of one-piece, 1/2 inch thick water-resistant, ivory colored solid phenolic with black edge. Clearance between back of shower seat and wall must be 1-1/2 inches to comply with ADA Accessibility Guidelines (ADAAG). Seat supports must not come into contact with the floor. Seat must be able to lock in upright position when not in use. Seat must be attached to wall by two 3 inch diameter mounting flanges constructed of type-304, 3/16 inch thick stainless steel with satin finish. Manufacturer's service and parts manual must be provided to building owner/manager upon completion of project.

### PART 3 EXECUTION

#### 3.1 INSTALLATION

Do not install items that show visual evidence of biological growth. Provide the same finish for the surfaces of fastening devices exposed after installation as the attached accessory. Provide oval exposed screw heads. Install accessories at the location and height indicated. Protect exposed surfaces of accessories with strippable plastic or by other means until the installation is accepted. After acceptance of accessories, remove and dispose of strippable plastic protection. Coordinate accessory manufacturer's mounting details with other trades as their work progresses. Use sealants for brackets, plates, anchoring devices and similar items in showers (a silicone or polysulfide sealant) as they are set to provide a watertight installation. After installation, thoroughly clean exposed surfaces and restore damaged work to its original condition or replace with new work.

##### 3.1.1 Recessed Accessories

Fasten accessories with wood screws to studs, blocking or rough frame in wood construction. Set anchors in mortar in masonry construction. Fasten to metal studs or framing with sheet metal screws in metal construction.

##### 3.1.2 Surface Mounted Accessories

Mount on concealed backplates, unless specified otherwise. Conceal fasteners on accessories without backplates. Install accessories with sheet metal screws or wood screws in lead-lined braided jute, PTFE or neoprene sleeves, or lead expansion shields, or with toggle bolts or other approved 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 solid wood blocking secured between wood studs, or to metal backplates secured to metal studs.

### 3.2 CLEANING

Clean material in accordance with manufacturer's recommendations. Do not use alkaline or abrasive agents. Take precautions to avoid scratching or marring exposed surfaces.

-- End of Section --



SECTION 10 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	(2016) 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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U.S. GENERAL SERVICES ADMINISTRATION (GSA)

FS AA-L-00486	(Rev J) Lockers, Clothing, Steel
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1.2 SUBMITTALS

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

SD-02 Shop Drawings

Types; G

Location; G

Installation

SD-03 Product Data

Material

Handles

Finish

Locker components

Assembly instructions

SD-04 Samples

Color chips; G

### 1.3 DELIVERY, HANDLING, AND STORAGE

Deliver lockers and associated materials in their original packages, containers, or bundles bearing the manufacturer's name and the name of the material. Protect from weather, soil, and damage during delivery, storage, and construction.

### 1.4 FIELD MEASUREMENTS

To ensure proper fits, make field measurements prior to the preparation of drawings and fabrication. Verify correct location.

### 1.5 QUALITY ASSURANCE

#### 1.5.1 Color Chips

Provide a minimum of three color chips, not less than 3 inches square, of each color.

Government may request performance-characteristic tests on assembled lockers. Tests and results must conform to FS AA-L-00486. Lockers not conforming will be rejected.

## PART 2 PRODUCTS

### 2.1 TYPES

Locker must have the following type and size in the location and quantities indicated. Locker finish colors will be as scheduled.

#### 2.1.1 Single-tier Lockers

Single-tier lockers must be as follows:

Type LK-1: Single-tier locker 12 inches wide, 18 inches deep, and 72 inches high, attached to 6-inch high legs

Type LK-2: Single-tier locker 36 inches wide, 24 inches deep, and 72 inches high, attached to 6-inch high legs

Type LK-4: Single-tier locker 12 inches wide, 12 inches deep, and 72 inches high, attached to 6-inch high legs

### 2.2 MATERIAL

#### 2.2.1 Galvanized Steel Sheet

ASTM A1008/A1008M, commercial quality, minimized spangle material. Prepare material surfaces for enamel finishing in accordance with FS AA-L-00486. Fabricate locker bodies from not less than 0.0239-inch thick steel sheet.

#### 2.2.2 Finish

##### 2.2.2.1 Color

As selected.

## 2.3 COMPONENTS

### 2.3.1 Coat Hooks

FS AA-L-00486, zinc plated.

### 2.3.2 Hanger Rods

FS AA-L-00486.

### 2.3.3 Door Handles

FS AA-L-00486. Provide zinc alloy or steel handles with a chromium coating.

### 2.3.4 Doors

FS AA-L-00486, not less than 0.0598 inch thick steel sheet.

#### 2.3.4.1 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. Weld or bolt hinges to the door frame. Weld, bolt, or rivet hinges to the door.

#### 2.3.4.2 Latching Mechanisms

FS AA-L-00486.

### 2.3.5 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.

### 2.3.6 Silencers

FS AA-L-00486.

### 2.3.7 Back and Side Panels, Tops, and Bottoms

FS AA-L-00486, not less than 0.0474 inch thick steel sheet.

### 2.3.8 Shelves

FS AA-L-00486. Fabricate from not less than 0.0598 inch thick steel sheet.

### 2.3.9 Legs

Provide legs as indicated on collateral equipment order data sheets.

### 2.3.10 Number Plates

On LK-1 lockers only. Provide consecutive numbers.

### 2.3.11 Fastening Devices

Provide bolts, nuts, and rivets as specified in FS AA-L-00486.

## PART 3 EXECUTION

### 3.1 ASSEMBLY AND INSTALLATION

Assemble lockers according to the locker manufacturer's instructions. Align lockers horizontally and vertically. Secure lockers to wall with screws as indicated. Bolt adjacent lockers together. Adjust doors to operate freely without sticking or binding and to ensure they close tightly.

### 3.2 NUMBERING SYSTEM

Install number plates on lockers consecutively.

### 3.3 FIELD QUALITY CONTROL

#### 3.3.1 Testing

Government may request performance-characteristic tests on assembled lockers in accordance with FS AA-L-00486. Lockers not conforming will be rejected.

#### 3.3.2 Repairing

Remove and replace damaged and unacceptable portions of completed work with new.

#### 3.3.3 Cleaning

Clean surfaces of the work, and adjacent surfaces soiled as a result of the work, in an approved manner. Remove equipment, surplus materials, and rubbish from the site.

-- End of Section --



SECTION 11 24 29

RIGID RAIL AIRCRAFT FALL PROTECTION SYSTEMS  
04/18

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 A 36/A 36M (2014) Standard Specification for Carbon Structural Steel

ASTM A 992/A 992M (2015) Standard Specification for Structural Steel Shapes

AMERICAN NATIONAL STANDARDS INSTITUTE (ANSI)

ANSI Z359.1 (2012) Safety Requirements for Personal Fall Arrest Systems, Subsystems and Components

AMERICAN WELDING SOCIETY (AWS)

AWS D1.1/D1.1M (2015; Errata 1 2015; Errata 2 2016) Structural Welding Code - Steel

CODE OF FEDERAL REGULATIONS (CFR) PUBLICATIONS

29 CFR Part 1926 Safety and Health Regulations for Construction

1.2 SUBMITTALS

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

SD-02 Shop Drawings

Materials; G

SD-03 Product Data

Track Systems  
Deceleration Devices  
Trolley  
Harnesses  
Accessories  
Spare Parts

Include capacities, sizes, performances, test certifications, operations, safety features, finishes, and similar information.

SD-04 Samples

Safety Suspension Trauma Straps  
Full Body Harness  
Self-Closing Carabiner  
Self Retracting Lifeline  
Fall Arrest Trolley  
Power Tag Line System

One sample of each item. Approved samples may be installed in the work if properly identified.

SD-05 Design Data

Engineering Analysis; G

SD-07 Certificates

Materials; G

SD-09 Manufacturer's Field Reports

Attendee List; G

Operational Test; G

SD-10 Operation and Maintenance Data

Materials; G

1.3 QUALITY ASSURANCE

1.3.1 Manufacturer Qualifications

Manufacturer shall have produced fall protection systems similar to those required for this Project full time for no less than 5 years and shall demonstrate successful installations in the last 5 years, free of litigation, injuries or fatalities resulting from their products or design.

1.3.2 Installer Qualifications

System manufacturer or manufacturer's authorized representative who is trained and approved for installation of units required for this project full time for no less than 5 years and demonstrate successful installations in the last 5 years, free of litigation, injuries or fatalities resulting from their products or design.

1.3.3 Professional Engineer Qualifications

Professional engineer shall be registered in the state of the manufacturer and be employed by the fall protection manufacturer as a full time fall arrest systems designer.

1.3.4 Welders

Welders shall meet requirements given in Section 05 12 00 STRUCTURAL STEEL.

#### 1.4 MAINTENANCE DATA

Provide maintenance data, parts list, and manufacturer's instructions for each fall arrest system for incorporation into maintenance manual.

Provide necessary special tools required for maintaining the fall arrest equipment.

Brief maintenance staff regarding proper care of equipment such as lubrication, adjustments, cleaning and general maintenance.

#### 1.5 SPARE PARTS

- One Set of safety suspension trauma straps
- One Body harness
- One Self retracting life line
- One Fall arrest trolley
- One Tag line
- One Power Tag line system

#### 1.6 TRAINING

On-site training session to be conducted at the completion of installation of the fall arrest systems. The following shall be provided:

- One hour minimum classroom training
- Training on fall protection basics
- Training on the use of the actual systems installed
- DVD including all training material required for all equipment operation and regular maintenance

#### 1.7 PROJECT CONDITIONS

##### 1.7.1 Field Measurements

Verify field measurements and indicate measurements on shop drawings to ensure required fit.

#### 1.8 DELIVERY, STORAGE, AND HANDLING

Deliver, store, and handle materials, components, and equipment in manufacturer's original unopened protective packaging. Store materials, components, and equipment in original unopened protective packaging off of ground, under cover, and in a dry location. Handle according to manufacturer's written recommendations to prevent damage, deterioration, or soiling.

### PART 2 PRODUCTS

#### 2.1 SYSTEM DESCRIPTION

Fall arrest system for the naval aircraft which allows users to walk uninterrupted the entire length of each system and provides secure anchorage to arrest a fall by users. System shall be hands-free, allowing user to work with both hands as if normally traveling along walking surface. Fall protection system is integral with the Corrosion Control Hangar Bay.

### 2.1.1 Engineering Analysis Design Requirements

- a. Fall protection systems to be designed by a Professional Engineer Registered in the manufacturer and experienced in the design of fall protection systems.
- b. Fall protection systems shall be designed for use above AV-8, F-15, F-35, H-1, H-60, CH-53, and MV-22 series aircraft with three concurrent users on two dual parallel systems above the fuselage and two users on each wing. The systems shall be designed to allow users to walk uninterrupted the entire length of each system without having to unhitch from the system to pass through intermediate support points.
- c. Dynamic and dead load reactions shall be generated for all intermediate and end supports of the fall protection system.
- d. Design all fall protection systems to safely resist the dynamically applied loads while maintaining a safety factor of two against failure.
- e. Design of fall protection systems shall be based on the understanding that the underlying structural steel supports are provided as part of the Corrosion Control Hangar and are adequate to support the imposed loads. Fall Protection loads shall be furnished to the Corrosion Control Hangar structural designer.
- f. Design Engineer shall prepare a fall clearance analysis verifying adequate fall distance to safely stop the worker in the event of a fall.
- g. Fuselage horizontal rails shall be designed for two workers falling at a time and wing horizontal rail shall be designed for three workers falling, with full body harness and shock absorbing lifeline with a maximum arresting force of 900 pounds per worker.
- h. The systems shall be designed to be supported by and integral with the Corrosion Control Hangar steel framing. Each anchor location shall be designed to support a minimum load of.
- i. Design Engineer shall coordinate Fall Protection System with structural, mechanical, electrical, lighting, and fire protection systems.
- j. Sealed and signed by licensed professional engineer who thereby certifies preparing or supervising preparation of data to comply with specified requirements and recognized engineering principles and practices. Include computations for justification of framing elements or sections, connections including fasteners and welds and anchorage assemblies required to support the fall protection system.

### 2.2 SYSTEM DESIGN

Aircraft fall arrest system manufacturer shall provide secondary framing and bracing required to transmit fall protection loads. Aircraft fall arrest system shall be designed to protect users while they are attached to track system. System shall be designed for:

- a. Two simultaneous user per rail over each wing (for a total of 4 users).
- b. Three simultaneous users per rail over the fuselage (for a total of 3

users).

#### 2.2.1 Track Systems

- a. Single track and dual track fall arrest systems.
- b. Constructed of ASTM A 36/A 36M or ASTM A 992/A 992M steel.
- c. Components shall be painted safety yellow.

#### 2.2.2 Trolley

- a. All steel body.
- b. Compatible with rail system.
- c. 360-degree rotating eye.

#### 2.2.3 Deceleration Devices

Provide 1 self-retracting lifeline/lanyard (SRL) for each user for which the system is designed. Meet or exceed applicable standards of ANSI Z359.1, 29 CFR Part 1926, and meeting following requirements:

- a. Maximum Load: 310 pounds.
- b. Weight: 20 pounds.
- c. Construction: Heavy duty self-contained, portable, sealed aluminum or stainless steel casing with 3/16 inch minimum stainless steel wire rope, with swiveling safety snap hooks, centrifugal braking system.
- d. Cable Length: As required to permit personnel to access the SRL from the ground.
- e. Fall Arrest Forces: Less than 900 pounds.

#### 2.2.4 Harnesses

Provide one harness for each user for which the system is designed. Meet or exceed applicable standards of ANSI Z359.1, and 29 CFR Part 1926. Full body harness, lightweight nylon, Class III, approved for fall arrest with back and front "Dee" ring.

#### 2.2.5 Accessories

Meet or exceed standards of ANSI Z359.1 and 29 CFR Part 1926.

- a. Tagline, nylon filament rope. One on each SRL for the purpose of pulling each cable to floor level for hooking up to the harness.
- b. As required for complete installation.
- c. Snap hooks.
- d. Provide stainless steel wall mounted assemblies as indicated on drawings to secure lifelines away from traffic paths when not in use.

## 2.3 MATERIALS

Fasteners shall be designed and provided by fall protection system manufacturer. All equipment shall be provided by a single source. All materials shall be new and undamaged. Fasteners shall be designed to support a load on the system of two times the maximum design load without failure. Structural steel supporting members supplied by the fall protection manufacture shall comply with Section 05 12 00 STRUCTURAL STEEL, and with AWS D1.1/D1.1M.

Fall protection system shall be sealed and signed by a licensed professional engineer responsible for preparation of engineering analysis who thereby certifies preparing or supervising preparation of data to comply with specified requirements and recognized engineering principles and practices. Show plans, elevations, sections, and large-scale details indicating coordination with Corrosion Control Hangar structure and relationships with other construction. Indicate maximum dynamic and static loads imposed on Corrosion Control Hangar structure at points of support. Indicate details of adjoining Work, even though not included in Work of this Section, to ensure coordination of Work and Work of other sections. Schedule and describe anchorage assemblies and their related components. Include data for capacity of each type of fastener for its intended use. Reference detail numbers where applicable. At conclusion of installation, provide "Conforming to Construction" set of Shop Drawings.

Submit letter signed by manufacturer certifying that system components comply with requirements and compliance with contract documents and 29 CFR Part 1926 and with approved drawings and calculations.

Submit operation and maintenance data for fall protection system, to include emergency, operation, and maintenance manuals. Include complete parts list. Include operation and maintenance procedures for proper use and safe operation of equipment.

### 2.3.1 Safety Suspension Trauma Straps

- a. Polyester webbing.
- b. Forged alloy steel hardware.

### 2.3.2 Full Body Harness

- a. Polyester webbing.
- b. Forged alloy steel hardware.
- c. Tongue buckle leg straps.

### 2.3.3 Self-Closing Carabiner

- a. Zinc plated forged alloy steel.

### 2.3.4 Self-Retracting Lifeline

- a. Galvanized wire rope.
- b. Plastic housing.

#### 2.3.5 Fall Arrest Trolley

- a. Zinc plated forged alloy and powder coated steel.
- b. Shielded wheel bearings.

#### 2.3.6 Power Tag Line System

- a. Rated Lifting Capacity: 50 lbs (Not rated for personnel).
- b. Electrical Requirements: 208 Volts, single phase, 60 Hz.
- c. Length of Tagline: 60 feet.
- d. Brackets: Alloy steel 3 by 3 by 1/4 inch slotted, adjustable from 1-1/2 by 18 inches.
- e. Winch: Electric, 75 feet per second travel speed, includes limit switch for automatic shut off, with 15 feet electric cord length.
- f. Wire Rope: 5 mm galvanized steel wire rope 19 kn tensile strength.
- g. Counter Weight: Alloy steel 3/4 inch dia. by 11 inch, weight 22.5 lbs.

#### 2.4 FINISH

Tracks to receive a painted factory finish in safety yellow color.

#### 2.5 FABRICATION

System components shall be of same material unless otherwise indicated. Exposed work shall be true to line and level with accurate angles, surfaces and with straight, square edges. Coordinate anchorage system with Corrosion Control Hangar structure. Fabricate anchoring devices as recommended by the manufacturer to provide adequate support for intended use.

### PART 3 EXECUTION

#### 3.1 INSTALLATION

Install according to the approved shop drawings and manufacturer's instructions. Install anchorage and fasteners in accordance with manufacturer's recommendations to obtain the allowable working loads published in the product literature and in accordance with this Section. Do not load or stress fall arrest system until all materials and fasteners are properly installed and ready for service. Deform threads of all bolted connections after nuts have been installed and torqued to the proper tension or provide prevailing torque lock nuts.

#### 3.2 FIELD QUALITY CONTROL

##### 3.2.1 Post-Erection Inspection

After erection, Contractor and Contracting Office shall jointly inspect installed system and components to determine compliance with specifications and approved submittals. Systems shall remain out of service until inspection is complete and Letter of Certification has been received by Contracting Officer.

### 3.2.2 Operational Test

After erection and inspection, statically test the fall protection system in service to determine that each component of system operates as specified, is properly installed and adjusted, and is free from defects in material, manufacture, installation, and workmanship. Rectify deficiencies disclosed by testing and retest system or component to prove that system is fully operational. Any weights required for static proof testing shall be provided by the Contractor. Provide Letter of Certification from licensed Design Engineer indicating completion of operational proof testing on installed systems.

### 3.2.3 Operator Training

Provide a minimum of one class (four hour minimum) of operator and maintenance training after system has been installed and proof tested. Training is to be for the users and maintainers of the system conducted at the installation site. The Contractor shall submit attendee list of attendees at training class in the use care and maintenance of fall protection equipment.

## 3.3 CLEANING

Remove loose materials, crating, and packing materials from premises.

-- End of Section --



SECTION 11 47 00

ICE MACHINES  
08/17

PART 1 GENERAL

1.1 REFERENCES

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

NSF INTERNATIONAL (NSF)

NSF/ANSI 12	(2017) Automatic Ice Making Equipment
NSF/ANSI 14	(2017b) Plastics Piping System Components and Related Materials
NSF/ANSI 169	(2012) Special Purpose Food Equipment and Devices

U.S. DEPARTMENT OF ENERGY (DOE)

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

29 CFR 1910-SUBPART D	Walking - Working Surfaces
29 CFR 1910.144	Safety Color Code for Marking Physical Hazards
29 CFR 1910.145	Accident Prevention Signs and Tags
29 CFR 1910.306	Specific Purpose Equipment and Installations

1.2 SUMMARY

The work includes furnishing and installing ice making equipment, including dispensing, production, storage equipment and related work. Include coordination of delivery through existing finished opening and vertical handling limitations within the building.

- a. Provide rough-in and connect utilities to equipment in accordance with requirements specified in other sections of this specification and in conformance with the physical dimensions, capacities, manufacturer's instructions, and other requirements of the equipment furnished.
- b. Equipment specified must also conform to the applicable requirements of the following reference standards: NSF/ANSI 12, NSF/ANSI 14, NSF/ANSI 169, and Energy Star for powered equipment.

### 1.3 SUBMITTALS

Government approval is required for submittals with a "G" designation; submittals not having a "G" designation are for information only. When used, a designation following the "G" designation identifies the office that will review the submittal for the Government. Submittals with an "S" are for inclusion in the Sustainability eNotebook, in conformance to Section 01 33 29 SUSTAINABILITY REPORTING. Submit the following in accordance with Section 01 33 00 SUBMITTAL PROCEDURES:

#### SD-01 Preconstruction Submittals

Contractor's Field Verification Data

#### SD-02 Shop Drawings

Detail Drawings; G

Custom Fabricated Equipment; G

Installation Instructions and Diagrams; G

#### SD-03 Product Data

Ice Making Equipment

#### SD-05 Design Data

Manufacturer's Applicable Literature

#### SD-06 Test Reports

Manufacturer's Test Data

Field Test Reports

#### SD-07 Certificates

NSF Certification

UL Certification

#### SD-08 Manufacturer's Instructions

Manufacturer's Instructions; G

#### SD-10 Operation and Maintenance Data

Ice Making equipment, Data Package 2

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

#### SD-11 Closeout Submittals

Manufacturer's Warranty

Contractor's Warranty for Installation

Energy Star label for ice machine; S

#### 1.4 ADMINISTRATIVE REQUIREMENTS

##### 1.4.1 Pre-Installation Meeting

Thirty days prior to the commencement of work, notify the Contracting Officer that the following items are prepared and ready for review:

##### 1.4.1.1 Shop Drawings

Detail drawings, as specified, including insulation and utility requirements, product data, installation instructions and diagrams. Submit custom fabricated equipment drawings after approval of ice machine equipment drawings. Drawings must be 1/4 inch scale minimum.

##### 1.4.1.2 Product Data

Submit the product data for the following equipment, as well as the associated manufacturer's data:

- a. ice making equipment
- c. Manufacturer's applicable literature
- d. Manufacturer's Test Data
- e. Energy Star Labeled
- f. Manufacturer's Instructions for shipping, handling, storage, installation, and start-up.

##### 1.4.2 LIST OF EQUIPMENT

Submit detailed Food Service Equipment List. Include submittal of NSF Certification, Energy Star Labeled and UL Certification for ice making equipment.

#### PART 2 PRODUCTS

##### 2.1 MATERIALS

Provide ice making equipment conforming to OSHA standards 29 CFR 1910.144, 29 CFR 1910.145, 29 CFR 1910.306, Energy Star, and related NSF and UL standards. Floor areas adjacent to ice making equipment point of operation must conform to 29 CFR 1910-SUBPART D.

Provide ice machine that is Energy Star labeled. Provide data identifying Energy Star label for ice machine.

##### 2.2 FACTORY TESTS AND CERTIFICATIONS

Submit two copies of all Manufacturer's Test Data and certifications, including NSF Certification; UL Certification, and Energy Star Labeled data to the Contracting Officer prior to the commencement of any installation work.

PART 3 EXECUTION

3.1 EXAMINATION

Do not install items that show visual evidence of biological growth.

After becoming familiar with all details of the work, verify all existing dimensions, contract drawings, product data and all related conditions prior to commencing rough-in work. Advise the Contracting Officer of any discrepancies prior to ordering equipment. Submit Contractor's Field Verification Data prior to the pre-installation meeting.

3.2 INSTALLATION

Refer to installation procedures, operation and maintenance manual requirements, training and project closeout procedures. Include all ice making equipment Field Test Reports.

3.3 MANUFACTURER'S WARRANTY

Submit all manufacturers' signed warranties to Contracting Officer prior to final commissioning and acceptance.

3.4 CONTRACTOR'S WARRANTY FOR INSTALLATION

Submit contractor's warranty for installation to the Contracting Officer prior to final commissioning and acceptance.

-- End of Section --

SECTION 11 50 10

PAINT SPRAY BOOTHS

04/17

PART 1 GENERAL

1.1 REFERENCES

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

AMERICAN CONFERENCE OF GOVERNMENTAL INDUSTRIAL HYGIENISTS (ACGIH)

ACGIH Industrial Ventilation: A Manual of  
Recommended Practice (28th Edition)

AMERICAN INSTITUTE OF STEEL CONSTRUCTION (AISC)

AISC Manual (2015) Manual of Steel Construction, 15th  
Edition

AMERICAN IRON AND STEEL INSTITUTE (AISI)

AISI S100 (2012) North American Specification for  
the Design of Cold-Formed Steel Structural  
Members

AMERICAN NATIONAL STANDARDS INSTITUTE (ANSI)

ANSI A14.3 (2008) Safety Requirements for Fixed  
Ladders

AMERICAN SOCIETY OF CIVIL ENGINEERS (ASCE)

ASCE 7 (2017) Minimum Design Loads for Buildings  
and Other Structures

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

ASHRAE 90.1 - SI (2010) Energy Standard for Buildings  
Except Low-Rise Residential Buildings

ASTM INTERNATIONAL (ASTM)

ASTM A123/A123M (2017) Standard Specification for Zinc  
(Hot-Dip Galvanized) Coatings on Iron and  
Steel Products

ASTM A29/A29M (2016) Standard Specification for General  
Requirements for Steel Bars, Carbon and  
Alloy, Hot-Wrought

ASTM B103/B103M (2015) Standard Specification for Phosphor  
Bronze Plate, Sheet, Strip, and Rolled Bar

NATIONAL FIRE PROTECTION ASSOCIATION (NFPA)

NFPA 1	(2015; ERTA 2015) Fire Code
NFPA 16	(2015) Standard for Installation of Foam-Water Sprinkler and Foam-Water Spray Systems
NFPA 33	(2018) Standard for Spray Application Using Flammable or Combustible Materials
NFPA 54	(2015) National Fuel Gas Code
NFPA 70	(2017; ERTA 1-2 2017; TIA 17-1; TIA 17-2; TIA 17-3; TIA 17-4; TIA 17-5; TIA 17-6; TIA 17-7; TIA 17-8; TIA 17-9; TIA 17-10; TIA 17-11; TIA 17-12; TIA 17-13; TIA 17-14) National Electrical Code
NFPA 90A	(2018) Standard for the Installation of Air Conditioning and Ventilating Systems
NFPA 91	(2015) Standard for Exhaust Systems for Air Conveying of Vapors, Gases, Mists and Noncombustible Particulate Solids
NFPA 101	(2018; TIA 18-1) Life Safety Code
NFPA 409	(2016; ERTA 2016) Standard on Aircraft Hangars

INSTITUTE OF ELECTRICAL AND ELECTRONICS ENGINEERS (IEEE)

IEEE 519	(2014) Recommended Practices and Requirements for Harmonic Control in Electrical Power Systems
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INTERNATIONAL CONFERENCE OF BUILDING OFFICIALS (ICBO)

IBC 2015	(2015) International Building Code
IMC 2015	(2015) International Mechanical Code
IPC 2015	(2015) International Plumbing Code
IFC 2015	(2015) International Fire Code

U.S. DEPARTMENT OF DEFENSE (DOD)

UFC 3-260-01	(2008) Airfield and Heliport Planning and Design
UFC 3-600-01	(2016; with Change 1) Fire Protection Engineering for Facilities
UFC 4-010-01	(2012; with Change 1) DoD Minimum Antiterrorism Standards for Buildings

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

40 CFR 63

National Emission Standards for Hazardous  
Air Pollutants for Source Categories

1.2 GENERAL REQUIREMENTS

Provide the design, furnishing, roughing-in, mechanical, electrical work, installation of equipment, testing and final connection of utilities, with labor, services, and incidentals necessary for complete and fully operational crossdraft aircraft paint booth equipment installation. Booth walls shall be self-supporting and not rely on the building structure for vertical or horizontal support or stability without coordination and approval of the structural designer of the building structure. Plenum doors, mechanical equipment, exhaust chambers, exhaust structures, and stacks shall be supported by the building structure. Provide piping, wiring, and switching between equipment and single-point utility connections connections, inclusive of all overcurrent protection devices, conduits, wires, circuits, interlocks, fixtures, controls, supports, etc., for a complete and operational system. The design, equipment, and installation shall be in accordance with, Unified Facilities Criteria, Engineering Technical Letters, NFPA 1, NFPA 16, NFPA 33, NFPA 54, NFPA 70, NFPA 90A, NFPA 91, NFPA 101, NFPA 409, IBC 2015, IMC 2015, IPC 2015, IFC 2015, and ACGIH standards.

1.3 QUALITY ASSURANCE

1.3.1 Experience

Paint Booth Contractor and equipment shall be produced by a manufacturer of established reputation with a minimum of 5 years' experience supplying specified equipment.

1.3.2 Manufacturer's Representative

- a. Installation: Provide a qualified manufacturer's representative on-site to supervise work related to equipment installation, check-out and start-up.
- b. Training: Provide technical representative to train Owner's maintenance personnel on-site in operation and maintenance of specified equipment.
- c. Commissioning Checks and Testing: Manufacturer's installation and start-up technicians shall complete all pre-functional checks as prepared by Commissioning Authority. Manufacturer shall also provide technical representative to operate paint booth systems as instructed by Commissioning Authority to verify Functional Performance of all modes of operation as required by final Commissioning Plan.

1.4 SUBMITTALS

Government approval is required for submittals with a "G" designation; submittals not having a "G" designation are for information only. When used, a designation following the "G" designation identifies the office that will review the submittal for the Government. All fire protection related submittals to be reviewed by Quality Control Fire Protection Engineer (QCFPE) in accordance with Section 01 45 00.00 20 QUALITY CONTROL.

Submit the following in accordance with Section 01 33 00 SUBMITTAL

PROCEDURES:

SD-03 Product Data

Paint Booth; G  
Materials and Construction; G  
Paint Booth Mechanical Systems; G

SD-05 Design Data

Submit structural design calculations signed and sealed by a professional engineer including:

Booth Structure and Foundation Loads; G  
Exhaust Chambers; G  
Exhaust Stack Structures; G

Submit design of the following systems for booth and door:

Paint Booth Mechanical Systems; G  
Paint Booth Electrical Equipment and Systems; G  
Fire Protection; G

Installation

Submit foundation forces and anchorage requirements (anchor types, sizes, locations and layouts) 90 days prior to start of foundation construction

SD-07 Certificates

Materials and Construction; G

SD-10 Operation and Maintenance Data

Materials and Construction; G

1.5 WARRANTY

Warrant work specified herein for one year from substantial completion against defects in materials, function and workmanship.

Warranty shall include materials and labor necessary to correct defects.

Defects shall include, but not be limited to noisy, rough or substandard operation; loose, damaged, and missing parts; and abnormal deterioration of finish.

All parts shall be readily available locally in the United States.

1.6 PRODUCT DELIVERY, STORAGE AND HANDLING

Deliver equipment in manufacturer's containers, appropriately packaged and/or crated for protection during domestic shipment and storage in humid, dusty conditions.

Indelibly label all containers, including those contained in others, on outside with item description(s) per title and Mark Number of this specification.



Provide equipment and materials specified complete in one shipment for each equipment item. Split or partial shipments are not permissible.

#### 1.7 LABELING

Manufacturer shall securely attach in a prominent location on each major item of equipment a noncorrosive nameplate showing manufacturer's name, address, model number, serial number, and pertinent utility or operating data.

All electrical equipment and materials shall be new and shall be listed by Underwriters Laboratories Inc. (UL) in categories for which standards have been set by that agency and labeled as such in the manufacturer's plant. Control panel shall be UL-labeled.

#### 1.8 COORDINATION

Paint Booth Contractor shall coordinate the work with the Base Engineers in the designing and installation of the paint booth. Paint booth manufacturer to provide full time on-site supervision person for the paint booth installation.

#### 1.9 PERMITS

Paint Booth Contractor shall coordinate with the Contracting Officer, Base Environmental Office, and obtain construction and operation permits.

#### 1.10 DESIGN PARAMETERS

Restoration bay booth contains both interior and exterior envelope conditions. The exterior surfaces are part of the door leaf structure and the interior elements form the majority of the booth area and are contained within the building shell. Each door leaf structure and mechanical components, including the supporting pivots locking mechanism and drive mechanism, shall be designed to accommodate the dead (gravity), worst combination of live loads, including wind, seismic, temperature and the differential settlement of the supporting pavement with respect to the door pivot. Booths, plenum doors, mechanical equipment, walls, and exhaust chambers shall be self-supporting and not rely on the building structure for vertical or lateral support or stability without coordination and approval of the structural designer of the building structure. Exhaust stack structures and stacks shall be supported by building structure for vertical or lateral support. All structural components shall be designed within the allowable working stress of the materials as established in the AISC Manual "Specifications for the Design, Fabrication and Erection of Structural Steel for Buildings", and the AISI S100. All structures shall be designed for dead, live, wind, seismic, and collateral loads in combinations stated in ASCE 7 as modified in paragraphs below for the doors. Components and claddings on structures that are exposed to wind shall be designed to ASCE 7 requirements for components and cladding. All mechanical drive and locking components shall be designed with a minimum safety factor of 4 on ultimate strength. The drive mechanism, including a gear motor and double chain and sprocket reduction, shall be designed to accommodate 125 percent of the design load (dead load plus wind load plus incline). The wheel traction shall be sufficient to operate the door and to restrain the door under wet conditions when stopped in any position under the design wind loads. Consideration shall be given to the effect on wheel traction of swaying

and vibration of the door leaf in the specified wind.

#### 1.10.1 Design Live Loads

The mechanical and structural components of the booth and doors shall be designed to accommodate the following live loads and operating conditions, including temperature differentials in addition to the dead load:

- a. Doors in Closed and Locked Position: The design live load conditions for the doors in the closed position under static load shall be either 1, 2, or 3, whichever is greater, as follows:
  - (1) Door shall be designed for wind pressures based on a minimum design wind speed as indicated on drawings and calculated in accordance with ASCE 7 (including components and cladding), with not more than 2 inches of deflection.
  - (2) Seismic criteria per requirements as indicated on drawings as calculated in accordance with IBC 2015.
  - (3) Temperature differential of 50 degrees F between the inside face, including plenums, and the outside of the building.
- b. Doors in Open Position or When Moving: The design live load condition shall be the combination of 1, 2, and 3, as follows:
  - (1) Wind: 60 mph per ASCE 7 acting in any direction or seismic forces, whichever is greater.
  - (2) Slab Slope: Incline due to differential movement of 6 inches within length of door travel.
  - (3) Weather: Dry and wet tracks (for design of drive mechanism).

#### 1.10.2 Booth Support Base Forces

Forces transmitted to foundations shall be vertical (tension or compression) and horizontal shear forces. Moments shall not be transferred to the foundations. Design support base details to interface with foundations of building structure.

#### 1.10.3 Maintenance Access Items

Equipment mounted above booth ceiling and other equipment on elevated structures shall have access platforms, access ladders, protective guard rails, steps, and lights necessary for maintenance activities. Live loads shall include appropriate loads in accordance with ASCE 7

#### 1.10.4 Seismic and AT/FP Bracing of Equipment

Mechanical, electrical and architectural items shall have seismic bracing in accordance with IBC 2015 and ASCE 7.

## PART 2 PRODUCTS

### 2.1 PAINT BOOTH

The Paint Booth Contractor shall be responsible for all coordination.

### 2.1.1 Capacities and Dimensions

- a. Interior Clearances: Width: Refer to Contract Drawings.
- b. Booth Envelope: Clear width and height: Refer to Contract Drawings and BIM Model. Confirm booth will fit in space available in hangar bay.
- c. Plenum Doors: Clear width and full clearance for airplane plus 10 feet minimum on all sides.
- d. Personnel Doors: Quantity: 5 minimum per code (sizes, location and construction as indicated).
- e. Fire Sprinklers: Coordinate with fire protection Contractor. See Section 21 13 13.00 20 WET PIPE SPRINKLER SYSTEM, FIRE PROTECTION. Fire protection systems shall be provided in accordance with UFC 3-600-01 and NFPA 33. Coordinate with fire suppression contractor to provided framed out enclosure openings to accept equipment indicated.
- f. Compressed Air and Breathing Air: Coordinate with plumbing Contractor.

### 2.2 MATERIALS AND CONSTRUCTION

Provide complete parts, operating and maintenance manual covering equipment at time of installation including, but not limited to:

- a. Description of system and components.
- b. Electrical single-line power diagram, including motor horsepower.
- c. Schematic diagrams of electrical (clearly indicating field wiring, wire type, wire size, wire insulation color code, and wire number), plumbing, compressed air, breathing air ductwork, and condenser water system.
- d. Manufacturer's printed operating instructions.
- e. Printed listing of periodic preventive maintenance items and recommended frequency required to validate warranties. Failure to provide maintenance information will indicate that preventive maintenance is not a condition for validation of warranties.
- f. List of original manufacturer's parts, including suppliers' part numbers, catalog cuts, recommended spare parts stockage quantity and local parts and service source.

#### 2.2.1 Construction

Paint booth shall be constructed of minimum 18-gauge electro-galvanized steel panels supported by structural I-beams at regular intervals for rigidity and integrity of booth structure and foundation loads. Interior surface of paint booth shall be color white, powder-coated, bake-on type finish. Booth interior walls to be comprised of pre-manufactured insulated metal panels. Insulation value of panels to be a min of R-13.

#### 2.2.2 Mounting

Paint booth partitions to be supported by independent foundation system furnished by Contractor.

#### 2.2.3 Paint Booth Personnel Doors

Include insulated hollow metal doors (and frames). Provide for effective sealing of opening.

#### 2.2.4 Utility Stations

Booth shall provide interior quick disconnects for shop air and breathable air systems as required from building supply sources. Utility stations shall be located on the side walls of booth for the compressed air and breathing air drops. See details on Drawings.

#### 2.2.5 Lighting

Lighting fixtures shall be 3 row LED, NFPA and OSHA code approved with clear tempered glass windows, 5000 K CCT, and ceiling recessed. Provide fixtures as indicated on plans. A minimum of 100 average, maintained, horizontal foot candles measured 30 inches above the floor shall be provided to all work areas within the booth. All wiring and devices located in areas designated hazardous on plans shall be rated explosion-proof and listed for Class I, Division I, Group D locations. All recessed, gasketed light fixtures shall be rated Class I Division II Group D. Light fixture maintenance shall be totally accessible from inside the booth. Light fixture hinged doors shall be interlocked with painting air to prevent painting air from operating when any light fixture door is open.

#### 2.2.6 Hazard Classification

Spray booth interior shall be rated as indicated on plans. All electrical installations shall comply with NEC.

#### 2.2.7 Door Seals

Coordinate the design of the door seal system with the building architectural and structural details, and the mechanical ventilation system. Use fully adjustable door seal system to permit initial setting during installation of the doors and to permit future adjustments. Use door sealing system designed for ease of replacement and that incorporates commercially available components.

#### 2.2.8 Electric Locking Mechanism

The latching devices shall be operated by electric brake motors and shall be interlocked to prevent door operation, unless the pins are fully retracted. Provide control and warning devices, conduit and wiring for the locking mechanisms. Locate operating devices to be readily accessible for inspection and servicing. Provide manual release of the locking pins in the event of power failure.

#### 2.2.9 Lock Pins

Equip leading edge of doors with top and bottom automatic lock pins designed to restrain the door in the full open or full closed positions,

under the design operating wind forces. Assure that doors are properly aligned in the fully closed position with seals compressed. Use non-sparking lock pin mechanisms designed to accommodate thermal expansion and contraction of the doors, with sufficient range of action horizontally to seat under full wind load defections (inward or outward). Seat bottom lock pins in special receptacles set in the concrete slab designed to accommodate the full travel of the pin, and designed to prevent dirt and water from accumulating inside. Use electric operated lock pins designed for normal operating conditions with mechanism to manually release the pins in the event of a failure of the control system. Use lock pin mechanism of the design indicated, or of a comparable, previously proven design for a similar type of door approved by the CQC Representative.

#### 2.2.9.1 Latches

The latching device shall be operated by electric brake motors and shall be interlocked to prevent door operation, unless the pins are fully retracted.

#### 2.2.9.2 Top Pin

Machine top pin cold drawn ASTM A29/A29M, Grade 1018 steel bar stock. Hard chrome plate top pin after machining. Machine pin bottom to mate with the clevis fitting on the air cylinder. Use two sets of bronze guide rollers to guide pin for the full stroke. Use bronze rollers designed to accommodate the maximum forces under the design loadings plus: forces due to temperature expansion and contraction of the door; forces due to settlement of the door; and other binding forces on the top pin when engaged in its receiver. Use top pin latching receiver assembly designed to accommodate the maximum pin loading and to mate with the plate provided for the lock mechanism. Use receiver assembly provided with a phosphor bronze liner sheet conforming to ASTM B103/B103M with a hard temper, minimum tensile strength of 80,000 psi and Rockwell Hardness Number B86.

#### 2.2.9.3 Bottom Pin

Machine bottom pin from cold drawn ASTM A29/A29M, Grade 1018 steel cold finished round stock. Machine pin to thread to the cylinder rod. Guide pins at the bottom of door with UHMW supported in a fabricated steel bracket. Engage pin in sockets embedded on the concrete in closed and full open position. Use sockets with UHMW sleeves.

#### 2.2.9.4 Top Lock Pin Maintenance Ladder

Provide a ladder, as required for maintenance of the top lock pin mechanism in the plenum doors.

#### 2.2.9.5 Ladders

Fabricate vertical ladders conforming to ANSI A14.3 of 2-1/2 by 3/8-inch steel flats for strings and 3/4-inch diameter steel rods for rungs. Space rungs a maximum 1 foot apart and plug weld or shoulder and head into strings. Hot-dip galvanized ladder assemblies after fabrication in conformance to ASTM A123/A123M. Install ladder so that rungs are not less than 7 inches from the finished wall surface or other structural element. Secure ladder to adjacent construction with heavy clip angles welded to the string and secured to structure as indicated. Install brackets as required for securing to ladders. Provide safety cage and spreaders as required.

## 2.3 PAINT BOOTH MECHANICAL SYSTEMS

### 2.3.1 Indoor and Outdoor Design Conditions

#### a. Outdoor Conditions:

- (1) Summer Dry Bulb: 86 degrees F DB/ 75 degrees F WB
- (2) Summer Dehumidification: 81 degrees F DB/ 136 gr/lb Humidity Ratio

#### b. Indoor Conditions (Inside Paint Booth):

- (1) Paint Booth (Spray Paint/Sanding Mode): 80 degrees F DB plus or minus 5 degrees F and 60 percent RH plus or minus 10 percent RH, at 100 fpm cross sectional velocity, with an 80/20 recirculation to outside air flow rate.
- (2) Paint Booth (Brush/Roll Painting Mode): 80 degrees F DB plus or minus 5 degrees F and 60 percent RH plus or minus 10 percent RH, at 50 fpm cross sectional velocity, with an 80/20 recirculation to outside air flow rate.
- (3) Paint Booth (Cure/Dry Mode): 75 degrees F DB plus or minus 5 degrees F and 60 percent RH plus or minus 25 percent RH, at cross sectional velocity, with an 80/20 recirculation to outside air flow rate.

#### c. Indoor Conditions (Outside Paint Booth):

- (1) The paint booth will be located within the shell of the building. The space surrounding the paint booth insert will be unconditioned.

### 2.3.2 Air Flow System

The airflow system shall serve all modes of operation for the paint booth and must be able to operate at a uniform cross sectional velocity across the entire length of the booth ranging from 100 fpm down to 50 fpm while maintaining the space conditions indicated. Negative pressure inside the booth shall be maintained at all times.

100 percent of the air from the paint booth will pass through a 3-stage NESHAP filter system. 20 percent of the air will be exhausted to the atmosphere, and 80 percent will be re-circulated to the supply plenum of the paint booth. A makeup air unit supplying 100 percent outside air will supply 20 percent of the total airflow to the paint booth.

Paint booth system shall have the following modes of operation: Spray Paint/Sanding Mode; Brush/Roll Painting Mode; Cure/Dry Mode; Purge Mode; and Off Mode.

The Spray Paint/Sanding Mode shall be designed for 100 fpm velocity in the booth to remove overspray. This mode will maintain the design conditions indicated above.

The Brush/Roll Painting Mode shall be designed for a reduced velocity of 50 fpm in the booth when areas of the aircraft are being painted using brushes or roller application means. This mode will maintain the design conditions indicated above.

The Cure/Dry Mode shall be designed at a reduced velocity of 50 fpm in the paint booth after painting. The temperature and humidity shall be maintained as indicated above.

The Purge Mode shall be designed for 100 fpm velocity in the paint booth. Sensors located in the exhaust or recirculation air stream shall be used to detect if the air is above 25 percent of the lower explosive limit. If 25 percent of this limit is exceeded, the paint booth shall go into the "Purge Mode" where the recirculation fans, exhaust fan, and makeup air unit shall be commanded on to their 100 fpm air flow rates. Alarms shall sound and the occupants shall evacuate the booth until the conditions return to normal. The temperature will be maintained as if in the spray paint/sanding mode during the Purge Mode.

The Off Mode shall be designed for all fans to be turned off. This mode shall be used during periods of complete booth inactivity and maintenance.

### 2.3.3 Heating, Ventilating, and Air Conditioning

The paint booth shall be air conditioned by means of a makeup air unit consisting of an inlet air damper, MERV-8 prefilter section, MERV-13 filter section, DX cooling coil, modulating hot gas reheat, modulating hot gas bypass, water cooled condensing section, and a supply fan section with a variable frequency drive. The makeup air unit shall be provided with a unit mounted controller indicating at a minimum alarms, faults, status, filter pressure drops, and temperatures at each section. The makeup air unit shall condition 100 percent outside air and will mix with the recirculation air at the plenum door. Recirculation air and exhaust fans shall be variable speed drive and shall be inline type fans. Duct mounted smoke detectors, controls and ductwork for the makeup air unit and recirculation fans shall be provided with the building. The recirculation fans shall be supported from the building's structure. The makeup air unit will be pad mounted located on the mechanical platform. The makeup air unit and recirculation and exhaust fans shall be installed in a manner that allows them to be accessible for routine maintenance and replacement. All electrical motors, starters, wiring, conduit, boxes, and associated equipment shall be rated for Class I, Division I locations if installed in such an area. Ductwork and duct accessories shall be in accordance with Section 23 00 00 AIR SUPPLY, DISTRIBUTION, VENTILATION, AND EXHAUST SYSTEM.

### 2.3.4 Duct Work

The paint bay manufacturer is responsible for the design and installation of all ductwork and duct accessories from the makeup air inlet louvers to the outlet of the exhaust stacks, including recirculation ductwork. The design and installation shall be coordinated with the Architects and Engineers. The ducts are required to be provided with low leakage dampers in accordance with UFC 4-010-01.

### 2.3.5 Paint Booth Controls

- a. The temperature controls for paint booth system shall be the paint booth insert manufacturer's standard PLC based controls capable of performing the controls specified herein and as indicated on the drawings. Provide sequence of operations for each mode of operation and a fully labeled control schematic. The temperature controls system shall be capable of recording and trending data and communicating with the building's BAS and with the basewide EMCS, which is a BACnet

system. The basewide system and the building's BAS shall be able to monitor the paint booth insert control system. Provide momentary red mushroom head (push to stop and pull to reset) HVAC emergency shutdown switch within the paint booth with clear, hinged cover.

- b. Control Panels: Provide an adequate number of control panels to enable timely maintenance and trouble-shooting of system. Provide a control panel at each major paint booth HVAC system component.
- c. The main PLC panel will be the operator's point of control for all paint booth HVAC functions. System modes of operation, lighting, messages and alarms will be accessed through this panel. This panel will provide remote I/O panel communication connections for all required booth functions. The main panel shall also contain the BACnet connection for the DOC system/and the building BAS. At a minimum the data logger shall record the following points every 30 minutes for 1 year duration: the mode, space temperature, space humidity, bay air flow, pressure drop across each of the filter banks, equipment failures and critical control/monitoring points.
- d. Control Panels to be NEMA-12 rated. Paint spray booth to have a control panel of adequate size to house main PLC, door-mounted touchscreen and magnehelic transmitters, control transformer, surge protected power supply, fuses and miscellaneous terminal blocks and relays.
- e. UL industrial listing required.
- f. Paint Booth Pressurization: Booth to have an "Auto-Balance System" designed to automatically keep the paint booth balanced during operation. The system shall consist of variable frequency drives that control the speed of the exhaust ventilation, differential pressure transmitters, and sensing probes. The PLC control system shall monitor the interior booth pressure versus the interstitial space and adjust the exhaust system fan speed to maintain constant airflow through the booth as the exhaust filter pressure drop increases.
- g. VOC Detection: Supply monitoring stations accessible from catwalk. Stations shall sample air from the lower and upper exhaust chambers and will provide a PPM reading to the control system. The system shall be utilized to determine high concentration of surrogate gases of poly-isocyanates and strontium chromate. Upon reaching a concentration in excess of the PEL for system operators, the system shall alarm and disable shop compressed air (spray operations) within the paint booth. The control system shall then initiate the purge process. The system exhaust fans, recirculation fans, and makeup air equipment will continue to operate until a safe condition exists. At this point, the system operator is allowed to acknowledge the alarm and restart the system. Once system operation has been proven, with no alarms, the control system shall enable shop compressed air to the paint booth. The control system shall maintain a historical log of the PEL levels for a period of 1 month based on FIFO data storage. This information shall be shared with the base DOC system. VOC monitors shall be manufactured by MSA or approved equal.
- h. LEL Detection: Supply monitoring stations at each recirculation duct shall be installed to verify system VOC concentrations below 10 percent of the lower explosive limit (LEL). The monitor shall be interlocked with the ventilation and exhaust system. In the event that



high LEL has been reached, the shop compressed air (paint gun) supply shall be shut down and the system begins a purge process. The system exhaust fans, recirculation fans, and makeup air equipment continue to operate until a safe condition exists. At this point, the system operators are allowed to acknowledge the alarm and restart the system. Once system operation has been proven, with no alarms, the control system shall enable shop compressed air to the paint booth. The control system will maintain a historical log of the LEL levels for a period of 1 month based on First-In-First-Out (FIFO) data storage. This information will be shared with the base DOC system. LEL monitors shall be manufactured by MSA or approved equal.

- i. Carbon Monoxide Monitoring: Carbon monoxide detectors shall be located in three locations. These locations, one at the makeup air supply duct one at the recirculating ductwork, and one at exhaust ductwork, will require that the monitoring device is located remotely at the ductwork. A separate display module will be utilized as an end-user interface and calibration means. The MSA monitor for the exhaust stack will be located near the control panel with easy access for maintenance and calibration. Upon sensing a carbon monoxide level in excess of 9 ppm, the paint booth ventilation & exhaust system will go into a warning mode. The control system will maintain a historical log of the CO levels for a period of 1 month based on FIFO data storage. This information will be shared with the base DDC system. CO monitors shall be manufactured by MSA or approved equal.
- j. Emergency Shutdown: The paint booth ventilation and exhaust system shall incorporate an alarm annunciation system consisting of amber, red and blue beacons and one horn within the paint booth. Depending upon the specific item of concern, these annunciation devices shall be utilized to signal the occupants of a warning or alarm within the system. In addition to these noted below, a full descriptive text summary shall be displayed at the touchscreen interface. Furthermore, green, amber and red stack lights are to be utilized as indicators at the user interface panel. The system operator at the touchscreen panel must first acknowledge all system alarms, before operations would be able to be continued. At a minimum, the following points shall be monitored by the alarm annunciation system. Alarms are characterized as either a "Warning" or "Alarm" by its associated amber and red strobes respectively. Upon any critical alarms, the shop compressed air (spray operations) within the paint booth shall be disabled. Items listed below are designated with its associated annunciation device with a RB (red beacon), AB (amber beacon) and H (horn).

- (1) Personnel Doors Not Proven Closed; AB.
- (2) Outside Hangar Door Not Proven Closed; AB.
- (3) Interior Hangar Filter Door Not Proven Closed; AB.
- (4) System Exhaust Fans Not Proven Operational; AB.
- (5) System Recirculation Fans Not Proven Operational; AB.
- (6) System Makeup Air Unit Proven Not Operational; AB.
- (7) Temperature & Humidity Conditions Not in Range; AB.
- (8) Lighting Lens Switch; AB.

- (9) Building Fire Alarm; RB; H.
- (10) Foam Fire System; RB; H.
- (11) Breathing Air Alarm; RB, H.
- (12) Paint Booth High LEL; RB, H.
- (13) Paint Booth High PEL; RB, H.
- (14) Paint Booth High CO; RB, H.
- (15) Paint Booth Low Airflow; AB.
- (16) Paint Booth High Space Pressure; AB.
- (17) Paint Booth Filters Dirty; AB.
- (18) Rollup Door Not Proven Closed; AB.
- (19) Transformer Room Door Not Proven Closed; AB.

#### 2.3.6 PLC Control Systems

##### General Specifications:

- a. This specification has been developed to establish minimum requirements for a solid-state programmable controller designed to provide high reliability in industrial applications. The internal wiring of the controller is to be fixed, with the logic functions it must perform in a given application to be programmed into its memory. The controller shall be supplied with the CPU, input/output scanner, inputs, outputs, memory, power supply, and all power and interface cables necessary to function as a complete and operable programmable controller system.
- b. The objective of the programmable controller will be to improve reliability, maintainability, and efficiency by reducing operating costs and downtime.
- c. Extend data outlets as required to paint booth systems for any network connectivity requirements for a complete and operational system.

#### 2.3.7 Booth Pressure Control System

The booth differential pressure will be continuously monitored by the PLC control system with respect to the hangar and maintained at a set point that is end-user definable -0.05 in w.c. to 0 in w.c.. The system shall be designed so that regardless of the individual loading of the exhaust filter system, the booth will maintain the pressure specified by the end user. Booth pressure to be controlled by varying the percent output signal to the exhaust fan VFDs.

#### 2.3.8 Exhaust Filter Monitoring

The paint arrestance (loading) of the filters is monitored with 3 magnehelic gauges with transmitters. These filter monitor stations allow the operator to gauge the loading of the filter wall in two locations.

### 2.3.9 Supervisory Control System

During "Painting and Sanding Modes," the control system will enable the shop compressed air (air to sanding/painting equipment and other pneumatic equipment) within the booth to system operators. Should one of the following safeties activate, shop compressed air will be shut off, preventing further operations until alarms have been acknowledged and systems are proven OK.

#### 2.3.9.1 Shop Compressed Air Interlocks

- a. Building fire alarm.
- b. Foam fire system activated.
- c. Paint booth door not proven closed.
- d. Breathing air system alarm.
- e. Paint booth - high LFL.
- f. Paint booth - high PEL.
- g. Paint booth - low air flow.
- h. Paint booth - high space pressure.
- i. Paint booth - high exhaust filter pressure drop.
- j. Paint booth light fixture lens opened.

#### 2.3.10 Exhaust Filtration System

The exhaust filtration system shall be based on the Best Available Control Technology (BACT) or the Lowest Available Emission Rate (LAER).

MSDS List of paint and other materials used in the paint booth shall be available upon request through the Contracting Officer.

##### 2.3.10.1 3-Stage NESHAP Compliant Paint Booth Filtration System

Exhaust filtration system shall include factory-fabricated, 3-stage filter system, replaceable air filters with holding frames. System shall be in accordance with 40 CFR 63 Sub-part GG. The filter system shall be 3-stage that meets Subpart GG requirements for a new booth and has a minimum particulate capture efficiency of 95 percent. Air filters shall be replaceable with holding frames. Stage 1 filter shall be 1-inch thick polyester flat filter panel with paint holding capacity of 2.7 pounds of paint per square foot of filter. Stage 2 filter shall be thick multi-layered tackified polyester media. Stage 3 filter shall be 12-inch thick, five pocket, angled filter. Filters shall be front loading for front access from inside the paint booth. Permanently gasket framing members shall prevent bypass of unfiltered air. Provide a magnahelic differential pressure gauge across each filter stage.

##### 2.3.10.2 Exhaust Fans and Stacks

Exhaust fans shall be variable speed drive and designed to maintain booth

under negative pressure. Stacks shall be designed as indicated on the drawings for a discharge velocity. Total stack height shall be a minimum 10 foot and shall not penetrate the airspace imaginary surfaces per UFC 3-260-01. Exhaust fans shall be installed in a manner that allows them to be accessible for routine maintenance and replacement. Exhaust stacks and exhaust equipment shall be supported by the building structure. Coordination of final weights shall be coordinated with structural engineer prior to commencement of construction. All structural parts shall be coated with a polyurethane powder coat coating or equal. Exhaust fans and stacks shall be in accordance with Section 23 35 19.00 20 INDUSTRIAL VENTILATION AND EXHAUST.

#### 2.3.11 Compressed Air

Compressed air shall be provided in the paint booth. Compressed air drops shall be located in a recessed compartment along the wall of the paint booth. The recessed compartment shall be large enough to house the piping, regulator and quick connect coupling so it does not protrude beyond the inside surface of the paint booth wall. These compartments can also contain the breathing air drop and vacuum/dust collection drop. Refer to the Drawings for the routing of the compressed air piping. Coordinate routing and penetration of compressed air drops with mechanical contractor.

#### 2.3.12 Breathing Air

Breathing air shall be provided in the paint booth. Breathing air drops shall be located in a recessed compartment along the wall of the paint booth. The recessed compartment shall be large enough to house the piping, regulator and quick connect coupling so it does not protrude beyond the inside surface of the paint booth wall. These compartments can also contain the compressed air drop. Refer to the Drawings for the routing of the breathing air piping. Coordinate routing and penetration of breathing air drops with plumbing contractor.

#### 2.3.13 Supply, Recirculation, and Exhaust Air Fans

Supply, recirculation, and exhaust air fans shall be equipped with variable frequency drives. Motors driven by variable frequency drives shall be "inverter duty" with 1.15 SF. All safety disconnects shall be fused and shall be provided by the Paint Booth Contractor. The average sound level of these fans shall not exceed 85 dBA. The total fan horse power for the paint bay system at design conditions shall be 20 percent below the fan horse power limitations as established by ASHRAE 90.1 - SI. All structural parts to be phosphatized and coated with polyester urethane powder coat coating or equal. Motors shall be installed per National Electric Code. Provide disconnecting means per NEC. Motors shall have the capability of being Locked-out/ Tagged-out. Fans shall be in accordance with Section 23 35 19.00 20 INDUSTRIAL VENTILATION AND EXHAUST.

#### 2.3.14 Equipment and Materials Selection

The applicable specification sections specified herein shall be used for selecting equipment and materials.

#### 2.3.15 Variable Frequency (Motor) Drives

Provide variable frequency drives for motors as specified in Section 26 29 23 VARIABLE FREQUENCY DRIVE, SYSTEMS UNDER 600 VOLTS.

## 2.4 PLENUM DOOR

Refer to Section 08 34 16 CORROSION CONTROL HANGAR DOORS.

## 2.5 PAINT BOOTH ELECTRICAL EQUIPMENT AND SYSTEMS

Provide a single-point electrical connection to the 480Y/277 volts AC panelboard (as indicated on plans) for the paint booth. Provide all necessary conduit, boxes, wire, receptacles, switches, panelboards, transformers, motor control centers, power distribution, associated connections, conduit, wiring, fused paint booth lighting, HVAC, and appurtenances to make for a functional installation. All electrical equipment shall be per Division 26 specification sections and shall comply with the NEC for the area in which it is installed. Paint booth installer shall coordinate all electrical installations with other electrical subcontractors on the jobsite. Provide the paint booth insert with the following:

- a. Provide control panel with integral door interlocked fused main electrical disconnect. Panel shall have a single-point electrical service and shall include all wiring, conduit, grounding, fuses, switches, required motor controllers, power distribution, fused control transformers, and control devices to serve all paint spray booth related equipment including spray booth ventilation and air-conditioning. Panel enclosure shall be weatherproof with NEMA 4X enclosure.
- b. Provide complete operator's control panel for HVAC system, lights and all other equipment located outside of the main door, in a non-hazardous location.
- c. Interlock paint spray nozzles with both ventilation system and light fixture lens door limit switches.
- d. Provide 12-pulse variable frequency drives (VFDs) which shall have 2 percent in-line reactors and harmonic mitigation to comply with IEEE 519 Tables 10.1 and 10.3.
- e. Control panel shall be located outside of the hazardous envelope. See plans for location.
- f. Provide HVAC system red maintained (push to stop and pull to reset) mushroom head push-button emergency shutdown with clear plastic hinged cover.
- g. Provide flashing back illuminated sign reading "Do Not Enter - Painting in Progress" over each personnel door that is "ON" when in the painting mode.
- h. Explosion-proof public address (PA) speakers (70.7 V) as indicated on plans (coordinate with PA system).
- i. Explosion-proof Mass Notification System (MNS) speakers (70.7 V) as indicated on plans (coordinate with MNS).
- j. Explosion-proof Fire Alarm/Mass Notification System clear strobes (24 volts DC) as indicated on plans (coordinate with MNS).

- k. One ground bus with wall mounted stand-off insulators.
- l. Explosion-proof UV/IR flame detectors (alarm only) (24 volts DC) as indicated on plans (coordinate with Fire Alarm).
- m. Explosion-proof foam foam releases/stop stations (each with hinged clear cover) as indicated on plans (coordinate with Fire Alarm).

### PART 3 EXECUTION

#### 3.1 INSPECTION

Coordinate location of rough-in work and utility stub-outs to assure match with equipment to be installed. Inspect delivered equipment for damage from shipping and exposure to weather. Compare delivered equipment with packing lists and specifications to assure receipt of all items.

#### 3.2 INSTALLATION

Perform work under direct supervision of Foreman or Construction Superintendent with authority to coordinate installation of scheduled equipment with Contracting Officer. Install equipment in accordance with plans, Shop Drawings, and manufacturer's instructions:

- a. Positioning: Place equipment in accordance with any noted special positioning requirements generally level, plumb and at right angles to adjacent work.
- b. Fitting: Where field cutting or trimming is necessary, perform in a neat, accurate, professional manner without damaging equipment or adjacent work.
- c. Anchorage: Steel embedment plates shall be provided for attachment of booth columns.
- d. Upon completion of work, finish surfaces shall be free of tool marks, scratches, blemishes, and stains.
- e. All electrical work shall comply with the NEC.
- f. All metal parts of the paint booth shall be effectively grounded by metal to metal contact.

#### 3.3 TESTING

After final connections are made and prior to authorizing payment, equipment shall be tested for compliance with all specified features in the presence of the Contracting Officer using acceptance procedures provided by the manufacturer. Conduct a 15-day endurance test on all mechanical systems.

##### 3.3.1 Performance Testing

Paint Booth Contractor shall submit statements signed by responsible representatives of the manufacturer attesting to conformance to the specified requirements. The statements shall be dated after on-site performance testing has been completed, and shall list the specific requirements which are being certified.

### 3.4 CLEANUP

- a. Touch-up damage to painted finishes.
- b. Wipe and clean equipment of any oil, grease, and solvents, and make ready for use.
- c. Clean area around equipment installation and remove packing or installation debris from job site.
- d. Notify Contracting Officer for acceptance inspection.

### 3.5 TRAINING

Direct the technical representative to provide the specified number of hours of on-site training to designated Owner's maintenance personnel in operation and maintenance of the following equipment. Coordinate, with Owner, training schedule and list of personnel to be trained.

- a. Aircraft Paint Spray Booth: 16 hours.

Obtain, from technical representative, a list of Owner's personnel trained in equipment operations and maintenance.

### 3.6 GROUNDING

Provide grounding of paint booth metallic structure per NEC. Coordinate with other electrical contractors on the jobsite.

### 3.7 FIELD QUALITY CONTROL

#### 3.7.1 Inspection

Examine each item for visual defects, and correct all defects to conform to the specifications.

-- End of Section --





SECTION 11 50 11

PLASTIC MEDIA BLAST BOOTH

02/18

PART 1 GENERAL

1.1 OVERVIEW

Manufacturer shall provide a complete operational plastic media blast and recovery system. The manufacturer shall provide the following:

- a. All the components, parts, electrical connections, control systems and monitoring equipment required to allow 4 people to simultaneously strip paint and other finishes from aircraft frames and component parts by plastic media blasting.
- b. All the components, parts, electrical connections, control systems and monitoring equipment required to recover and store the used blast media.
- c. All the components, parts, electrical connections, control systems, and monitoring equipment required to clean and sort the used blast media into a condition which allows it to be used again.
- d. A method of automatically returning the used cleaned media to the bead blast system.
- e. All required electrical wiring between components and back to the electrical panel.
- f. All control wiring including interconnects and safety systems.
- g. All structural frames including bracing, posts hangars and supports required to support equipment in the designed configuration including all dead loads, live loads, seismic loads, combination loads and loads imparted by motors and machinery.
- h. Complete equipment layout plan, sections and elevations and detail drawings indicating the location of each piece of equipment, connection points and safety clearance.
- i. Designed for Seismic Zone-D, with a wind load speed of 160 mph.
- j. Interior wall panels to be 12 gauge Powder coat painted with a Kynar finish.
- k. Mounting of wall panels to 3 hour rated wall.
- l. Lighting to be 100 foot candles average at 30 inches from floor.

1.2 DESIGN CONDITIONS

Bead blast equipment and recovery system shall be design based on the following criteria:

- a. System shall be designed to allow four individuals to use the equipment at same time.

- b. System designed to remove paint and other finishes from aircraft frames and other components.
- c. A blast booth area approximately 75 feet wide, 85 feet long, 40 feet high.
- d. Air flow velocity through booth area 100 feet per minute.
- e. Blast Media: Plastic media.
- f. All parts will be clean and free of moisture, oil, grease and any type of dense contamination such as sand or mud.

### 1.3 QUALIFICATIONS

#### 1.3.1 Manufacturer's Qualifications

Manufacturer who is regularly engaged in the design, fabrication, erection and servicing of plastic blast equipment and reclamation systems. The Manufacturer must have at least five years of similar blast equipment and reclamation systems design experience. Similar systems must have a comparable function and design including configuration and type of use, controls and safety features. The manufacture must submit written evidence of other designs and installations listing project name & location. Only manufacturers who can submit the evidence of installments shall be considered.

### 1.4 DELIVERY, STORAGE, AND HANDLING

The blast equipment and recovery system manufacture shall package all equipment to protect components and accessories from damage during delivery, storage and handling. Mark all packaging clearly with the manufacturer's brand name, component name and model number, project name and location. Shall be stored in dry location with adequate ventilation free from dust and water.

## PART 2 PRODUCTS

### 2.1 MEDIA RECOVERY SYSTEM

#### 2.1.1 Recessed Floor Media Recovery Hopper

Formed metal hopper of material and thickness as recommended by the manufacture and designed to fit within the trench provided. Hopper shall be designed with tight fitting connections and joints which prevent seepage of recovered media.

#### 2.1.2 Hopper Valve

Auto cycling, pneumatic diverter valve.

#### 2.1.3 Media Recovery Duct

Sized by the manufacturer for the anticipated volume of recovered media and connecting the in-ground hopper to the media recovery system.

#### 2.1.4 Media Floor Recovery System

Designed to move media from the in-ground hoppers to the Recovery Storage Hopper the unit shall consist of a high static fan with silencer. The fan shall be sized by the manufacturer to produce the volume and static air pressure required. Media shall be discharged to the recovery storage hopper through a vane rotary air lock.

#### 2.1.5 Recovery Storage Hopper

120 cubic feet. Hopper designed to hold the recovered media before it is moved to the separation system.

#### 2.1.6 Separation System

Designed to separate useable blast media from residue consisting of the following sub components. The DPS System combines a screen with an air-wash to separate the denser contaminants that could damage the substrate. Minimum capacity should be 3000 pph of 20-60 mesh plastic. Separator shall remove 1.9 S.G. and heavier material. Shall be designed and utilized in conjunction with complete media recovery and recycling system. Shall include all necessary bucket elevators and supporting equipment for operation.

##### 2.1.6.1 Cyclone Separator

Centrifugal action and air wash system designed to separate paint coating residue and plastic fines from the reusable plastic media. Paint coating residue and plastic fines are captured in the cyclone and carried into the plastic dust collector unit. The cyclone separator shall be designed to be adjustable allowing operator to determine the size of the fines to be removed from the reusable media.

##### 2.1.6.2 DPS System Hopper

Designed to collect media from the cyclone separators and sized appropriately to store material and support the cyclone separator.

##### 2.1.6.3 Rotary Air Lock

A 0.5 HP variable-speed, rotary airlock secured to the bottom of the reclaim hopper.

##### 2.1.6.4 Ionizer

Placed to affect the debris being conveyed through the reclaim ducts the Ionizer shall create an ionizing field which will dissipate any static build-up on the plastic media improving flow through the hoppers, screens and transport ducts.

##### 2.1.6.5 Screen Classifier

The screen classifier shall be a powered, 3-deck design which consists of mesh weave screens within a single enclosure designed to sort media by mesh size.

#### 2.1.7 Media Storage Hopper

Storage hopper designed to sit on top of the pressure assembly and

smoothly feed media into the pressure vessel. Hopper shall be constructed with minimum 10 gage steel walls.

#### 2.1.1.8 Pressure Vessel Assembly

Total of 4.

- a. Pressure vessel assembly shall be designed to allow for the connection of separate media blast hoses. A.S.M.E Coded and equipped with a 60 degree cone bottoms to ensure smooth media flow each individual assemble shall be fitted with a heavy duty metering valve mounted to the base of the pressure vessel that is adjustable for a precise even flow of any type of blasting media and shall include an automatic media shutoff feature that prevents media from draining into the blast hose when the nozzle is deactivated. Blast pressure shall be controllable from the control panel.
- b. Pressure vessels must be equipped with valve for low-pressure blasting abilities. Must be able to maintain consistent low-pressure blasting capabilities.
- c. Must have smooth blast actuation with independent pressure controlled closer valve.

#### 2.1.1.9 Hoses

Total of 4. Lightweight, 4 ply blast hose designed to work with the pressure vessel assembly and nozzle.

#### 2.1.1.10 Nozzles

Total of 4. Double venturi nozzles designed to work with bead blast system with "deadman" type automatic shut off device.

#### 2.1.1.11 Integrated Control Panel

Manufacturer's standard fully programmable solid state automatic control system with ethernet capability and full color HMI touch screen operator interface. The control panel shall be capable of real time monitoring of all system components. Control panel shall be housed in a NEMA 12 enclosure.

"Extend data outlets as required to paint booth systems for any network connectivity requirements for a complete and operational system."

### 2.2 DUST COLLECTION VENTILATION SYSTEM

Manufacturer designed and engineered. During operations the dust laden air will be drawn from the back of the blast booth, and ducted to a downflow, cartridge-style dust collection system. The air will be pulled through the dust collection system with an industrial centrifugal fan(s).

Filter system shall include HEPA filtration and clean air will then be expelled to the atmosphere.

The dust collectors will be designed to provide an automatic reverse pulse filter purging with automatic controls. Purging shall be accomplished by the use of short duration reverse pressurization.

Each dust collection system shall include pressurized air accumulator tanks as necessary to provide the required air pulses. Ductwork and duct accessories shall be in accordance with Section 23 35 19.00 20 INDUSTRIAL VENTILATION AND EXHAUST.

Duct collection ventilation system ductwork to be designed with approved 3 hour rated UL firestop system at penetration of 3 hour rated separation wall.

## 2.3 BLAST BOOTH ELECTRICAL EQUIPMENT AND SYSTEMS

Provide a single-point electrical connection to the 480Y/277 volts AC panelboard (as indicated on plans) for the balance of blast booth loads. Provide all necessary conduit, boxes, wire, receptacles, switches, panelboards, transformers, motor control centers, power distribution, associated connections, conduit, wiring, fused paint booth lighting, HVAC, and appurtenances to make for a functional installation. All electrical equipment shall be per Division 26 specification sections and shall comply with the NEC for the area in which it is installed. Paint booth installer shall coordinate all electrical installations with other electrical subcontractors on the jobsite. Provide the blast booth with the following:

- a. Provide complete operator's control panel for HVAC system, lights and all other equipment located outside of the main door, in a non-hazardous location.
- b. Interlock paint spray nozzles with both ventilation system and light fixture lens door limit switches.
- c. Provide HVAC system red maintained (push to stop and pull to reset) mushroom head push-button emergency shutdown with clear plastic hinged cover.
- d. Provide flashing back illuminated sign reading "Do Not Enter - Blasting in Progress" over each personnel door that is "ON" when in the blasting mode.
- e. Explosion-proof public address (PA) speakers (70.7 V) as indicated on plans (coordinate with PA system).

## PART 3 EXECUTION

### 3.1 INSTALLATION

Installation of bead blast equipment, bead blast media recovery equipment, ventilation equipment and control systems including fabrication, assembly, erection, inspection, and testing shall be in accordance with the manufacturer's written installation instructions and at the direction of the Manufacturer's Technical Representative.

### 3.2 DEMONSTRATION

Contractor shall conduct a training course for the operating staff as designated by the Contracting Officer. A training class shall be completed after the system is functionally complete. Approved operations and maintenance manuals as well as written directions of routine maintenance operations shall be provided.

-- End of Section --

SECTION 12 24 13

ROLLER WINDOW SHADES  
08/17

PART 1 GENERAL

1.1 GENERAL REQUIREMENTS

Provide roller window shades, complete with necessary brackets, fittings, and hardware as indicated. Mount and operate equipment in accordance with manufacturer's instructions. Windows to receive a shade must be completely covered.

- a. Submit drawings showing plans, elevations, sections, product details, installation details, operational clearances, wiring diagrams and relationship to adjacent work. Include the use of same room designations as indicated on the drawings.
- b. Provide manufacturer's data composed of catalog cuts, brochures, product information, and operating and maintenance instructions on each product to be used. Include styles, profiles and features.
- c. Furnish samples of each type and color of roller shade fabric and roller shade channel. Shade material shall be minimum 6 by 6 inch in size. Mark face of material to indicate interior faces.
- d. Mock up: Install shade in area designated by Contracting Officer. Do not proceed with remaining work until the Contracting Officer approves workmanship and operation. Re-work mock-up as required to produce acceptable work. The approved shade can be used in installation.
- e. Submit fire resistance data, flame spread and smoke contribution data.

1.2 REFERENCES

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

ASTM INTERNATIONAL (ASTM)

ASTM G21	(2015) Standard Practice for Determining Resistance of Synthetic Polymeric Materials to Fungi
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NATIONAL FIRE PROTECTION ASSOCIATION (NFPA)

NFPA 701	(2015) Standard Methods of Fire Tests for Flame Propagation of Textiles and Films
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SCIENTIFIC CERTIFICATION SYSTEMS (SCS)

SCS	SCS Global Services (SCS) Indoor Advantage
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UNDERWRITERS LABORATORIES (UL)

UL 2818	(2013) GREENGUARD Certification Program For Chemical Emissions For Building Materials, Finishes And Furnishings
UL 325	(2017) UL Standard for Safety Door, Drapery, Gate, Louver, and Window Operators and Systems

1.3 SUBMITTALS

Government approval is required for submittals with a "G" designation; submittals not having a "G" designation are for information only. When used, a designation following the "G" designation identifies the office that will review the submittal for the Government. Submittals with an "S" are for inclusion in the Sustainability eNotebook, in conformance to Section 01 33 29 SUSTAINABILITY REPORTING. Submit the following in accordance with Section 01 33 00 SUBMITTAL PROCEDURES

SD-02 Shop Drawings

Installation

SD-03 Product Data

Window Shades

SD-04 Samples

Window Shades; G

SD-06 Test Reports

Window Shades

SD-07 Certificates

Indoor Air Quality

SD-08 Manufacturer's Instructions

Window Shades

SD-10 Operation and Maintenance Data

Window Shades

SD-11 Closeout Submittals

Recycled Content for various fiber components; S

Indoor Air Quality for roller window shades; S

Warranty



#### 1.4 CERTIFICATES

##### 1.4.1 Indoor Air Quality Certifications

###### 1.4.1.1 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.

#### 1.5 QUALITY ASSURANCE

##### 1.5.1 Qualifications

###### 1.5.1.1 Manufacturer's Qualifications

Obtain motor-controlled roller shades through one source from a single manufacturer with a minimum of twenty years experience and minimum of three projects of similar scope and size in manufacturing products comparable to those specified in this section.

###### 1.5.1.2 Installer's Qualifications

Installer trained and certified by the manufacturer with a minimum of ten years experience in installing products comparable to those specified in this section.

##### 1.5.2 Flammability Requirements

Passes in accordance with NFPA 701 small and large-scale vertical burn. Materials tested must be identical to products proposed for use.

##### 1.5.3 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 will not be acceptable in lieu of system testing.

##### 1.5.4 Anti-Microbial Requirements

'No Growth' per ASTM G21 results for fungi ATCC9642, ATCC 9644, ATCC9645.

#### 1.6 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.

#### 1.7 WARRANTY

Provide 10 year minimum limited warranty.

## PART 2 PRODUCTS

### 2.1 WINDOW SHADES

Roller tube must operate smoothly and be of sufficient diameter and thickness to prevent excessive deflection. Provide brackets that are appropriate for mounting condition as indicated on drawings. The shade cloth must meet the performance described in NFPA 701, small scale test. Treat steel features for corrosion resistance.

Provide Various Fiber Components with a minimum of 60 percent recycled content. Provide data identifying percentage of recycled content for various fiber components.

Provide certification of indoor air quality for roller window shades.

#### 2.1.1 Light Filtering Shades

Provide light filtering window shades to conform with the following:

- a. Roller tube must be extruded aluminum or steel. Diameter, wall thickness, and material to be selected by the manufacturer to accommodate the shade size. Provide roller idler assembly of molded nylon and zinc-plated steel pin. Sliding pin must allow easy installation and removal of roller. Fabric must be connected to the roller tube with double sided adhesive specifically developed to attach coated textiles to metal to eliminate horizontal impressions in fabric or attached with a spline lock system.
- b. Fascia must be 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.
- c. End caps must be stamped steel with universal design suitable for mounting to window mullions. Provide size compatible with roller size. End cap covers must match fascia/headbox finish.
- d. Provide hardware that allows for field adjustment or removal of shade roller tube and other operable hardware component without requiring removal of brackets and end or center supports. Provide hardware system that allows for operation of multiple shade bands by a single operator. Connectors must be offset to assure alignment from the first to the last shade band. Provide shade hardware constructed of minimum 1/8 inch thick plated steel or heavier as required to support 150 percent of the full weight of each shade.
- e. Manual Operated Chain Drive Hardware must provide for universal, regular and offset drive capacity, allowing drive chain to fall at front, rear or non-offset for all shade drive end brackets. Universal offset must be adjustable for future change. Provide positive mechanical engagement of drive mechanism to shade roller tube. The drive bracket must be fully integrated with all accessories. Drive chain must be #10 stainless steel chain rated to 90 lb. minimum breaking strength.

## 2.2 COLOR

Provide color, pattern and texture for metal and shade fabric as indicated. Color listed is not intended to limit the selection of equal colors from other manufacturers. Openness factor of shade fabric must be as indicated on the drawings.

## 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.

Perform installation in accordance with the approved detail 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 adjust them 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, must be contained inside the pocket. For shades installed outside the jambs and mullions, overlap each jamb and mullion 0.75 inch or more when the jamb and mullion sizes permit. Include all hardware, brackets, anchors, fasteners, and accessories necessary for a complete, finished installation.

-- End of Section --



SECTION 12 48 13

ENTRANCE FLOOR MATS

08/17

PART 1 GENERAL

1.1 REFERENCES

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

ASTM INTERNATIONAL (ASTM)

ASTM D2047 (2011) Static Coefficient of Friction of Polish-Coated Floor Surfaces as Measured by the James Machine

ASTM E648 (2017) Standard Test Method for Critical Radiant Flux of Floor-Covering Systems Using a Radiant Heat Energy Source

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

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

1.2 SUSTAINABILITY REPORTING

Materials in this technical specification may increase contract compliance with sustainability requirements.

1.2.1 EPA Comprehensive Procurement Guidelines

See Section 01 33 29 SUSTAINABILITY REPORTING for requirements associated with EPA-designated products.

1.2.2 USDA Biobased

See Section 01 33 29 SUSTAINABILITY REPORTING for requirements associated with USDA Biobased products.

1.3 SUBMITTALS

Government approval is required for submittals with a "G" designation; submittals not having a "G" designation are for information only. When used, a designation following the "G" designation identifies the office that will review the submittal for the Government. Submittals with an "S" are for inclusion in the Sustainability eNotebook, in conformance to Section 01 33 29 SUSTAINABILITY REPORTING. Submit the following in accordance with Section 01 33 00 SUBMITTAL PROCEDURES:

SD-02 Shop Drawings

Installation Drawings; G

Detail Drawings; G

Custom Graphics Drawings; G

SD-03 Product Data

Entrance Floor Mats; G

Adhesives and Concrete Primers; G

SD-04 Samples

Entrance Floor Mats; G

Custom Graphics; G

SD-08 Manufacturer's Instructions

Manufacturer's Instructions

SD-10 Operation and Maintenance Data

Protection, Maintenance, and Repair Information

1.4 QUALITY CONTROL

Comply with 36 CFR 1191 Americans with Disabilities Act (ADA) Accessibility Guidelines for Buildings and Facilities; Architectural Barriers Act (ABA) Accessibility Guidelines for installed entrance floor mats and frames. Ensure that entrance floor mats and frames are slip-resistant in accordance with ASTM D2047, with a minimum 0.60 coefficient of friction, for accessible routes and are structurally capable of withstanding a wheel load of 400 lb/wheel. Ensure that flammability is in accordance with ASTM E648, Class 1, Critical Radiant Flux, minimum 0.45 watts/square meter.

1.5 DELIVERY, STORAGE, AND HANDLING

Deliver materials to the project site in their original packages or containers bearing labels clearly identifying the manufacturer, brand name, and quality or grade.

Store materials in their original unbroken packages or containers in the area in which they will be installed. Unwrap, inspect, and place mats at indicated locations. Remove all excess packing materials.

PART 2 PRODUCTS

2.1 MANUFACTURED UNITS

2.1.1 Entrance Floor Mats

Submit the manufacturer's catalog data. Submit samples of assembled sections of floor mats showing corners, intersections, and other details of construction. Submit samples of custom graphics, exposed floor mats, and accessories.

#### 2.1.1.1 Floor Grids

Provide a floor grid consisting of a series of aluminum tread rails spaced 1 1/2 inches on center and running counter to the traffic flow. Ensure that floor grids allow debris to fall to the subfloor. Provide a drain pan as indicated on drawings. Rest grid assemblies on a vinyl cushion mounted to each continuous foot at 20 inches on center. Provide a drain pan to include a drain and a stainless-steel strainer. Provide all anchors, fasteners, accessories, and other parts required for a complete installation.

#### 2.1.1.2 Tread Insert Options

Provide tread inserts consisting of carpet composed of solution-dyed nylon or polypropylene carpet fibers fusion-bonded to a rigid two-ply backing to prevent fraying and supplied in continuous splice-free lengths; carpet has antistatic and antistain treatments. Ensure that pile weight is a minimum 30 ounces per square yard.

#### 2.1.2 Adhesives and Concrete Primers

Provide adhesives and concrete primers, where required, according to the manufacturer's recommendations.

#### 2.1.3 Color and Size

Ensure that color is in accordance with the drawings. Ensure that the size of mat is as indicated on the drawings.

### PART 3 EXECUTION

#### 3.1 EXAMINATION

Comply with the manufacturer's requirements for substrates and floor conditions affecting installation of floor mats and frames. Ensure that all unsatisfactory conditions have been corrected before installation.

#### 3.2 INSTALLATION

Submit detail drawings, and custom graphics drawings as required. Provide installation drawings. Provide the manufacturer's protection, maintenance, and repair information.

Install floor mats and frames according to manufacturer's instructions. Set mat tops at the height recommended by the manufacturer for the most effective cleaning action. Provide clearance between bottoms of doors and tops of mats. Coordinate recess frame installation with concrete construction to ensure that frame anchorage is correct and that the base is level and flat. Install grout, if required to set mat tops at proper elevations, in recesses under mats. Finish grout and fill smooth and level.

-- End of Section --





SECTION 13 21 15

DECONTAMINATION AIR SHOWERS

04/18

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.

SOUTH COAST AIR QUALITY MANAGEMENT DISTRICT (SCAQMD)

SCAQMD Rule 1113 (2012) Architectural Coatings

SCAQMD Rule 1168 (1989; R 2005) Adhesive and Sealant Applications

1.2 SUBMITTALS

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

SD-02 Shop Drawings

Air Shower; G  
Air Handling Unit; G

Provide shop drawings of entire system, including sequence of operation for review and approval before start of work.

SD-03 Product Data

Air Shower; G

Provide manufacturer's printed product literature and data sheets for decontamination shower, and include product characteristics, performance criteria, physical size, finish and limitations.

SD-05 Design Data

Air Shower; G

SD-10 Operation and Maintenance Data

Air Shower; G  
Air Handling Unit; G

Provide operation and maintenance data for decontamination showers and components for incorporation into manual specified in Section Section 01 78 23 OPERATION AND MAINTENANCE DATA.

### 1.3 DESIGN DESCRIPTION

Air decontamination shower units consisting of a air shower with interlocked doors, adjustable time sequences, emergency override switches and accessible control panel.

#### 1.3.1 Air Shower Configurations

Stand alone units, single operative air showers with two side panels incorporating high velocity air supply nozzles, supply and return air plenums, interlocked toughened plate glass doors and roof section with modular light fitting. Configurations and external dimensions as indicated on drawings.

### 1.4 ADMINISTRATIVE REQUIREMENTS

Coordinate air shower units installation with related trades to avoid conflicts.

### 1.5 QUALITY ASSURANCE

Shower units to be fully assembled and tested prior to disassembling and shipping to site. Ships in two pieces to be assembled at job site.

#### 1.5.1 Manufacturer Qualifications

Company specializing in manufacturing the Products specified in this section with minimum 10 years experience supplying specified equipment to government, military and heavy industrial applications.

#### 1.5.2 Installer Qualifications

Company specializing in installation of the Products specified in this section and approved by the manufacturer.

### 1.6 DELIVERY, STORAGE AND HANDLING

Deliver, store and handle in accordance with manufacturer's written instructions. Deliver materials to the site in undamaged condition and in original unopened containers, marked to indicate brand name, manufacturer, and ULC markings. Store materials off ground, indoors and in accordance with manufacturer's recommendations in clean, dry, well-ventilated area.

#### 1.6.1 Packaging Waste Management

Remove and handle waste packaging materials in accordance with Section 01 74 19 CONSTRUCTION AND DEMOLITION WASTE MANAGEMENT. Collect and separate plastic, paper packaging and corrugated cardboard in accordance with Waste Management Plan. Fold up metal banding, flatten and place in designated area for recycling.

### 1.7 SUSTAINABILITY REQUIREMENTS

Limits in accordance with Section 01 33 29 SUSTAINABILITY REPORTING.

#### a. Low-Emitting Materials:

(1) Adhesives and sealants, Credit EQ-4.1, VOC content to

SCAQMD Rule 1168.

(2) Paints and Coatings, Credit EQ-4.2, VOC content to SCAQMD Rule 1113.

## PART 2 PRODUCTS

### 2.1 AIR SHOWER

Shower unit contractor to provide the wiring diagrams design data to general contractor.

#### 2.1.1 Wall Panels

16 gauge thick stainless steel satin finished pans, edges of pans folded, corners welded, ground off and polished.

#### 2.1.2 Exposed External Face Panels

16 gauge thick stainless steel sheet, extending 4 inches above suspended ceiling for later trimming.

#### 2.1.3 Supply Air Plenums

16gauge thick stainless steel sheet, bottom enclosed; tops finished with 4-3/4 inch diameter spigot for connection to flexible supply ducts from air handling unit. Five swivelling air jet nozzles per section.

#### 2.1.4 Extract Plenums

16 gauge thick stainless steel sheet, ends enclosed, complete with two 4-3/4 inch diameter spigots for connection to flexible exhaust ducts to air handling unit.

#### 2.1.5 Roof

16 gauge thick stainless steel pan-type section, satin finish, with 1 flush light fitting unit accessible from below.

#### 2.1.6 Doors

Locate doors as indicated on the drawings for air shower module. Interlocked, 3/8 inch thick, clear tempered glass door leaf mounted into stainless steel door frame. Outward opening, single swing, complete with concealed hydraulic closure, cast stainless steel closure arm, hinge set and "0" handles. Silicone rubber door seals on head and jamb sections. Door locks pre-wired with wiring contained within door frame and terminating in connection blocks, in accordance with manufacturer's wiring diagram.

#### 2.1.7 Noise and Vibrations

Units maximum noise level is 74 dba, with a background noise level of 10 dba. Interior noise levels shall not exceed 87 dba. Blower/fan assembly to be isolated by means of rubber isolator pads.

## 2.2 AIR HANDLING UNIT

### 2.2.1 Fan Filter Stack

Sloping base, rear mounted filter housings, internal carriage and clamping mechanism, filter access doors; filter validation scanning box and door and control panel.

### 2.2.2 Controls

#### 2.2.2.1 Drive and Electrical

480V, 60Hz, 3 Phase + Gnd single point connection.

#### 2.2.2.2 Motors

Motors to be 208 or 480V, 60Hz, 3 Phase. Motor shall be NEMA Design B with Class A insulation, designed to operate in 40 degrees, have a 87.5 percent efficiency and have sealed ball bearings.

#### 2.2.2.3 Blowers/Fans

Single paddled wheel non overloading fan blower. Size the high speed blower CFM to provide a minimum velocity of 7,000 feet per minute at the face of the nozzle. Blower fans will be capable of providing rated unit CFM of 0.6 to 1.2 inches static WG off the HEPA filter. Blower fans will have permanent indication of correct rotation direction attached to the blower housing.

#### 2.2.2.4 Control Panel

IP55 rated, powder coated steel mounted on mounting plate, operator station IP65 rated, shop wired.

#### 2.2.2.5 Filtration

- a. First Stage: Coalescent Filter with safe change, bag-in/bag-out, case constructed of stainless steel with EPDM seal.
- b. Second Stage: High capacity fine H14 HEPA filter with safe change, bag-in/bag-out.
- c. Efficiency: EN1822, 99.99 (typical MPPS - DEHS value).
- d. Classification: EN1822, 99.997 percent (typical NaCl value).

#### 2.2.2.6 Instrumentation

Pressure switches to monitor HEPA filter and pressure in supply duct to shower nozzles, with an alarm on both pressure switches and alarm light on shower body.

#### 2.2.2.7 Lighting Fixture

Complete with LED lighting fixture and lamp to be activated when unit is in use.

## 2.3 ELECTRICAL REQUIREMENTS

480V, 60Hz, 3 Phase to control panel by the Electrical Contractor. Control wiring shall be by the manufacturer. Control cabinet (non hazardous area construction), mounted by Contractor.

## 2.4 BACNET INTERFACE DEVICES

Provide BACnet Interface Devices for each decon shower so that the units are presented as a series of AV and BV BACnet objects.

# PART 3 EXECUTION

## 3.1 EXAMINATION

Verify existing conditions before starting work. Verify dimensions, tolerances, and method of attachment with other work.

## 3.2 INSTALLATION

Install shower units to manufacturer's written instructions.

## 3.3 FIELD QUALITY CONTROL

Provide qualified manufacturer's representative at the site to supervise work related to equipment installation.

## 3.4 CLOSEOUT ACTIVITIES

### 3.4.1 Start-Up

Provide qualified manufacturer's representative to provide equipment check out and start up procedures.

### 3.4.2 Training

Provide technical representative to train Owner's maintenance personnel in operation and maintenance of specified equipment.

## 3.5 INSTALLATION OF EQUIPMENT BACNET INTERFACE DEVICE

See Responsibility Matrix for the execution responsibilities for Equipment Supplier, Controls and Electrical Subcontractor. The supplier is responsible for supplying and installing the BACnet Interface Device. Electrical is responsible for power and any control wiring if the device does not have a single point of connection. It is assumed that this BACnet Interface Device is a BACnet/IP device.

-- End of Section --



SECTION 13 48 00

SEISMIC PROTECTION FOR MISCELLANEOUS EQUIPMENT  
08/08

PART 1 GENERAL

1.1 REFERENCES

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

ASME INTERNATIONAL (ASME)

ASME B18.2.1 (2012; Errata 2013) Square and Hex Bolts and Screws (Inch Series)

ASME B18.2.2 (2015) Nuts for General Applications: Machine Screw Nuts, Hex, Square, Hex Flange, and Coupling Nuts (Inch Series)

ASTM INTERNATIONAL (ASTM)

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

ASTM A307 (2014; E 2017) Standard Specification for Carbon Steel Bolts, Studs, and Threaded Rod 60 000 PSI Tensile Strength

ASTM A325 (2014) Standard Specification for Structural Bolts, Steel, Heat Treated, 120/105 ksi Minimum Tensile Strength

ASTM A36/A36M (2014) Standard Specification for Carbon Structural Steel

ASTM A500/A500M (2013) Standard Specification for Cold-Formed Welded and Seamless Carbon Steel Structural Tubing in Rounds and Shapes

ASTM A53/A53M (2012) Standard Specification for Pipe, Steel, Black and Hot-Dipped, Zinc-Coated, Welded and Seamless

ASTM A572/A572M (2015) Standard Specification for High-Strength Low-Alloy Columbium-Vanadium Structural Steel

ASTM A603 (1998; R 2014) Standard Specification for Zinc-Coated Steel Structural Wire Rope

ASTM A653/A653M (2017) Standard Specification for Steel Sheet, Zinc-Coated (Galvanized) or

Zinc-Iron Alloy-Coated (Galvannealed) by  
the Hot-Dip Process

ASTM E488/E488M

(2015) Standard Test Methods for Strength  
of Anchors in Concrete and Masonry Elements

U.S. DEPARTMENT OF DEFENSE (DOD)

UFC 3-310-04

(2013; with Change 1) Seismic Design for  
Buildings

## 1.2 SYSTEM DESCRIPTION

### 1.2.1 General Requirements

Apply the requirements for seismic protection measures, described in this section, to the mechanical equipment and systems outlined in Section 13 48 00.00 10 SEISMIC PROTECTION FOR MECHANICAL EQUIPMENT, the electrical equipment and systems outlined in Section 26 05 48.00 10 SEISMIC PROTECTION FOR ELECTRICAL EQUIPMENT, and the miscellaneous equipment and systems listed below, in accordance with UFC 3-310-04 and additional data furnished by the Contracting Officer. Provide seismic protection measures in addition to any other requirements called for in other sections of these specifications. The design for seismic protection shall be based on Building Risk Category III and on site response coefficients as indicated in the Structural Drawings. Accomplish resistance to lateral forces induced by earthquakes without consideration of friction resulting from gravity loads. The basic force formulas, for Ground Motions A and B in UFC 3-310-04, use the design spectral response acceleration parameters for the performance objective of the building, not for equipment in the building; therefore, corresponding adjustments to the formulas are required.

### 1.2.2 Miscellaneous Equipment and Systems

The bracing for the following miscellaneous equipment and systems shall be developed by the Contractor in accordance with the requirements of this specification:

- Storage cabinets
- Ornamentations
- Storage Racks
- Signs and Billboards
- Shelving
- Furnishings
- Partitions

## 1.3 SUBMITTALS

Government approval is required for submittals with a "G" designation; submittals not having a "G" designation are for Contractor Quality Control approval. Submittals with an "S" are for inclusion in the Sustainability eNotebook, in conformance to Section 01 33 29 SUSTAINABILITY REPORTING. Submit the following in accordance with Section 01 33 00 SUBMITTAL PROCEDURES:

SD-02 Shop Drawings



Bracing; G  
Resilient Vibration Isolation Devices; G  
Equipment Requirements; G

SD-03 Product Data

Bracing; G  
Equipment Requirements; G

SD-06 Test Reports

Anchor Bolts; G

PART 2 PRODUCTS

2.1 EQUIPMENT REQUIREMENTS

Submit detail drawings along with calculations, catalog cuts, templates, and erection and installation details, as appropriate, for the items listed below. Indicate thickness, type, grade, class of metal, and dimensions; and show construction details, reinforcement, anchorage, and installation with relation to the building construction. For equipment and systems in buildings that have a performance objective higher than life-safety, the drawings shall be stamped by the registered engineer who stamps the calculations. Calculations shall be stamped, by a registered engineer, and verify the capability of structural members to which bracing is attached for carrying the load from the brace.

2.1.1 Rigidly Mounted Equipment

Rigidly mounted equipment to be furnished under this contract shall be constructed and assembled to withstand the seismic forces specified in UFC 3-310-04. For any rigid equipment which is rigidly attached on both sides of a building expansion joint, provide flexible joints for piping, electrical conduit, etc., that are capable of accommodating displacements equal to the full width of the joint in both orthogonal directions.

2.1.2 Nonrigid or Flexibly-Mounted Equipment

Flexibly mounted equipment to be furnished shall be constructed and assembled to resist a horizontal lateral force calculated as the result of the seismic coefficient (based on response accelerations indicated in the structural drawings) times the operating weight of the equipment at the vertical center of gravity of the equipment.

2.2 BOLTS AND NUTS

Squarehead and hexhead bolts, and heavy hexagon nuts, ASME B18.2.1, ASME B18.2.2, or ASTM A325 for bolts and nuts. Provide bolts and nuts galvanized in accordance with ASTM A153/A153M when used underground and/or exposed to weather.

2.3 SWAY BRACING

Material used for members listed in this section and on the drawings, shall be structural steel conforming with the following:

- a. Plates, rods, and rolled shapes, ASTM A36/A36M and ASTM A572/A572M, Grade 503. ASTM A572/A572M, grade 503 will be allowed.

- b. Wire rope, ASTM A603.
- c. Tubes, ASTM A500/A500M, Grade B.
- d. Pipes, ASTM A53/A53M, Grade B.
- e. Light gauge angles, less than 1/4 inch thickness, ASTM A653/A653M .

### PART 3 EXECUTION

#### 3.1 BRACING

Provide bracing conforming to the arrangements shown. Secure trapeze-type hanger with not less than two 1/2 inch bolts.

#### 3.2 BUILDING DRIFT

Sway braces for a piping run shall not be attached to two dissimilar structural elements of a building that may respond differentially during an earthquake unless a flexible joint is provided.

#### 3.3 ANCHOR BOLTS

Submit copies of test results to verify the adequacy of the specific anchor and application, as specified.

##### 3.3.1 Cast-In-Place

Use cast-in-place anchor bolts, conforming to ASTM A307, for floor or pad mounted equipment, except as specified below. Provide two nuts on each bolt. Anchor bolts shall have an embedded straight length equal to at least 12 times nominal diameter of the bolt. Anchor bolts that exceed the normal depth of equipment foundation piers or pads shall either extend into concrete floor or the foundation or be increased in depth to accommodate bolt lengths.

##### 3.3.2 Expansion or Chemically Bonded Anchors

Do not use expansion or chemically bonded anchors: 1)Unless test data in accordance with ASTM E488/E488M has been provided to verify the adequacy of the specific anchor and application. 2)To resist pull-out in overhead and wall installations if the adhesive is manufactured with temperature sensitive epoxies and the location is accessible to a building fire. Install expansion and chemically bonded anchors in accordance with the manufacturer's recommendations. Adjust the allowable forces for the spacing between anchor bolts and the distance between the anchor bolt and the nearest edge, as specified by the manufacturer.

##### 3.3.2.1 General Testing

Test in place expansion and chemically bonded anchors not more than 24 hours after installation of the anchor, conducted by an independent testing agency; testing shall be performed on random anchor bolts as described below.

##### 3.3.2.2 Torque Wrench Testing

Perform torque wrench testing on not less than 50 percent of the total

installed expansion anchors and at least one anchor for every piece of equipment containing more than two anchors. The test torque shall equal the minimum required installation torque as required by the bolt manufacturer. Calibrate torque wrenches at the beginning of each day the torque tests are performed. Recalibrate torque wrenches for each bolt diameter whenever tests are run on bolts of various diameters. Apply torque between 20 and 100 percent of wrench capacity. Reach the test torque within one half turn of the nut, except for 3/8 inch sleeve anchors which shall reach their torque by one quarter turn of the nut. If any anchor fails the test, test similar anchors not previously tested until 20 consecutive anchors pass. Failed anchors shall be retightened and retested to the specified torque; if the anchor still fails the test it shall be replaced.

#### 3.3.2.3 Pullout Testing

Test expansion and chemically bonded anchors by applying a pullout load using a hydraulic ram attached to the anchor bolt. At least 5 percent of the anchors, but not less than 3 per day shall be tested. Apply the load to the anchor without removing the nut; when that is not possible, the nut shall be removed and a threaded coupler shall be installed of the same tightness as the original nut. Check the test setup to verify that the anchor is not restrained from withdrawing by the baseplate, the test fixture, or any other fixtures. The support for the testing apparatus shall be at least 1.5 times the embedment length away from the bolt being tested. Load each tested anchor to 1 times the design tension value for the anchor. The anchor shall have no observable movement at the test load. If any anchor fails the test, similar anchors not previously tested shall be tested until 20 consecutive anchors pass. Failed anchors shall be retightened and retested to the specified load; if the anchor still fails the test it shall be replaced.

### 3.4 RESILIENT VIBRATION ISOLATION DEVICES

Where the need for these devices is determined, based on the magnitude of the design seismic forces, selection of anchor bolts for vibration isolation devices and/or snubbers for equipment base and foundations shall follow the same procedure as in paragraph ANCHOR BOLTS, except that an equipment weight equal to five times the actual equipment weight shall be used.

#### 3.4.1 Resilient and Spring-Type Vibration Devices

Select vibration isolation devices so that the maximum movement of equipment from the static deflection point is 1/2 inch.

#### 3.4.2 Multidirectional Seismic Snubbers

Install multidirectional seismic snubbers employing elastomeric pads on floor- or slab-mounted equipment. These snubbers shall provide 1/4 inch free vertical and horizontal movement from the static deflection point. Snubber medium shall consist of multiple pads of cotton duct and neoprene or other suitable materials arranged around a flanged steel trunnion so both horizontal and vertical forces are resisted by the snubber medium.

### 3.5 SWAY BRACES FOR PIPING

Provide transverse sway bracing for steel and copper pipe at intervals not to exceed those shown on the drawings. Transverse sway bracing for pipes

of materials other than steel and copper shall be provided at intervals not to exceed the hanger spacing as specified in Section 22 00 00 PLUMBING, GENERAL PURPOSE. Provide bracing consisting of at least one vertical angle 2 by 2 inch by 16 gauge and one diagonal angle of the same size.

### 3.5.1 Longitudinal Sway Bracing

Provide longitudinal sway bracing in accordance with Section 13 48 00.00 10 SEISMIC CONTROL FOR MECHANICAL EQUIPMENT.

### 3.5.2 Anchor Rods, Angles, and Bars

Anchor rods, angles, and bars shall be bolted to either pipe clamps or pipe flanges at one end and cast-in-place concrete or masonry insert or clip angles bolted to the steel structure on the other end. Rods shall be solid metal or pipe as specified below. Anchor rods, angles, and bars shall not exceed lengths given in the tabulation below.

### 3.5.3 Maximum Length for Anchor Braces

Type	Size (in)	Maximum Length* (ft-in)
Angles	1-1/2 x 1-1/2 x 1/4	4-10
	2 x 2 x 1/4	6-6
	2-1/2 x 1-1/2 x 1/4	8-0
	3 x 2-1/2 x 1/4	8-10
	3 x 3 x 1/4	9-10
Rods	3/4	3-1
	7/8	3-8
Flat Bars	1-1/2 x 1/4	1-2
	2 x 1/4	1-2
	2 x 3/8	1-9
Pipes (40s)	1	7-0
	1-1/4	9-0
	1-1/2	10-4
	2	13-1

### 3.5.4 Bolts

Bolts used for attachment of anchors to pipe and structure shall be not less than 1/2 inch diameter.

### 3.6 EQUIPMENT SWAY BRACING

#### 3.6.1 Suspended Equipment and Light Fixtures

Provide equipment sway bracing for items supported from overhead floor or roof structural systems, including light fixtures. Braces shall consist of angles, rods, wire rope, bars, or pipes arranged as shown and secured at both ends with not less than 1/2 inch bolts. Provide sufficient braces for equipment to resist a horizontal force as specified in UFC 3-310-04 without exceeding safe working stress of bracing components. Provide, for approval, specific force calculations in accordance with UFC 3-310-04 for the equipment in the project. Submit details of equipment bracing for acceptance. In lieu of bracing with vertical supports, these items may be supported with hangers inclined at 45 degrees directed up and radially away from equipment and oriented symmetrically in 90-degree intervals on the horizontal plane, bisecting the angles of each corner of the equipment, provided that supporting members are properly sized to support operating weight of equipment when hangers are inclined at a 45-degree angle.

#### 3.6.2 Floor or Pad Mounted Equipment

##### 3.6.2.1 Shear Resistance

Bolt to the floor, floor mounted equipment. Requirements for the number and installation of bolts to resist shear forces shall be in accordance with paragraph ANCHOR BOLTS.

##### 3.6.2.2 Overturning Resistance

Use the ratio of the overturning moment from seismic forces to the resisting moment due to gravity loads to determine if overturning forces need to be considered in the sizing of anchor bolts. Provide calculations to verify the adequacy of the anchor bolts for combined shear and overturning.

### 3.7 SPECIAL INSPECTION AND TESTING FOR SEISMIC-RESISTING SYSTEMS

Perform special inspections and testing for seismic-resisting systems and components in accordance with Section 01 45 35 SPECIAL INSPECTIONS.

-- End of Section --



SECTION 13 48 00.00 10

SEISMIC PROTECTION FOR MECHANICAL EQUIPMENT  
10/07

PART 1 GENERAL

1.1 REFERENCES

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

AMERICAN INSTITUTE OF STEEL CONSTRUCTION (AISC)

AISC 325 (2017) Steel Construction Manual

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

SMACNA 1981 (2008) Seismic Restraint Manual Guidelines  
for Mechanical Systems, 3rd Edition

U.S. DEPARTMENT OF DEFENSE (DOD)

UFC 3-301-01 (2013; with Change 3) Structural  
Engineering

UFC 3-310-04 (2013; with Change 1) Seismic Design for  
Buildings

1.2 SYSTEM DESCRIPTION

1.2.1 General Requirements

Apply the requirements for seismic protection measures described in this section to the mechanical equipment and systems listed below. Structural requirements shall be in accordance with Section 13 48 00 SEISMIC PROTECTION FOR MISCELLANEOUS EQUIPMENT.

1.2.2 Mechanical Equipment

Mechanical equipment to be seismically protected shall include the following items to the extent required on the drawings or in other sections of these specifications:

Water Heaters	Water Piping
Expansion Air Separator Tanks	Valves and Fittings for Piping
Heat Exchangers	Cooling Towers
Air and Refrigerant Compressors	Refrigerant Piping

Air Handling Units	Pumps with Motors
Ducts	Exhaust and Return Fans
Makeup Air Units	Solar Heating Units
Dedicated Outside Air Units	

### 1.2.3 Mechanical Systems

Install the following mechanical systems as required on the drawings and other sections of these specifications and seismically protect them in accordance with this specification:

- a. All Piping Inside the Building Except as Specifically Stated Below Under "Items Not Covered By This Section".
- c. All Water Supply Systems.
- d. Storm and Sanitary Sewer Systems.
- e. All Process Piping.
- f. Condenser Water Piping Outside the Building.
- g. Water Storage Tanks.
- h. All Cooling and Ventilating Systems

### 1.2.4 Contractor Designed Bracing

Submit copies of the design calculations with the drawings. Calculations shall be approved, certified, stamped and signed by a registered Professional Engineer. Calculations shall verify the capability of structural members to which bracing is attached for carrying the load from the brace. Design the bracing in accordance with UFC 3-310-04 and additional data furnished by the Contracting Officer. Resistance to lateral forces induced by earthquakes shall be accomplished without consideration of friction resulting from gravity loads. UFC 3-310-04 uses parameters for the building, not for the equipment in the building; therefore, corresponding adjustments to the formulas shall be required. Loadings determined using UFC 3-310-04 are based on strength design; therefore, AISC 325 Specifications shall be used for the design.

### 1.2.5 Items Not Covered By This Section

#### 1.2.5.1 Fire Protection Systems

Seismic protection of piping for fire protection systems shall be installed as specified in Section 21 13 13.00 20 WET PIPE SPRINKLER SYSTEM, FIRE PROTECTION.

#### 1.2.5.2 Items Requiring No Seismic Restraints

Seismic restraints are not required for the following items:

- a. Gas piping less than 1 inch inside diameter.



- b. Piping in boiler and mechanical equipment rooms less than 1-1/4 inches inside diameter.
- c. All other piping less than 2-1/2 inches inside diameter.
- d. Rectangular air handling ducts less than 6 square feet in cross sectional area.
- e. Round air handling ducts less than 28 inches in diameter.
- f. Piping suspended by individual hangers 12 inches or less in length from the top of pipe to the bottom of the supporting structural member where the hanger is attached, except as noted below.
- g. Ducts suspended by hangers 12 inches or less in length from the top of the duct to the bottom of the supporting structural member, except as noted below.

In exemptions f. and g. all hangers shall meet the length requirements. If the length requirement is exceeded by one hanger in the run, the entire run shall be braced. Interior piping and ducts not listed above shall be seismically protected in accordance with the provisions of this specification.

### 1.3 SUBMITTALS

Government approval is required for submittals with a "G" designation; submittals not having a "G" designation are for information only. When used, a designation following the "G" designation identifies the office that will review the submittal for the Government. Submittals with an "S" are for inclusion in the Sustainability eNotebook, in conformance to Section 01 33 29 SUSTAINABILITY REPORTING. Submit the following in accordance with Section 01 33 00 SUBMITTAL PROCEDURES:

#### SD-02 Shop Drawings

- Coupling and Bracing
- Flexible Couplings or Joints
- Equipment Requirements
- Contractor Designed Bracing; G

#### SD-03 Product Data

- Coupling and Bracing; G
- Equipment Requirements; G
- Contractor Designed Bracing; G

#### SD-07 Certificates

- Flexible Ball Joints.

## PART 2 PRODUCTS

### 2.1 EQUIPMENT REQUIREMENTS

Submit copies of the design calculations with the detail drawings. Calculations shall be stamped by a registered engineer and shall verify the capability of structural members to which bracing is attached for

carrying the load from the brace.

#### 2.1.1 Rigidly Mounted Equipment

The following specific items of equipment to be furnished under this contract shall be constructed and assembled to withstand the seismic forces specified in UFC 3-310-04. Each item of rigid equipment shall be entirely located and rigidly attached on one side only of a building expansion joint. Piping, duct, electrical conduit, etc., which cross the expansion joint shall be provided with flexible joints that are capable of accommodating displacements equal to the full width of the joint in both orthogonal directions.

- Air-Handling Units
- Cooling Towers
- Makeup Air Unit
- Dedicated Outside Air Unit

#### 2.1.2 Nonrigid or Flexibly-Mounted Equipment

All other equipment weighing 30 pounds or more shall be constructed and assembled to resist a horizontal lateral force of calculated as the result of the seismic coefficient (based on response accelerations indicated in the structural drawings) times the operating weight of the equipment at the vertical center of gravity of the equipment.

#### 2.2 FLEXIBLE COUPLINGS

Flexible couplings shall have same pressure and temperature ratings as adjoining pipe.

#### 2.3 FLEXIBLE BALL JOINTS

Flexible ball joints shall have cast or wrought steel casing and ball parts capable of 360-degree rotation with not less than 15-degree angular movement. Flexible ball joints shall be certified to be suitable for the service intended by the manufacturer. Information verifying experience at not less than 3 locations of 2 years' satisfactory operation in a similar application shall be submitted.

#### 2.4 FLEXIBLE MECHANICAL JOINTS

- a. Mechanical couplings for steel or cast iron pipe shall be of the sleeve type and shall provide a tight flexible joint under all reasonable conditions, such as pipe movement caused by expansion, contraction, slight settling or shifting of the ground, minor variations in trench gradients, and traffic vibrations. Where permitted in other sections of these specifications, joints utilizing split-half couplings with grooved or shouldered pipe ends may be used.
- b. Sleeve-type couplings shall be used for joining plain-end pipe sections. The coupling shall consist of one steel middle ring, two steel followers, two gaskets, and necessary steel bolts and nuts to compress the gaskets.

#### 2.5 MANUFACTURED BALL JOINTS

Manufactured ball joints shall be as recommended by the manufacturer for the intended use, and shall be approved by the Contracting Officer before

installation.

## 2.6 SWAY BRACING MATERIALS

Sway bracing materials (e.g. rods, plates, rope, angles, etc.) shall be as specified in Section 13 48 00 SEISMIC PROTECTION FOR MISCELLANEOUS EQUIPMENT.

## PART 3 EXECUTION

### 3.1 COUPLING AND BRACING

- a. Submit detail drawings, as specified here and throughout this specification, along with catalog cuts, templates, and erection and installation details, as appropriate, for the items listed. Submittals shall be complete in detail; shall indicate thickness, type, grade, class of metal, and dimensions; and shall show construction details, reinforcement, anchorage, and installation with relation to the building construction.
- b. Coupling installation shall conform to the details shown on the drawings. Provisions of this paragraph apply to all piping within a 5 foot line around outside of building unless buried in the ground. Piping grouped for support on trapeze-type hangers shall be braced at the most frequent interval as determined by applying the requirements of this specification to each piping run on the common support.
- c. Bracing components shall be sized as required for the total load carried by the common supports. Bracing rigidly attached to pipe flanges, or similar, shall not be used where it would interfere with thermal expansion of piping.

### 3.2 BUILDING DRIFT

Joints capable of accommodating seismic displacements shall be provided for vertical piping between floors of the building, where pipes pass through a building seismic or expansion joint, or where rigidly supported pipes connect to equipment with vibration isolators. Horizontal piping across expansion joints shall accommodate the resultant of the drifts of each building unit in each orthogonal direction. For threaded piping, swing joints made of the same piping material shall be provided. For piping with manufactured ball joints the seismic drift shall be as indicated by UFC 3-301-01 and UFC 3-310-04 above the base where the seismic separation occurs; this drift value shall be used in place of the expansion given in the manufacturer's selection table.

### 3.3 FLEXIBLE COUPLINGS OR JOINTS

#### 3.3.1 Building Piping

Flexible couplings or joints in building piping shall be provided at bottom of all pipe risers for pipe larger than 3-1/2 inches in diameter. Flexible couplings or joints shall be braced laterally without interfering with the action of the flexible coupling or joint. Cast iron waste and vent piping need only comply with these provisions when caulked joints are used. Flexible bell and spigot pipe joints using rubber gaskets may be used at each branch adjacent to tees and elbows for underground waste piping inside of building to satisfy these requirements.

### 3.4 PIPE SLEEVES

Pipe sleeves in interior non-fire rated walls shall be sized as indicated on the drawings to provide clearances that will permit differential movement of piping without the piping striking the pipe sleeve. Pipe sleeves in fire rated walls shall conform to the requirements in Section 07 84 00 FIRESTOPPING.

### 3.5 SPREADERS

Spreaders shall be provided between adjacent piping runs to prevent contact during seismic activity whenever pipe or insulated pipe surfaces are less than 4 inches apart. Spreaders shall be applied at same interval as sway braces at an equal distance between the sway braces. If rack type hangers are used where the pipes are restrained from contact by mounting to the rack, spreaders are not required for pipes mounted in the rack. Spreaders shall be applied to surface of bare pipe and over insulation on insulated pipes utilizing high-density inserts and pipe protection shields in accordance with the requirements of Section 23 07 00 THERMAL INSULATION FOR MECHANICAL SYSTEMS.

### 3.6 SWAY BRACES FOR PIPING

Sway braces shall be provided to prevent movement of the pipes under seismic loading. Braces shall be provided in both the longitudinal and transverse directions, relative to the axis of the pipe. The bracing shall not interfere with thermal expansion requirements for the pipes as described in other sections of these specifications.

#### 3.6.1 Transverse Sway Bracing

Transverse sway bracing for steel and copper pipe shall be provided as specified in Section 13 48 00 SEISMIC PROTECTION FOR MISCELLANEOUS EQUIPMENT. All runs (length of pipe between end joints) shall have a minimum of two transverse braces. Transverse sway bracing for pipes of materials other than steel and copper shall be provided at intervals not to exceed the hanger spacing as specified in Section 22 00 00 PLUMBING, GENERAL PURPOSE.

#### 3.6.2 Longitudinal Sway Bracing

Longitudinal sway bracing shall be provided at 40 foot intervals unless otherwise indicated. All runs (length of pipe between end joints) shall have one longitudinal brace minimum. Sway braces shall be constructed in accordance with the drawings. Branch lines, walls, or floors shall not be used as sway braces.

#### 3.6.3 Vertical Runs

Run is defined as length of pipe between end joints. Vertical runs of piping shall be braced at not more than 10 foot vertical intervals. Braces for vertical runs shall be above the center of gravity of the segment being braced. All sway braces shall be constructed in accordance with the drawings. Sway braces shall attach to the structural system and shall not be connected to branch lines, walls, or floors.

#### 3.6.4 Clamps and Hangers

Clamps or hangers on uninsulated pipes shall be applied directly to pipe.

Insulated piping shall have clamps or hangers applied over insulation in accordance with Section 23 07 00 THERMAL INSULATION FOR MECHANICAL SYSTEMS.

### 3.7 SWAY BRACES FOR DUCTS

#### 3.7.1 Braced Ducts

Bracing details and spacing for rectangular and round ducts shall be in accordance with SMACNA 1981, including Appendix E and UFC 3-310-04 procedures. However, the design seismic loadings for these items shall not be less than loadings obtained using the procedures in UFC 3-310-04.

#### 3.7.2 Unbraced Ducts

Hangers for unbraced ducts shall be attached to the duct within 2 inches of the top of the duct in accordance with SMACNA 1981. Unbraced ducts shall be installed with a 6 inch minimum clearance to vertical ceiling hanger wires.

-- End of Section --



SECTION 14 24 23

HYDRAULIC PASSENGER ELEVATORS

05/16

PART 1 GENERAL

1.1 REFERENCES

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

AMERICAN WELDING SOCIETY (AWS)

AWS D1.1/D1.1M (2015; Errata 1 2015; Errata 2 2016)  
Structural Welding Code - Steel

ASME INTERNATIONAL (ASME)

ASME A17.1/CSA B44 (2016) Safety Code for Elevators and Escalators

ASME A17.2 (2015) Guide for Inspection of Elevators, Escalators, and Moving Walks Includes Inspection Procedures for Electric Traction and Winding Drum Elevators, Hydraulic Elevators, and Escalators and Moving Walks

ASME B16.11 (2016) Forged Fittings, Socket-Welding and Threaded

ASME B16.9 (2012) Standard for Factory-Made Wrought Steel Buttwelding Fittings

ASTM INTERNATIONAL (ASTM)

ASTM A106/A106M (2014) Standard Specification for Seamless Carbon Steel Pipe for High-Temperature Service

ASTM A53/A53M (2012) Standard Specification for Pipe, Steel, Black and Hot-Dipped, Zinc-Coated, Welded and Seamless

INSTITUTE OF ELECTRICAL AND ELECTRONICS ENGINEERS (IEEE)

IEEE C62.41 (1991; R 1995) Recommended Practice on Surge Voltages in Low-Voltage AC Power Circuits

INTERNATIONAL CODE COUNCIL (ICC)

ICC IBC (2017) International Building Code

NATIONAL ELEVATOR INDUSTRY, INC. (NEII)

NEII-1 (2000; R thru 2010) Building  
Transportation Standards and Guidelines,  
including the Performance Standards Matrix  
for New Elevator Installation

NATIONAL FIRE PROTECTION ASSOCIATION (NFPA)

NFPA 101 (2018; TIA 18-1) Life Safety Code

NFPA 70 (2017; ERTA 1-2 2017; TIA 17-1; TIA 17-2;  
TIA 17-3; TIA 17-4; TIA 17-5; TIA 17-6;  
TIA 17-7; TIA 17-8; TIA 17-9; TIA 17-10;  
TIA 17-11; TIA 17-12; TIA 17-13; TIA  
17-14) National Electrical Code

NFPA 70E (2018; TIA 18-1; TIA 81-2) Standard for  
Electrical Safety in the Workplace

NFPA 72 (2016) National Fire Alarm and Signaling  
Code

U.S. DEPARTMENT OF DEFENSE (DOD)

UFC 3-560-01 (2006, with Change 5) Electrical Safety,  
O&M

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

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

1.2 SUBMITTALS

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SD-02 Shop Drawings

Elevator System; G

Elevator Components; G

Machine and Elevator Controller; G

Wiring Diagrams; G

SD-03 Product Data

Elevator and Accessories; G



Elevator Components; G

Data Sheets; G

Elevator Microprocessor Controller; G

SD-05 Design Data

Emergency Power Systems; G

Heat Loads; G

Reaction Loads; G

SD-07 Certificates

Elevator Parts and Components Price Lists; G

Warranty

Endorsement Letter

Welders' Qualifications; G

Elevator Controller Certification; G

SD-10 Operation and Maintenance Data

Elevator, Data Package 4; G

Maintenance Control Program (MCP); G

Software and Documentation; G

Submit in accordance with Section 01 78 23 OPERATION AND  
MAINTENANCE DATA and 01 78 24.05 20 FACILITY OPERATION AND  
MAINTENANCE SUPPORT INFORMATION.

1.2.1 Shop Drawing Requirements

Provide assembly and arrangement of elevators, accessories, and elevator components. Show location of machine and elevator controller in elevator machine room. Provide details for materials and equipment, including but not limited to operating and signal fixtures, doors, door and car frames, car enclosure, controllers, motors, guide rails and brackets, layout of hoistway in plan and elevation, and other layout information and clearance dimensions.

1.2.2 Product Data Requirements

Provide manufacturers' product data for all elevator components, including but not limited to the following: elevator controller, hydraulic pump unit, hydraulic pump and motor, hydraulic cylinder, hydraulic piping and fittings, car and hall fixture buttons and switches, cab and machine room communication devices, door operator, door protection system, car roller guides, and buffers. For data sheets, provide document identification number or bulletin number, published or copyrighted prior to the date of contract bid opening. Provide controller manufacturer's published procedures for performance of each and all testing required by

ASME A17.1/CSA B44.

### 1.2.3 Design Data

#### 1.2.3.1 Reaction Loads

Provide calculations by registered professional engineer for reaction loads imposed on building by elevator system. Demonstrate calculations complying with ASME A17.1/CSA B44

#### 1.2.3.2 Heat Loads

Provide calculations from elevator manufacturer, or by registered professional engineer, for total anticipated heat loads generated by all of the elevator machine room equipment.

#### 1.2.3.3 Emergency Power Systems

Where the facility does have an emergency power system, confirm the elevators that will be connected to the emergency power system. Confirm the complete emergency power system and sequence of operation for all elevators, including operation of the elevator lobby manual selection switch. Provide wiring diagrams for building emergency power interface with elevator controls. For elevators not supplied by an emergency power system, provide manufacturers' product data for auxiliary power systems.

#### 1.2.4 Welders' Requirements

Comply with AWS D1.1/D1.1M, Section 5. Include certified copies of field welders' qualifications. List welders' names with corresponding code marks to identify each welder's welding work

#### 1.2.5 Maintenance Control Program (MCP)

For each elevator, prepare and provide a written Maintenance Control Program (MCP) that complies with ASME A17.1/CSA B44 Section 8.6, including written documentation that details the test procedures for each and every test that is required to be performed by ASME A17.1/CSA B44. Assemble all MCP documentation, and supporting technical attachments, in a single MCP package and provide in both electronic and hard copy. Assemble entire hard copy MCP in 3-ring binders. For each elevator provided, the MCP must include only documentation and instruction that apply to the elevator specified.

For each elevator, provide an additional, separate binder that includes all maintenance, repair, replacement, call back, and other records required by ASME A17.1/CSA B44. The records binder must be kept in the elevator mechanical room, maintained by elevator maintenance and service personnel, and be available at all times to authorized personnel.

Provide detailed information regarding emergency service procedures and elevator installation company personnel contact information. Provide a listing of all tools to be provided to the Contracting Officer as components of the elevator system.

### 1.3 QUALITY ASSURANCE

#### 1.3.1 Qualification

Provide a designed and engineered elevator system by an elevator contractor regularly engaged in the installation of elevator systems. Provide elevator components manufactured by companies regularly engaged in the manufacture of elevator components. Utilize only licensed and certified elevator personnel for the installation, adjusting, testing, and servicing of the elevators.

##### 1.3.1.1 Elevator Contractor's Elevator Technicians

For elevator installations in the United States, including United States territories, perform all elevator related work under the direct guidance of a state certified elevator technician with a minimum of three years of experience in the installation of elevator systems of the type and complexity specified in the contract documents. Provide an endorsement letter from the elevator manufacturer, certifying that the elevator specialist is qualified. All elevator technicians must carry a current certification issued by one of the following organizations:

- a. National Association of Elevator Contractors (NAEC)
- b. National Elevator Industry Education Program (NEIEP)

#### 1.3.2 Manufacturers' Technical Support

Provide elevator components from manufacturers that provide factory training and online and live telephone elevator technical support to any elevator installation, service, and maintenance contractor. Provide elevator components from manufacturers that guarantee accessibility to all replacement and repair parts and components to any elevator installation, service, and maintenance contractor. Use only elevator component manufacturers that provide current published price lists for all elevator parts and components.

#### 1.3.3 Operation and Maintenance Data

Assemble all shop drawing and product data material into O&M Data Packages in accordance with Article SUBMITTALS. Provide two complete O&M Data Packages in hard copy and two complete electronic O&M data packages on separate CDs, in PDF format. Provide all O&M Data Packages to Contracting Officer. Include controller diagnostic documentation and software as required under Article CONTROL EQUIPMENT.

#### 1.3.4 Wiring Diagrams

Provide complete wiring diagrams and sequence of operations, which show electrical connections and functions of elevator systems. Provide one set (11 inch by 17 inch minimum size) of wiring diagrams, with individual sheets laminated in plastic and assembled in binder, to be stored in the machine room cabinet. Provide one additional hard copy set and two complete electronic sets on separate CDs, in PDF format. Provide all wiring diagram sets to the Contracting Officer. Coded diagrams are not acceptable unless fully identified.

#### 1.3.5 Machine Room Cabinet

For storage of O&M Data Packages and Wiring Diagrams, provide locking metal cabinet with a minimum size of 20 inch W by 12 inch D by 30 inch H. Cabinet must be sized large enough to accommodate all O&M Data and hardware required in paragraphs OPERATION AND MAINTENANCE DATA and WIRING DIAGRAMS. Secure cabinet to machine room wall.

#### 1.4 NEW INSTALLATION SERVICE

Provide elevator warranty service in accordance with the manufacturer's maintenance plan, warranty requirements and applicable safety codes, for a period of 12 months after the date of acceptance by Contracting Officer. Perform this work during regular working hours. Provide supplies and parts to keep elevator system in operation. Perform service only by factory trained personnel. Provide Monthly services to include repairs, adjustments, greasing, oiling, and cleaning. Provide service log in elevator machine room and update Monthly, throughout the one-year warranty period.

Provide 24-hour emergency service, with one hour on-site response time, during this period without additional cost to the Government.

##### 1.4.1 Periodic Elevator Certification Inspection and Testing

Provide elevator mechanic to support NAVFAC QEI Certified Elevator Inspector in the periodic six-month and the annual Category 1 elevator certification inspection and testing. Perform Category 1 inspection and testing no greater than 30 days prior to the end of the warranty period. Perform all elevator certification testing in the presence of QEI Certified Elevator Inspector.

In conjunction with the testing noted above, test systems for Emergency Power Operation, Earthquake Emergency Operation, and Hospital Emergency Commandeering Service Operation, as applicable. Schedule so that testing does not interfere with building operations.

#### 1.5 FIRE PROTECTION SYSTEM

Coordinate interface between building fire protection system and elevator controls.

Additional fire protection requirements are located in: Section 21 13 13.00 20 WET PIPE SPRINKLER SYSTEM, FIRE PROTECTION; and Section 26 20 00 INTERIOR DISTRIBUTION SYSTEM.

##### 1.5.1 Fire Sprinklers

Provide fire sprinklers in accordance with all applicable safety codes and with Section 21 13 13.00 20 WET PIPE SPRINKLER SYSTEM, FIRE PROTECTION. Provide shutoff valve, check valve, and non-adjustable, zero time-delay flow switch, in each sprinkler line immediately outside of each machine room and hoistway, if applicable. Provide inspectors' test valve for periodic testing of flow switch and shunt trip disconnect.

Pipe sprinkler piping serving these spaces in a series manner with no laterals. Locate inspectors' test connection at the end of pipe runs such that operation of the test connection will purge air from system piping.

### 1.5.2 Shunt Trip Disconnect

Provide flow switches specified in paragraph FIRE SPRINKLERS to comply with ASME A17.1/CSA B44 and NFPA 72 for shunt trip of the main line power supply. For each elevator, provide control wiring connecting the flow switch to a shunt trip equipped circuit breaker located in the elevator machine room. Upon flow of water, flow switch will instantaneously cause opening of the shunt-trip circuit breaker and remove power from the elevator. Flow switch must also send a signal to fire alarm control panel to indicate water flow condition.

## PART 2 PRODUCTS

### 2.1 ELEVATOR DESCRIPTION

Provide elevator system that complies with ASME A17.1/CSA B44 in its entirety, ASME A17.2 in its entirety, and additional requirements specified herein. Provide elevator system that meets or exceeds the NEII-1 Ride Quality Performance Standards Matrix (RQPSM). Comply with the RQPSM "Intermediate Performance" criteria.

Provide and install elevators in accordance with 36 CFR 1191 - ABAAS, ICC IBC, IEEE C62.41, NFPA 70 and NFPA 101 requirements.

#### 2.1.1 Elevator Design Parameters

##### 2.1.1.1 Elevator No.1 - Emergency Medical Service Accessibility (EMSA)

Provide elevator(s) with minimum size and arrangement to accommodate an ambulance stretcher 24-inch by 84-inch with not less than 5-inch radius corners, in the open, horizontal position.

- a. Type: Holeless
- b. Rated load: 3500 lb.
- c. Rated Speed: 150 fpm
- d. Car Door Type: Single-speed side slide; front and rear opening.
- e. Car Door Opening Width: 3 ft.-6 in minimum.

#### 2.1.2 Cab Enclosure and Hoistway Entrance Assemblies

Provide finishes as listed below:

- a. Floor; ceramic tile.
- b. Walls; stainless steel. Provide each cab wall with equally spaced and equally sized wall panels. All wall panel fasteners must be concealed.
  - (1) Wall trim; stainless steel.
  - (2) Accessories; Provide hand rails on full length of back wall and side walls of elevator cab.
- c. Car doors, car door returns, and wall reveals; stainless steel.
- d. Ceilings; prefinished stainless steel panels.

(1) Ceiling frame; stainless steel.

e. Hoistway Entrance Assembly Material and Finishes; stainless steel.

## 2.2 ELEVATOR OPERATION

ASME A17.1/CSA B44, Introduction, Section 3, Definitions.

### 2.2.1 Single, Two-Stop, Automatic Operation

Provide Single Two-Stop Automatic Operation.

## 2.3 SPECIAL OPERATION AND CONTROL

Provide the following special operations and control systems.

### 2.3.1 Keys for Elevator Key Switches

Provide a minimum of twelve keys per unique cylinder used on all key switches for a single elevator. If there is more than one elevator, additional keys will not be required unless there are additional unique lock cylinders. Provide keys with brass or fiberglass tags marked "PROPERTY OF THE U.S. GOVERNMENT" on one side with function of key or approved code number on the other side.

### 2.3.2 Firefighters' Emergency Operation (FEO)

Provide FEO equipment and signaling devices. The designated level for the FEO Phase I key operated switch is the ground floor. In the FEO Phase I fixture, provide FEO Operating Instructions.

#### 2.3.2.1 Firefighters' Emergency Operation (FEO) Key Box

Provide flush mounted, locking, FEO Key Box of a minimum size of 5 inch W by 9 inch H by 1.5 inch D. Install at a height of 6 feet above floor level and directly above the FEO Phase I key switch. Provide box equipped with lock that uses the FEO K1 key.

### 2.3.3 Hoistway Access Operation

Provide hoistway access operation with switches at top and bottom terminal landings. Locate switch 6 feet above floor level, within 12 inches of elevator hoistway entrance frame or with the ferrule exposed when located in the elevator entrance frame.

### 2.3.4 In-Car Inspection Operation

Provide In-Car Inspection Operation.

### 2.3.5 Independent Service

Provide exposed key-operated switch in car operating panel to enable independent service and simultaneously disable in-car signals and landing-call responses. Provide indicator lights that automatically illuminate during independent service. For duplex or group operation, if one car is removed from group another car will respond to its hall calls.

#### 2.3.6 Selective Door Operation

For elevator with one or more rear openings at same level as front opening, provide full-selective operation with car and door operating buttons clearly marked for front and rear openings, front and rear car button for each such floor, and front and rear "DOOR OPEN" and "DOOR CLOSE" buttons. Only door for which the button was operated opens or closes.

#### 2.3.7 Elevator Emergency Power Operation

Provide elevator emergency power operation. Coordinate power supply and control wiring to accomplish initiation and operation of elevators on emergency power.

#### 2.3.8 Elevator Auxiliary Power Operating System

Provide elevator auxiliary power operating system.

### 2.4 ELEVATOR DRIVE SYSTEM

Provide elevator system that is designed for the elevator controller and pump unit to be installed in an elevator machine room. Provide hydraulic elevator drive system, including pump unit, piping, cylinder/plunger assembly, and associated equipment, which will operate at a maximum working pressure of 500 psi or less. Provide complete elevator system that meets or exceeds the NEII-1 Ride Quality Standard, including elevator ride quality and noise levels in car and in elevator machine room.

#### 2.4.1 Hydraulic Pump Unit

Provide self-contained pump unit, including oil-hydraulic elevator pump, electric motor, suction-line oil strainer, and structural steel outer base with tank supports and isolation pads. Provide oil tank capacity for full plunger displacement plus at least 10 gallons. Provide means to maintain oil temperature between 100 and 130 degrees F regardless of ambient temperature. Limit acoustic output in elevator machine room to 80 dbA.

##### 2.4.1.1 Pump Motor

Provide intermittent-duty pump motor rated at 120 starts/hour. Provide motor that is sized so that the motor amperage does not exceed the motor data tag amperage in any operating condition, exclusive of acceleration and deceleration. Provide minimum of one megohm insulation resistance between conductors and motor frame. Provide motor and pump nameplate and data tags permanently mounted on the outside of the pump unit frame, with all data viewable without the use of mirrors or other tools.

#### 2.4.2 Hydraulic Controls and Equipment

Provide control valve, overspeed safety valve, blowout-proof muffler, and hydraulic pump discharge strainer in the hydraulic oil supply line. Provide 1/4 turn, ball valve type manual shutoff valves in the elevator machine room and in the hoistway pit.

##### 2.4.2.1 Hydraulic Control Valve

Provide constant-velocity, down-speed regulated, control valve. Down-speed regulated control valve allows the car to travel at the same

speed in the down direction, regardless of the load on the elevator. In addition, the hydraulic control valve must have built-in adjustment capability to operate the elevator at 140 percent of rated speed to facilitate periodic testing of the overspeed safety valve.

#### 2.4.2.2 Hydraulic Overspeed Safety Valve

Provide overspeed safety valve in hydraulic oil supply line, directly adjacent to the hydraulic cylinder. Provide threaded pipe connections between the hydraulic cylinder and the overspeed valve. Provide valve equipped with manufacturer's manual shutoff feature. Overspeed valve must not be equipped with a manual or automatic lowering feature. Provide adjustable valve with means to seal adjustment after inspection and testing by certified elevator inspector.

#### 2.4.3 Hydraulic Piping and Accessories

Provide ASTM A53/A53M or ASTM A106/A106M, Schedule 80, black steel piping with ASME B16.9 or ASME B16.11 fittings for supply piping. Extend schedule 80 piping from the pump control valve body, inside the pump unit, to the hydraulic cylinder in the hoistway. Provide welded or threaded forged pipe fittings for all fittings and components of the hydraulic oil supply line. Provide hangers or supports for all piping and components.

#### 2.4.3.1 Containment of Hydraulic Oil Supply Line

Protect all portions of hydraulic oil supply line that are installed below ground, including portions encapsulated in concrete or covered by construction, with continuous, Schedule 80, PVC. Inside diameter of PVC must be 3 inches larger than the outside diameter of the hydraulic oil supply line pipe and couplings.

#### 2.4.4 Hydraulic Elevator Type

Provide a holeless direct plunger type hydraulic elevator. Elevator with telescopic or inverted cylinder-plungers are not acceptable and may not be used. Rope hydraulic elevator design is not acceptable and may not be used.

#### 2.4.4.1 Cylinder-Plunger (Jack) Unit

Provide a single-stage plunger of seamless steel construction. Provide cylinder with self-stabilizing mount that will support and hold cylinder plumb without the need for stabilization means at the bottom of the cylinder. Provide a threaded, 1/4 inch bleeder valve at the top of the cylinder, just below packing gland.

### 2.5 CONTROL EQUIPMENT

Enclose all elevator control equipment in factory-primed and baked-enamel coated sheet-metal cabinets with ventilation louvers and removable or hinged doors. Mount cabinets at a height of 10 inches above machine room finish floor.

#### 2.5.1 Motor Control Equipment

Provide elevator motor control with electronic, soft-start motor starter.



## 2.5.2 Elevator Microprocessor Controller

For each individual elevator controller, and for each group controller, provide a microprocessor controller that complies with the following paragraphs. Provide controller(s) package that includes all hardware and software required for the installation, maintenance, and service of the elevator, in its' entirety. Provide verification of technical support service that the controller manufacturer provides to any licensed elevator installation, service, and maintenance company.

Provide an elevator controller from a manufacturer that provides comprehensive factory training to include controller installation, adjustment, service, and maintenance. The training must be identified as available to any licensed elevator contractor. Provide verification of an established and documented training schedule, with pricing, for factory training classes that manufacturer has provided for a minimum period of one year prior to contract award date.

The elevator controller must be identified as available for purchase and installation by any licensed elevator contractor. All components, parts, diagnostic tools, and software must be available for purchase and installation and use by any licensed elevator contractor; "exchange-only" provisions for the purchase of spare parts are not acceptable. The elevator controller manufacturer must publish an industry competitive price listing for all controller parts, diagnostic tools, and software.

Provide verification of telephone and internet based technical support service that the elevator controller manufacturer provides to any licensed elevator installation, service, and maintenance company at an industry competitive price. The service must include live telephone based technical support for installation, adjustment, maintenance, and troubleshooting of the elevator controller and related elevator components. The service must be available during standard working hours.

Provide an elevator controller that is designed to automatically reestablish normal elevator operation following any temporary loss of power, regardless of duration.

### 2.5.2.1 Elevator Controller Interface Cabinet

For each individual elevator microprocessor controller, provide a separate elevator control cabinet with an integrated human interface system. For group elevator installations, a single cabinet and interface system with full access to each elevator controller may be utilized. The separate controller interface cabinet must be supplied by the elevator controller manufacturer and include a minimum 12 inch wide keyboard and a minimum 10 inch monitor. The elevator controller interface cabinet must comply with arc-flash protection requirements of NFPA 70E and UFC 3-560-01.

#### 2.5.2.1.1 Elevator Microprocessor Human Interface

The interface system must provide complete elevator controller interface capability and must include the elevator controller manufacturer's comprehensive package of installation and diagnostic software. The microprocessor interface system must provide unrestricted access to all parameters, all levels of adjustment, and all flags necessary for installation, adjustment, maintenance, and troubleshooting of each elevator and for the elevator group. All software programming must be stored in non-volatile memory. The elevator controller fault log must

provide non-volatile memory fault log storage of all faults, trouble calls, and fault history for a minimum of one year and the ability to download or print the fault log. The controller interface must also provide the capability to display and diagnose trouble calls, faults, and shutdowns. Expiring software, degrading operation, and "key" access controls are not acceptable.

#### 2.5.2.2 Software and Documentation

Provide three copies of the manufacturer's maintenance and service diagnostic software, with complete software documentation, that will enable the same level of unrestricted access to all controllers of the same make and model, regardless of the installation date or location. Provide signed certification, from the manufacturer's corporate headquarters, that guarantees that the microprocessor software and access system will not terminate the unlimited and unrestricted access at any future date.

#### 2.5.2.3 Elevator Controller Certification

For elevator installations in the United States, including United States territories, provide an elevator microprocessor controller that has a current certificate of safety code compliance issued by the Technical Standards and Safety Authority (TSSA), Toronto, Canada.

### 2.6 OPERATING PANELS, SIGNAL FIXTURES, AND COMMUNICATIONS CABINETS

For all panels and fixtures, provide identical and uniform panel and fixture design, material, finish, and components for all elevators. For all panels and fixtures, legibly and indelibly identify all buttons, devices, and all operating positions for each device. Use engraving and backfilling, or photo etching, for button and device designations. Do not use attached signs. Provide elevator manufacturers' standard grade for all key switches unless otherwise specified. All illuminating panels and fixture components must utilize LED lighting for energy efficiency.

#### 2.6.1 Car and Hall Buttons

For all cab and landing fixture buttons, provide industry-standard, vandal resistant push buttons with positive-stop assembly design. Buttons must be minimum 3/4 inch diameter, satin-finish stainless steel, with illuminating LED halo.

#### 2.6.2 Passenger Car-Operating Panel

Provide each car with one car operating panel that contains operation controls and communication devices. Provide exposed, flush mounted buttons for the controls identified in subparagraph PASSENGER CONTROLS. Provide a lockable service cabinet for the controls listed in subparagraph SERVICE CONTROLS. Use engraving and backfilling or photo etching for button and switch designations. Do not use attached signs.

##### 2.6.2.1 Passenger Controls

In addition to ASME A17.1/CSA B44 requirements, provide the following operating controls, identified as indicated:

- a. Illuminating car-call buttons identified to correspond to landings served by the elevator.

- b. "DOOR OPEN" and "DOOR CLOSE" buttons. For front and rear openings at the same floor, include the identification "F" and "R" for each opening.
- c. Red, illuminating "ALARM" button.
- d. Key-operated "Independent Service" switch.
- e. "Help" communication device to include communication between elevator cab and elevator machine room.

#### 2.6.2.2 Service Controls

In addition to ASME A17.1/CSA B44 requirements, provide the following operating controls, identified as indicated:

- a. Provide a key-operated, three-position switch for "In car Inspection Operation" and "Hoistway Access". The center switch position will provide normal, automatic operation.
- b. "Car Light" switch.
- c. "Car Fan" switch with two speed settings identified.
- d. 120-volt ac 60 Hz single-phase duplex electrical outlet of ground-fault-circuit-interrupt (GFCI) design.

#### 2.6.2.3 Certificate Window

Provide a minimum 4 inch wide by 6 inch high certificate window for elevator inspection certificate. Locate window in the Service Controls door of the Car Operating Panel.

#### 2.6.2.4 Emergency Signaling Devices

Provide an audible signaling device, operable from the Car Operating Panel button marked "ALARM". The audible signaling device must have a sound pressure rating between 80 and 90 dBA at 10 ft. Provide battery backup power capable of operating the audible signaling device for at least one hour.

#### 2.6.3 Elevator In-Car Position Indicators

For all elevators, provide illuminating position indicator in the Car Operating Panel.

#### 2.6.4 Elevator In-Car Direction Indicators

For 2-stop elevator installations, provide visual direction indicators and audible car arrival signal in the elevator car door jamb, in accordance with ABA Standards. Visual indicators must be visible from the hall call fixture.

#### 2.6.5 Hall Call Landing Fixtures

Provide a hall call fixture adjacent to each elevator. Provide a single push-button for terminal landings and dual push-buttons, up and down, at intermediate landings.

#### 2.6.5.1 Designated Landing Hall Call Fixture

##### 2.6.5.1.1 Location of COMMUNICATION MEANS FAILURE (CMF) Visual Signal

When required by ASME A17.1/CSA B44, provide an elevator CMF audible and illuminating signal, and reset switch, in the FEO Designated Landing hall call fixture. Mount the signal and reset switch at a minimum of 7 inches above the "UP" hall call button.

##### 2.6.5.1.2 COMMUNICATION MEANS FAILURE (CMF) Visual and Audible Signal Operation

Provide a CMF visual and audible signal system that conforms to ASME A17.1/CSA B44. Provide continuous verification of operability of the telephone line and immediate activation of audible and visual signals when verification means determines that the telephone line is not functioning. Provide illumination of visual signal at one second intervals. Provide a minimum of 65 dBA audible signal at 30 second intervals.

##### 2.6.5.1.3 Firefighters' Emergency Operation Phase I Switch and Visual Signal

When required by ASME A17.1/CSA B44, provide an elevator Firefighters' Emergency Operation Phase I switch and illuminating visual signal in the FEO Designated Landing hall call fixture. Provide FEO Phase I visual signal that is designed with intermittent, flashing, illumination when actuated by the machine room or hostway fire alarm initiating device. Locate FEO Phase I key switch above the CMF visual signal with a minimum of 6 inches vertical between the centerlines of the CMF signal and the FEO Phase I key switch. Locate FEO Phase I visual signal directly above the Phase I switch. In addition, locate Elevator Corridor Call Station Pictograph at top of hall call fixture.

#### 2.6.6 Elevator Car Position and Direction Indicators and Car Arrival Signal

For elevator installations with three or more stops, provide a separate hall landing fixture that includes the visual elevator position indicator, visual direction indicators, and audible car arrival signal, in accordance with ABA Standards.

#### 2.6.7 Designated Landing Elevator Identification Fixture

For duplex and group elevator installations, provide a separate elevator identification fixture for each elevator, with identification engraved and backfilled with a contrasting color. Number elevators from left to right, as seen during primary approach from building main entrance to elevator lobby. For multiple elevator groups, begin numbering with group that is closest to the building main entrance.

#### 2.6.8 Emergency or Standby Power

When emergency or standby power is provided for elevator operation, provide an elevator emergency power visual indicator that conforms to ASME A17.1/CSA B44. Locate the visual signal in the Firefighters Emergency Operation fixture for each simplex elevator and for each elevator group. When an emergency power selector switch is required, provide switch in a separate, flush mounted fixture located at the designated level, in view of all elevator entrances.

## 2.7 CAR DOOR EQUIPMENT

### 2.7.1 Car Door Operator

Provide elevator door operator equipment and circuitry that is designed and installed as discreet communication. Serial communication must not be used for this system.

### 2.7.2 Infra-red Curtain Unit

Provide Infra-red Curtain Unit (ICU) with multiple infra-red beams that protect to the full height and width of the door opening. Provide door nudging operation.

## 2.8 PASSENGER ELEVATOR GUIDES, PLATFORM, AND ENCLOSURE

### 2.8.1 Roller Guides

Provide coil-spring loaded roller guide assemblies in adjustable mountings on each side of car and counterweight frames in accurate alignment at top and bottom of frames.

### 2.8.2 Car Enclosure Wall Panels, Return Panels, Doors, Entrance Columns, and Transom

Provide 14 Gauge minimum stainless steel cab wall panels and entrance components. Use same material and finish for all hoistway and car entrance assemblies. Apply sound-deadening material on exterior of all cab wall panels.

### 2.8.3 Car Enclosure Top

Provide reinforced, 12 gauge minimum steel car enclosure top. Provide hinged emergency exit with lock that complies with the seismic risk zone 2 or greater design requirements of ASME A17.1/CSA B44. Locate emergency exit hinge towards the rear of the elevator cab. Design and configure the elevator cab interior ceiling to provide convenient and unobstructed access to, and use of, emergency exit from inside the elevator cab.

### 2.8.4 Car Door

Provide 16 gauge minimum stainless steel car doors of sandwich construction with flush surfaces on car and landing sides. Provide a minimum of 2 door guide assemblies per door panel, one guide at leading and one at trailing door edge with guides in the sill groove their entire length of travel.

### 2.8.5 Car Entrance Sill

Provide one piece cast nickel silver, stainless steel, or white bronze entrance sill(s). Set sills level and flush with floor finish. Use same material for hoistway and car entrance sills.

### 2.8.6 Cab Finish Floor

Provide cab finish floor with top of finish floor flush with the cab sill.

#### 2.8.7 Car Fan

Provide 2-speed fan for car enclosure forced ventilation. Fan must be mounted in the car enclosure top.

#### 2.8.8 Car Lighting

Utilize LED lighting for elevator car interior illumination. Provide a minimum of 10 foot-candles, measured at all areas of the car enclosure floor. Provide automatic car lighting operation that will turn off car lights after 3 minutes of inactivity. Car lights must automatically turn on upon actuation of an elevator car or hall call.

#### 2.8.9 Car Protection Pads and Hooks

Provide fire retardant, hanging car protection pads that provide protection for all car interior wall panels. Provide permanently installed studs in car that are designed for hanging the car protection pads in the car.

### 2.9 PASSENGER ELEVATOR HOISTWAY DOORS AND ENTRANCES

Provide hoistway entrance assemblies with a minimum 1-1/2 hour fire rating. Use same material and finish for all hoistway and car entrance assemblies.

#### 2.9.1 Hoistway Entrance Frames

Provide 14 gage minimum stainless steel hoistway entrance frames. Solidly grout uprights of entrance ways to height of 5 feet.

#### 2.9.2 Hoistway Entrance Sills

Provide one-piece cast nickel silver, stainless steel, or white bronze entrance sills. Set top of landing sill flush with top of finish floor. Solidly grout under full length of sill. Use same material for all hoistway and car entrance sills.

#### 2.9.3 Hoistway Entrance Doors

Provide hollow metal non-vision construction hoistway entrance doors with flush surfaces on car and landing sides. Provide a minimum of 2 door guide assemblies per door panel, one guide at leading edge and one at trailing edge with guides in the sill groove the entire length of door travel. Use same material and finish for all hoistway and car entrance assemblies.

#### 2.9.4 Hoistway Entrance Door Track Dust Covers

Provide sheet metal hoistway door track dust covers at each landing. Dust covers must cover top and hoistway side of door locks and door roller tracks, and extend the full width of the door track and associated hardware. Dust cover sections will not exceed 3 feet in length.

### 2.10 HOISTWAY EQUIPMENT

#### 2.10.1 Car Guide Rails and Fastenings

Provide T-section type guide rails for car. Paint rail shanks with one coat of black enamel.

#### 2.10.2 Pit Equipment and Support Channels

Provide rail-to-rail pit channels to serve as mounting surface for main guide rails and car buffers. Method of installation of channels, brackets and buffer mounts must be such that pit waterproofing is not punctured.

#### 2.10.3 Pit "STOP" Switch

Provide push-to-stop/pull-to-run type pit "STOP" switch.

#### 2.10.4 Traveling Cables

Suspend traveling cables by means of self-tightening webbed devices or internal suspension members.

#### 2.10.5 Hoistway Pit Ladder

Provide continuous horizontal rungs for the full height of the pit ladder.

### PART 3 EXECUTION

#### 3.1 INSTALLATION

Install in accordance with DOD design criteria, contract specifications, manufacturer's instructions, NEII-1 Building Transportation Standards and Guidelines, and all applicable building and safety code requirements.

##### 3.1.1 Structural Members and Finish Materials

Do not cut or alter structural members. Do not alter finish materials from manufacturer's original design. Restore any damaged or defaced work to original condition.

##### 3.1.2 Miscellaneous Requirements

Provide recesses, cutouts, slots, holes, patching, grouting, and refinishing to accommodate elevator installation. Use core drilling to drill all new holes in concrete. Finish work to be straight, level, and plumb. During installation, protect machinery and equipment from dirt, water, or mechanical damage. At completion, clean all work and spot paint.

#### 3.2 FIELD QUALITY CONTROL

The Contractor will provide and utilize a third-party licensed and certified Qualified Elevator Inspector (QEI) to conduct elevator pre-acceptance inspection and testing. The QEI must perform inspections and witness tests to ensure that the installation conforms to all applicable safety codes and contract requirements. The QEI will be directly employed by the Contractor and independent of the elevator contractor.

Upon completion, the QEI must provide written test data for all ASME A17.1/CSA B44 Acceptance Tests and written certification that the elevator is complete and ready for final Acceptance Inspection, Testing, and Commissioning.

### 3.3 ACCEPTANCE INSPECTION, TESTING AND COMMISSIONING

When elevator system installation is complete and ready for final inspection, notify Contracting Officer that elevator system is ready for Acceptance Inspection, Testing, and Commissioning. Provide QEI certification specified in Article FIELD QUALITY CONTROL.

Contracting Officer will obtain services of Naval Facilities Engineering Command (NAVFAC) QEI Certified Elevator Inspector. NAVFAC QEI will utilize the applicable NAVFAC Elevator Acceptance Inspection Form to record the results of inspection and testing and to identify safety code and contract deficiencies. Specific values must be provided for all tests required by ASME A17.1/CSA B44, ASME A17.2, and contract documents. Upon completion of inspection and testing, the NAVFAC QEI will sign a copy of the completed forms and provide the signed copy to the Contracting Officer or representative. Within 2 weeks of the inspection, the QEI will also prepare a formal inspection report, including all test results and deficiencies. Upon successful completion of inspection and testing, NAVFAC Certified Elevator Inspector will complete, sign and post form NAVFACENGCOM 9-11014/23(Rev.9-2009), Elevator Inspection Certificate.

#### 3.3.1 Acceptance Inspection Support

Prime and Elevator Contractors must provide inspection support and perform all required tests, in order to demonstrate proper operation of each elevator system and to prove that each system complies with contract requirements and all applicable building and safety codes. Inspection procedures in ASME A17.2 form a part of this inspection and acceptance testing. All inspection and testing must be conducted in the presence of the Qualified Elevator Inspector (QEI).

If the elevator does not comply with all contract and safety code requirements on the initial Acceptance Inspection and Test, the Contractor is responsible for all costs involved with re-inspection and re-testing required as a result of contractor delays and discrepancies discovered during inspection and testing.

#### 3.3.2 Testing Materials and Instruments

Furnish all testing materials and instruments necessary for Acceptance Inspection, Testing and Commissioning. At a minimum, include calibrated test weights, tachometer, accelerometer, hydraulic pressure gauge, 600-volt megohm meter, volt meter and ammeter, infrared temperature gauge, door pressure gage, dynamometer, and 20 foot tape measure.

#### 3.3.3 Field Tests

##### 3.3.3.1 Endurance Tests

Test each elevator for a period of one hour continuous, automatic operation, with specified rated load in the elevator cab. During the one hour test, stop car at each floor, in both directions of travel, and allow automatic door open and close operation. The requirements for Automatic Operation, Rated Speed, Leveling, Temperature Rise and Motor Amperes must be met throughout the duration of the Endurance Test. Restart the one hour test period from the beginning, following any shutdown or failure.



#### 3.3.3.2 Speed Tests

Determine actual speed of each elevator, in both directions of travel, with rated load and with no load in elevator car. Make Speed tests at the beginning and at the end of the Endurance test. Determine speed by tachometer reading or accelerometer, excluding accelerating and slow-down zones. Under all conditions, minimum acceptable elevator speed is the Rated speed specified. Maximum acceptable elevator speed is 110 percent of Rated speed.

#### 3.3.3.3 Leveling Tests

Test elevator car leveling operation and provide a leveling accuracy equal to or less than 1/8 inch at each floor with no load in car, and with rated load in car, in both directions of travel. Determine leveling accuracy at the beginning and at the end of the endurance tests.

#### 3.3.3.4 Temperature Rise Tests

Determine temperature rise of elevator pump motor and hydraulic fluid during one-hour full-load test run. Under these conditions, maximum temperature rise must not exceed acceptable temperature rise indicated on manufacturer's data plate. Start test only when equipment is within 5 degrees C of ambient temperature.

#### 3.3.3.5 Motor Ampere Tests

At beginning and end of Endurance test, measure and record motor amperage in both directions of travel and in both no-load and rated load conditions.

#### 3.3.3.6 Elevator Performance and Ride Quality Testing

Evaluate elevator performance to ensure compliance with specification requirements related to the NEII-1 Performance Standards Matrix for New Elevator Installations.

#### 3.3.3.7 Hydraulic Safety Valve (Automatic Shutoff Valve) Tests

In order to ensure consistent performance, regardless of hydraulic oil temperature, test the Hydraulic Safety Valve twice. Test once before the one-hour endurance test and once immediately after the one-hour test. For elevator certification, safety valve must perform to code in both tests.

#### 3.3.3.8 Hydraulic Pressure Tests

Check the hydraulic static pressure and rated-speed operating pressure at the hydraulic control valve, under both no load and rated load conditions.

#### 3.3.3.9 Pressure Test of Liner/Cylinder Assembly

Perform 20 psig pressure test of the completed and installed liner/cylinder assembly. Test liner/cylinder assembly as a sealed unit. Provide safety relief valve set to relieve at 20 psig; 4.5 inch diameter dial pressure gage scaled for 0 to 50 psig and calibrated to 0.5 percent

accuracy; and an air pressure admission throttle and shutoff valve. For safety, pressure test must only be performed when liner and cylinder are fully inserted and assembled in the well casing. Perform the test from remote location outside of the elevator pit. Perform test in the presence of, and witnessed by, a Certified Elevator Inspector.

-- End of Section --

SECTION 21 13 13.00 20

WET PIPE SPRINKLER SYSTEM, FIRE PROTECTION

04/08

PART 1 GENERAL

1.1 REFERENCES

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

ASME INTERNATIONAL (ASME)

ASME A13.1 (2015) Scheme for the Identification of Piping Systems

ASTM INTERNATIONAL (ASTM)

ASTM D709 (2017) Standard Specification for Laminated Thermosetting Materials

FM GLOBAL (FM)

FM APP GUIDE (updated on-line) Approval Guide  
<http://www.approvalguide.com/>

NATIONAL FIRE PROTECTION ASSOCIATION (NFPA)

NFPA 13 (2016; TIA 16-1; TIA 16-2; TIA 16-3 2016; Errata 17-1; Errata 17-2) Standard for the Installation of Sprinkler Systems

NFPA 1963 (2014) Standard for Fire Hose Connections

NFPA 20 (2016; ERTA 2016) Standard for the Installation of Stationary Pumps for Fire Protection

NFPA 24 (2016) Standard for the Installation of Private Fire Service Mains and Their Appurtenances

NFPA 25 (2017; TIA 17-1; TIA 17-2) Standard for the Inspection, Testing, and Maintenance of Water-Based Fire Protection Systems

NFPA 291 (2016) Recommended Practice for Fire Flow Testing and Marking of Hydrants

UNDERWRITERS LABORATORIES (UL)

UL 668 (2004; Reprint Jul 2016) UL Standard for Safety Hose Valves for Fire-Protection Service

UL Fire Prot Dir (2012) Fire Protection Equipment Directory

## 1.2 SYSTEM DESCRIPTION

Design and provide new automatic wet pipe fire extinguishing sprinkler systems for complete fire protection coverage throughout the entire building.

## 1.3 SPRINKLER SYSTEM DESIGN

Except as modified herein, design automatic wet pipe fire extinguishing sprinkler systems in accordance with the required and advisory provisions of NFPA 13, including all recommendations and advisory portions, which shall be considered mandatory; this includes advisory provisions listed in the appendices of such standard(s), as though the word "shall" had been substituted for the word "should" wherever it appears. Design system by hydraulic calculations for uniform distribution of water over the design area. Hydraulic calculations shall assume a 12 psi pressure loss for the backflow preventer assembly. Locate sprinklers in a consistent pattern with ceiling grid, lights, and air supply diffusers. Provide sprinklers and piping system layout. All Devices and equipment for fire protection service shall be UL Fire Prot Dir listed or FM APP GUIDE approved for use in wet pipe sprinkler systems. Provide seismic protection for the sprinkler system. Design and install seismic protection in accordance with the requirements of NFPA 13 section titled "Protection of Piping Against Damage Where Subject to Earthquakes." Provide automatic air vents at high points in the system to vent at least 95 percent of the volumetric capacity of the system. Design the sprinkler system to reduce the quantity of automatic air vents such as connecting branchlines or providing a cross-main at the peak. Design the sprinkler piping such that the majority or all of the system drains back to the riser.

### 1.3.1 Location of Sprinklers

Sprinklers in relation to the ceiling and the spacing of sprinklers shall not exceed that permitted by NFPA 13 for the hazards indicated on the contract drawings. Sprinklers shall provide coverage throughout 100 percent of the building. This includes, but is not limited to, telephone rooms, electrical equipment rooms, boiler rooms, switchgear rooms, transformer rooms, and other electrical and mechanical spaces.

### 1.3.2 Density of Application of Water

Size pipe to provide the specified density when the system is discharging the specified total maximum required flow. Application to horizontal surfaces below the sprinklers shall be in accordance with NFPA 13.

### 1.3.3 Sprinkler Discharge Area

Design the hydraulically most remote area in accordance with NFPA 13 as indicated on the contract drawings.

### 1.3.4 Outside Hose Allowances

Hose streams to be provided by the domestic water system and will not be included in hydraulic calculations, except for wet pipe sprinkler system serving the administration office support area.

#### 1.3.5 Water Supply

Base hydraulic calculations on the water supply data from the existing fire pump house serving Building P-904 for sprinkler systems within the hangar bay. Base hydraulic calculations for the administration area wet pipe sprinkler system on the existing domestic water distribution system. Contractor to perform fire hydrant flow test, in accordance with NFPA 291, within 12 months prior to shop drawing submittal for preparing hydraulic calculations. The contractor shall provide a fire pump test in accordance with NFPA 20 and NFPA 25. Contractor shall provide test reports and actual sequencing to the NAVFAC Pacific Fire Protection Engineer and Quality Control Fire Protection Engineer (QCFPE) within 7 days of testing.

#### 1.4 SUBMITTALS

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

Partial submittals and submittals not fully complying with the requirements and recommended practices of NFPA 13 and this specification section shall be returned disapproved without review. This contract stipulation is non-negotiable. Submittals shall include all plans, annotated cut sheets for all equipment, and components, and all calculations.

Submittals with an "S" are for inclusion in the Sustainability eNotebook, in conformance to Section 01 33 29 SUSTAINABILITY REPORTING. Submit the following in accordance with Section 01 33 00 SUBMITTAL PROCEDURES:

##### SD-02 Shop Drawings

###### Shop Drawings

Prepare 24 by 36 inch detail working drawings of sprinklers and piping. Floor plans shall be drawn to a scale not less than 1/8" = 1'-0". Show data essential for proper installation of each system. Show details, plan view, elevations and sections of the systems supply and piping. Show piping schematic of systems supply, devices, valves, pipe and fittings. Submit drawings bearing the review stamp of the Quality Control Fire Protection Engineer (QCFPE) as outlined in Section 01 45 00.00 20 QUALITY CONTROL. Provide three copies and one electronic PDF of the Sprinkler System Shop Drawings, no later than 7 days prior to the start of sprinkler system installation.

##### SD-03 Product Data

Pipe  
Fittings  
Valves, including gate, check, and globe  
Sprinklers  
Pipe hangers and supports  
Sprinkler Alarm Switches  
Fire department connections  
Mechanical couplings  
Backflow Prevention Assembly  
Seismic Bracing

Annotate descriptive data to show the specific model, type, and size of each item. Catalog cuts shall also indicate UL Listing/FM Approval and country of manufacture.

#### SD-05 Design Data

##### Hydraulic Calculations

Submit computer program generated hydraulic calculations to substantiate compliance with hydraulic design requirements. Calculations shall be performed by computer using software intended specifically for fire protection system design. Calculations shall include isometric diagram indicating hydraulic nodes and pipe segments. Submit name of software program used.

#### SD-06 Test Reports

Request to Schedule Preliminary Tests; G

Preliminary Test Report; G

Provide one copy and electronic PDF of the completed Preliminary Test Report, no later than 7 days after the completion of the Preliminary Tests. The Preliminary Test Report shall include the Contractor's Material and Testing Certificate for Underground Piping per NFPA 13 and NFPA 24 along with photographs of underground piping installation, the Contractor's Material and Testing Certificate for Aboveground per NFPA 13 for each riser, manifold, and fire department connection, and any fire pump test reports demonstrating compliance with NFPA 20 acceptance testing criteria. All items in the Preliminary Tests Report shall be signed by the QCFPE.

Request to schedule Final Acceptance Test; G

Final Acceptance Test Report; G

Provide one copy and electronic PDF of the completed Final Acceptance Tests Reports, no later than 7 days after the completion of the Final Acceptance Tests. All items in the Final Acceptance Report shall be signed by the QCFPE.

#### SD-07 Certificates

Inspection by Quality Control Fire Protection Engineer; G

Concurrent with the Final Acceptance Test Report, certification by the QCFPE that the sprinkler system is installed in accordance with the contract requirements, including signed approval of the Preliminary and Final Acceptance Test Reports.

Quality Control Fire Protection Engineer; G

The name and documentation of certification of the proposed Fire Protection Engineer, no later than 14 days after the Notice to Proceed and prior to the submittal of the sprinkler system drawings and hydraulic calculations.

Sprinkler System Installer

Submit data showing the Sprinkler System Installer has successfully installed systems of the same type and design as specified herein, Data shall include names and locations of at least two installations where the Contractor, or the subcontractor referred to above, has installed such systems. Indicate type and design of each system and certify that each system has performed satisfactorily in the manner intended for not less than 18 months. Provide NICET certification of the system technician. Contractor shall submit data along with submittal of the Fire Protection Engineer Qualifications.

#### SD-10 Operation and Maintenance Data

##### Operating and Maintenance Instructions

Submit in accordance with Section 01 78 23 OPERATION AND MAINTENANCE DATA as supplemented and modifies by this specification section.

Provide and electronic PDF and six manuals in accordance with NFPA 13. 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. Operations and Maintenance Manuals shall be submitted no later than 10 days prior to the Pre-Punchlist walkthrough.

#### SD-11 Closeout Submittals

##### As-built drawings

As-built shop drawings, at no later than 14 days after completion of the Final Tests. The Sprinkler System Drawings shall be updated to reflect as-built conditions after all related work is completed. Provide electronic drawings in dwg or pdf format.

##### On-site training

### 1.5 QUALIFICATIONS

#### 1.5.1 Quality Control Fire Protection Engineer (QCFPE)

A QCFPE is a registered professional engineer (P.E.) who has passed the fire protection engineering written examination administered by the National Council of Examiners for Engineering and Surveys (NCEES) and has relevant fire protection engineering experience. QCFPE must meet requirements as outlined in Section 01 45 00.00 20 QUALITY CONTROL.

#### 1.5.2 Sprinkler System Installer

The Sprinkler System Installer shall be regularly engaged in the installation of the type and complexity of system 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. Installation drawings, shop drawings and as-built drawings shall be prepared, by or under the supervision of,

an system technician who is experienced with the types of works specified herein, and is currently certified by the National Institute for Certification in Engineering Technologies (NICET) as an engineering technician with minimum Level III certification in Automatic Sprinkler System program or by a fire protection engineer.

## 1.6 QUALITY ASSURANCE

### 1.6.1 Material and Equipment Qualifications

Provide materials and equipment that are standard products of manufacturers regularly engaged in the manufacture of such products, which are of a similar material, design and workmanship. Standard products 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.

### 1.6.2 Alternative Qualifications

Products having less than a two-year field service record will be acceptable if a certified record of satisfactory field operation for not less than 6000 hours, exclusive of the manufacturer's factory or laboratory tests, can be shown.

### 1.6.3 Manufacturer's Nameplate

Each item of equipment shall have a nameplate bearing the manufacturer's name, address, model number, and serial number securely affixed in a conspicuous place; the nameplate of the distributing agent will not be acceptable.

### 1.6.4 Field Fabricated Nameplates

ASTM D709. Provide laminated plastic nameplates for each equipment enclosure, relay, switch, and device; as specified in the technical sections or as indicated on the drawings. Each nameplate inscription shall identify the function and, when applicable, the position. Nameplates shall be melamine plastic, 0.125 inch thick, white with red center core. Surface shall be matte finish. Corners shall be square. Accurately align lettering and engrave into the core. Minimum size of nameplates shall be one by 2.5 inches. Lettering shall be a minimum of 0.25 inch high normal block style.

## 1.7 ACCESSIBILITY

Install all work so that parts requiring periodic inspection, operation, maintenance, and repair are readily accessible. Install concealed valves, expansion joints, controls, dampers, and equipment requiring access, in locations freely accessible through access doors.

## 1.8 DELIVERY, STORAGE AND HANDLING

All equipment delivered and placed in storage shall be housed in a manner to preclude any damage from the weather, humidity and temperature variations, dirt and dust, or other contaminants. Additionally, all pipes shall either be capped or plugged until installed.



## PART 2 PRODUCTS

### 2.1 UNDERGROUND PIPING COMPONENTS

#### 2.1.1 Pipe

Pipe shall comply with NFPA 24. Minimum pipe size shall be 6 inches. Piping more than 5 feet outside the building walls shall comply with Section 33 11 00 WATER UTILITY DISTRIBUTION PIPING.

### 2.2 ABOVEGROUND PIPING COMPONENTS

All components of the aboveground piping shall fully comply with the requirements and recommended practices of NFPA 13 and this specification section. Aboveground piping shall be steel. Aboveground piping shall be copper at all exterior conditions where exposed to salt-air conditions.

#### 2.2.1 Steel Pipe

Pipe shall be rigid black steel. Steel pipe shall be minimum Schedule 40. Fittings into which sprinklers, sprinkler riser nipples, or drop nipples are threaded shall be welded, threaded, or grooved-end type. Plain-end fittings with mechanical couplings, fittings that use steel gripping devices to bite into the pipe and segmented welded fittings shall not be permitted. Rubber gasketed grooved-end pipe and fittings with mechanical couplings shall be permitted in pipe sizes 1.5 inches and larger. Fittings, mechanical couplings, and rubber gaskets shall be supplied by the same manufacturer. Steel piping with wall thickness less than Schedule 30 shall not be threaded. Side outlet tees using rubber gasketed fittings shall not be permitted. Sprinkler pipe and fittings shall be metal. Roll grooving of galvanized pipe is prohibited.

#### 2.2.2 Grooved Mechanical Joints and Fittings

Grooved couplings, fittings and grooving tools shall be products of the same manufacturer.

#### 2.2.3 Sprinklers

Sprinklers with internal O-rings shall not be used. Sprinklers shall be used in accordance with their listed coverage limitations. Where ceiling are present, provide recessed pendent quick response sprinklers. Sprinklers shall have a white polyester finish. Temperature classification shall be in accordance with NFPA 13 for the maximum anticipated ceiling temperature. Sprinklers in high heat areas including attic spaces or in close proximity to unit heaters shall have temperature classification in accordance with NFPA 13. Extended coverage sprinklers shall not be used. Provide PTFE corrosion-resistant sprinklers and sprinkler guards as required by NFPA 13.

#### 2.2.4 Valves

Provide valves of types approved for fire service. Valves shall open by counterclockwise rotation. Provide an OS&Y valve beneath each riser alarm check valve. Check valves shall be clear opening swing-check type with inspection and access cover plate. Provide supervision against valve closure or tampering of valve.

#### 2.2.5 Pipe Supports

Provide Pipe hangers and supports and Seismic Bracing in accordance with NFPA 13.

#### 2.2.6 Fire Department Connections

Fire department connection shall be flush type with cast brass body, matching wall escutcheon lettered "Auto Spkr" with a polished brass finish. The connection shall have two inlets with individual self-closing clappers, caps with drip drains and chains. Female inlets shall have 2-1/2 inch diameter American National Fire Hose Connection Screw Threads (NH) per NFPA 1963.

#### 2.2.7 Backflow Prevention Assembly

Provide listed double check valve assembly backflow preventer. Each check valve shall have a drain. Backflow prevention assemblies shall have current "Certificate of Approval from the Foundation for Cross-Connection Control and Hydraulic Research, FCCCHR List. Listing of the specific make, model, design, and size in the FCCCHR List shall be acceptable as the required documentation." Provide test header for forward flow testing of backflow prevention assembly. Provide angle or globe valves with 2.5-inch male national standard has threads with cap and chain.

### 2.3 ALARM INITIATING AND SUPERVISORY DEVICES

#### 2.3.1 Sprinkler Alarm Switches

Provide vane type flow switch(es) with circuit opener or closer for the automatic transmittal of an alarm over the facility fire alarm system. Connection of switch shall be under Section 28 31 76 INTERIOR FIRE ALARM AND MASS NOTIFICATION SYSTEM. Vane type Alarm actuating devices shall have mechanical diaphragm controlled retard device adjustable from 10 to 90 seconds and shall instantly recycle. Set alarm actuating device to approximately 60 seconds. Flow switches for elevator power shunt shall have no retard feature. 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".

#### 2.3.2 Valve Supervisory (Tamper) Switch

Switch shall be suitable for mounting to the type of control valve to be supervised open or closed, as indicated on the contract drawings. The switch shall be tamper resistant and contain one set of 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.

### 2.4 ACCESSORIES

#### 2.4.1 Sprinkler Cabinet

Provide metal cabinet with extra sprinklers and sprinkler wrench adjacent to each alarm valve. The number and types of extra sprinklers shall be as specified in NFPA 13.

#### 2.4.2 Pipe Escutcheon

Provide split hinge metal plates for piping entering walls, floors, and

ceilings in exposed spaces. Provide polished stainless steel plates or chromium-plated finish on copper alloy plates in finished spaces. Provide paint finish on metal plates in unfinished spaces.

### PART 3 EXECUTION

#### 3.1 INSPECTION BY QUALITY CONTROL FIRE PROTECTION ENGINEER (QCFPE)

The QCFPE shall inspect the sprinkler system periodically during the installation to assure the sprinkler system is being provided and installed in accordance with the contract requirements and the approved sprinkler system submittal(s). The QCFPE shall attend both the preliminary and final tests, and shall sign the test results. After the preliminary testing has been completed, the QCFPE, shall certify in writing the system is ready for the final inspections and tests. This report shall document any discrepancies found and what actions will be taken to correct. Any discrepancy noted during the periodic site visits or the preliminary testing shall be brought to the attention of the Contracting Officer in writing, no later than three working days after the discrepancy is discovered.

#### 3.2 UNDERGROUND PIPING INSTALLATION

The methods of fabrication and installation of the underground piping shall fully comply with the requirements and recommended practices of NFPA 13, NFPA 24 and the contract drawings. Contractor to photograph underground piping installation prior to burial.

#### 3.3 ABOVEGROUND PIPING INSTALLATION

The methods of fabrication and installation of the aboveground piping shall fully comply with the requirements and recommended practices of NFPA 13 and this specification section.

##### 3.3.1 Piping in Finished Areas

In areas with suspended or dropped ceilings and in areas with concealed spaces above the ceiling, piping shall be concealed above ceilings. Piping shall be inspected, tested and approved before being concealed. Risers and similar vertical runs of piping in finished areas shall be concealed.

##### 3.3.2 Pendent Sprinklers

Where sprinklers are installed below suspended or dropped ceilings, drop nipples shall be cut such that sprinkler ceiling plates or escutcheons are of a uniform depth throughout the finished space. The outlet of the reducing coupling shall not extend more than 1 inch below the underside of the ceiling.

##### 3.3.3 Pipe Joints

Pipe joints shall conform to NFPA 13, except as modified herein. 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 shall be provided where indicated or required by NFPA 13. Grooved pipe and fittings shall 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 shall be products of the same manufacturer. The diameter of grooves made in the field shall be measured using the method specifically approved by the coupling manufacturer for the intended application. Groove width and dimension of groove from end of pipe shall be measured and recorded for each change in grooving tool setup to verify compliance with coupling manufacturer's tolerances. A representative of the grooved couplings and fittings manufacturer shall conduct at least one onsite inspection of the piping installation to ensure the method of installation is in accordance with the manufacturer's requirements and recommended practices.

#### 3.3.4 Reducers

Reductions in pipe sizes shall be made with one-piece tapered reducing fittings. Bushings are prohibited.

#### 3.3.5 Pipe Penetrations

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 shall be core-drilled and provided with pipe sleeves. Each sleeve shall be Schedule 40 galvanized steel, ductile iron or cast iron pipe and shall extend through its respective wall or floor and be cut flush with each wall surface. Sleeves shall provide required clearance between the pipe and the sleeve per NFPA 13. The space between the sleeve and the pipe shall be firmly packed with mineral wool insulation. Where pipes penetrate fire walls, fire partitions, or floors, pipes shall be fire stopped in accordance with Section 07 84 00 FIRESTOPPING. In penetrations that are not fire-rated or not a floor penetration, the space between the sleeve and the pipe shall be sealed at both ends with plastic waterproof cement that will dry to a firm but pliable mass or with a mechanically adjustable segmented elastomer seal.

#### 3.3.6 Inspector's Test Connection

Locate inspector's test connections at the riser. Provide test connections approximately 6 feet above the floor for each sprinkler system or portion of each sprinkler system equipped with an alarm device. Provide test connection piping to a drain location that can accept full flow where the discharge will be readily visible and where water may be discharged without property damage. Discharge to floor drains, janitor sinks or similar fixtures shall not be permitted. Provide discharge orifice of same size as corresponding sprinkler orifice. The penetration of the exterior wall shall be no greater than 18 inches above finished grade. Terminate discharge outlet at 6 inches to 8 inches above finished grade. Provide splash block for each discharge outlet.

#### 3.3.7 Backflow Preventer 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."

#### 3.3.8 Drains

Main drain piping shall be provided to discharge at a safe point outside the building. Auxiliary drains shall be provided as required by NFPA 13.

Provide splash block for each drain discharge.

### 3.3.9 Installation of Fire Department Connection

Connection shall be mounted on the exterior wall approximately 3 feet above finished grade. The piping between the connection and the check valve shall be provided with an automatic drip in accordance with NFPA 13 and arranged to drain to the outside.

### 3.3.10 Identification Signs

Signs shall 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. Valve identification signs shall be minimum 6 inches wide by 2 inches high with enamel baked finish on minimum 18 gauge steel or 0.024 inch aluminum with red letters on a white background or white letters on red background. Hydraulic design data nameplates shall be permanently affixed to each sprinkler riser as specified in NFPA 13.

## 3.4 ELECTRICAL WORK

Except as supplemented and modified herein, electric equipment and wiring shall be in accordance with Section 26 20 00 INTERIOR DISTRIBUTION SYSTEM. Alarm signal wiring connected to the building fire alarm control system shall be in accordance with Section 28 31 76 INTERIOR FIRE ALARM AND MASS NOTIFICATION SYSTEM

## 3.5 PIPE PAINTING AND COLOR CODE MARKING

All exposed fire sprinkler piping shall be painted red for identification.

### 3.5.1 Fire Suppression Pipe Labeling

Mark all exposed interior piping with plastic wrap around-type labels conforming to ASME A13.1. Indicate the type of fluid carried and direction of flow. Labels that stick-on (adhesive backed) or are held on with straps/adhesive tape are not permitted. Labels are not required on any fire suppression system branchlines regardless of size, or mains and cross-mains less than a nominal 2-1/2 inches. Labels are not required on piping below the floor line in trenches or pits. At a minimum, the following labels are required: FIRE PROTECTION WATER - Used on dedicated potable and non-potable fire protection water supply piping. FIRE SPRINKLER - Used on water-only sprinkler piping.

## 3.6 PRELIMINARY TESTS

The system, including the underground water mains, and the aboveground piping and system components, shall be tested to assure that equipment and components function as intended. The underground and aboveground interior piping systems and attached appurtenances subjected to system working pressure shall be tested in accordance with NFPA 13 and NFPA 24. Submit request to schedule Preliminary Tests, no later than 14 days prior to the proposed start of the tests. Upon completion of specified tests, the Contractor shall submit for approval a Preliminary Test Report.

### 3.6.1 Underground Piping

#### 3.6.1.1 Flushing

Underground piping shall be flushed in accordance with NFPA 24.

#### 3.6.1.2 Hydrostatic Testing

New underground piping shall be hydrostatically tested in accordance with NFPA 24.

### 3.6.2 Aboveground Piping

#### 3.6.2.1 Hydrostatic Testing

Aboveground piping shall be hydrostatically tested in accordance with NFPA 13.

#### 3.6.2.2 Backflow Prevention Assembly Forward Flow Test

Each backflow prevention assembly shall be tested at system flow demand, including all applicable hose streams, as specified in NFPA 13. The Contractor shall provide all equipment and instruments necessary to conduct a complete forward flow test, including 2.5 inch diameter hoses, playpipe nozzles, calibrated pressure gauges, and pitot tube gauge. The Contractor shall 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) across the assembly shall be recorded. A metal placard shall 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 shall be compared to the manufacturer's data and the readings observed during the final inspections and tests.

### 3.7 FINAL ACCEPTANCE TEST

Final Acceptance Test shall begin only when the Preliminary Test Report has been approved. Submit request to schedule Final Acceptance Test, no later than 14 days prior to the proposed start of the tests. Notification shall include a copy of the Contractor's Material & Test Certificates.

This shall include operation of control valves and flowing of inspector's test connections to verify operation of associated waterflow alarm switches. After operation of control valves has been completed, the main drain test shall be repeated to assure that control valves are in the open position. In addition, the representative shall have available copies of as-built drawings and certificates of tests previously conducted. The installation shall not be considered accepted until identified discrepancies have been corrected and test documentation is properly completed and received. The Contractor shall submit the Final Acceptance Test Report as specified in the Submittals paragraph.

An experienced technician regularly employed by the system installer shall be present during the inspection. The QCFPE shall attend the final inspections and tests. At this inspection, repeat any or all of the required tests as directed. Correct defects in work provided by the Contractor, and make additional tests until the systems comply with contract requirements. Furnish appliances, equipment, water, electricity,

instruments, connecting devices, and personnel for the tests. The Government will furnish water for the tests. The Pacific Division, Naval Facilities Engineering Command, Fire Protection Engineer, will witness formal tests and approve systems before they are accepted.

### 3.8 ON-SITE TRAINING

Submit request to schedule the On-site Training, at least 14 days prior to the start of related training but prior to the final inspections and tests. The sprinkler contractor shall conduct a training course for operating and maintenance personnel as designated by the Contracting Officer. Training shall be provided for a period of 4 hours of normal working time and shall start after the system is functionally complete and after the Final Acceptance Test. The On-Site Training shall cover all of the items contained in the approved Operating and Maintenance Instructions.

-- End of Section --





SECTION 21 13 20.00 20

FOAM FIRE EXTINGUISHING FOR AIRCRAFT HANGARS

11/09

PART 1 GENERAL

1.1 REFERENCES

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

ASME INTERNATIONAL (ASME)

ASME A13.1 (2015) Scheme for the Identification of Piping Systems

FM GLOBAL (FM)

FM APP GUIDE (updated on-line) Approval Guide  
<http://www.approvalguide.com/>

NATIONAL FIRE PROTECTION ASSOCIATION (NFPA)

NFPA 11 (2016; ERTA 2016) Standard for Low-, Medium- and High- Expansion Foam

NFPA 13 (2016; TIA 16-1; TIA 16-2; TIA 16-3 2016; Errata 17-1; Errata 17-2) Standard for the Installation of Sprinkler Systems

NFPA 16 (2015) Standard for Installation of Foam-Water Sprinkler and Foam-Water Spray Systems

NFPA 20 (2016; ERTA 2016) Standard for the Installation of Stationary Pumps for Fire Protection

NFPA 25 (2017; TIA 17-1; TIA 17-2) Standard for the Inspection, Testing, and Maintenance of Water-Based Fire Protection Systems

NFPA 30 (2015; ERTA 1 2016) Flammable and Combustible Liquids Code

NFPA 33 (2018) Standard for Spray Application Using Flammable or Combustible Materials

NFPA 409 (2016; ERTA 2016) Standard on Aircraft Hangars

NFPA 70 (2017; ERTA 1-2 2017; TIA 17-1; TIA 17-2; TIA 17-3; TIA 17-4; TIA 17-5; TIA 17-6; TIA 17-7; TIA 17-8; TIA 17-9; TIA 17-10; TIA 17-11; TIA 17-12; TIA 17-13; TIA 17-14) National Electrical Code

NFPA 72 (2016) National Fire Alarm and Signaling Code

SOCIETY FOR PROTECTIVE COATINGS (SSPC)

SSPC SP 11 (2012) Power Tool Cleaning to Bare Metal

U.S. DEPARTMENT OF DEFENSE (DOD)

UFC 4-211-01 (2017; with Change 1) Aircraft Maintenance Hangars, with Change 1

MIL-PRF-24385 (1992; Rev F; Am 1 1994; Am2 2017) Fire Extinguishing Agent, Aqueous Film Forming Foam (AFFF) Liquid Concentrate, for Fresh and Seawater

U.S. GENERAL SERVICES ADMINISTRATION (GSA)

CID A-A-58092 (Basic; Notice 1; Notice 2) Tape, Antiseize, Polytetrafluoroethylene

FS WW-S-2739 (Basic; Notice 1; Notice 2) Strainers, Sediment: Pipeline, Water, Air, Gas, Oil, or Steam

UNDERWRITERS LABORATORIES (UL)

UL Fire Prot Dir (2012) Fire Protection Equipment Directory

## 1.2 RELATED REQUIREMENTS

Section 01 33 00 SUBMITTAL PROCEDURES, Section 01 45 00.00 20 QUALITY CONTROL, Section 09 90 00 PAINTS AND COATINGS, Section 23 03 00.00 20 BASIC MECHANICAL MATERIALS AND METHODS, Section 21 13 13.00 20 WET PIPE SPRINKLER SYSTEM, FIRE PROTECTION, Section 28 31 76 INTERIOR FIRE ALARM AND MASS NOTIFICATION SYSTEM, applies to this section, with the additions and modifications specified herein.

## 1.3 SYSTEM DESCRIPTION

### 1.3.1 Design Requirements

Design and provide a new automatic aqueous film forming foam (AFFF) deluge low level, low expansion trench grate nozzle suppression system for the entire paint booth insert area as indicated on the contract drawings. System shall provide uniform distribution of 3 percent AFFF solution to provide complete coverage throughout the areas indicated. The design, equipment, materials, installation, and workmanship shall be in strict accordance with the required and advisory provisions of NFPA 11, NFPA 13, NFPA 16, NFPA 30, NFPA 70, NFPA 72, NFPA 409, and UFC 4-211-01,, except as modified herein. Each system shall be designed for earthquakes and shall include all materials, accessories and equipment necessary to provide each system complete and ready for use. Design and install each system to give full consideration to blind spaces, piping, electrical equipment, ductwork, and all other construction and equipment to provide complete coverage in accordance with the drawings to be submitted for approval. Devices and equipment for fire protection service shall be of a make and

type listed by the Underwriter's Laboratories Inc. in the UL Fire Prot Dir, or approved by the Factory Mutual System and listed in FM APP GUIDE. In the publications referred to herein, the advisory provisions shall be considered to be mandatory, as though the word "shall" had been substituted for "should" wherever it appears; reference to the "authority having jurisdiction" shall be interpreted to mean the Pacific Division, Naval Facilities Engineering Command Fire Protection Engineer

#### 1.3.1.1 Shop Drawings

Prepare shop drawings for fire extinguishing system in accordance with Section 01 33 00 SUBMITTAL PROCEDURES and in accordance with the requirements for "Plans" as specified in NFPA 11 and "Working Plans" as specified in NFPA 13. Do not commence work until the design of each system and the various components have been approved. Show:

- a. Room, space or area layout and include data essential to the proper installation of each system.
- b. Discharge nozzles and system piping layout annotated with reference points for design calculations.
- c. Triple infrared (IR) optical flame detector manufacturer's recommended detector layout (plan view) including horizontal and vertical angles for correct aiming.

#### 1.3.1.2 Calculations

Submit design calculations for the system.

- a. Hydraulic calculations showing basis for design in accordance with NFPA 11 and NFPA 13.
- b. Pressure discharge graphs or tables showing pressure discharge relationship for sprinkler heads and discharge nozzles.
- c. System surge analysis showing surge pressure occurring throughout the system at both design flow and nonflow conditions.

#### 1.3.1.3 AFFF Containment and Disposal Plan

Submit AFFF containment and disposal plan as required under paragraph entitled "Environmental Protection."

#### 1.3.1.4 As-Built Drawings for the Fire Extinguishing System

Provide in accordance with Section 01 33 00 SUBMITTAL PROCEDURES upon completion, and before final acceptance of the work, submit a complete set of as-built drawings for the fire extinguishing system. Submit as-built drawings in addition to the record drawings required by Division 1.

#### 1.3.2 System Operation

Flow of water and AFFF shall be controlled by deluge valves. Foam proportioning equipment shall activate automatically upon tripping of the deluge valve(s) for the corresponding foam system(s). Deluge valves shall be tripped by independent detection systems. No valve will be operated by the building fire evacuation alarm system. Use of motor-operated valves is prohibited. Once activated, system(s) shall operate until shut down

manually.

#### 1.3.2.1 AFFF Foam/Water Trench Nozzle System

Trench nozzle system shall be controlled by deluge valves operated by triple infrared (IR) optical flame detectors and manual foam releasing stations. Nozzles shall be installed in trenches and spaced in accordance with UFC 4-211-01. Discharge pressure for all nozzles shall be maintained between 40 psig and 45 psig. Foam/water solution must be provided at the most remote nozzle within 30 seconds upon activation of the foam/water system via a manual releasing station or two simultaneous optical flame detectors within the protected zone.

#### 1.4 SUBMITTALS

Government approval is required for submittals with a "G" designation; submittals not having a "G" designation are for Contractor Quality Control approval. Submittals with an "S" are for inclusion in the Sustainability eNotebook, in conformance to Section 01 33 29 SUSTAINABILITY REPORTING. Submit the following in accordance with Section 01 33 00 SUBMITTAL PROCEDURES:

Partial submittals and submittals not fully complying with the requirements and recommended practices of NFPA 13 and this specification shall be returned disapproved without review.

##### SD-02 Shop Drawings

Fire extinguishing system

##### SD-03 Product Data

Pipe, fittings, and mechanical couplings

Deluge foam/water flow control valves

Trench Grate nozzles

Pipe hangers and supports

Waterflow pressure alarm switch

Detection devices

AFFF concentrate storage tanks

Proportioning equipment

AFFF concentrate

Strainers

Optical Flame Detectors

Manual release stations

Manual Foam Stop (Abort) Stations

Releasing Service Fire Alarm Control Unit

Data which describe more than one type of item shall be clearly marked to indicate which type the Contractor intends to provide. Submit only originals. Photocopies will not be accepted. Partial submittals will not be accepted.

Surge Arrestors

SD-05 Design Data

Hydraulic calculations

Pressure discharge graphs or tables

System surge analysis

SD-06 Test Reports

Preliminary tests; G

Acceptance tests; G

Submit for all inspections and tests specified under paragraph entitled "Field Quality Control."

SD-07 Certificates

Quality Control Fire Protection Engineer; G

The name and documentation of certification of the proposed QCFPE, no later than 14 days after the Notice to Proceed (NTP) and prior to the submittal of the sprinkler system drawings and hydraulic calculations.

Qualifications of installer; G

Submit installers qualifications as required under paragraph entitled "Qualifications of Installer."

AFFF containment and disposal plan

SD-10 Operation and Maintenance Data

Deluge valves, Data Package 3

Proportioning equipment, Data Package 3

Releasing Service Fire Alarm Control Unit, Data Package 3

AFFF concentrate storage tanks, Data Package 3

Trench Grate nozzles, Data Package 3

Instructions for operating the fire extinguishing system, Data Package 4

Submit in accordance with Section 01 78 23 OPERATION AND MAINTENANCE DATA. Furnish one complete set of data prior to the time that final acceptance tests are performed, and furnish the

remaining sets before the contract is completed.

#### SD-11 Closeout Submittals

As-built drawings for the fire extinguishing system;

### 1.5 QUALITY ASSURANCE

#### 1.5.1 Quality Control Fire Protection Engineer (QCFPE)

A QCFPE is a registered 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). The QCFPE shall meet the requirements of Section 01 45 00.00 20 QUALITY CONTROL and have relevant fire protection engineering experience.

#### 1.5.2 Qualifications of Installer

Prior to commencing work, submit data showing that the Contractor has successfully installed automatic foam fire extinguishing sprinkler systems of the same type and design as specified herein, or that he has a firm contractual agreement with a subcontractor having the required experience. Include the names and locations of at least two installations where the Contractor, or the subcontractor referred to above, has installed such systems. Indicate the type and design of each system, and certify that the system has performed satisfactorily for a period of at least 18 months.

Qualifications of System Technician: Installation drawings, shop drawing and as-built drawings shall be prepared, by or under the supervision of, an individual who is experienced with the types of works specified herein, and is currently certified by the National Institute for Certification in Engineering Technologies (NICET) as an engineering technician with minimum Level-IV certification in Special Hazard System program. Contractor shall submit data for approval showing the name and certification of all involved individuals with such qualifications at or prior to submittal of drawings.

### 1.6 SPARE PARTS

Furnish the following spare parts:

- a. 2 of each type of detector installed.
- b. 1 of each type of audible and/or visual alarm device installed.
- c. 2 of each type of fuse required by the system.
- d. 5 complete sets of system keys.

## PART 2 PRODUCTS

### 2.1 DESIGN OF FOAM SYSTEMS

Design of deluge fire extinguishing foam systems shall be by hydraulic calculations for uniform distribution of AFFF solution over the protected area and shall conform to the NFPA standards listed above and to the requirements as specified herein. Design and hydraulic calculations shall include the design area of the overhead sprinkler system as specified in

Section 21 13 13.00 20 WET-PIPE SPRINKLER SYSTEM, and all trench grate foam nozzles discharging simultaneously in the paint booth insert as indicated on the contract drawings.

#### 2.1.1.1 Deluge Foam/Water Flow Control Valves

Valves shall be operated by a detection system listed for releasing service and independent of the building fire alarm system. If 6 inch valves are used in 8 inch risers, provide smoothly tapered connections. In addition to automatic operation, arrange each valve for manual release at the valve. For hydraulic calculations include the manufacturer's minimum pressure drop across the flow control valve for the features indicated. Pipe the main drain from the flow control valve into the retention trench.

Provide pressure gauges and other appurtenances at the valves as required by NFPA 13. Provide a detection device at the end of each actuation circuit to test the circuit and mount the device adjacent to the valve between 6 and 8 feet above the finish floor. Label each testing device to indicate the valve it activates. Provide manual releasing stations as indicated on the contract drawings and in accordance with UFC 4-211-01. Provide flow control valve with remote resetting capability, automatic re-closing feature, adjustable speed control, and field adjustable pressure reducing trim. Provide a key operated supervised disconnect switch to physically disable the solenoid for each foam/water riser. Provide switch that disables the releasing function without the use of programming, while leaving all other functions of the panel operational. Locate disconnect switch in the riser room near the solenoid. Provide a sign near the disconnect switch with a white background and a minimum 1/2 inch wide blue border, with "DISABLE FOAM SYSTEM" in red lettering not less than 1 inch high. Provide engraved labels on the disconnect switch indicating when the system is "ENABLED" or "DISABLED". Do not install backboxes or route conduit in front of the sign in a manner that obstructs any lettering.

#### 2.1.1.2 AFFF Solution Distribution

Distribution shall be essentially uniform throughout the area as indicated on the drawings. Variation in discharge pressure from individual nozzles shall be 40 psig and 45 psig. Hydraulic calculations shall show the calculated pressure at each discharge nozzle is between 40 psig and 45 psig.

#### 2.1.1.3 Discharge Area

Area shall be the hydraulically most demanding 2,500 square foot area as defined by NFPA 13 and NFPA 33 for the overhead wet-pipe sprinkler system in the paint booth area designed in accordance with Section 21 13 13.00 20 WET PIPE SPRINKLER SYSTEM, combined with the entire floor area of all trench grate foam nozzles discharging simultaneously in the area indicated on the drawings.

#### 2.1.1.4 Friction Losses

Calculate losses in pipe in accordance with the Hazen-Williams Formula with 'C' value of 100 for steel pipe carrying foam/water solution, 150 for copper tube, and 140 for cement lined ductile iron pipe.

#### 2.1.1.5 Water Supply

Base hydraulic calculations on utilizing the existing fire pumps in the pump house serving the adjacent aircraft hangar P-904. The contractor

shall provide a fire pump test in accordance with NFPA 20 and NFPA 25.

#### 2.1.6 Duration of Discharge

System shall apply foam solution over the discharge area for a minimum of 10 minutes at the hydraulically calculated waterflow rate and 130 percent of the nominal concentrate injection rate. Reduction of the discharge duration based on a discharge rate higher than the specified minimum is not permitted. The water supply shall be capable of supplying 45 minutes of discharge of the combined overhead wet-pipe sprinkler system and low level foam protection system.

### 2.2 ELECTRIC DETECTION DEVICES

Provide X3301 Multispectrum IR Flame Detectors manufactured by Det-Tronics or approved equal. Provide Detectors with Hangar Mode as the factory default. Control and monitor optical flame detectors from a factory assembled Eagle Quantum Premier fire detection/releasing control unit manufactured by Det-Tronics. All wiring shall be supervised, shielded, and installed in protective metal conduit or tubing. Flame detectors shall be immune to radar and radio frequency emissions from hand held equipment or equipment on-board the aircraft.

#### 2.2.1 Releasing Service Fire Alarm Control Unit (FSCP)

Modular addressable type panel installed in a semi-recessed or surface mounted steel cabinet with hinged door and cylinder lock. Switches and other controls shall not be accessible without the use of a key. The control panel shall be a neat, compact, factory-wired assembly containing all parts and equipment required to provide specified operating and supervisory functions of the system. Panel cabinet shall be finished on the inside and outside with factory-applied enamel finish. Provide main annunciator located on the exterior of the cabinet door or visible through the cabinet door. Provide audible trouble signal. Provide prominent engraved rigid plastic or metal identification plates, or silk-screened labels attached to the rear face of the panel viewing window, for all lamps and switches. System power shall be 120 volts AC service, transformed through a two winding isolation transformer and rectified to 24 volts DC for operation of all system initiating, actuating, signal sounding, trouble signal and fire alarm tripping circuits. System shall be electrically supervised on all circuits. A ground fault condition or a single break in any circuit which prevents the required operation of the system shall result in the operation of the system trouble signal. A single open or ground fault condition in any detection (initiating) or signaling circuit shall not result in any loss of system function, but shall cause the actuation of system trouble signals. Loss of AC power, a break in the standby battery power circuits, or abnormal AC power or low battery voltage shall result in the operation of the system trouble signals. The abnormal position of any system switch in the control panel shall result in the operation of the system trouble signals. Trouble signals shall operate continuously until the system has been restored to normal at the control panel. System trouble shall also be annunciated on the appropriate zone of the building fire alarm panel through addressable modules and not networked together. FSCP alarm, supervisory, and trouble signal reporting to the Fire Alarm Control Panel must be via discrete dry contact output points. An alarm signal from the FSCP shall activate the fire alarm/mass notification system notification appliances. Locate the FSCP, releasing modules, and monitor modules integral to the releasing and stopping of the foam/water system in a normally occupied conditioned space



with the following parameters: temperature between 60 to 80 degrees F and a relative humidity of 85 percent at 86 degrees F. Openings or conduit entry into the top of the FSCP is not permitted. The enclosure shall be identified by an engraved nameplate. Lettering on the name plate shall not be less than one inch high and shall say "FOAM SYSTEM CONTROL PANEL". System control panel shall be UL listed or FM approved for extinguishing system control (releasing device service). Permanently label all switches. Provide panel with the following switches:

- a. Trouble silencing switch which transfers audible trouble signals (including remote trouble devices, if provided) to an indicating lamp. Upon correction of the trouble condition, audible signals will again sound until the switch is returned to its normal position, or the trouble signal circuit shall be automatically restored to normal upon correction of the trouble condition. The silencing switch may be a momentary action, self-resetting type.
- b. Alarm silencing switch which when activated will silence all associated alarm devices without resetting the panel, and cause operation of system trouble signals.
- c. Individual zone disconnect switches which when operated will disable only their respective initiating circuit and cause operation of the system and zone trouble signals.
- d. Reset switch which when activated will restore the system to normal standby status after the cause of the alarm has been corrected, and all activated initiating devices reset.
- e. Lamp test switch.
- f. Provide a 2-position non-key operated switch within the FSCP enclosure that when activated disables the optical flame detectors in the hangar bay through programming at the FSCP. Monitor the switch at the FSCP. Provide a supervisory signal to the receiving station indicating the optical flame detectors are inhibited. Label the switch "INHIBIT OPTICAL FLAME DETECTION." Provide engraved labels on the switch indicating when the optical flame detectors are in "NORMAL" or "INHIBIT" mode.

#### 2.2.1.1 Main Annunciator

Provide integral with the main control panel. Provide separate alarm and trouble lamps located on the exterior of the cabinet door or visible through the cabinet door. Lamps shall be LED (Light Emitting Diode) type. Annunciation shall provide specific identification of the zone area device by means of a direct readout. In no case shall zone identification consist of the words "Zone 1," "Zone 2," etc., but shall consist of the description of the zone area device. For example, foam manual station release, paint booth insert, northeast exit door.

#### 2.3 MANUAL RELEASE STATIONS

Provide release stations where shown, in accordance with UFC 4-211-01. Stations shall be of a type not subject to operation by jarring or vibration. Stations shall have a dual action release configuration to prevent accidental system discharge. Break-glass-front stations are not permitted. Station color shall be yellow and mounted on a lime yellow sign as detailed on the contract drawings. Station shall provide positive

visible indication of operation. Restoration shall require use of a key or special tool. Place warning signs at each station indicating that operation of the station will cause immediate AFFF discharge. Where a building fire alarm pull station is also mounted in the vicinity of a foam release station, separate the stations by at least 5 feet horizontally. Provide releasing station and tamper cover with colored portions in yellow and lettering reading "FOAM"; the words "FIRE", "ALARM", or "AGENT" are prohibited to appear on the cover or station. Route conduit into the bottom of the backbox for releasing stations, stop stations, and flame detectors. Provide the low point of this conduit with a drain. Where the conduit is in a hazardously classified area, provide breathers in isolated portions of the conduit such as where sealed offs are provided. Rate drains and breathers for the electrical hazard classification in which they are installed, but not less than NEMA 250 Type 4. Do not locate addressable monitor modules for the manual foam releasing stations in the paint booth insert. Install manual foam releasing stations within the paint booth insert so they are unobstructed, readily accessible, and located within 10 feet of each required exit or exit access from the paint booth insert. Provide clear plastic weather proof cover.

#### 2.4 MANUAL FOAM STOP (ABORT) STATIONS

Provide foam stop stations of the "dead-man" type. The stop stations must be used in conjunction with valves and equipment that will prohibit or stop the discharge of foam/water from the foam suppression system. The stations must have distinctive signage at each device. Provide a red mushroom type push button and include the word "PUSH". Colored portions of tamper cover must be blue and lettering on the cover must be "STOP"; the words "FIRE", "ALARM", or "AGENT" must not appear on the cover. A manual foam stop station will be provided at each manual foam releasing station. Once depressed, and so long as the button is held down, the stop station will prevent/stop discharge from the foam system regardless of whether or not the foam system was activated automatically or manually and whether or not the activation occurs prior to or after the stop station is pressed and held. Unless the FSCP has been reset and all activation alarms (manual and automatic) have been cleared; when the foam stop station button is released, the FSCP will instantaneously restore system operation and foam discharge. When the foam stop station button is depressed under full flow, the time to fully close the flow control valve will not exceed 15 seconds. The time for the flow control valve to fully open upon release of the foam stop station button will not exceed 5 seconds. Manual foam stop stations will be protected from mechanical damage and water infiltration (minimum NEMA 4). Manual foam stop stations will be provided with a clear plastic tamper cover that must be lifted prior to actuating the station. Conduits will enter the station back box from the bottom. Back box and conduits will not be placed in front of signage, and a breather and drain (at the low point in the conduit) will be provided. Where manual stop stations and foam releasing stations are provided at an exit door, they will be located on opposite sides of doorway from fire alarm manual pull station. Where not located at an exit door opening, the manual stop stations and foam releasing stations will be located at least 5 feet apart from the manual fire alarm pull station. Do not locate addressable monitor modules for the manual foam stop stations within the paint booth insert.

#### 2.5 OPTICAL FLAME DETECTORS

Optical flame detectors will be X3301 Multispectrum IR Flame Detector manufactured by Det-Tronics. Optical flame detection system will use triple infrared (IR) flame detectors listed/approved for the expected fuel

hazards in the hangar bay. The detectors will be immune to radar and radio frequency emissions. Provide shielding for the detectors and their circuits from radio frequency interference. All circuiting from the FSCP to the detectors will be shielded, and shielding will be grounded at one end. Detectors must be mounted in accordance with their listing at approximately 8 feet above the finished floor of the hangar. The specifics for each design must take into account facility construction, type of aircraft, aircraft configuration and positioning, fixed and mobile equipment within the aircraft servicing area, and all other relevant factors. Do not mount optical detectors in inaccessible locations. The detectors will be angled and blinds will be provided such that the cone-of-vision does not extend more than 5 feet outside the hangar bay. The horizontal and vertical axis of the detector determined during commissioning will be permanently marked on each detector. The optical flame detectors will be installed with 5 feet of flexible conduit to allow for any minor adjustments during testing or changes in mission of the hangar. Provide a sufficient number of optical flame detectors such that a fire at any position within the hangar bay will be within the range and cone-of vision of at least three detectors. With the exception of a manual foam release station, the cross-zoning of two optical flame detectors in the hangar bay is required to release the foam suppression system. Calibrate optical flame detectors to operate upon viewing the flame signature of the expected fuel to be in the paint booth insert. Use a 2 by 2 foot pool fire as the bases to set the sensitivity of the optical flame detectors. Upon the pool fire reaching full development, all detectors within the cone-of-vision are required to activate within 30 seconds.

## 2.6 ELECTRICAL WORK

Electrical work is specified in Section 26 20 00 INTERIOR DISTRIBUTION SYSTEM, except for control and fire alarm wiring. Fire alarm system is specified in Section 28 31 76 INTERIOR FIRE ALARM AND MASS NOTIFICATION SYSTEM.

### 2.6.1 Storage Batteries

All storage batteries for back up power shall be in accordance with Section 28 31 76 INTERIOR FIRE ALARM AND MASS NOTIFICATION SYSTEM.

## 2.7 SYSTEM ACTIVATION

### 2.7.1 Trench Grate Nozzle System Activation

Upon activation of two triple IR flame detectors or manual releasing stations, foam/water solution shall be delivered to all trench nozzles protecting the aircraft paint booth insert area. See fire alarm matrix on the contract drawings for more information.

## 2.8 ALARMS

### 2.8.1 Fire Alarm

Provide equipment for the automatic transmittal of an alarm over the building fire alarm system. Arrange so that the detection system and the flow of solution in each system will actuate the alarm.

#### 2.8.1.1 Waterflow Pressure Alarm Switch

Waterflow pressure alarm switch unit shall include a 1/2 inch NPT male

pipe thread, two 1/2 inch conduit knockouts, and two sets of SPDT (Form C) contacts. The switches shall be factory adjusted to transfer contacts at 4 to 8 psi on rising pressure. Unit shall include a water-tight NEMA 4 housing with a tamper resistant cover which requires a special key for removal. The cover shall be provided with a tamper switch which shall operate upon removal of cover. Units used on wet-pipe systems shall have an adjustable, instantly recycling pneumatic retard to prevent false alarms due to water pressure variation. Retard adjustment shall be set at approximately 20-40 seconds and adjustable between 0-90 seconds.

## 2.9 AFFF CONCENTRATE

Provide 3 percent AFFF concentrate meeting Military Specification MIL-PRF-24385 that is currently on the Qualified Products List (QPL).

## 2.10 FOAM INDUCTION SYSTEM

Foam proportioning must be by a single foam inductor for each foam-water riser. Inductor must, through a venturi, take concentrate and proportion such concentrate into the flow stream reliably at the designed system flow rate. Inductor shall be designed to 115 percent of the nominal injection rate. Inductor must be specifically manufactured and tuned for the system required flow rate, inlet pressure, back pressure, concentrate type, proportioning ratio, and lift height at the near empty tank level. The inductor must be equipped with the exact orifice at the entry of the foam pipe. Off the shelf pre-tuned generic model inductors are not permitted. Shop drawings must be accompanied with an inductor data sheet fully annotated with the flow rate, inlet pressure, back pressure, and concentrate lift height at the near empty tank level. Concentrate suction line of the inductor will be fitted with a low loss bronze or brass check valve assembly by the manufacturer that is included in the device's hydraulic design. Install inductor in the horizontal piping over the top of the concentrate tank. Provide the minimum straight pipe on both sides of the inductor in accordance with the manufacturer's recommendations (typically 5 pipe diameters). Provide liquid filled gauges, located no closer than 2 feet before and after the inductor. Acceptable manufacturers of foam inductors include Fomtec (distributed by Viking in US), Matre Maskin, Wilson Foam, and Delta Fire.

## 2.11 AFFF CONCENTRATE STORAGE TANKS

Tank shall be designed for storage of AFFF concentrate at atmospheric pressure, and shall be a closed cell double wall polyethylene storage tank. Tank shall have the following: Drain valve located at the lowest point in the tank, top-mounted fill connections and inspection hatch, and a pressure/vacuum relief vent. All openings and tank connections shall be installed at the factory, no holes shall be made in the tank shell in the field. Provide a reverse float level gauge with minimum 50 gallon increments permanently marked on the tank or gauge. Indicate on the tank or gauge the empty, full, minimum level required to operate the system. Do not include the inaccessible portion of concentrate at the bottom of the tank that cannot be accessed by the suction line, in the tank's capacity markings. For the foam inductor, enter the tank only through the top. Size tank to provide sufficient AFFF concentrate for the time specified when the system is discharging foam solution at total maximum system flow. Size the tank to support a 10 minute discharge at the hydraulically calculated waterflow rate and 130 percent of the nominal concentrate injection rate. Provide 1/4 inch layer of mineral oil on top of concentrate, after storage tank has been filled.

## 2.12 TRENCH GRATE NOZZLES

Use Viking Grate Nozzle, Models GN 200/360, 200/180, or 200/90 or approved equal for the low level AFFF system. Use nozzles that are UL Listed or FM approved. Space nozzles in accordance with UFC 4-211-01. The grate nozzle system shall withstand the load of aircraft parked over the grate nozzle. Design the system so that total nozzle obstructions do not negatively impact the hydraulics of the distribution system or the foam induction capabilities.

## 2.13 SURGE ARRESTORS

Surge tanks shall be provided at sprinkler and foam system risers, or on system header. Surge tanks shall be of carbon steel construction with buna-n rubber bladders. Surge tanks shall be UL listed or FM approved, and A.S.M.E. rated for 275 psi. Tanks shall bear the A.S.M.E. label. Surge tanks shall be bladder type, top repairable type. Surge tanks shall be sized in accordance with UFC 4-211-01, Section 3-6.5.2.

## 2.14 ABOVEGROUND PIPING SYSTEMS

Provide piping in accordance with Section 21 13 13.00 20 WET PIPE SPRINKLER SYSTEM, NFPA 13, except as modified herein. Piping shall be Schedule 40 hot dipped galvanized steel piping downstream of the flow control valve. Main drain from flow control valves shall be piped into the retention trench. No piping shall run atop the finished floor. Provide seismic earthquake protection in accordance with NFPA 13. Provide end caps tapped with a valve at the end of each branch line in the trench nozzle system. Use the taps for the attachment of pressure gauges during testing, and drainage of the piping system after activation. Do not roll groove galvanized pipe. Clean cutting oils and debris from any cut grooves, threaded ends, and areas where the zinc coating has been damaged. Dry and paint damaged areas with two full coats of a cold galvanizing primer containing a minimum 95 percent zinc.

### 2.14.1 Pipe, Fittings, and Mechanical Couplings

Pipe nipples 6 inches long and shorter shall be Schedule 80 steel pipe. Rubber gasketed grooved-end pipe and fittings with mechanical couplings shall only be permitted in pipe sizes 1 1/2 inches and larger. Rubber gaskets shall be UL listed for use in dry-pipe sprinkler systems. Use of restriction orifices, reducing flanges, and plain-end fittings with mechanical couplings (which utilize steel gripping devices to bite into the pipe when pressure is applied) are not permitted. Pipe and fittings in contact with AFFF concentrate shall be stainless steel. Fittings on concentrate lines shall be flanged or welded only. Screwed or mechanical fittings will not be permitted. Provide foam system with fitting to accommodate auxiliary tank of alternate test liquid. Provide a stainless steel full bore quarter turn ball valve with an electrically supervised tamper switch in the concentrate line. The use of automatically controller valves in the concentrate line is prohibited. Provide 3/4 inch copper line with ball valve from fire water supply used for flushing the concentrate line after use. Provide signage with the following instructions, "Flush concentrate line after discharge or testing. Close concentrate tank shutoff valve prior to opening this valve. After flushing, drain concentrate line through test connection prior to re-opening concentrate tank shutoff valve."

#### 2.14.2 Jointing Material

CID A-A-58092, Polytetrafluoroethylene (PTFE) tape. Pipe joint compound (pipe dope) is not acceptable.

#### 2.14.3 Duplex Basket Strainers

FS WW-S-2739, Style Y (Y pattern). Provide duplex basket strainers and an isolation valve with removable screens having standard perforations, 0.125 inch in diameter in the riser beneath the deluge valves.

#### 2.14.4 Pipe Hangers and Supports

In accordance with Section 21 13 13.00 20 WET PIPE SPRINKLER SYSTEM, except supports in the trenches shall be fully galvanized..

### 2.15 CONCENTRATE CONTROL VALVE ASSEMBLY

Assembly shall be specifically designed and constructed to control foam concentrate and shall be arranged to open upon application of water pressure from the deluge valve to which it is connected. Valve shall be a listed or approved hydraulically actuated ball valve specifically intended for this application. Valve body shall be bronze or stainless steel. All components shall be rated for a working pressure of 175 psi or maximum working pressure to which they could be subjected, whichever is greater. Valve shall be certified by the manufacturer to be operable with water inlet pressure as low as 40 psi. Valve ball shall be stainless steel. Valve shall be provided with a 316 stainless steel hydraulic actuator, designed for on/off operation of 1/4-turn ball valves. The actuator cylinder shall be designed for operation by water pressure. Valve seats shall be of glass-reinforced Teflon material. The valve shall have an external mechanical position indicator.

## PART 3 EXECUTION

### 3.1 AFFF SYSTEM INSTALLATION

Equipment, materials, installation, workmanship, fabrication, assembly, erection, examination, inspection, and testing shall be in accordance with the NFPA standards and UFC's referenced herein. Install piping straight and true to bear evenly on hangers and supports. Conceal piping to the maximum extent possible. Piping shall be inspected, tested and approved by the QC Fire Protection Engineer in accordance with Section 01 45 00.00 20. before being concealed. Provide fittings for changes in direction of piping and for all connections. Make changes in piping sizes through standard reducing pipe fittings; do not use bushings. Cut pipe accurately and work into place without springing or forcing. Ream pipe ends and free pipe and fittings from burrs. Clean with solvent to remove all varnish and cutting oil prior to assembly. Make screw joints with PTFE tape applied to male thread only.

### 3.2 FIELD PAINTING

Clean, prime, and paint new foam systems including valves, piping, conduit, hangers, miscellaneous metal work, and accessories. Exercise care to avoid the painting of sprinkler heads and operating devices. Upon completion of painting, remove materials which were used to protect sprinkler heads and operating devices while painting is in process. Remove sprinkler heads and operating devices which have been inadvertently

painted and provide new clean sprinkler heads and operating devices of the proper type. In accordance with Section 09 90 00 PAINTS AND COATINGS. Color shall be red. Stainless steel piping and fittings are not required to be painted.

### 3.2.1 Piping Labels

Mark all exposed interior piping with plastic wrap around-type labels conforming to ASME A13.1. Indicate the type of fluid carried and direction of flow. Labels that stick-on (adhesive backed) or are held on with straps/adhesive tape are not permitted. Labels are not required on any fire suppression system branchlines regardless of size, or mains and cross-mains less than a nominal 2-1/2 inches. Labels are not required on piping below the floor line in trenches or pits. At a minimum, the following labels are required:

FOAM CONCENTRATE - Used on foam concentrate piping.  
AFFF - Used on AFFF foam/water piping.

### 3.2.2 Supervision/Signage

Provide sequential signage on the control valves for the emergency shutdown of the foam/water system. Locate these signs so they are readily visible near each valve used in the shutdown sequence. Provide signs with white background and a minimum 1/2 inch wide blue border with red lettering not less than 1 inch high. At a minimum, provide each sign with the language, "EMERGENCY FOAM SHUTDOWN PROCEDURE" and the order and action to be performed as "1 - CLOSE FOAM CONCENTRATE VALVE", "2 - CLOSE FOAM/WATER RISER CONTROL VALVE". Continue the sequence as required for shutdown. Mechanically lock or provide tamper seals such as zip ties on trim valves, that when opened or closed are detrimental to the operation of the foam/water system such as the shutoff for the foam system pressure switch. Provide signage indicating the valve's normal operating position. Mechanically lock or provide tamper seals such as zip ties on drain or trim valving in the closed position, that when opened will cause discharge of the foam/water system such as the manual release valve on the foam/water system riser. Provide this valve with the following signage, "OPENING THIS VALVE WILL RELEASE THE FOAM SYSTEM."

### 3.2.3 Field Touch-Up

Clean damaged areas of shop coated tanks in accordance with SSPC SP 11 and coat cleaned areas with the same materials used for the shop applied coating system.

## 3.3 ELECTRICAL WORK

Electrical work is specified in Section 26 20 00 INTERIOR DISTRIBUTION SYSTEM, except for control and fire alarm wiring. Fire alarm system is specified in Section 28 31 76 INTERIOR FIRE ALARM AND MASS NOTIFICATION SYSTEM.

### 3.3.1 Wiring

Run wiring to UV-IR detectors alone in separate conduit if required by the detector manufacturer.

### 3.4 FLUSHING

Flush the piping system with potable water in accordance with NFPA 13. Continue flushing operation until water is clear, but for not less than 10 minutes.

### 3.5 FIELD QUALITY CONTROL

Prior to initial operation, the Contractor's QC Fire Protection Engineer shall inspect equipment and piping systems for compliance with drawings, specifications, and manufacturer's submittals. The QC Fire Protection Engineer shall perform tests in the presence of the Contracting Officer to determine conformance with the specified requirements.

#### 3.5.1 Preliminary Tests

Each piping system shall be hydrostatically tested at 200 psig in accordance with NFPA 13 and shall show no leakage or reduction in gauge pressure after 2 hours. The Contractor shall conduct complete preliminary tests witnessed by the QC Fire Protection Engineer, which shall encompass all aspects of system operation. Individually test all detectors, manual actuation stations, alarms, control panels, and all other components and accessories to demonstrate proper functioning. Test water flow alarms by flowing water through the inspector's test connection. When tests have been completed and all necessary corrections made, submit to the Contracting Officer a signed and dated certificate, similar to that specified in NFPA 13, attesting to the satisfactory completion of all testing and stating that the system is in operating condition. Also include a written request for a formal inspection and test.

#### 3.5.2 Formal Inspection and Tests (Acceptance Tests)

The QC Fire Protection Engineer and the Pacific Division, Naval Facilities Engineering Command Fire Protection Engineer, will witness formal tests and approve all systems before they are accepted. The system shall be considered ready for such testing only after all necessary preliminary tests have been made and all deficiencies found have been corrected to the satisfaction of the equipment manufacturer's technical representative and written certification to this effect is received by the NAVFAC Pacific Fire Protection Engineer. Submit the request for formal inspection at least 15 working days prior to the date the inspection is to take place. The control panel(s) and detection system(s) shall be in continuous service for a "break-in" period of at least 15 consecutive days prior to the formal inspection. Experienced technicians regularly employed by the Contractor in the installation of both the mechanical and electrical portions of such systems shall be present during the inspection and shall conduct the testing. All AFFF concentrate, instruments, including flame detector live fire test in accordance with UFC 4-211-01, personnel, appliances and equipment for testing shall be furnished by the Contractor. All necessary tests encompassing all aspects of system operation shall be made including the following, and any deficiency found shall be corrected and the system retested at no cost to the Government.

##### 3.5.2.1 Systems and Device Testing

The entire initiating, alarm, actuation systems shall be operated. As a minimum, operation and supervision of the following functions and devices shall be demonstrated:



- a. All operational and supervisory functions of the control and annunciator panels.
- b. Each manual actuation station and associated circuit(s).
- c. All detectors and associated circuits.
- d. All alarms and associated circuits.
- e. All actuator circuits and system control valve(s) (without foam discharge).
- f. Activation of the building fire evacuation alarm system.
- g. Activation of the Base fire alarm system (receipt of fire alarm at alarm office).
- h. All of the above tests shall then be repeated with the system on battery power only.

#### 3.5.2.2 AFFF Discharge and Concentration Testing

When all of the initiating, alarm, actuation, and supervisory functions of the system operate to the satisfaction of the system manufacturer's technical representative and the Division Fire Protection Engineer, a complete discharge test of each system shall be performed to demonstrate satisfactory performance, proper AFFF concentration, mechanical operation and operation of valves, release devices, alarms, and interlocks which control the protected areas. These tests shall be conducted by experienced personnel according to the equipment and AFFF manufacturers' recommendations.

- a. Test each deluge system by full flow of foam solution from the individual systems or combination of systems to achieve maximum design flow rate for at least 60 seconds.

The manufacturer's representative shall test samples of foam solution taken from each system to ensure proper AFFF concentration. Testing of the AFFF system shall utilize an environmentally friendly AFFF substitute formulated to mimic the physical properties of MIL-SPEC AFFF concentrate while having characteristics that enable its injection rate to be monitored by refractive index or conductivity measurement. Provide protection for all electrical fixtures and equipment exposed to possible damage during tests and protect doors and other openings leading from the protected area(s), to prevent migration of foam solution into other areas or spaces.

#### 3.5.2.3 Flushing and Rinsing

After completion of tests flush all piping carrying AFFF concentrate and solution with fresh water. Piping normally containing AFFF concentrate when the system is in standby mode need not be flushed. Rinse with fresh water all equipment and building surfaces exposed to AFFF discharge.

#### 3.5.3 Environmental Protection

Provide temporary measures to prevent AFFF from entering storm drains, sanitary sewers, drainage ditches, streams and water courses. Do not

allow AFFF concentrate or solution to come in contact with earth. Contain all discharged AFFF on paved surfaces. Collect all discharged AFFF and rinse and flushing water and dispose of it in an EPA - approved waste-water treatment facility which provides secondary (biological) treatment. At least 15 days prior to the date flow testing is to take place, submit written plan for AFFF containment and disposal methods(s) to the Contracting Officer for approval.

#### 3.5.4 Additional Tests

When deficiencies, defects or malfunctions develop during the tests required, all further testing of the system shall be suspended until proper adjustments, corrections or revisions have been made to assure proper performance of the system. If these revisions require more than a nominal delay, the Contracting Officer shall be notified when the additional work has been completed, to arrange a new inspection and test of the system. All tests required shall be repeated prior to final acceptance, unless directed otherwise.

#### 3.5.5 AFFF Concentrate Storage Tanks Fill-Up

Fill storage tanks including reserve tanks and piping normally containing concentrate when the system is in standby mode with Contractor furnished AFFF concentrate after acceptance of the system.

#### 3.5.6 Manufacturer's Representative

Provide the services of representatives or technicians from the manufacturers of the foam system, control panel, and flame detectors, experienced in the installation and operation of the type of system being provided, to supervise installation, adjustment, preliminary testing, and final testing of the system and to provide instruction to Government personnel.

### 3.6 OPERATING INSTRUCTIONS

Provide operating instructions at control equipment and at each remote control station. Instructions shall clearly indicate all necessary steps for the operation of the system. Submit the proposed legend for operating instructions for approval prior to installation. Instructions shall be in engraved white letters on red rigid plastic or red enameled steel backgrounds and shall be of adequate size to permit them to be easily read.

### 3.7 TRAINING REQUIREMENTS

Prior to final acceptance, the Contractor shall provide two sessions of 4 hours each of operation and maintenance training to the Base Fire Department and Public Works personnel on different days to accommodate all shifts of the Base Fire Department. Each training session shall include emergency procedures, and unique maintenance and safety requirements. Training areas will be provided by the Government in the same building as the protected areas. The training conducted shall use operation and maintenance manuals specified in paragraph entitled "Operations and Maintenance Manuals". Dates and times of the training period shall be coordinated through the Contracting Officer not less than two weeks prior

to the session.

-- End of Section --



SECTION 22 00 00

PLUMBING, GENERAL PURPOSE

11/15

PART 1 GENERAL

1.1 REFERENCES

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

AIR-CONDITIONING, HEATING AND REFRIGERATION INSTITUTE (AHRI)

AHRI 1010 (2002) Self-Contained, Mechanically Refrigerated Drinking-Water Coolers

ANSI/AHRI 520 (2004) Performance Rating of Positive Displacement Condensing Units

AMERICAN NATIONAL STANDARDS INSTITUTE (ANSI)

ANSI Z21.22/CSA 4.4 (2015) Relief Valves for Hot Water Supply Systems

ANSI/ISEA Z358.1 (2014) Standard for Plumbed and Portable Eyewash Stations

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

ASHRAE 189.1 (2014) Standard for the Design of High-Performance Green Buildings Except Low-Rise Residential Buildings

ASHRAE 90.1 - IP (2013) Energy Standard for Buildings Except Low-Rise Residential Buildings

AMERICAN SOCIETY OF CIVIL ENGINEERS (ASCE)

ASCE 7 (2017) Minimum Design Loads for Buildings and Other Structures

AMERICAN SOCIETY OF SANITARY ENGINEERING (ASSE)

ASSE 1001 (2016) Performance Requirements for Atmospheric Type Vacuum Breakers

ASSE 1003 (2009) Performance Requirements for Water Pressure Reducing Valves for Domestic Water Distribution Systems - (ANSI approved 2010)

ASSE 1010 (2004) Performance Requirements for Water Hammer Arresters (ANSI approved 2004)

ASSE 1011 (2004; Errata 2004) Performance

Requirements for Hose Connection Vacuum  
Breakers (ANSI approved 2004)

ASSE 1012	(2009) Performance Requirements for Backflow Preventer with an Intermediate Atmospheric Vent - (ANSI approved 2009)
ASSE 1013	(2011) Performance Requirements for Reduced Pressure Principle Backflow Preventers and Reduced Pressure Fire Protection Principle Backflow Preventers - (ANSI approved 2010)
ASSE 1014	(2005) Performance Requirements for Backflow Prevention Devices for Hand-Held Showers
ASSE 1016	(2011) Performance Requirements for Automatic Compensating Valves for Individual Showers and Tub/Shower Combinations
ASSE 1017	(2009) Performance Requirements for Temperature Actuated Mixing Valves for Hot Water Distribution Systems - (ANSI approved 2010)
ASSE 1018	(2001) Performance Requirements for Trap Seal Primer Valves - Potable Water Supplied (ANSI Approved 2002)
ASSE 1020	(2004; Errata 2004; Errata 2004) Performance Requirements for Pressure Vacuum Breaker Assembly (ANSI Approved 2004)
ASSE 1070	(2004) Performance Requirements for Water Temperature Limiting Devices

AMERICAN WATER WORKS ASSOCIATION (AWWA)

AWWA B300	(2010; Addenda 2011) Hypochlorites
AWWA B301	(2010) Liquid Chlorine
AWWA C203	(2008) Coal-Tar Protective Coatings and Linings for Steel Water Pipelines - Enamel and Tape - Hot-Applied
AWWA C606	(2015) Grooved and Shouldered Joints
AWWA C651	(2014) Standard for Disinfecting Water Mains
AWWA C652	(2011) Disinfection of Water-Storage Facilities
AWWA C701	(2015) Cold-Water Meters - Turbine Type for Customer Service

AWWA D100 (2011) Welded Steel Tanks for Water Storage

AMERICAN WELDING SOCIETY (AWS)

AWS A5.8/A5.8M (2011; Amendment 2012) Specification for  
Filler Metals for Brazing and Braze Welding

AWS B2.2/B2.2M (2016) Specification for Brazing Procedure  
and Performance Qualification

ASME INTERNATIONAL (ASME)

ASME A112.1.2 (2012; R 2017) Air Gaps in Plumbing  
Systems (For Plumbing Fixtures and  
Water-Connected Receptors)

ASME A112.19.2/CSA B45.1 (2013) Standard for Vitreous China  
Plumbing Fixtures and Hydraulic  
Requirements for Water Closets and Urinals

ASME A112.19.3/CSA B45.4 (2017; Errata 2017) Stainless Steel  
Plumbing Fixtures

ASME A112.36.2M (1991; R 2017) Cleanouts

ASME A112.6.1M (1997; R 2017) Floor Affixed Supports for  
Off-the-Floor Plumbing Fixtures for Public  
Use

ASME A112.6.1M (1997; R 2017) Floor Affixed Supports for  
Off-the-Floor Plumbing Fixtures for Public  
Use

ASME A112.6.3 (2016) Standard for Floor and Trench Drains

ASME B1.20.1 (2013) Pipe Threads, General Purpose (Inch)

ASME B16.12 (2009; R 2014) Cast Iron Threaded Drainage  
Fittings

ASME B16.15 (2013) Cast Copper Alloy Threaded Fittings  
Classes 125 and 250

ASME B16.18 (2012) Cast Copper Alloy Solder Joint  
Pressure Fittings

ASME B16.21 (2011) Nonmetallic Flat Gaskets for Pipe  
Flanges

ASME B16.22 (2013) 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 (2011) Cast Copper Alloy Pipe Flanges and  
Flanged Fittings: Classes 150, 300, 600,  
900, 1500, and 2500

ASME B16.29	(2012) Wrought Copper and Wrought Copper Alloy Solder Joint Drainage Fittings - DWV
ASME B16.3	(2011) Malleable Iron Threaded Fittings, Classes 150 and 300
ASME B16.4	(2011) Standard for Gray Iron Threaded Fittings; Classes 125 and 250
ASME B16.5	(2013) Pipe Flanges and Flanged Fittings: NPS 1/2 Through NPS 24 Metric/Inch Standard
ASME B16.50	(2013) Wrought Copper and Copper Alloy Braze-Joint Pressure Fittings
ASME B31.1	(2016; Errata 2016) Power Piping
ASME B31.5	(2016) Refrigeration Piping and Heat Transfer Components
ASME B40.100	(2013) Pressure Gauges and Gauge Attachments
ASME BPVC SEC IV	(2010) BPVC Section IV-Rules for Construction of Heating Boilers
ASME BPVC SEC IX	(2010) BPVC Section IX-Welding and Brazing Qualifications
ASME BPVC SEC VIII D1	(2015) BPVC Section VIII-Rules for Construction of Pressure Vessels Division 1

ASTM INTERNATIONAL (ASTM)

ASTM A105/A105M	(2014) Standard Specification for Carbon Steel Forgings for Piping Applications
ASTM A183	(2014) Standard Specification for Carbon Steel Track Bolts and Nuts
ASTM A193/A193M	(2016) Standard Specification for Alloy-Steel and Stainless Steel Bolting Materials for High-Temperature Service and Other Special Purpose Applications
ASTM A47/A47M	(1999; R 2014) Standard Specification for Ferritic Malleable Iron Castings
ASTM A515/A515M	(2010) Standard Specification for Pressure Vessel Plates, Carbon Steel, for Intermediate- and Higher-Temperature Service
ASTM A516/A516M	(2010; R 2015) Standard Specification for Pressure Vessel Plates, Carbon Steel, for Moderate- and Lower-Temperature Service
ASTM A53/A53M	(2012) Standard Specification for Pipe,



	Steel, Black and Hot-Dipped, Zinc-Coated, Welded and Seamless
ASTM A536	(1984; R 2014) Standard Specification for Ductile Iron Castings
ASTM A74	(2016) Standard Specification for Cast Iron Soil Pipe and Fittings
ASTM A888	(2013a) Standard Specification for Hubless Cast Iron Soil Pipe and Fittings for Sanitary and Storm Drain, Waste, and Vent Piping Applications
ASTM B117	(2016) Standard Practice for Operating Salt Spray (Fog) Apparatus
ASTM B152/B152M	(2013) Standard Specification for Copper Sheet, Strip, Plate, and Rolled Bar
ASTM B306	(2013) Standard Specification for Copper Drainage Tube (DWV)
ASTM B32	(2008; R 2014) Standard Specification for Solder Metal
ASTM B370	(2012) Standard Specification for Copper Sheet and Strip for Building Construction
ASTM B42	(2015a) Standard Specification for Seamless Copper Pipe, Standard Sizes
ASTM B43	(2014) Standard Specification for Seamless Red Brass Pipe, Standard Sizes
ASTM B584	(2014) Standard Specification for Copper Alloy Sand Castings for General Applications
ASTM B75/B75M	(2011) Standard Specification for Seamless Copper Tube
ASTM B813	(2016) Standard Specification for Liquid and Paste Fluxes for Soldering of Copper and Copper Alloy Tube
ASTM B819	(2000; R 2011) Standard Specification for Seamless Copper Tube for Medical Gas Systems
ASTM B828	(2016) Standard Practice for Making Capillary Joints by Soldering of Copper and Copper Alloy Tube and Fittings
ASTM B88	(2016) Standard Specification for Seamless Copper Water Tube
ASTM B88M	(2016) Standard Specification for Seamless Copper Water Tube (Metric)

ASTM C564	(2014) Standard Specification for Rubber Gaskets for Cast Iron Soil Pipe and Fittings
ASTM C920	(2018) Standard Specification for Elastomeric Joint Sealants
ASTM D2000	(2012; R 2017) Standard Classification System for Rubber Products in Automotive Applications
ASTM D2235	(2004; R 2016) Standard Specification for Solvent Cement for Acrylonitrile-Butadiene-Styrene (ABS) Plastic Pipe and Fittings
ASTM D2239	(2012) Standard Specification for Polyethylene (PE) Plastic Pipe (SIDR-PR) Based on Controlled Inside Diameter
ASTM D2241	(2015) Standard Specification for Poly(Vinyl Chloride) (PVC) Pressure-Rated Pipe (SDR Series)
ASTM D2466	(2017) Standard Specification for Poly(Vinyl Chloride) (PVC) Plastic Pipe Fittings, Schedule 40
ASTM D2467	(2015) Standard Specification for Poly(Vinyl Chloride) (PVC) Plastic Pipe Fittings, Schedule 80
ASTM D2564	(2012) Standard Specification for Solvent Cements for Poly(Vinyl Chloride) (PVC) Plastic Piping Systems
ASTM D2661	(2014) 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 D2683	(2014) Standard Specification for Socket-Type Polyethylene Fittings for Outside Diameter-Controlled Polyethylene Pipe and Tubing
ASTM D2737	(2012a) Polyethylene (PE) Plastic Tubing
ASTM D2822/D2822M	(2005; R 2011; E 2011) Standard Specification for Asphalt Roof Cement, Asbestos-Containing
ASTM D2846/D2846M	(2017) 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 D3035	(2015) Polyethylene (PE) Plastic Pipe (DR-PR) Based on Controlled Outside Diameter
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	(1998; R 2011) Joints for Plastic Pressure Pipes Using Flexible Elastomeric Seals
ASTM D3212	(2007; R 2013) Standard Specification for Joints for Drain and Sewer Plastic Pipes Using Flexible Elastomeric Seals
ASTM D3261	(2016) Standard Specification for Butt Heat Fusion Polyethylene (PE) Plastic Fittings for Polyethylene (PE) Plastic Pipe and Tubing
ASTM D3311	(2017) Standard Specification for Drain, Waste, and Vent (DWV) Plastic Fittings Patterns
ASTM E1	(2014) Standard Specification for ASTM Liquid-in-Glass Thermometers
ASTM F1760	(2016) Standard Specification for Coextruded Poly(Vinyl Chloride) (PVC) Non-Pressure Plastic Pipe Having Reprocessed-Recycled Content
ASTM F2389	(2017a) Standard Specification for Pressure-rated Polypropylene (PP) Piping Systems
ASTM F409	(2017) Standard Specification for Thermoplastic Accessible and Replaceable Plastic Tube and Tubular Fittings
ASTM F441/F441M	(2013; E 2013) Standard Specification for Chlorinated Poly(Vinyl Chloride) (CPVC) Plastic Pipe, Schedules 40 and 80
ASTM F442/F442M	(2013; E 2013) Standard Specification for Chlorinated Poly(Vinyl Chloride) (CPVC) Plastic Pipe (SDR-PR)
ASTM F477	(2014) Standard Specification for Elastomeric Seals (Gaskets) for Joining

Plastic Pipe

ASTM F493	(2014) Solvent Cements for Chlorinated Poly (Vinyl Chloride) (CPVC) Plastic Pipe and Fittings
ASTM F628	(2012; E 2013; E 2016) 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

CAST IRON SOIL PIPE INSTITUTE (CISPI)

CISPI 301	(2009) Hubless Cast Iron Soil Pipe and Fittings for Sanitary and Storm Drain, Waste, and Vent Piping Applications
CISPI 310	(2011) 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	(2010) Copper Tube Handbook
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INTERNATIONAL CODE COUNCIL (ICC)

ICC A117.1 COMM	(2017) Standard And Commentary Accessible and Usable Buildings and Facilities
ICC IPC	(2015) International Plumbing Code

MANUFACTURERS STANDARDIZATION SOCIETY OF THE VALVE AND FITTINGS INDUSTRY (MSS)

MSS SP-110	(2010) Ball Valves Threaded, Socket-Welding, Solder Joint, Grooved and Flared Ends
MSS SP-25	(2013) Standard Marking System for Valves, Fittings, Flanges and Unions
MSS SP-58	(1993; Reaffirmed 2010) Pipe Hangers and Supports - Materials, Design and Manufacture, Selection, Application, and Installation
MSS SP-67	(2017) Butterfly Valves
MSS SP-70	(2011) Gray Iron Gate Valves, Flanged and Threaded Ends
MSS SP-71	(2011; Errata 2013) 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-80 (2013) Bronze Gate, Globe, Angle and Check  
Valves

NACE INTERNATIONAL (NACE)

NACE SP0169 (2015) Control of External Corrosion on  
Underground or Submerged Metallic Piping  
Systems

NATIONAL ELECTRICAL MANUFACTURERS ASSOCIATION (NEMA)

NEMA 250 (2014) Enclosures for Electrical Equipment  
(1000 Volts Maximum)

NEMA MG 1 (2016; SUPP 2016) Motors and Generators

NEMA MG 11 (1977; R 2012) Energy Management Guide for  
Selection and Use of Single Phase Motors

NATIONAL FIRE PROTECTION ASSOCIATION (NFPA)

NFPA 90A (2018) Standard for the Installation of  
Air Conditioning and Ventilating Systems

NSF INTERNATIONAL (NSF)

NSF 372 (2011) Drinking Water System Components -  
Lead Content

NSF/ANSI 14 (2017b) Plastics Piping System Components  
and Related Materials

NSF/ANSI 61 (2016) Drinking Water System Components -  
Health Effects

PLUMBING AND DRAINAGE INSTITUTE (PDI)

PDI WH 201 (2010) Water Hammer Arresters Standard

SOCIETY OF AUTOMOTIVE ENGINEERS INTERNATIONAL (SAE)

SAE J1508 (2009) Hose Clamp Specifications

U.S. DEPARTMENT OF ENERGY (DOE)

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

U.S. DEPARTMENT OF DEFENSE (DOD)

UFC 3-310-04 (2013; with Change 1) Seismic Design for  
Buildings

U.S. ENVIRONMENTAL PROTECTION AGENCY (EPA)

EPA SM 9223 (2004) Enzyme Substrate Coliform Test  
PL 93-523 (1974; A 1999) Safe Drinking Water Act

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

10 CFR 430 Energy Conservation Program for Consumer Products  
40 CFR 141.80 National Primary Drinking Water Regulations; Control of Lead and Copper; General Requirements  
PL 109-58 Energy Policy Act of 2005 (EPAct05)

UNDERWRITERS LABORATORIES (UL)

UL 174 (2004; Reprint Apr 2015) Household Electric Storage Tank Water Heaters  
UL 430 (2009; Reprint Dec 2014) Standard for Waste Disposers

1.2 SUBMITTALS

Government approval is required for submittals with a "G" designation; submittals not having a "G" designation are for Contractor Quality Control approval. Submittals with an "S" are for inclusion in the Sustainability eNotebook, in conformance to Section 01 33 29 SUSTAINABILITY REPORTING. Submit the following in accordance with Section 01 33 00 SUBMITTAL PROCEDURES:

SD-02 Shop Drawings

Plumbing System; G

Detail drawings consisting of schedules, performance charts, instructions, diagrams, and other information to illustrate the requirements and operations of systems that are not covered by the Plumbing Code. Detail drawings for the complete plumbing system including piping layouts and locations of connections; dimensions for roughing-in, foundation, and support points; schematic diagrams and wiring diagrams or connection and interconnection diagrams. Detail drawings shall indicate clearances required for maintenance and operation. Where piping and equipment are to be supported other than as indicated, details shall include loadings and proposed support methods. Mechanical drawing plans, elevations, views, and details, shall be drawn to scale.

SD-03 Product Data

Fixtures

List of installed fixtures with manufacturer, model, and flow rate.

Flush Valve Water Closets

Flush Valve Urinals

Undercounter Lavatories

Kitchen/Break Room Sinks

Mop Sinks

Service Sinks

Drinking-Water Coolers; G

Expansion Tank; G

Water Heaters; G

Pumps; G

Backflow Prevention Assemblies; G

Shower Pan

Shower Heads and Faucets; G

Emergency Fixtures; G

Mixing Valves; G

Air Compressors; G

Air Receivers; G

Refrigerated Compressed Air Dryers; G

Breathing Air System; G

Water Meters; G

Welding

A copy of qualified procedures and a list of names and identification symbols of qualified welders and welding operators.

Seismic, Force Protection, and Vibration-Absorbing Features; G

Details of seismic, force protection, and vibration-absorbing features, including arrangement, foundation plan, dimensions and specifications.

Plumbing System

Diagrams, instructions, and other sheets proposed for posting. Manufacturer's recommendations for the installation of bell and spigot and hubless joints for cast iron soil pipe.

SD-06 Test Reports

Tests, Flushing and Disinfection

Test reports in booklet form showing all field tests performed to adjust each component and all field tests performed to prove compliance with the specified performance criteria, completion and testing of the installed system. Each test report shall indicate the final position of controls.

Test of Backflow Prevention Assemblies; G.

Certification of proper operation shall be as accomplished in accordance with state regulations by an individual certified by the state to perform such tests. If no state requirement exists, the Contractor shall have the manufacturer's representative test the device, to ensure the unit is properly installed and performing as intended. The Contractor shall provide written documentation of the tests performed and signed by the individual performing the tests.

#### SD-07 Certificates

##### Materials and Equipment

Where equipment is specified to conform to requirements of the ASME Boiler and Pressure Vessel Code, the design, fabrication, and installation shall conform to the code.

##### Bolts

Written certification by the bolt manufacturer that the bolts furnished comply with the specified requirements.

#### SD-10 Operation and Maintenance Data

##### Plumbing System; G

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

#### SD-11 Closeout Submittals

##### Water-Efficient Products; S

##### Energy-Efficient Water Heaters; S

### 1.3 STANDARD PRODUCTS

Specified materials and equipment shall be standard products of a manufacturer regularly engaged in the manufacture of such products. Specified equipment shall essentially duplicate equipment that has performed satisfactorily at least two years prior to bid opening. Standard products shall have been in satisfactory commercial or industrial use for 2 years prior to bid opening. The 2-year use shall include applications of equipment and materials under similar circumstances and of similar size. The product shall have been for sale on the commercial market through advertisements, manufacturers' catalogs, or brochures during the 2 year period.



#### 1.3.1 Alternative Qualifications

Products having less than a two-year field service record will be acceptable if a certified record of satisfactory field operation for not less than 6000 hours, exclusive of the manufacturer's factory or laboratory tests, can be shown.

#### 1.3.2 Service Support

The equipment items shall be supported by service organizations. Submit a certified list of qualified permanent service organizations for support of the equipment which includes their addresses and qualifications. These service organizations shall be reasonably convenient to the equipment installation and able to render satisfactory service to the equipment on a regular and emergency basis during the warranty period of the contract.

#### 1.3.3 Manufacturer's Nameplate

Each item of equipment shall have a nameplate bearing the manufacturer's name, address, model number, and serial number securely affixed in a conspicuous place; the nameplate of the distributing agent will not be acceptable.

#### 1.3.4 Modification of References

In each of the publications referred to herein, consider the advisory provisions to be mandatory, as though the word, "shall" had been substituted for "should" wherever it appears. Interpret references in these publications to the "authority having jurisdiction", or words of similar meaning, to mean the Contracting Officer.

##### 1.3.4.1 Definitions

For the International Code Council (ICC) Codes referenced in the contract documents, advisory provisions shall be considered mandatory, the word "should" shall be interpreted as "shall." Reference to the "code official" shall be interpreted to mean the "Contracting Officer." For Navy owned property, references to the "owner" shall be interpreted to mean the "Contracting Officer." References to the "permit holder" shall be interpreted to mean the "Contractor."

##### 1.3.4.2 Administrative Interpretations

For ICC Codes referenced in the contract documents, the provisions of Chapter 1, "Administrator," do not apply. These administrative requirements are covered by the applicable Federal Acquisition Regulations (FAR) included in this contract and by the authority granted to the Officer in Charge of Construction to administer the construction of this project. References in the ICC Codes to sections of Chapter 1, shall be applied appropriately by the Contracting Officer as authorized by his administrative cognizance and the FAR.

#### 1.4 DELIVERY, STORAGE, AND HANDLING

Handle, store, and protect equipment and materials to prevent damage before and during installation in accordance with the manufacturer's recommendations, and as approved by the Contracting Officer. Replace damaged or defective items.

## 1.5 PERFORMANCE REQUIREMENTS

### 1.5.1 Welding

Piping shall be welded in accordance with qualified procedures using performance-qualified welders and welding operators. Procedures and welders shall be qualified in accordance with ASME BPVC SEC IX. Welding procedures qualified by others, and welders and welding operators qualified by another employer, may be accepted as permitted by ASME B31.1. The Contracting Officer shall be notified 24 hours in advance of tests, and the tests shall be performed at the work site if practicable. Welders or welding operators shall apply their assigned symbols near each weld they make as a permanent record.

## 1.6 REGULATORY REQUIREMENTS

Unless otherwise required herein, plumbing work shall be in accordance with ICC IPC. Energy consuming products and systems shall be in accordance with PL 109-58 and ASHRAE 90.1 - IP

## 1.7 PROJECT/SITE CONDITIONS

The Contractor shall become familiar with details of the work, verify dimensions in the field, and advise the Contracting Officer of any discrepancy before performing any work.

## 1.8 INSTRUCTION TO GOVERNMENT PERSONNEL

When specified in other sections, furnish the services of competent instructors to give full instruction to the designated Government personnel in the adjustment, operation, and maintenance, including pertinent safety requirements, of the specified equipment or system. Instructors shall be thoroughly familiar with all parts of the installation and shall be trained in operating theory as well as practical operation and maintenance work.

Instruction shall be given during the first regular work week after the equipment or system has been accepted and turned over to the Government for regular operation. The number of man-days (8 hours per day) of instruction furnished shall be as specified in the individual section. When more than 4 man-days of instruction are specified, use approximately half of the time for classroom instruction. Use other time for instruction with the equipment or system.

When significant changes or modifications in the equipment or system are made under the terms of the contract, provide additional instruction to acquaint the operating personnel with the changes or modifications.

## 1.9 ACCESSIBILITY OF EQUIPMENT

Install all work so that parts requiring periodic inspection, operation, maintenance, and repair are readily accessible. Install concealed valves, expansion joints, controls, dampers, and equipment requiring access, in locations freely accessible through access doors.

## PART 2 PRODUCTS

### 2.1 PRODUCT SUSTAINABILITY CRITERIA

For products in this section, where applicable and to extent allowed by performance criteria, provide and document the following:

#### 2.1.1 Water-Efficient Products

Provide documentation in conformance with Section 01 33 29 SUSTAINABILITY REPORTING that the following products meet water efficiency requirements as outlined in this section and when applicable, that they are EPA WaterSense labeled products:

- a. Fixtures
- b. Flush valve water closets
- c. Flush valve urinals
- d. Undercounter lavatories
- e. Kitchen/break room sinks
- f. Service sinks
- g. Mop sinks
- h. Drinking-water coolers
- i. Water heaters
- j. Pumps
- k. Showerheads

#### 2.1.2 Energy-Efficient Water Heaters

Provide documentation in conformance with Section 01 33 29 SUSTAINABILITY REPORTING that the following products meet energy efficiency requirements as outlined in this section and when applicable, that they are Energy Star certified or FEMP-designated products:

- a. Heat Pump Water Heaters
- b. Solar Water Heaters

### 2.2 MATERIALS

Materials for various services shall be in accordance with TABLES I and II. PVC pipe shall contain a minimum of 25 percent recycled content in accordance with ASTM F1760. HDPE pipe shall contain a minimum of 100 percent post-consumer recycled content. Pipe schedules shall be selected based on service requirements. Pipe fittings shall be compatible with the applicable pipe materials. Plastic pipe, fittings, and solvent cement shall meet NSF/ANSI 14 and shall be NSF listed for the service intended. Plastic pipe, fittings, and solvent cement used for potable hot and cold water service shall bear the NSF seal "NSF-PW." Polypropylene pipe and fittings shall conform to dimensional requirements of Schedule 40, Iron

Pipe size and shall comply with NSF/ANSI 14, NSF/ANSI 61 and ASTM F2389. Polypropylene piping that will be exposed to UV light shall be provided with a Factory applied UV resistant coating. Pipe threads (except dry seal) shall conform to ASME B1.20.1. Grooved pipe couplings and fittings shall be from the same manufacturer. Material or equipment containing a weighted average of greater than 0.25 percent lead shall not be used in any potable water system intended for human consumption, and shall be certified in accordance with NSF/ANSI 61, Annex G or NSF 372. In line devices such as water meters, building valves, check valves, meter stops, valves, fittings and back flow preventers shall comply with PL 93-523 and NSF/ANSI 61, Section 8. End point devices such as drinking water fountains, lavatory faucets, kitchen and bar faucets, residential ice makers, supply stops and end point control valves used to dispense water for drinking must meet the requirements of NSF/ANSI 61, Section 9. Hubless cast-iron soil pipe shall not be installed underground, under concrete floor slabs, or in crawl spaces below kitchen floors. Cast-iron pipe shall contain a minimum of 100 percent recycled content. Plastic pipe shall not be installed in air plenums. Plastic pipe shall not be installed in a pressure piping system in buildings greater than three stories including any basement levels. PVC piping shall not be used for pressure piping in the building.

#### 2.2.1 Pipe Joint Materials

Grooved pipe and hubless cast-iron soil pipe shall not be used underground. Solder containing lead shall not be used with copper pipe. Cast iron soil pipe and fittings shall be marked with the collective trademark of the Cast Iron Soil Institute. Joints and gasket materials shall conform to the following:

- a. Coupling for Cast-Iron Pipe: for hub and spigot type ASTM A74, AWWA C606. For hubless type: CISPI 310
- b. Flange Gaskets: Gaskets shall be made of non-asbestos material in accordance with ASME B16.21. Gaskets shall be flat, 1/16 inch thick, and contain Aramid fibers bonded with Styrene Butadiene Rubber (SBR) or Nitro Butadiene Rubber (NBR). Gaskets shall be the full face or self centering flat ring type. Gaskets used for hydrocarbon service shall be bonded with NBR.
- c. Brazing Material: Brazing material shall conform to AWS A5.8/A5.8M, BCuP-5.
- d. Brazing Flux: Flux shall be in paste or liquid form appropriate for use with brazing material. Flux shall be as follows: lead-free; have a 100 percent flushable residue; contain slightly acidic reagents; contain potassium borides; and contain fluorides.
- e. Solder Material: Solder metal shall conform to ASTM B32.
- f. Solder Flux: Flux shall be liquid form, non-corrosive, and conform to ASTM B813, Standard Test 1.
- g. PTFE Tape: PTFE Tape, for use with Threaded Metal or Plastic Pipe.
- h. Rubber Gaskets for Cast-Iron Soil-Pipe and Fittings (hub and spigot

type and hubless type): ASTM C564.

- i. Rubber Gaskets for Grooved Pipe: ASTM D2000, maximum temperature 230 degrees F.
- j. Flexible Elastomeric Seals: ASTM D3139, ASTM D3212 or ASTM F477.
- k. Bolts and Nuts for Grooved Pipe Couplings: Heat-treated carbon steel, ASTM A183.
- l. Solvent Cement for Transition Joints between ABS and PVC Nonpressure Piping Components: ASTM D3138.
- m. Plastic Solvent Cement for ABS Plastic Pipe: ASTM D2235.
- n. Plastic Solvent Cement for PVC Plastic Pipe: ASTM D2564 and ASTM D2855.
- o. Plastic Solvent Cement for CPVC Plastic Pipe: ASTM F493.
- p. 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.
- q. Copper tubing shall conform to ASTM B88, Type K, L or M.

#### 2.2.2 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.

#### 2.2.3 Pipe Insulation Material

Insulation shall be as specified in Section 23 07 00 THERMAL INSULATION  
FOR MECHANICAL SYSTEMS.

#### 2.3 PIPE HANGERS, INSERTS, AND SUPPORTS

Pipe hangers, inserts, and supports shall conform to MSS SP-58.

#### 2.4 VALVES

Valves shall be provided on supplies to equipment and fixtures. Valves 2-1/2 inches and smaller shall be bronze with threaded bodies for pipe and solder-type connections for tubing. Valves 3 inches and larger shall have flanged iron bodies and bronze trim. Pressure ratings shall be based upon the application. Grooved end valves may be provided if the manufacturer certifies that the valves meet the performance requirements of applicable MSS standard. Valves shall conform to the following standards:

Description	Standard
Butterfly Valves	MSS SP-67
Cast-Iron Gate Valves, Flanged and Threaded Ends	MSS SP-70
Cast-Iron Swing Check Valves, Flanged and Threaded Ends	MSS SP-71
Ball Valves with Flanged Butt-Welding Ends for General Service	MSS SP-72
Ball Valves Threaded, Socket-Welding, Solder Joint, Grooved and Flared Ends	MSS SP-110
Bronze Gate, Globe, Angle, and Check Valves	MSS SP-80
Vacuum Relief Valves	ANSI Z21.22/CSA 4.4
Water Pressure Reducing Valves	ASSE 1003
Water Heater Drain Valves	ASME BPVC SEC IV, Part HLW-810: Requirements for Potable-Water Heaters Bottom Drain Valve

Trap Seal Primer Valves	ASSE 1018
Temperature and Pressure Relief Valves for Hot Water Supply Systems	ANSI Z21.22/CSA 4.4

#### 2.4.1 Wall Faucets

Wall faucets with ASSE 1011 vacuum-breaker backflow preventer shall be brass with 3/4 inch male inlet threads, hexagon shoulder, and 3/4 inch hose connection. Faucet handle shall be securely attached to stem.

#### 2.4.2 Wall Hydrants

Wall hydrant or hose bibb with ASSE 1011 vacuum-breaker backflow preventer shall have a nickel-brass or nickel-bronze wall plate or flange with nozzle and detachable key handle. Freeze-proof design not required. 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.

#### 2.4.3 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. The discharge pipe from the relief valve shall be the size of the valve outlet.

#### 2.4.4 Thermostatic Mixing Valves

Provide ASSE 1017 compliant water temperature control valve for hot water distribution system. Provide ASSE 1070 compliant thermostatic mixing valve for lavatory faucets. Mixing valves, thermostatic type, pressure-balanced or combination thermostatic and pressure-balanced shall be line size and shall be constructed with rough or finish bodies either with or without plating. Each valve shall be constructed to control the mixing of hot and cold water and to deliver water at a desired temperature regardless of pressure or input temperature changes. The control element shall be of an approved type. The body shall be of heavy cast bronze, and interior parts shall be brass, bronze, corrosion-resisting steel or copper. The valve shall be equipped with necessary stops, check valves, unions, and sediment strainers on the inlets. Mixing valves shall maintain water temperature within 5 degrees F of any setting.

### 2.5 FIXTURES

Fixtures shall be water conservation type, in accordance with ASHRAE 189.1 Section 6.3.2.1 (Plumbing fixtures and Fittings). Water closet

replacements in major renovations may have a flush valve of up to 1.28 GPF to accommodate existing plumbing capacity. Fixtures for use by the physically handicapped shall be in accordance with ICC A117.1 COMM. Vitreous China, nonabsorbent, hard-burned, and vitrified throughout the body shall be provided. 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, shall be equipped with a trap. Brass expansion or toggle bolts capped with acorn nuts shall be provided for supports, and polished chromium-plated pipe, valves, and fittings shall be provided where exposed to view. Fixtures with the supply discharge below the rim shall be equipped with backflow preventers. Internal parts of flush valves and flushometer valves, shower mixing valves, shower head face plates, pop-up stoppers of lavatory waste drains, and pop-up stoppers and overflow tees and shoes of waste drains may contain acetal resin, fluorocarbon, nylon, acrylonitrile-butadiene-styrene (ABS) or other plastic material, if the material has provided satisfactory service under actual commercial or industrial operating conditions for not less than 2 years or shall be copper alloy with all visible surfaces chrome plated.

#### 2.5.1 Flush Valve Water Closets

ASME A112.19.2/CSA B45.1, white vitreous china, siphon jet, elongated bowl, wall mounted, wall outlet. Top of toilet seat height above floor shall be 14 to 15 inches, except 17 to 19 inches for wheelchair water closets. Provide wax bowl ring including plastic sleeve. Provide white solid plastic elongated open-front seat.

Water flushing volume of the water closet and flush valve combination shall not exceed 1.28 gallons per flush. Water closets must meet the EPA WaterSense product definition specified in [http://www.epa.gov/watersense/partners/product\\_program\\_specs.html](http://www.epa.gov/watersense/partners/product_program_specs.html) and must be EPA WaterSense labeled products. Provide ASME A112.6.1M water closet wall carrier.

Provide large diameter flush valve including angle control-stop valve, vacuum breaker, tail pieces, slip nuts, and wall plates; exposed to view components shall be chromium-plated or polished stainless steel. Flush valves shall be nonhold-open type. Mount flush valves not less than 11 inches above the fixture. Mounted height of flush valve shall not interfere with the hand rail in ADA stalls.

#### 2.5.2 Flush Valve Urinals

ASME A112.19.2/CSA B45.1, white vitreous china, wall-mounted, wall outlet, siphon jet, integral trap, and extended side shields. Provide urinal with the rim 17 inches above the floor. Water flushing volume of the urinal and flush valve combination shall not exceed 0.125 gallons per flush. Urinals must meet the specifications of [http://www.epa.gov/watersense/partners/product\\_program\\_specs.html](http://www.epa.gov/watersense/partners/product_program_specs.html) and must be EPA WaterSense labeled products. 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.



### 2.5.3 Undercounter Lavatories

ASME A112.19.2/CSA B45.1, white vitreous china, undercounter, minimum dimensions of 19 inches wide by 14 inches front to rear. Furnish template and mounting kit by lavatory manufacturer. Provide aerator with faucet. Water flow rate shall not exceed 0.5 gpm when measured at a flowing water pressure of 60 psi. Lavatory faucets and lavatory faucet accessories 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. Mount counter with the top surface 34 inches above floor and with 29 inches minimum clearance from bottom of the counter face to floor. Provide top mounted washerless single lever actuated lavatory faucets. Provide perforated chrome-plated bronze or stainless steel strainer outlet.

### 2.5.4 Kitchen/Break Room Sinks

ASME A112.19.3/CSA B45.4, 20 gage stainless steel with integral mounting rim for flush installation, nominal dimensions of 33 inches wide by 18 inches front to rear, two 14 inch wide by 16 inch front to rear by 5-1/2 inch deep bowls with offset center rear outlet, with undersides fully sound deadened, with supply openings for use with top mounted single lever actuated washerless sink faucets with hose spray, and with 3.5 inch drain outlet. Provide aerator with faucet. Water flow rate shall not exceed 1.5 gpm when measured at a flowing water pressure of 60 psi. Provide stainless steel drain outlets and removable stainless steel basket strainers. Provide separate 1.5 inch P-trap and drain piping to vertical vent piping from each compartment. Provide top mounted washerless sink faucets with hose spray. Provide UL 430 waste disposer in right compartment.

### 2.5.5 Service Sinks

ASME A112.19.3/CSA B45.4 302 stainless steel two compartment scullery sink with side drain board with integral back and four tubular, adjustable floor mounted supports, nominal dimensions of 56 to 58 inches wide by 24 to 27 inches front to rear, with 16 to 18 inch wide by 18 to 24 inch front to rear by 9-1/2 inch deep bowls with center outlet, nominal 2-1/2 inch deep sides on the drainboards, and two supply openings in 12 inch high back. Provide removable perforated stainless steel strainer with undersink pop-up plunger valve, twist handle operator, and overflow drain assembly. Provide separate 1-1/2 inch P-trap and drain piping to vertical piping from each compartment. Provide wall-mounted rigid faucet, 8 inch centers with 4 inch wristblades, swivel gooseneck, ASSE 1001 vacuum breaker, and 1.5 gpm non-splash aerator. Gooseneck to be 8-3/4 inch high with 8-5/8 inch arm. Water connections provided with check stops.

### 2.5.6 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, two level bubbler style, air-cooled condensing unit, 8.0 gph of 50 degrees F water drinking water starting with 80 deg F water and 90 deg F ambient 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 38 to 43 inches above floor and at front of unit basin for non-ADA unit. For ADA unit, the spouts shall be mounted with 27 inch minimum knee clearance from front bottom of

unit to floor and 36 inch maximum spout height above floor. 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. Mount bottle filler over ASA basin.

#### 2.5.7 Precast Terrazzo Mop Sinks

Terrazzo shall be made of marble chips cast in white portland cement to produce 3000 psi minimum compressive strength 7 days after casting. Provide floor or wall outlet copper alloy body drain cast integral with terrazzo, with polished stainless steel strainers. Provide back mounted bracket supported, washerless service sink faucets with ASSE 1001 vacuum breaker and 0.75 inch external hose threads. Water connections provided with check stops.

#### 2.5.8 Emergency Fixtures

##### 2.5.8.1 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 20 gpm water flow shower head at 30 psig, and 3 gpm Eye and face wash as specified below, including alarm. Provide eyewash and stay-open ball valve operated by foot treadle or push handle.

##### 2.5.8.2 Emergency Eye and Face Wash

ANSI/ISEA Z358.1, floor pedestal-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 packaged, UL listed, alarm system; including an amber strobe lamp, horn with externally adjustable loudness and horn silencing switch, mounting hardware, and waterflow service within NEMA Type 3 or 4 enclosures and for explosion proof service within NEMA Type 7 or 9 enclosures.

#### 2.6 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.

## 2.7 DRAINS

### 2.7.1 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.

### 2.7.2 Garage Drains

Garage drains shall be plain pattern with nominal 20 inch diameter by 5 inch deep body, 15 inch diameter slotted heavy duty cast iron garage grate with 56 square inches of open area. Drains shall be cast iron with manufacturer's standard coating. Grate shall be easily lifted out for cleaning. Outlet shall be suitable for inside caulked connection to drain pipe. Drains shall conform to ASME A112.6.3.

### 2.7.3 Floor Sinks

Floor sinks shall be square, with 12 inch nominal overall width or diameter and 10 inch nominal overall depth. Floor sink shall have an acid-resistant enamel interior finish with cast-iron body, aluminum or ABS sediment bucket, and perforated grate of cast iron. The outlet pipe size shall be as indicated or of the same size as the connecting pipe.

### 2.7.4 Hub Drains

Hub drains shall consist of body, integral seepage pan, and adjustable strainer with perforated or slotted grate and funnel extension. The strainer shall have a threaded collar to permit adjustment to floor thickness. Drains shall be of double drainage pattern suitable for embedding in the floor construction. Drains shall have a galvanized heavy cast-iron body and seepage pan and chromium-plated bronze, nickel-bronze, or nickel-brass strainer and funnel combination. Drains shall be provided with threaded connection and with a separate cast-iron "P" trap, unless otherwise indicated. Drains shall be circular, unless otherwise indicated. The funnel shall be securely mounted over an opening in the center of the strainer. Minimum dimensions shall be as follows:

Area of strainer and collar: 36 square inches

Height of funnel: 3-3/4 inches

Diameter of lower portion: 2 inches of funnel

Diameter of upper portion: 4 inches of funnel

## 2.8 SHOWER PAN

Shower floors shall be pre-cast polyester resin with matte, non-slip floor finish. Base shall have coved corners and be pitched to the drain outlet. Provide with removable rectangular stainless steel drain opposite door. Accessible (ADA) showers shall have a maximum threshold height of 1/2 inch above finished floor

### 2.8.1 Shower Heads and Faucets

Provide single control pressure equalizing ASSE 1016 shower faucets with body mounted from behind the wall with threaded connections. Provide ball joint self-cleaning shower heads. Provide accessible showers with diverter valve for directing tempered water to either the overhead fixed shower or to the hand shower, adjustable commercial hand shower with non-positive shutoff, 24 inch vertical slide bar, 60 inch metal hose, wall supply elbow with flange, and in-line ASSE 1014 vacuum breaker. Provide shower heads and hand showers which deliver a maximum of 1.5 GPM per ASHRAE 189.1 Section 6.3.2.1 (Plumbing Fixtures and Fittings) requirements. Showerheads 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 tubing mounted from behind the wall between shower heads and diverter spouts. Provide separate globe valves or angle valves with union connections and check valves in each supply to faucet.

## 2.9 TRAPS

Unless otherwise specified, fixture 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.

### 2.10 INTERCEPTORS

#### 2.10.1 Lint Interceptor

Lint interceptor of the size indicated shall be commercially available stainless steel with manufacturer's traffic rated cover and shall be installed as shown on plans. Install with cover flush with surrounding surface, provide extension where necessary. Provide with anchor flange

for installation in concrete floor.

## 2.11 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 140 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 for each type of water heater specified. A factory pre-charged expansion tank shall be installed on the cold water supply to each water heater. Expansion tanks shall be specifically designed for use on potable water systems and shall be rated for 200 degrees F water temperature and 150 psi working pressure. The expansion tank size and acceptance volume shall be as indicated on the drawings.

### 2.11.1 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. Automatic storage type heaters must meet the Energy Star product definition specified in <https://www.energystar.gov/products/spec> and must be Energy Star certified.

#### 2.11.1.1 Heat Pump Water Heating Section

The electric models shall feature a heat pump operating with environmentally-friendly R134a refrigerant that will absorb ambient heat from the surrounding air reducing electrical consumption by up to 66 percent. Condenser shall be a double wall heat exchanger.

The heat pump water heater shall meet the ENERGY STAR requirement with 3.06 to 3.24 Energy Factor in hybrid mode and shall comply with the Federal Energy Conservation Standards effective April 16, 2015, in accordance with the Energy Policy and Conservation Act, (EPCA), as amended.

The electronic control shall accommodate four operating modes to match the heating requirements and shall include an LED display. The LED display will also read-out current status, set point and fault codes.

The four operating modes are:

- a. Efficiency: uses heat pump only.
- b. Hybrid mode: Heat pump with electrical resistance assist.
- c. Electric mode: Uses electric resistance only as a conventional electric water heater would.
- d. Vacation mode: maintains a minimum 60 degrees F in the tank.

#### 2.11.1.2 Electric Heating Element

Electric type water heaters shall conform to UL 174 with dual heating elements. Each element shall be 4.5 KW. The elements shall be wired so that only one element can operate at a time.

#### 2.11.1.3 Tank

The tank shall be a steel, glass lined insulated and metal jacketed tank, with all required openings built in, including dip-tube inlet, top outlet, drain opening with valve, pressure-temperature relief valve, temperature sensor, heating element/thermostat, and heat exchanger. tank shall meet efficiency requirements of the Federal Energy Conservation Standards effective April 16, 2015, in accordance with the Energy Policy and Conservation Act, (EPCA), as amended.

#### 2.12 HOT-WATER STORAGE TANKS

Hot-water storage tanks shall be constructed by one manufacturer, ASME stamped for the working pressure, and shall have the National Board (ASME) registration. The tank shall be cement-lined or glass-lined steel type in accordance with AWWA D100. The heat loss shall conform to TABLE III as determined by the requirements of ASHRAE 90.1 - IP. Each tank shall be equipped with a thermometer, conforming to ASTM E1, Type I, Class 3, Range C, style and form as required for the installation, and with 7 inch scale. Thermometer shall have a separable socket suitable for a 3/4 inch tapped opening. Tanks shall be equipped with a pressure gauge 6 inch minimum diameter face. Insulation shall be as specified in Section 23 07 00 THERMAL INSULATION FOR MECHANICAL SYSTEMS. Storage tank capacity shall be as shown.

#### 2.13 PUMPS

##### 2.13.1 Elevator Sump Pumps

Sump pumps shall be of capacities indicated. The pumps shall be of the automatic, electric motor-driven, submerged type, complete with necessary. The pumps shall be direct-connected by an approved flexible coupling to a vertical electric motor with oil filled motor bearings permanently lubricated by the oil which fills the motor housing. Motors shall be oil filled, capacitor start, class B insulated NEMA B design, rated for continuous duty. Single phase motor shall have an integral thermal overload switch in the windings to protect the motor. Pumps shall be equipped with an across-the-line magnetic controller in a NEMA 250, Type 1 enclosure. The suction inlet shall be between 3 and 6 inches above the sump bottom. The suction side of each pump shall have a strainer of ample capacity. The discharge line from each pump shall be provided with a union or flange, a nonclog swing check valve, and a stop valve in an accessible location near the pump.

A float switch assembly, with the switch completely enclosed in a NEMA 250, Type 1 enclosure, shall start and stop each motor at predetermined water levels. Provide an oil-minder control for elevator sump pump. Control shall include a high water alarm. Provide auto-dialer telephone communication device for high water alarm.

##### 2.13.2 Circulating Pumps

Domestic hot water circulating pumps shall be electrically driven, single-stage, centrifugal, with mechanical seals, suitable for the intended service. Pump and motor shall be close-coupled with an overhung impeller, and 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 Electronically Commutated Motors (ECMs) type 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 and relay controlled by BAS.

## 2.14 COMPRESSED AIR SYSTEM

### 2.14.1 Air Compressors

Air compressor unit shall be a factory-packaged assembly, including single phase, 120 or lower volt motor controls, switches, wiring, accessories, and motor controllers, in a NEMA 250, Type 4 enclosure. Air compressors shall have manufacturer's name and address, together with trade name, and catalog number on a nameplate securely attached to the equipment. Each compressor shall start and stop automatically at upper and lower pressure limits of the system, regulate pressure by constant speed compressor loading and unloading, and have a manual-off-automatic switch that when in the manual position, the compressor loads and unloads to meet the demand and, in the automatic position, a time delay relay shall allow the compressor to operate for an adjustable length of time unloaded, then stop the unit. Guards shall shield exposed moving parts. Each compressor motor shall be provided with a magnetic controller, complete with low-voltage release. An intake air filter and silencer shall be provided with each compressor. Aftercooler and moisture separator shall be installed between compressors and air receiver to remove moisture and oil condensate before the air enters the receiver. Intercoolers and aftercoolers shall be water-cooled, as indicated. The air shall pass through a sufficient number of tubes to affect cooling. Tubes shall be sized to give maximum heat transfer. Water to unit shall be controlled by a solenoid or pneumatic valve, which opens when the compressors start and closes when the compressors shut down. Cooling capacity of the aftercooler shall be sized for the total capacity of the compressors. Means shall be provided for draining condensed moisture from the unit by an automatic float type trap. Capacities of air compressors and receivers shall be as indicated.

### 2.14.2 Compressors

Compressors shall be two-stage. Compressors shall have the capacity and discharge pressure indicated. Compressors shall be assembled complete on a common subbase. The compressor main bearings shall be either roller or ball. The discharge passage of the high pressure air shall be piped to the air receiver with a copper pipe or tubing. A pressure gauge calibrated to 150 psi and equipped with a gauge cock and pulsation dampener shall be furnished for installation adjacent to pressure switches.

### 2.14.3 Refrigerated Compressed Air Dryers

Provide refrigerated compressed air dryers of the mechanical refrigeration type, equipped with an automatic temperature shutdown switch to prevent freezing, a regenerative air to air exchanger (in capacity sizes above 10 or 60 scfm as standard with the manufacturer), and a main compressed air cooling exchanger. Refrigeration system shall cool compressed air to dry the air. Dryer shall have no internal traps or filters and shall have pressure drop not greater than 3 psi. Air shall leave the dryer at a temperature of 70 degrees F and dew point of 35 degrees F, based on an inlet temperature of 100 degrees F. Provide internal tubing, wiring, and piping complete, such that only connections to air inlet and outlet, to refrigerant compressor contactor, and to condensate drain are necessary.

#### 2.14.3.1 Air Circuit

- a. Regenerative heat exchanger: Inlet compressed air to outlet compressed air heat exchanger (in capacity sizes above 10 or 60 scfm as standard with the manufacturer) designed to reduce cooling load at design conditions 20 degrees F by inlet air precooling.
- b. Main heat exchanger: Single-pass, with air in the tubes, heat sink, direct expansion, or flooded cooler type.
- c. Separator: Fabricated in accordance with ASME B31.1; code stamp not required; moisture separator low velocity type incorporating change of air flow direction to prevent moisture carryover.
- d. Dryer operating pressure: 100 to 125 psig working pressure.
- e. Drain line: Provide with exterior mounted condensate trap to facilitate servicing.

#### 2.14.3.2 Refrigeration System

- a. Refrigeration compressor: ANSI/AHRI 520. Hermetic, semi-hermetic, or open reciprocating type equipped with automatic start-stop or unloading capacity control; standard components include inherent motor protection, crankcase oil strainer, and suction screen. Refrigerant shall be R404A, R407C, R410A, or other currently available refrigerant.
- b. Dryer controls: Capable of automatic 0 to 100 percent capacity control. Refrigeration controls shall maintain pressure dew point within the specified range without freezing of condensate. Controls shall include such devices as capillary tube, expansion valve, suction pressure regulator, thermostat, or other approved devices as standard with the manufacturer. Dryer shall have automatic shutdown switch sensor located at point of lowest temperature to prevent freezing.
- c. Refrigerant dryer and suction line strainer.
- d. Water-cooled condenser.

#### 2.14.3.3 Instrumentation and Control

Include control panel in dryer cabinet containing:

- a. Indicators for the following services: Inlet air pressure gage, discharge air pressure gage, inlet air temperature gage, main exchanger temperature gage, refrigeration compressor suction pressure gage, refrigeration compressor discharge pressure gage, green "Power On" light, power interruption light, and high temperature light.
- b. Electrical relays: Locate in an enclosed portion of the panel, accessible for ease of servicing.
- c. Controls and interlocks: To maintain required compressed air dew point by cycling the refrigeration compressor.

#### 2.14.4 Air Receivers

Receivers shall be designed for 165 psig working pressure. Receivers



shall be factory air tested to 1-1/2 times the working pressure. Receivers shall be equipped with safety relief valves and accessories, including pressure gauges and automatic and manual drains. The outside of air receivers may be galvanized or supplied with commercial enamel finish. Receivers shall be designed and constructed in accordance with ASME BPVC SEC VIII D1 and shall have the design working pressures specified herein. A display of the ASME seal on the receiver or a certified test report from an approved independent testing laboratory indicating conformance to the ASME Code shall be provided.

#### 2.14.5 Intake Air Supply Filter

Dry type air filter shall be provided having a collection efficiency of 99 percent of particles larger than 10 microns. Filter body and media shall withstand a maximum 125 psi, capacity as indicated.

#### 2.14.6 Pressure Regulators

The air system shall be provided with the necessary regulator valves to maintain the desired pressure for the installed equipment. Regulators shall be designed for a maximum inlet pressure of 125 psi and a maximum temperature of 200 degrees F. Regulators shall be single-seated, pilot-operated with valve plug, bronze body and trim or equal, and threaded connections. The regulator valve shall include a pressure gauge and shall be provided with an adjustment screw for adjusting the pressure differential from 0 to 125 psi. Regulator shall be sized as indicated.

#### 2.14.7 Main Air Charging Valve

A main air charging valve shall provide even distribution of air at start-up when low pressure air would normally provide excessive velocity. Air charging valve shall interface with the compressor central control system.

#### 2.14.8 Breathing Air System (BAP-1)

Skid mounted package consisting of water separator, pre-filter and fine-coalescing filter, heatless desiccant dryer, a dual-stage cleaning stage consisting of carbon to eliminate hydrocarbons and a catalyst to convert carbon monoxide to carbon dioxide, a bacterial filter, and a carbon monoxide monitor. Discharge air quality shall meet OSHA Grade D breathing air.

##### 2.14.8.1 Breathing Air Desiccant Dryer Pre-filter

Shall be Coalescing Filter rated for 99.97 percent removal from 0.3 to 0.6 micron particles. The Coalescing filter shall remove liquid water, oils, mists and fogs to protect the desiccant dryers. May be one, two, or three elements. Clean pressure drop shall not exceed 1.0 psig at rated flow.

##### 2.14.8.2 Breathing Air Desiccant Dryer Particulate After-filter

Particulate filter shall remove 100 percent of solid particles 3 microns and larger and 98.5 percent of solid particles 0.5 microns and larger. Filter media shall consist of pleated, resin impregnated cellulose fibers. Clean pressure drop shall not exceed 1.0 psig at rated flow.

#### 2.14.8.3 Breathing Air Monitor

Electronic monitor equipped with a reliable electrochemical sensor that accurately indicates the level of carbon monoxide and displays the result on an LED display. In addition, the unit shall provide a 4-20mA ADC signal to the Breathing Air Unit for annunciation and communication to the Building Automation System. Unit shall have a measurement Range of 0 to 100 ppm (OSHA requires Grade D breathing air to have less than 10.0 ppm CO). Unit housing shall be NEMA 12 or better.

#### 2.14.8.4 Breathing Air Reserve Manifold

Provide breathing air gas regulator with manifold.

The gas regulator shall be a stainless steel single stage barstock regulator. Rated for an inlet pressure of 3,000 psig minimum, and adjustable 2 to 100 psig regulated outlet pressure, with regulated dead-end shut off. Complete with CGA gas inlet connector, 0 to 4000 psig inlet pressure gauge and 0 to 200 psig outlet pressure gauge, and adjustment knob.

Gas manifold shall be constructed of stainless steel barstock header with mounting hardware and shall include sufficient number of connections as indicated on the drawings; one end of the manifold shall be plugged and the other end provided with a CGA outlet adaptor. Each cylinder connection shall be complete with cylinder CGA quick disconnect hose connector with integral check valve for connecting to gas cylinder, 36 inches long 316 stainless steel flexible connector (pigtail), and a 316 stainless steel packless diaphragm valves with CTFE seats. Gas manifold shall be rated for 3,000 psig working pressure minimum.

#### 2.14.8.5 Breathing Air Reserve Tanks

Tanks shall be rated for 4,500 psig. Each tank is to be equipped with a new, soft seal valve, complete with appropriate approved safety relief device. Tanks shall be painted yellow with a 10 by 5 inch vinyl label stating the cylinders pressure rating and gas the cylinder is being used for. Each tank shall be internally inspected prior to valuing, with a dated sticker attesting to this inspection.

The tanks shall be securely mounted. A steel rail section and ridged clamp sets are to be provided to secure the tanks in place, properly spaced. Any components or fittings necessary for operation, but not mentioned above, will be considered to be included. A 5-year warranty is to be provided on all cascade components, including the tanks, fittings, gauges and valves.

#### 2.14.9 Piping Downstream of The Compressed Air Dryers and Breathing Air Equipment

General Requirements for Valves: Manufacturer cleaned, purged, and bagged according to CGA G-4.1 for oxygen service.

#### 2.14.10 Pipes, Tubes, and Fittings

Copper Medical Gas Tube: ASTM B819, Type L, seamless, drawn temper that has been manufacturer cleaned, purged, and sealed for medical gas service or according to CGA G-4.1 for oxygen service. Include standard color marking "OXY," "MED," "OXY/MED," "OXY/ACR," or "ACR/MED" in green for Type K tube and blue for Type L tube.

#### 2.14.11 Light-Wall Stainless Steel Pipe And Fittings

Tall piping is to be cleaned for Oxygen service and capped, prior to being shipped to the project site.

#### 2.14.12 Air Quality

Air at compressor intake will be considered breathing air quality conforming to CGA G 7.1, Type I, Grade D or better. Air compressors shall introduce no material, gases, or particles, or chemically alter any materials that will adversely affect or reduce the quality of the air passing through the unit.

##### 2.14.12.1 Outlet Conditions for Breathing Air

OSHA Grade D breathing air ISO 8573.1 Quality Class 1.2.1 - Air line filters remove 70 percent of aerosols and all solid particles one micron and larger, Oil removal filter removes 99.999 percent of oil aerosols and all solid particles 0.01 microns and larger. Desiccant dryer produces pressure dew point of - 40 degrees C. The Carbon Monoxide level must be less than 10.0 ppm when delivered to the end user. The following levels shall be achieved:

- a. Carbon Dioxide (CO<sub>2</sub>): < 220 ppm when inlet < 700 ppm.
- b. Carbon Monoxide (CO): < 1.0 ppm when inlet < 50 ppm.
- c. Sulfur Dioxide (SO<sub>2</sub>): < 0.2 ppm when inlet < 5.0 ppm.
- d. Nitrous Oxides (NO<sub>x</sub>): < 1.0 ppm when inlet < 5.0 ppm.
- e. Water Vapor (H<sub>2</sub>O PDP): (-40) Pressure Dew Point.
- f. Oil Vapor (Oil): < 0.003 mg/m<sup>3</sup>.
- g. Dust Particles (Dust): < 0.01 ppm.
- h. Taste and Odor: Taste and odor free.

##### 2.14.12.2 Seismic Performance

Air compressors, receivers, desiccant dryers, and breathing air equipment shall withstand the effects of earthquake motions determined according to ASCE 7 and UFC 3-310-04.

#### 2.15 DOMESTIC WATER SERVICE METER

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, indicating MGallons or 1,000 gallons. Meter shall be provided with a pulse generator, remote readout register and all necessary wiring and accessories.

Provide water meters to monitor use in building consuming indoor and outdoor water as required by DODI 4170.11 (Installation Energy Management). Implement sub-metering when authorized in writing by the installation. Refer to ASHRAE 189.1 Section 7.3.3 (Energy Consumption Management) for subsystem implementation.

Meters must be connected to the base wide energy and utility monitoring and control system using the installation's advanced metering protocols.

## 2.16 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 Electronically Commutated Motors (ECMs) 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 1. In addition to the requirements of Section 26 20 00 INTERIOR DISTRIBUTION SYSTEM, provide polyphase, squirrel-cage medium induction motors with continuous ratings, including motors that are part of a system, that meet the efficiency ratings for premium efficiency motors in accordance with NEMA MG 1. Provide motors in accordance with NEMA MG 1 and of sufficient size to drive the load at the specified capacity without exceeding the nameplate rating of the motor.

Motors shall be rated for continuous duty with the enclosure specified. Motor duty requirements shall allow for maximum frequency start-stop operation and minimum encountered interval between start and stop. Motor torque shall be capable of accelerating the connected load within 20 seconds with 80 percent of the rated voltage maintained at motor terminals during one starting period. Motor bearings shall be fitted with grease supply fittings and grease relief to outside of the enclosure.

Controllers and contactors shall have auxiliary contacts for use with the controls provided. Manual or automatic control and protective or signal devices required for the operation specified and any control wiring required for controls and devices specified, but not shown, shall be provided. For packaged equipment, the manufacturer shall provide controllers, including the required monitors and timed restart.

Power wiring and conduit for field installed equipment shall be provided under and conform to the requirements of Section 26 20 00 INTERIOR DISTRIBUTION SYSTEM.

## 2.17 MISCELLANEOUS PIPING ITEMS

### 2.17.1 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.

### 2.17.2 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.

#### 2.17.2.1 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.

#### 2.17.2.2 Sleeves Not in Masonry and Concrete

Provide 26 gage galvanized steel sheet or PVC plastic pipe sleeves.

#### 2.17.3 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.

#### 2.17.4 Nameplates

Provide 0.125 inch thick melamine laminated plastic nameplates, black matte finish with white center core, for equipment, gages, thermometers, and valves; valves in supplies to faucets will not require nameplates. Accurately align lettering and engrave minimum of 0.25 inch high normal block lettering into the white core. Minimum size of nameplates shall be 1.0 by 2.5 inches. Key nameplates to a chart and schedule for each system. Frame charts and schedules under glass and place where directed near each system. Furnish two copies of each chart and schedule.

### PART 3 EXECUTION

#### 3.1 GENERAL INSTALLATION REQUIREMENTS

Piping located in air plenums shall conform to NFPA 90A requirements. Piping located in shafts that constitute air ducts or that enclose air ducts shall be noncombustible in accordance with NFPA 90A. Installation of plastic PVC and CPVC pressure piping is prohibited. The plumbing system shall be installed complete with necessary fixtures, fittings, traps, valves, and accessories. Water and drainage piping shall be extended 5 feet outside the building, unless otherwise indicated. A full port ball valve and drain shall be installed on the water service line inside the building approximately 6 inches above the floor from point of entry. Piping shall be connected to the exterior service lines or capped or plugged if the exterior service is not in place. Sewer and water pipes shall be laid in separate trenches, except when otherwise shown. Exterior underground utilities shall be at least 12 inches below the finish grade or as indicated on the drawings. If trenches are closed or the pipes are otherwise covered before being connected to the service lines, the location of the end of each plumbing utility shall be marked with a stake or other acceptable means. Valves shall be installed with control no lower than the valve body.

### 3.1.1 Water Pipe, Fittings, and Connections

#### 3.1.1.1 Utilities

The piping shall be extended to fixtures, outlets, and equipment. The hot-water and cold-water piping system shall be arranged and installed to permit draining. The supply line to each item of equipment or fixture, except faucets, flush valves, or other control valves which are supplied with integral stops, shall be equipped with a shutoff valve to enable isolation of the item for repair and maintenance without interfering with operation of other equipment or fixtures. Supply piping to fixtures, faucets, hydrants, shower heads, and flushing devices shall be anchored to prevent movement.

Fixtures and faucets capable of cross connection between hot and cold water systems, where the hot water is recirculated, shall be provided with integral check valves or separately supplied check valves on the hot and cold water supplies to the fixture.

#### 3.1.1.2 Cutting and Repairing

The work shall be carefully laid out in advance, and unnecessary cutting of construction shall be avoided. Damage to building, piping, wiring, or equipment as a result of cutting shall be repaired by mechanics skilled in the trade involved.

#### 3.1.1.3 Protection of Fixtures, Materials, and Equipment

Pipe openings shall be closed with caps or plugs during installation. Fixtures and equipment shall be tightly covered and protected against dirt, water, chemicals, and mechanical injury. Upon completion of the work, the fixtures, materials, and equipment shall be thoroughly cleaned, adjusted, and operated. Safety guards shall be provided for exposed rotating equipment.

#### 3.1.1.4 Mains, Branches, and Runouts

Piping shall be installed as indicated. Pipe shall be accurately cut and worked into place without springing or forcing. Structural portions of the building shall not be weakened. Aboveground piping shall run parallel with the lines of the building, unless otherwise indicated. Branch pipes from service lines may be taken from top, bottom, or side of main, using crossover fittings required by structural or installation conditions. Supply pipes, valves, and fittings shall be kept a sufficient distance from other work and other services to permit not less than 1/2 inch between finished covering on the different services. Bare and insulated water lines shall not bear directly against building structural elements so as to transmit sound to the structure or to prevent flexible movement of the lines. Water pipe shall not be buried in or under floors unless specifically indicated or approved. Changes in pipe sizes shall be made with reducing fittings. Use of bushings will not be permitted except for use in situations in which standard factory fabricated components are furnished to accommodate specific accepted installation practice. Change in direction shall be made with fittings, except that bending of pipe 4 inches and smaller will be permitted, provided a pipe bender is used and wide sweep bends are formed. The center-line radius of bends shall be not less than six diameters of the pipe. Bent pipe showing kinks, wrinkles, flattening, or other malformations will not be acceptable.

#### 3.1.1.5 Pipe Drains

Pipe drains indicated shall consist of 3/4 inch hose bibb with renewable seat and ball valve ahead of hose bibb. At other low points, 3/4 inch brass plugs or caps shall be provided. Disconnection of the supply piping at the fixture is an acceptable drain.

#### 3.1.1.6 Expansion and Contraction of Piping

Allowance shall be made throughout for expansion and contraction of water pipe. Each hot-water and hot-water circulation riser shall have expansion loops or other provisions such as offsets and changes in direction where indicated and required. Risers shall be securely anchored as required or where indicated to force expansion to loops. Branch connections from risers shall be made with ample swing or offset to avoid undue strain on fittings or short pipe lengths. Horizontal runs of pipe over 50 feet in length shall be anchored to the wall or the supporting construction about midway on the run to force expansion, evenly divided, toward the ends. Sufficient flexibility shall be provided on branch runouts from mains and risers to provide for expansion and contraction of piping. Flexibility shall be provided by installing one or more turns in the line so that piping will spring enough to allow for expansion without straining. If mechanical grooved pipe coupling systems are provided, the deviation from design requirements for expansion and contraction may be allowed pending approval of Contracting Officer.

#### 3.1.1.7 Thrust Restraint

Plugs, caps, tees, valves and bends deflecting 11.25 degrees or more, either vertically or horizontally, in waterlines 4 inches in diameter or larger shall be provided with thrust blocks, where indicated, to prevent movement. Thrust blocking shall be concrete of a mix not leaner than: 1 cement, 2-1/2 sand, 5 gravel; and having a compressive strength of not less than 2000 psi after 28 days. Blocking shall be placed between solid ground and the fitting to be anchored. Unless otherwise indicated or directed, the base and thrust bearing sides of the thrust block shall be poured against undisturbed earth. The side of the thrust block not subject to thrust shall be poured against forms. The area of bearing will be as shown. Blocking shall be placed so that the joints of the fitting are accessible for repair. Steel rods and clamps, protected by galvanizing or by coating with bituminous paint, shall be used to anchor vertical down bends into gravity thrust blocks.

#### 3.1.1.8 Commercial-Type Water Hammer Arresters

Commercial-type water hammer arresters shall be provided on hot- and cold-water supplies and shall be located as generally indicated, with precise location and sizing to be in accordance with PDI WH 201. Water hammer arresters, where concealed, shall be accessible by means of access doors or removable panels. Commercial-type water hammer arresters shall conform to ASSE 1010. Vertical capped pipe columns will not be permitted.

#### 3.1.2 Joints

Installation of pipe and fittings shall be made in accordance with the manufacturer's recommendations. Mitering of joints for elbows and notching of straight runs of pipe for tees will not be permitted. Joints shall be made up with fittings of compatible material and made for the specific purpose intended.

### 3.1.2.1 Threaded

Threaded joints shall have American Standard taper pipe threads conforming to ASME B1.20.1. Only male pipe threads shall be coated with graphite or with an approved graphite compound, or with an inert filler and oil, or shall have a polytetrafluoroethylene tape applied.

### 3.1.2.2 Mechanical Couplings

Mechanical couplings may be used in conjunction with grooved pipe for aboveground, ferrous or non-ferrous, domestic hot and cold water systems, in lieu of unions, brazed, soldered, welded, flanged, or threaded joints.

Mechanical couplings are permitted in accessible locations including behind access plates. Flexible grooved joints will not be permitted, except as vibration isolators adjacent to mechanical equipment. Rigid grooved joints shall incorporate an angle bolt pad design which maintains metal-to-metal contact with equal amount of pad offset of housings upon installation to ensure positive rigid clamping of the pipe.

The Contracting Officer shall be notified 24 hours in advance of test to demonstrate operator's capability, and the test shall be performed at the work site, if practical, or at a site agreed upon. The operator shall demonstrate the ability to properly adjust the grooving tool, groove the pipe, and to verify the groove dimensions in accordance with the coupling manufacturer's specifications.

### 3.1.2.3 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.

### 3.1.2.4 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.

### 3.1.2.5 Copper Tube and Pipe

- a. Brazed. Brazed joints shall be made in conformance with AWS B2.2/B2.2M, ASME B16.50, and CDA A4015 with flux and are acceptable for all pipe sizes. Copper to copper joints shall include the use of copper-phosphorus or copper-phosphorus-silver brazing metal without flux. Brazing of dissimilar metals (copper to bronze or brass) shall include the use of flux with either a copper-phosphorus, copper-phosphorus-silver or a silver brazing filler metal.
- b. Soldered. Soldered joints shall be made with flux and are only acceptable for piping 2 inches and smaller. Soldered joints shall conform to ASME B31.5 and CDA A4015. Soldered joints shall not be used in compressed air piping between the air compressor and the receiver.
- c. Copper Tube Extracted Joint. Mechanically extracted joints shall be made in accordance with ICC IPC.



#### 3.1.2.6 Plastic Pipe

Acrylonitrile-Butadiene-Styrene (ABS) pipe shall have joints made with solvent cement. PVC and CPVC pipe shall have joints made with solvent cement elastomeric, threading, (threading of Schedule 80 Pipe is allowed only where required for disconnection and inspection; threading of Schedule 40 Pipe is not allowed), or mated flanged.

#### 3.1.2.7 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 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. Additionally, ductile iron, cast iron, and steel pressure pipe shall have joint bonding. 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:

Secure sleeves in position and location during construction. Provide sleeves of sufficient length to pass through entire thickness of walls, ceilings, roofs, and floors.

A modular mechanical type sealing assembly may be installed in lieu of a waterproofing clamping flange and caulking and sealing of annular space between pipe and sleeve. The seals shall consist of interlocking synthetic rubber links shaped to continuously fill the annular space between the pipe and sleeve using galvanized steel bolts, nuts, and pressure plates. The links shall be loosely assembled with bolts to form a continuous rubber belt around the pipe with a pressure plate under each bolt head and each nut. After the seal assembly is properly positioned in the sleeve, tightening of the bolt shall cause the rubber sealing elements

to expand and provide a watertight seal between the pipe and the sleeve. Each seal assembly shall be sized as recommended by the manufacturer to fit the pipe and sleeve involved.

Sleeves shall not be installed in structural members, except where indicated or approved. Rectangular and square openings shall be as detailed. Each sleeve shall extend through its respective floor, or roof, and shall be cut flush with each surface, except for special circumstances. Pipe sleeves passing through floors in wet areas such as mechanical equipment rooms, lavatories, kitchens, and other plumbing fixture areas shall extend a minimum of 4 inches above the finished floor.

Unless otherwise indicated, sleeves shall be of a size to provide a minimum of 1/4 inch clearance between bare pipe or insulation and inside of sleeve or between insulation and inside of sleeve. Sleeves in bearing walls and concrete slab on grade floors shall be steel pipe or cast-iron pipe. Sleeves in nonbearing walls or ceilings may be steel pipe, cast-iron pipe, galvanized sheet metal with lock-type longitudinal seam, or plastic.

Except as otherwise specified, the annular space between pipe and sleeve, or between jacket over insulation and sleeve, shall be sealed as indicated with sealants conforming to ASTM C920 and with a primer, backstop material and surface preparation as specified in Section 07 92 00 JOINT SEALANTS. The annular space between pipe and sleeve, between bare insulation and sleeve or between jacket over insulation and sleeve shall not be sealed for interior walls which are not designated as fire rated.

Sleeves through below-grade walls in contact with earth shall be recessed 1/2 inch from wall surfaces on both sides. Annular space between pipe and sleeve shall be filled with backing material and sealants in the joint between the pipe and 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 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 Supports and Structural Bracing, Seismic Requirements

Piping and attached valves shall be supported and braced to resist seismic loads as specified in Section 13 48 00 SEISMIC PROTECTION FOR MISCELLANEOUS EQUIPMENT. Structural steel required for reinforcement to properly support piping, headers, and equipment, but not shown, shall be provided. Material used for supports shall be as specified in Section 05 12 00 STRUCTURAL STEEL Section 05 50 13 MISCELLANEOUS METAL FABRICATIONS.

### 3.1.7.3 Pipe Hangers, Inserts, and Supports

Installation of pipe hangers, inserts and supports shall conform to MSS SP-58 except as modified herein.

- a. Types 5, 12, and 26 shall not be used.
- b. Type 3 shall not be used on insulated pipe.
- c. Type 18 inserts shall be secured to concrete forms before concrete is placed. Continuous inserts which allow more adjustment may be used if they otherwise meet the requirements for type 18 inserts.
- d. Type 19 and 23 C-clamps shall be torqued per MSS SP-58 and shall have both locknuts and retaining devices furnished by the manufacturer. Field-fabricated C-clamp bodies or retaining devices are not acceptable.
- e. Type 20 attachments used on angles and channels shall be furnished with an added malleable-iron heel plate or adapter.
- f. Type 24 may be used only on trapeze hanger systems or on fabricated frames.
- g. Type 39 saddles shall be used on insulated pipe 4 inches and larger when the temperature of the medium is 60 degrees F or higher. Type 39 saddles shall be welded to the pipe.
- h. Type 40 shields shall:
  - (1) Be used on insulated pipe less than 4 inches.
  - (2) Be used on insulated pipe 4 inches and larger when the temperature of the medium is 60 degrees F or less.
  - (3) Have a high density insert for all pipe sizes. High density inserts shall have a density of 8 pcf or greater.
- i. Horizontal pipe supports shall be spaced as specified in MSS SP-58 and a support shall be installed not over 1 foot from the pipe fitting joint at each change in direction of the piping. Pipe supports shall

be spaced not over 5 feet apart at valves. Operating temperatures in determining hanger spacing for PVC or CPVC pipe shall be 120 degrees F for PVC and 180 degrees F for CPVC. Horizontal pipe runs shall include allowances for expansion and contraction.

- j. Vertical pipe shall be supported at each floor, except at slab-on-grade, at intervals of not more than 15 feet nor more than 8 feet from end of risers, and at vent terminations. Vertical pipe risers shall include allowances for expansion and contraction.
- k. Type 35 guides using steel, reinforced polytetrafluoroethylene (PTFE) or graphite slides shall be provided to allow longitudinal pipe movement. Slide materials shall be suitable for the system operating temperatures, atmospheric conditions, and bearing loads encountered. Lateral restraints shall be provided as needed. Where steel slides do not require provisions for lateral restraint the following may be used:
  - (1) On pipe 4 inches and larger when the temperature of the medium is 60 degrees F or higher, a Type 39 saddle, welded to the pipe, may freely rest on a steel plate.
  - (2) On pipe less than 4 inches a Type 40 shield, attached to the pipe or insulation, may freely rest on a steel plate.
  - (3) On pipe 4 inches and larger carrying medium less than 60 degrees F a Type 40 shield, attached to the pipe or insulation, may freely rest on a steel plate.
- l. Pipe hangers on horizontal insulated pipe shall be the size of the outside diameter of the insulation. The insulation shall be continuous through the hanger on all pipe sizes and applications.
- m. Where there are high system temperatures and welding to piping is not desirable, the type 35 guide shall include a pipe cradle, welded to the guide structure and strapped securely to the pipe. The pipe shall be separated from the slide material by at least 4 inches or by an amount adequate for the insulation, whichever is greater.
- n. Hangers and supports for plastic pipe shall not compress, distort, cut or abrade the piping, and shall allow free movement of pipe except where otherwise required in the control of expansion/contraction.

#### 3.1.7.4 Structural Attachments

Attachment to building structure concrete and masonry shall be by cast-in concrete inserts, built-in anchors, or masonry anchor devices. Inserts and anchors shall be applied with a safety factor not less than 5. Supports shall not be attached to metal decking. Supports shall not be attached to the underside of concrete filled floor or concrete roof decks unless approved by the Contracting Officer. Masonry anchors for overhead applications shall be constructed of ferrous materials only. Do not connect supports to building structural steel members by welding. Use clamping devices.

#### 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 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 Heat Pump Water Heater

Installation shall conform to water heater manufacturer's instructions..

Storage water heaters that are not equipped with integral heat traps and having vertical pipe risers shall be installed with heat traps directly on both the inlet and outlet. Circulating systems need not have heat traps installed. An acceptable heat trap may be a piping arrangement such as elbows connected so that the inlet and outlet piping make vertically upward runs of not less than 24 inches just before turning downward or directly horizontal into the water heater's inlet and outlet fittings. Commercially available heat traps, specifically designed by the manufacturer for the purpose of effectively restricting the natural tendency of hot water to rise through vertical inlet and outlet piping during standby periods may also be approved.

### 3.2.3 Heat Traps

Piping to and from each water heater and hot water storage tank shall be routed horizontally and downward a minimum of 2 feet before turning in an upward direction.

### 3.2.4 Connections to Water Heaters

Connections of metallic pipe to water heaters shall be made with dielectric unions or flanges.

### 3.2.5 Expansion Tank

A pre-charged expansion tank shall be installed on the cold water supply between the water heater inlet and the cold water supply shut-off valve. The Contractor shall adjust the expansion tank air pressure, as recommended by the tank manufacturer, to match incoming water pressure.

## 3.3 FIXTURES AND FIXTURE TRIMMINGS

Polished chromium-plated pipe, valves, and fittings shall be provided where exposed to view. Angle stops, straight stops, stops integral with the faucets, or concealed type of lock-shield, and loose-key pattern stops for supplies with threaded, sweat or solvent weld inlets shall be furnished and installed with fixtures. Where connections between copper tubing and faucets are made by rubber compression fittings, a beading tool shall be used to mechanically deform the tubing above the compression fitting. Exposed traps and supply pipes for fixtures and equipment shall be connected to the rough piping systems at the wall, unless otherwise specified under the item. Floor and wall escutcheons shall be as specified. Drain lines and hot water lines of fixtures for handicapped personnel shall be insulated and do not require polished chrome finish. Plumbing fixtures and accessories shall be installed within the space shown.

### 3.3.1 Fixture Connections

Where space limitations prohibit standard fittings in conjunction with the cast-iron floor flange, special short-radius fittings shall be provided. Connections between earthenware fixtures and flanges on soil pipe shall be made gastight and watertight with a closet-setting compound or neoprene gasket and seal. Use of natural rubber gaskets or putty will not be permitted. Fixtures with outlet flanges shall be set the proper distance from floor or wall to make a first-class joint with the closet-setting compound or gasket and fixture used.

### 3.3.2 Flushometer Valves

Flushometer valves shall be secured to prevent movement by anchoring the long finished top spud connecting tube to wall adjacent to valve with approved metal bracket. Flushometer valves for water closets shall be installed 39 inches above the floor, except at water closets intended for use by the physically handicapped where flushometer valves shall be mounted at approximately 30 inches above the floor and arranged to avoid interference with grab bars. In addition, for water closets intended for handicap use, the flush valve handle shall be installed on the wide side of the enclosure.

### 3.3.3 Height of Fixture Rims Above Floor

Lavatories shall be mounted with rim 31 inches above finished floor. Wall-hung drinking fountains and water coolers shall be installed with rim 42 inches above floor. Wall-hung service sinks shall be mounted with rim 28 inches above the floor. Installation of fixtures for use by the physically handicapped shall be in accordance with ICC A117.1 COMM.

### 3.3.4 Shower Outfits

The area around the water supply piping to the mixing valves and behind the escutcheon plate shall be made watertight by caulking or gasketing.

### 3.3.5 Fixture Supports

Fixture supports for off-the-floor lavatories, urinals, water closets, and other fixtures of similar size, design, and use, shall be of the chair-carrier type. The carrier shall provide the necessary means of mounting the fixture, with a foot or feet to anchor the assembly to the floor slab. Adjustability shall be provided to locate the fixture at the desired height and in proper relation to the wall. Support plates, in lieu of chair carrier, shall be fastened to the wall structure only where it is not possible to anchor a floor-mounted chair carrier to the floor slab.

#### 3.3.5.1 Support for Steel Stud Frame Partitions

Chair carrier shall be used. The anchor feet and tubular uprights shall be of the heavy duty design; and feet (bases) shall be steel and welded to a square or rectangular steel tube upright. Wall plates, in lieu of floor-anchored chair carriers, shall be used only if adjoining steel partition studs are suitably reinforced to support a wall plate bolted to these studs.

#### 3.3.5.2 Wall-Mounted Water Closet Gaskets

Where wall-mounted water closets are provided, reinforced wax, treated felt, or neoprene gaskets shall be provided. The type of gasket furnished shall be as recommended by the chair-carrier manufacturer.

### 3.3.6 Backflow Prevention Devices

Plumbing fixtures, equipment, and pipe connections shall not cross connect or interconnect between a potable water supply and any source of nonpotable water. Backflow preventers shall be installed where indicated and in accordance with ICC IPC at all other locations necessary to preclude a cross-connect or interconnect between a potable water supply



and any nonpotable substance. In addition backflow preventers shall be installed at all locations where the potable water outlet is below the flood level of the equipment, or where the potable water outlet will be located below the level of the nonpotable substance. Backflow preventers shall be located so that no part of the device will be submerged. Backflow preventers shall be of sufficient size to allow unrestricted flow of water to the equipment, and preclude the backflow of any nonpotable substance into the potable water system. Bypass piping shall not be provided around backflow preventers. Access shall be provided for maintenance and testing. Each device shall be a standard commercial unit.

### 3.3.7 Access Panels

Access panels shall be provided for concealed valves and controls, or any item requiring inspection or maintenance. Access panels shall be of sufficient size and located so that the concealed items may be serviced, maintained, or replaced. All access panels shall be constructed of stainless steel. Access panels shall be as specified in Section 08 31 00 ACCESS DOORS AND PANELS.

### 3.3.8 Hub Drains

Hub drains shall be installed so that the indirect waste will terminate 2 inches above the flood rim of the funnel to provide an acceptable air gap.

### 3.3.9 Traps

Each trap shall be placed as near the fixture as possible, and no fixture shall be double-trapped. Traps installed on cast-iron soil pipe shall be cast iron. Traps installed on steel pipe or copper tubing shall be recess-drainage pattern, or brass-tube type. Traps installed on plastic pipe may be plastic conforming to ASTM D3311.

### 3.3.10 Shower Pans

Before installing shower pan, subfloor shall be free of projections such as nail heads or rough edges of aggregate. Drain shall be a bolt-down, clamping-ring type with weepholes, installed so the lip of the subdrain is flush with subfloor.

#### 3.3.10.1 General

The floor of each individual shower, the shower-area portion of combination shower and drying room, and the entire shower and drying room where the two are not separated by curb or partition, shall be made watertight with a shower pan. The shower pan shall be installed in accordance with shower pan manufacturer's instructions. The upstands shall be placed behind any wall or partition finish. Subflooring shall be smooth and clean, with nailheads driven flush with surface, and shall be sloped to drain. Shower pans shall be clamped to drains with the drain clamping ring.

### 3.3.11 Water Meters

Install meters at the location shown on the drawings. Allow for reading and ease of removal or maintenance.

### 3.4 SEISMIC, FORCE PROTECTION, AND VIBRATION-ABSORBING FEATURES

Mechanical equipment, including compressors and pumps, shall be isolated from the building structure by approved vibration-absorbing features, unless otherwise shown. Each foundation shall include an adequate number of standard isolation units. Each unit shall consist of machine and floor or foundation fastening, together with intermediate isolation material, and shall be a standard product with printed load rating. Piping connected to mechanical equipment shall be provided with flexible connectors. Isolation unit installation shall limit vibration to 10 percent of the lowest equipment rpm.

#### 3.4.1 Foundation-Mounted Compressors

Foundation attachment shall be as recommended by the compressor manufacturer.

### 3.5 WATER METER REMOTE READOUT REGISTER

The remote readout register shall be mounted at the location indicated or as directed by the Contracting Officer.

### 3.6 IDENTIFICATION SYSTEMS

#### 3.6.1 Identification Tags

Identification tags made of brass, engraved laminated plastic, or engraved anodized aluminum, indicating service and valve number shall be installed on valves, except those valves installed on supplies at plumbing fixtures. Tags shall be 1-3/8 inch minimum diameter, and marking shall be stamped or engraved. Indentations shall be black, for reading clarity. Tags shall be attached to valves with No. 12 AWG, copper wire, chrome-plated beaded chain, or plastic straps designed for that purpose.

#### 3.6.2 Pipe Color Code Marking

Color code marking of piping shall be as specified in Section 09 90 00 PAINTS AND COATINGS.

#### 3.6.3 Color Coding Scheme for Locating Hidden Utility Components

Scheme shall be provided in buildings having suspended grid ceilings. The color coding scheme shall identify points of access for maintenance and operation of operable components which are not visible from the finished space and installed in the space directly above the suspended grid ceiling. The operable components shall include valves, dampers, switches, linkages and thermostats. The color coding scheme shall consist of a color code board and colored metal disks. Each colored metal disk shall be approximately 3/8 inch in diameter and secured to removable ceiling panels with fasteners. The fasteners shall be inserted into the ceiling panels so that the fasteners will be concealed from view. The fasteners shall be manually removable without tools and shall not separate from the ceiling panels when panels are dropped from ceiling height. Installation of colored metal disks shall follow completion of the finished surface on which the disks are to be fastened. The color code board shall have the approximate dimensions of 3 foot width, 30 inches height, and 1/2 inch thickness. The board shall be made of wood fiberboard and framed under glass or 1/16 inch transparent plastic cover. Unless otherwise directed, the color code symbols shall be approximately 3/4 inch in diameter and the

related lettering in 1/2 inch high capital letters. The color code board shall be mounted and located in the mechanical or equipment room. The color code system shall be as indicated below:

Color	System	Item	Location

### 3.7 ESCUTCHEONS

Escutcheons shall be provided at finished surfaces where bare or insulated piping, exposed to view, passes through floors, walls, or ceilings, except in boiler, utility, or equipment rooms. Escutcheons shall be fastened securely to pipe or pipe covering and shall be satin-finish, corrosion-resisting steel, polished chromium-plated zinc alloy, or polished chromium-plated copper alloy. Escutcheons shall be either one-piece or split-pattern, held in place by internal spring tension or setscrew.

### 3.8 PAINTING

Painting of pipes, hangers, supports, and other iron work, either in concealed spaces or exposed spaces, is specified in Section 09 90 00 PAINTS AND COATINGS.

#### 3.8.1 Painting of New Equipment

New equipment painting shall be factory applied or shop applied, and shall be as specified herein, and provided under each individual section.

##### 3.8.1.1 Factory Painting Systems

Manufacturer's standard factory painting systems may be provided subject to certification that the factory painting system applied will withstand 125 hours in a salt-spray fog test, except that equipment located outdoors shall withstand 500 hours in a salt-spray fog test. Salt-spray fog test shall be in accordance with ASTM B117, and for that test the acceptance criteria shall be as follows: immediately after completion of the test, the paint shall show no signs of blistering, wrinkling, or cracking, and no loss of adhesion; and the specimen shall show no signs of rust creepage beyond 0.125 inch on either side of the scratch mark.

The film thickness of the factory painting system applied on the equipment shall not be less than the film thickness used on the test specimen. If manufacturer's standard factory painting system is being proposed for use on surfaces subject to temperatures above 120 degrees F, the factory painting system shall be designed for the temperature service.

##### 3.8.1.2 Shop Painting Systems for Metal Surfaces

Clean, pretreat, prime and paint metal surfaces; except aluminum surfaces need not be painted. Apply coatings to clean dry surfaces. Clean the surfaces to remove dust, dirt, rust, oil and grease by wire brushing and solvent degreasing prior to application of paint, except metal surfaces subject to temperatures in excess of 120 degrees F shall be cleaned to bare metal.

Where more than one coat of paint is specified, apply the second coat after the preceding coat is thoroughly dry. Lightly sand damaged painting and retouch before applying the succeeding coat. Color of finish coat shall be aluminum or light gray.

- a. Temperatures Less Than 120 Degrees F: Immediately after cleaning, the metal surfaces subject to temperatures less than 120 degrees F shall receive one coat of pretreatment primer applied to a minimum dry film thickness of 0.3 mil, one coat of primer applied to a minimum dry film thickness of one mil; and two coats of enamel applied to a minimum dry film thickness of one mil per coat.
- b. Temperatures Between 120 and 400 Degrees F: Metal surfaces subject to temperatures between 120 and 400 degrees F shall receive two coats of 400 degrees F heat-resisting enamel applied to a total minimum thickness of 2 mils.

### 3.9 TESTS, FLUSHING AND DISINFECTION

#### 3.9.1 Plumbing System

The following tests shall be performed on the plumbing system in accordance with ICC IPC, except that the drainage and vent system final test shall include the smoke test. The Contractor has the option to perform a peppermint test in lieu of the smoke test. If a peppermint test is chosen, the Contractor must submit a testing procedure and reasons for choosing this option in lieu of the smoke test to the Contracting Officer for approval.

- a. Drainage and Vent Systems Test. The final test shall include a smoke test.
- b. Building Sewers Tests.
- c. Water Supply Systems Tests.

##### 3.9.1.1 Test of Backflow Prevention Assemblies

Backflow prevention assembly shall be tested using gauges specifically designed for the testing of backflow prevention assemblies.

Backflow prevention assembly test gauges shall be tested annually for accuracy in accordance with the requirements of State or local regulatory agencies. If there is no State or local regulatory agency requirements, gauges shall be tested annually for accuracy in accordance with the requirements of University of Southern California's Foundation of Cross Connection Control and Hydraulic Research or the American Water Works Association Manual of Cross Connection (Manual M-14), or any other approved testing laboratory having equivalent capabilities for both laboratory and field evaluation of backflow prevention assembly test gauges. Report form for each assembly shall include, as a minimum, the following:

Data on Device	Data on Testing Firm
Type of Assembly	Name

Manufacturer	Address
Model Number	Certified Tester
Serial Number	Certified Tester No.
Size	Date of Test
Location	
Test Pressure Readings	Serial Number and Test Data of Gauges

If the unit fails to meet specified requirements, the unit shall be repaired and retested.

#### 3.9.1.2 Shower Pans

After installation of the pan and finished floor, the drain shall be temporarily plugged below the weep holes. The floor area shall be flooded with water to a minimum depth of 1 inch for a period of 24 hours. Any drop in the water level during test, except for evaporation, will be reason for rejection, repair, and retest.

#### 3.9.1.3 Compressed Air Piping

Piping systems shall be filled with oil-free dry air or gaseous nitrogen to 150 psig and hold this pressure for 2 hours with no drop in pressure.

#### 3.9.2 Defective Work

If inspection or test shows defects, such defective work or material shall be replaced or repaired as necessary and inspection and tests shall be repeated. Repairs to piping shall be made with new materials. Caulking of screwed joints or holes will not be acceptable.

#### 3.9.3 System Flushing

##### 3.9.3.1 During Flushing

Before operational tests or disinfection, potable water piping system shall be flushed with hot potable water. Sufficient water shall be used to produce a water velocity that is capable of entraining and removing debris in all portions of the piping system. This requires simultaneous operation of all fixtures on a common branch or main in order to produce a flushing velocity of approximately 4 fps through all portions of the piping system. In the event that this is impossible due to size of system, the Contracting Officer (or the designated representative) shall specify the number of fixtures to be operated during flushing. Contractor shall provide adequate personnel to monitor the flushing operation and to ensure that drain lines are unobstructed in order to prevent flooding of the facility. Contractor shall be responsible for any flood damage resulting from flushing of the system. Flushing shall be continued until entrained dirt and other foreign materials have been removed and until discharge water shows no discoloration. All faucets and drinking water fountains, to include any device considered as an end point device by NSF/ANSI 61, Section 9, shall be flushed a minimum of 0.25 gallons per 24

hour period, ten times over a 14 day period.

#### 3.9.3.2 After Flushing

System shall be drained at low points. Strainer screens shall be removed, cleaned, and replaced. After flushing and cleaning, systems shall be prepared for testing by immediately filling water piping with clean, fresh potable water. Any stoppage, discoloration, or other damage to the finish, furnishings, or parts of the building due to the Contractor's failure to properly clean the piping system shall be repaired by the Contractor. When the system flushing is complete, the hot-water system shall be adjusted for uniform circulation. Flushing devices and automatic control systems shall be adjusted for proper operation according to manufacturer's instructions. Comply with ASHRAE 90.1 - IP for minimum efficiency requirements. Unless more stringent local requirements exist, lead levels shall not exceed limits established by 40 CFR 141.80 (c)(1). The water supply to the building shall be tested separately to ensure that any lead contamination found during potable water system testing is due to work being performed inside the building.

#### 3.9.4 Operational Test

Upon completion of flushing and prior to disinfection procedures, the Contractor shall subject the plumbing system to operating tests to demonstrate satisfactory installation, connections, adjustments, and functional and operational efficiency. Such operating tests shall cover a period of not less than 8 hours for each system and shall include the following information in a report with conclusion as to the adequacy of the system:

- a. Time, date, and duration of test.
- b. Water pressures at the most remote and the highest fixtures.
- c. Operation of each fixture and fixture trim.
- d. Operation of each valve, hydrant, and faucet.
- e. Pump suction and discharge pressures.
- f. Temperature of each domestic hot-water supply.
- g. Operation of each floor and roof drain by flooding with water.
- h. Operation of each vacuum breaker and backflow preventer.
- i. Complete operation of each water pressure booster system, including pump start pressure and stop pressure.
- j. Compressed air readings at each compressor and at each outlet. Each indicating instrument shall be read at 1/2 hour intervals. The report of the test shall be submitted in quadruplicate. The Contractor shall furnish instruments, equipment, and personnel required for the tests; the Government will furnish the necessary water and electricity.

#### 3.9.5 Disinfection

After all system components are provided and operational tests are complete, the entire domestic hot- and cold-water distribution system

shall be disinfected. Before introducing disinfecting chlorination material, entire system shall be flushed with potable water until any entrained dirt and other foreign materials have been removed.

Water chlorination procedure shall be in accordance with AWWA C651 and AWWA C652 as modified and supplemented by this specification. The chlorinating material shall be hypochlorites or liquid chlorine. The chlorinating material shall be fed into the water piping system at a constant rate at a concentration of at least 50 parts per million (ppm). Feed a properly adjusted hypochlorite solution injected into the system with a hypochlorinator, or inject liquid chlorine into the system through a solution-feed chlorinator and booster pump until the entire system is completely filled.

Test the chlorine residual level in the water at 6 hour intervals for a continuous period of 24 hours. If at the end of a 6 hour interval, the chlorine residual has dropped to less than 25 ppm, flush the piping including tanks with potable water, and repeat the above chlorination procedures. During the chlorination period, each valve and faucet shall be opened and closed several times.

After the second 24 hour period, verify that no less than 25 ppm chlorine residual remains in the treated system. The 24 hour chlorination procedure must be repeated until no less than 25 ppm chlorine residual remains in the treated system.

Upon the specified verification, the system including tanks shall then be flushed with potable water until the residual chlorine level is reduced to less than one part per million. During the flushing period, each valve and faucet shall be opened and closed several times.

Take additional samples of water in disinfected containers, for bacterial examination, at locations specified by the Contracting Officer

Test these samples for total coliform organisms (coliform bacteria, fecal coliform, streptococcal, and other bacteria) in accordance with EPA SM 9223. The testing method used shall be EPA approved for drinking water systems and shall comply with applicable local and state requirements.

Disinfection shall be repeated until bacterial tests indicate the absence of coliform organisms (zero mean coliform density per 100 milliliters) in the samples for at least 2 full days. The system will not be accepted until satisfactory bacteriological results have been obtained.

### 3.10 POSTED INSTRUCTIONS

Framed instructions under glass or in laminated plastic, including wiring and control diagrams showing the complete layout of the entire system, shall be posted where directed. Condensed operating instructions explaining preventive maintenance procedures, methods of checking the system for normal safe operation, and procedures for safely starting and stopping the system shall be prepared in typed form, framed as specified above for the wiring and control diagrams and posted beside the diagrams. The framed instructions shall be posted before acceptance testing of the systems.

### 3.11 PERFORMANCE OF WATER HEATING EQUIPMENT

Standard rating condition terms are as follows:

EF = Energy factor, minimum overall efficiency.

ET = Minimum thermal efficiency with 70 degrees F delta T.

SL = Standby loss is maximum (Btu/h) based on a 70 degrees F temperature difference between stored water and ambient requirements.

V = Rated volume in gallons

Q = Nameplate input rate in kW (Btu/h)

#### 3.11.1 Storage Water Heaters

##### 3.11.1.1 Electric

- a. Storage capacity of 60 gallons shall have a minimum energy factor (EF) of 0.93 or higher per FEMP requirements.
- b. Storage capacity of 60 gallons or more shall have a minimum energy factor (EF) of 0.91 or higher per FEMP requirements.

#### 3.11.2 Unfired Hot Water Storage

All volumes and inputs: shall meet or exceed R-12.5.

### 3.12 ADJUSTMENTS

Perform the following adjustments:

- a. Adjust outlet temperatures of ASSE 1017 centralized thermostatic mixing valves to design temperature values for the project.
- b. Adjust outlet temperatures of ASSE 1020 fixture thermostatic mixing valves to 100 degrees F.
- c. Adjust outlet temperatures for solar water heating system and for back-up heat pump water heating system.
- d. Adjust maximum outlet temperatures for ASSE 1016 shower mixing valves to 115 degrees F.
- e. Adjust flushometers as required to deliver 1.28 gpf.
- f. Verify flow rates from shower, lavatory and sink faucets.
- g. Verify outlet temperatures for shower, lavatory and sink faucets.
- h. Verify flow rates for emergency fixtures.



3.13 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		
3	Cast iron drainage fittings, threaded, ASME B16.12 for use with Item 10				X			
4	Cast iron screwed fittings (threaded) ASME B16.4 for use with Item 10				X	X		
5	Grooved pipe couplings, ferrous and non-ferrous pipe ASTM A536 And ASTM A47/A47M				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		

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
7	Bronze sand casting grooved joint pressure fittings for non-ferrous pipe ASTM B584, for use with Item 5				X	X		X
8	Wrought copper grooved joint pressure 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					
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		
11	Seamless red brass pipe, ASTM B43				X			X
12	Bronzed flanged fittings, ASME B16.24 for use with Items 11 and 14				X			X
13	Cast copper alloy solder joint pressure fittings, ASME B16.18 for use with Item 14					X		X
14	Seamless copper pipe, ASTM B42							X
15	Cast bronze threaded fittings, ASME B16.15				X	X		

TABLE I								
PIPE AND FITTING MATERIALS FOR DRAINAGE, WASTE, VENT AND CONDENSATE DRAIN PIPING SYSTEMS								
Item #	Pipe and Fitting Materials	SERVICE A	SERVICE B	SERVICE C	SERVICE D	SERVICE E	SERVICE F	SERVICE G
16	Copper drainage tube, (DWV), ASTM B306		X		X	X		X
17	Wrought copper and wrought alloy solder-joint drainage fittings. ASME B16.29		X		X	X		X
18	Cast copper alloy solder joint drainage fittings, DWV, ASME B16.23		X		X	X		X
19	Acrylonitrile-Butadiene (ABS) plastic drain, waste, and vent pipe and fittings ASTM D2661, ASTM F628  ABS piping is not permitted under floor of hangars where fuel spills may be handled	X	X	X	X	X		
20	Polyvinyl Chloride plastic drain, waste and vent pipe and fittings, ASTM D2665, ASTM F891, (Sch 40) ASTM F1760  PVC piping is not permitted under floor of hangars where fuel spills may be handled	X	X	X	X	X		X

TABLE I								
PIPE AND FITTING MATERIALS FOR DRAINAGE, WASTE, VENT AND CONDENSATE DRAIN PIPING SYSTEMS								
It #	Pipe and Fitting Materials	SERVICE A	SERVICE B	SERVICE C	SERVICE D	SERVICE E	SERVICE F	SERVICE G
<p>SERVICE:</p> <p>A - Underground Building Soil, Waste and Storm Drain</p> <p>B - Aboveground Soil, Waste, Drain In Buildings</p> <p>C - Underground Vent</p> <p>D - Aboveground Vent</p> <p>E - Interior Rainwater Conductors Aboveground</p> <p>F - Corrosive Waste And Vent Above And Belowground</p> <p>G - Condensate Drain Aboveground</p>								

TABLE II					
PIPE AND FITTING MATERIALS FOR PRESSURE PIPING SYSTEMS					
Item #	Pipe and Fitting Materials	SERVICE A	SERVICE B	SERVICE C	SERVICE D
1	Steel pipe:				
	a. Seamless, galvanized, ASTM A53/A53M, Type S, Grade B	X	X		
	b. Seamless, black, ASTM A53/A53M, Type S, Grade B				
2	Seamless red brass pipe, ASTM B43	X	X		
3	Bronze flanged fittings, ASME B16.24 for use with Items 5 and 7	X	X		X
4	Seamless copper pipe, ASTM B42	X	X		X
5	Seamless copper water tube, ASTM B88 ASTM B88M	X**	X**	X**	X***
6	Cast bronze threaded fittings, ASME B16.15 for use with Items 5 and 7	X	X		X

TABLE II					
PIPE AND FITTING MATERIALS FOR PRESSURE PIPING SYSTEMS					
Item #	Pipe and Fitting Materials	SERVICE A	SERVICE B	SERVICE C	SERVICE D
7	Wrought copper and bronze solder-joint pressure fittings, ASME B16.22 for use with Items 5, 7 and 8	X	X	X	X
8	Cast copper alloy solder-joint pressure fittings, ASME B16.18 for use with Item 8	X	X	X	X
9	Polyethylene (PE) plastic pipe, Schedules 40 and 80, based on outside diameter	X			X
10	Polyethylene (PE) plastic pipe (SDR-PR), based on controlled outside diameter, ASTM D3035	X			X
11	Polyethylene (PE) plastic pipe (SIDR-PR), based on controlled inside diameter, ASTM D2239	X			X
12	Butt fusion polyethylene (PE) plastic pipe fittings, ASTM D3261 for use with Items 9, 10, and 11	X			X
13	Socket-type polyethylene fittings for outside diameter-controlled polyethylene pipe, ASTM D2683 for use with Item 11	X			X
14	Polyethylene (PE) plastic tubing, ASTM D2737	X			X
15	Chlorinated polyvinyl chloride (CPVC) plastic hot and cold water distribution system, ASTM D2846/D2846M	X	X		X
16	Chlorinated polyvinyl chloride (CPVC) plastic pipe, Schedule 80, ASTM F441/F441M	X	X		X

TABLE II					
PIPE AND FITTING MATERIALS FOR PRESSURE PIPING SYSTEMS					
Item #	Pipe and Fitting Materials	SERVICE A	SERVICE B	SERVICE C	SERVICE D
17	Chlorinated polyvinyl chloride (CPVC) plastic pipe (SDR-PR) ASTM F442/F442M	X	X		X
18	Polyvinyl chloride (PVC) pressure rated pipe (SDR Series), ASTM D2241	X			X
19	Polyvinyl chloride (PVC) plastic pipe fittings, Schedule 40 ASTM D2466	X			X
20	Socket-type polyvinyl chloride (PVC) plastic pipe fittings, schedule 80, ASTM D2467 for use with Items 20 and 21	X			X
21	Fittings: brass or bronze; ASME B16.15, and ASME B16.18 ASTM B828	X	X		
	SERVICE: A - Cold Water Service Aboveground B - Hot and Cold Water Distribution 180 degrees F Maximum Aboveground C - Compressed Air Lubricated D - Cold Water Service Belowground 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				

TABLE III				
STANDARD RATING CONDITIONS AND MINIMUM PERFORMANCE RATINGS FOR WATER HEATING EQUIPMENT				
<u>FUEL</u>	<u>STORAGE CAPACITY GALLONS</u>	<u>INPUT RATING</u>	<u>TEST PROCEDURE</u>	<u>REQUIRED PERFORMANCE</u>
A. STORAGE WATER HEATERS				
Elect. Heat Pump		24 Amps or less and 250 Volts or less	10 CFR 430	EF = 0.93-0.00132V
B. Unfired Hot Water Storage, R-12.5 min.				
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 --





SECTION 22 33 30.00 10

SOLAR WATER HEATING EQUIPMENT  
04/08

PART 1 GENERAL

1.1 REFERENCES

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

AMERICAN NATIONAL STANDARDS INSTITUTE (ANSI)

ANSI Z21.22/CSA 4.4 (2015) Relief Valves for Hot Water Supply Systems

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

ASHRAE 93 (2010; Errata 2013; Errata 2014) Methods of Testing to Determine the Thermal Performance of Solar Collectors

AMERICAN WATER WORKS ASSOCIATION (AWWA)

AWWA C606 (2015) Grooved and Shouldered Joints

AMERICAN WELDING SOCIETY (AWS)

AWS B2.1/B2.1M (2014; Errata 2015) Specification for Welding Procedure and Performance Qualification

AWS D1.2/D1.2M (2014) Structural Welding Code - Aluminum

ASME INTERNATIONAL (ASME)

ASME B1.20.1 (2013) Pipe Threads, General Purpose (Inch)

ASME B16.15 (2013) Cast Copper Alloy Threaded Fittings Classes 125 and 250

ASME B16.18 (2012) Cast Copper Alloy Solder Joint Pressure Fittings

ASME B16.22 (2013) Standard for Wrought Copper and Copper Alloy Solder Joint Pressure Fittings

ASME B16.24 (2011) Cast Copper Alloy Pipe Flanges and Flanged Fittings: Classes 150, 300, 600, 900, 1500, and 2500

ASME B16.26 (2013) Standard for Cast Copper Alloy Fittings for Flared Copper Tubes

ASME B16.39	(2014) Standard for Malleable Iron Threaded Pipe Unions; Classes 150, 250, and 300
ASME B31.9	(2017) Building Services Piping
ASME B40.100	(2013) Pressure Gauges and Gauge Attachments
ASME BPVC SEC VIII D1	(2015) BPVC Section VIII-Rules for Construction of Pressure Vessels Division 1
ASME PTC 19.3 TW	(2016) Thermowells Performance Test Codes

ASTM INTERNATIONAL (ASTM)

ASTM A183	(2014) Standard Specification for Carbon Steel Track Bolts and Nuts
ASTM A536	(1984; R 2014) Standard Specification for Ductile Iron Castings
ASTM B32	(2008; R 2014) Standard Specification for Solder Metal
ASTM B62	(2017) Standard Specification for Composition Bronze or Ounce Metal Castings
ASTM B75/B75M	(2011) Standard Specification for Seamless Copper Tube
ASTM B828	(2016) Standard Practice for Making Capillary Joints by Soldering of Copper and Copper Alloy Tube and Fittings
ASTM B88	(2016) Standard Specification for Seamless Copper Water Tube
ASTM C1048	(2012; E 2012) Standard Specification for Heat-Treated Flat Glass - Kind HS, Kind FT Coated and Uncoated Glass
ASTM D2000	(2012; R 2017) Standard Classification System for Rubber Products in Automotive Applications
ASTM F1199	(1988; R 2015) Cast (All Temperatures and Pressures) and Welded Pipe Line Strainers (150 psig and 150 degrees F Maximum)

MANUFACTURERS STANDARDIZATION SOCIETY OF THE VALVE AND FITTINGS  
INDUSTRY (MSS)

MSS SP-110	(2010) Ball Valves Threaded, Socket-Welding, Solder Joint, Grooved and Flared Ends
MSS SP-58	(1993; Reaffirmed 2010) Pipe Hangers and Supports - Materials, Design and

Manufacture, Selection, Application, and  
Installation

- MSS SP-72 (2010a) Ball Valves with Flanged or  
Butt-Welding Ends for General Service
- MSS SP-80 (2013) Bronze Gate, Globe, Angle and Check  
Valves

NATIONAL ELECTRICAL MANUFACTURERS ASSOCIATION (NEMA)

- NEMA MG 11 (1977; R 2012) Energy Management Guide for  
Selection and Use of Single Phase Motors

U.S. DEPARTMENT OF DEFENSE (DOD)

- UFC 3-310-04 (2013; with Change 1) Seismic Design for  
Buildings

1.2 SOLAR ENERGY SYSTEM

- a. Provide a solar energy system arranged for primary heating of service (domestic) water using flat plate liquid solar collectors. Include in the system components a solar collector array, storage tank, pumps, automatic controls, instrumentation, interconnecting piping and fittings, 100 percent water as the heat transfer fluid in a closed loop, heat exchanger, expansion tank, and accessories required for the operation of the system.
- b. Submit manufacturer's descriptive and technical literature; performance chart and curves; catalog cuts; and installation instructions. Proposed diagrams, instructions, and other sheets, prior to posting. A copy of the posted instructions proposed to be used, including a system schematic, wiring and control diagrams, and a complete layout of the entire system. Include with the instructions, in typed form, 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, methods of balancing and testing flow in the system, and methods of testing for control failure and proper system operation.
- c. Submit drawings containing a system schematic; a collector layout and roof plan noting reverse-return piping for the collector array; a system elevation; an equipment room layout; a schedule of operation and installation instructions; and a schedule of design information including collector height and width, recommended flow rate and pressure drop at that flow rate, and number of collectors to be grouped per bank.
- d. Include on the drawings complete wiring and schematic diagrams and any other details required to demonstrate that the system has been coordinated and will properly function as a unit. Drawings shall show proposed layout and anchorage of equipment and appurtenances, and equipment relationship to other parts of the work, including clearances for maintenance and operation.

1.3 SUBMITTALS

Government approval is required for submittals with a "G" designation;

submittals not having a "G" designation are for Contractor Quality Control approval. Submittals with an "S" are for inclusion in the Sustainability eNotebook, in conformance to Section 01 33 29 SUSTAINABILITY REPORTING. Submit the following in accordance with Section 01 33 00 SUBMITTAL PROCEDURES:

SD-02 Shop Drawings

Solar Energy System  
As-Built Drawings

SD-03 Product Data

Spare Parts  
Solar Energy System

SD-06 Test Reports

Inspection and Testing

SD-10 Operation and Maintenance Data

Operation and Maintenance Procedures; G

1.4 DELIVERY, STORAGE, AND HANDLING

Protect all equipment delivered and placed in storage from the weather, excessive humidity and excessive temperature variation, and dirt and dust or other contaminants.

1.5 WARRANTY

Provide a minimum 10-year warranty against the following: failure of manifold or riser tubing, joints or fittings; degradation of absorber plate selective surface; rusting or discoloration of collector hardware; and embrittlement of header manifold seals. Include in the warranty full repair or replacement of defective materials or equipment.

1.6 SPARE PARTS

Submit data for each different item of material and equipment listed, including a complete list of parts and supplies, with current unit prices and source of supply; a list of parts and supplies that are either normally furnished at no extra cost with the purchase of equipment, or specified to be furnished as part of the contract; and a list of additional items recommended by the manufacturer to ensure efficient operation for a period of 120 days.

PART 2 PRODUCTS

2.1 GENERAL EQUIPMENT REQUIREMENTS

2.1.1 Standard Products

Provide materials and equipment which are the standard products of a manufacturer 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. Equipment shall be supported by a service organization that is, in the opinion of the Contracting Officer,

reasonably convenient to the site.

#### 2.1.2 Nameplates

Each major item of equipment shall 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.

#### 2.1.3 Identical Items

Items of the same classification shall be identical, including equipment, assemblies, parts, and components.

#### 2.1.4 Equipment Guards

Fully enclose or guard belts, pulleys, chains, gears, couplings, projecting set-screws, keys, and other rotating parts so located that any person may come in close proximity. High-temperature equipment and piping so located as to endanger personnel or where it creates a potential fire hazard shall be properly guarded or covered with insulation of a type specified.

#### 2.1.5 Special Tools

Provide one set of special tools, calibration devices, and instruments required for operation, calibration, and maintenance of the equipment.

### 2.2 PIPING SYSTEM

Piping system shall be complete with pipe, pipe fittings, valves, strainers, expansion loops, hangers, inserts, supports, anchors, guides, sleeves, and accessories. System materials shall conform to the following:

#### 2.2.1 Copper Tubing

ASTM B88, Type K where buried, Type L otherwise. Collector risers Type L or M.

#### 2.2.2 Solder

ASTM B32, Type Sb5, Sn94, Sn95, or Sn96.

#### 2.2.3 Joints and Fittings for Copper Tubing

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 and ASTM B828. 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. Cast bronze threaded fittings shall conform to ASME B16.15. 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 230 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.

#### 2.2.4 Flanges

Bronze, Class 125 or 150 as applicable, ASME B16.24.

#### 2.2.5 Dielectric Waterways and Flanges

Waterways and flanges shall conform to the requirements of ASME B16.39. Dielectric waterways shall have metal connections at both ends suited to match connecting piping. Ends shall be threaded or soldered to match adjacent piping. Dielectric waterways shall be internally lined with an insulator specifically designed to prevent current flow between dissimilar metals. Dielectric waterways and flanges shall be suitable for the temperatures, pressures, and antifreeze encountered. Dielectric flanges shall meet the performance requirements described herein for dielectric waterways.

#### 2.2.6 Bronze Gate, Globe, Angle, and Check Valves

MSS SP-80, Type 1 (or nonslam, spring type), Class 125 or 150.

#### 2.2.7 Ball Valves

MSS SP-72 or MSS SP-110, Class 125 or 150.

#### 2.2.8 Relief Valves, Pressure and Temperature

ANSI Z21.22/CSA 4.4. Pressure relief valves located on the solar collector array upper manifold and on the expansion tank shall open and discharge the collector fluid into drain indicated when fluid pressure rises above 125 psig. Pressure and temperature relief valves located on the solar storage tank shall open and discharge water into drain indicated when fluid pressure rises above 125 psig or when fluid temperature rises above 210 degrees F.

#### 2.2.9 Air Vents

Brass or bronze valves or cocks suitable for 125 psig service. Air vents shall be provided with threaded plugs or caps.

#### 2.2.10 Strainers

ASTM F1199, removable basket and screen, Y pattern, cast iron strainer with pressures to 125 psig, simplex type; or a combination elbow-strainer with straightening vanes and strainer arranged for horizontal flow.

#### 2.2.11 Pressure Gauges

ASME B40.100. Pressure gauges shall be provided with throttling type needle valve or a pulsation dampener and shutoff valve. Minimum dial size shall be 3-1/2 inch.

#### 2.2.12 Thermometers

ASME PTC 19.3 TW, Type I, Class 3. Thermometers shall be supplied with wells and separable bronze sockets.

#### 2.2.13 Pipe Threads

ASME B1.20.1.

#### 2.2.14 Pipe Supports

MSS SP-58. Metal insulation shield shall be stainless steel.

### 2.3 ELECTRICAL WORK

Electric motor-driven equipment specified shall be provided complete with motor, motor starters, and controls. Electrical equipment and wiring shall be in accordance with Section 26 20 00 INTERIOR DISTRIBUTION SYSTEM. Electrical characteristics shall be as specified or indicated. Motor starters shall be provided complete with thermal overload protection and other appurtenances necessary for the motor control specified. Each motor shall be 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, shall be provided. Integral size motors shall be the premium efficiency type in accordance with NEMA MG 11.

### 2.4 COLLECTOR SUBSYSTEM

#### 2.4.1 Solar Collector Construction

Collectors shall be of the flat plate, liquid, internally manifolded type. Each collector shall be provided with cover glazing, an absorber plate, heat transfer liquid flow tubes, internal headers, weep holes, insulation, and a casing. Collectors shall be of weather-tight construction. Solar collectors shall withstand a stagnation temperature of 350 degrees F and a working pressure of 125 psig without degrading, out-gassing, or warping. Collector net aperture area shall be as shown and shall be a minimum of 28 square feet. Collector length, width, and volume shall be as shown.

#### 2.4.2 Absorber Plate and Flow Tubes

Absorber sheet or plate shall be copper. Top of absorber plate shall be coated with selective surface of black chrome and shall have an emissivity less than 0.2 and absorptivity greater than 0.9. Flow tubes shall be Type L or Type M copper, and shall be soldered, brazed, or mechanically bonded to the absorber plate. Tubes shall be installed on the absorber plate so that they drain by gravity.

#### 2.4.3 Cover Glazing

Each collector shall have a single layer of cover glazing made of clear float, water white or low iron type tempered glass. Glass shall meet ASTM C1048. Cover glazing shall be completely replaceable from the front of the collector without disturbing the piping or adjacent collectors. Cover glazing shall be separated from the collector by a continuous gasket made of EPDM rubber.

#### 2.4.4 Insulation

Back and sides of the absorber plate shall be insulated. Insulation shall fill space between absorber plate and casing and shall have an R value of

4 minimum. Insulation shall conform to EPA requirements in accordance with Section 01 33 29 SUSTAINABILITY REPORTING and shall be fibrous glass, polyisocyanurate, urethane foam, or other material suitable for the intended purpose, and shall withstand the moisture, sun exposure, and stagnation temperature limitations of the solar collector. Polyisocyanurate insulation shall not come in contact with the absorber plate.

#### 2.4.5 Casing

Casing shall be aluminum. Finish shall be mill finish or factory applied baked enamel, embossed or bronze anodized aluminum. Cover glazing shall be separated from the casing by an EPDM rubber gasket or equivalent material. Allowance shall be made for thermal expansion between the cover and absorber plates and the casing, and for drainage of moisture through weep holes.

#### 2.4.6 Mounting and Assembly Hardware

Mounting brackets and hinges shall be aluminum or stainless steel. Assembly hardware including all bolts, washers, and nuts shall be stainless steel.

#### 2.4.7 Solar Collector Performance

Thermal performance shall be plotted on the thermal efficiency curve in accordance with ASHRAE 93. The y-intercept shall be equal to or greater than 0.68, and the numerical value of the slope of the curve (FRUL) shall be between 0 and minus 1.0 Btu per hour per square foot per degree F. Manufacturer's recommended volumetric flow rate and the design pressure drop at the recommended flow rate shall be as shown. Manufacturer's recommendations shall allow at least seven collectors to be joined per bank while providing for balanced flow and for thermal expansion considerations.

### 2.5 SOLAR COLLECTOR ARRAY

#### 2.5.1 Net Absorber Area and Array Layout

Array shall consist of an assembly of solar collectors as shown with a minimum total array aperture area as shown on Drawings. Solar collectors shall be assembled as shown in banks of equal number of collectors. Banks shall consist of no less than 4 and no more than 7 collectors each. Collector array shall be oriented so that all collectors face the same direction and are oriented within 20 degrees of true south and with respect to true south as indicated. Collectors arranged in multiple rows shall be spaced so that no shading from other collectors is evident between 1000 hours and 1400 hours solar time on December 21. Minimum spacing between rows shall be as shown.

#### 2.5.2 Piping

The array piping shall include interconnecting piping between solar collectors, and shall be connected in a reverse-return configuration as indicated with approximately equal pipe length for any possible flow path. Flow rate through the collector array shall be as indicated. Automatic pressure relief valves shall be provided in the array piping system as indicated, and shall be adjusted to open when the pressure within the solar array rises above 125 psig. Each collector bank shall be



capable of being isolated by valves, and each bank capable of being separated shall have a pressure relief valve installed and shall be capable of being drained. Manually operated air vents shall be located at system high points, and all array piping shall be pitched a minimum of 0.25 inch/foot as shown so that piping can be drained by gravity.

### 2.5.3 Supports for Solar Collector Array

Support structure for collector array shall be aluminum and shall be in accordance with Section 05 50 13 MISCELLANEOUS METAL FABRICATIONS. Support structure shall secure collector array at the tilt angle close to that of the roof and at a slight pitch for positive draining and air removal and orientation with respect to true south as shown. Support structure shall withstand static weight of filled collectors and piping, wind, hurricane, seismic, and other loads as indicated. Seismic details shall conform to UFC 3-310-04 and Sections 13 48 00 SEISMIC PROTECTION FOR MISCELLANEOUS EQUIPMENT and 13 48 00.00 10 SEISMIC PROTECTION FOR MECHANICAL EQUIPMENT. Support structure shall allow access to all equipment for maintenance, repair, and replacement and at a slight pitch for positive draining and air removal. Support attachment shall be suitable for the standing seam roof.

### 2.6 STORAGE TANK AND DRAIN-BACK TANK

Solar system hot water storage tank and drain-back tank shall have a storage volume as shown on the Drawings. Solar system storage tank and drain-back tank shall conform to specifications for hot water storage tanks in Section 22 00 00 PLUMBING, GENERAL PURPOSE. Insulation shall be in accordance with Section 23 07 00 THERMAL INSULATION FOR MECHANICAL SYSTEMS, except that insulation shall have an R value of not less than 30. Tank penetrations shall be designed to allow for connections to copper piping without risk of corrosion due to dissimilar metals, and shall be factory installed as indicated. Solar storage tank shall be pressurized at street pressure and shall include temperature and pressure relief valve. The drain-back tank shall be vented.

### 2.7 TRANSPORT SUBSYSTEM

#### 2.7.1 Heat Exchanger

The heat exchanger construction and testing shall be in accordance with ASME BPVC SEC VIII D1. Minimum design pressure rating shall be 125 psig. Heat exchanger shall be capable of returning a hot-side exit temperature of 120 degrees F or less given a hot-side approach temperature of 140 degrees F and a cold-side approach temperature of 100 degrees F. Heat exchanger shall be capable of withstanding temperatures of at least 240 degrees F. Heat exchanger shall be capable of operation at the flow rates as shown.

##### 2.7.1.1 Plate Heat Exchanger

Heat exchanger shall be constructed with double wall construction as required for potable water and of multiple plates of 316 stainless steel, titanium, copper, copper-nickel, or brass. Plates shall be frame-mounted, mechanically bonded, welded, or brazed at edges. Plate-type heat exchanger shall be able to be cleaned. Gaskets shall be of EPDM rubber or Viton. All plate heat exchanger characteristics shall be as indicated.

## 2.7.2 Pumps

Circulating pumps shall be electrically-driven, single-stage, centrifugal type. The pumps shall be supported by the piping on which installed. The pumps shall have a capacity not less than that indicated and shall be either integrally-mounted with the motor or direct-connected by a flexible-shaft coupling on a cast-iron or steel subbase. The pump shaft shall be constructed of corrosion resistant alloy steel, sleeve bearings and glands of bronze designed to accommodate a mechanical seal. Pumps shall have stainless steel impellers and casings of bronze. The motors shall have sufficient power for the service required, shall be of a type approved by the manufacturer of the pump, shall be suitable for the available electric service and for the heat transfer fluid used, and shall conform to the requirements specified in Section 26 20 00 INTERIOR DISTRIBUTION SYSTEM. The motors shall be controlled by suitable switches that can be activated by either the differential temperature controller or by manual override (Hand-Off-Automatic). Each pump suction and discharge connection shall be provided with a pressure gauge as specified.

## 2.7.3 Pipe Insulation

Pipe insulation and coverings shall be applied in accordance with Section 23 07 00 THERMAL INSULATION FOR MECHANICAL SYSTEMS as called out for steam piping to 15 psig. Array piping insulation shall be capable of withstanding 250 degrees F, except that piping within 1.5 feet of collector connections shall be capable of withstanding 400 degrees F.

## 2.7.4 Expansion Tank

Expansion tank shall be constructed and tested in accordance with ASME BPVC SEC VIII D1 and as applicable for a working pressure of 125 psig. Tank shall be provided with an elastomeric EPDM bladder which separates the system fluid from the tank walls and is suitable for a maximum operating temperature of 240 degrees F. Expansion tank acceptance volume shall be a minimum of 18 gallons as shown. Total tank size and arrangement shall be as shown. Tank shall be provided with 125 psig pressure relief valve. Tank shall be provided with precharge pressure of 55 psig as shown.

## 2.7.5 Heat Transfer Fluid

- . Solar collector loop fluid shall be non-potable water.

## 2.8 CONTROL AND INSTRUMENTATION SUBSYSTEM

### 2.8.1 Differential Temperature Control Equipment

Differential temperature control equipment shall be supplied as a system by a single manufacturer. Controller shall be solid-state electronic type complete with an integral transformer to supply low voltage, shall allow a minimum adjustable temperature differential (on) of 8 to 20 degrees F, a minimum adjustable temperature differential (off) of 3 to 5 degrees F, and shall include a switching relay or solid state output device for pump control. Thermostat shall operate in the on-off mode. Controller accuracy shall be plus or minus 1 degree F. Controller shall be compatible with 10-kOhm thermistor temperature sensors. Differential control shall provide direct digital temperature readings of all temperatures sensed. Control shall indicate visually when pumps are energized. Control ambient operating range shall be a minimum of 32 to

120 degrees F.

#### 2.8.2 Thermistor Temperature Sensors

Temperature sensors shall be 10-kOhm thermistors supplied by the differential temperature controller manufacturer, with an accuracy of plus or minus 1 percent at 77 degrees F. Model supplied must have passed an accelerated life test conducted by subjecting thermistor assemblies to a constant temperature of 400 degrees F or greater for a period of 1000 hours minimum. Accuracy shall have remained within plus or minus 1 percent as stated above. Thermistors shall be hermetically sealed glass type. Operating range shall be minus 40 to plus 400 degrees F. Immersion wells or watertight threaded fittings shall be provided for temperature sensors.

#### 2.8.3 Sensor and Control Wiring

18 AWG minimum twisted and shielded 2, 3, or 4 conductor to match analog function hardware. Control wiring shall have 600 volt insulation. Multiconductor wire shall have an outer jacket of PVC.

#### 2.8.4 Flowmeters

Flowmeters shall consist of a venturi, 6 inch dial differential pressure meter, valved pressure taps, and bar stock needle valves. Venturi flow nozzle shall have threaded bronze ends for pipe sizes up to 2 inches and flanged ends for pipe sizes 2-1/2 inches and above. Venturi length shall not be less than 1.6 times the pipe size. Venturi shall be selected to read differential pressure corresponding to 0.5 to 1.5 times the system flow rate. Venturi shall have an accuracy of plus or minus 1 percent of the range. Meter shall have an accuracy of plus or minus 2 percent of the full scale range.

#### 2.8.5 Sight Flow Indicators

Sight flow indicators shall consist of a clear glass window or cylinder and a nonferrous or 316 stainless steel body and impeller. Indicator shall have threaded ends for pipe sizes up to 2 inches and flanged ends for pipe sizes 2-1/2 inches and above. Maximum operating pressure shall be no less than 125 psig. Maximum operating temperature shall be no less than 250 degrees F.

### 2.9 PAINTING AND FINISHING

Equipment and component items, when fabricated from ferrous metal and located inside the building, shall be factory finished with the manufacturer's standard finish.

## PART 3 EXECUTION

### 3.1 EXAMINATION

After becoming thoroughly familiar with all details of the work, verify all dimensions in the field, and advise the Contracting Officer of any discrepancy before performing any work.

### 3.2 INSTALLATION

#### 3.2.1 Collector Subsystem

##### 3.2.1.1 Collector Array

Solar collector array shall be installed at the tilt angle, orientation, and elevation above roof as indicated. For installation on flat roofs with rack type collector mounting, bottom of collector shall be a minimum of 18 inches from roof. Each solar collector shall be removable for maintenance, repair, or replacement. Solar collector array shall not impose additional loads on the structure beyond the loads scheduled on the structural drawings.

##### 3.2.1.2 Array Piping

Collector array piping shall be installed in a reverse-return configuration so that path lengths of collector supply and return are of approximately equal length. All piping must be coded with fluid type and flow direction labels in accordance with Section 09 90 00 PAINTS AND COATINGS.

##### 3.2.1.3 Array Support

Array support shall be installed in accordance with the recommendations of the collector manufacturer. Structural members requiring welding shall be welded in accordance with AWS D1.2/D1.2M for aluminum and welders should be qualified according to AWS B2.1/B2.1M.

#### 3.2.2 Storage Subsystem

Solar storage tank penetrations shall be installed as shown so that cold water inlet to storage tank and outlet from storage tank to collector array are located near the bottom of the tank, and inlet from collector array and outlet to load are located near the top of the tank.

#### 3.2.3 Transport Subsystem

##### 3.2.3.1 Flow Rates

System flow rate shall be based on recommended collector flow rate, and shall be as indicated on the Drawings. All flow rates shall be below 5 feet/second.

##### 3.2.3.2 Pumps

Additional pipe supports shall be provided for close-coupled in-line pumps. All in-line pumps shall have straight pipe between the suction side of the pump and the first elbow. The length of this pipe shall be a minimum of five times the diameter of the pipe size on the suction side of the pump. Drain line sizes from the pumps shall not be less than the drain trap or the pump dirt pocket, but in no case shall the drain line be less than 1/2 inch iron pipe size. Drain lines shall terminate to spill over the nearest floor or open sight drain.

##### 3.2.3.3 Expansion Tank

Expansion tank shall be installed on suction side of pump as shown.

#### 3.2.3.4 Piping, Valves, and Accessories

Piping shall be installed in accordance with Section 22 00 00 PLUMBING, GENERAL PURPOSE, except where noted otherwise. Solders used on piping shall be as shown. Piping shall be coded with fluid type and flow direction labels in accordance with Section 09 90 00 PAINTS AND COATINGS. All circuits must be labeled "CONTAINS UNINHIBITED NON-POTABLE WATER: INTRODUCTION OF ANY NONAPPROVED FLUID MAY CONSTITUTE A HEALTH HAZARD." Air vents shall be installed at the high points of the collector array and in the equipment room.

#### 3.2.3.5 Pipe Expansion

Expansion of supply and return pipes shall be provided for by changes in the direction of the run of pipe or by expansion loops as indicated. Expansion loops shall provide adequate expansion of the main straight runs of the system within the stress limits specified in ASME B31.9. Loops shall be cold-sprung and installed where indicated. Pipe guides shall be provided as indicated. Expansion joints shall not be used in system piping.

#### 3.2.3.6 Valves

Valves shall be installed at the locations indicated and where required for the proper functioning of the system. Valves shall be installed with their stems horizontal or above. Gate or ball valves shall be installed at the inlet and outlet of each bank of internally manifolded collectors. Calibrated balancing valves with integral pressure taps shall be installed at the outlet of each bank and at the pump discharge. Final setting for each valve shall be marked on each valve. Ball valves shall be installed with a union immediately adjacent. Gate valves shall be installed at the inlet and outlet of each pump and also at the inlet and outlet of each heat exchanger. A check valve shall be installed at pump discharges. Discharges of relief valves shall be piped to the nearest floor drain or as indicated on system drawings.

#### 3.2.3.7 Concrete Housekeeping Pads

Concrete concrete housekeeping pads or pads for storage tanks, heat exchangers, and other equipment covered by this specification shall be constructed in accordance with manufacturer's recommendations and be a minimum of 6 inches high with chamfered edges.

#### 3.2.4 Control Subsystem

##### 3.2.4.1 Differential Temperature Controller

Automatic control equipment shall be installed at the location shown in accordance with the manufacturer's instructions. Control wiring and sensor wiring shall be installed in conduit. Collector temperature sensor shall be mounted in a temperature sensor well in the fluid stream along the top manifold of a bank between two adjacent collector units. Collector temperature sensor shall be provided by differential temperature controller manufacturer and mounted directly on the absorber plate by the manufacturer. Unless otherwise indicated, operators, controllers, sensors, indicators, and like devices when installed on equipment casings and pipe lines shall be provided with stand-off mounting brackets, bases, nipples, adapters, or extended tubes to provide clearance, not less than the thickness of the insulation, between the surface and the device.

These stand-off mounting items shall be integral with the devices or standard accessories of the controls manufacturer unless otherwise approved. Clamp-on devices or instruments where direct contact with pipe surface is required shall be exempted from the use of the above mounting items. All control wiring shall be color coded and identified with permanent numeric or alphabetic codes.

#### 3.2.4.2 Sequence of Operation

The differential temperature controller sensing temperature difference between the fluid in a solar collector and water in the storage tank shall start solar collector loop and storage loop pumpss when the temperature differential (Delta T - ON) rises above 15 degrees F, and shall stop the pump when the differential (Delta T - OFF) falls below 5 degrees F.

### 3.3 INSPECTION AND TESTING

Submit an independent testing agency's certified reports of inspections and laboratory tests, including analysis, position of flow-balancing equipment, and interpretation of test results. Each report shall be properly identified. Describe test methods used and compliance with recognized test standards.

#### 3.3.1 Inspection

Make system available for inspection at all times.

#### 3.3.2 Testing Prior to Concealment

##### 3.3.2.1 Hydrostatic Test

Demonstrate to Contracting Officer that all piping has been hydrostatically tested, at a pressure of 125 psi for a period of time sufficient for inspection of every joint in the system and in no case less than 2 hours, prior to installation of insulation. Expansion tank and relief valves shall be isolated from test pressure. No loss of pressure shall be allowed. Leaks found during tests shall be repaired by replacing pipe or fittings and the system retested. Caulking of joints shall not be permitted.

##### 3.3.2.2 Cleaning of Piping

System piping shall be flushed with clean, fresh water prior to concealment of any individual section and prior to final operating tests. Prior to flushing piping, relief valves shall be isolated or removed. Solar collectors shall be covered to prevent heating of cleaning fluid, unless cleaning is performed during hours of darkness. The solution shall be circulated through the section to be cleaned at the design flow rate for a minimum of 2 hours.

#### 3.3.3 Posting Framed Instructions

Framed instructions under glass or in laminated plastic shall be posted where directed. These instructions shall include a system schematic, and wiring and control diagrams showing the complete layout of the entire system. Condensed operating instructions explaining preventative maintenance procedures, balanced flow rates, 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, and posted beside the diagrams. Proposed diagrams, instructions, and other sheets shall be submitted for approval prior to posting. The framed instructions shall be posted before acceptance testing of the system.

### 3.3.4 Acceptance Testing and Final Inspection

Notify the Contracting Officer 7 calendar days before the performance and acceptance tests are to be conducted. Tests shall be performed in the presence of the Contracting Officer. Furnish all instruments and personnel required for the tests. Electricity and water will be furnished by the Government. A written record of the results of all acceptance tests shall be maintained, to be submitted in booklet form. The tests shall be as follows:

#### 3.3.4.1 As-Built Drawings

Submit, as a condition of final acceptance, a complete set of as-built system drawings. Drawings shall clearly indicate the actual condition of the installed solar energy system at the time of the final test.

#### 3.3.4.2 Final Hydrostatic Test

Demonstrate to Contracting Officer that all piping has been hydrostatically tested at a pressure of 125 pounds per square inch for a period of time sufficient for inspection of every joint in the system and in no case less than 2 hours. Expansion tank and relief valves shall be isolated from test pressure. Gauges used in the test shall have been calibrated within the 6-month period preceding the test. Test shall be witnessed by Contracting Officer. No loss of pressure shall be allowed. Leaks found during tests shall be repaired by replacing pipe or fittings and the system retested. Caulking of joints shall not be permitted.

#### 3.3.4.3 System Flushing

For the final inspection, the system shall be thoroughly flushed, in no case for less than 2 hours, of all foreign matter until a white linen bag installed in a strainer basket shows no evidence of contamination. The white linen bag shall be in the strainer basket during the entire flushing operation prior to its being presented to the Contracting Officer for approval. The Contracting Officer will inspect the linen bag prior to completion of flushing and approve the flushing operation. System shall be drained prior to final filling.

#### 3.3.4.4 System Filling

System shall be filled through indicated connections with 100 percent non-potable water. Air shall be vented from the system after filling. System pressure at the high point on the roof shall be 10 psig minimum.

#### 3.3.4.5 Operational Test

Operational test shall occur over a period of 48 consecutive hours with sufficient solar insolation to cause activation of the solar energy system during daylight hours. With system fully charged so that pressure at the high point on the roof or the lowest system pressure is a minimum of 10 psig and with fluid and pumps energized, sight flow indicator must indicate flow and flowmeter must indicate flow as indicated. Calibrated balancing valves with pressure taps shall indicate bank flow rate as shown.

#### 3.3.4.6 Control Logic

By substituting variable resistors for collector and storage tank temperature sensors, demonstrate the differential temperature controller correctly energizes the system pumps when the collector sensor indicates a temperature of 15 degrees F greater than the storage tank temperature, as indicated on the controller display panel. The differential temperature controller shall de-energize the system pumps when the displayed temperature of the solar collectors is 5 degrees F greater than the displayed temperature of the storage tank.

#### 3.3.4.7 Temperature Sensor Diagnostics

Demonstrate that the controller will correctly identify open and short circuits on both the solar collector temperature sensor circuit and the storage tank sensor circuit.

#### 3.3.4.8 Overall System Operations

Demonstrate that the solar energy system will operate properly while unattended for a period of at least 72 hours and that the controller will start pumps after being warmed by the sun, and that it will properly shut down during cloudy weather or in the evening over a minimum of three complete cycles. Contractor is permitted to manipulate the temperature of the storage tank by the introduction of cold water at local groundwater temperature.

### 3.4 FIELD TRAINING

Provide a field training course for designated operating and maintenance staff members. Training shall be provided for a minimum period of 8 hours of normal working time and shall start after the system is functionally complete but prior to final acceptance tests. The training shall include discussion of the system design and layout and demonstrations of routine operation and maintenance procedures. This training shall include: normal system operation and control; flow balancing; detection of a nonfunctioning system due to sensor, controller, and/or mechanical failure; filling, draining, and venting of the collector array; replacement of sensors, collectors, and collector components; collector cleaning and inspection for leaks; and heat exchanger cleaning and expansion tank charging if applicable. Submit 6 hard copies and one (pdf) copy of operation and 6 hard copies and one (pdf) copy of maintenance manuals for the equipment furnished. One complete set prior to performance testing and the remainder upon acceptance. Manuals shall be approved prior to the field training course. Operating manuals shall detail the step-by-step procedures required for system filling, startup, operation, and shutdown. Operating manuals shall include the manufacturer's name, model number, service manual, parts list, and brief descriptions of all equipment and their basic operating features. Maintenance manuals shall list routine maintenance procedures, possible breakdowns and repairs, troubleshooting guides, piping and equipment layout, balanced fluid flow rates, and simplified wiring and control diagrams of the system as installed.

-- End of Section --