# PROJECT MANUAL

## FOR

# Administration Office
## at Beal Memorial Cemetery
### Fort Walton Beach, Florida

**March 2022**

## For Construction

**Prepared By**

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# SECTION 031000

# CONCRETE FORMWORK

## PART 1 - GENERAL

1.1 RELATED DOCUMENTS

Drawings and general provisions of the Contract, including General and Supplementary Conditions and Division 1 Specification Sections, apply to this Section.

1.2 RELATED SECTIONS

A. Section 032000 - Concrete Reinforcement.

B. Section 033000 - Cast-in-Place Concrete.

1.3 WORK INSTALLED BUT FURNISHED BY OTHERS

Build in anchors, inserts, bolts, hangers, sleeves, ferrules, water stops and other accessories.

1.4 DESIGN REQUIREMENTS

Design, construct and erect formwork per ACI 347R-94, Guide to Formwork for Concrete.

1.5 ALLOWABLE TOLERANCES

In accordance with ACI-301-96 as listed in Table 4.3. I-Tolerances for Formed Surfaces.

## PART 2 - PRODUCTS

2.1 MATERIALS

A. Concealed concrete: No.2 Common Southern Pine, S4S, or better.

B. Exposed Concrete: B-B Plyform, Class I or II, EXT -AP A, Metal or Fiberglass forms may be used.

C. Construction joint forms for slabs-on-grade: Key-type steel formers, Vulcan Screed Joints, Burke Keyed Kold Joint Form, Dayton Sure-Grip G-20, or equal.

D. Expansion joint filler: Asphalt impregnated, premolded fiberboard by full thickness of slab or joint, ASTM D994-94.

E. Form-coating: Non-staining mineral oil.

F. Form ties: Snap-off type which will break off at least W' below surface of concrete.

2.2 EARTH FORMS

Where soil is firm enough to permit cutting to true size, concrete may be placed without forms.

## PART 3 - EXECUTION

3.1 ERECTING

A. Erect forms to obtain shapes, designs and dimensions indicated. Make forms sufficiently tight to prevent leakage. Brace, shore and tie forms together to maintain position without sagging or bulging.

B. Provide 3/4" chamfering at comers (exposed or unexposed).

C. Prepare insides of forms so that concrete will have a smooth, uniform finish, free from fms, stone pockets, voids and other surface defects.

D. For slabs-on-grade, provide construction joint forms where concrete placement terminates at the end of a day or because of other reasons.

E. Where soil conditions are such that concrete cannot be placed without forms, and where other conditions cause trenches to be opened wider than footing or slab widths, erect forms for footing or slabs.

3.2 PREPARING

A. Prepare insides of forms so that concrete will have a smooth, uniform finish free of surface defects.

B. Coat forms before reinforcement steel is placed. Where mill-oiled forming material is used, follow manufacturer's instructions for recoating. Where forming material is not mill-oiled, coat forms before each use.

C. Before reusing forms, thoroughly clean them and remove projecting nails or similar devices.

3.3 FORM REMOVAL

Remove forms in such a manner and such time as to insure safety of structure and to avoid chipping and spalling of concrete. Refer to Section 6.2 of ACI 318-95, Section 6.2 of the requirements. Commentary to ACI 318-95, and Section 3.7 of ACI 347R-94 for form removal

END OF SECTION

# SECTION 032000

# CONCRETE REINFORCEMENT

## PART 1 - GENERAL

1.1 RELATED DOCUMENTS

Drawings and general provisions of the Contract, including General and Supplementary Conditions and Division 1 Specification Sections, apply to this Section.

1.2 RELATED SECTIONS

A. Section 031000 - Concrete Formwork.

B. Section 033000 - Cast-in-Place Concrete.

1.3 QUALITY ASSURANCE

The placement of all concrete reinforcement shall be monitored.

1.4 SUBMITTALS

A. Submit warranty from mill or supplier stating that materials meet requirements of referenced ASTM and ACI Standards.

B. Submit one reproducible sepia and one print of shop drawings. Only marked up sepia will be returned. Detail reinforcing steel in accord with ACI SP-66 94, "Details and Detailing of Concrete Reinforcement." Shop drawings shall indicate bending and placement of reinforcement as well as sleeve and built-in work locations. Submit shop drawings for similar slabs and/or full column stacks at the same time.

C. Shop drawings shall include the following note completed and signed by the Contractor: The data submitted does not contain material deviation from requirements of contract documents except as follows:

1.5 PRODUCT DELIVERY, STORAGE, AND HANDLING

A. Deliver materials to project site in bundles marked with metal tags for easy identification.

B. Handle and store materials to prevent contamination.

C. Deliver and store welding electrodes in accordance with American Welding Society D 1.4-92.

## PART 2 - PRODUCTS

2.1 REINFORCEMENT STEEL

A. ASTM A615-95c, Grade 60.

B. Epoxy-coated reinforcing bars per ASTM A775-95a.

2.2 REINFORCEMENT WIRE

Welded steel wire fabric, ASTM A185-94.

2.3 BAR SUPPORTS

A. Bar supports and spacing of same shall be as per recommendations set forth by Chapter 3 of the CRSI Manual of Standard Practice, 24th Edition, 1986.

B. Steel wire bar supports in concrete where soffits are exposed to view, weather, or liquid shall be Class 1 or Class 2, Types A or B; Class 3 is acceptable for other uses.

2.4 OTHER SUPPORTS

Concrete brick may be used to support reinforcement to obtain proper clearance from earth and rigidity of reinforcement under concreting operations.

2.5 TIE WIRE

Wire shall be 16-1/2 gauge or heavier, black-annealed.

2.6 FABRICATING

In accordance with CRSI Manual of Standard Practice, 24th Edition, 1986.

3.1 CONDITION OF SURFACES

Maintain reinforcement surfaces free of mud, oil or other coatings which might impair band as described in Section 7.4 of ACI 318-95. Rust or mill scale is acceptable provided the minimum dimensions are not less than applicable ASTM Standards. Loose rust scale to be removed with wire brush.

3.2 INSTALLING REINFORCING STEEL

A. Handle, place and tie reinforcement steel in accordance with "Building Code Requirements for Reinforced Concrete, " ACI 318-95 and CRSI publication "Placing Reinforcing Bars," 4th Edition, 1981.

B. All reinforcement bars shall be supported and secured as directed in ACI 315-94 and CRSI Manual of Standard Practice, 24th Edition, 1986.

C. For all splices, unless noted otherwise, provide the following lap splice length of reinforcement steel:

1. In concrete member: Class B
2. In masonry member: 48 bar diameters
3. Do not splice reinforcement steel except as authorized by Architect.

D. Accomplish welding in accordance with American Welding Society publication "Recommended Practices for Welding Reinforcing Steel, Metal Inserts, and Connections in Reinforced Concrete Construction", AWS D1.4-92.

E. Bend bars cold. Do not field bend bars partially embedded in concrete except as specifically permitted by Architect. Do not heat or cut bars with a torch.

3.3 INSTALLING WELDED WIRE FABRIC

A. For Slabs-on-Grade:

1. Install welded wire fabric after vapor barrier (or under floor waterproofing, if applicable) has been placed.
2. Locate welded wire fabric in center third of slabs.

B. For Slabs on Metal Form:

1. Provide W.W.F. 6x6 – W1.4 x W1.4, unless noted otherwise
2. Locate welded wire fabric at mid-depth of slab measured between top of slab and top of metal form.

C. Lap side one full mesh plus 2 inches. Lap end two full meshes. Offset end laps in adjacent width to prevent continuous laps.

3.4 CONCRETE PROTECTION FOR REINFORCEMENT

A. Protect reinforcing by thickness of concrete indicated on Contract Drawings.

B. Variation from clear cover shall conform to Section 7.5 of ACI 318-95.

END OF SECTION

**SECTION 033000 - CONCRETE WORK**

## PART 1 - GENERAL

1.1 RELATED DOCUMENTS:

A. Drawings and general provisions of Contract, including General and Supplementary Conditions and Division-1 Specification sections, apply to work of this section.

1.2 SUMMARY:

A. Extent of concrete work is shown on drawings.

B. Concrete curbwork is specified in Section 02513 - Asphalt/Concrete Paving and Curbwork.

1.3 SUBMITTALS:

A. Product Data: Submit data for proprietary materials and items, including reinforcement and forming accessories, admixtures, patching compounds, joint systems, curing compounds, and others as requested by Architect.

B. Shop Drawings; Reinforcement: Submit original shop drawings prepared for fabrication, bending, and placement of concrete reinforcement. Comply with ACI 315 "Manual of Standard Practice for Detailing Reinforced Concrete Structures" showing bar schedules, stirrup spacing, diagrams of bent bars, arrangement of concrete reinforcement. Include special reinforcement required for openings through concrete structures. Submit shop drawings in pdf format.

C. Laboratory Test Reports: Submit laboratory test reports for concrete materials and mix design test.

D. Materials Certificates: Provide materials certificates in lieu of materials laboratory test reports when permitted by Architect. Materials certificates shall be signed by manufacturer and Contractor, certifying that each material item complies with, or exceeds, specified requirements. Provide certification from admixture manufacturers that chloride content complies with specification requirements.

E. Mix Designs: Provide design mixture for each concrete mixture to be used. Mix submittal to include proportions of materials and documentation of average strength in accordance with ACI 318 Chapter 5.

1.4 QUALITY ASSURANCE:

A. Codes and Standards: Comply with provisions of following codes, specifications, and standards, except where more stringent requirements are shown or specified:

ACI 301 "Specifications for Structural Concrete for Buildings".
ACI 318 "Building Code Requirements for Reinforced Concrete".
Concrete Reinforcing Steel Institute (CRSI), "Manual of Standard Practice".

B. Concrete Testing Service: Engage a testing laboratory acceptable to Architect to perform material evaluation tests and to design concrete mixes.

C. Materials and installed work may require testing and retesting at anytime during progress of work. Tests, including retesting of rejected materials for installed work, shall be done at Contractor's expense.

1.5 PROJECT CONDITIONS:

A. Protection of Footings Against Freezing: Cover completed work at footing level with sufficient temporary or permanent cover as required to protect footings and adjacent subgrade against possibility of freezing; maintain cover for time period as necessary.

B. Protect adjacent finish materials against spatter during concrete placement.

## PART 2 - PRODUCTS

2.1 REINFORCING MATERIALS:

A. Reinforcing Bars: ASTM A 615, Grade 60, deformed.

B. Steel Wire: ASTM A 82, plain, cold-drawn steel.

C. Welded Wire Fabric: ASTM A 185, welded steel wire fabric, flat sheets only.

D. Supports for Reinforcement: Bolsters, chairs, spacers, and other devices for spacing, supporting, and fastening reinforcing bars and welded wire fabric in place. Use wire bar type supports complying with CRSI specifications.

For slabs-on-grade, use supports with sand plates or horizontal runners where base material will not support chair legs. (Do not use brick). Space supports for welded wire fabric at not more than 36" centers.

2.2 CONCRETE MATERIALS:

A. Portland Cement: ASTM C 150, Type I.

Use one brand of cement throughout project, unless otherwise acceptable to Architect.

B. Fly Ash: ASTM C 618, Type C.

C. Normal Weight Aggregates: ASTM C 33, and as herein specified. Provide aggregates from a single source for exposed concrete.
Local aggregates not complying with ASTM C 33 but which have shown by special test or actual service to produce concrete of adequate strength and durability may be used when acceptable to the Architect.

D. Water: Drinkable.

E. Air-Entraining Admixture: ASTM C 260, certified by manufacturer to be compatible with other required admixtures. The use of air-entraining admixture is not allowed in floor slab receiving hard trowel finish.

F. Water-Reducing Admixture: ASTM C 494, Type A, and containing not more than 0.1 percent chloride ions.

G. High-Range Water-Reducing Admixture (Super Plasticizer): ASTM C 494, Type F or Type G and containing not more than 0.1 percent chloride ions.

H. Water-Reducing, Non-Chloride Accelerator Admixture: ASTM C 494, Type E, and containing not more than 0.1 percent chloride ions.

I. Water-Reducing, Retarding Admixture: ASTM C 494, Type D, and containing not more than 0.1 percent chloride ions.

J. Prohibited Admixtures: Calcium chloride thyocyanates or admixtures containing more than 2.1 percent chloride ions are not permitted.

2.3 RELATED MATERIALS:

A. Vapor Retarder:" Provide vapor retarder cover over prepared base material where indicated below slabs on grade. Use only materials which are resistant to decay when tested in accordance with ASTM E 154, as follows:

Polyethethene sheet not less than **10** mils thick.

B. Non-Shrink Grout: CRD-C 621, factory pre-mixed grout (non-metalic).

C. Absorptive Cover: Burlap cloth made from jute or kenaf, weighing approximately 9 oz. per sq. yd. complying with AASHTO M 182, Class 2.

D. Moisture-Retaining Cover: One of the following, complying with ASTM C 171.

Waterproof paper.
Polyethylene film.
Polyethylene-coated burlap.

E. Liquid Membrane-Forming Curing Compound: Liquid type membrane-forming curing compound complying with ASTM C 309, Type I, Class A. Moisture loss not more than 0.055 sq./sq. cm. when applied at 200 sq. ft./gal.

F. Bonding Compound: Polyvinyl acetate or acrylic base.

G. Epoxy Adhesive: ASTM C 881, two component material suitable for use on dry or damp surfaces. Provide material "Type", "Grade", and "Class" to suit project requirements.

2.5 PROPORTIONING AND DESIGN OF MIXES:

A. Prepare design mixes for each type and strength of concrete by either laboratory trial batch or field experience methods as specified in ACI 301.

B. Submit written reports to Architect and Structural Engineer of each proposed mix for each class of concrete at least 15 days prior to start of work. Do not begin concrete production until mixes have been reviewed by Architect.

C. Design mixes to provide normal weight concrete with the following properties, as indicated on drawings and schedules:

D. Admixtures:

Use water-reducing admixture or high range water-reducing admixture (super plasticizer) in concrete as required for placement and workability.

Use non-chloride accelerating admixture in concrete slabs placed at ambient temperatures below 50 degrees F (10 deg C).

Use high-range water-reducing admixture in pumped concrete, concrete for industrial slabs, architectural concrete, parking structure slabs, concrete required to be watertight, and concrete with water/cement ratios below 0.50.

Use admixtures for water-reducing and set-control in strict compliance with manufacturer's directions.

E. Water-Cement Ratio:

Provide concrete for following conditions with maximum water-cement (W/C) ratios as follows:
Subjected to freezing and thawing; W/C 0.50.

F. Slump Limits:

Proportion and design mixes to result in concrete slump at point of placement as follows:
Ramps, slabs, and sloping surfaces: Not more than 4".

Reinforced foundation systems: Not less than 1" and not more than 4".

Concrete containing HRWR admixture (super-plasticizer): Not more than 8" after addition of HRWR to site-verified 2"-3" slump concrete.

Other concrete: Not less than 1" nor more than 4".

2.6 CONCRETE MIXING:

A. Ready-Mix Concrete: Comply with requirements of ASTM C 94, and as herein specified.

During hot weather, or under conditions contributing to rapid setting of concrete, a shorter mixing time than specified in ASTM C 94 may be required.

**PART 3 - EXECUTION**

3.1 GENERAL:

A. Coordinate the installation of joint materials and vapor retarders with placement of forms and reinforcing steel.

3.2 VAPOR RETARDER INSTALLATION:

A. Following leveling and tamping of base for slabs on grade, place vapor retarder sheeting with longest dimension parallel with direction of pour.

B. Lap joints 6" and seal with appropriate tape.

3.3 PLACING REINFORCEMENT:

A. Comply with Concrete Reinforcing Steel Institute's recommended practice for "Placing Reinforcing Bars", for details and methods of reinforcement placement and supports, and as herein specified. Avoiding cutting or puncturing vapor retarder during reinforcement placement and concreting operations.

B. Clean reinforcement of loose rust and mill scale, earth, ice, and other materials which reduce or destroy bond with concrete.

C. Accurately position, support, and secure reinforcement against displacement by formwork, construction, or concrete placement operations. Provide, locate and support reinforcing by metal chairs, runners, bolsters, spacers, and hangers, as required.

D. Place reinforcement to obtain at least minimum coverages for concrete protection. Arrange, space, and securely tie bars and bar supports to hold reinforcement in position during concrete placement operations. Set wire ties so ends are directed into concrete, not toward exposed concrete surfaces.

E. Install welded wire fabric in as long lengths as practicable. Lap adjoining pieces at least one full mesh and lace splices with wire. Offset end laps in adjacent widths to prevent continuous laps in either direction. Provide chairs to center welded wire in slab depth.

3.4 JOINTS:

A. Construction Joints: Locate and install construction joints as indicated or, if not indicated, locate so as not to impair strength and appearance of the structure, as acceptable to Architect.

B. Provide keyways at least 1-1/2" deep in construction joints in slabs, and between walls and footings; accepted bulkheads designed for this purpose may be used for slabs.

C. Place construction joints perpendicular to main reinforcement. Continue reinforcement across construction joints, except as otherwise indicated.

D. Isolation Joints in Slabs-on-Ground: Construct isolation joints in slabs-on-ground at points of contact between slabs-on-ground and vertical surfaces, such as column pedestals, foundation walls, grade beams, and elsewhere as indicated.

Joint filler and sealant materials are specified in Division-7 sections of these specifications.

E. Contraction (Control) Joints in Slabs-on-Ground: Construct contraction joints in slabs-on-ground to form panels of patterns as shown. Use saw cuts 1/8" x 1/4 slab depth or inserts 1/4" wide x 1/4 of slab depth, unless otherwise indicated. Use “green saw” to cut slab as soon as finishing is completed.

3.5 CONCRETE PLACEMENT:

A. Preplacement Inspection: Before placing concrete, inspect and complete formwork installation, reinforcing steel, and items to be embedded or cast-in. Notify other crafts to permit installation of their work; cooperate with other trades in setting such work. Moisten wood forms immediately before placing concrete where form coatings are not used.

B. General: Comply with ACI 304 "Recommended Practice for Measuring, Mixing, Transporting, and Placing Concrete", and as herein specified.

Deposit concrete continuously or in layers of such thickness that no concrete will be placed on concrete which has hardened sufficiently to cause the formation of seams or planes of weakness. If a section cannot be placed continuously, provide construction joints as herein specified. Deposit concrete as nearly as practicable to its final location to avoid segregation.

C. Consolidate placed concrete by mechanical vibrating equipment supplemented by hand-spading, rodding, or tamping. Use equipment and procedures for consolidation of concrete in accordance with ACI 309.

D. Do not use vibrators to transport concrete inside forms. Insert and withdraw vibrators vertically at uniformly spaced locations not farther than visible effectiveness of machine. Place vibrators to rapidly penetrate placed layer and at least 6" into preceding layer. Do not insert vibrators into lower layers of concrete that have begun to set. At each insertion limit duration of vibration to time necessary to consolidate concrete and complete embedment of reinforcement and other embedded items without causing segregation of mix.

E. Placing Concrete Slabs: Deposit and consolidate concrete slabs in a continuous operation, within limits of construction joints, until the placing of a panel or section is completed.

F. Consolidate concrete during placing operations so that concrete is thoroughly worked around reinforcement and other embedded items and into corners.

G. Bring slab surfaces to correct level with straightedge and strikeoff. Use bull floats or darbies to smooth surface, free of humps or hollows. Do not disturb slab surfaces prior to beginning finishing operations.

H. Cold Weather Placing: Protect concrete work from physical damage or reduced strength which could be caused by frost, freezing actions, or low temperatures, in compliance with ACI 306.

I. Hot Weather Placing: When hot weather conditions exist that would seriously impair quality and strength of concrete, place concrete in compliance with ACI 305.

3.6 FINISHES:

A. Trowel Finish: Apply trowel finish to monolithic slab surfaces to be exposed-to-view, and slab surfaces to be covered with resilient flooring, carpet, ceramic tile, paint, or other thin film finish coating, system.

After floating, begin first trowel finish operation using a power- driven trowel. Begin final troweling when surface produces a ringing sound as trowel is moved over surface. Consolidate concrete surface by final hand-troweling operation, free of trowel marks, uniform in texture and appearance, and with surface leveled to tolerances of $F_F$ 20 - $F_L$ 17. Grind smooth surface defects which would telegraph through applied floor covering system.

B. Trowel and Fine Broom Finish: Where ceramic tile is to be installed with thin-set mortar, apply trowel finish as specified, then immediately follow with slightly scarifying surface by fine brooming.

C. Non-Slip Broom Finish: Apply non-slip broom finish to exterior concrete platforms, steps, and ramps, and elsewhere as indicated.

Immediately after float finishing, slightly roughen concrete surface by brooming with fiber bristle broom perpendicular to main traffic route. Coordinate required final finish with Architect before application.

3.7 CONCRETE CURING AND PROTECTION:

A. General: Protect freshly placed concrete from premature drying and excessive cold or hot temperatures. Start initial curing as soon as free water has disappeared from concrete surface after placing and finishing. Weather permitting, keep continuously moist for not less than 7 days. Begin final curing procedures immediately following initial curing and before concrete has dried. Continue final curing for at least 7 days in accordance with ACI 301 procedures. Avoid rapid drying at end of final curing period.

B. Curing Methods: Perform curing of concrete by curing and sealing compound, by moist curing, by moisture-retaining cover curing, and by combinations thereof, as herein specified.

1. Provide moisture curing by following methods.

Keep concrete surface continuously wet by covering with water.
Continuous water-fog spray.
Covering concrete surface with specified absorptive cover, thoroughly saturating cover with water and keeping continuously wet. Place absorptive cover to provide coverage of concrete surfaces and edges, with 4" lap over adjacent absorptive covers.

2. Provide curing and sealing compound to exposed interior slabs and to exterior slabs, walks, and curbs, as follows:

Apply specified curing and sealing compound to concrete slabs as soon as final finishing operations are complete (within 2 hours). Apply uniformly in continuous operation by power-spray or roller in accordance with manufacturer's directions. Recoat areas subjected to heavy rainfall within 3 hours after initial application. Maintain continuity of coating and repair damage during curing period.

Do not use membrane curing compounds on surfaces which are to be covered with coating material applied directly to concrete, liquid floor hardener, waterproofing, dampproofing, membrane roofing, flooring (such as ceramic or quarry tile, glue-down carpet), painting, and other coatings and finish materials, unless otherwise acceptable to Architect.

C. Curing Formed Surfaces: Cure formed concrete surfaces, including undersides of 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, continue curing by methods specified above, as applicable.

D. Curing Unformed Surfaces: Cure unformed surfaces, such as slabs, floor topping, and other flat surfaces by application of appropriate curing method.

E. Final cure concrete surfaces to receive liquid floor hardener or finish flooring by use of moisture-retaining cover, unless otherwise directed.

F. Sealer and Dustproofer: Apply a second coat of specified curing and sealing compound only to surfaces given a first coat.

3.8 CONCRETE SURFACE REPAIRS:

A. Patching Defective Areas: Repair and patch defective areas with cement mortar immediately after removal of forms, when acceptable to Architect.

Cut out honeycomb, rock pockets, voids over 1/4" in any dimension, and holes left by tie rods and bolts, down to solid concrete but, in no case to a depth of less than 1". Make edges of cuts perpendicular to the concrete surface. Thoroughly clean, dampen with water, and brush-coat the area to be patched with specified bonding agent. Place patching mortar after bonding compound has dried.

B. Repair of Formed Surfaces: Remove and replace concrete having defective surfaces if defects cannot be repaired to satisfaction of Architect. Surface defects, as such, include color and texture irregularities, cracks, spalls, air bubbles, honeycomb, rock pockets; fins and other projections on surface; and stains and other discolorations that cannot be removed by cleaning. Flush out form tie holes, fill with dry pack mortar, or precast cement cone plugs secured in place with bonding agent.

3.10 QUALITY CONTROL TESTING DURING CONSTRUCTION:

A. Employ a testing laboratory to perform tests and to submit test reports.

B. Sampling and testing for quality control during placement of concrete may include the following, as directed by Architect.

C. Sampling Fresh Concrete: ASTM C 172, except modified for slump to comply with ASTM C 94.

Slump: ASTM C 143; one test at point of discharge for each day's pour of each type of concrete; additional tests when concrete consistency seems to have changed.

Air Content: ASTM C 173, volumetric method for lightweight or normal weight concrete; ASTM C 231 pressure method for normal weight concrete; one for each day's pour of each type of air-entrained concrete.

Concrete Temperature: Test hourly when air temperature is 40 deg F (4 deg C) and below, and when 80 deg F (27 deg C) and above; and each time a set of compression test specimens made.

Compression Test Specimen: ASTM C 31; one set of 4 standard cylinders for each compressive strength test, unless otherwise directed. Mold and store cylinders for laboratory cured test specimens except when field-cure test specimens are required.

Compressive Strength Tests: ASTM C 39; one set for each day's pour exceeding 5 cu. yds. plus additional sets for each 50 cu. yds. over and above the first 25 cu. yds. of each concrete class placed in any one day; one specimen tested at 7 days, two specimens tested at 28 days, and one specimen retained in reserve for later testing if required.

When frequency of testing will provide less than 5 strength tests for a given class of concrete, conduct testing from at least 5 randomly selected batches or from each batch if fewer than 5 are used.

When total quantity of a given class of concrete is less than 50 cu. yds., strength test may be waived by Architect if, in his judgement, adequate evidence of satisfactory strength is provided.

When strength of field-cured cylinders is less than 85 percent of companion laboratory-cured cylinders, evaluate current operations and provide corrective procedures for protecting and curing the in-place concrete.

Strength level of concrete will be considered satisfactory if averages of sets of three consecutive strength test results equal or exceed specified compressive strength, and no individual strength test result falls below specified compressive strength by more than 500 psi.

D. Test results will be reported in writing to Architect, Structural Engineer and Contractor within 24 hours after tests. Reports of compressive strength tests shall contain the project identification name and number, date of concrete placement, name of concrete testing service, concrete type and class, location of concrete batch in structure, design compressive strength at 28 days, concrete mix proportions and materials; compressive breaking strength and type of break for both 7-day tests and 28-day tests.

**END OF SECTION 03310**

## SECTION 042000 - UNIT MASONRY

### PART 1 - GENERAL

1.1 RELATED DOCUMENTS:

A. Drawings and general provisions of Contract, including General and Supplementary Conditions and Division-1 Specification sections, apply to work of this section.

1.2 DESCRIPTION OF WORK:

A. Types of masonry work required include:

1. Brick masonry; with colored mortar.
2. Concrete Masonry Units (CMU) with standard grey mortar.

1.3 QUALITY ASSURANCE:

A. Single Source Responsibility for Masonry Units: Obtain exposed masonry units of uniform texture and color, or a uniform blend within the ranges accepted for these characteristics, from one manufacturer for each different product required for each continuous surface or visually related surfaces.

B. Single Source Responsibility for Mortar Materials: Obtain mortar ingredients of uniform quality, including color for exposed masonry, from one manufacturer for each cementitious component and from one source and producer for each aggregate.

C. Field Constructed Mock-Ups: Prior to installation of masonry work, erect sample wall panels to further verify selections made for color and textural characteristics, under sample submittals of masonry units and mortar, and to represent completed masonry work for qualities of appearance, materials and construction. 2 sample panels are to be built, approximately 4' x 4' showing full range of brick for consideration.

1.4 SUBMITTALS:

A. Product Data: Submit manufacturer's product data for each type of masonry unit, accessory, and other manufactured products, including certifications that each type complies with specified requirements. Submit all shop drawings in pdf format.

B. Colored masonry mortar samples for each color required showing the full range of color which can be expected in the finished work. Label samples to indicate type and amount of colorant used.

1.5 DELIVERY, STORAGE, AND HANDLING:

A. Deliver masonry materials to project in undamaged condition.

B. Store and handle masonry units and accessories to prevent their deterioration or damage due to moisture, temperature changes, contaminants, corrosion or other causes.

C. Store cementitious materials off the ground, under cover and in dry location.

1.6 PROJECT CONDITIONS:

A. Protection of Work: During erection, cover top of walls with waterproof sheeting at end of each day's work.

B. Staining: Prevent grout or mortar or soil from staining the face of masonry to be left exposed or painted. Remove immediately grout or mortar in contact with such masonry.

C. Protect base of walls from rain-splashed mud and mortar splatter by means of coverings spread on ground and over wall surface.

D. Protect sills, ledges and projections from droppings of mortar.

E. Cold Weather Protection:

1. Do not lay masonry units which are wet or frozen.
2. Remove any ice or snow formed on masonry bed by carefully applying heat until top surface is dry to the touch.
3. Remove masonry damaged by freezing conditions.
4. For clay masonry units with initial rates of absorption (suction) which require them to be wetted before laying, comply with the BIA recommendations for laying masonry.

F. Perform the following construction procedures while masonry work is progressing. Temperature ranges indicated below apply to air temperatures existing at time of installation except for grout. For grout, temperature ranges apply to anticipated minimum night temperatures. In heating mortar and grout materials, maintain mixing temperature selected within 10 deg.F (6 deg.C).

1. 40 deg.F (4 deg.C) to 32 deg.F (0 deg.C):
   Mortar: Heat mixing water to produce mortar temperature between 40 deg.F (4 deg.C) and 120 deg.F (49 deg.C).
   Grout: Follow normal masonry procedures.
2. Do not lay brick or masonry when temperatures drop below 32 deg. F.

G. Protect completed masonry and masonry not being worked on in the following manner. Temperature ranges indicated apply to mean daily air temperatures except for grouted masonry. For grouted masonry, temperature ranges apply to anticipated minimum night temperatures.

1. 40 deg.F (4 deg.C) to 32 deg.F (0 deg.C):
   Protect masonry from rain or snow for at least 24 hours by covering with weather-resistive membrane.

**PART 2 - PRODUCTS**

2.1 CONCRETE MASONRY UNITS:

A. Provide concrete masonry units, lightweight, made to minimize efflorescence. Provide manufacturer's standard special shapes where required for lintels, corners, jambs, sash, control joints, headers, bonding and other special conditions.

1. Unit size to be 16" x 8" x thicknesses of 12", 8", 6" and 4", Provide 90 degree corner units for all thicknesses as shown.

2. Provide grade S, Hollow Loadbearing Block: ASTM C 90, Weight Classification: Lightweight, or Medium weight with minimum compressive strength of 1500 psi. Provide units complying with fire ratings for interior wall as shown.

2.2 MORTAR AND GROUT MATERIALS:

**A. Masonry Cement: ASTM C 91.**

B. For Face Brick use **colored mortar**. Use premixed colored masonry cements of formulation required to produce color from manufacturer's standard formulations.

C. Mortar and Grout Products: Subject to compliance with requirements, provide one of the following:

1. Blue Circle Masonry Products Company
2. "Atlas Custom Color Masonry Cement"; Lehigh Portland Cement Co.
3. "Flamingo Color Masonry Cement"; The Riverton Corporation.
4. "SGS Mortars; Solomon Grind-chem Service
5. "Rainbow" Diversified Manufacturers, Inc.

D. Mortar color for CMU's: standard grey.

2.3 MASONRY TIES:

A. Masonry Ties: Hot-Dip Galvanized Carbon Steel Sheet: ASTM A 366, Class 2 or ASTM A 635; hot-dip galvanized after fabrication to comply with ASTM A 153, Class B.. For masonry walls, provide ladder ties with eye-&-pintle type ties for brick attachment.

B. Joint Reinforcement: Provide welded-wire units prefabricated with deformed continuous side rods and plain cross rods into straight lengths of not less than 10', with prefabricated corner and tee units, and complying with requirements indicated below:

1. Width: Fabricate joint reinforcement in units with widths of approximately 2" less than nominal width of walls and partitions as required to provide mortar coverage of not less than 5/8" on joint faces exposed to exterior and 1/2" elsewhere.

2. Ladder design with cross rods spaced not more than 16" o.c. One side rod for each face shell of concrete masonry back-up and one rod for brick wythe.

3. Brick to stud framing: corrugated hot-dipped galvanized; 1" crimped, pre-drilled; 16 gauge straps. Zinc-Coated (Galvanized) Steel Sheet: Carbon steel with zinc coating complying with ASTM A 525, Coating Designation G90; hot-dip galvanized after fabrication to comply with ASTM A 153, Class B.

Metal Fasteners for Steel Studs: Steel drill screws, #10 diameter x length required to penetrate steel stud flange by not less than 3 exposed threads, complying with ASTM C 954 except with hex washer head and neoprene washer, cadmium-plated.

C. Manufacturers: Subject to compliance with requirements, provide products of one of the following:
AA Wire Products Co.
Dur-O-Wall, Inc.
Heckman Building Products, Inc.
Hohmann & Barnard, Inc.
Masonry Reinforcing Corp. of America.
National Wire Products Corp.

D. Anchor Bolts: Provide steel bolts with hex nuts and flat washers complying with ASTM A 307, Grade A, hot-dip galvanized to comply with ASTM C 153, Class C, in sizes and configurations indicated.

2.5 CONCEALED FLASHING MATERIALS:

A. Vinyl Sheet Flashing: Flexible sheet flashings especially formulated from virgin polyvinyl chloride with plasticizers and other modifiers to remain flexible and waterproof in concealed masonry applications, black in color; 30 mils thick.

B. Adhesive for Flashings: Of type recommended by manufacturer of flashing material for use indicated.

Vinyl Sheet Flashing:
1. "Vi-Seal Plastic Flashing"; Afco Products Inc.
2. "BFG" Vinyl Water Barrier; B.F. Goodrich Co.
3. "Nuflex"; Sandell Manufacturing Co., Inc.
4. "Wascoseal"; York Manufacturing, Inc.

2.6 MISCELLANEOUS MASONRY ACCESSORIES:

A. Reinforcing Bars: Deformed steel, ASTM A 615, Grade 60 for bars No. 3 to No. 18.

B. Non-Metallic Expansion Joint Strips: Premolded, flexible cellular neoprene rubber filler strips complying with ASTM D1056, Grade RE41E1, capable of compression up to 35%, of width and thickness indicated.

C. Premolded Control Joint Strips: Material as indicated below, designed to fit standard sash block and to maintain lateral stability in masonry wall; size and configuration as indicated.
Styrene-butadiene rubber compound complying with ASTM D 2000, Designation 2AA-805.

D. Bond Breaker Strips: Asphalt-saturated organic roofing felt complying with ASTM D 226, Type I (No. 15 asphalt felt).

E. Weepholes/drainage material
   1. Cavity Drainage Material: 2-inch thick, 200 denier 100% recycled polyester, 90% open mesh, dovetail shaped to maintain unobstructed drainage at weep holes. Mortar Net Green or approved equal.
   2. Weeps Holes: "Weep Vents" by Mortar Net USA Ltd. at 24" o.c. 3.

F. Surface conditioner: Latex based, water dispensed liquid, Perm-A-Barrier surface conditioner.

G. Mastic: Rubberized asphalt based mastic for use with flashing membrane, Bituthene Mastic.

2.7 MASONRY CLEANERS:

A. Detergent Solution: As acceptable to masonry material manufacturer, provide "Sure Klean" No. 600 Detergent; ProSoCo, Inc., or approved equal. Do not use acid cleaners.

2.8 MORTAR AND GROUT MIXES:

A. General: Do not add admixtures including coloring pigments, air-entraining agents, accelerators, retarders, water repellent agents, anti-freeze compounds or other admixtures, unless otherwise indicated.

   Do not use calcium chloride in mortar or grout.

B. Mixing: Combine and thoroughly mix cementitious, water and aggregates in a mechanical batch mixer; comply with referenced ASTM standards for mixing time and water content.

C. Mortar for Unit Masonry: Comply with ASTM C 270, Proportion Specification, for types of mortar required, unless otherwise indicated.

   Limit cementitious materials in mortar to portland cement-lime.

   Use Type S mortar.

D. Colored Pigmented Mortar: Select and proportion pigments with other ingredients to produce color required. Do not exceed pigment-to-cement ratio of 1-to-10, by weight.

E. Grout for Unit Masonry: Comply with ASTM C 476 for grout for use in construction of reinforced and non-reinforced unit masonry. Use grout of consistency indicated or if not otherwise indicated, of consistency (fine or coarse) at time of placement which will completely fill all spaces intended to receive grout. Grout to have minimum 3,000 psi compressive strength at 28 days when tested in accordance with ASTM C1019.

   Use fine grout in grout spaces less than 2" in horizontal direction, unless otherwise indicated.

   Use coarse grout in grout spaces 2" or more in least horizontal dimension, unless otherwise indicated.

## PART 3 - EXECUTION

3.1 INSTALLATION, GENERAL:

A. Wetting Clay Brick: Wet brick made from clay or shale which have ASTM C 67 initial rates of absorption (suction) of more than 30 grams per 30 sq. in. per minute. Use wetting methods which ensure each clay masonry unit being nearly saturated but surface dry when laid.

B. Do not wet concrete masonry units.

C. Cleaning Reinforcing: Before placing, remove loose rust, ice and other coatings from reinforcing.

D. Cut masonry units using motor-driven saws to provide clean, sharp, unchipped edges. Cut units as required to provide continuous pattern and to fit adjoining work. Use full-size units without cutting where possible.

Use dry cutting saws to cut concrete masonry units.

3.2 CONSTRUCTION TOLERANCES:

A. Variation from Plumb: For vertical lines and surfaces of columns, walls and arises do not exceed 1/4" in 10', or 3/8" in a story height not to exceed 20', nor 1/2" in 40' or more. For external corners, expansion joints, control joints and other conspicuous lines, do not exceed 1/4" in any story or 20' maximum, nor 1/2" in 40' or more. For vertical alignment of head joints do not exceed plus or minus 1/4" in 10', 1/2" maximum.

B. Variation from Level: For bed joints and lines of exposed lintels, sills, parapets, horizontal grooves and other conspicuous lines, do not exceed 1/4" in any bay or 20' maximum, nor 1/2" in 40' or more. For top surface of bearing walls do not exceed 1/8" between adjacent floor elements in 10' or 1/16" within width of a single unit.

C. Variation of Linear Building Line: For position shown in plan and related portion of columns, walls and partitions, do not exceed 1/2" in any bay or 20' maximum, nor 3/4" in 40' or more.

D. Variation in Cross-Sectional Dimensions: For columns and thickness of walls, from dimensions shown, do not exceed minus 1/4" nor plus 1/2".

E. Variation in Mortar Joint Thickness: Do not exceed bed joint thickness indicated by more than plus or minus 1/8", with a maximum thickness limited to 1/2". Do not exceed head joint thickness indicated by more than plus or minus 1/8".

3.3 LAYING MASONRY WALLS:

A. Appearance: Lay brick so that not less than a ½ brick (3 1/2”) is laid at all areas including end walls, window openings, lintels and headers. Do not cut header bricks so the height is less than a full brick (2 1/4").

B. Layout walls in advance for accurate spacing of surface bond patterns with uniform joint widths and to accurately locate openings, movement-type joints, returns and offsets. Avoid the use of less-than-half-size units at corners, jambs and wherever possible at other locations.

C. Lay-up walls to comply with specified construction tolerances, with courses accurately spaced and coordinated with other work.

D. Pattern Bond: Lay exposed masonry in running bond with vertical joint in each course centered on units in courses above and below. Lay concealed masonry with all units in a wythe in running bond or bonded by lapping not less than 2". Bond and interlock each course of each wythe at corners. Do not use units with less that nominal 4" horizontal face dimensions at corners or jambs.

E. Stopping and Resuming Work: Rack back 1/2-unit length in each course; do not tooth. Clean exposed surfaces of set masonry, wet units lightly (if required) and remove loose masonry units and mortar prior to laying fresh masonry.

F. Fill cores in hollow concrete masonry units with grout 3 courses (24") under bearing plates, beams, lintels, posts and similar items, unless otherwise indicated.

3.4 MORTAR BEDDING AND JOINTING:

A. Lay solid brick size masonry units with completely filled bed and head joint; butter ends with sufficient mortar to fill head joints and shove into place. Do not slush head joints.

B. Lay hollow concrete masonry units with full mortar coverage on horizontal and vertical face shells. Bed webs in mortar in starting course on footings and in all courses of piers, columns and pilasters, and where adjacent to cells or cavities to be reinforced or filled with concrete or grout. For starting course on footings where cells are not grouted, spread out full mortar bed including areas under cells.

C. Maintain joint widths shown, except for minor variations required to maintain bond alignment. If not shown, lay walls with 3/8" joints.

D. Cut joints flush for masonry walls which are to be concealed or to be covered by other materials, unless otherwise indicated.

E. Tool exposed joints slightly concave using a jointer larger than joint thickness.

F. Remove masonry units disturbed after laying; clean and reset in fresh mortar. Do not pound corners or jambs to shift adjacent stretcher units which have been set in position. If adjustments are required, remove units, clean off mortar and reset in fresh mortar.

3.5 FLASHING OF MASONRY WORK:

A. General: Provide concealed flashing in masonry work at, or above, angles, ledges and other obstructions to the downward flow of water in the wall so as to divert such water to the exterior. Prepare masonry surfaces smooth and free from projections which could puncture flashing. Place

through-wall flashing on sloping bed of mortar and cover with mortar. Seal penetrations in flashing with mastic before covering with mortar.

3.6 REPAIR, POINTING AND CLEANING:

A. Remove and replace masonry units which are loose, chipped, broken, stained or otherwise damaged, or if units do not match adjoining units as intended. Provide new units to match adjoining units and install in fresh mortar or grout, pointed to eliminate evidence of replacement.

B. Pointing: During the tooling of joints, enlarge any voids or holes, except weep holes, and completely fill with mortar. Point-up all joints including corners, openings and adjacent work to provide a neat, uniform appearance, and prepare for application of sealants.

C. Final Cleaning: After mortar is thoroughly set and cured, clean masonry as follows:
Remove large mortar particles by hand with wooden paddles and non-metallic scrape hoes or chisels.

Test cleaning methods on sample wall panel; leave 1/2 panel uncleaned for comparison purposes. Obtain Architect's approval of sample cleaning before proceeding with cleaning of masonry.

Saturate wall surfaces with water prior to application of cleaners; remove cleaners promptly by rinsing thoroughly with clear water.

Use bucket and brush hand cleaning method described in BIA"Technical Note No. 20 Revised" to clean brick masonry made from clay or shale, except use detergent masonry cleaner

Clean concrete unit masonry to comply with masonry manufacturer's directions and applicable NCMA "Tek" bulletins.

D. Protection: Provide final protection and maintain conditions in a manner acceptable to Installer, which ensures unit masonry work being without damage and deterioration at time of substantial completion.

**END OF SECTION 04200**

# SECTION 051200

## STRUCTURAL STEEL

## PART I - GENERAL

1.1 RELATED DOCUMENTS

Drawings and general provisions of the Contract, including General and Supplementary Conditions and Division I Specification Sections, apply to this Section.

1.2 RELATED SECTIONS

A. Grouting under base and bearing plates: Section 033000 - Cast-in-Place Concrete.

B. Section 053000 - Steel Decking.

1.3 PRODUCTS FURNISHED BUT NOT INSTALLED UNDER THIS SECTION

A. Anchor bolts and setting templates:

1. Section 033000 - Cast-in-Place Concrete.

2. Section 031000 - Concrete Formwork.

1.4 SCOPE

This is a Performance specification. Work under this section includes, but is not limited to, a complete resolution of the geometry of the Structural Steel members and their joints, producing shop drawings which accurately reflect the geometry of the members and joints fabricating and erecting of the structural steel to achieve a finished structural frame. The fabricator and erector shall include in their bid the expense of making any field corrections required to achieve a workable structure.

1.5 SUBMITTALS

A. Steel fabricator and erector to supply a list of five previous projects similar in size and complexity to this project to establish that they are capable to perform the work for this project. List shall include the name and location of each project with the name and phone number of the Contractor and Architect for which the previous projects were performed~ Architect may reject any steel fabricator or erector that, in his opinion, fails to appear capable of performing the required work. Steel fabricator shall be approved by the Architect prior to the production of shop drawings.

B. Shop drawings prepared by the fabricator. Submit one reproducible sepia and one print of shop drawings. Only marked up sepia will be returned. Connections not detailed on the design drawings shall be designed by the fabricator. Structural design drawings are for design intent only. It is the responsibility of the fabricator to ensure that the shop drawings reflect all necessary information required for fabrication and erection. Reproduction of structural design drawings for the shop drawing submittal will not be permitted nor will they be reviewed.·

C. Prequalified welding procedures, prepared by the steel fabricator and erector, as a written procedure specification to Engineer. Prepare these procedures in accordance with Appendix E of the AWS "Structural Welding Code," AWS D1.1-85. Obtain Architect's approval before erecting steel.

D. Submit mill certification that steel supplied meets requirements of specifications.

E. Submit electrode manufacturer's certification that the electrode and flux combination the requirements of the particular classification or grade of electrodes.

F. Submit manufacturer's certification that shear stud bases are qualified.

G. Submit a minimum of three copies of each report from the Testing Laboratory to the Architect. See Field Quality Control section this specification for inspections and test required of the Testing Laboratory.

H. Submittals shall include the following note completed and signed by the Contractor:
The data submitted does not contain material deviation from requirements of contract documents except as follows:

1.6 QUALITY ASSURANCE

A. Structural steel: Meet requirements of Manual of Steel Construction, Ninth Edition~ Allowable Stress Design and Plastic Design for types of steel specified.

B. Fabrication and erection: Meet requirements of Specification for the Design Fabrication and Erection of Structural Steel for Buildings, June 1, 1989, and all subsequent modifications or addendums (referred to below as Structural Steel for Buildings) as indicated.

C. Welding: In accordance with requirements of American Welding Society "Structural Welding Code," AWS D1.1-85.

D. Testing Agency _ Personnel performing tests and inspection will be certified by American Society for Non-Destructive Testing, for Level II.

E. Included in the responsibilities for structural steel testing and inspection are the following:

1. Observe the A WS qualifications of all welders.
2. Inspect and test a representative sampling of a minimum of 10% of the high strength bolts for proper installation and tensioning.
3. Verify that electrodes are compatible with the base metals joined.
4. Ultrasonically test complete penetration welds and visually inspect all fillet welds.

1.7 QUALIFICATIONS

A. Steel Fabricator: Fabricator shall be approved by the Architect. See Submittal section this specification for requirements.

B. Welders, tackers, and welding operators: Qualified in accordance with Code for Welding in Building Construction, A WS DI.I-96 to perform the type of work required.

1.8 PRODUCT HANDLING

A. Deliver materials, such as anchor bolts and other anchor devices to be embedded in concrete and masonry construction, to project site in time to be installed in proper sequence with concrete and masonry work. provide setting drawings, templates and directions for installation of anchor bolts and other devices.

B. Deliver steel to project site and stack in designated area.

C. Stack and store steel above ground on platforms, studs or other supports. Protect steel from corrosion and damage. Keep materials clean.

D. Store other materials in a weather tight, dry place until ready for use.

E. Store packaged materials in their original, unbroken package or container.

F. Store shear studs in a protected, weather tight, dry place until ready for use.

## PART 2 - PRODUCTS

2.1 STRUCTURAL STEEL

A. ASTM A36-96, Standard Specification for Structural Steel for plates, channels and angles.

B. ASTM A572-94ce2, Grade 50, High Strength, Low Alloy Columbian-Vanadium Steels of Structural Quality for all other rolled shapes.

2.2 STEEL PIPE

ASTM A53-96, Grade B, Standard Specification for Pipe, Steel, Black and Hot-Dipped, Zinc-Coated Welded and Seamless.

2.3 STEEL TUBING

ASTM A500-93, Grade B, Standard Specification for Cold-Formed Welded and Seamless Carbon Structural Tubing.

2.4 SHEAR STUDS

Shall be in accordance with A WS Structural Welding Code A WS D 1.1-96, Section 7.

2.5 WELDING ELECTRODES

A. Electrodes having low hydrogen covering shall be purchased in hermetically-sealed containers.

B. For fabricating plant use: E70 electrodes, AWS A5.1-91, A5.5-96, A5.17-89 or A5.2095.

C. For shear studs, in accordance with A WS Structural Welding Code A WS Dl.l-96, Part F. Provide heat-resistant arc shields with studs.

2.6 BOLTS

A. High strength bolts, nuts and washer: Type 1 or 2, ASTM A325-96, Standard Specification for High-Strength Bolts for Structural Joints, Including Suitable Nuts and Plain Hardened Washers. Provide %" diameter bolts unless noted otherwise.

B. High strength bolts shall be load-indicator bolts. Provide load-indicator bolts as manufactured by Bethlehem, Le Juene, or approved substitute. Load-indicator bolts shall be installed using equipment specifically manufactured for this . use. Load indicator bolts in tension shall have rounded heads that cannot accept the application of a wrench.

C. Unfinished bolts: ASTM A307-94, Standard Specification for Carbon Steel and Externally Threaded Standard Fasteners

D. Expansion (wedge) anchors:

| Manufacturer | Product |
|---|---|
| Ramset Fastening Systems | Trubolt anchors |
| Hilti Fastening Systems | Hilti anchors |
| Simpson Strong-Tie | Wedge-All anchors |

2.7 SHOP COATING

A. A high grade rust-inhibiting primer. Use red oxide primer unless otherwise noted.

B. Paint shall be VOC compliant, lead and chromate free and shall be compatible with products specified in Division 9 specifications.

## PART 3 – EXECUTION

3.1 FABRICATING

A. Fabricate in accordance with applicable requirements of M2 of "Specification For Structural Steel Building" by AISC.

B. Design all connections, except for those fully detailed on the Structural Drawings.

3.2 SHOP COATING

A. Before steel leaves fabricator's shop, remove loose mill scale, ruS4 weld slag and flux deposit, dirt, foreign matter and oil and grease. Prepare surface as recommended by paint manufacturer for the intended exposure. Do not sandblast, flame clean, or pickle material.

B. Thoroughly and evenly apply one coat of shop paint to cleaned surfaces. Thickness of shop paint coat shall be applied to a minimum dry film thickness of 1 mil Of as required by surface preparation.

C. Do not paint steel to be encased in concrete, plaster and sprayed-on- fireproofing.

3.3 ERECTING

A. Before commencing erecting work, notify Architect in writing at 48 hours in advance.

B. Erect steel in accordance with requirements of Section M4 of "Specification For Structural Steel Buildings" by AISC, except paragraph M4.6 is hereby modified to make field painting a part of the work on this section.

C. Use specified high-strength bolts for bolted connections, except where unfinished bolts and welded connections are allowed below. Use a minimum of2 bolts at each bolted connection. Use hardened washers under bolt or nut, whichever is the element turned in tightening. Prior to tightening the bolts of a connection to final tension, there shall first be enough bolts brought to a "snug tight" condition to insure that the parts of the joint are brought into good contact with each other.

D. Bolts in bearing type conditions which are not subject to fatigue or load fluctuations need only to be tightened to a snug-tight condition. Bolts in tension shall be tightened to full tension values. Refer to Drawings for location of bolts required to be fully tightened.

E. Use unfinished bolts in places indicated.

F. Install expansion anchors per manufacturer's instructions.

G. Use shear studs where indicated.

H. Weld connections where indicated. Do not peen welds unless authorized in writing by Architect. Any shop paint on surfaces adjacent to joints to be field welded shall be wire brushed to reduce the paint film to a minimum.

I. Field Painting: For shop coated steel, touch up welds and scarred and damaged shop coat.

J. Protect all structural steel below grade by encasing in concrete or painting with bitumastic paint.

K. Do not field cut or alter structural members without approval of Architect/Engineer.

3.4 FIELD QUALITY CONTROL

A. Shop and field welding will be tested and inspected in accordance with A WS Structural Welding Code. Welds will be visually or ultrasonically tested, depending on types of welded joints. All penetration welds shall be ultrasonically tested and inspected. A minimum representative sampling of 10 percent of all other welds shall be inspected by the Testing Laboratory for compliance with the design drawings and shop drawings. Additional inspections and testing shall be directed by the Architect. Additional testing as a result of non-conformances will be at the expense of the Contractor.

B. The Testing Laboratory shall inspect and test a minimum representative sampling of 10 percent of all bolted connections. Additional inspections and testing of bolted connections shall be performed by the Testing Laboratory as directed by the Architect. Additional testing as a result of non-conformances will be at the expense of the Contractor.

C. Shear studs shall be tested and inspected by Testing Laboratory in accordance with A WS D 1.1-96, Section 7. Submit three (3) copies of reports to Architect.

D. The steel fabricator shall be fully responsible for insuring that all steel fabrication and erection is in accordance with the Contract Documents. Failure of Architect or Testing Laboratory to detect defective work, workmanship, materials, or erection shall in no way prevent rejection of the work and the steel fabricator taking approved corrective action when such defects are discovered. The Architect or the Testing Laboratory shall not, thereby, be obligated to make a final acceptance.

END OF SECTION

SECTION 054000

COLD-FORMED METAL FRAMING

## PART 1 - GENERAL

1.1 RELATED DOCUMENTS

Drawings and general provisions of the Contract, including General and Supplementary Conditions and Division 01 Specification Sections, apply to this Section.

1.2 SUMMARY

A. This Section includes exterior non-load-bearing wall framing.

B. Related Sections include Division 09 Section "Non-Structural Metal Framing" for interior non-load-bearing, metal-stud framing and ceiling-suspension assemblies.

1.3 PERFORMANCE REQUIREMENTS

A. Structural Performance: Provide cold-formed metal framing capable of withstanding design loads within limits and under conditions indicated.

1. Design Loads: As indicated on drawings.

2. Deflection Limits: Design framing systems to withstand design loads without deflections greater than the horizontal deflection of 1/600 of the wall height.

B. Cold-Formed Steel Framing, General:

1. Design according to AISI's "Standard for Cold-Formed Steel Framing - General Provisions" .

2. Design exterior non-load-bearing wall framing to accommodate horizontal deflection without regard for contribution of sheathing materials.

1.4 SUBMITTALS

A. Product Data: For each type of cold-formed metal framing product and accessory indicated.

B. Shop Drawings:

1. Show layout, spacing, sizes, thicknesses, and types of cold-formed metal framing; fabrication; and fastening and anchorage details, including mechanical fasteners. Show reinforcing channels, opening framing, supplemental framing, strapping, bracing, bridging, splices, accessories, connection details, and attachment to adjoining work.

2. For cold-formed metal framing indicated to comply with design loads, include structural analysis data signed and sealed by the qualified professional engineer responsible for their preparation.

C. Welding certificates.

D. Qualification Data: For professional engineer.

E. Mill certificates signed by steel sheet producer indicating that steel complies with requirements.

F. Meeting Records: Minutes of pre-installation conference.

1.5 QUALITY ASSURANCE

A. Engineering Responsibility: Preparation of Shop Drawings, design calculations, and other structural

data by a qualified professional engineer.

B. Professional Engineer Qualifications: A professional engineer who is legally qualified to practice in jurisdiction where Project is located and who is experienced in providing engineering services of the kind indicated. Engineering services are defined as those performed for installations of cold-formed metal framing that are similar to those indicated for this Project in material, design, and extent.

C. Product Tests: Mill certificates or data from a qualified independent testing agency, or in-house testing with calibrated test equipment indicating steel sheet complies with requirements, including base-metal thickness, yield strength, tensile strength, total elongation, chemical requirements, ductility, and metallic-coating thickness.

D. Welding: Qualify procedures and personnel according to AWS D1.1/D1.1M, "Structural Welding Code--Steel," and A WS D1.3, "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 E 119 by a testing and inspecting agency acceptable to authorities having jurisdiction.

F. AISI Specifications and Standards: Comply with AISI's "North American Specification for the Design of Cold-Formed Steel Structural Members" and its "Standard for Cold Formed Steel Framing - General Provisions."

1. Comply with AISI's "Standard for Cold-Formed Steel Framing - Truss Design." 2. Comply with AISI's "Standard for Cold-Formed Steel Framing - Header Design."

G. Pre-Installation Conference: Conduct conference at Project site to comply with requirements in Division 01 Section "Project Management and Coordination."

1.6 DELIVERY,- STORAGE, AND HANDLING

A. Protect cold-formed metal framing from corrosion, deformation, and other damage during delivery, storage, and handling.

B. Store cold-formed metal framing, protect with a waterproof covering, and ventilate to avoid condensation.

## PART 2 - PRODUCTS

2.1 MANUFACTURERS

A. Available Manufacturers: Subject to compliance with requirements, manufacturers offering cold-formed metal framing that may be incorporated into the Work include, but are not limited to, the following:

1. Consolidated Fabricators Corp.; Building Products Division.
2. Dale/Incor.
3. Dietrich Metal Framing; a Worthington Industries Company.
4. National Gypsum Company

2.2 NON-LOAD-BEARING STEEL FRAMING, GENERAL

A. Framing Members, General: Comply with ASTM C 754 for conditions indicated.

1. Steel Sheet Components: Comply with ASTM C 645 requirements for meta~ unless

otherwise indicated.

2. Protective Coating: ASTM A 653, G40, hot-dip galvanized, unless otherwise indicated.

2.3 EXTERIOR NON-LOAD-BEARING WALL FRAMING

A. 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, unless otherwise indicated.

2. Flange Width: 1-5/8 inches, unless otherwise indicated.

B. Steel Track: Manufacturer's standard U-shaped steel track, of web depths indicated, unpunched, with unstiffened flanges, and as follows:

1. Minimum Base-Metal Thickness: 0.0329 inch, unless otherwise indicated.

2. Flange Width: 1-1/4 inches, unless otherwise indicated.

C. Vertical Deflection Clips: Manufacturer's standard bypass clips, capable of accommodating upward and downward vertical displacement of primary structure through positive mechanical attachment to stud web.

D. Single Deflection Track: Manufacturer's single, deep-leg, U-shaped steel track; I? unpunched, with unstiffened flanges, of web depth to contain studs while allowing free .Jl. vertical movement, with flanges designed to support horizontal and lateral loads and transfer them to the primary structure, and as follows:

1. Minimum Base-Metal Thickness: 0.0428 inch, unless otherwise indicated.
2. Flange Width: 1 inch plus the design gap for I-story structures and 1 inch plus twice the design gap for other applications.

2.4 FRAMING ACCESSORIES

A. Fabricate steel-framing accessories from steel sheet, ASTM A l003/A 1003M, Structural Grade, Type H, metallic coated, of same grade and coating weight used for framing members.

B. Provide accessories of manufacturer's standard thickness and configuration, unless otherwise indicated, as follows:

1. Supplementary framing.

2. Bracing, bridging, and solid blocking.

3. Web stiffeners.

4. Anchor clips.

5. End clips.

6. Foundation clips.

7. Gusset plates.

8. Stud kickers, knee braces, and girts.

9. Joist hangers and end closures.

10. Hole reinforcing plates.

11. Backer plates.

2.5 ANCHORS, CLIPS, AND FASTENERS

A. Steel Shapes and Clips: ASTM A 36, zinc coated by hot-dip process according to ASTMA 123.

B. Anchor Bolts: ASTM F 1554, Grade 36, threaded carbon-steel hex-headed bolts and carbon-steel nuts; and flat, hardened-steel washers; zinc coated by hot-dip process according to ASTM A 153, Class C.

C. Expansion Anchors: Fabricated from corrosion-resistant materials, with capability to sustain, without failure, a load equal to 5 times design load, as determined by testing per ASTM E 488 conducted by a qualified independent testing agency.

D. Mechanical Fasteners:

1. ASTM C 1513, corrosion-resistant-coated, self-drilling, self-tapping steel drill screws.

2. Head Type: Low-profile head beneath sheathing, manufacturer's standard elsewhere.

E. Welding Electrodes: Comply with A WS standards.

2.6 MISCELLANEOUS MATERIALS

A. Galvanizing Repair Paint: [SSPC-Paint 20 or DOD-P-21 035] [ASTM A 780].

B. Nonmetallic, Nonshrink Grout: Premixed, nonmetallic, noncorrosive, nonstaining grout containing selected silica sands, portland cement, shrinkage-compensating agents, and plasticizing and water-reducing agents, complying with ASTM C 1107, with fluid consistency and 30-minute working time.

C. Shims: Load bearing, high-density multimonomer plastic, nonleaching.

D. Sealer Gaskets: Closed-cell neoprene foam, 1/4 inch thick, selected from manufacturer's standard widths to match width of bottom track or rim track members.

2.7 FABRICATION

A. Fabricate cold-formed metal framing 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.

1. Fabricate framing assemblies using jigs or templates.

2. Cut framing members by sawing or shearing; do not torch cut.

3. Fasten cold-formed metal framing members by welding, screw fastening, clinch fastening, or riveting as standard with fabricator. Wire tying of framing members is not permitted.

a. Comply with A WS D1.3 requirements and procedures for welding, appearance and quality of welds, and methods used in correcting welding work.

b. Locate mechanical fasteners and install according to Shop Drawings, with screw penetrating joined members by not less than three exposed screw threads.

4. Fasten other materials to cold-formed metal framing by welding, bolting, or screw fastening, according to Shop Drawings.

B. Reinforce, stiffen, and brace framing assemblies to withstand handling, delivery, and erection stresses. Lift fabricated assemblies to prevent damage or permanent distortion.

C. Fabrication Tolerances: Fabricate assemblies level, plumb, and true to line to a maximum allowable tolerance variation of 1/8 inch in 10 feet and as follows:

1. Spacing: Space individual framing members no more than plus or minus 1/8 inch from plan location. Cumulative error shall not exceed minimum fastening requirements of sheathing or other finishing materials.

2. Squareness: Fabricate each cold-formed metal framing assembly to a maximum out-of-square tolerance of 1/8 inch.

## PART 3 - EXECUTION

### 3.1 EXAMINATION

A. Examine supporting substrates and abutting structural framing for compliance with requirements for installation tolerances and other conditions affecting performance.

B. Proceed with installation only after unsatisfactory conditions have been corrected.

### 3.2 PREPARATION

A. Before sprayed fire-resistive materials are applied, attach continuous angles, supplementary framing, or tracks to structural members indicated to receive sprayed fire-resistive materials.

B. After applying sprayed fire-resistive materials, remove only as much of these materials as needed to complete installation of cold-formed framing without reducing thickness of fire-resistive materials below that are required to obtain fire-resistance rating indicated. Protect remaining fire-resistive materials from damage.

C. Install sealer gaskets to isolate the underside of wall bottom track or rim track and the top of foundation wall or slab at stud or joist locations.

### 3.3 INSTALLATION, GENERAL

A. Cold-formed metal framing may be shop or field fabricated for installation, or it may be field assembled.

B. Install cold-formed metal framing according to AISI's "Standard for Cold-Formed Steel Framing ~ General Provisions" and to manufacturer's written instructions unless more stringent requirements are indicated.

C. Install cold-formed metal framing and accessories plumb, square, and true to line, and with connections securely fastened.

1. Cut framing members by sawing or shearing; do not torch cut.

2. Fasten cold-formed metal framing members by welding, screw fastening, clinch fastening, or riveting. Wire tying of framing members is not permitted.

   a. Comply with A WS DI.3 requirements and procedures for welding, appearance and quality of welds, and methods used in correcting welding work.

   b. Locate mechanical fasteners and install according to Shop Drawings, and complying with requirements for spacing, edge distances, and screw penetration.

D. Install framing members in one-piece lengths unless splice connections are indicated for track or tension members.

E. Install temporary bracing and supports to secure framing and support loads comparable in intensity to those for which structure was designed. Maintain braces and supports in place, undisturbed, until entire integrated supporting structure has been completed and permanent connections to framing are secured.

F. Do not bridge building expansion and control joints with cold-formed metal framing. Independently frame both sides of joints.

G. Install insulation, specified in Division 07 Section "Thermal Insulation", in built-up exterior framing members, such as headers, sills, boxed joists, and multiple studs at openings, that are inaccessible on completion of framing work.

H. Fasten hole reinforcing plate over web penetrations that exceed size of manufacturer's standard punched openings.

I. Erection Tolerances:

1. Install cold-formed metal framing level, plumb, and true to line to a maximum allowable tolerance variation of 1/8 inch in 10 feet and as follows:

2. Space individual framing members no more than plus or minus 1/8 inch from plan location. Cumulative error shall not exceed minimum fastening requirements of sheathing or other finishing materials.

3.4 EXTERIOR NON-LOAD-BEARING WALL INSTALLATION

A. Install continuous tracks sized to match studs. Align tracks accurately and securely anchor to supporting structure as indicated.

B. Fasten both flanges of studs to top and bottom track, unless otherwise indicated. Space studs as indicated on drawings.

C. Set studs plumb, except as needed for diagonal bracing or required for nonplumb walls or warped surfaces and similar requirements.

D. Isolate non-load-bearing steel framing from building structure to prevent transfer of vertical loads while providing lateral support.

1. Install single-leg deflection tracks and anchor to building structure.

2. Connect vertical deflection clips to bypassing or in ftH studs and anchor to building structure.

3. Connect drift clips to cold formed metal framing and anchor to building structure.

E. Install horizontal bridging in wall studs, spaced in rows indicated on Shop Drawings but not more than 48 inches apart. Fasten at each stud intersection.

1. Top Bridging for Single Deflection Track: Install row of horizontal bridging within 12 inches of single deflection track. Install a combination of flat, taut, steel sheet straps of width and thickness indicated and stud or stud-track solid blocking of width and thickness matching studs. Fasten flat straps to stud flanges and secure solid blocking to stud webs or flanges.

2. Bridging: Combination of flat, taut, steel sheet straps of width and thickness indicated and stud-track solid blocking of width and thickness to match studs. Fasten flat strops to stud flanges and secure solid blocking to stud webs or flanges.

F. Install miscellaneous framing and connections, including stud kickers, web stiffeners, clip angles, continuous angles, anchors, fasteners, and stud girts, to provide a complete and stable wall-framing

system.

3.5 REPAIRS AND PROTECTION

A. Galvanizing Repairs: Prepare and repair damaged galvanized coatings on fabricated and installed cold-formed metal framing with galvanized repair paint according to ASTM A 780 and manufacturer's written instructions.

B. Provide final protection and maintain conditions, in a manner acceptable to manufacturer and Installer that ensure that cold-formed metal framing is without damage or deterioration at time of Substantial Completion.

END OF SECTION

SECTION 055000

METAL FABRICATIONS

## PART 1 - GENERAL

1.1 RELATED DOCUMENTS

Drawings and general provisions of the Contract, including General and Supplementary Conditions and Division 1 Specification Sections, apply to this Section.

1.2 SUMMARY

A. This Section includes, but not limited to, the following:

1. Support angles.

B. Related Sections include the following:

1. Division 03 Section "Cast-in-Place Concrete" for installing anchor bolts, steel pipe sleeves, wedge-type inserts and other items indicated to be cast into concrete.
2. Division 05 Section "Structural Steel".

1.3 PERFORMANCE REQUIREMENTS

A. Structural Performance of Ladders: Provide ladders capable of withstanding the effects of loads and stresses within limits and under conditions specified in ANSI AI4.3.

B. Thermal Movements:

1. Provide exterior metal fabrications that allow for thermal movements resulting from the following maximum change (range) in ambient and surface temperatures by preventing buckling, opening of joints, overstressing of components, failure of connections, and other detrimental effects. Base engineering calculation on surface temperatures of materials due to both solar heat gain and nighttime-sky heat loss.
2. Temperature Change (Range): 120 deg F, ambient; 180 deg F, material surfaces.

1.4 SUBMITTALS

A. Product Data: For the following:

1. Paint products.
2. Grout.

B. Shop Drawings: Show fabrication and installation details for metal fabrications.

1. Include plans, elevations, sections, and details of metal fabrications and their connections. Show anchorage and accessory items.
2. Provide templates for anchors and bolts specified for installation under other Sections.
3. For installed products indicated to comply with design loads, include structural analysis data signed and sealed by the qualified professional engineer responsible for their preparation.

C. Mill Certificates: Signed by manufacturers of stainless-steel sheet certifying that products furnished comply with requirements.

D. Welding certificates.

E. Qualification Data: For professional engineer.

1.5 QUALITY ASSURANCE

A. Welding: Qualify procedures and personnel according to the following:

1. AWS D1.1, "Structural Welding Code--Steel".

2. AWS D1.2, "Structural Welding Code--Aluminum".

1.6 PROJECT CONDITIONS

A. Field Measurements: V verify actual locations of walls and other construction contiguous with metal fabrications by field measurements before fabrication and indicate measurements on Shop Drawings.

B. Established Dimensions: Where field measurements cannot be made without delaying the Work, establish dimensions and proceed with fabricating metal fabrications without field measurements. Coordinate wall and other contiguous construction to ensure that actual dimensions correspond to established dimensions.

C. Provide allowance for trimming and fitting at site.

1.7 COORDINATION

Coordinate installation of anchorages for metal fabrications. Furnish setting drawings, templates, and directions for installing anchorages, including sleeves, concrete inserts, anchor bolts, and items with integral anchors, that are to be embedded in concrete or masonry. Deliver such items to Project site in time for installation.

## PART 2 - PRODUCTS

2.1 METALS, GENERAL

Metal Surfaces, General: Provide materials with smooth, flat surfaces, unless otherwise indicated. For metal fabrications exposed to view in the completed Work, provide materials without seam marks, roller marks, rolled trade names, or blemishes.

2.2 FERROUS METALS

A. Steel Plates, Shapes, and Bars: ASTM A 36.

B. Steel Tubing: ASTM A 500, cold-formed steel tubing.

C. Steel Pipe: ASTM A 53, standard weight (Schedule 40), unless another weight is indicated or required by structural loads.

2.3 FASTENERS

General: Unless otherwise indicated, provide Type 304 stainless-steel fasteners for exterior use and zinc-plated fasteners with coating complying with ASTM B 633, Class *Fe*/*Zn* 5, at exterior walls. Select fasteners for type, grade, and class required.

2.4 MISCELLANEOUS MATERIALS

A. Welding Rods and Bare Electrodes: Select according to A WS specifications for metal alloy welded.

B. Universal Shop Primer: Fast-curing, lead- and chromate-free, universal modified-alkyd primer

complying with MPI#79.

1. Use primer with a VOC content of 420 g/L (3.5-lb/gal.) or less when calculated according to 40 CFR 59, Subpart D (EPA Method 24).
2. Use primer containing pigments that make it easily distinguishable from zinc-rich primer.

C. Galvanizing Repair Paint: High-zinc-dust-content paint for re-galvanizing welds in steel, complying with SSPC-Paint 20.

D. Non-shrink, Nonmetallic Grout: Factory-packaged, non-staining, noncorrosive, non-gaseous grout complying with ASTM C 1107. Provide grout specifically recommended by manufacturer for interior and exterior applications.

2.5 FABRICATION, GENERAL

A. Shop Assembly: Preassemble items in the shop to greatest extent possible. Disassemble units only as necessary for shipping and handling limitations. Use connections that maintain structural value of joined pieces. Clearly mark units for reassembly and coordinated installation.

B. Cut, drill, and punch metals cleanly and accurately. Remove burrs and ease edges to a radius of approximately 1/32 inch, unless otherwise indicated. Remove sharp or rough areas on exposed surfaces.

C. Form bent-metal comers to smallest radius possible without causing grain separation or otherwise impairing work.

D. Form exposed work true to line and level with accurate angles and surfaces and straight edges.

E. Weld corners and seams continuously to comply with the following:
1. Use materials and methods that minimize distortion and develop strength and corrosion resistance of base metals.
2. Obtain fusion without undercut or overlap.
3. Remove welding flux immediately.
4. At exposed connections, finish exposed welds and surfaces smooth and blended so no roughness shows after finishing and contour of welded surface matches that of adjacent surface.

F. Form exposed connections with hairline joints, flush and smooth, using concealed fasteners where possible. Where exposed fasteners are required, use Phillips flat-head (countersunk) screws or bolts, unless otherwise indicated. Locate joints where least conspicuous.

G. Fabricate seams and other connections that will be exposed to weather in a manner to exclude water. Provide weep holes where water may accumulate.

H. Cut, reinforce, drill, and tap metal fabrications as indicated to receive finish hardware, screws, and similar items.

I. Provide for anchorage of type indicated; coordinate with supporting structure. Space anchoring devices to secure metal fabrications rigidly in place and to support indicated loads. Where units are indicated to be cast into concrete or built into masonry, equip with integrally welded steel strap anchors, 1/8 by 1-1/2 inches, with a minimum 6-inch embedment and 2-inch hook, not less than 8 inches from ends and comers of units and 24 inches o.c., unless otherwise indicated.

2.6 MISCELLANEOUS FRAMING AND SUPPORTS

A. General: Provide steel framing and supports not specified in other Sections as needed to complete the Work.

B. Fabricate units from steel shapes, plates, and bars of welded construction, unless otherwise indicated. Fabricate to sizes, shapes, and profiles indicated and as necessary to receive adjacent construction retained by framing and supports. Cut, drill, and tap units to receive hardware, hangers, and similar items.

C. Fabricate supports for operable partitions from continuous steel beams of sizes indicated with attached bearing plates, anchors, and braces as indicated. Drill bottom flanges of beams to receive partition track hanger rods; locate holes where indicated on operable partition Shop Drawings.

D. Galvanize miscellaneous framing and supports where indicated.

E. Prime miscellaneous framing and supports with zinc-rich primer where indicated.

2.7 LOOSE STEEL LINTELS

A. Fabricate loose steel lintels from steel angles and shapes of size indicated for openings and recesses in masonry walls and partitions at locations indicated. Weld adjoining members together to form a single unit where indicated.

B. Size loose lintels to provide bearing length at each side of openings equal to 1/12 of clear span but not less than 8 inches, unless otherwise indicated.

C. Galvanize loose steel lintels located in exterior walls.

2.8 METAL LADDERS

A. General:

1. Comply with ANSI AI4.3, unless otherwise indicated.
2. For elevator pit ladders, comply with ASME AI7.I.
3. Space side rails 18 inches apart, unless otherwise indicated.

B. Support each ladder at top and bottom and not more than 60 inches o.c. with welded or bolted brackets, made from same metal as ladder. Steel Ladders:

1. Side rails: Continuous, 3/S-by-2-1/2-inch steel flat bars, with eased edges.
2. Rungs: 3/4-inch-diameter steel bars.
3. Fit rungs in centerline of side rails; plug-weld and grind smooth on outer rail faces.
4. Provide nonslip surfaces on top of each rung, either by coating rung with aluminum-oxide granules set in epoxy-resin adhesive or by using a type of manufactured rung filled with aluminum-oxide grout.
5. Galvanize ladders, including brackets and fasteners.

2.9 FINISHES, GENERAL

A. Comply with NAAMM's "Metal Finishes Manual for Architectural and Metal Products" for recommendations for applying and designating finishes.

B. Finish metal fabrications after assembly.

2.10 STEEL AND IRON FINISHES

A. Galvanizing: Hot-dip galvanize items as indicated to comply with applicable standard listed below:

1. ASTM A 123, for galvanizing steel and iron products.

2. ASTM A 153, for galvanizing steel and iron hardware.

B. Preparation for Shop Priming: Prepare uncoated ferrous-metal surfaces to comply with minimum requirements indicated below for SSPC surface preparation specifications and environmental exposure conditions of installed metal fabrications:

1. Exteriors (SSPC Zone IB) and Items Indicated to Receive Zinc-Rich Primer: SSPC-SP 6/NACE No.3, "Commercial Blast Cleaning".

2. Interiors (SSPC Zone IA): SSPC-SP 3, "Power Tool Cleaning".

C. Shop Priming: Apply shop primer to uncoated surfaces of metal fabrications, except those with galvanized finishes and those to be embedded in concrete, sprayed-on fireproofing, or masonry, unless otherwise indicated. Comply with SSPC-PA 1, "Paint Application Specification No.1: Shop, Field, and Maintenance Painting of Steel," for shop painting.

## PART 3 - EXECUTION

3.1 INSTALLATION, GENERAL

A. Cutting, Fitting, and Placement: Perform cutting, drilling, and fitting required for installing metal fabrications. Set metal fabrications accurately in location, alignment, and elevation; with edges and surfaces level, plumb, true, and free of rack; and measured from established lines and levels.

B. Fit exposed connections accurately together to form hairline joints. Weld connections that are not to be left as exposed joints but cannot be shop welded because of shipping size limitations. Do not weld, cut, or abrade surfaces of exterior units that have been hot-dip galvanized after fabrication and are for bolted or screwed field connections.

C. Field Welding: Comply with the following requirements:

1. Use materials and methods that minimize distortion and develop strength and corrosion resistance of base metals.

2. Obtain fusion without undercut or overlap.

3. Remove welding flux immediately.

4. At exposed connections, finish exposed welds and surfaces smooth and blended so no roughness shows after finishing and contour of welded surface matches that of adjacent surface.

D. Fastening to In-Place Construction: Provide anchorage devices and fasteners where metal fabrications are required to be fastened to in-place construction. Provide threaded fasteners for use with concrete and masonry inserts, toggle bolts, through bolts, lag bolts, wood screws, and other connectors.

E. Provide temporary bracing or anchors in formwork for items that are to be built into concrete, masonry, or similar construction.

3.2 INSTALLING MISCELLANEOUS FRAMING AND SUPPORTS

General: Install framing and supports to comply with requirements of items being supported, including manufacturers' written instructions and requirements indicated on Shop Drawings.

3.3 ADJUSTING AND CLEANING

A. Touch-up Painting:

1. Immediately after erection, clean field welds, bolted connections, and abraded areas. Paint uncoated and abraded areas with the same material as used for shop painting to comply with SSPC-P A I for touching up shop-painted surfaces.

2. Apply by brush or spray to provide a minimum 2.0-mil dry film thickness.

B. Galvanized Surfaces: Clean field welds, bolted connections, and abraded areas and repair galvanizing to comply with ASTM A 780.

END OF SECTION

# SECTION 061000

# ROUGH CARPENTRY

## PART 1 - GENERAL

### 1.1 RELATED DOCUMENTS

Drawings and general provisions of the Contract, including General and Supplementary Conditions and Division 1 Specification Sections, apply to this Section.

### 1.2 SUMMARY

A. This Section includes the following:
   1. Wood blocking and nailers.
   2. Plywood backing panels.
   3. Framing with dimension lumber.

B. Related Sections include the following:
   1. Division 06 Section "Sheathing".
   2. Division 06 Section "Exterior Finish Carpentry" for nonstructural carpentry items exposed to view and not specified in anther Section.
   3. Division 06 Section "Interior Architectural Woodwork" for nonstructural carpentry items exposed to view and not specified in another Section.

### 1.3 DEFINITIONS

A. Rough Carpentry: Carpentry work not specified in other Sections and not exposed, unless otherwise indicated.

B. Dimension Lumber: Lumber of 2 inches nominal or greater but less than 5 inches nominal in least dimension.

C. Lumber grading agencies, and the abbreviations used to reference them, include the following:
   1. NELMA - Northeastern Lumber Manufacturers Association.
   2. NLGA - National Lumber Grades Authority.
   3. SPIB - Southern Pine Inspection Bureau.
   4. WCLIB - West Coast Lumber Inspection Bureau.
   5. WWPA - Western Wood Products Association.

### 1.4 SUBMITTALS

A. Product Data: For each type of process and factory-fabricated product. Indicate component materials and dimensions and include construction and application details.
   1. Include data for wood-preservative treatment from chemical treatment manufacturer and certification by treating plant that treated materials comply with requirements. Indicate type of preservative used, net amount of preservative retained, and chemical treatment manufacturer's written instructions for handling, storing, installing, and finishing treated material.

2. Include data for fire-retardant treatment from chemical treatment manufacturer and certification by treating plant that treated materials comply with requirements. Include physical properties of treated materials, both before and after exposure to elevated temperatures when tested according to ASTM D 5516 and ASTM D 5664.
3. For products receiving a waterborne treatment, include statement that moisture content of treated materials was reduced to levels specified before shipment to Project site.
4. Include copies of warranties: From chemical treatment manufacturers for each type of treatment.

B. Material Certificates: For dimension lumber specified to comply with minimum allowable unit stresses. Indicate species and grade selected for each use and design values approved by the American Lumber Standards Committee Board of Review.

C. Research/Evaluation Reports: For the following, showing compliance with building code in effect for Project:

1. Preservative-treated wood.
2. Fire-retardant-treated wood.
3. Power-driven fasteners.
4. Powder-actuated fasteners.
5. Expansion anchors.

1.5 QUALITY ASSURANCE

Source Limitations for Fire-Retardant- Treated Wood: Obtain each type of fire-retardant treated wood product through one source from a single producer.

1.6 DELIVERY, STORAGE, AND HANDLING

Stack lumber, plywood, and other panels; place spacers between each bundle to provide air circulation. Provide for air circulation around stacks and under coverings.

## PART 2 - PRODUCTS

2.1 WOOD PRODUCTS, GENERAL

A. Lumber: DOC PS 20 and applicable rules of lumber grading agencies certified by the American Lumber Standards Committee Board of Review.

1. Factory mark each piece of lumber with grade stamp of grading agency.
2. For exposed lumber indicated to receive a stained or natural finish, mark grade stamp on end or back of each piece, or omit grade stamp and provide certificates of grade compliance issued by grading agency.
3. Where nominal sizes are indicated, provide actual sizes required by DOC PS 20 for moisture content specified. Where actual sizes are indicated, they are minimum dressed sizes for dry lumber.
4. Provide dressed lumber, S4S, unless otherwise indicated.

1.

5. Provide dry lumber with 19 percent maximum moisture content at time of dressing for 2-inch nominal thickness or less, unless otherwise indicated.

B. Plywood Backing Panels: DOC PS 1, Exposure 1, C-D Plugged, fire-retardant treated, in thickness

indicated or, if not indicated, not less than 1/2 inches thick.

2.2 WOOD-PRESERVATIVE-TREATED MATERIALS

A. Preservative Treatment by Pressure Process: A WP A C2 (lumber) and A WP A C9 (plywood), except that lumber that is not in contact with the ground and is continuously protected from liquid water may be treated according to A WP A C31 with inorganic boron (SBX).

1. Preservative Chemicals: Acceptable to authorities having jurisdiction and one of the following:

a. Ammonia cal, or amine, copper quat (ACQ).

b. Copper bis (dimethyldithiocarbamate) (CDDC).

c. Ammonia cal copper citrate (CC).

d. Copper azole, Type A (CBA-A).

e. Oxine copper (copper-8-quinolinolate) in a light petroleum solvent.

2. For exposed items indicated to receive a stained or natural finish, use chemical formulations that do not require incising, contain colorants, bleed through, or otherwise adversely affect finishes.

B. Kiln-dry material after treatment to maximum moisture content of 19 percent for lumber and 15 percent for plywood. Do not use material that is warped or does not comply with requirements for untreated material.

C. Mark each treated item with the treatment quality mark of an inspection agency approved by the American Lumber Standards Committee Board of Review.

D. Application: Treat items indicated on drawings, and wood cants, mailers, blocking, and similar members in connection with roofing, flashing, vapor barriers, and waterproofing.

2.3 FIRE-RETARDANT-TREATED MATERIALS

A. General: Where fire-retardant-treated materials are indicated, provide materials that comply with performance requirements in A WP A C20 (lumber) and A WP A C27 (plywood). Identify fire-retardant-treated wood with appropriate classification marking of UL, U.S. Testing, Timber Products Inspection, or another testing and inspecting agency acceptable to authorities having jurisdiction.

1. Use treatment for which chemical manufacturer publishes physical properties of treated wood after exposure to elevated temperatures, when tested by a qualified independent testing agency according to ASTM D 5664, for lumber and ASTM D 5516, for plywood.

2. Use treatment that does not promote corrosion of metal fasteners.

3. Use Interior Type A High Temperature (HT), unless otherwise indicated. Use exterior type for exterior locations and where indicated.

B. For exposed items indicated to receive a stained or natural finish, use chemical formulations that do not bleed through, contain colorants, or otherwise adversely affect finishes.

2.4 DIMENSION LUMBER

A. General: Provide dimension lumber of grades indicated according to the American Lumber Standards Committee National Grading Rule provisions of the grading agency indicated.

B. Framing: Construction, Stud, or No.2 grade and any of the following species:

1. Mixed southern pine; SPIB.

2. Spruce-pine-fir (south) or Spruce-pine-fir; NELMA, NLGA, WCLIB, or WWPA.

2.5 MISCELLANEOUS LUMBER

A. General: Provide lumber for support or attachment of other construction, including the following:

1. Blocking.

2. Nailers.

B. For items of dimension lumber size, provide Construction, Stud, or No.2 grade lumber with 19 percent maximum moisture content and any of the following species:

1. Mixed southern pine; SPIB.

2. Hem-fir or Hem-fir (north); NLGA, WCLIB, or WWP A.

3. Spruce-pine-fir (south) or Spruce-pine-fir; NELMA, NLGA, WCLIB, or WWPA.

C. For concealed boards, provide lumber with 19 percent maximum moisture content and any of the following species and grades:

1. Mixed southern pine, No.2 grade; SPIB.

2. Hem-fir or Hem-fir (north), Construction or 2 Common grade; NLGA, WCLIB, or WWPA.

3. Spruce-pine-fir (south) or Spruce-pine-fir, Construction or 2 Common grade; NELMA, NLGA, WCLIB, or WWP A.

2.6 PLYWOOD BACKING PANELS

Telephone and Electrical Equipment Backing Panels: DOC PS I, Exposure I, C-D Plugged, fire-retardant treated, in thickness indicated or, if not indicated, not less than 1/2 inches thick.

2. 7 FASTENERS

A. General: Provide fasteners of size and type indicated that comply with requirements specified in this Article for material and manufacture. Where rough carpentry is exposed to weather, in ground contact, or in area of high relative humidity, provide fasteners with hot-dip zinc coating complying with ASTM A 153.

B. Nails, Brads, and Staples: ASTM F 1667.

C. Power-Driven Fasteners: CABO NER-272.

D. Wood Screws: ASME B18.6.1.

E. Screws for Fastening to Cold-Formed Metal Framing: ASTM C 954, except with wafer heads and reamer wings, length as recommended by screw manufacturer for material being fastened.

F. Lag Bolts: ASME B18.2.1.

G. Bolts: Steel bolts complying with ASTM A 307, Grade A; with ASTM A 563 hex nuts and, where indicated, flat washers.

H. Expansion Anchors: Anchor bolt and sleeve assembly of material indicated below with capability to

sustain, without failure, a load equal to 6 times the load imposed when installed in unit masonry assemblies and equal to 4 times the load imposed when installed in concrete as determined by testing per ASTM E 488 conducted by a qualified independent testing and inspecting agency. Material: Carbon-steel components, zinc plated to comply with ASTM B 633, Class Fe/Zn 5.

## PART 3 - EXECUTION

3.1 INSTALLATION, GENERAL

A. Set rough carpentry to required levels and lines, with members plumb, true to line, cut, and fitted. Fit rough carpentry to other construction; scribe and cope as needed for accurate fit. Locate nailers, blocking, and similar supports to comply with requirements for attaching other construction.

B. Do not use materials with defects that impair quality of rough carpentry or pieces that are too small to use with minimum number of joints or optimum joint arrangement.

C. Apply field treatment complying with A WP A M4 to cut surfaces of preservative treated lumber and plywood.

D. Securely attach rough carpentry work to substrate by anchoring and fastening as indicated, complying with the following:

1. CABO NER-272 for power-driven fasteners.

2. "Fastening Schedule," in the Ohio Building Code.

E. Use common wire nails, unless otherwise indicated. Select fasteners of size that will not fully penetrate members where opposite side will be exposed to view or will receive finish materials. Make tight connections between members. Install fasteners without splitting wood; predrill as required.

3.2 WOOD BLOCKING AND NAILER INSTALLATION

A. Install where indicated and where required for attaching other work. Form to shapes indicated and cut as required for true line and level of attached work. Coordinate locations with other work involved.

B. Attach items to substrates to support applied loading. Recess bolts and nuts flush with surfaces, unless otherwise indicated. Build anchor bolts into masonry during installation of masonry work. Where possible, secure anchor bolts to formwork before concrete placement.

3.3 PLYWOOD BACKING PANELS

Fastening Methods: Screw to cold-formed metal framing or concrete masonry unit walls.

3.4 WOOD FRAMING INSTALLATION, GENERAL

A. Framing Standard: Comply with AFPA's "Manual for Wood Frame Construction," unless otherwise indicated.

B. General: Arrange studs so wide face of stud is perpendicular to direction of wall or partition and narrow face is parallel. Provide single bottom plate and double top plates using members of 2-inch nominal thickness whose widths equal that of studs, except single top plate may be used for non-load-bearing partitions. Anchor or nail plates to supporting construction, unless otherwise indicated.

C. Construct comers and intersections with three or more studs. Provide blocking and framing as indicated and as required to support facing materials, fixtures, specialty items, and trim.

D. Frame openings with multiple studs and headers. Provide nailed header members of thickness equal

to width of studs. Set headers on edge and support on jamb studs.

3.5 CEILING JOIST FRAMING INSTALLATION

A. Ceiling Joists: Install ceiling joists with crown edge up and complying with requirements specified above for floor joists. Face nail to ends of parallel rafters.

B. Provide collar beams (ties) as indicated or, if not indicated, provide I-by-6-inch nominal- size boards between every third pair of rafters, but not more than 48 inches o.c. Locate below ridge member, at third point of rafter span. Cut ends to fit roof slope and nail to rafters.

C. Provide special framing as indicated for eaves, overhangs, dormers, and similar conditions, if any.

3.6 PROTECTION

A. Protect wood that has been treated with inorganic boron (SBX) from weather. If, despite protection, inorganic boron-treated wood becomes wet, apply EP A-registered borate treatment. Apply borate solution by spraying to comply with EP A-registered label.

B. Protect rough carpentry from weather. If, despite protection, rough carpentry becomes wet, apply EP A-registered borate treatment. Apply borate solution by spraying to comply with EP A-registered label.

END OF SECTION

# SECTION 061600

# SHEATHING

## PART 1 - GENERAL

1.1 RELATED DOCUMENTS

Drawings and general provisions of the Contract, including General and Supplementary Conditions and Division 01 Specification Sections, apply to this Section.

1.2 SUMMARY

A. This Section includes the following:

1. Wall sheathing.
2. Roof sheathing.
3. Building wrap.
4. Flexible flashing at openings in sheathing.

B. Related Sections include the following:

1. Division 06 Section "Rough Carpentry" for plywood backing panels.
2. Division 07 Section "Metal Roof Panels" for underlayment materials over plywood sheathing.

1.3 SUBMITTALS

A. Product Data: For each type of process and factory-fabricated product. Indicate component materials and dimensions and include construction and application details.

1. Include data for wood-preservative treatment from chemical treatment manufacturer and certification by treating plant that treated plywood complies with requirements. Indicate type of preservative used and net amount of preservative retained.
2. Include data for fire-retardant treatment from chemical treatment manufacturer and certification by treating plant that treated plywood complies with requirements. Include physical properties of treated materials.
3. For products receiving a waterborne treatment, include statement that moisture content of treated materials was reduced to levels specified before shipment to Project site.
4. Include copies of warranties from chemical treatment manufacturers for each type of treatment.
5. For building wrap, include data on air-/moisture-infiltration protection based on testing according to referenced standards.

C. Compliance Certificates:

1. For lumber that is not marked with grade stamp.
2. For preservative-treated wood that is not marked with treatment quality mark.
3. For fire-retardant-treated wood that is not marked with classification marking of testing and inspecting agency.

1.4 QUALITY ASSURANCE

A. Fire-Test Response Characteristics:

1. For assemblies with fire-resistance ratings, provide materials and construction identical to those of assemblies tested for fire resistance per ASTM E 119 by a testing and inspecting agency acceptable to authorities having jurisdiction.

2. Fire-Resistance Ratings: Indicated by design designations from UL's "Fire Resistance Directory".

1.5 DELIVERY, STORAGE , AND HANDLING

Stack plywood and other panels flat with spacers between each bundle to provide air circulation. Provide for air circulation around stacks and under coverings.

## PART 2 – PRODUCTS

2.1 WOOD PANEL PRODUCTS, GENERAL

A. Plywood: Eigher DOC PS 1 or DOC PS 2, unless otherwise indicated.

B. Thickness: As needed to comply with requirements specified, but not less than thickness indicated.

C. Factory mark panels to indicate compliance with applicable standard.

2.2 PRESERVATIVE-TREATED PLYWOOD

A. Preservative Treatment by Pressure Process: A WPA C9

B. Preservative Chemicals: Acceptable to authorities having jurisdiction and containing no arsenic or chromium.

C. Mark plywood with appropriate classification marking of an inspection agency acceptable to authorities having jurisdiction.

D. Application: Treat all plywood sheathing, unless otherwise indicated.

2.3 FIRE-RETARDANT-TREATED PLYW00D

A. General: Comply with performance requirements in A APA C27.

1. Use treatment that does not promote corrosion of metal fasteners.

2. Use Exterior type for exterior locations and where indicated.

3. Use Interior Type A, unless otherwise indicated.

B. Kiln-dry material after treatment to a maximum moisture content of 15 percent. Do not use material that is warped or does not comply with requirements for untreated material.

C. Identify fire-retardant-treated plywood with appropriate classification marking of UL, U.S. Testing, Timber Products Inspection, or another testing and inspection agency acceptable to authorities having jurisdiction.

D. Application:

1. Treat all plywood sheathing, unless otherwise indicated.

2. Subflooring and underlayment for raised platforms.

2.4 WALL SHEATHING

A. Glass-Mat Gypsum Wall Sheathing: ASTM C 1177/1177M.

1. Product: Subject to compliance with requirements, provide “Dens-Glass Gold” by G-P Gypsum Corporation.
2. Type and Thickness: Regular, ½ inch thick.
3. Size: 48 by 96 inches for vertical installation

2.5 ROOF SHEATHING

A. Plywood Roof Sheathing: Exterior, Structural I sheathing.
   1. Span Rating: Not less than 24/0.
   2. Nominal Thickness: Not less than 15/32 inch

2.6 SUBFLOORING AND UNDERLAYMENT

A. Plywood Subflooring:
   1. Exterior single-floor panels or sheathing.
   2. Nominal Thickness: Not less than 23/32 inch.
B. Vapor Retarder: ASTM D 4397, polyethylene sheet not less than 6.0 mils thick.

2.7 FASTENERS

A. General: Provide fasteners of size and type indicated that comply with requirements specified in this Article for material and manufacture. For roof and wall sheathing, provide fasteners with hot-dip zinc coating complying with ASTM A 153.
B. Nails, Brads, and Staples: ASTM F 1667.
C. Power-Driven Fasteners: NES NER-272
D. Wood Screws: SAME B18.6.1.
E. Screws for Fastening Wood Structural Panels to Cold-Formed Metal Framing:
   1. ASTM C954, except with wafer heads and reamer wings, length as recommended by screw manufacturer for material being fastened.
   2. For wall and roof sheathing panels, provide screws with organic-polymer or other corrosion-protective coating having a salt-spray resistance of more than 800 hours according to ASTM B 117.
F. Screws for Fastening Gypsum Sheathing to Cold-Formed Metal Framing:
   1. Steel drill screws, in length recommended by sheathing manufacturer for thickness of sheathing board to be attached, with organic-polymer or other corrosion-protective coating having a salt-spray resistance of more than 800 hours according to ASTM B 117.
   2. For steel framing less than 0.0329 inch thick, attach sheathing to comply with ASTM C 1002.

2.8 WEATHER-RESISTANT SHEATHING PAPER

A. Building Wrap: ASTM E 1677, Type 1 air retarder; with flame-spread and smoke-developed indexes of less than 25 and 450, respectively, when tested according to ASTM E 84; UV stabilized; and acceptable to authorities having jurisdiction.
   1. Available Products: Subject to compliance with requirements, products that may be incorporated into the Work include, but are not limited to, the following:

a. Dow Chemical Company (The); Styrofoam Weathermate Plus Brand Housewrap.

b. DuPont (E. I. Du Pont de Nemours and Company); Tyvek Commercial Wrap.

2. Water-Vapor Permeance: Not less than 63 g through 1 sq. m of surface in 24 hours per ASTM E 96, Desiccant Method (Procedure).

3. Allowable UV Exposure Time: Not less than three months.

B. Building-Wrap Tape: Pressure-sensitive plastic tape recommended by building-wrap manufacture for sealing joints and penetrations in building wrap.

2.9 SHEATHING JOINT-AND-PENETRATION TREATMENT MATERIALS

A. Sealant for Glass-Mat Gypsum Sheathing Board: Silicone emulsion sealant complying with ASTM C 834, compatible with sheathing tape and sheathing, and recommended by tape and sheathing manufacturers for use with glass-fiber sheathing tape and for covering exposed fasteners.

B. Sheathing Tape for Glass-Mat Gypsum Sheathing Board: Self-adhering glass-fiber tape, minimum 2 inches wide, 10 by 10 or 10 by 20 threads/inch, of type recommended by sheathing and tape manufacturers for use with silicone emulsion sealant in sealing joints in glass-mat gypsum sheathing board and with a history of successful in-service use.

2.10 MISCELLANEOUS MATERIALS

A. Adhesives for Field Gluing Panels to Framing:

1. Formulation complying with ASTM D 3498 that is approved for use with type of construction panel indicated by manufacturers of both adhesives and panels.

2. Use adhesives that have a VOC content of 70 g/L or less when calculated according to 40 CFR 59, Subpart D (EPA Method 24).

B. Flexible Flashing: Composite, self-adhesive, flashing product consisting of a pliable, rubberized-asphalt compound, bonded to a high-density, cross-laminated polyethylene film to produce an overall thickness of not less than 0.025 inch.

1. Available Products: Subject to compliance with requirements, products that may be incorporated into the Work include, but are not limited to, the following:

a. Carlisle Coatings & Waterproofing; CCW-705-TWF Thru-Wall Flashing.

b. Grace Construction Products, a unit of W. R. Grace & Co. – Conn.; Vycor Plus Self-Adhered Flashing.

C. Primer for Flexible Flashing: Product recommended by manufacturer of flexible flashing for substrate.

## PART 3 – EXECUTION

3.1 INSTALLATION, GENERAL

A. Do not use materials with defects that impair quality of shea5thing or pieces that are too small to use with minimum number of joints or optimum joint arrangement.

B. Cut panels at penetrations, edges, and other obstructions of work; fit tightly against abutting construction, unless otherwise indicated.

C. Securely attach to substrate by fastening as indicated, complying with the following:

1. NES NER-272 for power-drive fasteners.
2. Table 2306.1, “Fastening Schedule,” in SBCCI’s “Standard Building Code:”.

D. Use common wire nails, unless otherwise indicated. Select fasteners of size that will not fully penetrate members where opposite side will be exposed to view or will receive finish materials. Make tight connections. Install fasteners without splitting wood.

E. Coordinate wall and roof sheathing installation with flashing and joint-sealant installation so these materials are installed in sequence and manner that prevent exterior moisture from passing through completed assembly.

F. Do not bridge building expansion joints; cut and space edges of panels to match spacing of structural support elements.

G. Coordinate sheathing installation with installation of materials installed over sheathing so sheathing is not exposed to precipitation or left exposed at end of the workday when rain is forecast.

3.2 WOOD STRUCTURAL PANEL INSTALLATION

A. General: Comply with applicable recommendations in ATA Form No. E30S, “Engineered Wood Construction Guide,” for types of structural-use panels and applications indicated.

B. Fastening Methods: Fasten panels as indicated below:

1. Roof Sheathing:
   a. Nail to wood framing. Apply a continuous bead of glue to framing members at edges of wall sheathing panels.
   b. Screw to cold-formed metal framing.
   c. Space panels 1/8 inch apart at edges and ends.

3.3 GYPSUM SHEATHING INSTALLATION

A. Comply with GA-253 and with manufacturer’s written instructions.

1. Fasten gypsum sheathing to cold-formed metal framing with screws.
2. Install boards with 3/8-inch gap where non-load-bearing construction abuts structural elements.

B. Apply fasteners so heads bear tightly against face of sheathing boards but do not cut into facing.

C. Vertical Installation: Install board vertical edges centered over studs. Abut ends and edges of each board with those of adjacent boards. Attach boards at perimeter and within field of board to each stud.

1. Space fasteners approximately 8 inches o.c. and set back a minimum of 3/8 inch from edges and ends of boards.
2. For sheathing under stucco cladding, boards may be initially tacked in place with screws if overlying self-furring metal lath is screw-attached through sheathing to studs immediately after sheathing is installed.

3.4 WEATHER-RESISTANT SHEATHING-PAPER INSTALLATION

A. General: Cover sheathing with weather-resistant sheathing paper as follows:

1. Cut back barrier ½ inch on each side of the break in supporting members at expansion- or control-

joint locations.

2. Apply barrier to cover vertical flashing with a minimum 4-inch overlap, unless otherwise indicated.

B. Building Wrap: Comply with manufacturer's written instructions.

1. Seal seams, edges, fasteners, and penetrations with tape.

2. Extend into jambs of openings and seal corners with tape.

3.5 SHEATHING JIONT-AND-PENETRATION TREATMENT

A. Seal sheathing joints according to sheathing manufacturer's written instructions.

1. Apply elastomeric sealant to joints and fasteners and trowel flat. Apply sufficient quantity of sealant to completely cover joints and fasteners after troweling. Seal other penetrations and openings.

2. Apply glass-fiber sheathing tape to glass-mat gypsum sheathing board joints, and apply and trowel silicone emulsion sealant to embed entire face of tape in sealant. Apply sealant to exposed fasteners wit a trowel so fasteners are completely covered. Seal other penetrations and openings.

3.6 FLEXIBLE FLASHING INSTALLATION

A. Apply flexible flashing where indicated to comply with manufacturers written instructions.

1. Prime substrates as recommended by flashing manufacturer.

2. Lap seams and junctures with other materials at least 4 inches, except that at flashing flanges of other construction, laps need not exceed flange width.

3. Lap flashing over weather-resistant building paper at bottom and sides of openings.

4. After flashing ahs been applied, roll surfaces with a hard rubber or metal roller to ensure that flashing is completely adhered to substrates.

3.7 PROTECTION

Paper-Surfaced Gypsum Sheathing: Protect sheathing by covering exposed exterior surface of sheathing with weather-resistant sheathing paper securely fastened to framing. Apply covering immediately after sheathing is installed.

END OF SECTION

SECTION 06400

ARCHITECTURAL WOODWORK

## PART 1 – GENERAL

### 1.1 RELATED DOCUMENTS:

A. Drawings and general provisions of Contract, including General and Supplementary Conditions and Division-1 Specification sections, apply to work of this section.

B. Related work specified elsewhere includes:

.. Section 06100 – "Rough Carpentry"
.. Section 06200 – "Finish Carpentry"
.. Section 07900 – "Joint Sealers"
.. Section 09900 – "Painting"

### 1.2 DESCRIPTION OF WORK:

A. Extent of each type of architectural woodwork is indicated on drawings and in schedules.

B. Types of architectural woodwork include the following, and related work and trim:

1. Plastic Laminate cabinets and solid surface countertops.

2. Hardware for architectural woodwork.

C. Architectural woodwork and components are intended to be finish painted on-site, under Section 09900.

### 1.3 QUALITY ASSURANCE:

A. AWI Quality Standard: Comply with applicable requirements of "Architectural Woodwork Quality Standards" published by the Architectural Woodwork Institute (AWI), except as otherwise indicated.

B. Fabricator Qualifications: Fabricators shall be experienced firms specializing in the types of architectural woodwork required for this project for at least 5 verifiable years and on at least 5 verifiable projects of similar size, scope, complexity, and quality of this project.

C. Installer Qualifications: Arrange for installation of architectural woodwork by a firm which can demonstrate at least 5 verifiable years successful experience in installing architectural woodwork items on at least 5 verifiable projects, similar in type and quality to those required for this project.

D. Refer to Section 01015 – "Special Conditions," for additional information and minimum experience requirements.

### 1.4 SUBMITTALS:

A. Shop Drawings: Submit shop drawings showing location of each item, dimensioned plans and elevations, large scale details, attachment devices and other components.

1. Manufacturer's current and complete product data, for manufactured units of work including color selection data and samples; and design load capacities for wood columns, and their plinths and anchorage systems.

B. Samples: Submit the following samples:

1. Lumber and panel products with or for transparent finish; 6-inches x ¾-inch x 18-inches, for each species and cut, finished on 1 side and 1 edge.

2. Lumber and panel products with factory-applied opaque finish, 8-inches x 10-inches, for each finish system and color.

3. Exposed Cabinet Hardware Support Hardware: One unit of each type and finish, which will be returned for use on the project, upon request by the Contractor.

## 1.5 DELIVERY, STORAGE AND HANDLING:

A. Protect woodwork during transit, delivery, storage and handling to prevent damage, soiling and deterioration.

B. Do not deliver woodwork, until painting, wet work, grinding and similar operations which could damage, soil or deteriorate woodwork have been completed in installation areas. If, due to unforeseen circumstances, woodwork must be stored in other than installation areas, store only in areas meeting requirements specified for installation areas.

## 1.6 PROJECT CONDITIONS:

A. Conditioning: Woodwork Manufacturer and Installer shall advise Contractor of temperature and humidity requirements for woodwork installation and storage areas. Do not install woodwork until required temperature and relative humidity have been stabilized and will be maintained in installation areas.

B. Maintain temperature and humidity in installation area as required to maintain moisture content of installed woodwork within a 1.0% tolerance of optimum moisture content, from date of installation through remainder of construction period. Require Woodwork Manufacturer to establish optimum moisture content and required temperature and humidity conditions.

# PART 2 – PRODUCTS

## 2.1 ACCEPTABLE MANUFACTURERS:

A. Cabinet Manufacturers: Subject to compliance with requirements, provide premium grade custom made cabinets and woodwork from a millwork shop complying with requirements of “Quality Assurance” article above.

B. Plastic Laminate Manufacturer: Subject to compliance with requirements, provide solid, stippled, textured, and/or patterned high pressure decorate laminates of one of the following:

1. Corian (color to be determined) – Solid Surface Counter Tops
2. Equal Manufacturers acceptable – Submit to architect for review.

## 2.2 FABRICATION GENERAL:

A. Wood Moisture Content: Comply with requirements of referenced quality standard for moisture content of lumber at time of fabrication and for relative humidity conditions in the installation areas.

B. Fabricate woodwork to dimensions, profiles, and details indicated with dowel, dado, glue and screw construction, with openings and mortises precut, where possible, to receive hardware and other items and work.

1. Ease edges to a 1/16-inch radius, for corners of cabinets and edges of solid wood (lumber) members less than 1-inch in nominal thickness, 1/8-inch radius for edges of rails and similar members over 1-inch in nominal thickness.

C. Complete fabrication, assembly, hardware application, and other work before shipment to project site to maximum extent possible. Disassemble components only as necessary for shipment and installation. Where necessary for fitting at site, provide ample allowance for scribing, trimming, and fitting.

D. Pre-Cut Openings: Fabricate architectural woodwork with pre-cut openings, where possible, to receive hardware, appliances, plumbing fixtures, electrical work and similar items. Locate openings accurately and use templates or roughing-in diagrams for proper size and shape. Smooth edges of cutoffs and, where located in countertops and similar exposures seal edges of cutouts with a water-resistant coating.

E. Measurements: Before proceeding with fabrication of woodwork required to be fitted to other construction, obtain field measurements and verify dimensions and shop drawing details as required for accurate fit. A tight fit of less than 1/8-inch is expected.

## 2.3 FIRE-RETARDANT MATERIALS:

A. Where fire-retardant treated lumber is indicated, provide materials which are pressure impregnated with fire-retardant chemicals and comply with the following requirements:

1. As required to comply with referenced standards and finish classifications necessary as per the Standard Building Code, NFPA 101 – Life Safety Code, authorities having jurisdiction, and acceptable in all respects for indoor use and finish requirements.

2. Fire-Retardant Chemicals: Use chemicals of type and for applications indicated which do not bleed-through or otherwise adversely affect finishes. Do not use colorants in solution to distinguish treated lumber from untreated lumber.

B. Fire Performance Characteristics: Provide materials which are identical to those tested per ASTM methods and time periods indicated, are marked and listed for fire performance characteristics by Underwriters Laboratories, Inc., or other testing and inspecting agency acceptable to authorities having jurisdiction, and comply with the following requirements:

1. Mill lumber after treatment, within limits set for wood removal which does not affect listed fire performance characteristics, using a woodworking plant certified by testing and inspecting agency.

C. Marking: Identify treated lumber with separable paper classification marking of inspecting and testing agency, unless otherwise indicated.

D. Surface Burning Characteristics: Not exceeding values required by latest edition of the “Standard Building Code” and “NFPA 101” (with amendments), tested per ASTM E 84 for standard time period.

1. Flame Spread: Per Code.

2. Smoke Developed: Per Code.

E. Kiln-dry woodwork after treatment to levels required for non-fire-retardant treated woodwork materials. Maintain moisture content required by kiln drying, before and after treatment.

1. Discard treated lumber which does not comply with requirements of referenced woodworking standard. Do not use twisted, warped, bowed, discolored, or otherwise damaged or defective lumber.

## 2.4 STANDING AND RUNNING TRIM, AND SILLS:

A. Quality Standard: Comply with AWI Section 300.

B. Rout or groove backs of flat trim members, kerf backs of other wide flat members, except for members with ends exposed in finished work.

C. Assemble Casings in plant except where limitations of access to place of installation require field assembly.

D. Interior Trim and Sills for Transparent Finish (only where specifically indicated, if any). Comply with the following requirements:

1. Grade: Premium.

2. Lumber Species: White or Yellow Poplar.

3. Locations: Provide stained transparent finish within rooms which have new woodwork with transparent finish, and all other exposed locations, unless indicated otherwise.

E. Interior Trim and Sills for Opaque Finish (typical finish unless specifically indicated otherwise). Comply with the following requirements.

1. Grade: Premium.

2. Lumber Species: Any closed-grain hardwood listed in referenced woodworking standard.

3. Locations: Provide opaque finish within rooms which have new woodwork with opaque finish, unless indicated otherwise.

## 2.5 ARCHITECTURAL CABINET TOPS:

A. Quality Standard: Comply with applicable 400 and its Divisions 400B and 400C.

B. Type of Top – Solid Surface:

A. Solid polymer components

1. Cast, nonporous, filled polymer, not coated, laminated or of composite construction with through body colors meeting ANSI Z124.3 or ANSI Z124.6, having minimum physical and performance properties specified.

2. Superficial damage to a depth of 0.010 inch (.25 mm) shall be repairable by sanding and/or polishing.

3. Thickness: 3 cm

4. Edge treatment: Beveled

5. Color: To be selected from standard color palette.

## 2.6 CABINET HARDWARE AND ACCESSORY MATERIALS:

A. General: Provide cabinet hardware and accessory materials associated with architectural cabinets, except for items which are specified in Division-8 Section 08700 – "Finish Hardware."

B. Cabinet Hardware Schedule: Refer to schedule at end of this Section for cabinet hardware required for architectural cabinets.

C. Hardware Standard: Comply with ANSI/BHMA A156.9 "American National Standard for Cabinet Hardware" for items indicated by reference to BHMA numbers or referenced to this standard.

D. Hardware Finishes: Comply with BHMA 1301 for finishes indicated by BHMA Code Numbers or it not otherwise indicated, provide finishes complying with requirements indicated.

1. For exposed hardware comply with requirements indicated for finish and base indicated at the end of this Section 06400.

2. For concealed hardware provide manufacturer's standard brushed chrome or brass finish with complies with product class requirements of ANSI/BHMA A156.9, and to match exposed hardware on same cabinet unit.

## 2.7 FASTENERS AND ANCHORS:

A. Screws: Select material, type, size and finish required for each use. Comply with FS FF-S-11 for applicable requirements.

B. Nails: Select material, type, size and finish required for each use. Comply with FS FF-N-105 for applicable requirements.

C. Anchors: Select material, type, size and finish required by each substrate for secure anchorage. Provide non-ferrous metal or hot-dip galvanized anchors and inserts for exterior installations and elsewhere as required for corrosion-resistance. Provide toothed steel or lead expansion bolt devices for drilled-in-place anchors. Furnish inserts and anchors, as required, to be set into concrete or masonry work for subsequent woodwork anchorage.

## 2.8 FINISHING OF INTERIOR ARCHITECTURAL WOODWORK:

A. Quality Standard: Comply with AWI Section 1500, unless otherwise indicated.

B. Preparation for Finishing: Comply with referenced quality standard for sanding, filling countersunk fasteners, sealing of concealed surfaces and similar preparations for finishing of architectural woodwork, as applicable to each unit of work.

## 2.9 INTERIOR FRAMES AND JAMBS FOR OPAQUE FINISH (if any):

A. Quality Standard: Comply with AWI Section 900.

1. Grade: Premium.

B. Wood Species: Any closed-grain hardwood listed in referenced woodworking standard.

## PART 3 – EXECUTION

### 3.1 PREPARATION:

A. Condition woodwork to average prevailing humidity conditions in installation areas prior to installing.

B. Pre-Installation Meeting: Meet at project site prior to delivery of architectural woodwork and review coordination and environmental controls required for proper installation and ambient conditioning in areas to receive work. Include in meeting the Contractor; Architect and other Owner Representatives (if any);; Installers of architectural woodwork, we work such as plastering, other finishes, painting, mechanical work and electrical work; and firms or persons responsible for continued operation (whether temporary or permanent) of HVAC system as required to maintain temperature and humidity conditions. Proceed with woodwork installation only when everyone concerned agrees that required ambient conditions can be maintained.

C. Deliver concrete inserts and similar anchoring devices to be built into substrates, well in advance of time substrates are to be built.

1. Coordinate location and placement of concealed treated blocking (by others) prior to finish materials installations.

D. Prior to installation of architectural woodwork, examine shop fabricated work for completion, and complete work as required, including back priming and removal of packing.

### 3.2 INSTALLATION:

A. Quality Standard: Install woodwork to comply with AWI Section 1700 for the same grade specified in Part 2 of this Section for type of woodwork involved.

B. Install woodwork plumb, level, true and straight with no distortions. Shim as required using concealed shims. Install to a tolerance of 1/8-inch in 8'-0" for plumb and level (including tops); and with no variations in flushness of adjoining surfaces.

C. Scribe and cut woodwork to fit adjoining work, and refinish cut surfaces or repair damaged finish at cuts.

1. Seal all hardware cuts, routed slots, etc., before installation of hardware.

D. Anchor woodwork to anchors or blocking built-in directly attached to substrates. Secure to grounds, stripping and blocking with countersunk, concealed fasteners and blind nailing as required, use fine finishing nails for exposed nailing, countersunk and filled flush with woodwork, and matching final finish where transparent finish is indicated.

E. Standing and Running Trim, and Sills: Install with maximum number of joints possible, using full-length pieces (from maximum length of lumber available) to the greatest extent possible. Stagger joints in adjacent and related members. Cope at returns, miter at corners and comply with referenced Quality Standards for joinery.

F. Cabinets: Install without distortion so that doors and drawers fit openings properly and are accurately aligned. Adjust hardware to center doors and drawers in openings and to provide unencumbered operation. Complete the installation of hardware and accessory items as indicated. Maintain veneer sequence matching (if any) of cabinets with transparent finish.

1. Install cabinets with no more than 1/8-inch in 96-inches sag, bow, or other variation from a straight line.

G. Wood Storage Shelving: Complete the assembly of units and install in the areas indicated, including hardware and accessories as indicated.

H. Tops: Anchor securely to base units and other support systems indicated. Caulk space between backsplash and wall with specified sealant.

1. Install countertops with no more than 1/8-inch in 96-inches sag, bow, or other variation from a straight line.

I. Wood Panels: Anchor panels to supporting substrate with concealed panel-hanger clips and by blind nailing on backup strips, splined-connection strips, and similar associated trim and framing. Do not face nail unless otherwise indicated.

1. Install flush panels with no more than 1/16-inch in 96-inches vertical cup or bow and 1/8-inch in 96-inches horizontal variation from a true plane.

J. Refer to Section 09900 – "Painting," for final finishing of installed architectural woodwork.

## 3.3 ADJUSTMENT, CLEANING, FINISHING AND PROTECTION:

A. Repair damaged and defective woodwork where possible to eliminate defects functionally and visually; where not possible to repair replace woodwork. Adjust joinery for uniform appearance.

B. Clean, lubricate and adjust hardware.

C. Clean woodwork on exposed and semi-exposed surfaces. Touch-up shop-applied finishes to restore damaged or soiled areas.

D. Complete the finishing work specified as work of this Section, to whatever extent not completed at shop or prior to installation of woodwork.

E. Provide final protection and maintain conditions, in a manner acceptable to Fabricator and Installer, which ensures architectural woodwork being without damage or deterioration at time of substantial completion.

## 3.4 CABINET HARDWARE SCHEDULE:

A. General: Subject to requirements and finishes stated above, furnish the following items in quantities and at locations indicated, by named manufacturers or equivalent products acceptable to Architect.

1. Cabinet Hinges: 170$^{o}$ adjustable "CLIP System" concealed self-closing hinges as manufactured by Julius Blum, Inc., or equivalent by Grass or Stanley.

B. Cabinet Door and Drawer Pulls:

1. Wire pulls, equivalent to Stanley No. 4484, solid brass (ANSI B12012), 4-inches long, with 1-inch clearance. Finish to match Section 08710 – "Finish Hardware" finish in room(s) where occurs.

C. Cabinet Door Catches: Manufacturer's standard 2-screw sill mounted unit made of molded nylon, lipped over sill to form bumper and hold in place, with 2-screw mounted heavy door mounted unit with nylon roller; provide spring-mounted units where required.

1. Acceptable Manufacturers: Any of manufacturer's listed for other cabinet hardware.

D. Drawer Slides: Heavy Duty, non-corrosive (galvanized) full extension ball bearing slides rated at 100-pounds, with positive stop, and self-closing and lift-out disconnect features; Model NO. 1429, as manufactured by Knape & Vogt, or equivalent by Blum or Grant.

1. At legal size drawers, use K&V No. 1483 or equivalent, rated at 150-pounds, with same features as noted above.

E. Shelf Standards: Manufacturer's standard steel units with anchors and supports 5/8-inch wide x 3/16-inch high, adjustable on ½-inch centers; Series 255, as manufactured by K&V, or equivalent by Grant or Stanley.

1. Wood Cabinets: Model No. 255 BRN with No. 256 BRN supports and matching fasteners.

2. Omit standards where fixed shelves are indicated.

3. All standards to be recess mounted (flush in routed dados), unless specifically indicated otherwise.

F. Locks: Where indicated on the Drawings, provide cabinet manufacturer's standard 5-disc tumbler, cam type, keyed differently at each room and at each room and at each teller station, and master keyed.

1. Furnish 2 keys for each lock.

2. Furnish 5 master keys.

3. Finish to match Section 08710 – "Finish Hardware" finish in room(s) where occurs.

END OF SECTION

SECTION 072100

THERMAL INSULATION

## PART 1- GENERAL

1.1 RELATED DOCUMENTS

Drawings and general provisions of the Contract, including General and Supplementary Conditions and Division 1 Specification Sections, apply to this Section.

1.2 SUMMARY

A. This Section includes the following:

1. Sound attenuation insulation.
2. Concealed building insulation.

B. Related Sections include the following:

1. Division 07 Section "Ethylene-Propylene-Diene-Monomer (EPDM) Roofing" for insulation specified as part of roofing construction.
2. Division 07 Section "Fire-Resistive Joint Systems" for insulation installed as part of a perimeter fire-resistive joint system.
3. Division 21 Section "Fire-Suppression Systems Insulation" .
4. Division 22 Section "Plumbing Insulation".
5. Division 23 Section "HVAC Insulation".

1.3 DEFINITIONS

Mineral-Fiber Insulation: Insulation composed of rock-wool fibers, slag-wool fibers, or glass fibers; produced in boards and blanket with latter formed into batts (flat-cut lengths) or rolls.

1.4 SUBMITTALS

A. Product Data: For each type of product indicated.

B. Product Test Reports: Based on evaluation of comprehensive tests performed by a qualified testing agency, for insulation products.

C. Research Evaluation Reports: For foam-plastic insulation.

1.5 QUALITY ASSURANCE

A. Source Limitations: Obtain each type of building insulation through one source.!

B. Fire-Test-Response Characteristics: Provide insulation and related materials with the fire-test-response characteristics indicated, as determined by testing identical products per test method indicated below by UL or another testing and inspecting agency acceptable to authorities having jurisdiction. Identify materials with appropriate markings of applicable testing and inspecting agency.

1. Surface-Burning Characteristics: ASTM E 84.
2. Fire-Resistance Ratings: ASTM E 119.
3. Combustion Characteristics: ASTM E 136.

1.6 DELIVERY, STORAGE, AND HANDLING

Protect insulation materials from physical damage and from deterioration by moisture, soiling, and other sources. Store inside and in a dry location. Comply with manufacturer's written instructions for handling, storing, and protecting during installation.

## PART 2 - PRODUCTS

2.1 MANUFACTURERS

A. Available Manufacturers: Subject to compliance with requirements, manufacturers offering glass-fiber insulation products that may be incorporated into the Work include, but are not limited to, the following:

1. CertainTeed Corporation.
2. Johns Manville Corporation.
3. Knauf Fiber Glass.
4. Owens Coming.

2.2 INSULATING MATERIALS

A. General: Provide insulating materials that comply with requirements and with referenced standards. Preformed Units: Sizes to fit applications indicated; selected from manufacturer's standard thicknesses, widths, and lengths.

B. Sound Attenuation Insulation (Unfaced Mineral-Fiber Blanket Insulation):
ASTM C 665, Type I (blankets without membrane facing); consisting of fibers manufactured from glass; with maximum flame-spread and smoke-developed indices of 25 and 50, respectively; passing ASTM E 136 for combustion characteristics.

C. Concealed Building Insulation (Faced Mineral-Fiber Blanket Insulation):
ASTM C 665, Type III (blankets with reflective membrane facing), Class A (membrane-faced surface with a flame spread of25 or less); Category 1 (membrane is a vapor barrier), faced with foil-scrim-kraft, foil-scrim, or foil-scrim-polyethylene vapor retarder membrane on one face; consisting of fibers manufactured from glass.

D. Open Cell Spray Foam Insulation: Two-component, polyurethane cellular foam with a nominal density of 0.5 pcf. Foam shall have the following minimum physical properties when cured:

1. Apparent Density: 0.5 pcf when tested in accordance with ASTM D 1622.
2. R-Value (aged) when tested in accordance with ASTM C 518: 3.9 at 1 inch, 13 at 3.5 inches, 19 at 5.5 inches.
3. Oxygen Index: 25 when tested in accordance with ASTM D 2863.
4. Compressive Strength: 0.5 psi when tested in accordance with ASTM D 1621.
5. Fungi Resistance: Zero Rating when tested in accordance with ASTM G 21.
6. Air Leakage: Less than 0.02 (L/s)/m2 when tested in accordance with ASTM E 283.
7. Sound Transmission Coefficient: 51 (STC) when tested in accordance with ASTM E 90.
8. Noise Reduction Coefficient: 0.7 (NRC) when tested in accordance with ASTM C 423.
9. Open Cell Content: Greater than 90 percent when tested in accordance with ASTM D 2846.
10. Tensile Strength: Less than 5 psi when tested in accordance with ASTM D 1623.
11. Shear Strength: 1.4 psi when tested in accordance with ASTM C 273.
12. Permeability: 21 perm-inch when tested in accordance with ASTM E 96.

13. Dimensional Stability: Less than 15 percent change in volume when tested in accordance with ASTM D 2126.
14. Surface Burning Characteristics:

    a. Flame Spread/Smoke Developed: At maximum 4 inch (102 mm) thickness, flame spread index of less than 25 and a smoke developed index of less than 450 when tested in accordance with ASTM E 84.
    b. Corner Test: Thickness up to 12 inches (305 mm) for wall cavities and 16 inches for ceiling cavities meets NFPA 286 when covered with 1/2 inch (13 mm) gypsum board or equivalent thermal barrier.

2.3 AUXILIARY INSULATING MATERIALS

Adhesive for Bonding Insulation: Product with demonstrated capability to bond insulation securely to substrates indicated without damaging insulation and substrates.

## PART 3 - EXECUTION

3.1 EXAMINATION

A. Examine substrates and conditions, with Installer present, for compliance with requirements for Sections in which substrates and related work are specified and other conditions affecting performance.

B. Proceed with installation only after unsatisfactory conditions have been corrected.

3.2 PREPARATION

Clean substrates of substances harmful to insulations.

3.3 INSTALLATION, GENERAL

A. Comply with insulation manufacturer's written instructions applicable to products and application indicated.

B. Install insulation that is undamaged, dry, and unsoiled and that has not been left exposed at any time to ice and snow.

C. Extend insulation in thickness indicated to envelop entire area to be insulated. Cut and fit tightly around obstructions and fill voids with insulation. Remove projections that interfere with placement.

D. Water-Piping Coordination: If water piping is located on inside of insulated exterior walls, coordinate location of piping to ensure that it is placed on warm side of insulation and insulation encapsulates piping.

3.4 INSTALLATION OF GENERAL BUILDING INSULATION

A. Apply insulation units to substrates by method indicated, complying with manufacturer's written instructions. If no specific method is indicated, bond units to substrate with adhesive or use mechanical anchorage to provide permanent placement and support of units.

B. Set vapor-retarder-faced units with vapor retarder to warm side of construction, unless otherwise indicated. Do not obstruct ventilation spaces, except for fire stopping. Tape joints and ruptures in vapor retarder, and seal each continuous area of insulation to surrounding construction to ensure airtight installation.

C. Install mineral-fiber blankets in cavities formed by framing members according to the following requirements:

1. Use blanket widths and lengths that fill the cavities formed by framing members. If more than one length is required to fill cavity, provide lengths that will produce a snug fit between ends.
2. Place blankets in cavities formed by framing members to produce a friction fit between edges of insulation and adjoining framing members.
3. For metal-framed wall cavities where cavity heights exceed 96 inches, support unfaced blankets mechanically and support faced blankets by taping stapling flanges to flanges of metal studs.

3.5 INSTALLATION OF INSULATION IN CEILINGS FOR SOUND ATTENUATION

Install 3-inch-thick, unfaced glass-fiber blanket insulation over suspended ceilings at partitions in a width that extends insulation 48 inches on either side of partition.

3.6 PROTECTION

Protect installed insulation from damage due to harmful weather exposures, physical abuse, and other causes. Provide temporary coverings or enclosures where insulation is subject to abuse and cannot be concealed and protected by permanent construction immediately after installation.

END OF SECTION

SECTION 074113

METAL ROOF PANELS

## PART I-GENERAL

1.1 RELATED DOCUMENTS

Drawings and general provisions of the Contract, including General and Supplementary Conditions and Division 1 Specification Sections, apply to this Section.

1.2 SUMMARY

A. This Section includes factory-formed and field-assembled, standing-seam metal roof panels. Work of this section shall include gutters, downspouts, flashing, and trim associated with metal roofing system.

B. Metal roof panels products included in this section are to match existing, If product description does not match the existing product, verify requirements with the Architect.

C. Related Sections include the following:

1. Division 06 Section "Rough Carpentry" for plywood roof deck supporting metal roof panels.
2. Division 07 Section "Sheet Metal Flashing and Trim" for sheet metal work not part of metal roof panel assemblies.
3. Division 07 Section "Joint Sealants" for field-applied sealants not otherwise specified in this Section.

1.3 DEFINITIONS

A. Metal Roof Panel Assembly: Metal roof panels, attachment system components, flashing, gutters, downspouts, and accessories necessary for a complete weather tight roofing system.

B. Steel Sheet Thickness: Minimum thickness of base metal without metallic coatings or painted finishes..

1.4 PERFORMANCE REQUIREMENTS

A. General: Provide metal roof panel assemblies that comply with performance requirements specified as determined by testing manufacturers' standard assemblies similar to those indicated for this Project, by a qualified testing and inspecting agency.

B. Air Infiltration: Air leakage through assembly of not more than 0.06 cfm lsq. ft. of roof area when tested according to ASTM E 283 at the following test-pressure difference:

1. Test-Pressure Difference: Negative 1.57 lbf/sq. ft.
2. Positive Preload Test-Pressure Difference: Greater than or equal to 15.0 lbf/sq. ft. and the greater of 75 percent of building live load or 50 percent of building design positive wind-pressure difference.
3. Negative Preload Test-Pressure Difference: 50 percent of design wind-uplift pressure difference.

C. Water Penetration: No water penetration when tested according to ASTM E 331 at the following test-pressure difference:

1. Test-Pressure Difference: 2.86 lbf/sq. ft...
2. Positive Preload Test-Pressure Difference: Greater than or equal to 15.0 lbf/sq. ft. and the greater of75 percent of building live load or 50 percent of building design positive wind-pressure difference.

3. Negative Preload Test-Pressure Difference: 50 percent of design wind-uplift pressure difference.

D. Wind-Uplift Resistance: Provide metal roof panel assemblies that comply with UL 580 for wind-uplift resistance class indicated.

E. Thermal Movements: Provide metal roof panel assemblies that allow for thermal movements resulting from a temperature change (range) of 120 deg F, ambient temperature and 180 deg F. material surfaces temperature, by preventing buckling, opening of joints, overstressing of components, failure of joint sealants, failure of connections, and other detrimental effects. Base engineering calculation on surface temperatures of materials due to both solar heat gain and nighttime-sky heat loss.

1.5 SUBMITTALS

A. Product Data: Include construction details, material descriptions, dimensions of individual components and profiles, and finishes for each type of metal roof panel and accessory.

B. Shop Drawings: Show fabrication and installation layouts of metal roof panels; details of edge conditions, joints, panel profiles, comers, anchorages, trim, flashings, closures, and accessories; and special details. Distinguish between factory- and field-assembled works. Include roof plans, drawn to scale, for coordinating penetrations. Accessories: Include details of flashing, trim, gutters, and downspouts at a scale of not less than I1/2 inches per 12 inches.

C. Samples for Initial Selection: For each type of metal roof panel indicated with factory applied color finishes.

D. Samples for Verification: For each type of exposed finish required, prepared on 12 inch long by actual panel width Samples of metal roof panels and 12 inch long Samples of trim and accessories.

E. Qualification Data: For installer, professional engineer, and testing agency.

F. Field quality-control inspection reports.

G. Product Test Reports: Based on evaluation of comprehensive tests performed by a qualified testing agency, for metal roof panels. Include reports for air infiltration, water penetration, and structural performance.

H. Maintenance Data: For metal roof panels to include in maintenance manuals.

I. Warranties: Special warranties specified in this Section.

J. Meeting Record: Minutes of pre-installation conference.

1.6 QUALITY ASSURANCE

A. Installer Qualifications:

1. An employer of workers trained and approved by manufacturer.

2. Installer's responsibilities include fabricating and installing metal roof panel assemblies and providing professional engineering services needed to assume engineering responsibility.

B. Source Limitations: Obtain each type of metal roof panels through one source from a single manufacturer.

C. Pre-Installation Conference: Conduct conference at Project site to comply with requirements in Division 1 Section "Project Management and Coordination." Review methods and procedures related to metal roof panel assemblies including, but not limited to, the following:

1. Meet with Owner, Architect, Owner's insurer if applicable, testing and inspecting agency representative, metal roof panel Installer, metal roof panel manufacturer's representative, deck Installer, and installers whose work interfaces with or affects metal roof panels including installers of roof accessories and roof-mounted equipment ..
2. Review and finalize construction schedule and verify availability of materials, Installer's personnel, equipment, · and facilities needed to make progress and avoid delays.
3. Review methods and procedures related to metal roof panel instal1atio~ including manufacturer's written instructions.
4. Examine deck substrate conditions for compliance with requirements, including flatness and attachment to structural members.
5. Review structural loading limitations of deck during and after roofing.
6. Review flashings, special roof details, roof drainage, roof penetrations, and condition of other construction that will affect metal roof panels.
7. Review governing regulations and requirements for insurance, certificates, and testing and inspecting· if applicable.
8. Review temporary protection requirements for metal roof panel assembly during and after installation.
9. Review roof observation and repair procedures after metal roof panel installation.
10. Document proceedings, including corrective measures and actions required, and furnish copy of record to each participant.

1.7 DELIVERY, STORAGE, AND HANDLING

A. Deliver components, sheets, metal roof panels, and other manufactured items so as not to be damaged or deformed. Package metal roof panels for protection during transportation and handling.

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

C. Stack metal roof panels. on platforms or pallets, covered with 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.

D. Protect strippable protective covering on metal roof panels from exposure to sunlight and high humidity, except to extent necessary for period of metal roof panel installation.

1.8 PROJECT CONDITIONS

A. Weather Limitations: Proceed with installation only when existing and forecasted weather conditions permit assembly of metal roof panels to be performed according to manufacturers' written instructions and warranty requirements.

B. Field Measurements: Verify locations of roof framing and roof opening dimensions by field measurements before metal roof panel fabrication and indicate measurements on Shop Drawings.

C. Established Dimensions: Where field measurements cannot be made without delaying the Work, either establish framing and opening dimensions and proceed with fabricating metal roof panels without field

measurements, or allow for field-trimming of panels. Coordinate roof construction to ensure that actual building dimensions, locations of structural members, and openings correspond to established dimensions.

1.9 COORDINATION

A. Coordinate installation of roof penetrations.

B. Coordinate metal panel roof assemblies with rain drainage work, flashing, trim, and construction of decks, and other adjoining work to provide a leak proof, secure, and non-corrosive installation.

1.10 WARRANTY

A. General Warranty: Special warranties specified in this Article shall not deprive Owner of other rights Owner may have under other provisions of the Contract Documents and shall be in addition to, and run concurrent with, other warranties made by Contractor under requirements of the Contract Documents.

B. Special Warranty: Manufacturer's standard form in which manufacturer agrees to repair or replace components of metal roof panel assemblies that fail in materials or workmanship within specified warranty period.

1. Failures include, but are not limited to, the following:

a. Structural failures, including rupturing, cracking, or puncturing.

b. Deterioration of metals, metal finishes, and other materials beyond normal weathering.

2. Warranty Period: Two years from date of Substantial Completion.

C. Special Warranty on Panel Finishes: Manufacturer's standard form in which manufacturer agrees to repair finish or replace metal roof panels that show evidence of deterioration of factory-applied finishes within specified warranty period.

1. Fluor polymer Finish: Deterioration includes, but is not limited to, the following:

a. Color fading more than 5 Hunter units when tested according to ASTM D 2244.

b. Chalking in excess of a No.8 rating when tested according to ASTM D 4214.

c. Cracking, checking, peeling, or failure of paint to adhere to bare metal.

2. Finish Warranty Period: 20 years from date of Substantial Completion.

D. Special Weather Tightness Warranty for Standing-Seam Metal Roof Panels:

Manufacturer's standard form in which manufacturer agrees to repair or replace standing-seam metal roof panel assemblies that fail to remain weather tight, including leaks, within specified warranty period. Warranty period shall be 20 years from date of Substantial Completion.

## PART 2- PRODUCTS

2.1 PANEL MATERIALS

A. Metallic-Coated Steel Sheet Pre-painted with Coil Coating: Steel sheet metallic coated by the hot-dip process and pre-painted by the coil-coating process to comply with ASTM A 755.

1. Zinc-Coated (Galvanized) Steel Sheet: ASTM A 653, G90 coating designation; structural quality.

2. Surface: Smooth, flat finish.

3. Exposed Finish: Apply the following high-performance organic coil coating finish:

   a. Preparation: Prepare, pretreat, and apply coating to exposed metal surfaces to comply with coating and resin manufacturers' written instructions.

   b. Fluor polymer Two-Coat System: Manufacturer's standard two-coat, thermo cured system consisting of specially formulated inhibitive primer and fluoropolymer color topcoat containing not less than 70 percent polyvinylidene fluoride resin by weight; complying with physical properties and coating performance requirements of AAMA 2605, except as modified below:

      1) Humidity Resistance: 2000 hours.

      2) Salt-Spray Resistance: 2000 hours.

4. Concealed Finish: Apply pretreatment and manufacturer's standard white or light-colored acrylic or polyester backer finish, consisting of prime coat and wash coat with a minimum total dry film thickness of 0.5 mil.

B. Panel Sealants:

1. Sealant Tape: Pressure-sensitive, 100 percent solids, gray polyisobutylene compound sealant tape with release-paper backing. Provide permanently elastic, non-sag, nontoxic, non-staining tape 1/2 inch wide and 1/8 inch thick.

2. Joint Sealant: ASTM C 920; elastomeric polyurethane, polysulfide, or silicone sealant; of type, grade, class, and use classifications required to seal joints in metal roof panels and remain weather tight; and as recommended in writing by metal roof Panel manufacturer.

3. Butyl-Rubber-Based, Solvent-Release Sealant: ASTM C 1311.

2.2 UNDERLAYMENT MATERIALS

A. Self-Adhering, Polyethylene-Faced Sheet: ASTM D 1970, 40 mils thick minimum, consisting of slip-resisting polyethylene-film reinforcing and top surface laminated to SBS-modified asphalt adhesive, with release-paper backing; cold applied.

B. Basis-of-Design: The design for self-adhering, polyethylene-faced sheet is based on the "Grace Ice and Water Shield" manufactured by. Grace, W. R. & Co. Subject to compliance with requirements provides either the named product or a comparable product by other approved manufacturers.

2.3 MISCELLANEOUS MATERIALS

A. Fasteners: Self-tapping screws, bolts, nuts, self-locking rivets and bolts, end-welded studs, and other suitable fasteners designed to withstand design loads. Provide exposed fasteners with heads matching color of metal roof panels by means of plastic caps or factory-applied coating.

1. Fasteners for Roof Panels: Self-drilling or self-tapping, zinc-plated, hex-head carbon-steel screws, with a stainless-steel cap or zinc-aluminum-alloy head and EPDM or neoprene sealing washer.

2. Fasteners for Flashing and Trim: Blind fasteners or self-drilling screws with hex washer head.

3. Blind Fasteners: High-strength aluminum or stainless-steel rivets.

B. Bituminous Coating: Cold-applied asphalt mastic, SSPC-Paint 12, compounded for 15mil dry film thickness per coat. Provide inert-type non-corrosive compound free of asbestos fibers, sulfur components, and other deleterious impurities.

2.4 STANDING-SEAM METAL ROOF PANELS

A. General: Provide factory-formed metal roof panels designed to be field assembled by lapping and interconnecting raised side edges of adjacent panels with joint type indicated and mechanically attaching panels to supports using concealed clips in side laps. Include clips, cleats, pressure plates, and accessories required for weather tight installation. For steel panel systems, unless more stringent requirements are indicated, comply with ASTM E 1514.

B. Vertical-Rib, Seamed-Joint, Standing-Seam Metal Roof Panels: Formed with vertical ribs at panel edges and flat pan between ribs; designed for sequential installation by mechanically attaching panels to supports using concealed clips located under one side of panels and engaging opposite edge of adjacent panels, and mechanically seaming panels together.

1. Basis-of-Design Product: The design for metal roof panels is based on "MagnaLoc" as manufactured by Metal Sales Manufacturing Corporation. Subject to compliance with requirements, provide either the named product or a comparable product by one of the following:
   a. AEP-Span.
   b. Fabral, Inc.
   c. McElroy Metal, Inc.
   d. Metal Sales Manufacturing Corporation.
   e. Steelox Systems Inc.
2. Material: Zinc-coated (galvanized) steel sheet, 22 gage (0.0269 inches) thick.
   a. Exterior Finish: Fluor polymer.
   b. Color: As selected by Architect from manufacturer's full range.
3. Clips: Floating to accommodate thermal movement. Material shall be 0.0269-inch-thick, aluminum-zinc alloy-coated steel sheet.
4. Joint Type: Single folded.
5. Panel Coverage: 18 inches.
6. Panel Height: 2.0 inches.
7. Uplift Rating: UL 90.

2.5 ACCESSORIES

A. Roof Panel Accessories: Provide components required for a complete metal roof panel assembly including trim, fasciae, corner units, ridge closures, clips, flashings, sealants, gaskets, fillers, closure strips, and similar items. Match material and finish of metal roof panels, unless otherwise indicated.

1. Closures: Provide closures at eaves and ridges, fabricated of same metal as metal roof panels.
2. Clips: Minimum O.0625-inch- thick, stainless-steel panel clips designed to withstand negative-load requirements.
3. Cleats: Mechanically seamed cleats formed from minimum O.0250-inch- thick, stainless-steel or nylon-coated aluminum sheet.
4. Backing Plates: Provide metal backing plates at panel end splices, if any, fabricated from material

recommended by manufacturer.

5. Closure Strips: Closed-cell, expanded cellular, rubber or cross linked, polyolefoam or closed-cell laminated polyethylene; minimum l-inch- thick, flexible closure strips; cut or pre-molded to match metal roof panel profile. Provide closure strips where indicated or necessary to ensure weather tight construction.

B. Flashing and Trim: Formed from O.0179-inch- thick, zinc-coated (galvanized) steel sheet or aluminum-zinc alloy-coated steel sheet pre-painted with coil coating. Provide flashing and trim as required to seal against weather and to provide finished appearance. Locations include, but are not limited to, eaves, rakes, corners, bases, Framed openings, ridges, fasciae, and fillers. Finish flashing and trim with same finish system as adjacent metal roof panels.

C. Gutters: Formed from 0.0179-inch- thick~ zinc-coated (galvanized) steel sheet or aluminum-zinc alloy-coated steel sheet pre-painted with coil coating. Match profile of gable trim, complete with end pieces, outlet tubes, and other special pieces as required. Fabricate in minimum 96-inch-long sections, sized according to SMACNA's "Architectural Sheet Metal Manual". Furnish gutter supports spaced 36 inches o.c., fabricated from same metal as gutters. Provide bronze, copper, or aluminum wire ball strainers at outlets. Finish gutters to match metal roof panels.

D. Downspouts: Formed from O.0179-mch- thick, zinc-coated (galvanized) steel sheet or aluminum-zinc alloy-coated steel sheet pre-painted with coil coating; in 10-foot- long sections complete with formed elbows and offsets. Finish downspouts in color as selected by Architect from manufacturer's standard colors, which may or may not match metal roof panels.

E. Pipe Flashing: Pre-molded, EPDM pipe collar with flexible aluminum ring bonded to base.

2.6 FABRICATION

A. General: Fabricate and finish metal roof panels and accessories at the factory to greatest extent possible, by manufacturer's standard procedures and processes, as necessary to fulfill indicated performance requirements demonstrated by laboratory testing. Comply with indicated profiles and with dimensional and structural requirements.

B. Provide panel profile, including major ribs, for full length of panel.

C. Fabricate metal roof panel joints with factory-installed captive gaskets or separator strips that provide a tight seal and prevent metal-to-metal contact, in a manner that will minimize noise from movements within panel assembly.

D. Sheet Metal Accessories: Fabricate flashing and trim to comply with recommendations in SMACNA's "Architectural Sheet Metal Manual" that apply to the design, dimensions, metal, and other characteristics of item indicated.

1. 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.
2. Seams for Aluminum: Fabricate nonmoving seams with flat-lock seams. Form seams and seal with epoxy seam sealer. Rivet joints for additional strength.
3. Seams for Other Than Aluminum: Fabricate nonmoving seams in accessories with flat-lock seams. Tin edges to be seamed, form seams, and solder.
4. Sealed Joints: Form non-expansion but movable joints in metal to accommodate elastomeric

sealant to comply with SMACNA standards.

5. Conceal fasteners and expansion provisions where possible. Exposed fasteners are not allowed on faces of accessories exposed to view.

6. Fabricate cleats and attachment devices from same material as accessory being anchored or from compatible, non-corrosive metal recommended by metal roof panel manufacturer. Provide size as recommended by SMACNA's "Architectural Sheet Metal Manual" or metal roof panel manufacturer for application but not less than thickness of metal being secured.

2.7 FINISHES, GENERAL

A. Comply with NAAMM's "Metal Finishes Manual for Architectural and Metal Products" for recommendations for applying and designating finishes.

B. Protect mechanical and painted finishes on exposed surfaces from damage by applying a strippable, temporary protective covering before shipping.

C. Appearance of Finished Work: Variations in appearance of abutting or adjacent pieces are acceptable if they are within one-half of the range of approved Samples. Noticeable variations in the same piece are not acceptable. Variations in appearance of other components are acceptable if they are within the range of approved Samples and are assembled or installed to minimize contrast.

## PART 3 - EXECUTION

3.1 EXAMINATION

A. Examine substrates, areas, and conditions, with Installer present, for compliance with requirements for installation tolerances, metal roof panel supports, and other conditions affecting performance of work.

1. Examine solid roof sheathing to verify that sheathing joints are supported by framing or blocking and that installation is within flatness tolerances required by metal roof panel manufacturer.

2. For the record, prepare written report, endorsed by Installer, listing conditions detrimental to performance of work.

B. Examine roughing-in for components and systems penetrating metal roof panels to verify actual locations of penetrations relative to seam locations of metal roof panels before metal roof panel installation.

C. Proceed with installation only after unsatisfactory conditions have been corrected.

3.2 PREPARATION

A. Clean substrates of substances harmful to insulation, including removing projections capable of interfering with insulation attachment.

B. Install flashings and other sheet metal to comply with requirements of SMACNA's "Architectural Sheet Metal Manual" and metal roof panel manufacturer.

3.3 UNDERLAYMENT INSTALLATION

A. Self-Adhering Sheet Underlayment: Install self-adhering sheet underlayment; wrinkle free, on roof sheathing under metal roof panels. Apply primer if required by manufacturer. Comply with temperature restrictions of underlayment manufacturer for installation; use primer rather than nails for installing underlayment at low temperatures. Apply over entire roof, in shingle fashion to shed water, with end laps of not less than 6 inches staggered 24 inches between courses. Overlap side edges not less than 3MI/2

inches. Extend underlayment into gutter trough. Roll laps with roller. Cover underlayment within 14 days.

B. Install flashings to cover underlayment to comply with requirements of SMACNA's "Architectural Sheet Metal Manual" and metal roof panel manufacturer. Extend edge flashing into gutter trough.

3.4 METAL ROOF PANEL INSTALLATION, GENERAL

A. General: Provide metal roof panels of full length from eave to ridge, unless otherwise indicated or restricted by shipping limitations. Anchor metal roof panels and other components of the Work securely in place, with provisions for thermal and structural movement.

1. Field cutting of metal roof panels by torch is not permitted.
2. Rigidly fasten eave end of metal roof panels and allow ridge end free movement due to thermal expansion and contraction. Pre-drill panels.
3. Provide metal closures at peaks, rake edges, and each side of ridge caps.
4. Flash and seal metal roof panels with weather closures at eaves, rakes, and at perimeter of all openings. Fasten with self-tapping screws.
5. Locate and space fastenings in uniform vertical and horizontal alignment.
6. Install ridge caps as metal roof panel work proceeds.
7. Locate panel splices over, but not attached to, structural supports. Stagger panel splices and end laps to avoid a four-panel lap splice condition.
8. Lap metal flashing over metal roof panels to allow moisture to run over and off the material.

B. Fasteners for Steel Roof Panels: Use stainless-steel fasteners for surfaces exposed to the exterior and galvanized steel fasteners for surfaces exposed to the interior.

C. 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 roof panel manufacturer.

D. Joint Sealers: Install gaskets, joint fillers, and sealants where indicated and where required for weatherproof performance of metal roof panel assemblies. Provide types of gaskets, fillers, and sealants indicated or, if not indicated, types recommended by metal roof panel manufacturer. Seal side joints where recommended by metal roof panel manufacturer.

3.5 FIELD-ASSEMBLED STANDINGMSEAM METAL ROOF PANEL INSTALLATION

A. Fasten metal roof panels to supports with concealed clips at each standing-seam joint at location, spacing, and with fasteners recommended by manufacturer.

B. Install clips to supports with self-tapping fasteners.

C. Install pressure plates at locations indicated in manufacturer's written installation instructions.

D. Seamed Joint: Crimp standing seams with manufacturer-approved motorized seamer tool so clip, metal roof panel, and factory-applied sealant are completely engaged.

3.6 ACCESSORY INSTALLATION

A. General: Install accessories with positive anchorage to building and weather tight mounting and provide for thermal expansion. Coordinate installation with flashings and other components. Install components

required for a complete metal roof panel assembly including trim, ridge closures, seam covers, flashings, sealants, gaskets, fillers, closure strips, and similar items.

B. Flashing and Trim: Comply with performance requirements, manufacturer's written installation instructions, and SMACNA's "Architectural Sheet Metal Manual". 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.

C. Install exposed flashing and trim that is without excessive oil canning, buckling, and tool marks and that is true to line and levels indicated, with exposed edges folded back to form hems. Install sheet metal flashing and trim to fit substrates and to result in waterproof and weather-resistant performance. Provide for thermal expansion of exposed flashing and trim. Space movement joints at a maximum of 10 feet with no joints allowed within 24 inches of comer or intersection. Where lapped or bayonet type expansion provisions cannot be used or would not be sufficiently weather resistant and waterproof, form expansion joints of intermeshing hooked flanges, not less than I inch deep, filled with mastic sealant (concealed within joints).

D. Gutters: Join sections with riveted and soldered or lapped and sealed joints. Attach gutters to eave with gutter hangers spaced not more than 4 feet o.c. using manufacturer's standard fasteners. Provide end closures and seal watertight with sealant. Provide for thermal expansion.

E. Downspouts: Join sections with 1-1/2-inchtelescoping joints. Provide fasteners designed to hold downspouts securely 1 inch away from walls; locate fasteners at top and bottom and at approximately 60 inches o.c. in between. Tie downspouts to underground drainage system indicated.

F. Pipe Flashing: Form flashing around pipe penetration and metal roof panels. Fasten and seal to metal roof panels as recommended by manufacturer.

3.7 ERECTION TOLERANCES

Installation Tolerances: Shim and align metal roof panel units within installed tolerance of 1/4 inch in 20 feet on slope and location lines as indicated and within 1/8-inch offset of adjoining faces and of alignment of matching profiles.

3.8 . CLEANING AND PROTECTION

A. Remove temporary protective coverings and strippable films, if any, as metal roof panels are installed, unless otherwise indicated in manufacturer's written installation instructions. On completion of metal roof panel installation, clean finished surfaces as recommended by metal roof panel manufacturer. Maintain in a clean condition during construction.

B. Replace metal roof panels that have been damaged or have deteriorated beyond successful repair by finish touchup or similar minor repair procedures.

END OF SECTION

SECTION 076200

FLASHING AND SHEET METAL

## PART 1 - GENERAL

### 1.1 RELATED DOCUMENTS:

A. Drawings and general provisions of Contract, including General and Supplementary Conditions and Division 1 Specification Sections, apply to work of this Section.

B. Related work specified elsewhere includes:

1. Section 06100 - “Rough Carpentry”
2. Section 07540 - “Thermoplastic Membrane Roofing”
3. Section 07900 - “Joint Sealers”
4. Section 09900 - “Painting”

### 1.2 SUMMARY:

A. This Section includes the following, where indicated, and where required by project conditions, and which are not part of other Sections:

1. Prefinished metal counter flashing and base flashing.
2. Miscellaneous prefinished metal wall flashing, counterflashing, and reglets.
3. Exposed prefinished metal trim/fascia units, parapet caps (copings), gutters, downspouts (with precast concrete splashblocks at grade; metal splash pans at roofing), and other items as indicated on the Drawings.
4. Elastic flashing at top of all curbs, top course of double wythe walls, at perimeters of all exterior wall openings (i.e.: doors, windows, louvers, etc.), through-wall flashing, and elsewhere as indicated.
5. Miscellaneous sheet metal accessories as indicated and as required by project conditions.

B. Exposed metal flashing is intended to be prefinished baked enamel, as specified, in manufacturer’s standard non-metallic color(s) selected by Architect after bidding.

### 1.3 SUBMITTALS:

A. General: Submit the following in accordance with Conditions of Contract and Division 1 Specification Sections.

B. Product data for Flashing, Sheet Metal and Accessories: Manufacturer’s current technical product data, installation instructions and general recommendations for each specified sheet material, fabricated product, coating system, and color selection data.

C. Samples of the following flashing, sheet metal, and accessory items:

1. 12-inch-long samples of factory-fabricated products exposed as finished work. Provide complete with specified factory finish.
2. Physical samples for color selections, where color selection is required.

D. Shop drawings showing layout, profiles, methods of joining, and anchorages details, including major counterflashings, trim/fascia units, expansion joint systems, and other fabricated work. Provide layouts at 1/4-inch scale and details at 3-inch scale.

## 1.4 PROJECT CONDITIONS:

A. Coordinate work of this section with interfacing and adjoining work for proper sequencing of each installation. Ensure best possible weather resistance and durability of work and protection of materials and finishes.

## PART 2 - PRODUCTS

## 2.1 SHEET METAL, TRIM UNITS, FLASHING, COPING, ANY GUTTERS AND DOWNSPOUTS, AND AT TRIM MATERIALS:

A. Fabricate of minimum 24-gage metal, with minimum 50,000 p.s.i. yield, with 3-coat full strength (70-percent) Kynar 500 resin (20-year) finish. Provide one of the following base metals, to be the same base metal used for other sheet metal applications and systems:

1. ASTM A 792 aluminum-zinc allow coated steel sheet ("Galvalume"), or
2. ASTM A 653, G-90 (galvanized) zinc-coated steel sheet.
3. Typical metal flashing, except where specifically indicated otherwise.

B. Prefinished Metal Drip Edge (if any): Brake-formed sheet metal with at least a 4-inch roof deck flange at "flat" roofs; 1/2" raised edge at single-ply roofing; with a 1-1/2-inch fascia flange with a 3/8-inch hemmed edge drip at lower edge at any metal roofing, which is not already included with metal roofing system. Furnish in lengths of at least 10 feet.

C. Prefinished Metal Flashing and 2-Inch High Diverter Strips (if any):

1. Install diverter strips 1'-0" above low roof edge(s) of sloped roofs, at all locations over exterior doors, and over exterior mechanical units where roof edge gutters or parapet walls do not occur.

D. Prefinished Coping System: Provide prefinished aluminum coping system, including chairs, "drainable gutters" at joints, clips, trim and all necessary accessories for a complete and properly installed water-tight system.

1. Product/Manufacturer: Manufactured or brake-metal system, equivalent to "AP Standard Coping" system, as manufactured by Architectural Products Co.; Covington, Kentucky; Phone: 1-606-341-1171.

a. Baked enamel finish on minimum 0.063" (1.6 mm) aluminum sheet or extrusion, with depths and widths indicated on the Drawings, including all necessary trim and accessories as recommended by manufacturer and required by project conditions.

2. At Contractor's option, provide similar profile, but from brake-metal coping system, with continuous clip across top of and length of parapets (full secondary concealed wall cap), with 1-inch high standing seam joints - filled with sealant, double-folded, and corners turned down at 45-degrees.

E. Finishes:

1. Finish for any exposed metal flashings, coping systems, etc., shall be 3-coat 70% resin "Kynar 500" coating (i.e.: primer, color coat and clear topcoat), complying with AAMA 2605.2, with a total dry film thickness of not less than 2.4-mils, and manufacturer's standard 20-year finish warranty.
2. Colors: As selected by Architect, from manufacturer's standard solid colors - 15 colors minimum to select from, to include in part, color(s) to match existing metalwork, and/or clear anodized aluminum finish - which may require a solid color or a solid color metallic finish to achieve.

## 2.2 LEAD FLASHING (AT VENT STACKS):

A. 4-pound lead sheet, fabricated to extend 4 inches minimum onto roof and turn down 1 inch minimum down inside vent stacks.

1. For metal roofing, provide counterflashing over vent stacks, curbs, and other penetrations' flashings in same material and color as metal roofing.

## 2.3 ELASTIC VINYL SHEET FLASHING:

A. Flexible sheet flashings especially formulated from virgin polyvinyl chloride with plasticizers and other modifiers, to remain flexible and waterproof in concealed masonry applications, black in color and of thickness indicated below.

1. Thickness: 30 mils.; Smooth finish at both sides (not grained, textured, etc.).

B. Product/Manufacturer: "Nervastral 300", or pre-approved equivalent submitted at least 10-days prior to original Bid Date and subsequently approved, including mastic, and where required companion surface conditioner product, and all other materials and components required.

C. Application: Use where flashing is fully concealed, including in part, over roof curbs, wall flashing, through-wall flashing at exterior masonry walls, below any exterior caps and sills, at perimeter of all openings in exterior walls (i.e.: doors, windows, louvers, etc.), and elsewhere as indicated and/or required by project conditions.

1. At heads and sills of openings, and similar locations, turn ends up to form a dam, and to direct water / moisture to weeps and out of walls.

D. Adhesive for Flashings: Type recommended by manufacturer of flashing material, for each use indicated; All joints shall be sealed.

## 2.4 MISCELLANEOUS MATERIALS AND ACCESSORIES:

A. Solder:

1. For use with steel or copper: Provide 50 - 50 tin/lead solder (ASTM B 32), with rosin flux.
2. For use with stainless steel: Provide 60 - 40 tin/lead solder (ASTM B 32), with acid-chloride type flux, except use rosin flux over tinned surfaces.

B. Fasteners: Same metal as flashing/sheet metal or other non-corrosive metal as recommended by sheet manufacturer. Match finish of exposed heads with material being fastened.

C. Bituminous Coating: SSPC - Paint 12, solvent-type bituminous mastic, nominally free of sulfur, compounded for 15-mil dry film thickness per coat.

D. Mastic Sealant: Polyisobutylene; non-hardening, non-skinning, non-drying and non-migrating sealant.

E. Elastomeric Sealant: Generic type recommended by manufacturer of metal and fabricator of components being sealed and complying with requirements for joint sealants as specified in Section 07900 - "Joint Sealers."

F. Paper Slip Sheet: 5-lb. rosin-sized building paper.

G. Counterflashing and Reglets: Metal units of type and profile indicated, or if not indicated, as required for the intended use, compatible with flashing indicated, noncorrosive.

1. At surface-mounted parapet and wall flashing conditions, equivalent to 2-piece "Springlok" Flashing Systems, as manufactured by Fry Reglet; Norcross, Georgia; Phone: 1-770-441-2337, except where brake-formed metal is specifically indicated.

H. Metal Accessories: Provide sheet metal clips, straps, anchoring devices, and similar accessory units as required for installation of work, matching or compatible with material being installed, noncorrosive, size and gage required for performance.

I. Fibered Aluminum Roof Coating: ASTM D 2824, Type II; FS TT-C-1079. Equivalent to Perma-Seal coating No. 3910; Brush applied only.

## 2.5 FABRICATED UNITS:

A. General Metal Fabrication: Shop-fabricate work to greatest extent possible. Comply with details shown and with applicable requirements of SMACNA "Architectural Sheet Metal Manual" and other recognized industry practices. Fabricate for waterproof and weather-resistant performance, with expansion provisions for running work, sufficient to permanently prevent leakage, damage, or deterioration of the work. Form work to fit substrates. Comply with material manufacturer instructions and recommendations for forming material. Form exposed sheet metal work without excessive oil-canning, buckling, and tool marks, true to line and levels indicated, with exposed edges folded back to form hems.

1. At metal roofing and horizontal or sloped metal flashings over 6-inches wide, provide custom configurations and continuous brake-metal roofing system, with continuous concealed clip anchors rated for I-90 uplift conditions, with 1-inch high standing seam Pittsburgh lock-seam joints - filled with sealant, double-folded, and corners turned down at 45-degrees.
2. Provide matching materials and finish for fascia metal covering, flashing, counterflashing and trim.

B. Seams: Fabricate nonmoving seams in sheet metal with standing seam at exposed tops and lapped side or edge seams. For metal other than aluminum, tin edges to be seamed, form seams, and solder. Form aluminum seams with epoxy seam sealer. Pop-rivet joints for additional strength where required and at vertical faces.

C. Separations: Provide for separation of metal from non-compatible metal or corrosive substrates by coating concealed surfaces at locations of contact, with bituminous coating or other permanent separation as recommended by manufacturer/fabricator.

# PART 3 - EXECUTION

## 3.1 INSTALLATION REQUIREMENTS:

A. General: Except as otherwise indicated, comply with manufacturer's current written installation instructions and recommendations, with SMACNA "Architectural Sheet Metal Manual," and reviewed submittals and shop drawings.

1. Install manufactured, bought-out items in accordance with manufacturer's current written instructions and recommendations.
2. Anchor units of work securely in place by methods indicated, providing for thermal expansion of metal units; conceal 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 weatherproof.

B. Underlayment: Where stainless steel or aluminum is to be installed directly on cementitious or wood substrates, install a slip sheet of red rosin paper and a course of polyethylene underlayment.

C. Bed flanges of work in a thick coat of bituminous roofing cement where required for waterproof performance.

D. Install reglets to receive counterflashing in manner and by methods indicated, in a straight line and single elevation.

E. Install counterflashing in reglets, by snap-in seal arrangement for anchorage and filling reglet with mastic or elastomeric sealant, as indicated and depending on degree of sealant exposure, or if not indicated, as recommended by referenced standards, flashing and roofing manufacturers, and otherwise as required for the intended application.

F. Nail or anchor flanges of expansion joint units to curb nailers, at maximum spacing of 6 inches o.c. Fabricate seams at joints between units with minimum 3-inch overlap, to form a continuous, waterproof system.

G. Flashing:

1. Comply with manufacturer's current written instructions and recommendations for installation of all systems components in all applications indicated on the Drawings, and as otherwise required by project conditions.
2. At any parapet wall and roof curbs applications, extend flashing continuous, over top of wall or curb, and turn down one inch (1") minimum on exterior side of wall and mechanically anchor in place at side of top of wall, below and concealed by continuous metal clip anchor (acting as termination bar) and metal cap flashing or coping, and down over top edge of roofing flashing material at roof side.

## 3.2 CLEANING AND PROTECTION:

A. Clean exposed metal surfaces, removing substances that might cause corrosion of metal or deterioration of finishes.

1. After cleaning, repair and restore damaged metal and metal finishes with prefinished paint manufacturer's special air-drying touch-up paint, in manner such that touch-up is not apparent.
2. Replace damaged flashing and sheet metal work which cannot be repaired and when finish repair and restoration is not acceptable to Architect.

B. Protection: Advise Contractor of required procedures for surveillance and protection of flashings and sheet metal work during construction to ensure that work will be without damage or deterioration other than natural weathering at time of Substantial Completion.

END OF SECTION

SECTION 079200

JOINT SEALANTS

## PART 1- GENERAL

### 1.1 RELATED DOCUMENTS

Drawings and general provisions of the Contract, including General and Supplementary Conditions and Division 1 Specification Sections, apply to this Section.

### 1.2 SUMMARY

A. This Section includes joint sealants for the following applications, including those specified by reference to this Section and joints in new and existing construction:

1. Exterior joints in the following vertical surfaces and horizontal nontraffic surfaces:
   a. Construction joints in cast-in-place concrete.
   b. Joints in exterior wood trim and siding.
   c. Joints in exterior insulation and finish systems.
   d. Joints between different materials listed above.
   e. Perimeter joints between materials listed above and frames of doors, windows and louvers.
   f. Control and expansion joints in ceilings and overhead surfaces.
   g. Existing joints disturbed by selective demolition.
   h. Joints between existing and new construction.
   1. Other joints as indicated.
2. Exterior joints in the following horizontal traffic surfaces:
   a. Isolation and contraction joints in cast-in-place concrete slabs.
   b. Existing joints disturbed by selective demolition.
   c. Joints between existing and new construction.
   d. Other joints as indicated.
3. Interior joints in the following vertical surfaces and horizontal nontraffic surfaces:
   a. Control and expansion joints on exposed interior surfaces of exterior walls.
   b. Perimeter joints of exterior openings where indicated.
   c. Tile control and expansion joints.
   d. Vertical joints on exposed surfaces of interior unit masonry walls and partitions.
   e. Perimeter joints between interior wall surfaces and frames of interior and exterior doors and windows.
   f. Joints between plumbing fixtures and adjoining walls, floors, and counters.
   g. Existing joints disturbed by selective demolition.
   h. Joints between existing and new construction.

i. Other joints as indicated.

4. Interior joints in the following horizontal traffic surfaces:

a. Isolation joints in cast-in-place concrete slabs.

b. Control and expansion joints in tile flooring.

c. Existing joints disturbed by selective demolition.

d. Joints between existing and new construction.

e. Other joints as indicated.

B. Related Sections include the following:

1. Division 04 Section "Unit Masonry Assemblies" for masonry control and expansion joint filers and gaskets.

2. Division 07 Section "Fire-Resistive Joint Systems" for sealing joints in fire resistance-rated construction.

3. Division 09 Section "Gypsum Board" for sealing perimeter joints of gypsum board partitions to reduce sound transmission.

4. Division 09 Section "Acoustical Panel Ceilings" for sealing edge moldings at perimeters of acoustical ceilings.

1.3 PERFORMANCE REQUIREMENTS

A. Provide elastomeric joint sealants that establish and maintain watertight and airtight continuous joint seals without staining or deteriorating joint substrates.

B. Provide joint sealants for interior applications that establish and maintain airtight and water-resistant continuous joint seals without staining or deteriorating joint substrates.

1.4 SUBMITTALS

A. Product Data: For each joint-sealant product indicated.

B. Samples for Initial Selection: Manufacturer's color charts consisting of strips of cured sealants showing the full range of colors available for each product exposed to view.

C. Samples for Verification: For each type and color of joint sealant required, provide Samples with joint sealants in l/2-inch- wide joints formed between two 6-inch- long strips of material matching the appearance of exposed surfaces adjacent to joint sealants.

D. Product Certificates: For each type of joint sealant and accessory, signed by product manufacturer.

E. Qualification Data: For Installer.

F. Preconstruction Field Test Reports: Indicate which sealants and joint preparation methods resulted in optimum adhesion to joint substrates based on preconstruction testing specified in "Quality Assurance" Article.

G. Compatibility and Adhesion Test Reports: From sealant manufacturer, indicating the following:

1. Materials forming joint substrates and joint-sealant backings have been tested for compatibility and adhesion with joint sealants.

2. Interpretation of test results and written recommendations for primers and substrate preparation needed for adhesion.

H. Field Test Report Log: For each elastomeric sealant application.

I. Product Test Reports: Based on comprehensive testing of product formulations performed by a qualified testing agency, indicating that sealants comply with requirements.

1. Warranties: Special warranties specified in this Section.

K. Meeting Records: Minutes from Pre-Installation Conference.

1.5 QUALITY ASSURANCE

A. Installer Qualifications: Manufacturer's authorized Installer who is approved or licensed for installation of elastomeric sealants required for this Project.

B. Source Limitations: Obtain each type of joint sealant through one source from a single manufacturer.

C. Preconstruction Compatibility and Adhesion Testing: Submit to joint-sealant manufacturers, for testing indicated below, samples of materials that will contact or affect joint sealants.

1. Use ASTM C 1087 to determine whether priming and other specific joint preparation techniques are required to obtain rapid, optimum adhesion of joint sealants to joint substrates.

2. Submit not fewer than eight pieces of each type of material, including joint substrates, shims, joint-sealant backings, secondary seals, and miscellaneous materials.

3. Schedule sufficient time for testing and analyzing results to prevent delaying the Work.

4. For materials failing tests, obtain joint-sealant manufacturer's written instructions for corrective measures including use of specially formulated primers.

5. Testing will not be required if joint-sealant manufacturers submit joint preparation data that are based on previous testing of current sealant products for adhesion to, and compatibility with, joint substrates and other materials matching those submitted.

D. Product Testing: Obtain test results for "Product Test Reports" Paragraph in "Submittals" Article from a qualified testing agency or manufacturer based on testing current sealant formulations within a 36-month period preceding the Notice to Proceed with the Work.

1. Testing Agency Qualifications: An independent testing agency qualified according to ASTM C 1021 to conduct the testing indicated, as documented according to ASTM E 548.

2. Test elastomeric joint sealants for compliance with requirements specified by reference to ASTM C 920, and where applicable, to other standard test methods.

3. Test other joint sealants for compliance with requirements indicated by referencing standard specifications and test methods.

E. Preconstruction Field-Adhesion Testing: Before installing elastomeric sealants, field test their adhesion to Project joint substrates as follows:

1. Locate test joints where indicated on Project or, if not indicated, as directed by Architect.

2. Conduct field tests for each application indicated below:

a Each type of elastomeric sealant and joint substrate indicated.

b. Each type of non-elastomeric sealant and joint substrate indicated.

3. Notify Architect seven days in advance of dates and times when test joints will be erected.

4. Arrange for tests to take place with joint-sealant manufacturer's technical representative present.

a. Test Method: Test joint sealants according to Method A, Field Applied Sealant Joint Hand Pull Tab, in Appendix Xl in ASTM C 1193.

b. For joints with dissimilar substrates, verify adhesion to each substrate separately; extend cut along one side, verifying adhesion to opposite side. Repeat procedure for opposite side.

5. Report whether sealant in joint connected to pulled-out portion failed to adhere to joint substrates or tore cohesively. Include data on pull distance used to test each type of product and joint substrate. For sealants that fail adhesively, retest until satisfactory adhesion is obtained.
6.Evaluation of Preconstruction Field-Adhesion- Test Results: Sealants not evidencing adhesive failure from testing, in absence of other indications of noncompliance with requirements, will be considered satisfactory. Do not use sealants that fail to adhere to joint substrates during testing.

F. Pre-Installation Conference: Conduct conference at Project site to comply with requirements in Division 1 Section "Project Management and Coordination."

1.6 PROJECT CONDITIONS

A. Do not proceed with installation of joint sealants under the following conditions:

1. When ambient and substrate temperature conditions are outside limits permitted by joint-sealant manufacturer or are below 40 deg F.

2. When joint substrates are wet.

3. Where joint widths are less than those allowed by joint-sealant manufacturer for applications indicated.

4. Contaminants capable of interfering with adhesion have not yet been removed from joint substrates.

1.7 WARRANTY

A. General Warranty: Special warranty specified in this Article shall not deprive Owner of other rights Owner may have under other provisions of the Contract Documents and shall be in addition to, and run concurrent with, other warranties made by Contractor under requirements of the Contract Documents.

B. Special Installer's Warranty: Installer's standard form in which Installer agrees to repair or replace elastomeric joint sealants that do not comply with performance and other requirements specified in this Section within warranty period of2 (two) years from date of Substantial Completion.

C. Special Manufacturer's Warranty: Manufacturer's standard form in which elastomeric sealant manufacturer agrees to furnish elastomeric joint sealants to repair or replace those that do not comply with performance and other requirements specified in this Section within warranty period of 10 (ten) years from date of Substantial Completion.

D. Special warranties specified in this Article exclude deterioration or failure of elastomeric joint sealants from the following:

1. Movement of the structure resulting in stresses on the sealant exceeding sealant manufacturer's written specifications for sealant elongation and compression caused by structural settlement or errors attainable to design or construction.

2. Disintegration of joint substrates from natural causes exceeding design specifications.
3. Mechanical damage caused by individuals, tools, or other outside agents.
4. Changes in sealant appearance caused by accumulation of dirt or other atmospheric contaminants.

## PART 2 - PRODUCTS

### 2.1 MATERIALS, GENERAL

A. Compatibility: Provide joint sealants, backings, and other related materials that are compatible with one another and with joint substrates under conditions of service and application, as demonstrated by sealant manufacturer, based on testing and field experience.

B. VOC Content of Interior Sealants: Provide interior sealants and sealant primers that comply with the following limits for VOC content when calculated according to 40 CFR 59, Subpart D (EPAMethod 24):

1. Sealants: 250 glL.
2. Sealant Primers for Nonporous Substrates: 250 gl.
3. Sealant Primers for Porous Substrates: 775 gl.

C. Colors of Exposed Joint Sealants: As selected by Architect from manufacturer's full range.

### 2.2 ELASTOMERIC JOINT SEALANTS

A. Elastomeric Sealants: Comply with ASTM C 920 and other requirements indicated for each liquid-applied chemically curing sealant specified, including those referencing ASTM C 920 classifications for type, grade, class, and uses related to exposure and joint substrates.

B. Single-Component Neutral- and Basic-Curing Silicone Sealant:

1. Available Products: Subject to compliance with requirements, products that may be incorporated into the Work include, but are not limited to, the following:
   a. Dow Corning Corporation; 790.
   b. GE Silicones; SilPruf LM SCS2700.
   c. Tremco; Spectrem 1 (Basic).
2. Type and Grade: S (single component) and NS (non-sag).
3. Class: 100/50.
4. Use Related to Exposure: NT (non-traffic).
5. Uses Related to Joint Substrates: M, G, A, and, as applicable to joint substrates indicated, O.
6. Stain- Test-Response Characteristics: Non-staining to porous substrates per ASTM C 1248.
7. Applications: Exterior non-traffic and interior wet areas.

C. Multicomponent Pourable Urethane Sealant:

1. Available Products: Subject to compliance with requirements, products that may be incorporated into the Work include, but are not limited to, the following:
   a. Meadows, W. R., Inc.; POURTHANE.
   b. Pecora Corporation; Urexpan NR-200.

c. Tremco; THC-900.

2. Type and Grade: M (multicomponent) and P (pourable).

3. Class: 25.

4. Use Related to Exposure: T (traffic).

5. Uses Related to Joint Substrates: M, A, and, as applicable to joint substrates indicated, O.

6. Applications: Exterior and interior traffic areas.

2.3 LATEX JOINT SEALANTS

A. Latex Sealant: Comply with ASTM C 834, Type P, Grade NF.

B. Available Products: Subject to compliance with requirements, products that may be incorporated into the Work include, but are not limited to, the following:

1. Bostik Findley; Chem-Calk 600.

2. Pecora Corporation; AC-20+.

3. Sonneborn, Division of ChemRex Inc.; Sonolac.

4. Tremco; Tremflex 834.

C. Application: Interior joints, except at wet areas, traffic joints, and locations where acoustical or fire-rated joint sealants are required.

2.4 PREFORMED JOINT SEALANTS

A Preformed Foam Sealant: Manufacturer's standard preformed, pre-compressed, open cell foam sealant that is manufactured from high-density urethane foam impregnated with a nondrying, water-repellent agent; is factory produced in pre-compressed sizes in roll or stick form to fit joint widths indicated; is coated on one side with a pressure sensitive adhesive and covered with protective wrapping; develops a watertight and airtight seal when compressed to the degree specified by manufacturer.

B. Available Products: Subject to compliance with requirements, products that may be incorporated into the Work include, but are not limited to, the following:

1.EMSEAL Joint Systems, Ltd.; Emseal25V. 2. Illbruck

Sealant Systems, Inc.; Wilseal600.

C. Properties: Permanently elastic, mildew resistant, nonmigratory, nonstammg, and compatible with joint substrates and other joint sealants. Density: Manufacturer's standard.

D. Application: As indicated on Drawings.

2.5 JOINT-SEALANT BACKING

A. General: Provide sealant backings of material and type that are nonstaining; are compatible with joint substrates, sealants, primers, and other joint filers; and are approved for applications indicated by sealant manufacturer based on field experience and laboratory testing.

B. Cylindrical Sealant Backings: ASTM C 1330, Type as approved in writing by joint sealant manufacturer for joint application indicated, and of size and density to control sealant depth and otherwise contribute to producing optimum sealant performance:

C. Bond-Breaker Tape: Polyethylene tape or other plastic tape recommended by sealant manufacturer for

preventing sealant from adhering to rigid, inflexible joint-filler materials or joint surfaces at back of joint where such adhesion would result in sealant failure. Provide self-adhesive tape where applicable.

2.6 MISCELLANEOUS MATERIALS

A. Primer: Material recommended by joint-sealant manufacturer where required for adhesion of sealant to joint substrates indicated, as determined from preconstruction joint-sealant-substrate tests and field tests.

B. Cleaners for Nonporous Surfaces: Chemical cleaners acceptable to manufacturers of sealants and sealant backing materials, free of oily residues or other substances capable of staining or harming joint substrates and adjacent nonporous surfaces in any way, and formulated to promote optimum adhesion of sealants to joint substrates.

C. Masking Tape: Non-staining, nonabsorbent material compatible with joint sealants and surfaces adjacent to joints.

## PART 3 - EXECUTION

3.1 EXAMINATION

A. Examine joints indicated to receive joint sealants, with Installer present, for compliance with requirements for joint configuration, installation tolerances, and other conditions affecting joint-sealant performance.

B. Proceed with installation only after unsatisfactory conditions have been corrected.

3.2 PREPARATION

A. Surface Cleaning of Joints: Clean out joints immediately before installing joint sealants to comply with joint-sealant manufacturer's written instructions and the following requirements:

1. Remove all foreign material from joint substrates that could interfere with adhesion of joint sealant, including dust, paints (except for permanent, protective coatings tested and approved for sealant adhesion and compatibility by sealant manufacturer), old joint sealants, oil, grease, waterproofing, water repellents, water, surface dirt, and frost.

2. Clean porous joint substrate surfaces by brushing, grinding, blast cleaning, mechanical abrading, or a combination of these methods to produce a clean, sound substrate capable of developing optimum bond with joint sealants. Remove loose particles remaining after cleaning operations above by vacuuming or blowing out joints with oil-free compressed air. Porous joint substrates include, but are not necessarily limited to, the following:

   a. Concrete.

   b. Masonry.

3. Remove laitance and form-release agents from concrete.

4. Clean nonporous surfaces with chemical cleaners or other means that do not stain, harm substrates, or leave residues capable of interfering with adhesion of joint sealants. Nonporous joint substrates include, but are not necessarily limited to, the following:

   a. Metal.

   b. Glass.

   c. Vitreous china.

   d. Glazed surfaces of ceramic tile.

B. Joint Priming: Prime joint substrates, where recommended in writing by joint-sealant manufacturer, based on preconstruction joint-sealant-substrate test~ or prior experience. Apply primer to comply with joint-sealant manufacturer's written instructions. Confine primers to areas of joint-sealant bond; do not allow spillage or migration onto adjoining surfaces.

C. Masking Tape: Use masking tape where required to prevent contact of sealant with adjoining surfaces that otherwise would be permanently stained or damaged by such contact or by cleaning methods required to remove sealant smears. Remove tape immediately after tooling without disturbing joint seal.

3.3 INSTALLATION OF JOINT SEALANTS

A. General: Comply with joint-sealant manufacturer's written installation instructions for products and applications indicated, unless more stringent requirements apply.

B. Sealant Installation Standard: Comply with recommendations in ASTM C 1193 for use of joint sealants as applicable to materials, applications, and conditions indicated.

C. Acoustical Sealant Application Standard: Comply with recommendations in ASTM C 919 for use of joint sealants in acoustical applications as applicable to . materials, applications, and conditions indicated.

D. Install sealant backings of type indicated to support sealants during application and at position required to produce cross-sectional shapes and depths of installed sealants relative to joint widths that allow optimum sealant movement capability.

1. Do not leave gaps between ends of sealant backings.
2. Do not stretch, twist, puncture, or tear sealant backings.
3. Remove absorbent sealant backings that have become wet before sealant application and replace them with dry materials.

E. Install bond-breaker tape behind sealants where sealant backings are not used between sealants and backs of joints.

F. Install sealants using proven techniques that comply with the following and at the same time backings are installed:

1. Place sealants so they directly contact and fully wet joint substrates.
2. Completely fill recesses in each joint configuration.
3. Produce uniform, cross-sectional shapes and depths relative to joint widths that allow optimum sealant movement capability.

G. Tooling of Non-sag Sealants: Immediately after sealant application and before skinning or curing begins, tool sealants according to requirements specified below to form smooth, uniform beads of configuration indicated; to eliminate air pockets; and to ensure contact and adhesion of sealant with sides of joint.

1. Remove excess sealant from surfaces adjacent to joints.
2. Use tooling agents that are approved in writing by sealant manufacturer and that do not discolor sealants or adjacent surfaces.
5. Provide concave joint configuration per Figure 5A m ASTM C 1193, unless otherwise indicated.
4. Provide flush joint configuration where indicated per Figure 5B in ASTM C 1193.
5. Provide recessed joint configuration ·of recess depth and at locations indicated per Figure 5C in ASTM C 1193. Use masking tape to protect surfaces adjacent to recessed tooled joints.

6. Installation of Preformed Foam Sealants: Install each length of sealant immediately after removing protective wrapping, taking care not to pull or stretch material, producing seal continuity at ends, turns, and intersections of joints. For applications at low ambient temperatures where expansion of sealant requires acceleration to produce seal, apply heat to sealant in compliance with sealant manufacturer's written instructions.

3.4 FIELD QUALITY CONTROL

A. Field-Adhesion Testing: Field test joint-sealant adhesion to joint substrates as follows:

1. Extent of Testing: Test completed elastomeric sealant joints as follows:

a. Perform 10 tests for the first 1000 feet of joint length for each type of elastomeric sealant and joint substrate.

b. Perform 1 test for each 1000 feet of joint length thereafter or 1 test per each floor per elevation.

2. Test Method:

a. Test joint sealants according to Method A, Field-Applied Sealant Joint Hand Pull Tab in Appendix XI in ASTM C 1193, as appropriate for type of joint sealant application indicated.

b. For joints with dissimilar substrates, verify adhesion to each substrate separately; do this by extending cut along one side, verifying adhesion to opposite side. Repeat procedure for opposite side.

3. Inspect joints for complete fill, for absence of voids, and for joint configuration complying with specified requirements. Record results in a field-adhesion-test log.

a. Whether sealants in joints connected to pulled-out portion failed to adhere to joint substrates or tore cohesively. Include data on pull distance used to test each type of product and joint substrate. Compare these results to determine if adhesion passes sealant manufacturer's field-adhesion hand-pull test criteria.

b. Whether sealants filled joint cavities and are free of voids.

c. Whether sealant dimensions and configurations comply with specified requirements.

4. Record test results in a field-adhesion-test log. Include dates when sealants were installed, names of persons who installed sealants, test dates, test locations, whether joints were primed, adhesion results and percent elongations, sealant fill, sealant configuration, and sealant dimensions.

5. Repair sealants pulled from test area by applying new sealants following same procedures used originally to seal joints. Ensure that original sealant surfaces are clean and that new sealant contacts original sealant.

B. Manufacturer's Field-Adhesion Testing: Perform other field-adhesion testing as required by manufacturer for warranty execution.

C. Evaluation of Field Test Results: Sealants not evidencing adhesive failure from testing or noncompliance with other indicated requirements will be considered satisfactory. Remove sealants that fail to adhere to joint substrates during testing or to comply with other requirements. Retest failed applications until test results prove sealants comply with indicated requirements.

3.5 CLEANING

Clean off excess sealant or sealant smears adjacent to joints as the Work progresses by methods and with

cleaning materials approved in writing by manufacturers of joint sealants and of products in which joints occur.

3.6 PROTECTION

Protect joint sealants during and after curing period from contact with contaminating substances and from damage resulting from construction operations or other causes so sealants are without deterioration or damage at time of Substantial Completion. If, despite such protection, damage or deterioration occurs, cut out and remove damaged or deteriorated joint sealants immediately so installations with repaired areas are indistinguishable from original work.

END OF SECTION

SECTION 081113

HOLLOW METAL DOORS AND FRAMES

## PART - GENERAL

### 1.1 RELATED DOCUMENTS:

A. Drawings and general provisions of Contract, including General and Supplementary Conditions and Division 1 Specification Sections, apply to this Section.

B. Related work specified elsewhere includes:

1. Section 06100 - “Rough Carpentry”
2. Section 08710 - “Finish Hardware”
3. Section 09250 - “Gypsum Drywall”
4. Section 09900 - “Painting”

### 1.2 DESCRIPTION OF WORK:

A. Work described in this section includes steel doors and steel frames.

1. All frames shall be equally rabbetted.

### 1.3 QUALITY ASSURANCE:

A. Provide doors and frames complying with Steel Door Institute “Recommended Specifications: Standard Steel Doors and Frames” (SDI-100) and as herein specified.

B. Fire-Rated Door Assemblies:

1. Where fire-rated door assemblies are indicated or required, provide fire-rated door and frame assemblies that comply with NFPA 80 “Standard for Fire Doors and Windows,” and have been tested, listed and labeled in accordance with ASTM E 152 “Standard Methods of Fire Tests of Door Assemblies” by a nationally recognized independent testing and inspection agency acceptable to authorities having jurisdiction.

2. Labels mounted on doors and door frames must indicate the time rating of the door/frame assembly.

### 1.4 SUBMITTALS:

A. Product Data: Submit manufacturer’s technical product data substantiating that products comply with requirements.

B. Shop Drawings:

1. Submit for fabrication and installation of steel doors and frames. Include details of each frame type, elevations of door design types, conditions at openings, details of construction, location and installation requirements of finish hardware and reinforcements, and details of joints and connections. Show anchorage and accessory items.

2. Provide schedule of doors and frames using same reference numbers for details and openings as those on contract drawings.

3. Coordinate glazing frames and stops with glass and glazing requirements.

## 1.5 DELIVERY, STORAGE AND HANDLING:

A. Deliver hollow metal work cartoned or crated to provide protection during transit and job storage. Provide additional sealed plastic wrapping for factory finished doors.

B. Inspect hollow metal work upon delivery for damage. Minor damages may be repaired provided finish items are equivalent in all respects to new work and acceptable to Architect; otherwise, remove and replace damaged items as directed.

C. Store doors and frames at building site under cover. Place units on minimum 4-inch-high wood blocking. Avoid use of non-vented plastic or canvas shelters which could create humidity chamber. If cardboard wrapper on door becomes wet, remove carton immediately. Provide 1/4-inch spaces between stacked doors to promote air circulation.

# PART 2 - PRODUCTS

## 2.1 ACCEPTABLE MANUFACTURERS:

A. Manufacturer: Subject to compliance with requirements, provide steel doors and frames by one of the following:

1. Steel Doors and Frames, (General):

a. Amweld Div, American Welding & Mfg. Co.,
b. Builder's Manufacturing Company
c. BYMOCO Metal Fabricators, Inc.
d. Ceco Corp.
e. Curries Manufacturing, Inc.
f. Dittco Products Inc.
g. Fenestra Corp.
h. Habersham Metal Products Company
i. Mesker Industries, Inc.
j. Overly Manufacturing Company
k. Pioneer Bldrs. Products Corp./Div. CORE Industries, Inc.
l. Republic Builders Products Corp./Subs. Republic Steel.
m. SteelCraft/Div. American Standard Co.

2. Thermal Rated Steel Door and Frame Assemblies:

a. Subject to compliance with requirements, any above named manufacturer.
b. Ceco Corp.
c. Copco Door Co.
d. Curries Mfg., Inc.
e. Fenestra Corp.
f. Mesker Industries, Inc.
g. Pioneer Bldrs, Products Corp./Div. CORE Industries, Inc.

## 2.2 MATERIALS:

A. Hot-Rolled Steel Sheets and Strip: Commercial quality carbon steel, pickled and oiled, complying with ASTM A 569 and ASTM A 568.

B. Cold-Rolled Steel Sheets: Commercial quality carbon steel, complying with ASTM A 366 and ASTM SA 568.

C. Galvanized Steel Sheets: Zinc-coated carbon steel sheets of commercial quality, complying with ASTM A 526, with ASTM A 525, G60 zinc coating, mill phosphatized.

D. Supports and Anchors: Fabricate of not less than 18-gage galvanized sheet steel.

E. Inserts, Bolts and Fasteners: Manufacturer's standard units, except hot-dip galvanize items to be built into exterior walls, complying with ASTM A 153, Class C or D as applicable.

F. Galvanizing Repair Paint: High zinc dust content paint for repair of galvanized surfaces damaged by fabrication or welding, complying with M.I. Specification MIL-P-21035.

G. Shop Applied Primer: Rust-inhibitive enamel or paint, either air drying or baking, suitable as a base for specified finish paints.

## 2.3 FABRICATION:

A. Fabricate steel door and frame units to be rigid, neat in appearance and free from defects, warp or buckle. Wherever practicable, fit and assemble units in manufacturer's plant. Clearly identify work that cannot be permanently factory assembled before shipment, to assure proper assembly at project site.

B. Fabricate exposed faces of doors and panels, including stiles and rails of non-flush units, from only cold-rolled steel.

C. Fabricate frames, concealed stiffeners, reinforcement, edge channels, louvers and moldings from either cold-rolled or hot-rolled steel (at fabricator's option).

D. Fabricate exterior doors, panels and frames from galvanized sheet steel. Close top and bottom edges of exterior doors as integral part of door construction or by addition of minimum 16-gauge inverted steel channels.

1. Use galvanizing repair paint for surfaces damaged by fabrication or welding.

E. Exposed Fasteners: Unless otherwise indicated, provide countersunk flat Phillips heads for exposed screws and bolts.

F. Thermal-Rated (Insulating) Assemblies:

1. At exterior locations and elsewhere as shown or scheduled, provide doors which have been fabricated as thermal insulating door and frame assemblies and tested in accordance with ASTM C 236.

2. Unless otherwise indicated, provide urethane insulated thermal-rated assemblies with U factor of 0.12 Btu, (hr./ft2./F Degrees) or better.

G. Finish Hardware Preparation:

1. Prepare doors and frames to receive mortise and concealed finish hardware in accordance with final Finish Hardware Schedule and templates provided by hardware supplier. Comply with applicable requirements of ANSI A 115 series specifications for door and frame preparation for hardware.

2. Reinforce doors and frames to receive surface applied hardware. Drilling and tapping for surface-applied finish hardware may be done at project site.

3. Locate finish hardware as indicated on final shop drawings, or if not indicated, in accordance with "Recommended Locations for Builders' Hardware," published by Door and Hardware Institute.

H. Shop Painting:

1. Clean, treat and paint exposed surfaces of steel door and frame units, including galvanized surfaces.

2. Clean steel surfaces of mill scale, rust, oil, grease, dirt and other foreign materials before application of paint.

3. Use galvanizing repair paint for surfaces damaged by fabrication or welding, prior to prime coat.

4. Apply shop coat of prime paint of even consistency to provide a uniformly finished surface ready to receive finish paint.

5. Do not paint fire labels on doors or frames.

## 2.4 STANDARD STEEL DOORS:

A. Provide metal doors of types and styles as indicated on drawings or schedules, of seamless, hollow steel construction with 16-gauge face sheets. Form exterior doors of hot dip galvanized steel.

## 2.5 STANDARD STEEL FRAMES:

A. Provide metal frames for doors, transoms, sidelights, borrowed lights, and other openings, of types and styles as shown on drawings and schedules. Conceal fastenings, unless otherwise indicated. Fabricated frames of minimum 16-gauge cold-rolled furniture steel.

1. Frames for doors 7'-10" or more in height and/or over 3'-5" in width: 14 gauge cold-rolled furniture steel, and one additional hinge, whether or not indicated in hardware schedule.

B. Frames shall be formed by press brake with corners sharp and true. Corners shall be mitered and accurately fitted, and shall be fully electrically welded and then ground smooth. Removable spreaders shall be welded to the bottom of the frame. Frames shall be accurately mortise for hardware.

C. A minimum of three wall anchors shall be provided at each jamb, except four at doors 7'-10" high or more, and six at doors 10-foot high or more. Anchors shall be attached to door frames, adjustable, suitable for wall conditions and job requirements, and shall be 16 gauge minimum. Floor anchors shall be provided and welded to foot of each jamb with two 5/16" holes for securing to the floor.

D. Reinforcements of adequate gauge shall be provided for strikes, closers and brackets and other surface applied hardware for field drilling and tapping.

E. Form exterior frames of hot dip galvanized steel.

F. Door Silencers: Except on weatherstripped frames, drill stops to receive 3 silencers on strike jambs of single-swing frames and 2 silencers on heads of double-swing frames. Provide silencers equivalent to "GJ64" silencers as manufactured by Glenn-Johnson Corp., for metal frames, when not provided under the work of Section 08710 - "Finish Hardware."

1. Provide additional door silencers at doors over 3'-0" wide or 7'-0" in height.

G. Plaster Guards: Provide 26-gauge steel plaster guards or mortar boxes, welded to frame, at back of finish hardware cutouts where mortar or other materials might obstruct hardware operation.

## 2.6 DOOR LOUVERS:

A. Provide prefinished louvers according to SDI 111C, at locations indicated, with blades or baffles formed of 0.0239-inch (0.6-mm) thick cold-rolled steel sheet set into minimum 0.0359-inch (0.9-mm) thick steel frame; Galvanized at exterior.

1. Sight-Proof Louvers: Stationary louvers constructed with inverted Y-shaped blades. Minimum free air area calculated per AMCA shall be 36-percent.

2. Finish:

a. Surface Preparation: Solvent clean surfaces to comply with SSPC-SP 1 to remove dirt, oil, grease, and other contaminants that could impair paint bond. Remove mill scale and rust, if present, from uncoated steel, to comply with SSPC-SP 5 (White Metal Blast Cleaning) or SSPC-SP 8 (Pickling).

b. Pretreatment: Immediately after surface preparation, apply conversion coating of type suited to organic coating applied over it.

c. Baked Enamel Finish: Immediately after cleaning and pretreating, apply manufacturer's standard 2-coat baked enamel finish, consisting of prime coat and thermosetting topcoat that complies with ANSI A250.3. Comply with paint manufacturer's current written instructions for applying and baking to achieve a minimum dry film thickness of 2 mils (0.0508 mm).

d. Color and Gloss: As selected by Architect from manufacturer's full range of choices for standard non-metallic colors and gloss.

3. Final finish painting is specified in Section 09900 - "Painting," not the work of this Section 08110.

B. Provide removable bird screens for exterior louvers.

1. Fabricate screen frames of same metal and finish as louver units to which secured, unless otherwise indicated.

2. Provide frames consisting of U-shaped metal for permanently securing screen mesh.

3. Use 1/4-inch x 1/4-inch mesh formed with 0.063-inch diameter aluminum wire.

4. Color: To match louver, or black.

5. Locate screens on inside face of louvers. Secure screens to louver frames with machine screws, spaced at each corner and at 12-inch o.c. between.

## PART 3 - EXECUTION

### 3.1 INSTALLATION:

A. General: Install standard steel doors, frames and accessories in accordance with final shop drawings and manufacturer's data, and as herein specified.

B. Placing Frames:

1. Comply with provisions of SDI-1-06 "Recommended Erection Instructions for Steel Frames," unless otherwise indicated.

2. Except for frames located at in-place concrete or masonry, place frames prior to construction of enclosing walls and ceilings. Set frames accurately in position, plumbed, aligned, and braced securely until permanent anchors are set. After wall construction is completed, remove temporary braces and spreaders leaving surfaces smooth and undamaged.

3. In masonry construction, locate a minimum of 3 wall anchors per jamb at hinge and strike levels. Add 1 wall anchor per jamb at hinge and strike levels for each whole 1'-10" height increment over 6'-0"; Similar at glazed and cased openings.

4. At in-place concrete or masonry construction, set frames and secure to adjacent construction with machine screws and masonry anchorage devices.

5. In metal stud partitions, install at least 3 wall anchors per jamb at hinge and strike levels. Attach wall anchors to studs with tapping screws. Add additional anchors as indicated in Paragraph 3.1-B3 above.

6. Install fire-rated frames in accordance with NFPA Std. No. 80.

C. Door Installation:

1. Fit hollow metal doors accurately in frames, within clearances specified in SDI-100.

2. Place fire-rated doors with clearances as specified in NFPA Std. No. 80.

3. Install silencers after all painting of doors and frames has been completed.

### 3.2 ADJUST AND CLEAN:

A. Prime Coat Touch-up:

1. Immediately after erection, sand smooth any rusted or damaged areas of prime coat and apply touch-up of compatible air-drying primer.

2. Use galvanizing repair paint for galvanized surfaces, prior to prime coat.

B. Final Adjustments: Check and readjust operating finish hardware items, leaving steel doors and frames undamaged and in complete and proper operating condition.

END OF HOLLOW METAL DOORS AND FRAMES

SECTION 082110

FLUSH WOOD DOORS

## PART 1 - GENERAL

### 1.1 RELATED DOCUMENTS:

A. Drawings and general provisions of Contract, including General and Supplementary Conditions and Division 1 Specification Sections, apply to this Section.

B. Related work specified elsewhere includes:

1. Section 09900 - “Painting”
3. Division 15 - “Mechanical” (Door Louvers and Frames)

### 1.2 DESCRIPTION OF WORK:

A. Work described in this section includes solid core flush wood doors with veneer faces and metal frames for any light openings.

B. Unless otherwise indicated, all wood doors will receive “transparent” finish specified in Section 09900 - “Painting”, or factory finish.

C. Note: Any wood doors indicated to have wood frames, shall have hardwood frames with opaque paint finish unless specifically indicated otherwise. Refer to Sections 06200 and 09900 for additional information and requirements.

### 1.3 SUBMITTALS:

A. Product Data: Submit door manufacturer’s technical data for each type of door, including details of core and edge construction, and trim for openings and louvers.

B. Shop Drawings: Submit shop drawings indicating location and size of each door, elevation of each kind of door, details of construction, details of metal frames for light openings, location and extent of hardware blocking, fire ratings, and other pertinent data.

### 1.4 QUALITY ASSURANCE:

A. Quality Standards: Comply with the following standards:

1. NWWDA Quality Standard: I.S.1 “Industry Standard for Wood Flush Doors”, of National Wood Window and Door Association (NWWDA).
2. AWI Quality Standard: “Architectural Woodwork Quality Standards”, including Section 1300 “Architectural Flush Doors”, of Architectural Woodwork Institute (AWI) for grade of door, core construction, finish and other requirements exceeding those of NWWDA quality standard.

B. NWWDA Quality Marking:

1. Mark each wood door with NWWDA Wood Flush Door Certification Hallmark certifying compliance with applicable requirements of NWWDA I.S. 1 Series.

2. For manufacturers not participating in NWWDA Hallmark Program, a certification of compliance may be substituted for marking of individual doors.

C. Fire-Rated Wood Doors: Provide wood doors which are identical in materials and construction to units tested in door and frame assemblies per ASTM E 152 and which are labeled and listed for ratings indicated by UL, Warnock Hersey or other testing and inspection agency acceptable to authorities having jurisdiction.

D. Manufacturer:

1. Obtain doors from a single manufacturer, selecting from manufacturers listed herein.
2. Other manufacturers may be considered, however, approval must be requested from the Architect in writing at least ten (10) days prior to original bid date. Architect will issue only written approval, via letter and/or Addendum, and conditionally subject to compliance with specified requirements.

## 1.5 PRODUCT DELIVER, STORAGE AND HANDLING:

A. Protect wood doors during transit, storage and handling to prevent damage, soiling and deterioration. Comply with requirements of referenced standards and recommendations of NWWDA pamphlet “How to Store, Handle, Finish, Install, and Maintain Wood Doors” as well as with manufacturer’s instructions.

B. Identify each door with individual opening numbers which correlate with designation system used on shop drawings for door, frames, and hardware, using temporary, removable or concealed markings.

## 1.6 PROJECT CONDITIONS:

A. Conditioning:

1. Do not deliver or install doors until conditions for temperature and relative humidity have been stabilized and will be maintained in storage and installation areas during remainder of construction period to comply with the following requirements applicable to project’s geographical location:
2. Referenced AWI quality standard including Section 100-S-3 “Moisture Content”.

## 1.7 WARRANTY:

A. General: Warranties shall run concurrently with, be in addition to, and not a limitation of, other rights the Owner may have under the Contract Documents or otherwise.

B. Door Manufacturer’s Warranty:

1. Submit written agreement on door manufacturer’s standard form signed by Manufacturer, Installer and Contractor, agreeing to repair or replace defective doors that have warped (bow, cup or twist), or that show telegraphing of core construction in face veneers, or do not conform to tolerance limitations of referenced quality standards.
2. Warranty shall also include refinishing and reinstallation which may be required due to repair or replacement of defective doors where defect was not apparent prior to hanging.
3. Warranty shall be in effect during following period to time after date of Substantial Completion.

a. Solid Core Interior Doors: Life of installation.

C. Contractor's Responsibilities: Replace or refinish doors where Contractor's work contributed to rejection or to voiding of manufacturer's warranty.

## PART 2 - PRODUCTS

### 2.1 ACCEPTABLE MANUFACTURERS:

A. Available Manufacturers: Subject to compliance with requirements, provide doors on one of the following:

1. Solid Core Doors with Wood Veneer Faces:

   a. Algoma Hardwoods, Inc.
   b. Eggers Industries, Architectural Door Division.
   c. Ipik Door Co., Inc.
   d. Marshfield Door Systems, Inc.
   e. Oshkosh Architectural Door Co.

2. Metal Frames for Light Openings in Fire Rated and Other Doors: Manufacturer's standard beveled or square frame of 18-gage cold-rolled steel, factory-primed, and approved for use in door of fire-rating indicated or required, and in other doors where indicated.

### 2.2 INTERIOR FLUSH WOOD DOORS:

A. Solid Core Doors: Comply with the following requirements.

1. Faces for Transparent Finish: Birch, Plain Sliced; Consistent similar appearance on all doors, with no "green" or "brown" colored wood.

   a. Similar color and appearance at both sides of doors.

2. AWI Grade:

   a. Transparent Finish: Premium; Veneer Grade: A or better.

3. Solid Core Construction: PC-7 (Particle board core, 7-ply, hot-pressed method), except at wood doors where 30 percent or more of their area is glass use SLC-7 (Staved lumber core, 7-ply, hot-pressed method).

B. Fire-Rated Solid Core Doors:

1. Comply with the following requirements - Faces and AWI Grade: Provide faces and grade to match non-rated doors in same area of building, unless otherwise indicated.
2. Construction: Manufacturer's standard core construction as required to provide fire-resistance rating indicated.
3. Edge Construction: Provide manufacturer's standard laminated edge construction for improved screw-holding capability and split resistance as compared to edges composed of a single layer of treated lumber.
4. Pairs: Provide fire-rated pairs with fire-retardant stiles which are labeled and listed for kinds of applications indicated without formed steel edges and astragals.

## PART 3 - EXECUTION

### 3.1 EXAMINATION:

A. Examine installed door frames prior to hanging door:

1. Verify that frames comply with indicated requirements for type, size, location, and swing characteristics and have been installed with plumb jambs and level heads.
2. Reject doors with defects.

### 3.2 INSTALLATION:

A. Hardware: For installation see Division 8 Section “Finish Hardware”, of these specifications.

B. Manufacturer’s Instructions:

1. Install wood doors to comply with manufacturer’s current written instructions and recommendations, and to comply with referenced AWI standard, and as indicated.
2. Install fire-rated doors in corresponding fire-rated frames in accordance with requirements of NFPA 80.
3. Trim light openings with moldings of material and profile indicated.

C. Job-Fit Doors:

1. Align and fit doors in frames with uniform clearances and bevels as indicated below; do not trim stiles and rails in excess of limits set by manufacturer or permitted with fire-rated doors. Machine doors of hardware. Seal cut surfaces after fitting and machining.
2. Fitting Clearances for Non-Rated Doors: Provide 1/8" at jambs and heads; 1/16" per leaf at meeting stiles for pairs of doors; and 1/8" from bottom of door to top of decorative floor finish or covering. Where threshold is shown or scheduled, provide 1/4" clearance from bottom of door to top of threshold.
3. Fitting Clearances for Fire-Rated Doors: Comply with NFPA 80.
4. Bevel non-rated doors 1/8" in 2" at lock and hinge edges.
5. Bevel fire-rated doors 1/8" in 2" in lock edge; trim stiles and rails only to extent permitted by labeling agency.

D. Prefit Doors: Fit to frames for uniform clearance at each edge.

E. Factory-Finished Doors: Refer to Section 09900 - “Painting” for requirements for finishing wood doors.

### 3.3 ADJUSTING AND PROTECTION:

A. Operation: Rehang or replace doors which do not swing or operate freely.

B. Protect doors as recommended by door manufacturer to ensure that wood doors will be without damage or deterioration at time of Substantial Completion.

END OF FLUSH WOOD DOORS

SECTION 083310

OVERHEAD COILING DOORS

## PART I - GENERAL

### 1.1 RELATED DOCUMENTS:

A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and Division 1 Specification Sections, apply to this Section.

B. Related work specified elsewhere includes:

1. Section 05120 - “Structural Steel”
2. Section 05500 - “Metal Fabrications”
3. Section 06100 - “Rough Carpentry”
4. Section 09900 - “Painting”
5. Section 01030 - “Add Alternates”

### 1.2 SUMMARY:

A. This Section includes the following types of overhead coiling doors:

1. Electric motor operated, prefinished factory prime coated, insulated, galvanized steel exterior doors, and all related work.

### 1.3 DEFINITIONS:

A. Operation Cycle: One complete cycle of a door begins with the door in the closed position. The door is then moved to the open position and back to the closed position.

### 1.4 PERFORMANCE REQUIREMENTS:

A. Structural Performance: Provide overhead coiling doors capable of withstanding the effects of gravity loads and the following loads and stresses without evidencing permanent deformation of door components:

1. Wind Load: Uniform pressure (velocity pressure) required by the Florida Building Code, acting inward and outward.

2. Project Wind Load - Basic Wind Speed: In accordance with applicable building requirements, 145 mph unless higher wind load speed is indicated on Structural Drawings.

B. Operation-Cycle Requirements: Design and warranty overhead coiling door components and operator to operate for not less than 30,000 cycles and for 10 cycles per day.

1. Include tamperproof cycle counter.

### 1.5 QUALITY ASSURANCE:

A. Installer Qualifications: Engage an experienced installer who is an authorized representative of the overhead coiling door manufacturer for both installation and maintenance of units required for this Project.

B. Source Limitations: Obtain overhead doors through one source from a single manufacturer, for exterior coiling service doors and for interior high speed roll-up doors.

1. Obtain operators and any controls from the overhead coiling door manufacturer.

C. Refer to Division 1 Section "Special Conditions" for additional information and minimum experience requirements.

D. Fire-Rated Door Assemblies (if any): Provide assemblies complying with NFPA 80 that are identical to door and frame assemblies tested for fire-test-response characteristics per UL 10b, and that are labeled and listed for fire ratings indicated by UL, FM, ITS/Warnock Hersey, or another testing and inspecting agency acceptable to authorities having jurisdiction.

E. Listing and Labeling: Provide electrically operated fixtures specified in this Section that are listed and labeled.

1. The Terms "Listed" and "Labeled": As defined in NFPA 70, Article 100.

## 1.6 WARRANTIES AND GUARANTEES:

A. Manufacturer's Warranty: Manufacturer's standard guarantees and warranties for products, components, motor, finishes, labor and materials, and total overhead coiling door assemblies. Signed by an authorized representative of overhead coiling doors manufacturers, on form published with current product literature as of date of Contract Documents.

B. The Guarantees and Warranties shall be in addition to and run concurrent with other warranties made by the Contractor under the requirements of the Contract Documents, and shall not deprive or limit the Owner of any other rights the Owner may have for remedy.

# PART 2 - PRODUCTS

## 2.1 MANUFACTURERS:

A. Manufacturer: Subject to compliance with requirements, provide products by one of the following:

1. Coiling Service Doors:

a. Alpine Overhead Doors, Inc.
b. Atlas Door Corp.; Div. of Clopay Building Products Co.
c. The Cookson Company.
d. Cornell Iron Works Inc.
e. Overhead Door Corporation.
f. Raynor Garage Doors.
g. Rite Hite Corporation.
h. Roll-Lite Door Corp.; Div. of Clopay Building Products Co.
i. Wayne-Dalton Corp.
j. Windsor Door; A United Dominion Company.

## 2.2 SERVICE DOORS - EXTERIOR:

A. Overhead Coiling Door - Product/Manufacturer: Provide Series No. 625, as manufactured by Overhead Door Corporation; Dallas, Texas (1-800-887-3667 or 1-706-548-0534), and as specified, or equivalent by one of the above named manufacturers, complete with all standard features and accessories, and as follows:

1. Flat profile, insulated, 24-gauge galvanized steel slats.
2. Insulation: CFC-free and HCFC-free polyurethane.
3. Finishes - General: Galvanized steel with baked enamel primer paint finish.
4. Galvanized structural steel angles at bottom bar with astragal, with combination bottom weatherseal and pneumatic sensor edge.
5. Roll-formed galvanized steel guides, with weatherstripping, end-locks and wind-locks.
6. Torsion springs counterbalance mechanism.
7. Galvanized steel hood, box-shaped, 24-gauge, with internal weather / wind baffle.
8. Electric motor operation, with slide bolt locking bars equipped to accept padlocks.
9. Designed for face-of-wall mounting, unless between jambs mounting is indicated on the Drawings.
10. Weatherseals: Bottom, exterior guides, interior hood, and interior guides.
11. Push/Pull Handles: For push-up-operated or emergency operated doors, provide galvanized steel lifting handles on each side of door.
    a. Provide pull-down straps or pole hooks for doors more than 84-inches high.
12. Chain Lock Keeper: For emergency operation; suitable for padlock.
13. Provide safety interlock switch to disengage power supply when door is locked.
14. Manufacturer's standard guarantees and warranties for products, components, motor, finishes, labor and materials, and total overhead coiling door assemblies.

## 2.3 ELECTRIC DOOR OPERATORS:

A. General: Provide electric door operator assembly of size and capacity recommended and provided by door manufacturer for door and operational life specified, with electric motor and factory-prewired motor controls, starter, gear-reduction unit, solenoid-operated brake, clutch, remote-control stations, control devices, integral gearing for locking door, and accessories required for proper operation.

B. Comply with NFPA 70.

C. Disconnect Device: Provide hand-operated disconnect or mechanism for automatically engaging sprocket-chain operator and releasing brake for emergency manual operation while disconnecting motor, without affecting timing of limit switch. Mount disconnect and operator so they are accessible from floor level. Include interlock device to automatically prevent motor from operating when emergency operator is engaged.

D. Design operator so motor may be removed without disturbing limit-switch adjustment and without affecting emergency auxiliary operator.

E. Provide control equipment complying with NEMA ICS 1, NEMA ICS 2, and NEMA ICS 6, with NFPA 70 Class 2 control circuit, maximum 24-V, ac or dc.

F. Door-Operator Type: Provide wall-mounted, jackshaft, gear-head hoist-type door operator unit consisting of electric motor, enclosed worm-gear running-in-oil primary drive, chain and sprocket secondary drive, and auxiliary chain-hoist and floor level disconnect.

G. Electric Motors: Provide high-starting torque, reversible, continuous-duty, Class A insulated, electric motors, complying with NEMA MG 1, with overload protection, sized to start, accelerate, and

operate door in either direction, from any position, at not less than 2/3 fps0.2 m/s or more than 1 fps0.3 m/s, without exceeding nameplate ratings or considering service factor.

1. Type: Polyphase, medium-induction type.
2. Service Factor: According to NEMA MG 1, unless otherwise indicated.
3. Coordinate wiring requirements and electric characteristics of motors with building electrical system; If building electrical system is not to be provided with initial construction, Contractor and supplier should assume single-phase power will be available.
4. Provide open dripproof-type motor, and controller with NEMA ICS 6, Type 1 enclosure.

H. Remote-Control Station: Provide momentary-contact, 3-button control station with push-button controls labeled “Open,” “Close,” and “Stop.”

1. Provide interior units, full-guarded, surface-mounted, heavy-duty type, with general-purpose NEMA ICS 6, Type 1 enclosure.

I. Obstruction Detection Device: Provide each motorized door with indicated external automatic safety sensor able to protect full width of door opening. Activation of sensor immediately stops and reverses downward door travel.

1. Sensor Edge: Provide each motorized door with an automatic safety sensor edge, located within astragal or weather stripping mounted to bottom bar. Contact with sensor immediately stops and reverses downward door travel. Connect to control circuit using manufacturer’s standard take-up reel or self-coiling cable.

a. Provide pneumatically actuated automatic bottom bar.

1) Self-Monitoring Type: Provide self-monitoring, 4-wire configured device.

J. Limit Switches: Provide adjustable switches, interlocked with motor controls and set to automatically stop door at fully opened and fully closed positions.

1. Provide electric operators with ADA-AG compliant audible alarm and visual indicator lights.

## PART 3 - EXECUTION

### 3.1 INSTALLATION:

A. General: Install doors and operating equipment complete with necessary hardware, jamb and head mold strips, anchors, inserts, hangers, and equipment supports according to reviewed Shop Drawings, manufacturer’s current written instructions, and as specified.

1. Install any fire-rated doors to comply with NFPA 80.

B. Provide complete installation with all standard and listed optional accessories and features, so as to provide complete, properly operating and fully functional installations.

### 3.2 ADJUSTING:

A. Lubricate bearings and sliding parts; adjust doors to operate easily, free from warp, twist, and/or distortion, and fitting weathertight for entire perimeter.

B. Repair damaged components and restore damaged finishes, to original and unnoticeable condition, or replace.

## 3.3 DEMONSTRATION:

A. Startup Services: Engage a factory-authorized service representative to perform startup services and to train Owner's maintenance personnel as specified below:

1. Test and adjust controls and safeties. Replace damaged and malfunctioning controls and equipment.

2. Fire-Rated Doors (if any):

a. Test door closing when activated by detector or alarm connected fire-release system. Reset door-closing mechanism after successful test.

b. Train Owner's maintenance personnel on procedures and schedules related to startup and shutdown, troubleshooting, servicing, preventive maintenance, and procedures for testing and resetting release devices.

3. Review data in the maintenance manuals. Refer to Division 1 Section "Project Closeout."

4. Schedule training with Owner with at least 7 days' advance notice.

END OF SECTION

SECTION 084100

ALUMINUM ENTRANCES AND STOREFRONT

## PART 1 - GENERAL

### 1.1 RELATED DOCUMENTS:

A. Section Includes: Kawneer Aluminum Entrances, glass and glazing, and door hardware and components.

1. Types of Kawneer Aluminum Hurricane Resistant Entrances include:

a. 350 IR Entrances; Medium stile, 3-1/2" vertical face dimension, 1-3/4" depth, Interior structural silicone glazed, High traffic/impact resistant applications.

b. IR 501 Framing System: 2-1/2” x 5”, non-thermal, center glazed for 1-5/16” impact resistant glazing interior structural silicone glazed, screw spline fabrication.

B. Related Sections:

.. SECTION 07270 – “Fire Stopping”
.. SECTION 07900 – “Joint Sealers”
.. SECTION 08410 – “Aluminum Entrances and Storefronts”
.. SECTION 08710 – “Door Hardware”
.. SECTION 08800 – “Glass and Glazing”

### 1.2 SYSTEM DESCRIPTION:

A. Entrance Performance Requirements:

1. Windloads: Provide immediate door framing for swing doors, including anchorage, capable of withstanding windload design pressures. These design pressures are based upon Florida Building Code, 2017 Edition.

2. Air Infiltration: For single acting offset pivot, butt hung or continuous geared hinge entrances in the closed and locked position, the test specimen shall be tested in accordance with DCBCCO Protocol PA 202 and ASTM E 283 at a pressure differential of 1.57 psf for pairs of doors. A pair of 6'0" x 8'0" entrance doors and frame shall not exceed 1.2 cfm\ft2.

3. Structural: Corner strength shall be tested per Kawneer’s dual moment load test procedure and certified by an independent testing laboratory to ensure weld compliance and corner integrity [Testing procedure and certified test results available upon request.

4. Uniform Load: A static air design load of 85 psf (65 psf for 9/16" laminated infill) shall be applied in the positive and negative direction in accordance with DCBCCO Protocol PA 202 and ASTM E 330. There shall be no deflection in excess of l/180 of the span of any framing member. At a structural test load equal to 1.5 times the specified design load, no glass breakage shall occur.

5. Impact Resistance: Large Missile, tested in accordance with DCBCCO Protocols PA 201, PA 203, SBCCI SSTD-12 and ASTM E 1886 at a door opening of 6'0" x 8'0".

6. Forced Entry: Tested in accordance with SFBC 3603.2 (b) (5).

## 1.3 SUBMITTALS:

A. General: Prepare, review, approve, and submit specified submittals in accordance with "Conditions of the Contract" and Division 1 Submittals Sections. Product data, shop drawings, samples, and similar submittals are defined in "Conditions of the Contract."

B. Quality Assurance/Control Submittals:

1. Test Reports: Submit certified test reports showing compliance with specified performance characteristics.

## 1.4 WARRANTY:

A. Project Warranty: Refer to "Conditions of the Contract" for project warranty provisions.

B. Manufacturer's Product Warranty: Submit, for Owner's acceptance, manufacturer's warranty for entrance system as follows:

1. Warranty Period: Two (2) years from Date of Substantial Completion of the project provided however that the Limited Warranty shall begin in no event later than six months from date of shipment by Kawneer. In addition, welded door corner construction shall be supported with a limited lifetime warranty for the life of the door under normal use.

## 1.5 QUALITY ASSURANCE:

A. Qualifications:

1. Installer Qualifications: Installer experienced (as determined by contractor) to perform work of this section who has specialized in the installation of work similar to that required for this project and who is acceptable to product manufacturer.

2. Manufacturer Qualifications: Manufacturer capable of providing field service representation during construction, approving acceptable installer and approving application method.

B. Pre-Installation Meetings: Conduct pre-installation meeting to verify project requirements, substrate conditions, manufacturer's installation instructions, and manufacturer's warranty requirements.

## 1.7 DELIVERY, STORAGE AND HANDLING:

A. Ordering: Comply with manufacturer's ordering instructions and lead-time requirements to avoid construction delays.

B. Packing, Shipping, Handling and Unloading: Deliver materials in manufacturer's original, unopened, undamaged containers with identification labels intact.

C. Storage and Protection: Store materials protected from exposure to harmful weather conditions. Handle storefront material and components to avoid damage. Protect storefront material against

damage from elements, construction activities, and other hazards before, during and after storefront installation.

## PART 2 - PRODUCTS

### 2.1 MANUFACTURERS:

A. Acceptable Manufacturers: Kawneer Company, Inc.

1. Address: Kawneer Company, Inc. or
555 Guthridge Court,
Technology Park/Atlanta,
Norcross, GA 30092
a. Telephone: 770 449 5555
b. Fax: 770 734 1560

2. Proprietary Product(s)/System(s): Kawneer Aluminum Hurricane Resistant Entrances/Framing System.

a. Series: 350 IR Entrances – 3-1/2" vertical stile, 3-1/2" top rail, 10" bottom rail.

b. Series: IR 501 Framing System – 2-1/2" x 5" non-thermal, center glazed, interior structural silicone glazed, screw spline fabrication.

c. Finish/Color: (See 2.6 Finishes)

B. Substitutions:

1. General: Refer to Division 1 Substitutions for procedures and submission requirements.

a. Pre-Contract (Bidding Period) Substitutions: Submit written requests ten (10) days prior to bid date.

2. Substitution Documentation

a. Product Literature and Drawings: Submit product literature and drawings modified to suit specific project requirements and job conditions.

b. Certificates: Submit certificate(s) certifying substitute manufacturer (1) attesting to adherence to specification requirements for entrance system performance criteria, and (2) has been engaged in the design, manufacturer and fabrication of aluminum entrances for a period of not less than ten (10) years. (Company Name)

c. Test Reports: Submit test reports verifying compliance with each test requirement required by the project.

d. Product Sample and Finish: Submit product sample, with specified finish and color.

3. Substitution Acceptance: Acceptance will be in written form, either as an addendum or modification, and documented by a formal change order signed by the Owner and Contractor.

## 2.2 MATERIALS:

A. Aluminum (Entrances and Components):

1. Material Standard: ASTM B 221; 6063-T6 alloy and temper

2. The door stile and rail face dimensions of the 350 IR Entrance doors will be as follows:

| Door | Vertical Stile | Top Rail | Bottom Rail |
|---|---|---|---|
| 350 IR | 3-1/2" | 3-1/2" | 10" |

3. Major portions of the door members to be 0.125" nominal in thickness and glazing molding to be 0.050" thick.

4. Tolerances: Reference to 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.

B. Glazing gaskets shall be either EPDM elastomeric extrusions or a thermoplastic elastomer.

C. Structural silicone sealant to be Dow Corning 983 or 995.

## 2.3 HARDWARE:

A. Fasteners: Where exposed, shall be stainless steel.

B. Perimeter Anchors: When steel anchors are used, provide insulation between steel material and aluminum material to prevent galvanic action.

C. Standard Entrance Hardware

1. Weather stripping:

a. Meeting stiles on pairs of doors shall be equipped with an adjustable astragal utilizing wool pile with polymeric fin.
b. The door weathering on a single acting offset pivot or butt hung door and frame (single or pairs) shall be Kawneer Sealair® weathering. This is comprised of a thermoplastic elastomer weathering on a tubular shape with a semi-rigid polymeric backing.

2. Sill Sweep Strips: EPDM blade gasket sweep strip in an aluminum extrusion applied to the interior exposed surface of the bottom rail with concealed fasteners. (Necessary to meet specified performance tests.)

3. Threshold: Extruded aluminum, one piece per door opening, with ribbed surface, meeting ADA requirements.

4. Offset Pivots: Kawneer standard top and bottom pivots with one intermediate offset pivot.

5. Butt Hinge: 1-1/2 pair Kawneer standard 4-1/2" x 4" ball bearing hinges.

6. Continuous Geared Hinge: [_____] (tested to +/- 65 psf Uniform Load).
7. Push/Pull: CPN style.

8. Panic Device: Jackson 2086 Concealed Vertical Rod Exit Device or Paneline Concealed Rod Exit Device (tested to +/- 65 psf Uniform Load).

9. Closer: Surface or concealed closer (concealed closer with non-transom and non-sidelite Trifab VG 450 (Center) and 1600 Wall sub-frames only).

10. Security Lock/Dead Lock: MS 1850A lock with 3-point active stile locking and hurricane flushbolts on pairs or MS 1850A lock with 1871 cylinder operated flushbolts.

11. Cylinder(s)/Thumbturn: Kawneer standard.

12. Cylinder Guard: Kawneer standard.

## 2.4 RELATED MATERIALS:

A. Sealants: Refer to Joint Treatment (Sealants) Section.

B. Glass:

1. Entrance Doors: Viracon – HRG-2, 9/16” infil, tinted.

2. IR 501 Framing System: 1-5/16” insulated laminated infill with 0.090 PVB (solutia saflex), tinted.

## 2.5 FABRICATION:

A. Entrance System Fabrication:

1. Door corner construction shall consist of mechanical clip fastening, SIGMA deep penetration plug welds and 1-1/8" long fillet welds inside and outside of all four corners. Exterior glazing stop shall be hook-in type with EPDM glazing gaskets reinforced with non-stretchable cord. Interior glazing stop shall be mechanically fastened to the door member and it shall incorporate a silicone compatible spacer used with silicone sealant.

2. Accurately fit and secure joints and corners. Make joints hairline in appearance.

3. Prepare components with internal reinforcement for door hardware.

4. Arrange fasteners and attachments to conceal from view.

## 2.6 FINISHES:

A. Shop Finishing:

1. Kawneer Permanodic® AA-M12C22A31, AAMA 611, Architectural Class II Clear Anodic Coating. Color #17 Clear; Standard.

## 2.7 SOURCE QUALITY CONTROL:

A. Source Quality: Provide aluminum entrances specified herein from a single source.

1. Building Enclosure System: When aluminum entrances are part of a building enclosure system, including storefront framing, windows, curtain wall system and related products, provide building enclosure system products from a single source manufacturer.

B. Fabrication Tolerances: Fabricate aluminum entrances in accordance with entrance manufacturer's prescribed tolerances.

## PART 3 - EXECUTION

### 3.1 EXAMINATION:

A. Site Verification of Conditions: Verify substrate conditions (which have been previously installed under other sections) are acceptable for product installation in accordance with manufacturer's instructions. Verify openings are sized to receive storefront system and sill plate is level in accordance with manufacturer's acceptable tolerances.

1. Field Measurements: Verify actual measurements/openings by field measurements before fabrication; show recorded measurements on shop drawings. Coordinate field measurements, fabrication schedule with construction progress to avoid construction delays.

### 3.2 INSTALLATION:

A. General: Install entrance system in accordance with manufacturer's instructions and AAMA storefront and entrance guide specifications manual.

1. Attach to structure to permit sufficient adjustment to accommodate construction tolerances and other irregularities.

2. Provide alignment attachments and shims to permanently fasten system to building structure.

3. Align assembly plumb and level, free of warp and twist. Maintain assembly dimensional tolerances aligning with adjacent work.

4. Set thresholds in bed of mastic and secure.

5. Adjusting: Adjust operating hardware for smooth operation.

B. Related Products Installation Requirements:

1. Sealants (Perimeter): Refer to Section 7 Joint Treatment (Sealants).

2. Glass: Refer to Section 8 Glass and Glazing.

a. Reference: ANSI Z97.1, CPSC 16 CFR 1201 and GANA Glazing Manual.

### 3.3 PROTECTION AND CLEANING:

A. Protection: Protect installed product's finish surfaces from damage during construction. Protect aluminum storefront system from damage from grinding and polishing compounds, plaster, lime, acid, cement, or other harmful contaminants.

B. Cleaning: Repair or replace damaged installed products. Clean installed products in accordance with manufacturer's instructions prior to owner's acceptance. Remove construction debris from project site and legally dispose of debris.

END OF SECTION

SECTION 087100

FINISH HARDWARE

## PART 1 - GENERAL

### 1.1 SECTION INCLUDES

A. All items known commercially as Finish or Door Hardware.

B. Thresholds and Weatherstripping/Door Seals.

### 1.2 RELATED SECTIONS

A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and Division 1 Specification Sections, apply to this Section.

B. Related work specified elsewhere includes the following:

1. Section 08110 – “Steel Doors and Frames”

### 1.3 REFERENCES

A. BHMA (Builders Hardware Manufacturers Association) A156 series.

B. DHI (Door and Hardware Institute) A115 series.

C. SDI – 107 – 84 – Hardware on Steel Doors (Reinforcement – Application.)

D. SDI – 109 – 88 – Hardware for Standard Steel Doors & Frames.

E. NFPA – 80 – Fire Doors and Windows.

F. NFPA – 101-2000 - Life Safety Code.

G. ADA-AG – Americans with Disabilities Act - Accessibility Guidelines.

### 1.4 SUBMITTALS

A. General: Submit the following in accordance with Conditions of Contract and Division 1 Specification Sections.

B. Product Data – Submit two (2) copies of manufacturer’s catalog sheets describing each item of hardware to be supplied.

C. Schedules: Submit six (6) copies of hardware schedules for Architect’s approval. Schedules are to include quantity, type, location, finish and manufacturer of each item of hardware for each opening. Schedule may be horizontal or vertical format. No material is to be ordered until the submittal is approved. After approval, no substitutions will be allowed without the written approval of the Architect.

D. Samples: If requested by the Architect, submit a sample of each hardware item in the design and finish to be used on the project. Samples may be used on the project provided they are undamaged during the submittal process.

E. Templates: Furnish template information to the General Contractor for use by other trades in fabricating related materials.

F. Project Closeout: On completion of the project, furnish one (1) copy of the "as furnished" hardware schedule along with one (1) copy each of the keying schedule, manufacturer's maintenance instructions and any special tools which may be required to maintain or adjust the hardware. In addition, furnish copies of all manufacturer's warranties for the owner's records.

## 1.5 QUALITY ASSURANCE

A. Manufacturers and model numbers listed in the hardware sets portion of this specification are for the purpose of establishing a standard of quality. Similar products by approved manufacturers that are equal in design, function and quality will be acceptable upon prior approval of the Architect provided the required physical samples and data are submitted in accordance with Section 01015.

B. The hardware supplier shall be a firm specializing in finish hardware. The firm shall have been engaged in this business for a period of not less than five (5) years and shall have in its employ a full time, certified Architectural Hardware Consultant (AHC) or person of equivalent experience. This person shall be available to the Architect at reasonable times for consultation regarding this project. This supplier shall be a direct, factory authorized distributor for the manufacturer of the materials being furnished.

C. The hardware manufacturer shall be a recognized firm regularly engaged in the manufacture and sale of finished hardware items.

D. If required, the hardware supplier shall furnish certification and documentation that his materials meet all physical and environmental requirements of the project.

E. As near as possible, obtain each type of hardware (hinges, locks, closers, etc.) from a single manufacturer.

F. Provide hardware for fire rated openings that complies with the requirements of NFPA 80 and authorities having jurisdiction. Provide only items of door hardware that have been tested and listed by UL, FM, Warnock-Hersey or other testing organizations acceptable to the authorities having jurisdiction.

G. Products and installation under the work of this Section shall be in compliance with applicable provisions of published U. S. Justice Department Regulations for the "Americans with Disabilities Act of 1990" (ADA; ADA-AG); ANSI A117.1; and the "Uniform Federal Accessibility Standards" (UFAS), 1988 Edition; And revisions and amendments thereto.

1. Where this requires any substitution of products specified herein, advise Architect in writing for necessary approvals.

## 1.6 DELIVERY, STORAGE AND PROTECTION

A. Refer to Division 1 Sections "Summary of Work" and "Special Conditions" for additional information and requirements regarding transportation, handling and storage of project materials.

B. Package each item individually. Label and clearly identify each package with item nomenclature and door opening. Correlate all making and opening numbers to match the hardware schedule.

C. The General Contractor is to provide a secure, locked storage area for all items delivered to the jobsite.

D. The General Contractor shall inventory all items delivered to the jobsite within forty-eight hours and advise the supplier immediately of any shortages.

## 1.7 PROJECT CONDITIONS

A. The General Contractor will coordinate the work between this supplier and other related sections such as hollow metal and wood door suppliers to insure proper manufacturer and fabrication of doors to receive the approved hardware.

## 1.8 WARRANTY

A. Provide manufacturers warranties from hardware supplier as follows:

1. Closers: Ten years
2. Exit Devices & Locksets: Three years
3. Locksets: Three Years.
4. All other Hardware: Two years.

B. Warranties shall cover failure due to manufacturing defects or material failure only. They shall not cover abuse, vandalism, improper installation or maintenance. Defective materials are to be replaced at no cost to the owner.

C. The above warranties shall be in addition to, shall be in effect simultaneously with, and shall not alter other project or product warranties or guarantees, nor shall they serve as a limitation to other remedies available to the Owner.

# PART 2 - PRODUCTS

## 2.1 MANUFACTURERS

A. Acceptable products and their manufacturers are listed below. Specific information regarding functions, sizes, mounting and types is found in the hardware sets at the end of the section.

1. Hinges:

| | MFG'R | FINISH | TYPE/SERIES |
|---|---|---|---|
| a. | Stanley | 26D/CL | FBB179/661HD |

2. Exit Devices:

| | MFG'R | FINISH | SERIES/DESIGN |
|---|---|---|---|
| a. | Stanley | 32D | 2100 Series x 1700 & 4900 Trim |
| b. | Von Duprin | 32D | 98 Series x 697 & 996L Trim |

Note: All exit devices for exterior openings to meet hurricane codes.

3. Locks, Latches and Dummy Trim:

| MFG'R | FINISH | SERIES/DESIGN |
|---|---|---|

| | | | |
|---|---|---|---|
| a. | Best | 26D | 93K14D |
| b. | Schlage | 26D | ND Series x IC Core X SPA Trim |

4. Cylinders, Deadlocks & Misc. Locks:

| | MFG'R | FINISH | SERIES/DESIGN |
|---|---|---|---|
| a. | Best | 26D | 48H |

5. Closers:

| | MFG'R | FINISH | SERIES/DESIGN |
|---|---|---|---|
| a. | Stanley | | |

6. Push/Pulls/Kickplates:

| | MFG'R | FINISH | TYPE/SERIES |
|---|---|---|---|
| a. | Rockwood | 32D | 70F/107 x 70C/K1050 |
| b. | Hager | 32D | 30S/33J/190S |
| c. | Ives | 32D | 8200/8300-8/8400 |

7. Bolts/DP Strikes/Misc.:

| | MFG'R | FINISH | TYPE/SERIES |
|---|---|---|---|
| a. | Rockwood | 26D | 555/570 |
| b. | Hager | 26D | 282D/280X |
| c. | Ives | 26D | FB458/DP2 |

8. Overhead Stops:

| | MFG'R | FINISH | TYPE/SERIES |
|---|---|---|---|
| | NONE | | |

9. Stops and Miscellaneous Items:

| | MFG'R | FINISH | ITEM |
|---|---|---|---|
| a. | Rockwood | 32D | 408/443 |
| b. | Hager | 32D | 232W/243F |
| c. | Ives | 32D | WS408/FS438 |
| d. | LCN | 689 | SEM7840 |

10. Thresholds and Weatherstripping:

| | MFG'R | FINISH | TYPE/ITEM |
|---|---|---|---|
| a. | Pemko | AL | As Specified |
| b. | Hager | AL | Equal |
| c. | Natl Guard | AL | Equal |

B. Substitutions: Substitutions from the listed manufacturers and products without prior approval of the architect are not permitted. Suppliers desiring to bid products not listed must make written application to the architect no less than seven (7) working days prior to the bid date. Applications must be accompanied by manufacturer's complete literature and/or samples to allow the Architect to make an informed decision. Verbal requests will not be considered. Approval of alternate

manufacturer's products will only be in writing or by addendum to insure an equitable competitive situation for all bidders.

## 2.2 MATERIALS AND FABRICATION

A. Base Metals: Produce hardware units of basic metal and forming method indicated using manufacturer's standard metal alloy, composition, temper and hardness, but in no case of lesser (commercially recognized) quality than specified for applicable hardware units for finish designations indicated.

B. Fasteners: Provide hardware manufactured to conform to published templates, generally prepared for machine screw installation. Do not provide hardware that has been prepared for self-tapping sheet metal screws, except as specifically indicated.

C. Furnish stainless steel screws for installation with each hardware item. Provide Phillips flat-head screws except as otherwise indicated. Furnish exposed (exposed under any condition) screws to match hardware finish or if exposed in surfaces of other work, to match finish of this other work as closely as possible including "prepared for paint" surfaces to receive painted finish.

D. Provide concealed fasteners for hardware units that are exposed when door is closed except to the extent no standard units of type specified are available with concealed fasteners. Do not use thru-bolts for installation where bolt heads or nuts are exposed on opposite face unless their use is the only means of adequately securing the hardware or where required on labeled doors. In no case are thru-bolts to be used as a substitute for proper reinforcement of doors or frames.

## 2.3 FINISHES

A. Finishes for all items are as listed in the hardware schedule at the end of this section.

B. Finish designations are as listed in ANSI/BHMA A156.18 "American Standards for Materials and Finishes: and are the industry recognized standard commercial finishes.

## 2.4 KEYING

A. Key all cylinders into the existing system or a new MK system as required. Furnish the following:

1. 6 Master Keys per new group.
2. 3 Change Keys per cylinder.
3. Temporary cores for all cylinders

B. Meet with owner's representative to determine exact keying requirements. Ship permanent cores and keys direct from factory to owner.

# PART 3 - EXECUTION

## 3.1 INSTALLATION

A. Mount hardware units at heights indicated in following applicable publications, except as specifically indicated or required to comply with governing regulations and except as otherwise directed by architect.

1. "Recommended Locations for Builders Hardware for Standard Steel Doors and Frames" by the DOOR AND HARDWARE INSTITUTE.

2 WDMA Industry Standard I.S. 1.A-97, "Hardware Locations for Wood Flush Doors."

B. Install each hardware item in compliance with the manufacturer's instructions and recommendations. Where cutting and fitting is required to install hardware onto or into surfaces that are later to be painted or finished in another way, coordinate removal, storage, and reinstallation or application of surface protection with finishing work specified in the Division 9 Section "Painting". Do not install surface-mounted items until finishes have been completed on the substrates involved.

C. Set units level, plumb, and true to line and location. Adjust and reinforce the attachment substrate as necessary for proper installation and operation.

D. Drill and countersink units that are not factory prepared for anchorage fasteners. Space fasteners and anchors in accordance with industry standards.

E. Set thresholds in sealant complying with requirements specified in Division 7 Section "Joint Sealers".

F. Weatherstripping and Seals: Comply with manufacturer's instructions and recommendations to the extent installation requirements are not otherwise indicated.

## 3.2 ADJUSTING AND CLEANING

A. Adjust and check each operating item of hardware and each door to ensure proper operation or function of every unit. Replace units that cannot be adjusted to operate freely and smoothly or as intended for the application made.

B. Where door hardware is installed more than one month prior to acceptance or occupancy of a space or area, return to the installation during the week prior to acceptance or occupancy and make final check and adjustment of all hardware items in such space or area. Clean operating items as necessary to restore proper functions and finish of hardware and doors. Adjust door control devices to compensate for final operation of heating and ventilating equipment.

C. Clean adjacent surfaces soiled by hardware applications.

## 3.3 HARDWARE SCHEDULE

A. Hardware Sets – ***** COORDINATE WITH HARDWARE SCHEUDLE ON DRAWINGS *****

NOTES:
1. Mount all closers inside; away from exterior, lobbies, corridors etc.
2. Furnish 3 silencers, Rockwood 608, for each hollow metal frame and 2 for each double.
3. Determine required voltage for magnetic holders, where required, before ordering (if any).

END OF SECTION

SECTION 088000

GLASS AND GLAZING
(Impact Resistant Glass)

## PART 1 - GENERAL

### 1.1 RELATED DOCUMENTS:

A. Drawings and general provisions of Contract, including General and Supplementary Conditions and Division-1 Specification sections, apply to work of this section.

B. Related work specified elsewhere includes:

.. Section 07900 - “Joint Sealers”
.. Section 08110 - “Steel Doors and Frames”
.. Section 08211 - “Flush Wood Doors”
.. Section 08410 - “Aluminum Entrances and Storefront”

### 1.2 SUMMARY:

A. Extent of glass and glazing work is indicated on drawings and schedules.

B. Types of work in this section include glass and glazing for:

1. Hollow metal doors, transoms, and windows.
2. Aluminum doors, transoms, and windows (storefront).
3. Wood Doors.
4. Glazing accessories.

C. General Locations - Glazing Types:

1. Insulating Glass Assemblies shall be used at all exterior openings, except doors.

2. Single Pane Glass shall be used at all other locations, and at doors.

3. Refer to Drawings and Specifications for locations where heat treated/tempered glass, etc., are required.

D. Glass Assemblies - Glass Colors:

1. Typical exterior glass shall be as follows:

a. Exterior Pane: 1/4-inch tinted grey glass, as specified, selected by Architect.
b. Interior Pane: 1/4-inch clear transparent glass, as specified, after bidding.

2. Exterior glass where indicated to be “frosted,” “obscure,” or “etched,” shall be as specified at Paragraph 2.5-C3 “Etched Glass,” which requires smooth sandblasted finish on the exterior side of the inside pane.

E. Single Pane Glass Assemblies - Glass Colors:

1. Typical interior glass and glass at interior and exterior doors shall be as follows:

   a. 1/4-inch clear transparent tempered safety glass, as specified.

2. Glass indicated to be “frosted,” “obscure,” or “etched,” as specified in Paragraph 2.5-C3 “Etched” Glass, which requires smooth sandblasted finish on one side.

   a. Mount etched side of single pane glass facing toward the interior of the building.

## 1.3 SYSTEM DESCRIPTION:

A. Provide glass and glazing that has been produced, fabricated and installed to withstand normal thermal movement, wind loading and impact loading (where applicable), without failure including loss or breakage of glass, failure of sealants or gaskets to remain watertight and airtight, deterioration of glass and glazing materials and other defects in the work.

1. Normal thermal movement is defined as that resulting from an ambient temperature range of 120□F (67□C) and from a consequent temperature range within glass and glass framing members of 180□F (100□C), minimum. Modify as required for more extreme conditions.

2. Deterioration of insulating glass is defined as failure of hermetic seal due to other causes than breakage which results in intrusion of dirt or moisture, internal condensation or fogging, deterioration of protected internal glass coating, if any, resulting from seal failure, and any other visual evidence of seal failure or performance.

3. Deterioration of coated glass is defined as the development of manufacturing defects including peeling, cracking or other indications of deterioration in metallic or other coating due to normal conditions of use.

## 1.4 SUBMITTALS:

A. Product Data: Submit manufacturer’s technical data for each glazing material and fabricated glass product required, including installation and maintenance instructions.

B. Samples: Submit, when requested by Architect, for verification purposes, 12-inch square samples of each type of glass indicated except for clear single pane units, and 12-inches long samples of each color required (except black) for each type of sealant or gasket exposed to view. Install sealant or gasket sample between two strips of material representative of adjoining framing system in color.

C. Certificate: Submit certificates from respective manufacturers attesting that glass and glazing materials furnished for project comply with requirements.

1. Separate certification will not be required for glazing materials bearing manufacturer’s permanent labels designating type and thickness of glass, provided labels represent a quality control program involving a recognized certification agency or independent testing laboratory acceptable to authorities having jurisdiction.

D. Warranty: Submit sample of manufacturer’s warranty for each product for which a warranty is either required by these Specifications or otherwise available from the manufacturer.

## 1.5 QUALITY ASSURANCE:

A. General: All glass shall comply with FS DD-G-451, except where more stringent standard is indicated or required by authorities having jurisdiction.

1. At locations where glass size cannot be supplied as indicated, provide similar glass in better quality and/or greater thickness; Coordinate with glass framing.

2. Furnish each piece of glass with a label indicating type, quality, thickness, etc., and do not remove until after written approval is received from Architect and Owner's representative.

B. Glazing Standards: Comply with recommendations of Flat Glass Marketing Association (FGMA) "Glazing Manual" and "Sealant Manual", and SIGMA TM-3000, "Vertical Glazing Guidelines", except where more stringent requirements are indicated. Refer to those publications for definitions of glass and glazing terms not otherwise defined in this section or other referenced standards.

C. Safety Glazing Standard: Where safety glass is indicated or required by authorities having jurisdiction, provide type of products indicated which comply with ANSI Z97.1 and testing requirements of 16 CFR Part 1201 for Category II materials.

D. Fire Resistance Rated Wire Glass: Provide wire glass products that are identical to those tested per ASTM E 163 (UL 9) and are labeled and listed by UL or other testing and inspecting agency acceptable to authorities having jurisdiction.

E. Insulating Glass Certification Program: Provide insulating glass units permanently marked either on spacers or at least one component pane of units with appropriate certification label of the inspecting and testing organization indicated below:

1. Insulating Glass Certification Council (IGCC).

a. Certification: CBA.

F. Single Source Responsibility for Glass: To ensure consistent quality of appearance and performance, provide materials produced by a single manufacturer or fabricator for each kind and condition of glass indicated and composed of primary glass obtained from a single source for each type and class required.

G. Subcontractor Qualifications: Glazing Subcontractors shall comply with experience requirements for work on this project the same as stated in Section 08410 - "Aluminum Entrances and Storefront."

H. Windborne-Debris-Impact Resistance: Provide exterior glazing that passes enhanced-protection testing requirements in ASTM E 1996 for 145 miles per hour Wind Zone when tested according to ASTM E 1886. Test specimens shall be no smaller in width and length than glazing indicated for use on the Project and shall be installed in same manner as glazing indicated for use on the Project.

1. Large-Missile Test: For all glazing, regardless of height above grade.

## 1.6 DELIVERY, STORAGE, AND HANDLING:

A. Protect glass and glazing materials during delivery, storage and handling to comply with manufacturer's directions and as required to prevent edge damage to glass, and damage to glass and glazing materials from effects of moisture including condensation, of temperature changes, of direct exposure to sun, and from other causes.

1. Where insulating glass units will be exposed to substantial altitude changes, avoid hermetic seal ruptures by complying with insulating glass fabricator's recommendations for venting and sealing.

## 1.7 PROJECT CONDITIONS:

A. Environmental Conditions: Do not proceed with glazing when ambient and substrate temperature conditions are outside the limits permitted by glazing material manufacturer or when joint substrates are wet due to rain, frost, condensation or other causes.

## 1.8 WARRANTY:

A. General: Warranties shall run concurrently with other warranties made by the Contractor under requirements of the Contract Documents, and shall be in addition to, and not a limitation of, other rights the Owner may have under the Contract Documents or otherwise.

1. Manufacturer's Special Project Warranty on Coated Glass Products: Provide written warranty signed by manufacturer of each type of coated glass agreeing to furnish F.O.B. point of manufacture, with freight provided to project site, within specified warranty period indicated below, replacements and all installation costs and expenses for those coated glass units which develop manufacturing defects. Manufacturing defects are defined as peeling, cracking, wrinkling, discoloring, staining, or deterioration in metallic, or opacifier coating due to normal conditions and not due to handling or installation or cleaning practices contrary to glass manufacturer's published instructions.

   a. Warranty Period: Manufacturer's standard but not less than 10-years after date of project substantial completion.

2. Manufacturer's Special Project Warranty on Insulating Glass: Provide written warranty signed by manufacturer of insulating glass agreeing to furnish F.O.B. point of manufacture, with freight provided to project site, within specified warranty period indicated below, replacements and all installation costs and expenses for those insulating glass units developing manufacturing defects. Manufacturing defects are defined as failure of hermetic seal of air space (beyond that due to glass breakage) as evidenced by intrusion of dirt or moisture, internal condensation or fogging, deterioration of protected internal glass coatings, if any, and other visual indications of seal failure or performance; provided the manufacturer's instructions for handling, installing, protecting and maintaining units have been complied with during the warranty period.

   a. Warranty Period: Manufacturer's standard but not less than 10-years after date of substantial completion.

3. Manufacturer's Special Project Warranty on Laminated Glass: Provide written warranty signed by manufacturer of laminated glass agreeing to furnish F.O.B. point of manufacturer, with freight provided to project site, within specified warranty period indicated below, replacements and all installation costs and expenses for those laminated glass units which develop manufacturing defects. Manufacturing defects are defined as delamination, discoloring, staining, or deterioration in laminated glass units, due to normal project conditions and not due to handling or installation or cleaning practices contrary to glass manufacturer's published instructions.
   a. Warranty Period: Manufacturer's standard but not less than 5-years after date of entire project's substantial completion.

4. Replacements Under Warranties: Glass units replaced under Warranty provisions shall be required to carry the same warranty as original glass and glazing, beginning from the date of replacement completion.

## PART 2 - PRODUCTS

### 2.1 MANUFACTURERS:

A. Manufacturers: Subject to compliance with requirements, provide products of one of the following:

1. Manufacturers of Clear Float Glass:

.. AFG Industries, Inc.
.. Ford Glass Division.
.. Guardian Industries Corp.
.. LOF Glass, Inc.
.. PPG Industries, Inc.
.. Saint-Gobain/Euroglass.

2. Manufacturers of Wire Glass (1/2-inch square mesh pattern):

.. AFG Industries, Inc.
.. Blue Ridge.
.. Guardian Industries Corp.
.. Hordis Brothers, Inc.
.. Pilkington Sales (North American) Limited.

3. Manufacturers of Heat-Treated Glass:

.. AFG Industries, Inc.
.. Cardinal IG.
.. Environmental Glass Products.
.. Falconer Glass Industries.
.. Ford Glass Division.
.. Guardian Industries Corp.
.. Hordis Brothers, Inc.
.. LOF Glass, Inc.
.. PPG Industries, Inc.
.. Saint-Gobain/Euroglass.
.. Spectrum Glass Prod. Div., H. H. Robertson Co.
.. Viracon, Inc.

4. Manufacturers of Coated Glass:

.. Advanced Coating Technology.
.. Cardinal IG.
.. Environmental Glass Products.
.. Falconer Glass Industries.
.. Ford Glass Division.
.. Guardian Industries Corp.
.. Hordis Brothers, Inc.
.. Independent Insulating Glass.
.. Interpane Coatings, Inc.

.. LOF Glass, Inc.
.. PPG Industries, Inc.
.. Saint-Gobain/Euroglass.
.. Spectrum Glass Prod. Div.; H.H. Robertson Co.
.. Viracon, Inc.

5. Manufacturers of Insulating Glass:

.. Advanced Coating Technology.
.. AFG Industries, Inc.
.. Cardinal IG.
.. Environmental Glass Products.
.. Falconer Glass Industries.
.. Ford Glass Division.
.. Guardian Industries Corp.
.. Hordis Brothers, Inc.
.. Independent Insulating Glass.
.. PPG Industries, Inc.
.. Spectrum Glass Prod. Div.; H.H. Robertson Co.
.. Viracon, Inc.

6. Manufacturers of Fire-Rated and Impact Resistant Glass:

.. AFG Industries, Inc.
.. Blue Ridge.
.. Guardian Industries Corp.
.. Hordis Brothers, Inc.
.. Pilkington Sales (North American) Limited.

## 2.2 GLASS PRODUCTS, GENERAL:

A. Primary Glass Standard: Provide primary glass which complies with FS DD-G-451 and ASTM C 1036 requirements, including those indicated by reference to type, class, quality, and, if applicable, form, finish, mesh and pattern.

B. Heat-Treated Glass Standard: Provide heat-treated glass which complies with ASTM C 1048 requirements, including those indicated by reference to kind, condition, type, quality, class, and, if applicable, form, finish, and pattern.

C. Sizes: Fabricate glass to sizes required for glazing openings indicated, with edge clearances and tolerances complying with recommendations of glass manufacturer. Provide thicknesses indicated or, if not otherwise indicated, as recommended by glass manufacturer for application indicated.

## 2.3 PRIMARY GLASS PRODUCTS:

A. Clear Float Glass: IR 501 Framing System: 1-5/16” insulated laminated infill with 0.090 PVB (solutia saflex), tinted.

B. Windborne-Debris-Impact Resistant Glass - General: 9/16-inch minimum, laminated clear transparent glass, heat strengthened or fully tempered glass (as required by glass size and code).

1. 1/4-inch (6-mm) clear transparent outboard pane;
2. 0.100 interlayer of “Saflex HP” by Solutia;

3. 1/4-inch (6-mm) clear transparent inboard pane, and as specified.

C. Refer to requirements for sealed insulating glass units for performance characteristics of assembled units composed of clear transparent glass, relative to visible light transmittance, U-values, shading coefficient and visible reflectance.

D. Wire Glass: Type II (patterned and wired glass, flat), Class 1 (translucent), Quality q8 (glazing); complying with ANSI Z97.1; 1/4-inch thick; of form and mesh pattern indicated below:

1. Polished Wire Glass: Form 1 (wired, polished both sides), Mesh m2 (1/2-inch square).

2. Location: Fire-rated doors, and otherwise as indicated or required.

## 2.4 HEAT-TREATED GLASS PRODUCTS:

A. Manufacturing Process: Manufacture heat-treated glass as follows:

1. By horizontal (roller hearth) process with roll wave distortion parallel with bottom edge of glass as installed, unless otherwise indicated.

B. Uncoated Clear Heat-Treated Float Glass: Condition A (uncoated surfaces), Type I (transparent glass, flat), Class 1 (clear), Quality q3 (glazing select), kind as indicated below.

1. Type: Fully Tempered.

2. Thickness: 1/4-inch, unless indicated otherwise.

## 2.5 SEALED INSULATING GLASS UNITS:

A. General: All units shall be preassembled consisting of organically sealed panes of glass enclosing a hermetically sealed dehydrated air space and complying with ASTM E 774 for performance classification indicated as well as with other requirements specified for glass characteristics, air space, sealing system, sealant, spacer material, corner design and desiccant.

1. For properties of individual glass panes making up units, refer to product requirements specified elsewhere in this section and in Sections where the materials are provided, applicable to types, classes, kinds and conditions of glass products indicated.

2. Provide heat-treated panes of type and at locations indicated or, if not indicated, provide heat-strengthened panes where recommended by manufacturer for application indicated and tempered where indicated or where safety glass is designated or required.

3. Performance characteristics designated for insulating glass are nominal values based on manufacturer's published test data for units with 1/4-inch thick panes of glass and 1/2-inch thick air space.

a. U-values indicated are expressed in the number of Btu's per hour per square feet per degree F difference.

4. Performance Classification per ASTM E 774: Class A.

a. Thickness of Each Pane: 1/4-inch, unless indicated otherwise.
b. Air Space Thickness: 1/2-inch, unless indicated otherwise.

c. Sealing System: Manufacturer's standard, in compliance with referenced standards.

d. Spacer Material: Aluminum, in compliance with referenced standards, same color as exposed framing where it occurs.

e. Desiccant: Manufacturer's standard; either molecular sieve or silica gel or blend of both. Comply with requirements of referenced standards.

f. Corner Construction: Manufacturer's standard corner construction.

B. Other Types of Insulated Glass Units: Provide at locations indicated on the Drawings.

1. Tempered Glass: Same as for general use, with interior and exterior glass fully tempered.

2. Etched Glass: Same as for general use except at insulated glass, exterior face of interior glass shall be sandblasted to obscure vision through it, and where indicated for single pane etched glass, the interior face shall be similarly sandblasted.

## 2.6 ELASTOMERIC GLAZING SEALANTS AND PREFORMED GLAZING TAPES:

A. General: Provide products of type indicated and complying with the following requirements:

1. Compatibility: Select glazing sealants and tapes of proven compatibility with other materials with which they will come into contact, including glass products, seals of insulating glass units, and glazing channel substrates, under conditions of installation and service, as demonstrated by testing and field experience.

2. Suitability: Comply with recommendations of sealant and glass manufacturers for selection of glazing sealants and tapes which have performance characteristics suitable for applications indicated and conditions at time of installation.

3. Elastomeric Sealant Standard: Provide manufacturer's standard chemically curing, elastomeric sealant of base polymer indicated which complies with ASTM C 920 requirements, including those for Type, Grade, Class and Uses.

4. Colors: Provide color of exposed sealants indicated or, if not indicated, as selected by Architect from manufacturer's standard colors.

5. Asbestos prohibited: Refer to Section 01015 - “Special Conditions,” for requirements.

B. Glazing Sealant: Use only the following materials, or pre-approved substitutes:

1. One-Part Non-Acid-Curing Silicone Glazing Sealant: Type S; Grade NS, Class 25; Uses NT, G, A, and, as applicable to uses indicated, O; and complying with the following requirements for modules and additional joint movement capability.

a. Low Modules: Tensile strength of 45 psi or less at 100-percent elongation when tested per ASTM D 412 after 14-days at 77□F (20□C) and 50-percent relative humidity.

b. Additional capability, when tested per ASTM C 719 for adhesion and cohesion under maximum cyclic movement, to withstand the following percentage increase

and decrease of joint width, as measured at time of application, and remain in compliance with other requirements of ASTM C 920.

2. Preformed Butyl-Polyisobutylene Glazing Tape: Provide manufacturer's standard solvent-free butyl-polyisobutylene formulation with a solids content of 100- percent; complying with AAMA A 804.1; in extruded tape form; non-staining and non-migrating in contact with nonporous surfaces; packaged on rolls with a release paper on one side; with or without continuous spacer rod as recommended by manufacturers of tape and glass for application indicated.

C. Products: Subject to compliance with requirements, provide one of the following:

1. One-Part Non-Acid Curing Low-Modules Silicone Glazing Sealant:

.. "Chem-Calk 1000"; Bostik Construction Products Div.
.. "Dow Corning 790"; Dow Corning Corp.
.. "864"; Pecora Corp.
.. "Omniseal"; Sonneborn Bldg. Prod. Div., Rexnord Chemical Prod., Inc.
.. "Spectrum 1"; Tremco, Inc.

2. Preformed Butyl-Polyisobutylene Glazing Tape Without Spacer Rod:

.. "Chem-Tape 40"; Bostik Construction Products Div.
.. "Extru-Seal"; Pecora Corp.

.. "PTI 303" Glazing Tape; Protective Treatments, Inc.
.. "Tremco 440 Tape"; Tremco Inc.

3. Preformed Butyl-Polyisobutylene Glazing Tape With Spacer Rod:

.. "Chem-Tape 60"; Bostik Construction Products Div.
.. "Shim-Seal"; Pecora Corp.
.. "PTI 303" Shim Tape; Protective Treatments, Inc.
.. "Pre-shimmed Tremco 440 Tape"; Tremco Inc.

## 2.7 GLAZING GASKETS:

A. Dense Elastomeric Compression Seal Gaskets: Molded or extruded neoprene or EPDM gaskets, complying with ASTM C 864, of profile and hardness required to maintain watertight seal.

B. Cellular Elastomeric Preformed Gaskets: Extruded or molded closed cell, integral-skinned neoprene of profile and hardness required to maintain watertight seal; complying with ASTM C 509, Type II; black.

C. Manufacturers: Subject to compliance with requirements, provide products of one of the following:

1. Manufacturers of Preformed Gaskets:

.. D. S. Brown Co.
.. Maloney Precision Products Co.
.. Tremco.

## 2.8 MISCELLANEOUS GLAZING MATERIALS:

A. Compatibility: Provide materials with proven record of compatibility with surfaces contacted in installation.

B. Cleaners, Primers and Sealers: Type recommended by sealant or gasket manufacturer.

C. Setting Blocks: Neoprene, EPDM or silicone blocks as required for compatibility with glazing sealants, 80 to 90 Shore A durometer hardness.

D. Spacers: Neoprene, EPDM or silicone blocks, or continuous extrusions, as required for compatibility with glazing sealant, of size, shape and hardness recommended by glass and sealant manufacturers for application indicated.

E. Edge Blocks: Neoprene, EPDM or silicone blocks as required for compatibility with glazing sealant, of size and hardness required to limit lateral movement (side-walking) of glass.

F. Compressible Filler Rods: Closed-cell or waterproof-jacketed rod stock of synthetic rubber or plastic foam, flexible and resilient, with 5-10 psi compression strength for 25- percent deflection.

## 2.9 GLAZING ACCESSORIES:

A. General: Provide accessories in quantities and at locations as indicated on the Drawings, including all components, templates, etc., required for complete and proper installation which is fully compatible with glazing at locations where accessories occur.

# PART 3 - EXECUTION

## 3.1 EXAMINATION:

A. Require Glazier to inspect work of glass framing erector for compliance with manufacturing and installation tolerances, including those for size, squareness, offsets at corners; for presence and functioning of weep system; for existence of minimum required face or edge clearances; and for effective sealing of joinery. Obtain Glazier's written report listing conditions detrimental to performance of glazing work. Do not allow glazing work to proceed until unsatisfactory conditions have been corrected.

## 3.2 PREPARATION:

A. Clean glazing channels and other framing members to receive glass, immediately before glazing. Remove coatings which are not firmly bonded to substrates. Remove lacquer from metal surfaces where elastomeric sealants are indicated for use.

## 3.3 GLAZING, GENERAL:

A. Comply with combined current printed recommendations of glass manufacturers, of manufacturers of sealants, gaskets and other glazing materials, except where more stringent requirements are indicated, including those of referenced glazing standards.

B. Glazing channel dimensions as indicated in details are intended to provide for necessary bite on glass, minimum edge and face clearances, and adequate sealant thicknesses, with reasonable tolerances. Adjust as required by job conditions at time of installation.

C. Protect glass from edge damage during handling and installation; use a rolling block in rotating glass units to prevent damage to glass corners. Do not impact glass with metal framing. Use suction cups to shift glass units within openings; do not raise or drift glass with a pry bar. Rotate glass with flares or bevels along one horizontal edge which would occur in vicinity of setting blocks so that these are located at top of opening. Remove from project and dispose of glass units with edge damage or other imperfections of kind that, when installed, weakens glass and impairs performance and appearance.

D. Apply primers to joint surfaces where required for adhesion of sealants, as determined by preconstruction sealant-substrate testing.

E. Clean and trim excess glazing materials from glass, muntins, frames, etc., promptly after installation.

## 3.4 GLAZING:

A. Install setting blocks of proper size in sill rabbet, located one quarter of glass width from each corner, but with edge nearest corner not closer than 6-inches from corner, unless otherwise required. Set blocks in thin course of sealant which is acceptable for heel bead use.

B. Provide spacers inside and out, of correct size and spacing to preserve required face clearances, for glass sizes larger than 50-united-inches (length plus height), except where gaskets or glazing tapes with continuous spacer rods are used for glazing. Provide 1/8-inch minimum bite of spacers on glass and use thickness equal to sealant width, except with sealant tape use thickness slightly less than final compressed thickness of tape.

C. Provide edge blocking to comply with requirements of referenced glazing standard, except where otherwise required by glass unit manufacturer.

D. Set units of glass in each series with uniformity of pattern, draw, bow and similar characteristics.

E. Provide compressible filler rods or equivalent back-up material, as recommended by sealant and glass manufacturers, to prevent sealant from extruding into glass channel weep systems and from adhering to joints back surface as well as to control depth of sealant for optimum performance, unless otherwise indicated.

F. Force sealants into glazing channels to eliminate voids and to ensure complete “wetting” or bond of sealant to glass and channel surfaces.

G. Tool exposed surfaces of sealants to provide a substantial “wash” away from glass. Install pressurized tapes and gaskets to protrude slightly out of channel, so as to eliminate dirt and moisture pockets.

H. Where wedge-shaped gaskets are driven into one side of channel to pressurize sealant or gasket on opposite side, provide adequate anchorage to ensure that gasket will not “walk” out when installation is subjected to movement.

I. Miter cut wedge-shaped gaskets at corners and install gaskets in manner recommended by gasket manufacturer to prevent pull away at corners; seal corner joints and butt joints with sealant recommended by gasket manufacturer.

J. Provide cut-outs, where required, install glazing accessories at locations indicated.

## 3.5 PROTECTION AND CLEANING:

A. Protect exterior glass from breakage immediately upon installation by use of crossed streamers attached to framing and held away from glass. Do not apply markers to surfaces of glass. Remove nonpermanent labels and clean surfaces.

B. Protect glass from contact with contaminating substances resulting from construction operations. If, despite such protection, contaminating substances do come into contact with glass, remove immediately by method recommended by glass manufacturer.

C. Examine glass surfaces adjacent to or below exterior concrete and other masonry surfaces at frequent intervals during construction, but not less often than once a month, for build-up of dirt, scum, alkali deposits or staining. When examination reveals presence of these forms of residue, remove by method recommended in writing by glass manufacturer.

D. Remove and replace glass which is broken, chipped, cracked, abraded or damaged in other ways during construction period, including natural causes, accidents and vandalism.

E. Wash glass on both faces not more than 4-days prior to date scheduled for inspections intended to establish date of substantial completion in each area of project. Wash glass by method recommended by glass manufacturer.

END OF SECTION

SECTION 092500

GYPSUM DRYWALL

## PART 1 - GENERAL

### 1.1 RELATED DOCUMENTS:

A. Drawings and general provisions of Contract, including General and Supplementary conditions and Division 1 Specification Sections, apply to this Section.

B. Related work specified elsewhere includes:

1. Section 06100 - "Rough Carpentry" (grounds and concealed P.T. blocking)
2. Section 06200 - "Finish Carpentry"
3. Section 07900 - "Joint Sealers"
4. Section 09900 - "Painting"

### 1.2 DESCRIPTION OF WORK:

A. Work described in this section includes the following types of gypsum board construction:

1. Steel framing members to receive gypsum board.

2. High-impact abuse resistant gypsum board screw-attached to steel framing and furring members, and to wood framing, where indicated.

3. Gypsum sheathing (if any), with air infiltration barrier.

4. Grid type suspension systems for sloped and horizontal ceiling applications of interior gypsum board products which are not attached directly to primary framing systems.

5. Notes:

a. Extend framing and gypsum board up at fire-rated walls to bottom of fire-rated enclosures above (where occurs) or to roof or floor deck, and mud top edges.

b. Extend non-rated walls up to bottom of structure.

c. Extend only that partition framing specifically indicated as not full-height up to finished ceilings and tie-off every 4th stud to structure above.

### 1.3 DEFINITIONS:

A. Gypsum Board Construction Terminology: Refer to ASTM C 11 and GA 505 for definitions of terms for gypsum board construction not otherwise defined in this section or other referenced standards.

### 1.4 SUBMITTALS:

A. Submit the following according to Conditions of the Contract and Division 1 Specifications Sections.

1. Current product data and installation instructions from manufacturers for each type of product specified; Six (6) Sets - minimum.

## 1.5 QUALITY ASSURANCE:

A. Fire-Resistance Ratings:

1. Where indicated, provide materials and construction which are identical with those of assemblies whose fire resistance rating has been determined per ASTM E 119 by a testing and inspecting organization acceptable to authorities having jurisdiction.

2. Provide fire-resistance rated assemblies identical to those indicated by reference to GA File numbers in GA-600 “Fire Resistance Design Manual” or to design designations in U.L. “Fire Resistance Directory” or in listing of other testing agencies acceptable to authorities having jurisdiction.

B. Single Source Responsibility: Obtain all steel framing and all metal trim, and each type of gypsum board and related joint treatment materials from a single manufacturer.

C. Pre-Construction Conference: Prior to beginning work associated with roof system, the Contractor and appropriate subcontractors shall meet to discuss coordination of the work of the trades associated with the installation of the roof system, suspended acoustical and gypsum board ceiling, suspended mechanical ductwork, suspended light fixtures, etc. This work shall be planned and coordinated to provide hanger attachments needed by the various trades in a manner that will minimize conflict with installation of the roof system.

## 1.6 DELIVERY, STORAGE AND HANDLING:

A. Deliver materials in original packages, containers or bundles bearing brand name and identification of manufacturer or supplier.

B. Store materials inside, under cover, and keep them dry and protected against damage from weather, direct sunlight, surface contamination, corrosion, construction traffic and other causes. Neatly stack gypsum boards flat to prevent sagging.

C. When materials are moved into the building, distribute pallets and loads evenly around work areas so as to avoid overloading structure, causing damage to any materials, interfering with work of other trades, etc.

D. Handle gypsum boards to prevent damage to edges, ends and surfaces. Do not bend or otherwise damage metal corner beads, trim, etc.

E. Refer to Division 1 Sections “Summary of Work” and “Special Conditions” for additional information and requirements regarding stored materials.

## 1.7 PROJECT CONDITIONS:

A. Environmental Requirements, General: Establish and maintain environmental conditions for application and finishing gypsum board to comply with ASTM C 840, with gypsum board manufacturer’s recommendations, and with adhesive manufacturer’s recommendations, for before, during, and after installation.

B. Minimum Room Temperatures: For non-adhesive attachment of gypsum board to framing, maintain not less than 40 deg. F.

C. Ventilate building spaces to remove water not required for drying joint treatment materials. Avoid drafts during dry, hot weather to prevent materials from drying too rapidly.

## 1.8 SEQUENCING AND SCHEDULING:

A. Sequence installation of gypsum board and sheathing with installation of exterior cladding and roofing to comply with requirements indicated below:

1. Do not leave gypsum sheathing board exposed to weather after its application for more than one month or, if protected as indicated below, for more than 6 months:

a. Cover exterior surface of sheathing with a temporary air infiltration barrier equivalent to 6-mil polyethylene film. Apply covering immediately after sheathing is installed.

b. Remove covering just prior to installation of asphalt felt, face brick, and similarly applied exterior materials.

# PART 2 - PRODUCTS

## 2.1 ACCEPTABLE MANUFACTURERS:

A. Manufacturer: Subject to compliance with requirements, provide products of one of the following:

1. Steel Framing and Furring:

a. Bostwick Steel Framing Company
b. Dale Industries, Inc.
c. Dietrich Industries, Inc.
d. Gold Bond Building Products Division, National Gypsum Company
e. Harrison Manufacturing Company
f. Marino Industries Corp.
g. Milcor Division; Inryco, Inc.
h. Unimast Incorporated
i. United States Gypsum Company

2. Grid or Direct Suspension Systems:

a. Armstrong World Industries, Inc.
b. Chicago Metallic Corp.
c. USG Interiors, Inc.; United States Gypsum Company
d. Worthington Steel Company (formerly National Rolling Mills).

3. Gypsum Board and Related Products:

a. CertainTeed
b. Georgia-Pacific Corp.
c. Gold Bond Building Products Div., National Gypsum Company
d. United States Gypsum Company

4. Extruded Moldings and Reveal Moldings:

a. AMICO
b. Fry Reglet Corporation
c. Gordan, Inc.
d. M&M Systems Corporation

2.2 STEEL FRAMING COMPONENTS FOR SUSPENDED AND FURRED CEILINGS (if any):

A. General: Provide components which comply with ASTM C 754 for materials and sizes, unless otherwise indicated.

B. Wires for Hangers and Ties: ASTM A 641, Class 1 zinc coating, soft temper.

C. Flat Hangers: Mild steel, zinc coated or protected with rust-inhibitive paint.

D. Steel Studs for Furring Channels: ASTM C 645, with flange edges bent back 90 deg. and doubled over to form 3/16-inch minimum lip (return), minimum thickness of base (uncoated) metal and minimum depth as follows:

1. Thickness: 20 gauge, unless otherwise indicated.

2. Depth: As indicated.

3. Spacing: As indicated in referenced standard and on drawings, but no less than at all edges and 24-inches o.c.

E. Steel Rigid Furring Channels: ASTM C645, hat-shaped, depth of 7/8-inch, and minimum thickness of base (uncoated) metal as follows:

1. Thickness: 20 gauge at interior and 18-gauge at exterior, unless otherwise indicated.

2. Spacing: As indicated in referenced standard and on drawings, but not less than at all edges and 24-inches o.c.

a. At ceilings and soffits indicated to receive more than a single layer of gypsum board, spacing shall be not less than at all edges and 16-inches o.c.

F. Grid Suspension System: ASTM C 645, manufacturer's standard grid suspension system composed of main beams and cross furring members which interlock to form a modular supporting network.

1. Locations for Use: Provide grid type suspension systems for sloped and horizontal ceiling applications of interior gypsum board products which are not attached directly to primary framing system; Minimum 4-feet x 4-feet grid and cross tees at 2-feet o. c., with minimum installation requirements as required by manufacturer's current written instructions, referenced standards, and as indicated in this Section 09250 and Section 09511 - "Acoustical Panel Ceilings". Provide and comply with manufacturer's published requirements for accessories, trim, and hanger wire, and as otherwise required to provide flat ceilings without deflection or sag.

2. Product/Manufacturer: Provide suspended modular grid furring system equivalent to standard drywall suspension system for flat ceilings, with 1-1/2-inch grid faces, and as follows:

a. Equivalent to “Rigid X” system, as manufactured by USG Interiors, or one of the other three above named manufacturers.

## 2.3 STEEL FRAMING FOR WALLS AND PARTITIONS:

A. Steel Studs and Runners:

1. ASTM C 645, with flange edges bent back 90 deg. and doubled over to form 3/16-inch minimum lip (return), and complying with the following requirements for minimum thickness of base (uncoated) metal and minimum depth as follows:

2. Metal studs at interior partitions shall be 3-5/8-inches x 20 gauge (362S162-33), 6-inches x 20 gauge (600S162-33), or 8-inches x 18 gauge (800S162-43), at locations indicated on the Drawings, spaced at 16-inches o.c., unless otherwise indicated below, or otherwise shown on drawings or required by project conditions. Stud width shall be 1-5/8-inches unless otherwise indicated.

3. Use double studs or 6-inch studs, as indicated or as otherwise required, for chase walls, piping, conduits, or etc.

4. Metal studs at shaft wall or similar construction shall be type, thickness, depth and configuration indicted, or if not indicated, not less than the studs used in the tested assembly. Minimum thickness of 3-5/8-inch studs shall be 22 gauge, and of 6-inch studs shall be 20 gauge.

5. Special stud tracks for all curved walls shall be equivalent to “Flex-C Trac” galvanized flexible segmented track with slidable side straps, as manufactured by Flex-Ability Concepts, Inc.; Edmond, OK; Phone: (405) 302-0611.

6. Any interior load-bearing studs, if any, shall be at least 6-inches depth x 18 gauge (600S162-43), or 8-inches x 18 gauge (800S162-43), unless otherwise indicated on Drawings - galvanized C-studs spaced at 16-inches o.c.

B. Fasteners: Provide fasteners of type, material, size, corrosion resistance, holding power and other properties required to fasten steel framing and furring members securely to substrates involved; complying with the recommendations of gypsum drywall manufacturers for applications indicated.

C. Continuous Horizontal Bridging / Bracing:

1. 1-1/2-inch cold-rolled channels (galvanized).

2. Spacing: 4’-0” or 4’-6” o.c. vertically, through pre-punched slots in studs.

3. Splice Plates: 16 gauge at all splices.

4. Anchors (bridging channels to studs): 1-1/2-inches x 2-inches x 16 gauge clip angle, 1/4-inch less than stud width, secured with four (4) 5/8-inch S-14 screws. (Anchors required at ends of runs, where snap-in fit to stud slots is not snug or allows stud to move/slide on channels, and at studs on each side of splices in bridging channels).

D. Strap Bracing: 1-1/2-inch x 20-gauge galvanized steel, anchored at ends, splices, and each stud with typical framing screws. Placement at curved walls shall align with radius or curve indicated at each such location.

E. Extruded Moldings and Reveal Moldings: Provide manufacturer's standard alloy 6063-T5 extruded units with 70% resin 2-coat "Kynar 500" baked enamel finish, and as follows:

1. Design: Provide shapes and configurations as indicated on the Drawings.

a. Form reveal moldings to cover at least two sides and rear of reveal.

b. At drywall (or plaster) edge, provide continuous expanded metal edge, designed for mudding-in.

c. At ceiling grid edge, provide continuous edge designed for compatibility with lay-in ceiling grid.

2. Color: To match ceiling grid in same room where occurs, unless indicated otherwise, and color as selected by Architect at any exterior locations.

## 2.4 GYPSUM BOARD:

A. General: Provide gypsum board of types indicated in maximum lengths available to minimize end-to-end joints.

B. Gypsum Wallboard: ASTM C 36, and as follows:

1. Type: High-impact abuse resistant; Type X at all locations.
2. Edges: Tapered and featured (rounded or beveled) for prefilling.
3. Thickness: 5/8-inch for general use, except where 1/4-inch layers (at least two layers) may be indicated or required for curved wall or ceiling assemblies.

C. Gypsum Backing Board for Multi-Layer Applications: ASTM C 442 or, where backing board is not available from manufacturer, gypsum wallboard, ASTM C 36, and as follows:

1. Type: High-impact abuse resistant; Type X at all locations.
2. Edges: Manufacturer's standard.
3. Thickness: 5/8-inch.

D. Moisture- and Mold- Resistant Gypsum Board: ASTM C 36, and as follows:

1. Type: Type X, high-impact abuse resistant at all locations; Moisture- and mold- resistant core and facings/surfaces.
2. Edges: Manufacturer's standard.
3. Thickness: 5/8-inch.
4. Locations: At rooms with toilet fixtures and/or service sinks, entire wall behind sinks, and elsewhere only as indicated.
5. Use equivalent to 5/8-inch thick Georgia-Pacific "Dens-Shield" tile backer board with sealed and facing-taped joints, at ceramic and hard tile; ASTM C 1177 or ASTM C 1178.
6. Use "exterior gypsum board" where exposed at any exterior locations; ASTM C 931 or ASTM C 1396.

E. Gypsum Sheathing Board with Water-Resistant Core: Gypsum sheathing board consisting of noncombustible gypsum core incorporating a water-resistant material, surfaced on face, back and long edges with water-repellent surface; complying with ASTM C 1177, and requirements indicated below:

1. Type: Type X at all locations.

2. Edge and End Configuration: Square.
3. Thickness: 5/8-inch, unless indicated otherwise on the Drawings.
4. Size: 4'-0" x 8'-0" or 9'-0" as required for coordination with framing.
5. Note: Use equivalent to 5/8-inch thick CertainTeed "GlasRoc Sheathing" or Georgia-Pacific "Dens-Glass Gold", with sealed and facing-taped joints at any exterior EIFS systems, stucco systems, and metal siding systems, only where plywood or other wood sheathing is not indicated.
6. Cover ALL SHEATHING with air infiltration barrier.

## 2.5 TRIM ACCESSORIES:

A. Cornerbead and Edge Trim for Interior Installation: Provide corner beads, edge trim and control joints which comply with ASTM C 1047 and requirements indicated below:

1. Material: Formed metal, plastic, or metal combined with paper, with metal complying with the following requirement.

a. Sheet steel coated with zinc by hot-dip or electrolytic processes, or with aluminum.

2. Edge trim shapes indicated below by reference to designations of Fig. 1 in ASTM C 1047:

a. "LC" Bead, unless otherwise indicated.
b. "L" Bead where indicated or required.
c. "U" Bead where indicated.

3. One-Piece Control Joint: Formed with vee-shaped slot per Fig. 1 in ASTM C 1047, with slot opening covered with removable strip.

## 2.7 GYPSUM BOARD JOINT TREATMENT MATERIALS:

A. General: Provide materials complying with ASTM C 475, ASTM C 840, and recommendations of manufacturer of both gypsum board and joint treatment materials for the application indicated.

B. Joint Tape: Paper reinforcing tape.

C. Drying-Type Joint Compounds:

1. Factory-prepackaged vinyl-based products complying with the following requirements for formulation and intended use.

2. Ready-Mix Formulation: Factory-premixed product.

3. Taping compound formulated for embedding tape and for first coat over fasteners and flanges of corner beads and edge trim.

4. Topping compound formulated for fill (second) and finish (third) coats.

5. All-purpose compound for use as both taping and topping compound.

D. Setting-Type Joint Compound:

1. Factory-prepackaged, job-mixed, chemical-hardening powder products formulated for uses indicated.

2. For filling joints and treating fasteners of water-resistant gypsum backing board behind base for ceramic tile, use formulation recommended by gypsum board manufacturer for this purpose.

## 2.8 MISCELLANEOUS MATERIALS:

A. General: Provide auxiliary materials for gypsum drywall construction which comply with referenced standards and the recommendations of the manufacturer of the gypsum board.

B. Spot Grout: ASTM C 475, setting-type joint compound of type recommended for spot grouting hollow metal door frames.

C. Fasteners: Type S steel drill screws, 1-inch long unless otherwise required for shaft wall or multi-layer application, with corrosion-resistant finish in form of cadmium plating or proprietary coating, and as follows:

1. For attachment of gypsum board panels to light gauge steel framing of less than 0.033 of an inch in thickness (20 gauge), provide steel drill screws complying with ASTM C 1002.

2. For attachment of gypsum board panels, including sheathing, to steel framing from 0.033 (20 gauge) to 0.112 of an inch in thickness, provide steel drill screws complying with ASTM C 954.

D. Air Infiltration Barrier: Asphalt-saturated organic felt complying with ASTM D 226, Type 1 (No. 15 asphalt felt), unperforated; unless indicated otherwise.

# PART 3 - EXECUTION

## 3.1 EXAMINATION:

A. Examine substrates to which drywall construction attaches or abuts, preset hollow metal frames, cast-in-anchors, and structural framing, with Installer present, for compliance with requirements for installation tolerances and other conditions affecting performance of drywall. Do not proceed with installation until unsatisfactory conditions have been corrected.

## 3.2 PREPARATION FOR METAL SUPPORT SYSTEMS:

A. Ceiling Anchorages:

1. Coordinate installation of ceiling suspension system with installation of overhead structural systems to ensure that inserts and other structural anchorage provisions have been installed to receive ceiling anchors in a manner that will develop their full strength and at spacing required to support ceiling.

## 3.3 INSTALLATION OF STEEL FRAMING, GENERAL:

A. Steel Framing Installation Standard: Install steel framing to comply with ASTM C 754 and with ASTM C 840 requirements that apply to framing installation.

B. Install supplementary framing, blocking and bracing at terminations in the work and for support of fixtures, equipment services, heavy trim, cabinets, countertops, shelving, grab bars, toilet accessories, furnishings, and similar construction to comply with details indicated and with

recommendations of gypsum board manufacturer, or if none available, with "Gypsum Construction Handbook" published by United States Gypsum Co.

1. Refer to Section 06100 - "Rough Carpentry" for additional information and requirements.

2. Provide additional horizontal framing (flat studs or tracks) at 24-inches o.c. minimum in walls at cabinets and at ends of countertops, and as otherwise required, to assure square corners and flat walls without bowing, warping, etc.

C. Isolate steel framing from building structure to prevent transfer of loading imposed by structural movement, at locations indicated below to comply with details shown on Drawings:

1. Where edges of suspended ceilings abut building structure horizontally at ceiling perimeters or penetration of structural elements.

2. Where partition and wall framing abuts overhead structure:

a. Provide slip or cushioned type joints as detailed to attain lateral support and avoid axial loading.

b. Unless framing is specifically indicated to terminate below ceilings, all framing and gypsum board shall extend up to bottom of structure above.

D. Do not bridge building expansion and control joints with steel framing or furring members; independently frame both sides of joints with framing or furring members or as indicated.

## 3.4 INSTALLATION OF STEEL FRAMING FOR SUSPENDED AND FURRED CEILINGS:

A. Suspend ceiling hangers from building structural members and as follows:

1. Install hangers plumb and free from contact with insulation or other objects within ceiling plenum that are not part of supporting structural or ceiling suspension system. Splay hangers only where required to miss obstructions and offset resulting horizontal forces by bracing, countersplaying, or other equally effective means.

2. Where width of ducts and other construction within ceiling plenum produces hanger spacings that interfere with the location of hangers required to support standard suspension system members, install supplemental suspension members and hangers in form of trapezes or equivalent devices. Size supplemental suspension members and hangers to support ceiling loads within performance limits established by referenced standards.

3. Secure wire hangers by looping and wire-tying, either directly to structures or to inserts, eye screws, or other devices and fasteners that are secure and appropriate for substrate, and in a manner that will not cause them to deteriorate or otherwise fail due to age, corrosion, or elevated temperatures.

4. Secure flat, angle, channel, and rod hangers to structure, including intermediate framing members, by attaching to inserts, eye screws, or other devices and fasteners that are secure and appropriate for structure as well as for type of hanger involved, and in a manner that will not cause them to deteriorate or fail due to age, corrosion, or elevated temperatures.

5. Secure hangers to structural support by connecting directly to structure where possible; otherwise, connect to anchorage devices or fasteners as indicated or required.

6. Do not support ceilings directly from permanent metal forms. Furnish cast-in-place hanger inserts that extend through forms.

7. Do not attach hangers to steel deck tabs.

8. Do not attach hangers to steel roof deck. Attach hangers to structural members.

9. Do not connect or suspend steel framing from ducts, pipes or conduit.

10. Keep hangers and braces 2-inches clear of ducts, pipes and conduits.

11. Sway-brace suspended steel framing with hangers used for support.

12. Install suspended steel framing components in sizes and at spacing indicated but not less than that required by referenced steel framing installation standard.

13. Installation Tolerances: Install steel framing components for suspended ceilings so that cross furring members or grid suspension members are level to within 1/8-inch in 12 ft. as measured both lengthwise on each member and transversely between parallel members.

14. Grid Suspension System: Attach perimeter wall track or angle where grid suspension system meets vertical surfaces. Mechanically join main beam and cross furring members to each other and butt-cut to fit into wall track.

15. Suspension Systems:

    a. Suspend ceiling hangers from building structural members and as follows below, with system leveling tolerance of 1/8 inch in 12'-0".

    b. Install hangers plumb and free from contact with insulation or other objects within ceiling plenum that are not part of supporting structural or ceiling suspension system. Splay hangers only where required to miss obstructions and offset resulting horizontal forces by bracing, countersplaying, or other equally effective means.

    c. Wire Hangers: 0.1620-inch diameter (8 gauge), 4-feet on center. Install supplementary hangers as necessary at ceiling fixtures to provide a hanger at each corner of each fixture, diffuser, grille, and other ceiling-mounted equipment.

    d. Where width of ducts and other construction within ceiling plenum produces hanger spacings that interfere with the location of hangers at spacings required to support standard suspension system members, install supplemental suspension members and hangers in form of trapezes or equivalent devices. Size supplemental suspension members and hangers to support ceiling loads within performance limits indicated and as established by referenced standards.

    e. Secure wire hangers by looping and wire-tying, either directly to structures or to inserts, eye screws, or other devices that are secure and appropriate for substrate, and in a manner that will not cause them to deteriorate or otherwise fail due to age, corrosion, or elevated temperatures.

f. Secure, angle, and rod hangers, (if any) 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 due to age, corrosion, or elevated temperatures.

g. Space hangers not more than 4'-0" o.c. along each member supported directly from hangers, unless otherwise shown, and provide hangers not more than 8 inches from ends of each member.

h. Provide additional hangers as necessary, so that one hanger occurs on each side of lay-in and surface-mounted light fixtures, and at other grid supported equipment, devices, etc.

## 3.5 INSTALLATION OF STEEL FRAMING FOR WALLS AND PARTITIONS:

A. Install runners (tracks) at floors, ceilings and structural walls and columns, where gypsum drywall stud system abuts other construction.

B. Installation Tolerances: Install each steel framing and furring member so that fastening surface does not vary more than 1/8-inch from plane of faces of adjacent framing.

C. Extend wall and partition framing full height to structural supports or substrates above suspended ceilings, except where partitions are indicated to terminate at suspended ceilings. Continue framing over frames for doors and openings and frame around ducts penetrating partitions above ceiling to provide support for gypsum board.

1. Provide studs up to tie to structure at 4'-0" o.c. minimum, from partitions terminating below ceilings.

D. Install steel studs and furring in sizes and at spacings, indicated but not less than that required by referenced steel framing installation standard.

E. Install steel studs so that flanges point in the same direction and gypsum boards can be installed in the direction opposite to that of the flange.

F. Install horizontal steel bridging/bracing in all walls, and the additional strap bracing at curved walls as steel framing progresses (refer to Paragraph 2.3 C and D above). Install in compliance with stud manufacturer's recommendations, at spacing indicated.

1. Galvanized steel strap bracing shall be provided continuous at top and bottom runner tracks and at bridging locations at all curved stud walls.

G. Frame door openings to comply with details indicated, with GA-219 and with applicable published recommendations of gypsum board manufacturer. Attach vertical studs at jambs with screws either directly to frames or to jamb anchor clips on door frames; install runner track section (for cripple studs) at head and secure to jamb studs.

1. Extend vertical jamb studs (double studs-typical) through suspended ceilings and attach to underside of floor or roof structure above, unless otherwise indicated.

H. Frame openings other than door openings to comply with details indicated, or if none indicated, in same manner as required for door openings; and install framing below sills of openings to match framing required for door heads.

3.6 APPLICATION AND FINISHING OF GYPSUM BOARD, GENERAL:

A. Gypsum Board Application and Finishing Standard: Install and finish gypsum board to comply with ASTM C 840 and GA-216.

B. Locate exposed end-butt joints as far from center of walls and ceilings as possible, and stagger not less than 24-inches in alternate courses of board.

C. Install ceiling boards across framing in the manner which minimizes the number of end-butt joints, and which avoids end joints in the central area of each ceiling. Stagger end joints at least 24- inches.

D. Install wall/partitions boards in manner which minimizes the number of end-butt joints or avoids them entirely where possible. At high walls, install boards horizontally with end joints staggered over studs.

E. Install exposed gypsum board with face side out. Do not install imperfect, damaged or damp boards. Butt boards together for a light contact at edges and ends with not more than 1/16-inch open space between boards. Do not force into place.

F. Locate either edge or end joints over supports, except in horizontal applications where intermediate supports or gypsum board back-blocking is provided behind end joints. Position boards so that like edges abut, tapered edges against tapered edges and mill-cut or field-cut ends against mill-cut or field-cut ends. Do not place tapered edges against cut edges or ends. Stagger vertical joints over different studs on opposite sides of partitions.

G. Attach gypsum board to steel studs so that leading edge or end of each board is attached to open (unsupported) edge of stud flange first.

H. Attach gypsum board to supplementary framing and blocking provided for additional support at openings and cutouts.

I. Spot grout hollow metal door frames for solid core wood doors, hollow metal doors and doors over 32-inches wide. Apply spot grout at each jamb anchor clip just before inserting board into frame.

J. Form control joints and expansion joints at locations indicated, with space between edges of boards, prepared to receive trim accessories.

1. Provide control joints in long partitions and walls at a maximum spacing of 30 feet on center, unless a closer spacing is indicated. Provide control joints in large ceiling areas at a maximum spacing of 50 feet on center in each direction, unless a closer spacing is indicated. Consult with Architect on locations of all control joints prior to beginning work.

K. Cover both faces of steel stud partition framing with gypsum board in concealed spaces (above ceilings, etc.), except inside double or chase walls which are required to be braced internally.

1. Except where concealed application is required for sound, fire, air, or smoke ratings, coverage may be accomplished with scraps of not less than 8 sq. ft. area, and may be limited to not less than 75% of full coverage.

2. Fit gypsum board around ducts, pipes, and conduits.

3. Where partitions intersect open concrete coffers, concrete joists, and other structural members projecting below underside of floor/roof slabs and decks, cut gypsum panels to

fit profile formed by coffers, joists, and other structural members; allow 1/4-to-1/2-inch-wide joints to install sealant.

4. Fire-stop around penetrations as required by Codes and authorities having jurisdiction. Refer to Section 07270 for additional information and requirements.

L. Where interior partitions are indicated to extend to the structure above, the drywall shall also extend to the structure with the same number of layers as required below the ceiling.

M. Isolate perimeter of non-load-bearing drywall partitions at structural abutments. Provide 1/4-inch to 1/2-inch space and trim edge with "U" bead edge trim. Seal joints with acoustical sealant.

N. At all interior walls, seal construction at perimeters, control and expansion joints, openings and penetrations with a continuous bead of acoustical sealant including a bead at both faces of partitions. Comply with ASTM C 919 and manufacturer's recommendations for location of edge trim, and close off sound-flanking paths around or through construction, including sealing of partitions above acoustical ceilings.

O. Space fasteners in gypsum boards in accordance with referenced gypsum board application and finishing standard and manufacturer's recommendations.

P. Install "sound batts" and insulation as the work progresses. Refer to Section 07210 for additional information and requirements.

## 3.7 METHODS OF GYPSUM BOARD APPLICATION:

A. Single-layer Application: Install gypsum wallboard as follows:

1. On ceilings apply gypsum board prior to wall/partition board application to the greatest extent possible.

2. On partitions/walls apply gypsum board vertically (parallel to framing), unless otherwise indicated or required for fire or smoke resistive rated assemblies. Provide maximum length panels, to minimize end joints.

3. On partitions/walls 8'-1" or less in height apply gypsum board horizontally (perpendicular to framing); use maximum length sheets possible to minimize end joints.

B. Multi-Layer Application:

1. Install gypsum backing board for base layer and gypsum wallboard for face layer.

2. On ceilings apply base layer(s) prior to base layer application on walls/partitions; apply face layers in same sequence. Offset joints between layers at least 10-inches. Apply base layers at right angles to supports unless otherwise indicated.

3. On partitions/walls apply base layer(s) and face layers vertically (parallel to framing) with joints of base layers over supports and face layer joints offset at least one stud or furring member space from base layer joints.

C. Single-Layer Fastening Methods: Apply gypsum boards to supports as follows:

1. Fasten with screws.

D. Multi-Layer Fastening Methods:

1. Apply base layer(s) of gypsum board and face layer to base layer(s) as follows:

2. Fasten both base layer(s) and face layer separately to supports with screws.

## 3.8 INSTALLATION OF DRYWALL TRIM ACCESSORIES:

A. General: Where feasible, use the same fasteners to anchor trim accessory flanges as required to fasten gypsum board to the supports. Otherwise, fasten flanges to comply with manufacturer's recommendations.

B. Install corner beads at external corners.

C. Install metal edge trim whenever edge of gypsum board would otherwise be exposed or semi-exposed, and except where plastic trim is indicated. Provide type with face flange to receive joint compound except where "U" bead (semi-finishing type) is indicated.

1. Install "LC" bead where drywall construction is tightly abutted to other construction and back flange can be attached to framing or supporting substrate.

2. Install "L" bead where edge trim can only be installed after gypsum board is installed.

3. Install U-type trim where edge is exposed, revealed, gasketed, or sealant-filled (including expansion joints).

D. Install edge trim where indicated on wall panels at juncture with ceilings.

E. Install control joints at locations indicated, or if not indicated, at spacings and locations required by referenced gypsum board application and finish standard, and approved by the Architect for visual effect.

## 3.9 FINISHING OF DRYWALL:

A. General: Apply treatment at gypsum board joints (both directions); flanges of corner bead, edge trim, and control joints; penetrations; fastener heads, surface defects and elsewhere as required to prepare work for decoration.

B. Prefill open joints and rounded or beveled edges, if any, using setting-type joint compound.

C. Apply joint tape at joints between gypsum boards, except where trim accessories are indicated.

D. Finish interior gypsum wallboard by applying the following joint compounds in 3 coats (not including prefill of openings in base), and sand between coats and after last coat:

1. Embedding and First Coat: Ready-mix drying-type all-purpose or taping compound.

2. Fill (Second) Coat: Ready-mix drying-type all-purpose or topping compound.

3. Finish (Third) Coat: Ready-mix drying-type all-purpose or topping compound.

E. Water-Resistant Gypsum Board and Exterior Gypsum Board: Finish joints between water-resistant backing board with tape and setting-type joint compound to comply with gypsum board manufacturer's written recommendations and installation standards referenced in related sections.

F. Partial Finishing: Omit third coat and sanding on concealed drywall construction which is indicated for drywall finishing, except where finishing is required to achieve fire-resistance rating, sound rating or to act as air or smoke barrier.

## 3.10 GYPSUM WALL SHEATHING (if any):

A. General:

1. Comply with manufacturer's current written instructions, GA 252, and the following for the installation of gypsum sheathing.

2. Cut boards at penetrations, edges and other obstructions of the work; fit tight against abutting work, except provide 3/8-inch setback where non-loadbearing work abuts structural elements at head and jambs.

3. Coordinate installation of sheathing with installation of flashing and joint sealers so that these combined materials are installed in the sequence and manner which prevents exterior moisture from passing through complete exterior wall assembly to the interior.

4. Apply fasteners so that screw heads bear tightly against face of gypsum sheathing boards but do not cut into face paper.

5. Do not bridge building expansion joints with gypsum sheathing; cut and space edges to match spacing of structural support elements.

B. Vertical Installation: Install 4-feet wide gypsum sheathing boards vertically with vertical edges centered over flanges of steel studs. Abut ends and edges of each board with those of adjoining boards. Screw-attach boards at perimeter and within field of board to each steel stud as follows:

1. Fasteners spaced approximately 8-inches o.c. and set back 3/8-inch minimum from edges and ends of boards.

C. Air Infiltration Barrier Application:

1. Cover gypsum board sheathing with air infiltration barrier as follows:

2. Location: Apply felt type over gypsum sheathing occurring behind masonry veneer or metal siding.

3. Cut back air infiltration barrier 1/2-inch on each side of break in supporting members at control joint locations.

4. For asphalt-saturated organic felt and polyethylene film, apply horizontally with 2-inches overlap and 6-inches end-lap; fasten to sheathing with corrosion-resistant staples.

## 3.11 CLEANING AND PROTECTION OF WORK:

A. Promptly remove any joint compound and adhesives and similar residue from adjacent surfaces, as it may occur.

B. Provide final protection and maintain conditions, in a manner suitable to Installer, which ensures gypsum drywall construction remain without damage or deterioration at time of Substantial Completion.

END OF SECTION

SECTION 09300

# TILE

## PART 1 - GENERAL

### 1.1 RELATED DOCUMENTS:

A. Drawings and general provisions of Contract, including General and Supplementary Conditions and Division-1 Specification sections, apply to work of this section.

B. Related work specified elsewhere includes:

1. Section 03310 - “Concrete”
2. Section 07900 - “Joint Sealers” (sealing expansion joints in tile work)

### 1.2 DESCRIPTION OF WORK:

A. Definition: Tile includes ceramic surfacing units made from clay or other ceramic materials.

B. Extent of tile work is indicated on drawings and schedules. Provide grout setting bed sloped to floor drains at locations where recessed slabs are indicated.

C. Types of tile work in this section include the following:

1. Porcelain ceramic tile flooring, and glazed wall tile, coved base and trim.

a. Patterns as indicated by the Architect.

3. Stone thresholds, where indicated.

4. Colored grouts.

5. Waterproofing membrane below all tile work in rooms with toilet fixtures, sinks and lavatories, and below tile work at control and expansion joints in width indicated.

D. Chemical Resistant Epoxy grout installation system is required at entire are within Toilet and Shower Rooms, at Janitor’s Rooms, at Kitchens, and rooms where food is stored, prepared, cooked, served, and dining areas, where tile is scheduled to occur, and at any exterior tile work.

E. Note that all tile flooring, base, and wall tile specified herein shall be installed with grouted joints, also as specified.

### 1.3 QUALITY ASSURANCE:

A. Source of Materials: Provide materials obtained from one source for each type and color of tile, grout, and setting materials.

B. Installer Qualifications: Engage an experienced installer who has successfully completed tile installations similar in material, design, and extent to that indicated for this Project.

1. Refer to Division 1 Section “Special Conditions”, for additional information and minimum experience requirements.

C. Flooring Products: Installation surfaces' co-efficient of friction (slip-resistance), etc., shall be as designed by the manufacturer to comply with published U.S. Justice Department Regulations for the "Americans with Disabilities Act of 1990" (ADA, ADA-AG), ANSI A 117.1, and the "Uniform Federal Accessibility Standards" (UFAS), 1988 Edition; And revisions and amendments thereto.

1. Where this requires any substitution of products specified herein, advise Architect in writing prior to Bid Date, for necessary approvals.

## 1.4 SUBMITTALS:

A. Product Data: Submit manufacturer's technical information and installation instructions for materials required, except bulk materials.

B. Shop Drawings: Submit shop drawings indicating tile patterns and locations and widths of control, isolation, contraction and expansion joints in tile surfaces.

C. Samples for Initial Selection Purposes: Submit manufacturer's color charts consisting of actual stone and tiles or sections of tile showing full range of colors, textures and patterns available for each type of tile indicated. Include samples of grout and accessories involving color selection.

D. Samples for Verification Purposes, submit the following upon request by Architect:

1. Samples for each type of tile and for each color and texture required, not less than 12-inches square, on plywood or hardboard backing and grouted.

2. Full size samples for each type of trim, accessory and for each color.

3. 6-inch long samples of stone thresholds.

E. Certification: Furnish Master Grade Certificates for each shipment and type of tile, signed by manufacturer and Installer.

## 1.5 DELIVERY, STORAGE, AND HANDLING:

A. Deliver and store packaged materials in original containers with seals unbroken and labels intact until time of use. Prevent damage or contamination to materials by water, freezing, foreign matter or other causes.

1. Comply with requirements of ANSI A137.1 for labeling sealed tile packages.

B. Refer to Division 1 Sections "Summary of Work" and "Special Conditions" for additional information and requirements regarding stored materials.

## 1.6 PROJECT CONDITIONS:

A. Maintain environmental conditions and protect work during and after installation to comply with referenced standards and manufacturer's printed recommendations.

B. Vent temporary heaters to exterior to prevent damage to tile work from carbon dioxide buildup.

C. Maintain temperatures at not less than 50 degrees F (10 degrees C) in tiled areas during installation and for 7-days after completion, unless higher temperatures are required by referenced installation standard and/or tile and grout manufacturers' current written instructions and recommendations.

## 2.1 ACCEPTABLE MANUFACTURERS:

A. Manufacturers: Subject to compliance with requirements, provide products of one of the following manufacturers:

1. Manufacturers of Porcelain Ceramic Tile:

   a. American Olean Tile Co., Inc.
   b. Aztec Ceramics Corp.
   c. Cerdisa
   d. Crossville Ceramics
   e. Dal-Tile Corp.
   f. Flor Gres Porcelain Stoneware
   g. Mid-State Tile
   h. Quamagra Tile, Inc.
   i. Summitville Tiles, Inc.
   j. Smov
   k. United States Ceramic Tile Co.
   l. Wenczel Tile Co.
   m. Winburn Tile Manufacturing Co.

2. Manufacturers of Latex-Portland Cement Mortars:

   a. American Olean Tile Co., Inc.
   b. Boiardi Products Corp.
   c. Cambridge Tile Mfg. Co.
   d. Custom Building Products.
   e. C-Cure Chemical Co., Inc.
   f. H. B. Fuller Co.
   g. Jamo, Inc.
   h. L & M Surco Mfg., Inc.
   i. Laticrete International, Inc.
   j. Southern Grouts & Mortars, Inc.
   k. Summitville Tiles, Inc.
   l. Syracuse Adhesives Co.
   m. Upco Co. Div., Emhart Corp.
   n. W. R. Bonsal Co.

3. Manufacturers of Organic Adhesives, Type I:

   a. Boiardi Products Corp.
   b. Cambridge Tile Mfg. Co.
   c. Custom Building Products.
   d. C-Cure Chemical Co., Inc.
   e. H. B. Fuller Co.
   f. Jamo, Inc.
   g. L & M Surco Mfg., Inc.
   h. Southern Grouts & Mortars, Inc.
   i. Syracuse Adhesives Co.
   j. Upco Co. Div., Emhart Corp.

4. Manufacturers of Latex-Portland Cement Grouts:

   a. Boiardi Products Corp.
   b. Cambridge Tile Mfg. Co.
   c. Custom Building Products.
   d. C-Cure Chemical Co., Inc.
   e. H. B. Fuller Co.
   f. Jamo, Inc.
   g. L & M Surco Mfg., Inc.
   h. Southern Grouts & Mortars, Inc.
   i. Syracuse Adhesives Co.
   j. Upco Co. Div., Emhart Corp.
   k. W. R. Bonsal Co.

5. Manufacturers of Chemical Resistant Epoxy Grouts:

   a. Atlas Minerals & Chemicals, Inc.
   b. Boiardi Products Corp.
   c. Cambridge Tile Mfg. Co.
   d. C-Cure Chemical Co., Inc.
   e. H. B. Fuller Co.
   f. L & M Surco Mfg., Inc.
   g. Laticrete International, Inc.
   h. Southern Grouts & Mortars, Inc.
   i. Summitville Tiles, Inc.
   j. Syracuse Adhesives Co.
   k. Upco Co. Div., Emhart Corp.

6. Manufacturers of Chemical-Resistant Joint Sealants:

   a. Atlas Minerals and Chemical Co.
   b. Pennwalt Corporation.

7. Manufacturers of Tile Cleaners:

   a. Hillyard Chemical Co.
   b. L & M Surco Mfg. Co., Inc.

## 2.2 PRODUCTS - GENERAL:

A. ANSI Standard for Ceramic Tile: Comply with ANSI A137.1 “American National Standard Specifications for Ceramic Tile” for types and grades of tile indicated.

   1. Furnish tile complying with “Standard Grade” requirements unless otherwise indicated.

B. ANSI Standard for Tile Installation Materials: Comply with ANSI standard referenced with products and materials indicated for setting and grouting.

C. Colors, Textures and Patterns: For tile, grout and other products requiring selection of colors, surface textures or other appearance characteristics, provide products to match characteristics indicated or, if not otherwise indicated, as selected by Architect from manufacturer’s standards.

   1. Provide tile trim and accessories which match color and finish of adjoining flat tile.

D. Mounting: Where factory-mounted tile is required provide back or edge-mounted tile assemblies as standard with manufacturer unless another mounting method is indicated.

1. Where tile is indicated for installation, on exteriors or in wet areas, do not use back or edge-mounted tile assemblies unless tile manufacturer specifies that this type of mounting is suitable for these kinds of use and has been successfully used on other projects.

## 2.3 CERAMIC TILE PRODUCTS:

A. Ceramic Floor Tile (floor tile): Provide square-edged flat tile complying with the following requirements;

1. Wearing Surface: Abrasive embedded in surface where slip-resistant tile is indicated or required by Code or referenced standards; Non-abrasive elsewhere.

2. Nominal Facial Dimensions: 12-inches x 12-inches, unless indicated otherwise on Drawings.

3. Nominal Thickness: 3/8-inches.

4. Color: Colors will be selected by Architect from manufacturer's full line of standard colors, after Bid Date.

5. Trim Units: 6-inches high x 12-inches wide x 1/2-inches thick, coved, and to align with joints in adjoining flat tile unless not practical or approved otherwise. Bullnose to match color.

6. Provide with removable coating, to remain until grouting is complete and to be removed prior to application of filler/sealer.

B. Glazed Ceramic Tile (wall tile): Provide square-edged flat tile complying with the following requirements;

1. Wearing Surface: Non-abrasive.

2. Nominal Facial Dimensions: 4-inches x 4-inches, unless indicated otherwise on Drawings.

3. Nominal Thickness: 3/8-inches.

4. Color: Colors will be selected by Architect from manufacturer's full line of standard colors, after Bid Date.

5. Bullnose to match color.

6. Provide with removable coating, to remain until grouting is complete and to be removed prior to application of filler/sealer.

C. Trim Units: Provide tile trim units, if indicated, to match characteristics of adjoining flat tile and to comply with following requirements; to match existing:

1. Size: As indicated, coordinated with sizes and coursing of adjoining flat tile, where applicable.

2. Shapes (if any): As follows, selected from manufacturer's standard shapes:

a. Base for Portland Cement Mortar and thinset Mortar Installations: Coved.

b. Wainscot Cap for Portland Cement Mortar Installations: Bullnose cap.

c. Wainscot Cap for Thinset Mortar Installations: Surface bullnose.

d. External Corners for Portland Cement Mortar Installations: Bullnose shape with a radius of not less than 3/4-inch unless otherwise indicated.

e. External Corners for Thinset Installations: Surface bullnose.

3. Colors: Colors will be selected by Architect from manufacturer's full line of standard colors, after Bid Date.

## 2.4 STONE THRESHOLDS:

A. General: Provide stone which is uniform in color and finish, fabricated to sizes and profiles indicated or required to provide transition between tile surfaces and adjoining finished floor surfaces.

B. Marble Thresholds: Provide marble thresholds complying with ASTM C 503 requirements for exterior use and abrasion resistance for uses subject to heavy foot traffic.

1. Color shall be white, if not indicated on drawings.

2. Provide white, honed marble complying with MIA Group "A" requirements for soundness, where indicated to be white.

3. Size: 2-inches wide x 1-inch thick (nominal) with beveled exposed edges, unless otherwise indicated or required.

a. Provide heavy duty wide thresholds at interior doors and wall openings leading into kitchen and serving areas and related/contiguous offices, storage rooms, utility rooms, etc., and where mobile equipment and hand trucks may pass over. Size: 5-inches wide x 1-1/4-inch thick (nominal), with beveled exposed edges.

## 2.5 SETTING MATERIALS:

A. Portland Cement Mortar Installation Materials: Provide materials to comply with ANSI A108.1 as required for installation method designated, unless otherwise indicated.

B. Latex-Portland Cement Mortar: Provide product complying with ANSI A118.4 and the following requirement for composition:

1. Latex additive (water emulsion) of type described below, serving as a replacement for part or all of gauging water, added at job site to prepackaged dry mortar mix supplied or specified by latex manufacturer.

a. Latex Type: Acrylic resin.

C. Organic Adhesive: Provide product complying with ANSI A136.1 for Type I.

## 2.6 GROUTING MATERIALS:

A. Latex-Portland Cement Grout: Provide product complying with ANSI A118.6 for the following composition and of color indicated:

1. Latex additive (water emulsion) serving as a replacement for part or all of gauging water, added at job site to prepackaged dry grout mix, with type of latex and dry grout mix complying with requirements indicated below:

   a. Latex Type: Acrylic resin.

   b. Grout Type: Commercial portland cement grout specified or supplied by latex manufacturer.

B. Chemical Resistant Epoxy Grout: Provide product complying with ANSI A118.3 of color indicated.

1. Provide product with resistance to temperatures up to 300 degrees F (149 degrees C), certified by grout manufacturer for intended use.

2. Locations: All floor, base, and wall tile work within Toilet Rooms, at Janitor's Rooms, at rooms where food is stored, prepared and/or cooked, and at exterior tile work.

## 2.7 MISCELLANEOUS MATERIALS:

A. Filler/Sealer for Quarry Tile: Proprietary product designed for filling quarry tile to prevent staining.

B. Tile Cleaner: Product specifically acceptable to manufacturer of tile and grout manufacturer for application indicated and as recommended by National Tile Promotion Federation, 112 North Alfred Street, Alexandria, VA 22134 or Ceramic Tile Institute, 700 North Virgil Avenue, Los Angeles, CA 90029.

C. Waterproofing Membrane: Equivalent to "ECB Anti-Fracture Membrane", as manufactured by NAC Products, Inc.; Cuyahoga Falls, Ohio (Phone: 1-800-633-4622).

1. Provide complete system, including substrate primer/sealer, 40-mil, two component, self-adhering membrane, and appropriate top-coat primer for the material(s) to be placed over the ECB system.

2. Locations for Use:

   a. Below all tile flooring in rooms with toilet fixtures, sinks, and lavatories, turned up 1-inch at all edges and concealed by base material, and turned down at least 2-inches into floor drains.
   b. Below tile flooring and centered over control and expansion joints, in rooms other than above, 12-inches wide and wall to wall.

3. Completed membrane system is intended for waterproofing, and to bridge substrate joints within the limitations stated in manufacturer's current written product data.

## 2.8 MIXING MORTARS AND GROUT:

A. Mix mortars and grouts to comply with requirements of referenced standards and manufacturers for accurately proportioning of materials, water or additive content, mixing equipment and mixer speeds, mixing containers, mixing time, and other procedures needed to produce mortars and grouts of uniform quality with optimum performance characteristics for application indicated.

# PART 3 - EXECUTION

3.1 EXAMINATION:

A. Examine surfaces to receive tile work and conditions under which tile will be installed. Do not proceed with tile work until surfaces and conditions comply with requirements indicated in referenced tile installation standard.

1. Verify that substrates for setting tile are firm, dry, clean, and free from oil or waxy films and curing or cleaning compounds.

2. Verify that installation of all required grounds, anchors, recessed frames, electrical and mechanical units of work, and similar items located in or behind tile has been completed before installing tile.

B. Do not proceed with installation until unsatisfactory conditions and incomplete work have been corrected.

3.2 INSTALLATION, GENERAL:

A. ANSI Tile Installation Standard: Comply with applicable parts of ANSI 108 series of tile installation standards included under "American National Standard Specifications for the Installation of Ceramic Tile."

B. TCA Installation Guidelines: TCA "Handbook for Ceramic Tile Installation"; comply with TCA installation methods indicated or, if not otherwise indicated, as applicable to installation conditions shown.

C. Extend tile work into recesses and under or behind equipment and fixtures, to form a complete covering without interruptions, except as otherwise shown. Terminate work neatly at obstructions, edges and corners without disrupting pattern or joint alignments.

D. Accurately form intersections and returns. Perform cutting and drilling of tile without marring visible surfaces. Carefully grind cut edges of tile abutting trim, finish or built-in items for straight aligned joints. Fit tile closely to electrical outlets, piping, fixtures and other penetrations so that plates, collars, or covers overlap tile.

E. Jointing Pattern: Unless otherwise shown, lay tile in grid pattern. Align joints when adjoining tiles on floor, base, walls and trim are same size. Layout tile work and center tile fields in both directions in each space or on each wall area. Adjust to minimize tile cutting. Provide uniform joint widths, unless otherwise shown.

1. For tile mounted in sheets make joints between tile sheets same width as joints within tile sheets so that extent of each sheet is not apparent in finished work.

F. Expansion Joints: Locate expansion joints and other sealant filled joints, including control, contraction and isolation joints, where indicated, or if not indicated, at spacings and locations recommended in TCA "Handbook for Ceramic Tile Installation," and approved by Architect. Do not saw cut joints.

1. Sealing of joints is specified in Section 07900 - "Joint Sealers."

2. Provide expansion joints in tile and setting beds directly above all unsealed and unbridged expansion joints, control joints, construction joints, cold joints and saw-cut control joints in the building structure; and where tile work abuts restraining surfaces such as perimeter walls, dissimilar floors, curbs, columns, pipes, ceilings, and where changes occur in backing materials. Expansion joints shall be provided as follows:

a. Floor Tile: Minimum 1/4-inch joint width; joints 36-feet o.c. maximum.

3. Joints in tile and setting materials directly over any unsealed and unbridged structural joints shall never be narrower than the width of the structural joint. Joints over saw-cut control joints shall never be less than the width of the saw-cut joint width. Preparation and installation shall be as required for expansion joints.

4. To insure that locations of any unsealed and unbridged joints in tile work align with existing joints in substrates, joints in tile work shall be constructed during installation of mortar beds and/or tile, rather than saw-cutting joints after installation.

5. Keep expansion joint cavities open and free of dirt, debris, grout, mortar and setting materials.

6. Set compressible back-up strip when mortar is placed or utilize removable wood strip to provide space for back-up after mortar has cured.

7. Install sealant after tile work and grout are dry.

G. Grout tile to comply with the requirements of the following installation standards:

1. For ceramic tile grouts (sand-portland cement, dry-set, commercial portland cement, and latex-portland cement grouts) comply with ANSI A108.10.

2. For chemical resistant epoxy grouts comply with ANSI A108.6.

## 3.3 FLOOR INSTALLATION METHODS:

A. Quarry Tile: Install tile to comply with requirements indicated below for setting bed method, TCA installation method related to type of subfloor construction, and grout type:

1. Portland Cement Mortar: ANSI A108.1.

2. Bond Coat: Portland cement paste on plastic bed or the following thin-set mortar on cured bed, ANSI A108.5, at Contractor's option:

a. Latex-portland cement mortar.

3. Concrete Subfloor, Interior: TCA F111 or F121.

4. Concrete Subfloor, Interior: TCA F112 (bonded).

5. Concrete Subfloor, Interior: TCA F114 (with epoxy chemical resistant resin grout).

6. Grout:

a. Latex-portland cement (ANSI 108.10).

b. Chemical resistant epoxy (ANSI 108.6).

7. Grout - Locations for Use:

a. Latex-portland cement, (interior).

b. Epoxy (exterior, and where indicated at interior).

B. Ceramic Tile: Install tile to comply with requirements indicated below for setting bed methods, TCA installation methods related to types of subfloor construction, and grout types:

1. Portland Cement Mortar: ANSI A108.1.

2. Bond Coat: Portland cement paste on plastic bed or the following thin-set mortar on cured bed or concrete slabs, ANSI A108.5, at Contractors option:

a. Latex-portland cement mortar.

3. Concrete Subfloors, Interior: TCA F112 (bonded).

4. Concrete Subfloors, Interior: TCA F114 (with chemical resistant epoxy grout).

5. Grout:

a. Latex-portland cement (interior).

b. Chemical Resistant Epoxy: ANSI 108.6.

C. Stone Thresholds: Install stone thresholds at locations indicated; set in same type of setting bed as abutting field tile unless otherwise indicated.

1. Set thresholds in latex-portland cement mortar for locations where mortar bed would otherwise be exposed above adjacent non-tile floor finish.

## 3.4 WALL TILE AND TRIM INSTALLATION METHODS:

A. Install types of tile designated for wall application to comply with requirements indicated below for setting bed methods, TCA installation methods related to subsurface wall conditions, and grout types:

1. Portland Cement Mortar: ANSI A108.1.

a. Masonry or Concrete, Interior: TCA W211 (bonded).

b. Grout: Sand-portland cement (ANSI 108.10), except chemical resistant epoxy (ANSI 118.3) at toilet rooms.

c. Location: Quarry tile bases at locations indicated on Drawings, and otherwise as applicable at conditions required by actual project conditions.

2. Organic Adhesive: ANSI A108.4.

a. Solid Backing, Interior: TCA W223.

b. Grout: Latex-portland cement, (ANSI 108.10), except chemical resistant epoxy (ANSI 118.3) at toilet rooms.

## 3.5 CLEANING AND PROTECTION - TILE WORK:

A. Cleaning: Upon completion of placement and grouting, clean all new and adjacent existing tile surfaces so they are free of foreign matter.

1. Unglazed tile may be cleaned with acid solutions only when permitted by tile and grout manufacturer's printed instructions, but no sooner than 14-days after installation. Protect metal surfaces, cast iron and vitreous plumbing fixtures from effects of acid cleaning. Flush surface with clean water before and after cleaning.

2. Remove temporary protective wax coating from quarry tile, using methods recommended by manufacturers of tile and grout.

    a. Apply quarry tile filler to clean, dry quarry tile in compliance with filler manufacturer's directions. Repeat application as necessary to obtain uniform color in appearance of both tile and grout.

B. Finished Tile Work: Leave finished installation clean and free of cracked, chipped, broken, unbonded, or otherwise defective tile work.

C. Protection: When recommended by tile manufacturer, apply a protective coat of neutral protective cleaner to completed tile walls and floors. Protect installed tile work with kraft paper or other heavy covering during construction period to prevent staining, damage and wear.

1. When recommended by tile manufacturer, apply a protective coat of neutral protective cleaner to completed tile walls and floors. Protect installed tile work with draft paper or other heavy covering during construction period to prevent staining, damage, and wear.

2. Prohibit foot and wheel traffic from using tiled floors for at least 7-days after grouting is completed.

3. Before final inspection, remove protective coverings and rinse neutral cleaner from tile surfaces.

END OF TILE

SECTION 095110

ACOUSTICAL PANEL CEILINGS

## PART 1 - GENERAL

### 1.1 RELATED DOCUMENTS:

A. Drawings and general provisions of Contract, including General and Supplementary Conditions and Division 1 Specification Sections, apply to this Section.

B. Related work specified elsewhere includes:

.. Section 06100 - "Rough Carpentry" (concealed P.T. wood blocking and grounds)
.. Section 06200 - "Finish Carpentry"
.. Section 07210 - "Building Insulation"
.. Section 07900 - "Joint Sealers"
.. Section 09250 - "Gypsum Drywall"
.. Division 15 - (Mechanical items, etc., mounted in ceilings).
.. Division 16 - (Electrical items, light fixtures, etc., mounted in ceilings).

C. Thermal insulation for installation on acoustical panel ceilings, if required, is specified in Section 07210 - "Building Insulation."

### 1.2 SUMMARY:

A. This Section includes acoustical and non-acoustical panel ceilings installed with exposed grid suspension systems.

1. Type 1 (ACT-1): Square Edge Tile.

### 1.3 SUBMITTALS:

A. General: Submit the following in accordance with Conditions of Contract and Division 1 Specification Sections.

1. Product data for each type of product specified.

2. Samples for verification purposes of each type of exposed finish required, prepared on samples of size indicated below and of same thickness and material indicated for final unit of Work. Where finishes involve normal color and texture variations, include sample sets showing full range of variations expected.

a. 6-inch-square samples of each acoustical panel type, pattern, and color.

b. Set of 12-inch-long samples of exposed suspension system members, including moldings, for each color and system type required.

### 1.4 QUALITY ASSURANCE:

A. Installer Qualifications: Engage an experienced Installer who has successfully completed acoustical ceilings similar in material, design, and extent to those indicated for Project, and which is acceptable

to manufacturer of acoustical products herein, as indicated by written statement by their manufacturer(s).

1. Refer to Section 01015 - "Special Conditions", for additional experience requirements and information.

B. Fire-Performance Characteristics: Provide acoustical ceilings that are identical to those tested for the following fire-performance characteristics, per ASTM test method indicated below, by UL or other testing and inspecting organizations acceptable to authorities having jurisdiction. Identify acoustical ceiling components with appropriate markings of applicable testing and inspecting organization.

1. Surface Burning Characteristics: As follows, tested per ASTM E 84 and complying with ASTM E 1264 for Class A products.

a. Flame Spread: 25 or less.
b. Smoke Developed: 50 or less.

C. Acoustical Performance Characteristics: Provide acoustical ceiling systems which have been tested by UL or other acceptable independent testing organization, to certify compliance with STC and CAC minimum requirements indicated herein.

D. Single-Source Responsibility for Ceiling Units: Obtain each type of acoustical ceiling unit from a single source with resources to provide products of consistent quality in appearance and physical properties without delaying progress of the Work.

E. Coordination of Work: Coordinate layout and installation of acoustical ceiling units and suspension system components with other construction that penetrates ceilings or is supported by them, including light fixtures, HVAC equipment, and wall and partition systems.

## 1.5 DELIVERY, STORAGE, AND HANDLING:

A. Deliver acoustical ceiling units to project site in original, unopened packages and store them in a fully enclosed space where they will be protected against damage from moisture, direct sunlight, surface contamination, and other causes.

B. Before installing acoustical ceiling units, permit them to reach room temperature and a stabilized moisture content.

C. Handle acoustical ceiling units carefully to avoid chipping edges or damaging units in any way.

## 1.6 PROJECT CONDITIONS:

A. Space Enclosure: Do not install interior acoustical ceilings until space is enclosed and weatherproof, wet-work in space is completed and nominally dry, work above ceilings is complete, and ambient conditions of temperature and humidity will be continuously maintained at values near those indicated for final occupancy.

## 1.7 EXTRA MATERIAL:

A. Deliver extra materials to Owner. Furnish extra materials described below that match products installed, are packaged with protective covering for storage, and are identified with appropriate labels.

1. Acoustical and Non-Acoustical Ceiling Units: Furnish quantity of full-size units equal to 2.0 percent of amount installed, in whole unused cartons.

## PART 2 - PRODUCTS

### 2.1 ACOUSTICAL CEILING UNITS, GENERAL:

A. Standard for Acoustical Ceiling Units: Provide manufacturer's standard units of configuration indicated that comply with ASTM E 1264 classifications as designated by reference to types, patterns, acoustical ratings, and light reflectance, unless otherwise indicated.

1. Mounting Method for Measuring NRC: Type E-400 (plenum mounting in which face of test specimen is 15-3/4 inches [400 mm] away from the test surface) per ASTM E 795.

B. Colors and Patterns: Provide products to match appearance characteristics indicated under each product type, or if not indicated, as selected by Architect from manufacturer's standard colors, surface textures, and patterns available for ceiling panels and exposed metal suspension systems of quality indicated herein.

### 2.2 ACOUSTICAL UNITS:

A. Type 1 (ACT-1): Manufacturer's standard lay-in non-directional random pattern, lightly fissured, heavily perforated panels, and as follows, unless indicated otherwise:

1. Size: 24 inches x 24 inches x 3/4 inch.

2. Edge: 9/16 beveled tegular.

3. NRC Range: .70 - .80.

4. CAC Range: 35-39.

5. Color: White.

6. Manufacturer/Product No.:

a. USG "Frost Clima-Plus Premium"

7. Grid: USG Fine Line DXF 9/16-inch exposed tee grid, in standard white color.

### 2.3 METAL SUSPENSION SYSTEMS, GENERAL:

A. Standard for Metal Suspension Systems: Provide manufacturer's standard metal suspension systems of types, structural classifications, and finishes indicated that comply with applicable ASTM C 635 requirements.

B. Finishes and Colors: Provide manufacturer's standard factory-applied finish for type of system indicated, unless otherwise required.

1. High-Humidity Finish: Comply with ASTM C 635 requirements for "Coating Classification for Severe Environment Performance" where high-humidity finishes are indicated.

a. Product/Manufacturer:

1) "Environmental ZXA Grid System," as manufactured by USG Interiors or Donn.
2) "Exposed Environmental (HD) Series," as manufactured by National Rolling Mills.
3) "Prelude Plus" Environmental Tee System, as manufactured by Armstrong World Industries, Inc.

C. Attachment Devices: Size for 5 times design load indicated in ASTM C 635, Table 1, Direct Hung unless otherwise indicated.

D. Wire for Hangers and Ties: ASTM A 641, Class 1 zinc coating, soft temper, pre-stretched.

1. Gauge: Provide wire sized to that stress at 3 times hanger design load (ASTM C 635, Table 1, Direct-Hung), will be less than yield stress of wire, but provide not less than 0.106-inch diameter (12 gauge).

E. Hanger Rods - (as required): Mild steel, zinc coated, or protected with rust-inhibitive paint.

F. Angle Hangers - (as required): Angles with legs not less than 7/8 inch wide, formed with 0.0365-inch-thick galvanized steel sheet complying with ASTM A 446, Coating Designation G90, with bolted connections and 5/16-inch-diameter bolts.

G. Edge Moldings and Trim: Metal or extruded aluminum of types and profiles indicated or, if not indicated, manufacturer's standard moldings for edges and penetrations that fit type of edge detail and suspension system indicated.

H. Subject to compliance with requirements, provide suspension systems of one of the following:

1. Manufacturers of Steel Exposed Suspension Systems:

a. Same as ceiling panel unit manufacturer.
b. Armstrong World Industries, Inc.
c. Chicago Metallic Corporation.
d. Donn Corporation.

2. Manufacturers of Moldings and Trim:

a. Construction Specialties.
b. Fry Reglet Corporation.
c. Gordon, Inc.
d. MM Systems.
e. Technical Ceiling Systems, Inc.
f. Same as Suspension system manufacturer.

## 2.4 NON-FIRE-RESISTANCE-RATED DIRECT-HUNG SUSPENSION SYSTEMS:

A. Wide-Face Capped Double-Web Steel Suspension System: Main and cross-runners roll-formed from prepainted or electrolytic zinc-coated cold-rolled steel sheet, with prefinished 15/16-inch-wide metal caps on flanges; other characteristics as follows:

1. Structural Classification: Intermediate-Duty System.

2. End Condition of Cross-Runners: Override (stepped) or butt-edge type, as standard with manufacturer.

3. Cap Material and Finish:

   a. Steel sheet, painted (typical).
   b. Aluminum sheet with painted finish, (at “Environmental Grid Systems”).

## PART 3 - EXECUTION

### 3.1 EXAMINATION:

A. Examine substrates and structural framing to which ceiling system attaches or abuts, with Installer present, for compliance with requirements specified in this and other sections that affect installation and anchorage of ceiling system. Do not proceed with installation until unsatisfactory conditions have been corrected.

### 3.2 PREPARATION:

A. Coordination: Furnish layouts for preset inserts, clips, and other ceiling anchors, or supports, whose installation is specified in other sections.

   1. Furnish galvanized inserts and similar devices as required for wood structure (if required), to other trades for installation well in advance of time needed for coordination of other work.

B. Measure each ceiling area and establish layout of acoustical units to balance border widths at opposite edges of each ceiling. Avoid use of less-than-half-width units at borders, and comply with reflected ceiling plans.

### 3.3 INSTALLATION:

A. General: Install acoustical ceiling systems to comply with installation standard referenced below, per manufacturer’s current written instructions and CISCA “Ceiling Systems Handbook.”

   1. Standard for Installation of Ceiling Suspension Systems: Comply with ASTM C 636.

B. Arrange acoustical units and orient directionally patterned units, (if any) in a manner shown by reflected ceiling plans.

   1. Install panels with pattern running in one direction, as indicated, or if not indicated, as requested from and directed by Architect.

C. Suspend ceiling hangers from building structural members and as follows, with system leveling tolerance of 1/8 inch in 12'-0":

   1. Install hangers plumb and free from contact with insulation or other objects within ceiling plenum that are not part of supporting structural or ceiling suspension system. Splay hangers only where required to miss obstructions and offset resulting horizontal forces by bracing, countersplaying, or other equally effective means.

   2. Where width of ducts and other construction within ceiling plenum produces hanger spacings that interfere with the location of hangers at spacings required to support standard suspension system members, install supplemental suspension members and hangers in

form of trapezes or equivalent devices. Size supplemental suspension members and hangers to support ceiling loads within performance limits established by referenced standards.

3. Secure wire hangers by looping and wire-tying, either directly to structures or to inserts, eyescrews, or other devices that are secure and appropriate for substrate, and in a manner that will not cause them to deteriorate or otherwise fail due to age, corrosion, or elevated temperatures.

4. Secure, angle, and rod hangers, (if any) to structure, including intermediate framing members, by attaching to inserts, eyescrews, 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 due to age, corrosion, or elevated temperatures.

5. Space hangers not more than 4'-0" o.c. along each member supported directly from hangers, unless otherwise shown, and provide hangers not more than 8 inches from ends of each member.

   a. Provide additional hangers as necessary, so that one hanger occurs on each side of lay-in and surface-mounted light fixtures, and at other grid supported equipment, devices, etc.

6. Install “high humidity finish” systems at all areas indicated to receive lay-in vinyl-faced gypsum “non-acoustical” ceiling panels.

D. Install edge moldings of type indicated at perimeter of acoustical ceiling area and where necessary to conceal edges of acoustical units.

1. Screw-attach moldings to substrate at intervals not over 16 inches o.c. and not more than 3 inches from ends, leveling with ceiling suspension system to tolerance of 1/8 inch in 12'-0". Miter corners accurately and connect securely.

## 3.4 CLEANING:

A. Clean exposed surfaces of acoustical ceilings, including trim, edge moldings, and suspension members. Comply with manufacturer’s instructions for cleaning and touch-up of minor finish damage. Remove and replace work that cannot be successfully cleaned and repaired to permanently eliminate evidence of damage.

## 3.5 EXTRA MATERIALS:

A. Deliver extra materials stock as indicated above, to Owner.

END OF SECTION

SECTION 096710

# EPOXY FLOOR COATING

## PART 1 - GENERAL

### 1.1 RELATED DOCUMENTS

A. Drawings and general provisions of the Contract, including General and Division 1 Specification Sections, apply to this Section.

### 1.2 SUMMARY

A. This Section includes the following:
1. Epoxy floor coating

B. Related Sections include the following:
1. Division 3 Section “Concrete” for concrete substrates to receive resinous flooring.

### 1.3 SUBMITTALS FOR REVIEW

A. Product Data: For each type of product specified. Include manufacturer’s technical data, installationinstructions, and recommendations for each epoxy floor coating system component required.

B. Samples for Verification: Of each epoxy floor coating system required, 6 inches (150 mm) square, applied by Installer for this Project to a rigid backing, in color, texture, and finish indicated. Where finishes involve normal color and texture variations, include Sample sets showing the full range of variations expected.

### 1.4 SUBMITTALS FOR INFORMATION

A. Installer Certificates: Signed by manufacturer certifying that installers comply with specified requirements.

B. Material Certificates: Signed by manufacturers certifying that materials furnished comply with equirements.

### 1.5 SUBMITTALS AT PROJECT CLOSEOUT

A. Maintenance Data: For epoxy floor coating system to be included in maintenance manuals.

B. Maintenance Data: Include maintenance procedures, recommended maintenance materials, procedures for stain removal, repairing surface, and suggested schedule for cleaning.

### 1.6 QUALITY ASSURANCE

A. Installer Qualifications: Engage an experienced installer (applicator) who has specialized in installing resinous flooring similar in material, design, and extent to that indicated for this Project and who is acceptable to resinous flooring manufacturer.

1. Engage an installer who employs only persons trained and approved by resinous flooring manufacturer or installing resinous flooring systems specified.

B. Source Limitations: Obtain primary resinous flooring materials, including primers, resins, hardening agents, and sealing or finish coats, through one source from a single manufacturer. Provide secondary materials including patching and fill material, joint sealant, and repair materials of type and from source recommended by manufacturer of primary materials.

## 1.7 DELIVERY, STORAGE AND HANDLING

A. Deliver materials in original packages and containers, with seals unbroken, bearing manufacturer's labels indicating brand name and directions for storage and mixing with other components.

B. Store materials to comply with manufacturer's written instructions to prevent deterioration from moisture, heat, cold, direct sunlight, or other detrimental effects.

## 1.8 PROJECT CONDITIONS

A. Environmental Limitations: Comply with epoxy floor coating system manufacturer's written instructions for substrate temperature, ambient temperature, moisture, ventilation, and other conditions affecting resinous flooring installation.

B. Lighting: Provide permanent lighting or, if permanent lighting is not in place, simulate permanent lighting conditions during epoxy floor coating system installation.

C. . Close spaces to traffic during resinous flooring application and for not less than 24 hours after application, unless manufacturer recommends a longer period.

# PART 2 - PRODUCTS

## 2.1 MANUFACTURERS

A. Products: Subject to compliance with requirements, provide products by one of the following manufacturers:
1. Dex-O-Tex; Division of Crossfield Products Corporation: Decor-Flor.
2. BASF Construction Chemicals, LLC.: Selbatwede 41.
3. Sika Corporation: Sikafloor Quartzite 6000.
4. Tnemec Company, Inc; StrataShield Series 222 Deco-Tread system. Tnemec, P.O. Box 165770, North Kansas City, MO 64116, 1(800) TNEMEC-1.
5. Dur-A-Flex, Inc.: Dur-a-Quartz Epoxy Flooring System.

## 2.2 MATERIALS

A. Epoxy Floor Coating: Resinous floor surfacing system consisting of primer; body coat(s) including resin, hardener, aggregates, and colorants, if any; and sealing or finish coat(s).

B. Patching and Fill Material: Resinous product of or approved by resinous flooring manufacturer and recommended by manufacturer for application indicated.

## PART 3 - EXECUTION

### 3.1 EXAMINATION

A. Verify floor and lower wall surfaces are free of substances that may impair adhesion of adhesive and finish materials, adhesive and finish materials.

### 3.2 PREPARATION

A. General: Prepare and clean substrate according to resinous flooring manufacturers written instructions for substrate indicated. Provide clean, dry, and neutral substrate for resinous flooring application.

B. Concrete Substrates: Provide sound concrete surfaces free of laitance, glaze, efflorescence, curing compounds, form release agents, dust, dirt, grease, oil, and other contaminates incompatible with epoxy floor system.

1. Test for moisture vapor transmission. The recognized methods are:
   a. ASTM-F-1869-04: Standard Test Method for Measuring Moisture Vapor Emission Rate of Concrete Subfloor Using Anhydrous Calcium Chloride: The maximum allowed water/vapor transmission rate is 3 pounds per 1,000 sq. ft. per 24 hours.
   b. ASTM F-2170-02: Standard Test Method for Determining Relative Humidity in Concrete Floor Slabs Using In Situ Probes: This test measures the relative humidity in the slab below the surface. If taken over a period of time, it will show the rate of drying in the slab. The maximum relative humidity should be below 80%.
   c. ASTM-D-4263-83(2005): Plastic Sheet Test: This test gives an indication that moisture may be present.
2. Old Concrete: Old concrete surfaces must be structurally sound. Any unsound areas must be repaired prior to proceeding with the resinous installation. For proper patching and repairing, remove existing paint, scale and loose concrete by rough sanding, sandblasting, shot blasting, or grinding. In some cases where plant conditions allow, a stripper may be used to remove excessive build-up of paints or sealers. Remove any contamination. Use vacuum shot blasting to achieve a good bonding profile. Before Examined for moisture vapor transmission using any of the approved tests:
   a. ASTM-F-1869-04: Standard Test Method for Measuring Moisture Vapor Emission Rate of Concrete Subfloor Using Anhydrous Calcium Chloride.
   b. ASTM-F-2170-02: Standard Test Method for Determining Relative Humidity in Concrete Floor Slabs Using In Situ Probes.
   c. ASTM-D-4263-83(2005): Standard Test Method for Indicating Moisture in Concrete by the Plastic Sheet Method. This test is only an indication and should not be used to determine moisture migration.
3. Other ASTM Tests which are applicable to concrete preparation are:
   a. ASTM-D-4258-05 Standard Practice for Surface Cleaning Concrete for Coating.
   b. ASTM-D-4259-88(2006) Standard Practice for Abrading Concrete.
   c. ASTM-D-4260-05 Standard Practice for Acid Etching Concrete.
   d. ASTM-D-4261-05 Standard Practice for Surface Cleaning Concrete Unit Masonry for Coating.
   e. ASTM-C-811-98(2003) Standard Practice for Surface Preparation of Concrete for Application of Chemical Resistant Resin Monolithic Surfacing.

4. New Concrete: New concrete must be well cured and dry prior to coating. Allow to cure a minimum of 28 days unless using green concrete primer. No curing agents or sealing compounds should be used at any time prior to coating. A light steel trowel finish is recommended hen finishing the concrete surface.
   a. Any oil, grease, laitance, or other foreign material must be removed.
   b. Steam clean with a strong degreaser such as tri-sodium phosphate.
   c. Laitance and other foreign material shall be removed by mechanical methods such as vacuum blasting, scarification, or grinding.
   d. All new concrete shall be mechanically prepared by vacuum shotblasting. Shot-blast surfaces with an apparatus that abrades the concrete surface, contains the dispensed shot within the apparatus, and recirculates the shot by vacuum pickup.
   e. Before the installation of epoxy resinous system, the surface should be examined for moisture. Use tests noted above for old concrete.
5. Repair damaged and deteriorated concrete according to resinous flooring manufacturers written recommendations.
6. Comply with the requirements noted above unless manufacturers' written instructions are more stringent.
7. Repair damaged and deteriorated concrete according to resinous flooring manufacturers written recommendations.

C. Resinous Materials: Mix components and prepare materials according to epoxy floor coating manufacturer's written instructions.

D. Use patching and fill material to fill holes and depressions in substrates according to manufacturers written instructions.

E. Treat control joints and other nonmoving substrate cracks to prevent cracks form reflecting through resinous flooring according to manufacturers written recommendations.

F. Perform Anhydrous Calcium Chloride Test in accordance with ASTM F 1869-04 once for every 1,000 square feet of surface to be coated. The maximum limit for moisture vapor emissions rate shall be 3.0 lbs. per 1,000ft sq. per 24-hour period. If tests indicate rates higher than 3.0 lbs. per 1,000ft sq. 1,000ft sq. per 24-hour period, a water vapor reduction system shall be applied to the substrate. The water vapor reduction system shall be Koester VAP 1 2000 System by Koester American Corporation, 2585 Aviator Drive, Virginia Beach, VA 23453, 1 (757) 425-1206, or equivalent.

G. Any repairs to the concrete substrate that are required prior to installation of the epoxy floor coating system shall comply with the International Concrete Repair Institute (ICRI) Guideline 03732 CSP 3-4.

## 3.3 APPLICATION

A. General: Apply components of epoxy floor coating system according to manufacture's written instructions to product a uniform, monolithic wearing surface of thickness indicated.
   1. Coordinate application of components to provide optimum adhesion of resinous flooring system to substrate and optimum intercoat adhesion.

2. Cure resinous flooring components according to manufacturer's written instruction. Prevent contamination during application and curing processes.
3. At substrate expansion and isolation joints, provide joint in epoxy floor coating system to comply with epoxy floor coating manufacturer's written recommendations.

B. Epoxy Floor Coating
1. Apply primer over prepared substrate at manufacturers recommended spreading rate.
2. Apply reinforcing membrane to substrate cracks.
3. Apply self-leveling slurry body coat(s) to minimum thickness minimum 3/16 inch thickness. Provide body coat of resin using roller, squeegee of trowel. Broadcast pre-mixed grains to saturation.
   a. Broadcast aggregates and after resin is cured, remove excess aggregates to provide surface texture indicated.
4. Apply grout coat and topcoat at manufacturers recommended coverage to provide uniform, dense, slip resistant surface.
5. Allow proper cure time for each installation step.
6. Integral Cove Base: Apply cove base mix to wall surfaces at locations indicated. Round internal and external corners. Install cove base according to manufacturers written instructions and details including taping, mixing, priming, troweling, sanding and top coating of base.

## 3.4 CLEANING AND PROTECTING

A. Protect resinous flooring from damage and wear during the remainder of construction period. Use protective methods and materials, including temporary covering, recommended in writing by resinous flooring manufacturer.
B. Clean resinous flooring not more than 4 days before dates scheduled for inspections intended to establish date of Substantial Completion in each project area. Use cleaning materials and procedures recommended in writing by resinous flooring manufacturer.

END OF SECTION

SECTION 099113

EXTERIOR PAINTING

## PART I - GENERAL

1.1 RELATED DOCUMENTS

Drawings and general provisions of the Contract, including General and Supplementary Conditions and Division 01 Specification Sections, apply to this Section

1.2 SUMMARY

A. This Section includes surface preparation and field painting of exposed exterior items and surfaces. Surface preparation, priming, and finish coats specified in this Section are in addition to shop priming and surface treatment specified in other Sections.

B. Paint exposed surfaces, except where these Specifications indicate that the surface or material is not to be painted or is to remain natural. If an item or a surface is not specifically mentioned~ paint the item or surface the same as similar adjacent materials or surfaces. Refer to Finish Schedule for specific paint colors. If a color of finish is not indicated, Architect will select from full range of standard colors and finishes available.

C. Painting includes field painting of exposed bare and covered pipes and ducts (including color coding), hangers, exposed steel and iron supports, and surfaces of mechanical and electrical equipment that do not have a factory-applied final finish.

D. Do not paint themed items. Finishing of themed items shall be part of "Themeing Contract".

E. Do not paint prefinished items, concealed surfaces, finished metal surfaces, operating parts, and labels, unless otherwise indicated.

1. Prefinished items include the following factory-finished components:

   a. Finished mechanical and electrical equipment.

   b. Light fixtures.

2. Finished metal surfaces include the following:

   a Anodized aluminum.

   a. Stainless steel.

   b. Chromium plate.

   d. Copper and copper alloys.

   e. Bronze and brass.

3. Operating parts include moving parts of operating equipment and the following:

   a. Valve and damper operators.

   b. Linkages.

   c. Sensing devices.

   d. Motor and fan shafts.

1. Labels: Do not paint over UL, FMG, or other code-required labels or equipment name,

identification, performance rating, or nomenclature plates.

F. Related Sections include the following:

1. Division 05 Section "Pipe and Tube Railings" for shop priming exterior railings.
2. Division 08 Section "Standard Steel Doors and Frames" for factory priming steel doors and frames.
3. Division 09 Section "Interior Painting" for surface preparation and the application of paint systems on interior substrates.

1.3 DEFINITIONS

Standard coating terms defined in ASTM D 16 apply to this Section.

1. A Flat refers to a lusterless or matte finish with a gloss range below 15 when measured at an 85-degree meter.
2. Eggshell refers to low-sheen finish with a gloss range between 20 and 35 when measured at a 60-degree meter.
3. Semi gloss refers to medium-sheen finish with a gloss range between 35 and 70 when measured at a 60-degree meter.
4. Full gloss refers to high-sheen finish with a gloss range more than 70 when measured at a 60-degree meter.

1.4 SUBMITTALS

A. Product Data: For each paint system indicated .. Include block fillers and primers.

1. Material List: An inclusive list of required coating materials. Indicate each material and cross-reference specific coating, finish system, and application. Identify each material by manufacturer's catalog number and general classification.
2. Manufacturer's Information: Manufacturer's technical information, including label analysis and instructions for handling, storing, and applying each coating material.

B. Samples for Initial Selection: For each type of topcoat product indicated.

C. Samples for Verification: For each type of paint system and each color and gloss of topcoat indicated.

1. Submit Samples on rigid backing, 8 inches square for flat surfaces and 8 inches long for linear elements.
2. Step coats on Samples to show each coat required for system.
3. Label each coat of each Sample.
4. Label each Sample for location and application area.

D. Product List: For each product indicated, cross-reference to paint system and locations of application areas. Use same designations indicated on Drawings and in schedules.

E. Qualification Data: For Applicator.

1.5 QUALITY ASSURANCE

A. Applicator Qualifications: A firm or individual experienced in applying paints and coatings similar in

material, design, and extent to those indicated for this Project, whose work has resulted in applications with a record of successful in-service performance.

B. Source Limitations: Obtain block fillers and primers for each coating system from the same manufacturer as the finish coats.

C. MPI Standards: Preparation and Workmanship, comply with requirements in "MPI Architectural Painting Specification Manual" for products and paint systems indicated.

1.6 DELIVERY, STORAGE, AND HANDLING

A. Deliver materials to Project site in manufacturer's original, unopened packages and containers bearing manufacturer's name and label and the following information:

1. Product name or title of material.
2. Product description (generic classification or binder type).
3. Manufacturer's stock number and date of manufacture.
4. Contents by volume, for pigment and vehicle constituents.
5. Thinning instructions.
6. Application instructions.
7. Color name and number.
8. VOC content.

B. Store materials not in use in tightly covered containers in a well-ventilated area at a minimum ambient temperature of 45 deg F. Maintain storage containers in a clean condition, free of foreign materials and residue. Protect from freezing. Keep storage area neat and orderly. Remove oily rags and waste daily.

1. 7 PROJECT CONDITIONS

A. Apply paints only when temperature of surfaces to be painted and ambient air temperatures are between 50 and 95 deg F.

B. Do not apply paints in snow, rain, fog, or mist; when relative humidity exceeds 85 percent; at temperatures less than 5 deg F above the dew point; or to damp or wet surfaces.

## PART 2 - PRODUCTS

2.1 MANUFACTURERS

A. Basis-of-Design Products: The design is based on the products listed as manufactured by PPG Industries (Pittsburgh Paints). Subject to compliance with requirements, provide either the named product or a comparable product by one of the other following manufacturers:

1. Benjamin Moore & Co. (Benjamin Moore).
2. PPG Industries, Inc. (Pittsburgh Paints).
3. Sherwin-Williams Co. (Sherwin-Williams).

2.2 PAINT, GENERAL

A. Material Compatibility:

1. Provide materials for use within each paint system that are compatible with one another and substrates indicated, under conditions of service and application as demonstrated by manufacturer, based on testing and field experience.
2. For each coat in a paint system, provide products recommended in writing by manufacturers of topcoat for use in paint system and on substrate indicated.

B. Material Quality:

1. Provide manufacturer's best-quality paint material of the various coating types specified that are factory formulated and recommended by manufacturer for application indicated. Paint-material containers not displaying manufacturer's product identification will not be acceptable.
2. Proprietary Names: Use of manufacturer's proprietary product names to designate colors or materials is not intended to imply that products named are required to be used to the exclusion of equivalent products of other manufacturers. Furnish manufacturer's material data and certificates of performance for proposed substitutions.

C. Colors: Refer to Finish Schedule. If a color of finish is not indicated, Architect will select from manufacturer's full range.

2.3 E.I.F.S CLEANER

A. Basis-of-Design: The design for Existing E.I.F.S. is based on "Enviro Klean EIFS Clean N Prep" manufactured by Prosoco. Subject to compliance with requirements, provide either the named product or a comparable product by another approved manufacturer.

B. Do not use acidic cleaner.

## PART 3 - EXECUTION

3.1 EXAMINATION

A. Examine substrates and conditions, with Applicator present, for compliance with requirements for maximum moisture content and other conditions affecting performance of work.

B. Maximum Moisture Content of Substrates: When measured with an electronic moisture meter as follows:

1. Concrete: 12 percent.
2. Masonry (Clay and CMU): 12 percent.
3. Wood: 15 percent.

C. Verify suitability of substrates, including surface conditions and compatibility with existing finishes and primers ..

D. Begin coating application only after unsatisfactory conditions have been corrected and surfaces are dry.

E. Beginning coating application constitutes Contractor's acceptance of substrates and conditions.

F. Coordination of Work: Review other Sections in which primers are provided to ensure compatibility of the total system for various substrates. On request, furnish information on characteristics of finish materials to ensure use of compatible primers. Notify Architect about anticipated problems when using the materials specified over substrates primed by others.

3.2 PREPARATION

A. Comply with manufacturer's written instructions and recommendations in "MPI Architectural Painting Specification Manual" applicable to substrates indicated.

B. General: Remove hardware and hardware accessories, plates, machined surfaces, lighting fixtures, and similar items already installed that are not to be painted. If removal is impractical or impossible because of size or weight of the item, provide surface-applied protection before surface preparation and painting. After completing painting operations in each space or area, reinstall items removed using workers skilled in the trades involved.

C. Cleaning: Before applying paint or other surface treatments, clean substrates of substances that could impair bond of the various coatings. Remove oil and grease before cleaning. Schedule cleaning and painting so dust and other contaminants from the cleaning process will not fall on wet, newly painted surfaces.

D. Surface Preparation: Clean and prepare surfaces to be painted according to manufacturer's written instructions for each particular substrate condition and as specified.

1. Provide barrier coats over incompatible primers or remove and reprime.

2. Cementitious Materials: Prepare concrete and concrete unit masonry to be painted.
   Remove efflorescence, chalk, dust, dirt, grease, oils, and release agents. Roughen as required to remove glaze. If hardeners or sealers have been used to improve curing, use mechanical methods of surface preparation.

   a. Use abrasive blast-cleaning methods if recommended by paint manufacturer.

   b. Determine alkalinity and moisture content of surfaces by performing appropriate tests. If surfaces are sufficiently alkaline to cause the finish paint to blister and burn, correct this condition before application. Do not paint surfaces if moisture content exceeds that permitted in manufacturer's written instructions.

3. Wood: Clean· surfaces of dirt, oil, and other foreign substances with scrapers, mineral spirits, and sandpaper, as required. Sand surfaces exposed to view smooth and dust off.

   a. Scrape and clean small, dry~ seasoned knots, and apply a thin coat of white shellac or other recommended knot sealer before applying primer. After priming, fill holes and imperfections in finish surfaces with putty or plastic wood filler. Sand smooth when dried.

   b. Prime wood to be painted immediately on delivery. Prime edges, ends, faces, undersides, and back sides of wood, including cabinets, counters, cases, and paneling.

4. Ferrous Metals: Clean ungalvanized ferrous-metal surfaces that have not been shop coated; remove oil, grease, dirt, loose mill scale, and other foreign substances. Use solvent or mechanical cleaning methods that comply with SSPC's recommendations.

   a. Blast steel surfaces clean as recommended by paint system manufacturer and according to SSPC-SP 6/NACE No.3.

   b. Treat bare and sandblasted or pickled clean metal with a metal treatment wash coat before priming.

   c. Touch up bare areas and shop-applied prime coats that have been damaged.
      Wire-brush, clean with solvents recommended by paint manufacturer, and touch up with same primer as the shop coat.

5. Galvanized Surfaces: Clean galvanized surfaces with nonpetroleum-based solvents so surface

is free of oil and surface contaminants. Remove pretreatment from galvanized sheet metal fabricated from coil stock by mechanical methods.

6. E.LF.S.: Clean EIFS surfaces with EIFS cleaner followed by a mild pressurized water clean and rinse. Comply with cleaner's manufacturer's written instructions.

E. Material Preparation: Mix and prepare paint materials according to manufacturer's written instructions.

1. Maintain containers used in mixing and applying paint in a clean condition, free of foreign materials and residue.

2. Stir material before application to produce a mixture of uniform density. Stir as required during application. Do not stir surface film into material. If necessary, remove surface film and strain material before using.

3. Use only thinners approved by paint manufacturer and only within recommended limits.

F. Tinting: Tint each undercoat a lighter shade to simplify identification of each coat when multiple coats of same material are applied. Tint undercoats to match the color of the finish coat, but provide sufficient differences in shade of undercoats to distinguish each

3.3 APPLICATION

A. General: Apply paint according to manufacturer's written instructions. Use applicators and techniques best suited for substrate and type of material being applied.

1. Paint colors, surface treatments, and finishes are indicated in the paint schedules.

2. Do not paint over dirt, rust, scale, grease, moisture, scuffed surfaces, or conditions detrimental to formation of a durable paint film.

3. Provide finish coats that are compatible with primers used.

4. The term "exposed surfaces" includes areas visible when permanent or built-in fixtures, grilles, convector covers, covers for finned tube radiation, and similar components are in place. Extend coatings in these areas, as required, to maintain system integrity and provide desired protection.

5. Paint surfaces behind movable equipment and furniture the same as similar exposed surfaces. Before final installation of equipment, paint surfaces behind permanently fixed equipment or furniture with prime coat only ..

6. Paint interior surfaces of ducts with a flat, nonspecular black paint where visible through registers or grilles.

7. Paint back sides of access panels and removable or hinged covers to match exposed surfaces.

8. Finish exterior doors on tops, bottoms, and side edges the same as exterior faces.

B. Scheduling Painting: Apply first coat to surfaces that have been cleaned, pretreated, or otherwise prepared for painting as soon as practicable after preparation and before subsequent surface deterioration.

1. The number of coats and film thickness required are the same regardless of application method. Do not apply succeeding coats until previous coat has cured as recommended by

manufacturer. If sanding is required to produce a smooth, even surface according to manufacturer's written instructions, sand between applications.

2. Omit primer over metal surfaces that have been shop primed and touchup painted.

3. If undercoats, stains, or other conditions show through final coat of paint, apply additional coats until paint film is of uniform finish, color, and appearance. Give special attention to ensure that edges, comers, crevices, welds, and exposed fasteners receive a dry film thickness equivalent to that of flat surfaces.

4. Allow sufficient time between successive coats to permit proper drying. Do not recoat surfaces until paint has dried to where it feels firm, and does not deform or feel sticky under moderate thumb pressure, and until application of another coat of paint does not cause undercoat to lift or lose adhesion.

C. Application Procedures: Apply paints and coatings by brush, roller, spray, or other applicators according to manufacturer's written instructions.

1. Brushes: Use brushes best suited for type of material applied. Use brush of appropriate size for surface or item being painted.
2. Rollers: Use rollers of carpet, velvet-back, or high-pile sheep's wool as recommended by manufacturer for material and texture required.
3. Spray Equipment: Use airless spray equipment with orifice size as recommended by manufacturer for material and texture required.

D. Minimum Coating Thickness: Apply paint materials no thinner than manufacturer's recommended spreading rate to achieve dry film thickness indicated. Provide total dry film thickness of the entire system as recommended by manufacturer.

E. Mechanical and Electrical Work: Painting of mechanical and electrical work is limited to items exposed on rooftops and other visible exterior areas.

F. Mechanical items to be painted include, but are not limited to, the following:

1. Uninsulated metal piping.
2. Uninsulated plastic piping.
3. Pipe hangers and supports.
4. Tanks that do not have factory-applied final finishes.
5. Visible portions of internal surfaces of metal ducts, without liner, behind air inlets and outlets.
6. Duct, equipment, and pipe insulation having "all-service jacket" or other paintable jacket material.
7. Mechanical equipment that is indicated to have a factory-primed finish for field painting.
8. All items exposed to public view.

G. Electrical items to be painted include, but are not limited to, the following:

1. Switchgear.
2. Panel boards.
3. Electrical equipment that is indicated to have a factory-primed finish for field painting.

4. All items exposed to public view.

H. Block Fillers: Apply block fillers to concrete masonry block at a rate to ensure complete coverage with pores filled.

I. Prime Coats: Before applying finish coats, apply a prime coat, as recommended by manufacturer, to material that is required to be painted or finished and that has not been prime coated by others. Recoat primed and sealed surfaces where evidence of suction spots or unsealed areas in first coat appears, to ensure a finish coat with no burn through or other defects due to insufficient sealing.

J. Pigmented (Opaque) Finishes: Completely cover surfaces as necessary to provide a smooth, opaque surface of uniform finish, color, appearance, and coverage.
Cloudiness, spotting, holidays, laps, brush marks, runs, sags, ropiness, or other surface imperfections will not be acceptable.

K. Completed Work: Match approved samples for color, texture, and coverage. Remove, refinish, or repaint work not complying with requirements.

3.4 FIELD QUALITY CONTROL

A. Owner reserves the right to invoke the following test procedure at any time and as often as Owner deems necessary during the period when paint is being applied:

B. Owner will engage a qualified independent testing agency to sample paint material being used. Samples of material delivered to Project will be taken, identified, sealed, and certified in the presence of Contractor.

C. Owner may direct Contractor to stop painting if test results show material being used does not comply with specified requirements. Contractor shall remove noncomplying paint from Project site, pay for testing, and repaint surfaces previously coated with the noncomplying paint. If necessary, Contractor may be required to remove noncomplying paint from previously painted surfaces if, on repainting with specified paint, the two coatings are incompatible.

3.5 CLEANING

A. At the end of each workday, remove empty CaI1$, rags, rubbish, and other discarded paint materials from Project site.

B. After completing painting, clean glass and paint-spattered surfaces. Remove spattered paint by washing and scraping without scratching or damaging adjacent finished surfaces.

3.6 PROTECTION

A. Protect work of other trades, whether being painted or not, against damage from painting. Correct damage by cleaning, repairing or replacing, and repainting, as approved by Architect.

B. Provide "Wet Paint" signs to protect newly painted finishes. After completing painting operations, remove temporary protective wrappings provided by others to protect their work.

C. After work of other trades is complete, touch up and restore damaged or defaced painted surfaces. Comply with procedures specified in PDCA Pl.

3.7 EXTERIOR PAINT SCHEDULE

A. Wood: Provide the following finish system over exterior wood surfaces to receive opaque finish:

1. Semi-Gloss Acrylic-Enamel Finish: Two finish coats over a primer.

   a Primer: Exterior Alkyd-Oil Reain. Pittsburgh Paints, 6-9 Series Speed Hide Exterior Wood Primer Oil. Apply at a dry film thickness of not less than 1.8 mil.

   b. Finish Coats: Exterior semi-gloss acrylic enamel. Pittsburgh Paints, 6900 Series Speed Hide Exterior House & Trim Semi-Gloss Acrylic Latex Paint. Apply at a dry film thickness of not less than 1.5 mils.

B. Ferrous Metal: Provide the following finish systems over exterior ferrous metal.

Primer is not required on shop-primed items.

1. Semi-Gloss Acrylic-Enamel Finish: Two finish coats over a rust-inhibitive primer.

   a Primer: Exterior ferrous-metal primer. Pittsburgh Paints, 6-208 Speed hide Interior Exterior Rust Inhibitive Steel Primer. Apply at a dry film thickness of not less than 1.5 mils.

   b. Finish Coats: Exterior semi-gloss acrylic enamel. Pittsburgh Paints, 6900 Series Speed Hide Exterior House & Trim Semi-Gloss Acrylic Latex Paint. Apply at a dry film thickness of not less than 1.5 mils.

C. Zinc-Coated Metal: Provide the following finish systems over exterior zinc-coated metal surfaces:

1. Semi-Gloss Acrylic-Enamel Finish: Two finish coats over a galvanized metal primer.

   a. Primer: Exterior galvanized metal primer. Pittsburgh Paints, 90- 708 Pitt-Tech Interior Exterior Primer Finish DTM Industrial Enamel. Apply at a dry film thickness of not less than 2.0 mils.

2. Finish Coats: Exterior semi-gloss acrylic enamel. Pittsburgh Paints, 6900 Series Speed Hide Exterior House & Trim Semi-Gloss Acrylic Latex Paint. Apply at a dry film thickness of not less than 1.5 mils.

END OF SECTION

SECTION 099123

INTERIOR PAINTING

## PART 1 - GENERAL

1.1 RELATED DOCUMENTS

Drawings and general provisions of the Contract, including General and Supplementary Conditions and Division 01 Specification Sections, apply to this Section.

1.2 SUMMARY

A. This Section includes surface preparation and field painting of exposed interior items and surfaces. Surface preparation, priming, and finish coats specified in this Section are in addition to shop priming and surface treatment specified in other Sections.

B. Paint exposed surfaces, except where these Specifications indicate that the surface or material is not to be painted or is to remain natural. If an item or a surface is not specifically mentioned, paint the item or surface the same as similar adjacent materials or surfaces. Refer to Finish Schedule for specific paint colors. If a color of finish is not indicated, Architect will select from full range of standard colors and finishes available.

C. Painting includes field painting of exposed bare and covered pipes and ducts (including color coding), hangers, exposed steel and iron supports, and surfaces of mechanical and electrical equipment that do not have a factory-applied final finish.

D. Painting shall include identification of fire and smoke partitions. All smoke stop partitions and fire-rated walls or partitions required to have protected openings shall be effectively and permanently identified with signs or stenciling in a manner acceptable to the authority having jurisdiction. Such identification shall be above any decorative ceiling and in concealed spaces. Unless otherwise directed by authority having jurisdiction, wording shall read "Fire and Smoke Barrier - Protect all Openings".

E. Do not paint themed items. Finishing of themed items shall be part of "Theming Contract" .

F. Do not paint prefinished items, concealed surfaces, finished metal surfaces, operating parts, and labels, unless otherwise indicated.

1. Prefinished items include the following factory-finished components:

   a. Toilet enclosures.

   b. Elevator entrance doors and frames.

   c. Elevator equipment.

   d. Finished mechanical and electrical equipment, except paint exposed equipment in ceiling areas of exposed structure.

   e. Light fixtures.

2. Concealed surfaces include walls or ceilings in the following generally inaccessible spaces:

   a. Furred areas.
   b. Ceiling plenums.

   c. Utility tunnels.

d. Pipe spaces.

e. Duct shafts.

f. Elevator shafts.

3. Finished metal surfaces include the following:

a. Anodized aluminum.

b. Stainless steel.

c. Chromium plate.

d. Copper and copper alloys.

e. Bronze and brass.

4. Operating parts include moving parts of operating equipment and the following:

a. Valve and damper operators.

b. Linkages.

c. Sensing devices.

d. Motor and fan shafts.

5. Labels: Do not paint over UL, FMG, or other code-required labels or equipment name, identification, performance rating, or nomenclature plates.

G. Related Sections include the following:

1. Division 05 Section "Structural Steel" for shop priming structural steel.

2. Division 05 Section "Metal Fabrications" for shop priming ferrous metal.

3. Division 05 Section "Metal Stairs" for shop priming ferrous metal.

4. Division 05 Section "Pipe and Tube Railings" for shop priming interior railings.

5. Division 08 Section "Standard Steel Doors and Frames" for factory priming steel doors and frames.

6. Division 08 Section "Flush Wood Doors" for factory-finishing of wood doors and factory priming of wood doors for opaque finish.

7. Division 09 Section "Exterior Painting" for surface preparation and the application of paint systems on exterior substrates.

1.3 DEFINITIONS

Standard coating terms defined in ASTM D 16 apply to this Section.

A. Flat refers to a lusterless or matte finish with a gloss range below 15 when measured at an 85-degree meter.

B. Eggshell refers to low-sheen finish with a gloss range between 20 and 35 when measured at a 60-degree meter.

C. Semi gloss refers to medium-sheen finish with a gloss range between 35 and 70 when measured at a 60-degree meter.

D. Full gloss refers to high-sheen finish with a gloss range more than 70 when measured at a 60-degree meter.

1.4 SUBMITTALS

A. Product Data: For each paint system indicated. Include block fillers and primers.

1. Material List: An inclusive list of required coating materials. Indicate each material and cross-reference specific coating, finish system, and application Identify each material by manufacturer's catalog number and general classification.

2. Manufacturer's Information: Manufacturer's technical information, including label analysis and instructions for handling, storing, and applying each coating material.

B. Samples for Initial Selection: For each type of topcoat product indicated.

C. Samples for Verification: For each type of paint system and in each color and gloss of topcoat indicated.

1. Submit Samples on rigid backing, 8 inches square for flat surfaces and 8 inches long for linear elements.

2. Step coats on Samples to show each coat required for system.

3. Label each coat of each Sample.

4. Label each Sample for location and application area.

D. Product List: For each product indicated, cross-reference to paint system and locations of application areas. Use same designations indicated on Drawings and in schedules.

E. Qualification Data: For Applicator.

1.5 QUALITY ASSURANCE

A. Applicator Qualifications: A firm or individual experienced in applying paints and coatings similar in material, design, and extent to those indicated for this Project, whose work has resulted in applications with a record of successful in-service performance.

B. Source Limitations: Obtain block fillers and primers for each coating system from the same manufacturer as the finish coats.

C. MPI Standards: Preparation and Workmanship, comply with requirements in "MPI Architectural Painting Specification Manual" for products and paint systems indicated.

1.6 DELIVERY, STORAGE, AND HANDLING

A. Deliver materials to Project site in manufacturer's original, unopened packages and containers bearing manufacturer's name and label and the following information:

1. Product name or title of material.
2. Product description (generic classification or binder type).
3. Manufacturer's stock number and date of manufacture.
4. Contents by volume, for pigment and vehicle constituents.
5. Thinning instructions.
6. Application instructions.

7. Color name and number.

8. VOC content.

B. Store materials not in use in tightly covered containers in a well-ventilated area at a minimum ambient temperature of 45 deg F. Maintain storage containers in a clean condition, free of foreign materials and residue. Protect from freezing. Keep storage area neat and orderly. Remove oily rags and waste daily.

1 .7 PROJECT CONDITIONS

A. Apply paints only when temperature of surfaces to be painted and ambient air temperatures are between 50 and 95 deg F.

B. Do not apply paints when relative humidity exceeds 85 percent; at temperatures less than 5 deg F above the dew point; or to damp or wet surfaces.

## PART 2 - PRODUCTS

2.1 MANUFACTURERS

A. Basis-of-Design Products: The design is based on the products listed as manufactured by PPG Industries (Pittsburgh Paints). Subject to compliance with requirements, provide either the named product or a comparable product by one of the other following manufacturers:

1. Benjamin Moore & Co. (Benjamin Moore).

2. PPG Industries, Inc. (Pittsburgh Paints).

3. Sherwin-Williams Co. (Sherwin-Williams).

2.2 PAINT, GENERAL

A. Material Compatibility:

1. Provide materials for use within each paint system that are compatible with one another and substrates indicated, under conditions of service and application as demonstrated by manufacturer, based on testing and field experience.

2. For each coat in a paint system, provide products recommended in writing by manufacturers of topcoat for use in paint system and on substrate indicated.

B. Chemical Components of Field-Applied Interior Paints and Coatings: Provide products that comply with the following limits for VOC content, exclusive of colorants added to a tint base, when calculated according to 40 CPR 59, Subpart D (EPA Method 24) and the following chemical restrictions; these requirements do not apply to primers or finishes that are applied in a fabrication or finishing shop:

1. Flat Paints and Coatings: VOC content of not more than 50 gIL.

2. Non Flat Paints and Coatings: VOC content of not more than 150 g/L.

3. Aromatic Compounds: Paints and coatings shall not contain more than 1.0 percent by weight of total aromatic compounds (hydrocarbon compounds containing one or more benzene rings).

4. Restricted Components: Paints and coatings shall not contain any of the following:

a. Acrolein.

b. Acrylonitrile.

c. Antimony.

d. Benzene.

e. Butyl benzyl phthalate.

f. Cadmium.

g. Di (2-ethylhexyl) phthalate.

h. Di-n-butyl phthalate.

i. Di-n-octyl phthalate.

j. 1,2-dichlorobenzene.

k. Diethyl phthalate.

1. Dimethyl phthalate.

m. Ethylbenzene.

n. Fonnaldehyde.

o. Hexavalent chromium.

p. Isophorone.

q. Lead.

r. Mercury.

s. Methyl ethyl ketone.

t. Methyl isobutyl ketone.

u. Methylene chloride.

v. Naphthalene.

w. Toluene (methylbenzene).

x. l,l,l .. trichloroethane.

y. Vinyl chloride.

C. Material Quality:

1. Provide manufacturer's best-quality paint material of the various coating types specified that are factory formulated and recommended by manufacturer for application indicated. Paint-material containers not displaying manufacturer's product identification will not be acceptable.

2. Proprietary Names: Use of manufacturer's proprietary product names to designate colors or materials is not intended to imply that products named are required to be used to the exclusion of equivalent products of other manufacturers. Furnish manufacturer's material data and certificates of performance for proposed substitutions.

D. Colors: Refer to Finish Schedule. If a color of finish is not indicated, Architect will select from manufacturer's full range.

## PART 3 - EXECUTION

3.1 EXAMINATION

A. Examine substrates and conditions, with Applicator present, for compliance with requirements for maximum moisture content and other conditions affecting performance of work.

B. Maximum Moisture Content of Substrates: When measured with an electronic moisture meter as follows:

1. Masonry (Clay and CMU): 12 percent.
2. Wood: 15 percent.
3. Gypsum Board: 12 percent.

C. Verify suitability of substrates, including surface conditions and compatibility with existing finishes and primers.

D. Begin coating application only after unsatisfactory conditions have been corrected and surfaces are dry.

E. Beginning coating application constitutes Contractor's acceptance of substrates and conditions.

F. Coordination of Work: Review other Sections in which primers are provided to ensure compatibility of the total system for various substrates. On request. furnish information on characteristics of finish materials to ensure use of compatible primers. Notify Architect about anticipated problems when using the materials specified over substrates primed by others.

3.2 PREPARATION

A. Comply with manufacturer's written instructions and recommendations in "MPI" Architectural Painting Specification Manual" applicable to substrates indicated.

B. General: Remove hardware and hardware accessories. plates. machined surfaces, lighting fixtures. and similar items already installed that are not to be painted. If removal is impractical or impossible because of size or weight of the item, provide surface-applied protection before surface preparation and painting. After completing painting operations in each space or area, reinstall items removed using workers skilled . in the trades involved.

C. Cleaning: Before applying paint or other surface treatments, clean substrates of substances that could impair bond of the various coatings. Remove oil and grease before cleaning. Schedule cleaning and painting so dust and other contaminants from the cleaning process will not fall on wet, newly painted surfaces.

D. Surface Preparation: Clean and prepare surfaces to be painted according to manufacturer's written instructions for each particular----substrate-condition-and-as--specified.

1. Provide barrier coats over incompatible primers or remove and reprime.
2. Cementitious Materials: Prepare concrete and concrete unit masonry to be painted.

Remove efflorescence, chalk, dust, dirt, grease, oils, and release agents. Roughen as required to remove glaze. If hardeners or sealers have been used to improve curing, use mechanical methods of surface preparation.

a. Use abrasive blast-cleaning methods if recommended by paint manufacturer.

b. Determine alkalinity and moisture content of surfaces by performing appropriate tests. If surfaces are sufficiently alkaline to cause the finish paint to blister and burn, correct this condition before application. Do not paint surfaces if moisture content exceeds that permitted in manufacturer's written instructions.

3. Wood: Clean surfaces of dirt, oil, and other foreign substances with scrapers, mineral spirits, and sandpaper, as required. Sand surfaces exposed to view smooth and dust off.

a. Scrape and clean small, dry, seasoned knots, and apply a thin coat of white shellac or other recommended knot sealer before applying primer. After priming, fill holes and imperfections in finish surfaces with putty or plastic wood filler. Sand smooth when dried.

b. Prime wood to be painted immediately on delivery. Prime edges, ends, faces, undersides, and back sides of wood, including cabinets, counters, cases, and paneling.

4. Ferrous Metals: Clean ungalvanized ferrous-metal surfaces that have not been shop coated; remove oil, grease, dirt, loose mill scale, and other foreign substances. Use solvent or mechanical cleaning methods that comply with SSPC's recommendations.

a. Blast steel surfaces clean as recommended by paint system manufacturer and according to SSPC-SP 6/NACE No.3.

b. Treat bare and sandblasted or pickled clean metal with a metal treatment wash coat before priming.

c. Touch up bare areas and shop-applied prime coats that have been damaged. Wire-brush, clean with solvents recommended by paint manufacturer and touch up with same primer as the shop coat.

5. Galvanized Surfaces: Clean galvanized surfaces with nonpetroleum-based solvents so surface is free of oil and surface contaminants. Remove pretreatment from galvanized sheet metal fabricated from coil stock by mechanical methods.

6. Gypsum Board Substrates: Do not begin paint application until finishing compound is dry and sanded smooth.

7. Cotton or Canvas Insulation Covering Substrates: Remove dust, dirt, and other foreign material that might impair bond of paints to substrates.

E. Material Preparation: Mix and prepare paint materials according to manufacturer's written instructions.

1. Maintain containers used in mixing and applying paint in a clean condition, free of foreign materials and residue.

2. Stir material before application to produce a mixture of uniform density. Stir as required during application. Do not stir surface film into material. If necessary, remove surface film and strain

material before using.

3. Use only thinners approved by paint manufacturer and only within recommended limits.

F. Tinting: Tint each undercoat a lighter shade to simplify identification of each coat when multiple coats of same material are applied. Tint undercoats to match the color of the finish coat, but provide sufficient differences in shade of undercoats to distinguish each separate coat.

3.3 APPLICATION

A. General: Apply paint according to manufacturer's written instructions. Use applicators and techniques best suited for substrate and type of material being applied.

1. Paint colors, surface treatments, and finishes are indicated in the paint schedules.

2. Do not paint over dirt, rust, scale, grease, moisture, scuffed surfaces, or conditions detrimental to formation of a durable paint film.

3. Provide finish coats that are compatible with primers used.

4. The term "exposed surfaces" includes areas visible when permanent or built-in fixtures, grilles, convector covers, covers for finned-tube radiation, and similar components are in place. Extend coatings in these areas, as required, to maintain system integrity and provide desired protection.

5. Paint surfaces behind movable equipment and furniture the same as similar exposed surfaces. Before final installation of equipment, paint surfaces behind permanently fixed equipment or furniture with prime coat only.

6. Paint interior surfaces of ducts with a flat, nonspecular black paint where visible through registers or grilles.

7. Paint back sides of access panels and removable or hinged covers to match exposed surfaces.

B. Scheduling Painting: Apply first coat to surfaces that have been cleaned~ pretreated, or otherwise prepared for painting as soon as practicable after preparation and before subsequent surface deterioration.

1. The number of coats and film thickness required are the same regardless of application method. Do not apply succeeding coats until previous coat has cured as recommended by manufacturer. If sanding is required to produce a smooth, even surface according to manufacturer's written instructions, sand between applications.

2. Omit primer over metal surfaces that have been shop primed and touchup painted.

3. If undercoats, stains, or other conditions show through :final coat of paint, apply additional coats until paint film is of uniform finish, color, and appearance. Give special attention to ensure that edges, corners, crevices, welds, and exposed fasteners receive a dry film thickness equivalent to that of flat surfaces.

4. Allow sufficient time between successive coats to permit proper drying. Do not recoat surfaces until paint has dried to where. it feels firm, and does not deform or feel sticky under moderate thumb pressure, and until application of another coat of paint does not cause undercoat to lift or lose adhesion.

C. Application Procedures: Apply paints and coatings by brush, roller, spray, or other applicators according to manufacturer's written instructions.

1. Brushes: Use brushes best suited for type of material applied. Use brush of appropriate size for surface or item being painted.
2. Rollers: Use rollers of carpet, velvet-back, or high-pile sheep's wool as recommended by manufacturer for material and texture required.
3. Spray Equipment: Use airless spray equipment with orifice size as recommended by manufacturer for material and texture required.

D. Minimum Coating Thickness: Apply paint materials no thinner than manufacturer's recommended spreading rate to achieve dry film thickness indicated. Provide total dry film thickness of the entire system as recommended by manufacturer.

E. Mechanical and Electrical Work: Painting of mechanical and electrical work is limited to items exposed in equipment rooms and occupied.

1. Mechanical items to be painted include, but are not limited to, the following:
   a. Uninsulated metal piping.
   b. Uninsulated plastic piping.
   c. Pipe hangers and supports.
   d. Tanks that do not have factory-applied final finishes.
   e. Visible portions of internal surfaces of metal ducts, without liner, behind air inlets and outlets.
   f. Duct, equipment, and pipe insulation having "all-service jacket" or other paintable jacket material.
   g. Mechanical equipment that is indicated to have a factory-primed finish for field painting.
   h. All items exposed to public view.
2. Electrical items to be painted include, but are not limited to, the following:
   a. Switchgear.
   b. Panelboards.
   c. Electrical equipment that is indicated to have a factory-primed finish for field painting.
   d. All items exposed to public view.

F. Block Fillers: Apply block fillers to concrete masonry block at a rate to ensure complete coverage with pores filled.

G. Prime Coats: Before applying finish coats, apply a prime coat, as recommended by manufacturer, to material that is required to be painted or finished and that has not been prime coated by others. Recoat primed and sealed surfaces where evidence of suction spots or unsealed areas in first coat appears, to ensure a finish coat with no burn through or other defects due to insufficient sealing.

H. Pigmented (Opaque) Finishes: Completely cover surfaces as necessary to provide a smooth, opaque surface of uniform finish, color, appearance, and coverage. Cloudiness, spotting, holidays, laps, brush marks, runs, sags, ropiness, or other surface imperfections will not be acceptable.

I. Completed Work: Match approved samples for color, texture, and coverage. Remove, refinish, or repaint work not complying with requirements.

3.4 FIELD QUALITY CONTROL

A. Owner reserves the right to invoke the following test procedure at any time and as often as Owner deems necessary during the period when paint is being applied:

B. Owner will engage a qualified independent testing agency to sample paint material . being used. Samples of material delivered to Project will be taken, identified, sealed, and certified in the presence of Contractor.

C. Owner may direct Contractor to stop painting if test results show material being used does not comply with specified requirements. Contractor shall remove noncomplying paint from Project site, pay for testing, and repaint surfaces previously coated with the noncomplying paint. If necessary, Contractor may be required to remove noncomplying paint from previously painted surfaces if, on repainting with specified paint, the two coatings are incompatible.

3.5 CLEANING

A. At the end of each workday, remove empty cans, rags, rubbish, and other discarded paint materials from Project site.

B. After completing painting, clean glass and paint-spattered surfaces. Remove spattered paint by washing and scraping without scratching or damaging adjacent finished surfaces.

3.6 PROTECTION

A. Protect work of other trades, whether being painted or not, against damage from painting. Correct damage by cleaning, repairing or replacing, and repainting, as approved by Architect.

B. Provide "Wet Paint" signs to protect newly painted finishes. After completing painting operations, remove temporary protective wrappings provided by others to protect their work.

C. After work of other trades is complete, touch up and restore damaged or defaced painted surfaces. Comply with procedures specified in PDCA Pl.

3.7 INTERIOR PAINT SCHEDULE

A. Gypsum Board: Provide the following finish systems over interior gypsum board surfaces:

1. Eggshell Vinyl Acrylic-Enamel Finish: Two finish coats over a primer. Provide only one finish coat over a primer behind Themeing

a. Primer: Interior gypsum board primer. Pittsburgh Paints, 6-2· Speed Hide Interior Quick-Drying Latex Sealer. Apply at a dry film thickness of not less than 1.0 mil.

b. Finish Coats: Interior eggshell vinyl acrylic enamel. Pittsburgh Paints, 6411 Series Speed Hide Interior Enamel Eggshell Latex. Apply at a dry film thickness of not less than 1.25 mils.

B. Wood: Provide the following finish system over interior wood surfaces to receive opaque finish:

1. Semi-Gloss Acrylic Latex Finish: Two finish coats over a primer.

a. Primer: Interior wood primer. Pittsburgh Paints, 6-8-55 Series Speed Hide Interior Latex Enamel Undercoater. Apply at a dry film thickness of not less than 1.0 mil.

b. Finish Coats: Interior semi-gloss acrylic latex. Pittsburgh Paints, 6-510 Series Speed Hide Interior Semi-Gloss Acrylic Latex. Apply at a dry film thickness of not less than 1.0 mil.

C. Ferrous Metal: Provide the following finish systems over ferrous metal:

1. Semi gloss Acrylic-Enamel Finish: Two finish coats over a primer.

a. Primer: Interior ferrous-metal primer. Pittsburgh Paints, 90-708 Pitt-Tech Interior Exterior Primer Finish DTM Industrial Enamel. Apply at a dry film thickness of not less than 2.0 mils.

b. Finish Coats: Interior semi-gloss acrylic enamel. Pittsburgh Paints, 6500 Series Speed Hide Interior Semi-Gloss Latex. Apply at a dry film thickness of not less than 1.0 mil.

D. Zinc-Coated Metal: Provide the following finish systems over interior zinc-coated metal surfaces:

1. Semi-Gloss Acrylic-Enamel Finish: Two finish coats over a primer.

a. Primer: Interior zinc-coated metal primer. Pittsburgh Paints, 90-708 Pitt-Tech Interior Exterior Primer/Finish DTM Industrial Enamel. Apply at a dry film thickness of not less than 2.0 mils.

b. Finish Coats: Interior semi-gloss acrylic enamel. Pittsburgh Paints, 6500 Series Speed Hide Interior Semi-Gloss Latex. Apply at a dry film thickness of not less than 1.0 mil.

E. Areas of Exposed Structure: Provide the following finish system over interior primed ferrous metal surface, zinc-coated metal surfaces, including all exposed structural members, deck, ductwork, piping and electrical conduit, and spray-fireproofing:

1. Acrylic Dry Fog Coating. One finish coat over primer.

a. Primer:

b. Finish Coat: Factory-formulated flat acrylic dry fog coating for interior spray application. Pittsburgh Paints, 6-725 Series Speed hide Interior Super Tech WB Acrylic Dry-Fog Flat Latex: Applied at a dry film thickness of not less than 2.1 mil.

END OF SECTION

SECTION 102800

TOILET AND BATH ACCESSORIES

## PART 1- GENERAL

1.1 RELATED DOCUMENTS

Drawings and general provisions of the Contract, including General and Supplementary Conditions and Division 01 Specification Sections, apply to this Section.

1.2 SUMMARY

This Section includes public-use washroom accessories.

1.3 SUBMITALS

A. Product Data: For each type of product indicated. Include the following:

1. Construction details and dimensions.
2. Anchoring and mounting requirements, including requirements for cutouts in other work and substrate preparation.
3. Material and finish descriptions.
4. Features that will be included for Project.

B. Product Schedule: Indicating types, quantities, sizes, and installation locations by room of each accessory required.

1. Identify locations using room designations indicated on Drawings.
2. Identify products using designations indicated on Drawings.

C. Maintenance Data: For toilet and bath accessories to include in maintenance manuals.

1.4 QUALITY ASSURANCE

A. Source Limitations: For products listed together in the same articles in Part 2, provide products of same manufacturer unless otherwise approved by Architect.

B. Electrical Components, Devices, and Accessories: Listed and labeled as defined in NFP A 70, Article 100, by a testing agency acceptable to authorities having jurisdiction, and marked for intended use.

1.5 COORDINATION

Coordinate accessory locations with other work to prevent interference with clearances required for access by· people with disabilities, and for proper installation, adjustment, operation, cleaning, and servicing of accessories.

## PART 2 - PRODUCTS

2.1 MATERIALS

A. Stainless Steel: ASTM A 666, Type 304,0.0312-inch minimum nominal thickness, unless otherwise indicated.

B. Steel Sheet: ASTM A 1008/ A 1008M, Designation CS (cold rolled, commercial steel), O.0359-inch minimum nominal thickness.

C. Fasteners: Screws, bolts, and other devices of same material as. accessory unit and

tamper-and-theft resistant where exposed, and of galvanized steel where concealed.

D. Chrome Plating: ASTM B 456, Service Condition Number SC 2 (moderate service).

E. ABS Plastic: Acrylonitrile-butadiene-styrene resin formulation.

F. Mirrors: ASTM C 1503, Mirror Glazing Quality, clear-glass mirrors, nomina16.0 mm thick.

2.2 PUBLIC-USE WASHROOM ACCESSORIES

A. Basis-of-Design Product: The design for accessories is based on products indicated and coordinated with construction drawings. Subject to compliance with requirements, provide the named product or a comparable product by one of the following:
1. American Specialties, Inc.
2. Bobrick Washroom Equipment, Inc.
3. Bradley Corporation.

B. Grab Bar:
1. Basis-of-Design Product: Model 812 by Bradley.
2. Mounting: Flanges with concealed fasteners.
3. Material: Stainless steel, 0.05 inch thick.
4. Finish: Smooth, No.4, satin finish on ends and slip-resistant texture in grip area.
5. Outside Diameter: 1-1/2 inches.
6. Configuration and Length: As indicated on Drawings.

C. Mop Holder With Shelf:
1. Basis-of-Design Product: Model 9984 by Bradley.
2. Mounting Height: 60-inches A.F.F. to top of shelf.

D. Mirror Units:
1. Basis of Design Product: Model 740 by Bradley; 24-inches x 30-inches high.
2. Stainless Steel Framed Mirror Units: Fabricate frame with angle shapes of not less than 18 gauge, with square welded corners mitered and ground smooth. Provide with bright polished finish.
3. Locations: At each lavatory in each Toilet Room, and as otherwise indicated. Provide tilt mirror with fully enclosed back at one lavatory in each toilet room, for use by the disabled and handicapped.
4. Mountings: Concealed type, manufacturer's standard.
5. Mounting Height: 40-inches A.F.F. to bottom of mirror.

E. Sanitary Napkin Dispenser:
1. Basis of Design Product: Model 4722-15 by Bradley.
2. Stainless Steel Units: Fabricate frame with angle shapes, with square welded corners mitered and ground smooth. Provide with satin finish.
3. Locations: At each toilet stall in each Women's Toilet Room, and as otherwise indicated.
4. Mountings: Manufacturer's standard.
5. Mounting Height: As indicated on drawings.

F. Toilet Tissue Dispenser:
1. Basis-of-Design Product: Model 5402 by Bradley.
2. Material: Stainless steel.
3. Finish: Smooth, No.4, satin finish on ends and slip-resistant texture in grip area.
4. Spindle: Holds 2 Rolls up to 5.25" diameter; extra roll drops when first is depleted.
5. Configuration and Location: As indicated on Drawings.

G. Soap Dispenser:
1. Basis-of-Design Product: Model 6562 by Bradley.
2. Material: Stainless steel.
3. Finish: Smooth, No.4, satin finish on ends and slip-resistant texture in grip area.
4. Valve Type: Push-In valve.
5. Configuration and Location: As indicated on Drawings.

H. Hand Dryer:
1. Product: Xlerator.
2. Model: XL-GR.
3. Finish: Textured Graphite.
4. Activation: Automatic Sensor Operated.
5. Configuration and Location: As indicated on Drawings.
6. Provide Custom Cover (School Logo) pricing as Option to owner.

2.3 FABRICATION

A. General: Fabricate Units with tight seams and joints, and exposed edges rolled. Hang doors and access panels with full-length, continuous hinges. Equip units for concealed anchorage and with corrosion-resistant backing plates.

B. Keys: Provide universal keys for internal access to accessories for servicing and resupplying. Provide minimum of six keys to Owner's representative.

## PART 3 - EXECUTION

3.1 INSTALLATION

A. Install accessories according to manufacturers' written instructions, using fasteners appropriate to substrate indicated and recommended by unit manufacturer. Install units level, plumb, and firmly anchored in locations and at heights indicated.

B. Grab Bars: Install to withstand a downward load of at least 250 lbf, when tested according to method in ASTM F 446.

3.2 ADJUSTING AND CLEANING

A. Adjust accessories for unencumbered, smooth operation. Replace damaged or defective items.

B. Remove temporary labels and protective coatings.

C. Clean and polish exposed surfaces according to manufacturer's written recommendations.

END OF SECTION

SECTION 104413

FIRE EXTINGUISHER CABINETS

## PART 1 - GENERAL

1.1 RELATED DOCUMENTS

Drawings and general provisions of the Contract, including General and Supplementary Conditions and Division 01 Specification Sections, apply to this Section.

1.2 SUMMARY

A. This section includes fire protection cabinets for portable fire extinguishers

B. Related sections include Division 10 Section "Fire Extinguishers".

1.3 SUBMITTALS

A. Product Data: For each type of product indicated.

1. Include construction details, material descriptions, dimensions of individual components and profiles, and finishes for fire protection cabinets.

2. Include roughing-in dimensions, details showing mounting methods, relationships of box and trim to surrounding construction, door hardware, cabinet type, trim style, and panel style.

B. Shop Drawings: For fire protection cabinets. Include plans, elevations, sections, details, and attachments to other work

C. Samples for Verification: For each type of exposed finish required, prepared on Samples of size 6 by 6 inches square.

D. Maintenance Data: For fire protection cabinets to include in maintenance manuals.

E. Meeting Records: Minutes of pre-installation conference.

1.4 QUALITY ASSURANCE

Pre installation Conference: Conduct conference at Project site. Review methods and procedures related to fire protection cabinets including, but not limited to, schedules and coordination requirements.

1.5 COORDINATION

A. Coordinate size of fire protection cabinets to ensure that type and capacity of fire extinguishers indicated are accommodated.

B. Coordinate sizes and locations of fire protection cabinets with wall depths.

## PART 2 - PRODUCTS

2.1 MATERIALS

A. Cold-Rolled Steel Sheet: ASTM A 1008, Commercial Steel (CS), Type B.

B. Stainless-Steel Sheet: ASTM A 666, Type 304.

C. Tempered Float Glass: ASTM C 1048, Kind FT, Condition A, Type I, Quality q3, 3 mm thick, Class 1 (clear).

2.2 FIRE PROTECTION CABINET

A. Basis-of-Design Product: The design for fire protection cabinets is based on "Architectural Series" by Larsen's Manufacturing Company. Subject to compliance with requirements, provide either the named product or a comparable product by one of the following:

1. JL Industries, Inc.
2. Potter Roemer; Div. of Smith Industries, Inc.

B. Cabinet Type: Suitable for fire extinguisher.

C. Cabinet Construction: Rated where required in rated walls.

D. Cabinet Material: Enameled-steel sheet.

E. Recessed Cabinet:

1. Cabinet box recessed in walls of sufficient depth to suit style of trim indicated.
2. Exposed Flat Trim: One-piece combination trim and perimeter door frame overlapping surrounding wall surface with exposed trim face and wall return at outer edge (backbend) of 114 to 5/16 inch.

F. Cabinet Trim Material: Stainless-steel sheet.

G. Door Material: Stainless-steel sheet.

H. Door Style: Vertical duo panel with frame.

I. Door Glazing: Tempered float glass (clear).

J. Door Hardware: Manufacturer's standard door-operating hardware of proper type for cabinet type, trim style, and door material and style indicated.

1. Provide projecting lever handle with earn-action latch.
2. Provide continuous hinge, of same material and finish as trim, permitting door to open 180 degrees.

K. Accessories:

1. Mounting Bracket: Manufacturer's standard steel, designed to secure tire extinguisher to fire-protection cabinet, of sizes required for types and capacities of fire extinguishers indicated, with plated or baked-enamel finish.
2. Door Lock: Cam lock that allows door to be opened during emergency by pulling sharply on door handle.
3. Alarm: Manufacturer's standard alarm that actuates when tire-protection cabinet door is opened and that is powered by low voltage, complete with transformer.

L. Finishes:

1. Stainless Steel: No. 4 finish.

2.3 FABRICATION

A. Fire Protection Cabinets: Provide manufacturer's standard box (tub) with trim, frame, door, and hardware to suit cabinet type, trim style, and door style indicated.

1. Weld joints and grind smooth.

2. Provide factory-drilled mounting holes.

3. Prepare doors and frames to receive locks.

4. Install door locks at factory.

B. Cabinet Doors: Fabricate doors according to manufacturer's standards, from materials indicated and coordinated with cabinet types and trim styles selected.

1. Fabricate door frames with tubular stiles and rails and hollow-metal design, minimum 1/2 inch thick.

2. Miter and weld perimeter door frames.

C. Cabinet Trim: Fabricate cabinet trim in one piece with comers mitered, welded, and ground smooth.

2.4 GENERAL FINISH REQUIREMENTS

A. Comply with NAAMM's "Metal Finishes Manual for Architectural and Metal Products" for recommendations for applying and designating finishes.

B. Protect mechanical finishes on exposed surfaces of fire protection cabinets from damage by applying a strippable, temporary protective covering before shipping.

C. Finish fire protection cabinets after assembly.

D. Appearance of Finished Work: Noticeable variations in same piece are not acceptable. Variations in appearance of adjoining components are acceptable if they are within the range of approved Samples and are assembled or installed to minimize contrast.

2.5 STEEL FINISHES

A. Surface Preparation: Clean surfaces of dirt, oil, grease, mill scale, rust, and other contaminants that could impair paint bond using manufacturer's standard methods.

B. Baked-Enamel Finish: Immediately after cleaning and pre treating, apply manufacturer's standard two-coat, baked-enamel finish consisting of prime coat and thermosetting topcoat. Comply with paint manufacturer's written instructions for applying and baking to achieve a minimum dry film thickness of2 mils.

2.6 STAINLESS-STEEL FINISHES

A. Surface Preparation: Remove tool and die marks and stretch lines, or blend into finish.

B. Polished Finishes: Grind and polish surfaces to produce uniform finish, free of cross scratches.

1. Run grain of directional finishes with long dimension of each piece.

2. When polishing is completed, passivate and rinse surfaces. Remove embedded foreign matter and leave surfaces chemically clean.

3. Directional Satin Finish: No.4.

## PART 3 - EXECUTION

3.1 EXAMINATION

A. Examine walls and partitions for suitable framing depth and blocking where recessed cabinets will be installed.

B. Proceed with installation only after unsatisfactory conditions have been corrected.

3.2 PREPARATION

Prepare recesses for recessed fire protection cabinets as required by type and size of cabinet and trim style.

3.3 INSTALLATION

A. General:

1. Install fire protection cabinets in locations and at mounting heights indicated or, if not indicated, at heights acceptable to authorities having jurisdiction.
2. Fire Protection Cabinets: 54 inches above finished floor to top of cabinet.

B. Fire Protection Cabinets: Fasten cabinets to structure, square and plumb.

1. Unless otherwise indicated, provide recessed fire protection cabinets. If wall thickness is not adequate for recessed cabinets, provide semi-recessed fire protection cabinets.
2. Fasten mounting brackets to inside surface of fire protection cabinets, square and plumb.

C. Identification: Apply vinyl lettering at locations indicated.

3.4 ADJUSTING AND CLEANING

A. Remove temporary protective coverings and strippable films, if any, as fire protection cabinets are installed unless otherwise indicated in manufacturer's written installation instructions.

B. Adjust fire protection cabinet doors to operate easily without binding. Verify that integral locking devices operate properly.

C. On completion of fire protection cabinet installation, clean interior and exterior surfaces as recommended by manufacturer.

D. Touch up marred finishes, or replace fire protection cabinets that cannot be restored to factory-finished appearance. Use only materials and procedures recommended or furnished by fire protection cabinet and mounting bracket manufacturers.

E. Replace fire protection cabinets that have been damaged or have deteriorated beyond successful repair by finish touchup or similar minor repair procedures.

END OF SECTION

SECTION 104416

FIRE EXTINGUISHERS

## PART 1 - GENERAL

1.1 RELATED DOCUMENTS

Drawings and general provisions of the Contract, including General and Supplementary Conditions and Division 01 Specification Sections, apply to this Section.

1.2 SUMMARY

A Section includes portable, hand-carried fire extinguishers and mounting brackets for fire extinguishers.

B. Related Sections:

1. Division 10 Section "Fire Extinguisher Cabinets".

2. Division 23 Section "Commercial-Kitchen Hoods" for fire extinguishing systems provided as part of commercial-kitchen exhaust hoods.

1.3 SUBMITTALS

A Product Data: For each type of product indicated. Include rating and classification, material descriptions, dimensions of individual components and profiles, and finishes for fire extinguisher and mounting brackets.

B. Operation and Maintenance Data: For fire extinguishers to include in maintenance manuals.

C. Warranty: Sample of special warranty.

1.4 QUALITY ASSURANCE

A. NFP A Compliance: Fabricate and label fire extinguishers to comply with NFP A 10, "Portable Fire Extinguishers".

B. Fire Extinguishers: Listed and labeled for type, rating, and classification by an independent testing agency acceptable to authorities having jurisdiction.

1.5 COORDINATION

Coordinate type and capacity of fire extinguishers with fire protection cabinets to ensure fit and function.

1.6 WARRANTY

A. General Warranty: Special warranty specified in this Article shall not deprive Owner of other rights Owner may have under other provisions of the Contract Documents and shall be in addition to, and run concurrent with, other warranties made by Contractor under requirements of the Contract Documents.

B. Special Warranty: Manufacturer's standard form in which manufacturer agrees to repair or replace

fire extinguishers that fails in materials or workmanship within specified warranty period.

1. Failures include, but are not limited to, the following:
    a. Failure of hydrostatic test according to NFPA 10.
    b. Faulty operation of valves or release levers.
2. Warranty Period: 6 (Six) years from date of Substantial Completion.

## PART 2 - PRODUCTS

### 2.1 PORTABLE, HAND-CARRIED FIRE EXTINGUISHERS

A. Fire Extinguishers: Type, size, and capacity for each fire protection cabinet and mounting bracket indicated.

1. 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. J. L. Industries, Inc.; a division of Activar Construction Products Group.
    b. Larsen's Manufacturing Company.
    c. Potter Roemer LLC.
2. Handles and Levers: Manufacturer's standard.
3. Instruction Labels: Include pictorial marking system complying with NFP A 10, Appendix B.

B. Multipurpose Dry-Chemical Type in Steel Container: UL-rated 3-A: 40-B:C, 5-lb nominal capacity, with mono ammonium phosphate-based dry chemical in enameled steel container.

### 2.2 MOUNTING BRACKETS

A. Mounting Brackets: Manufacturer's standard steel, designed to secure fire extinguisher to wall or structure, of sizes required for types and capacities of fire extinguishers indicated, with plated or red baked-enamel finish.

B. Identification: Lettering complying with authorities having jurisdiction for letter style, size, spacing, and location. Locate as indicated by Architect.

1. Identify bracket-mounted fire extinguishers with the words "FIRE EXTINGUISHER" in red letter decals applied to mounting surface.
2. Orientation: Vertical.

C. Location: Where fire extinguishers are to be wall mounted without a cabinet.

## PART 3 - EXECUTION

### 3.1 EXAMINATION

A. Examine fire extinguishers for proper charging and tagging.

B. Remove and replace damaged, defective, or undercharged fire extinguishers.

C. Proceed with installation only after unsatisfactory conditions have been corrected.

3.2 INSTALLATION

A. General:

1. Install fire extinguishers and mounting brackets in locations indicated and in compliance with requirements of authorities having jurisdiction.

2. Mounting Brackets: 54 inches above finished floor to top of fire extinguisher.

B. Mounting Brackets: Fasten mounting brackets to surfaces, square and plumb, at locations indicated.

END OF SECTION

SECTION 131200

PRE-ENGINEERED STRUCTURES

## PART 1- GENERAL

### 1.1 RELATED DOCUMENTS

A. The General Provisions of the Contract, including General and Supplementary Conditions and General Requirements, apply to work specified in this Section.

B. Division 9 "Painting"

C. Division 3 "Structural Concrete"

Related work provided by the Pre-Engineered Structures:

D. Section 13121 "Pre-Engineered Architecturally Exposed Structural Steel Framing"

E. Section 13511 "Pre-Engineered Steel Stairs"

F. Section 13521 "Pre-Engineered Pipe Railings"

### 1.2 DESCRIPTION OF THE WORK

A. The extent of the Work shall include two buildings comprised of one single story office building and one single story office/storage building. The design shall meet the standards set by the latest edition of the Florida Building Code for pre-engineered metal structures, walls, floors, stairs, and roofs (components of cladding).

B. See structural Drawing for required loading and wind pressures required for design of structure and components of cladding, as well as second floor framing.

### 1.3 QUALITY ASSURANCE

A. Provide pre-engineered building components from a single-building manufacturer for BOTH buildings.

B. Metal building manufacturer shall be a member in good standing with "MBMA."

### 1.4 SUBMITTAL

A. As per Section 01340, provide fully engineered drawings and calculations signed and sealed by a P.E. registered in the State of Florida. The structural design shall include, but not limited to, all components including point load super imposed by the hoist, mechanical, and electrical equipment. Submit twelve (12) sets of signed and sealed drawings, and calculations of which six (6) shall be used for the Building Department for permits.

B. Product data consisting of metal building structural framing system, roofing and siding panels, and other metal building components.

C. Provide complete erection drawing prepared under the direction of a Florida Registered Professional Engineer. Include details showing fabrication and assembly of the metal building system. Show anchor bolt settings, reactions end-wall and roof framing. Include transverse cross-sections.

1. Erection drawings prepared to scale will show the relationship of building components.

2. Erection drawings show proposed openings coordinated for the size and location of component that is to be installed. Components include, but not limited to, louvers, doors, windows, storefront, balconies, canopies, stairs, changes in level, chases, ducts, fans, vents, and other building components shown on the drawings and other sections of the specifications.

D. Roofing and Siding Panels: Provide layouts of panels on walls and roofs, details of edge conditions, joints, corners, custom profiles, supports, anchorages, trim, flashings, closures, and special details. Include flashing details of roof to wall intersection. Include transverse cross-sections.

E. Provide details to drawn to scale of plan, section of opening conditions. Coordinate all required clearances for installation of all framing components and comply with rough opening requirements for components installed in the openings. Coordinate with drawings and other section of work shown and specified elsewhere in the specifications.

F. Where UL-Listed assemblies are required by drawings and other sections of the specifications. Comply with the structural requirements for compliance with the UL listing. Fire ratings and details are shown on the drawings.

G. Building Accessory Components: Provide details of metal building accessory components to clearly indicate methods of installation, including the following:

1. Personnel doors: Provide elevations and details of each type of door and requirements for finish hardware. Provide schedule of doors and frames using the same reference numbers for details and openings as those indicated on the drawings; include complete hardware schedule.

2. Aluminum louvers: Provide 1/4" scale elevations of louver units and not less than 3/4" scale details showing anchors, hardware, and flashing details.

3. Sheet metal accessories: Provide layouts at 1/4“ scale. Provide details of ventilators, louvers, gutters, downspouts, and other sheet metal accessories at not less than 1-1/2” scale showing profiles, methods of joining, and anchorages.

4. All building accessory components will have wind-rated assemblies that comply and are installed per Miami/Dade County Approval System or the Florida Building Code Approval System for wind loads and exposure listed on the drawings.

H. Samples for initial selection purposes in form of manufacturer's color charts or chips showing full range of colors, textures, and patterns available for metal roofing and siding panels with factory-applied finishes.

I. Samples for verification purposes of roofing and siding panels. Provide sample panels 12" long by actual panel width, in the profile, style, color, and texture indicated. Include clips, battens, fasteners, closures, and other panel accessories.

J. Installer certificates signed by metal building manufacturer written certification certifying that the installer complies with requirements included under the "Quality Assurance" Article.

K. Professional Engineer's certificate prepared and signed by a Professional Engineer, legally authorized to practice in the jurisdiction where project is located, verifying that the structural framing and covering panels meet indicated loading requirements and codes of authorities having jurisdiction.

## 1.5 DESIGN

A. Design Authorities:

1. Structural Steel: All structural steel sections and welded plate members shall be designed in accordance with the allowable stresses and design requirement sections of the latest edition of the "A.I.S.C. Manual of Steel Construction".

2. Cold-Formed: All cold-formed members, including exterior covering, shall be designed in accordance with the allowable stresses and design requirement sections of the latest edition of "The A.I.S.I. Cold-Formed Steel Design Manual".

## 1.6 DESIGN LOADS

A. Wind and Live Loads: Loads shall be applied in accordance to the more stringent of requirements set forth by the "Florida Building Code 2020" requirements latest edition. Wind design three- (3) second gust at 160 m.p.h. minimum.

B. Dead Loads: Dead loads shall be the weight of the structure, mechanical systems, electrical and lighting systems, suspended ceiling system, roof, insulation, partition walls and miscellaneous loads. Include dead load required by the Florida Building Code 2017 and as indicated in the plans.

C. Live loads: Live loads shall be applied for corridors, office area, balcony, and elevated walkway as indicated in the plans. Floor vibration due to live loading and mechanical equipment shall be minimized and limited as per the AISC Design Guideline 11 "Floor Vibrations due to Human Activity".

## 1.7 QUALITY ASSURANCE

A. Installer Qualifications: Engage an experienced Installer to erect the pre-engineered metal building who has specialized in the erection and installation of types of metal buildings systems similar to that required for this project and who is certified in writing by the metal building system manufacturer as qualified for erection of the manufacturer's products.

B. Manufacturer's Qualifications: Provide pre-engineered metal buildings manufactured by a firm experienced in manufacturing metal buildings systems that are similar to those indicated for this project and have a record of successful in-service performance.

C. Single-Source Responsibility: Obtain the metal building system components, including structural framing, wall and roof covering, and accessory components, from one source from a single manufacturer.

D. Design Criteria: The drawings indicate size, profiles, and dimensional requirements of the pre-engineered metal buildings and are based on the specific type and model indicated. Metal building systems having equal characteristics by other manufacturers may be considered provided that deviations in dimensions and profiles are minor and do not change the design concept or intended performance as judged by the Architect. The burden of proof of equality is on the proposer.

## 1.8 DELIVERY, STORAGE, AND HANDLING

A. Deliver prefabricated components, sheets, panels, and other manufactured items so they will not be damaged or deformed. Package wall and roof panels for protection against transportation damage.

B. Handling: Exercise care in unloading, storing, and erecting wall and roof covering panels to prevent bending, warping, twisting, and surface damage.

C. Stack materials on platforms or pallets, covered with tarpaulins or other suitable weather-tight ventilated covering. Store metal wall and roof panels so that water accumulations will drain freely. Do not store panels in contact with other materials that might cause staining, denting or other surface damage.

## 1.9 WARRANTY

A. Roofing and Siding Panel Finish Warranty: Furnish the roofing and siding panel manufacturer's written warranty, covering failure of the factory-applied exterior finish on metal wall and roof panels within the warranty period. This warranty shall be in addition to and not a limitation of other rights the Owner may have against the Contractor under the Contract Documents. Warranty period for factory-applied exterior finishes on wall and roof panels is twenty (20) years after the date of Substantial Completion.

## 1.10 EXTRA MATERIALS

A. Maintenance Stock: Furnish at least 5% excess over required amount of nuts, bolts, screws, washers, wall panels, trim, fascias, and other required fasteners. Pack in cartons labeled to identify the contents and store on the site where directed.

## PART 2- PRODUCT

### 2.1 MANUFACTURERS

A. Available Manufacturers: Subject to compliance with requirements, manufacturers offering metal building systems that may be incorporated in the work include, but are not limited to, the following:

1. Butler Manufacturing Company
2. Ceco Buildings Division
3. Gulf States Manufacturers, Inc.
4. Mesco Metal Buildings Corp.
5. Star Buildings Division, H.H. Robertson Company
6. Varco-Pruden Buildings
7. NUCOR Building Systems

### 2.2 LOAD COMBINATIONS

A. The design load combinations for all buildings shall be the most stringent of the following specified by the "Florida Building Code 2020", latest edition. The Delegated Engineer shall design second floor framing as part of the entire shell design including the second floor balconies and elevated walkways. The most stringent load conditions in the building framing design shall be considered based on inclusion and exclusion of the second floor balconies and walkway (ADD ALTERNATE A scope of work).

### 2.3 ANCHOR BOLTS

A. Anchor bolts shall be sized to resist all shears and uplifts induced by the structure and shall not be less than the sizes and quantities shown by the structural plans. All anchor bolts shall be unpainted to bond to the concrete and shall be set in strict accordance with the structural drawings. See Structural for foundation and load criteria.

### 2.4 MATERIALS

A. Primary Framing Steel:

1. Steel for hot-rolled structural sections shall conform to the requirements of ASTM specification A-36.
2. Steel for all built-up sections shall meet as applicable the physical and chemical properties of ASTM A572-88C modified to 55,000 psi minimum yield and 70,000 psi minimum tensile strength, or ASTM A607-85, Grade 55, or ASTM A570-88, Grade 55.Steel for all end wall "C" sections shall meet the physical and chemical properties of ASTM A570-88, Grade 55.

B. Secondary Framing Steel:

1. Steel used to form purlins, girts, eave struts, and "C" sections shall meet the physical and chemical properties of ASTM A570-88, Grade 55.

C. Roof Panel Material:

1. Roof for both buildings:

a. Standing seam.

b. 22-gauge, Grade 50B, aluminum-zinc, alloy-coated steel, coating designation, galvanized, factory-applied, baked-on paint with a total film thickness of 1 mil on exposed white as manufactured by Bethlehem, ASTM A792 sheet coating 55% aluminum, 43.4% zinc, 1.6% silicon nominal percentage by weight. Roof design based on Florida Building Code 2017 wind load requirement, but not less than 22-gauge material.

D. Fasteners:

1. Clips: 16-guage panel clips.

2. Cleats: Factory-caulked, mechanically seamed cleats formed from 24-gauge, Grade C, zinc-coated-steel sheets.

E. All roofing components, fasteners, and connections will have wind-rated assemblies that comply and are installed as per Miami/Dade County Approval System or the Florida Building Code Approval System.

## 2.5 SIDING PANELS

A. All materials and assemblies shall comply with the Florida Building Code wind pressures for cladding. Provide certified engineered lab test that shows compliance. See structural drawing for wind pressure and load required for compliance.

B. Face Sheets: Fabricate wall and roof panel face sheets to the profile or configuration indicated from 22-gauge, structural quality, Grade 50B, alloy-coated steel. Coating designation, galvanized with factory-applied, baked-on paint with a total film thickness of 1 mil on exposed side. Color to be selected by Architect, Bethlehem, ASTM A792, sheet coating 55% aluminum, 43.4% zinc, 1.6% silicone, nominal percentage by weight.

C. Fasteners: Self-tappings screws, bolts, nuts, self-locking rivets, self-locking bolts, end-welded studs, and other suitable fasteners designed to withstand design loads.

1. Provide metal-backed neoprene washers under heads of fasteners bearing on weather side of panels.

2. Use aluminum or stainless-steel fasteners for exterior application and galvanized or cadmium-plated fasteners for interior applications.

3. Locate and space fastenings in true vertical and horizontal alignment. Use proper tools to obtain controlled uniform compression for positive seal without rupture of neoprene washer.

4. Provide fasteners with heads matching color of roofing or siding sheets by means of plastic caps or factory applied coating.

D. Accessories: Provide the following sheet metal accessories factory-formed of the same material in the same finish as roof and wall panels:

1. Flashings

2. Closers

3. Fillers

4. Ridge covers

5. Fascias

6. Inside closure strip

7. Base angle

8. Miscellaneous accessories as required to complete a weatherproof installation.

E. Flexible Closure Strips: Closed-cell, expanded cellular rubber, self-extinguishing flexible closure strips. Cut or premold to match configuration of roofing and siding sheets. Provide closure strips where indicated or necessary to ensure weather-tight construction.

F. Sealing Tape: Pressure-sensitive, 100% solid, gray polyisobutylene, compound-sealing tape with release paper backing. Provide permanently elastic, nonsag, nontoxic, nonstaining tape 1/2" wide and 1/8" thick.

G. Joint Sealant: One-part elastomeric polyurethane, polysulfide, or silicone rubber sealant as recommended by the building manufacturer.

H. Fluoropolymer Finish: Provide shop-applied fluoropolymer finish to galvanized-steel roofing and siding panels, and related trim and accessory elements.

1. Clean galvanized steel with an alkaline compound, then treat with a zinc phosphate conversion coating and seal with a chromic acid rinse.

2. Apply a two- (2) coat fluoropolymer coating system to pretreated steel. Coating shall consist of a specially-formulated inhibitive primer applied to a dry film thickness of 0.15 mil to 0.25 mil, and a fluorocarbon color coat containing not less than 70% polyvinylidene fluoride resin by weight applied to a dry film thickness of 0.80 mils to 1.3 mils. Color to be selected by the Architect.

I. All roofing and wall components, fasteners, and connections will have wind-rated assemblies that comply and are installed as per Miami/Dade County Approval System or the Florida Building Code Approval System.

## 2.6 OTHER MATERIALS

A. Sealant Materials Provide:

1. Silicone Sealant: Single-component elastomeric silicone sealant complying with FS TT-S-001543, Class A, nonsag, and ASTM C920, Type S, Grade NS, Class 25, Uses G, A, and O. Provide low-modulus, nonacid curing type, except use acid type if channel surfaces are porous.

2. Polysulfide Sealant: 2-component elastomeric polysulfide sealant complying with FS TT-S-00227, Class A, Type2, and ASTM C920, Type M, Grade NS, Class 25, Uses G, A, and O, as applicable.

3. Acrylic Sealant: Single-component acrylic terpolymer or polypropenate solvent-based, thermo-plastic sealant complying with FS 55-2-00230, Class B, Type II, and ASTM C920, Type S, Grade NS, Class 12-1/2, Uses G, A, and O, as applicable.

4. Filler Rods: Compressible closed-cell or waterproof-jacketed rod stock of flexible and resilient synthetic rubber or plastic foam with 5-10 psi compression strength for 25% deflection.

B. Thermal Insulation at roof of office; glass fiber blanket insulation, complying with ASTM C991, of 0.5 lb per cu. ft. density, thickness as indicated, with UL flame spread classification of 25 or less, and 2" wide continuous vapor-tight edge tabs, and retainer clips, 26-gauge, formed galvanized-steel retainer clip painted to match vinyl ad noted on the drawings.

C. Thermal Insulation at roof of building; glass fiber blanket insulation, complying with ASTM C991, of 0.5 lb per cu. ft. density, thickness as indicated, with UL flame spread classification of 25 or less, and 2" wide continuous vapor-tight edge tabs as noted on drawings.

## 2.7 PAINT AND COATING MATERIALS

A. Comply with performance requirements of the federal specifications indicated. Unless specifically indicated otherwise, compliance with compositional requirements of federal specifications indicated is not required.

1. Shop Primer for Ferrous Metal: Fast-curing, lead-free, universal primer, selected by the manufacturer for resistance to normal atmospheric corrosion, compatibility with finish paint systems, and capability to provide a sound foundation for field-applied topcoats despite prolonged exposure. Comply with FS TT-P-636D.

2. Pre-painted galvalume panel each face.

a. Roof Panels

b. Wall Panels

**2.8** ROD

A. All rod used as structural bracing shall have a minimum yield strength of 36,000 psi.

**2.9** HIGH-STRENGTH BOLTS

A. All bolts used in primary structural connections shall be zinc-plated, high-strength (ASTM A325) bolts with a yellow dichromate dip.

**2.10** HIGH-STRENGTH NUTS

A. ASTM 194 Grade 2H, ASTM 563 Grade C, C3, D, D4, D43

**2.11** STANDARD BOLTS

A. All bolts used in secondary structural connections shall be standard zinc-plated machine bolts (ASTM A-307, Grade 2).

**2.12** STANDARD NUTS

A. ASTM A563 Grade A or Grade 2

**2.13** WIND BRACING

A. Wind bracing shall be as shown on the building manufacturer's erection drawings and shall be accomplished by diagonal, rod bracing, steel column, or other means necessary to satisfy roof and wall wind loads. All diagonal wind bracing shall include necessary hillside washers and adjustment nuts at each end. Do not use diagonal rod bracing at locations of doors, louvers, and openings.

**2.14** NOT USED

**2.15** BUILDING TRIM

A. General: Preformed 24-gauge galvalume steel with factory baked-on paint flashing shall be provided at corners, end wall rakes, eaves, and openings to assure a neat, weather-tight structure. All trim shall comply with wind loads in structural drawing for wind pressures for components of cladding. Provide approved engineered testing certificates that show compliance with Florida Building Code.

B. Eave Flashing: The junction of the roof panels and side wall panels shall be adequately flashed with preformed 24-gauge galvalume steel with factory baked-on paint. Eave flashing shall be as shown on Architectural drawings and as per manufacturer's recommendations.

C. Eave Gutter: Eave gutter shall be a suspended box section supported at 3'-0" on center maximum and formed to match the configuration shown on Architectural drawings. Eave gutters shall

have a minimum cross-sectioned area as required by rainfall amounts set by the Florida Building Code. Pop rivets and sealant shall be used to secure and seal the gutter end laps.

D. Eave Gutter Downspouts: Downspouts shall be 28-gauge, galvalume, factory-painted, square sections sized per Florida Building Code Requirements. Spacing of the downspouts as shown on Architectural drawings. Eave gutter outlets shall be provided to connect the downspouts to the eave gutter. Field connected downspout elbows shall be provided to divert water away from the building.

E. Corner Flashing: The junction of side wall panels and end wall panels shall be adequately flashed to provide weather tightness and good appearance. The flashing shall be designed to complement the wall panel used and shall match the wall panel color.

F. Accessory Flashing: Accessories which penetrate the wall or roof panels shall be adequately flashed and sealed as necessary for weather tightness and neat appearance.

## 2.16 PERSONNEL DOORS

A. Materials: Fabricate personnel doors and frames from commercial quality, cold-rolled carbon steel sheet, or commercial quality hot-rolled, pickled, and oiled carbon steel sheet.

1. Zinc-coated Steel Sheets: Comply with ASTM A526; with G60 coating complying with ASTM A525, mill phosphatized.

B. Anchors and Accessories: Provide manufacturer's standard units for items built into exterior walls, use galvanized units complying with ASTM A153. Spacing and type per Miami-Dade NOA-tested assembly.

C. Doors: Provide doors of types and styles indicated. Comply with SDI-100 for material quality, metal gages, and construction details.

1. Provide sightproof lovers for interior doors with indicated, constructed of 24-gauge (0.0239-inch) steel V-shaped or Y-shaped blades, set into 20-gauge (0.0359-inch) steel frame.

2. Provide Miami-Dade NOA-tested assembly.

D. Frames: Provide frames of the types and sizes indicated. Comply with SDI-100 for material quality, metal gages, and construction details.

1. Provide standard hollow metal frames for doors, transoms, sidelights, borrowed lights, and other openings as indicated.

2. Provide Miami-Dade NOA-tested assembly.

E. Fabrication: Fabricate units to be rigid, neat in appearance, and free from defects, warp, or buckle. Provide continuous welds on exposed joints; grind, dress, and make welds smooth, flush, and invisible.

F. Hardware: See Door Hardware Section 08700.

G. Shop-paint exposed surfaces, including galvanized surfaces, using manufacturer's standard baked-on, rust-inhibitive primer.

H. Factory-painted doors and door frames with baked enamel paint.

## 2.17 SHOP FABRICATION

A. Scope: All fabricated members shall be sheared, formed, punched, welded, and painted in the plant of the manufacturer. All holes and clips required to facilitate the attachment of secondary framing shall be provided by the metal building manufacturer. See Architectural, Structural, Mechanical drawings for other items to be attached to the structure.

B. Welding: All shop welding shall be in accordance with the American Welding Society's Structural Welding Code (AWS D1.1) current edition, except for Sections 3.5 and 8.13. All welding shall be done by welders certified in accordance with AWS Code. Flanges and webs of "I" sections shall be joined by a continuous automatic submerged arc welding process or a semi- automatic GMAW process. The web shall be joined to the flanges by a minimum of 50% web penetration.

C. Structural Primer: All fabricated members other than galvalume, galvanized, pre-painted panel, and flashing material shall receive a factory-applied coat of rust-inhibiting green primer. The primer shall be formulated to equal or exceed the performance of Federal Specification TT-P- 636D.

D. Identification: All fabricated or purchased items shall have an identifying mark that corresponds to the mark shown on the erection drawings. The mark shall be stamped, stenciled, or printed on or attached to the items.

## 2.18 CLOSURE AND SEALANTS

A. Closure Strips: The corrugations of the roof and wall panels shall be filled with preformed closed cell non-shrinking, laminated polyethylene closures along the eave, ridge, and rake for weather tightness.

B. Metal Closures: The corrugations and pan area of the standing seam roof panel shall be filled with formed-metal closures. The closures shall be formed from 20-gauge steel to the shape of the configuration. The closure exterior finish shall be AZ 55 Aluminum-zinc alloy coated.

C. Sealer: Standing Seam, side laps shall have factory-applied mastic, Sika SikaCaulk 501, or approved equal. Its composition shall be 91% solids by weight. Service temperature range shall be -60 degrees F to +250 degrees F. The material shall or surpass the requirements of Federal Specification TT-C-1796A, Type I, Class A.

D. Sealer: Standing Seam, ridges and eave closures shall be sealed with tape mastic, Sika SikaTape 65, or approved equal. The material shall be non-staining, non-corrosive, non-toxic, and non-volatile. Composition shall be 100% solid-ethylene propylene copolymer tape. Service Temperature shall be from -60 degrees F to + 212 degrees F. The material shall meet or surpass the requirements of Federal Specifications TT-C-1796a Type II, Class B.

E. Pipe Flashing: Manufactured one- (1) piece construction from EPDM membrane and shall have an aluminum base that can be field conformed to any panel configuration.

F. Louvers: See drawing and Section 10200 for requirements.

## 2.19 MISCELLANEOUS TRIM

A. Provide miscellaneous custom section, trim, flashing, and panels as required by the drawings to achieve final function and/or aesthetic effect.

## PART-3 EXECUTION

## 3.1 INSTALLATION

A. The erection of the structural members and the installation of the standing seam roofing, insulation, wall panels and miscellaneous accessories shall be performed in accordance with the drawings, project manual, and in accordance to the manufacturers written and drawn instructions. The erection shall be performed by a manufacturer-approved erector. All erection practices shall conform to Section 6, Common Industry Practices found in the "Low Rise Building Systems Manual", MBMA latest edition. Do not make any field modifications to structural members without the written acceptance of the Architect/Engineer of Record.

B. Clean surfaces as per manufacturer's recommendations.

## 3.2 ERECTION

A. Framing: Erect framing true to line, level, plumb, rigid, and secure. Level base plates to a true even plane with full bearing to supporting structures, set with double-nutted anchor bolts. Use a non-shrinking grout to obtain uniform bearing and to maintain a level base line elevation. Moist cure grout for not less than seven (7) days after placement.

B. Purlins and Girts: Provide rake or gable purlins with tight-fitting closure channels and fascias. Locate and space wall girts to suit door and window arrangements and heights. Secure purlins and girts to structural framing and hold rigidly to a straight line by sag rods.

C. Bracing: Provide diagonal rod or angle bracing in roof and side walls as indicated.

1. Movement-resisting frames may be used in lieu of side wall rod bracing, to suit manufacturer's standards.

2. Where diaphragm strength of roof or wall covering is adequate to resist wind forces, rod or angle bracing will not be required.

D. Framed Openings: Provide shapes of proper design and size to reinforce openings and to carry loads and vibrations imposed, including equipment furnished under mechanical and electrical work. Securely attach to building structural frame.

E. Coordinate erection of structure with Section 09900 " Painting".

## 3.3 ROOFING AND SIDING

A. General: Arrange and nest side lap joints so prevailing winds blow over, not into, lapped joints. Lap ribbed or fluted sheets one full-rib corrugation. Apply panels and associated items for neat and weather-tight enclosure. Avoid "panel creep" or application not true to line. Protect factory finishes from damage.

1. Field cutting of exterior panels by torch is not permitted.

2. Provide weather seal under ridge cap. Flash and seal roof panels at eave and rake with rubber, neoprene, or other closures to exclude weather.

B. Standing-Seam Roof Panel System: Fasten roof panels to purlins with concealed clip in accordance with the manufacturer's instructions.

1. Install clips at each support with self-drilling fasteners.

2. At end laps of panels, install tape caulk between panels.

3. Install factory-caulked cleats at standing-seam points. Machine-seam cleats to the panels to provide a weather-tight joint.

4. Provide for system thermal expansion.

C. Wall Sheets: Apply elastomeric sealant continuously between metal-base channel (sill angle) and concrete and elsewhere as necessary for waterproofing. Handle and apply sealant and backup in accordance with the sealant manufacturer's recommendations.

1. Align bottom of wall panels and fasten panels with blind rivets, bolts, or self-tapping screws. Fasten flashings and trim around openings and similar elements with self-tapping screws. Fasten window and door frames with machine screws or bolts. When building height requires two (2) rows of panels at gable ends, align lap of gable panels over wall panels at eave height.

2. Install screw fasteners with power tools having controlled torque adjusted to compress neoprene washer tightly without damage to washer, screw threads, or panels. Install screws in predrilled holes.

3. Provide weatherproof escutcheons for pipe and conduit penetrating exterior walls.

D. Sheet Metal Accessories: Install gutters, downspouts, ventilators, louvers, and other sheet metal accessories in accordance with manufacturer's recommendations for positive anchorage to building and weather-tight mounting. Adjust operating mechanism for precise operation.

E. Hollow Metal Doors and Frames: Install doors and frames straight, plumb, and level. Securely anchor frames to building structure. Set units with 1/8" maximum clearance between door and frame at jambs and head and 3/4" maximum between door and floor. Adjust hardware for proper operation.

F. Thermal Insulation: Install insulation concurrently with installation of roof panels in accordance with manufacturer's directions. Install blankets straight and true in one-piece lengths with both sets of tabs sealed to provide a complete vapor barrier. Locate insulation on underside of roof sheets, extending across the top flange of purlin members and held taut and snug to roofing panels

with retainer clips. Install retainer strips at each longitudinal joint, straight and taut, nesting with roof rib to hold insulation in place.

END OF PRE-ENGINEERED STRUCTURES

# SECTION 220513 - COMMON MOTOR REQUIREMENTS FOR PLUMBING EQUIPMENT

## PART 1 - GENERAL

### 1.1 SUMMARY

A. Section includes general requirements for single-phase and polyphase, general-purpose, horizontal, small and medium, squirrel-cage induction motors for use on ac power systems up to 600 V and installed at equipment manufacturer's factory or shipped separately by equipment manufacturer for field installation.

### 1.2 COORDINATION

A. Coordinate features of motors, installed units, and accessory devices to be compatible with the following:

1. Motor controllers.
2. Torque, speed, and horsepower requirements of the load.
3. Ratings and characteristics of supply circuit and required control sequence.
4. Ambient and environmental conditions of installation location.

## PART 2 - PRODUCTS

### 2.1 GENERAL MOTOR REQUIREMENTS

A. Comply with NEMA MG 1 unless otherwise indicated.

### 2.2 MOTOR CHARACTERISTICS

A. Duty: Continuous duty at ambient temperature of 40 deg C and at altitude of 3300 feet above sea level.

B. Capacity and Torque Characteristics: Sufficient to start, accelerate, and operate connected loads at designated speeds, at installed altitude and environment, with indicated operating sequence, and without exceeding nameplate ratings or considering service factor.

### 2.3 POLYPHASE MOTORS

A. Description: NEMA MG 1, Design B, medium induction motor.

B. Efficiency: Energy efficient, as defined in NEMA MG 1.

C. Service Factor: 1.15.

D. Multispeed Motors: Variable torque.

1. For motors with 2:1 speed ratio, consequent pole, single winding.
2. For motors with other than 2:1 speed ratio, separate winding for each speed.

E. Rotor: Random-wound, squirrel cage.

F. Bearings: Regreasable, shielded, antifriction ball bearings suitable for radial and thrust loading.

G. Temperature Rise: Match insulation rating.

H. Insulation: Class F.

I. Code Letter Designation:

1. Motors 15 HP and Larger: NEMA starting Code F or Code G.
2. Motors Smaller than 15 HP: Manufacturer's standard starting characteristic.

J. Enclosure Material: Cast iron for motor frame sizes 324T and larger; rolled steel for motor frame sizes smaller than 324T.

## 2.4 POLYPHASE MOTORS WITH ADDITIONAL REQUIREMENTS

A. Motors Used with Reduced-Voltage and Multispeed Controllers: Match wiring connection requirements for controller with required motor leads. Provide terminals in motor terminal box, suited to control method.

B. Motors Used with Variable Frequency Controllers: Ratings, characteristics, and features coordinated with and approved by controller manufacturer.

1. Windings: Copper magnet wire with moisture-resistant insulation varnish, designed and tested to resist transient spikes, high frequencies, and short time rise pulses produced by pulse-width modulated inverters.
2. Energy- and Premium-Efficient Motors: Class B temperature rise; Class F insulation.
3. Inverter-Duty Motors: Class F temperature rise; Class H insulation.
4. Thermal Protection: Comply with NEMA MG 1 requirements for thermally protected motors.

## 2.5 SINGLE-PHASE MOTORS

A. Motors larger than 1/20 hp shall be one of the following, to suit starting torque and requirements of specific motor application:

1. Permanent-split capacitor.

2. Split phase.
3. Capacitor start, inductor run.
4. Capacitor start, capacitor run.

B. Multispeed Motors: Variable-torque, permanent-split-capacitor type.

C. Bearings: Prelubricated, antifriction ball bearings or sleeve bearings suitable for radial and thrust loading.

D. Motors 1/20 HP and Smaller: Shaded-pole type.

E. Thermal Protection: Internal protection to automatically open power supply circuit to motor when winding temperature exceeds a safe value calibrated to temperature rating of motor insulation. Thermal-protection device shall automatically reset when motor temperature returns to normal range.

PART 3 - EXECUTION (Not Applicable)

END OF SECTION 220513

# SECTION 220516 - EXPANSION FITTINGS AND LOOPS FOR PLUMBING PIPING

## PART 1 - GENERAL

### 1.1 SUMMARY

A. Section Includes:

1. Metal-bellows packless expansion joints.
2. Pipe loops and swing connections.
3. Alignment guides and anchors.

### 1.2 ACTION SUBMITTALS

A. Product Data: For each type of product indicated.

B. Delegated-Design Submittal: For each anchor and alignment guide indicated to comply with performance requirements and design criteria, including analysis data signed and sealed by the qualified professional engineer responsible for their preparation.

1. Design Calculations: Calculate requirements for thermal expansion of piping systems and for selecting and designing expansion joints, loops, and swing connections.
2. Anchor Details: Detail fabrication of each anchor indicated. Show dimensions and methods of assembly and attachment to building structure.
3. Alignment Guide Details: Detail field assembly and attachment to building structure.
4. Schedule: Indicate type, manufacturer's number, size, material, pressure rating, end connections, and location for each expansion joint.

### 1.3 INFORMATIONAL SUBMITTALS

A. Product certificates.

### 1.4 CLOSEOUT SUBMITTALS

A. Maintenance data.

## PART 2 - PRODUCTS

### 2.1 PACKLESS EXPANSION JOINTS

A. Metal-Bellows Packless Expansion Joints:

1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
2. Basis-of-Design Product: Subject to compliance with requirements, provide product indicated on Drawings or comparable product by one of the following:

    a. Adsco Manufacturing LLC.
    b. American BOA, Inc.
    c. Badger Industries, Inc.
    d. Expansion Joint Systems, Inc.
    e. Flex Pression Ltd.
    f. Flex-Hose Co., Inc.
    g. Flex-Weld, Inc.
    h. Flexicraft Industries.
    i. Flo Fab inc.
    j. Hyspan Precision Products, Inc.
    k. Mason Industries, Inc.
    l. Metraflex Company (The).
    m. Proco Products, Inc.
    n. Senior Flexonics Pathway.
    o. Tozen Corporation.
    p. U.S. Bellows, Inc.
    q. Unaflex.
    r. Unisource Manufacturing, Inc.
    s. Universal Metal Hose.
    t. WahlcoMetroflex.

3. Standards: ASTM F 1120 and EJMA's "Standards of the Expansion Joint Manufacturers Association, Inc."
4. Type: Circular, corrugated bellows with external tie rods.
5. Minimum Pressure Rating: 150 psig unless otherwise indicated.
6. Configuration: Single joint Single joint with base and double joint with base class(es) unless otherwise indicated.
7. Expansion Joints for Copper Tubing: Single- or multi-ply phosphor-bronze bellows, copper pipe ends, and brass shrouds.

    a. End Connections for Copper Tubing NPS 2 and Smaller: Solder joint or threaded.
    b. End Connections for Copper Tubing NPS 2-1/2 to NPS 4: Solder joint or threaded.
    c. End Connections for Copper Tubing NPS 5 and Larger: Flanged.

## 2.2 ALIGNMENT GUIDES AND ANCHORS

A. Alignment Guides:

1. Description: Steel, factory-fabricated alignment guide, with bolted two-section outer cylinder and base for attaching to structure; with two-section guiding spider for bolting to pipe.

B. Anchor Materials:

1. Steel Shapes and Plates: ASTM A 36/A 36M.
2. Bolts and Nuts: ASME B18.10 or ASTM A 183, steel hex head.
3. Washers: ASTM F 844, steel, plain, flat washers.
4. Mechanical Fasteners: Insert-wedge-type stud with expansion plug anchor for use in hardened portland cement concrete, with tension and shear capacities appropriate for application.

    a. Stud: Threaded, zinc-coated carbon steel.
    b. Expansion Plug: Zinc-coated steel.
    c. Washer and Nut: Zinc-coated steel.

5. Chemical Fasteners: Insert-type-stud, bonding-system anchor for use with hardened portland cement concrete, with tension and shear capacities appropriate for application.

    a. Bonding Material: ASTM C 881/C 881M, Type IV, Grade 3, two-component epoxy resin suitable for surface temperature of hardened concrete where fastener is to be installed.
    b. Stud: ASTM A 307, zinc-coated carbon steel with continuous thread on stud unless otherwise indicated.
    c. Washer and Nut: Zinc-coated steel.

PART 3 - EXECUTION

3.1 EXPANSION-JOINT INSTALLATION

A. Install expansion joints of sizes matching sizes of piping in which they are installed.

B. Install metal-bellows expansion joints according to EJMA's "Standards of the Expansion Joint Manufacturers Association, Inc."

3.2 PIPE LOOP AND SWING CONNECTION INSTALLATION

A. Install pipe loops cold-sprung in tension or compression as required to partly absorb tension or compression produced during anticipated change in temperature.

B. Connect risers and branch connections to mains with at least five pipe fittings including tee in main.

C. Connect risers and branch connections to terminal units with at least four pipe fittings including tee in riser.

D. Connect mains and branch connections to terminal units with at least four pipe fittings including tee in main.

3.3 ALIGNMENT-GUIDE AND ANCHOR INSTALLATION

A. Install alignment guides to guide expansion and to avoid end-loading and torsional stress.

B. Install one guide(s) on each side of pipe expansion fittings and loops. Install guides nearest to expansion joint not more than four pipe diameters from expansion joint.

C. Attach guides to pipe and secure guides to building structure.

D. Install anchors at locations to prevent stresses from exceeding those permitted by ASME B31.9 and to prevent transfer of loading and stresses to connected equipment.

E. Anchor Attachments:

1. Anchor Attachment to Galvanized-Steel Pipe: Attach with pipe hangers. Use MSS SP-69, Type 42, riser clamp welded to anchor.
2. Anchor Attachment to Copper Tubing: Attach with pipe hangers. Use MSS SP-69, Type 24, U-bolts bolted to anchor.

F. Fabricate and install steel anchors by welding steel shapes, plates, and bars. Comply with ASME B31.9 and AWS D1.1/D1.1M.

1. Anchor Attachment to Steel Structural Members: Attach by welding.
2. Anchor Attachment to Concrete Structural Members: Attach by fasteners. Follow fastener manufacturer's written instructions.

G. Use grout to form flat bearing surfaces for guides and anchors attached to concrete.

END OF SECTION 220516

# SECTION 220517 - SLEEVES AND SLEEVE SEALS FOR PLUMBING PIPING

## PART 1 - GENERAL

### 1.1 SUMMARY

A. Section Includes:

1. Sleeves.
2. Sleeve-seal systems.
3. Grout.

### 1.2 ACTION SUBMITTALS

A. Product Data: For each type of product indicated.

## PART 2 - PRODUCTS

### 2.1 SLEEVES

A. Cast-Iron Wall Pipes: Cast or fabricated of cast or ductile iron and equivalent to ductile-iron pressure pipe, with plain ends and integral waterstop unless otherwise indicated.

B. Galvanized-Steel Wall Pipes: ASTM A 53/A 53M, Schedule 40, with plain ends and welded steel collar; zinc coated.

C. Galvanized-Steel-Pipe Sleeves: ASTM A 53/A 53M, Type E, Grade B, Schedule 40, zinc coated, with plain ends.

D. PVC-Pipe Sleeves: ASTM D 1785, Schedule 40.

E. Galvanized-Steel-Sheet Sleeves: 0.0239-inch minimum thickness; round tube closed with welded longitudinal joint.

### 2.2 SLEEVE-SEAL SYSTEMS

A. Manufacturers: Subject to compliance with requirements, provide products by one of the following:

B. Basis-of-Design Product: Subject to compliance with requirements, provide product indicated on Drawings or comparable product by one of the following:

1. Advance Products & Systems, Inc.
2. CALPICO, Inc.
3. Metraflex Company (The).
4. Pipeline Seal and Insulator, Inc.
5. Proco Products, Inc.

C. Description: Modular sealing-element unit, designed for field assembly, for filling annular space between piping and sleeve.

1. Sealing Elements: EPDM-rubber interlocking links shaped to fit surface of pipe. Include type and number required for pipe material and size of pipe.
2. Pressure Plates: Carbon steel.
3. Connecting Bolts and Nuts: Carbon steel, with corrosion-resistant coating, of length required to secure pressure plates to sealing elements.

## 2.3 GROUT

A. Standard: ASTM C 1107/C 1107M, Grade B, post-hardening and volume-adjusting, dry, hydraulic-cement grout.

B. Characteristics: Nonshrink; recommended for interior and exterior applications.

C. Design Mix: 5000-psi, 28-day compressive strength.

D. Packaging: Premixed and factory packaged.

# PART 3 - EXECUTION

## 3.1 SLEEVE INSTALLATION

A. Install sleeves for piping passing through penetrations in floors, partitions, roofs, and walls.

B. For sleeves that will have sleeve-seal system installed, select sleeves of size large enough to provide 1-inch annular clear space between piping and concrete slabs and walls.

1. Sleeves are not required for core-drilled holes.

C. Install sleeves in concrete floors, concrete roof slabs, and concrete walls as new slabs and walls are constructed.

1. Cut sleeves to length for mounting flush with both surfaces.

a. Exception: Extend sleeves installed in floors of mechanical equipment areas or other wet areas 2 inches above finished floor level.

2. Using grout, seal the space outside of sleeves in slabs and walls without sleeve-seal system.

D. Install sleeves for pipes passing through interior partitions.

1. Cut sleeves to length for mounting flush with both surfaces.
2. Install sleeves that are large enough to provide 1/4-inch annular clear space between sleeve and pipe or pipe insulation.
3. Seal annular space between sleeve and piping or piping insulation; use joint sealants appropriate for size, depth, and location of joint. Comply with requirements for sealants specified in Section 079200 "Joint Sealants."

E. Fire-Barrier Penetrations: Maintain indicated fire rating of walls, partitions, ceilings, and floors at pipe penetrations. Seal pipe penetrations with firestop materials. Comply with requirements for firestopping specified in Section 078413 "Penetration Firestopping."

## 3.2 SLEEVE-SEAL-SYSTEM INSTALLATION

A. Install sleeve-seal systems in sleeves in exterior concrete walls and slabs-on-grade at service piping entries into building.

B. Select type, size, and number of sealing elements required for piping material and size and for sleeve ID or hole size. Position piping in center of sleeve. Center piping in penetration, assemble sleeve-seal system components, and install in annular space between piping and sleeve. Tighten bolts against pressure plates that cause sealing elements to expand and make a watertight seal.

## 3.3 SLEEVE AND SLEEVE-SEAL SCHEDULE

A. Use sleeves and sleeve seals for the following piping-penetration applications:

1. Exterior Concrete Walls above Grade:

a. Piping Smaller Than NPS 6: Galvanized-steel wall sleeves.
b. Piping NPS 6 and Larger: Galvanized-steel wall sleeves.

2. Exterior Concrete Walls below Grade:

a. Piping Smaller Than NPS 6: Galvanized-steel wall sleeves with sleeve-seal system.

1) Select sleeve size to allow for 1-inch annular clear space between piping and sleeve for installing sleeve-seal system.

b. Piping NPS 6 and Larger: Galvanized-steel wall sleeves with sleeve-seal system.

1) Select sleeve size to allow for 1-inch annular clear space between piping and sleeve for installing sleeve-seal system.

3. Concrete Slabs-on-Grade:

a. Piping Smaller Than NPS 6: Galvanized-steel wall sleeves with sleeve-seal system.

1) Select sleeve size to allow for 1-inch annular clear space between piping and sleeve for installing sleeve-seal system.

b. Piping NPS 6 and Larger: Galvanized-steel wall sleeves with sleeve-seal system.

1) Select sleeve size to allow for 1-inch annular clear space between piping and sleeve for installing sleeve-seal system.

4. Concrete Slabs above Grade:

a. Piping Smaller Than NPS 6: Galvanized-steel-pipe sleeves.
b. Piping NPS 6 and Larger: Galvanized-steel-pipe sleeves.

END OF SECTION 220517

# SECTION 220518 - ESCUTCHEONS FOR PLUMBING PIPING

## PART 1 - GENERAL

### 1.1 SUMMARY

A. Section Includes:

1. Escutcheons.
2. Floor plates.

### 1.2 ACTION SUBMITTALS

A. Product Data: For each type of product indicated.

## PART 2 - PRODUCTS

### 2.1 ESCUTCHEONS

A. One-Piece, Cast-Brass Type: With polished, chrome-plated finish and setscrew fastener.

B. One-Piece, Deep-Pattern Type: Deep-drawn, box-shaped brass with chrome-plated finish and spring-clip fasteners.

C. One-Piece, Stamped-Steel Type: With chrome-plated finish and spring-clip fasteners.

### 2.2 FLOOR PLATES

A. One-Piece Floor Plates: Cast-iron flange with holes for fasteners.

## PART 3 - EXECUTION

### 3.1 INSTALLATION

A. Install escutcheons for piping penetrations of walls, ceilings, and finished floors.

B. Install escutcheons with ID to closely fit around pipe, tube, and insulation of piping and with OD that completely covers opening.

1. Escutcheons for New Piping:

a. Piping with Fitting or Sleeve Protruding from Wall: One-piece, deep-pattern type.
b. Chrome-Plated Piping: One-piece, cast-brass type with polished, chrome-plated finish.
c. Insulated Piping: One-piece, stamped-steel type.
d. Bare Piping at Wall and Floor Penetrations in Finished Spaces: One-piece, cast-brass type with polished, chrome-plated finish.
e. Bare Piping at Wall and Floor Penetrations in Finished Spaces: One-piece, stamped-steel type.
f. Bare Piping at Ceiling Penetrations in Finished Spaces: One-piece, cast-brass type with polished, chrome-plated finish.
g. Bare Piping at Ceiling Penetrations in Finished Spaces: One-piece, stamped-steel type.
h. Bare Piping in Equipment Rooms: One-piece, cast-brass type with polished, chrome-plated finish.
i. Bare Piping in Equipment Rooms: One-piece, stamped-steel type.

C. Install floor plates for piping penetrations of equipment-room floors.

D. Install floor plates with ID to closely fit around pipe, tube, and insulation of piping and with OD that completely covers opening.

1. New Piping: One-piece, floor-plate type.

3.2 FIELD QUALITY CONTROL

A. Replace broken and damaged escutcheons and floor plates using new materials.

END OF SECTION 220518

# SECTION 220523 - GENERAL-DUTY VALVES FOR PLUMBING PIPING

## PART 1 - GENERAL

### 1.1 SUMMARY

A. Section Includes:

1. Brass ball valves.
2. Bronze ball valves.
3. Bronze swing check valves.
4. Bronze gate valves.
5. Bronze globe valves.

B. Related Sections:

1. Section 221116 "Domestic Water Piping" for valves applicable only to this piping.
2. Section 221319 "Sanitary Waste Piping Specialties" for valves applicable only to this piping.

### 1.2 ACTION SUBMITTALS

A. Product Data: For each type of valve indicated.

### 1.3 QUALITY ASSURANCE

A. ASME Compliance: ASME B16.10 and ASME B16.34 for ferrous valve dimensions and design criteria.

B. NSF Compliance: NSF 61 for valve materials for potable-water service.

## PART 2 - PRODUCTS

### 2.1 GENERAL REQUIREMENTS FOR VALVES

A. Refer to valve schedule articles for applications of valves.

B. Valve Pressure and Temperature Ratings: Not less than indicated and as required for system pressures and temperatures.

C. Valve Sizes: Same as upstream piping unless otherwise indicated.

D. Valve Actuator Types:

1. Handlever: For quarter-turn valves NPS 6 and smaller except plug valves.

E. Valves in Insulated Piping: With 2-inch stem extensions and the following features:

1. Gate Valves: With rising stem.
2. Ball Valves: With extended operating handle of non-thermal-conductive material, and protective sleeve that allows operation of valve without breaking the vapor seal or disturbing insulation.
3. Butterfly Valves: With extended neck.

F. Valve-End Connections:

1. Flanged: With flanges according to ASME B16.1 for iron valves.
2. Solder Joint: With sockets according to ASME B16.18.
3. Threaded: With threads according to ASME B1.20.1.

2.2 BRASS BALL VALVES

A. One-Piece, Reduced-Port, Brass Ball Valves with Brass Trim:

1. Manufacturers: Subject to compliance with requirements, provide products by one of the following available manufacturers offering products that may be incorporated into the Work include, but are not limited to, the following:

a. Kitz Corporation.

2. Description:

a. Standard: MSS SP-110.
b. CWP Rating: 400 psig.
c. Body Design: One piece.
d. Body Material: Forged brass.
e. Ends: Threaded.
f. Seats: PTFE or TFE.
g. Stem: Brass.
h. Ball: Chrome-plated brass.
i. Port: Reduced.

B. Two-Piece, Full-Port, Brass Ball Valves with Brass Trim:

1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:

a. Crane Co.; Crane Valve Group; Crane Valves.

b. Crane Co.; Crane Valve Group; Jenkins Valves.
c. DynaQuip Controls.
d. Flow-Tek, Inc.; a subsidiary of Bray International, Inc.
e. Hammond Valve.
f. Jamesbury; a subsidiary of Metso Automation.
g. Jomar International, LTD.
h. Kitz Corporation.
i. Legend Valve.
j. Marwin Valve; a division of Richards Industries.
k. Milwaukee Valve Company.
l. NIBCO INC.
m. Red-White Valve Corporation.
n. RuB Inc.

2. Description:

a. Standard: MSS SP-110.
b. SWP Rating: 150 psig.
c. CWP Rating: 600 psig.
d. Body Design: Two piece.
e. Body Material: Forged brass.
f. Ends: Threaded.
g. Seats: PTFE or TFE.
h. Stem: Brass.
i. Ball: Chrome-plated brass.
j. Port: Full.

C. Two-Piece, Regular-Port, Brass Ball Valves with Brass Trim:

1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:

a. Hammond Valve.
b. Jamesbury; a subsidiary of Metso Automation.
c. Legend Valve.
d. Marwin Valve; a division of Richards Industries.
e. Milwaukee Valve Company.

2. Description:

a. Standard: MSS SP-110.
b. SWP Rating: 150 psig.
c. CWP Rating: 600 psig.
d. Body Design: Two piece.
e. Body Material: Forged brass.
f. Ends: Threaded.
g. Seats: PTFE or TFE.

h. Stem: Brass.
i. Ball: Chrome-plated brass.
j. Port: Regular.

2.3 BRONZE BALL VALVES

A. One-Piece, Reduced-Port, Bronze Ball Valves with Bronze Trim:

1. 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. American Valve, Inc.
b. Conbraco Industries, Inc.; Apollo Valves.
c. NIBCO INC.

2. Description:

a. Standard: MSS SP-110.
b. CWP Rating: 400 psig.
c. Body Design: One piece.
d. Body Material: Bronze.
e. Ends: Threaded.
f. Seats: PTFE or TFE.
g. Stem: Bronze.
h. Ball: Chrome-plated brass.
i. Port: Reduced.

B. Two-Piece, Full-Port, Bronze Ball Valves with Bronze Trim:

1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:

a. American Valve, Inc.
b. Conbraco Industries, Inc.; Apollo Valves.
c. Crane Co.; Crane Valve Group; Crane Valves.
d. Hammond Valve.
e. Lance Valves; a division of Advanced Thermal Systems, Inc.
f. Legend Valve.
g. Milwaukee Valve Company.
h. NIBCO INC.
i. Red-White Valve Corporation.
j. Watts Regulator Co.; a division of Watts Water Technologies, Inc.

2. Description:

a. Standard: MSS SP-110.

b. SWP Rating: 150 psig.
c. CWP Rating: 600 psig.
d. Body Design: Two piece.
e. Body Material: Bronze.
f. Ends: Threaded.
g. Seats: PTFE or TFE.
h. Stem: Bronze.
i. Ball: Chrome-plated brass.
j. Port: Full.

C. Two-Piece, Regular-Port, Bronze Ball Valves with Bronze Trim:

1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:

a. American Valve, Inc.
b. Conbraco Industries, Inc.; Apollo Valves.
c. Crane Co.; Crane Valve Group; Jenkins Valves.
d. Crane Co.; Crane Valve Group; Stockham Division.
e. DynaQuip Controls.
f. Hammond Valve.
g. Lance Valves; a division of Advanced Thermal Systems, Inc.
h. Milwaukee Valve Company.
i. NIBCO INC.

2. Description:

a. Standard: MSS SP-110.
b. SWP Rating: 150 psig.
c. CWP Rating: 600 psig.
d. Body Design: Two piece.
e. Body Material: Bronze.
f. Ends: Threaded.
g. Seats: PTFE or TFE.
h. Stem: Bronze.
i. Ball: Chrome-plated brass.
j. Port: Regular.

2.4 BRONZE SWING CHECK VALVES

A. Class 125, Bronze Swing Check Valves with Bronze Disc:

1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:

a. American Valve, Inc.
b. Crane Co.; Crane Valve Group; Crane Valves.

c. Crane Co.; Crane Valve Group; Jenkins Valves.
d. Crane Co.; Crane Valve Group; Stockham Division.
e. Hammond Valve.
f. Kitz Corporation.
g. Milwaukee Valve Company.
h. NIBCO INC.
i. Powell Valves.
j. Red-White Valve Corporation.
k. Watts Regulator Co.; a division of Watts Water Technologies, Inc.
l. Zy-Tech Global Industries, Inc.

2. Description:

a. Standard: MSS SP-80, Type 3.
b. CWP Rating: 200 psig.
c. Body Design: Horizontal flow.
d. Body Material: ASTM B 62, bronze.
e. Ends: Threaded.
f. Disc: Bronze.

B. Class 125, Bronze Swing Check Valves with Nonmetallic Disc:

1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:

a. Crane Co.; Crane Valve Group; Crane Valves.
b. Crane Co.; Crane Valve Group; Jenkins Valves.
c. Crane Co.; Crane Valve Group; Stockham Division.
d. Hammond Valve.
e. Kitz Corporation.
f. Milwaukee Valve Company.
g. NIBCO INC.
h. Red-White Valve Corporation.
i. Watts Regulator Co.; a division of Watts Water Technologies, Inc.

2. Description:

a. Standard: MSS SP-80, Type 4.
b. CWP Rating: 200 psig.
c. Body Design: Horizontal flow.
d. Body Material: ASTM B 62, bronze.
e. Ends: Threaded.
f. Disc: PTFE or TFE.

2.5 BRONZE GATE VALVES

A. Class 125, NRS Bronze Gate Valves:

1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:

   a. American Valve, Inc.
   b. Crane Co.; Crane Valve Group; Crane Valves.
   c. Crane Co.; Crane Valve Group; Jenkins Valves.
   d. Crane Co.; Crane Valve Group; Stockham Division.
   e. Hammond Valve.
   f. Kitz Corporation.
   g. Milwaukee Valve Company.
   h. NIBCO INC.
   i. Powell Valves.
   j. Red-White Valve Corporation.
   k. Watts Regulator Co.; a division of Watts Water Technologies, Inc.
   l. Zy-Tech Global Industries, Inc.

2. Description:

   a. Standard: MSS SP-80, Type 1.
   b. CWP Rating: 200 psig.
   c. Body Material: ASTM B 62, bronze with integral seat and screw-in bonnet.
   d. Ends: Threaded or solder joint.
   e. Stem: Bronze.
   f. Disc: Solid wedge; bronze.
   g. Packing: Asbestos free.

B. Class 125, RS Bronze Gate Valves:

1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:

   a. American Valve, Inc.
   b. Crane Co.; Crane Valve Group; Crane Valves.
   c. Crane Co.; Crane Valve Group; Jenkins Valves.
   d. Crane Co.; Crane Valve Group; Stockham Division.
   e. Hammond Valve.
   f. Kitz Corporation.
   g. Milwaukee Valve Company.
   h. NIBCO INC.
   i. Powell Valves.
   j. Watts Regulator Co.; a division of Watts Water Technologies, Inc.
   k. Zy-Tech Global Industries, Inc.

2. Description:

   a. Standard: MSS SP-80, Type 2.
   b. CWP Rating: 200 psig.
   c. Body Material: ASTM B 62, bronze with integral seat and screw-in bonnet.

d. Ends: Threaded or solder joint.
e. Stem: Bronze.
f. Disc: Solid wedge; bronze.
g. Packing: Asbestos free.

2.6 BRONZE GLOBE VALVES

A. Class 125, Bronze Globe Valves with Bronze Disc:

1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:

a. Crane Co.; Crane Valve Group; Crane Valves.
b. Crane Co.; Crane Valve Group; Stockham Division.
c. Hammond Valve.
d. Kitz Corporation.
e. Milwaukee Valve Company.
f. NIBCO INC.
g. Powell Valves.
h. Red-White Valve Corporation.
i. Watts Regulator Co.; a division of Watts Water Technologies, Inc.
j. Zy-Tech Global Industries, Inc.

2. Description:

a. Standard: MSS SP-80, Type 1.
b. CWP Rating: 200 psig.
c. Body Material: ASTM B 62, bronze with integral seat and screw-in bonnet.
d. Ends: Threaded or solder joint.
e. Stem and Disc: Bronze.
f. Packing: Asbestos free.
g. Handwheel: Malleable iron, bronze, or aluminum.

B. Class 125, Bronze Globe Valves with Nonmetallic Disc:

1. 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. Crane Co.; Crane Valve Group; Crane Valves.
b. Crane Co.; Crane Valve Group; Stockham Division.
c. NIBCO INC.
d. Red-White Valve Corporation.

2. Description:

a. Standard: MSS SP-80, Type 2.

b. CWP Rating: 200 psig.
c. Body Material: ASTM B 62, bronze with integral seat and screw-in bonnet.
d. Ends: Threaded or solder joint.
e. Stem: Bronze.
f. Disc: PTFE or TFE.
g. Packing: Asbestos free.
h. Handwheel: Malleable iron, bronze, or aluminum.

PART 3 - EXECUTION

3.1 VALVE INSTALLATION

A. Install valves with unions or flanges at each piece of equipment arranged to allow service, maintenance, and equipment removal without system shutdown.

B. Locate valves for easy access and provide separate support where necessary.

C. Install valves in horizontal piping with stem at or above center of pipe.

D. Install valves in position to allow full stem movement.

3.2 ADJUSTING

A. Adjust or replace valve packing after piping systems have been tested and put into service but before final adjusting and balancing. Replace valves if persistent leaking occurs.

3.3 GENERAL REQUIREMENTS FOR VALVE APPLICATIONS

A. If valve applications are not indicated, use the following:

1. Shutoff Service: Ball, butterfly, or gate valves.
2. Throttling Service: Globe ball, or butterfly valves.
3. Pump-Discharge Check Valves:

a. NPS 2 and Smaller: Bronze swing check valves with bronze or nonmetallic disc.
b. NPS 2-1/2 and Larger for Domestic Water: Iron swing check valves with lever and weight or with spring.
c. NPS 2-1/2 and Larger for Sanitary Waste and Storm Drainage: Iron swing check valves with lever and weight or spring.

B. If valves with specified SWP classes or CWP ratings are not available, the same types of valves with higher SWP class or CWP ratings may be substituted.

C. Select valves, except wafer types, with the following end connections:

1. For Copper Tubing, NPS 2 and Smaller: Threaded ends except where solder-joint valve-end option is indicated in valve schedules below.
2. For Copper Tubing, NPS 2-1/2 to NPS 4: Flanged ends except where threaded valve-end option is indicated in valve schedules below.
3. For Copper Tubing, NPS 5 and Larger: Flanged ends.

3.4 DOMESTIC, HOT- AND COLD-WATER VALVE SCHEDULE

A. Pipe NPS 2-1/2 and Smaller:

1. Bronze and Brass Valves: May be provided with solder-joint ends instead of threaded ends.
2. Bronze Angle Valves: Class 125, bronze disc.
3. Ball Valves: Two piece, full port, brass or bronze with brass trim.
4. Bronze Swing Check Valves: Class 125, bronze disc.
5. Bronze Gate Valves: Class 125, NRS.
6. Bronze Globe Valves: Class 125, bronze disc.

3.5 SANITARY-WASTE VALVE SCHEDULE

A. Pipe NPS 2-1/2 and Smaller:

1. Bronze and Brass Valves: May be provided with solder-joint ends instead of threaded ends.
2. Ball Valves: Two piece, full port, brass or bronze with brass trim.
3. Bronze Swing Check Valves: Class 125, bronze disc.
4. Bronze Gate Valves: Class 125, NRS.
5. Bronze Globe Valves: Class 125, bronze disc.

END OF SECTION 220523

# SECTION 220523.12 - BALL VALVES FOR PLUMBING PIPING

## PART 1 - GENERAL

### 1.1 SUMMARY

A. Section Includes:

1. Brass ball valves.
2. Bronze ball valves.

### 1.2 ACTION SUBMITTALS

A. Product Data: For each type of valve.

1. Certification that products comply with NSF 61 Annex G and NSF 372.

## PART 2 - PRODUCTS

### 2.1 GENERAL REQUIREMENTS FOR VALVES

A. Source Limitations for Valves: Obtain each type of valve from single source from single manufacturer.

B. ASME Compliance:

1. ASME B1.20.1 for threads for threaded end valves.
2. ASME B16.10 and ASME B16.34 for ferrous valve dimensions and design criteria.
3. ASME B16.18 for solder-joint connections.
4. ASME B31.9 for building services piping valves.

C. NSF Compliance: NSF 61 Annex G and NSF 372 for valve materials for potable-water service.

D. Bronze valves shall be made with dezincification-resistant materials. Bronze valves made with copper alloy (brass) containing more than 15 percent zinc are not permitted.

E. Valve Pressure-Temperature Ratings: Not less than indicated and as required for system pressures and temperatures.

F. Valve Sizes: Same as upstream piping unless otherwise indicated.

G. Valve Actuator Types:

1. Gear Actuator: For quarter-turn valves NPS 4 (DN 100) and larger.
2. Handlever: For quarter-turn valves smaller than NPS 4 (DN 100).

H. Valves in Insulated Piping:

1. Include 2-inch (50-mm) stem extensions.
2. Extended operating handles of nonthermal-conductive material and protective sleeves that allow operation of valves without breaking vapor seals or disturbing insulation.
3. Memory stops that are fully adjustable after insulation is applied.

## 2.2 BRASS BALL VALVES

A. Brass Ball Valves, One-Piece:

1. Manufacturers: Subject to compliance with requirements, provide products by the following:

   a. KITZ Corporation.

2. Description:

   a. Standard: MSS SP-110.
   b. CWP Rating: 400 psig (2760 kPa).
   c. Body Design: One piece.
   d. Body Material: Forged brass or bronze.
   e. Ends: Threaded and soldered.
   f. Seats: PTFE.
   g. Stem: Brass or stainless steel.
   h. Ball: Chrome-plated brass or stainless steel.
   i. Port: Reduced.

B. Brass Ball Valves, Two-Piece with Full Port and Brass Trim:

1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:

   a. American Valve, Inc.
   b. Apollo Flow Controls; Conbraco Industries, Inc.
   c. Crane; Crane Energy Flow Solutions.
   d. DynaQuip Controls.
   e. Elkhart Products Corporation.
   f. FNW; Ferguson Enterprises, Inc.
   g. Hammond Valve.
   h. Jomar Valve.
   i. KITZ Corporation.
   j. Legend Valve & Fitting, Inc.
   k. Marwin Valve; Richards Industries.
   l. Milwaukee Valve Company.
   m. NIBCO INC.
   n. Red-White Valve Corp.
   o. Stockham; Crane Energy Flow Solutions.
   p. WATTS.

2. Description:

a. Standard: MSS SP-110.
b. CWP Rating: 600 psig (4140 kPa).
c. Body Design: Two piece.
d. Body Material: Forged brass.
e. Ends: Threaded and soldered.
f. Seats: PTFE.
g. Stem: Brass.
h. Ball: Chrome-plated brass.
i. Port: Full.

C. Brass Ball Valves, Two-Piece with Regular Port and Brass Trim:

1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:

a. Apollo Flow Controls; Conbraco Industries, Inc.
b. FNW; Ferguson Enterprises, Inc.
c. Hammond Valve.
d. Legend Valve & Fitting, Inc.
e. Milwaukee Valve Company.
f. NIBCO INC.
g. WATTS.

2. Description:

a. Standard: MSS SP-110.
b. CWP Rating: 600 psig (4140 kPa).
c. Body Design: Two piece.
d. Body Material: Forged brass.
e. Ends: Threaded and soldered.
f. Seats: PTFE.
g. Stem: Brass.
h. Ball: Chrome-plated brass.
i. Port: Regular.

## 2.3 BRONZE BALL VALVES

A. Bronze Ball Valves, One-Piece:

1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:

a. Apollo Flow Controls; Conbraco Industries, Inc.
b. FNW; Ferguson Enterprises, Inc.
c. NIBCO INC.
d. WATTS.

2. Description:

a. Standard: MSS SP-110.
b. CWP Rating: 400 psig (2760 kPa).
c. Body Design: One piece.
d. Body Material: Bronze.
e. Ends: Threaded.
f. Seats: PTFE.
g. Stem: Bronze.
h. Ball: Chrome-plated brass.
i. Port: Reduced.

B. Bronze Ball Valves, Two-Piece with Full Port, and Bronze or Brass Trim:

1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:

a. Apollo Flow Controls; Conbraco Industries, Inc.
b. Crane; Crane Energy Flow Solutions.
c. FNW; Ferguson Enterprises, Inc.
d. Hammond Valve.
e. Lance Valves.
f. Milwaukee Valve Company.
g. NIBCO INC.
h. WATTS.
i. Zurn Industries, LLC.

2. Description:

a. Standard: MSS SP-110.
b. CWP Rating: 600 psig (4140 kPa).
c. Body Design: Two piece.
d. Body Material: Bronze.
e. Ends: Threaded and soldered.
f. Seats: PTFE.
g. Stem: Bronze or brass.
h. Ball: Chrome-plated brass.
i. Port: Full.

C. Bronze Ball Valves, Two-Piece with Regular Port and Bronze or Brass Trim:

1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:

a. Apollo Flow Controls; Conbraco Industries, Inc.
b. DynaQuip Controls.
c. Hammond Valve.
d. Milwaukee Valve Company.
e. NIBCO INC.
f. WATTS.

2. Description:

a. Standard: MSS SP-110.
b. CWP Rating: 600 psig (4140 kPa).
c. Body Design: Two piece.
d. Body Material: Bronze.
e. Ends: Threaded.
f. Seats: PTFE.
g. Stem: Bronze or brass.
h. Ball: Chrome-plated brass.
i. Port: Regular.

## PART 3 - EXECUTION

### 3.1 VALVE INSTALLATION

A. Install valves with unions or flanges at each piece of equipment arranged to allow service, maintenance, and equipment removal without system shutdown.

B. Locate valves for easy access and provide separate support where necessary.

C. Install valves in horizontal piping with stem at or above center of pipe.

D. Install valves in position to allow full stem movement.

### 3.2 GENERAL REQUIREMENTS FOR VALVE APPLICATIONS

A. If valves with specified CWP ratings are unavailable, the same types of valves with higher CWP ratings may be substituted.

B. Select valves with the following end connections:

1. For Copper Tubing, NPS 2 (DN 50) and Smaller: Threaded ends except where solder-joint valve-end option is indicated in valve schedules below.
2. For Steel Piping, NPS 2 (DN 50) and Smaller: Threaded ends.

### 3.3 LOW-PRESSURE, COMPRESSED-AIR VALVE SCHEDULE (150 PSIG (1035 kPa) OR LESS)

A. Pipe NPS 2 (DN 50) and Smaller:

1. Bronze and Brass Valves: May be provided with solder-joint ends instead of threaded ends.
2. Brass ball valves, one piece.
3. Bronze ball valve, one piece with bronze trim.
4. Brass ball valves, two-piece with full port and brass trim.
5. Bronze ball valves, two-piece with full port and bronze or brass trim.

3.4 HIGH-PRESSURE, COMPRESSED-AIR VALVE SCHEDULE (150 TO 200 PSIG (1035 TO 1380 kPa)

A. Pipe NPS 2 (DN 50) and Smaller:

1. Bronze and Brass Valves: May be provided with solder-joint ends instead of threaded ends.
2. Brass ball valve, one piece.
3. Bronze ball valve with bronze trim, one piece.
4. Brass ball valves, two-piece with full port and brass trim.
5. Bronze ball valves, two-piece with full port and bronze or brass trim.

3.5 DOMESTIC HOT- AND COLD-WATER VALVE SCHEDULE

A. Pipe NPS 2 (DN 50) and Smaller:

1. Bronze and Brass Valves: May be provided with solder-joint ends instead of threaded ends.
2. **Brass** ball valve, one piece.
3. Bronze ball valve, one piece with bronze trim.
4. Brass ball valves, two-piece with full port and brass trim.
5. Bronze ball valves, two-piece with full port and bronze or brass trim.

END OF SECTION 220523.12

# SECTION 220523.14 - CHECK VALVES FOR PLUMBING PIPING

## PART 1 - GENERAL

### 1.1 SUMMARY

A. Section Includes:

1. Bronze swing check valves.
2. Iron swing check valves with closure control.

### 1.2 ACTION SUBMITTALS

A. Product Data: For each type of valve.

1. Certification that products comply with NSF 61 Annex G and NSF 372.

## PART 2 - PRODUCTS

### 2.1 GENERAL REQUIREMENTS FOR VALVES

A. Source Limitations for Valves: Obtain each type of valve from single source from single manufacturer.

B. ASME Compliance:

1. ASME B1.20.1 for threads for threaded end valves.
2. ASME B16.1 for flanges on iron valves.
3. ASME B16.10 and ASME B16.34 for ferrous valve dimensions and design criteria.
4. ASME B16.18 for solder joint.
5. ASME B31.9 for building services piping valves.

C. NSF Compliance: NSF 61 Annex G and NSF 372 for valve materials for potable-water service.

D. Bronze valves shall be made with dezincification-resistant materials. Bronze valves made with copper alloy (brass) containing more than 15 percent zinc are not permitted.

E. Valve Pressure-Temperature Ratings: Not less than indicated and as required for system pressures and temperatures.

F. Valve Sizes: Same as upstream piping unless otherwise indicated.

G. Valve Bypass and Drain Connections: MSS SP-45.

2.2 BRONZE SWING CHECK VALVES

A. Bronze Swing Check Valves with Bronze Disc, Class 125:

1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:

a. American Valve, Inc.
b. Apollo Flow Controls; Conbraco Industries, Inc.
c. Crane; Crane Energy Flow Solutions.
d. Hammond Valve.
e. Jenkins Valves; Crane Energy Flow Solutions.
f. KITZ Corporation.
g. Macomb Groups (The).
h. Milwaukee Valve Company.
i. NIBCO INC.
j. Powell Valves.
k. Red-White Valve Corp.
l. Stockham; Crane Energy Flow Solutions.
m. WATTS.

2. Description:

a. Standard: MSS SP-80, Type 3.
b. CWP Rating: 200 psig (1380 kPa).
c. Body Design: Horizontal flow.
d. Body Material: ASTM B 62, bronze.
e. Ends: Threaded or soldered. See valve schedule articles.
f. Disc: Bronze.

B. Bronze Swing Check Valves with Nonmetallic Disc, Class 125:

1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:

a. Apollo Flow Controls; Conbraco Industries, Inc.
b. Crane; Crane Energy Flow Solutions.
c. Hammond Valve.
d. Jenkins Valves; Crane Energy Flow Solutions.
e. KITZ Corporation.
f. Milwaukee Valve Company.
g. NIBCO INC.
h. Red-White Valve Corp.
i. Stockham; Crane Energy Flow Solutions.
j. WATTS.

2. Description:

a. Standard: MSS SP-80, Type 4.
b. CWP Rating: 200 psig (1380 kPa).

c. Body Design: Horizontal flow.
d. Body Material: ASTM B 62, bronze.
e. Ends: Threaded or soldered. See valve schedule articles.
f. Disc: PTFE.

## 2.3 IRON SWING CHECK VALVES WITH CLOSURE CONTROL

A. Iron Swing Check Valves with Lever- and Spring-Closure Control, Class 125:

1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:

a. Crane; Crane Energy Flow Solutions.
b. Hammond Valve.
c. Jenkins Valves; Crane Energy Flow Solutions.
d. Milwaukee Valve Company.
e. NIBCO INC.
f. Stockham; Crane Energy Flow Solutions.
g. WATTS.

2. Description:

a. Standard: MSS SP-71, Type I.
b. CWP Rating: 200 psig (1380 kPa).
c. Body Design: Clear or full waterway.
d. Body Material: ASTM A 126, gray iron with bolted bonnet.
e. Ends: Flanged or threaded. See valve schedule articles.
f. Trim: Bronze.
g. Gasket: Asbestos free.
h. Closure Control: Factory-installed exterior lever and spring.

B. Iron Swing Check Valves with Lever and Weight-Closure Control, Class 125:

1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:

a. Apollo Flow Controls; Conbraco Industries, Inc.
b. Crane; Crane Energy Flow Solutions.
c. Hammond Valve.
d. Jenkins Valves; Crane Energy Flow Solutions.
e. Milwaukee Valve Company.
f. NIBCO INC.
g. Stockham; Crane Energy Flow Solutions.
h. WATTS.

2. Description:

a. Standard: MSS SP-71, Type I.
b. CWP Rating: 200 psig (1380 kPa).

c. Body Design: Clear or full waterway.
d. Body Material: ASTM A 126, gray iron with bolted bonnet.
e. Ends: Flanged or threaded. See valve schedule articles.
f. Trim: Bronze.
g. Gasket: Asbestos free.
h. Closure Control: Factory-installed exterior lever and weight.

## PART 3 - EXECUTION

### 3.1 VALVE INSTALLATION

A. Install valves with unions or flanges at each piece of equipment arranged to allow service, maintenance, and equipment removal without system shutdown.

B. Locate valves for easy access and provide separate support where necessary.

C. Install valves in horizontal piping with stem at or above center of pipe.

D. Install valves in position to allow full stem movement.

E. Install swing check valves for proper direction of flow in horizontal position with hinge pin level.

### 3.2 ADJUSTING

A. Adjust or replace valve packing after piping systems have been tested and put into service but before final adjusting and balancing. Replace valves if persistent leaking occurs.

### 3.3 GENERAL REQUIREMENTS FOR VALVE APPLICATIONS

A. If valve applications are not indicated, use the following:

1. Pump-Discharge Check Valves:

a. NPS 2 (DN 50) and Smaller: Bronze swing check valves with bronze or nonmetallic disc.
b. NPS 2-1/2 (DN 65) and Larger for Domestic Water: Iron swing check valves with lever and weight or spring; metal-seat or resilient-seat check valves.
c. NPS 2-1/2 (DN 65) and Larger for Sanitary Waste and Storm Drainage: Iron swing check valves with lever and weight or spring.

B. If valves with specified CWP ratings are unavailable, the same types of valves with higher CWP ratings may be substituted.

C. End Connections:

1. For Copper Tubing, NPS 2 (DN 50) and Smaller: Threaded or soldered.

2. For Copper Tubing, NPS 2-1/2 to NPS 4 (DN 65 to DN 100): Flanged or threaded.
3. For Copper Tubing, NPS 5 (DN 125) and Larger: Flanged.
4. For Steel Piping, NPS 2 (DN 50) and Smaller: Threaded.
5. For Steel Piping, NPS 2-1/2 to NPS 4 (DN 65 to DN 100): Flanged or threaded.
6. For Steel Piping, NPS 5 (DN 125) and Larger: Flanged.

3.4 LOW-PRESSURE, COMPRESSED-AIR VALVE SCHEDULE (150 PSIG (**1035 kPa**) OR LESS)

A. Pipe NPS 2 (DN 50) and Smaller:

1. Horizontal and Vertical Applications: Bronze swing check valves with bronze disc, Class 125, with soldered or threaded end connections.

B. Pipe NPS 2-1/2 (DN 65) and Larger:

1. Iron swing check valves with metal seats, Class 125, with threaded or flanged end connections.

3.5 HIGH-PRESSURE, COMPRESSED-AIR VALVE SCHEDULE (150 TO 200 PSIG (1035 TO 1380 kPa)

A. Pipe NPS 2 (DN 50) and Smaller:

1. Horizontal and Vertical Applications: Bronze swing check valves bronze disc, Class 125, with soldered or threaded end connections.

B. Pipe NPS 2-1/2 (DN 65) and Larger:

1. Iron swing check valves with metal seats, Class 125, with threaded or flanged end connections.

3.6 DOMESTIC HOT- AND COLD-WATER VALVE SCHEDULE

A. Pipe NPS 2 (DN 50) and Smaller: Bronze swing check valves bronze disc, Class 125, with soldered or threaded end connections.

B. Pipe NPS 2-1/2 (DN 65) and Larger:

1. Iron swing check valves with metal seats, Class 125, with threaded or flanged end connections.
2. Iron swing check valves with closure control, lever and spring, Class 125, with threaded or flanged end connections.

END OF SECTION 220523.14

# SECTION 220523.15 - GATE VALVES FOR PLUMBING PIPING

## PART 1 - GENERAL

### 1.1 SUMMARY

A. Section Includes:

1. Bronze gate valves.
2. Iron gate valves.
3. Chainwheels.

### 1.2 ACTION SUBMITTALS

A. Product Data: For each type of valve.

1. Certification that products comply with NSF 61 Annex G and NSF 372.

## PART 2 - PRODUCTS

### 2.1 GENERAL REQUIREMENTS FOR VALVES

A. Source Limitations for Valves: Obtain each type of valve from single source from single manufacturer.

B. ASME Compliance:

1. ASME B1.20.1 for threads for threaded end valves.
2. ASME B16.1 for flanges on iron valves.
3. ASME B16.10 and ASME B16.34 for ferrous valve dimensions and design criteria.
4. ASME B16.18 for solder joint.
5. ASME B31.9 for building services piping valves.

C. NSF Compliance: NSF 61 Annex G and NSF 372 for valve materials for potable-water service.

D. Bronze valves shall be made with dezincification-resistant materials. Bronze valves made with copper alloy (brass) containing more than 15 percent zinc are not permitted.

E. Valve Pressure-Temperature Ratings: Not less than indicated and as required for system pressures and temperatures.

F. Valve Sizes: Same as upstream piping unless otherwise indicated.

G. RS Valves in Insulated Piping: With 2-inch (50-mm) stem extensions.

H. Valve Bypass and Drain Connections: MSS SP-45.

## 2.2 BRONZE GATE VALVES

A. Bronze Gate Valves, NRS, Class 125:

1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:

   a. American Valve, Inc.
   b. Apollo Flow Controls; Conbraco Industries, Inc.
   c. Crane; Crane Energy Flow Solutions.
   d. FNW; Ferguson Enterprises, Inc.
   e. Hammond Valve.
   f. Jenkins Valves; Crane Energy Flow Solutions.
   g. Jomar Valve.
   h. KITZ Corporation.
   i. Macomb Groups (The).
   j. Milwaukee Valve Company.
   k. NIBCO INC.
   l. Powell Valves.
   m. Red-White Valve Corp.
   n. Stockham; Crane Energy Flow Solutions.
   o. WATTS.

2. Description:

   a. Standard: MSS SP-80, Type 1.
   b. CWP Rating: 200 psig (1380 kPa).
   c. Body Material: Bronze with integral seat and screw-in bonnet.
   d. Ends: Threaded or solder joint.
   e. Stem: Bronze.
   f. Disc: Solid wedge; bronze.
   g. Packing: Asbestos free.
   h. Handwheel: Malleable iron, bronze, or aluminum.

B. Bronze Gate Valves, RS, Class 125:

1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:

   a. American Valve, Inc.
   b. Apollo Flow Controls; Conbraco Industries, Inc.
   c. Crane; Crane Energy Flow Solutions.
   d. FNW; Ferguson Enterprises, Inc.
   e. Hammond Valve.
   f. Jenkins Valves; Crane Energy Flow Solutions.
   g. KITZ Corporation.
   h. Macomb Groups (The).

i. Milwaukee Valve Company.
j. NIBCO INC.
k. Powell Valves.
l. Stockham; Crane Energy Flow Solutions.
m. WATTS.

2. Description:

a. Standard: MSS SP-80, Type 2.
b. CWP Rating: 200 psig (1380 kPa).
c. Body Material: Bronze with integral seat and screw-in bonnet.
d. Ends: Threaded or solder joint.
e. Stem: Bronze.
f. Disc: Solid wedge; bronze.
g. Packing: Asbestos free.
h. Handwheel: Malleable iron, bronze, or aluminum.

## 2.3 IRON GATE VALVES

A. Iron Gate Valves, NRS, Class 125:

1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:

a. Apollo Flow Controls; Conbraco Industries, Inc.
b. Crane; Crane Energy Flow Solutions.
c. Flo Fab Inc.
d. Hammond Valve.
e. Jenkins Valves; Crane Energy Flow Solutions.
f. KITZ Corporation.
g. Legend Valve & Fitting, Inc.
h. Macomb Groups (The).
i. Milwaukee Valve Company.
j. NIBCO INC.
k. Powell Valves.
l. Red-White Valve Corp.
m. Stockham; Crane Energy Flow Solutions.
n. WATTS.
o. Zurn Industries, LLC.

2. Description:

a. Standard: MSS SP-70, Type I.
b. CWP Rating: 200 psig (1380 kPa).
c. Body Material: Gray iron with bolted bonnet.
d. Ends: Flanged.
e. Trim: Bronze.
f. Disc: Solid wedge.
g. Packing and Gasket: Asbestos free.

B. Iron Gate Valves, OS&Y, Class 125:

1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:

a. Apollo Flow Controls; Conbraco Industries, Inc.
b. Crane; Crane Energy Flow Solutions.
c. Flo Fab Inc.
d. FNW; Ferguson Enterprises, Inc.
e. Hammond Valve.
f. Jenkins Valves; Crane Energy Flow Solutions.
g. KITZ Corporation.
h. Legend Valve & Fitting, Inc.
i. Macomb Groups (The).
j. Milwaukee Valve Company.
k. NIBCO INC.
l. Powell Valves.
m. Red-White Valve Corp.
n. Stockham; Crane Energy Flow Solutions.
o. WATTS.

2. Description:

a. Standard: MSS SP-70, Type I.
b. CWP Rating: 200 psig (1380 kPa).
c. Body Material: Gray iron with bolted bonnet.
d. Ends: Flanged.
e. Trim: Bronze.
f. Disc: Solid wedge.
g. Packing and Gasket: Asbestos free.

## 2.4 CHAINWHEELS

A. Manufacturers: Subject to compliance with requirements, provide products by one of the following:

1. Babbitt Steam Specialty Co.
2. Roto Hammer Industries.
3. Trumbull Industries.

B. Description: Valve actuation assembly with sprocket rim, chain guides, chain, and attachment brackets for mounting chainwheels directly to hand wheels.

1. Sprocket Rim with Chain Guides: Ductile iron, of type and size required for valve. Include zinc or epoxy coating.
2. Chain: Hot-dip galvanized steel of size required to fit sprocket rim.

PART 3 - EXECUTION

3.1 VALVE INSTALLATION

A. Install valves with unions or flanges at each piece of equipment arranged to allow service, maintenance, and equipment removal without system shutdown.

B. Locate valves for easy access and provide separate support where necessary.

C. Install valves in horizontal piping with stem at or above center of pipe.

D. Install valves in position to allow full stem movement.

E. Install chainwheels on operators for gate valves NPS 4 (DN 100) and larger and more than 96 inches (2400 mm) above floor. Extend chains to 60 inches (1520 mm) above finished floor.

3.2 ADJUSTING

A. Adjust or replace valve packing after piping systems have been tested and put into service but before final adjusting and balancing. Replace valves if persistent leaking occurs.

3.3 GENERAL REQUIREMENTS FOR VALVE APPLICATIONS

A. Use gate valves for shutoff service only.

B. If valves with specified CWP ratings are unavailable, the same types of valves with higher CWP ratings may be substituted.

3.4 LOW-PRESSURE, COMPRESSED-AIR VALVE SCHEDULE (150 PSIG (1035 kPa) OR LESS)

A. Pipe NPS 2 (DN 50) and Smaller: Bronze gate valves, NRS, Class 125 with soldered ends.

B. Pipe NPS 2-1/2 (DN 65) and Larger: Iron gate valves, NRS, Class 125 with flanged ends.

3.5 HIGH-PRESSURE, COMPRESSED-AIR VALVE SCHEDULE (150 TO 200 PSIG (1035 TO 1380 kPa)

A. Pipe NPS 2 (DN 50) and Smaller: Bronze gate valves, NRS, Class 125 with soldered ends.

B. Pipe NPS 2-1/2 (DN 65) and Larger: Iron gate valves, NRS, Class 125 with flanged ends.

3.6 DOMESTIC HOT- AND COLD-WATER VALVE SCHEDULE

A. Pipe NPS 2 (DN 50) and Smaller: Bronze gate valves, NRS, Class 125 with soldered ends.

B. Pipe NPS 2-1/2 (DN 65) and Larger: Iron gate valves, NRS, Class 125 with flanged ends.

END OF SECTION 220523.15

# SECTION 220529 - HANGERS AND SUPPORTS FOR PLUMBING PIPING AND EQUIPMENT

## PART 1 - GENERAL

### 1.1 SUMMARY

A. Section Includes:

1. Metal pipe hangers and supports.
2. Trapeze pipe hangers.
3. Thermal-hanger shield inserts.
4. Fastener systems.
5. Pipe positioning systems.
6. Equipment supports.

### 1.2 PERFORMANCE REQUIREMENTS

A. Delegated Design: Design trapeze pipe hangers and equipment supports, including comprehensive engineering analysis by a qualified professional engineer, using performance requirements and design criteria indicated.

B. Structural Performance: Hangers and supports for plumbing piping and equipment shall withstand the effects of gravity loads and stresses within limits and under conditions indicated according to ASCE/SEI 7.

1. Design supports for multiple pipes capable of supporting combined weight of supported systems, system contents, and test water.
2. Design equipment supports capable of supporting combined operating weight of supported equipment and connected systems and components.
3. Design seismic-restraint hangers and supports for piping and equipment.

### 1.3 ACTION SUBMITTALS

A. Product Data: For each type of product indicated.

B. Shop Drawings: Show fabrication and installation details and include calculations for the following; include Product Data for components:

1. Trapeze pipe hangers.
2. Equipment supports.

C. Delegated-Design Submittal: For trapeze hangers indicated to comply with performance requirements and design criteria, including analysis data signed and sealed by the qualified professional engineer responsible for their preparation.

1.4 INFORMATIONAL SUBMITTALS

A. Welding certificates.

1.5 QUALITY ASSURANCE

A. Structural Steel Welding Qualifications: Qualify procedures and personnel according to AWS D1.1/D1.1M, "Structural Welding Code - Steel."

B. Pipe Welding Qualifications: Qualify procedures and operators according to ASME Boiler and Pressure Vessel Code.

PART 2 - PRODUCTS

2.1 METAL PIPE HANGERS AND SUPPORTS

A. Carbon-Steel Pipe Hangers and Supports:

1. Description: MSS SP-58, Types 1 through 58, factory-fabricated components.
2. Galvanized Metallic Coatings: Pregalvanized or hot dipped.
3. Nonmetallic Coatings: Plastic coating, jacket, or liner.
4. Padded Hangers: Hanger with fiberglass or other pipe insulation pad or cushion to support bearing surface of piping.
5. Hanger Rods: Continuous-thread rod, nuts, and washer made of carbon steel.

B. Stainless-Steel Pipe Hangers and Supports:

1. Description: MSS SP-58, Types 1 through 58, factory-fabricated components.
2. Padded Hangers: Hanger with fiberglass or other pipe insulation pad or cushion to support bearing surface of piping.
3. Hanger Rods: Continuous-thread rod, nuts, and washer made of stainless steel.

C. Copper Pipe Hangers:

1. Description: MSS SP-58, Types 1 through 58, copper-coated-steel, factory-fabricated components.
2. Hanger Rods: Continuous-thread rod, nuts, and washer made of copper-coated steel.

2.2 TRAPEZE PIPE HANGERS

A. Description: MSS SP-69, Type 59, shop- or field-fabricated pipe-support assembly made from structural carbon-steel shapes with MSS SP-58 carbon-steel hanger rods, nuts, saddles, and U-bolts.

2.3 THERMAL-HANGER SHIELD INSERTS

A. Insulation-Insert Material for Cold Piping: ASTM C 552, Type II cellular glass with 100-psig or ASTM C 591, Type VI, Grade 1 polyisocyanurate with 125-psig minimum compressive strength and vapor barrier.

B. Insulation-Insert Material for Hot Piping: ASTM C 552, Type II cellular glass with 100-psig or ASTM C 591, Type VI, Grade 1 polyisocyanurate with 125-psig minimum compressive strength.

C. For Trapeze or Clamped Systems: Insert and shield shall cover entire circumference of pipe.

D. For Clevis or Band Hangers: Insert and shield shall cover lower 180 degrees of pipe.

E. Insert Length: Extend 2 inches beyond sheet metal shield for piping operating below ambient air temperature.

2.4 FASTENER SYSTEMS

A. Powder-Actuated Fasteners: Threaded-steel stud, for use in hardened portland cement concrete with pull-out, tension, and shear capacities appropriate for supported loads and building materials where used.

B. Mechanical-Expansion Anchors: Insert-wedge-type, zinc-coated steel anchors, for use in hardened portland cement concrete; with pull-out, tension, and shear capacities appropriate for supported loads and building materials where used.

2.5 PIPE POSITIONING SYSTEMS

A. Description: IAPMO PS 42, positioning system of metal brackets, clips, and straps for positioning piping in pipe spaces; for plumbing fixtures in commercial applications.

2.6 EQUIPMENT SUPPORTS

A. Description: Welded, shop- or field-fabricated equipment support made from structural carbon-steel shapes.

2.7 MISCELLANEOUS MATERIALS

A. Structural Steel: ASTM A 36/A 36M, carbon-steel plates, shapes, and bars; black and galvanized.

B. Grout: ASTM C 1107, factory-mixed and -packaged, dry, hydraulic-cement, nonshrink and nonmetallic grout; suitable for interior and exterior applications.

1. Properties: Nonstaining, noncorrosive, and nongaseous.

2. Design Mix: 5000-psi, 28-day compressive strength.

PART 3 - EXECUTION

3.1 HANGER AND SUPPORT INSTALLATION

A. Metal Pipe-Hanger Installation: Comply with MSS SP-69 and MSS SP-89. Install hangers, supports, clamps, and attachments as required to properly support piping from the building structure.

B. Metal Trapeze Pipe-Hanger Installation: Comply with MSS SP-69 and MSS SP-89. Arrange for grouping of parallel runs of horizontal piping, and support together on field-fabricated trapeze pipe hangers.

1. Pipes of Various Sizes: Support together and space trapezes for smallest pipe size or install intermediate supports for smaller diameter pipes as specified for individual pipe hangers.
2. Field fabricate from ASTM A 36/A 36M, carbon-steel shapes selected for loads being supported. Weld steel according to AWS D1.1/D1.1M.

C. Thermal-Hanger Shield Installation: Install in pipe hanger or shield for insulated piping.

D. Fastener System Installation:

1. Install powder-actuated fasteners for use in lightweight concrete or concrete slabs less than 4 inches thick in concrete after concrete is placed and completely cured. Use operators that are licensed by powder-actuated tool manufacturer. Install fasteners according to powder-actuated tool manufacturer's operating manual.
2. Install mechanical-expansion anchors in concrete after concrete is placed and completely cured. Install fasteners according to manufacturer's written instructions.

E. Pipe Positioning-System Installation: Install support devices to make rigid supply and waste piping connections to each plumbing fixture.

F. Install hangers and supports complete with necessary attachments, inserts, bolts, rods, nuts, washers, and other accessories.

G. Equipment Support Installation: Fabricate from welded-structural-steel shapes.

H. Install hangers and supports to allow controlled thermal and seismic movement of piping systems, to permit freedom of movement between pipe anchors, and to facilitate action of expansion joints, expansion loops, expansion bends, and similar units.

I. Install lateral bracing with pipe hangers and supports to prevent swaying.

J. Install building attachments within concrete slabs or attach to structural steel. Install additional attachments at concentrated loads, including valves, flanges, and strainers, NPS 2-1/2 and larger and at changes in direction of piping. Install concrete inserts before concrete is placed; fasten inserts to forms and install reinforcing bars through openings at top of inserts.

K. Load Distribution: Install hangers and supports so that piping live and dead loads and stresses from movement will not be transmitted to connected equipment.

L. Pipe Slopes: Install hangers and supports to provide indicated pipe slopes and to not exceed maximum pipe deflections allowed by ASME B31.9 for building services piping.

M. Insulated Piping:

1. Attach clamps and spacers to piping.

    a. Piping Operating above Ambient Air Temperature: Clamp may project through insulation.
    b. Piping Operating below Ambient Air Temperature: Use thermal-hanger shield insert with clamp sized to match OD of insert.
    c. Do not exceed pipe stress limits allowed by ASME B31.9 for building services piping.

2. Install MSS SP-58, Type 39, protection saddles if insulation without vapor barrier is indicated. Fill interior voids with insulation that matches adjoining insulation.

    a. Option: Thermal-hanger shield inserts may be used. Include steel weight-distribution plate for pipe NPS 4 and larger if pipe is installed on rollers.

3. Install MSS SP-58, Type 40, protective shields on cold piping with vapor barrier. Shields shall span an arc of 180 degrees.

    a. Option: Thermal-hanger shield inserts may be used. Include steel weight-distribution plate for pipe NPS 4 and larger if pipe is installed on rollers.

4. Shield Dimensions for Pipe: Not less than the following:

    a. NPS 1/4 to NPS 3-1/2: 12 inches long and 0.048 inch thick.
    b. NPS 4: 12 inches long and 0.06 inch thick.
    c. NPS 5 and NPS 6: 18 inches long and 0.06 inch thick.
    d. NPS 8 to NPS 14: 24 inches long and 0.075 inch thick.
    e. NPS 16 to NPS 24: 24 inches long and 0.105 inch thick.

5. Pipes NPS 8 and Larger: Include wood or reinforced calcium-silicate-insulation inserts of length at least as long as protective shield.
6. Thermal-Hanger Shields: Install with insulation same thickness as piping insulation.

3.2 EQUIPMENT SUPPORTS

A. Fabricate structural-steel stands to suspend equipment from structure overhead or to support equipment above floor.

B. Grouting: Place grout under supports for equipment and make bearing surface smooth.

C. Provide lateral bracing, to prevent swaying, for equipment supports.

3.3 METAL FABRICATIONS

A. Cut, drill, and fit miscellaneous metal fabrications for trapeze pipe hangers and equipment supports.

B. Fit exposed connections together to form hairline joints. Field weld connections that cannot be shop welded because of shipping size limitations.

C. Field Welding: Comply with AWS D1.1/D1.1M procedures for shielded, metal arc welding; appearance and quality of welds; and methods used in correcting welding work; and with the following:

1. Use materials and methods that minimize distortion and develop strength and corrosion resistance of base metals.
2. Obtain fusion without undercut or overlap.
3. Remove welding flux immediately.
4. Finish welds at exposed connections so no roughness shows after finishing and so contours of welded surfaces match adjacent contours.

3.4 ADJUSTING

A. Hanger Adjustments: Adjust hangers to distribute loads equally on attachments and to achieve indicated slope of pipe.

B. Trim excess length of continuous-thread hanger and support rods to 1-1/2 inches.

3.5 PAINTING

A. Touchup: Clean field welds and abraded areas of shop paint. Paint exposed areas immediately after erecting hangers and supports. Use same materials as used for shop painting. Comply with SSPC-PA 1 requirements for touching up field-painted surfaces.

1. Apply paint by brush or spray to provide a minimum dry film thickness of 2.0 mils.

B. Touchup: Cleaning and touchup painting of field welds, bolted connections, and abraded areas of shop paint on miscellaneous metal are specified in Section 099113 "Exterior Painting."

C. Galvanized Surfaces: Clean welds, bolted connections, and abraded areas and apply galvanizing-repair paint to comply with ASTM A 780.

3.6 HANGER AND SUPPORT SCHEDULE

A. Specific hanger and support requirements are in Sections specifying piping systems and equipment.

B. Comply with MSS SP-69 for pipe-hanger selections and applications that are not specified in piping system Sections.

C. Use hangers and supports with galvanized metallic coatings for piping and equipment that will not have field-applied finish.

D. Use nonmetallic coatings on attachments for electrolytic protection where attachments are in direct contact with copper tubing.

E. Use carbon-steel pipe hangers and supports and metal trapeze pipe hangers and attachments for general service applications.

F. Use stainless-steel pipe hangers and stainless-steel or corrosion-resistant attachments for hostile environment applications.

G. Use copper-plated pipe hangers and copper or stainless-steel attachments for copper piping and tubing.

H. Use padded hangers for piping that is subject to scratching.

I. Use thermal-hanger shield inserts for insulated piping and tubing.

J. Horizontal-Piping Hangers and Supports: Unless otherwise indicated and except as specified in piping system Sections, install the following types:

1. Adjustable, Steel Clevis Hangers (MSS Type 1): For suspension of noninsulated or insulated, stationary pipes NPS 1/2 to NPS 30.
2. Yoke-Type Pipe Clamps (MSS Type 2): For suspension of up to 1050 deg F, pipes NPS 4 to NPS 24, requiring up to 4 inches of insulation.
3. Carbon- or Alloy-Steel, Double-Bolt Pipe Clamps (MSS Type 3): For suspension of pipes NPS 3/4 to NPS 36, requiring clamp flexibility and up to 4 inches of insulation.
4. Adjustable, Steel Band Hangers (MSS Type 7): For suspension of noninsulated, stationary pipes NPS 1/2 to NPS 8.
5. U-Bolts (MSS Type 24): For support of heavy pipes NPS 1/2 to NPS 30.
6. Pipe Saddle Supports (MSS Type 36): For support of pipes NPS 4 to NPS 36, with steel-pipe base stanchion support and cast-iron floor flange or carbon-steel plate.
7. Pipe Stanchion Saddles (MSS Type 37): For support of pipes NPS 4 to NPS 36, with steel-pipe base stanchion support and cast-iron floor flange or carbon-steel plate, and with U-bolt to retain pipe.

8. Single-Pipe Rolls (MSS Type 41): For suspension of pipes NPS 1 to NPS 30, from two rods if longitudinal movement caused by expansion and contraction might occur.
9. Complete Pipe Rolls (MSS Type 44): For support of pipes NPS 2 to NPS 42 if longitudinal movement caused by expansion and contraction might occur but vertical adjustment is not necessary.

K. Vertical-Piping Clamps: Unless otherwise indicated and except as specified in piping system Sections, install the following types:

1. Extension Pipe or Riser Clamps (MSS Type 8): For support of pipe risers NPS 3/4 to NPS 24.
2. Carbon- or Alloy-Steel Riser Clamps (MSS Type 42): For support of pipe risers NPS 3/4 to NPS 24 if longer ends are required for riser clamps.

L. Hanger-Rod Attachments: Unless otherwise indicated and except as specified in piping system Sections, install the following types:

1. Steel Turnbuckles (MSS Type 13): For adjustment up to 6 inches for heavy loads.
2. Steel Clevises (MSS Type 14): For 120 to 450 deg F piping installations.

M. Building Attachments: Unless otherwise indicated and except as specified in piping system Sections, install the following types:

1. Steel or Malleable Concrete Inserts (MSS Type 18): For upper attachment to suspend pipe hangers from concrete ceiling.
2. Top-Beam C-Clamps (MSS Type 19): For use under roof installations with bar-joist construction, to attach to top flange of structural shape.
3. Side-Beam or Channel Clamps (MSS Type 20): For attaching to bottom flange of beams, channels, or angles.
4. Center-Beam Clamps (MSS Type 21): For attaching to center of bottom flange of beams.
5. Welded Beam Attachments (MSS Type 22): For attaching to bottom of beams if loads are considerable and rod sizes are large.
6. C-Clamps (MSS Type 23): For structural shapes.
7. Welded-Steel Brackets: For support of pipes from below, or for suspending from above by using clip and rod. Use one of the following for indicated loads:

    a. Light (MSS Type 31): 750 lb.
    b. Medium (MSS Type 32): 1500 lb.
    c. Heavy (MSS Type 33): 3000 lb.

8. Side-Beam Brackets (MSS Type 34): For sides of steel or wooden beams.
9. Plate Lugs (MSS Type 57): For attaching to steel beams if flexibility at beam is required.

N. Saddles and Shields: Unless otherwise indicated and except as specified in piping system Sections, install the following types:

1. Steel-Pipe-Covering Protection Saddles (MSS Type 39): To fill interior voids with insulation that matches adjoining insulation.

2. Protection Shields (MSS Type 40): Of length recommended in writing by manufacturer to prevent crushing insulation.
3. Thermal-Hanger Shield Inserts: For supporting insulated pipe.

O. Spring Hangers and Supports: Unless otherwise indicated and except as specified in piping system Sections, install the following types:

1. Spring Cushions (MSS Type 48): For light loads if vertical movement does not exceed 1-1/4 inches.
2. Spring-Cushion Roll Hangers (MSS Type 49): For equipping Type 41, roll hanger with springs.
3. Variable-Spring Base Supports (MSS Type 52): Preset to indicated load and limit variability factor to 25 percent to allow expansion and contraction of piping system from base support.

P. Comply with MSS SP-69 for trapeze pipe-hanger selections and applications that are not specified in piping system Sections.

Q. Use powder-actuated fasteners or mechanical-expansion anchors instead of building attachments where required in concrete construction.

R. Use pipe positioning systems in pipe spaces behind plumbing fixtures to support supply and waste piping for plumbing fixtures.

END OF SECTION 220529

# SECTION 220548.13 - VIBRATION CONTROLS FOR PLUMBING PIPING AND EQUIPMENT

## PART 1 - GENERAL

### 1.1 SUMMARY

A. Section Includes:

1. Elastomeric isolation pads.
2. Elastomeric isolation mounts.
3. Restrained elastomeric isolation mounts.
4. Open-spring isolators.
5. Housed-spring isolators.
6. Restrained-spring isolators.
7. Housed-restrained-spring isolators.
8. Pipe-riser resilient supports.
9. Resilient pipe guides.
10. Elastomeric hangers.
11. Spring hangers.

### 1.2 ACTION SUBMITTALS

A. Product Data: For each type of product.

B. Delegated-Design Submittal: For each vibration isolation device.

1. Include design calculations for selecting vibration isolators.

## PART 2 - PRODUCTS

### 2.1 ELASTOMERIC ISOLATION PADS

A. Elastomeric Isolation Pads: .

1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:

a. Ace Mountings Co., Inc.
b. California Dynamics Corporation.
c. Isolation Technology, Inc.
d. Kinetics Noise Control, Inc.
e. Mason Industries, Inc.
f. Novia; A Division of C&P.
g. Vibration Eliminator Co., Inc.
h. Vibration Isolation.

i. Vibration Mountings & Controls, Inc.

2. Fabrication: Single or multiple layers of sufficient durometer stiffness for uniform loading over pad area.
3. Size: Factory or field cut to match requirements of supported equipment.
4. Pad Material: Oil and water resistant with elastomeric properties.
5. Surface Pattern: Smooth pattern.
6. Infused nonwoven cotton or synthetic fibers.
7. Load-bearing metal plates adhered to pads.

## 2.2 ELASTOMERIC ISOLATION MOUNTS

A. Double-Deflection, Elastomeric Isolation Mounts: .

1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:

a. Ace Mountings Co., Inc.
b. California Dynamics Corporation.
c. Isolation Technology, Inc.
d. Kinetics Noise Control, Inc.
e. Mason Industries, Inc.
f. Novia; A Division of C&P.
g. Vibration Eliminator Co., Inc.
h. Vibration Isolation.
i. Vibration Mountings & Controls, Inc.

2. Mounting Plates:

a. Top Plate: Encapsulated steel load transfer top plates, factory drilled and threaded with threaded studs or bolts.
b. Baseplate: Encapsulated steel bottom plates with holes provided for anchoring to support structure.

3. Elastomeric Material: Molded, oil-resistant rubber, neoprene, or other elastomeric material.

## 2.3 RESTRAINED ELASTOMERIC ISOLATION MOUNTS

A. Restrained Elastomeric Isolation Mounts: .

1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:

a. Ace Mountings Co., Inc.
b. California Dynamics Corporation.
c. Isolation Technology, Inc.
d. Kinetics Noise Control, Inc.

e. Mason Industries, Inc.
f. Novia; A Division of C&P.
g. Vibration Eliminator Co., Inc.
h. Vibration Isolation.
i. Vibration Mountings & Controls, Inc.

2. Description: All-directional isolator with restraints containing two separate and opposing elastomeric elements that prevent central threaded element and attachment hardware from contacting the housing during normal operation.

a. Housing: Cast-ductile iron or welded steel.
b. Elastomeric Material: Molded, oil-resistant rubber, neoprene, or other elastomeric material.

## 2.4 OPEN-SPRING ISOLATORS

A. Freestanding, Laterally Stable, Open-Spring Isolators: .

1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:

a. Ace Mountings Co., Inc.
b. California Dynamics Corporation.
c. Isolation Technology, Inc.
d. Kinetics Noise Control, Inc.
e. Mason Industries, Inc.
f. Novia; A Division of C&P.
g. Vibration Eliminator Co., Inc.
h. Vibration Isolation.
i. Vibration Mountings & Controls, Inc.

2. Outside Spring Diameter: Not less than 80 percent of the compressed height of the spring at rated load.
3. Minimum Additional Travel: 50 percent of the required deflection at rated load.
4. Lateral Stiffness: More than 80 percent of rated vertical stiffness.
5. Overload Capacity: Support 200 percent of rated load, fully compressed, without deformation or failure.
6. Baseplates: Factory-drilled steel plate for bolting to structure with an elastomeric isolator pad attached to the underside. Baseplates shall limit floor load to 500 psig (3447 kPa).
7. Top Plate and Adjustment Bolt: Threaded top plate with adjustment bolt and cap screw to fasten and level equipment.

## 2.5 HOUSED-SPRING ISOLATORS

A. Freestanding, Laterally Stable, Open-Spring Isolators in Two-Part Telescoping Housing: .

1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:

a. Ace Mountings Co., Inc.
b. California Dynamics Corporation.
c. Isolation Technology, Inc.
d. Kinetics Noise Control, Inc.
e. Mason Industries, Inc.
f. Vibration Eliminator Co., Inc.
g. Vibration Isolation.
h. Vibration Mountings & Controls, Inc.

2. Outside Spring Diameter: Not less than 80 percent of the compressed height of the spring at rated load.
3. Minimum Additional Travel: 50 percent of the required deflection at rated load.
4. Lateral Stiffness: More than 80 percent of rated vertical stiffness.
5. Overload Capacity: Support 200 percent of rated load, fully compressed, without deformation or failure.
6. Two-Part Telescoping Housing: A steel top and bottom frame separated by an elastomeric material and enclosing the spring isolators.

a. Drilled base housing for bolting to structure with an elastomeric isolator pad attached to the underside. Bases shall limit floor load to 500 psig (3447 kPa).
b. Top housing with attachment and leveling bolt.

## 2.6 RESTRAINED-SPRING ISOLATORS

A. Freestanding, Laterally Stable, Open-Spring Isolators with Vertical-Limit Stop Restraint: .

1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:

a. Ace Mountings Co., Inc.
b. California Dynamics Corporation.
c. Isolation Technology, Inc.
d. Kinetics Noise Control, Inc.
e. Mason Industries, Inc.
f. Novia; A Division of C&P.
g. Vibration Eliminator Co., Inc.
h. Vibration Isolation.
i. Vibration Mountings & Controls, Inc.

2. Housing: Steel housing with vertical-limit stops to prevent spring extension due to weight being removed.

a. Base with holes for bolting to structure with an elastomeric isolator pad attached to the underside. Bases shall limit floor load to 500 psig (3447 kPa).
b. Top plate with threaded mounting holes.
c. Internal leveling bolt that acts as blocking during installation.

3. Restraint: Limit stop as required for equipment and authorities having jurisdiction.

4. Outside Spring Diameter: Not less than 80 percent of the compressed height of the spring at rated load.
5. Minimum Additional Travel: 50 percent of the required deflection at rated load.
6. Lateral Stiffness: More than 80 percent of rated vertical stiffness.
7. Overload Capacity: Support 200 percent of rated load, fully compressed, without deformation or failure.

## 2.7 HOUSED-RESTRAINED-SPRING ISOLATORS

A. Freestanding, Steel, Open-Spring Isolators with Vertical-Limit Stop Restraint in Two-Part Telescoping Housing: .

1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:

   a. Ace Mountings Co., Inc.
   b. California Dynamics Corporation.
   c. Isolation Technology, Inc.
   d. Kinetics Noise Control, Inc.
   e. Mason Industries, Inc.
   f. Vibration Eliminator Co., Inc.
   g. Vibration Isolation.
   h. Vibration Mountings & Controls, Inc.

2. Two-Part Telescoping Housing: A steel top and bottom frame separated by an elastomeric material and enclosing the spring isolators. Housings are equipped with adjustable snubbers to limit vertical movement.

   a. Drilled base housing for bolting to structure with an elastomeric isolator pad attached to the underside. Bases shall limit floor load to 500 psig (3447 kPa).
   b. Threaded top housing with adjustment bolt and cap screw to fasten and level equipment.

3. Outside Spring Diameter: Not less than 80 percent of the compressed height of the spring at rated load.
4. Minimum Additional Travel: 50 percent of the required deflection at rated load.
5. Lateral Stiffness: More than 80 percent of rated vertical stiffness.
6. Overload Capacity: Support 200 percent of rated load, fully compressed, without deformation or failure.

## 2.8 PIPE-RISER RESILIENT SUPPORT

A. Description: All-directional, acoustical pipe anchor consisting of two steel tubes separated by a minimum 1/2-inch- (13-mm-) thick neoprene.

1. Vertical-Limit Stops: Steel and neoprene vertical-limit stops arranged to prevent vertical travel in both directions.

2. Maximum Load Per Support: 500 psig (3.45 MPa)on isolation material providing equal isolation in all directions.

## 2.9 RESILIENT PIPE GUIDES

A. Description: Telescopic arrangement of two steel tubes or post and sleeve arrangement separated by a minimum 1/2-inch- (13-mm-) thick neoprene.

1. Factory-Set Height Guide with Shear Pin: Shear pin shall be removable and reinsertable to allow for selection of pipe movement. Guides shall be capable of motion to meet location requirements.

## 2.10 ELASTOMERIC HANGERS

A. Elastomeric Mount in a Steel Frame with Upper and Lower Steel Hanger Rods: .

1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:

a. Ace Mountings Co., Inc.
b. California Dynamics Corporation.
c. Isolation Technology, Inc.
d. Kinetics Noise Control, Inc.
e. Mason Industries, Inc.
f. Novia; A Division of C&P.
g. Vibration Eliminator Co., Inc.
h. Vibration Mountings & Controls, Inc.

2. Frame: Steel, fabricated with a connection for an upper threaded hanger rod and an opening on the underside to allow for a maximum of 30 degrees of angular lower hanger-rod misalignment without binding or reducing isolation efficiency.
3. Dampening Element: Molded, oil-resistant rubber, neoprene, or other elastomeric material with a projecting bushing for the underside opening preventing steel to steel contact.

## 2.11 SPRING HANGERS

A. Combination Coil-Spring and Elastomeric-Insert Hanger with Spring and Insert in Compression: .

1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:

a. Ace Mountings Co., Inc.
b. California Dynamics Corporation.
c. Kinetics Noise Control, Inc.
d. Mason Industries, Inc.

e. Novia; A Division of C&P.
f. Vibration Eliminator Co., Inc.
g. Vibration Isolation.
h. Vibration Mountings & Controls, Inc.

2. Frame: Steel, fabricated for connection to threaded hanger rods and to allow for a maximum of 30 degrees of angular hanger-rod misalignment without binding or reducing isolation efficiency.
3. Outside Spring Diameter: Not less than 80 percent of the compressed height of the spring at rated load.
4. Minimum Additional Travel: 50 percent of the required deflection at rated load.
5. Lateral Stiffness: More than 80 percent of rated vertical stiffness.
6. Overload Capacity: Support 200 percent of rated load, fully compressed, without deformation or failure.
7. Elastomeric Element: Molded, oil-resistant rubber or neoprene. Steel-washer-reinforced cup to support spring and bushing projecting through bottom of frame.
8. Adjustable Vertical Stop: Steel washer with neoprene washer "up-stop" on lower threaded rod.
9. Self-centering hanger rod cap to ensure concentricity between hanger rod and support spring coil.

## PART 3 - EXECUTION

### 3.1 VIBRATION CONTROL DEVICE INSTALLATION

A. Coordinate the location of embedded connection hardware with supported equipment attachment and mounting points and with requirements for concrete reinforcement and formwork specified in Section 033000 "Cast-in-Place Concrete."

B. Installation of vibration isolators must not cause any change of position of equipment, piping, or ductwork resulting in stresses or misalignment.

END OF SECTION 220548.13

# SECTION 220553 - IDENTIFICATION FOR PLUMBING PIPING AND EQUIPMENT

## PART 1 - GENERAL

### 1.1 SUMMARY

A. Section Includes:

1. Equipment labels.
2. Warning signs and labels.
3. Pipe labels.

### 1.2 ACTION SUBMITTALS

A. Product Data: For each type of product indicated.

## PART 2 - PRODUCTS

### 2.1 EQUIPMENT LABELS

A. Metal Labels for Equipment:

1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:

   a. Brady Corporation.
   b. Brimar Industries, Inc.
   c. Carlton Industries, LP.
   d. Champion America.
   e. Craftmark Pipe Markers.
   f. emedco.
   g. Kolbi Pipe Marker Co.
   h. LEM Products Inc.
   i. Marking Services, Inc.
   j. Seton Identification Products.

2. Material and Thickness: Brass, 0.032-inch (0.8-mm) stainless steel, 0.025-inch (0.64-mm) aluminum, 0.032-inch (0.8-mm) or anodized aluminum, 0.032-inch (0.8-mm) minimum thickness, and having predrilled or stamped holes for attachment hardware.
3. Letter Color: Black.
4. Background Color: White.
5. Minimum Label Size: Length and width vary for required label content, but not less than 2-1/2 by 3/4 inch (64 by 19 mm).
6. Minimum Letter Size: 1/4 inch (6.4 mm) for name of units if viewing distance is less than 24 inches (600 mm), 1/2 inch (13 mm) for viewing distances up to 72 inches (1830 mm),

and proportionately larger lettering for greater viewing distances. Include secondary lettering two-thirds to three-quarters the size of principal lettering.

7. Fasteners: Stainless-steel rivets or self-tapping screws.
8. Adhesive: Contact-type permanent adhesive, compatible with label and with substrate.

B. Plastic Labels for Equipment:

1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:

   a. Brady Corporation.
   b. Brimar Industries, Inc.
   c. Carlton Industries, LP.
   d. Champion America.
   e. Craftmark Pipe Markers.
   f. emedco.
   g. Kolbi Pipe Marker Co.
   h. LEM Products Inc.
   i. Marking Services, Inc.
   j. Seton Identification Products.

2. Material and Thickness: Multilayer, multicolor, plastic labels for mechanical engraving, 1/16 inch (1.6 mm) thick, and having predrilled holes for attachment hardware.
3. Letter Color: Black.
4. Background Color: White.
5. Maximum Temperature: Able to withstand temperatures up to 160 deg F (71 deg C).
6. Minimum Label Size: Length and width vary for required label content, but not less than 2-1/2 by 3/4 inch (64 by 19 mm).
7. Minimum Letter Size: 1/4 inch (6.4 mm) for name of units if viewing distance is less than 24 inches (600 mm), 1/2 inch (13 mm) for viewing distances up to 72 inches (1830 mm), and proportionately larger lettering for greater viewing distances. Include secondary lettering two-thirds to three-quarters the size of principal lettering.
8. Fasteners: Stainless-steel rivets or self-tapping screws.
9. Adhesive: Contact-type permanent adhesive, compatible with label and with substrate.

C. Label Content: Include equipment's Drawing designation or unique equipment number, Drawing numbers where equipment is indicated (plans, details, and schedules), and the Specification Section number and title where equipment is specified.

D. Equipment Label Schedule: For each item of equipment to be labeled, on 8-1/2-by-11-inch (A4) bond paper. Tabulate equipment identification number, and identify Drawing numbers where equipment is indicated (plans, details, and schedules) and the Specification Section number and title where equipment is specified. Equipment schedule shall be included in operation and maintenance data.

## 2.2 WARNING SIGNS AND LABELS

A. Manufacturers: Subject to compliance with requirements, provide products by one of the following:

1. Brady Corporation.
2. Brimar Industries, Inc.
3. Carlton Industries, LP.
4. Champion America.
5. Craftmark Pipe Markers.
6. emedco.
7. LEM Products Inc.
8. Marking Sevices Inc.
9. National Marker Company.
10. Seton Identification Products.
11. Stranco, Inc.

B. Material and Thickness: Multilayer, multicolor, plastic labels for mechanical engraving, 1/16 inch (1.6 mm) thick, and having predrilled holes for attachment hardware.

C. Letter Color: White.

D. Background Color: Red.

E. Maximum Temperature: Able to withstand temperatures up to 160 deg F (71 deg C).

F. Minimum Label Size: Length and width vary for required label content, but not less than 2-1/2 by 3/4 inch (64 by 19 mm).

G. Minimum Letter Size: 1/4 inch (6.4 mm) for name of units if viewing distance is less than 24 inches (600 mm), 1/2 inch (13 mm) for viewing distances up to 72 inches (1830 mm), and proportionately larger lettering for greater viewing distances. Include secondary lettering two-thirds to three-quarters the size of principal lettering.

H. Fasteners: Stainless-steel rivets or self-tapping screws.

I. Adhesive: Contact-type permanent adhesive, compatible with label and with substrate.

J. Label Content: Include caution and warning information plus emergency notification instructions.

## 2.3 PIPE LABELS

A. Manufacturers: Subject to compliance with requirements, provide products by one of the following:

1. Actioncraft Products, Inc.; a division of Industrial Test Equipment Co., Inc.
2. Brady Corporation.
3. Brimar Industries, Inc.
4. Carlton Industries, LP.
5. Champion America.
6. Craftmark Pipe Markers.
7. emedco.
8. Kolbi Pipe Marker Co.

9. LEM Products Inc.
10. Marking Sevices Inc.
11. Seton Identification Products.

B. General Requirements for Manufactured Pipe Labels: Preprinted, color-coded, with lettering indicating service, and showing flow direction.

C. Pretensioned Pipe Labels: Precoiled, semirigid plastic formed to cover full circumference of pipe and to attach to pipe without fasteners or adhesive.

D. Self-Adhesive Pipe Labels: Printed plastic with contact-type, permanent-adhesive backing.

E. Pipe Label Contents: Include identification of piping service using same designations or abbreviations as used on Drawings; also include pipe size and an arrow indicating flow direction.

1. Flow-Direction Arrows: Integral with piping-system service lettering to accommodate both directions or as separate unit on each pipe label to indicate flow direction.
2. Lettering Size: Size letters according to ASME A13.1 for piping.

## PART 3 - EXECUTION

### 3.1 EQUIPMENT LABEL INSTALLATION

A. Install or permanently fasten labels on each major item of mechanical equipment.

B. Locate equipment labels where accessible and visible.

### 3.2 PIPE LABEL INSTALLATION

A. Piping Color Coding: Painting of piping is specified in Section 099123 "Interior Painting."

B. Pipe Label Locations: Locate pipe labels where piping is exposed or above accessible ceilings in finished spaces; machine rooms; accessible maintenance spaces such as shafts, tunnels, and plenums; and exterior exposed locations as follows:

1. Near each valve and control device.
2. Near each branch connection, excluding short takeoffs for fixtures and terminal units. Where flow pattern is not obvious, mark each pipe at branch.
3. Near penetrations and on both sides of through walls, floors, ceilings, and inaccessible enclosures.
4. At access doors, manholes, and similar access points that permit view of concealed piping.
5. Near major equipment items and other points of origination and termination.
6. Spaced at maximum intervals of 50 feet (15 m) along each run. Reduce intervals to 25 feet (7.6 m) in areas of congested piping and equipment.
7. On piping above removable acoustical ceilings. Omit intermediately spaced labels.

C. Pipe Label Color Schedule:

1. Low-Pressure Compressed Air Piping:

   a. Background: Safety blue.
   b. Letter Colors: White.

2. High-Pressure Compressed Air Piping:

   a. Background: Safety blue.
   b. Letter Colors: White.

3. Domestic Water Piping

   a. Background: Safety green.
   b. Letter Colors: White.

4. Sanitary Waste and Storm Drainage Piping:

   a. Background Color: Safety purple.
   b. Letter Color: White.

END OF SECTION 220553

# SECTION 220593 - TESTING, ADJUSTING, AND BALANCING FOR PLUMBING

## PART 1 - GENERAL

### 1.1 SUMMARY

A. Section Includes:

1. TAB of domestic water system.
2. TAB of plumbing equipment:

    a. Domestic hot-water in-line circulation pumps.

3. Pipe-leakage test verification.
4. Testing, adjusting, and balancing of existing plumbing systems and equipment.

### 1.2 DEFINITIONS

A. AABC: Associated Air Balance Council.

B. NEBB: National Environmental Balancing Bureau.

C. TAB: Testing, adjusting, and balancing.

D. TABB: Testing, Adjusting, and Balancing Bureau.

E. TAB Specialist: An independent entity meeting qualifications to perform TAB work.

F. TDH: Total dynamic head.

### 1.3 INFORMATIONAL SUBMITTALS

A. Qualification Data: Within 30 days of Contractor's Notice to Proceed, submit documentation that the TAB specialist and this Project's TAB team members meet the qualifications specified in "Quality Assurance" Article.

B. Contract Documents Examination Report: Within 30 days of Contractor's Notice to Proceed, submit the Contract Documents review report, as specified in Part 3.

C. Strategies and Procedures Plan: Within 30 days of Contractor's Notice to Proceed, submit TAB strategies and step-by-step procedures, as specified in "Preparation" Article.

D. System Readiness Checklists: Within 30 days of Contractor's Notice to Proceed, submit system readiness checklists, as specified in "Preparation" Article.



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E. Examination Report: Submit a summary report of the examination review required in "Examination" Article.

F. Certified TAB reports.

G. Sample report forms.

H. Instrument calibration reports, to include the following:

1. Instrument type and make.
2. Serial number.
3. Application.
4. Dates of use.
5. Dates of calibration.

## 1.4 QUALITY ASSURANCE

A. TAB Specialists Qualifications, Certified by AABC:

1. TAB Field Supervisor: Employee of the TAB specialist and certified by AABC.
2. TAB Technician: Employee of the TAB specialist and certified by AABC.

B. TAB Specialists Qualifications, Certified by NEBB or TABB:

1. TAB Field Supervisor: Employee of the TAB specialist and certified by NEBB or TABB.
2. TAB Technician: Employee of the TAB specialist and certified by NEBB or TABB.

C. Instrumentation Type, Quantity, Accuracy, and Calibration: Comply with requirements in ASHRAE 111, Section 4, "Instrumentation."

D. ASHRAE 111 Compliance: Requirements in ASHRAE 111 applicable to analogous domestic water system and plumbing equipment balancing.

E. ASHRAE 188 Compliance: Comply with balancing and report requirements, Section 8.3 "Balancing."

F. Code and Authorities Having Jurisdiction Compliance: TAB is required to comply with governing codes and requirements of authorities having jurisdiction.

## 1.5 FIELD CONDITIONS

A. Full Owner Occupancy: Owner will occupy the site and existing building during entire TAB period. Cooperate with Owner during TAB operations to minimize conflicts with Owner's operations.

B. Partial Owner Occupancy: Owner may occupy completed areas of building before Substantial Completion. Cooperate with Owner during TAB operations to minimize conflicts with Owner's operations.



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PART 2 - PRODUCTS (Not Applicable)

PART 3 - EXECUTION

3.1 EXAMINATION

A. Examine the Contract Documents to become familiar with Project requirements and to discover conditions in systems designs that may preclude proper TAB of systems and equipment.

B. Examine installed systems for balancing devices, such as test ports, gauge cocks, thermometer wells, flow-control devices, and balancing valves and fittings. Verify that locations of these balancing devices are applicable for intended purpose and are accessible.

C. Examine approved submittals for plumbing systems and equipment.

D. Examine design data, including plumbing system descriptions, statements of design assumptions for environmental conditions and systems output, and statements of philosophies and assumptions about plumbing system and equipment controls.

E. Examine equipment performance data, including pump curves.

1. Relate performance data to Project conditions and requirements, including pump system effects that can create undesired or unpredicted conditions that cause reduced capacities in all or part of a system.
2. Calculate pump system-effect factors to reduce performance ratings of plumbing equipment when installed under conditions different from the conditions used to rate equipment performance. Compare results with the design data and installed conditions.

F. Examine system and equipment installations, and verify that field quality-control testing, cleaning, and adjusting specified in individual Sections have been performed.

G. Examine test reports specified in individual system and equipment Sections.

H. Examine plumbing equipment and verify that bearings are greased, belts are aligned and tight, filters are clean, and equipment with functioning controls is ready for operation.

I. Examine temporary and permanent strainers. Verify that temporary strainer screens used during system cleaning and flushing have been removed and permanent strainers are installed and clean.

J. Examine control valves for proper installation for their intended function of isolating, throttling, diverting, or mixing fluid flows.

K. Examine system pumps to ensure absence of entrained air in the suction piping.

L. Examine operating safety interlocks and controls on plumbing equipment.



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M. Report deficiencies discovered before and during performance of TAB procedures. Observe and record system reactions to changes in conditions. Record default set points if different from indicated values.

## 3.2 PREPARATION

A. Prepare a TAB plan that includes the following:

1. Equipment and systems to be tested.
2. Strategies and step-by-step procedures for balancing the systems.
3. Instrumentation to be used.
4. Sample forms with specific identification for all equipment.

B. Perform system-readiness checks of plumbing systems and equipment to verify system readiness for TAB work. Include, at a minimum, the following:

1. Domestic Water System:

a. Verify leakage and pressure tests on water distribution systems have been satisfactorily completed in accordance with applicable code and authority having jurisdiction.
b. Water heaters are installed and functioning.
c. Piping is complete and all points of outlet are installed.
d. Water treatment is complete.
e. Systems are flushed, filled, and air purged.
f. Strainers are clean.
g. Control valves are functioning in accordance with the sequence of operation.
h. Shutoff and balance valves are 100 percent open.
i. hot-water circulating pumps are operational and proper rotation is verified.
j. Pump gauge connections are installed directly at pump inlet and outlet flanges or in discharge and suction pipe prior to valves or strainers.
k. Variable-frequency controllers' startup is complete and safeties are verified.
l. Suitable access to balancing devices and equipment is provided.

2. Sanitary Sewage/Drainage System:

a. Leakage and pressure tests on sanitary sewage/drainage systems have been completed in accordance with applicable code and authority having jurisdiction requirements.
b. Piping is complete.
c. Sanitary sewage pumps/drainage pumps are operational.
d. Control valves are functioning in accordance with the sequence of operation.
e. Shutoff valves are 100 percent open.
f. Suitable access to equipment is provided.

3. Compressed-Air System:

a. Leakage and pressure tests on compressed air distribution system have been satisfactorily completed in accordance with Division 22 requirements.



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b. Piping is complete and all points of outlet are installed.
c. Systems are flushed, filled, and air purged.
d. Strainers are clean.
e. Control valves are functioning in accordance with the sequence of operation.
f. Shutoff and balance valves are 100 percent open.
g. Compressors are operational and of proper rotation.
h. Gauge connections are installed directly at compressor inlet and outlet flanges prior to valves or strainers.
i. Variable-frequency controllers' startup is complete and safeties are verified.
j. Suitable access to balancing devices and equipment is provided,

4. Vacuum System:

a. Leakage and pressure tests on vacuum system have been satisfactorily completed in accordance with Division 22 requirements.
b. Piping is complete and all points of inlet are installed.
c. Systems are flushed, filled, and purged.
d. Strainers are clean.
e. Control valves are functioning in accordance with the sequence of operation.
f. Shutoff and balance valves are 100 percent open.
g. Vacuum pumps are operational and of proper rotation.
h. Gauge connections are installed directly at vacuum pump inlet and outlet flanges prior to valves or strainers.
i. Variable-frequency controllers' startup is complete and safeties are verified.
j. Suitable access to balancing devices and equipment is provided.

## 3.3 GENERAL PROCEDURES FOR TESTING AND BALANCING

A. Perform testing and balancing procedures on each system in accordance with the procedures contained in AABC's "National Standards for Total System Balance" and in this Section.

B. Cut insulation, pipes, and equipment casings for installation of test probes to the minimum extent necessary for TAB procedures.

1. Where holes for probes are required in piping or equipment, install pressure and temperature test plugs to seal systems.
2. Install and join new insulation that matches removed materials. Restore insulation, coverings, vapor barrier, and finish in accordance with Section 220716 "Plumbing Equipment Insulation" and Section 220719 "Plumbing Piping Insulation."

C. Mark equipment and balancing devices, including valve position indicators and similar controls and devices, with paint or other suitable, permanent identification material to show final settings.

D. Take and report testing and balancing measurements in inch-pound (IP) units.



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## 3.4 GENERAL PROCEDURES FOR PLUMBING EQUIPMENT

A. Test, adjust, and balance plumbing equipment indicated on Drawings, including, but not limited to, the following:

1. Motors.
2. Domestic water in-line pumps.
3. Domestic water heaters.

## 3.5 PROCEDURES FOR DOMESTIC WATER SYSTEMS

A. Prepare test reports for pumps and other equipment. Obtain approved submittals and manufacturer-recommended testing procedures. Crosscheck the summation of required equipment flow rates with system design flow rates.

B. Prepare schematic diagrams of systems' Record drawings piping layouts.

C. In addition to requirements in "Preparation" Article, prepare domestic water systems for testing and balancing as follows:

1. Check expansion tank for proper setting.
2. Check water heater for proper discharge temperature setting.
3. Check remotest point of outlet for adequate pressure.
4. Check flow-control valves for proper position.
5. Locate start-stop and disconnect switches, electrical interlocks, and motor controllers.
6. Verify that motor controllers are equipped with properly sized thermal protection.
7. Check that air has been purged from the system.

D. Measure and record upstream and downstream pressure of each piece of equipment.

E. Measure and record upstream and downstream pressure of pressure-reducing valves.

F. Check settings and operation of automatic temperature-control valves, self-contained control valves, and pressure-reducing valves. Record final settings.

G. Check settings and operation of each safety valve. Record settings.

## 3.6 PROCEDURES FOR COMPRESSED-AIR SYSTEMS

A. Prepare test reports for air compressors, and other equipment. Obtain approved submittals and manufacturer-recommended testing procedures. Crosscheck the summation of required equipment flow rates with system design flow rates.

B. Prepare schematic diagrams of systems' Record drawings piping layouts.

C. In addition to requirements in "Preparation" Article, prepare compressed-air systems for testing and balancing as follows:

1. Check remotest point of outlet for adequate pressure.



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2. Check pressure-control valves for proper position.
3. Locate start-stop and disconnect switches, electrical interlocks, and motor controllers.
4. Verify that motor controllers are equipped with properly sized thermal protection.

D. Measure and record upstream and downstream pressure of pressure-reducing valves.

E. Check settings and operation of pressure-reducing valves. Record final settings.

F. Check settings and operation of each safety valve. Record settings.

## 3.7 PROCEDURES FOR VACUUM SYSTEMS

A. Prepare test reports for vacuum pumps and other equipment. Obtain approved submittals and manufacturer-recommended testing procedures. Crosscheck the summation of required equipment flow rates with system design flow rates.

B. Prepare schematic diagrams of systems' Record drawings piping layouts.

C. In addition to requirements in "Preparation" Article, prepare domestic water systems for testing and balancing as follows:

1. Check remotest point of inlet for adequate vacuum.
2. Locate start-stop and disconnect switches, electrical interlocks, and motor controllers.
3. Verify that motor controllers are equipped with properly sized thermal protection.

## 3.8 PROCEDURES FOR DOMESTIC WATER SYSTEM BOOSTER PUMPS

A. Adjust pumps to deliver total design flow.

1. Measure total water flow.

a. Position valves for full flow through coils.
b. Measure flow by main flow meter, if installed.
c. If main flow meter is not installed, determine flow by pump TDH or known equipment pressure drop.

2. Measure pump TDH as follows:

a. Measure discharge pressure directly at the pump outlet flange or in discharge pipe prior to any valves.
b. Measure inlet pressure directly at the pump inlet flange or in suction pipe prior to any valves or strainers.
c. Convert pressure to head and correct for differences in gauge heights.
d. Verify pump impeller size by measuring the TDH with the discharge valve closed. Note the point on manufacturer's pump curve at zero flow, and verify that the pump has the intended impeller size.
e. With valves open, read pump TDH. Adjust pump discharge valve until design water flow is achieved. If excessive throttling is required to achieve desired flow, recommend pump impellers be trimmed to reduce excess throttling.



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3. Monitor motor performance during procedures, and do not operate motor in an overloaded condition.

B. Adjust flow-measuring devices installed in mains and branches to design water flows.

1. Measure flow in main and branch pipes.
2. Adjust main and branch balance valves for design flow.
3. Re-measure each main and branch after all have been adjusted.

C. Verify final system conditions as follows:

1. Re-measure and confirm that total water flow is within design.
2. Re-measure final pumps' operating data, TDH, volts, amps, and static profile.
3. Mark final settings.

D. Verify that memory stops have been set.

## 3.9 PROCEDURES FOR DOMESTIC HOT-WATER CIRCULATING INLINE PUMP

A. Balance system with manual or automatic balancing valves by setting at design flow.

1. Measure flow in main and branch pipes.
2. Adjust main and branch balance valves for design flow.
3. Re-measure each main and branch after all have been adjusted.

B. Adjust pump to deliver total design flow.

1. Measure pump TDH as follows:

a. Measure discharge pressure directly at the pump outlet flange or in discharge pipe prior to any valves.
b. Measure inlet pressure directly at the pump inlet flange or in suction pipe prior to any valves or strainers.
c. Convert pressure to head and correct for differences in gauge heights.
d. Verify pump impeller size by measuring the TDH with the discharge valve closed. Note the point on manufacturer's pump curve at zero flow, and verify that the pump has the intended impeller size.

2. Monitor motor performance during procedures, and do not operate motor in an overloaded condition.
3. Mark final settings and verify that all memory stops have been set.
4. Verify final system conditions as follows:

a. Re-measure and confirm that total flow is within design.
b. Re-measure final pumps' operating data, TDH, volts, amps, speed, and static profile.
c. Mark final settings.



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3.10 PROCEDURES FOR MOTORS

A. Motors 1/2 HP and Larger: Test at final balanced conditions and record the following data:

1. Manufacturer's name, model number, and serial number.
2. Motor horsepower rating.
3. Motor rpm.
4. Phase and hertz.
5. Nameplate and measured voltage, each phase.
6. Nameplate and measured amperage, each phase.
7. Starter size and thermal-protection-element rating.
8. Service factor and frame size.

B. Motors Driven by Variable-Frequency Controllers: Test manual bypass of controller to prove proper operation.

3.11 PROCEDURES FOR WATER HEATERS

A. Electric Water Heaters:

1. Measure and record entering- and leaving-water temperatures.
2. Measure and record water flow.
3. Measure and record pressure drop.
4. Measure and Record relief valve(s) pressure setting.
5. Capacity: Calculate in Btu/h (kW) of heating output.
6. Efficiency: Calculate operating efficiency for comparison to submitted equipment.

B. Gas- and Oil-Fired Water Heaters:

1. Measure and record entering- and leaving-water temperatures.
2. Measure and record water flow.
3. Measure and record pressure drop.
4. Measure and Record relief valve(s) pressure setting.
5. Capacity: Calculate in Btu/h (kW) of heating output.
6. Fuel Consumption: If fuel supply is equipped with flow meter, measure and record consumption.
7. Efficiency: Calculate operating efficiency for comparison to submitted equipment.
8. Fan, motor, and motor controller operating data.

3.12 PROCEDURES FOR TESTING, ADJUSTING, AND BALANCING EXISTING SYSTEMS

A. Perform a preconstruction inspection of existing equipment that is to remain and be reused.

1. Measure and record flows, temperatures, and pressures of each piece of equipment. Compare the values to design or nameplate information, where information is available.
2. Measure motor voltage and amperage. Compare the values to motor nameplate information.
3. Check the condition of filters.



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4. Check bearings and other lubricated parts for proper lubrication.
5. Report on the operating condition of the equipment and the results of the measurements taken. Report deficiencies.

B. TAB After Construction: Before performing testing and balancing of renovated existing systems, inspect existing equipment that is to remain and be reused to verify that existing equipment has been cleaned and refurbished in accordance with renovation scope indicated by Contract Documents. Verify the following:

1. New filters are installed.
2. Bearings and other parts are properly lubricated.
3. Deficiencies noted in the preconstruction report are corrected.

C. Perform testing and balancing of existing systems to the extent that existing systems are affected by the renovation work.

1. Compare the indicated system flows of the renovated work to the measured flows, and determine the new pump speed.
2. Verify that the indicated system flows of the renovated work result in velocities and pump speeds that are within the acceptable limits defined by equipment manufacturer.
3. If calculations increase or decrease the system flow rates by more than 5 percent, make equipment adjustments to achieve the calculated rates. If increase or decrease is 5 percent or less, equipment adjustments are not required.

## 3.13 TOLERANCES

A. Set plumbing system's flow rates within the following tolerances:

1. Domestic Water Flow Rate: Plus or minus 10 percent. If design value is less than 10 gpm (0.63 L/s), within 10 percent.
2. Compressed-Air Flow Rate: Plus or minus 10 percent. If design value is less than 10 gpm (0.63 L/s), within 10 percent.
3. Vacuum Flow Rate: Plus or minus 10 percent.

## 3.14 PROGRESS REPORTING

A. Initial Construction-Phase Report: Based on examination of the Contract Documents as specified in "Examination" Article, prepare a report on the adequacy of design for system-balancing devices. Recommend changes and additions to system-balancing devices, to facilitate proper performance measuring and balancing. Recommend changes and additions to plumbing systems and general construction to allow access for performance-measuring and -balancing devices.

B. Status Reports: Prepare monthly progress reports to describe completed procedures, procedures in progress, and scheduled procedures. Include a list of deficiencies and problems found in systems being tested and balanced. Prepare a separate report for each system and each building floor for systems serving multiple floors.



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3.15 FINAL REPORT

A. General: Prepare a certified written report; tabulate and divide the report into separate sections for tested systems and balanced systems.

1. Include a certification sheet at the front of the report's binder, signed and sealed by the certified testing and balancing engineer.
2. Include a list of instruments used for procedures, along with proof of calibration.
3. Certify validity and accuracy of field data.

B. Final Report Contents: In addition to certified field-report data, include the following:

1. Pump curves.
2. Manufacturers' test data.
3. Field test reports prepared by system and equipment installers.
4. Other information relative to equipment performance; do not include Shop Drawings and Product Data.

C. General Report Data: In addition to form titles and entries, include the following data:

1. Title page.
2. Name and address of the TAB specialist.
3. Project name.
4. Project location.
5. Architect's name and address.
6. Engineer's name and address.
7. Contractor's name and address.
8. Report date.
9. Signature of TAB supervisor who certifies the report.
10. Table of Contents with the total number of pages defined for each section of the report. Number each page in the report.
11. Summary of contents, including the following:

    a. Indicated versus final performance.
    b. Notable characteristics of systems.
    c. Description of system operation sequence if it varies from the Contract Documents.

12. Nomenclature sheets for each item of equipment.
13. Notes to explain why certain final data in the body of reports vary from indicated values.
14. Test conditions for pump performance forms, including the following:

    a. Variable-frequency controller settings for variable-flow hydronic systems.
    b. Settings for pressure controller(s).
    c. Other system operating conditions that affect performance.

D. System Diagrams: Include schematic layouts of distribution systems. Present each system with single-line diagram and include the following:

1. Flow rates.



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2. Pipe and valve sizes and locations.
3. Balancing stations.
4. Position of balancing devices.

E. Electric Water Heater Test Reports: In addition to manufacturer's factory startup equipment reports, include the following:

1. Unit Data:

a. System identification.
b. Location.
c. Model number and unit size.
d. Manufacturer's serial number.
e. Output capacity in Btu/h (kW).
f. Number of stages.
g. Connected volts, phase, and hertz.
h. Rated amperage.

2. Test Data (Indicated and Actual Values):

a. Heat output in Btu/h (kW).
b. Entering-water temperature in deg F (deg C).
c. Leaving-water temperature in deg F (deg C).
d. High-temperature-limit setting in deg F (deg C).
e. Operating set point in deg F (deg C).
f. Voltage at each connection.
g. Amperage for each phase.

F. Pump Test Reports: Calculate impeller size by plotting the shutoff head on pump curves, and include the following:

1. Unit Data:

a. Unit identification.
b. Location.
c. Service.
d. Make and size.
e. Model number and serial number.
f. Water flow rate in gpm (L/s).
g. Water-pressure differential in feet of head or psig (kPa).
h. Required net positive suction head in feet of head or psig (kPa).
i. Pump speed.
j. Impeller diameter in inches (mm).
k. Motor make and frame size.
l. Motor horsepower and rpm.
m. Voltage at each connection.
n. Amperage for each phase.
o. Full-load amperage and service factor.
p. Seal type.



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2. Test Data (Indicated and Actual Values):

a. Static head in feet of head or psig (kPa).
b. Pump shutoff pressure in feet of head or psig (kPa).
c. Actual impeller size in inches (mm).
d. Full-open flow rate in gpm (L/s).
e. Full-open pressure in feet of head or psig (kPa).
f. Final discharge pressure in feet of head or psig (kPa).
g. Final suction pressure in feet of head or psig (kPa).
h. Final total pressure in feet of head or psig (kPa).
i. Final water flow rate in gpm (L/s).
j. Voltage at each connection.
k. Amperage for each phase.

G. Instrument Calibration Reports:

1. Report Data:

a. Instrument type and make.
b. Serial number.
c. Application.
d. Dates of use.
e. Dates of calibration.

## 3.16 ADDITIONAL TESTS

A. Within 90 days of completing TAB, perform additional TAB to verify that balanced conditions are being maintained throughout and to correct unusual conditions.

END OF SECTION 220593



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SECTION 220719 - PLUMBING PIPING INSULATION

PART 1 - GENERAL

1.1 SUMMARY

A. Section includes insulating the following plumbing piping services:

1. Domestic hot-water piping.
2. Domestic recirculating hot-water piping.
3. Sanitary waste piping exposed to freezing conditions.
4. Storm-water piping exposed to freezing conditions.
5. Roof drains and rainwater leaders.
6. Supplies and drains for handicap-accessible lavatories and sinks.

B. Related Sections:

1. Section 220716 "Plumbing Equipment Insulation."

1.2 ACTION SUBMITTALS

A. Product Data: For each type of product indicated.

B. Shop Drawings: Include plans, elevations, sections, details, and attachments to other work.

1. Detail application of protective shields, saddles, and inserts at hangers for each type of insulation and hanger.
2. Detail attachment and covering of heat tracing inside insulation.
3. Detail insulation application at pipe expansion joints for each type of insulation.
4. Detail insulation application at elbows, fittings, flanges, valves, and specialties for each type of insulation.
5. Detail removable insulation at piping specialties, equipment connections, and access panels.
6. Detail application of field-applied jackets.
7. Detail application at linkages of control devices.

1.3 INFORMATIONAL SUBMITTALS

A. Field quality-control reports.

1.4 QUALITY ASSURANCE

A. Surface-Burning Characteristics: For insulation and related materials, as determined by testing identical products according to ASTM E 84 by a testing agency acceptable to authorities having jurisdiction. Factory label insulation and jacket materials and adhesive, mastic, tapes, and cement material containers, with appropriate markings of applicable testing agency.

1. Insulation Installed Indoors: Flame-spread index of 25 or less, and smoke-developed index of 50 or less.
2. Insulation Installed Outdoors: Flame-spread index of 75 or less, and smoke-developed index of 150 or less.

B. Comply with the following applicable standards and other requirements specified for miscellaneous components:

1. Supply and Drain Protective Shielding Guards: ICC A117.1.

PART 2 - PRODUCTS

2.1 INSULATION MATERIALS

A. Comply with requirements in "Piping Insulation Schedule, General," "Indoor Piping Insulation Schedule," "Outdoor, Aboveground Piping Insulation Schedule," and "Outdoor, Underground Piping Insulation Schedule" articles for where insulating materials shall be applied.

B. Products shall not contain asbestos, lead, mercury, or mercury compounds.

C. Products that come in contact with stainless steel shall have a leachable chloride content of less than 50 ppm when tested according to ASTM C 871.

D. Insulation materials for use on austenitic stainless steel shall be qualified as acceptable according to ASTM C 795.

E. Foam insulation materials shall not use CFC or HCFC blowing agents in the manufacturing process.

F. Cellular Glass: Inorganic, incombustible, foamed or cellulated glass with annealed, rigid, hermetically sealed cells. Factory-applied jacket requirements are specified in "Factory-Applied Jackets" Article.

1. Products: Subject to compliance with requirements, provide the following available products that may be incorporated into the Work include, but are not limited to, the following:

a. Pittsburgh Corning Corporation; Foamglas.

2. Special-Shaped Insulation: ASTM C 552, Type III.
3. Preformed Pipe Insulation without Jacket: Comply with ASTM C 552, Type II, Class 1.
4. Preformed Pipe Insulation with Factory-Applied ASJ: Comply with ASTM C 552, Type II, Class 2.
5. Factory fabricate shapes according to ASTM C 450 and ASTM C 585.

G. Flexible Elastomeric Insulation: Closed-cell, sponge- or expanded-rubber materials. Comply with ASTM C 534, Type I for tubular materials.

1. Products: Subject to compliance with requirements, provide the following available products that may be incorporated into the Work include, but are not limited to, the following:

a. Aeroflex USA, Inc.; Aerocel.
b. Armacell LLC; AP Armaflex.
c. K-Flex USA; Insul-Lock, Insul-Tube, and K-FLEX LS.

H. Mineral-Fiber, Preformed Pipe Insulation:

1. Products: Subject to compliance with requirements, provide the following:

a. Fibrex Insulations Inc.; Coreplus 1200.
b. Johns Manville; Micro-Lok.
c. Knauf Insulation; 1000-Degree Pipe Insulation.
d. Manson Insulation Inc.; Alley-K.
e. Owens Corning; Fiberglas Pipe Insulation.

2. Type I, 850 Deg F Materials: Mineral or glass fibers bonded with a thermosetting resin. Comply with ASTM C 547, Type I, Grade A, with factory-applied ASJ. Factory-applied jacket requirements are specified in "Factory-Applied Jackets" Article.

I. Polyolefin: Unicellular, polyethylene thermal plastic insulation. Comply with ASTM C 534 or ASTM C 1427, Type I, Grade 1 for tubular materials.

1. Products: Subject to compliance with requirements, provide the following available products that may be incorporated into the Work include, but are not limited to, the following:

a. Armacell LLC; Tubolit.
b. Nomaco Insulation; IMCOLOCK and NOMALOCK.

## 2.2 INSULATING CEMENTS

A. Mineral-Fiber, Hydraulic-Setting Insulating and Finishing Cement: Comply with ASTM C 449.

1. Products: Subject to compliance with requirements, provide the following available products that may be incorporated into the Work include, but are not limited to, the following:

   a. Ramco Insulation, Inc.; Ramcote 1200 and Quik-Cote.

2.3 ADHESIVES

A. Materials shall be compatible with insulation materials, jackets, and substrates and for bonding insulation to itself and to surfaces to be insulated, unless otherwise indicated.

B. Cellular-Glass Adhesive: Two-component, thermosetting urethane adhesive containing no flammable solvents, with a service temperature range of minus 100 to plus 200 deg F.

1. Products: Subject to compliance with requirements, provide the following available products that may be incorporated into the Work include, but are not limited to, the following:

   a. Foster Brand, Specialty Construction Brands, Inc., a business of H. B. Fuller Company; 81-84.

2. For indoor applications, adhesive shall have a VOC content of 50 g/L or less when calculated according to 40 CFR 59, Subpart D (EPA Method 24).
3. Adhesive shall comply with the testing and product requirements of the California Department of Health Services' "Standard Practice for the Testing of Volatile Organic Emissions from Various Sources Using Small-Scale Environmental Chambers."

C. Flexible Elastomeric and Polyolefin Adhesive: Comply with MIL-A-24179A, Type II, Class I.

1. Products: Subject to compliance with requirements, provide the following available products that may be incorporated into the Work include, but are not limited to, the following:

   a. Aeroflex USA, Inc.; Aeroseal.
   b. Armacell LLC; Armaflex 520 Adhesive.
   c. Foster Brand, Specialty Construction Brands, Inc., a business of H. B. Fuller Company; 85-75.
   d. K-Flex USA; R-373 Contact Adhesive.

2. For indoor applications, adhesive shall have a VOC content of 50 g/L or less when calculated according to 40 CFR 59, Subpart D (EPA Method 24).
3. Adhesive shall comply with the testing and product requirements of the California Department of Health Services' "Standard Practice for the Testing of Volatile Organic Emissions from Various Sources Using Small-Scale Environmental Chambers."

D. Mineral-Fiber Adhesive: Comply with MIL-A-3316C, Class 2, Grade A.

1. Products: Subject to compliance with requirements, provide the following available products that may be incorporated into the Work include, but are not limited to, the following:

    a. Childers Brand, Specialty Construction Brands, Inc., a business of H. B. Fuller Company; CP-127.
    b. Eagle Bridges - Marathon Industries; 225.
    c. Foster Brand, Specialty Construction Brands, Inc., a business of H. B. Fuller Company; 85-60/85-70.
    d. Mon-Eco Industries, Inc.; 22-25.

2. For indoor applications, adhesive shall have a VOC content of 80 g/L or less when calculated according to 40 CFR 59, Subpart D (EPA Method 24).
3. Adhesive shall comply with the testing and product requirements of the California Department of Health Services' "Standard Practice for the Testing of Volatile Organic Emissions from Various Sources Using Small-Scale Environmental Chambers."

E. ASJ Adhesive, and FSK Jacket Adhesive: Comply with MIL-A-3316C, Class 2, Grade A for bonding insulation jacket lap seams and joints.

1. Products: Subject to compliance with requirements, provide the following available products that may be incorporated into the Work include, but are not limited to, the following:

    a. Childers Brand, Specialty Construction Brands, Inc., a business of H. B. Fuller Company; CP-82.
    b. Eagle Bridges - Marathon Industries; 225.
    c. Foster Brand, Specialty Construction Brands, Inc., a business of H. B. Fuller Company; 85-20.
    d. Mon-Eco Industries, Inc.; 22-25.

2. For indoor applications, adhesive shall have a VOC content of 50 g/L or less when calculated according to 40 CFR 59, Subpart D (EPA Method 24).
3. Adhesive shall comply with the testing and product requirements of the California Department of Health Services' "Standard Practice for the Testing of Volatile Organic Emissions from Various Sources Using Small-Scale Environmental Chambers."

F. PVC Jacket Adhesive: Compatible with PVC jacket.

1. Products: Subject to compliance with requirements, provide the following available products that may be incorporated into the Work include, but are not limited to, the following:

    a. Dow Corning Corporation; 739, Dow Silicone.
    b. Johns Manville; Zeston Perma-Weld, CEEL-TITE Solvent Welding Adhesive.
    c. P.I.C. Plastics, Inc.; Welding Adhesive.
    d. Speedline Corporation; Polyco VP Adhesive.

2. For indoor applications, adhesive shall have a VOC content of 50 g/L or less when calculated according to 40 CFR 59, Subpart D (EPA Method 24).
3. Adhesive shall comply with the testing and product requirements of the California Department of Health Services' "Standard Practice for the Testing of Volatile Organic Emissions from Various Sources Using Small-Scale Environmental Chambers."

2.4 MASTICS

A. Materials shall be compatible with insulation materials, jackets, and substrates; comply with MIL-PRF-19565C, Type II.

1. For indoor applications, use mastics that have a VOC content of 50 g/L or less when calculated according to 40 CFR 59, Subpart D (EPA Method 24).

B. Vapor-Barrier Mastic: Water based; suitable for indoor use on below-ambient services.

1. Products: Subject to compliance with requirements, provide the following available products that may be incorporated into the Work include, but are not limited to, the following:

a. Foster Brand, Specialty Construction Brands, Inc., a business of H. B. Fuller Company; 30-80/30-90.
b. Vimasco Corporation; 749.

2. Water-Vapor Permeance: ASTM E 96/E 96M, Procedure B, 0.013 perm at 43-mil dry film thickness.
3. Service Temperature Range: Minus 20 to plus 180 deg F.
4. Solids Content: ASTM D 1644, 58 percent by volume and 70 percent by weight.
5. Color: White.

C. Breather Mastic: Water based; suitable for indoor and outdoor use on above-ambient services.

1. Products: Subject to compliance with requirements, provide the following available products that may be incorporated into the Work include, but are not limited to, the following:

a. Childers Brand, Specialty Construction Brands, Inc., a business of H. B. Fuller Company; CP-10.
b. Eagle Bridges - Marathon Industries; 550.
c. Foster Brand, Specialty Construction Brands, Inc., a business of H. B. Fuller Company; 46-50.
d. Mon-Eco Industries, Inc.; 55-50.
e. Vimasco Corporation; WC-1/WC-5.

2. Water-Vapor Permeance: ASTM F 1249, 1.8 perms at 0.0625-inch dry film thickness.
3. Service Temperature Range: Minus 20 to plus 180 deg F.

4. Solids Content: 60 percent by volume and 66 percent by weight.
5. Color: White.

2.5 SEALANTS

A. Joint Sealants:

1. Joint Sealants for Cellular-Glass Products: Subject to compliance with requirements, provide the following available products that may be incorporated into the Work include, but are not limited to, the following:

   a. Childers Brand, Specialty Construction Brands, Inc., a business of H. B. Fuller Company; CP-76.
   b. Eagle Bridges - Marathon Industries; 405.
   c. Foster Brand, Specialty Construction Brands, Inc., a business of H. B. Fuller Company; 30-45.
   d. Mon-Eco Industries, Inc.; 44-05.
   e. Pittsburgh Corning Corporation; Pittseal 444.

2. Materials shall be compatible with insulation materials, jackets, and substrates.
3. Permanently flexible, elastomeric sealant.
4. Service Temperature Range: Minus 100 to plus 300 deg F.
5. Color: White or gray.
6. For indoor applications, sealants shall have a VOC content of 420 g/L or less when calculated according to 40 CFR 59, Subpart D (EPA Method 24).
7. Sealants shall comply with the testing and product requirements of the California Department of Health Services' "Standard Practice for the Testing of Volatile Organic Emissions from Various Sources Using Small-Scale Environmental Chambers."

B. FSK and Metal Jacket Flashing Sealants:

1. Products: Subject to compliance with requirements, provide the following available products that may be incorporated into the Work include, but are not limited to, the following:

   a. Childers Brand, Specialty Construction Brands, Inc., a business of H. B. Fuller Company; CP-76.
   b. Eagle Bridges - Marathon Industries; 405.
   c. Foster Brand, Specialty Construction Brands, Inc., a business of H. B. Fuller Company; 95-44.
   d. Mon-Eco Industries, Inc.; 44-05.

2. Materials shall be compatible with insulation materials, jackets, and substrates.
3. Fire- and water-resistant, flexible, elastomeric sealant.
4. Service Temperature Range: Minus 40 to plus 250 deg F.
5. Color: Aluminum.

6. For indoor applications, sealants shall have a VOC content of 420 g/L or less when calculated according to 40 CFR 59, Subpart D (EPA Method 24).
7. Sealants shall comply with the testing and product requirements of the California Department of Health Services' "Standard Practice for the Testing of Volatile Organic Emissions from Various Sources Using Small-Scale Environmental Chambers."

C. ASJ Flashing Sealants, and Vinyl, PVDC, and PVC Jacket Flashing Sealants:

1. Products: Subject to compliance with requirements, provide the following available products that may be incorporated into the Work include, but are not limited to, the following:

   a. Childers Brand, Specialty Construction Brands, Inc., a business of H. B. Fuller Company; CP-76.

2. Materials shall be compatible with insulation materials, jackets, and substrates.
3. Fire- and water-resistant, flexible, elastomeric sealant.
4. Service Temperature Range: Minus 40 to plus 250 deg F.
5. Color: White.
6. For indoor applications, sealants shall have a VOC content of 420 g/L or less when calculated according to 40 CFR 59, Subpart D (EPA Method 24).
7. Sealants shall comply with the testing and product requirements of the California Department of Health Services' "Standard Practice for the Testing of Volatile Organic Emissions from Various Sources Using Small-Scale Environmental Chambers."

## 2.6 FACTORY-APPLIED JACKETS

A. Insulation system schedules indicate factory-applied jackets on various applications. When factory-applied jackets are indicated, comply with the following:

1. ASJ: White, kraft-paper, fiberglass-reinforced scrim with aluminum-foil backing; complying with ASTM C 1136, Type I.
2. ASJ-SSL: ASJ with self-sealing, pressure-sensitive, acrylic-based adhesive covered by a removable protective strip; complying with ASTM C 1136, Type I.
3. FSK Jacket: Aluminum-foil, fiberglass-reinforced scrim with kraft-paper backing; complying with ASTM C 1136, Type II.

## 2.7 FIELD-APPLIED FABRIC-REINFORCING MESH

A. Woven Polyester Fabric: Approximately 1 oz./sq. yd. with a thread count of 10 strands by 10 strands/sq. in., in a Leno weave, for pipe.

1. Products: Subject to compliance with requirements, provide the following available products that may be incorporated into the Work include, but are not limited to, the following:

a. Foster Brand, Specialty Construction Brands, Inc., a business of H. B. Fuller Company; Mast-A-Fab.
b. Vimasco Corporation; Elastafab 894.

2.8 FIELD-APPLIED JACKETS

A. Field-applied jackets shall comply with ASTM C 921, Type I, unless otherwise indicated.

B. PVC Jacket: High-impact-resistant, UV-resistant PVC complying with ASTM D 1784, Class 16354-C; thickness as scheduled; roll stock ready for shop or field cutting and forming. Thickness is indicated in field-applied jacket schedules.

1. Products: Subject to compliance with requirements, provide the following available products that may be incorporated into the Work include, but are not limited to, the following:

a. Johns Manville; Zeston.
b. P.I.C. Plastics, Inc.; FG Series.
c. Proto Corporation; LoSmoke.
d. Speedline Corporation; SmokeSafe.

2. Adhesive: As recommended by jacket material manufacturer.
3. Color: White.
4. Factory-fabricated fitting covers to match jacket if available; otherwise, field fabricate.

a. Shapes: 45- and 90-degree, short- and long-radius elbows, tees, valves, flanges, unions, reducers, end caps, soil-pipe hubs, traps, mechanical joints, and P-trap and supply covers for lavatories.

C. Aluminum Jacket: Comply with ASTM B 209, Alloy 3003, 3005, 3105, or 5005, Temper H-14.

1. Products: Subject to compliance with requirements, provide the following available products that may be incorporated into the Work include, but are not limited to, the following:

a. Childers Brand, Specialty Construction Brands, Inc., a business of H. B. Fuller Company; Metal Jacketing Systems.
b. ITW Insulation Systems; Aluminum and Stainless Steel Jacketing.
c. RPR Products, Inc.; Insul-Mate.

2. Sheet and roll stock ready for shop or field sizing.
3. Finish and thickness are indicated in field-applied jacket schedules.
4. Moisture Barrier for Indoor Applications: 3-mil-thick, heat-bonded polyethylene and kraft paper.
5. Moisture Barrier for Outdoor Applications: 3-mil-thick, heat-bonded polyethylene and kraft paper.
6. Factory-Fabricated Fitting Covers:

a. Same material, finish, and thickness as jacket.
b. Preformed 2-piece or gore, 45- and 90-degree, short- and long-radius elbows.
c. Tee covers.
d. Flange and union covers.
e. End caps.
f. Beveled collars.
g. Valve covers.
h. Field fabricate fitting covers only if factory-fabricated fitting covers are not available.

D. Underground Direct-Buried Jacket: 125-mil-thick vapor barrier and waterproofing membrane consisting of a rubberized bituminous resin reinforced with a woven-glass fiber or polyester scrim and laminated aluminum foil.

1. Products: Subject to compliance with requirements, provide the following available products that may be incorporated into the Work include, but are not limited to, the following:

a. Pittsburgh Corning Corporation; Pittwrap.
b. Polyguard Products, Inc.; Insulrap No Torch 125.

## 2.9 TAPES

A. ASJ Tape: White vapor-retarder tape matching factory-applied jacket with acrylic adhesive, complying with ASTM C 1136.

1. Products: Subject to compliance with requirements, provide the following available products that may be incorporated into the Work include, but are not limited to, the following:

a. ABI, Ideal Tape Division; 428 AWF ASJ.
b. Avery Dennison Corporation, Specialty Tapes Division; Fasson 0836.
c. Compac Corporation; 104 and 105.
d. Venture Tape; 1540 CW Plus, 1542 CW Plus, and 1542 CW Plus/SQ.

2. Width: 3 inches.
3. Thickness: 11.5 mils.
4. Adhesion: 90 ounces force/inch in width.
5. Elongation: 2 percent.
6. Tensile Strength: 40 lbf/inch in width.
7. ASJ Tape Disks and Squares: Precut disks or squares of ASJ tape.

B. FSK Tape: Foil-face, vapor-retarder tape matching factory-applied jacket with acrylic adhesive; complying with ASTM C 1136.

1. Products: Subject to compliance with requirements, provide the following available products that may be incorporated into the Work include, but are not limited to, the following:

    a. ABI, Ideal Tape Division; 491 AWF FSK.
    b. Avery Dennison Corporation, Specialty Tapes Division; Fasson 0827.
    c. Compac Corporation; 110 and 111.
    d. Venture Tape; 1525 CW NT, 1528 CW, and 1528 CW/SQ.

2. Width: 3 inches.
3. Thickness: 6.5 mils.
4. Adhesion: 90 ounces force/inch in width.
5. Elongation: 2 percent.
6. Tensile Strength: 40 lbf/inch in width.
7. FSK Tape Disks and Squares: Precut disks or squares of FSK tape.

C. PVC Tape: White vapor-retarder tape matching field-applied PVC jacket with acrylic adhesive; suitable for indoor and outdoor applications.

1. Products: Subject to compliance with requirements, provide the following available products that may be incorporated into the Work include, but are not limited to, the following:

    a. ABI, Ideal Tape Division; 370 White PVC tape.
    b. Compac Corporation; 130.
    c. Venture Tape; 1506 CW NS.

2. Width: 2 inches.
3. Thickness: 6 mils.
4. Adhesion: 64 ounces force/inch in width.
5. Elongation: 500 percent.
6. Tensile Strength: 18 lbf/inch in width.

D. Aluminum-Foil Tape: Vapor-retarder tape with acrylic adhesive.

1. Products: Subject to compliance with requirements, provide the following available products that may be incorporated into the Work include, but are not limited to, the following:

    a. ABI, Ideal Tape Division; 488 AWF.
    b. Avery Dennison Corporation, Specialty Tapes Division; Fasson 0800.
    c. Compac Corporation; 120.
    d. Venture Tape; 3520 CW.

2. Width: 2 inches.
3. Thickness: 3.7 mils.
4. Adhesion: 100 ounces force/inch in width.
5. Elongation: 5 percent.

6. Tensile Strength: 34 lbf/inch in width.

2.10 SECUREMENTS

A. Aluminum Bands: ASTM B 209, Alloy 3003, 3005, 3105, or 5005; Temper H-14, 0.020 inch thick, 1/2 inch wide with wing seal or closed seal.

1. Products: Subject to compliance with requirements, provide the following available products that may be incorporated into the Work include, but are not limited to, the following:

a. ITW Insulation Systems; Gerrard Strapping and Seals.
b. RPR Products, Inc.; Insul-Mate Strapping and Seals.

B. Staples: Outward-clinching insulation staples, nominal 3/4-inch-wide, stainless steel or Monel.

C. Wire: 0.080-inch nickel-copper alloy.

1. Manufacturers: Subject to compliance with requirements, provide products by one of the following available manufacturers offering products that may be incorporated into the Work include, but are not limited to, the following:

a. C & F Wire.

2.11 PROTECTIVE SHIELDING GUARDS

A. Protective Shielding Pipe Covers,:

1. Manufacturers: Subject to compliance with requirements, provide products by the following available manufacturers offering products that may be incorporated into the Work include, but are not limited to, the following:

a. Engineered Brass Company.
b. Insul-Tect Products Co.; a subsidiary of MVG Molded Products.
c. McGuire Manufacturing.
d. Plumberex.
e. Truebro; a brand of IPS Corporation.
f. Zurn Industries, LLC; Tubular Brass Plumbing Products Operation.

2. Description: Manufactured plastic wraps for covering plumbing fixture hot- and cold-water supplies and trap and drain piping. Comply with Americans with Disabilities Act (ADA) requirements.

B. Protective Shielding Piping Enclosures,:

1. Manufacturers: Subject to compliance with requirements, provide products by the following available manufacturers offering products that may be incorporated into the Work include, but are not limited to, the following:

   a. Truebro; a brand of IPS Corporation.
   b. Zurn Industries, LLC; Tubular Brass Plumbing Products Operation.

2. Description: Manufactured plastic enclosure for covering plumbing fixture hot- and cold-water supplies and trap and drain piping. Comply with ADA requirements.

PART 3 - EXECUTION

3.1 PREPARATION

A. Surface Preparation: Clean and dry surfaces to receive insulation. Remove materials that will adversely affect insulation application.

B. Coordinate insulation installation with the trade installing heat tracing. Comply with requirements for heat tracing that apply to insulation.

C. Mix insulating cements with clean potable water; if insulating cements are to be in contact with stainless-steel surfaces, use demineralized water.

3.2 GENERAL INSTALLATION REQUIREMENTS

A. Install insulation materials, accessories, and finishes with smooth, straight, and even surfaces; free of voids throughout the length of piping including fittings, valves, and specialties.

B. Install insulation materials, forms, vapor barriers or retarders, jackets, and thicknesses required for each item of pipe system as specified in insulation system schedules.

C. Install accessories compatible with insulation materials and suitable for the service. Install accessories that do not corrode, soften, or otherwise attack insulation or jacket in either wet or dry state.

D. Install insulation with longitudinal seams at top and bottom of horizontal runs.

E. Install multiple layers of insulation with longitudinal and end seams staggered.

F. Do not weld brackets, clips, or other attachment devices to piping, fittings, and specialties.

G. Keep insulation materials dry during application and finishing.

H. Install insulation with tight longitudinal seams and end joints. Bond seams and joints with adhesive recommended by insulation material manufacturer.

I. Install insulation with least number of joints practical.

J. Where vapor barrier is indicated, seal joints, seams, and penetrations in insulation at hangers, supports, anchors, and other projections with vapor-barrier mastic.

1. Install insulation continuously through hangers and around anchor attachments.
2. For insulation application where vapor barriers are indicated, extend insulation on anchor legs from point of attachment to supported item to point of attachment to structure. Taper and seal ends at attachment to structure with vapor-barrier mastic.
3. Install insert materials and install insulation to tightly join the insert. Seal insulation to insulation inserts with adhesive or sealing compound recommended by insulation material manufacturer.
4. Cover inserts with jacket material matching adjacent pipe insulation. Install shields over jacket, arranged to protect jacket from tear or puncture by hanger, support, and shield.

K. Apply adhesives, mastics, and sealants at manufacturer's recommended coverage rate and wet and dry film thicknesses.

L. Install insulation with factory-applied jackets as follows:

1. Draw jacket tight and smooth.
2. Cover circumferential joints with 3-inch-wide strips, of same material as insulation jacket. Secure strips with adhesive and outward clinching staples along both edges of strip, spaced 4 inches o.c.
3. Overlap jacket longitudinal seams at least 1-1/2 inches. Install insulation with longitudinal seams at bottom of pipe. Clean and dry surface to receive self-sealing lap. Staple laps with outward clinching staples along edge at 2 inches o.c.

    a. For below-ambient services, apply vapor-barrier mastic over staples.

4. Cover joints and seams with tape, according to insulation material manufacturer's written instructions, to maintain vapor seal.
5. Where vapor barriers are indicated, apply vapor-barrier mastic on seams and joints and at ends adjacent to pipe flanges and fittings.

M. Cut insulation in a manner to avoid compressing insulation more than 75 percent of its nominal thickness.

N. Finish installation with systems at operating conditions. Repair joint separations and cracking due to thermal movement.

O. Repair damaged insulation facings by applying same facing material over damaged areas. Extend patches at least 4 inches beyond damaged areas. Adhere, staple, and seal patches similar to butt joints.

P. For above-ambient services, do not install insulation to the following:

1. Vibration-control devices.

2. Testing agency labels and stamps.
3. Nameplates and data plates.
4. Cleanouts.

3.3 PENETRATIONS

A. Insulation Installation at Roof Penetrations: Install insulation continuously through roof penetrations.

1. Seal penetrations with flashing sealant.
2. For applications requiring only indoor insulation, terminate insulation above roof surface and seal with joint sealant. For applications requiring indoor and outdoor insulation, install insulation for outdoor applications tightly joined to indoor insulation ends. Seal joint with joint sealant.
3. Extend jacket of outdoor insulation outside roof flashing at least 2 inches below top of roof flashing.
4. Seal jacket to roof flashing with flashing sealant.

B. Insulation Installation at Underground Exterior Wall Penetrations: Terminate insulation flush with sleeve seal. Seal terminations with flashing sealant.

C. Insulation Installation at Aboveground Exterior Wall Penetrations: Install insulation continuously through wall penetrations.

1. Seal penetrations with flashing sealant.
2. For applications requiring only indoor insulation, terminate insulation inside wall surface and seal with joint sealant. For applications requiring indoor and outdoor insulation, install insulation for outdoor applications tightly joined to indoor insulation ends. Seal joint with joint sealant.
3. Extend jacket of outdoor insulation outside wall flashing and overlap wall flashing at least 2 inches.
4. Seal jacket to wall flashing with flashing sealant.

D. Insulation Installation at Interior Wall and Partition Penetrations (That Are Not Fire Rated): Install insulation continuously through walls and partitions.

E. Insulation Installation at Fire-Rated Wall and Partition Penetrations: Install insulation continuously through penetrations of fire-rated walls and partitions.

1. Comply with requirements in Section 078413 "Penetration Firestopping" for firestopping and fire-resistive joint sealers.

F. Insulation Installation at Floor Penetrations:

1. Pipe: Install insulation continuously through floor penetrations.
2. Seal penetrations through fire-rated assemblies. Comply with requirements in Section 078413 "Penetration Firestopping."

3.4 GENERAL PIPE INSULATION INSTALLATION

A. Requirements in this article generally apply to all insulation materials except where more specific requirements are specified in various pipe insulation material installation articles.

B. Insulation Installation on Fittings, Valves, Strainers, Flanges, and Unions:

1. Install insulation over fittings, valves, strainers, flanges, unions, and other specialties with continuous thermal and vapor-retarder integrity unless otherwise indicated.
2. Insulate pipe elbows using preformed fitting insulation or mitered fittings made from same material and density as adjacent pipe insulation. Each piece shall be butted tightly against adjoining piece and bonded with adhesive. Fill joints, seams, voids, and irregular surfaces with insulating cement finished to a smooth, hard, and uniform contour that is uniform with adjoining pipe insulation.
3. Insulate tee fittings with preformed fitting insulation or sectional pipe insulation of same material and thickness as used for adjacent pipe. Cut sectional pipe insulation to fit. Butt each section closely to the next and hold in place with tie wire. Bond pieces with adhesive.
4. Insulate valves using preformed fitting insulation or sectional pipe insulation of same material, density, and thickness as used for adjacent pipe. Overlap adjoining pipe insulation by not less than two times the thickness of pipe insulation, or one pipe diameter, whichever is thicker. For valves, insulate up to and including the bonnets, valve stuffing-box studs, bolts, and nuts. Fill joints, seams, and irregular surfaces with insulating cement.
5. Insulate strainers using preformed fitting insulation or sectional pipe insulation of same material, density, and thickness as used for adjacent pipe. Overlap adjoining pipe insulation by not less than two times the thickness of pipe insulation, or one pipe diameter, whichever is thicker. Fill joints, seams, and irregular surfaces with insulating cement. Insulate strainers so strainer basket flange or plug can be easily removed and replaced without damaging the insulation and jacket. Provide a removable reusable insulation cover. For below-ambient services, provide a design that maintains vapor barrier.
6. Insulate flanges and unions using a section of oversized preformed pipe insulation. Overlap adjoining pipe insulation by not less than two times the thickness of pipe insulation, or one pipe diameter, whichever is thicker.
7. Cover segmented insulated surfaces with a layer of finishing cement and coat with a mastic. Install vapor-barrier mastic for below-ambient services and a breather mastic for above-ambient services. Reinforce the mastic with fabric-reinforcing mesh. Trowel the mastic to a smooth and well-shaped contour.
8. For services not specified to receive a field-applied jacket except for flexible elastomeric and polyolefin, install fitted PVC cover over elbows, tees, strainers, valves, flanges, and unions. Terminate ends with PVC end caps. Tape PVC covers to adjoining insulation facing using PVC tape.
9. Stencil or label the outside insulation jacket of each union with the word "union." Match size and color of pipe labels.

C. Insulate instrument connections for thermometers, pressure gages, pressure temperature taps, test connections, flow meters, sensors, switches, and transmitters on insulated pipes. Shape insulation at these connections by tapering it to and around the connection with insulating cement and finish with finishing cement, mastic, and flashing sealant.

D. Install removable insulation covers at locations indicated. Installation shall conform to the following:

1. Make removable flange and union insulation from sectional pipe insulation of same thickness as that on adjoining pipe. Install same insulation jacket as adjoining pipe insulation.
2. When flange and union covers are made from sectional pipe insulation, extend insulation from flanges or union long at least two times the insulation thickness over adjacent pipe insulation on each side of flange or union. Secure flange cover in place with stainless-steel or aluminum bands. Select band material compatible with insulation and jacket.
3. Construct removable valve insulation covers in same manner as for flanges, except divide the two-part section on the vertical center line of valve body.
4. When covers are made from block insulation, make two halves, each consisting of mitered blocks wired to stainless-steel fabric. Secure this wire frame, with its attached insulation, to flanges with tie wire. Extend insulation at least 2 inches over adjacent pipe insulation on each side of valve. Fill space between flange or union cover and pipe insulation with insulating cement. Finish cover assembly with insulating cement applied in two coats. After first coat is dry, apply and trowel second coat to a smooth finish.
5. Unless a PVC jacket is indicated in field-applied jacket schedules, finish exposed surfaces with a metal jacket.

## 3.5 INSTALLATION OF CELLULAR-GLASS INSULATION

A. Insulation Installation on Straight Pipes and Tubes:

1. Secure each layer of insulation to pipe with wire or bands and tighten bands without deforming insulation materials.
2. Where vapor barriers are indicated, seal longitudinal seams, end joints, and protrusions with vapor-barrier mastic and joint sealant.
3. For insulation with factory-applied jackets on above-ambient services, secure laps with outward clinched staples at 6 inches o.c.
4. For insulation with factory-applied jackets on below-ambient services, do not staple longitudinal tabs. Instead, secure tabs with additional adhesive as recommended by insulation material manufacturer and seal with vapor-barrier mastic and flashing sealant.

B. Insulation Installation on Pipe Flanges:

1. Install preformed pipe insulation to outer diameter of pipe flange.
2. Make width of insulation section same as overall width of flange and bolts, plus twice the thickness of pipe insulation.

3. Fill voids between inner circumference of flange insulation and outer circumference of adjacent straight pipe segments with cut sections of cellular-glass block insulation of same thickness as pipe insulation.
4. Install jacket material with manufacturer's recommended adhesive, overlap seams at least 1 inch, and seal joints with flashing sealant.

C. Insulation Installation on Pipe Fittings and Elbows:

1. Install preformed sections of same material as straight segments of pipe insulation when available. Secure according to manufacturer's written instructions.
2. When preformed sections of insulation are not available, install mitered sections of cellular-glass insulation. Secure insulation materials with wire or bands.

D. Insulation Installation on Valves and Pipe Specialties:

1. Install preformed sections of cellular-glass insulation to valve body.
2. Arrange insulation to permit access to packing and to allow valve operation without disturbing insulation.
3. Install insulation to flanges as specified for flange insulation application.

3.6 INSTALLATION OF FLEXIBLE ELASTOMERIC INSULATION

A. Seal longitudinal seams and end joints with manufacturer's recommended adhesive to eliminate openings in insulation that allow passage of air to surface being insulated.

B. Insulation Installation on Pipe Flanges:

1. Install pipe insulation to outer diameter of pipe flange.
2. Make width of insulation section same as overall width of flange and bolts, plus twice the thickness of pipe insulation.
3. Fill voids between inner circumference of flange insulation and outer circumference of adjacent straight pipe segments with cut sections of sheet insulation of same thickness as pipe insulation.
4. Secure insulation to flanges and seal seams with manufacturer's recommended adhesive to eliminate openings in insulation that allow passage of air to surface being insulated.

C. Insulation Installation on Pipe Fittings and Elbows:

1. Install mitered sections of pipe insulation.
2. Secure insulation materials and seal seams with manufacturer's recommended adhesive to eliminate openings in insulation that allow passage of air to surface being insulated.

D. Insulation Installation on Valves and Pipe Specialties:

1. Install preformed valve covers manufactured of same material as pipe insulation when available.

2. When preformed valve covers are not available, install cut sections of pipe and sheet insulation to valve body. Arrange insulation to permit access to packing and to allow valve operation without disturbing insulation.
3. Install insulation to flanges as specified for flange insulation application.
4. Secure insulation to valves and specialties and seal seams with manufacturer's recommended adhesive to eliminate openings in insulation that allow passage of air to surface being insulated.

3.7 INSTALLATION OF MINERAL-FIBER PREFORMED PIPE INSULATION

A. Insulation Installation on Straight Pipes and Tubes:

1. Secure each layer of preformed pipe insulation to pipe with wire or bands and tighten bands without deforming insulation materials.
2. Where vapor barriers are indicated, seal longitudinal seams, end joints, and protrusions with vapor-barrier mastic and joint sealant.
3. For insulation with factory-applied jackets on above-ambient surfaces, secure laps with outward clinched staples at 6 inches o.c.
4. For insulation with factory-applied jackets on below-ambient surfaces, do not staple longitudinal tabs. Instead, secure tabs with additional adhesive as recommended by insulation material manufacturer and seal with vapor-barrier mastic and flashing sealant.

B. Insulation Installation on Pipe Flanges:

1. Install preformed pipe insulation to outer diameter of pipe flange.
2. Make width of insulation section same as overall width of flange and bolts, plus twice the thickness of pipe insulation.
3. Fill voids between inner circumference of flange insulation and outer circumference of adjacent straight pipe segments with mineral-fiber blanket insulation.
4. Install jacket material with manufacturer's recommended adhesive, overlap seams at least 1 inch, and seal joints with flashing sealant.

C. Insulation Installation on Pipe Fittings and Elbows:

1. Install preformed sections of same material as straight segments of pipe insulation when available.
2. When preformed insulation elbows and fittings are not available, install mitered sections of pipe insulation, to a thickness equal to adjoining pipe insulation. Secure insulation materials with wire or bands.

D. Insulation Installation on Valves and Pipe Specialties:

1. Install preformed sections of same material as straight segments of pipe insulation when available.
2. When preformed sections are not available, install mitered sections of pipe insulation to valve body.

3. Arrange insulation to permit access to packing and to allow valve operation without disturbing insulation.
4. Install insulation to flanges as specified for flange insulation application.

3.8 INSTALLATION OF POLYOLEFIN INSULATION

A. Insulation Installation on Straight Pipes and Tubes:

1. Seal split-tube longitudinal seams and end joints with manufacturer's recommended adhesive to eliminate openings in insulation that allow passage of air to surface being insulated.

B. Insulation Installation on Pipe Flanges:

1. Install pipe insulation to outer diameter of pipe flange.
2. Make width of insulation section same as overall width of flange and bolts, plus twice the thickness of pipe insulation.
3. Fill voids between inner circumference of flange insulation and outer circumference of adjacent straight pipe segments with cut sections of polyolefin sheet insulation of same thickness as pipe insulation.
4. Secure insulation to flanges and seal seams with manufacturer's recommended adhesive to eliminate openings in insulation that allow passage of air to surface being insulated.

C. Insulation Installation on Pipe Fittings and Elbows:

1. Install mitered sections of polyolefin pipe insulation.
2. Secure insulation materials and seal seams with manufacturer's recommended adhesive to eliminate openings in insulation that allow passage of air to surface being insulated.

D. Insulation Installation on Valves and Pipe Specialties:

1. Install cut sections of polyolefin pipe and sheet insulation to valve body.
2. Arrange insulation to permit access to packing and to allow valve operation without disturbing insulation.
3. Install insulation to flanges as specified for flange insulation application.
4. Secure insulation to valves and specialties, and seal seams with manufacturer's recommended adhesive to eliminate openings in insulation that allow passage of air to surface being insulated.

3.9 FIELD-APPLIED JACKET INSTALLATION

A. Where FSK jackets are indicated, install as follows:

1. Draw jacket material smooth and tight.
2. Install lap or joint strips with same material as jacket.

3. Secure jacket to insulation with manufacturer's recommended adhesive.
4. Install jacket with 1-1/2-inch laps at longitudinal seams and 3-inch-wide joint strips at end joints.
5. Seal openings, punctures, and breaks in vapor-retarder jackets and exposed insulation with vapor-barrier mastic.

B. Where PVC jackets are indicated, install with 1-inch overlap at longitudinal seams and end joints. Seal with manufacturer's recommended adhesive.

1. Apply two continuous beads of adhesive to seams and joints, one bead under lap and the finish bead along seam and joint edge.

C. Where metal jackets are indicated, install with 2-inch overlap at longitudinal seams and end joints. Overlap longitudinal seams arranged to shed water. Seal end joints with weatherproof sealant recommended by insulation manufacturer. Secure jacket with stainless-steel bands 12 inches o.c. and at end joints.

3.10 FINISHES

A. Insulation with ASJ, Glass-Cloth, or Other Paintable Jacket Material: Paint jacket with paint system identified below and as specified in Section 099113 "Exterior Painting" and Section 099123 "Interior Painting."

1. Flat Acrylic Finish: Two finish coats over a primer that is compatible with jacket material and finish coat paint. Add fungicidal agent to render fabric mildew proof.

a. Finish Coat Material: Interior, flat, latex-emulsion size.

B. Flexible Elastomeric Thermal Insulation: After adhesive has fully cured, apply two coats of insulation manufacturer's recommended protective coating.

C. Color: Final color as selected by Architect. Vary first and second coats to allow visual inspection of the completed Work.

D. Do not field paint aluminum or stainless-steel jackets.

3.11 FIELD QUALITY CONTROL

A. Perform tests and inspections.

B. Tests and Inspections:

1. Inspect pipe, fittings, strainers, and valves, randomly selected by Architect, by removing field-applied jacket and insulation in layers in reverse order of their installation. Extent of inspection shall be limited to three locations of straight pipe, three locations of threaded fittings, three locations of welded fittings, two locations of threaded strainers,

two locations of welded strainers, three locations of threaded valves, and three locations of flanged valves for each pipe service defined in the "Piping Insulation Schedule, General" Article.

C. All insulation applications will be considered defective Work if sample inspection reveals noncompliance with requirements.

3.12 PIPING INSULATION SCHEDULE, GENERAL

A. Acceptable preformed pipe and tubular insulation materials and thicknesses are identified for each piping system and pipe size range. If more than one material is listed for a piping system, selection from materials listed is Contractor's option.

B. Items Not Insulated: Unless otherwise indicated, do not install insulation on the following:

1. Drainage piping located in crawl spaces.
2. Underground piping.
3. Chrome-plated pipes and fittings unless there is a potential for personnel injury.

3.13 INDOOR PIPING INSULATION SCHEDULE

A. Domestic Cold, Hot and Recirculated Hot Water: Insulation shall be one of the following:

1. Flexible Elastomeric: 3/4 inch thick.
2. Mineral-Fiber, Preformed Pipe Insulation, Type I: 1/2 inch thick.
3. Polyolefin: 3/4 inch thick.

B. Stormwater and Overflow: Insulation shall be one of the following:

1. Flexible Elastomeric: 1 inch thick.
2. Mineral-Fiber, Preformed Pipe Insulation, Type I: 1 inch thick.
3. Polyolefin: 1 inch thick.

C. Roof Drain and Overflow Drain Bodies: Insulation shall be one of the following:

1. Flexible Elastomeric: 1 inch thick.
2. Mineral-Fiber, Preformed Pipe Insulation, Type I: 1 inch thick.
3. Polyolefin: 1 inch thick.

D. Exposed Sanitary Drains, Domestic Water, Domestic Hot Water, and Stops for Plumbing Fixtures for People with Disabilities: Insulation shall be one of the following:

1. Flexible Elastomeric: 1/2 inch thick.
2. Mineral-Fiber, Preformed Pipe Insulation, Type I: 1/2 inch thick.
3. Polyolefin: 1/2 inch thick.

E. Sanitary Waste Piping Where Heat Tracing Is Installed: Mineral-fiber, preformed pipe insulation, Type I, 1-1/2 inches thick.

3.14 OUTDOOR, ABOVEGROUND PIPING INSULATION SCHEDULE

A. Domestic Water Piping: Insulation shall be one of the following:

1. Cellular Glass: 2 inches thick.
2. Flexible Elastomeric: 2 inches thick.
3. Mineral-Fiber, Preformed Pipe Insulation, Type I: 2 inches thick.
4. Polyolefin: 2 inches thick.

B. Domestic Hot and Recirculated Hot Water: Insulation shall be one of the following:

1. Cellular Glass: 2 inches thick.
2. Flexible Elastomeric: 2 inches thick.
3. Mineral-Fiber, Preformed Pipe Insulation, Type I: 2 inches thick.
4. Polyolefin: 2 inches thick.

C. Sanitary Waste Piping Where Heat Tracing Is Installed: Insulation shall be one of the following:

1. Cellular Glass: 2 inches thick.
2. Mineral-Fiber, Preformed Pipe Insulation, Type I: 2 inches thick.

3.15 OUTDOOR, UNDERGROUND PIPING INSULATION SCHEDULE

A. Sanitary Waste Piping, All Sizes, Where Heat Tracing Is Installed: Cellular glass, 2 inches thick.

3.16 INDOOR, FIELD-APPLIED JACKET SCHEDULE

A. Install jacket over insulation material. For insulation with factory-applied jacket, install the field-applied jacket over the factory-applied jacket.

B. If more than one material is listed, selection from materials listed is Contractor's option.

C. Piping, Concealed:

1. None.

D. Piping, Exposed:

1. PVC: 30 mils thick.
2. Aluminum, Smooth: 0.016 inch thick.

3.17 OUTDOOR, FIELD-APPLIED JACKET SCHEDULE

A. Install jacket over insulation material. For insulation with factory-applied jacket, install the field-applied jacket over the factory-applied jacket.

B. If more than one material is listed, selection from materials listed is Contractor's option.

C. Piping, Concealed:

1. PVC: 30 mils thick.
2. Aluminum, Smooth: 0.016 inch thick.

D. Piping, Exposed:

1. PVC: 30 mils thick.
2. Painted Aluminum, Smooth: 0.016 inch thick.

3.18 UNDERGROUND, FIELD-INSTALLED INSULATION JACKET

A. For underground direct-buried piping applications, install underground direct-buried jacket over insulation material.

END OF SECTION 220719

# SECTION 221113 - FACILITY WATER DISTRIBUTION PIPING

## PART 1 - GENERAL

### 1.1 SUMMARY

A. This Section includes water-distribution piping and related components outside the building for combined water service and fire-service mains.

B. Utility-furnished products include water meters that will be furnished to the site, ready for installation.

### 1.2 ACTION SUBMITTALS

A. Product Data: For each type of product indicated.

B. Shop Drawings: Detail precast concrete vault assemblies and indicate dimensions, method of field assembly, and components.

### 1.3 INFORMATIONAL SUBMITTALS

A. Field quality-control test reports.

### 1.4 CLOSEOUT SUBMITTALS

A. Operation and maintenance data.

### 1.5 QUALITY ASSURANCE

A. Regulatory Requirements:

1. Comply with requirements of utility company supplying water. Include tapping of water mains and backflow prevention.
2. Comply with standards of authorities having jurisdiction for potable-water-service piping, including materials, installation, testing, and disinfection.
3. Comply with standards of authorities having jurisdiction for fire-suppression water-service piping, including materials, hose threads, installation, and testing.

B. Piping materials shall bear label, stamp, or other markings of specified testing agency.

C. Comply with ASTM F 645 for selection, design, and installation of thermoplastic water piping.

D. Comply with FMG's "Approval Guide" or UL's "Fire Protection Equipment Directory" for fire-service-main products.

E. NFPA Compliance: Comply with NFPA 24 for materials, installations, tests, flushing, and valve and hydrant supervision for fire-service-main piping for fire suppression.

F. NSF Compliance:

1. Comply with NSF 14 for plastic potable-water-service piping. Include marking "NSF-pw" on piping.
2. Comply with NSF 61 Annex G for materials for water-service piping and specialties for domestic water.

1.6 PROJECT CONDITIONS

A. Interruption of Existing Water-Distribution Service: Do not interrupt service to facilities occupied by Owner or others unless permitted under the following conditions and then only after arranging to provide temporary water-distribution service according to requirements indicated:

1. Notify Construction Manager no fewer than two days in advance of proposed interruption of service.
2. Do not proceed with interruption of water-distribution service without Construction Manager's written permission.

1.7 COORDINATION

A. Coordinate connection to water main with utility company.

PART 2 - PRODUCTS

2.1 PIPE AND FITTINGS

A. Soft Copper Tube: ASTM B 88, Type K (ASTM B 88M, Type A) and ASTM B 88, Type L (ASTM B 88M, Type B), water tube, annealed temper.

1. Copper, Solder-Joint Fittings: ASME B16.18, cast-copper-alloy or ASME B16.22, wrought-copper, solder-joint pressure type. Furnish only wrought-copper fittings if indicated.

B. Hard Copper Tube: ASTM B 88, Type K (ASTM B 88M, Type A) and ASTM B 88, Type L (ASTM B 88M, Type B), water tube, drawn temper.

1. Copper, Solder-Joint Fittings: ASME B16.18, cast-copper-alloy or ASME B16.22, wrought-copper, solder-joint pressure type. Furnish only wrought-copper fittings if indicated.

C. Mechanical-Joint, Ductile-Iron Pipe: AWWA C151, with mechanical-joint bell and plain spigot end unless grooved or flanged ends are indicated.

1. Mechanical-Joint, Ductile-Iron Fittings: AWWA C110, ductile- or gray-iron standard pattern or AWWA C153, ductile-iron compact pattern.
2. Glands, Gaskets, and Bolts: AWWA C111, ductile- or gray-iron glands, rubber gaskets, and steel bolts.

D. Push-on-Joint, Ductile-Iron Pipe: AWWA C151, with push-on-joint bell and plain spigot end unless grooved or flanged ends are indicated.

1. Push-on-Joint, Ductile-Iron Fittings: AWWA C110, ductile- or gray-iron standard pattern or AWWA C153, ductile-iron compact pattern.
2. Gaskets: AWWA C111, rubber.

E. Grooved-Joint, Ductile-Iron Pipe: AWWA C151, with cut, rounded-grooved ends.

1. Grooved-End, Ductile-Iron Pipe Appurtenances:

a. Manufacturers: Subject to compliance with requirements, provide products by one of the following:

1) Anvil International.
2) Smith-Cooper International.
3) Victaulic Company.

F. PE, Fire-Service Pipe: ASTM F 714, AWWA C906, or equivalent for PE water pipe; FMG approved, with minimum thickness equivalent to FMG Class 150 and Class 200.

1. Molded PE Fittings: ASTM D 3350, PE resin, socket- or butt-fusion type, made to match PE pipe dimensions and class.

G. PVC, AWWA Pipe: AWWA C900, Class 150 and Class 200, with bell end with gasket, and with spigot end.

1. Comply with UL 1285 for fire-service mains if indicated.
2. PVC Fabricated Fittings: AWWA C900, Class 150 and Class 200, with bell-and-spigot or double-bell ends. Include elastomeric gasket in each bell.
3. PVC Molded Fittings: AWWA C907, Class 150, with bell-and-spigot or double-bell ends. Include elastomeric gasket in each bell.
4. Push-on-Joint, Ductile-Iron Fittings: AWWA C110, ductile- or gray-iron standard pattern or AWWA C153, ductile-iron compact pattern.

a. Gaskets: AWWA C111, rubber.

5. Mechanical-Joint, Ductile-Iron Fittings: AWWA C110, ductile- or gray-iron standard pattern or AWWA C153, ductile-iron compact pattern.

a. Glands, Gaskets, and Bolts: AWWA C111, ductile- or gray-iron glands, rubber gaskets, and steel bolts.

2.2 JOINING MATERIALS

A. Refer to Section 330500 "Common Work Results for Utilities" for commonly used joining materials.

B. Brazing Filler Metals: AWS A5.8, BCuP Series.

C. Bonding Adhesive for Fiberglass Piping: As recommended by fiberglass piping manufacturer.

D. Plastic Pipe-Flange Gasket, Bolts, and Nuts: Type and material recommended by piping system manufacturer, unless otherwise indicated.

2.3 PIPING SPECIALTIES

A. Transition Fittings: Manufactured fitting or coupling same size as, with pressure rating at least equal to and ends compatible with, piping to be joined.

B. Tubular-Sleeve Pipe Couplings:

1. Description: Metal, bolted, sleeve-type, reducing or transition coupling, with center sleeve, gaskets, end rings, and bolt fasteners and with ends of same sizes as piping to be joined.

a. Standard: AWWA C219.

2.4 GATE VALVES

A. AWWA, Cast-Iron Gate Valves:

1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:

a. American AVK Co.
b. American Cast Iron Pipe Company.
c. Clow Valve Company; a subsidiary of McWane, Inc.
d. Crane; Crane Energy Flow Solutions.
e. EJ.
f. Flomatic Corporation.
g. Kennedy Valve Company; a division of McWane, Inc.
h. M & H Valve Company; a division of McWane, Inc.
i. McWane, Inc.
j. Mueller Co.
k. NIBCO INC.
l. Tyler Pipe; a subsidiary of McWane Inc.
m. U.S. Pipe and Foundry Company.
n. Zurn Industries, LLC.

2. Nonrising-Stem, Metal-Seated Gate Valves:

a. Description: Gray- or ductile-iron body and bonnet; with cast-iron or bronze double-disc gate, bronze gate rings, bronze stem, and stem nut.

1) Standard: AWWA C500.
2) Minimum Pressure Rating: 200 psig (1380 kPa).
3) End Connections: Mechanical joint.
4) Interior Coating: Complying with AWWA C550.

3. Nonrising-Stem, Resilient-Seated Gate Valves:

a. Description: Gray- or ductile-iron body and bonnet; with bronze or gray- or ductile-iron gate, resilient seats, bronze stem, and stem nut.

1) Standard: AWWA C509.
2) Minimum Pressure Rating: 200 psig (1380 kPa).
3) End Connections: Mechanical joint.
4) Interior Coating: Complying with AWWA C550.

4. Nonrising-Stem, High-Pressure, Resilient-Seated Gate Valves:

a. Description: Ductile-iron body and bonnet; with bronze or ductile-iron gate, resilient seats, bronze stem, and stem nut.

1) Standard: AWWA C509.
2) Minimum Pressure Rating: 250 psig (1725 kPa).
3) End Connections: Push on or mechanical joint.
4) Interior Coating: Complying with AWWA C550.

5. OS&Y, Rising-Stem, Metal-Seated Gate Valves:

a. Description: Cast- or ductile-iron body and bonnet, with cast-iron double disc, bronze disc and seat rings, and bronze stem.

1) Standard: AWWA C500.
2) Minimum Pressure Rating: 200 psig (1380 kPa).
3) End Connections: Flanged.

6. OS&Y, Rising-Stem, Resilient-Seated Gate Valves:

a. Description: Cast- or ductile-iron body and bonnet, with bronze or gray- or ductile-iron gate, resilient seats, and bronze stem.

1) Standard: AWWA C509.
2) Minimum Pressure Rating: 200 psig (1380 kPa).
3) End Connections: Flanged.

B. UL/FMG, Cast-Iron Gate Valves:

1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:

a. American Cast Iron Pipe Company.
b. Clow Valve Company; a subsidiary of McWane, Inc.
c. Crane; Crane Energy Flow Solutions.
d. Kennedy Valve Company; a division of McWane, Inc.
e. M & H Valve Company; a division of McWane, Inc.
f. McWane, Inc.
g. Mueller Co.
h. NIBCO INC.
i. Stockham; Crane Energy Flow Solutions.
j. U.S. Pipe and Foundry Company.
k. Zurn Industries, LLC.

2. UL/FMG, Nonrising-Stem Gate Valves:

a. Description: Iron body and bonnet with flange for indicator post, bronze seating material, and inside screw.

1) Standards: UL 262 and FMG approved.
2) Minimum Pressure Rating: 175 psig (1207 kPa).
3) End Connections: Flanged.

3. OS&Y, Rising-Stem Gate Valves:

a. Description: Iron body and bonnet and bronze seating material.

1) Standards: UL 262 and FMG approved.
2) Minimum Pressure Rating: 175 psig (1207 kPa).
3) End Connections: Flanged.

C. Bronze Gate Valves:

1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:

a. Crane; Crane Energy Flow Solutions.
b. Hammond Valve.
c. Jenkins Valves; Crane Energy Flow Solutions.
d. Milwaukee Valve Company.
e. NIBCO INC.
f. Red-White Valve Corp.
g. Stockham; Crane Energy Flow Solutions.
h. Zurn Industries, LLC.

2. OS&Y, Rising-Stem Gate Valves:

a. Description: Bronze body and bonnet and bronze stem.

1) Standards: UL 262 and FMG approved.
2) Minimum Pressure Rating: 175 psig (1207 kPa).
3) End Connections: Threaded.

3. Nonrising-Stem Gate Valves:

a. Description: Class 125, Type 1, bronze with solid wedge, threaded ends, and malleable-iron handwheel.

1) Standard: MSS SP-80.

## 2.5 GATE VALVE ACCESSORIES AND SPECIALTIES

A. Tapping-Sleeve Assemblies:

1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:

a. American Cast Iron Pipe Company.
b. Clow Valve Company; a subsidiary of McWane, Inc.
c. EJ.
d. Flowserve Corporation.
e. Kennedy Valve Company; a division of McWane, Inc.
f. M & H Valve Company; a division of McWane, Inc.
g. McWane, Inc.
h. Mueller Co.
i. U.S. Pipe and Foundry Company.

2. Description: Sleeve and valve compatible with drilling machine.

a. Standard: MSS SP-60.
b. Tapping Sleeve: Cast- or ductile-iron or stainless-steel, two-piece bolted sleeve with flanged outlet for new branch connection. Include sleeve matching size and type of pipe material being tapped and with recessed flange for branch valve.
c. Valve: AWWA, cast-iron, nonrising-stem, metal-seated gate valve with one raised face flange mating tapping-sleeve flange.

B. Valve Boxes: Comply with AWWA M44 for cast-iron valve boxes. Include top section, adjustable extension of length required for depth of burial of valve, plug with lettering "WATER," and bottom section with base that fits over valve and with a barrel approximately 5 inches (125 mm) in diameter.

1. Operating Wrenches: Steel, tee-handle with one pointed end, stem of length to operate deepest buried valve, and socket matching valve operating nut.

C. Indicator Posts: UL 789, FMG-approved, vertical-type, cast-iron body with operating wrench, extension rod, and adjustable cast-iron barrel of length required for depth of burial of valve.

## 2.6 CORPORATION VALVES AND CURB VALVES

A. Manufacturers:

1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:

    a. A.Y. McDonald Mfg. Co.
    b. Amcast Industrial Corporation.
    c. Ford Meter Box Company, Inc. (The).
    d. Jones, James Company.
    e. Master Meter, Inc.
    f. Mueller Co.
    g. Red Hed Manufacturing Company; a division of Everett J. Prescott, Inc.

B. Service-Saddle Assemblies: Comply with AWWA C800. Include saddle and valve compatible with tapping machine.

1. Service Saddle: Copper alloy with seal and AWWA C800, threaded outlet for corporation valve.
2. Corporation Valve: Bronze body and ground-key plug, with AWWA C800, threaded inlet and outlet matching service piping material.
3. Manifold: Copper fitting with two to four inlets as required, with ends matching corporation valves and outlet matching service piping material.

C. Curb Valves: Comply with AWWA C800. Include bronze body, ground-key plug or ball, and wide tee head, with inlet and outlet matching service piping material.

D. Service Boxes for Curb Valves: Similar to AWWA M44 requirements for cast-iron valve boxes. Include cast-iron telescoping top section of length required for depth of burial of valve, plug with lettering "WATER," and bottom section with base that fits over curb valve and with a barrel approximately 3 inches (75 mm) in diameter.

1. Shutoff Rods: Steel, tee-handle with one pointed end, stem of length to operate deepest buried valve, and slotted end matching curb valve.

## 2.7 WATER METERS

A. Water meters will be furnished by utility company.

B. Manufacturers:

1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:

    a. AMCO Water Metering Systems.
    b. Badger Meter, Inc.
    c. Carlon Meter.
    d. Hays Fluid Controls.
    e. McCrometer, Inc.
    f. Mueller Co.
    g. Neptune Technology Group Inc.
    h. Sensus Metering Systems.

C. Displacement-Type Water Meters:

1. Description: With bronze main case.

a. Standard: AWWA C700.
b. Registration: Flow in gallons (liters).

D. Compound-Type Water Meters:

1. Description:

a. Standard: AWWA C702.
b. Registration: Flow in gallons (liters).

## 2.8 BACKFLOW PREVENTERS

A. Reduced-Pressure-Principle Backflow Preventers:

1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:

a. Ames Fire & Waterworks; A WATTS Brand.
b. Apollo Flow Controls; Conbraco Industries, Inc.
c. FEBCO; A WATTS Brand.
d. Flowmatic Corporation.
e. WATTS.
f. Wilkins.
g. Zurn Industries, LLC.

2. Standard: ASSE 1013 or AWWA C511.
3. Operation: Continuous-pressure applications.
4. Pressure Loss: 12 psig (83 kPa) maximum, through middle 1/3 of flow range.
5. Body: Bronze for NPS 2 (DN 50) and smaller; cast iron with interior lining complying with AWWA C550 or that is FDA approved for NPS 2-1/2 (DN 65) and larger.
6. End Connections: Threaded for NPS 2 (DN 50) and smaller; flanged for NPS 2-1/2 (DN 65) and larger.
7. Configuration: Designed for vertical inlet, horizontal center section, and vertical outlet flow.
8. Accessories:

a. Valves: Ball type with threaded ends on inlet and outlet of NPS 2 (DN 50) and smaller; OS&Y gate type with flanged ends on inlet and outlet of NPS 2-1/2 (DN 65) and larger.
b. Air-Gap Fitting: ASME A112.1.2, matching backflow preventer connection.

B. Double-Check, Backflow-Prevention Assemblies:

1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:

a. Ames Fire & Waterworks; A WATTS Brand.
b. Apollo Flow Controls; Conbraco Industries, Inc.
c. FEBCO; A WATTS Brand.
d. Flowmatic Corporation.
e. WATTS.
f. Wilkins.
g. Zurn Industries, LLC.

2. Standard: ASSE 1015 or AWWA C510.
3. Operation: Continuous-pressure applications, unless otherwise indicated.
4. Pressure Loss: 5 psig (35 kPa) maximum, through middle 1/3 of flow range.
5. Body: Bronze for NPS 2 (DN 50) and smaller; cast iron with interior lining complying with AWWA C550 or that is FDA approved for NPS 2-1/2 (DN 65) and larger.
6. End Connections: Threaded for NPS 2 (DN 50) and smaller; flanged for NPS 2-1/2 (DN 65) and larger.
7. Configuration: Designed for horizontal, straight through flow.
8. Accessories: Ball valves with threaded ends on inlet and outlet of NPS 2 (DN 50) and smaller; OS&Y gate valves with flanged ends on inlet and outlet of NPS 2-1/2 (DN 65) and larger.

## 2.9 WATER METER BOXES

A. Description: Cast-iron body and cover for disc-type water meter, with lettering "WATER METER" in cover; and with slotted, open-bottom base section of length to fit over service piping.

1. Option: Base section may be cast-iron, PVC, clay, or other pipe.

B. Description: Cast-iron body and double cover for disc-type water meter, with lettering "WATER METER" in top cover; and with separate inner cover; air space between covers; and slotted, open-bottom base section of length to fit over service piping.

C. Description: Polymer-concrete body and cover for disc-type water meter, with lettering "WATER" in cover; and with slotted, open-bottom base section of length to fit over service piping. Include vertical and lateral design loadings of 15,000 lb minimum over 10 by 10 inches (6800 kg minimum over 254 by 254 mm) square.

## 2.10 CONCRETE VAULTS

A. Description: Precast, reinforced-concrete vault, designed for A-16 load designation according to ASTM C 857 and made according to ASTM C 858.

1. Ladder: ASTM A 36/A 36M, steel or polyethylene-encased steel steps.
2. Manhole: ASTM A 48/A 48M Class No. 35A minimum tensile strength, gray-iron traffic frame and cover.

a. Dimension: 24-inch (610-mm) minimum diameter, unless otherwise indicated.

3. Manhole: ASTM A 536, Grade 60-40-18, ductile-iron traffic frame and cover.

   a. Dimension: 24-inch- (610-mm-) minimum diameter, unless otherwise indicated.

4. Drain: ASME A112.6.3, cast-iron floor drain with outlet of size indicated. Include body anchor flange, light-duty cast-iron grate, bottom outlet, and integral or field-installed bronze ball or clapper-type backwater valve.

## PART 3 - EXECUTION

### 3.1 EARTHWORK

A. Refer to Section 312000 "Earth Moving" for excavating, trenching, and backfilling.

### 3.2 PIPING APPLICATIONS

A. General: Use pipe, fittings, and joining methods for piping systems according to the following applications.

B. Transition couplings and special fittings with pressure ratings at least equal to piping pressure rating may be used, unless otherwise indicated.

C. Do not use flanges or unions for underground piping.

D. Flanges, unions, and special fittings may be used, instead of joints indicated, on aboveground piping and piping in vaults.

E. Underground water-service piping NPS 3/4 to NPS 3 (DN 20 to DN 80) shall be soft copper tube, ASTM B 88, Type K (ASTM B 88M, Type A); wrought-copper, solder-joint fittings; and brazed joints.

F. Underground water-service piping NPS 4 and NPS 6 (DN 100 and DN 150) shall be any of the following:

   1. Soft copper tube, ASTM B 88, Type K (ASTM B 88M, Type A); wrought-copper, solder-joint fittings; and brazed joints.
   2. Ductile-iron, push-on-joint pipe; ductile-iron, push-on-joint fittings; and gasketed joints.
   3. NPS 4 and NPS 6 (DN 100 and DN 150): NPS 6 (DN 150) PVC, AWWA Class 150 pipe; PVC, AWWA Class 150 molded fittings; and gasketed joints.

G. Water Meter Box Water-Service Piping NPS 3/4 to NPS 2 (DN 20 to DN 50) shall be same as underground water-service piping.

H. Aboveground Water-Service Piping NPS 3/4 to NPS 3 (DN 20 to DN 80) shall be hard copper tube, ASTM B 88, Type K (ASTM B 88M, Type A); wrought-copper, solder-joint fittings; and brazed joints.

I. Abovegroundwater-service piping NPS 4 and NPS 6 (DN 100 and DN 150) shall be any of the following:

1. Hard copper tube, ASTM B 88, Type K (ASTM B 88M, Type A); wrought-copper, solder-joint fittings; and brazed joints.
2. Ductile-iron, grooved-end pipe; ductile-iron, grooved-end appurtenances; and grooved joints.

J. Underground Fire-Service-Main Piping NPS 4 to NPS 8 (DN 100 to DN 200) shall be any of the following:

1. Ductile-iron, mechanical-joint pipe; ductile-iron, mechanical-joint fittings; and mechanical joints.
2. PE, Class 150, fire-service pipe; molded PE fittings; and heat-fusion joints.
3. PVC, AWWA Class 150 pipe listed for fire-protection service; PVC Class 150 fabricated or molded fittings; and gasketed joints.
4. PVC, AWWA Class 200 pipe listed for fire-protection service; PVC Class 200 fabricated fittings; and gasketed joints.

K. Aboveground Fire-Service-Main Piping NPS 4 to NPS 8 (DN 100 to DN 200) shall be ductile-iron, grooved-end pipe; ductile-iron-pipe appurtenances; and grooved joints.

L. Underground Combined Water-Service and Fire-Service-Main Piping NPS 6 to NPS 10 (DN 150 to DN 250) shall be any of the following:

1. Ductile-iron, mechanical-joint pipe; ductile-iron, mechanical-joint fittings; and mechanical grooved-end pipe; ductile-iron-pipe appurtenances; and grooved joints.
2. PVC, AWWA Class 150 pipe listed for fire-protection service; PVC fabricated or molded fittings of same class as pipe; and gasketed joints.

M. Aboveground Combined Water Service and Fire-Service-Main Piping NPS 6 to NPS 10 (DN 150 to DN 250) shall be ductile-iron, grooved-end pipe; ductile-iron-pipe appurtenances; and grooved joints.

## 3.3 VALVE APPLICATIONS

A. General Application: Use mechanical-joint-end valves for NPS 3 (DN 80) and larger underground installation. Use threaded- or flanged-end valves for installation in vaults. Use UL/FMG, nonrising-stem gate valves for installation with indicator posts. Use corporation valves and curb valves with ends compatible with piping, for NPS 2 (DN 50) and smaller installation.

B. Drawings indicate valve types to be used. Where specific valve types are not indicated, the following requirements apply:

1. Underground Valves, NPS 3 (DN 80) and Larger: AWWA, cast-iron, nonrising-stem, metal-seated gate valves with valve box.
2. Underground Valves, NPS 4 (DN 100) and Larger, for Indicator Posts: UL/FMG, cast-iron, nonrising-stem gate valves with indicator post.

3. Use the following for valves in vaults and aboveground:

   a. Gate Valves, NPS 2 (DN 50) and Smaller: Bronze, nonrising stem.
   b. Gate Valves, NPS 3 (DN 80) and Larger: AWWA, cast iron, OS&Y rising stem, metal seated.

## 3.4 PIPING SYSTEMS - COMMON REQUIREMENTS

A. See Section 330500 "Common Work Results for Utilities" for piping-system common requirements.

## 3.5 PIPING INSTALLATION

A. Water-Main Connection: Arrange with utility company for tap of size and in location indicated in water main.

B. Water-Main Connection: Tap water main according to requirements of water utility company and of size and in location indicated.

C. Make connections larger than NPS 2 (DN 50) with tapping machine according to the following:

1. Install tapping sleeve and tapping valve according to MSS SP-60.
2. Install tapping sleeve on pipe to be tapped. Position flanged outlet for gate valve.
3. Use tapping machine compatible with valve and tapping sleeve; cut hole in main. Remove tapping machine and connect water-service piping.
4. Install gate valve onto tapping sleeve. Comply with MSS SP-60. Install valve with stem pointing up and with valve box.

D. Make connections NPS 2 (DN 50) and smaller with drilling machine according to the following:

1. Install service-saddle assemblies and corporation valves in size, quantity, and arrangement required by utility company standards.
2. Install service-saddle assemblies on water-service pipe to be tapped. Position outlets for corporation valves.
3. Use drilling machine compatible with service-saddle assemblies and corporation valves. Drill hole in main. Remove drilling machine and connect water-service piping.
4. Install corporation valves into service-saddle assemblies.
5. Install manifold for multiple taps in water main.
6. Install curb valve in water-service piping with head pointing up and with service box.

E. Comply with NFPA 24 for fire-service-main piping materials and installation.

1. Install copper tube and fittings according to CDA's "Copper Tube Handbook."

F. Install ductile-iron, water-service piping according to AWWA C600 and AWWA M41.

G. Install PE pipe according to ASTM D 2774 and ASTM F 645.

H. Install PVC, AWWA pipe according to ASTM F 645 and AWWA M23.

I. Bury piping with depth of cover over top at least 30 inches (750 mm), with top at least 12 inches (300 mm) below level of maximum frost penetration.

J. Extend water-service piping and connect to water-supply source and building-water-piping systems at outside face of building wall in locations and pipe sizes indicated.

1. Terminate water-service piping at building wall until building-water-piping systems are installed. Terminate piping with caps, plugs, or flanges as required for piping material. Make connections to building-water-piping systems when those systems are installed.

K. Sleeves are specified in Section 220517 "Sleeves and Sleeve Seals for Plumbing Piping."

L. Mechanical sleeve seals are specified in Section 220517 "Sleeves and Sleeve Seals for Plumbing Piping."

M. Install underground piping with restrained joints at horizontal and vertical changes in direction. Use restrained-joint piping, thrust blocks, anchors, tie-rods and clamps, and other supports.

## 3.6 JOINT CONSTRUCTION

A. See Section 330500 "Common Work Results for Utilities" for basic piping joint construction.

B. Make pipe joints according to the following:

1. Ductile-Iron Piping, Gasketed Joints for Water-Service Piping: AWWA C600 and AWWA M41.
2. Ductile-Iron Piping, Gasketed Joints for Fire-Service-Main Piping: UL 194.
3. Ductile-Iron Piping, Grooved Joints: Cut-groove pipe. Assemble joints with grooved-end, ductile-iron-piping couplings, gaskets, lubricant, and bolts according to coupling manufacturer's written instructions.
4. PE Piping Insert-Fitting Joints: Use plastic insert fittings and fasteners according to fitting manufacturer's written instructions.
5. PVC Piping Gasketed Joints: Use joining materials according to AWWA C900. Construct joints with elastomeric seals and lubricant according to ASTM D 2774 or ASTM D 3139 and pipe manufacturer's written instructions.
6. Dissimilar Materials Piping Joints: Use adapters compatible with both piping materials, with OD, and with system working pressure.

## 3.7 ANCHORAGE INSTALLATION

A. Anchorage, General: Install water-distribution piping with restrained joints. Anchorages and restrained-joint types that may be used include the following:

1. Concrete thrust blocks.
2. Locking mechanical joints.
3. Set-screw mechanical retainer glands.
4. Bolted flanged joints.
5. Heat-fused joints.

6. Pipe clamps and tie rods.

B. Install anchorages for tees, plugs and caps, bends, crosses, valves, and hydrant branches. Include anchorages for the following piping systems:

1. Gasketed-Joint, Ductile-Iron, Water-Service Piping: According to AWWA C600.
2. Gasketed-Joint, PVC Water-Service Piping: According to AWWA M23.
3. Fire-Service-Main Piping: According to NFPA 24.

C. Apply full coat of asphalt or other acceptable corrosion-resistant material to surfaces of installed ferrous anchorage devices.

## 3.8 VALVE INSTALLATION

A. AWWA Gate Valves: Comply with AWWA C600 and AWWA M44. Install each underground valve with stem pointing up and with valve box.

B. UL/FMG, Gate Valves: Comply with NFPA 24. Install each underground valve and valves in vaults with stem pointing up and with vertical cast-iron indicator post.

C. MSS Valves: Install as component of connected piping system.

D. Corporation Valves and Curb Valves: Install each underground curb valve with head pointed up and with service box.

## 3.9 WATER METER INSTALLATION

A. Install water meters, piping, and specialties according to utility company's written instructions.

B. Water Meters: Install displacement-type water meters, NPS 2 (DN 50) and smaller, in meter boxes with shutoff valves on water meter inlets. Include valves on water meter outlets and valved bypass around meters unless prohibited by authorities having jurisdiction.

C. Water Meters: Install compound-type water meters, NPS 3 (DN 80) and larger, in meter vaults. Include shutoff valves on water meter inlets and outlets and valved bypass around meters. Support meters, valves, and piping on brick or concrete piers.

## 3.10 BACKFLOW PREVENTER INSTALLATION

A. Install backflow preventers of type, size, and capacity indicated. Include valves and test cocks. Install according to requirements of plumbing and health department and authorities having jurisdiction.

B. Do not install backflow preventers that have relief drain in vault or in other spaces subject to flooding.

C. Do not install bypass piping around backflow preventers.

D. Support NPS 2-1/2 (DN 65) and larger backflow preventers, valves, and piping near floor and on brick or concrete piers.

## 3.11 WATER METER BOX INSTALLATION

A. Install water meter boxes in paved areas flush with surface.

B. Install water meter boxes in grass or earth areas with top 2 inches (50 mm) above surface.

## 3.12 CONNECTIONS

A. See Section 330500 "Common Work Results for Utilities" for piping connections to valves and equipment.

B. Connect water-distribution piping to utility water main. Use tapping sleeve and tapping valve.

C. Connect water-distribution piping to interior domestic water and fire-suppression piping.

D. Connect waste piping from concrete vault drains to sanitary sewerage system. See Section 221313 "Facility Sanitary Sewers" for connection to sanitary-sewer piping.

## 3.13 FIELD QUALITY CONTROL

A. Piping Tests: Conduct piping tests before joints are covered and after concrete thrust blocks have hardened sufficiently. Fill pipeline 24 hours before testing and apply test pressure to stabilize system. Use only potable water.

B. Hydrostatic Tests: Test at not less than one-and-one-half times working pressure for two hours.

1. Increase pressure in 50-psig (350-kPa) increments and inspect each joint between increments. Hold at test pressure for 1 hour; decrease to 0 psig (0 kPa). Slowly increase again to test pressure and hold for 1 more hour. Maximum allowable leakage is 2 quarts (1.89 L) per hour per 100 joints. Remake leaking joints with new materials and repeat test until leakage is within allowed limits.

C. Prepare reports of testing activities.

## 3.14 IDENTIFICATION

A. Install continuous underground detectable warning tape during backfilling of trench for underground water-distribution piping. Locate below finished grade, directly over piping. Underground warning tapes are specified in Section 312000 "Earth Moving."

B. Permanently attach equipment nameplate or marker indicating plastic water-service piping, on main electrical meter panel. See Section 330500 "Common Work Results for Utilities" for identifying devices.

3.15 CLEANING

A. Clean and disinfect water-distribution piping as follows:

1. Purge new water-distribution piping systems and parts of existing systems that have been altered, extended, or repaired before use.
2. Use purging and disinfecting procedure prescribed by authorities having jurisdiction or, if method is not prescribed by authorities having jurisdiction, use procedure described in NFPA 24 for flushing of piping. Flush piping system with clean, potable water until dirty water does not appear at points of outlet.
3. Use purging and disinfecting procedure prescribed by authorities having jurisdiction or, if method is not prescribed by authorities having jurisdiction, use procedure described in AWWA C651 or do as follows:

    a. Fill system or part of system with water/chlorine solution containing at least 50 ppm of chlorine; isolate and allow to stand for 24 hours.
    b. Drain system or part of system of previous solution and refill with water/chlorine solution containing at least 200 ppm of chlorine; isolate and allow to stand for 3 hours.
    c. After standing time, flush system with clean, potable water until no chlorine remains in water coming from system.
    d. Submit water samples in sterile bottles to authorities having jurisdiction. Repeat procedure if biological examination shows evidence of contamination.

B. Prepare reports of purging and disinfecting activities.

END OF SECTION 221113

SECTION 221116 - DOMESTIC WATER PIPING

PART 1 - GENERAL

1.1 SUMMARY

A. Section includes under-building-slab and aboveground domestic water pipes, tubes, and fittings inside buildings.

1.2 ACTION SUBMITTALS

A. Product Data: For transition fittings and dielectric fittings.

1.3 INFORMATIONAL SUBMITTALS

A. System purging and disinfecting activities report.

B. Field quality-control reports.

PART 2 - PRODUCTS

2.1 PIPING MATERIALS

A. Comply with requirements in "Piping Schedule" Article for applications of pipe, tube, fitting materials, and joining methods for specific services, service locations, and pipe sizes.

B. Potable-water piping and components shall comply with NSF 14 and NSF 61. Plastic piping components shall be marked with "NSF-pw."

C. Any reference within the specifications referring to PEX piping shall be construed to describe PEX-a piping as manufactured by Uponor or equal.

2.2 COPPER TUBE AND FITTINGS

A. Hard Copper Tube: ASTM B 88, Type L water tube, drawn temper.

B. Soft Copper Tube: ASTM B 88, Type K and ASTM B 88, Type L water tube, annealed temper.

C. Cast-Copper, Solder-Joint Fittings: ASME B16.18, pressure fittings.

D. Wrought-Copper, Solder-Joint Fittings: ASME B16.22, wrought-copper pressure fittings.

E. Bronze Flanges: ASME B16.24, Class 150, with solder-joint ends.

F. Copper Unions:

1. MSS SP-123.
2. Cast-copper-alloy, hexagonal-stock body.
3. Ball-and-socket, metal-to-metal seating surfaces.
4. Solder-joint or threaded ends.

G. Copper Pressure-Seal-Joint Fittings:

1. Fittings for NPS 2 and Smaller: Wrought-copper fitting with EPDM-rubber, O-ring seal in each end.
2. Fittings for NPS 2-1/2 to NPS 4: Cast-bronze or wrought-copper fitting with EPDM-rubber, O-ring seal in each end.

H. Copper Push-on-Joint Fittings:

1. Cast-copper fitting complying with ASME B16.18 or wrought-copper fitting complying with ASME B 16.22.
2. Stainless-steel teeth and EPDM-rubber, O-ring seal in each end instead of solder-joint ends.

2.3 DUCTILE-IRON PIPE AND FITTINGS

A. Mechanical-Joint, Ductile-Iron Pipe:

1. AWWA C151/A21.51, with mechanical-joint bell and plain spigot end unless grooved or flanged ends are indicated.
2. Glands, Gaskets, and Bolts: AWWA C111/A21.11, ductile- or gray-iron glands, rubber gaskets, and steel bolts.

B. Standard-Pattern, Mechanical-Joint Fittings:

1. AWWA C110/A21.10, ductile or gray iron.
2. Glands, Gaskets, and Bolts: AWWA C111/A21.11, ductile- or gray-iron glands, rubber gaskets, and steel bolts.

C. Compact-Pattern, Mechanical-Joint Fittings:

1. AWWA C153/A21.53, ductile iron.
2. Glands, Gaskets, and Bolts: AWWA C111/A21.11, ductile- or gray-iron glands, rubber gaskets, and steel bolts.

2.4 GALVANIZED-STEEL PIPE AND FITTINGS

A. Galvanized-Steel Pipe:

1. ASTM A 53/A 53M, Type E, Grade B, Standard Weight.
2. Include ends matching joining method.

B. Galvanized-Steel Pipe Nipples: ASTM A 733, made of ASTM A 53/A 53M or ASTM A 106/A 106M, Standard Weight, seamless steel pipe with threaded ends.

C. Galvanized, Gray-Iron Threaded Fittings: ASME B16.4, Class 125, standard pattern.

D. Malleable-Iron Unions:

1. ASME B16.39, Class 150.
2. Hexagonal-stock body.
3. Ball-and-socket, metal-to-metal, bronze seating surface.
4. Threaded ends.

E. Flanges: ASME B16.1, Class 125, cast iron.

2.5 CPVC PIPING

A. CPVC Pipe: ASTM F 441/F 441M, Schedule 40 and Schedule 80.

1. CPVC Socket Fittings: ASTM F 439 for Schedule 80.
2. CPVC Threaded Fittings: ASTM F 437, Schedule 80.

B. CPVC Piping System: ASTM D 2846/D 2846M, SDR 11, pipe and socket fittings.

C. CPVC Tubing System: ASTM D 2846/D 2846M, SDR 11, tube and socket fittings.

2.6 PEX TUBE AND FITTINGS

A. PEX Distribution System: ASTM F 877, SDR 9 tubing.

B. Fittings for PEX Tube: ASTM F 1807, metal-insert type with copper or stainless-steel crimp rings and matching PEX tube dimensions.

C. Manifold: Multiple-outlet, plastic or corrosion-resistant-metal assembly complying with ASTM F 877; with plastic or corrosion-resistant-metal valve for each outlet.

2.7 PVC PIPE AND FITTINGS

A. PVC Pipe: ASTM D 1785, Schedule 80.

B. PVC Socket Fittings: ASTM D 2467 for Schedule 80.

C. PVC Schedule 80 Threaded Fittings: ASTM D 2464.

2.8 PIPING JOINING MATERIALS

A. Pipe-Flange Gasket Materials:

1. AWWA C110/A21.10, rubber, flat face, 1/8 inch thick or ASME B16.21, nonmetallic and asbestos free unless otherwise indicated.
2. Full-face or ring type unless otherwise indicated.

B. Metal, Pipe-Flange Bolts and Nuts: ASME B18.2.1, carbon steel unless otherwise indicated.

C. Solder Filler Metals: ASTM B 32, lead-free alloys.

D. Flux: ASTM B 813, water flushable.

E. Brazing Filler Metals: AWS A5.8/A5.8M, BCuP Series, copper-phosphorus alloys for general-duty brazing unless otherwise indicated.

F. Solvent Cements for Joining CPVC Piping and Tubing: ASTM F 493.

1. CPVC solvent cement shall have a VOC content of 490 g/L or less when calculated according to 40 CFR 59, Subpart D (EPA Method 24).
2. Adhesive primer shall have a VOC content of 550 g/L or less when calculated according to 40 CFR 59, Subpart D (EPA Method 24).
3. Solvent cement and adhesive primer shall comply with the testing and product requirements of the California Department of Health Services' "Standard Practice for the Testing of Volatile Organic Emissions from Various Sources Using Small-Scale Environmental Chambers."

G. Solvent Cements for Joining PVC Piping: ASTM D 2564. Include primer according to ASTM F 656.

1. PVC solvent cement shall have a VOC content of 510 g/L or less when calculated according to 40 CFR 59, Subpart D (EPA Method 24).
2. Adhesive primer shall have a VOC content of 550 g/L or less when calculated according to 40 CFR 59, Subpart D (EPA Method 24).
3. Solvent cement and adhesive primer shall comply with the testing and product requirements of the California Department of Health Services' "Standard Practice for the Testing of Volatile Organic Emissions from Various Sources Using Small-Scale Environmental Chambers."

H. Plastic, Pipe-Flange Gaskets, Bolts, and Nuts: Type and material recommended by piping system manufacturer unless otherwise indicated.

2.9 TRANSITION FITTINGS

A. General Requirements:

1. Same size as pipes to be joined.
2. Pressure rating at least equal to pipes to be joined.
3. End connections compatible with pipes to be joined.

B. Fitting-Type Transition Couplings: Manufactured piping coupling or specified piping system fitting.

C. Plastic-to-Metal Transition Fittings:

1. Manufacturers: Subject to compliance with requirements, provide products by the following available manufacturers offering products that may be incorporated into the Work include, but are not limited to, the following:
2. Basis-of-Design Product: Subject to compliance with requirements, provide product indicated on Drawings or comparable product by one of the following:

   a. Charlotte Pipe and Foundry Company.
   b. Harvel Plastics, Inc.
   c. Spears Manufacturing Company.

3. Description:

   a. CPVC or PVC one-piece fitting with manufacturer's Schedule 80 equivalent dimensions.
   b. One end with threaded brass insert and one solvent-cement-socket or threaded end.

D. Plastic-to-Metal Transition Unions:

1. Manufacturers: Subject to compliance with requirements, provide products by the following available manufacturers offering products that may be incorporated into the Work include, but are not limited to, the following:
2. Basis-of-Design Product: Subject to compliance with requirements, provide product indicated on Drawings or comparable product by one of the following:

   a. Colonial Engineering, Inc.
   b. NIBCO Inc.
   c. Spears Manufacturing Company.

3. Description:

   a. CPVC or PVC four-part union.
   b. Brass or stainless-steel threaded end.
   c. Solvent-cement-joint or threaded plastic end.
   d. Rubber O-ring.

e. Union nut.

2.10 DIELECTRIC FITTINGS

A. General Requirements: Assembly of copper alloy and ferrous materials with separating nonconductive insulating material. Include end connections compatible with pipes to be joined.

B. Dielectric Unions:

1. Manufacturers: Subject to compliance with requirements, provide products by the following available manufacturers offering products that may be incorporated into the Work include, but are not limited to, the following:
2. Basis-of-Design Product: Subject to compliance with requirements, provide product indicated on Drawings or comparable product by one of the following:

   a. Capitol Manufacturing Company; member of the Phoenix Forge Group.
   b. Central Plastics Company.
   c. Hart Industries International, Inc.
   d. Jomar International.
   e. Matco-Norca.
   f. McDonald, A. Y. Mfg. Co.
   g. Watts; a division of Watts Water Technologies, Inc.
   h. Wilkins; a Zurn company.

3. Standard: ASSE 1079.
4. Pressure Rating: 125 psig minimum at 180 deg F.
5. End Connections: Solder-joint copper alloy and threaded ferrous.

C. Dielectric Flanges:

1. Manufacturers: Subject to compliance with requirements, provide products by the following available manufacturers offering products that may be incorporated into the Work include, but are not limited to, the following:
2. Basis-of-Design Product: Subject to compliance with requirements, provide product indicated on Drawings or comparable product by one of the following:

   a. Capitol Manufacturing Company; member of the Phoenix Forge Group.
   b. Central Plastics Company.
   c. Matco-Norca.
   d. Watts; a division of Watts Water Technologies, Inc.
   e. Wilkins; a Zurn company.

3. Standard: ASSE 1079.
4. Factory-fabricated, bolted, companion-flange assembly.
5. Pressure Rating: 125 psig minimum at 180 deg F.

6. End Connections: Solder-joint copper alloy and threaded ferrous; threaded solder-joint copper alloy and threaded ferrous.

D. Dielectric-Flange Insulating Kits:

1. Manufacturers: Subject to compliance with requirements, provide products by the following available manufacturers offering products that may be incorporated into the Work include, but are not limited to, the following:
2. Basis-of-Design Product: Subject to compliance with requirements, provide product indicated on Drawings or comparable product by one of the following:

    a. Advance Products & Systems, Inc.
    b. Calpico, Inc.
    c. Central Plastics Company.
    d. Pipeline Seal and Insulator, Inc.

3. Nonconducting materials for field assembly of companion flanges.
4. Pressure Rating: 150 psig.
5. Gasket: Neoprene or phenolic.
6. Bolt Sleeves: Phenolic or polyethylene.
7. Washers: Phenolic with steel backing washers.

E. Dielectric Nipples:

1. Manufacturers: Subject to compliance with requirements, provide products by the following available manufacturers offering products that may be incorporated into the Work include, but are not limited to, the following:
2. Basis-of-Design Product: Subject to compliance with requirements, provide product indicated on Drawings or comparable product by one of the following:

    a. Elster Perfection Corporation.
    b. Grinnell Mechanical Products; Tyco Fire Products LP.
    c. Matco-Norca.
    d. Precision Plumbing Products, Inc.
    e. Victaulic Company.

3. Standard: IAPMO PS 66.
4. Electroplated steel nipple complying with ASTM F 1545.
5. Pressure Rating and Temperature: 300 psig at 225 deg F.
6. End Connections: Male threaded or grooved.
7. Lining: Inert and noncorrosive, propylene.

PART 3 - EXECUTION

3.1 EARTHWORK

A. Comply with requirements in "Earth Moving" for excavating, trenching, and backfilling.

3.2 PIPING INSTALLATION

A. Drawing plans, schematics, and diagrams indicate general location and arrangement of domestic water piping. Indicated locations and arrangements are used to size pipe and calculate friction loss, expansion, and other design considerations. Install piping as indicated unless deviations to layout are approved on coordination drawings.

B. Install copper tubing under building slab according to CDA's "Copper Tube Handbook."

C. Install ductile-iron piping under building slab with restrained joints according to AWWA C600 and AWWA M41.

D. Install shutoff valve, hose-end drain valve, strainer, pressure gage, and test tee with valve inside the building at each domestic water-service entrance. Comply with requirements for drain valves and strainers in Section 221119 "Domestic Water Piping Specialties."

E. Install shutoff valve immediately upstream of each dielectric fitting.

F. Install water-pressure-reducing valves downstream from shutoff valves. Comply with requirements for pressure-reducing valves in Section 221119 "Domestic Water Piping Specialties."

G. Install domestic water piping level with 0.25 percent slope downward toward drain and plumb.

H. Rough-in domestic water piping for water-meter installation according to utility company's requirements.

I. Install seismic restraints on piping. Comply with requirements for seismic-restraint devices in Section 220548 "Vibration and Seismic Controls for Plumbing Piping and Equipment."

J. Install piping concealed from view and protected from physical contact by building occupants unless otherwise indicated and except in equipment rooms and service areas.

K. Install piping indicated to be exposed and piping in equipment rooms and service areas at right angles or parallel to building walls. Diagonal runs are prohibited unless specifically indicated otherwise.

L. Install piping above accessible ceilings to allow sufficient space for ceiling panel removal, and coordinate with other services occupying that space.

M. Install piping to permit valve servicing.

N. Install nipples, unions, special fittings, and valves with pressure ratings the same as or higher than the system pressure rating used in applications below unless otherwise indicated.

O. Install piping free of sags and bends.

P. Install fittings for changes in direction and branch connections.

Q. Install PEX piping with loop at each change of direction of more than 90 degrees.

R. Install unions in copper tubing at final connection to each piece of equipment, machine, and specialty.

S. Install pressure gages on suction and discharge piping for each plumbing pump and packaged booster pump. Comply with requirements for pressure gages in Section 220519 "Meters and Gages for Plumbing Piping."

T. Install thermostats in hot-water circulation piping. Comply with requirements for thermostats in Section 221123 "Domestic Water Pumps."

U. Install sleeves for piping penetrations of walls, ceilings, and floors. Comply with requirements for sleeves specified in Section 220517 "Sleeves and Sleeve Seals for Plumbing Piping."

V. Install sleeve seals for piping penetrations of concrete walls and slabs. Comply with requirements for sleeve seals specified in Section 220517 "Sleeves and Sleeve Seals for Plumbing Piping."

W. Install escutcheons for piping penetrations of walls, ceilings, and floors. Comply with requirements for escutcheons specified in Section 220518 "Escutcheons for Plumbing Piping."

3.3 JOINT CONSTRUCTION

A. Ream ends of pipes and tubes and remove burrs. Bevel plain ends of steel pipe.

B. Remove scale, slag, dirt, and debris from inside and outside of pipes, tubes, and fittings before assembly.

C. Threaded Joints: Thread pipe with tapered pipe threads according to ASME B1.20.1. Cut threads full and clean using sharp dies. Ream threaded pipe ends to remove burrs and restore full ID. Join pipe fittings and valves as follows:

1. Apply appropriate tape or thread compound to external pipe threads.
2. Damaged Threads: Do not use pipe or pipe fittings with threads that are corroded or damaged.

D. Brazed Joints for Copper Tubing: Comply with CDA's "Copper Tube Handbook," "Brazed Joints" chapter.

E. Soldered Joints for Copper Tubing: Apply ASTM B 813, water-flushable flux to end of tube. Join copper tube and fittings according to ASTM B 828 or CDA's "Copper Tube Handbook."

F. Pressure-Sealed Joints for Copper Tubing: Join copper tube and pressure-seal fittings with tools recommended by fitting manufacturer.

G. Flanged Joints: Select appropriate asbestos-free, nonmetallic gasket material in size, type, and thickness suitable for domestic water service. Join flanges with gasket and bolts according to ASME B31.9.

H. Joint Construction for Solvent-Cemented Plastic Piping: Clean and dry joining surfaces. Join pipe and fittings according to the following:

1. Comply with ASTM F 402 for safe-handling practice of cleaners, primers, and solvent cements. Apply primer.
2. CPVC Piping: Join according to ASTM D 2846/D 2846M Appendix.
3. PVC Piping: Join according to ASTM D 2855.

I. Joints for PEX Piping: Join according to ASTM F 1807.

J. Joints for Dissimilar-Material Piping: Make joints using adapters compatible with materials of both piping systems.

## 3.4 TRANSITION FITTING INSTALLATION

A. Install transition couplings at joints of dissimilar piping.

B. Transition Fittings in Underground Domestic Water Piping:

1. Fittings for NPS 1-1/2 and Smaller: Fitting-type coupling.
2. Fittings for NPS 2 and Larger: Sleeve-type coupling.

C. Transition Fittings in Aboveground Domestic Water Piping NPS 2 and Smaller: Plastic-to-metal transition fittings or unions.

## 3.5 DIELECTRIC FITTING INSTALLATION

A. Install dielectric fittings in piping at connections of dissimilar metal piping and tubing.

B. Dielectric Fittings for NPS 2 and Smaller: Use dielectric couplings or nipples unions.

C. Dielectric Fittings for NPS 2-1/2 to NPS 4: Use dielectric flange kits.

D. Dielectric Fittings for NPS 5 and Larger: Use dielectric flange kits.

3.6 HANGER AND SUPPORT INSTALLATION

A. Comply with requirements for seismic-restraint devices in Section 220548 "Vibration and Seismic Controls for Plumbing Piping and Equipment."

B. Comply with requirements for pipe hanger, support products, and installation in Section 220529 "Hangers and Supports for Plumbing Piping and Equipment."

1. Vertical Piping: MSS Type 8 or 42, clamps.
2. Individual, Straight, Horizontal Piping Runs:

    a. 100 Feet and Less: MSS Type 1, adjustable, steel clevis hangers.
    b. Longer Than 100 Feet: MSS Type 43, adjustable roller hangers.
    c. Longer Than 100 Feet if Indicated: MSS Type 49, spring cushion rolls.

3. Multiple, Straight, Horizontal Piping Runs 100 Feet or Longer: MSS Type 44, pipe rolls. Support pipe rolls on trapeze.
4. Base of Vertical Piping: MSS Type 52, spring hangers.

C. Support vertical piping and tubing at base and at each floor.

D. Rod diameter may be reduced one size for double-rod hangers, to a minimum of 3/8 inch.

E. Install hangers for copper tubing with the following maximum horizontal spacing and minimum rod diameters:

1. NPS 3/4 and Smaller: 60 inches with 3/8-inch rod.
2. NPS 1 and NPS 1-1/4: 72 inches with 3/8-inch rod.
3. NPS 1-1/2 and NPS 2: 96 inches with 3/8-inch rod.
4. NPS 2-1/2: 108 inches with 1/2-inch rod.
5. NPS 3 to NPS 5: 10 feet with 1/2-inch rod.
6. NPS 6: 10 feet with 5/8-inch rod.
7. NPS 8: 10 feet with 3/4-inch rod.

F. Install supports for vertical copper tubing every 10 feet.

G. Install hangers for steel piping with the following maximum horizontal spacing and minimum rod diameters:

1. NPS 1-1/4 and Smaller: 84 inches with 3/8-inch rod.
2. NPS 1-1/2: 108 inches with 3/8-inch rod.
3. NPS 2: 10 feet with 3/8-inch rod.
4. NPS 2-1/2: 11 feet with 1/2-inch rod.
5. NPS 3 and NPS 3-1/2: 12 feet with 1/2-inch rod.
6. NPS 4 and NPS 5: 12 feet with 5/8-inch rod.
7. NPS 6: 12 feet with 3/4-inch rod.
8. NPS 8 to NPS 12: 12 feet with 7/8-inch rod.

H. Install supports for vertical steel piping every 15 feet.

I. Install vinyl-coated hangers for CPVC piping with the following maximum horizontal spacing and minimum rod diameters:

1. NPS 1 and Smaller: 36 inches with 3/8-inch rod.
2. NPS 1-1/4 to NPS 2: 48 inches with 3/8-inch rod.
3. NPS 2-1/2 to NPS 3-1/2: 48 inches with 1/2-inch rod.
4. NPS 4 and NPS 5: 48 inches with 5/8-inch rod.
5. NPS 6: 48 inches with 3/4-inch rod.
6. NPS 8: 48 inches with 7/8-inch rod.

J. Install supports for vertical CPVC piping every 60 inches for NPS 1 and smaller, and every 72 inches for NPS 1-1/4 and larger.

K. Install vinyl-coated hangers for PEX piping with the following maximum horizontal spacing and minimum rod diameters:

1. NPS 1 and Smaller: 32 inches with 3/8-inch rod.

L. Install hangers for vertical PEX piping every 48 inches.

M. Install vinyl-coated hangers for PVC piping with the following maximum horizontal spacing and minimum rod diameters:

1. NPS 2 and Smaller: 48 inches with 3/8-inch rod.
2. NPS 2-1/2 to NPS 3-1/2: 48 inches with 1/2-inch rod.
3. NPS 4 and NPS 5: 48 inches with 5/8-inch rod.
4. NPS 6: 48 inches with 3/4-inch rod.
5. NPS 8: 48 inches with 7/8-inch rod.

N. Install supports for vertical PVC piping every 48 inches.

O. Support piping and tubing not listed in this article according to MSS SP-69 and manufacturer's written instructions.

## 3.7 CONNECTIONS

A. Drawings indicate general arrangement of piping, fittings, and specialties.

B. When installing piping adjacent to equipment and machines, allow space for service and maintenance.

C. Connect domestic water piping to exterior water-service piping. Use transition fitting to join dissimilar piping materials.

D. Connect domestic water piping to water-service piping with shutoff valve; extend and connect to the following:

1. Domestic Water Booster Pumps: Cold-water suction and discharge piping.
2. Water Heaters: Cold-water inlet and hot-water outlet piping in sizes indicated, but not smaller than sizes of water heater connections.
3. Plumbing Fixtures: Cold- and hot-water-supply piping in sizes indicated, but not smaller than that required by plumbing code.
4. Equipment: Cold- and hot-water-supply piping as indicated, but not smaller than equipment connections. Provide shutoff valve and union for each connection. Use flanges instead of unions for NPS 2-1/2 and larger.

## 3.8 IDENTIFICATION

A. Identify system components. Comply with requirements for identification materials and installation in Section 220553 "Identification for Plumbing Piping and Equipment."

B. Label pressure piping with system operating pressure.

## 3.9 FIELD QUALITY CONTROL

A. Perform the following tests and inspections:

1. Piping Inspections:

a. Do not enclose, cover, or put piping into operation until it has been inspected and approved by authorities having jurisdiction.
b. During installation, notify authorities having jurisdiction at least one day before inspection must be made. Perform tests specified below in presence of authorities having jurisdiction:

1) Roughing-in Inspection: Arrange for inspection of piping before concealing or closing in after roughing in and before setting fixtures.
2) Final Inspection: Arrange for authorities having jurisdiction to observe tests specified in "Piping Tests" Subparagraph below and to ensure compliance with requirements.

c. Reinspection: If authorities having jurisdiction find that piping will not pass tests or inspections, make required corrections and arrange for reinspection.
d. Reports: Prepare inspection reports and have them signed by authorities having jurisdiction.

2. Piping Tests:

a. Fill domestic water piping. Check components to determine that they are not air bound and that piping is full of water.

b. Test for leaks and defects in new piping and parts of existing piping that have been altered, extended, or repaired. If testing is performed in segments, submit a separate report for each test, complete with diagram of portion of piping tested.
c. Leave new, altered, extended, or replaced domestic water piping uncovered and unconcealed until it has been tested and approved. Expose work that was covered or concealed before it was tested.
d. Cap and subject piping to static water pressure of 50 psig above operating pressure, without exceeding pressure rating of piping system materials. Isolate test source and allow it to stand for four hours. Leaks and loss in test pressure constitute defects that must be repaired.
e. Repair leaks and defects with new materials, and retest piping or portion thereof until satisfactory results are obtained.
f. Prepare reports for tests and for corrective action required.

B. Domestic water piping will be considered defective if it does not pass tests and inspections.

C. Prepare test and inspection reports.

3.10 ADJUSTING

A. Perform the following adjustments before operation:

1. Close drain valves, hydrants, and hose bibbs.
2. Open shutoff valves to fully open position.
3. Open throttling valves to proper setting.
4. Adjust balancing valves in hot-water-circulation return piping to provide adequate flow.

    a. Manually adjust ball-type balancing valves in hot-water-circulation return piping to provide hot-water flow in each branch.
    b. Adjust calibrated balancing valves to flows indicated.

5. Remove plugs used during testing of piping and for temporary sealing of piping during installation.
6. Remove and clean strainer screens. Close drain valves and replace drain plugs.
7. Remove filter cartridges from housings and verify that cartridges are as specified for application where used and are clean and ready for use.
8. Check plumbing specialties and verify proper settings, adjustments, and operation.

3.11 CLEANING

A. Clean and disinfect potable domestic water piping as follows:

1. Purge new piping and parts of existing piping that have been altered, extended, or repaired before using.

2. Use purging and disinfecting procedures prescribed by authorities having jurisdiction; if methods are not prescribed, use procedures described in either AWWA C651 or AWWA C652 or follow procedures described below:

    a. Flush piping system with clean, potable water until dirty water does not appear at outlets.
    b. Fill and isolate system according to either of the following:

        1) Fill system or part thereof with water/chlorine solution with at least 50 ppm of chlorine. Isolate with valves and allow to stand for 24 hours.
        2) Fill system or part thereof with water/chlorine solution with at least 200 ppm of chlorine. Isolate and allow to stand for three hours.

    c. Flush system with clean, potable water until no chlorine is in water coming from system after the standing time.
    d. Repeat procedures if biological examination shows contamination.
    e. Submit water samples in sterile bottles to authorities having jurisdiction.

B. Prepare and submit reports of purging and disinfecting activities. Include copies of water-sample approvals from authorities having jurisdiction.

C. Clean interior of domestic water piping system. Remove dirt and debris as work progresses.

3.12 PIPING SCHEDULE

A. Transition and special fittings with pressure ratings at least equal to piping rating may be used in applications below unless otherwise indicated.

B. Flanges and unions may be used for aboveground piping joints unless otherwise indicated.

C. Fitting Option: Extruded-tee connections and brazed joints may be used on aboveground copper tubing.

D. Under-building-slab, domestic water, building-service piping, NPS 3 and smaller, shall be one of the following:

1. Soft copper tube, ASTM B 88, Type K; wrought-copper, solder-joint fittings; and brazed joints.
2. PVC, Schedule 80; socket fittings; and solvent-cemented joints.

E. Under-building-slab, domestic water, building-service piping, NPS 4 to NPS 8 and larger, shall be one of the following:

1. Soft copper tube, ASTM B 88, Type K; wrought-copper, solder-joint fittings; and brazed joints.
2. Plain-end, ductile-iron pipe; grooved-joint, ductile-iron-pipe appurtenances; and grooved joints.

3. PVC, Schedule 80; socket fittings; and solvent-cemented joints.

F. Under-building-slab, combined domestic water, building-service, and fire-service-main piping, NPS 6 to NPS 12, shall be one of the following:

1. Plain-end, ductile-iron pipe; grooved-joint, ductile-iron-pipe appurtenances; and grooved joints.

G. Under-building-slab, domestic water piping, NPS 2 and smaller, shall be one of the following:

1. Hard or soft copper tube, ASTM B 88, Type L; wrought-copper, solder-joint fittings; and brazed joints.
2. PVC, Schedule 80; socket fittings; and solvent-cemented joints.

H. Aboveground domestic water piping, NPS 2 and smaller, shall be one of the following:

1. Galvanized-steel pipe and nipples; galvanized, gray-iron threaded fittings; and threaded joints.
2. Hard copper tube, ASTM B 88, Type L; cast- or wrought-copper, solder-joint fittings; and brazed joints.
3. Hard copper tube, ASTM B 88, Type L or ASTM B 88, Type M; copper pressure-seal-joint fittings; and pressure-sealed joints.
4. Hard copper tube, ASTM B 88, Type L or ASTM B 88, Type M; copper push-on-joint fittings; and push-on joints.
5. CPVC, Schedule 80; socket fittings; and solvent-cemented joints.
6. CPVC, Schedule 80 pipe; CPVC, Schedule 80 threaded fittings; and threaded joints.
7. CPVC Tubing System: CPVC tube; CPVC socket fittings; and solvent-cemented joints. NPS 1-1/2 and NPS 2 CPVC pipe with CPVC socket fittings may be used instead of tubing.
8. PEX tube, NPS 1 and smaller; fittings for PEX tube; and crimped joints.
9. PVC, Schedule 80; socket fittings; and solvent-cemented joints.

I. Aboveground domestic water piping, NPS 2-1/2 to NPS 4, shall be one of the following:

1. Hard copper tube, ASTM B 88, Type L; cast- or wrought-copper, solder-joint fittings; and brazed joints.
2. Hard copper tube, ASTM B 88, Type L or ASTM B 88, Type M; copper pressure-seal-joint fittings; and pressure-sealed joints.
3. Hard copper tube, ASTM B 88, Type L or ASTM B 88, Type M; grooved-joint, copper-tube appurtenances; and grooved joints.
4. Galvanized-steel pipe and nipples; galvanized, gray-iron threaded fittings; and threaded joints.
5. CPVC, Schedule 80; socket fittings; and solvent-cemented joints.
6. CPVC, Schedule 80 pipe; CPVC, Schedule 80 threaded fittings; and threaded joints.
7. PVC, Schedule 80; socket fittings; and solvent-cemented joints.

J. Aboveground domestic water piping, NPS 5 to NPS 8, shall be one of the following:

1. Hard copper tube, ASTM B 88, Type L; cast- or wrought-copper, solder-joint fittings; and brazed joints.
2. Hard copper tube, ASTM B 88, Type L or ASTM B 88, Type M; grooved-joint, copper-tube appurtenances; and grooved joints.
3. Galvanized-steel pipe and nipples; galvanized, gray-iron threaded fittings; and threaded joints.
4. CPVC, Schedule 80; socket fittings; and solvent-cemented joints.
5. CPVC, Schedule 80 pipe; CPVC, Schedule 80 threaded fittings; and threaded joints.
6. PVC, Schedule 80; socket fittings; and solvent-cemented joints.

K. Aboveground, combined domestic water-service and fire-service-main piping, NPS 6 to NPS 12, shall be one of the following:

1. Plain-end, ductile-iron pipe; grooved-joint, ductile-iron-pipe appurtenances; and grooved joints.
2. Galvanized-steel pipe and nipples; galvanized, gray-iron threaded fittings; and threaded joints.

END OF SECTION 221116

# SECTION 221119 - DOMESTIC WATER PIPING SPECIALTIES

## PART 1 - GENERAL

### 1.1 SUMMARY

A. Section Includes:

1. Vacuum breakers.
2. Backflow preventers.
3. Water pressure-reducing valves.
4. Balancing valves.
5. Temperature-actuated, water mixing valves.
6. Strainers.
7. Hose bibbs.
8. Wall hydrants.
9. Drain valves.
10. Water-hammer arresters.
11. Trap-seal primer valves.

B. Related Requirements:

1. Section 224716 "Pressure Water Coolers" for water filters for water coolers.

### 1.2 ACTION SUBMITTALS

A. Product Data: For each type of product.

### 1.3 INFORMATIONAL SUBMITTALS

A. Field quality-control reports.

### 1.4 CLOSEOUT SUBMITTALS

A. Operation and maintenance data.

PART 2 - PRODUCTS

2.1 GENERAL REQUIREMENTS FOR PIPING SPECIALTIES

A. Potable-water piping and components shall comply with NSF 61 and NSF 14. Mark "NSF-pw" on plastic piping components.

2.2 PERFORMANCE REQUIREMENTS

A. Minimum Working Pressure for Domestic Water Piping Specialties: 125 psig unless otherwise indicated.

2.3 VACUUM BREAKERS

A. Pipe-Applied, Atmospheric-Type Vacuum Breakers

1. Standard: ASSE 1001.
2. Size: NPS 1/4 to NPS 3, as required to match connected piping.
3. Body: Bronze.
4. Inlet and Outlet Connections: Threaded.
5. Finish: Rough bronze.

B. Hose-Connection Vacuum Breakers

1. Standard: ASSE 1011.
2. Body: Bronze, nonremovable, with manual drain.
3. Outlet Connection: Garden-hose threaded complying with ASME B1.20.7.
4. Finish: Chrome or nickel plated.

2.4 BACKFLOW PREVENTERS

A. Intermediate Atmospheric-Vent Backflow Preventers

1. Standard: ASSE 1012.
2. Operation: Continuous-pressure applications.
3. Size: NPS 1/2.
4. Body: Bronze.
5. End Connections: Union, solder joint.
6. Finish: Chrome plated.

B. Reduced-Pressure-Principle Backflow Preventers

1. Standard: ASSE 1013.
2. Operation: Continuous-pressure applications.
3. Pressure Loss: 12 psig maximum, through middle third of flow range.

4. Body: Bronze for NPS 2 and smaller; cast iron with interior lining that complies with AWWA C550 or that is FDA approved for NPS 2-1/2 and larger.
5. End Connections: Threaded for NPS 2 and smaller; flanged for NPS 2-1/2 and larger.
6. Configuration: Designed for horizontal, straight-through flow.
7. Accessories:

    a. Valves NPS 2 and Smaller: Ball type with threaded ends on inlet and outlet.
    b. Valves NPS 2-1/2 and Larger: Outside-screw and yoke-gate type with flanged ends on inlet and outlet.
    c. Air-Gap Fitting: ASME A112.1.2, matching backflow-preventer connection.

C. Double-Check, Backflow-Prevention Assemblies

1. Standard: ASSE 1015.
2. Operation: Continuous-pressure applications unless otherwise indicated.
3. Pressure Loss: 5 psig maximum, through middle third of flow range.
4. Body: Bronze for NPS 2 and smaller; cast iron with interior lining that complies with AWWA C550 or that is FDA approved for NPS 2-1/2 and larger.
5. End Connections: Threaded for NPS 2 and smaller; flanged for NPS 2-1/2 and larger.
6. Configuration: Designed for horizontal, straight-through flow.
7. Accessories:

    a. ValvesNPS 2 and Smaller: Ball type with threaded ends on inlet and outlet.
    b. ValvesNPS 2-1/2 and Larger: Outside-screw and yoke-gate type with flanged ends on inlet and outlet.

## 2.5 WATER PRESSURE-REDUCING VALVES

A. Water Regulators

1. Manufacturers: Subject to compliance with requirements, provide products by the following available manufacturers offering products that may be incorporated into the Work include, but are not limited to, the following:
2. Basis-of-Design Product: Subject to compliance with requirements, provide product indicated on Drawings or comparable product by one of the following:

    a. Cash Acme; a division of Reliance Worldwide Corporation.
    b. Conbraco Industries, Inc.
    c. Honeywell International Inc.
    d. Watts; a division of Watts Water Technologies, Inc.; Watts Regulator Company.
    e. Zurn Industries, LLC; Plumbing Products Group; Wilkins Water Control Products.

3. Standard: ASSE 1003.
4. Pressure Rating: Initial working pressure of 150 psig.
5. Body: Bronze with chrome-plated finish for NPS 2 and smaller; cast iron with interior lining that complies with AWWA C550 or that is FDA approved for NPS 2-1/2 and NPS 3.
6. Valves for Booster Heater Water Supply: Include integral bypass.

7. End Connections: Threaded for NPS 2 and smaller; flanged for NPS 2-1/2 and NPS 3.

## 2.6 BALANCING VALVES

A. Memory-Stop Balancing Valves

1. Manufacturers: Subject to compliance with requirements, provide products by the following available manufacturers offering products that may be incorporated into the Work include, but are not limited to, the following:
2. Basis-of-Design Product: Subject to compliance with requirements, provide product indicated on Drawings or comparable product by one of the following:

    a. Conbraco Industries, Inc.
    b. Crane Co.; Crane Valve Group; Crane Valves.
    c. Crane Co.; Crane Valve Group; Jenkins Valves.
    d. Crane Co.; Crane Valve Group; Stockham Div.
    e. Hammond Valve.
    f. Milwaukee Valve Company.
    g. NIBCO Inc.
    h. Red-White Valve Corp.

3. Standard: MSS SP-110 for two-piece, copper-alloy ball valves.
4. Pressure Rating: 400-psig minimum CWP.
5. Size: NPS 2 or smaller.
6. Body: Copper alloy.
7. Port: Standard or full port.
8. Ball: Chrome-plated brass.
9. Seats and Seals: Replaceable.
10. End Connections: Solder joint or threaded.
11. Handle: Vinyl-covered steel with memory-setting device.

## 2.7 TEMPERATURE-ACTUATED, WATER MIXING VALVES

A. Water-Temperature Limiting Devices

1. Manufacturers: Subject to compliance with requirements, provide products by the following available manufacturers offering products that may be incorporated into the Work include, but are not limited to, the following:
2. Basis-of-Design Product: Subject to compliance with requirements, provide product indicated on Drawings or comparable product by one of the following:

    a. Armstrong International, Inc.
    b. Cash Acme; a division of Reliance Worldwide Corporation.
    c. Conbraco Industries, Inc.
    d. Honeywell International Inc.
    e. Legend Valve.

f. Leonard Valve Company.
g. Powers; a division of Watts Water Technologies, Inc.
h. Symmons Industries, Inc.
i. TACO Incorporated.
j. Watts; a division of Watts Water Technologies, Inc.; Watts Regulator Company.
k. Zurn Industries, LLC; Plumbing Products Group; Wilkins Water Control Products.

3. Standard: ASSE 1017.
4. Pressure Rating: 125 psig.
5. Type: Thermostatically controlled, water mixing valve.
6. Material: Bronze body with corrosion-resistant interior components.
7. Connections: Threaded union inlets and outlet.
8. Accessories: Check stops on hot- and cold-water supplies, and adjustable, temperature-control handle.
9. Tempered-Water Setting: 110 deg F.
10. Valve Finish: Chrome plated.

B. Primary, Thermostatic, Water Mixing Valves

1. Manufacturers: Subject to compliance with requirements, provide products by the following available manufacturers offering products that may be incorporated into the Work include, but are not limited to, the following:
2. Basis-of-Design Product: Subject to compliance with requirements, provide product indicated on Drawings or comparable product by one of the following:

a. Armstrong International, Inc.
b. Lawler Manufacturing Company, Inc.
c. Leonard Valve Company.
d. Powers; a division of Watts Water Technologies, Inc.
e. Symmons Industries, Inc.

3. Standard: ASSE 1017.
4. Pressure Rating: 125 psigminimum unless otherwise indicated.
5. Type: Exposed-mounted, thermostatically controlled, water mixing valve.
6. Material: Bronze body with corrosion-resistant interior components.
7. Connections: Threaded union inlets and outlet.
8. Accessories: Manual temperature control, check stops on hot- and cold-water supplies, and adjustable, temperature-control handle.
9. Valve Finish: Chrome plated.
10. Piping Finish: Chrome plated.
11. Cabinet: Factory fabricated, stainless steel, for recessed mounting and with hinged, stainless-steel door.

## 2.8 STRAINERS FOR DOMESTIC WATER PIPING

A. Y-Pattern Strainers

1. Pressure Rating: 125 psig minimum unless otherwise indicated.
2. Body: Bronze for NPS 2 and smaller; cast iron with interior lining that complies with AWWA C550 or that is FDA approved, epoxy coated and for NPS 2-1/2 and larger.
3. End Connections: Threaded for NPS 2 and smaller; flanged for NPS 2-1/2 and larger.
4. Screen: Stainless steel with round perforations unless otherwise indicated.
5. Perforation Size:

    a. Strainers NPS 2 and Smaller: 0.020 inch.
    b. Strainers NPS 2-1/2 to NPS 4: 0.045 inch.
    c. Strainers NPS 5 and Larger: 0.10 inch.

6. Drain: Pipe plug.

## 2.9 HOSE BIBBS

A. Hose Bibbs

1. Standard: ASME A112.18.1 for sediment faucets.
2. Body Material: Bronze.
3. Seat: Bronze, replaceable.
4. Supply Connections: NPS 1/2 or NPS 3/4 threaded or solder-joint inlet.
5. Outlet Connection: Garden-hose thread complying with ASME B1.20.7.
6. Pressure Rating: 125 psig.
7. Vacuum Breaker: Integral or field-installation, nonremovable, drainable, hose-connection vacuum breaker complying with ASSE 1011.
8. Finish for Equipment Rooms: Rough bronze, or chrome or nickel plated.
9. Finish for Service Areas: Rough bronze.
10. Finish for Finished Rooms: Chrome or nickel plated.
11. Operation for Equipment Rooms: Wheel handle or operating key.
12. Operation for Service Areas: Wheel handle.
13. Operation for Finished Rooms: Wheel handle.
14. Include operating key with each operating-key hose bibb.
15. Include integral wall flange with each chrome- or nickel-plated hose bibb.

## 2.10 WALL HYDRANTS

A. Nonfreeze Wall Hydrants

1. Standard: ASME A112.21.3M for concealed-outlet, self-draining wall hydrants.
2. Pressure Rating: 125 psig.
3. Operation: Loose key.
4. Casing and Operating Rod: Of length required to match wall thickness. Include wall clamp.
5. Inlet: NPS 3/4 or NPS 1.
6. Outlet: Concealed, with integral vacuum breaker and garden-hose thread complying with ASME B1.20.7.

7. Box: Deep, flush mounted with cover.
8. Box and Cover Finish: Polished nickel bronze.
9. Outlet: Exposed, with integral vacuum breaker and garden-hose thread complying with ASME B1.20.7.
10. Nozzle and Wall-Plate Finish: Polished nickel bronze.
11. Operating Keys(s): One with each wall hydrant.

B. Nonfreeze, Hot- and Cold-Water Wall Hydrants

1. Standard: ASME A112.21.3M for concealed-outlet, self-draining wall hydrants.
2. Pressure Rating: 125 psig.
3. Operation: Loose key.
4. Casing and Operating Rods: Of length required to match wall thickness. Include wall clamps.
5. Inlet: NPS 3/4 or NPS 1.
6. Outlet: Concealed.
7. Box: Deep, flush mounted with cover.
8. Box and Cover Finish: Polished nickel bronze.
9. Vacuum Breaker:

    a. Nonremovable, manual-drain-type, hose-connection vacuum breaker complying with ASSE 1011 or backflow preventer complying with ASSE 1052.
    b. Garden-hose thread complying with ASME B1.20.7 on outlet.

10. Operating Keys(s): One with each wall hydrant.

C. Vacuum Breaker Wall Hydrants

1. Standard: ASSE 1019, Type A or Type B.
2. Type: Freeze-resistant, automatic draining with integral air-inlet valve.
3. Classification: Type A, for automatic draining with hose removed or Type B, for automatic draining with hose removed or with hose attached and nozzle closed.
4. Pressure Rating: 125 psig.
5. Operation: Loose key or wheel handle.
6. Casing and Operating Rod: Of length required to match wall thickness. Include wall clamp.
7. Inlet: NPS 1/2 or NPS 3/4.
8. Outlet: Exposed with garden-hose thread complying with ASME B1.20.7.

2.11 DRAIN VALVES

A. Ball-Valve-Type, Hose-End Drain Valves

1. Standard: MSS SP-110 for standard-port, two-piece ball valves.
2. Pressure Rating: 400-psig minimum CWP.
3. Size: NPS 3/4.
4. Body: Copper alloy.

5. Ball: Chrome-plated brass.
6. Seats and Seals: Replaceable.
7. Handle: Vinyl-covered steel.
8. Inlet: Threaded or solder joint.
9. Outlet: Threaded, short nipple with garden-hose thread complying with ASME B1.20.7 and cap with brass chain.

## 2.12 WATER-HAMMER ARRESTERS

A. Water-Hammer Arresters

1. Manufacturers: Subject to compliance with requirements, provide products by the following:
2. Basis-of-Design Product: Subject to compliance with requirements, provide product indicated on Drawings or comparable product by one of the following:

    a. AMTROL, Inc.
    b. Josam Company.
    c. MIFAB, Inc.
    d. Precision Plumbing Products, Inc.
    e. Sioux Chief Manufacturing Company, Inc.
    f. Smith, Jay R. Mfg. Co.; Division of Smith Industries, Inc.
    g. Tyler Pipe; Wade Div.
    h. Watts Drainage Products.
    i. Zurn Industries, LLC; Plumbing Products Group; Specification Drainage Products.

3. Standard: ASSE 1010 or PDI-WH 201.
4. Type: Copper tube with piston.
5. Size: ASSE 1010, Sizes AA and A through F, or PDI-WH 201, Sizes A through F.

## 2.13 TRAP-SEAL PRIMER DEVICE

A. Supply-Type, Trap-Seal Primer Device

1. Manufacturers: Subject to compliance with requirements, provide products by the following available manufacturers offering products that may be incorporated into the Work include, but are not limited to, the following:
2. Basis-of-Design Product: Subject to compliance with requirements, provide product indicated on Drawings or comparable product by one of the following:

    a. MIFAB, Inc.
    b. Precision Plumbing Products, Inc.
    c. Sioux Chief Manufacturing Company, Inc.
    d. Smith, Jay R. Mfg. Co.; Division of Smith Industries, Inc.
    e. Watts; a division of Watts Water Technologies, Inc.; Watts Regulator Company.

3. Standard: ASSE 1018.
4. Pressure Rating: 125 psig minimum.
5. Body: Bronze.
6. Inlet and Outlet Connections: NPS 1/2 threaded, union, or solder joint.
7. Gravity Drain Outlet Connection: NPS 1/2 threaded or solder joint.
8. Finish: Chrome plated, or rough bronze for units used with pipe or tube that is not chrome finished.

B. Drainage-Type, Trap-Seal Primer Device

1. Manufacturers: Subject to compliance with requirements, provide products by the following available manufacturers offering products that may be incorporated into the Work include, but are not limited to, the following:
2. Basis-of-Design Product: Subject to compliance with requirements, provide product indicated on Drawings or comparable product by one of the following:

   a. Smith, Jay R. Mfg. Co.; Division of Smith Industries, Inc.

3. Standard: ASSE 1044, lavatory P-trap with NPS 3/8 minimum, trap makeup connection.
4. Size: NPS 1-1/4 minimum.
5. Material: Chrome-plated, cast brass.

PART 3 - EXECUTION

3.1 INSTALLATION

A. Install backflow preventers in each water supply to mechanical equipment and systems and to other equipment and water systems that may be sources of contamination. Comply with authorities having jurisdiction.

1. Locate backflow preventers in same room as connected equipment or system.
2. Install drain for backflow preventers with atmospheric-vent drain connection with air-gap fitting, fixed air-gap fitting, or equivalent positive pipe separation of at least two pipe diameters in drain piping and pipe-to-floor drain. Locate air-gap device attached to or under backflow preventer. Simple air breaks are unacceptable for this application.
3. Do not install bypass piping around backflow preventers.

B. Install water regulators with inlet and outlet shutoff valves and bypass with memory-stop balancing valve. Install pressure gages on inlet and outlet.

C. Install balancing valves in locations where they can easily be adjusted.

D. Install temperature-actuated, water mixing valves with check stops or shutoff valves on inlets and with shutoff valve on outlet.

1. Install cabinet-type units recessed in or surface mounted on wall as specified.

E. Install Y-pattern strainers for water on supply side of each control valve water pressure-reducing valve solenoid valve and pump.

F. Set nonfreeze, nondraining-type post hydrants in concrete or pavement.

G. Set freeze-resistant yard hydrants with riser pipe in concrete or pavement. Do not encase canister in concrete.

H. Install water-hammer arresters in water piping according to PDI-WH 201.

I. Install supply-type, trap-seal primer valves with outlet piping pitched down toward drain trap a minimum of 1 percent, and connect to floor-drain body, trap, or inlet fitting. Adjust valve for proper flow.

J. Install drainage-type, trap-seal primer valves as lavatory trap with outlet piping pitched down toward drain trap a minimum of 1 percent, and connect to floor-drain body, trap, or inlet fitting.

## 3.2 CONNECTIONS

A. Comply with requirements for ground equipment in Section 260526 "Grounding and Bonding for Electrical Systems."

B. Fire-retardant-treated-wood blocking is specified in Section 260519 "Low-Voltage Electrical Power Conductors and Cables" for electrical connections.

## 3.3 FIELD QUALITY CONTROL

A. Perform the following tests and inspections:

1. Test each pressure vacuum breaker reduced-pressure-principle backflow preventer double-check, backflow-prevention assembly and double-check, detector-assembly backflow preventer according to authorities having jurisdiction and the device's reference standard.

B. Domestic water piping specialties will be considered defective if they do not pass tests and inspections.

C. Prepare test and inspection reports.

## 3.4 ADJUSTING

A. Set field-adjustable pressure set points of water pressure-reducing valves.

B. Set field-adjustable flow set points of balancing valves.

C. Set field-adjustable temperature set points of temperature-actuated, water mixing valves.

END OF SECTION 221119

# SECTION 221313 - FACILITY SANITARY SEWERS

## PART 1 - GENERAL

### 1.1 SUMMARY

A. Section Includes:

1. Hub-and-spigot, cast-iron soil pipe and fittings.
2. Hubless cast-iron soil pipe and fittings.
3. Nonpressure-type transition couplings.
4. Pressure-type pipe couplings.
5. Expansion joints and deflection fittings.
6. Backwater valves.
7. Cleanouts.
8. Encasement for piping.
9. Manholes.
10. Concrete.

### 1.2 ACTION SUBMITTALS

A. Product Data: For each type of product.

B. Shop Drawings: For manholes. Include plans, elevations, sections, details, and frames and covers.

### 1.3 INFORMATIONAL SUBMITTALS

A. Coordination Drawings:

1. Show system piping in profile. Draw profiles to horizontal scale of not less than 1 inch equals 50 feet (1:500) and to vertical scale of not less than 1 inch equals 5 feet (1:50). Indicate manholes and piping. Show types, sizes, materials, and elevations of other utilities crossing system piping.

B. Product Certificates: For each type of pipe and fitting.

C. Field quality-control reports.

## PART 2 - PRODUCTS

### 2.1 HUB-AND-SPIGOT, CAST-IRON SOIL PIPE AND FITTINGS

A. Pipe and Fittings: ASTM A 74, Service and Extra-Heavy classes.

B. Gaskets: ASTM C 564, rubber.

C. Calking Materials: ASTM B 29, pure lead and oakum or hemp fiber.

2.2 HUBLESS CAST-IRON SOIL PIPE AND FITTINGS

A. Pipe and Fittings: ASTM A 888 or CISPI 301.

B. CISPI-Trademark, Shielded Couplings:

1. Description: ASTM C 1277 and CISPI 310, with stainless-steel corrugated shield; stainless-steel bands and tightening devices; and ASTM C 564, rubber sleeve with integral, center pipe stop.

2. Manufacturers: Subject to compliance with requirements, provide products by one of the following:

a. ANACO-Husky.
b. Charlotte Pipe and Foundry Company.
c. Dallas Specialty & Mfg. Co.
d. Fernco Inc.
e. Mission Rubber Company, LLC; a division of MCP Industries.
f. Tyler Pipe; a subsidiary of McWane Inc.

C. Heavy-Duty, Shielded Couplings:

1. Description: ASTM C 1277 and ASTM C 1540, with stainless-steel shield; stainless-steel bands and tightening devices; and ASTM C 564, rubber sleeve with integral, center pipe stop.

2. Manufacturers: Subject to compliance with requirements, provide products by one of the following:

a. ANACO-Husky.
b. Clamp-All Corp.
c. Dallas Specialty & Mfg. Co.
d. Mission Rubber Company, LLC; a division of MCP Industries.
e. Tyler Pipe; a subsidiary of McWane Inc.

2.3 PVC PIPE AND FITTINGS

A. PVC Corrugated Sewer Piping:

1. Pipe: ASTM F 949, PVC corrugated pipe with bell-and-spigot ends for gasketed joints.
2. Fittings: ASTM F 949, PVC molded or fabricated, socket type.
3. Gaskets: ASTM F 477, elastomeric seals.

B. PVC Type PSM Sewer Piping:

1. Pipe: ASTM D 3034, SDR 35, PVC Type PSM sewer pipe with bell-and-spigot ends for gasketed joints.
2. Fittings: ASTM D 3034, PVC with bell ends.
3. Gaskets: ASTM F 477, elastomeric seals.

## 2.4 NONPRESSURE-TYPE TRANSITION COUPLINGS

A. Comply with ASTM C 1173, elastomeric, sleeve-type, reducing or transition coupling; for joining underground nonpressure piping. Include ends of same sizes as piping to be joined and include corrosion-resistant-metal tension band and tightening mechanism on each end.

B. Sleeve Materials:

1. For Cast-Iron Soil Pipes: ASTM C 564, rubber.
2. For Plastic Pipes: ASTM F 477, elastomeric seal or ASTM D 5926, PVC.
3. For Dissimilar Pipes: ASTM D 5926, PVC or other material compatible with pipe materials being joined.

C. Unshielded, Flexible Couplings:

1. Description: Elastomeric sleeve with stainless-steel shear ring and corrosion-resistant-metal tension band and tightening mechanism on each end.

2. Manufacturers: Subject to compliance with requirements, provide products by one of the following:

a. Dallas Specialty & Mfg. Co.
b. Fernco Inc.
c. Logan Clay Pipe.
d. Mission Rubber Company, LLC; a division of MCP Industries.
e. NDS Inc.
f. Plastic Oddities.

D. Ring-Type, Flexible Couplings:

1. Description: Elastomeric compression seal with dimensions to fit inside bell of larger pipe and for spigot of smaller pipe to fit inside ring.

2. Manufacturers: Subject to compliance with requirements, provide products by one of the following:

a. Fernco Inc.
b. Logan Clay Pipe.
c. Mission Rubber Company, LLC; a division of MCP Industries.

E. Nonpressure-Type, Rigid Couplings:

1. Description: ASTM C 1461, sleeve-type, reducing- or transition-type mechanical coupling; molded from ASTM C 1440, TPE material; with corrosion-resistant-metal tension band and tightening mechanism on each end.

2. Manufacturers: Subject to compliance with requirements, provide products by the following:

   a. ANACO-Husky.

2.5 BACKWATER VALVES

A. Cast-Iron Backwater Valves:

1. Description: ASME A112.14.1, gray-iron body and bolted cover, with bronze seat.

2. Manufacturers: Subject to compliance with requirements, provide products by one of the following:

   a. Jay R. Smith Mfg. Co.
   b. Josam Company.
   c. Tyler Pipe; a subsidiary of McWane Inc.
   d. WATTS.
   e. Zurn Industries, LLC.

3. Horizontal type; with swing check valve and hub-and-spigot ends.
4. Combination horizontal and manual gate-valve type; with swing check valve, integral gate valve, and hub-and-spigot ends.
5. Terminal type; with bronze seat, swing check valve, and hub inlet.

B. PVC Backwater Valves:

1. Description: Horizontal type; with PVC body, PVC removable cover, and PVC swing check valve.

2. Manufacturers: Subject to compliance with requirements, provide products by one of the following:

   a. Canplas LLC.
   b. IPS Corporation.
   c. NDS Inc.
   d. Plastic Oddities.
   e. Sioux Chief Manufacturing Company, Inc.
   f. Zurn Industries, LLC.

2.6 CLEANOUTS

A. Cast-Iron Cleanouts:

1. Description: ASME A112.36.2M, round, gray-iron housing with clamping device and round, secured, scoriated, gray-iron cover. Include gray-iron ferrule with inside calk or spigot connection and countersunk, tapered-thread, brass closure plug.

2. Manufacturers: Subject to compliance with requirements, provide products by one of the following:

   a. Jay R. Smith Mfg. Co.
   b. Josam Company.
   c. MIFAB, Inc.
   d. Tyler Pipe; a subsidiary of McWane Inc.
   e. WATTS.
   f. Zurn Industries, LLC.

3. Top-Loading Classification(s): Heavy Duty and Extra-Heavy Duty.
4. Sewer Pipe Fitting and Riser to Cleanout: ASTM A 74, Service class, cast-iron soil pipe and fittings.

## 2.7 ENCASEMENT FOR PIPING

A. Standard: ASTM A 674 or AWWA C105/A21.5.

B. Material: Linear low-density polyethylene film of 0.008-inch (0.20-mm) or high-density, cross-laminated polyethylene film of 0.004-inch (0.10-mm) minimum thickness.

C. Form: Sheet or tube.

D. Color: Black or natural.

## 2.8 MANHOLES

A. Standard Precast Concrete Manholes:

1. Description: ASTM C 478 (ASTM C 478M), precast, reinforced concrete, of depth indicated, with provision for sealant joints.
2. Diameter: 48 inches (1200 mm) minimum unless otherwise indicated.
3. Ballast: Increase thickness of precast concrete sections or add concrete to base section, as required to prevent flotation.
4. Base Section: 6-inch (150-mm) minimum thickness for floor slab and 4-inch (100-mm) minimum thickness for walls and base riser section; with separate base slab or base section with integral floor.
5. Riser Sections: 4-inch (100-mm) minimum thickness, of length to provide depth indicated.
6. Top Section: Eccentric-cone type unless concentric-cone or flat-slab-top type is indicated; with top of cone of size that matches grade rings.
7. Joint Sealant: ASTM C 990 (ASTM C 990M), bitumen or butyl rubber.
8. Resilient Pipe Connectors: ASTM C 923 (ASTM C 923M), cast or fitted into manhole walls, for each pipe connection.

9. Steps: Individual FRP steps, FRP ladder, or ASTM A 615/A 615M, deformed, 1/2-inch (13-mm) steel reinforcing rods encased in ASTM D 4101, PP; wide enough to allow worker to place both feet on one step and designed to prevent lateral slippage off step. Cast or anchor steps into sidewalls at 12- to 16-inch (300- to 400-mm) intervals. Omit steps if total depth from floor of manhole to finished grade is less than 60 inches (1500 mm).
10. Adjusting Rings: Interlocking HDPE rings, with level or sloped edge in thickness and diameter matching manhole frame and cover, and with height as required to adjust manhole frame and cover to indicated elevation and slope. Include sealant recommended by ring manufacturer.
11. Grade Rings: Reinforced-concrete rings, 6- to 9-inch (150- to 225-mm) total thickness, with diameter matching manhole frame and cover, and with height as required to adjust manhole frame and cover to indicated elevation and slope.

B. Manhole Frames and Covers:

1. Description: Ferrous; 24-inch (610-mm) ID by 7- to 9-inch (175- to 225-mm) riser, with 4-inch- (100-mm-) minimum-width flange and 26-inch- (660-mm-) diameter cover. Include indented top design with lettering cast into cover, using wording equivalent to "SANITARY SEWER."
2. Material: ASTM A 536, Grade 60-40-18 ductile iron unless otherwise indicated.

## 2.9 CONCRETE

A. General: Cast-in-place concrete complying with ACI 318, ACI 350 (ACI 350M), and the following:

1. Cement: ASTM C 150/C 150M, Type II.
2. Fine Aggregate: ASTM C 33/C 33M, sand.
3. Coarse Aggregate: ASTM C 33/C 33M, crushed gravel.
4. Water: Potable.

B. Portland Cement Design Mix: 4000 psi (27.6 MPa) minimum, with 0.45 maximum water/cementitious materials ratio.

1. Reinforcing Fabric: ASTM A 1064/A 1064M, steel, welded wire fabric, plain.
2. Reinforcing Bars: ASTM A 615/A 615M, Grade 60 (420-MPa) deformed steel.

C. Manhole Channels and Benches: Factory or field formed from concrete. Portland cement design mix, 4000 psi (27.6 MPa) minimum, with 0.45 maximum water/cementitious materials ratio. Include channels and benches in manholes.

1. Channels: Concrete invert, formed to same width as connected piping, with height of vertical sides to three-fourths of pipe diameter. Form curved channels with smooth, uniform radius and slope.

   a. Invert Slope: 1 percent through manhole.

2. Benches: Concrete, sloped to drain into channel.

a. Slope: 4 percent.

D. Ballast and Pipe Supports: Portland cement design mix, 3000 psi (20.7 MPa) minimum, with 0.58 maximum water/cementitious materials ratio.

1. Reinforcing Fabric: ASTM A1064/A 1064M, steel, welded wire fabric, plain.
2. Reinforcing Bars: ASTM A 615/A 615M, Grade 60 (420-MPa) deformed steel.

## PART 3 - EXECUTION

### 3.1 EARTHWORK

A. Excavating, trenching, and backfilling are specified in Section 312000 "Earth Moving."

### 3.2 PIPING INSTALLATION

A. General Locations and Arrangements: Drawing plans and details to indicate general location and arrangement of underground sanitary sewer piping. Location and arrangement of piping layout take into account design considerations. Install piping as indicated, to extent practical. Where specific installation is not indicated, follow piping manufacturer's written instructions.

B. Install piping beginning at low point, true to grades and alignment indicated with unbroken continuity of invert. Place bell ends of piping facing upstream. Install gaskets, seals, sleeves, and couplings according to manufacturer's written instructions for using lubricants, cements, and other installation requirements.

C. Install manholes for changes in direction unless fittings are indicated. Use fittings for branch connections unless direct tap into existing sewer is indicated.

D. Install proper size increasers, reducers, and couplings where different sizes or materials of pipes and fittings are connected. Reducing size of piping in direction of flow is prohibited.

E. When installing pipe under streets or other obstructions that cannot be disturbed, use pipe-jacking process of microtunneling.

F. Install gravity-flow, nonpressure, drainage piping according to the following:

1. Install piping pitched down in direction of flow, at minimum slope of 1 percent unless otherwise indicated.
2. Install piping NPS 6 (DN 150) and larger with restrained joints at tee fittings and at changes in direction. Use corrosion-resistant rods, pipe or fitting manufacturer's proprietary restraint system, or cast-in-place-concrete supports or anchors.
3. Install piping with 36-inch (915-mm) minimum cover.
4. Install hub-and-spigot, cast-iron soil piping according to CISPI's "Cast Iron Soil Pipe and Fittings Handbook."
5. Install hubless cast-iron soil piping according to CISPI 310 and CISPI's "Cast Iron Soil Pipe and Fittings Handbook."
6. Install PVC corrugated sewer piping according to ASTM D 2321 and ASTM F 1668.

7. Install PVC Type PSM sewer piping according to ASTM D 2321 and ASTM F 1668.

G. Install corrosion-protection piping encasement over the following underground metal piping according to ASTM A 674 or AWWA C105/A21.5:

1. Hub-and-spigot, cast-iron soil pipe.
2. Hubless cast-iron soil pipe and fittings.
3. Expansion joints and deflection fittings.

H. Clear interior of piping and manholes of dirt and superfluous material as work progresses. Maintain swab or drag in piping, and pull past each joint as it is completed. Place plug in end of incomplete piping at end of day and when work stops.

## 3.3 PIPE JOINT CONSTRUCTION

A. Join gravity-flow, nonpressure, drainage piping according to the following:

1. Join hub-and-spigot, cast-iron soil piping with gasket joints according to CISPI's "Cast Iron Soil Pipe and Fittings Handbook" for compression joints.
2. Join hub-and-spigot, cast-iron soil piping with calked joints according to CISPI's "Cast Iron Soil Pipe and Fittings Handbook" for lead and oakum calked joints.
3. Join hubless cast-iron soil piping according to CISPI 310 and CISPI's "Cast Iron Soil Pipe and Fittings Handbook" for hubless-coupling joints.
4. Join PVC corrugated sewer piping according to ASTM D 2321.
5. Join PVC Type PSM sewer piping according to ASTM D 2321 and ASTM D 3034 for elastomeric-seal joints or ASTM D 3034 for elastomeric-gasket joints.
6. Join dissimilar pipe materials with nonpressure-type, flexible or rigid couplings.

B. Pipe couplings, expansion joints, and deflection fittings with pressure ratings at least equal to piping rating may be used in applications below unless otherwise indicated.

1. Use nonpressure flexible couplings where required to join gravity-flow, nonpressure sewer piping unless otherwise indicated.

a. Unshielded flexible or rigidcouplings for pipes of same or slightly different OD.
b. Unshielded, increaser/reducer-pattern, flexible or rigidcouplings for pipes with different OD.
c. Ring-type flexible couplings for piping of different sizes where annular space between smaller piping's OD and larger piping's ID permits installation.

## 3.4 MANHOLE INSTALLATION

A. General: Install manholes complete with appurtenances and accessories indicated.

B. Install precast concrete manhole sections with sealants according to ASTM C 891.

C. Form continuous concrete channels and benches between inlets and outlet.

D. Set tops of frames and covers flush with finished surface of manholes that occur in pavements. Set tops 3 inches (76 mm) above finished surface elsewhere unless otherwise indicated.

## 3.5 CONCRETE PLACEMENT

A. Place cast-in-place concrete according to ACI 318.

## 3.6 BACKWATER VALVE INSTALLATION

A. Install horizontal-type backwater valves in piping manholes or pits.

B. Install combination horizontal and manual gate-type valves in piping and in manholes.

C. Install terminal-type backwater valves on end of piping and in manholes. Secure units to sidewalls.

## 3.7 CLEANOUT INSTALLATION

A. Install cleanouts and riser extensions from sewer pipes to cleanouts at grade. Use cast-iron soil pipe fittings in sewer pipes at branches for cleanouts, and use cast-iron soil pipe for riser extensions to cleanouts. Install piping so cleanouts open in direction of flow in sewer pipe.
1. Use Heavy-Duty, top-loading classification cleanouts in vehicle-traffic service areas.
2. Use Extra-Heavy-Duty, top-loading classification cleanouts in roads.

B. Set cleanout frames and covers in earth in cast-in-place-concrete block, 18 by 18 by 12 inches (450 by 450 by 300 mm) deep. Set with tops 1 inch (25 mm) above surrounding grade.

C. Set cleanout frames and covers in concrete pavement and roads with tops flush with pavement surface.

## 3.8 CONNECTIONS

A. Connect nonpressure, gravity-flow drainage piping to building's sanitary building drains specified in Section 221316 "Sanitary Waste and Vent Piping."

B. Make connections to existing piping and underground manholes.

1. Use commercially manufactured wye fittings for piping branch connections. Remove section of existing pipe, install wye fitting into existing piping, and encase entire wye fitting plus 6-inch (150-mm) overlap with not less than 6 inches (150 mm) of concrete with 28-day compressive strength of 3000 psi (20.7 MPa).
2. Make branch connections from side into existing piping, NPS 4 to NPS 20 (DN 100 to DN 500). Remove section of existing pipe, install wye fitting into existing piping, and encase entire wye with not less than 6 inches (150 mm) of concrete with 28-day compressive strength of 3000 psi (20.7 MPa).
3. Make branch connections from side into existing piping, NPS 21 (DN 525) or larger, or to underground manholes by cutting opening into existing unit large enough to allow 3

inches (76 mm) of concrete to be packed around entering connection. Cut end of connection pipe passing through pipe or structure wall to conform to shape of, and be flush with, inside wall unless otherwise indicated. On outside of pipe or manhole wall, encase entering connection in 6 inches (150 mm) of concrete for minimum length of 12 inches (300 mm) to provide additional support of collar from connection to undisturbed ground.

a. Use concrete that will attain a minimum 28-day compressive strength of 3000 psi (20.7 MPa) unless otherwise indicated.
b. Use epoxy-bonding compound as interface between new and existing concrete and piping materials.

4. Protect existing piping and manholes to prevent concrete or debris from entering while making tap connections. Remove debris or other extraneous material that may accumulate.

C. Connect to grease interceptors specified in Section 221323 "Sanitary Waste Interceptors."

## 3.9 CLOSING ABANDONED SANITARY SEWER SYSTEMS

A. Abandoned Piping: Close open ends of abandoned underground piping indicated to remain in place. Include closures strong enough to withstand hydrostatic and earth pressures that may result after ends of abandoned piping have been closed. Use either procedure below:

1. Close open ends of piping with at least 8-inch- (203-mm-) thick, brick masonry bulkheads.
2. Close open ends of piping with threaded metal caps, plastic plugs, or other acceptable methods suitable for size and type of material being closed. Do not use wood plugs.

B. Abandoned Manholes: Excavate around manhole as required and use either procedure below:

1. Remove manhole and close open ends of remaining piping.
2. Remove top of manhole down to at least 36 inches (915 mm) below final grade. Fill to within 12 inches (300 mm) of top with stone, rubble, gravel, or compacted dirt. Fill to top with concrete.

C. Backfill to grade according to Section 312000 "Earth Moving."

## 3.10 IDENTIFICATION

A. Comply with requirements in Section 312000 "Earth Moving" for underground utility identification devices. Arrange for installation of green warning tapes directly over piping and at outside edges of underground manholes.

1. Use warning tape or detectable warning tape over ferrous piping.
2. Use detectable warning tape over nonferrous piping and over edges of underground manholes.

3.11 FIELD QUALITY CONTROL

A. Inspect interior of piping to determine whether line displacement or other damage has occurred. Inspect after approximately 24 inches (600 mm) of backfill is in place, and again at completion of Project.

1. Submit separate report for each system inspection.
2. Defects requiring correction include the following:

a. Alignment: Less than full diameter of inside of pipe is visible between structures.
b. Deflection: Flexible piping with deflection that prevents passage of ball or cylinder of size not less than 92.5 percent of piping diameter.
c. Damage: Crushed, broken, cracked, or otherwise damaged piping.
d. Infiltration: Water leakage into piping.
e. Exfiltration: Water leakage from or around piping.

3. Replace defective piping using new materials, and repeat inspections until defects are within allowances specified.
4. Reinspect and repeat procedure until results are satisfactory.

B. Test new piping systems, and parts of existing systems that have been altered, extended, or repaired, for leaks and defects.

1. Do not enclose, cover, or put into service before inspection and approval.
2. Test completed piping systems according to requirements of authorities having jurisdiction.
3. Schedule tests and inspections by authorities having jurisdiction with at least 24 hours' advance notice.
4. Submit separate report for each test.
5. Hydrostatic Tests: Test sanitary sewerage according to requirements of authorities having jurisdiction and the following:

a. Fill sewer piping with water. Test with pressure of at least 10-foot (3-m) head of water, and maintain such pressure without leakage for at least 15 minutes.
b. Close openings in system and fill with water.
c. Purge air and refill with water.
d. Disconnect water supply.
e. Test and inspect joints for leaks.

6. Manholes: Perform hydraulic test according to ASTM C 969 (ASTM C 969M).

C. Leaks and loss in test pressure constitute defects that must be repaired.

D. Replace leaking piping using new materials, and repeat testing until leakage is within allowances specified.

END OF SECTION 221313

# SECTION 221316 - SANITARY WASTE AND VENT PIPING

## PART 1 - GENERAL

### 1.1 SUMMARY

A. Section Includes:

1. Pipe, tube, and fittings.
2. Specialty pipe fittings.

B. NOTE: This building contains plenums. Any pipe installed within plenum spaces (typically above ceilings) must be plenum rated.

### 1.2 ACTION SUBMITTALS

A. Product Data: For each type of product indicated.

### 1.3 INFORMATIONAL SUBMITTALS

A. Seismic Qualification Certificates: For waste and vent piping, accessories, and components, from manufacturer.

1. Basis for Certification: Indicate whether withstand certification is based on actual test of assembled components or on calculation.
2. Detailed description of piping anchorage devices on which the certification is based and their installation requirements.

B. Field quality-control reports.

### 1.4 QUALITY ASSURANCE

A. Piping materials shall bear label, stamp, or other markings of specified testing agency.

B. Comply with NSF/ANSI 14, "Plastics Piping Systems Components and Related Materials," for plastic piping components. Include marking with "NSF-dwv" for plastic drain, waste, and vent piping and "NSF-sewer" for plastic sewer piping.

PART 2 - PRODUCTS

2.1 PIPING MATERIALS

A. Comply with requirements in "Piping Schedule" Article for applications of pipe, tube, fitting materials, and joining methods for specific services, service locations, and pipe sizes.

2.2 HUB-AND-SPIGOT, CAST-IRON SOIL PIPE AND FITTINGS

A. Pipe and Fittings: ASTM A 74,Service class.

B. Gaskets: ASTM C 564, rubber.

2.3 HUBLESS, CAST-IRON SOIL PIPE AND FITTINGS

A. Pipe and Fittings: ASTM A 888 or CISPI 301.

B. CISPI, Hubless-Piping Couplings:

1. Manufacturers: Subject to compliance with requirements, provide products by one of the following available manufacturers offering products that may be incorporated into the Work include, but are not limited to, the following:

a. ANACO-Husky.
b. Dallas Specialty & Mfg. Co.
c. Fernco Inc.
d. Matco-Norca, Inc.
e. MIFAB, Inc.
f. Mission Rubber Company; a division of MCP Industries, Inc.
g. Stant.
h. Tyler Pipe.

2. Standards: ASTM C 1277 and CISPI 310.
3. Description: Stainless-steel corrugated shield with stainless-steel bands and tightening devices; and ASTM C 564, rubber sleeve with integral, center pipe stop.

C. Heavy-Duty, Hubless-Piping Couplings:

1. Manufacturers: Subject to compliance with requirements, provide products by one of the following available manufacturers offering products that may be incorporated into the Work include, but are not limited to, the following:

a. ANACO-Husky.
b. Clamp-All Corp.
c. Dallas Specialty & Mfg. Co.
d. MIFAB, Inc.
e. Mission Rubber Company; a division of MCP Industries, Inc.
f. Stant.

g. Tyler Pipe.

2. Standards: ASTM C 1277 and ASTM C 1540.
3. Description: Stainless-steel shield with stainless-steel bands and tightening devices; and ASTM C 564, rubber sleeve with integral, center pipe stop.

## 2.4 COPPER TUBE AND FITTINGS

A. Copper DWV Tube: ASTM B 306, drainage tube, drawn temper.

B. Copper Drainage Fittings: ASME B16.23, cast copper or ASME B16.29, wrought copper, solder-joint fittings.

C. Copper Flanges: ASME B16.24, Class 150, cast copper with solder-joint end.

1. Flange Gasket Materials: ASME B16.21, full-face, flat, nonmetallic, asbestos-free, 1/8-inch (3.2-mm) maximum thickness unless thickness or specific material is indicated.
2. Flange Bolts and Nuts: ASME B18.2.1, carbon steel unless otherwise indicated.

D. Solder: ASTM B 32, lead free with ASTM B 813, water-flushable flux.

## 2.5 ABS PIPE AND FITTINGS

A. Solid-Wall ABS Pipe: ASTM D 2661, Schedule 40.

B. Cellular-Core ABS Pipe: ASTM F 628, Schedule 40.

C. ABS Socket Fittings: ASTM D 2661, made to ASTM D 3311, drain, waste, and vent patterns.

D. Solvent Cement: ASTM D 2235.

1. ABS solvent cement shall have a VOC content of 325 g/L or less when calculated according to 40 CFR 59, Subpart D (EPA Method 24).
2. Solvent cement shall comply with the testing and product requirements of the California Department of Health Services' "Standard Practice for the Testing of Volatile Organic Emissions from Various Sources Using Small-Scale Environmental Chambers."

## 2.6 PVC PIPE AND FITTINGS

A. Solid-Wall PVC Pipe: ASTM D 2665, drain, waste, and vent.

B. Cellular-Core PVC Pipe: ASTM F 891, Schedule 40.

C. PVC Socket Fittings: ASTM D 2665, made to ASTM D 3311, drain, waste, and vent patterns and to fit Schedule 40 pipe.

D. Adhesive Primer: ASTM F 656.

1. Adhesive primer shall have a VOC content of 550 g/L or less when calculated according to 40 CFR 59, Subpart D (EPA Method 24).
2. Adhesive primer shall comply with the testing and product requirements of the California Department of Health Services' "Standard Practice for the Testing of Volatile Organic Emissions from Various Sources Using Small-Scale Environmental Chambers."

E. Solvent Cement: ASTM D 2564.

1. PVC solvent cement shall have a VOC content of 510 g/L or less when calculated according to 40 CFR 59, Subpart D (EPA Method 24).
2. Solvent cement shall comply with the testing and product requirements of the California Department of Health Services' "Standard Practice for the Testing of Volatile Organic Emissions from Various Sources Using Small-Scale Environmental Chambers."

## 2.7 SPECIALTY PIPE FITTINGS

A. Transition Couplings:

1. General Requirements: Fitting or device for joining piping with small differences in OD's or of different materials. Include end connections same size as and compatible with pipes to be joined.
2. Fitting-Type Transition Couplings: Manufactured piping coupling or specified piping system fitting.
3. Unshielded, Nonpressure Transition Couplings:

   a. Manufacturers: Subject to compliance with requirements, provide products by one of the following available manufacturers offering products that may be incorporated into the Work include, but are not limited to, the following:

      1) Dallas Specialty & Mfg. Co.
      2) Fernco Inc.
      3) Mission Rubber Company; a division of MCP Industries, Inc.
      4) Plastic Oddities; a division of Diverse Corporate Technologies, Inc.

   b. Standard: ASTM C 1173.
   c. Description: Elastomeric, sleeve-type, reducing or transition pattern. Include shear ring and corrosion-resistant-metal tension band and tightening mechanism on each end.
   d. Sleeve Materials:

      1) For Cast-Iron Soil Pipes: ASTM C 564, rubber.
      2) For Plastic Pipes: ASTM F 477, elastomeric seal or ASTM D 5926, PVC.
      3) For Dissimilar Pipes: ASTM D 5926, PVC or other material compatible with pipe materials being joined.

4. Shielded, Nonpressure Transition Couplings:

a. Manufacturers: Subject to compliance with requirements, provide products by one of the following available manufacturers offering products that may be incorporated into the Work include, but are not limited to, the following:

1) Cascade Waterworks Mfg. Co.
2) Mission Rubber Company; a division of MCP Industries, Inc.

b. Standard: ASTM C 1460.
c. Description: Elastomeric or rubber sleeve with full-length, corrosion-resistant outer shield and corrosion-resistant-metal tension band and tightening mechanism on each end.

## PART 3 - EXECUTION

### 3.1 EARTH MOVING

A. Comply with requirements for excavating, trenching, and backfilling specified in Section "Earth Moving" or equivalent section.

### 3.2 PIPING INSTALLATION

A. Drawing plans, schematics, and diagrams indicate general location and arrangement of piping systems. Indicated locations and arrangements were used to size pipe and calculate friction loss, expansion, pump sizing, and other design considerations. Install piping as indicated unless deviations to layout are approved on coordination drawings.

B. Install piping in concealed locations unless otherwise indicated and except in equipment rooms and service areas.

C. Install piping indicated to be exposed and piping in equipment rooms and service areas at right angles or parallel to building walls. Diagonal runs are prohibited unless specifically indicated otherwise.

D. Install piping above accessible ceilings to allow sufficient space for ceiling panel removal.

E. Install piping at indicated slopes.

F. Install piping free of sags and bends.

G. Install fittings for changes in direction and branch connections.

H. Install seismic restraints on piping. Comply with requirements for seismic-restraint devices specified in Section 220548 "Vibration and Seismic Controls for Plumbing Piping and Equipment."

I. Make changes in direction for soil and waste drainage and vent piping using appropriate branches, bends, and long-sweep bends. Sanitary tees and short-sweep 1/4 bends may be used on vertical stacks if change in direction of flow is from horizontal to vertical. Use long-turn,

double Y-branch and 1/8-bend fittings if two fixtures are installed back to back or side by side with common drain pipe. Straight tees, elbows, and crosses may be used on vent lines. Do not change direction of flow more than 90 degrees. Use proper size of standard increasers and reducers if pipes of different sizes are connected. Reducing size of drainage piping in direction of flow is prohibited.

J. Lay buried building drainage piping beginning at low point of each system. Install true to grades and alignment indicated, with unbroken continuity of invert. Place hub ends of piping upstream. Install required gaskets according to manufacturer's written instructions for use of lubricants, cements, and other installation requirements. Maintain swab in piping and pull past each joint as completed.

K. Install soil and waste drainage and vent piping at the following minimum slopes unless otherwise indicated:

1. Building Sanitary Drain: 2 percent downward in direction of flow for piping NPS 3 (DN 80) and smaller; 1 percent downward in direction of flow for piping NPS 4 (DN 100) and larger.
2. Horizontal Sanitary Drainage Piping: 2 percent downward in direction of flow.
3. Vent Piping: 1 percent down toward vertical fixture vent or toward vent stack.

L. Install cast-iron soil piping according to CISPI's "Cast Iron Soil Pipe and Fittings Handbook," Chapter IV, "Installation of Cast Iron Soil Pipe and Fittings."

M. Install aboveground copper tubing according to CDA's "Copper Tube Handbook."

N. Install aboveground ABS piping according to ASTM D 2661.

O. Install aboveground PVC piping according to ASTM D 2665.

P. Install underground ABS and PVC piping according to ASTM D 2321.

Q. Plumbing Specialties:

1. Install backwater valves in sanitary waste gravity-flow piping. Comply with requirements for backwater valves specified in Section 221319 "Sanitary Waste Piping Specialties."
2. Install cleanouts at grade and extend to where building sanitary drains connect to building sanitary sewers in sanitary drainage gravity-flow piping. Comply with requirements for cleanouts specified in Section 221319 "Sanitary Waste Piping Specialties."
3. Install drains in sanitary drainage gravity-flow piping. Comply with requirements for drains specified in Section 221319 "Sanitary Waste Piping Specialties."

R. Do not enclose, cover, or put piping into operation until it is inspected and approved by authorities having jurisdiction.

S. Install sleeves for piping penetrations of walls, ceilings, and floors. Comply with requirements for sleeves specified in Section 220517 "Sleeves and Sleeve Seals for Plumbing Piping."

T. Install sleeve seals for piping penetrations of concrete walls and slabs. Comply with requirements for sleeve seals specified in Section 220517 "Sleeves and Sleeve Seals for Plumbing Piping."

U. Install escutcheons for piping penetrations of walls, ceilings, and floors. Comply with requirements for escutcheons specified in Section 220518 "Escutcheons for Plumbing Piping."

## 3.3 JOINT CONSTRUCTION

A. Join hub-and-spigot, cast-iron soil piping with gasket joints according to CISPI's "Cast Iron Soil Pipe and Fittings Handbook" for compression joints.

B. Join hubless, cast-iron soil piping according to CISPI 310 and CISPI's "Cast Iron Soil Pipe and Fittings Handbook" for hubless-piping coupling joints.

C. Join copper tube and fittings with soldered joints according to ASTM B 828. Use ASTM B 813, water-flushable, lead-free flux and ASTM B 32, lead-free-alloy solder.

D. Flanged Joints: Align bolt holes. Select appropriate gasket material, size, type, and thickness. Install gasket concentrically positioned. Use suitable lubricants on bolt threads. Torque bolts in cross pattern.

E. Plastic, Nonpressure-Piping, Solvent-Cement Joints: Clean and dry joining surfaces. Join pipe and fittings according to the following:

1. Comply with ASTM F 402 for safe-handling practice of cleaners, primers, and solvent cements.
2. ABS Piping: Join according to ASTM D 2235 and ASTM D 2661 Appendixes.
3. PVC Piping: Join according to ASTM D 2855 and ASTM D 2665 Appendixes.

## 3.4 SPECIALTY PIPE FITTING INSTALLATION

A. Transition Couplings:

1. Install transition couplings at joints of piping with small differences in OD's.
2. In Drainage Piping: Unshielded, nonpressure transition couplings.

## 3.5 VALVE INSTALLATION

A. Backwater Valves: Install backwater valves in piping subject to backflow.

1. Horizontal Piping: Horizontal backwater valves. Use normally closed type unless otherwise indicated.
2. Floor Drains: Drain outlet backwater valves unless drain has integral backwater valve.
3. Install backwater valves in accessible locations.
4. Comply with requirements for backwater valve specified in Section 221319 "Sanitary Waste Piping Specialties."

3.6 HANGER AND SUPPORT INSTALLATION

A. Comply with requirements for seismic-restraint devices specified in Section 220548 "Vibration and Seismic Controls for Plumbing Piping and Equipment."

B. Comply with requirements for pipe hanger and support devices and installation specified in Section 220529 "Hangers and Supports for Plumbing Piping and Equipment."

1. Install carbon-steel pipe hangers for horizontal piping in noncorrosive environments.
2. Install stainless-steel pipe hangers for horizontal piping in corrosive environments.
3. Install carbon-steel pipe support clamps for vertical piping in noncorrosive environments.
4. Install stainless-steel pipe support clamps for vertical piping in corrosive environments.
5. Vertical Piping: MSS Type 8 or Type 42, clamps.
6. Install individual, straight, horizontal piping runs:

    a. 100 Feet (30 m) and Less: MSS Type 1, adjustable, steel clevis hangers.
    b. Longer Than 100 Feet (30 m): MSS Type 43, adjustable roller hangers.
    c. Longer Than 100 Feet (30 m) if Indicated: MSS Type 49, spring cushion rolls.

7. Multiple, Straight, Horizontal Piping Runs 100 Feet (30 m) or Longer: MSS Type 44, pipe rolls. Support pipe rolls on trapeze.
8. Base of Vertical Piping: MSS Type 52, spring hangers.

C. Support horizontal piping and tubing within 12 inches (300 mm) of each fitting, valve, and coupling.

D. Support vertical piping and tubing at base and at each floor.

E. Rod diameter may be reduced one size for double-rod hangers, with 3/8-inch (10-mm) minimum rods.

F. Install hangers for cast-iron soil piping with the following maximum horizontal spacing and minimum rod diameters:

1. NPS 1-1/2 and NPS 2 (DN 40 and DN 50): 60 inches (1500 mm) with 3/8-inch (10-mm) rod.
2. NPS 3 (DN 80): 60 inches (1500 mm) with 1/2-inch (13-mm) rod.
3. NPS 4 and NPS 5 (DN 100 and DN 125): 60 inches (1500 mm) with 5/8-inch (16-mm) rod.
4. NPS 6 and NPS 8 (DN 150 and DN 200): 60 inches (1500 mm) with 3/4-inch (19-mm) rod.
5. Spacing for 10-foot (3-m) lengths may be increased to 10 feet (3 m). Spacing for fittings is limited to 60 inches (1500 mm).

G. Install supports for vertical cast-iron soil piping every 15 feet (4.5 m).

H. Install hangers for copper tubing with the following maximum horizontal spacing and minimum rod diameters:

1. NPS 1-1/4 (DN 32): 72 inches (1800 mm) with 3/8-inch (10-mm) rod.

2. NPS 1-1/2 and NPS 2 (DN 40 and DN 50): 96 inches (2400 mm) with 3/8-inch (10-mm) rod.
3. NPS 2-1/2 (DN 65): 108 inches (2700 mm) with 1/2-inch (13-mm) rod.
4. NPS 3 and NPS 5 (DN 80 and DN 125): 10 feet (3 m) with 1/2-inch (13-mm) rod.
5. NPS 6 (DN 150): 10 feet (3 m) with 5/8-inch (16-mm) rod.
6. NPS 8 (DN 200): 10 feet (3 m) with 3/4-inch (19-mm) rod.

I. Install supports for vertical copper tubing every 10 feet (3 m).

J. Install hangers for ABS and PVC piping with the following maximum horizontal spacing and minimum rod diameters:

1. NPS 1-1/2 and NPS 2 (DN 40 and DN 50): 48 inches (1200 mm) with 3/8-inch (10-mm) rod.
2. NPS 3 (DN 80): 48 inches (1200 mm) with 1/2-inch (13-mm) rod.
3. NPS 4 and NPS 5 (DN 100 and DN 125): 48 inches (1200 mm) with 5/8-inch (16-mm) rod.
4. NPS 6 and NPS 8 (DN 150 and DN 200): 48 inches (1200 mm) with 3/4-inch (19-mm) rod.

K. Install supports for vertical ABS and PVC piping every 48 inches (1200 mm).

L. Support piping and tubing not listed above according to MSS SP-69 and manufacturer's written instructions.

## 3.7 CONNECTIONS

A. Drawings indicate general arrangement of piping, fittings, and specialties.

B. Connect soil and waste piping to exterior sanitary sewerage piping. Use transition fitting to join dissimilar piping materials.

C. Connect drainage and vent piping to the following:

1. Plumbing Fixtures: Connect drainage piping in sizes indicated, but not smaller than required by plumbing code.
2. Plumbing Fixtures and Equipment: Connect atmospheric vent piping in sizes indicated, but not smaller than required by authorities having jurisdiction.
3. Plumbing Specialties: Connect drainage and vent piping in sizes indicated, but not smaller than required by plumbing code.
4. Install test tees (wall cleanouts) in conductors near floor and floor cleanouts with cover flush with floor.
5. Install horizontal backwater valves with cleanout cover flush with floor.
6. Comply with requirements for backwater valves cleanouts and drains specified in Section 221319 "Sanitary Waste Piping Specialties."
7. Equipment: Connect drainage piping as indicated. Provide shutoff valve if indicated and union for each connection. Use flanges instead of unions for connections NPS 2-1/2 (DN 65) and larger.

D. Where installing piping adjacent to equipment, allow space for service and maintenance of equipment.

E. Make connections according to the following unless otherwise indicated:

1. Install unions, in piping NPS 2 (DN 50) and smaller, adjacent to each valve and at final connection to each piece of equipment.
2. Install flanges, in piping NPS 2-1/2 (DN 65) and larger, adjacent to flanged valves and at final connection to each piece of equipment.

## 3.8 IDENTIFICATION

A. Identify exposed sanitary waste and vent piping.

## 3.9 FIELD QUALITY CONTROL

A. During installation, notify authorities having jurisdiction at least 24 hours before inspection must be made. Perform tests specified below in presence of authorities having jurisdiction.

1. Roughing-in Inspection: Arrange for inspection of piping before concealing or closing-in after roughing-in and before setting fixtures.
2. Final Inspection: Arrange for final inspection by authorities having jurisdiction to observe tests specified below and to ensure compliance with requirements.

B. Reinspection: If authorities having jurisdiction find that piping will not pass test or inspection, make required corrections and arrange for reinspection.

C. Reports: Prepare inspection reports and have them signed by authorities having jurisdiction.

D. Test sanitary drainage and vent piping according to procedures of authorities having jurisdiction or, in absence of published procedures, as follows:

1. Test for leaks and defects in new piping and parts of existing piping that have been altered, extended, or repaired. If testing is performed in segments, submit separate report for each test, complete with diagram of portion of piping tested.
2. Leave uncovered and unconcealed new, altered, extended, or replaced drainage and vent piping until it has been tested and approved. Expose work that was covered or concealed before it was tested.
3. Roughing-in Plumbing Test Procedure: Test drainage and vent piping except outside leaders on completion of roughing-in. Close openings in piping system and fill with water to point of overflow, but not less than 10-foot head of water (30 kPa). From 15 minutes before inspection starts to completion of inspection, water level must not drop. Inspect joints for leaks.
4. Finished Plumbing Test Procedure: After plumbing fixtures have been set and traps filled with water, test connections and prove they are gastight and watertight. Plug vent-stack openings on roof and building drains where they leave building. Introduce air into piping system equal to pressure of 1-inch wg (250 Pa). Use U-tube or manometer inserted in trap of water closet to measure this pressure. Air pressure must remain

constant without introducing additional air throughout period of inspection. Inspect plumbing fixture connections for gas and water leaks.

5. Repair leaks and defects with new materials and retest piping, or portion thereof, until satisfactory results are obtained.
6. Prepare reports for tests and required corrective action.

## 3.10 CLEANING AND PROTECTION

A. Clean interior of piping. Remove dirt and debris as work progresses.

B. Protect drains during remainder of construction period to avoid clogging with dirt and debris and to prevent damage from traffic and construction work.

C. Place plugs in ends of uncompleted piping at end of day and when work stops.

D. Exposed ABS and PVC Piping: Protect plumbing vents exposed to sunlight with two coats of water-based latex paint.

## 3.11 PIPING SCHEDULE

A. Flanges and unions may be used on aboveground pressure piping unless otherwise indicated.

B. Aboveground, soil and waste piping NPS 4 (DN 100) and smaller shall be any of the following:

1. Service class, cast-iron soil pipe and fittings; gaskets; and gasketed joints.
2. Hubless, cast-iron soil pipe and fittings; CISPI hubless-piping couplings; and coupled joints.
3. Copper DWV tube, copper drainage fittings, and soldered joints.
4. Solid-wall ABS pipe, ABS socket fittings, and solvent-cemented joints.
5. Solid-wall PVC pipe, PVC socket fittings, and solvent-cemented joints.
6. Dissimilar Pipe-Material Couplings: Unshielded, nonpressure transition couplings.

C. Aboveground, soil and waste piping NPS 5 (DN 125) and larger shall be any of the following:

1. Service class, cast-iron soil pipe and fittings; gaskets; and gasketed joints.
2. Hubless, cast-iron soil pipe and fittings; CISPI hubless-piping couplings; and coupled joints.
3. Solid-wall PVC pipe, PVC socket fittings, and solvent-cemented joints.
4. Dissimilar Pipe-Material Couplings: Unshielded, nonpressure transition couplings.

D. Aboveground, vent piping NPS 4 (DN 100) and smaller shall be any of the following:

1. Service class, cast-iron soil pipe and fittings; gaskets; and gasketed joints.
2. Hubless, cast-iron soil pipe and fittings; CISPI hubless-piping couplings; and coupled joints.
3. Copper DWV tube, copper drainage fittings, and soldered joints.
4. Solid-wall ABS pipe, ABS socket fittings, and solvent-cemented joints.
5. Solid-wall PVC pipe, PVC socket fittings, and solvent-cemented joints.

6. Dissimilar Pipe-Material Couplings: Unshielded, nonpressure transition couplings.

E. Aboveground, vent piping NPS 5 (DN 125) and larger shall be any of the following:

1. Service class, cast-iron soil pipe and fittings; gaskets; and gasketed joints.
2. Hubless, cast-iron soil pipe and fittings; CISPI hubless-piping couplings; and coupled joints.
3. Solid-wall PVC pipe, PVC socket fittings, and solvent-cemented joints.
4. Dissimilar Pipe-Material Couplings: Unshielded, nonpressure transition couplings.

F. Underground, soil, waste, and vent piping NPS 4 (DN 100) and smaller shall be any of the following:

1. Service class, cast-iron soil piping; gaskets; and gasketed joints.
2. Hubless, cast-iron soil pipe and fittings; CISPI cast-iron hubless-piping couplings; and coupled joints.
3. Solid wall ABS pipe, ABS socket fittings, and solvent-cemented joints.
4. Solid wall PVC pipe, PVC socket fittings, and solvent-cemented joints.
5. Dissimilar Pipe-Material Couplings: Unshielded, nonpressure transition couplings.

G. Underground, soil and waste piping NPS 5 (DN 125) and larger shall be any of the following:

1. Service class, cast-iron soil piping; gaskets; and gasketed joints.
2. Hubless, cast-iron soil pipe and fittings; CISPI cast-iron hubless-piping couplings; coupled joints.
3. Solid-wall PVC pipe; PVC socket fittings; and solvent-cemented joints.
4. Dissimilar Pipe-Material Couplings: Unshielded, nonpressure transition couplings.

END OF SECTION 221316

# SECTION 221319 - SANITARY WASTE PIPING SPECIALTIES

## PART 1 - GENERAL

### 1.1 SUMMARY

A. Section Includes:

1. Backwater valves.
2. Cleanouts.
3. Floor drains.
4. Roof flashing assemblies.
5. Miscellaneous sanitary drainage piping specialties.
6. Flashing materials.
7. Oil/Sand interceptors.

### 1.2 ACTION SUBMITTALS

A. Product Data: For each type of product indicated. Include rated capacities, operating characteristics, and accessories for grease interceptors.

### 1.3 QUALITY ASSURANCE

A. Drainage piping specialties shall bear label, stamp, or other markings of specified testing agency.

## PART 2 - PRODUCTS

### 2.1 BACKWATER VALVES

A. Horizontal, Cast-Iron Backwater Valves

1. Manufacturers: Subject to compliance with requirements, provide products by the following available manufacturers offering products that may be incorporated into the Work include, but are not limited to, the following:
2. Basis-of-Design Product: Subject to compliance with requirements, provide product indicated on Drawings or comparable product by one of the following:

a. Josam Company; Josam Div.
b. MIFAB, Inc.
c. Smith, Jay R. Mfr. Co.; Division of Smith Industries, Inc.
d. Tyler Pipe; Wade Div.

e. Watts Drainage Products Inc.
f. Zurn Plumbing Products Group; Specification Drainage Operation.

3. Standard: ASME A112.14.1.
4. Size: Same as connected piping.
5. Body: Cast iron.
6. Cover: Cast iron with bolted or threaded access check valve.
7. End Connections: Hub and spigot or hubless.
8. Type Check Valve: Removable, bronze, swing check, factory assembled or field modified to hang closed.
9. Extension: ASTM A 74, Service class; full-size, cast-iron, soil-pipe extension to field-installed cleanout at floor; replaces backwater valve cover.

B. Drain-Outlet Backwater Valves

1. Manufacturers: Subject to compliance with requirements, provide products by the following available manufacturers offering products that may be incorporated into the Work include, but are not limited to, the following:
2. Basis-of-Design Product: Subject to compliance with requirements, provide product indicated on Drawings or comparable product by one of the following:

a. Josam Company; Josam Div.
b. Smith, Jay R. Mfr. Co.; Division of Smith Industries, Inc.
c. Watts Drainage Products Inc.
d. Zurn Plumbing Products Group; Specification Drainage Operation.

3. Size: Same as floor drain outlet.
4. Body: Cast iron or bronze made for vertical installation in bottom outlet of floor drain.
5. Check Valve: Removable ball float.
6. Inlet: Threaded.
7. Outlet: Threaded or spigot.

2.2 CLEANOUTS

A. Exposed Cast-Iron Cleanouts

1. Manufacturers: Subject to compliance with requirements, provide products by the following available manufacturers offering products that may be incorporated into the Work include, but are not limited to, the following:
2. Basis-of-Design Product: Subject to compliance with requirements, provide product indicated on Drawings or comparable product by one of the following:

a. Josam Company.
b. MIFAB, Inc.
c. Smith, Jay R. Mfg. Co.
d. Tyler Pipe.
e. Watts Drainage Products.

f. Zurn Plumbing Products Group.

3. Standard: ASME A112.36.2M for cast iron for cleanout test tee.
4. Size: Same as connected drainage piping
5. Body Material: Hub-and-spigot, cast-iron soil pipe T-branch as required to match connected piping.
6. Closure: Countersunk or raised-head, brass plug.
7. Closure Plug Size: Same as or not more than one size smaller than cleanout size.

B. Cast-Iron Floor Cleanouts

1. Manufacturers: Subject to compliance with requirements, provide products by the following available manufacturers offering products that may be incorporated into the Work include, but are not limited to, the following:
2. Basis-of-Design Product: Subject to compliance with requirements, provide product indicated on Drawings or comparable product by one of the following:

a. Josam Company; Josam Div.
b. Oatey.
c. Sioux Chief Manufacturing Company, Inc.
d. Smith, Jay R. Mfg. Co.; Division of Smith Industries, Inc.
e. Tyler Pipe; Wade Div.
f. Watts Drainage Products Inc.
g. Zurn Plumbing Products Group; Light Commercial Operation.
h. Zurn Plumbing Products Group; Specification Drainage Operation.

3. Standard: ASME A112.36.2M for heavy-duty, adjustable housing cleanout.
4. Size: Same as connected branch.
5. Type: Threaded, adjustable housing.
6. Body or Ferrule: Cast iron.
7. Clamping Device: Required.
8. Outlet Connection: Inside calk.
9. Closure: Brass plug with straight threads and gasket.
10. Adjustable Housing Material: Cast iron with set-screws or other device.
11. Frame and Cover Material and Finish: Nickel-bronze, copper alloy.
12. Frame and Cover Shape: Round.
13. Top Loading Classification: Extra Heavy Duty.
14. Riser: ASTM A 74, Extra-Heavy class, cast-iron drainage pipe fitting and riser to cleanout.

C. Cast-Iron Wall Cleanouts

1. Manufacturers: Subject to compliance with requirements, provide products by the following available manufacturers offering products that may be incorporated into the Work include, but are not limited to, the following:
2. Basis-of-Design Product: Subject to compliance with requirements, provide product indicated on Drawings or comparable product by one of the following:

a. Josam Company; Josam Div.
b. MIFAB, Inc.
c. Smith, Jay R. Mfg. Co.; Division of Smith Industries, Inc.
d. Tyler Pipe; Wade Div.
e. Watts Drainage Products Inc.
f. Zurn Plumbing Products Group; Specification Drainage Operation.

3. Standard: ASME A112.36.2M. Include wall access.
4. Size: Same as connected drainage piping.
5. Body: Hub-and-spigot, cast-iron soil pipe T-branch as required to match connected piping.
6. Closure: Countersunk or raised-head, drilled-and-threaded brass plug.
7. Closure Plug Size: Same as or not more than one size smaller than cleanout size.
8. Wall Access: Round, deep, chrome-plated bronze cover plate with screw.
9. Wall Access: Round, nickel-bronze, copper-alloy, or stainless-steel wall-installation frame and cover.

## 2.3 FLOOR DRAINS

A. Cast-Iron Floor Drains

1. Manufacturers: Subject to compliance with requirements, provide products by the following available manufacturers offering products that may be incorporated into the Work include, but are not limited to, the following:
2. Basis-of-Design Product: Subject to compliance with requirements, provide product indicated on Drawings or comparable product by one of the following:

a. Commercial Enameling Co.
b. Josam Company; Josam Div.
c. MIFAB, Inc.
d. Prier Products, Inc.
e. Smith, Jay R. Mfg. Co.; Division of Smith Industries, Inc.
f. Tyler Pipe; Wade Div.
g. Watts Drainage Products Inc.
h. Zurn Plumbing Products Group; Light Commercial Operation.
i. Zurn Plumbing Products Group; Specification Drainage Operation.

3. Standard: ASME A112.6.3 with backwater valve.
4. Pattern: Floor Sanitary drain.
5. Body Material: Gray iron.
6. Seepage Flange: Required.
7. Anchor Flange: Required.
8. Clamping Device: Required.
9. Outlet: Bottom.
10. Backwater Valve: Drain-outlet type.
11. Top or Strainer Material: Bronze.

12. Top of Body and Strainer Finish: Nickel bronze.
13. Top Shape: Round.
14. Top Loading Classification: Extra Heavy-Duty.
15. Funnel: Not required.
16. Inlet Fitting: Not required.
17. Trap Material: Bronze.
18. Trap Pattern: Deep-seal P-trap.
19. Trap Features: Trap-seal primer valve drain connection.

## 2.4 ROOF FLASHING ASSEMBLIES

A. Roof Flashing Assemblies

1. Manufacturers: Subject to compliance with requirements, provide products by the following available manufacturers offering products that may be incorporated into the Work include, but are not limited to, the following:
2. Basis-of-Design Product: Subject to compliance with requirements, provide product indicated on Drawings or comparable product by one of the following:

    a. Acorn Engineering Company; Elmdor/Stoneman Div.
    b. Thaler Metal Industries Ltd.

3. Description: Manufactured assembly made of 4.0-lb/sq. ft., 0.0625-inch-thick, lead flashing collar and skirt extending at least 6 inches from pipe, with galvanized-steel boot reinforcement and counterflashing fitting.

    a. Open-Top Vent Cap: Without cap.
    b. Low-Silhouette Vent Cap: With vandal-proof vent cap.
    c. Extended Vent Cap: With field-installed, vandal-proof vent cap.

## 2.5 MISCELLANEOUS SANITARY DRAINAGE PIPING SPECIALTIES

A. Open Drains

1. Description: Shop or field fabricate from ASTM A 74, Service class, hub-and-spigot, cast-iron, soil-pipe fittings. Include P-trap, hub-and-spigot riser section; and where required, increaser fitting joined with ASTM C 564, rubber gaskets.
2. Size: Same as connected waste piping.

B. Deep-Seal Traps

1. Description: Cast-iron or bronze casting, with inlet and outlet matching connected piping and cleanout trap-seal primer valve connection.
2. Size: Same as connected waste piping.

    a. NPS 2: 4-inch-minimum water seal.

b. NPS 2-1/2 and Larger: 5-inch-minimum water seal.

C. Floor-Drain, Trap-Seal Primer Fittings

1. Description: Cast iron, with threaded inlet and threaded or spigot outlet, and trap-seal primer valve connection.
2. Size: Same as floor drain outlet with NPS 1/2 side inlet.

D. Air-Gap Fittings (Funnel Traps)

1. Standard: ASME A112.1.2, for fitting designed to ensure fixed, positive air gap between installed inlet and outlet piping.
2. Body: Bronze or cast iron.
3. Inlet: Opening in top of body.
4. Outlet: Larger than inlet.
5. Size: Same as connected waste piping and with inlet large enough for associated indirect waste piping.

E. Sleeve Flashing Device

1. Description: Manufactured, cast-iron fitting, with clamping device, that forms sleeve for pipe floor penetrations of floor membrane. Include galvanized-steel pipe extension in top of fitting that will extend 1 inch above finished floor and galvanized-steel pipe extension in bottom of fitting that will extend through floor slab.
2. Size: As required for close fit to riser or stack piping.

F. Stack Flashing Fittings

1. Description: Counterflashing-type, cast-iron fitting, with bottom recess for terminating roof membrane, and with threaded or hub top for extending vent pipe.
2. Size: Same as connected stack vent or vent stack.

G. Vent Caps

1. Description: Cast-iron body with threaded or hub inlet and vandal-proof design. Include vented hood and setscrews to secure to vent pipe.
2. Size: Same as connected stack vent or vent stack.

2.6 FLASHING MATERIALS

A. Lead Sheet: ASTM B 749, Type L51121, copper bearing, with the following minimum weights and thicknesses, unless otherwise indicated:

1. General Use: 4.0-lb/sq. ft., 0.0625-inch thickness.
2. Vent Pipe Flashing: 3.0-lb/sq. ft., 0.0469-inch thickness.
3. Burning: 6-lb/sq. ft., 0.0938-inch thickness.

B. Fasteners: Metal compatible with material and substrate being fastened.

C. Metal Accessories: Sheet metal strips, clamps, anchoring devices, and similar accessory units required for installation; matching or compatible with material being installed.

D. Solder: ASTM B 32, lead-free alloy.

E. Bituminous Coating: SSPC-Paint 12, solvent-type, bituminous mastic.

## 2.7 OIL/SAND INTERCEPTORS

A. Interceptors:

1. Cast-Iron or Steel Grease Interceptors:

a. Manufacturers: Subject to compliance with requirements, provide products by the following available manufacturers offering products that may be incorporated into the Work include, but are not limited to, the following:

b. Basis-of-Design Product: Subject to compliance with requirements, provide product indicated on Drawings or comparable product by one of the following:

1) Applied Chemical Technology, Incorporated.
2) Josam Company.
3) MIFAB, Inc.
4) Rockford Sanitary Systems, Inc.
5) Schier Products Company.
6) Smith, Jay R. Mfg. Co.
7) Tyler Pipe.
8) Watts Drainage Products.
9) Zurn Plumbing Products Group.

2. Plastic Oil/Sand Interceptors:

a. Manufacturers: Subject to compliance with requirements, provide products by the following available manufacturers offering products that may be incorporated into the Work include, but are not limited to, the following:

b. Basis-of-Design Product: Subject to compliance with requirements, provide product indicated on Drawings or comparable product by one of the following:

1) Ashland Trap Distribution Co.
2) Bio-Microbics, Inc.
3) Canplas LLC.
4) Schier Products Company.
5) Zurn Plumbing Products Group.

3. Plumbing and Drainage Institute Seal: Not required.
4. Body Material: Plastic.
5. Interior Lining: Not required.

6. Exterior Coating: Not required.
7. Cleanout: Integral or field installed on outlet.
8. Flow-Control Fitting: Required.
9. Operation: Manual cleaning.

PART 3 - EXECUTION

3.1 INSTALLATION

A. Install backwater valves in building drain piping. For interior installation, provide cleanout deck plate flush with floor and centered over backwater valve cover, and of adequate size to remove valve cover for servicing.

B. Install cleanouts in aboveground piping and building drain piping according to the following, unless otherwise indicated:

1. Size same as drainage piping up to NPS 4. Use NPS 4 for larger drainage piping unless larger cleanout is indicated.
2. Locate at each change in direction of piping greater than 45 degrees.
3. Locate at minimum intervals of 50 feet for piping NPS 4 and smaller and 100 feet for larger piping.
4. Locate at base of each vertical soil and waste stack.

C. For floor cleanouts for piping below floors, install cleanout deck plates with top flush with finished floor.

D. For cleanouts located in concealed piping, install cleanout wall access covers, of types indicated, with frame and cover flush with finished wall.

E. Install floor drains at low points of surface areas to be drained. Set grates of drains flush with finished floor, unless otherwise indicated.

1. Position floor drains for easy access and maintenance.
2. Set floor drains below elevation of surrounding finished floor to allow floor drainage. Set with grates depressed according to the following drainage area radii:

    a. Radius, 30 Inches or Less: Equivalent to 1 percent slope, but not less than 1/4-inch total depression.
    b. Radius, 30 to 60 Inches: Equivalent to 1 percent slope.
    c. Radius, 60 Inches or Larger: Equivalent to 1 percent slope, but not greater than 1-inch total depression.

3. Install floor-drain flashing collar or flange so no leakage occurs between drain and adjoining flooring. Maintain integrity of waterproof membranes where penetrated.
4. Install individual traps for floor drains connected to sanitary building drain, unless otherwise indicated.

F. Install roof flashing assemblies on sanitary stack vents and vent stacks that extend through roof.

G. Install flashing fittings on sanitary stack vents and vent stacks that extend through roof.

H. Assemble open drain fittings and install with top of hub 1 inch above floor.

I. Install deep-seal traps on floor drains and other waste outlets, if indicated.

J. Install floor-drain, trap-seal primer fittings on inlet to floor drains that require trap-seal primer connection.

1. Exception: Fitting may be omitted if trap has trap-seal primer connection.
2. Size: Same as floor drain inlet.

K. Install air-gap fittings on draining-type backflow preventers and on indirect-waste piping discharge into sanitary drainage system.

L. Install sleeve flashing device with each riser and stack passing through floors with waterproof membrane.

M. Install vent caps on each vent pipe passing through roof.

N. Install grease interceptors, including trapping, venting, and flow-control fitting, according to authorities having jurisdiction and with clear space for servicing.

1. Above-Floor Installation: Set unit with bottom resting on floor, unless otherwise indicated.
2. Flush with Floor Installation: Set unit and extension, if required, with cover flush with finished floor.
3. Recessed Floor Installation: Set unit in receiver housing having bottom or cradle supports, with receiver housing cover flush with finished floor.
4. Install cleanout immediately downstream from interceptors not having integral cleanout on outlet.

O. Install traps on plumbing specialty drain outlets. Omit traps on indirect wastes unless trap is indicated.

## 3.2 CONNECTIONS

A. Comply with requirements in Section 221316 "Sanitary Waste and Vent Piping" for piping installation requirements. Drawings indicate general arrangement of piping, fittings, and specialties.

B. Install piping adjacent to equipment to allow service and maintenance.

C. Grease Interceptors: Connect inlet and outlet to unit, and connect flow-control fitting and vent to unit inlet piping. Install valve on outlet of automatic drawoff-type unit.

3.3 FLASHING INSTALLATION

A. Fabricate flashing from single piece unless large pans, sumps, or other drainage shapes are required. Join flashing according to the following if required:

1. Lead Sheets: Burn joints of lead sheets 6.0-lb/sq. ft., 0.0938-inch thickness or thicker. Solder joints of lead sheets 4.0-lb/sq. ft., 0.0625-inch thickness or thinner.

B. Install sheet flashing on pipes, sleeves, and specialties passing through or embedded in floors and roofs with waterproof membrane.

1. Pipe Flashing: Sleeve type, matching pipe size, with minimum length of 10 inches, and skirt or flange extending at least 8 inches around pipe.
2. Sleeve Flashing: Flat sheet, with skirt or flange extending at least 8 inches around sleeve.
3. Embedded Specialty Flashing: Flat sheet, with skirt or flange extending at least 8 inches around specialty.

C. Set flashing on floors and roofs in solid coating of bituminous cement.

D. Secure flashing into sleeve and specialty clamping ring or device.

E. Install flashing for piping passing through roofs with counterflashing or commercially made flashing fittings, according to Section 076200 "Sheet Metal Flashing and Trim."

F. Extend flashing up vent pipe passing through roofs and turn down into pipe, or secure flashing into cast-iron sleeve having calking recess.

3.4 LABELING AND IDENTIFYING

A. Equipment Nameplates and Signs: Install engraved plastic-laminate equipment nameplate or sign on or near each grease interceptor.

B. Distinguish among multiple units, inform operator of operational requirements, indicate safety and emergency precautions, and warn of hazards and improper operations, in addition to identifying unit. Nameplates and signs are specified in Section 220553 "Identification for Plumbing Piping and Equipment."

3.5 PROTECTION

A. Protect drains during remainder of construction period to avoid clogging with dirt or debris and to prevent damage from traffic or construction work.

B. Place plugs in ends of uncompleted piping at end of each day or when work stops.

END OF SECTION 221319

# SECTION 221319.13 - SANITARY DRAINS

## PART 1 - GENERAL

### 1.1 SUMMARY

A. Section Includes:

1. Floor drains.
2. Trench drains.

### 1.2 DEFINITIONS

A. ABS: Acrylonitrile-butadiene styrene.

B. FRP: Fiberglass-reinforced plastic.

C. HDPE: High-density polyethylene.

D. PE: Polyethylene.

E. PP: Polypropylene.

F. PVC: Polyvinyl chloride.

### 1.3 ACTION SUBMITTALS

A. Product Data: For each type of product.

## PART 2 - PRODUCTS

### 2.1 DRAIN ASSEMBLIES

A. Sanitary drains shall bear label, stamp, or other markings of specified testing agency.

B. Comply with NSF 14 for plastic sanitary piping specialty components.

### 2.2 FLOOR DRAINS

A. Cast-Iron Floor Drains:

1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:

a. Commercial Enameling Company.
b. Jay R. Smith Mfg. Co.
c. Josam Company.
d. MIFAB, Inc.
e. Prier Products, Inc.
f. Sioux Chief Manufacturing Company, Inc.
g. Wade; a subsidiary of McWane Inc.
h. WATTS.
i. Zurn Industries, LLC.

2. Standard: ASME A112.6.3 with backwater valve.
3. Pattern: Area drain.
4. Body Material: Gray iron.
5. Seepage Flange: Required.
6. Anchor Flange: Required.
7. Clamping Device: Required.
8. Outlet: Bottom.
9. Backwater Valve: Drain-outlet type.
10. Coating on Interior and Exposed Exterior Surfaces: Not required.
11. Sediment Bucket: Not required.
12. Top or Strainer Material: Bronze.
13. Top of Body and Strainer Finish: Nickel bronze.
14. Top Shape: Round.
15. Funnel: Not required.
16. Inlet Fitting: Gray iron, with threaded inlet and threaded or spigot outlet, and trap-seal primer valve connection.
17. Trap Material: Bronze.
18. Trap Pattern: Deep-seal P-trap.
19. Trap Features: Trap-seal primer valve drain connection.

## 2.3 TRENCH DRAINS

A. Trench Drains:

1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:

a. Jay R. Smith Mfg. Co.
b. Josam Company.
c. MIFAB, Inc.
d. Sioux Chief Manufacturing Company, Inc.
e. Wade; a subsidiary of McWane Inc.
f. WATTS.
g. Zurn Industries, LLC.

2. Standard: ASME A112.6.3 for trench drains.
3. Material: Ductile or gray iron.
4. Flange: Seepage.
5. Clamping Device: Required.

6. Outlet: Bottom.
7. Grate Material: Stainless steel.
8. Grate Finish: Not required.
9. Top Loading Classification: Heavy Duty.
10. Trap Material: Cast iron.
11. Trap Pattern: Standard P-trap.

## PART 3 - EXECUTION

### 3.1 INSTALLATION

A. Install floor drains at low points of surface areas to be drained. Set grates of drains flush with finished floor, unless otherwise indicated.

1. Position floor drains for easy access and maintenance.
2. Set floor drains below elevation of surrounding finished floor to allow floor drainage.
3. Set with grates depressed according to the following drainage area radii:

    a. Radius, 30 Inches (750 mm) or Less: Equivalent to 1 percent slope, but not less than 1/4-inch (6.35-mm) total depression.
    b. Radius, 30 to 60 Inches (750 to 1500 mm): Equivalent to 1 percent slope.
    c. Radius, 60 Inches (1500 mm) or Larger: Equivalent to 1 percent slope, but not greater than 1-inch (25-mm) total depression.

4. Install floor-drain flashing collar or flange, so no leakage occurs between drain and adjoining flooring.

    a. Maintain integrity of waterproof membranes where penetrated.

5. Install individual traps for floor drains connected to sanitary building drain, unless otherwise indicated.

B. Install trench drains at low points of surface areas to be drained.

1. Set grates of drains flush with finished surface, unless otherwise indicated.
2. Install on support devices, so that top will be flush with adjacent surface.

C. Install open drain fittings with top of hub 1 inch (25 mm) above floor.

### 3.2 CONNECTIONS

A. Comply with requirements in Section 221316 "Sanitary Waste and Vent Piping" for piping installation requirements. Drawings indicate general arrangement of piping, fittings, and specialties.

B. Comply with requirements in Section 221319 "Sanitary Waste Piping Specialties" for backwater valves, air admittance devices and miscellaneous sanitary drainage piping specialties.

C. Comply with requirements in Section 221323 "Sanitary Waste Interceptors" for grease interceptors, grease-removal devices, oil interceptors, sand interceptors, and solid interceptors.

D. Install piping adjacent to equipment to allow service and maintenance.

E. Ground equipment according to Section 260526 "Grounding and Bonding for Electrical Systems."

F. Connect wiring according to Section 260519 "Low-Voltage Electrical Power Conductors and Cables."

## 3.3 LABELING AND IDENTIFYING

A. Distinguish among multiple units, inform operator of operational requirements, indicate safety and emergency precautions, and warn of hazards and improper operations, in addition to identifying unit. Nameplates and signs are specified in Section 220553 "Identification for Plumbing Piping and Equipment."

## 3.4 PROTECTION

A. Protect drains during remainder of construction period to avoid clogging with dirt or debris and to prevent damage from traffic or construction work.

B. Place plugs in ends of uncompleted piping at end of each day or when work stops.

END OF SECTION 221319.13

# SECTION 221413 - FACILITY STORM DRAINAGE PIPING

## PART 1 - GENERAL

### 1.1 SUMMARY

A. Section Includes:

1. Pipe, tube, and fittings.
2. Specialty pipe fittings.

B. Related Section:

1. Section 334100 "Storm Utility Drainage Piping" for storm drainage piping outside the building.

### 1.2 PERFORMANCE REQUIREMENTS

A. Seismic Performance: Storm drainage piping and support and installation shall withstand the effects of earthquake motions determined according to ASCE/SEI 7.

### 1.3 ACTION SUBMITTALS

A. Product Data: For each type of product indicated.

### 1.4 INFORMATIONAL SUBMITTALS

A. Seismic Qualification Certificates: For storm drainage piping, accessories, and components, from manufacturer.

B. Field quality-control reports.

### 1.5 QUALITY ASSURANCE

A. Piping materials shall bear label, stamp, or other markings of specified testing agency.

B. Comply with NSF/ANSI 14, "Plastics Piping System Components and Related Materials," for plastic piping components. Include marking with "NSF-drain" for plastic drain piping and "NSF-sewer" for plastic sewer piping.

PART 2 - PRODUCTS

2.1 PIPING MATERIALS

A. Comply with requirements in "Piping Schedule" Article for applications of pipe, tube, fitting materials, and joining methods for specific services, service locations, and pipe sizes.

2.2 HUB-AND-SPIGOT, CAST-IRON SOIL PIPE AND FITTINGS

A. Pipe and Fittings: ASTM A 74, Service class.

B. Gaskets: ASTM C 564, rubber.

2.3 HUBLESS, CAST-IRON SOIL PIPE AND FITTINGS

A. Pipe and Fittings: ASTM A 888 or CISPI 301.

B. CISPI, Hubless-Piping Couplings:

1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:

a. ANACO-Husky.
b. Charlotte Pipe and Foundry Company.
c. Dallas Specialty & Mfg. Co.
d. Fernco Inc.
e. Ideal Clamp Products, Inc.
f. Matco-Norca.
g. MIFAB, Inc.
h. Mission Rubber Company, LLC; a division of MCP Industries.
i. NewAge Casting.
j. Tyler Pipe; a subsidiary of McWane Inc.

2. Standards: ASTM C 1277 and CISPI 310.
3. Description: Stainless-steel corrugated shield with stainless-steel bands and tightening devices; and ASTM C 564, rubber sleeve with integral, center pipe stop.

C. Heavy-Duty, Hubless-Piping Couplings:

1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:

a. ANACO-Husky.
b. Charlotte Pipe and Foundry Company.
c. Clamp-All Corp.
d. Dallas Specialty & Mfg. Co.
e. Ideal Clamp Products, Inc.
f. MIFAB, Inc.

g. Mission Rubber Company, LLC; a division of MCP Industries.
h. NewAge Casting.
i. Tyler Pipe; a subsidiary of McWane Inc.

2. Standards: ASTM C 1277 and ASTM C 1540.
3. Description: Stainless-steel shield with stainless-steel bands and tightening devices; and ASTM C 564, rubber sleeve with integral, center pipe stop.

## 2.4 COPPER TUBE AND FITTINGS

A. Copper DWV Tube: ASTM B 306, drainage tube, drawn temper.

B. Copper Drainage Fittings: ASME B16.23, cast-copper fittings or ASME B16.29, wrought-copper, solder-joint fittings.

C. Copper Flanges: ASME B16.24, Class 150, cast copper with solder-joint end.

1. Flange Gasket Materials: ASME B16.21, full-face, flat, nonmetallic, asbestos-free, 1/8-inch (3.2-mm) maximum thickness unless thickness or specific material is indicated.
2. Flange Bolts and Nuts: ASME B18.2.1, carbon steel unless otherwise indicated.

D. Solder: ASTM B 32, lead free with ASTM B 813, water-flushable flux.

## 2.5 ABS PIPE AND FITTINGS

A. Solid-Wall ABS Pipe: ASTM D 2661, Schedule 40.

B. Cellular-Core ABS Pipe: ASTM F 628, Schedule 40.

C. ABS Socket Fittings: ASTM D 2661, made to ASTM D 3311, drain, waste, and vent patterns.

D. Solvent Cement: ASTM D 2235.

## 2.6 PVC PIPE AND FITTINGS

A. Solid-Wall PVC Pipe: ASTM D 2665, drain, waste, and vent.

B. Cellular-Core PVC Pipe: ASTM F 891, Schedule 40.

C. PVC Socket Fittings: ASTM D 2665, made to ASTM D 3311, drain, waste, and vent patterns and to fit Schedule 40 pipe.

D. Adhesive Primer: ASTM F 656.

E. Solvent Cement: ASTM D 2564.

2.7 SPECIALTY PIPE FITTINGS

A. Transition Couplings:

1. General Requirements: Fitting or device for joining piping with small differences in ODs or of different materials. Include end connections same size as and compatible with pipes to be joined.
2. Fitting-Type Transition Couplings: Manufactured piping coupling or specified-piping-system fitting.

3. Shielded, Nonpressure Transition Couplings:

a. Manufacturers: Subject to compliance with requirements, provide products by one of the following:

1) Cascade Waterworks Mfg. Co.
2) Mission Rubber Company, LLC; a division of MCP Industries.

b. Standard: ASTM C 1460.
c. Description: Elastomeric or rubber sleeve with full-length, corrosion-resistant outer shield and corrosion-resistant-metal tension band and tightening mechanism on each end.

PART 3 - EXECUTION

3.1 EARTH MOVING

A. Comply with requirements for excavating, trenching, and backfilling specified in Section 312000 "Earth Moving."

3.2 PIPING INSTALLATION

A. Drawing plans, schematics, and diagrams indicate general location and arrangement of piping systems. Indicated locations and arrangements were used to size pipe and calculate friction loss, expansion, pump sizing, and other design considerations. Install piping as indicated unless deviations from layout are approved on coordination drawings.

B. Install piping in concealed locations unless otherwise indicated and except in equipment rooms and service areas.

C. Install piping indicated to be exposed and piping in equipment rooms and service areas at right angles or parallel to building walls. Diagonal runs are prohibited unless specifically indicated otherwise.

D. Install piping above accessible ceilings to allow sufficient space for ceiling panel removal.

E. Install piping at indicated slopes.

F. Install piping free of sags and bends.

G. Install fittings for changes in direction and branch connections.

H. Install seismic restraints on piping. Comply with requirements for seismic-restraint devices specified in Section 220548 "Vibration and Seismic Controls for Plumbing Piping and Equipment."

I. Make changes in direction for storm drainage piping using appropriate branches, bends, and long-sweep bends. Do not change direction of flow more than 90 degrees. Use proper size of standard increasers and reducers if pipes of different sizes are connected. Reducing size of drainage piping in direction of flow is prohibited.

J. Lay buried building storm drainage piping beginning at low point of each system. Install true to grades and alignment indicated, with unbroken continuity of invert. Place hub ends of piping upstream. Install required gaskets according to manufacturer's written instructions for use of lubricants, cements, and other installation requirements. Maintain swab in piping and pull past each joint as completed.

K. Install storm drainage piping at the following minimum slopes unless otherwise indicated:

1. Building Storm Drain: 1 percent downward in direction of flow for piping NPS 3 (DN 80) and smaller; 1 percent downward in direction of flow for piping NPS 4 (DN 100) and larger.
2. Horizontal Storm-Drainage Piping: 2 percent downward in direction of flow.

L. Install cast-iron soil piping according to CISPI's "Cast Iron Soil Pipe and Fittings Handbook," Chapter IV, "Installation of Cast Iron Soil Pipe and Fittings."

1. Install encasement on underground piping according to ASTM A 674 or AWWA C105.

M. Install aboveground copper tubing according to CDA's "Copper Tube Handbook."

N. Install aboveground ABS piping according to ASTM D 2661.

O. Install aboveground PVC piping according to ASTM D 2665.

P. Install underground ABS and PVC piping according to ASTM D 2321.

Q. Plumbing Specialties:

1. Install backwater valves in storm drainage gravity-flow piping. Comply with requirements for backwater valves specified in Section 221423 "Storm Drainage Piping Specialties."
2. Install cleanouts at grade and extend to where building storm drains connect to building storm sewers in storm drainage gravity-flow piping. Install cleanout fitting with closure plug inside the building in storm drainage force-main piping. Comply with requirements for cleanouts specified in Section 221423 "Storm Drainage Piping Specialties."
3. Install drains in storm drainage gravity-flow piping. Comply with requirements for drains specified in Section 221423 "Storm Drainage Piping Specialties."

R. Do not enclose, cover, or put piping into operation until it is inspected and approved by authorities having jurisdiction.

S. Install sleeves for piping penetrations of walls, ceilings, and floors. Comply with requirements for sleeves specified in Section 220517 "Sleeves and Sleeve Seals for Plumbing Piping."

T. Install sleeve seals for piping penetrations of concrete walls and slabs. Comply with requirements for sleeve seals specified in Section 220517 "Sleeves and Sleeve Seals for Plumbing Piping."

U. Install escutcheons for piping penetrations of walls, ceilings, and floors. Comply with requirements for escutcheons specified in Section 220518 "Escutcheons for Plumbing Piping."

## 3.3 JOINT CONSTRUCTION

A. Join hub-and-spigot, cast-iron soil piping with gasketed joints according to CISPI's "Cast Iron Soil Pipe and Fittings Handbook" for compression joints.

B. Join hubless, cast-iron soil piping according to CISPI 310 and CISPI's "Cast Iron Soil Pipe and Fittings Handbook" for hubless-piping coupling joints.

C. Join copper tube and fittings with soldered joints according to ASTM B 828 procedure. Use ASTM B 813, water-flushable, lead-free flux and ASTM B 32, lead-free-alloy solder.

D. Flanged Joints: Align bolt holes. Select appropriate gasket material, size, type, and thickness. Install gasket concentrically positioned. Use suitable lubricants on bolt threads. Torque bolts in cross pattern.

E. Plastic, Nonpressure-Piping, Solvent-Cemented Joints: Clean and dry joining surfaces. Join pipe and fittings according to the following:

1. Comply with ASTM F 402 for safe-handling practice of cleaners, primers, and solvent cements.
2. ABS Piping: Join according to ASTM D 2235 and ASTM D 2661 Appendices.
3. PVC Piping: Join according to ASTM D 2855 and ASTM D 2665 Appendices.

## 3.4 SPECIALTY PIPE FITTING INSTALLATION

A. Transition Couplings:

1. Install transition couplings at joints of piping with small differences in ODs.
2. In Drainage Piping: Shielded, nonpressure transition couplings.

## 3.5 VALVE INSTALLATION

A. Backwater Valves: Install backwater valves in piping subject to backflow.

1. Horizontal Piping: Horizontal backwater valves. Use normally closed type unless otherwise indicated.
2. Install backwater valves in accessible locations.
3. Comply with requirements for backwater valves specified in Section 221423 "Storm Drainage Piping Specialties."

## 3.6 HANGER AND SUPPORT INSTALLATION

A. Comply with requirements for seismic-restraint devices specified in Section 220548 "Vibration and Seismic Controls for Plumbing Piping and Equipment."

B. Comply with requirements for pipe hanger and support devices and installation specified in Section 220529 "Hangers and Supports for Plumbing Piping and Equipment."

1. Install carbon-steel pipe hangers for horizontal piping in noncorrosive environments.
2. Install stainless-steel pipe hangers for horizontal piping in corrosive environments.
3. Install carbon-steel pipe support clamps for vertical piping in noncorrosive environments.
4. Install stainless-steel pipe support clamps for vertical piping in corrosive environments.
5. Vertical Piping: MSS Type 8 or Type 42, clamps.
6. Individual, Straight, Horizontal Piping Runs:
    a. 100 Feet (30 m) and Less: MSS Type 1, adjustable, steel clevis hangers.
    b. Longer than 100 Feet (30 m): MSS Type 43, adjustable roller hangers.
    c. Longer than 100 Feet (30 m) if Indicated: MSS Type 49, spring cushion rolls.
7. Multiple, Straight, Horizontal Piping Runs 100 Feet (30 m) or Longer: MSS Type 44, pipe rolls. Support pipe rolls on trapeze.
8. Base of Vertical Piping: MSS Type 52, spring hangers.

C. Support horizontal piping and tubing within 12 inches (300 mm) of each fitting, valve, and coupling.

D. Support vertical piping and tubing at base and at each floor.

E. Rod diameter may be reduced one size for double-rod hangers, with 3/8-inch (10-mm) minimum rods.

F. Install hangers for cast-iron soil piping with the following maximum horizontal spacing and minimum rod diameters:

1. NPS 1-1/2 and NPS 2 (DN 40 and DN 50): 60 inches (1500 mm) with 3/8-inch (10-mm) rod.
2. NPS 3 (DN 80): 60 inches (1500 mm) with 1/2-inch (13-mm) rod.
3. NPS 4 and NPS 5 (DN 100 and DN 125): 60 inches (1500 mm) with 5/8-inch (16-mm) rod.
4. NPS 6 and NPS 8 (DN 150 and DN 200): 60 inches (1500 mm) with 3/4-inch (19-mm) rod.
5. NPS 10 and NPS 12 (DN 250 and DN 300): 60 inches (1500 mm) with 7/8-inch (22-mm) rod.

6. Spacing for 10-foot (3-m) pipe lengths may be increased to 10 feet (3 m). Spacing for fittings is limited to 60 inches (1500 mm).

G. Install supports for vertical cast-iron soil piping every 15 feet (4.5 m).

H. Install hangers for copper tubing with the following maximum horizontal spacing and minimum rod diameters:

1. NPS 1-1/4 (DN 32): 72 inches (1800 mm) with 3/8-inch (10-mm) rod.
2. NPS 1-1/2 and NPS 2 (DN 40 and DN 50): 96 inches (2400 mm) with 3/8-inch (10-mm) rod.
3. NPS 2-1/2 (DN 65): 108 inches (2700 mm) with 1/2-inch (13-mm) rod.
4. NPS 3 to NPS 5 (DN 80 to DN 125): 10 feet (3 m) with 1/2-inch (13-mm) rod.
5. NPS 6 (DN 150): 10 feet (3 m) with 5/8-inch (16-mm) rod.
6. NPS 8 (DN 200): 10 feet (3 m) with 3/4-inch (19-mm) rod.

I. Install supports for vertical copper tubing every 10 feet (3 m).

J. Install hangers for ABS and PVC piping with the following maximum horizontal spacing and minimum rod diameters:

1. NPS 1-1/2 and NPS 2 (DN 40 and DN 50): 48 inches (1200 mm) with 3/8-inch (10-mm) rod.
2. NPS 3 (DN 80): 48 inches (1200 mm) with 1/2-inch (13-mm) rod.
3. NPS 4 and NPS 5 (DN 100 and DN 125): 48 inches (1200 mm) with 5/8-inch (16-mm) rod.
4. NPS 6 and NPS 8 (DN 150 and DN 200): 48 inches (1200 mm) with 3/4-inch (19-mm) rod.
5. NPS 10 and NPS 12 (DN 250 and DN 300): 48 inches (1200 mm) with 7/8-inch (22-mm) rod.

K. Install supports for vertical ABS and PVC piping every 48 inches (1200 mm).

L. Support piping and tubing not listed above according to MSS SP-69 and manufacturer's written instructions.

## 3.7 CONNECTIONS

A. Drawings indicate general arrangement of piping, fittings, and specialties.

B. Connect interior storm drainage piping to exterior storm drainage piping. Use transition fitting to join dissimilar piping materials.

C. Connect storm drainage piping to roof drains and storm drainage specialties.

1. Install test tees (wall cleanouts) in conductors near floor, and floor cleanouts with cover flush with floor.
2. Install horizontal backwater valves with cleanout cover flush with floor.

3. Comply with requirements for backwater valves cleanouts and drains specified in Section 221423 "Storm Drainage Piping Specialties."

D. Where installing piping adjacent to equipment, allow space for service and maintenance of equipment.

## 3.8 IDENTIFICATION

A. Identify exposed storm drainage piping. Comply with requirements for identification specified in Section 220553 "Identification for Plumbing Piping and Equipment."

## 3.9 FIELD QUALITY CONTROL

A. During installation, notify authorities having jurisdiction at least 24 hours before inspection must be made. Perform tests specified below in presence of authorities having jurisdiction.

1. Roughing-in Inspection: Arrange for inspection of piping before concealing or closing-in after roughing-in.
2. Final Inspection: Arrange for final inspection by authorities having jurisdiction to observe tests specified below and to ensure compliance with requirements.

B. Reinspection: If authorities having jurisdiction find that piping will not pass test or inspection, make required corrections and arrange for reinspection.

C. Reports: Prepare inspection reports and have them signed by authorities having jurisdiction.

D. Test storm drainage piping according to procedures of authorities having jurisdiction or, in absence of published procedures, as follows:

1. Test for leaks and defects in new piping and parts of existing piping that have been altered, extended, or repaired. If testing is performed in segments, submit separate report for each test, complete with diagram of portion of piping tested.
2. Leave uncovered and unconcealed new, altered, extended, or replaced storm drainage piping until it has been tested and approved. Expose work that was covered or concealed before it was tested.
3. Test Procedure: Test storm drainage piping, except outside leaders, on completion of roughing-in. Close openings in piping system and fill with water to point of overflow, but not less than 10-foot head of water (30 kPa). From 15 minutes before inspection starts until completion of inspection, water level must not drop. Inspect joints for leaks.
4. Repair leaks and defects with new materials and retest piping, or portion thereof, until satisfactory results are obtained.
5. Prepare reports for tests and required corrective action.

## 3.10 CLEANING

A. Clean interior of piping. Remove dirt and debris as work progresses.

B. Protect drains during remainder of construction period to avoid clogging with dirt and debris and to prevent damage from traffic and construction work.

C. Place plugs in ends of uncompleted piping at end of day and when work stops.

3.11 PIPING SCHEDULE

A. Flanges and unions may be used on aboveground pressure piping unless otherwise indicated.

B. Aboveground storm drainage piping NPS 6 (DN 150) and smaller shall be any of the following:

1. Service class, cast-iron soil pipe and fittings; gaskets; and gasketed joints.
2. Hubless, cast-iron soil pipe and fittings; CISPI, heavy-duty, hubless-piping couplings; and coupled joints.
3. Copper DWV tube, copper drainage fittings, and soldered joints.
4. Solid-wall ABS pipe, ABS socket fittings, and solvent-cemented joints.
5. Solid-wall PVC pipe, PVC socket fittings, and solvent-cemented joints.
6. Dissimilar Pipe-Material Couplings: Shielded, nonpressure transition couplings.

C. Aboveground, storm drainage piping NPS 8 (DN 200) and larger shall be any of the following:

1. Service class, cast-iron soil pipe and fittings; gaskets; and gasketed joints.
2. Hubless, cast-iron soil pipe and fittings; CISPI, heavy-duty, hubless-piping couplings; and coupled joints.
3. Copper DWV tube, copper drainage fittings, and soldered joints.
4. Solid-wall PVC pipe, PVC socket fittings, and solvent-cemented joints.
5. Dissimilar Pipe-Material Couplings: Shielded, nonpressure transition couplings.

D. Underground, storm drainage piping NPS 8 (DN 200) and larger shall be any of the following:

1. Extra Heavy Service class, cast-iron soil pipe and fittings; gaskets; and gasketed joints.
2. Hubless, cast-iron soil pipe and fittings; CISPI, heavy-duty, cast-iron, hubless-piping couplings; and coupled joints.
3. Solid-wall PVC pipe, PVC socket fittings, and solvent-cemented joints.
4. Cellular-core, sewer and drain series, PVC pipe; PVC socket fittings; and solvent-cemented joints.
5. Dissimilar Pipe-Material Couplings: Shielded, nonpressure transition couplings.

END OF SECTION 221413

# SECTION 221423 - STORM DRAINAGE PIPING SPECIALTIES

## PART 1 - GENERAL

### 1.1 SUMMARY

A. Section Includes:

1. Roof drains.
2. Miscellaneous storm drainage piping specialties.
3. Cleanouts.
4. Backwater valves.
5. Flashing materials.

### 1.2 ACTION SUBMITTALS

A. Product Data: For each type of product indicated.

### 1.3 QUALITY ASSURANCE

A. Drainage piping specialties shall bear label, stamp, or other markings of specified testing agency.

## PART 2 - PRODUCTS

### 2.1 METAL ROOF DRAINS

A. Cast-Iron, Large-Sump, General-Purpose Roof Drains:

1. Standard: ASME A112.6.4, for general-purpose roof drains.
2. Body Material: Cast iron.
3. Dimension of Body: Nominal 14-inch (357-mm) diameter.
4. Combination Flashing Ring and Gravel Stop: Not required.
5. Flow-Control Weirs: Not required.
6. Outlet: Bottom.
7. Extension Collars: Not required.
8. Underdeck Clamp: Not required.
9. Expansion Joint: Not required.
10. Sump Receiver Plate: Not required.
11. Dome Material: Aluminum.
12. Perforated Gravel Guard: Not required.
13. Vandal-Proof Dome: Not required.
14. Water Dam: Not required.

B. Cast-Iron, Medium-Sump, General-Purpose Roof Drains:

1. Standard: ASME A112.6.4, for general-purpose roof drains.
2. Body Material: Cast iron.
3. Dimension of Body: 8- to 12-inch (203- to 305-mm) diameter.
4. Combination Flashing Ring and Gravel Stop: Not required.
5. Flow-Control Weirs: Not required.
6. Outlet: Bottom.
7. Extension Collars: Not required.
8. Underdeck Clamp: Not required.
9. Expansion Joint: Not required.
10. Sump Receiver Plate: Not required.
11. Dome Material: Aluminum.
12. Perforated Gravel Guard: Not required.
13. Vandal-Proof Dome: Not required.
14. Water Dam: Not required.

C. Metal, Cornice and Gutter Roof Drains:

1. Standard: ASME A112.6.4, for cornice and gutter roof drains.
2. Body Material: Metal.
3. Dimension of Body: Nominal 6-inch (152-mm) diameter.
4. Outlet: Bottom.
5. Dome Material: Bronze.
6. Vandal-Proof Dome: Not required.

D. Metal, Parapet Roof Drains:

1. Standard: ASME A112.6.4, for parapet roof drains.
2. Body Material: Cast iron.
3. Outlet: Back.
4. Grate Material: Bronze.
5. Vandal-Proof Grate: Not required.

## 2.2 MISCELLANEOUS STORM DRAINAGE PIPING SPECIALTIES

A. Downspout Adaptors:

1. Description: Manufactured, gray-iron casting, for attaching to horizontal-outlet, parapet roof drain and to exterior, sheet metal downspout.
2. Size: Inlet size to match parapet drain outlet.

B. Downspout Boots:

1. Description: Manufactured, ASTM A 48/A 48M, gray-iron casting, with strap or ears for attaching to building; NPS 4 (DN 100) outlet; and shop-applied bituminous coating.
2. Size: Inlet size to match downspout and NPS 4 (DN 100) outlet.

C. Conductor Nozzles:

1. Description: Bronze body with threaded inlet and bronze wall flange with mounting holes.
2. Size: Same as connected conductor.

2.3 CLEANOUTS

A. Floor Cleanouts:

1. Standard: ASME A112.36.2M, for adjustable housing cast-iron soil pipe with cast-iron ferrule cleanouts.
2. Size: Same as connected branch.
3. Type: Adjustable housing Cast-iron soil pipe with cast-iron ferrule Heavy-duty, adjustable housing.
4. Body or Ferrule Material: Cast iron.
5. Clamping Device: Not required.
6. Outlet Connection: Spigot.
7. Closure: Brass plug with tapered threads.
8. Adjustable Housing Material: Cast iron with threads.
9. Frame and Cover Material and Finish: Nickel-bronze, copper alloy.
10. Frame and Cover Shape: Round.
11. Top-Loading Classification: Extra-Heavy Duty.
12. Riser: ASTM A 74, Extra-Heavy Service class, cast-iron drainage pipe fitting and riser to cleanout.

B. Test Tees:

1. Standard: ASME A112.36.2M and ASTM A 74, ASTM A 888, or CISPI 301, for cleanout test tees.
2. Size: Same as connected drainage piping.
3. Body Material: Hub-and-spigot, cast-iron soil-pipe T-branch or hubless, cast-iron soil-pipe test tee as required to match connected piping.
4. Closure Plug: Countersunk, brass.
5. Closure Plug Size: Same as or not more than one size smaller than cleanout size.

C. Wall Cleanouts:

1. Standard: ASME A112.36.2M, for cleanouts. Include wall access.
2. Size: Same as connected drainage piping.
3. Body Material: Hub-and-spigot, cast-iron soil-pipe T-branch as required to match connected piping.
4. Closure: Countersunk or raised-head, drilled-and-threaded brass plug.
5. Closure Plug Size: Same as or not more than one size smaller than cleanout size.
6. Wall Access: Round, deep, chrome-plated bronze cover plate with screw.
7. Wall Access: Round, nickel-bronze, copper-alloy, or stainless-steel wall-installation frame and cover.

2.4 BACKWATER VALVES

A. Cast-Iron, Horizontal Backwater Valves:

1. Standard: ASME A112.14.1, for backwater valves.
2. Size: Same as connected piping.
3. Body Material: Cast iron.
4. Cover: Cast iron with bolted or threaded access check valve.
5. End Connections: Hub and spigot or hubless.
6. Check Valve: Removable, bronze, swing check, factory assembled or field modified to hang closed.
7. Extension: ASTM A 74, Service class; full-size, cast-iron soil-pipe extension to field-installed cleanout at floor; replaces backwater valve cover.

2.5 FLASHING MATERIALS

A. Copper Sheet: ASTM B 152/B 152M, 12 oz./sq. ft. (3.7 kg/sq. m or 0.41-mm thickness).

B. Zinc-Coated Steel Sheet: ASTM A 653/A 653M, with 0.20 percent copper content and 0.04-inch (1.01-mm) minimum thickness unless otherwise indicated. Include G90 (Z275) hot-dip galvanized, mill-phosphatized finish for painting if indicated.

C. Elastic Membrane Sheet: ASTM D 4068, flexible, chlorinated polyethylene, 40-mil (1.01-mm) minimum thickness.

D. Fasteners: Metal compatible with material and substrate being fastened.

E. Metal Accessories: Sheet metal strips, clamps, anchoring devices, and similar accessory units required for installation; matching or compatible with material being installed.

F. Solder: ASTM B 32, lead-free alloy.

PART 3 - EXECUTION

3.1 INSTALLATION

A. Install roof drains at low points of roof areas according to roof membrane manufacturer's written installation instructions.

1. Install flashing collar or flange of roof drain to prevent leakage between drain and adjoining roofing. Maintain integrity of waterproof membranes where penetrated.
2. Install expansion joints, if indicated, in roof drain outlets.
3. Position roof drains for easy access and maintenance.

B. Install downspout adapters on outlet of back-outlet parapet roof drains and connect to sheet metal downspouts.

C. Install downspout boots at grade with top 6 inches (152 mm) above grade. Secure to building wall.

D. Install conductor nozzles at exposed bottom of conductors where they spill onto grade.

E. Install cleanouts in aboveground piping and building drain piping according to the following instructions unless otherwise indicated:

1. Use cleanouts the same size as drainage piping up to NPS 4 (DN 100). Use NPS 4 (DN 100) for larger drainage piping unless larger cleanout is indicated.
2. Locate cleanouts at each change in direction of piping greater than 45 degrees.
3. Locate cleanouts at minimum intervals of 50 feet (15 m) for piping NPS 4 (DN 100) and smaller and 100 feet (30 m) for larger piping.
4. Locate cleanouts at base of each vertical soil and waste stack.

F. For floor cleanouts for piping below floors, install cleanout deck plates with top flush with finished floor.

G. For cleanouts located in concealed piping, install cleanout wall access covers, of types indicated, with frame and cover flush with finished wall.

H. Install horizontal backwater valves in floor with cover flush with floor.

I. Install test tees in vertical conductors and near floor.

J. Install wall cleanouts in vertical conductors. Install access door in wall if indicated.

K. Install trench drains at low points of surface areas to be drained. Set grates of drains flush with finished surface unless otherwise indicated.

L. Install sleeve flashing device with each conductor passing through floors with waterproof membrane.

## 3.2 CONNECTIONS

A. Comply with requirements for piping specified in Section 221413 "Facility Storm Drainage Piping." Drawings indicate general arrangement of piping, fittings, and specialties.

## 3.3 FLASHING INSTALLATION

A. Fabricate flashing from single piece of metal unless large pans, sumps, or other drainage shapes are required. Join flashing according to the following if required:

1. Lead Sheets: Burn joints of 6.0-lb/sq. ft. (30-kg/sq. m) lead sheets, 0.0938-inch (2.4-mm) thickness or thicker. Solder joints of 4.0-lb/sq. ft. (20-kg/sq. m) lead sheets, 0.0625-inch (1.6-mm) thickness or thinner.
2. Copper Sheets: Solder joints of copper sheets.

B. Install sheet flashing on pipes, sleeves, and specialties passing through or embedded in floors and roofs with waterproof membrane.

1. Pipe Flashing: Sleeve type, matching the pipe size, with a minimum length of 10 inches (250 mm) and with skirt or flange extending at least 8 inches (200 mm) around pipe.
2. Sleeve Flashing: Flat sheet, with skirt or flange extending at least 8 inches (200 mm) around sleeve.
3. Embedded Specialty Flashing: Flat sheet, with skirt or flange extending at least 8 inches (200 mm) around specialty.

C. Set flashing on floors and roofs in solid coating of bituminous cement.

D. Secure flashing into sleeve and specialty clamping ring or device.

E. Fabricate and install flashing and pans, sumps, and other drainage shapes.

## 3.4 PROTECTION

A. Protect drains during remainder of construction period to avoid clogging with dirt or debris and to prevent damage from traffic or construction work.

B. Place plugs in ends of uncompleted piping at end of each day or when work stops.

END OF SECTION 221423

# SECTION 224100 - RESIDENTIAL PLUMBING FIXTURES

## PART 1 - GENERAL

### 1.1 SUMMARY

A. Section Includes:

1. Kitchen sinks.
2. Water closets.
3. Toilet seats.
4. Supply fittings.
5. Waste fittings.
6. Grout.

B. Related Requirements:

1. Section 224216.13 "Commercial Lavatories."
2. Section 224216.16 "Commercial Sinks."
3. Section 224716 "Pressure Water Coolers."

### 1.2 ACTION SUBMITTALS

A. Product Data: For each type of product.

B. Shop Drawings: Include diagrams for power, signal, and control wiring.

### 1.3 INFORMATIONAL SUBMITTALS

A. Coordination Drawings: Counter cutout templates for mounting of counter-mounted plumbing fixtures.

B. Sample Warranty: For special warranty.

### 1.4 CLOSEOUT SUBMITTALS

A. Operation and maintenance data.

### 1.5 WARRANTY

A. Provide standard one year warranty from time of occupancy certificate issued.



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PART 2 - PRODUCTS

2.1 GENERAL REQUIREMENTS

2.2 KITCHEN SINKS

A. Kitchen Sinks - Counter Mounted:

1. Stainless Steel Kitchen Sinks:

a. Manufacturers: Subject to compliance with requirements, provide products by one of the following:

1) American Standard.
2) Elkay.
3) Just Manufacturing.
4) Kohler Co.
5) Sterling.

2. Fixture:

a. ASME A112.19.3/CSA B45.4 for stainless steel kitchen sinks.
b. Overall Dimensions: 22”x24”x8”.
c. Metal Thickness: 0.050 inch (1.3 mm).
d. Bowl:

1) Drain: 3-1/2-inch (89-mm) crumb cup.

a) Location: Centered in bowl.

3. Faucet: Solid brass with chrome exterior.
4. Supply Fittings: Comply with requirements in "Supply Fittings" Article.
5. Waste Fittings: Comply with requirements in "Waste Fittings" Article, except include continuous waste for multibowl sinks.

a. Disposer: Not required.
b. Hot-Water Dispenser: Not required.

2.3 SINK FAUCETS

A. NSF Standard: Comply with NSF 61 and NSF 372 for faucet materials that will be in contact with potable water.

B. Sink Faucets:

1. General-Duty, Solid-Brass Faucets:



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a. Manufacturers: Subject to compliance with requirements, provide products by one of the following:

1) American Standard.
2) Bradley Corporation.
3) Chicago Faucets; Geberit Company.
4) Kohler Co.
5) Price Pfister, Inc.
6) T&S Brass and Bronze Works, Inc.

## 2.4 WATER CLOSETS

A. Water Closets: Floor mounted, floor outlet, close coupled (gravity tank), vitreous china, 1.6 gal./flush (6 L)/flush).

1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:

a. American Standard.
b. Kohler Co.
c. TOTO USA, INC.

2. Bowl:

a. Standards: ASME A112.19.2/CSA B45.1, ASME A112.19.5/CSA B45.15, and ASSE 1037/ASME A112.1060/CSA B125.16.
b. Bowl Type: Siphon jet.
c. Height: Handicapped/elderly.
d. Rim Contour: Elongated.
e. Water Consumption: Low.
f. Color: White.

3. Toilet Seat: .
4. Supply Fittings:

a. Standard: ASME A112.18.1/CSA B125.1.
b. Supply Piping: Chrome-plated-brass pipe or chrome-plated-copper tube matching water-supply piping size. Include chrome-plated wall flange.
c. Stop: Chrome-plated-brass, one-quarter-turn, ball-type or compression stop with inlet connection matching water-supply piping type and size.

1) Operation: Wheel handle.

d. Riser:

1) Size: NPS 3/8 (DN 10).
2) Material: ASME A112.18.6/CSA 125.6, braided- or corrugated-stainless steel flexible hose riser.



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## 2.5 TOILET SEATS

A. Toilet Seats:

1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:

   a. American Standard.
   b. Bemis Manufacturing Company.
   c. Church Seats; Bemis Manufacturing Company.
   d. Kohler Co.

2. Standard: IAPMO Z124.5/ANSI Z124.5.
3. Material: Plastic.
4. Type: Commercial (Standard).
5. Shape: Elongated rim (Open front).
6. Configuration: Open front with cover.
7. Size: Elongated.
8. Hinge Type: Self-sustaining, check.
9. Hinge Material: Noncorroding metal.
10. Seat Cover: Required.
11. Color: White.

## 2.6 SUPPLY FITTINGS

A. NSF Standard: Comply with NSF 61 and NSF 372 for faucet materials that will be in contact with potable water.

B. Standard: ASME A112.18.1/CSA B125.1.

C. Kitchen Sink Supply Fittings:

1. Supply Piping: Chrome-plated-brass pipe or chrome-plated-copper tube matching water-supply piping size. Include chrome-plated wall flange.
2. Stops: Chrome-plated-brass, one-quarter-turn, ball-type or compression stop with inlet connection matching water-supply piping type and size.

   a. Operation: Wheel handle.

3. Risers:

   a. Size:

      1) **NPS 1/2 (DN 15)** for kitchen sinks.

   b. Material: ASME A112.18.6/CSA B125.6, braided- or corrugated-stainless-steel flexible hose riser.



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2.7 WASTE FITTINGS

A. Standard: ASME A112.18.2/CSA B125.2.

B. Drain: Grid type with NPS 1-1/4 (DN 32) offset tailpiece for accessible lavatories.

C. Drain: Pop-up type with NPS 1-1/4 (DN 32) straight tailpiece as part of faucet for standard lavatories.

D. Drain: Grid type with NPS 1-1/2 (DN 40) offset tailpiece for accessible kitchen sinks.

E. Drain: Grid type with NPS 1-1/2 (DN 40) straight tailpiece for standard kitchen sinks.

F. Trap:

1. Size:

a. NPS 1-1/2 (DN 40) for kitchen sinks.

2. Material:

a. Chrome-plated, two-piece, cast-brass trap and swivel elbow with 0.032-inch- (0.83-mm-) thick brass tube to wall; and chrome-plated-brass or -steel wall flange.
b. Stainless steel, two-piece trap and swivel elbow with 0.012-inch- (0.30-mm-) thick stainless steel tube to wall; and stainless steel wall flange.

2.8 GROUT

A. Standard: ASTM C1107/C1107M, Grade B, post-hardening and volume-adjusting, dry, hydraulic-cement grout.

B. Characteristics: Nonshrink; recommended for interior and exterior applications.

C. Design Mix: 5000 psi (34.5 MPa), 28-day compressive strength.

D. Packaging: Premixed and factory packaged.

PART 3 - EXECUTION

3.1 INSTALLATION

A. Install plumbing fixtures level and plumb in accordance with roughing-in drawings.

B. Install floor-mounted water closets on closet flange attachments to drainage piping.

C. Install counter-mounting fixtures in and attached to casework.

D. Install pedestal lavatories on pedestals and secured to wood blocking in wall.



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E. Install water-supply piping with stop on each supply to each fixture to be connected to water distribution piping. Attach supplies to supports or substrate within pipe spaces behind fixtures. Install stops in locations where they can be easily reached for operation.

1. Use ball or gate valves if supply stops are not specified with fixture. Comply with valve requirements specified in Section 220523.12 "Ball Valves for Plumbing Piping" and Section 220523.15 "Gate Valves for Plumbing Piping."

F. Install tanks for accessible, tank-type water closets with lever handle mounted on wide side of compartment.

G. Install toilet seats on water closets.

H. Install faucet flow-control fittings with specified flow rates and patterns in faucet spouts if faucets are not available with required rates and patterns. Include adapters if required.

I. Install traps on fixture outlets.

1. Omit trap on fixtures with integral traps.
2. Omit trap on indirect wastes unless otherwise indicated.

J. Install protective shielding pipe covers and enclosures on exposed supplies and waste piping of accessible sinks. Comply with requirements in Section 220719 "Plumbing Piping Insulation."

K. Install wall flanges or escutcheons at piping wall penetrations in exposed, finished locations. Use deep-pattern escutcheons if required to conceal protruding fittings. Comply with escutcheon requirements specified in Section 220518 "Escutcheons for Plumbing Piping."

L. Seal joints between plumbing fixtures, counters, floors, and walls using sanitary-type, one-part, mildew-resistant silicone sealant. Match sealant color to fixture color. Comply with sealant requirements specified in Section 079200 "Joint Sealants."

## 3.2 PIPING CONNECTIONS

A. Connect fixtures with water supplies, stops, and risers, and with traps, soil, waste, and vent piping. Use size fittings required to match fixtures.

B. Comply with water piping requirements specified in Section 221116 "Domestic Water Piping."

C. Comply with soil and waste piping requirements specified in Section 221316 "Sanitary Waste and Vent Piping."

D. Install protective shielding pipe covers and enclosures on exposed supplies and waste piping of accessible sinks. Comply with requirements in Section 220719 "Plumbing Piping Insulation."

## 3.3 ADJUSTING

A. Operate and adjust plumbing fixtures and controls. Replace damaged and malfunctioning fixtures, fittings, and controls.



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B. Adjust water pressure at faucets to produce proper flow.

3.4 CLEANING AND PROTECTION

A. After completing installation of plumbing fixtures, inspect and repair damaged finishes.

B. Clean plumbing fixtures, faucets, and other fittings with manufacturers' recommended cleaning methods and materials.

C. Provide protective covering for installed plumbing fixtures and fittings.

D. Do not allow use of plumbing fixtures for temporary facilities unless approved in writing by Owner.

END OF SECTION 224100



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# SECTION 224216.13 - COMMERCIAL LAVATORIES

## PART 1 - GENERAL

### 1.1 SUMMARY

A. Section Includes:

1. Lavatories.
2. Faucets.

### 1.2 ACTION SUBMITTALS

A. Product Data: For each type of product.

B. Shop Drawings: Include diagrams for power, signal, and control wiring of automatic faucets.

### 1.3 INFORMATIONAL SUBMITTALS

A. Coordination Drawings: Counter cutout templates for mounting of counter-mounted lavatories.

### 1.4 CLOSEOUT SUBMITTALS

A. Operation and Maintenance Data: For lavatories and faucets to include in operation and maintenance manuals.

1. In addition to items specified in Section 017823 "Operation and Maintenance Data," include the following:

a. Servicing and adjustments of automatic faucets.

## PART 2 - PRODUCTS

### 2.1 VITREOUS-CHINA, COUNTER-MOUNTED LAVATORIES

A. Lavatory: Oval, self-rimming, vitreous china, counter mounted.

1. Manufacturers: Subject to compliance with requirements, provide products by the following available manufacturers offering products that may be incorporated into the Work include, but are not limited to, the following:
2. Basis-of-Design Product: Kohler Pennington K-2196. Subject to compliance with requirements, provide product indicated on Drawings or comparable product by one of the following:

a. American Standard America.
b. Briggs Plumbing Products, Inc.
c. Capizzi.
d. Crane Plumbing, L.L.C.
e. Ferguson Enterprises, Inc.; ProFlo Brand.
f. Gerber Plumbing Fixtures LLC.
g. Kohler Co.
h. Mansfield Plumbing Products LLC.
i. Peerless Pottery Sales, Inc.
j. TOTO USA, INC.
k. Zurn Industries, LLC; Commercial Brass and Fixtures.

3. Fixture:

a. Standard: ASME A112.19.2/CSA B45.1.
b. Type: Self-rimming for above-counter mounting.
c. Nominal Size: Oval, 20 by 17 inches (508 by 432 mm).
d. Faucet-Hole Punching: Three holes, 2-inch (51-mm) centers.
e. Faucet-Hole Location: Top.
f. Color: White.
g. Mounting Material: Sealant.

B. Lavatory: Oval, vitreous china, undercounter mounted.

1. Manufacturers: Subject to compliance with requirements, provide products by the following available manufacturers offering products that may be incorporated into the Work include, but are not limited to, the following:
2. Basis-of-Design Product: Kohler Caxton K-2211-0. Subject to compliance with requirements, provide product indicated on Drawings or comparable product by one of the following:

a. American Standard America.
b. Capizzi.
c. Crane Plumbing, L.L.C.
d. Ferguson Enterprises, Inc.; ProFlo Brand.
e. Gerber Plumbing Fixtures LLC.
f. Kohler Co.
g. Mansfield Plumbing Products LLC.
h. Peerless Pottery Sales, Inc.
i. TOTO USA, INC.
j. Zurn Industries, LLC; Commercial Brass and Fixtures.

3. Fixture:

a. Standard: ASME A112.19.2/CSA B45.1.
b. Type: For under counter mounting.
c. Nominal Size: Oval, 21 by 17 inches (533 by 432 mm).
d. Faucet-Hole Punching: No holes.
e. Faucet-Hole Location: On countertop.
f. Color: White.

g. Mounting Material: Sealant and undercounter mounting kit.

## 2.2 VITREOUS-CHINA, WALL-MOUNTED LAVATORIES

A. Lavatory: Wheelchair, vitreous china, wall mounted.

1. Manufacturers: Subject to compliance with requirements, provide products by the following available manufacturers offering products that may be incorporated into the Work include, but are not limited to, the following:
2. Basis-of-Design Product: Kohler Kingston K-2005. Subject to compliance with requirements, provide product indicated on Drawings or comparable product by one of the following:

   a. American Standard America.
   b. Crane Plumbing, L.L.C.
   c. Ferguson Enterprises, Inc.; ProFlo Brand.
   d. Gerber Plumbing Fixtures LLC.
   e. Kohler Co.
   f. Mansfield Plumbing Products LLC.
   g. Peerless Pottery Sales, Inc.

3. Fixture:

   a. Standard: ASME A112.19.2/CSA B45.1.
   b. Type: Slab or wheelchair.
   c. Nominal Size: Rectangular, 21 by 18 inches (533 by 457 mm).
   d. Faucet-Hole Punching: Three holes, 4-inch (102-mm) centers.
   e. Faucet-Hole Location: Top.
   f. Color: White.
   g. Mounting: For concealed-arm carrier.

4. Support: ASME A112.6.1M, Type II, concealed-arm lavatory carrier with rectangular, steel uprights.

## 2.3 COMMERCIAL, BATTERY OPERATED FAUCETS

A. NSF Standard: Comply with NSF/ANSI 61, "Drinking Water System Components - Health Effects," for faucet materials that will be in contact with potable water.

B. Lavatory Faucets: Automatic-type, mixing, commercial electronic pedestal faucet.

1. Manufacturers: Subject to compliance with requirements, provide products by the following available manufacturers offering products that may be incorporated into the Work include, but are not limited to, the following:
2. Basis-of-Design Product: Sloan SF-2150. Subject to compliance with requirements, provide product indicated on Drawings or comparable product by one of the following:

   a. American Standard America.
   b. Bradley Corporation.

c. Chicago Faucets.
d. Delta Faucet Company.
e. Elkay Manufacturing Co.
f. Grohe America, Inc.
g. Just Manufacturing.
h. Kohler Co.
i. Moen Incorporated.
j. Speakman Company.
k. T & S Brass and Bronze Works, Inc.
l. Zurn Industries, LLC; Commercial Brass and Fixtures.

3. Standard: ASME A112.18.1/CSA B125.1.
4. General: Coordinate faucet inlets with supplies and fixture hole punchings; coordinate outlet with spout and fixture receptor.
5. Body Type: Centerset.
6. Body Material: Commercial, solid brass.
7. Finish: Polished chrome plate.
8. Maximum Flow Rate: 0.5 gpm (1.5 L/min.).
9. Mounting Type: Deck, exposed.
10. Valve Handle(s): Electronic sensor operated.
11. Spout: Rigid, gooseneck type.
12. Spout Outlet: Aerator.
13. Operation: Automatic.
14. Drain: Not part of faucet.

## 2.4 SUPPLY FITTINGS

A. NSF Standard: Comply with NSF/ANSI 61, "Drinking Water System Components - Health Effects," for supply-fitting materials that will be in contact with potable water.

B. Standard: ASME A112.18.1/CSA B125.1.

C. Supply Piping: Chrome-plated-brass pipe or chrome-plated copper tube matching water-supply piping size. Include chrome-plated-brass or stainless-steel wall flange.

D. Supply Stops: Chrome-plated-brass, one-quarter-turn, ball-type or compression valve with inlet connection matching supply piping.

E. Operation: Wheel handle.

F. Risers:

1. NPS 1/2 (DN 15).
2. ASME A112.18.6, braided- or corrugated-stainless-steel, flexible hose riser.

## 2.5 WASTE FITTINGS

A. Standard: ASME A112.18.2/CSA B125.2.

B. Drain: Grid type with NPS 1-1/4 (DN 32) offset and straight tailpiece.

C. Trap:

1. Size: NPS 1-1/4 (DN 32).
2. Material: Chrome-plated, two-piece, cast-brass trap and swivel elbow with 0.032-inch- (0.83-mm-) thick brass tube to wall; and chrome-plated, brass or steel wall flange.
3. Material: Stainless-steel, two-piece trap and swivel elbow with 0.012-inch- (0.30-mm-) thick stainless-steel tube to wall; and stainless-steel wall flange.

## PART 3 - EXECUTION

### 3.1 EXAMINATION

A. Examine roughing-in of water supply and sanitary drainage and vent piping systems to verify actual locations of piping connections before lavatory installation.

B. Examine counters and walls for suitable conditions where lavatories will be installed.

C. Proceed with installation only after unsatisfactory conditions have been corrected.

### 3.2 INSTALLATION

A. Install lavatories level and plumb according to roughing-in drawings.

B. Install supports, affixed to building substrate, for wall-mounted lavatories.

C. Install accessible wall-mounted lavatories at handicapped/elderly mounting height for people with disabilities or the elderly, according to ICC/ANSI A117.1.

D. Install wall flanges or escutcheons at piping wall penetrations in exposed, finished locations. Use deep-pattern escutcheons if required to conceal protruding fittings. Comply with escutcheon requirements specified in Section 220518 "Escutcheons for Plumbing Piping."

E. Seal joints between lavatories and counters and walls using sanitary-type, one-part, mildew-resistant silicone sealant. Match sealant color to fixture color. Comply with sealant requirements specified in Section 079200 "Joint Sealants."

F. Install protective shielding pipe covers and enclosures on exposed supplies and waste piping of accessible lavatories. Comply with requirements in Section 220719 "Plumbing Piping Insulation."

### 3.3 CONNECTIONS

A. Connect fixtures with water supplies, stops, and risers, and with traps, soil, waste, and vent piping. Use size fittings required to match fixtures.

B. Comply with water piping requirements specified in Section 221116 "Domestic Water Piping."

C. Comply with soil and waste piping requirements specified in Section 221316 "Sanitary Waste and Vent Piping."

3.4 ADJUSTING

A. Operate and adjust lavatories and controls. Replace damaged and malfunctioning lavatories, fittings, and controls.

B. Adjust water pressure at faucets to produce proper flow.

C. Install fresh batteries in battery-powered, electronic-sensor mechanisms.

3.5 CLEANING AND PROTECTION

A. After completing installation of lavatories, inspect and repair damaged finishes.

B. Clean lavatories, faucets, and other fittings with manufacturers' recommended cleaning methods and materials.

C. Provide protective covering for installed lavatories and fittings.

D. Do not allow use of lavatories for temporary facilities unless approved in writing by Owner.

END OF SECTION 224216.13

SECTION 224216.16 - COMMERCIAL SINKS

PART 1 - GENERAL

1.1 SUMMARY

A. Section Includes:

1. Service basins.
2. Service sinks.
3. Utility sinks.
4. Handwash sinks.
5. Sink faucets.
6. Laminar-flow, faucet-spout outlets.
7. Supply fittings.
8. Waste fittings.

1.2 ACTION SUBMITTALS

A. Product Data: For each type of product.

1.3 INFORMATIONAL SUBMITTALS

A. Coordination Drawings: Counter cutout templates for mounting of counter-mounted lavatories.

1.4 CLOSEOUT SUBMITTALS

A. Maintenance data.

PART 2 - PRODUCTS

2.1 SERVICE BASINS

A. Service Basins: Floor mounted.

1. Manufacturers: Subject to compliance with requirements, provide products by the following available manufacturers offering products that may be incorporated into the Work include, but are not limited to, the following:
2. Basis-of-Design Product: Subject to compliance with requirements, provide product indicated on Drawings or comparable product by one of the following:

a. Crane Plumbing, L.L.C.
b. Ferguson Enterprises, Inc.; ProFlo Brand.

c. Florestone Products Co., Inc.
d. Mustee, E. L., & Sons, Inc.
e. Swan Corporation (The).
f. Zurn Industries, LLC; Light Commercial Specialty Plumbing Products.

3. Fixture:

a. Standard: IAPMO/ANSI Z124.6.
b. Material: Cast polymer.
c. Nominal Size: 24 by 36 by 10 inches (610 by 915 mm by 255 mm).
d. Tiling Flange: On two sides.
e. Rim Guard: On all top surfaces.
f. Color: Not applicable.
g. Drain: Grid with NPS 2 (DN 50) outlet.

4. Mounting: On floor and flush to wall.

5. Faucet:

a. Number Required: One.
b. Mounting: Wall.
c. Handles: Two lever.
d. Hose Connection: Yes.
e. Flow: Laminar.
f. Pail Hook: Yes.
g. Vacuum breaker: Yes.
h. Construction: Commercial solid brass.

## 2.2 COUNTERTOP SINKS

A. Sinks **S-1**: Stainless steel, countertop mounted.

1. Manufacturers: Subject to compliance with requirements, provide products by the following available manufacturers offering products that may be incorporated into the Work include, but are not limited to, the following:
2. Basis-of-Design Product: Elkay LR1722PD. Subject to compliance with requirements, provide product indicated on Drawings or comparable product by one of the following:

a. Advance Tabco.
b. Eagle Group; Foodservice Equipment Division.
c. Elkay Manufacturing Co.
d. Griffin Products, Inc.
e. Just Manufacturing.

3. Fixture:

a. Standard: ASME A112.19.3/CSA B45.4.
b. Type: Countertop mounted.
c. Number of Compartments: One.

d. Metal Thickness: 18 gauge (1.2 mm) type 304 stainless steel.
e. Compartment: 16”x13-1/2”x7-5/8”.

1) Drain: Grid with NPS 1/2 (DN 15) tailpiece and twist drain.
2) Drain Location: Centered in compartment.

4. Faucet(s): .

a. Number Required: One.
b. Mounting: On ledge.

5. Supply Fittings:

a. Standard: ASME A112.18.1/CSA B125.1.
b. Supplies: Chrome-plated brass compression stop with inlet connection matching water-supply piping type and size.

1) Operation: Wheel handle.
2) Risers: NPS 1/2 (DN 15),ASME A112.18.6, braided or corrugated stainless-steel flexible hose.

6. Waste Fittings:

a. Standard: ASME A112.18.2/CSA B125.2.
b. Trap(s):

1) Size: NPS 1/2 (DN 15).
2) Material: Chrome-plated, two-piece, cast-brass trap and swivel elbow with 0.032-inch- (0.83-mm-) thick brass tube to wall; and chrome-plated brass or steel wall flange.
3) Material: Stainless-steel, two-piece trap and swivel elbow with 0.012-inch- (0.30-mm-) thick stainless-steel tube to wall; and stainless-steel wall flange.

c. Continuous Waste:

1) Size: NPS 1/2 (DN 15).
2) Material: Chrome-plated, 0.032-inch- (0.83-mm-) thick brass tube.

7. Mounting: On counter with sealant.

## 2.3 COUNTERTOP SINKS

A. Sinks **S-2**: Stainless steel, countertop mounted.

1. Manufacturers: Subject to compliance with requirements, provide products by the following available manufacturers offering products that may be incorporated into the Work include, but are not limited to, the following:
2. Basis-of-Design Product: Elkay CDKR2517. Subject to compliance with requirements, provide product indicated on Drawings or comparable product by one of the following:

a. Advance Tabco.
b. Eagle Group; Foodservice Equipment Division.
c. Elkay Manufacturing Co.
d. Griffin Products, Inc.
e. Just Manufacturing.

3. Fixture:

a. Standard: ASME A112.19.3/CSA B45.4.
b. Type: Countertop Mounted.
c. Number of Compartments: One.
d. Metal Thickness: 20 gauge, type 304 stainless steel.
e. Compartment: 14”x15-3/4”x6-7/8”.

1) Drain: Grid with NPS 1/2 (DN 15) tailpiece and twist drain.
2) Drain Location: Centered in compartment.

4. Faucet(s): .

a. Number Required: Two (One being bubbler equal to Elkay LKSS1141A.
b. Mounting: On ledge.

5. Supply Fittings:

a. Standard: ASME A112.18.1/CSA B125.1.
b. Supplies: Chrome-plated brass compression stop with inlet connection matching water-supply piping type and size.

1) Operation: Wheel handle.
2) Risers: NPS 1/2 (DN 15),ASME A112.18.6, braided or corrugated stainless-steel flexible hose.

6. Waste Fittings:

a. Standard: ASME A112.18.2/CSA B125.2.
b. Trap(s):

1) Size: NPS 1/2 (DN 15).
2) Material: Chrome-plated, two-piece, cast-brass trap and swivel elbow with 0.032-inch- (0.83-mm-) thick brass tube to wall; and chrome-plated brass or steel wall flange.
3) Material: Stainless-steel, two-piece trap and swivel elbow with 0.012-inch- (0.30-mm-) thick stainless-steel tube to wall; and stainless-steel wall flange.

c. Continuous Waste:

1) Size: NPS 1/2 (DN 15).
2) Material: Chrome-plated, 0.032-inch- (0.83-mm-) thick brass tube.

7. Mounting: On counter with sealant.

2.4 COUNTERTOP SINKS

A. Sinks KS: Stainless steel, countertop mounted, double compartment.

1. Manufacturers: Subject to compliance with requirements, provide products by the following available manufacturers offering products that may be incorporated into the Work include, but are not limited to, the following:
2. Basis-of-Design Product: Elkay LR3322PD. Subject to compliance with requirements, provide product indicated on Drawings or comparable product by one of the following:

a. Advance Tabco.
b. Eagle Group; Foodservice Equipment Division.
c. Elkay Manufacturing Co.
d. Griffin Products, Inc.
e. Just Manufacturing.

3. Fixture:

a. Standard: ASME A112.19.3/CSA B125.2.
b. Type: Countertop Mounted.
c. Number of Compartments: Two.
d. Metal Thickness: 18 gauge, type 304 stainless steel.
e. Compartment: 33”x22”x9-5/8”.

1) Drain: Grid with NPS 1/2 (DN 15) tailpiece and twist drain.
2) Drain Location: Centered in compartment.

4. Faucet(s): .

a. Number Required: One.
b. Mounting: On ledge.

5. Supply Fittings:

a. Standard: ASME A112.18.1/CSA B125.1.
b. Supplies: Chrome-plated brass compression stop with inlet connection matching water-supply piping type and size.

1) Operation: Wheel handle.
2) Risers: NPS 1/2 (DN 15),ASME A112.18.6, braided or corrugated stainless-steel flexible hose.

6. Waste Fittings:

a. Standard: ASME A112.18.2/CSA B125.2.
b. Trap(s):

1) Size: NPS 1/2 (DN 15).

2) Material: Chrome-plated, two-piece, cast-brass trap and swivel elbow with 0.032-inch- (0.83-mm-) thick brass tube to wall; and chrome-plated brass or steel wall flange.
3) Material: Stainless-steel, two-piece trap and swivel elbow with 0.012-inch- (0.30-mm-) thick stainless-steel tube to wall; and stainless-steel wall flange.

c. Continuous Waste:

1) Size: NPS 1/2 (DN 15).
2) Material: Chrome-plated, 0.032-inch- (0.83-mm-) thick brass tube.

7. Mounting: On counter with sealant.

## 2.5 SINK FAUCETS

A. NSF Standard: Comply with NSF/ANSI 61, "Drinking Water System Components - Health Effects," for faucet-spout materials that will be in contact with potable water.

B. Sink Faucets: for KS. Manual type, single-lever-handle mixing valve.

1. Commercial, Solid-Brass Faucets:

a. Manufacturers: Subject to compliance with requirements, provide products by the following available manufacturers offering products that may be incorporated into the Work include, but are not limited to, the following:
b. Basis-of-Design Product: Elkay LK3001. Subject to compliance with requirements, provide product indicated on Drawings or comparable product by one of the following:

1) American Standard America.
2) Bradley Corporation.
3) Chicago Faucets.
4) Delta Faucet Company.
5) Elkay Manufacturing Co.
6) GROHE America, Inc.
7) Just Manufacturing.
8) Kohler Co.
9) Moen Incorporated.
10) Speakman Company.
11) T & S Brass and Bronze Works, Inc.
12) Zurn Plumbing Products Group.

2. Standard: ASME A112.18.1/CSA B125.1.
3. General: Include hot- and cold-water indicators; coordinate faucet inlets with supplies and fixture hole punchings; coordinate outlet with spout and sink receptor.
4. Body Type: Centerset.
5. Body Material: Commercial, solid brass.
6. Finish: Chrome plated.
7. Maximum Flow Rate: 2.2 gpm (8.3 L/min.).

8. Handle(s): Lever.
9. Mounting Type: Sink, exposed.
10. Spout Type: Swing, round tubular.
11. Spout Outlet: Swivel Aerator.

C. Sink Faucets: for S-1 & S-2. Manual type, two-lever-handle mixing valve.

1. Commercial, Solid-Brass Faucets:

a. Manufacturers: Subject to compliance with requirements, provide products by the following available manufacturers offering products that may be incorporated into the Work include, but are not limited to, the following:
b. Basis-of-Design Product: Elkay LK406GN04T4. Subject to compliance with requirements, provide product indicated on Drawings or comparable product by one of the following:

1) American Standard America.
2) Bradley Corporation.
3) Chicago Faucets.
4) Delta Faucet Company.
5) Elkay Manufacturing Co.
6) GROHE America, Inc.
7) Just Manufacturing.
8) Kohler Co.
9) Moen Incorporated.
10) Speakman Company.
11) T & S Brass and Bronze Works, Inc.
12) Zurn Plumbing Products Group.

2. Standard: ASME A112.18.1/CSA B125.1.
3. General: Include hot- and cold-water indicators; coordinate faucet inlets with supplies and fixture hole punchings; coordinate outlet with spout and sink receptor.
4. Body Type: Centerset.
5. Body Material: Commercial, solid brass.
6. Finish: Chrome plated.
7. Maximum Flow Rate: 1.5 gpm (5.7 L/min.).
8. Handle(s): 4” wrist blade.
9. Mounting Type: Sink, exposed.
10. Spout Type: Limited swing, round tubular.
11. Spout Outlet: Swivel Aerator.

## 2.6 SUPPLY FITTINGS

A. NSF Standard: Comply with NSF/ANSI 61, "Drinking Water System Components - Health Effects," for supply-fitting materials that will be in contact with potable water.

B. Standard: ASME A112.18.1/CSA B125.1.

C. Supply Piping: Chrome-plated brass pipe or chrome-plated copper tube matching water-supply piping size. Include chrome-plated brass or stainless-steel wall flange.

D. Supply Stops: Chrome-plated brass, one-quarter-turn, ball-type or compression valve with inlet connection matching supply piping.

E. Operation: Wheel handle.

F. Risers:

1. NPS 1/2 (DN 15)
2. ASME A112.18.6, braided or corrugated stainless-steel flexible hose.

## 2.7 WASTE FITTINGS

A. Standard: ASME A112.18.2/CSA B125.2.

B. Drain: Grid type with NPS 1-1/2 (DN 40) offset and straight tailpiece.

C. Trap:

1. Size: NPS 1-1/2 (DN 40).
2. Material: Chrome-plated, two-piece, cast-brass trap and swivel elbow with 0.032-inch- (0.83-mm-) thick brass tube to wall; and chrome-plated brass or steel wall flange.
3. Material: Stainless-steel, two-piece trap and swivel elbow with 0.012-inch- (0.30-mm-) thick stainless-steel tube to wall; and stainless-steel wall flange.

# PART 3 - EXECUTION

## 3.1 EXAMINATION

A. Examine roughing-in of water supply and sanitary drainage and vent piping systems to verify actual locations of piping connections before sink installation.

B. Examine walls, floors, and counters for suitable conditions where sinks will be installed.

C. Proceed with installation only after unsatisfactory conditions have been corrected.

## 3.2 INSTALLATION

A. Install sinks level and plumb according to roughing-in drawings.

B. Install supports, affixed to building substrate, for wall-hung sinks.

C. Install accessible wall-mounted sinks at handicapped/elderly mounting height according to ICC/ANSI A117.1.

D. Set floor-mounted sinks in leveling bed of cement grout.

E. Install water-supply piping with stop on each supply to each sink faucet.

1. Exception: Use ball, gate, or globe valves if supply stops are not specified with sink. Comply with valve requirements specified in Section 220523 "General-Duty Valves for Plumbing Piping."
2. Install stops in locations where they can be easily reached for operation.

F. Install wall flanges or escutcheons at piping wall penetrations in exposed, finished locations. Use deep-pattern escutcheons if required to conceal protruding fittings. Comply with escutcheon requirements specified in Section 220518 "Escutcheons for Plumbing Piping."

G. Seal joints between sinks and counters, floors, and walls using sanitary-type, one-part, mildew-resistant silicone sealant. Match sealant color to fixture color. Comply with sealant requirements specified in Section 079200 "Joint Sealants."

H. Install protective shielding pipe covers and enclosures on exposed supplies and waste piping of accessible sinks. Comply with requirements in Section 220719 "Plumbing Piping Insulation."

## 3.3 CONNECTIONS

A. Connect sinks with water supplies, stops, and risers, and with traps, soil, waste, and vent piping. Use size fittings required to match fixtures.

B. Comply with water piping requirements specified in Section 221116 "Domestic Water Piping."

C. Comply with soil and waste piping requirements specified in Section 221316 "Sanitary Waste and Vent Piping."

## 3.4 ADJUSTING

A. Operate and adjust sinks and controls. Replace damaged and malfunctioning sinks, fittings, and controls.

B. Adjust water pressure at faucets to produce proper flow.

## 3.5 CLEANING AND PROTECTION

A. After completing installation of sinks, inspect and repair damaged finishes.

B. Clean sinks, faucets, and other fittings with manufacturers' recommended cleaning methods and materials.

C. Provide protective covering for installed sinks and fittings.

D. Do not allow use of sinks for temporary facilities unless approved in writing by Owner.

END OF SECTION 224216.16

# SECTION 224716 - PRESSURE WATER COOLERS

## PART 1 - GENERAL

### 1.1 SUMMARY

A. Section includes pressure water coolers and related components.

### 1.2 ACTION SUBMITTALS

A. Product Data: For each type of pressure water cooler.

B. Shop Drawings: Include diagrams for power, signal, and control wiring.

### 1.3 CLOSEOUT SUBMITTALS

A. Maintenance Data: For pressure water coolers to include in maintenance manuals.

### 1.4 MAINTENANCE MATERIAL SUBMITTALS

A. Furnish extra materials that match products installed and that are packaged with protective covering for storage and identified with labels describing contents.

## PART 2 - PRODUCTS

### 2.1 PRESSURE WATER COOLERS

A. Pressure Water Coolers: Flush to wall.

1. Manufacturers: Subject to compliance with requirements, provide products by the following available manufacturers offering products that may be incorporated into the Work include, but are not limited to, the following:
2. Basis-of-Design Product: Elkay LNTEM8K, subject to compliance with requirements, provide product indicated on Drawings or comparable product by one of the following:

    a. Elkay Manufacturing Co.
    b. Halsey Taylor.
    c. Haws Corporation.
    d. Larco Inc.
    e. Tri Palm International, LLC; Oasis Brand.
    f. Tri Palm International, LLC; Sunroc Brand.

3. Standards:

    a. Comply with NSF 61.
    b. Comply with ASHRAE 34, "Designation and Safety Classification of Refrigerants," for water coolers. Provide HFC 134a (tetrafluoroethane) refrigerant unless otherwise indicated.
    c. Comply with ADA requirements.

4. Cabinet: All stainless steel.
5. Bubbler: One, with adjustable stream regulator, located on deck.
6. Control: Push button.
7. Drain: Grid with NPS 1-1/4 tailpiece.
8. Supply: NPS 3/8 with shutoff valve.
9. Waste Fitting: ASME A112.18.2/CSA B125.2, NPS 1-1/4 brass P-trap.
10. Filter: One or more water filters complying with NSF 42 and NSF 53 for cyst and lead reduction to below EPA standards; with capacity sized for unit peak flow rate.
11. Cooling System: Electric, with precooler, hermetically sealed compressor, cooling coil, air-cooled condensing unit, corrosion-resistant tubing, refrigerant, corrosion-resistant-metal storage tank, and adjustable thermostat.

    a. Electrical Components, Devices, and Accessories: Listed and labeled as defined in NFPA 70, by a qualified testing agency, and marked for intended location and application.

12. Capacities and Characteristics:

    a. Cooled Water: 7.5 gph.
    b. Ambient-Air Temperature: 90 deg F.
    c. Inlet-Water Temperature: 80 deg F
    d. Cooled-Water Temperature: 50 deg F.

## PART 3 - EXECUTION

### 3.1 EXAMINATION

A. Examine roughing-in for water-supply and sanitary drainage and vent piping systems to verify actual locations of piping connections before fixture installation.

B. Examine walls and floors for suitable conditions where fixtures will be installed.

C. Proceed with installation only after unsatisfactory conditions have been corrected.

3.2 INSTALLATION

A. Install fixtures level and plumb according to roughing-in drawings. For fixtures indicated for children, install at height required by authorities having jurisdiction.

B. Set freestanding pressure water coolers on floor.

C. Install off-the-floor carrier supports, affixed to building substrate, for wall-mounted fixtures.

D. Install water-supply piping with shutoff valve on supply to each fixture to be connected to domestic-water distribution piping. Use ball, gate, or globe valve. Install valves in locations where they can be easily reached for operation. Valves are specified in Section 220523 "General-Duty Valves for Plumbing Piping."

E. Install trap and waste piping on drain outlet of each fixture to be connected to sanitary drainage system.

F. Install wall flanges or escutcheons at piping wall penetrations in exposed, finished locations. Use deep-pattern escutcheons where required to conceal protruding fittings. Comply with escutcheon requirements specified in Section 220518 "Escutcheons for Plumbing Piping."

G. Seal joints between fixtures and walls using sanitary-type, one-part, mildew-resistant, silicone sealant. Match sealant color to fixture color.

3.3 CONNECTIONS

A. Connect fixtures with water supplies, stops, and risers, and with traps, soil, waste, and vent piping. Use size fittings required to match fixtures.

B. Comply with water piping requirements specified in Section 221116 "Domestic Water Piping."

C. Install ball, gate, or globe shutoff valve on water supply to each fixture. Install valve upstream from filter for water cooler. Comply with valve requirements specified in Section 220523 "General-Duty Valves for Plumbing Piping."

D. Comply with soil and waste piping requirements specified in Section 221316 "Sanitary Waste and Vent Piping."

3.4 ADJUSTING

A. Adjust fixture flow regulators for proper flow and stream height.

B. Adjust pressure water-cooler temperature settings.

3.5 CLEANING

A. After installing fixture, inspect unit. Remove paint splatters and other spots, dirt, and debris. Repair damaged finish to match original finish.

B. Clean fixtures, on completion of installation, according to manufacturer's written instructions.

C. Provide protective covering for installed fixtures.

D. Do not allow use of fixtures for temporary facilities unless approved in writing by Owner.

END OF SECTION 224716

# SECTION 230513 - COMMON MOTOR REQUIREMENTS FOR HVAC EQUIPMENT

## PART 1 - GENERAL

### 1.1 SUMMARY

A. Section includes general requirements for single-phase and polyphase, general-purpose, horizontal, small and medium, squirrel-cage induction motors for use on ac power systems up to 600 V and installed at equipment manufacturer's factory or shipped separately by equipment manufacturer for field installation.

### 1.2 COORDINATION

A. Coordinate features of motors, installed units, and accessory devices to be compatible with the following:

1. Motor controllers.
2. Torque, speed, and horsepower requirements of the load.
3. Ratings and characteristics of supply circuit and required control sequence.
4. Ambient and environmental conditions of installation location.

## PART 2 - PRODUCTS

### 2.1 GENERAL MOTOR REQUIREMENTS

A. Comply with NEMA MG 1 unless otherwise indicated.

### 2.2 MOTOR CHARACTERISTICS

A. Duty: Continuous duty at ambient temperature of 40 deg C and at altitude of 3300 feet above sea level.

B. Capacity and Torque Characteristics: Sufficient to start, accelerate, and operate connected loads at designated speeds, at installed altitude and environment, with indicated operating sequence, and without exceeding nameplate ratings or considering service factor.

### 2.3 POLYPHASE MOTORS

A. Description: NEMA MG 1, Design B, medium induction motor.

B. Efficiency: Energy efficient, as defined in NEMA MG 1.

C. Service Factor: 1.15.

D. Multispeed Motors: Variable torque.

1. For motors with 2:1 speed ratio, consequent pole, single winding.
2. For motors with other than 2:1 speed ratio, separate winding for each speed.

E. Rotor: Random-wound, squirrel cage.

F. Bearings: Regreasable, shielded, antifriction ball bearings suitable for radial and thrust loading.

G. Temperature Rise: Match insulation rating.

H. Insulation: Class F.

I. Code Letter Designation:

1. Motors 15 HP and Larger: NEMA starting Code F or Code G.
2. Motors Smaller than 15 HP: Manufacturer's standard starting characteristic.

J. Enclosure Material: Cast iron for motor frame sizes 324T and larger; rolled steel for motor frame sizes smaller than 324T.

## 2.4 POLYPHASE MOTORS WITH ADDITIONAL REQUIREMENTS

A. Motors Used with Reduced-Voltage and Multispeed Controllers: Match wiring connection requirements for controller with required motor leads. Provide terminals in motor terminal box, suited to control method.

B. Motors Used with Variable Frequency Controllers: Ratings, characteristics, and features coordinated with and approved by controller manufacturer.

1. Windings: Copper magnet wire with moisture-resistant insulation varnish, designed and tested to resist transient spikes, high frequencies, and short time rise pulses produced by pulse-width modulated inverters.
2. Energy- and Premium-Efficient Motors: Class B temperature rise; Class F insulation.
3. Inverter-Duty Motors: Class F temperature rise; Class H insulation.
4. Thermal Protection: Comply with NEMA MG 1 requirements for thermally protected motors.

## 2.5 SINGLE-PHASE MOTORS

A. Motors larger than 1/20 hp shall be one of the following, to suit starting torque and requirements of specific motor application:

1. Permanent-split capacitor.

2. Split phase.
3. Capacitor start, inductor run.
4. Capacitor start, capacitor run.

B. Multispeed Motors: Variable-torque, permanent-split-capacitor type.

C. Bearings: Prelubricated, antifriction ball bearings or sleeve bearings suitable for radial and thrust loading.

D. Motors 1/20 HP and Smaller: Shaded-pole type.

E. Thermal Protection: Internal protection to automatically open power supply circuit to motor when winding temperature exceeds a safe value calibrated to temperature rating of motor insulation. Thermal-protection device shall automatically reset when motor temperature returns to normal range.

PART 3 - EXECUTION (Not Applicable)

END OF SECTION 230513

# SECTION 230548.13 - VIBRATION CONTROLS FOR HVAC

## PART 1 - GENERAL

### 1.1 SUMMARY

A. Section Includes:

1. Elastomeric isolation mounts.
2. Housed-restrained-spring isolators.
3. Pipe-riser resilient supports.
4. Resilient pipe guides.
5. Elastomeric hangers.
6. Spring hangers.

### 1.2 ACTION SUBMITTALS

A. Product Data: For each type of product.

B. Delegated-Design Submittal: For each vibration isolation device.

1. Include design calculations for selecting vibration isolators.

## PART 2 - PRODUCTS

### 2.1 ELASTOMERIC ISOLATION MOUNTS

A. Double-Deflection, Elastomeric Isolation Mounts to be installed under air handling units.

1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:

a. Ace Mountings Co., Inc.
b. California Dynamics Corporation.
c. Isolation Technology, Inc.
d. Kinetics Noise Control, Inc.
e. Mason Industries, Inc.
f. Novia; A Division of C&P.
g. Vibration Eliminator Co., Inc.
h. Vibration Isolation.
i. Vibration Mountings & Controls, Inc.

2. Mounting Plates:

a. Top Plate: Encapsulated steel load transfer top plates, factory drilled and threaded with threaded studs or bolts.
b. Baseplate: Encapsulated steel bottom plates with holes provided for anchoring to support structure.

3. Elastomeric Material: Molded, oil-resistant rubber, neoprene, or other elastomeric material.

## 2.2 RESTRAINED ELASTOMERIC ISOLATION MOUNTS

A. Restrained Elastomeric Isolation Mounts:

1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:

a. Ace Mountings Co., Inc.
b. California Dynamics Corporation.
c. Isolation Technology, Inc.
d. Kinetics Noise Control, Inc.
e. Mason Industries, Inc.
f. Novia; A Division of C&P.
g. Vibration Eliminator Co., Inc.
h. Vibration Isolation.
i. Vibration Mountings & Controls, Inc.

2. Description: All-directional isolator with restraints containing two separate and opposing elastomeric elements that prevent central threaded element and attachment hardware from contacting the housing during normal operation.

a. Housing: Cast-ductile iron or welded steel.
b. Elastomeric Material: Molded, oil-resistant rubber, neoprene, or other elastomeric material.

## 2.3 HOUSED-SPRING ISOLATORS

A. Freestanding, Laterally Stable, Open-Spring Isolators in Two-Part Telescoping Housing: .

1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:

a. Ace Mountings Co., Inc.
b. California Dynamics Corporation.
c. Isolation Technology, Inc.
d. Kinetics Noise Control, Inc.
e. Mason Industries, Inc.
f. Vibration Eliminator Co., Inc.
g. Vibration Isolation.
h. Vibration Mountings & Controls, Inc.

2. Outside Spring Diameter: Not less than 80 percent of the compressed height of the spring at rated load.
3. Minimum Additional Travel: 50 percent of the required deflection at rated load.
4. Lateral Stiffness: More than 80 percent of rated vertical stiffness.
5. Overload Capacity: Support 200 percent of rated load, fully compressed, without deformation or failure.
6. Two-Part Telescoping Housing: A steel top and bottom frame separated by an elastomeric material and enclosing the spring isolators.

    a. Drilled base housing for bolting to structure with an elastomeric isolator pad attached to the underside. Bases shall limit floor load to 500 psig (3447 kPa).
    b. Top housing with threaded mounting holes and internal leveling device.

## 2.4 PIPE-RISER RESILIENT SUPPORT

A. Description: All-directional, acoustical pipe anchor consisting of two steel tubes separated by a minimum 1/2-inch- (13-mm-) thick neoprene.

1. Vertical-Limit Stops: Steel and neoprene vertical-limit stops arranged to prevent vertical travel in both directions.
2. Maximum Load Per Support: 500 psig (3.45 MPa)on isolation material providing equal isolation in all directions.

## 2.5 RESILIENT PIPE GUIDES

A. Description: Telescopic arrangement of two steel tubes or post and sleeve arrangement separated by a minimum 1/2-inch- (13-mm-) thick neoprene.

1. Factory-Set Height Guide with Shear Pin: Shear pin shall be removable and reinsertable to allow for selection of pipe movement. Guides shall be capable of motion to meet location requirements.

## 2.6 ELASTOMERIC HANGERS

A. Elastomeric Mount in a Steel Frame with Upper and Lower Steel Hanger Rods: .

1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:

    a. Ace Mountings Co., Inc.
    b. California Dynamics Corporation.
    c. Isolation Technology, Inc.
    d. Kinetics Noise Control, Inc.
    e. Mason Industries, Inc.
    f. Novia; A Division of C&P.
    g. Vibration Eliminator Co., Inc.
    h. Vibration Mountings & Controls, Inc.

2. Frame: Steel, fabricated with a connection for an upper threaded hanger rod and an opening on the underside to allow for a maximum of 30 degrees of angular lower hanger-rod misalignment without binding or reducing isolation efficiency.
3. Dampening Element: Molded, oil-resistant rubber, neoprene, or other elastomeric material with a projecting bushing for the underside opening preventing steel to steel contact.

## 2.7 SPRING HANGERS

A. Combination Coil-Spring and Elastomeric-Insert Hanger with Spring and Insert in Compression: .

1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:

   a. Ace Mountings Co., Inc.
   b. California Dynamics Corporation.
   c. Kinetics Noise Control, Inc.
   d. Mason Industries, Inc.
   e. Novia; A Division of C&P.
   f. Vibration Eliminator Co., Inc.
   g. Vibration Isolation.
   h. Vibration Mountings & Controls, Inc.

2. Frame: Steel, fabricated for connection to threaded hanger rods and to allow for a maximum of 30 degrees of angular hanger-rod misalignment without binding or reducing isolation efficiency.
3. Outside Spring Diameter: Not less than 80 percent of the compressed height of the spring at rated load.
4. Minimum Additional Travel: 50 percent of the required deflection at rated load.
5. Lateral Stiffness: More than 80 percent of rated vertical stiffness.
6. Overload Capacity: Support 200 percent of rated load, fully compressed, without deformation or failure.
7. Elastomeric Element: Molded, oil-resistant rubber or neoprene. Steel-washer-reinforced cup to support spring and bushing projecting through bottom of frame.
8. Adjustable Vertical Stop: Steel washer with neoprene washer "up-stop" on lower threaded rod.
9. Self-centering hanger rod cap to ensure concentricity between hanger rod and support spring coil.

# PART 3 - EXECUTION

## 3.1 VIBRATION CONTROL DEVICE INSTALLATION

A. Coordinate the location of embedded connection hardware with supported equipment attachment and mounting points and with requirements for concrete reinforcement and formwork specified in Section 033000 "Cast-in-Place Concrete."

B. Installation of vibration isolators must not cause any change of position of equipment, piping, or ductwork resulting in stresses or misalignment.

END OF SECTION 230548.13

# SECTION 230553 - IDENTIFICATION FOR HVAC PIPING AND EQUIPMENT

## PART 1 - GENERAL

### 1.1 SUMMARY

A. Section Includes:

1. Equipment labels.
2. Warning signs and labels.
3. Duct labels.

### 1.2 ACTION SUBMITTAL

A. Product Data: For each type of product indicated.

## PART 2 - PRODUCTS

### 2.1 EQUIPMENT LABELS

A. Metal Labels for Equipment:

1. Material and Thickness: Brass, 0.032-inch (0.8-mm) minimum thickness, and having predrilled or stamped holes for attachment hardware.
2. Minimum Label Size: Length and width vary for required label content, but not less than 2-1/2 by 3/4 inch (64 by 19 mm).
3. Minimum Letter Size: 1/4 inch (6.4 mm) for name of units if viewing distance is less than 24 inches (600 mm), 1/2 inch (13 mm) for viewing distances up to 72 inches (1830 mm), and proportionately larger lettering for greater viewing distances. Include secondary lettering two-thirds to three-fourths the size of principal lettering.
4. Fasteners: Stainless-steel rivets or self-tapping screws.
5. Adhesive: Contact-type permanent adhesive, compatible with label and with substrate.

B. Plastic Labels for Equipment:

1. Material and Thickness: Multilayer, multicolor, plastic labels for mechanical engraving, 1/16 inch (1.6 mm) thick, and having predrilled holes for attachment hardware.
2. Letter Color: Red.
3. Background Color: White.
4. Maximum Temperature: Able to withstand temperatures up to 160 deg F (71 deg C).
5. Minimum Label Size: Length and width vary for required label content, but not less than 2-1/2 by 3/4 inch (64 by 19 mm).
6. Minimum Letter Size: 1/4 inch (6.4 mm) for name of units if viewing distance is less than 24 inches (600 mm), 1/2 inch (13 mm) for viewing distances up to 72 inches (1830

mm), and proportionately larger lettering for greater viewing distances. Include secondary lettering two-thirds to three-fourths the size of principal lettering.

7. Fasteners: Stainless-steel rivets or self-tapping screws.
8. Adhesive: Contact-type permanent adhesive, compatible with label and with substrate.

C. Label Content: Include equipment's Drawing designation or unique equipment number, Drawing numbers where equipment is indicated (plans, details, and schedules), plus the Specification Section number and title where equipment is specified.

D. Equipment Label Schedule: For each item of equipment to be labeled, on 8-1/2-by-11-inch (A4) bond paper. Tabulate equipment identification number and identify Drawing numbers where equipment is indicated (plans, details, and schedules), plus the Specification Section number and title where equipment is specified. Equipment schedule shall be included in operation and maintenance data.

## 2.2 WARNING SIGNS AND LABELS

A. Material and Thickness: Multilayer, multicolor, plastic labels for mechanical engraving, 1/16 inch (1.6 mm) thick, and having predrilled holes for attachment hardware.

B. Letter Color: Black.

C. Background Color: Yellow.

D. Maximum Temperature: Able to withstand temperatures up to 160 deg F (71 deg C).

E. Minimum Label Size: Length and width vary for required label content, but not less than 2-1/2 by 3/4 inch (64 by 19 mm).

F. Minimum Letter Size: 1/4 inch (6.4 mm) for name of units if viewing distance is less than 24 inches (600 mm), 1/2 inch (13 mm) for viewing distances up to 72 inches (1830 mm), and proportionately larger lettering for greater viewing distances. Include secondary lettering two-thirds to three-fourths the size of principal lettering.

G. Fasteners: Stainless-steel rivets or self-tapping screws.

H. Adhesive: Contact-type permanent adhesive, compatible with label and with substrate.

I. Label Content: Include caution and warning information, plus emergency notification instructions.

## 2.3 DUCT LABELS

A. Material and Thickness: Multilayer, multicolor, plastic labels for mechanical engraving, 1/16 inch (1.6 mm) thick, and having predrilled holes for attachment hardware.

B. Letter Color: White.

C. Background Color: Red.

D. Maximum Temperature: Able to withstand temperatures up to 160 deg F (71 deg C).

E. Minimum Label Size: Length and width vary for required label content, but not less than 2-1/2 by 3/4 inch (64 by 19 mm).

F. Minimum Letter Size: 1/4 inch (6.4 mm) for name of units if viewing distance is less than 24 inches (600 mm), 1/2 inch (13 mm) for viewing distances up to 72 inches (1830 mm), and proportionately larger lettering for greater viewing distances. Include secondary lettering two-thirds to three-fourths the size of principal lettering.

G. Fasteners: Stainless-steel rivets or self-tapping screws.

H. Adhesive: Contact-type permanent adhesive, compatible with label and with substrate.

I. Duct Label Contents: Include identification of duct service using same designations or abbreviations as used on Drawings, duct size, and an arrow indicating flow direction.

1. Flow-Direction Arrows: Integral with duct system service lettering to accommodate both directions, or as separate unit on each duct label to indicate flow direction.
2. Lettering Size: At least 1-1/2 inches (38 mm) high.

## PART 3 - EXECUTION

### 3.1 PREPARATION

A. Clean piping and equipment surfaces of substances that could impair bond of identification devices, including dirt, oil, grease, release agents, and incompatible primers, paints, and encapsulants.

### 3.2 EQUIPMENT LABEL INSTALLATION

A. Install or permanently fasten labels on each major item of mechanical equipment.

B. Locate equipment labels where accessible and visible.

### 3.3 DUCT LABEL INSTALLATION

A. Install plastic-laminated self-adhesive duct labels with permanent adhesive on air ducts in the following color codes:

1. Blue: For cold-air supply ducts.
2. Green: For exhaust-, outside-, relief-, return-, and mixed-air ducts.
3. ASME A13.1 Colors and Designs: For hazardous material exhaust.

B. Locate labels near points where ducts enter into concealed spaces and at maximum intervals of 50 feet (15 m) in each space where ducts are exposed or concealed by removable ceiling system.

END OF SECTION 230553

# SECTION 230593 - TESTING, ADJUSTING, AND BALANCING FOR HVAC

## PART 1 - GENERAL

### 1.1 SUMMARY

A. Section Includes:

1. Balancing Air Systems:

a. Constant-volume air systems.
b. Variable-air-volume systems.

2. Balancing Hydronic Piping Systems:

a. Constant-flow hydronic systems.
b. Variable-flow hydronic systems.

### 1.2 DEFINITIONS

A. AABC: Associated Air Balance Council.

B. NEBB: National Environmental Balancing Bureau.

C. TAB: Testing, adjusting, and balancing.

D. TABB: Testing, Adjusting, and Balancing Bureau.

E. TAB Specialist: An entity engaged to perform TAB Work.

### 1.3 INFORMATIONAL SUBMITTALS

A. Strategies and Procedures Plan: Within 30 days of Contractor's Notice to Proceed, submit TAB strategies and step-by-step procedures as specified in "Preparation" Article.

B. Certified TAB reports.

### 1.4 QUALITY ASSURANCE

A. TAB Contractor Qualifications: Engage a TAB entity certified by AABC NEBB or TABB.

1. TAB Field Supervisor: Employee of the TAB contractor and certified by AABC NEBB or TABB.

2. TAB Technician: Employee of the TAB contractor and who is certified by AABC NEBB or TABB as a TAB technician.

B. Certify TAB field data reports and perform the following:

1. Review field data reports to validate accuracy of data and to prepare certified TAB reports.
2. Certify that the TAB team complied with the approved TAB plan and the procedures specified and referenced in this Specification.

C. TAB Report Forms: Use standard TAB contractor's forms approved by Architect.

D. Instrumentation Type, Quantity, Accuracy, and Calibration: As described in ASHRAE 111, Section 5, "Instrumentation."

E. ASHRAE Compliance: Applicable requirements in ASHRAE 62.1, Section 7.2.2 - "Air Balancing."

F. ASHRAE/IESNA Compliance: Applicable requirements in ASHRAE/IESNA 90.1, Section 6.7.2.3 - "System Balancing."

PART 2 - PRODUCTS (Not Applicable)

PART 3 - EXECUTION

3.1 EXAMINATION

A. Examine the Contract Documents to become familiar with Project requirements and to discover conditions in systems' designs that may preclude proper TAB of systems and equipment.

B. Examine systems for installed balancing devices, such as test ports, gage cocks, thermometer wells, flow-control devices, balancing valves and fittings, and manual volume dampers. Verify that locations of these balancing devices are accessible.

C. Examine the approved submittals for HVAC systems and equipment.

D. Examine design data including HVAC system descriptions, statements of design assumptions for environmental conditions and systems' output, and statements of philosophies and assumptions about HVAC system and equipment controls.

E. Examine ceiling plenums and underfloor air plenums used for supply, return, or relief air to verify that they meet the leakage class of connected ducts as specified in Section 233113 "Metal Ducts" and are properly separated from adjacent areas. Verify that penetrations in plenum walls are sealed and fire-stopped if required.

F. Examine equipment performance data including fan and pump curves.

1. Relate performance data to Project conditions and requirements, including system effects that can create undesired or unpredicted conditions that cause reduced capacities in all or part of a system.
2. Calculate system-effect factors to reduce performance ratings of HVAC equipment when installed under conditions different from the conditions used to rate equipment performance. To calculate system effects for air systems, use tables and charts found in AMCA 201, "Fans and Systems," or in SMACNA's "HVAC Systems - Duct Design." Compare results with the design data and installed conditions.

G. Examine system and equipment installations and verify that field quality-control testing, cleaning, and adjusting specified in individual Sections have been performed.

H. Examine test reports specified in individual system and equipment Sections.

I. Examine HVAC equipment and filters and verify that bearings are greased, belts are aligned and tight, and equipment with functioning controls is ready for operation.

J. Examine terminal units, such as variable-air-volume boxes, and verify that they are accessible and their controls are connected and functioning.

K. Examine strainers. Verify that startup screens are replaced by permanent screens with indicated perforations.

L. Examine three-way valves for proper installation for their intended function of diverting or mixing fluid flows.

M. Examine heat-transfer coils for correct piping connections and for clean and straight fins.

N. Examine system pumps to ensure absence of entrained air in the suction piping.

O. Examine operating safety interlocks and controls on HVAC equipment.

P. Report deficiencies discovered before and during performance of TAB procedures. Observe and record system reactions to changes in conditions. Record default set points if different from indicated values.

## 3.2 PREPARATION

A. Prepare a TAB plan that includes strategies and step-by-step procedures.

B. Complete system-readiness checks and prepare reports. Verify the following:

1. Permanent electrical-power wiring is complete.
2. Hydronic systems are filled, clean, and free of air.
3. Automatic temperature-control systems are operational.
4. Equipment and duct access doors are securely closed.
5. Balance, smoke, and fire dampers are open.

6. Isolating and balancing valves are open and control valves are operational.
7. Ceilings are installed in critical areas where air-pattern adjustments are required and access to balancing devices is provided.
8. Windows and doors can be closed so indicated conditions for system operations can be met.

3.3 GENERAL PROCEDURES FOR TESTING AND BALANCING

A. Perform testing and balancing procedures on each system according to the procedures contained in AABC's "National Standards for Total System Balance" and in this Section.

1. Comply with requirements in ASHRAE 62.1, Section 7.2.2 - "Air Balancing."

B. Cut insulation, ducts, pipes, and equipment cabinets for installation of test probes to the minimum extent necessary for TAB procedures.

1. After testing and balancing, patch probe holes in ducts with same material and thickness as used to construct ducts.
2. Install and join new insulation that matches removed materials. Restore insulation, coverings, vapor barrier, and finish.

C. Mark equipment and balancing devices, including damper-control positions, valve position indicators, fan-speed-control levers, and similar controls and devices, with paint or other suitable, permanent identification material to show final settings.

D. Take and report testing and balancing measurements in inch-pound (IP) units.

3.4 GENERAL PROCEDURES FOR BALANCING AIR SYSTEMS

A. Prepare test reports for both fans and outlets. Obtain manufacturer's outlet factors and recommended testing procedures. Crosscheck the summation of required outlet volumes with required fan volumes.

B. Prepare schematic diagrams of systems' "as-built" duct layouts.

C. For variable-air-volume systems, develop a plan to simulate diversity.

D. Determine the best locations in main and branch ducts for accurate duct-airflow measurements.

E. Check airflow patterns from the outdoor-air louvers and dampers and the return- and exhaust-air dampers through the supply-fan discharge and mixing dampers.

F. Locate start-stop and disconnect switches, electrical interlocks, and motor starters.

G. Verify that motor starters are equipped with properly sized thermal protection.

H. Check dampers for proper position to achieve desired airflow path.

I. Check for airflow blockages.

J. Check condensate drains for proper connections and functioning.

K. Check for proper sealing of air-handling-unit components.

L. Verify that air duct system is sealed as specified in Section 233113 "Metal Ducts."

3.5 PROCEDURES FOR CONSTANT-VOLUME AIR SYSTEMS

A. Adjust fans to deliver total indicated airflows within the maximum allowable fan speed listed by fan manufacturer.

1. Measure total airflow.

a. Where sufficient space in ducts is unavailable for Pitot-tube traverse measurements, measure airflow at terminal outlets and inlets and calculate the total airflow.

2. Measure fan static pressures as follows to determine actual static pressure:

a. Measure outlet static pressure as far downstream from the fan as practical and upstream from restrictions in ducts such as elbows and transitions.
b. Measure static pressure directly at the fan outlet or through the flexible connection.
c. Measure inlet static pressure of single-inlet fans in the inlet duct as near the fan as possible, upstream from the flexible connection, and downstream from duct restrictions.
d. Measure inlet static pressure of double-inlet fans through the wall of the plenum that houses the fan.

3. Measure static pressure across each component that makes up an air-handling unit, rooftop unit, and other air-handling and -treating equipment.

a. Report the cleanliness status of filters and the time static pressures are measured.

4. Measure static pressures entering and leaving other devices, such as sound traps, heat-recovery equipment, and air washers, under final balanced conditions.
5. Review Record Documents to determine variations in design static pressures versus actual static pressures. Calculate actual system-effect factors. Recommend adjustments to accommodate actual conditions.
6. Obtain approval from Architect for adjustment of fan speed higher or lower than indicated speed. Comply with requirements in Sections for air-handling units for

adjustment of fans, belts, and pulley sizes to achieve indicated air-handling-unit performance.

7. Do not make fan-speed adjustments that result in motor overload. Consult equipment manufacturers about fan-speed safety factors. Modulate dampers and measure fan-motor amperage to ensure that no overload will occur. Measure amperage in full-cooling, full-heating, economizer, and any other operating mode to determine the maximum required brake horsepower.

B. Adjust volume dampers for main duct, submain ducts, and major branch ducts to indicated airflows within specified tolerances.

1. Measure airflow of submain and branch ducts.

a. Where sufficient space in submain and branch ducts is unavailable for Pitot-tube traverse measurements, measure airflow at terminal outlets and inlets and calculate the total airflow for that zone.

2. Measure static pressure at a point downstream from the balancing damper, and adjust volume dampers until the proper static pressure is achieved.
3. Remeasure each submain and branch duct after all have been adjusted. Continue to adjust submain and branch ducts to indicated airflows within specified tolerances.

C. Measure air outlets and inlets without making adjustments.

1. Measure terminal outlets using a direct-reading hood or outlet manufacturer's written instructions and calculating factors.

D. Adjust air outlets and inlets for each space to indicated airflows within specified tolerances of indicated values. Make adjustments using branch volume dampers rather than extractors and the dampers at air terminals.

1. Adjust each outlet in same room or space to within specified tolerances of indicated quantities without generating noise levels above the limitations prescribed by the Contract Documents.
2. Adjust patterns of adjustable outlets for proper distribution without drafts.

## 3.6 PROCEDURES FOR MOTORS

A. Motors, 1/2 HP and Larger: Test at final balanced conditions and record the following data:

1. Manufacturer's name, model number, and serial number.
2. Motor horsepower rating.
3. Motor rpm.
4. Efficiency rating.
5. Nameplate and measured voltage, each phase.
6. Nameplate and measured amperage, each phase.
7. Starter thermal-protection-element rating.

B. Motors Driven by Variable-Frequency Controllers: Test for proper operation at speeds varying from minimum to maximum. Test the manual bypass of the controller to prove proper operation. Record observations including name of controller manufacturer, model number, serial number, and nameplate data.

3.7 PROCEDURES FOR CONDENSING UNITS

A. Verify proper rotation of fans.

B. Measure entering- and leaving-air temperatures.

C. Record compressor data.

3.8 PROCEDURES FOR HEAT-TRANSFER COILS

A. Measure, adjust, and record the following data for each water coil:

1. Entering- and leaving-water temperature.
2. Water flow rate.
3. Water pressure drop.
4. Dry-bulb temperature of entering and leaving air.
5. Wet-bulb temperature of entering and leaving air for cooling coils.
6. Airflow.
7. Air pressure drop.

B. Measure, adjust, and record the following data for each electric heating coil:

1. Nameplate data.
2. Airflow.
3. Entering- and leaving-air temperature at full load.
4. Voltage and amperage input of each phase at full load and at each incremental stage.
5. Calculated kilowatt at full load.
6. Fuse or circuit-breaker rating for overload protection.

C. Measure, adjust, and record the following data for each steam coil:

1. Dry-bulb temperature of entering and leaving air.
2. Airflow.
3. Air pressure drop.
4. Inlet steam pressure.

D. Measure, adjust, and record the following data for each refrigerant coil:

1. Dry-bulb temperature of entering and leaving air.
2. Wet-bulb temperature of entering and leaving air.
3. Airflow.

4. Air pressure drop.
5. Refrigerant suction pressure and temperature.

3.9 TOLERANCES

A. Set HVAC system's air flow rates and water flow rates within the following tolerances:

1. Supply, Return, and Exhaust Fans and Equipment with Fans: Plus or minus 10 percent.
2. Air Outlets and Inlets: Plus or minus 10 percent.

3.10 REPORTING

A. Initial Construction-Phase Report: Based on examination of the Contract Documents as specified in "Examination" Article, prepare a report on the adequacy of design for systems' balancing devices. Recommend changes and additions to systems' balancing devices to facilitate proper performance measuring and balancing. Recommend changes and additions to HVAC systems and general construction to allow access for performance measuring and balancing devices.

B. Status Reports: Prepare weekly progress reports to describe completed procedures, procedures in progress, and scheduled procedures. Include a list of deficiencies and problems found in systems being tested and balanced. Prepare a separate report for each system and each building floor for systems serving multiple floors.

3.11 FINAL REPORT

A. General: Prepare a certified written report; tabulate and divide the report into separate sections for tested systems and balanced systems.

1. Include a certification sheet at the front of the report's binder, signed and sealed by the certified testing and balancing engineer.
2. Include a list of instruments used for procedures, along with proof of calibration.

B. Final Report Contents: In addition to certified field-report data, include the following:

1. Fan curves.
2. Manufacturers' test data.
3. Field test reports prepared by system and equipment installers.
4. Other information relative to equipment performance; do not include Shop Drawings and product data.

C. General Report Data: In addition to form titles and entries, include the following data:

1. Title page.
2. Name and address of the TAB contractor.

3. Project name.
4. Project location.
5. Architect's name and address.
6. Engineer's name and address.
7. Contractor's name and address.
8. Report date.
9. Signature of TAB supervisor who certifies the report.
10. Table of Contents with the total number of pages defined for each section of the report. Number each page in the report.
11. Summary of contents including the following:

    a. Indicated versus final performance.
    b. Notable characteristics of systems.
    c. Description of system operation sequence if it varies from the Contract Documents.

12. Nomenclature sheets for each item of equipment.
13. Data for terminal units, including manufacturer's name, type, size, and fittings.
14. Notes to explain why certain final data in the body of reports vary from indicated values.
15. Test conditions for fans and pump performance forms including the following:

    a. Settings for outdoor-, return-, and exhaust-air dampers.
    b. Conditions of filters.
    c. Cooling coil, wet- and dry-bulb conditions.
    d. Face and bypass damper settings at coils.
    e. Fan drive settings including settings and percentage of maximum pitch diameter.
    f. Inlet vane settings for variable-air-volume systems.
    g. Settings for supply-air, static-pressure controller.
    h. Other system operating conditions that affect performance.

D. System Diagrams: Include schematic layouts of air and hydronic distribution systems. Present each system with single-line diagram and include the following:

1. Quantities of outdoor, supply, return, and exhaust airflows.
2. Duct, outlet, and inlet sizes.
3. Pipe and valve sizes and locations.
4. Balancing stations.
5. Position of balancing devices.

3.12 ADDITIONAL TESTS

A. Within 90 days of completing TAB, perform additional TAB to verify that balanced conditions are being maintained throughout and to correct unusual conditions.

B. Seasonal Periods: If initial TAB procedures were not performed during near-peak summer and winter conditions, perform additional TAB during near-peak summer and winter conditions.

END OF SECTION 230593

# SECTION 230713 - DUCT INSULATION

## PART 1 - GENERAL

### 1.1 SUMMARY

A. Section includes insulating the following duct services:

1. Indoor, concealed supply and outdoor air.
2. Indoor, exposed supply and outdoor air.
3. Indoor, concealed return located in unconditioned space.
4. Indoor, exposed return located in unconditioned space.
5. Indoor, concealed exhaust between isolation damper and penetration of building exterior.
6. Indoor, exposed exhaust between isolation damper and penetration of building exterior.
7. Outdoor, concealed supply and return.
8. Outdoor, exposed supply and return.

B. Related Sections:

1. Section 233113 "Metal Ducts" for duct liners.

### 1.2 ACTION SUBMITTALS

A. Product Data: For each type of product indicated.

B. Shop Drawings: Include plans, elevations, sections, details, and attachments to other work.

1. Detail application of protective shields, saddles, and inserts at hangers for each type of insulation and hanger.
2. Detail insulation application at elbows, fittings, dampers, specialties and flanges for each type of insulation.
3. Detail application of field-applied jackets.
4. Detail application at linkages of control devices.

### 1.3 INFORMATIONAL SUBMITTALS

A. Field quality-control reports.

### 1.4 QUALITY ASSURANCE

A. Surface-Burning Characteristics: For insulation and related materials, as determined by testing identical products according to ASTM E 84, by a testing agency acceptable to authorities

having jurisdiction. Factory label insulation and jacket materials and adhesive, mastic, tapes, and cement material containers, with appropriate markings of applicable testing agency.

1. Insulation Installed Indoors: Flame-spread index of 25 or less, and smoke-developed index of 50 or less.
2. Insulation Installed Outdoors: Flame-spread index of 75 or less, and smoke-developed index of 150 or less.

PART 2 - PRODUCTS

2.1 INSULATION MATERIALS

A. Comply with requirements in "Duct Insulation Schedule, General," "Indoor Duct and Plenum Insulation Schedule," and "Aboveground, Outdoor Duct and Plenum Insulation Schedule" articles for where insulating materials shall be applied.

B. Products shall not contain asbestos, lead, mercury, or mercury compounds.

C. Products that come in contact with stainless steel shall have a leachable chloride content of less than 50 ppm when tested according to ASTM C 871.

D. Insulation materials for use on austenitic stainless steel shall be qualified as acceptable according to ASTM C 795.

E. Foam insulation materials shall not use CFC or HCFC blowing agents in the manufacturing process.

F. Mineral-Fiber Blanket Insulation: Mineral or glass fibers bonded with a thermosetting resin. Comply with ASTM C 553, Type II and ASTM C 1290, Type II with factory-applied vinyl jacket. Factory-applied jacket requirements are specified in "Factory-Applied Jackets" Article.

1. Products: Subject to compliance with requirements, provide one of the following:

   a. CertainTeed Corp.; SoftTouch Duct Wrap.
   b. Johns Manville; Microlite.
   c. Knauf Insulation; Friendly Feel Duct Wrap.
   d. Manson Insulation Inc.; Alley Wrap.
   e. Owens Corning; SOFTR All-Service Duct Wrap.

G. Mineral-Fiber Board Insulation: Mineral or glass fibers bonded with a thermosetting resin. Comply with ASTM C 612, Type IA or Type IB. For duct and plenum applications, provide insulation with factory-applied ASJ. Factory-applied jacket requirements are specified in "Factory-Applied Jackets" Article.

1. Products: Subject to compliance with requirements, provide one of the following:

a. CertainTeed Corp.; Commercial Board.
b. Fibrex Insulations Inc.; FBX.
c. Johns Manville; 800 Series Spin-Glas.
d. Knauf Insulation; Insulation Board.
e. Manson Insulation Inc.; AK Board.
f. Owens Corning; Fiberglas 700 Series.

2.2 FIRE-RATED INSULATION SYSTEMS

A. Fire-Rated Blanket: High-temperature, flexible, blanket insulation with FSK jacket that is tested and certified to provide a 2-hour fire rating by an NRTL acceptable to authorities having jurisdiction.

1. Products: Subject to compliance with requirements, provide one of the following:

a. CertainTeed Corp.; FlameChek.
b. Johns Manville; Firetemp Wrap.
c. Nelson Fire Stop Products; Nelson FSB Flameshield Blanket.
d. Thermal Ceramics; FireMaster Duct Wrap.
e. 3M; Fire Barrier Wrap Products.
f. Unifrax Corporation; FyreWrap.

2.3 ADHESIVES

A. Materials shall be compatible with insulation materials, jackets, and substrates and for bonding insulation to itself and to surfaces to be insulated unless otherwise indicated.

B. Mineral-Fiber Adhesive: Comply with MIL-A-3316C, Class 2, Grade A.

1. Products: Subject to compliance with requirements, provide one of the following:

a. Childers Brand, Specialty Construction Brands, Inc., a business of H. B. Fuller Company; CP-127.
b. Eagle Bridges - Marathon Industries; 225.
c. Foster Brand, Specialty Construction Brands, Inc., a business of H. B. Fuller Company; 85-60/85-70.
d. Mon-Eco Industries, Inc.; 22-25.

2. For indoor applications, adhesive shall have a VOC content of 80 g/L or less when calculated according to 40 CFR 59, Subpart D (EPA Method 24).
3. Adhesive shall comply with the testing and product requirements of the California Department of Health Services' "Standard Practice for the Testing of Volatile Organic Emissions from Various Sources Using Small-Scale Environmental Chambers."

C. ASJ Adhesive, and FSK Jacket Adhesive: Comply with MIL-A-3316C, Class 2, Grade A for bonding insulation jacket lap seams and joints.

1. Products: Subject to compliance with requirements, provide one of the following:

   a. Childers Brand, Specialty Construction Brands, Inc., a business of H. B. Fuller Company; CP-82.
   b. Eagle Bridges - Marathon Industries; 225.
   c. Foster Brand, Specialty Construction Brands, Inc., a business of H. B. Fuller Company; 85-50.
   d. Mon-Eco Industries, Inc.; 22-25.

2. For indoor applications, adhesive shall have a VOC content of 50 g/L or less when calculated according to 40 CFR 59, Subpart D (EPA Method 24).
3. Adhesive shall comply with the testing and product requirements of the California Department of Health Services' "Standard Practice for the Testing of Volatile Organic Emissions from Various Sources Using Small-Scale Environmental Chambers."

D. PVC Jacket Adhesive: Compatible with PVC jacket.

1. Products: Subject to compliance with requirements, provide one of the following:

   a. Dow Corning Corporation; 739, Dow Silicone.
   b. Johns Manville; Zeston Perma-Weld, CEEL-TITE Solvent Welding Adhesive.
   c. P.I.C. Plastics, Inc.; Welding Adhesive.
   d. Speedline Corporation; Polyco VP Adhesive.

2. For indoor applications, adhesive shall have a VOC content of 50 g/L or less when calculated according to 40 CFR 59, Subpart D (EPA Method 24).
3. Adhesive shall comply with the testing and product requirements of the California Department of Health Services' "Standard Practice for the Testing of Volatile Organic Emissions from Various Sources Using Small-Scale Environmental Chambers."

## 2.4 MASTICS

A. Materials shall be compatible with insulation materials, jackets, and substrates; comply with MIL-PRF-19565C, Type II.

1. For indoor applications, use mastics that have a VOC content of 50 g/L or less when calculated according to 40 CFR 59, Subpart D (EPA Method 24).

B. Vapor-Barrier Mastic: Water based; suitable for indoor use on below ambient services.

1. Products: Subject to compliance with requirements, provide one of the following:

   a. Foster Brand, Specialty Construction Brands, Inc., a business of H. B. Fuller Company; 30-80/30-90.
   b. Vimasco Corporation; 749.

2. Water-Vapor Permeance: ASTM E 96/E 96M, Procedure B, 0.013 perm at 43-mil dry film thickness.
3. Service Temperature Range: Minus 20 to plus 180 deg F.
4. Solids Content: ASTM D 1644, 58 percent by volume and 70 percent by weight.
5. Color: White.

C. Breather Mastic: Water based; suitable for indoor and outdoor use on above ambient services.

1. Products: Subject to compliance with requirements, provide one of the following:

a. Childers Brand, Specialty Construction Brands, Inc., a business of H. B. Fuller Company; CP-10.
b. Eagle Bridges - Marathon Industries; 550.
c. Foster Brand, Specialty Construction Brands, Inc., a business of H. B. Fuller Company; 46-50.
d. Mon-Eco Industries, Inc.; 55-50.
e. Vimasco Corporation; WC-1/WC-5.

2. Water-Vapor Permeance: ASTM F 1249, 1.8 perms at 0.0625-inch dry film thickness.
3. Service Temperature Range: Minus 20 to plus 180 deg F.
4. Solids Content: 60 percent by volume and 66 percent by weight.
5. Color: White.

## 2.5 SEALANTS

A. FSK and Metal Jacket Flashing Sealants:

1. Products: Subject to compliance with requirements, provide one of the following:

a. Childers Brand, Specialty Construction Brands, Inc., a business of H. B. Fuller Company; CP-76.
b. Eagle Bridges - Marathon Industries; 405.
c. Foster Brand, Specialty Construction Brands, Inc., a business of H. B. Fuller Company; 95-44.
d. Mon-Eco Industries, Inc.; 44-05.

2. Materials shall be compatible with insulation materials, jackets, and substrates.
3. Fire- and water-resistant, flexible, elastomeric sealant.
4. Service Temperature Range: Minus 40 to plus 250 deg F.
5. Color: Aluminum.
6. For indoor applications, use sealants that have a VOC content of 420 g/L or less when calculated according to 40 CFR 59, Subpart D (EPA Method 24).
7. Sealants shall comply with the testing and product requirements of the California Department of Health Services' "Standard Practice for the Testing of Volatile Organic Emissions from Various Sources Using Small-Scale Environmental Chambers."

B. ASJ Flashing Sealants, and Vinyl and PVC Jacket Flashing Sealants:

1. Products: Subject to compliance with requirements, provide the following available products that may be incorporated into the Work include, but are not limited to, the following:

a. Childers Brand, Specialty Construction Brands, Inc., a business of H. B. Fuller Company; CP-76.

2. Materials shall be compatible with insulation materials, jackets, and substrates.
3. Fire- and water-resistant, flexible, elastomeric sealant.
4. Service Temperature Range: Minus 40 to plus 250 deg F.
5. Color: White.
6. For indoor applications, sealants shall have a VOC content of 420 g/L or less when calculated according to 40 CFR 59, Subpart D (EPA Method 24).
7. Sealants shall comply with the testing and product requirements of the California Department of Health Services' "Standard Practice for the Testing of Volatile Organic Emissions from Various Sources Using Small-Scale Environmental Chambers."

## 2.6 FACTORY-APPLIED JACKETS

A. Insulation system schedules indicate factory-applied jackets on various applications. When factory-applied jackets are indicated, comply with the following:

1. ASJ: White, kraft-paper, fiberglass-reinforced scrim with aluminum-foil backing; complying with ASTM C 1136, Type I.
2. ASJ-SSL: ASJ with self-sealing, pressure-sensitive, acrylic-based adhesive covered by a removable protective strip; complying with ASTM C 1136, Type I.
3. FSK Jacket: Aluminum-foil, fiberglass-reinforced scrim with kraft-paper backing; complying with ASTM C 1136, Type II.
4. FSP Jacket: Aluminum-foil, fiberglass-reinforced scrim with polyethylene backing; complying with ASTM C 1136, Type II.
5. Vinyl Jacket: White vinyl with a permeance of 1.3 perms when tested according to ASTM E 96/E 96M, Procedure A, and complying with NFPA 90A and NFPA 90B.

## 2.7 FIELD-APPLIED FABRIC-REINFORCING MESH

A. Woven Polyester Fabric: Approximately 1 oz./sq. yd. with a thread count of 10 strands by 10 strands/sq. in., in a Leno weave, for ducts.

1. Products: Subject to compliance with requirements, provide the following available products that may be incorporated into the Work include, but are not limited to, the following:

a. Foster Brand, Specialty Construction Brands, Inc., a business of H. B. Fuller Company; Mast-A-Fab.

b. Vimasco Corporation; Elastafab 894.

2.8 FIELD-APPLIED JACKETS

A. Field-applied jackets shall comply with ASTM C 921, Type I, unless otherwise indicated.

B. FSK Jacket: Aluminum-foil-face, fiberglass-reinforced scrim with kraft-paper backing.

C. PVC Jacket: High-impact-resistant, UV-resistant PVC complying with ASTM D 1784, Class 16354-C; thickness as scheduled; roll stock ready for shop or field cutting and forming. Thickness is indicated in field-applied jacket schedules.

1. Products: Subject to compliance with requirements, provide one of the following:

a. Johns Manville; Zeston.
b. P.I.C. Plastics, Inc.; FG Series.
c. Proto Corporation; LoSmoke.
d. Speedline Corporation; SmokeSafe.

2. Adhesive: As recommended by jacket material manufacturer.
3. Color: White.

D. Aluminum Jacket: Comply with ASTM B 209, Alloy 3003, 3005, 3105, or 5005, Temper H-14.

1. Products: Subject to compliance with requirements, provide the following available products that may be incorporated into the Work include, but are not limited to, the following:

a. Childers Brand, Specialty Construction Brands, Inc., a business of H. B. Fuller Company; Metal Jacketing Systems.
b. ITW Insulation Systems; Aluminum and Stainless Steel Jacketing.
c. RPR Products, Inc.; Insul-Mate.

2. Sheet and roll stock ready for shop or field sizing.
3. Finish and thickness are indicated in field-applied jacket schedules.
4. Moisture Barrier for Indoor Applications: 3-mil-thick, heat-bonded polyethylene and kraft paper.
5. Moisture Barrier for Outdoor Applications: 3-mil-thick, heat-bonded polyethylene and kraft paper.

E. Self-Adhesive Outdoor Jacket: 60-mil-thick, laminated vapor barrier and waterproofing membrane for installation over insulation located aboveground outdoors; consisting of a rubberized bituminous resin on a crosslaminated polyethylene film covered with white aluminum-foil facing.

1. Products: Subject to compliance with requirements, provide the following available products that may be incorporated into the Work include, but are not limited to, the following:

   a. Polyguard Products, Inc.; Alumaguard 60.

2.9 TAPES

A. ASJ Tape: White vapor-retarder tape matching factory-applied jacket with acrylic adhesive, complying with ASTM C 1136.

1. Products: Subject to compliance with requirements, provide one of the following:

   a. ABI, Ideal Tape Division; 428 AWF ASJ.
   b. Avery Dennison Corporation, Specialty Tapes Division; Fasson 0836.
   c. Compac Corporation; 104 and 105.
   d. Venture Tape; 1540 CW Plus, 1542 CW Plus, and 1542 CW Plus/SQ.

2. Width: 3 inches.
3. Thickness: 11.5 mils.
4. Adhesion: 90 ounces force/inch in width.
5. Elongation: 2 percent.
6. Tensile Strength: 40 lbf/inch in width.
7. ASJ Tape Disks and Squares: Precut disks or squares of ASJ tape.

B. FSK Tape: Foil-face, vapor-retarder tape matching factory-applied jacket with acrylic adhesive; complying with ASTM C 1136.

1. Products: Subject to compliance with requirements, provide one of the following:

   a. ABI, Ideal Tape Division; 491 AWF FSK.
   b. Avery Dennison Corporation, Specialty Tapes Division; Fasson 0827.
   c. Compac Corporation; 110 and 111.
   d. Venture Tape; 1525 CW NT, 1528 CW, and 1528 CW/SQ.

2. Width: 3 inches.
3. Thickness: 6.5 mils.
4. Adhesion: 90 ounces force/inch in width.
5. Elongation: 2 percent.
6. Tensile Strength: 40 lbf/inch in width.
7. FSK Tape Disks and Squares: Precut disks or squares of FSK tape.

C. PVC Tape: White vapor-retarder tape matching field-applied PVC jacket with acrylic adhesive; suitable for indoor and outdoor applications.

1. Products: Subject to compliance with requirements, provide the following available products that may be incorporated into the Work include, but are not limited to, the following:

   a. ABI, Ideal Tape Division; 370 White PVC tape.
   b. Compac Corporation; 130.
   c. Venture Tape; 1506 CW NS.

2. Width: 2 inches.
3. Thickness: 6 mils.
4. Adhesion: 64 ounces force/inch in width.
5. Elongation: 500 percent.
6. Tensile Strength: 18 lbf/inch in width.

D. Aluminum-Foil Tape: Vapor-retarder tape with acrylic adhesive.

1. Products: Subject to compliance with requirements, provide the following available products that may be incorporated into the Work include, but are not limited to, the following:

   a. ABI, Ideal Tape Division; 488 AWF.
   b. Avery Dennison Corporation, Specialty Tapes Division; Fasson 0800.
   c. Compac Corporation; 120.
   d. Venture Tape; 3520 CW.

2. Width: 2 inches.
3. Thickness: 3.7 mils.
4. Adhesion: 100 ounces force/inch in width.
5. Elongation: 5 percent.
6. Tensile Strength: 34 lbf/inch in width.

## 2.10 SECUREMENTS

A. Aluminum Bands: ASTM B 209, Alloy 3003, 3005, 3105, or 5005; Temper H-14, 0.020 inch thick, 1/2 inch wide with wing seal or closed seal.

1. Products: Subject to compliance with requirements, provide the following available products that may be incorporated into the Work include, but are not limited to, the following:

   a. ITW Insulation Systems; Gerrard Strapping and Seals.
   b. RPR Products, Inc.; Insul-Mate Strapping, Seals, and Springs.

B. Insulation Pins and Hangers:

1. Metal, Adhesively Attached, Perforated-Base Insulation Hangers: Baseplate welded to projecting spindle that is capable of holding insulation, of thickness indicated, securely

in position indicated when self-locking washer is in place. Comply with the following requirements:

a. Products: Subject to compliance with requirements, provide the following available products that may be incorporated into the Work include, but are not limited to, the following:

1) AGM Industries, Inc.; Tactoo Perforated Base Insul-Hangers.
2) GEMCO; Perforated Base.
3) Midwest Fasteners, Inc.; Spindle.

b. Baseplate: Perforated, galvanized carbon-steel sheet, 0.030 inch thick by 2 inches square.
c. Spindle: Copper- or zinc-coated, low-carbon steel, fully annealed, 0.106-inch-diameter shank, length to suit depth of insulation indicated.
d. Adhesive: Recommended by hanger manufacturer. Product with demonstrated capability to bond insulation hanger securely to substrates indicated without damaging insulation, hangers, and substrates.

2. Nonmetal, Adhesively Attached, Perforated-Base Insulation Hangers: Baseplate fastened to projecting spindle that is capable of holding insulation, of thickness indicated, securely in position indicated when self-locking washer is in place. Comply with the following requirements:

a. Products: Subject to compliance with requirements, provide the following available products that may be incorporated into the Work include, but are not limited to, the following:

1) GEMCO; Nylon Hangers.
2) Midwest Fasteners, Inc.; Nylon Insulation Hangers.

b. Baseplate: Perforated, nylon sheet, 0.030 inch thick by 1-1/2 inches in diameter.
c. Spindle: Nylon, 0.106-inch-diameter shank, length to suit depth of insulation indicated, up to 2-1/2 inches.
d. Adhesive: Recommended by hanger manufacturer. Product with demonstrated capability to bond insulation hanger securely to substrates indicated without damaging insulation, hangers, and substrates.

3. Self-Sticking-Base Insulation Hangers: Baseplate welded to projecting spindle that is capable of holding insulation, of thickness indicated, securely in position indicated when self-locking washer is in place. Comply with the following requirements:

a. Products: Subject to compliance with requirements, provide the following available products that may be incorporated into the Work include, but are not limited to, the following:

1) AGM Industries, Inc.; Tactoo Self-Adhering Insul-Hangers.
2) GEMCO; Peel & Press.

3) Midwest Fasteners, Inc.; Self Stick.

b. Baseplate: Galvanized carbon-steel sheet, 0.030 inch thick by 2 inches square.
c. Spindle: Copper- or zinc-coated, low-carbon steel, fully annealed, 0.106-inch-diameter shank, length to suit depth of insulation indicated.
d. Adhesive-backed base with a peel-off protective cover.

4. Insulation-Retaining Washers: Self-locking washers formed from 0.016-inch-thick, galvanized-steel sheet, with beveled edge sized as required to hold insulation securely in place but not less than 1-1/2 inches in diameter.

a. Products: Subject to compliance with requirements, provide the following available products that may be incorporated into the Work include, but are not limited to, the following:

1) AGM Industries, Inc.; RC-150.
2) GEMCO; R-150.
3) Midwest Fasteners, Inc.; WA-150.
4) Nelson Stud Welding; Speed Clips.

b. Protect ends with capped self-locking washers incorporating a spring steel insert to ensure permanent retention of cap in exposed locations.

5. Nonmetal Insulation-Retaining Washers: Self-locking washers formed from 0.016-inch-thick nylon sheet, with beveled edge sized as required to hold insulation securely in place but not less than 1-1/2 inches in diameter.

a. Manufacturers: Subject to compliance with requirements, provide products by one of the following available manufacturers offering products that may be incorporated into the Work include, but are not limited to, the following:

1) GEMCO.
2) Midwest Fasteners, Inc.

C. Staples: Outward-clinching insulation staples, nominal 3/4-inch-wide, stainless steel or Monel.

D. Wire: 0.080-inch nickel-copper alloy.

1. Manufacturers: Subject to compliance with requirements, provide products by one of the following available manufacturers offering products that may be incorporated into the Work include, but are not limited to, the following:

a. C & F Wire.

2.11 CORNER ANGLES

A. PVC Corner Angles: 30 mils thick, minimum 1 by 1 inch, PVC according to ASTM D 1784, Class 16354-C. White or color-coded to match adjacent surface.

B. Aluminum Corner Angles: 0.040 inch thick, minimum 1 by 1 inch, aluminum according to ASTM B 209, Alloy 3003, 3005, 3105, or 5005; Temper H-14.

PART 3 - EXECUTION

3.1 PREPARATION

A. Surface Preparation: Clean and dry surfaces to receive insulation. Remove materials that will adversely affect insulation application.

3.2 GENERAL INSTALLATION REQUIREMENTS

A. Install insulation materials, accessories, and finishes with smooth, straight, and even surfaces; free of voids throughout the length of ducts and fittings.

B. Install insulation materials, vapor barriers or retarders, jackets, and thicknesses required for each item of duct system as specified in insulation system schedules.

C. Install accessories compatible with insulation materials and suitable for the service. Install accessories that do not corrode, soften, or otherwise attack insulation or jacket in either wet or dry state.

D. Install insulation with longitudinal seams at top and bottom of horizontal runs.

E. Install multiple layers of insulation with longitudinal and end seams staggered.

F. Keep insulation materials dry during application and finishing.

G. Install insulation with tight longitudinal seams and end joints. Bond seams and joints with adhesive recommended by insulation material manufacturer.

H. Install insulation with least number of joints practical.

I. Where vapor barrier is indicated, seal joints, seams, and penetrations in insulation at hangers, supports, anchors, and other projections with vapor-barrier mastic.

1. Install insulation continuously through hangers and around anchor attachments.
2. For insulation application where vapor barriers are indicated, extend insulation on anchor legs from point of attachment to supported item to point of attachment to structure. Taper and seal ends at attachment to structure with vapor-barrier mastic.

3. Install insert materials and install insulation to tightly join the insert. Seal insulation to insulation inserts with adhesive or sealing compound recommended by insulation material manufacturer.

J. Apply adhesives, mastics, and sealants at manufacturer's recommended coverage rate and wet and dry film thicknesses.

K. Install insulation with factory-applied jackets as follows:

1. Draw jacket tight and smooth.
2. Cover circumferential joints with 3-inch-wide strips, of same material as insulation jacket. Secure strips with adhesive and outward clinching staples along both edges of strip, spaced 4 inches o.c.
3. Overlap jacket longitudinal seams at least 1-1/2 inches. Clean and dry surface to receive self-sealing lap. Staple laps with outward clinching staples along edge at 2 inches o.c.

    a. For below ambient services, apply vapor-barrier mastic over staples.

4. Cover joints and seams with tape, according to insulation material manufacturer's written instructions, to maintain vapor seal.
5. Where vapor barriers are indicated, apply vapor-barrier mastic on seams and joints and at ends adjacent to duct flanges and fittings.

L. Cut insulation in a manner to avoid compressing insulation more than 75 percent of its nominal thickness.

M. Finish installation with systems at operating conditions. Repair joint separations and cracking due to thermal movement.

N. Repair damaged insulation facings by applying same facing material over damaged areas. Extend patches at least 4 inches beyond damaged areas. Adhere, staple, and seal patches similar to butt joints.

## 3.3 PENETRATIONS

A. Insulation Installation at Roof Penetrations: Install insulation continuously through roof penetrations.

1. Seal penetrations with flashing sealant.
2. For applications requiring only indoor insulation, terminate insulation above roof surface and seal with joint sealant. For applications requiring indoor and outdoor insulation, install insulation for outdoor applications tightly joined to indoor insulation ends. Seal joint with joint sealant.
3. Extend jacket of outdoor insulation outside roof flashing at least 2 inches below top of roof flashing.
4. Seal jacket to roof flashing with flashing sealant.

B. Insulation Installation at Aboveground Exterior Wall Penetrations: Install insulation continuously through wall penetrations.

1. Seal penetrations with flashing sealant.
2. For applications requiring only indoor insulation, terminate insulation inside wall surface and seal with joint sealant. For applications requiring indoor and outdoor insulation, install insulation for outdoor applications tightly joined to indoor insulation ends. Seal joint with joint sealant.
3. Extend jacket of outdoor insulation outside wall flashing and overlap wall flashing at least 2 inches.
4. Seal jacket to wall flashing with flashing sealant.

C. Insulation Installation at Interior Wall and Partition Penetrations (That Are Not Fire Rated): Install insulation continuously through walls and partitions.

D. Insulation Installation at Fire-Rated Wall and Partition Penetrations: Terminate insulation at fire damper sleeves for fire-rated wall and partition penetrations. Externally insulate damper sleeves to match adjacent insulation and overlap duct insulation at least 2 inches.

1. Comply with requirements in Section 078413 "Penetration Firestopping" for firestopping and fire-resistive joint sealers.

E. Insulation Installation at Floor Penetrations:

1. Duct: For penetrations through fire-rated assemblies, terminate insulation at fire damper sleeves and externally insulate damper sleeve beyond floor to match adjacent duct insulation. Overlap damper sleeve and duct insulation at least 2 inches.
2. Seal penetrations through fire-rated assemblies. Comply with requirements in Section 078413 "Penetration Firestopping."

3.4 INSTALLATION OF MINERAL-FIBER INSULATION

A. Blanket Insulation Installation on Ducts and Plenums: Secure with adhesive and insulation pins.

1. Apply adhesives according to manufacturer's recommended coverage rates per unit area, for 100 percent coverage of duct and plenum surfaces.
2. Apply adhesive to entire circumference of ducts and to all surfaces of fittings and transitions.
3. Install either capacitor-discharge-weld pins and speed washers or cupped-head, capacitor-discharge-weld pins on sides and bottom of horizontal ducts and sides of vertical ducts as follows:

a. On duct sides with dimensions 18 inches and smaller, place pins along longitudinal centerline of duct. Space 3 inches maximum from insulation end joints, and 16 inches o.c.

b. On duct sides with dimensions larger than 18 inches, place pins 16 inches o.c. each way, and 3 inches maximum from insulation joints. Install additional pins to hold insulation tightly against surface at cross bracing.
c. Pins may be omitted from top surface of horizontal, rectangular ducts and plenums.
d. Do not overcompress insulation during installation.
e. Impale insulation over pins and attach speed washers.
f. Cut excess portion of pins extending beyond speed washers or bend parallel with insulation surface. Cover exposed pins and washers with tape matching insulation facing.

4. For ducts and plenums with surface temperatures below ambient, install a continuous unbroken vapor barrier. Create a facing lap for longitudinal seams and end joints with insulation by removing 2 inches from one edge and one end of insulation segment. Secure laps to adjacent insulation section with 1/2-inch outward-clinching staples, 1 inch o.c. Install vapor barrier consisting of factory- or field-applied jacket, adhesive, vapor-barrier mastic, and sealant at joints, seams, and protrusions.

a. Repair punctures, tears, and penetrations with tape or mastic to maintain vapor-barrier seal.
b. Install vapor stops for ductwork and plenums operating below 50 deg F at 18-foot intervals. Vapor stops shall consist of vapor-barrier mastic applied in a Z-shaped pattern over insulation face, along butt end of insulation, and over the surface. Cover insulation face and surface to be insulated a width equal to two times the insulation thickness, but not less than 3 inches.

5. Overlap unfaced blankets a minimum of 2 inches on longitudinal seams and end joints. At end joints, secure with steel bands spaced a maximum of 18 inches o.c.
6. Install insulation on rectangular duct elbows and transitions with a full insulation section for each surface. Install insulation on round and flat-oval duct elbows with individually mitered gores cut to fit the elbow.
7. Insulate duct stiffeners, hangers, and flanges that protrude beyond insulation surface with 6-inch-wide strips of same material used to insulate duct. Secure on alternating sides of stiffener, hanger, and flange with pins spaced 6 inches o.c.

B. Board Insulation Installation on Ducts and Plenums: Secure with adhesive and insulation pins.

1. Apply adhesives according to manufacturer's recommended coverage rates per unit area, for 100 percent coverage of duct and plenum surfaces.
2. Apply adhesive to entire circumference of ducts and to all surfaces of fittings and transitions.
3. Install either capacitor-discharge-weld pins and speed washers or cupped-head, capacitor-discharge-weld pins on sides and bottom of horizontal ducts and sides of vertical ducts as follows:

a. On duct sides with dimensions 18 inches and smaller, place pins along longitudinal centerline of duct. Space 3 inches maximum from insulation end joints, and 16 inches o.c.
b. On duct sides with dimensions larger than 18 inches, space pins 16 inches o.c. each way, and 3 inches maximum from insulation joints. Install additional pins to hold insulation tightly against surface at cross bracing.
c. Pins may be omitted from top surface of horizontal, rectangular ducts and plenums.
d. Do not overcompress insulation during installation.
e. Cut excess portion of pins extending beyond speed washers or bend parallel with insulation surface. Cover exposed pins and washers with tape matching insulation facing.

4. For ducts and plenums with surface temperatures below ambient, install a continuous unbroken vapor barrier. Create a facing lap for longitudinal seams and end joints with insulation by removing 2 inches from one edge and one end of insulation segment. Secure laps to adjacent insulation section with 1/2-inch outward-clinching staples, 1 inch o.c. Install vapor barrier consisting of factory- or field-applied jacket, adhesive, vapor-barrier mastic, and sealant at joints, seams, and protrusions.

   a. Repair punctures, tears, and penetrations with tape or mastic to maintain vapor-barrier seal.
   b. Install vapor stops for ductwork and plenums operating below 50 deg F at 18-foot intervals. Vapor stops shall consist of vapor-barrier mastic applied in a Z-shaped pattern over insulation face, along butt end of insulation, and over the surface. Cover insulation face and surface to be insulated a width equal to two times the insulation thickness, but not less than 3 inches.

5. Install insulation on rectangular duct elbows and transitions with a full insulation section for each surface. Groove and score insulation to fit as closely as possible to outside and inside radius of elbows. Install insulation on round and flat-oval duct elbows with individually mitered gores cut to fit the elbow.
6. Insulate duct stiffeners, hangers, and flanges that protrude beyond insulation surface with 6-inch-wide strips of same material used to insulate duct. Secure on alternating sides of stiffener, hanger, and flange with pins spaced 6 inches o.c.

3.5 FIELD-APPLIED JACKET INSTALLATION

A. Where FSK jackets are indicated, install as follows:

1. Draw jacket material smooth and tight.
2. Install lap or joint strips with same material as jacket.
3. Secure jacket to insulation with manufacturer's recommended adhesive.
4. Install jacket with 1-1/2-inch laps at longitudinal seams and 3-inch-wide joint strips at end joints.

5. Seal openings, punctures, and breaks in vapor-retarder jackets and exposed insulation with vapor-barrier mastic.

B. Where PVC jackets are indicated, install with 1-inch overlap at longitudinal seams and end joints; for horizontal applications, install with longitudinal seams along top and bottom of tanks and vessels. Seal with manufacturer's recommended adhesive.

1. Apply two continuous beads of adhesive to seams and joints, one bead under lap and the finish bead along seam and joint edge.

C. Where metal jackets are indicated, install with 2-inch overlap at longitudinal seams and end joints. Overlap longitudinal seams arranged to shed water. Seal end joints with weatherproof sealant recommended by insulation manufacturer. Secure jacket with stainless-steel bands 12 inches o.c. and at end joints.

## 3.6 FIRE-RATED INSULATION SYSTEM INSTALLATION

A. Where fire-rated insulation system is indicated, secure system to ducts and duct hangers and supports to maintain a continuous fire rating.

B. Insulate duct access panels and doors to achieve same fire rating as duct.

C. Install firestopping at penetrations through fire-rated assemblies. Fire-stop systems are specified in Section 078413 "Penetration Firestopping."

## 3.7 FINISHES

A. Insulation with ASJ or Other Paintable Jacket Material: Paint jacket with paint system identified below and as specified in Section 099113 "Exterior Painting" and Section 099123 "Interior Painting."

1. Flat Acrylic Finish: Two finish coats over a primer that is compatible with jacket material and finish coat paint. Add fungicidal agent to render fabric mildew proof.

a. Finish Coat Material: Interior, flat, latex-emulsion size.

B. Color: Final color as selected by Architect. Vary first and second coats to allow visual inspection of the completed Work.

C. Do not field paint aluminum or stainless-steel jackets.

## 3.8 FIELD QUALITY CONTROL

A. Perform tests and inspections.

B. Tests and Inspections:

1. Inspect ductwork, randomly selected by Architect, by removing field-applied jacket and insulation in layers in reverse order of their installation. Extent of inspection shall be limited to one location(s) for each duct system defined in the "Duct Insulation Schedule, General" Article.

C. All insulation applications will be considered defective Work if sample inspection reveals noncompliance with requirements.

3.9 DUCT INSULATION SCHEDULE, GENERAL

A. Plenums and Ducts Requiring Insulation:

1. Indoor, concealed supply and outdoor air.
2. Indoor, exposed supply and outdoor air.
3. Indoor, concealed return located in unconditioned space.
4. Indoor, exposed return located in unconditioned space.
5. Indoor, concealed exhaust between isolation damper and penetration of building exterior.
6. Indoor, exposed exhaust between isolation damper and penetration of building exterior.
7. Outdoor, concealed supply and return.
8. Outdoor, exposed supply and return.

B. Items Not Insulated:

1. Fibrous-glass ducts.
2. Metal ducts with duct liner of sufficient thickness to comply with energy code and ASHRAE/IESNA 90.1.
3. Factory-insulated flexible ducts.
4. Factory-insulated plenums and casings.
5. Flexible connectors.
6. Vibration-control devices.
7. Factory-insulated access panels and doors.

3.10 INDOOR DUCT AND PLENUM INSULATION SCHEDULE

A. Concealed, Supply-Air Duct and Plenum Insulation: Mineral-fiber blanket, 2 inches thick and 1.5-lb/cu. ft. nominal density.

B. Concealed, Return-Air Duct and Plenum Insulation: Mineral-fiber blanket, 2 inches thick and 1.5-lb/cu. ft. nominal density.

C. Concealed, Outdoor-Air Duct and Plenum Insulation: Mineral-fiber blanket, 2 inches thick and 1.5-lb/cu. ft. nominal density.

D. Concealed, Exhaust-Air Duct and Plenum Insulation: Mineral-fiber blanket, 2 inches thick and 1.5-lb/cu. ft. nominal density.

E. Concealed, Type I, Commercial, Kitchen Hood Exhaust Duct and Plenum Insulation: Fire-rated blanket or board; thickness as required to achieve 2-hour fire rating.

F. Exposed, Supply-Air Duct and Plenum Insulation: Mineral-fiber board, 2 inches thick and 1.5-lb/cu. ft. nominal density.

G. Exposed, Return-Air Duct and Plenum Insulation: Mineral-fiber board, 2 inches thick and 1.5-lb/cu. ft. nominal density.

H. Exposed, Outdoor-Air Duct and Plenum Insulation: Mineral-fiber board, 2 inches thick and 1.5-lb/cu. ft. nominal density.

I. Exposed, Exhaust-Air Duct and Plenum Insulation: Mineral-fiber board, 2 inches thick and 1.5-lb/cu. ft. nominal density.

3.11 ABOVEGROUND, OUTDOOR DUCT AND PLENUM INSULATION SCHEDULE

A. Insulation materials and thicknesses are identified below. If more than one material is listed for a duct system, selection from materials listed is Contractor's option.

B. Concealed, Supply-Air Duct and Plenum Insulation: Mineral-fiber board, 3 inches thick and 3-lb/cu. ft. nominal density.

C. Concealed, Return-Air Duct and Plenum Insulation: Mineral-fiber board, 3 inches thick and 3-lb/cu. ft. nominal density.

D. Concealed, Outdoor-Air Duct and Plenum Insulation: Mineral-fiber board, 3 inches thick and 3-lb/cu. ft. nominal density.

E. Exposed, Supply-Air Duct and Plenum Insulation: Mineral-fiber board, 3 inches thick and 3-lb/cu. ft. nominal density.

F. Exposed, Return-Air Duct and Plenum Insulation: Mineral-fiber board, 3 inches thick and 3-lb/cu. ft. nominal density.

3.12 INDOOR, FIELD-APPLIED JACKET SCHEDULE

A. Install jacket over insulation material. For insulation with factory-applied jacket, install the field-applied jacket over the factory-applied jacket.

B. If more than one material is listed, selection from materials listed is Contractor's option.

C. Ducts and Plenums, Concealed:

1. None.
2. PVC: 30 mils thick.
3. Aluminum, Smooth: 0.016 inch thick.

D. Ducts and Plenums, Exposed:

1. None.
2. PVC: 30 mils thick.
3. Aluminum, Smooth: 0.016 inch thick.

3.13 OUTDOOR, FIELD-APPLIED JACKET SCHEDULE

A. Install jacket over insulation material. For insulation with factory-applied jacket, install the field-applied jacket over the factory-applied jacket.

B. If more than one material is listed, selection from materials listed is Contractor's option.

C. Ducts and Plenums, Concealed:

1. None.
2. PVC: 30 mils thick.
3. Aluminum, Smooth: 0.016 inch thick.

D. Ducts and Plenums, Exposed, up to 48 Inches in Diameter or with Flat Surfaces up to 72 Inches:

1. Aluminum, Smooth: 0.016 inch thick.

E. Ducts and Plenums, Exposed, Larger Than 48 Inches in Diameter or with Flat Surfaces Larger Than 72 Inches:

1. Painted Aluminum, Smooth with 1-1/4-Inch-Deep Corrugations: 0.040 inch thick.

END OF SECTION 230713

# SECTION 230923.12 - CONTROL DAMPERS

## PART 1 - GENERAL

### 1.1 SUMMARY

A. Section includes control dampers and actuators.

### 1.2 ACTION SUBMITTALS

A. Product Data: For each type of product.

B. Shop Drawings: Include diagrams for power, signal, and control wiring.

C. Delegated-Design Submittal:

1. Schedule and design calculations for control dampers and actuators, including the following.

a. Flow at project design and minimum flow conditions.
b. Face velocity at project design and minimum airflow conditions.
c. Pressure drop across damper at project design and minimum airflow conditions.
d. AMCA 500D damper installation arrangement used to calculate and schedule pressure drop, as applicable to installation.
e. Maximum close-off pressure.
f. Leakage airflow at maximum system pressure differential (fan close-off pressure).
g. Torque required at worst case condition for sizing actuator.
h. Actuator selection indicating torque provided.

### 1.3 CLOSEOUT SUBMITTALS

A. Operation and maintenance data.

## PART 2 - PRODUCTS

### 2.1 PERFORMANCE REQUIREMENTS

A. Electrical Components, Devices, and Accessories: Listed and labeled as defined in NFPA 70, by a qualified testing agency, and marked for intended location and application.

B. Delegated Design: Engage a qualified professional engineer, as defined in Section 014000 "Quality Requirements," to size products where indicated as delegated design.

C. Ground Fault: Products shall not fail due to ground fault condition when suitably grounded.

D. Selection Criteria:

1. Control dampers shall be suitable for operation at following conditions:

a. Supply Air: 1.5”W.G.
b. Return Air: 1.5”W.G..
c. Outdoor Air: 1.5”W.G..
d. Mixed Air: 1.5”W.G..
e. Exhaust Air: 1.5”W.G..

2. Fail positions unless otherwise indicated:

a. Supply Air: Open.
b. Return Air: Open.
c. Outdoor Air: Close.
d. Mixed Air: Close.
e. Exhaust Air: Close.

3. Select modulating dampers for a pressure drop of 2 percent of fan total static pressure unless otherwise indicated.

## 2.2 RECTANGULAR CONTROL DAMPERS

A. General Requirements:

1. Unless otherwise indicated, use parallel blade configuration for two-position control, equipment isolation service, and when mixing two airstreams. For other applications, use opposed blade configuration.
2. Factory assemble multiple damper sections to provide a single damper assembly of size required by the application.

B. Rectangular Dampers with Aluminum Airfoil Blades:

1. 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. Greenheck.

2. Performance:

a. Leakage: AMCA 511, Class 1A. Leakage shall not exceed 3 cfm/sq. ft. against 1-in. wg differential static pressure.
b. Pressure Drop: 0.05-in. wg at 1500 fpm across a 24-by-24-inch damper when tested according to AMCA 500-D, figure 5.3.

c. Velocity: Up to 6000 fpm.
d. Temperature: Minus 40 to plus 185 deg F.
e. Pressure Rating: Damper close-off pressure equal to fan shutoff pressure with a maximum blade deflection of 1/200 of blade length.
f. Damper shall have AMCA seal for both air leakage and air performance.

3. Construction:

a. Frame:

1) Material: ASTM B 211, Alloy 6063 T5 extruded-aluminum profiles,0.07 inch thick.
2) Hat-shaped channel with integral flange(s). Mating face shall be a minimum of 1 inch.
3) Width not less than 5 inches.

b. Blades:

1) Hollow, airfoil, extruded aluminum.
2) Parallel or opposed blade configuration as required by application.
3) Material: ASTM B 211, Alloy 6063 T5 aluminum, 0.07 inch thick.
4) Width not to exceed 6 inches.
5) Length as required by close-off pressure, not to exceed 48 inches.

c. Seals:

1) Blades: Replaceable, mechanically attached extruded silicone, vinyl, or plastic composite.
2) Jambs: Stainless steel, compression type.

d. Axles: 0.5-inch-diameter plated or stainless steel, mechanically attached to blades.
e. Bearings:

1) Molded synthetic or stainless-steel sleeve mounted in frame.
2) Where blade axles are installed in vertical position, provide thrust bearings.

f. Linkage:

1) Concealed in frame.
2) Constructed of aluminum and plated or stainless steel.
3) Hardware: Stainless steel.

g. Transition:

1) For round and flat oval duct applications, provide damper assembly with integral transitions to mate to adjoining field connection.

2) Factory mount damper in a sleeve with a close transition to mate to field connection.
3) Damper size and sleeve shall be connection size plus 2 inches.
4) Sleeve length shall be not less than 12 inches for dampers without jackshafts and shall be not less than 16 inches for dampers with jackshafts.
5) Sleeve material shall match adjacent duct.

h. Additional Corrosion Protection for Corrosive Environments:

1) Provide anodized finish for aluminum surfaces in contact with airstream. Anodized finish shall be a minimum of 0.0007 inch thick.
2) Axles, damper linkage, and hardware shall be constructed of Type 316L stainless steel.

4. Airflow Measurement:

a. 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:

1) Trane

2) Automated Logic.

b. Where indicated, provide damper assembly with integral airflow monitoring.
c. Accuracy shall be within 5 percent of the actual flow rate between the range of minimum and design airflow. For applications with a large variation in range between the minimum and design airflow, configure the damper sections and flow measurement assembly as required to comply with the stated accuracy over the entire modulating range.
d. Provide a straightening device as part of the flow measurement assembly to achieve the specified accuracy with configuration indicated.
e. Suitable for operation in untreated and unfiltered air.
f. Provide temperature and altitude compensation and correction to maintain accuracy over temperature range encountered at site altitude.
g. Provide automatic zeroing feature.

5. Airflow Control:

a. 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:

1) Trane.

2) Automated Logic.

b. Where indicated, provide damper assembly with integral airflow measurement and control.
c. A factory-furnished and -calibrated controller shall be programmed, in nonvolatile EPROM, with application-specific airflow set point and range.
d. The controller and actuator shall communicate to control the desired airflow.
e. The controller shall receive a zero- to 10-V dc input signal and report a zero- to 20-mA output signal that is proportional to the airflow.
f. Airflow measurement and control range shall be suitable for operation between 150 to 2000 fpm.
g. Ambient Operating Temperature Range: Minus 40 to plus 140 deg F.
h. Ambient Operating Humidity Range: 5 to 95 percent relative humidity, non-condensing.
i. Provide unit with control transformer rated for not less than 85 VA. Provide transformer with primary and secondary protection and primary disconnecting means. Coordinate requirements with field power connection.
j. Provide screw terminals for interface to field wiring.
k. Factory mount electronics within a NEMA 250, Type 1 painted steel enclosure.

C. Rectangular Dampers with Steel Airfoil Blades:

1. 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. Greenheck.

b. Ruskin.

2. Performance:

a. Leakage: AMCA 511, Class 1A. Leakage shall not exceed 3 cfm/sq. ft. against 1-in. wg differential static pressure.
b. Pressure Drop: 0.06-in. wg at 1500 fpm across a 24-by-24-inch damper when tested according to AMCA 500-D, figure 5.3.
c. Velocity: Up to 6000 fpm.
d. Temperature: Minus 40 to plus 185 deg F.
e. Pressure Rating: Damper close-off pressure equal to fan shutoff pressure with a maximum blade deflection of 1/200 of blade length.
f. Damper shall have AMCA seal for both air leakage and air performance.

3. Construction:

a. Frame:

1) Material: ASTM A 653/A 653M galvanized-steel profiles, 0.06 inch thick.
2) Hat-shaped channel with integral flanges. Mating face shall be a minimum of 1 inch.
3) Width not less than 5 inches.

b. Blades:

1) Hollow, airfoil, galvanized steel.
2) Parallel or opposed blade configuration as required by application.
3) Material: ASTM A 653/A 653M galvanized steel, 0.05 inch thick.
4) Width not to exceed 6 inches.
5) Length as required by close-off pressure, not to exceed 48 inches.

c. Seals:

1) Blades: Replaceable, mechanically attached extruded silicone, vinyl, or plastic composite.
2) Jambs: Stainless steel, compression type.

d. Axles: 0.5-inch-diameter plated or stainless steel, mechanically attached to blades.

e. Bearings:

1) Stainless steel mounted in frame.
2) Where blade axles are installed in vertical position, provide thrust bearings.

f. Linkage:

1) Concealed in frame.
2) Constructed of aluminum and plated or stainless steel.
3) Hardware: Stainless steel.

g. Transition:

1) For round and flat oval duct applications, provide damper assembly with integral transitions to mate to adjoining field connection.
2) Factory mount damper in a sleeve with a close transition to mate to field connection.
3) Damper size and sleeve shall be connection size plus 2 inches.
4) Sleeve length shall be not less than 12 inches for dampers without jackshafts and shall be not less than 16 inches for dampers with jackshafts.
5) Sleeve material shall match adjacent duct.

h. Additional Corrosion Protection for Corrosive Environments:

1) Provide epoxy finish for surfaces in contact with airstream.
2) Axles, damper linkage, and hardware shall be constructed of Type 316L stainless steel.

D. Rectangular Dampers with Aluminum Flat Blades:

1. 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. Greenheck.

    b. Ruskin.

2. Performance:

    a. Leakage: Leakage shall not exceed 3.2 cfm/sq. ft. against 1-in. wg differential static pressure.
    b. Pressure Drop: 0.07-in. wg at 1500 fpm across a 24-by-24-inch damper when tested according to AMCA 500-D, figure 5.3.
    c. Velocity: Up to 2000 fpm.
    d. Temperature: Minus 50 to plus 250 deg F.
    e. Pressure Rating: Damper close-off pressure equal to fan shutoff pressure with a maximum blade deflection of 1/200 of blade length, not to exceed 3-in. wg.
    f. Damper shall have AMCA seal for both air leakage and air performance.

3. Construction:

    a. Frame:

        1) Material: ASTM B 211, Alloy 6063 T5 extruded-aluminum profiles,0.12 inch thick.
        2) Hat-shaped channel with integral flanges.
        3) Width not less than 5 inches.

    b. Blades:

        1) Flat blades of extruded aluminum.
        2) Parallel or opposed blade configuration as required by application.
        3) Material: ASTM B 211, Alloy 6063 T5 extruded-aluminum profiles,0.12 inch thick.
        4) Width not to exceed 6 inches.
        5) Length as required by close-off pressure, not to exceed 48 inches.

    c. Seals:

        1) Blades: Replaceable, mechanically attached extruded silicone, vinyl or plastic composite.
        2) Jambs: Stainless steel, compression type.

    d. Axles: 0.5-inch-diameter plated or stainless steel, mechanically attached to blades.
    e. Bearings:

1) Molded-synthetic sleeve, mounted in frame.
2) Where blade axles are installed in vertical position, provide thrust bearings.

f. Linkage:

1) Concealed in frame.
2) Constructed of plated or stainless steel.
3) Hardware: Stainless steel.

g. Transition:

1) For round and flat oval duct applications, provide damper assembly with integral transitions to mate to adjoining field connection.
2) Factory mount damper in a sleeve with a close transition to mate to field connection.
3) Damper size and sleeve shall be connection size plus 2 inches.
4) Sleeve length shall be not less than 12 inches for dampers without jackshafts and shall be not less than 16 inches for dampers with jackshafts.
5) Sleeve material shall match adjacent duct.

h. Additional Corrosion Protection for Corrosive Environments:

1) Provide anodized finish for aluminum surfaces in contact with airstream. Anodized finish shall be a minimum of 0.0007 inch thick.
2) Axles, damper linkage, and hardware shall be constructed of Type 316L stainless steel.

E. Rectangular Dampers with Steel Flat Blades:

1. 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. Greenheck.

b. Ruskin.

2. Performance:

a. Leakage: Leakage shall not exceed 4.8 cfm/sq. ft. against 1-in. wg differential static pressure.
b. Pressure Drop: 0.1-in. wg at 1500 fpm across a 24-by-24-inch damper when tested according to AMCA 500-D, figure 5.3.
c. Velocity: Up to 1500 fpm.
d. Temperature: Minus 25 to plus 180 deg F.
e. Pressure Rating: Damper close-off pressure equal to fan shutoff pressure with a maximum blade deflection of 1/200 of blade length, not to exceed 4-in. wg.
f. Damper shall have AMCA seal for both air leakage and air performance.

3. Construction:

a. Frame:

1) Material: Galvanized or stainless steel,0.06 inch thick.
2) Hat-shaped channel with integral flanges.
3) Width not less than 5 inches.

b. Blades:

1) Flat blades with multiple grooves positioned axially for reinforcement.
2) Parallel or opposed blade configuration as required by application.
3) Material: Galvanized or stainless steel, 0.06 inch thick.
4) Width not to exceed 6 inches.
5) Length as required by close-off pressure, not to exceed 48 inches.

c. Seals:

1) Blades: Replaceable, mechanically attached, PVC-coated polyester.
2) Jambs: Stainless steel, compression type.

d. Axles: 0.5-inch-diameter plated or stainless steel, mechanically attached to blades.

e. Bearings:

1) Molded-synthetic sleeve, mounted in frame.
2) Where blade axles are installed in vertical position, provide thrust bearings.

f. Linkage:

1) Concealed in frame.
2) Constructed of plated or stainless steel.
3) Hardware: Stainless steel.

2.3 GENERAL CONTROL-DAMPER ACTUATORS REQUIREMENTS

A. Actuators shall operate related damper(s) with sufficient reserve power to provide smooth modulating action or two-position action and proper speed of response at velocity and pressure conditions to which the damper is subjected.

B. Actuators shall produce sufficient power and torque to close off against the maximum system pressures encountered. Actuators shall be sized to close off against the fan shutoff pressure as a minimum requirement.

C. The total damper area operated by an actuator shall not exceed 80 percent of manufacturer's maximum area rating.

D. Provide one actuator for each damper assembly where possible. Multiple actuators required to drive a single damper assembly shall operate in unison.

E. Avoid the use of excessively oversized actuators which could overdrive and cause linkage failure when the damper blade has reached either its full open or closed position.

F. Use jackshafts and shaft couplings in lieu of blade-to-blade linkages when driving axially aligned damper sections.

G. Provide mounting hardware and linkages for connecting actuator to damper.

H. Select actuators to fail in desired position in the event of a power failure.

I. Actuator Fail Positions: As indicated below:

1. Exhaust Air: Close.
2. Outdoor Air: Close.
3. Supply Air: Open.
4. Return Air: Open.

2.4 ELECTRIC AND ELECTRONIC ACTUATORS

A. Type: Motor operated, with or without gears, electric and electronic.

B. Voltage:

1. Actuator shall deliver torque required for continuous uniform movement of controlled device from limit to limit when operated at rated voltage.
2. Actuator shall function properly within a range of 85 to 120 percent of nameplate voltage.

C. Construction:

1. Less Than 100 W: Fiber or reinforced nylon gears with steel shaft, copper alloy or nylon bearings, and pressed steel enclosures.
2. 100 up to 400 W: Gears ground steel, oil immersed, shaft-hardened steel running in bronze, copper alloy, or ball bearings. Operator and gear trains shall be totally enclosed in dustproof cast-iron, cast-steel, or cast-aluminum housing.
3. Greater Than 400 W: Totally enclosed reversible induction motors with auxiliary hand crank and permanently lubricated bearings.

D. Field Adjustment:

1. Spring return actuators shall be easily switchable from fail open to fail closed in the field without replacement.
2. Provide gear-type actuators with an external manual adjustment mechanism to allow manual positioning of the damper when the actuator is not powered.

E. Two-Position Actuators: Single direction, spring return or reversing type.

F. Modulating Actuators:

1. Capable of stopping at all points across full range, and starting in either direction from any point in range.
2. Control Input Signal:

a. Three Point, Tristate, or Floating Point: Clockwise and counter-clockwise inputs. One input drives actuator to open position, and other input drives actuator to close position. No signal of either input remains in last position.
b. Proportional: Actuator drives proportional to input signal and modulates throughout its angle of rotation. Suitable for zero- to 10- or 2- to 10-V dc and 4- to 20-mA signals.
c. Pulse Width Modulation (PWM): Actuator drives to a specified position according to a pulse duration (length) of signal from a dry-contact closure, triac sink or source controller.
d. Programmable Multi-Function:

1) Control input, position feedback, and running time shall be factory or field programmable.
2) Diagnostic feedback of hunting or oscillation, mechanical overload, mechanical travel, and mechanical load limit.
3) Service data, including at a minimum, number of hours powered and number of hours in motion.

G. Position Feedback:

1. Equip two-position actuators with limits switches or other positive means of a position indication signal for remote monitoring of open and close position.
2. Equip modulating actuators with a position feedback through current or voltage signal for remote monitoring.
3. Provide a position indicator and graduated scale on each actuator indicating open and closed travel limits.

H. Fail-Safe:

1. Where indicated, provide actuator to fail to an end position.
2. Internal spring return mechanism to drive controlled device to an end position (open or close) on loss of power.
3. Batteries, capacitors, and other non-mechanical forms of fail-safe operation are acceptable only where uniquely indicated.

I. Integral Overload Protection:

1. Provide against overload throughout the entire operating range in both directions.
2. Electronic overload, digital rotation sensing circuitry, mechanical end switches, or magnetic clutches are acceptable methods of protection.

J. Damper Attachment:

1. Unless otherwise required for damper interface, provide actuator designed to be directly coupled to damper shaft without need for connecting linkages.
2. Attach actuator to damper drive shaft in a way that ensures maximum transfer of power and torque without slippage.
3. Bolt and set screw method of attachment is acceptable only if provided with at least two points of attachment.

K. Temperature and Humidity:

1. Temperature: Suitable for operating temperature range encountered by application with minimum operating temperature range of minus 20 to plus 120 deg F.
2. Humidity: Suitable for humidity range encountered by application; minimum operating range shall be from 5 to 95 percent relative humidity, non-condensing.

L. Enclosure:

1. Suitable for ambient conditions encountered by application.
2. NEMA 250, Type 2 for indoor and protected applications.
3. NEMA 250, Type 4 or Type 4X for outdoor and unprotected applications.
4. Provide actuator enclosure with a heater and controller where required by application.

M. Stroke Time:

1. Operate damper from fully closed to fully open within 60 seconds.
2. Operate damper from fully open to fully closed within 60 seconds.
3. Move damper to failed position within 5 seconds.
4. Select operating speed to be compatible with equipment and system operation.
5. Actuators operating in smoke control systems comply with governing code and NFPA requirements.

N. Sound:

1. Spring Return: 62 dBA.
2. Non-Spring Return: 45 dBA.

## PART 3 - EXECUTION

### 3.1 INSTALLATION, GENERAL

A. Furnish and install products required to satisfy most stringent requirements indicated.

B. Properly support dampers and actuators, tubing, wiring, and conduit to comply with requirements indicated. Brace all products to prevent lateral movement and sway or a break in attachment.

C. Provide ceiling, floor, roof, and wall openings and sleeves required by installation. Before proceeding with drilling, punching, or cutting, check location first for concealed products that could potentially be damaged. Patch, flash, grout, seal, and refinish openings to match adjacent condition.

D. Seal penetrations made in fire-rated and acoustically rated assemblies.

E. Fastening Hardware:

1. Stillson wrenches, pliers, or other tools that will cause injury to or mar surfaces of rods, nuts, and other parts are prohibited for assembling and tightening nuts.
2. Tighten bolts and nuts firmly and uniformly. Do not overstress threads by excessive force or by oversized wrenches.
3. Lubricate threads of bolts, nuts, and screws with graphite and oil before assembly.

F. Install products in locations that are accessible and that will permit calibration and maintenance from floor, equipment platforms, or catwalks. Where ladders are required for Owner's access, confirm unrestricted ladder placement is possible under occupied condition.

G. Corrosive Environments:

1. Use products that are suitable for environment to which they will be subjected.
2. If possible, avoid or limit use of materials in corrosive environments, including, but not limited to, the following:

    a. Laboratory exhaust airstreams.
    b. Process exhaust airstreams.

3. Use Type 316 stainless-steel tubing and fittings when in contact with a corrosive environment.
4. When conduit is in contact with a corrosive environment, use Type 316 stainless-steel conduit and fittings or conduit and fittings that are coated with a corrosive-resistant coating that is suitable for environment.
5. Where actuators are located in a corrosive environment and are not corrosive resistant from manufacturer, field install products in a NEMA 250, Type 4X enclosure constructed of Type 316L stainless steel.

## 3.2 ELECTRIC POWER

A. Furnish and install electrical power to products requiring electrical connections.

B. Furnish and install circuit breakers. Comply with requirements in Section 262816 "Enclosed Switches and Circuit Breakers."

C. Furnish and install power wiring. Comply with requirements in Section 260519 "Low-Voltage Electrical Power Conductors and Cables."

D. Furnish and install raceways. Comply with requirements in Section 260533 "Raceways and Boxes for Electrical Systems."

3.3 CONTROL DAMPERS

A. Install smooth transitions, not exceeding 15 degrees, to dampers smaller than adjacent duct. Install transitions as close to damper as possible but at distance to avoid interference and impact to performance. Consult manufacturer for recommended clearance.

B. Clearance:

1. Locate dampers for easy access and provide separate support of dampers that cannot be handled by service personnel without hoisting mechanism.
2. Install dampers with at least 24 inches of clear space on sides of dampers requiring service access.

C. Service Access:

1. Dampers and actuators shall be accessible for visual inspection and service.
2. Install access door(s) in duct or equipment located upstream of damper to allow service personnel to hand clean any portion of damper, linkage, and actuator. Comply with requirements in Section 233300 "Air Duct Accessories."

D. Install dampers straight and true, level in all planes, and square in all dimensions. Install supplementary structural steel reinforcement for large multiple-section dampers if factory support alone cannot handle loading.

E. Attach actuator(s) to damper drive shaft.

F. For duct-mounted and equipment-mounted dampers installed outside of equipment, install a visible and accessible indication of damper position from outside.

G. Connect electrical devices and components to electrical grounding system. Comply with requirements in Section 260526 "Grounding and Bonding for Electrical Systems."

H. Identify system components, wiring, cabling, and terminals. Each piece of wire, cable, and tubing shall have the same designation at each end for operators to determine continuity at points of connection. Comply with requirements for identification specified in Section 260553 "Identification for Electrical Systems."Section 16075 "Electrical Identification."

I. Install engraved phenolic nameplate with damper identification on damper and on face of ceiling where damper is concealed above ceiling.

3.4 CHECKOUT PROCEDURES

A. Control-Damper Checkout:

1. Check installed products before continuity tests, leak tests, and calibration.
2. Check dampers for proper location and accessibility.
3. Verify that control dampers are installed correctly for flow direction.
4. Verify that proper blade alignment, either parallel or opposed, has been provided.
5. Verify that damper frame attachment is properly secured and sealed.
6. Verify that damper actuator and linkage attachment are secure.
7. Verify that actuator wiring is complete, enclosed, and connected to correct power source.
8. Verify that damper blade travel is unobstructed.

3.5 ADJUSTMENT, CALIBRATION, AND TESTING:

A. Stroke and adjust control dampers following manufacturer's recommended procedure, from 100 percent open to 100 percent closed back to 100 percent open.

B. Check and document open and close cycle times for applications with a cycle time of less than 30 seconds.

C. For control dampers equipped with positive position indication, check feedback signal at multiple positions to confirm proper position indication.

END OF SECTION 230923.12

SECTION 232300 - REFRIGERANT PIPING

PART 1 - GENERAL

1.1 SUMMARY

A. This Section includes refrigerant piping used for air-conditioning applications.

1.2 PERFORMANCE REQUIREMENTS

A. Line Test Pressure for Refrigerant R-22:

1. Suction Lines for Air-Conditioning Applications: 185 psig.
2. Suction Lines for Heat-Pump Applications: 325 psig.
3. Hot-Gas and Liquid Lines: 325 psig.

1.3 ACTION SUBMITTALS

A. Product Data: For each type of valve and refrigerant piping specialty indicated. Include pressure drop based on manufacturer's test data.

B. Shop Drawings: Show layout of refrigerant piping and specialties, including pipe, tube, and fitting sizes, flow capacities, valve arrangements and locations, slopes of horizontal runs, oil traps, double risers, wall and floor penetrations, and equipment connection details. Show interface and spatial relationships between piping and equipment.

1. Refrigerant piping indicated on Drawings is schematic only. Size piping and design actual piping layout, including oil traps, double risers, specialties, and pipe and tube sizes to accommodate, as a minimum, equipment provided, elevation difference between compressor and evaporator, and length of piping to ensure proper operation and compliance with warranties of connected equipment.

1.4 INFORMATIONAL SUBMITTALS

A. Field quality-control test reports.

1.5 CLOSEOUT SUBMITTALS

A. Operation and maintenance data.

1.6 QUALITY ASSURANCE

A. Comply with ASHRAE 15, "Safety Code for Refrigeration Systems."

B. Comply with ASME B31.5, "Refrigeration Piping and Heat Transfer Components."

1.7 PRODUCT STORAGE AND HANDLING

A. Store piping in a clean and protected area with end caps in place to ensure that piping interior and exterior are clean when installed.

PART 2 - PRODUCTS

2.1 COPPER TUBE AND FITTINGS

A. Copper Tube: ASTM B 280, Type ACR.

B. Wrought-Copper Fittings: ASME B16.22.

C. Wrought-Copper Unions: ASME B16.22.

D. Solder Filler Metals: ASTM B 32. Use 95-5 tin antimony or alloy HB solder to join copper socket fittings on copper pipe.

E. Brazing Filler Metals: AWS A5.8.

F. Flexible Connectors:

1. Body: Tin-bronze bellows with woven, flexible, tinned-bronze-wire-reinforced protective jacket.
2. End Connections: Socket ends.
3. Offset Performance: Capable of minimum 3/4-inch misalignment in minimum 7-inch-long assembly.
4. Pressure Rating: Factory test at minimum 500 psig.
5. Maximum Operating Temperature: 250 deg F.

2.2 VALVES AND SPECIALTIES

A. Diaphragm Packless Valves:

1. Body and Bonnet: Forged brass or cast bronze; globe design with straight-through or angle pattern.
2. Diaphragm: Phosphor bronze and stainless steel with stainless-steel spring.
3. Operator: Rising stem and hand wheel.
4. Seat: Nylon.

5. End Connections: Socket, union, or flanged.
6. Working Pressure Rating: 500 psig.
7. Maximum Operating Temperature: 275 deg F.

B. Packed-Angle Valves:

1. Body and Bonnet: Forged brass or cast bronze.
2. Packing: Molded stem, back seating, and replaceable under pressure.
3. Operator: Rising stem.
4. Seat: Nonrotating, self-aligning polytetrafluoroethylene.
5. Seal Cap: Forged-brass or valox hex cap.
6. End Connections: Socket, union, threaded, or flanged.
7. Working Pressure Rating: 500 psig.
8. Maximum Operating Temperature: 275 deg F.

C. Check Valves:

1. Body: Ductile iron, forged brass, or cast bronze; globe pattern.
2. Bonnet: Bolted ductile iron, forged brass, or cast bronze; or brass hex plug.
3. Piston: Removable polytetrafluoroethylene seat.
4. Closing Spring: Stainless steel.
5. Manual Opening Stem: Seal cap, plated-steel stem, and graphite seal.
6. End Connections: Socket, union, threaded, or flanged.
7. Maximum Opening Pressure: 0.50 psig.
8. Working Pressure Rating: 500 psig.
9. Maximum Operating Temperature: 275 deg F.

D. Service Valves:

1. Body: Forged brass with brass cap including key end to remove core.
2. Core: Removable ball-type check valve with stainless-steel spring.
3. Seat: Polytetrafluoroethylene.
4. End Connections: Copper spring.
5. Working Pressure Rating: 500 psig.

E. Solenoid Valves: Comply with ARI 760 and UL 429; listed and labeled by an NRTL.

1. Body and Bonnet: Plated steel.
2. Solenoid Tube, Plunger, Closing Spring, and Seat Orifice: Stainless steel.
3. Seat: Polytetrafluoroethylene.
4. End Connections: Threaded.
5. Electrical: Molded, watertight coil in NEMA 250 enclosure of type required by location with 1/2-inch conduit adapter, and 24-V ac coil.
6. Working Pressure Rating: 400 psig.
7. Maximum Operating Temperature: 240 deg F.
8. Manual operator.

F. Safety Relief Valves: Comply with ASME Boiler and Pressure Vessel Code; listed and labeled by an NRTL.

1. Body and Bonnet: Ductile iron and steel, with neoprene O-ring seal.
2. Piston, Closing Spring, and Seat Insert: Stainless steel.
3. Seat Disc: Polytetrafluoroethylene.
4. End Connections: Threaded.
5. Working Pressure Rating: 400 psig.
6. Maximum Operating Temperature: 240 deg F.

G. Thermostatic Expansion Valves: Comply with ARI 750.

1. Body, Bonnet, and Seal Cap: Forged brass or steel.
2. Diaphragm, Piston, Closing Spring, and Seat Insert: Stainless steel.
3. Packing and Gaskets: Non-asbestos.
4. Capillary and Bulb: Copper tubing filled with refrigerant charge.
5. Suction Temperature: 40 deg F.
6. Superheat: Adjustable.
7. Reverse-flow option (for heat-pump applications).
8. End Connections: Socket, flare, or threaded union.
9. Working Pressure Rating: 700 psig.

H. Straight-Type Strainers:

1. Body: Welded steel with corrosion-resistant coating.
2. Screen: 100-mesh stainless steel.
3. End Connections: Socket or flare.
4. Working Pressure Rating: 500 psig.
5. Maximum Operating Temperature: 275 deg F.

I. Angle-Type Strainers:

1. Body: Forged brass or cast bronze.
2. Drain Plug: Brass hex plug.
3. Screen: 100-mesh monel.
4. End Connections: Socket or flare.
5. Working Pressure Rating: 500 psig.
6. Maximum Operating Temperature: 275 deg F.

J. Moisture/Liquid Indicators:

1. Body: Forged brass.
2. Window: Replaceable, clear, fused glass window with indicating element protected by filter screen.
3. Indicator: Color coded to show moisture content in ppm.
4. Minimum Moisture Indicator Sensitivity: Indicate moisture above 60 ppm.
5. End Connections: Socket or flare.
6. Working Pressure Rating: 500 psig.

7. Maximum Operating Temperature: 240 deg F.

K. Replaceable-Core Filter Dryers: Comply with ARI 730.

1. Body and Cover: Painted-steel shell with ductile-iron cover, stainless-steel screws, and neoprene gaskets.
2. Filter Media: 10 micron, pleated with integral end rings; stainless-steel support.
3. Desiccant Media: Activated alumina.
4. Designed for reverse flow (for heat-pump applications).
5. End Connections: Socket.
6. Access Ports: NPS 1/4 connections at entering and leaving sides for pressure differential measurement.
7. Maximum Pressure Loss: 2 psig.
8. Working Pressure Rating: 500 psig.
9. Maximum Operating Temperature: 240 deg F.

L. Permanent Filter Dryers: Comply with ARI 730.

1. Body and Cover: Painted-steel shell.
2. Filter Media: 10 micron, pleated with integral end rings; stainless-steel support.
3. Desiccant Media: Activated alumina.
4. Designed for reverse flow (for heat-pump applications).
5. End Connections: Socket.
6. Access Ports: NPS 1/4 connections at entering and leaving sides for pressure differential measurement.
7. Maximum Pressure Loss: 2 psig.
8. Working Pressure Rating: 500 psig.
9. Maximum Operating Temperature: 240 deg F.

M. Liquid Accumulators: Comply with ARI 495.

1. Body: Welded steel with corrosion-resistant coating.
2. End Connections: Socket or threaded.
3. Working Pressure Rating: 500 psig.
4. Maximum Operating Temperature: 275 deg F.

## 2.3 REFRIGERANTS

A. Available Manufacturers: Subject to compliance with requirements, manufacturers offering products that may be incorporated into the Work include, but are not limited to, the following:

B. Manufacturers: Subject to compliance with requirements, provide products by one of the following:

1. Atofina Chemicals, Inc.
2. DuPont Company; Fluorochemicals Div.
3. Honeywell, Inc.; Genetron Refrigerants.

4. INEOS Fluor Americas LLC.

PART 3 - EXECUTION

3.1 PIPING APPLICATIONS

A. Suction Lines NPS 1-1/2 and Smaller for Conventional Air-Conditioning Applications: Copper, Type ACR, annealed-temper tubing and wrought-copper fittings with brazed or soldered joints.

B. Suction Lines NPS 4 and Smaller for Conventional Air-Conditioning Applications: Copper, Type ACR, drawn-temper tubing and wrought-copper fittings with brazed or soldered joints.

C. Hot-Gas and Liquid Lines, and Suction Lines for Heat-Pump Applications: Copper, Type ACR, annealed-temper tubing and wrought-copper fittings with brazed or soldered joints.

D. Hot-Gas and Liquid Lines, and Suction Lines for Heat-Pump Applications: Copper, Type ACR, drawn-temper tubing and wrought-copper fittings with soldered joints.

E. Hot-Gas and Liquid Lines, and Suction Lines for Heat-Pump Applications:

1. NPS 1-1/2 and Smaller: Copper, Type ACR, annealed-temper tubing and wrought-copper fittings with brazed or soldered joints.
2. NPS 1-1/2 and Smaller: Copper, Type ACR, drawn-temper tubing and wrought-copper fittings with brazed or soldered joints.
3. NPS 2 to NPS 3: Copper, Type K, annealed- or drawn-temper tubing and wrought-copper fittings with brazed or soldered joints.
4. NPS 4: Copper, Type ACR, drawn-temper tubing and wrought-copper fittings with soldered joints.

F. Safety-Relief-Valve Discharge Piping: Copper, Type ACR, drawn-temper tubing and wrought-copper fittings with soldered joints.

G. Safety-Relief-Valve Discharge Piping:

1. NPS 1-1/2 and Smaller: Copper, Type ACR, annealed-temper tubing and wrought-copper fittings with brazed or soldered joints.
2. NPS 1-1/2 and Smaller: Copper, Type ACR, drawn-temper tubing and wrought-copper fittings with brazed joints.
3. NPS 2 to NPS 3: Copper, Type K, annealed- or drawn-temper tubing and wrought-copper fittings with brazed or soldered joints.
4. NPS 4: Copper, Type ACR, drawn-temper tubing and wrought-copper fittings with soldered joints.

3.2 VALVE AND SPECIALTY APPLICATIONS

A. Install diaphragm packless valves in suction and discharge lines of compressor.

B. Install service valves for gage taps at strainers if they are not an integral part of strainers.

C. Install a check valve at the compressor discharge and a liquid accumulator at the compressor suction connection.

D. Except as otherwise indicated, install diaphragm packless valves on inlet and outlet side of filter dryers.

E. Install a full-sized, three-valve bypass around filter dryers.

F. Install solenoid valves upstream from each expansion valve. Install solenoid valves in horizontal lines with coil at top.

G. Install thermostatic expansion valves as close as possible to distributors on evaporators.

1. Install valve so diaphragm case is warmer than bulb.
2. Secure bulb to clean, straight, horizontal section of suction line using two bulb straps. Do not mount bulb in a trap or at bottom of the line.
3. If external equalizer lines are required, make connection where it will reflect suction-line pressure at bulb location.

H. Install safety relief valves where required by ASME Boiler and Pressure Vessel Code. Pipe safety-relief-valve discharge line to outside according to ASHRAE 15.

I. Install moisture/liquid indicators in liquid line at the inlet of the thermostatic expansion valve or at the inlet of the evaporator coil capillary tube.

J. Install strainers upstream from and adjacent to the following unless they are furnished as an integral assembly for device being protected:

1. Solenoid valves.
2. Thermostatic expansion valves.
3. Compressor.

K. Install filter dryers in liquid line between compressor and thermostatic expansion valve.

L. Install flexible connectors at compressors.

3.3 PIPING INSTALLATION

A. Drawing plans, schematics, and diagrams indicate general location and arrangement of piping systems; indicated locations and arrangements were used to size pipe and calculate friction

loss, expansion, pump sizing, and other design considerations. Install piping as indicated unless deviations to layout are approved on Shop Drawings.

B. Install refrigerant piping according to ASHRAE 15.

C. Install piping in concealed locations unless otherwise indicated and except in equipment rooms and service areas.

D. Install piping indicated to be exposed and piping in equipment rooms and service areas at right angles or parallel to building walls. Diagonal runs are prohibited unless specifically indicated otherwise.

E. Install piping above accessible ceilings to allow sufficient space for ceiling panel removal.

F. Install piping adjacent to machines to allow service and maintenance.

G. Install piping free of sags and bends.

H. Install fittings for changes in direction and branch connections.

I. Select system components with pressure rating equal to or greater than system operating pressure.

J. Install piping as short and direct as possible, with a minimum number of joints, elbows, and fittings.

K. Arrange piping to allow inspection and service of refrigeration equipment. Install valves and specialties in accessible locations to allow for service and inspection. Install access doors or panels as specified in Section 083113 "Access Doors and Frames" if valves or equipment requiring maintenance is concealed behind finished surfaces.

L. Install refrigerant piping in protective conduit where installed belowground.

M. Install refrigerant piping in rigid or flexible conduit in locations where exposed to mechanical injury.

N. Slope refrigerant piping as follows:

1. Install horizontal hot-gas discharge piping with a uniform slope downward away from compressor.
2. Install horizontal suction lines with a uniform slope downward to compressor.
3. Install traps and double risers to entrain oil in vertical runs.
4. Liquid lines may be installed level.

O. When brazing or soldering, remove solenoid-valve coils and sight glasses; also remove valve stems, seats, and packing, and accessible internal parts of refrigerant specialties. Do not apply heat near expansion-valve bulb.

P. Install piping with adequate clearance between pipe and adjacent walls and hangers or between pipes for insulation installation.

Q. Identify refrigerant piping and valves according to Section 230553 "Identification for HVAC Piping and Equipment."

R. Install sleeves for piping penetrations of walls, ceilings, and floors. Comply with requirements for sleeves specified in Section 230517 "Sleeves and Sleeve Seals for HVAC Piping."

S. Install sleeve seals for piping penetrations of concrete walls and slabs. Comply with requirements for sleeve seals specified in Section 230517 "Sleeves and Sleeve Seals for HVAC Piping."

T. Install escutcheons for piping penetrations of walls, ceilings, and floors. Comply with requirements for escutcheons specified in Section 230518 "Escutcheons for HVAC Piping."

## 3.4 PIPE JOINT CONSTRUCTION

A. Soldered Joints: Construct joints according to ASTM B 828 or CDA's "Copper Tube Handbook."

B. Brazed Joints: Construct joints according to AWS's "Brazing Handbook," Chapter "Pipe and Tube."

1. Use Type BcuP, copper-phosphorus alloy for joining copper socket fittings with copper pipe.
2. Use Type BAg, cadmium-free silver alloy for joining copper with bronze or steel.

## 3.5 HANGERS AND SUPPORTS

A. Hanger, support, and anchor products are specified in Section 230529 "Hangers and Supports for HVAC Piping and Equipment."

B. Install the following pipe attachments:

1. Adjustable steel clevis hangers for individual horizontal runs less than 20 feet long.
2. Roller hangers and spring hangers for individual horizontal runs 20 feet or longer.
3. Pipe Roller: MSS SP-58, Type 44 for multiple horizontal piping 20 feet or longer, supported on a trapeze.
4. Spring hangers to support vertical runs.
5. Copper-clad hangers and supports for hangers and supports in direct contact with copper pipe.

C. Install hangers for copper tubing with the following maximum spacing and minimum rod sizes:

1. NPS 1/2: Maximum span, 60 inches; minimum rod size, 1/4 inch.
2. NPS 5/8: Maximum span, 60 inches; minimum rod size, 1/4 inch.

3. NPS 1: Maximum span, 72 inches; minimum rod size, 1/4 inch.
4. NPS 1-1/4: Maximum span, 96 inches; minimum rod size, 3/8 inch.
5. NPS 1-1/2: Maximum span, 96 inches; minimum rod size, 3/8 inch.
6. NPS 2: Maximum span, 96 inches; minimum rod size, 3/8 inch.
7. NPS 2-1/2: Maximum span, 108 inches; minimum rod size, 3/8 inch.
8. NPS 3: Maximum span, 10 feet; minimum rod size, 3/8 inch.
9. NPS 4: Maximum span, 12 feet; minimum rod size, 1/2 inch.

D. Support multifloor vertical runs at least at each floor.

## 3.6 FIELD QUALITY CONTROL

A. Perform tests and inspections and prepare test reports.

B. Tests and Inspections:

1. Comply with ASME B31.5, Chapter VI.
2. Test refrigerant piping and specialties. Isolate compressor, condenser, evaporator, and safety devices from test pressure if they are not rated above the test pressure.
3. Test high- and low-pressure side piping of each system separately at not less than the pressures indicated in Part 1 "Performance Requirements" Article.

    a. Fill system with nitrogen to the required test pressure.
    b. System shall maintain test pressure at the manifold gage throughout duration of test.
    c. Test joints and fittings with electronic leak detector or by brushing a small amount of soap and glycerin solution over joints.
    d. Remake leaking joints using new materials, and retest until satisfactory results are achieved.

## 3.7 SYSTEM CHARGING

A. Charge system using the following procedures:

1. Install core in filter dryers after leak test but before evacuation.
2. Evacuate entire refrigerant system with a vacuum pump to 500 micrometers. If vacuum holds for 12 hours, system is ready for charging.
3. Break vacuum with refrigerant gas, allowing pressure to build up to 2 psig.
4. Charge system with a new filter-dryer core in charging line.

## 3.8 ADJUSTING

A. Adjust thermostatic expansion valve to obtain proper evaporator superheat.

B. Adjust high- and low-pressure switch settings to avoid short cycling in response to fluctuating suction pressure.

C. Adjust set-point temperature of air-conditioning or chilled-water controllers to the system design temperature.

D. Perform the following adjustments before operating the refrigeration system, according to manufacturer's written instructions:

1. Open shutoff valves in condenser water circuit.
2. Verify that compressor oil level is correct.
3. Open compressor suction and discharge valves.
4. Open refrigerant valves except bypass valves that are used for other purposes.
5. Check open compressor-motor alignment and verify lubrication for motors and bearings.

E. Replace core of replaceable filter dryer after system has been adjusted and after design flow rates and pressures are established.

END OF SECTION 232300

# SECTION 233113 - METAL DUCTS

## PART 1 - GENERAL

### 1.1 SUMMARY

A. Section Includes:

1. Rectangular ducts and fittings.
2. Round ducts and fittings.
3. Sheet metal materials.
4. Sealants and gaskets.
5. Hangers and supports.
6. Seismic-restraint devices.

B. Related Sections:

1. Section 230593 "Testing, Adjusting, and Balancing for HVAC" for testing, adjusting, and balancing requirements for metal ducts.
2. Section 233116 "Nonmetal Ducts" for fibrous-glass ducts, thermoset fiber-reinforced plastic ducts, thermoplastic ducts, PVC ducts, and concrete ducts.
3. Section 233119 "HVAC Casings" for factory- and field-fabricated casings for mechanical equipment.
4. Section 233300 "Air Duct Accessories" for dampers, sound-control devices, duct-mounting access doors and panels, turning vanes, and flexible ducts.

### 1.2 PERFORMANCE REQUIREMENTS

A. Delegated Duct Design: Duct construction, including sheet metal thicknesses, seam and joint construction, reinforcements, and hangers and supports, shall comply with SMACNA's "HVAC Duct Construction Standards - Metal and Flexible" and performance requirements and design criteria indicated in "Duct Schedule" Article.

B. Structural Performance: Duct hangers and supports shall withstand the effects of gravity loads and stresses within limits and under conditions described in SMACNA's "HVAC Duct Construction Standards - Metal and Flexible"

1. Seismic Hazard Level A: Seismic force to weight ratio, 0.48.
2. Seismic Hazard Level B: Seismic force to weight ratio, 0.30.
3. Seismic Hazard Level C: Seismic force to weight ratio, 0.15.

C. Airstream Surfaces: Surfaces in contact with the airstream shall comply with requirements in ASHRAE 62.1.

1.3 ACTION SUBMITTALS

A. Product Data: For each type of product indicated.

B. Shop Drawings:

1. Fabrication, assembly, and installation, including plans, elevations, sections, components, and attachments to other work.
2. Factory- and shop-fabricated ducts and fittings.
3. Duct layout indicating sizes, configuration, and static-pressure classes.
4. Elevation of top of ducts.
5. Dimensions of main duct runs from building grid lines.
6. Fittings.
7. Reinforcement and spacing.
8. Seam and joint construction.
9. Penetrations through fire-rated and other partitions.
10. Equipment installation based on equipment being used on Project.
11. Locations for duct accessories, including dampers, turning vanes, and access doors and panels.
12. Hangers and supports, including methods for duct and building attachment and vibration isolation.

C. Delegated-Design Submittal:

1. Sheet metal thicknesses.
2. Joint and seam construction and sealing.
3. Reinforcement details and spacing.
4. Materials, fabrication, assembly, and spacing of hangers and supports.
5. Design Calculations: Calculations for selecting hangers and supports.

1.4 INFORMATIONAL SUBMITTALS

A. Coordination Drawings: Plans, drawn to scale, on which the following items are shown and coordinated with each other, using input from installers of the items involved:

1. Duct installation in congested spaces, indicating coordination with general construction, building components, and other building services. Indicate proposed changes to duct layout.
2. Suspended ceiling components.
3. Structural members to which duct will be attached.
4. Size and location of initial access modules for acoustical tile.
5. Penetrations of smoke barriers and fire-rated construction.
6. Items penetrating finished ceiling including the following:

a. Lighting fixtures.
b. Air outlets and inlets.
c. Speakers.

d. Sprinklers.
e. Access panels.
f. Perimeter moldings.

B. Welding certificates.

1.5 QUALITY ASSURANCE

A. Welding Qualifications: Qualify procedures and personnel according to AWS D1.1/D1.1M, "Structural Welding Code - Steel," for hangers and supports. AWS D1.2/D1.2M, "Structural Welding Code - Aluminum," for aluminum supports. AWS D9.1M/D9.1, "Sheet Metal Welding Code," for duct joint and seam welding.

B. Welding Qualifications: Qualify procedures and personnel according to the following:

1. AWS D1.1/D1.1M, "Structural Welding Code - Steel," for hangers and supports.
2. AWS D1.2/D1.2M, "Structural Welding Code - Aluminum," for aluminum supports.
3. AWS D9.1M/D9.1, "Sheet Metal Welding Code," for duct joint and seam welding.

C. ASHRAE Compliance: Applicable requirements in ASHRAE 62.1, Section 5 - "Systems and Equipment" and Section 7 - "Construction and System Start-up."

D. ASHRAE/IESNA Compliance: Applicable requirements in ASHRAE/IESNA 90.1, Section 6.4.4 - "HVAC System Construction and Insulation."

PART 2 - PRODUCTS

2.1 RECTANGULAR DUCTS AND FITTINGS

A. General Fabrication Requirements: Comply with SMACNA's "HVAC Duct Construction Standards - Metal and Flexible" based on indicated static-pressure class unless otherwise indicated.

B. Transverse Joints: Select joint types and fabricate according to SMACNA's "HVAC Duct Construction Standards - Metal and Flexible," Figure 2-1, "Rectangular Duct/Transverse Joints," for static-pressure class, applicable sealing requirements, materials involved, duct-support intervals, and other provisions in SMACNA's "HVAC Duct Construction Standards - Metal and Flexible."

C. Longitudinal Seams: Select seam types and fabricate according to SMACNA's "HVAC Duct Construction Standards - Metal and Flexible," Figure 2-2, "Rectangular Duct/Longitudinal Seams," for static-pressure class, applicable sealing requirements, materials involved, duct-support intervals, and other provisions in SMACNA's "HVAC Duct Construction Standards - Metal and Flexible."

D. Elbows, Transitions, Offsets, Branch Connections, and Other Duct Construction: Select types and fabricate according to SMACNA's "HVAC Duct Construction Standards - Metal and Flexible," Chapter 4, "Fittings and Other Construction," for static-pressure class, applicable sealing requirements, materials involved, duct-support intervals, and other provisions in SMACNA's "HVAC Duct Construction Standards - Metal and Flexible."

## 2.2 ROUND DUCTS AND FITTINGS

A. General Fabrication Requirements: Comply with SMACNA's "HVAC Duct Construction Standards - Metal and Flexible," Chapter 3, "Round, Oval, and Flexible Duct," based on indicated static-pressure class unless otherwise indicated.

1. Manufacturers: Subject to compliance with requirements, provide products by one of the following available manufacturers offering products that may be incorporated into the Work include, but are not limited to, the following:

a. Lindab Inc.
b. McGill AirFlow LLC.
c. SEMCO Incorporated.
d. Sheet Metal Connectors, Inc.
e. Spiral Manufacturing Co., Inc.

B. Transverse Joints: Select joint types and fabricate according to SMACNA's "HVAC Duct Construction Standards - Metal and Flexible," Figure 3-1, "Round Duct Transverse Joints," for static-pressure class, applicable sealing requirements, materials involved, duct-support intervals, and other provisions in SMACNA's "HVAC Duct Construction Standards - Metal and Flexible."

1. Transverse Joints in Ducts Larger Than 60 Inches in Diameter: Flanged.

C. Longitudinal Seams: Select seam types and fabricate according to SMACNA's "HVAC Duct Construction Standards - Metal and Flexible," Figure 3-2, "Round Duct Longitudinal Seams," for static-pressure class, applicable sealing requirements, materials involved, duct-support intervals, and other provisions in SMACNA's "HVAC Duct Construction Standards - Metal and Flexible."

1. Fabricate round ducts larger Than 90 inches in diameter with butt-welded longitudinal seams.

D. Tees and Laterals: Select types and fabricate according to SMACNA's "HVAC Duct Construction Standards - Metal and Flexible," Figure 3-5, "90 Degree Tees and Laterals," and Figure 3-6, "Conical Tees," for static-pressure class, applicable sealing requirements, materials involved, duct-support intervals, and other provisions in SMACNA's "HVAC Duct Construction Standards - Metal and Flexible."

2.3 SHEET METAL MATERIALS

A. General Material Requirements: Comply with SMACNA's "HVAC Duct Construction Standards - Metal and Flexible" for acceptable materials, material thicknesses, and duct construction methods unless otherwise indicated. Sheet metal materials shall be free of pitting, seam marks, roller marks, stains, discolorations, and other imperfections.

B. Galvanized Sheet Steel: Comply with ASTM A 653/A 653M.

1. Galvanized Coating Designation: G60.
2. Finishes for Surfaces Exposed to View: Mill phosphatized.

C. Carbon-Steel Sheets: Comply with ASTM A 1008/A 1008M, with oiled, matte finish for exposed ducts.

D. Stainless-Steel Sheets: Comply with ASTM A 480/A 480M, Type 304 or 316, as indicated in the "Duct Schedule" Article; cold rolled, annealed, sheet. Exposed surface finish shall be No. 2B, No. 2D, No. 3, or No. 4 as indicated in the "Duct Schedule" Article.

E. Aluminum Sheets: Comply with ASTM B 209 Alloy 3003, H14 temper; with mill finish for concealed ducts, and standard, one-side bright finish for duct surfaces exposed to view.

F. Reinforcement Shapes and Plates: ASTM A 36/A 36M, steel plates, shapes, and bars; black and galvanized.

1. Where black- and galvanized-steel shapes and plates are used to reinforce aluminum ducts, isolate the different metals with butyl rubber, neoprene, or EPDM gasket materials.

G. Tie Rods: Galvanized steel, 1/4-inch minimum diameter for lengths 36 inches or less; 3/8-inch minimum diameter for lengths longer than 36 inches.

2.4 SEALANT AND GASKETS

A. General Sealant and Gasket Requirements: Surface-burning characteristics for sealants and gaskets shall be a maximum flame-spread index of 25 and a maximum smoke-developed index of 50 when tested according to UL 723; certified by an NRTL.

B. Two-Part Tape Sealing System:

1. Tape: Woven cotton fiber impregnated with mineral gypsum and modified acrylic/silicone activator to react exothermically with tape to form hard, durable, airtight seal.
2. Tape Width: 3 inches.
3. Sealant: Modified styrene acrylic.
4. Water resistant.
5. Mold and mildew resistant.

6. Maximum Static-Pressure Class: 10-inch wg, positive and negative.
7. Service: Indoor and outdoor.
8. Service Temperature: Minus 40 to plus 200 deg F.
9. Substrate: Compatible with galvanized sheet steel (both PVC coated and bare), stainless steel, or aluminum.
10. For indoor applications, sealant shall have a VOC content of 250 g/L or less when calculated according to 40 CFR 59, Subpart D (EPA Method 24).
11. Sealant shall comply with the testing and product requirements of the California Department of Health Services' "Standard Practice for the Testing of Volatile Organic Emissions from Various Sources Using Small-Scale Environmental Chambers."

C. Water-Based Joint and Seam Sealant:

1. Application Method: Brush on.
2. Solids Content: Minimum 65 percent.
3. Shore A Hardness: Minimum 20.
4. Water resistant.
5. Mold and mildew resistant.
6. VOC: Maximum 75 g/L (less water).
7. Maximum Static-Pressure Class: 10-inch wg, positive and negative.
8. Service: Indoor or outdoor.
9. Substrate: Compatible with galvanized sheet steel (both PVC coated and bare), stainless steel, or aluminum sheets.

D. Flanged Joint Sealant: Comply with ASTM C 920.

1. General: Single-component, acid-curing, silicone, elastomeric.
2. Type: S.
3. Grade: NS.
4. Class: 25.
5. Use: O.
6. For indoor applications, sealant shall have a VOC content of 250 g/L or less when calculated according to 40 CFR 59, Subpart D (EPA Method 24).
7. Sealant shall comply with the testing and product requirements of the California Department of Health Services' "Standard Practice for the Testing of Volatile Organic Emissions from Various Sources Using Small-Scale Environmental Chambers."

E. Flange Gaskets: Butyl rubber, neoprene, or EPDM polymer with polyisobutylene plasticizer.

F. Round Duct Joint O-Ring Seals:

1. Seal shall provide maximum 3 cfm/100 sq. ft. at 1-inch wg (0.14 L/s per sq. m) and shall be rated for10-inch wg static-pressure class, positive or negative.
2. EPDM O-ring to seal in concave bead in coupling or fitting spigot.
3. Double-lipped, EPDM O-ring seal, mechanically fastened to factory-fabricated couplings and fitting spigots.

2.5 HANGERS AND SUPPORTS

A. Hanger Rods for Noncorrosive Environments: Cadmium-plated steel rods and nuts.

B. Hanger Rods for Corrosive Environments: Electrogalvanized, all-thread rods or galvanized rods with threads painted with zinc-chromate primer after installation.

C. Strap and Rod Sizes: Comply with SMACNA's "HVAC Duct Construction Standards - Metal and Flexible," Table 5-1, "Rectangular Duct Hangers Minimum Size," and Table 5-2, "Minimum Hanger Sizes for Round Duct."

D. Steel Cables for Galvanized-Steel Ducts: Galvanized steel complying with ASTM A 603.

E. Steel Cables for Stainless-Steel Ducts: Stainless steel complying with ASTM A 492.

F. Steel Cable End Connections: Cadmium-plated steel assemblies with brackets, swivel, and bolts designed for duct hanger service; with an automatic-locking and clamping device.

G. Duct Attachments: Sheet metal screws, blind rivets, or self-tapping metal screws; compatible with duct materials.

H. Trapeze and Riser Supports:

1. Supports for Galvanized-Steel Ducts: Galvanized-steel shapes and plates.
2. Supports for Stainless-Steel Ducts: Stainless-steel shapes and plates.
3. Supports for Aluminum Ducts: Aluminum or galvanized steel coated with zinc chromate.

2.6 SEISMIC-RESTRAINT DEVICES

A. Manufacturers: Subject to compliance with requirements, provide products by one of the following available manufacturers offering products that may be incorporated into the Work include, but are not limited to, the following:

1. Cooper B-Line, Inc.; a division of Cooper Industries.
2. Ductmate Industries, Inc.
3. Hilti Corp.
4. Kinetics Noise Control.
5. Loos & Co.; Cableware Division.
6. Mason Industries.
7. TOLCO; a brand of NIBCO INC.
8. Unistrut Corporation; Tyco International, Ltd.

B. General Requirements for Restraint Components: Rated strengths, features, and applications shall be as defined in reports by an agency acceptable to authorities having jurisdiction.

1. Structural Safety Factor: Allowable strength in tension, shear, and pullout force of components shall be at least four times the maximum seismic forces to which they will be subjected.

C. Channel Support System: Shop- or field-fabricated support assembly made of slotted steel channels rated in tension, compression, and torsion forces and with accessories for attachment to braced component at one end and to building structure at the other end. Include matching components and corrosion-resistant coating.

D. Restraint Cables: ASTM A 492, stainless-steel cables with end connections made of cadmium-plated steel assemblies with brackets, swivel, and bolts designed for restraining cable service; and with an automatic-locking and clamping device or double-cable clips.

E. Hanger Rod Stiffener: Steel tube or steel slotted-support-system sleeve with internally bolted connections to hanger rod.

F. Mechanical Anchor Bolts: Drilled-in and stud-wedge or female-wedge type. Select anchor bolts with strength required for anchor and as tested according to ASTM E 488.

## PART 3 - EXECUTION

### 3.1 DUCT INSTALLATION

A. Drawing plans, schematics, and diagrams indicate general location and arrangement of duct system. Indicated duct locations, configurations, and arrangements were used to size ducts and calculate friction loss for air-handling equipment sizing and for other design considerations. Install duct systems as indicated unless deviations to layout are approved on Shop Drawings and Coordination Drawings.

B. Install ducts according to SMACNA's "HVAC Duct Construction Standards - Metal and Flexible" unless otherwise indicated.

C. Install round ducts in maximum practical lengths.

D. Install ducts with fewest possible joints.

E. Install factory- or shop-fabricated fittings for changes in direction, size, and shape and for branch connections.

F. Unless otherwise indicated, install ducts vertically and horizontally, and parallel and perpendicular to building lines.

G. Install ducts close to walls, overhead construction, columns, and other structural and permanent enclosure elements of building.

H. Install ducts with a clearance of 1 inch, plus allowance for insulation thickness.

I. Route ducts to avoid passing through transformer vaults and electrical equipment rooms and enclosures.

J. Where ducts pass through non-fire-rated interior partitions and exterior walls and are exposed to view, cover the opening between the partition and duct or duct insulation with sheet metal flanges of same metal thickness as the duct. Overlap openings on four sides by at least 1-1/2 inches.

K. Where ducts pass through fire-rated interior partitions and exterior walls, install fire dampers. Comply with requirements in Section 233300 "Air Duct Accessories" for fire and smoke dampers.

L. Protect duct interiors from moisture, construction debris and dust, and other foreign materials. Comply with SMACNA's "IAQ Guidelines for Occupied Buildings Under Construction," Appendix G, "Duct Cleanliness for New Construction Guidelines."

3.2 INSTALLATION OF EXPOSED DUCTWORK

A. Protect ducts exposed in finished spaces from being dented, scratched, or damaged.

B. Trim duct sealants flush with metal. Create a smooth and uniform exposed bead. Do not use two-part tape sealing system.

C. Grind welds to provide smooth surface free of burrs, sharp edges, and weld splatter. When welding stainless steel with a No. 3 or 4 finish, grind the welds flush, polish the exposed welds, and treat the welds to remove discoloration caused by welding.

D. Maintain consistency, symmetry, and uniformity in the arrangement and fabrication of fittings, hangers and supports, duct accessories, and air outlets.

E. Repair or replace damaged sections and finished work that does not comply with these requirements.

3.3 DUCT SEALING

A. Seal ducts for duct static-pressure, seal classes, and leakage classes specified in "Duct Schedule" Article according to SMACNA's "HVAC Duct Construction Standards - Metal and Flexible."

B. Seal ducts to the following seal classes according to SMACNA's "HVAC Duct Construction Standards - Metal and Flexible":

1. Comply with SMACNA's "HVAC Duct Construction Standards - Metal and Flexible."
2. Outdoor, Supply-Air Ducts: Seal Class A.
3. Outdoor, Exhaust Ducts: Seal Class C.
4. Outdoor, Return-Air Ducts: Seal Class C.

5. Unconditioned Space, Supply-Air Ducts in Pressure Classes 2-Inch wg and Lower: Seal Class B.
6. Unconditioned Space, Supply-Air Ducts in Pressure Classes Higher Than 2-Inch wg: Seal Class A.
7. Unconditioned Space, Exhaust Ducts: Seal Class C.
8. Unconditioned Space, Return-Air Ducts: Seal Class B.
9. Conditioned Space, Supply-Air Ducts in Pressure Classes 2-Inch wg and Lower: Seal Class C.
10. Conditioned Space, Supply-Air Ducts in Pressure Classes Higher Than 2-Inch wg: Seal Class B.
11. Conditioned Space, Exhaust Ducts: Seal Class B.
12. Conditioned Space, Return-Air Ducts: Seal Class C.

3.4 HANGER AND SUPPORT INSTALLATION

A. Comply with SMACNA's "HVAC Duct Construction Standards - Metal and Flexible," Chapter 5, "Hangers and Supports."

B. Building Attachments: Concrete inserts, powder-actuated fasteners, or structural-steel fasteners appropriate for construction materials to which hangers are being attached.

1. Where practical, install concrete inserts before placing concrete.
2. Install powder-actuated concrete fasteners after concrete is placed and completely cured.
3. Use powder-actuated concrete fasteners for standard-weight aggregate concretes or for slabs more than 4 inches thick.
4. Do not use powder-actuated concrete fasteners for lightweight-aggregate concretes or for slabs less than 4 inches thick.
5. Do not use powder-actuated concrete fasteners for seismic restraints.

C. Hanger Spacing: Comply with SMACNA's "HVAC Duct Construction Standards - Metal and Flexible," Table 5-1, "Rectangular Duct Hangers Minimum Size," and Table 5-2, "Minimum Hanger Sizes for Round Duct," for maximum hanger spacing; install hangers and supports within 24 inches of each elbow and within 48 inches of each branch intersection.

D. Hangers Exposed to View: Threaded rod and angle or channel supports.

E. Support vertical ducts with steel angles or channel secured to the sides of the duct with welds, bolts, sheet metal screws, or blind rivets; support at each floor and at a maximum intervals of 16 feet.

F. Install upper attachments to structures. Select and size upper attachments with pull-out, tension, and shear capacities appropriate for supported loads and building materials where used.

3.5 CONNECTIONS

A. Make connections to equipment with flexible connectors complying with Section 233300 "Air Duct Accessories."

B. Comply with SMACNA's "HVAC Duct Construction Standards - Metal and Flexible" for branch, outlet and inlet, and terminal unit connections.

3.6 START UP

A. Air Balance: Comply with requirements in Section 230593 "Testing, Adjusting, and Balancing for HVAC."

3.7 DUCT SCHEDULE

A. Supply Ducts:

1. Ducts Connected to Fan Coil Units, Furnaces, Heat Pumps, and Terminal Units:

a. Pressure Class: Positive 2-inch wg.
b. Minimum SMACNA Seal Class: A.
c. SMACNA Leakage Class for Rectangular: 12.
d. SMACNA Leakage Class for Round and Flat Oval: 12.

2. Ducts Connected to Constant-Volume Air-Handling Units:

a. Pressure Class: Positive 3-inch wg.
b. Minimum SMACNA Seal Class: A.
c. SMACNA Leakage Class for Rectangular: 6.
d. SMACNA Leakage Class for Round and Flat Oval: 6.

3. Ducts Connected to Equipment Not Listed Above:

a. Pressure Class: Positive 3-inch wg.
b. Minimum SMACNA Seal Class: A.
c. SMACNA Leakage Class for Rectangular: 6.
d. SMACNA Leakage Class for Round and Flat Oval: 6.

B. Return Ducts:

1. Ducts Connected to Fan Coil Units, Furnaces, Heat Pumps, and Terminal Units:

a. Pressure Class: Positive or negative 2-inch wg.
b. Minimum SMACNA Seal Class: A.
c. SMACNA Leakage Class for Rectangular: 12.
d. SMACNA Leakage Class for Round and Flat Oval: 12.

2. Ducts Connected to Air-Handling Units:

    a. Pressure Class: Positive or negative 3-inch wg.
    b. Minimum SMACNA Seal Class: A.
    c. SMACNA Leakage Class for Rectangular: 6.
    d. SMACNA Leakage Class for Round and Flat Oval: 6.

3. Ducts Connected to Equipment Not Listed Above:

    a. Pressure Class: Positive or negative 3-inch wg.
    b. Minimum SMACNA Seal Class: A.
    c. SMACNA Leakage Class for Rectangular: 6.
    d. SMACNA Leakage Class for Round and Flat Oval: 6.

C. Exhaust Ducts:

1. Ducts Connected to Fans Exhausting (ASHRAE 62.1, Class 1 and 2) Air:

    a. Pressure Class: Negative 1-inch wg.
    b. Minimum SMACNA Seal Class: A if negative pressure, and A if positive pressure.
    c. SMACNA Leakage Class for Rectangular: 12.
    d. SMACNA Leakage Class for Round and Flat Oval: 6.

2. Ducts Connected to Air-Handling Units:

    a. Pressure Class: Positive or negative 3-inch wg.
    b. Minimum SMACNA Seal Class: A if negative pressure, and A if positive pressure.
    c. SMACNA Leakage Class for Rectangular: 6.
    d. SMACNA Leakage Class for Round and Flat Oval: 6.

3. Ducts Connected to Equipment Not Listed Above:

    a. Pressure Class: Positive or negative 3-inch wg.
    b. Minimum SMACNA Seal Class: A if negative pressure, and A if positive pressure.
    c. SMACNA Leakage Class for Rectangular: 6.
    d. SMACNA Leakage Class for Round and Flat Oval: 6.

D. Outdoor-Air (Not Filtered, Heated, or Cooled) Ducts:

1. Ducts Connected to Fan Coil Units, Furnaces, Heat Pumps, and Terminal Units:

    a. Pressure Class: Positive or negative 1-inch wg.
    b. Minimum SMACNA Seal Class: A.
    c. SMACNA Leakage Class for Rectangular: 12.
    d. SMACNA Leakage Class for Round and Flat Oval: 6.

2. Ducts Connected to Air-Handling Units:

a. Pressure Class: Positive or negative 2-inch wg.
b. Minimum SMACNA Seal Class: A.
c. SMACNA Leakage Class for Rectangular: 6.
d. SMACNA Leakage Class for Round and Flat Oval: 6.

3. Ducts Connected to Equipment Not Listed Above:

a. Pressure Class: Positive or negative 3-inch wg.
b. Minimum SMACNA Seal Class: A.
c. SMACNA Leakage Class for Rectangular: 6.
d. SMACNA Leakage Class for Round and Flat Oval: 6.

E. Intermediate Reinforcement:

1. Galvanized-Steel Ducts: Galvanized steel.
2. PVC-Coated Ducts:

a. Exposed to Airstream: Match duct material.
b. Not Exposed to Airstream: Match duct material.

3. Stainless-Steel Ducts:

a. Exposed to Airstream: Match duct material.
b. Not Exposed to Airstream: Match duct material.

4. Aluminum Ducts: Aluminumor galvanized sheet steel coated with zinc chromate.

F. Elbow Configuration:

1. Rectangular Duct: Comply with SMACNA's "HVAC Duct Construction Standards - Metal and Flexible," Figure 4-2, "Rectangular Elbows."

a. Velocity 1000 fpm or Lower:

1) Radius Type RE 1 with minimum 0.5 radius-to-diameter ratio.
2) Mitered Type RE 4 without vanes.

b. Velocity 1000 to 1500 fpm:

1) Radius Type RE 1 with minimum 1.0 radius-to-diameter ratio.
2) Radius Type RE 3 with minimum 0.5 radius-to-diameter ratio and two vanes.
3) Mitered Type RE 2 with vanes complying with SMACNA's "HVAC Duct Construction Standards - Metal and Flexible," Figure 4-3, "Vanes and Vane Runners," and Figure 4-4, "Vane Support in Elbows."

c. Velocity 1500 fpm or Higher:

1) Radius Type RE 1 with minimum 1.5 radius-to-diameter ratio.
2) Radius Type RE 3 with minimum 1.0 radius-to-diameter ratio and two vanes.
3) Mitered Type RE 2 with vanes complying with SMACNA's "HVAC Duct Construction Standards - Metal and Flexible," Figure 4-3, "Vanes and Vane Runners," and Figure 4-4, "Vane Support in Elbows."

2. Rectangular Duct: Comply with SMACNA's "HVAC Duct Construction Standards - Metal and Flexible," Figure 4-2, "Rectangular Elbows."

a. Radius Type RE 1 with minimum 1.5 radius-to-diameter ratio.
b. Radius Type RE 3 with minimum 1.0 radius-to-diameter ratio and two vanes.
c. Mitered Type RE 2 with vanes complying with SMACNA's "HVAC Duct Construction Standards - Metal and Flexible," Figure 4-3, "Vanes and Vane Runners," and Figure 4-4, "Vane Support in Elbows."

3. Round Duct: Comply with SMACNA's "HVAC Duct Construction Standards - Metal and Flexible," Figure 3-4, "Round Duct Elbows."

a. Minimum Radius-to-Diameter Ratio and Elbow Segments: Comply with SMACNA's "HVAC Duct Construction Standards - Metal and Flexible," Table 3-1, "Mitered Elbows." Elbows with less than 90-degree change of direction have proportionately fewer segments.

1) Velocity 1000 fpm or Lower: 0.5 radius-to-diameter ratio and three segments for 90-degree elbow.
2) Velocity 1000 to 1500 fpm: 1.0 radius-to-diameter ratio and four segments for 90-degree elbow.
3) Velocity 1500 fpm or Higher: 1.5 radius-to-diameter ratio and five segments for 90-degree elbow.
4) Radius-to Diameter Ratio: 1.5.

b. Round Elbows, 12 Inches and Smaller in Diameter: Stamped or pleated.
c. Round Elbows, 14 Inches and Larger in Diameter: Standing seam.

G. Branch Configuration:

1. Rectangular Duct: Comply with SMACNA's "HVAC Duct Construction Standards - Metal and Flexible," Figure 4-6, "Branch Connection."

a. Rectangular Main to Rectangular Branch: 45-degree entry.
b. Rectangular Main to Round Branch: Spin in.

2. Round: Comply with SMACNA's "HVAC Duct Construction Standards - Metal and Flexible," Figure 3-5, "90 Degree Tees and Laterals," and Figure 3-6, "Conical Tees." Saddle taps are permitted in existing duct.

a. Velocity 1000 fpm or Lower: 90-degree tap.

b. Velocity 1000 to 1500 fpm: Conical tap.
c. Velocity 1500 fpm or Higher: 45-degree lateral.

END OF SECTION 233113

SECTION 233300 - AIR DUCT ACCESSORIES

PART 1 - GENERAL

1.1 SUMMARY

A. Section Includes:

1. Backdraft and pressure relief dampers.
2. Manual volume dampers.
3. Control dampers.
4. Fire dampers.
5. Smoke dampers.
6. Flange connectors.
7. Turning vanes.
8. Duct-mounted access doors.
9. Flexible connectors.
10. Flexible ducts.
11. Duct accessory hardware.

1.2 ACTION SUBMITTALS

A. Product Data: For each type of product.

B. Shop Drawings: For duct accessories. Include plans, elevations, sections, details and attachments to other work.

1. Detail duct accessories fabrication and installation in ducts and other construction. Include dimensions, weights, loads, and required clearances; and method of field assembly into duct systems and other construction. Include the following:

a. Special fittings.
b. Manual volume damper installations.
c. Control-damper installations.
d. Fire-damper and smoke-damper installations, including sleeves; and duct-mounted access doors.
e. Wiring Diagrams: For power, signal, and control wiring.

1.3 CLOSEOUT SUBMITTALS

A. Operation and maintenance data.

PART 2 - PRODUCTS

2.1 ASSEMBLY DESCRIPTION

A. Comply with NFPA 90A, "Installation of Air Conditioning and Ventilating Systems," and with NFPA 90B, "Installation of Warm Air Heating and Air Conditioning Systems."

B. Comply with SMACNA's "HVAC Duct Construction Standards - Metal and Flexible" for acceptable materials, material thicknesses, and duct construction methods unless otherwise indicated. Sheet metal materials shall be free of pitting, seam marks, roller marks, stains, discolorations, and other imperfections.

2.2 MATERIALS

A. Galvanized Sheet Steel: Comply with ASTM A 653/A 653M.

1. Galvanized Coating Designation: G60.
2. Exposed-Surface Finish: Mill phosphatized.

B. Stainless-Steel Sheets: Comply with ASTM A 480/A 480M, Type 304, and having a No. 2 finish for concealed ducts and painted finish for exposed ducts.

C. Aluminum Sheets: Comply with ASTM B 209, Alloy 3003, Temper H14; with mill finish for concealed ducts and standard, 1-side bright finish for exposed ducts.

D. Extruded Aluminum: Comply with ASTM B 221, Alloy 6063, Temper T6.

E. Reinforcement Shapes and Plates: Galvanized-steel reinforcement where installed on galvanized sheet metal ducts; compatible materials for aluminum and stainless-steel ducts.

F. Tie Rods: Galvanized steel, 1/4-inch minimum diameter for lengths 36 inches or less; 3/8-inch minimum diameter for lengths longer than 36 inches.

2.3 BACKDRAFT AND PRESSURE RELIEF DAMPERS

A. Manufacturers: Subject to compliance with requirements, provide products by one of the following:

B. Basis-of-Design Product: Subject to compliance with requirements, provide product indicated on Drawings or comparable product by one of the following:

1. Air Balance Inc.; a division of Mestek, Inc.
2. American Warming and Ventilating; a division of Mestek, Inc.
3. Cesco Products; a division of Mestek, Inc.
4. Greenheck Fan Corporation.
5. Lloyd Industries, Inc.

6. Nailor Industries Inc.
7. NCA Manufacturing, Inc.
8. Pottorff.
9. Ruskin Company.
10. Vent Products Company, Inc.

C. Description: Gravity balanced.

D. Maximum Air Velocity: 1250 fpm.

E. Maximum System Pressure: 2-inch wg.

F. Frame: Hat-shaped, 0.05-inch-thick, galvanized sheet steel, with welded corners or mechanically attached and mounting flange.

G. Blades: Multiple single-piece blades, center pivoted, maximum 6-inch width, 0.025-inch-thick, roll-formed aluminum noncombustible, tear-resistant, neoprene-coated fiberglass with sealed edges.

H. Blade Action: Parallel.

I. Blade Seals: Neoprene, mechanically locked.

J. Blade Axles:

1. Material: Nonferrous metal.
2. Diameter: 0.20 inch.

K. Tie Bars and Brackets: Aluminum.

L. Return Spring: Adjustable tension.

M. Bearings: Steel ball or synthetic pivot bushings.

N. Accessories:

1. Adjustment device to permit setting for varying differential static pressure.
2. Counterweights and spring-assist kits for vertical airflow installations.
3. Electric actuators.
4. Chain pulls.
5. Screen Mounting: Front mounted in sleeve.

    a. Sleeve Thickness: 20 gage minimum.
    b. Sleeve Length: 6 inches minimum.

6. Screen Mounting: Rear mounted.
7. Screen Material: Aluminum.
8. Screen Type: Insect.

9. 90-degree stops.

2.4 MANUAL VOLUME DAMPERS

A. Standard, Steel, Manual Volume Dampers:

1. Manufacturers: Subject to compliance with requirements, provide products by the following available manufacturers offering products that may be incorporated into the Work include, but are not limited to, the following:
2. Basis-of-Design Product: Subject to compliance with requirements, provide product indicated on Drawings or comparable product by one of the following:

   a. Air Balance Inc.; a division of Mestek, Inc.
   b. American Warming and Ventilating; a division of Mestek, Inc.
   c. Flexmaster U.S.A., Inc.
   d. McGill AirFlow LLC.
   e. Nailor Industries Inc.
   f. Pottorff.
   g. Ruskin Company.
   h. Trox USA Inc.
   i. Vent Products Company, Inc.

3. Standard leakage rating, with linkage outside airstream.
4. Suitable for horizontal or vertical applications.
5. Frames:

   a. Frame: Hat-shaped, 0.094-inch-thick, galvanized sheet steel.
   b. Mitered and welded corners.
   c. Flanges for attaching to walls and flangeless frames for installing in ducts.

6. Blades:

   a. Multiple or single blade.
   b. Parallel- or opposed-blade design.
   c. Stiffen damper blades for stability.
   d. Galvanized-steel, 0.064 inch thick.

7. Blade Axles: Galvanized steel.
8. Bearings:

   a. Oil-impregnated bronze.
   b. Dampers in ducts with pressure classes of 3-inch wg or less shall have axles full length of damper blades and bearings at both ends of operating shaft.

9. Tie Bars and Brackets: Galvanized steel.

B. Standard, Aluminum, Manual Volume Dampers:

1. Manufacturers: Subject to compliance with requirements, provide products by the following available manufacturers offering products that may be incorporated into the Work include, but are not limited to, the following:
2. Basis-of-Design Product: Subject to compliance with requirements, provide product indicated on Drawings or comparable product by one of the following:

    a. Air Balance Inc.; a division of Mestek, Inc.
    b. American Warming and Ventilating; a division of Mestek, Inc.
    c. McGill AirFlow LLC.
    d. Nailor Industries Inc.
    e. Pottorff.
    f. Ruskin Company.
    g. Trox USA Inc.
    h. Vent Products Company, Inc.

3. Standard leakage rating, with linkage outside airstream.
4. Suitable for horizontal or vertical applications.
5. Frames: Hat-shaped, 0.10-inch-thick, aluminum sheet channels; frames with flanges for attaching to walls and flangeless frames for installing in ducts.
6. Blades:

    a. Multiple or single blade.
    b. Parallel- or opposed-blade design.
    c. Stiffen damper blades for stability.
    d. Roll-Formed Aluminum Blades: 0.10-inch-thick aluminum sheet.
    e. Extruded-Aluminum Blades: 0.050-inch-thick extruded aluminum.

7. Blade Axles: Galvanized steel.
8. Bearings:

    a. Oil-impregnated bronze.
    b. Dampers in ducts with pressure classes of 3-inch wg or less shall have axles full length of damper blades and bearings at both ends of operating shaft.

9. Tie Bars and Brackets: Aluminum.

C. Jackshaft:

1. Size: 0.5-inch diameter.
2. Material: Galvanized-steel pipe rotating within pipe-bearing assembly mounted on supports at each mullion and at each end of multiple-damper assemblies.
3. Length and Number of Mountings: As required to connect linkage of each damper in multiple-damper assembly.

D. Damper Hardware:

1. Zinc-plated, die-cast core with dial and handle made of 3/32-inch-thick zinc-plated steel, and a 3/4-inch hexagon locking nut.

2. Include center hole to suit damper operating-rod size.
3. Include elevated platform for insulated duct mounting.

2.5 CONTROL DAMPERS

A. Manufacturers: Subject to compliance with requirements, provide products by the following available manufacturers offering products that may be incorporated into the Work include, but are not limited to, the following:

B. Basis-of-Design Product: Subject to compliance with requirements, provide product indicated on Drawings or comparable product by one of the following:

1. American Warming and Ventilating; a division of Mestek, Inc.
2. Arrow United Industries; a division of Mestek, Inc.
3. Cesco Products; a division of Mestek, Inc.
4. Greenheck Fan Corporation.
5. Lloyd Industries, Inc.
6. McGill AirFlow LLC.
7. Metal Form Manufacturing, Inc.
8. Nailor Industries Inc.
9. NCA Manufacturing, Inc.
10. Pottorff.
11. Ruskin Company.
12. Vent Products Company, Inc.
13. Young Regulator Company.

C. Frames:

1. Hat shaped.
2. 0.094-inch-thick, galvanized sheet steel.
3. Mitered and welded corners.

D. Blades:

1. Multiple blade with maximum blade width of 6 inches.
2. Opposed-blade design.
3. Galvanized-steel.
4. 0.064 inch thick single skin.
5. Blade Edging: Closed-cell neoprene.
6. Blade Edging: Inflatable seal blade edging, or replaceable rubber seals.

E. Blade Axles: 1/2-inch-diameter; galvanized steel; blade-linkage hardware of zinc-plated steel and brass; ends sealed against blade bearings.

1. Operating Temperature Range: From minus 40 to plus 200 deg F.

F. Bearings:

1. Oil-impregnated bronze.
2. Dampers in ducts with pressure classes of 3-inch wg or less shall have axles full length of damper blades and bearings at both ends of operating shaft.
3. Thrust bearings at each end of every blade.

2.6 FIRE DAMPERS

A. Manufacturers: Subject to compliance with requirements, provide products by the following available manufacturers offering products that may be incorporated into the Work include, but are not limited to, the following:

B. Basis-of-Design Product: Subject to compliance with requirements, provide product indicated on Drawings or comparable product by one of the following:

1. Air Balance Inc.; a division of Mestek, Inc.
2. Arrow United Industries; a division of Mestek, Inc.
3. Cesco Products; a division of Mestek, Inc.
4. Greenheck Fan Corporation.
5. Nailor Industries Inc.
6. NCA Manufacturing, Inc.
7. Pottorff.
8. Prefco; Perfect Air Control, Inc.
9. Ruskin Company.
10. Vent Products Company, Inc.
11. Ward Industries, Inc.; a division of Hart & Cooley, Inc.

C. Type: Static and dynamic; rated and labeled according to UL 555 by an NRTL.

D. Closing rating in ducts up to 4-inch wg static pressure class and minimum 2000-fpm velocity.

E. Fire Rating: 1-1/2 and 3 hours.

F. Frame: Curtain type with blades outside airstream except when located behind grille where blades may be inside airstream; fabricated with roll-formed, 0.034-inch-thick galvanized steel; with mitered and interlocking corners.

G. Mounting Sleeve: Factory- or field-installed, galvanized sheet steel.

1. Minimum Thickness: 0.138 inch or 0.39 inch thick, as indicated, and of length to suit application.
2. Exception: Omit sleeve where damper-frame width permits direct attachment of perimeter mounting angles on each side of wall or floor; thickness of damper frame must comply with sleeve requirements.

H. Mounting Orientation: Vertical or horizontal as indicated.

I. Blades: Roll-formed, interlocking, 0.024-inch-thick, galvanized sheet steel. In place of interlocking blades, use full-length, 0.034-inch-thick, galvanized-steel blade connectors.

J. Horizontal Dampers: Include blade lock and stainless-steel closure spring.

K. Heat-Responsive Device: Replaceable, 165 deg F rated, fusible links.

L. Heat-Responsive Device: , replaceable link and switch package, factory installed, 165 deg F and 212 deg F rated.

## 2.7 FLANGE CONNECTORS

A. Manufacturers: Subject to compliance with requirements, provide products by the following available manufacturers offering products that may be incorporated into the Work include, but are not limited to, the following:

B. Basis-of-Design Product: Subject to compliance with requirements, provide product indicated on Drawings or comparable product by one of the following:

1. Ductmate Industries, Inc.
2. Nexus PDQ; Division of Shilco Holdings Inc.
3. Ward Industries, Inc.; a division of Hart & Cooley, Inc.

C. Description: Add-on or roll-formed, factory-fabricated, slide-on transverse flange connectors, gaskets, and components.

D. Material: Galvanized steel.

E. Gage and Shape: Match connecting ductwork.

## 2.8 TURNING VANES

A. Manufacturers: Subject to compliance with requirements, provide products by the following available manufacturers offering products that may be incorporated into the Work include, but are not limited to, the following:

B. Basis-of-Design Product: Subject to compliance with requirements, provide product indicated on Drawings or comparable product by one of the following:

1. Ductmate Industries, Inc.
2. Duro Dyne Inc.
3. Elgen Manufacturing.
4. METALAIRE, Inc.
5. SEMCO Incorporated.
6. Ward Industries, Inc.; a division of Hart & Cooley, Inc.

C. Manufactured Turning Vanes for Metal Ducts: Curved blades of galvanized sheet steel; support with bars perpendicular to blades set; set into vane runners suitable for duct mounting.

1. Acoustic Turning Vanes: Fabricate airfoil-shaped aluminum extrusions with perforated faces and fibrous-glass fill.

D. Manufactured Turning Vanes for Nonmetal Ducts: Fabricate curved blades of resin-bonded fiberglass with acrylic polymer coating; support with bars perpendicular to blades set; set into vane runners suitable for duct mounting.

E. General Requirements: Comply with SMACNA's "HVAC Duct Construction Standards - Metal and Flexible"; Figures 4-3, "Vanes and Vane Runners," and 4-4, "Vane Support in Elbows."

F. Vane Construction: Double wall.

## 2.9 DUCT-MOUNTED ACCESS DOORS

A. Manufacturers: Subject to compliance with requirements, provide products by the following available manufacturers offering products that may be incorporated into the Work include, but are not limited to, the following:

B. Basis-of-Design Product: Subject to compliance with requirements, provide product indicated on Drawings or comparable product by one of the following:

1. American Warming and Ventilating; a division of Mestek, Inc.
2. Cesco Products; a division of Mestek, Inc.
3. Ductmate Industries, Inc.
4. Elgen Manufacturing.
5. Flexmaster U.S.A., Inc.
6. Greenheck Fan Corporation.
7. McGill AirFlow LLC.
8. Nailor Industries Inc.
9. Pottorff.
10. Ventfabrics, Inc.
11. Ward Industries, Inc.; a division of Hart & Cooley, Inc.

C. Duct-Mounted Access Doors: Fabricate access panels according to SMACNA's "HVAC Duct Construction Standards - Metal and Flexible"; Figures 7-2, "Duct Access Doors and Panels," and 7-3, "Access Doors - Round Duct."

1. Door:

a. Double wall, rectangular.
b. Galvanized sheet metal with insulation fill and thickness as indicated for duct pressure class.
c. Vision panel.

d. Hinges and Latches: 1-by-1-inchbutt or piano hinge and cam latches.
e. Fabricate doors airtight and suitable for duct pressure class.

2. Frame: Galvanized sheet steel, with bend-over tabs and foam gaskets.
3. Number of Hinges and Locks:

a. Access Doors Less Than 12 Inches Square: No hinges and two sash locks.
b. Access Doors up to 18 Inches Square: Continuous and two sash locks.
c. Access Doors up to 24 by 48 Inches: Continuous and two compression latches.
d. Access Doors Larger Than 24 by 48 Inches: Continuous and two compression latches with outside and inside handles.

D. Pressure Relief Access Door:

1. Door and Frame Material: Galvanized sheet steel.
2. Door: Double wall with insulation fill with metal thickness applicable for duct pressure class.
3. Operation: Open outward for positive-pressure ducts and inward for negative-pressure ducts.
4. Factory set at 3.0- to 8.0-inch wg.
5. Doors close when pressures are within set-point range.
6. Hinge: Continuous piano.
7. Latches: Cam.
8. Seal: Neoprene or foam rubber.
9. Insulation Fill: 1-inch-thick, fibrous-glass or polystyrene-foam board.

## 2.10 DUCT ACCESS PANEL ASSEMBLIES

A. Manufacturers: Subject to compliance with requirements, provide products by the following available manufacturers offering products that may be incorporated into the Work include, but are not limited to, the following:

B. Basis-of-Design Product: Subject to compliance with requirements, provide product indicated on Drawings or comparable product by one of the following:

1. Ductmate Industries, Inc.
2. Flame Gard, Inc.
3. 3M.

C. Labeled according to UL 1978 by an NRTL.

D. Panel and Frame: Minimum thickness 0.0528-inch carbon steel.

E. Fasteners: Carbon steel. Panel fasteners shall not penetrate duct wall.

F. Gasket: Comply with NFPA 96; grease-tight, high-temperature ceramic fiber, rated for minimum 2000 deg F.

G. Minimum Pressure Rating: 10-inch wg, positive or negative.

2.11 FLEXIBLE CONNECTORS

A. Manufacturers: Subject to compliance with requirements, provide products by the following available manufacturers offering products that may be incorporated into the Work include, but are not limited to, the following:

B. Basis-of-Design Product: Subject to compliance with requirements, provide product indicated on Drawings or comparable product by one of the following:

1. Ductmate Industries, Inc.
2. Duro Dyne Inc.
3. Elgen Manufacturing.
4. Ventfabrics, Inc.
5. Ward Industries, Inc.; a division of Hart & Cooley, Inc.

C. Materials: Flame-retardant or noncombustible fabrics.

D. Coatings and Adhesives: Comply with UL 181, Class 1.

E. Metal-Edged Connectors: Factory fabricated with a fabric strip 3-1/2 inches wide attached to two strips of 2-3/4-inch-wide, 0.028-inch-thick, galvanized sheet steel or 0.032-inch-thick aluminum sheets. Provide metal compatible with connected ducts.

F. Indoor System, Flexible Connector Fabric: Glass fabric double coated with neoprene.

1. Minimum Weight: 26 oz./sq. yd..
2. Tensile Strength: 480 lbf/inch in the warp and 360 lbf/inch in the filling.
3. Service Temperature: Minus 40 to plus 200 deg F.

G. Outdoor System, Flexible Connector Fabric: Glass fabric double coated with weatherproof, synthetic rubber resistant to UV rays and ozone.

1. Minimum Weight: 24 oz./sq. yd..
2. Tensile Strength: 530 lbf/inch in the warp and 440 lbf/inch in the filling.
3. Service Temperature: Minus 50 to plus 250 deg F.

2.12 FLEXIBLE DUCTS

A. Manufacturers: Subject to compliance with requirements, provide products by the following available manufacturers offering products that may be incorporated into the Work include, but are not limited to, the following:

B. Basis-of-Design Product: Subject to compliance with requirements, provide product indicated on Drawings or comparable product by one of the following:

1. Flexmaster U.S.A., Inc.
2. McGill AirFlow LLC.
3. Ward Industries, Inc.; a division of Hart & Cooley, Inc.

C. Noninsulated, Flexible Duct: UL 181, Class 1, 2-ply vinyl film supported by helically wound, spring-steel wire.

1. Pressure Rating: 10-inch wg positive and 1.0-inch wg negative.
2. Maximum Air Velocity: 4000 fpm.
3. Temperature Range: Minus 10 to plus 160 deg F.

D. Insulated, Flexible Duct: UL 181, Class 1, aluminum laminate and polyester film with latex adhesive supported by helically wound, spring-steel wire; fibrous-glass insulation; aluminized vapor-barrier film.

1. Pressure Rating: 10-inch wg positive and 1.0-inch wg negative.
2. Maximum Air Velocity: 4000 fpm.
3. Temperature Range: Minus 20 to plus 210 deg F.
4. Insulation R-value: Comply with ASHRAE/IESNA 90.1.

E. Flexible Duct Connectors:

1. Clamps: Stainless-steel band with cadmium-plated hex screw to tighten band with a worm-gear action in sizes 3 through 18 inches, to suit duct size.
2. Non-Clamp Connectors: Adhesive.

## 2.13 DUCT ACCESSORY HARDWARE

A. Instrument Test Holes: Cast iron or cast aluminum to suit duct material, including screw cap and gasket. Size to allow insertion of pitot tube and other testing instruments and of length to suit duct-insulation thickness.

B. Adhesives: High strength, quick setting, neoprene based, waterproof, and resistant to gasoline and grease.

# PART 3 - EXECUTION

## 3.1 INSTALLATION

A. Install duct accessories according to applicable details in SMACNA's "HVAC Duct Construction Standards - Metal and Flexible" for metal ducts and in NAIMA AH116, "Fibrous Glass Duct Construction Standards," for fibrous-glass ducts.

B. Install duct accessories of materials suited to duct materials; use galvanized-steel accessories in galvanized-steel and fibrous-glass ducts, stainless-steel accessories in stainless-steel ducts, and aluminum accessories in aluminum ducts.

C. Install backdraft dampers at inlet of exhaust fans or exhaust ducts as close as possible to exhaust fan unless otherwise indicated.

D. Install volume dampers at points on supply, return, and exhaust systems where branches extend from larger ducts. Where dampers are installed in ducts having duct liner, install dampers with hat channels of same depth as liner, and terminate liner with nosing at hat channel.

1. Install steel volume dampers in steel ducts.
2. Install aluminum volume dampers in aluminum ducts.

E. Set dampers to fully open position before testing, adjusting, and balancing.

F. Install test holes at fan inlets and outlets and elsewhere as indicated.

G. Install fire dampers according to UL listing.

H. Install duct access doors on sides of ducts to allow for inspecting, adjusting, and maintaining accessories and equipment at the following locations:

1. On both sides of duct coils.
2. Upstream and downstream from duct filters.
3. At outdoor-air intakes and mixed-air plenums.
4. At drain pans and seals.
5. Downstream from manual volume dampers, control dampers, backdraft dampers, and equipment.
6. Adjacent to and close enough to fire or smoke dampers, to reset or reinstall fusible links. Access doors for access to fire or smoke dampers having fusible links shall be pressure relief access doors and shall be outward operation for access doors installed upstream from dampers and inward operation for access doors installed downstream from dampers.
7. At each change in direction and at maximum 50-foot spacing.
8. Upstream and downstream from turning vanes.
9. Upstream or downstream from duct silencers.
10. Control devices requiring inspection.
11. Elsewhere as indicated.

I. Install access doors with swing against duct static pressure.

J. Access Door Sizes:

1. One-Hand or Inspection Access: 8 by 5 inches.
2. Two-Hand Access: 12 by 6 inches.
3. Head and Hand Access: 18 by 10 inches.

4. Head and Shoulders Access: 21 by 14 inches.
5. Body Access: 25 by 14 inches.
6. Body plus Ladder Access: 25 by 17 inches.

K. Label access doors according to Section 230553 "Identification for HVAC Piping and Equipment" to indicate the purpose of access door.

L. Install flexible connectors to connect ducts to equipment.

M. Connect terminal units to supply ducts with maximum 12-inch lengths of flexible duct. Do not use flexible ducts to change directions.

N. Connect diffusers or light troffer boots to ducts directly or with maximum 60-inch lengths of flexible duct clamped or strapped in place.

O. Connect flexible ducts to metal ducts with liquid adhesive plus tape.

P. Install duct test holes where required for testing and balancing purposes.

3.2 FIELD QUALITY CONTROL

A. Tests and Inspections:

1. Operate dampers to verify full range of movement.
2. Inspect locations of access doors and verify that purpose of access door can be performed.
3. Operate fire and smoke dampers to verify full range of movement and verify that proper heat-response device is installed.
4. Inspect turning vanes for proper and secure installation.

END OF SECTION 233300

# SECTION 233346 - FLEXIBLE DUCTS

## PART 1 - GENERAL

### 1.1 SUMMARY

A. Section Includes:

1. Insulated flexible ducts.

### 1.2 ACTION SUBMITTALS

A. Product Data: For each type of product.

B. Shop Drawings: For flexible ducts.

1. Include plans showing locations and mounting and attachment details.

### 1.3 INFORMATIONAL SUBMITTALS

A. Coordination Drawings: Reflected ceiling plans, drawn to scale, and coordinated with each other, using input from installers of the items involved.

## PART 2 - PRODUCTS

### 2.1 ASSEMBLY DESCRIPTION

A. Comply with NFPA 90A, "Installation of Air Conditioning and Ventilating Systems," and with NFPA 90B, "Installation of Warm Air Heating and Air Conditioning Systems."

B. Comply with SMACNA's "HVAC Duct Construction Standards - Metal and Flexible" for acceptable materials, material thicknesses, and duct construction methods unless otherwise indicated. Sheet metal materials shall be free of pitting, seam marks, roller marks, stains, discolorations, and other imperfections.

C. Comply with the Air Diffusion Council's "ADC Flexible Air Duct Test Code FD 72-R1."

D. Comply with ASTM E 96/E 96M, "Test Methods for Water Vapor Transmission of Materials."

### 2.2 INSULATED FLEXIBLE DUCTS

A. Manufacturers: Subject to compliance with requirements, provide products by one of the following:

1. Flexmaster U.S.A., Inc.
2. JP Lamborn Co.
3. McGill AirFlow LLC.
4. Thermaflex; a Flex-Tek Group company.
5. Ward Industries; a brand of Hart & Cooley, Inc.

B. Insulated, Flexible Duct: UL 181, Class 1, two-ply vinyl film supported by helically wound, spring-steel wire; fibrous-glass insulation; polyethylene vapor-barrier film.

1. Pressure Rating: 10-inch wg (2500 Pa) positive and 1.0-inch wg (250 Pa) negative.
2. Maximum Air Velocity: 4000 fpm (20 m/s).
3. Temperature Range: Minus 10 to plus 160 deg F (Minus 23 to plus 71 deg C).
4. Insulation R-Value: Comply with ASHRAE/IES 90.1 R8.

C. Insulated, Flexible Duct: UL 181, Class 1, multiple layers of aluminum laminate supported by helically wound, spring-steel wire; fibrous-glass insulation; polyethylene vapor-barrier film.

1. Pressure Rating: 10-inch wg (2500 Pa) positive and 1.0-inch wg (250 Pa) negative.
2. Maximum Air Velocity: 4000 fpm (20 m/s).
3. Temperature Range: Minus 20 to plus 210 deg F (Minus 29 to plus 99 deg C).
4. Insulation R-Value: Comply with ASHRAE/IES 90.1 R8.

## 2.3 FLEXIBLE DUCT CONNECTORS

A. Clamps: Stainless-steel band with cadmium-plated hex screw to tighten band with a worm-gear action in sizes 3 through 18 inches (75 through 460 mm), to suit duct size.

B. Non-Clamp Connectors: Liquid adhesive plus tape.

# PART 3 - EXECUTION

## 3.1 INSTALLATION

A. Install flexible ducts according to applicable details in SMACNA's "HVAC Duct Construction Standards - Metal and Flexible" for metal ducts and in NAIMA AH116, "Fibrous Glass Duct Construction Standards," for fibrous-glass ducts.

B. Install in indoor applications only. Flexible ductwork should not be exposed to UV lighting.

C. Connect terminal units to supply ducts directly or with maximum 12-inch (300-mm) lengths of flexible duct. Do not use flexible ducts to change directions.

D. Connect diffusers or light troffer boots to ducts directly or with maximum 60-inch (1500-mm) lengths of flexible duct clamped or strapped in place.

E. Connect flexible ducts to metal ducts with liquid adhesive plus tape.

F. Install duct test holes where required for testing and balancing purposes.

G. Installation:

1. Install ducts fully extended.
2. Do not bend ducts across sharp corners.
3. Bends of flexible ducting shall not exceed a minimum of one duct diameter.
4. Avoid contact with metal fixtures, water lines, pipes, or conduits.
5. Install flexible ducts in a direct line, without sags, twists, or turns.

H. Supporting Flexible Ducts:

1. Suspend flexible ducts with bands 1-1/2 inches (38 mm) wide or wider and spaced a maximum of 48 inches (1200 mm) apart. Maximum centerline sag between supports shall not exceed 1/2 inch (13 mm) per 12 inches (300 mm).
2. Install extra supports at bends placed approximately one duct diameter from center line of the bend.
3. Ducts may rest on ceiling joists or truss supports. Spacing between supports shall not exceed the maximum spacing per manufacturer's written installation instructions.
4. Vertically installed ducts shall be stabilized by support straps at a maximum of 72 inches (1800 mm) o.c.

END OF SECTION 233346

# SECTION 233713 - DIFFUSERS, REGISTERS, AND GRILLES

## PART 1 - GENERAL

### 1.1 SUMMARY

A. Section Includes:

1. Rectangular and square ceiling diffusers.
2. Louver face diffusers.
3. Linear bar diffusers.
4. Adjustable bar registers and grilles.
5. Fixed face registers and grilles.
6. Linear bar grilles.

B. Related Sections:

1. Section 233300 "Air Duct Accessories" for fire and smoke dampers and volume-control dampers not integral to diffusers, registers, and grilles.

### 1.2 ACTION SUBMITTALS

A. Product Data: For each type of product indicated, include the following:

1. Data Sheet: Indicate materials of construction, finish, and mounting details; and performance data including throw and drop, static-pressure drop, and noise ratings.
2. Diffuser, Register, and Grille Schedule: Indicate drawing designation, room location, quantity, model number, size, and accessories furnished.

B. Samples: For each exposed product and for each color and texture specified.

## PART 2 - PRODUCTS

### 2.1 CEILING DIFFUSERS

A. Rectangular and Square Ceiling Diffusers:

1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
2. Basis-of-Design Product: Subject to compliance with requirements, provide product indicated on Drawings or comparable product by one of the following:

a. A-J Manufacturing Co., Inc.

b. Anemostat Products; a Mestek company.
c. Carnes.
d. Hart & Cooley Inc.
e. Krueger.
f. METALAIRE, Inc.
g. Nailor Industries Inc.
h. Price Industries.
i. Titus.
j. Tuttle & Bailey.

3. Devices shall be specifically designed for variable-air-volume flows.
4. Material: Aluminum.
5. Finish: Baked enamel, color selected by Architect.
6. Face Size: 24 by 24 inches or 12 by 12 inches.
7. Face Style: Four cone.
8. Mounting: T-bar.
9. Pattern: Adjustable.
10. Dampers: Radial opposed blade.
11. Accessories:

a. Equalizing grid.
b. Plaster ring.
c. Safety chain.
d. Wire guard.
e. Sectorizing baffles.
f. Operating rod extension.

B. Louver Face Diffuser:

1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
2. Basis-of-Design Product: Subject to compliance with requirements, provide product indicated on Drawings or comparable product by one of the following:

a. A-J Manufacturing Co., Inc.
b. Anemostat Products; a Mestek company.
c. Carnes.
d. METALAIRE, Inc.
e. Nailor Industries Inc.
f. Price Industries.
g. Titus.
h. Tuttle & Bailey.

3. Devices shall be specifically designed for variable-air-volume flows.
4. Material: Aluminum.
5. Finish: Baked enamel, color selected by Architect.
6. Mounting: Surface.

7. Pattern: One-way & Adjustable core style.
8. Dampers: Radial opposed blade.
9. Accessories:

    a. Square to round neck adaptor.
    b. Adjustable pattern vanes.
    c. Throw reducing vanes.
    d. Equalizing grid.
    e. Plaster ring.
    f. Safety chain.
    g. Wire guard.
    h. Sectorizing baffles.
    i. Operating rod extension.

## 2.2 CEILING LINEAR SLOT OUTLETS

A. Linear Bar Diffuser:

1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
2. Basis-of-Design Product: Subject to compliance with requirements, provide product indicated on Drawings or comparable product by one of the following:

    a. Air Research Diffuser Products, Inc.
    b. Anemostat Products; a Mestek company.
    c. Carnes.
    d. Dayus Register & Grille Inc.
    e. Hart & Cooley Inc.
    f. Krueger.
    g. METALAIRE, Inc.
    h. Nailor Industries Inc.
    i. Price Industries.
    j. Titus.
    k. Tuttle & Bailey.

3. Devices shall be specifically designed for variable-air-volume flows.
4. Material: Aluminum.
5. Finish: Baked enamel, color selected by Architect.
6. Narrow Core Spacing Arrangement: 1/8-inch-thick blades spaced 1/4 inch apart, zero-degree deflection.
7. Wide Core Spacing Arrangement: 1/8-inch-thick blades spaced 1/2 inch apart, zero-degree deflection.
8. Wide Core Spacing Arrangement: 3/16-inch-thick blades spaced 1/2 inch apart, zero-degree deflection.
9. Pencil-Proof Core Spacing Arrangement: 3/16-inch-thick blades spaced 7/16 inch apart, zero-degree deflection.

10. One-Way Deflection Vanes: Extruded construction fixed louvers with removable core.
11. Frame: 1 inch wide.
12. Accessories: Directional vanes.

B. Linear Slot Diffuser:

1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
2. Basis-of-Design Product: Subject to compliance with requirements, provide product indicated on Drawings or comparable product by one of the following:

    a. Air Research Diffuser Products, Inc.
    b. Anemostat Products; a Mestek company.
    c. Carnes.
    d. Hart & Cooley Inc.
    e. Krueger.
    f. METALAIRE, Inc.
    g. Nailor Industries Inc.
    h. Price Industries.
    i. Titus.
    j. Tuttle & Bailey.

3. Devices shall be specifically designed for variable-air-volume flows.
4. Material - Shell: Aluminum, noninsulated.
5. Material - Pattern Controller and Tees: Aluminum.
6. Finish - Face and Shell: Baked enamel, black.
7. Finish - Pattern Controller: Baked enamel, black.
8. Finish - Tees: Baked enamel, color selected by Architect.
9. Slot Width: 1-1/2 inches.
10. Number of Slots: Two.
11. Length: 48 inches.
12. Accessories: T-bar slot.

2.3 REGISTERS AND GRILLES

A. Adjustable Bar Register:

1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
2. Basis-of-Design Product: Subject to compliance with requirements, provide product indicated on Drawings or comparable product by one of the following:

    a. A-J Manufacturing Co., Inc.
    b. Anemostat Products; a Mestek company.
    c. Carnes.
    d. Dayus Register & Grille Inc.
    e. Hart & Cooley Inc.

f. Krueger.
g. METALAIRE, Inc.
h. Nailor Industries Inc.
i. Price Industries.
j. Titus.
k. Tuttle & Bailey.

3. Material: Aluminum.
4. Finish: Baked enamel, color selected by Architect.
5. Face Blade Arrangement: Horizontal spaced 3/4 inch apart.
6. Core Construction: Removable.
7. Rear-Blade Arrangement: Vertical spaced 3/4 inch apart.
8. Frame: 1-1/4 inches wide.
9. Mounting: Countersunk screw.
10. Damper Type: Adjustable opposed blade.
11. Accessories:

a. Rear-blade gang operator.
b. Filter.

B. Adjustable Bar Grille:

1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
2. Basis-of-Design Product: Subject to compliance with requirements, provide product indicated on Drawings or comparable product by one of the following:

a. A-J Manufacturing Co., Inc.
b. Anemostat Products; a Mestek company.
c. Carnes.
d. Dayus Register & Grille Inc.
e. Hart & Cooley Inc.
f. Krueger.
g. METALAIRE, Inc.
h. Nailor Industries Inc.
i. Price Industries.
j. Titus.
k. Tuttle & Bailey.

3. Material: Aluminum.
4. Finish: Baked enamel, color selected by Architect.
5. Face Blade Arrangement: Horizontal spaced 3/4 inch apart.
6. Core Construction: Removable.
7. Rear-Blade Arrangement: Vertical spaced 3/4 inch apart.
8. Frame: 1-1/4 inches wide.
9. Mounting: Countersunk screw.

C. Fixed Face Register:

1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
2. Basis-of-Design Product: Subject to compliance with requirements, provide product indicated on Drawings or comparable product by one of the following:

    a. A-J Manufacturing Co., Inc.
    b. Anemostat Products; a Mestek company.
    c. Carnes.
    d. Dayus Register & Grille Inc.
    e. Hart & Cooley Inc.
    f. Krueger.
    g. Nailor Industries Inc.
    h. Price Industries.
    i. Titus.
    j. Tuttle & Bailey.

3. Material: Aluminum.
4. Finish: Baked enamel, color selected by Architect.
5. Face Arrangement: 1/2-by-1/2-by-1/2-inch grid core.
6. Core Construction: Removable.
7. Frame: 1-1/4 inches wide.
8. Mounting: Countersunk screw.
9. Damper Type: Adjustable opposed blade.
10. Accessory: Filter.

D. Fixed Face Grille:

1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
2. Basis-of-Design Product: Subject to compliance with requirements, provide product indicated on Drawings or comparable product by one of the following:

    a. A-J Manufacturing Co., Inc.
    b. Anemostat Products; a Mestek company.
    c. Carnes.
    d. Dayus Register & Grille Inc.
    e. Hart & Cooley Inc.
    f. Krueger.
    g. Nailor Industries Inc.
    h. Price Industries.
    i. Titus.
    j. Tuttle & Bailey.

3. Material: Aluminum.
4. Finish: Baked enamel, color selected by Architect.

5. Face Arrangement: 1/2-by-1/2-by-1/2-inch grid core.
6. Core Construction: Removable.
7. Frame: 1-1/4 inches wide.
8. Mounting: Lay in.
9. Accessory: Filter.

E. Linear Bar Grille:

1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
2. Basis-of-Design Product: Subject to compliance with requirements, provide product indicated on Drawings or comparable product by one of the following:

    a. A-J Manufacturing Co., Inc.
    b. Anemostat Products; a Mestek company.
    c. Carnes.
    d. Dayus Register & Grille Inc.
    e. Hart & Cooley Inc.
    f. Krueger.
    g. Nailor Industries Inc.
    h. Price Industries.
    i. Titus.
    j. Tuttle & Bailey.

3. Material: Aluminum.
4. Finish: Baked enamel, color selected by Architect.
5. Face Arrangement: 1/2-by-1/2-by-1/2-inch grid core.
6. Distribution plenum.

    a. Internal insulation.
    b. Inlet damper.

7. Frame: 1-1/4 inches wide.
8. Mounting: Lay in.
9. Damper Type: Adjustable opposed blade.

## 2.4 SOURCE QUALITY CONTROL

A. Verification of Performance: Rate diffusers, registers, and grilles according to ASHRAE 70, "Method of Testing for Rating the Performance of Air Outlets and Inlets."

PART 3 - EXECUTION

3.1 INSTALLATION

A. Install diffusers, registers, and grilles level and plumb.

B. Ceiling-Mounted Outlets and Inlets: Drawings indicate general arrangement of ducts, fittings, and accessories. Air outlet and inlet locations have been indicated to achieve design requirements for air volume, noise criteria, airflow pattern, throw, and pressure drop. Make final locations where indicated, as much as practical. For units installed in lay-in ceiling panels, locate units in the center of panel. Where architectural features or other items conflict with installation, notify Architect for a determination of final location.

C. Install diffusers, registers, and grilles with airtight connections to ducts and to allow service and maintenance of dampers, air extractors, and fire dampers.

3.2 ADJUSTING

A. After installation, adjust diffusers, registers, and grilles to air patterns indicated, or as directed, before starting air balancing.

END OF SECTION 233713

# SECTION 234100 - PARTICULATE AIR FILTRATION

## PART 1 - GENERAL

### 1.1 SUMMARY

A. Section Includes:

1. Pleated panel filters.
2. Filter gauges.

B. Related Requirements:

1. Section 237313.16 "Indoor, Semi-Custom Air-Handling Units".

### 1.2 ACTION SUBMITTALS

A. Product Data: For each type of product.

B. Shop Drawings: For air filters. Include plans, elevations, sections, details, and attachments to other work.

1. Show filter rack assembly, dimensions, materials, and methods of assembly of components.
2. Include setting drawings, templates, and requirements for installing anchor bolts and anchorages.

### 1.3 INFORMATIONAL SUBMITTALS

A. Seismic Qualification Data: Certificates, for filters, accessories, and components from manufacturer.

B. Product test reports.

C. Field quality-control reports.

### 1.4 CLOSEOUT SUBMITTALS

A. Operation and Maintenance Data: For each type of filter and rack to include in emergency, operation, and maintenance manuals.

### 1.5 QUALITY ASSURANCE

A. Testing Agency Qualifications: An NRTL.

PART 2 - PRODUCTS

2.1 PERFORMANCE REQUIREMENTS

A. ASHRAE Compliance:

1. Comply with applicable requirements in ASHRAE 62.1, Section 4 - "Outdoor Air Quality"; Section 5 - "Systems and Equipment"; and Section 7 - "Construction and Startup."
2. Comply with ASHRAE 52.2 for MERV for methods of testing and rating air-filter units.

B. Comply with NFPA 90A and NFPA 90B.

C. Comply with UL 900.

D. Electrical Components, Devices, and Accessories: Listed and labeled as defined in NFPA 70, by a qualified testing agency, and marked for intended location and application.

2.2 PLEATED PANEL FILTERS

A. Description: Factory-fabricated, self-supported, extended-surface, pleated, panel-type, disposable air filters with holding frames.

1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:

a. 3M.
b. AAF International.
c. AirGuard; Clarcor Air Filtration Products, Inc.
d. Air-Nu.
e. Camfil Farr.
f. Columbus Industries, Inc.
g. Filtration Group.
h. Flanders Corporation.
i. Glasfloss Industries.
j. Koch Filter Corporation.
k. Tri-Dim Filter Corporation.

B. Capacities and Characteristics:

1. Drawing Tag No.: AHU-1, AHU-2 or AHU-3
2. Face Size: Per manufacturer’s requirements.
3. Depth: 2 inches (50 mm) nominal.
4. Number of Filters, Wide by High: Per manufacturer’s requirements.
5. System Airflow: See drawings.
6. Maximum or Rated Face Velocity: 350 fpm.
7. Initial Resistance: 0.25-inch wg (62 Pa) at 350 fpm (1.8 m/s).
8. Recommended Final Resistance: 0.50 inches wg (Pa).

9. Minimum Efficiency Reporting Value: MERV 13, with "Composite Average Particle Size Efficiency, Percent in Size Range, Micrometers" according to ASHRAE 52.2.
10. Access: Side.

C. Media: Cotton and synthetic fibers coated with nonflammable adhesive. Coat media with an antimicrobial agent.

1. Separators shall be bonded to the media to maintain pleat configuration.
2. Welded-wire grid shall be on downstream side to maintain pleat.
3. Media shall be bonded to frame to prevent air bypass.
4. Support members on upstream and downstream sides to maintain pleat spacing.

D. Filter-Media Frame: Cardboard frame with perforated metal retainer sealed or bonded to the media.

## 2.3 FILTER GAUGES

A. Diaphragm-type gauge with dial and pointer in metal case, vent valves, black figures on white background, and front recalibration adjustment.

1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:

   a. AirGuard; Clarcor Air Filtration Products, Inc.
   b. Dwyer Instruments, Inc.

2. Diameter: 2 inches (50 mm).
3. Scale Range for Filter Media Having a Recommended Final Resistance of 0.5-Inch wg (125 Pa) or Less: 0- to 0.5-inch wg (0 to 125 Pa).
4. Scale Range for Filter Media Having a Recommended Final Resistance of 0.5- to 1.0-Inch wg (125 to 250 Pa) or Less: 0- to 1.0-inch wg (0 to 250 Pa).
5. Scale Range for Filter Media Having a Recommended Final Resistance of 1.0- to 2.0-Inch wg (250 to 500 Pa) or Less: 0- to 2.0-inch wg (0 to 500 Pa).
6. Scale Range for Filter Media Having a Recommended Final Resistance of 2.0- to 3.0-Inch wg (500 to 750 Pa) or Less: 0- to 3.0-inch wg (0 to 750 Pa).
7. Scale Range for Filter Media Having a Recommended Final Resistance of 3.0- to 4.0-Inch wg (750 to 1000 Pa) or Less: 0- to 4.0-inch wg (0 to 1000 Pa).

B. Manometer-Type Filter Gauge: Molded plastic, with epoxy-coated aluminum scale and logarithmic-curve tube gage with integral leveling gage, graduated to read from 0- to 3.0-inch wg (0 to 750 Pa), and accurate within 3 percent of the full-scale range.

C. Accessories: Static-pressure tips, tubing, gauge connections, and mounting bracket.

PART 3 - EXECUTION

3.1 INSTALLATION OF FILTERS

A. Position each filter unit with clearance for normal service and maintenance. Anchor filter holding frames to substrate.

B. Install filters in position to prevent passage of unfiltered air.

C. Install filter gauge for each filter bank.

D. Do not operate fan system until filters (temporary or permanent) are in place. Replace temporary filters used during construction and testing with new, clean filters.

E. Coordinate filter installations with duct and air-handling-unit installations.

3.2 INSTALLATION OF FILTER GAUGES

A. Install filter gauge for each filter bank.

B. Install filter-gauge, static-pressure tips upstream and downstream from filters. Install filter gauges on filter banks with separate static-pressure taps upstream and downstream from filters. Mount filter gauges on outside of filter housing or filter plenum in an accessible position. Adjust and level inclined gauges.

3.3 CONTROL CONNECTIONS

A. Install control and electrical power wiring to field-mounted control devices.

B. Connect control wiring between pressure sensors and DDC system.

C. Connect control wiring between controlled devices.

D. Connect control wiring according to Section 260523 "Control-Voltage Electrical Power Cables."

3.4 FIELD QUALITY CONTROL

A. Testing Agency: Owner will engage a qualified testing agency to perform tests and inspections.

B. Testing Agency: Engage a qualified testing agency to perform tests and inspections.

C. Perform tests and inspections with the assistance of a factory-authorized service representative.

D. Tests and Inspections:

1. Test for leakage of unfiltered air while system is operating.

E. Air filter will be considered defective if it does not pass tests and inspections.

F. Prepare test and inspection reports.

3.5 CLEANING

A. After completing system installation and testing, adjusting, and balancing of air-handling and air-distribution systems, clean filter housings and install new filter media.

END OF SECTION 234100

# SECTION 238126 - SPLIT-SYSTEM AIR-CONDITIONERS

## PART 1 - GENERAL

### 1.1 SUMMARY

A. Section includes split-system air-conditioning and heat-pump units consisting of separate evaporator-fan and compressor-condenser components.

### 1.2 ACTION SUBMITTALS

A. Product Data: For each type of product indicated.

B. Shop Drawings: Include plans, elevations, sections, details, and attachments to other work.

1. Detail equipment assemblies and indicate dimensions, weights, loads, required clearances, method of field assembly, components, and location and size of each field connection.

### 1.3 INFORMATIONAL SUBMITTALS

A. Warranty: Sample of special warranty.

### 1.4 CLOSEOUT SUBMITTALS

A. Operation and maintenance data.

### 1.5 QUALITY ASSURANCE

A. Electrical Components, Devices, and Accessories: Listed and labeled as defined in NFPA 70, by a qualified testing agency, and marked for intended location and application.

B. ASHRAE Compliance:

1. Fabricate and label refrigeration system to comply with ASHRAE 15, "Safety Standard for Refrigeration Systems."
2. ASHRAE Compliance: Applicable requirements in ASHRAE 62.1, Section 4 - "Outdoor Air Quality," Section 5 - "Systems and Equipment," Section 6 - " Procedures," and Section 7 - "Construction and System Start-up."

C. ASHRAE/IESNA Compliance: Applicable requirements in ASHRAE/IESNA 90.1.

1.6 WARRANTY

A. Special Warranty: Manufacturer's standard form in which manufacturer agrees to repair or replace components of split-system air-conditioning units that fail in materials or workmanship within specified warranty period.

1. Warranty Period:

a. For Compressor: One year(s) from date of Substantial Completion.
b. For Parts: One year(s) from date of Substantial Completion.
c. For Labor: One year(s) from date of Substantial Completion.

PART 2 - PRODUCTS

2.1 MANUFACTURERS

A. Manufacturers: Subject to compliance with requirements, provide products by one of the following available manufacturers offering products that may be incorporated into the Work include, but are not limited to, the following:

B. Basis-of-Design Product: Subject to compliance with requirements, provide product indicated on Drawings or comparable product by one of the following:

1. Carrier Corporation; Home Comfort and HVAC Building & Industrial Systems.
2. Mitsubishi Electric & Electronics USA, Inc.; HVAC Advanced Products Division.
3. Mitsubishi Electric Sales Canada Inc.
4. Trane; a business of American Standard companies.
5. YORK; a Johnson Controls company.

2.2 INDOOR UNITS (5 TONS OR LESS)

A. Concealed Evaporator-Fan Components:

1. Chassis: Galvanized steel with flanged edges, removable panels for servicing, and insulation on back of panel.
2. Insulation: Faced, glass-fiber duct liner.
3. Refrigerant Coil: Copper tube, with mechanically bonded aluminum fins and thermal-expansion valve. Comply with ARI 206/110.
4. Water Coil: Copper tube, with mechanically bonded aluminum fins spaced no closer than 0.1 inch; leak tested to 300 psig underwater; with a two-position control valve.
5. Electric Coil: Helical, nickel-chrome, resistance-wire heating elements; with refractory ceramic support bushings, automatic-reset thermal cutout, built-in magnetic contactors, manual-reset thermal cutout, airflow proving device, and one-time fuses in terminal box for overcurrent protection.

6. Fan: Forward-curved, double-width wheel of galvanized steel; directly connected to motor.
7. Fan Motors:

    a. Comply with NEMA designation, temperature rating, service factor, enclosure type, and efficiency requirements specified in Section 230513 "Common Motor Requirements for HVAC Equipment."
    b. Variable speed with internal thermal protection and permanent lubrication.
    c. Wiring Terminations: Connect motor to chassis wiring with plug connection.

8. Airstream Surfaces: Surfaces in contact with the airstream shall comply with requirements in ASHRAE 62.1.
9. Filters: Permanent, cleanable.
10. Condensate Drain Pans:

    a. Fabricated with one percent slope in at least two planes to collect condensate from cooling coils (including coil piping connections, coil headers, and return bends) and humidifiers, and to direct water toward drain connection.

        1) Length: Extend drain pan downstream from leaving face to comply with ASHRAE 62.1.
        2) Depth: A minimum of 2 inches deep.

    b. Single-wall, stainless-steel sheet.
    c. Double-wall, stainless-steel sheet with space between walls filled with foam insulation and moisture-tight seal.
    d. Drain Connection: Located at lowest point of pan and sized to prevent overflow. Terminate with threaded nipple on one end of pan.

        1) Minimum Connection Size: NPS 1.

    e. Pan-Top Surface Coating: Asphaltic waterproofing compound.
    f. Units with stacked coils shall have an intermediate drain pan to collect condensate from top coil.

2.3 OUTDOOR UNITS (5 TONS OR LESS)

A. Air-Cooled, Compressor-Condenser Components:

1. Casing: Steel, finished with baked enamel in color selected by Architect, with removable panels for access to controls, weep holes for water drainage, and mounting holes in base. Provide brass service valves, fittings, and gage ports on exterior of casing.
2. Compressor: Hermetically sealed with crankcase heater and mounted on vibration isolation device. Compressor motor shall have thermal- and current-sensitive overload devices, start capacitor, relay, and contactor.

    a. Compressor Type: Scroll.

b. Minimum Two-speed compressor motor with manual-reset high-pressure switch and automatic-reset low-pressure switch.
c. Refrigerant Charge: R-410A.
d. Refrigerant Coil: Copper tube, with mechanically bonded aluminum fins and liquid subcooler. Comply with ARI 206/110.

3. Heat-Pump Components: Reversing valve and low-temperature-air cutoff thermostat.
4. Fan: Aluminum-propeller type, directly connected to motor.
5. Motor: Permanently lubricated, with integral thermal-overload protection.
6. Low Ambient Kit: Permits operation down to 45 deg F.
7. Mounting Base: Polyethylene.
8. Coil Guards: Required. Install from factory or field installed.
9. Mount on 6" thick concrete pad and secure for 160 mph wind loading.

2.4 ACCESSORIES

A. Thermostat: Programmable, touch screen, low voltage with subbase to control compressor and evaporator fan.

B. Thermostat: Wireless infrared functioning to remotely control compressor and evaporator fan, with the following features:

1. Compressor time delay.
2. 24-hour time control of system stop and start.
3. Liquid-crystal display indicating temperature, set-point temperature, time setting, operating mode, and fan speed.
4. Fan-speed selection including auto setting.

C. Automatic-reset timer to prevent rapid cycling of compressor.

D. Refrigerant Line Kits: Soft-annealed copper suction and liquid lines factory cleaned, dried, pressurized, and sealed; factory-insulated suction line with flared fittings at both ends.

E. Drain Hose: For condensate.

F. Additional Monitoring:

1. Monitor constant and variable motor loads.
2. Monitor variable-frequency-drive operation.
3. Monitor economizer cycle.
4. Monitor cooling load.
5. Monitor air distribution static pressure and ventilation air volumes.

2.5 CAPACITIES AND CHARACTERISTICS

A. Cooling Capacity: See Drawings.

PART 3 - EXECUTION

3.1 INSTALLATION

A. Install units level and plumb.

B. Install evaporator-fan components using manufacturer's standard mounting devices securely fastened to building structure.

C. Install roof-mounted, compressor-condenser components on equipment supports specified in Section 077200 "Roof Accessories." Anchor units to supports with removable, cadmium-plated fasteners.

D. Equipment Mounting:

1. Install ground-mounted, compressor-condenser components on cast-in-place concrete equipment base(s). Comply with requirements for equipment bases and foundations specified in Section 033000 "Cast-in-Place Concrete."
2. Install ground-mounted, compressor-condenser components on polyethylene mounting base.
3. Comply with requirements for vibration isolation and seismic control devices specified in Section 230548 "Vibration and Seismic Controls for HVAC."
4. Comply with requirements for vibration isolation devices specified in Section 230548.13 "Vibration Controls for HVAC."

E. Install and connect precharged refrigerant tubing to component's quick-connect fittings. Install tubing to allow access to unit.

3.2 CONNECTIONS

A. Where piping is installed adjacent to unit, allow space for service and maintenance of unit.

B. Duct Connections: Duct installation requirements are specified in Section 233113 "Metal Ducts." Drawings indicate the general arrangement of ducts. Connect supply and return ducts to split-system air-conditioning units with flexible duct connectors. Flexible duct connectors are specified in Section 233300 "Air Duct Accessories."

3.3 FIELD QUALITY CONTROL

A. Perform tests and inspections.

1. Manufacturer's Field Service: Engage a factory-authorized service representative to inspect components, assemblies, and equipment installations, including connections, and to assist in testing.

B. Tests and Inspections:

1. Leak Test: After installation, charge system and test for leaks. Repair leaks and retest until no leaks exist.
2. Operational Test: After electrical circuitry has been energized, start units to confirm proper motor rotation and unit operation.
3. Test and adjust controls and safeties. Replace damaged and malfunctioning controls and equipment.

C. Remove and replace malfunctioning units and retest as specified above.

D. Prepare test and inspection reports.

3.4 DEMONSTRATION

A. Train Owner's maintenance personnel to adjust, operate, and maintain units.

END OF SECTION 238126

# SECTION 260526 - GROUNDING AND BONDING FOR ELECTRICAL SYSTEMS

## PART 1 - GENERAL

### 1.1 SUMMARY

A. Section Includes:

1. Grounding and bonding conductors.
2. Grounding and bonding clamps.
3. Grounding and bonding bushings.
4. Grounding and bonding hubs.
5. Grounding and bonding connectors.
6. Intersystem bonding bridge grounding connector.
7. Grounding and bonding busbars.
8. Grounding (earthing) electrodes.

B. Related Requirements:

1. Section 260010 "Supplemental Requirements for Electrical" for additional abbreviations, definitions, submittals, qualifications, testing agencies, and other Project requirements applicable to Work specified in this Section.
2. Section 260011 "Facility Performance Requirements for Electrical" for seismic-load, wind-load, acoustical, and other field conditions applicable to Work specified in this Section.

### 1.2 ACTION SUBMITTALS

A. Product Data:

1. For each type of product indicated.

## PART 2 - PRODUCTS

### 2.1 GROUNDING AND BONDING CONDUCTORS

A. Equipment Grounding Conductor:

1. General Characteristics: 600 V, THHN/THWN-2 or THWN-2, copper wire or cable, green color, in accordance with Section 260519 "Low-Voltage Electrical Power Conductors and Cables."

B. Isolated Equipment Grounding Conductor:

1. General Characteristics: 600 V, THHN/THWN-2 or THWN-2, copper wire or cable, green color with one or more yellow stripes, in accordance with Section 260519 "Low-Voltage Electrical Power Conductors and Cables."

C. ASTM - Bare Copper Grounding and Bonding Conductor:
   1. Referenced Standards: Complying with one or more of the following:

      a. Soft or Annealed Copper Wire: ASTM B3
      b. Concentric-Lay Stranded Copper Conductor: ASTM B8.
      c. Tin-Coated Soft or Annealed Copper Wire: ASTM B33.
      d. 19-Wire Combination Unilay-Stranded Copper Conductor: ASTM B787/B787M.

## 2.2 GROUNDING AND BONDING CLAMPS

A. Description: Clamps suitable for attachment of grounding and bonding conductors to grounding electrodes, pipes, tubing, and rebar. Grounding and bonding clamps specified in this article are also suitable for use with communications applications; see Section 270526 "Grounding and Bonding for Communications Systems," for selection and installation guidelines.

B. Performance Criteria:

   1. Regulatory Requirements:

      a. Listed and labeled in accordance with NFPA 70, by qualified electrical testing laboratory recognized by authorities having jurisdiction, and marked for intended location and application.

   2. Listing Criteria:

      a. Grounding and Bonding Equipment: UL CCN KDER; including UL 467.

   3. Sustainability Characteristics:

## 2.3 GROUNDING AND BONDING BUSHINGS

A. Description: Bonding bushings connect conduit fittings, tubing fittings, threaded metal conduit, and unthreaded metal conduit to metal boxes and equipment enclosures, and have one or more bonding screws intended to provide electrical continuity between bushing and enclosure. Grounding bushings have provision for connection of bonding or grounding conductor and may or may not also have bonding screws.

B. Performance Criteria:

   1. Regulatory Requirements:

      a. Listed and labeled in accordance with NFPA 70, by qualified electrical testing laboratory recognized by authorities having jurisdiction, and marked for intended location and application.

   2. Listing Criteria:

a. Grounding and Bonding Equipment: UL CCN KDER; including UL 467.

## 2.4 GROUNDING AND BONDING CONNECTORS

A. Performance Criteria:

1. Regulatory Requirements:

a. Listed and labeled in accordance with NFPA 70, by qualified electrical testing laboratory recognized by authorities having jurisdiction, and marked for intended location and application.

2. Listing Criteria:

a. Grounding and Bonding Equipment: UL CCN KDER; including UL 467.
b. Grounding and Bonding Equipment for Communications: UL CCN KDSH; including UL 467.

## 2.5 INTERSYSTEM BONDING BRIDGE GROUNDING CONNECTORS

A. Description: Devices that provide means for connecting communications systems grounding and bonding conductors at service equipment or at disconnecting means for buildings or structures.

B. Performance Criteria:

1. Regulatory Requirements:

a. Listed and labeled in accordance with NFPA 70, by qualified electrical testing laboratory recognized by authorities having jurisdiction, and marked for intended location and application.

2. Listing Criteria:

a. Grounding and Bonding Equipment for Communications: UL CCN KDSH; including UL 467.

## 2.6 GROUNDING AND BONDING BUSBARS

A. Description: Miscellaneous grounding and bonding device that serves as common connection for multiple grounding and bonding conductors.

B. Performance Criteria:

1. Regulatory Requirements:

a. Listed and labeled in accordance with NFPA 70, by qualified electrical testing laboratory recognized by authorities having jurisdiction, and marked for intended location and application.

2. Listing Criteria:

a. Grounding and Bonding Equipment: UL CCN KDER; including UL 467.

## 2.7 GROUNDING (EARTHING) ELECTRODES

A. Description: Grounding electrodes include rod electrodes, ring electrodes, metal underground water pipes, metal building frames, concrete-encased electrodes, and pipe and plate electrodes.

B. Performance Criteria:

1. Regulatory Requirements:

a. Listed and labeled in accordance with NFPA 70, by qualified electrical testing laboratory recognized by authorities having jurisdiction, and marked for intended location and application.

2. Listing Criteria:

a. Grounding and Bonding Equipment: UL CCN KDER; including UL 467.

C. Rod Electrode:
1. General Characteristics: Copper-clad steel, sectional type; 3/4 inch by 10 ft.

# PART 3 - EXECUTION

## 3.1 EXAMINATION

A. Examine facility's grounding electrode system and equipment grounding for compliance with requirements for maximum ground-resistance level and other conditions affecting performance of grounding and bonding of electrical system.

B. Inspect test results of grounding system measured at point of electrical service equipment connection.

C. Prepare written report, endorsed by Installer, listing conditions detrimental to performance of the Work.

D. Proceed with connection of electrical service equipment only after unsatisfactory conditions have been corrected.

## 3.2 SELECTION OF GROUNDING AND BONDING CONDUCTORS

A. Conductors: Install solid conductor for 8 AWG and smaller, and stranded conductors for 6 AWG and larger unless otherwise indicated.

B. Custom-Length Insulated Equipment Bonding Jumpers: 6 AWG, 19-strand, Type THHN.

C. Bonding Cable: 28 kcmil, 14 strands of 17 AWG conductor, 1/4 inch in diameter.

D. Bonding Conductor: 4 AWG or 6 AWG, stranded conductor.

E. Bonding Jumper: Copper tape, braided conductors terminated with copper ferrules; 1-5/8 inch wide and 1/16 inch thick.

F. Tinned Bonding Jumper: Tinned-copper tape, braided conductors terminated with copper ferrules; 1-5/8 inch wide and 1/16 inch thick.

G. Underground Grounding Conductors: Install bare copper conductor as indicated on drawings.

1. Bury at least 30 inch below grade.

## 3.3 SELECTION OF CONNECTORS

A. Conductor Terminations and Connections:

1. Pipe and Equipment Grounding Conductor Terminations: Bolted connectors.
2. Underground Connections: Welded connectors except at test wells and as otherwise indicated.
3. Connections to Ground Rods at Test Wells: Bolted connectors.
4. Connections to Structural Steel: Welded connectors.

## 3.4 INSTALLATION

A. Comply with manufacturer's published instructions.

1. Electrodes:

a. Ground Rods: Drive rods until tops are 2 inch below finished floor or final grade unless otherwise indicated.

1) Interconnect ground rods with grounding electrode conductor below grade and as otherwise indicated. Make connections without exposing steel or damaging coating if any.
2) Use exothermic welds for below-grade connections.

b. For grounding electrode system, install at least three rods spaced at least one-rod length from each other and located at least same distance from other grounding electrodes, and connect to service grounding electrode conductor.

c. Concrete-Encased Electrode (Ufer Ground):

1) Fabricate in accordance with NFPA 70; using electrically conductive coated steel reinforcing bars or rods, at least 20 ft long. If reinforcing is in multiple pieces, connect together by usual steel tie wires or exothermic welding to create required length.

2. Grounding at Service:

a. Equipment grounding conductors and grounding electrode conductors must be connected to ground bus. Install main bonding jumper between neutral and ground buses.

3. Equipment Grounding:

a. Install insulated equipment grounding conductors with feeders and branch circuits.

b. Air-Duct Equipment Circuits: Install insulated equipment grounding conductor to duct-mounted electrical devices operating at 120 V and more, including air cleaners, heaters, dampers, humidifiers, and other duct electrical equipment. Bond conductor to each unit and to air duct and connected metallic piping.

c. Water Heater, Heat-Tracing, and Antifrost Heating Cables: Install separate insulated equipment grounding conductor to each electric water heater and heat-tracing cable. Bond conductor to heater units, piping, connected equipment, and components.

d. Isolated Grounding Receptacle Circuits: Install insulated equipment grounding conductor connected to receptacle grounding terminal. Isolate conductor from raceway and from panelboard grounding terminals. Terminate at equipment grounding conductor terminal of applicable derived system or service unless otherwise indicated.

e. Metallic Fences: Comply with requirements of IEEE C2.

1) Grounding Conductor: Bare, copper, not less than 8 AWG.
2) Gates: Must be bonded to grounding conductor with flexible bonding jumper.
3) Barbed Wire: Strands must be bonded to grounding conductor.

## 3.5 FIELD QUALITY CONTROL

A. Testing Preparation:

B. Tests and Inspections:

1. After installing grounding system but before permanent electrical circuits have been energized, test for compliance with requirements.
2. Inspect physical and mechanical condition. Verify tightness of accessible, bolted, electrical connections with calibrated torque wrench in accordance with manufacturer's published instructions.
3. Test completed grounding system at each location where maximum ground-resistance level is specified, at service disconnect enclosure grounding terminal, and at individual ground rods. Make tests at ground rods before conductors are connected.

a. Measure ground resistance no fewer than two full days after last trace of precipitation and without soil being moistened by means other than natural drainage or seepage and without chemical treatment or other artificial means of reducing natural ground resistance.

b. Perform tests by fall-of-potential method in accordance with IEEE Std 81.

c. Excessive Ground Resistance: If resistance to ground exceeds specified values, notify Architect promptly and include recommendations to reduce ground resistance.

C. Nonconforming Work:

1. Grounding system will be considered defective if it does not pass tests and inspections.
2. Remove and replace defective components and retest.

3.6 PROTECTION

A. After installation, protect grounding and bonding cables and equipment from construction activities. Remove and replace items that are contaminated, defaced, damaged, or otherwise caused to be unfit for use prior to acceptance by Owner.

END OF SECTION 260526

# SECTION 260529 - HANGERS AND SUPPORTS FOR ELECTRICAL SYSTEMS

## PART 1 - GENERAL

### 1.1 SUMMARY

A. Section Includes:

1. Steel slotted support systems.
2. Conduit and cable support devices.
3. Support for conductors in vertical conduit.
4. Structural steel for fabricated supports and restraints.
5. Mounting, anchoring, and attachment components, including powder-actuated fasteners, mechanical expansion anchors, concrete inserts, clamps, through bolts, toggle bolts, and hanger rods.
6. Fabricated metal equipment support assemblies.

B. Related Requirements:

1. Section 260010 "Supplemental Requirements for Electrical" for additional abbreviations, definitions, submittals, qualifications, testing agencies, and other Project requirements applicable to Work specified in this Section.
2. Section 260011 "Facility Performance Requirements for Electrical" for seismic-load, wind-load, acoustical, and other field conditions applicable to Work specified in this Section.

### 1.2 ACTION SUBMITTALS

A. Product Data: For each type of product.

B. Shop Drawings: For fabrication and installation details for electrical hangers and support systems.

1. Hangers. Include product data for components.
2. Slotted support systems.
3. Equipment supports.
4. Vibration Isolation Base Details: Detail fabrication including anchorages and attachments to structure and to supported equipment. Include adjustable motor bases, rails, and frames for equipment mounting.

### 1.3 INFORMATIONAL SUBMITTALS

A. Welding certificates.

PART 2 - PRODUCTS

2.1 SUPPORT, ANCHORAGE, AND ATTACHMENT COMPONENTS

A. Steel Slotted Support Systems: Preformed steel channels and angles with minimum 13/32 inch (10 mm) diameter holes at a maximum of 8 inch (200 mm) on center in at least one surface.

1. <Double click here to find, evaluate, and insert list of manufacturers and products.>
2. Standard: Comply with MFMA-4 factory-fabricated components for field assembly.
3. Material for Channel, Fittings, and Accessories: Galvanized steel.
4. Channel Width: Selected for applicable load criteria 1-5/8 inch (41.25 mm).
5. Metallic Coatings: Hot-dip galvanized after fabrication and applied according to MFMA-4.

B. Conduit and Cable Support Devices: Steel hangers, clamps, and associated fittings, designed for types and sizes of raceway or cable to be supported.

C. Support for Conductors in Vertical Conduit: Factory-fabricated assembly consisting of threaded body and insulating wedging plug or plugs for nonarmored electrical conductors or cables in riser conduits. Plugs must have number, size, and shape of conductor gripping pieces as required to suit individual conductors or cables supported. Body must be made of malleable iron.

D. Structural Steel for Fabricated Supports and Restraints: ASTM A36/A36M steel plates, shapes, and bars; black and galvanized.

E. Mounting, Anchoring, and Attachment Components: Items for fastening electrical items or their supports to building surfaces include the following:

1. Mechanical-Expansion Anchors: Insert-wedge-type, [zinc-coated] [stainless] steel, for use in hardened portland cement concrete, with tension, shear, and pullout capacities appropriate for supported loads and building materials where used.

2. Concrete Inserts: Steel or malleable-iron, slotted support system units are similar to MSS Type 18 units and comply with MFMA-4 or MSS SP-58.
3. Clamps for Attachment to Steel Structural Elements: MSS SP-58 units are suitable for attached structural element.
4. Through Bolts: Structural type, hex head, and high strength. Comply with ASTM F3125/F3125M, Grade A325 (Grade A325M).
5. Toggle Bolts: [All] [Stainless] steel springhead type.
6. Hanger Rods: Threaded steel.

PART 3 - EXECUTION

3.1 SELECTION

A. Comply with the following standards for selection and installation of hangers and supports, except where requirements on Drawings or in this Section are stricter:

1. NECA NEIS 101
2. NECA NEIS 102.
3. NECA NEIS 105.
4. NECA NEIS 111.

B. Comply with requirements in Section 078413 "Penetration Firestopping" for firestopping materials and installation for penetrations through fire-rated walls, ceilings, and assemblies.

C. Comply with requirements for raceways and boxes specified in Section 260533 "Raceway and Boxes for Electrical Systems."

D. Maximum Support Spacing and Minimum Hanger Rod Size for Raceways: Space supports for EMT, IMC, and ERMC as scheduled in NECA NEIS 1, where its Table 1 lists maximum spacings that are less than those stated in NFPA 70. Minimum rod size must be 1/4 inch (6 mm) in diameter.

E. Multiple Raceways or Cables: Install trapeze-type supports fabricated with steel slotted [or other ]support system, sized so capacity can be increased by at least 25 percent in future without exceeding specified design load limits.

1. Secure raceways and cables to these supports with two-bolt conduit clamps.

## 3.2 INSTALLATION OF SUPPORTS

A. Comply with NECA NEIS 101 for installation requirements except as specified in this article.

B. Raceway Support Methods: In addition to methods described in NECA NEIS 1, EMT, IMC and ERMC may be supported by openings through structure members, in accordance with NFPA 70.

C. Strength of Support Assemblies: Where not indicated, select sizes of components so strength will be adequate to carry present and future static loads within specified loading limits. Minimum static design load used for strength determination must be weight of supported components plus 200 lb (90 kg).

D. Mounting and Anchorage of Surface-Mounted Equipment and Components: Anchor and fasten electrical items and their supports to building structural elements by the following methods unless otherwise indicated by code:

1. To Wood: Fasten with lag screws or through bolts.
2. To New Concrete: Bolt to concrete inserts.
3. To Masonry: Approved toggle-type bolts on hollow masonry units and expansion anchor fasteners on solid masonry units.
4. To Existing Concrete: Expansion anchor fasteners.
5. To Steel: Beam clamps (MSS SP-58, Type 19, 21, 23, 25, or 27), complying with MSS SP-69.
6. To Light Steel: Sheet metal screws.
7. Items Mounted on Hollow Walls and Nonstructural Building Surfaces: Mount cabinets, panelboards, disconnect switches, control enclosures, pull and junction boxes, transformers, and other devices on slotted-channel racks attached to substrate.

E. Drill holes for expansion anchors in concrete at locations and to depths that avoid the need for reinforcing bars.

3.3 INSTALLATION OF FABRICATED METAL SUPPORTS

A. Comply with installation requirements in Section 055000 "Metal Fabrications" for site-fabricated metal supports.

B. Cut, fit, and place miscellaneous metal supports accurately in location, alignment, and elevation to support and anchor electrical materials and equipment.

C. Field Welding: Comply with AWS D1.1/D1.1M. Submit welding certificates.

END OF SECTION 260529

# SECTION 260533 - RACEWAY AND BOXES FOR ELECTRICAL SYSTEMS

## PART 1 - GENERAL

### 1.1 SUMMARY

A. Section Includes:

1. Type EMT-A and Type EMT-SS raceways and elbows.
2. Type EMT-S raceways and elbows.
3. Type ERMC-A and Type ERMC-SS raceways, elbows, couplings, and nipples.
4. Type ERMC-S raceways, elbows, couplings, and nipples.
5. Type IMC raceways.
6. Type LFMC raceways.
7. Type PVC raceways and fittings.
8. Fittings for conduit, tubing, and cable.
9. Threaded metal joint compound.
10. Solvent cements.
11. Surface metal raceways and fittings.
12. Wireways and auxiliary gutters.
13. Metallic outlet boxes, device boxes, rings, and covers.
14. Nonmetallic outlet boxes, device boxes, rings, and covers.
15. Termination boxes.
16. Cabinets, cutout boxes, junction boxes, and pull boxes.
17. Cover plates for device boxes.
18. Hoods for outlet boxes.

B. Related Requirements:

1. Section 260010 "Supplemental Requirements for Electrical" for additional abbreviations, definitions, submittals, qualifications, testing agencies, and other Project requirements applicable to Work specified in this Section.
2. Section 260011 "Facility Performance Requirements for Electrical" for seismic-load, wind-load, acoustical, and other field conditions applicable to Work specified in this Section.

### 1.2 ACTION SUBMITTALS

A. Product Data: For the following:

1. Wireways and auxiliary gutters.
2. Surface metal raceways.
3. Floor boxes.
4. Cabinets and cutout boxes.

B. Sustainable Design Submittals:

C. Shop Drawings: For custom enclosures and cabinets. Include plans, elevations, sections, and attachment details. Show that floor boxes are located to avoid interferences and are structurally allowable. Indicate floor thickness where boxes are embedded in concrete floors and underfloor clearances where boxes are installed in raised floors.

1.3 INFORMATIONAL SUBMITTALS

A. Manufacturers' Instructions:

1. For Type ERMC-S-PVC.

PART 2 - PRODUCTS

2.1 TYPE EMT-A AND TYPE EMT-SS RACEWAYS AND ELBOWS

A. Performance Criteria:

1. Regulatory Requirements: Listed and labeled in accordance with NFPA 70 and marked for intended location and use.
2. General Characteristics: UL 797A and UL Category Control Number FJMX.

B. Stainless Steel Electrical Metal Tubing (EMT-SS) and Elbows:
1. Material: Stainless steel.
2. Options:

a. Minimum Trade Size: Metric designator 16 (trade size 1/2).
b. Colors: As indicated on Drawings.

2.2 TYPE EMT-S RACEWAYS AND ELBOWS

A. Performance Criteria:

1. Regulatory Requirements: Listed and labeled in accordance with NFPA 70 and marked for intended location and use.
2. General Characteristics: UL 797 and UL Category Control Number FJMX.

B. Steel Electrical Metal Tubing (EMT-S) and Elbows:
1. Material: Steel.
2. Options:

a. Exterior Coating: Zinc.
b. Minimum Trade Size: Metric designator 16 (trade size 1/2).

2.3 TYPE ERMC-A AND TYPE ERMC-SS RACEWAYS, ELBOWS, COUPLINGS, AND NIPPLES

A. Performance Criteria:

1. Regulatory Requirements: Listed and labeled in accordance with NFPA 70 and marked for intended location and use.
2. General Characteristics: UL 6A and UL Category Control Number DYWV.

B. Aluminum Flexible Metal Conduit (FMC-A):
1. Material: Aluminum.
2. Options:

a. Minimum Trade Size: Metric designator 16 (trade size 1/2).

## 2.4 TYPE IMC RACEWAYS

A. Performance Criteria:

1. Regulatory Requirements: Listed and labeled in accordance with NFPA 70 and marked for intended location and use.
2. General Characteristics: UL 1242 and UL Category Control Number DYBY.

B. Steel Electrical Intermediate Metal Conduit (IMC):
1. Options:

a. Exterior Coating: Zinc.
b. Minimum Trade Size: Metric designator 16 (trade size 1/2).

## 2.5 TYPE LFMC RACEWAYS

A. Performance Criteria:

1. Regulatory Requirements: Listed and labeled in accordance with NFPA 70 and marked for intended location and use.
2. General Characteristics: UL 360 and UL Category Control Number DXHR.

B. Stainless Steel Liquidtight Flexible Metal Conduit (LFMC-SS):
1. Material: Stainless steel.
2. Options:

a. Minimum Trade Size: Metric designator 16 (trade size 1/2).

## 2.6 TYPE PVC RACEWAYS AND FITTINGS

A. Performance Criteria:

1. Regulatory Requirements: Listed and labeled in accordance with NFPA 70 and marked for intended location and use.
2. General Characteristics: UL 651 and UL Category Control Number DZYR.

B. Schedule 40 Rigid PVC Conduit (PVC-40) and Fittings:
1. Dimensional Specifications: Schedule 40.
2. Options:

a. Minimum Trade Size: Metric designator 16 (trade size 1/2).
b. Markings: For use with maximum 90 deg C wire.

## 2.7 FITTINGS FOR CONDUIT, TUBING, AND CABLE

A. Performance Criteria:

1. Regulatory Requirements: Listed and labeled in accordance with NFPA 70 and marked for intended location and use.

B. Fittings for Type ERMC, Type IMC, and Type PVC Raceways:
1. General Characteristics: UL 514B and UL Category Control Number DWTT.
2. Options:

a. Material: Steel.
b. Coupling Method: Compression coupling.
c. Conduit Fittings for Hazardous (Classified) Locations: UL 1203.
d. Expansion and Deflection Fittings: UL 651 with flexible external bonding jumper.

C. Fittings for Type EMT Raceways:
1. General Characteristics: UL 514B and UL Category Control Number FKAV.
2. Options:

a. Material: Steel.
b. Coupling Method: Compression coupling.
c. Conduit Fittings for Hazardous (Classified) Locations: UL 1203.
d. Expansion and Deflection Fittings: UL 651 with flexible external bonding jumper.

D. Fittings for Type FMC Raceways:
1. General Characteristics: UL 514B and UL Category Control Number ILNR.

E. Fittings for Type LFMC Raceways:
1. General Characteristics: UL 514B and UL Category Control Number DXAS.

## 2.8 SOLVENT CEMENTS

A. Performance Criteria:

1. Regulatory Requirements: Listed and labeled in accordance with NFPA 70 and marked for intended location and use.
2. General Characteristics: As recommended by conduit manufacturer in accordance with UL 514B and UL Category Control Number DWTT.
3. Sustainability Characteristics:

## 2.9 SURFACE METAL RACEWAYS AND FITTINGS

A. Performance Criteria:

1. Regulatory Requirements: Listed and labeled in accordance with NFPA 70 and marked for intended location and use.
2. General Characteristics: UL 5 and UL Category Control Number RJBT.

B. Surface Metal Raceways and Fittings with Metal Covers:
1. Options:

a. Galvanized steel base with snap-on covers.
b. Manufacturer's standard enamel finish in color selected by Architect.
c. Wiring Channels: Dual. Multiple channels must be capable of housing a standard 20 to 30 A NEMA device flush within the raceway.

C. Surface Metal Raceways and Fittings with Nonmetallic Covers:
1. Additional Characteristics: UL 94, V-0 requirements for self-extinguishing characteristics.
2. Options:

a. Galvanized steel base with snap-on covers.
b. Provide texture and color selected by Architect from manufacturer's standard colors.
c. Wiring Channels: Dual. Multiple channels must be capable of housing a standard 20 to 30 A NEMA device flush within the raceway.

## 2.10 WIREWAYS AND AUXILIARY GUTTERS

A. Performance Criteria:

1. Regulatory Requirements: Listed and labeled in accordance with NFPA 70 and marked for intended location and use.
2. General Characteristics: UL 870 and UL Category Control Number ZOYX.

B. Metal Wireways and Auxiliary Gutters:
1. Additional Characteristics:

a. Fittings and Accessories: Include covers, couplings, offsets, elbows, expansion joints, adapters, hold-down straps, end caps, and other fittings to match and mate with wireways as required for complete system.
b. Finish: Manufacturer's standard enamel finish.

2. Options:
a. Wireway Covers: Screw-cover type unless otherwise indicated.

## 2.11 METALLIC OUTLET BOXES, DEVICE BOXES, RINGS, AND COVERS

A. Performance Criteria:

1. Regulatory Requirements: Listed and labeled in accordance with NFPA 70 and marked for intended location and use.
2. General Characteristics: UL 514A and UL Category Control Number QCIT.

B. Metallic Outlet Boxes:

1. Description: Box having pryout openings, knockouts, threaded entries, or hubs in either the sides of the back, or both, for entrance of conduit, conduit or cable fittings, or cables, with provisions for mounting outlet box cover, but without provisions for mounting wiring device directly to box.
2. Options:

a. Material: Sheet steel.
b. Luminaire Outlet Boxes and Covers: Nonadjustable, listed and labeled for attachment of luminaire weighing up to 50 lb (23 kg).
c. Paddle Fan Outlet Boxes and Covers: Nonadjustable, designed for attachment of paddle fan weighing up to 70 lb (32 kg).

C. Metallic Conduit Bodies:

1. Description: Means for providing access to interior of conduit or tubing system through one or more removable covers at junction or terminal point. In the United States, conduit bodies are listed in accordance with outlet box requirements.

D. Metallic Device Boxes:

1. Description: Box with provisions for mounting wiring device directly to box.
2. Options:

a. Material: Sheet steel.

E. Metallic Floor Boxes and Floor Box Covers:

1. Description: Box mounted in floor with floor box cover and other components to complete floor box enclosure.

F. Metallic Recessed Access-Floor Boxes and Recessed Floor Box Covers:

1. Description: Floor box with provisions for mounting wiring devices below floor surface and floor box cover with provisions for passage of cords to recessed wiring devices mounted within floor box.

G. Metallic Concrete Boxes and Covers:

1. Description: Box intended for use in poured concrete.

## 2.12 NONMETALLIC OUTLET BOXES, DEVICE BOXES, RINGS, AND COVERS

A. Performance Criteria:

1. Regulatory Requirements: Listed and labeled in accordance with NFPA 70 and marked for intended location and use.
2. General Characteristics: UL 514C and UL Category Control Number QCMZ.

B. Nonmetallic Outlet Boxes:

1. Description: Box having pryout openings, knockouts, threaded entries, or hubs in either the sides or the back, or both, for entrance of conduit, conduit or cable fittings, or cables, with provisions for mounting outlet box cover, but without provisions for mounting wiring device directly to box.

C. Nonmetallic Conduit Bodies:

1. Description: Means for providing access to interior of conduit or tubing system through one or more removable covers at junction or terminal point. In the United States, conduit bodies are listed in accordance with outlet box requirements.

D. Nonmetallic Device Boxes:

1. Description: Box with provisions for mounting wiring device directly to box.

E. Nonmetallic Floor Boxes and Floor Box Covers:

1. Description: Box mounted in floor with floor box cover and other components to complete floor box enclosure.

F. Nonmetallic Recessed Access-Floor Boxes and Recessed Floor Box Covers:

1. Description: Floor box with provisions for mounting wiring devices below floor surface and floor box cover with provisions for passage of cords to recessed wiring devices mounted within floor box.

G. Nonmetallic Concrete Boxes and Covers:

1. Description: Box intended for use in poured concrete.

## 2.13 TERMINATION BOXES

A. Description: Enclosure for termination base consisting of lengths of bus bars, terminal strips, or terminal blocks with provision for wire connectors to accommodate incoming or outgoing conductors or both.

B. Performance Criteria:

1. Regulatory Requirements: Listed and labeled in accordance with NFPA 70 and marked for intended location and use.
2. General Characteristics: UL 1773 and UL Category Control Number XCKT.

C. Termination Boxes and Termination Bases for Installation on Line Side of Service Equipment:
1. Additional Characteristics: Listed and labeled for installation on line side of service equipment.

D. Termination Boxes and Termination Bases for Installation on Load Side of Service Equipment:
1. Additional Characteristics: Listed and labeled for installation on load side of service equipment.

2.14 CABINETS, CUTOUT BOXES, JUNCTION BOXES, AND PULL BOXES

A. Performance Criteria:

1. Regulatory Requirements: Listed and labeled in accordance with NFPA 70 and marked for intended location and use.
2. General Characteristics:

a. Non-Environmental Characteristics: UL 50.
b. Environmental Characteristics: UL 50E.

B. Indoor Sheet Metal Cabinets:

1. Description: Enclosure provided with frame, mat, or trim in which swinging door or doors are or can be hung.
2. Additional Characteristics: UL Category Control Number CYIV.

C. Indoor Sheet Metal Cutout Boxes:

1. Description: Enclosure that has swinging doors or covers secured directly to and telescoping with walls of enclosure.
2. Additional Characteristics: UL Category Control Number CYIV.

D. Indoor Sheet Metal Junction and Pull Boxes:

1. Description: Box with a blank cover that serves the purpose of joining different runs of raceway or cable.
2. Additional Characteristics: UL Category Control Number BGUZ.

E. Indoor Cast-Metal Junction and Pull Boxes:

1. Description: Box with a blank cover that serves the purpose of joining different runs of raceway or cable.
2. Additional Characteristics: UL Category Control Number BGUZ.

F. Indoor Polymeric Junction and Pull Boxes:

1. Description: Box with a blank cover that serves the purpose of joining different runs of raceway or cable.
2. Additional Characteristics: UL Category Control Number BGUZ.

G. Outdoor Sheet Metal Cabinets:

1. Description: Enclosure provided with frame, mat, or trim in which swinging door or doors are or can be hung.
2. Additional Characteristics: UL Category Control Number CYIV.

H. Outdoor Sheet Metal Cutout Boxes:

1. Description: Enclosure that has swinging doors or covers secured directly to and telescoping with walls of enclosure.
2. Additional Characteristics: UL Category Control Number CYIV.

I. Outdoor Sheet Metal Junction and Pull Boxes:

1. Description: Box with a blank cover that serves the purpose of joining different runs of raceway or cable.
2. Additional Characteristics: UL Category Control Number BGUZ.

## 2.15 COVER PLATES FOR DEVICES BOXES

A. Performance Criteria:

1. Regulatory Requirements: Listed and labeled in accordance with NFPA 70 and marked for intended location and use.
2. General Characteristics:

a. Reference Standards: UL 514D and UL Category Control Numbers QCIT and QCMZ.
b. Wallplate-Securing Screws: Metal with head color to match wallplate finish.

B. Metallic Cover Plates for Device Boxes:
1. Options:

a. Damp and Wet Locations: Listed, labeled, and marked for location and use. Provide gaskets and accessories necessary for compliance with listing.

C. Nonmetallic Cover Plates for Device Boxes:
1. Options:

a. Damp and Wet Locations: Listed, labeled, and marked for location and use. Provide gaskets and accessories necessary for compliance with listing.
b. Wallplate Material: 0.060 inch (1.5 mm) thick high-impact thermoplastic (nylon) with smooth finish and color matching wiring device.
c. Color: Selected by architect from standard colors.

# PART 3 - EXECUTION

## 3.1 SELECTION OF RACEWAYS

A. Unless more stringent requirements are specified in Contract Documents or manufacturers' written instructions, comply with NFPA 70 for selection of raceways. Consult Architect for resolution of conflicting requirements.

B. Outdoors:

1. Exposed and Subject to Severe Physical Damage: ERMC.
2. Exposed and Subject to Physical Damage: IMC.

a. Locations less than 2.5 m (8 ft) above finished floor.

3. Exposed and Not Subject to Physical Damage: Corrosion-resistant EMT.

4. Concealed Aboveground: EMT.
5. Direct Buried: PVC-40.
6. Concrete Encased Not in Trench: PVC-80.
7. Concrete Encased in Trench: PVC-80.
8. Connection to Vibrating Equipment (Including Transformers and Hydraulic, Pneumatic, Electric Solenoid, or Motor-Driven Equipment): LFMC.

C. Indoors:

1. Hazardous Classified Locations: ERMC.
2. Exposed and Subject to Severe Physical Damage: ERMC. Subject to severe physical damage includes the following locations:

    a. Loading docks.
    b. Corridors used for traffic of mechanized carts, forklifts, and pallet-handling units.
    c. Mechanical rooms.
    d. Gymnasiums.

3. Exposed and Subject to Physical Damage: IMC. Subject to physical damage includes the following locations:

    a. Locations less than 2.5 m (8 ft) above finished floor.
    b. Stub-ups to above suspended ceilings.

4. Exposed and Not Subject to Physical Damage: EMT.
5. Concealed in Ceilings and Interior Walls and Partitions: EMT.
6. Damp or Wet Locations: Corrosion-resistant EMT.
7. Connection to Vibrating Equipment (Including Transformers and Hydraulic, Pneumatic, Electric Solenoid, or Motor-Driven Equipment): FMC.

D. Raceway Fittings: Select fittings in accordance with NEMA FB 2.10 guidelines.

1. ERMC and IMC: Provide threaded type fittings unless otherwise indicated.

## 3.2 SELECTION OF BOXES AND ENCLOSURES

A. Unless more stringent requirements are specified in Contract Documents or manufacturers' written instructions, comply with NFPA 70 for selection of boxes and enclosures. Consult Architect for resolution of conflicting requirements.

B. Degree of Protection:

1. Outdoors:

    a. Type 3R unless otherwise indicated.
    b. Locations Exposed to Hosedown: Type 4X.
    c. Locations Subject to Potential Flooding: Type 6P.
    d. Locations in-Ground or Exposed to Corrosive Agents: Type 4X.
    e. Locations in-Ground or Exposed to Corrosive Agents Where Mechanism Must Operate When Ice Covered: Type 3SX.

2. Indoors:

    a. Type 1 unless otherwise indicated.
    b. Flush Mounted in Kitchens and Other Locations Exposed to Oil or Coolants: Type 12.
    c. Locations Exposed to Airborne Dust, Lint, Fibers, or Flyings: Type 4.
    d. Locations Exposed to Hosedown: Type 6P.
    e. Locations Exposed to Corrosive Agents: Type 4X.

C. Exposed Boxes Installed Less Than 2.5 m (8 ft) Above Floor:

1. Provide cast-metal boxes. Boxes with knockouts or unprotected openings are prohibited.
2. Provide exposed cover. Flat covers with angled mounting slots or knockouts are prohibited.

## 3.3 INSTALLATION OF RACEWAYS

A. Installation Standards:

1. Unless more stringent requirements are specified in Contract Documents or manufacturers' written instructions, comply with NFPA 70 for installation of raceways. Consult Architect for resolution of conflicting requirements.
2. Comply with NFPA 70 limitations for types of raceways allowed in specific occupancies and number of floors.
3. Comply with requirements in Section 260529 "Hangers and Supports for Electrical Systems" for hangers and supports.
4. Comply with NECA NEIS 101 for installation of steel raceways.
5. Comply with NECA NEIS 102 for installation of aluminum raceways.
6. Comply with NECA NEIS 111 for installation of nonmetallic raceways.
7. Install raceways square to the enclosure and terminate at enclosures without hubs with locknuts on both sides of enclosure wall. Install locknuts hand tight, plus one-quarter turn more.
8. Terminate threaded conduits into threaded hubs or with locknuts on inside and outside of boxes or cabinets. Install bushings on conduits up to metric designator 35 (trade size 1-1/4) and insulated throat metal bushings on metric designator 41 (trade size 1-1/2) and larger conduits terminated with locknuts.[ Install insulated throat metal grounding bushings on service conduits].
9. Raceway Terminations at Locations Subject to Moisture or Vibration:

B. General Requirements for Installation of Raceways:

1. Complete raceway installation before starting conductor installation.
2. Provide stub-ups through floors with coupling threaded inside for plugs, set flush with finished floor. Plug coupling until conduit is extended above floor to final destination or a minimum of 2 ft (0.6 m) above finished floor.
3. Make bends in raceway using large-radius preformed ells except for parallel bends. Field bending must be in accordance with NFPA 70 minimum radii requirements. Provide only equipment specifically designed for material and size involved.
4. Conceal conduit within finished walls, ceilings, and floors unless otherwise indicated. Install conduits parallel or perpendicular to building lines.

5. Support conduit within 12 inch (300 mm) of enclosures to which attached.
6. Install raceway sealing fittings at accessible locations in accordance with NFPA 70 and fill them with listed sealing compound. For concealed raceways, install fitting in flush steel box with blank cover plate having finish similar to that of adjacent plates or surfaces. Install raceway sealing fittings in accordance with NFPA 70.
7. Install devices to seal raceway interiors at accessible locations. Locate seals so no fittings or boxes are between the seal and the following changes of environments. Seal interior of raceways at the following points:

    a. Where conduits pass from warm to cold locations, such as boundaries of refrigerated spaces.
    b. Where an underground service raceway enters a building or structure.
    c. Conduit extending from interior to exterior of building.
    d. Conduit extending into pressurized duct and equipment.
    e. Conduit extending into pressurized zones that are automatically controlled to maintain different pressure set points.
    f. Where otherwise required by NFPA 70.
8. Do not install conduits within 2 inch (50 mm) of the bottom side of a metal deck roof.
9. Keep raceways at least 6 inch (150 mm) away from parallel runs of flues and steam or hot-water pipes. Install horizontal raceway runs above water and steam piping.
10. Cut conduit perpendicular to the length. For conduits metric designator 53 (trade size 2) and larger, use roll cutter or a guide to make cut straight and perpendicular to the length. Ream inside of conduit to remove burrs.
11. Install pull wires in empty raceways. Provide polypropylene or monofilament plastic line with not less than 200 lb (90 kg) tensile strength. Leave at least 12 inch (300 mm) of slack at both ends of pull wire. Cap underground raceways designated as spare above grade alongside raceways in use.

C. Requirements for Installation of Specific Raceway Types:

1. Types EMT-A, ERMC-A, and FMC-A:

    a. Do not install aluminum raceways or fittings in contact with concrete or earth.

2. Types ERMC and IMC:

3. Type ERMC-S-PVC:

    a. Follow manufacturer's installation instructions for clamping, cutting, threading, bending, and assembly.
    b. Provide PVC-coated sealing locknut for exposed male threads transitioning into female NPT threads that do not have sealing sleeves, including transitions from PVC couplings/female adapters to Type ERMC-S-PVC elbows in direct-burial applications. PVC-coated sealing locknuts must not be used in place of conduit hub. PVC-coated sealing locknut must cover exposed threads on Type ERMC-S-PVC raceway.
    c. Coat field-cut threads on PVC-coated raceway with manufacturer-approved corrosion-preventing conductive compound prior to assembly.

4. Types FMC and LFMC:

a. Comply with NEMA RV 3. Provide a maximum of 72 inch (1830 mm) of flexible conduit for recessed luminaires, equipment subject to vibration, noise transmission, or movement; and for transformers and motors.

5. Type PVC:

a. Conductor ratings must be limited to 75 deg C except where installed in a trench outside buildings with concrete encasement, where 90 deg C conductors are permitted.
b. Comply with manufacturer's written instructions for solvent welding and fittings.

D. Stub-ups to Above Recessed Ceilings:

1. Provide EMT, IMC, or ERMC for raceways.
2. Provide a conduit bushing or insulated fitting to terminate stub-ups not terminated in hubs or in an enclosure.

E. Raceway Fittings: Install fittings in accordance with NEMA FB 2.10 guidelines.

1. ERMC-S-PVC: Provide only fittings listed for use with this type of conduit. Patch and seal joints, nicks, and scrapes in PVC coating after installing conduits and fittings. Provide sealant recommended by fitting manufacturer and apply in thickness and number of coats recommended by manufacturer.
2. EMT: Provide [setscrew] [compression], [steel] [cast-metal] fittings. Comply with NEMA FB 2.10.
3. Flexible Conduit: Provide only fittings listed for use with flexible conduit type. Comply with NEMA FB 2.20.

F. Raceways Penetrating Rooms or Walls with Acoustical Requirements:

1. Seal raceway openings on both sides of rooms or walls with acoustically rated putty[ or firestopping].

## 3.4 INSTALLATION OF SURFACE RACEWAYS

Retain this article if applicable to Project.

A. Install surface raceways only where indicated on Drawings.

B. Install surface raceway with a minimum 2 inch (50 mm) radius control at bend points.

C. Secure surface raceway with screws or other anchor-type devices at intervals not exceeding 48 inch (1200) mm) and with no less than two supports per straight raceway section. Support surface raceway in accordance with manufacturer's written instructions. Tape and glue are unacceptable support methods.

## 3.5 INSTALLATION OF BOXES AND ENCLOSURES

A. Provide boxes in wiring and raceway systems wherever required for pulling of wires, making connections, and mounting of devices or fixtures.

B. Mount boxes at heights indicated on Drawings. If mounting heights of boxes are not individually indicated, give priority to ADA requirements. Install boxes with height measured to [center] [top] [bottom] of box unless otherwise indicated.

C. Recessed Boxes in Masonry Walls: Saw-cut opening for box in center of cell of masonry block, and install box flush with surface of wall. Prepare block surfaces to provide a flat surface for a raintight connection between box and cover plate or supported equipment and box, whether installed indoors or outdoors.

D. Horizontally separate boxes mounted on opposite sides of walls so they are not in the same vertical channel.

E. Locate boxes so that cover or plate will not span different building finishes.

F. Support boxes in recessed ceilings independent of ceiling tiles and ceiling grid.

G. Support boxes of three gangs or more from more than one side by spanning two framing members or mounting on brackets specifically designed for purpose.

H. Fasten junction and pull boxes to, or support from, building structure. Do not support boxes by conduits.

I. Set metal floor boxes level and flush with finished floor surface.

J. Set nonmetallic floor boxes level. Trim after installation to fit flush with finished floor surface.

K. Do not install aluminum boxes, enclosures, or fittings in contact with concrete or earth.

L. Do not rely on locknuts to penetrate nonconductive coatings on enclosures. Remove coatings in the locknut area prior to assembling conduit to enclosure to ensure a continuous ground path.

M. Boxes and Enclosures in Areas or Walls with Acoustical Requirements:

1. Seal openings and knockouts in back and sides of boxes and enclosures with acoustically rated putty.
2. Provide gaskets for wallplates and covers.

## 3.6 FIRESTOPPING

A. Install firestopping at penetrations of fire-rated floor and wall assemblies. Comply with requirements in Section 078413 "Penetration Firestopping."

## 3.7 PROTECTION

A. Protect coatings, finishes, and cabinets from damage and deterioration.

1. Repair damage to galvanized finishes with zinc-rich paint recommended by manufacturer.
2. Repair damage to PVC coatings or paint finishes with matching touchup coating recommended by manufacturer.

3.8 CLEANING

A. Boxes: Remove construction dust and debris from device boxes, outlet boxes, and floor-mounted enclosures before installing wallplates, covers, and hoods.

END OF SECTION 260533

# SECTION 262416 - PANELBOARDS

## PART 1 - GENERAL

### 1.1 SUMMARY

A. Section Includes:

1. Power panelboards.
2. Lighting and appliance branch-circuit panelboards.
3. Disconnecting and overcurrent protective devices.

B. Related Requirements:

1. Section 260010 "Supplemental Requirements for Electrical" for additional abbreviations, definitions, submittals, qualifications, testing agencies, and other Project requirements applicable to Work specified in this Section.
2. Section 260011 "Facility Performance Requirements for Electrical" for seismic-load, wind-load, acoustical, and other field conditions applicable to Work specified in this Section.

### 1.2 DEFINITIONS

A. GFEP: Ground-fault equipment protection.

B. VPR: Voltage protection rating.

### 1.3 ACTION SUBMITTALS

A. Product Data:

1. Panelboards.
2. Load centers.
3. Disconnecting and overcurrent protective devices.
4. Include materials, switching and overcurrent protective devices, SPDs, accessories, and components indicated.
5. Include dimensions and manufacturers' technical data on features, performance, electrical characteristics, ratings, and finishes.

B. Shop Drawings: For each panelboard and related equipment.

1. Include dimensioned plans, elevations, sections, and details.
2. Show tabulations of installed devices with nameplates, conductor termination sizes, equipment features, and ratings.
3. Detail enclosure types including mounting and anchorage, environmental protection, knockouts, corner treatments, covers and doors, gaskets, hinges, and locks.
4. Detail bus configuration, current, and voltage ratings.

5. Short-circuit current rating of panelboards and overcurrent protective devices.
6. Include evidence of listing, by qualified electrical testing laboratory recognized by authorities having jurisdiction, for series rating of installed devices.
7. Include evidence of listing, by qualified electrical testing laboratory recognized by authorities having jurisdiction, for SPD as installed in panelboard.
8. Detail features, characteristics, ratings, and factory settings of individual overcurrent protective devices and auxiliary components.

1.4 INFORMATIONAL SUBMITTALS

A. Panelboard Schedules: For installation in panelboards.

B. Manufacturers' Published Instructions: Record copy of official installation instructions issued to Installer by manufacturer for the following:

1. Recommended procedures for installing panelboards.
2. Recommended torque settings for bolted connections on panelboards.
3. Recommended temperature range for energizing panelboards.

C. Sample warranties.

1.5 CLOSEOUT SUBMITTALS

A. Warranty documentation.

1.6 WARRANTY

A. Special Installer Extended Warranty: Installer warrants that fabricated and installed panelboards perform in accordance with specified requirements and agrees to repair or replace components or products that fail to perform as specified within extended-warranty period.

PART 2 - PRODUCTS

2.1 PANELBOARDS AND LOAD CENTERS COMMON REQUIREMENTS

A. Electrical Components, Devices, and Accessories: Listed and labeled in accordance with NFPA 70, by qualified electrical testing agency recognized by authorities having jurisdiction, and marked for intended location and application.

B. Comply with NEMA PB 1.

C. Comply with NFPA 70.

D. Enclosures: Flush and Surface-mounted, dead-front cabinets as indicated.

1. NEMA enclosure as indicated on drawings.

2. Height: 7 ft (2.13 m) maximum.
3. Front: Secured to box with concealed trim clamps. For surface-mounted fronts, match box dimensions; for flush-mounted fronts, overlap box. Trims must cover live parts and may have no exposed hardware.

E. Phase, Neutral, and Ground Buses:

1. Material: Tin-plated aluminum.
2. Ground Lugs and Bus-Configured Terminators: Mechanical type, with lug on bar for each pole in panelboard.
3. Feed-Through Lugs: Mechanical type, suitable for use with conductor material. Locate at opposite end of bus from incoming lugs or main device.

F. Panelboard Short-Circuit Current Rating:
1. Fully rated to interrupt symmetrical short-circuit current available at terminals. Assembly listed, by qualified electrical testing laboratory recognized by authorities having jurisdiction, for 100 percent interrupting capacity.

G. Surge Suppression: Factory installed as integral part of indicated panelboards, complying with UL 1449 SPD Type 2.

## 2.2 POWER PANELBOARDS

A. Listing Criteria: NEMA PB 1, distribution type.

B. Mains: Circuit breaker.

C. Branch Overcurrent Protective Devices for Circuit-Breakers: Bolt-on circuit breakers.

## 2.3 DISCONNECTING AND OVERCURRENT PROTECTIVE DEVICES

A. MCCB: Comply with UL 489, with interrupting capacity to meet available fault currents.

1. Thermal-Magnetic Circuit Breakers:

a. Inverse time-current element for low-level overloads.
b. Instantaneous magnetic trip element for short circuits.
c. Adjustable magnetic trip setting for circuit-breaker frame sizes 250 A and larger.

2. Adjustable Instantaneous-Trip Circuit Breakers: Magnetic trip element with front-mounted, field-adjustable trip setting.
3. Electronic Trip Circuit Breakers:

a. RMS sensing.
b. Field-replaceable rating plug or electronic trip.
c. Digital display of settings, trip targets, and indicated metering displays.
d. Multi-button keypad to access programmable functions and monitored data.
e. Ten-event, trip-history log. Each trip event must be recorded with type, phase, and magnitude of fault that caused trip.

f. Integral test jack for connection to portable test set or laptop computer.
g. Field-Adjustable Settings:

1) Instantaneous trip.
2) Long- and short-time pickup levels.
3) Long and short time adjustments.
4) Ground-fault pickup level, time delay, and I squared T response.

4. GFCI Circuit Breakers: Single- and double-pole configurations with Class A ground-fault protection (6 mA trip).
5. GFEP Circuit Breakers: Class B ground-fault protection (30 mA trip).
6. Arc-Fault Circuit Interrupter Circuit Breakers: Comply with UL 1699; 120/240 V, single-pole configuration.
7. Subfeed Circuit Breakers: Vertically mounted.
8. MCCB Features and Accessories:

a. Standard frame sizes, trip ratings, and number of poles.
b. Breaker handle indicates tripped status.
c. UL listed for reverse connection without restrictive line or load ratings.
d. Lugs: Mechanical style, suitable for number, size, trip ratings, and conductor materials.

## PART 3 - EXECUTION

### 3.1 INSTALLATION

A. Comply with manufacturer's published instructions.
1. Mount top of trim 7.5 ft (2.3 m) above finished floor unless otherwise indicated.
2. Mount panelboard cabinet plumb and rigid without distortion of box.
3. Mount recessed panelboards with fronts uniformly flush with wall finish and mating with back box.
4. Install overcurrent protective devices and controllers not already factory installed.

5. Make grounding connections and bond neutral for services and separately derived systems to ground. Make connections to grounding electrodes, separate grounds for isolated ground bars, and connections to separate ground bars.
6. Install filler plates in unused spaces.
7. Stub four 1 inch (25 mm) empty conduits from panelboard into accessible ceiling space or space designated to be ceiling space in future. Stub four 1 inch (25 mm) empty conduits into raised floor space or below slab not on grade.

### 3.2 IDENTIFICATION

A. Identify field-installed conductors, interconnecting wiring, and components.

B. Panelboard Nameplates: Label each panelboard with nameplate complying with requirements for identification specified as indicated on drawings.

C. Panelboard Label: Manufacturer's name and trademark, voltage, amperage, number of phases, and number of poles must be located on interior of panelboard door.

D. Breaker Labels: Faceplate must list current rating, UL and IEC certification standards, and AIC rating.

E. Circuit Directory:

1. Provide directory card inside panelboard door, mounted in transparent card holder.

a. Circuit directory must identify specific purpose with detail sufficient to distinguish it from other circuits.

2. Provide computer-generated circuit directory mounted inside panelboard door with transparent plastic protective cover.

a. Circuit directory must identify specific purpose with detail sufficient to distinguish it from other circuits.

3. Create directory to indicate installed circuit loads; incorporate Owner's final room designations. Obtain approval before installing. Handwritten directories are not acceptable. Install directory inside panelboard door.

## 3.3 FIELD QUALITY CONTROL

A. Acceptance Testing Preparation:
1. Test continuity of each circuit.

B. Tests and Inspections:

1. Perform each visual and mechanical inspection and electrical test for low-voltage air circuit breakers and low-voltage surge arrestors stated in NETA ATS, Paragraph 7.6 Circuit Breakers and Paragraph 7.19.1 Surge Arrestors, Low-Voltage. Do not perform optional tests. Certify compliance with test parameters.
2. Correct malfunctioning units on-site, where possible, and retest to demonstrate compliance; otherwise, replace with new units and retest.

C. Nonconforming Work:

1. Panelboards will be considered defective if they do not pass tests and inspections.
2. Remove and replace defective units and retest.

D. Collect, assemble, and submit test and inspection reports, including certified report that identifies panelboards included and that describes scanning results, with comparisons of two scans. Include notation of deficiencies detected, remedial action taken, and observations after remedial action.

END OF SECTION 262416

# SECTION 262726 - WIRING DEVICES

## PART 1 - GENERAL

### 1.1 SUMMARY

A. Section Includes:

1. General-use switches, dimmer switches, and fan-speed controller switches.
2. General-grade single straight-blade receptacles.
3. General-grade duplex straight-blade receptacles.
4. Receptacles with arc-fault and ground-fault protective devices.
5. Locking receptacles.
6. Pin-and-sleeve receptacles.
7. Connectors, cords, and plugs.

B. Related Requirements:

1. Section 260010 "Supplemental Requirements for Electrical" for additional abbreviations, definitions, submittals, qualifications, testing agencies, and other Project requirements applicable to Work specified in this Section.
2. Section 260011 "Facility Performance Requirements for Electrical" for seismic-load, wind-load, acoustical, and other field conditions applicable to Work specified in this Section.
3. Section 262726.31 "General-Grade Single Straight-Blade Receptacles" for additional wiring device products.
4. Section 262726.33 "General-Grade Duplex Straight-Blade Receptacles" for additional wiring device products.
5. Section 262726.37 "Receptacles with Arc-Fault and Ground-Fault Protective Devices" for additional wiring device products.
6. Section 262726.39 "Locking Receptacles" for additional wiring device products.
7. Section 262726.41 "Pin-and-Sleeve Receptacles" for additional wiring device products.
8. Section 262726.51 "Connectors, Cords, and Plugs" for additional wiring device products.

### 1.2 ACTION SUBMITTALS

A. Product Data:

1. Toggle switches.
2. Momentary-contact switches.
3. Dimmer switches.
4. Fan-speed controllers.
5. Single straight-blade receptacles
6. Duplex straight-blade receptacles.
7. Duplex straight-blade receptacles with integral switching means.
8. Receptacles with AFCI device.
9. Receptacles with AFCI and GFCI devices.

10. Receptacles with GFCI device.
11. Locking receptacles.
12. Pin-and-sleeve receptacles.
13. Spring-driven commercial/industrial-use cord reels.
14. Cord connectors.

B. Shop Drawings:

1. Wiring diagrams for duplex straight-blade receptacles with integral switching means.

C. Field Quality-Control Submittals:

1. Field quality-control reports.

1.3 INFORMATIONAL SUBMITTALS

A. Manufacturers' Instructions: Record copy of official installation instructions issued to Installer by manufacturer for the following:

1. Dimmers.
2. Fan-speed controllers.
3. Single straight-blade receptacles.
4. Duplex straight-blade receptacles.
5. Duplex straight-blade receptacles with integral switching means.
6. Hospital-grade straight-blade receptacles.
7. Receptacles with AFCI device.
8. Receptacles with AFCI and GFCI devices.
9. Receptacles with GFCI device.
10. Locking receptacles.
11. Pin-and-sleeve receptacles.
12. Spring-driven commercial/industrial-use cord reels.
13. Cord reels for use in hazardous locations.

B. Sample warranties.

PART 2 - PRODUCTS

2.1 GENERAL-USE SWITCHES, DIMMER SWITCHES, AND FAN-SPEED CONTROLLER SWITCHES

A. Toggle Switch:
1. Regulatory Requirements:

a. Listed and labeled in accordance with NFPA 70, by qualified electrical testing laboratory recognized by authorities having jurisdiction, and marked for intended location and application.

2. General Characteristics:

a. Reference Standards: UL CCN WMUZ and UL 20.

3. Options:

a. Device Color: selected by architect from standard colors.
b. Configuration:
1) General-duty, 120-277 V, 20 A, single pole, double pole, three way, or four way.

4. Accessories:

a. Cover Plate: 0.060 inch (1.5 mm) thick, high-impact thermoplastic (nylon) with smooth finish and color matching wiring device; from same manufacturer as wiring device.
b. Securing Screws for Cover Plate: Metal with head color matching wallplate finish.

B. Type I Dimmer Switch:
1. Regulatory Requirements:

a. Listed and labeled in accordance with NFPA 70, by qualified electrical testing laboratory recognized by authorities having jurisdiction, and marked for intended location and application.

2. General Characteristics:

a. Reference Standards: UL CCN EOYX and UL 1472 Type I dimmer.

3. Options:

a. Device Color: Selected by architect from standard colors.
b. Switch Style: Toggle.
c. Dimming Control Style: Slide.

4. Accessories:

a. Cover Plate: 0.060 inch (1.5 mm) thick, high-impact thermoplastic (nylon) with smooth finish and color matching wiring device; from same manufacturer as wiring device.
b. Securing Screws for Cover Plate: Metal with head color matching wallplate finish.

## 2.2 RECEPTACLES

A. Duplex Straight-Blade Receptacle:
1. Regulatory Requirements:

a. Listed and labeled in accordance with NFPA 70, by qualified electrical testing laboratory recognized by authorities having jurisdiction, and marked for intended location and application.

2. General Characteristics:

a. Reference Standards: UL CCN RTRT and UL 498.

3. Options:

a. Device Color: Selected by architect from standard colors.
b. Configuration: as indicated on drawings.

4. Accessories:

a. Cover Plate: 0.060 inch (1.5 mm) thick, high-impact thermoplastic (nylon) with smooth finish and color matching wiring device; from same manufacturer as wiring device.
b. Securing Screws for Cover Plate: Metal with head color matching wallplate finish.

## 2.3 CONNECTORS, CORDS, AND PLUGS

A. Outdoor-Use, Watertight, Sealed Cord Connector <Insert drawing designation>:
1. Regulatory Requirements:

a. Listed and labeled in accordance with NFPA 70, by qualified electrical testing laboratory recognized by authorities having jurisdiction, and marked for intended location and application.

2. General Characteristics:

a. Reference Standards: UL CCN AXUT and UL 498.

3. Options:

a. Configuration: as indicated on drawings.

# PART 3 - EXECUTION

## 3.1 EXAMINATION

A. Receptacles:

1. Verify that receptacles to be procured and installed for Owner-furnished equipment are compatible with mating attachment plugs on equipment.

B. Cord Reels:

1. Examine roughing-in for cord reel mounting and power connections to verify actual locations of mounts and power connections before cord reel installation.
2. Examine walls, floors, and ceilings for suitable conditions where cord reel will be installed.
3. Proceed with installation only after unsatisfactory conditions have been corrected.

3.2 SELECTION OF GFCI RECEPTACLES

A. Healthcare Facilities: Unless protection of downstream branch-circuit wiring, cord sets, and power-supply cords is required by NFPA 70 or NFPA 99, provide non-feed-through GFCI receptacles.

3.3 INSTALLATION OF SWITCHES

A. Comply with manufacturer's instructions.

B. Reference Standards:

1. Unless more stringent requirements are specified in Contract Documents or manufacturers' instructions, comply with installation instructions in NECA NEIS 130.
2. Mounting Heights: Unless otherwise indicated in Contract Documents, comply with mounting heights recommended in NECA NEIS 1.
3. Consult Architect for resolution of conflicting requirements.

3.4 INSTALLATION OF RECEPTACLES

A. Comply with manufacturer's instructions.

B. Reference Standards:

1. Unless more stringent requirements are specified in Contract Documents or manufacturers' instructions, comply with installation instructions in NECA NEIS 130.
2. Mounting Heights: Unless otherwise indicated in Contract Documents, comply with mounting heights recommended in NECA NEIS 1.
3. Receptacle Orientation: Unless otherwise indicated in Contract Documents, orient receptacle to match configuration diagram in NEMA WD 6.

3.5 INSTALLATION OF CORD REELS AND FITTINGS

A. Comply with manufacturer's instructions.

3.6 INSTALLATION OF CONNECTORS, CORDS, AND PLUGS

A. Comply with manufacturer's instructions.

B. Reference Standards:

1. Unless more stringent requirements are specified in Contract Documents or manufacturers' instructions.
2. Consult Architect for resolution of conflicting requirements.

3.7 FIELD QUALITY CONTROL OF RECEPTACLES

A. Tests and Inspections:

1. Insert and remove test plug to verify that device is securely mounted.
2. Verify polarity of hot and neutral pins.
3. Measure line voltage.
4. Measure grounding circuit continuity; impedance must be not greater than 2 ohms.

3.8 FIELD QUALITY CONTROL OF CONNECTORS, CORDS, AND PLUGS

A. Tests and Inspections:

1. Perform tests and inspections indicated in manufacturer's instructions.

2. r use prior to acceptance by Owner.

END OF SECTION 262726

# SECTION 264313 - SURGE PROTECTIVE DEVICES FOR LOW-VOLTAGE ELECTRICAL POWER CIRCUITS

## PART 1 - GENERAL

### 1.1 SUMMARY

A. Section includes:

1. Type 1 surge protective devices.
2. Type 2 surge protective devices.
3. Enclosures.

B. Related Requirements:

1. Section 260010 "Supplemental Requirements for Electrical" for additional abbreviations, definitions, submittals, qualifications, testing agencies, and other Project requirements applicable to Work specified in this Section.
2. Section 260011 "Facility Performance Requirements for Electrical" for seismic-load, wind-load, acoustical, and other field conditions applicable to Work specified in this Section.
3. Section 262416 "Panelboards" for integral SPDs installed by panelboard manufacturer.

### 1.2 DEFINITIONS

A. $I_n$: Nominal discharge current.

B. Voltage Protection Rating (VPR): A rating selected from UL 1449 list of preferred values assigned to each mode of protection.

### 1.3 ACTION SUBMITTALS

A. Product Data:

1. For each type of product.

a. Include electrical characteristics, specialties, and accessories for SPDs.
b. Certification of compliance with UL 1449 by qualified electrical testing laboratory recognized by authorities having jurisdiction including the following information:

1) Tested values for VPRs.
2) $I_n$ ratings.
3) MCOV, type designations.
4) OCPD requirements.
5) Manufacturer's model number.
6) System voltage.

7) Modes of protection.

B. Field quality-control reports.

1.4 WARRANTY

A. Special Manufacturer Extended Warranty: Manufacturer warrants that SPDs perform in accordance with specified requirements and agrees to provide repair or replacement of SPDs that fail to perform as specified within extended warranty period.

1. Initial Warranty Period: Five year(s) from date of Substantial Completion, for labor, materials, and equipment.

PART 2 - PRODUCTS

2.1 TYPE 1 SURGE PROTECTIVE DEVICES (SPDs)

A. Source Limitations: Obtain devices from single source from single manufacturer.

B. General Characteristics:

1. Reference Standards: UL 1449, Type 1.
2. MCOV: Not less than 125 percent of nominal system voltage for 208Y/120 V and 120/240 V power systems, and not less than 115 percent of nominal system voltage for 480Y/277 V power systems.
3. Peak Surge Current Rating: Minimum single-pulse surge current withstand rating per phase must not be less than 160 kA. Peak surge current rating must be arithmetic sum of the ratings of individual MOVs in a given mode.

a. Line to Neutral: 700 V for 208Y/120 V.
b. Line to Line: 1200 V for 208Y/120 V.

4. Protection modes and UL 1449 VPR for 240/120 V, single-phase, three-wire circuits must not exceed the following:

a. Line to Neutral: 700 V.
b. Line to Line: 1200 V.

5. SCCR: Not less than [100] [200] <Insert value> kA.
6. $I_n$ Rating: 20 kA.

C. Options:
1. Include indicator light display for protection status.
2. Include audible alarm.
3. Include surge counter.

2.2 TYPE 2 SURGE PROTECTIVE DEVICES (SPDs)

A. Source Limitations: Obtain devices from single source from single manufacturer.

B. General Characteristics:

1. Reference Standards: UL 1449, Type 2; UL 1283.
2. MCOV: Not less than 125 percent of nominal system voltage for 208Y/120 V and 120/240 V power systems, and not less than 115 percent of nominal system voltage for 480Y/277 V power systems.
3. Peak Surge Current Rating: Minimum single-pulse surge current withstand rating per phase must not be less than 100 kA. Peak surge current rating must be arithmetic sum of the ratings of individual MOVs in a given mode.
4. Protection modes and UL 1449 VPR for grounded wye circuits with 208Y/120 V, three-phase, four-wire circuits must not exceed the following:

    a. Line to Neutral: 700 V for 208Y/120 V.
    b. Line to Ground: 700 V for 208Y/120 V.
    c. Neutral to Ground: 700 V for 208Y/120 V.
    d. Line to Line: 1200 V for 208Y/120 V.

5. Protection modes and UL 1449 VPR for 240/120 V, single-phase, three-wire circuits must not exceed the following:

    a. Line to Neutral: 700 V.
    b. Line to Ground: 700 V.
    c. Neutral to Ground: 700 V.
    d. Line to Line: 1200 V.

6. SCCR: Equal or exceed 100 kA.
7. $I_n$ Rating: 10 kA.

C. Options:

1. Include LED indicator lights for power and protection status.
2. Include surge counter.

2.3 TYPE 3, TYPE 4, AND TYPE 5 SURGE PROTECTIVE DEVICES (SPDs)

A. Type 3, Type 4, and Type 5 SPDs are not approved for field installation.

2.4 ENCLOSURES

A. Indoor Enclosures: Type 1.

B. Outdoor Enclosures: Type 3R.

PART 3 - EXECUTION

3.1 INSTALLATION

A. Provide OCPD and disconnect for installation of SPD in accordance with UL 1449 and manufacturer's instructions.

3.2 FIELD QUALITY CONTROL

A. Tests and Inspections:

1. Compare equipment nameplate data for compliance with Drawings and the Specifications.
2. Inspect anchorage, alignment, grounding, and clearances.
3. Verify that electrical wiring installation complies with manufacturer's installation requirements.

B. Prepare test and inspection reports.

3.3 STARTUP SERVICE

A. Complete startup checks in accordance with manufacturer's instructions.

B. Do not perform insulation-resistance tests of the distribution wiring equipment with SPDs installed. Disconnect SPDs before conducting insulation-resistance tests; reconnect them immediately after the testing is over.

C. Energize SPDs after power system has been energized, stabilized, and tested.

END OF SECTION 264313

# SECTION 265119 - LED INTERIOR LIGHTING

## PART 1 - GENERAL

### 1.1 ACTION SUBMITTALS

A. Product Data: For each type of product.

1. Manufacturers' Certified Data: Photometric data certified by manufacturer's laboratory with a current accreditation under the National Voluntary Laboratory Accreditation Program for Energy Efficient Lighting Products.

### 1.2 INFORMATIONAL SUBMITTALS

A. Product Certificates: For each type of luminaire.

B. Product test reports.

C. Sample warranty.

### 1.3 CLOSEOUT SUBMITTALS

A. Operation and maintenance data.

### 1.4 QUALITY ASSURANCE

A. Luminaire Photometric Data Testing Laboratory Qualifications: Luminaire manufacturer's laboratory that is accredited under the NVLAP for Energy Efficient Lighting Products.

B. Provide luminaires from a single manufacturer for each luminaire type.

### 1.5 WARRANTY

A. Warranty: Manufacturer and Installer agree to repair or replace components of luminaires that fail in materials or workmanship within specified warranty period.

B. Warranty Period: Five year(s) from date of Substantial Completion.

PART 2 - PRODUCTS

2.1 LUMINAIRE REQUIREMENTS

A. Electrical Components, Devices, and Accessories: Listed and labeled as defined in NFPA 70, by a qualified testing agency, and marked for intended location and application.

B. Factory-Applied Labels: Comply with UL 1598. Include recommended lamps. Locate labels where they will be readily visible to service personnel, but not seen from normal viewing angles when lamps are in place.

1. Label shall include the following lamp characteristics:

a. "USE ONLY" and include specific lamp type.
b. Lamp diameter, shape, size, wattage, and coating.
c. CCT and CRI.

C. Recessed luminaires shall comply with NEMA LE 4.

D. NRTL Compliance: Luminaires for hazardous locations shall be listed and labeled for indicated class and division of hazard by an NRTL.

E. FM Global Compliance: Luminaires for hazardous locations shall be listed and labeled for indicated class and division of hazard by FM Global.

2.2 MATERIALS

A. Metal Parts:

1. Free of burrs and sharp corners and edges.
2. Sheet metal components shall be steel unless otherwise indicated.
3. Form and support to prevent warping and sagging.

B. Steel:

1. ASTM A36/A36M for carbon structural steel.
2. ASTM A568/A568M for sheet steel.

C. Stainless Steel:

1. 1. Manufacturer's standard grade.
2. 2. Manufacturer's standard type, ASTM A240/240M.

D. Galvanized Steel: ASTM A653/A653M.

E. Aluminum: ASTM B209.

2.3 METAL FINISHES

A. Variations in finishes are unacceptable in the same piece. Variations in finishes of adjoining components are acceptable if they are within the range of approved Samples and if they can be and are assembled or installed to minimize contrast.

2.4 LUMINAIRE SUPPORT

A. Comply with requirements in Section 260529 "Hangers and Supports for Electrical Systems" for channel and angle iron supports and nonmetallic channel and angle supports.

B. Single-Stem Hangers: 1/2-inch (13-mm) steel tubing with swivel ball fittings and ceiling canopy. Finish same as luminaire.

C. Wires: ASTM A641/A641M, Class 3, soft temper, zinc-coated steel, [12 gage (2.68 mm)] <Insert size>.

D. Rod Hangers: 3/16-inch (5-mm) minimum diameter, cadmium-plated, threaded steel rod.

E. Hook Hangers: Integrated assembly matched to luminaire, line voltage, and equipment with threaded attachment, cord, and locking-type plug.

PART 3 - EXECUTION

3.1 INSTALLATION

A. Comply with NECA 1.

B. Install luminaires level, plumb, and square with ceilings and walls unless otherwise indicated.

C. Install lamps in each luminaire.

D. Supports:

1. Sized and rated for luminaire weight.
2. Able to maintain luminaire position after cleaning and relamping.
3. Provide support for luminaire without causing deflection of ceiling or wall.
4. Luminaire-mounting devices shall be capable of supporting a horizontal force of 100 percent of luminaire weight and a vertical force of 400 percent of luminaire weight.

E. Comply with requirements in Section 260519 "Low-Voltage Electrical Power Conductors and Cables" for wiring connections.

3.2 IDENTIFICATION

A. Identify system components, wiring, cabling, and terminals. Comply with requirements for identification specified in Section 260553 "Identification for Electrical Systems."

3.3 FIELD QUALITY CONTROL

A. Perform the following tests and inspections:

1. Operational Test: After installing luminaires, switches, and accessories, and after electrical circuitry has been energized, test units to confirm proper operation.
2. Test for Emergency Lighting: Interrupt power supply to demonstrate proper operation. Verify transfer from normal power to battery power and retransfer to normal.

B. Luminaire will be considered defective if it does not pass operation tests and inspections.

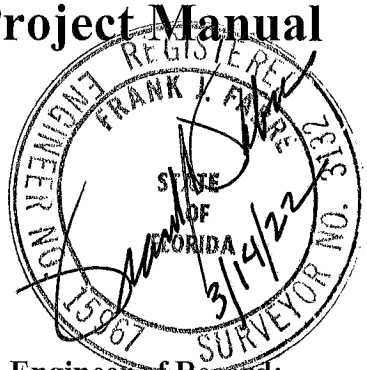
C. Prepare test and inspection reports.

END OF SECTION 265119

# Beal Cemetery Expansion

## Fort Walton Beach, FL

## Project Manual




**Engineer of Record:**

**Frank J. Fabre, FL PE #15967**

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**FEI Project # 210043**

**SUBMITTED BY:**

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## SECTION 32001 POTABLE WATER PIPEWORK

This section includes furnishing and installing all potable water pipework and appurtenances necessary for a fully operable water system.

1. Potable Water Mains

Mains shall be looped where possible. A calculated minimum pressure of 30 psig at peak hourly demand shall be maintained at all points in the system.

2. Materials

All material shall be free from defects impairing strength and durability and be of the best commercial quality for the purpose specified. It shall have structural properties sufficient to safely sustain or withstand strains and stresses to which is normally subjected and be true to detail.

Certified records of material tests made by the manufacturer or by a reliable commercial laboratory shall be submitted to the Engineer.

All pipework will be inspected upon delivery and such as does not conform to the requirements of these specifications shall be rejected and must be immediately removed from the site by the Contractor. The Contractor shall furnish and provide all labor necessary to assist the Engineer in inspecting the material.

The basis of rejection shall be as specified in applicable AWWA Specifications.

3. Unplasticized Polyvinyl Chloride (PVC) Pressure Pipe

Provide pipe meeting ASTM D2241, Type 1, Grade 1 PVC 1120 Standards as follows:

| DIAMETER | STANDARD | REQUIRED SDR/DR |
|---|---|---|
| 1" | D2241 | 26 (Maximum) |

PVC pressure pipe shall have a bell-type joint designed for conveying potable water under pressure. Ring-type neoprene gasket shall be provided in recesses in the bells to make the joints watertight for all slip joint piping. Only where specifically called for on the construction plans shall solvent-weld or flanged connections be used. All fittings shall be of the same joint design as recommended by the manufacturer. PVC pipe shall meet or exceed the minimum requirements of Commercial Standard CS 256063 for type 1120 material made to SDR 26 or SDR 21 dimensions as required. PVC compounds used shall be as specified in ASTM D1784. Dimensions and specifications for PVC pipe shall be as required in ASTM D2241, latest, class designation 12454-B. PVC joints shall meet ASTM D3139, for Bell End Pipe. PVC pipe shall be as manufactured by the Johns-Manville Co., the Ethyl Corp., the

Certain-Teed Products Corp., the Clow Corporation or approved equivalent. All potable water mains shall be white in color.

All fittings for PVC pressure pipe shall be ductile iron mechanical joint meeting the requirements of ANSI/AWWA C153/A21.53-84 ductile iron compact fittings 3 inch through 12 inch for water and other liquids.

The working pressure rating for fittings shall be 350 psi. Fittings shall be furnished with an asphaltic outside coating in accordance with ANSI/AWWA C153/A21.53 and cement lined and seal coated with an asphaltic material in accordance with ANSI/AWWA C104/A21.4.

Standard laying lengths shall be 20 feet and randoms shall not be less than 10 feet.

Pipe must be certified as suitable for potable water use by the National Sanitation Foundation (N.S.F.) and marked as follows: NSF-PW.

Each length of pipe shall be clearly marked with the following information at intervals of five feet or less:

1) Nominal pipe size and OD base
2) Material code designation
3) Dimension ratio number
4) AWWA pressure class and standard designation number
5) Manufacturer's name or trademark
6) NSF approval seal

6. Submittals

The Contractor shall submit a minimum of five (5) copies of catalog data for approval by the Engineer for materials to be used. This submittal shall include but not be limited to the following:

a. Pipe
b. Fittings
c. Interior Coating
d. Exterior Coating

## VALVES, METERS AND MISCELLANEOUS APPURTENANCES

This section includes furnishing and installing all equipment and materials necessary for a complete and fully operable system.

1. Materials

All material shall be free from defects impairing strength and durability and be of the best commercial quality for the purpose specified. It shall have structural properties sufficient to safely sustain or withstand strains and stresses to which it is normally subjected and be true to detail.

All pipework will be inspected upon delivery and such as does not conform to the requirements of these specifications shall rejected and must be immediately removed from the site by the Contractor. The Contractor shall furnish and provide all labor necessary to assist the Engineer in inspecting the material.

The basis of rejection shall be as specified in applicable AWWA Specifications.

2. Valves

a. Gate Valves: Provide gate valves meeting the following requirements

Gate Valves Two Inches and Larger: Gate valves shall be of the resilient seated wedge-type, epoxy coated to AWWA C550 cast iron body design. They shall comply with the American Water Works Association Gate Valve Standard C-509 as latest revised. Valves shall be rated for zero leakage at 200 psi water working pressure and have a 400 psi hydrostatic test for structural soundness. All testing shall be conducted in accordance with AWWA C-509.

Gate valves shall be furnished with type of end connection specified as follows: mechanical joint per AWWA C-111.
All cast iron shall conform to ASTM-A-126 Class B. Castings shall be clean and sound without defects that will impair their service. No plugging or welding of such defects will be allowed. Stems shall be manganese bronze having a minimum tensile strength of 60,000 psi, a minimum yield of 20,000 psi. Bolts shall be electro-zinc plated steel with hex heads and hex nuts in accordance with ASTM A-307.

Valves shall be M & H Model 3067-NRS or approved equivalent.

Gate Valves Under Two Inches: Gate Valves under two inches shall be bronze body, threaded ends, non rising stem, solid wedge disc and shall be American Model 3FG or approved equivalent.

b. Check Valves: Provide check valves meeting the following requirements:

Over Three-Inches: The check valves over three-inches (3") shall be iron-body, bronze-mounted, horizontal-swing check with flanged ends. All working parts shall

be spring-loaded to prevent slamming. The check valves shall be M & H Fig. 250F, American Darling 50 Line or approved equivalent.

Under Three-Inches: Check valves under three-inches (3") shall be screwed-end, bronze-body, silent check valves as manufactured by Crane Co., No. 34 or approved equivalent.

c. Air Release and Vacuum Valve: The combination air release and vacuum valve shall be furnished with both a large and small orifice. The valve shall automatically function to release to atmosphere both large and small amounts of air that accumulate in this pipeline. Once the air has been exhausted both the large and small valves shall seat tightly to prevent water leakage. The valve shall also function to admit air into a line, tank, or chamber under emergency conditions or when it is being drained. The valve body and cover shall be of semi-steel; floats of stainless steel; levers of bronze and resilient seats. The air and vacuum valve shall be manufactured by G-A Industries, Inc., Type 1-AV or approved equivalent.

d. Butterfly Valves: Provide valves conforming to AWWA C504 (latest) with lug wafer type body suitable for use between ANSI 125 or 150 lb. flanges. Disc shall be 316 stainless steel or have a welded nickel edge. Valve shaft shall be supported on three permanently lubricated bronze or on TFE coated stainless steel bearings. The valve seat shall be of Hycar or equivalent. Disc-to-shaft connections shall be 316 stainless steel and securely locked in position. Valves 8 inches and larger shall have a thrust collar of stainless steel. Three shaft seals shall protect bearings from internal and external corrosion. Infinite position levers shall provide manual throttling and locking in any position from open to closed.

Butterfly valves and actuators shall be Figure 632 as manufactured by DeZurick or approved equivalent.

e. Hose Bibs: Hose bibs shall be Crane No. 58 or equivalent.

3. Water Services

a. Meter Boxes: Meter boxes shall be furnished and installed by the Contractor and shall be "Ametek" Standard Meter Box with Plastic Reader Cover or approved equivalent.

b. Meters: Meter sizes up to 2" shall be provided by Midway Water System, Inc. Larger sized meters and boxes shall be provided by the Contractor and subject to approval by the Midway Water System, Inc.

c. Service Clamps: Service clamps shall be Ford Model FS202 or approved equivalent.

d. Corporation Stops: Corporation stops shall be Ford Model No. F-1000 or approved equivalent. Inlets shall have iron pipe threads and outlets shall have compression connections.

e. Curb Stops: Curb stops shall be Ford Model No. BH 41-233 or approved equivalent. Inlets shall have compression connections and outlet shall have iron pipe threads. Valves shall be equipped with padlock eyes or approved equivalent.

f. Service Tubing: Service tubing shall meet the requirements of ASTM-D-2737, SDR 9 and shall be listed as having the approval of the National Sanitation Foundation for Water Distribution and shall have the NSF approval designation stamped on the tubing. Service tubing shall be polyethylene (PE) meeting ASTM D1248, PE 3408 requirements for polyethylene tubing. It shall be delivered in rolls and cut to required lengths.

g. Wye Branches: Wye branches for double services are to be pack joint wye branches, Ford Model Number Y44-243 or approved equivalent.

4. Valve Boxes

Cast iron valve boxes shall be provided for all underground valve installations. They shall consist of a base covering the operating nut and head of the valve, a vertical shaft, at least 5-1/4 inches in diameter, and a top section extending to a point even with the finished ground surface. Provide a cast iron cover marked "WATER" and placed concentrically over the operating nut. The valve boxes shall be Clow F-2452 screw type valve box, or an approved equivalent.

5. Backflow Preventer

Double Check Valve Assembly shall be a complete assembly including two positive seating check valves, tight closing shut-off valves located upstream and downstream of the check valves, and four suitably placed ball-type test cocks. The device shall be bronze construction. The first and second check valves shall be of modular design and they shall be identical, completely removable and interchangeable.

The backflow preventer shall be in full conformance with the American Society of Sanitary Engineering Standard for Double Check Valve Assemblies, ASSE Standard 1015 and with the requirements of the U.S.C. Foundation for Cross-Connection Control. Double-check valve assemblies shall be Watts Model No. 709 or approved equivalent.

Backflow Preventers on residential water services shall be dual check valve assemblies, ASSE Standard 1024, Watts Model No. 7, or approved equivalent.
Reduced pressure backflow preventers shall be used for hazardous water supply applications.

Reduced pressure backflow preventers shall meet ASSE Standard 1013 and shall be Watts Model No. 909 or approved equivalent.

8. Submittals

The Contractor shall submit a minimum of five (5) copies of catalog data for approval by the Engineer for materials to be used. This submittals shall include but not be limited to the following:

a. Pipe and Fittings
b. Tubing
c. Valves
d. Hydrants
e. All Service Materials
f. Casing
g. Backflow Preventer

## INSTALLATION

This section covers installation of pressure pipework. Excavation and backfilling shall be in accordance with the preceding, applicable section of these specifications.

1. General

a. All pipe, fittings, and valves shall be carefully handled at all times to prevent damage to the pipe or other installation on the job site.

b. At times when pipe installation is not in progress, the open ends of the pipe shall be closed by approved means and shall remain closed until construction on that particular section is resumed, eliminating the possibility of any flow obstructions getting into the pipe.

c. All joints shall be wiped free of all dirt, sand and foreign material and the pipe shall be carefully examined for defects before installation.

d. Cutting of pipe for inserting valves, fittings, or closure pieces shall be done in a neat and workmanlike manner without damage to the pipe.

e. Deviations from the piping location, line and grade indicated on the construction

plans shall not be made without the prior approval of the Engineer.

2. Pipe Laying Procedures

a. Pressure Piping: Pressure piping shall be installed in strict accordance with the manufacturer's printed instructions. Before lowering the pipe into the trench, the bottom of the trench shall be graded so that when the pipe rests on the trench bottom it will have a uniform bearing for its entire length. The pipe shall be carefully examined for defects and the inside cleaned. After placing the pipe in the trench, the ends shall be wiped free from all dirt, sand and foreign material. The joints shall be made in accordance with the recommendations of the pipe manufacturer.

Suitable concrete reaction or thrust blocks shall be applied on all lines (except those having screwed or flanged joints), at all tees, plugs, caps, and bends deflecting 22-1/2 degrees or more, or movements shall be prevented by attaching metal rods or straps approved by the Engineer. Unless otherwise directed, the pipe shall be laid with bell ends facing in the direction of laying. Whenever it is necessary to deflect the pipe from a straight line, either in the vertical or horizontal plane, to avoid obstruction, to plumb stems, or where long radius curves are permitted, the degree at deflection shall be as recommended by the manufacturer of the pipe.

The minimum cover for pipe will be 30-inches unless otherwise indicated on the approved plans. The depth of cover shall be measured from the established street grades or the surface of the permanent improvement to the top of the barrel of the pipe. At street intersections or where the new pipe lines cross existing underground lines at the approximate same depth as the new line, the cover shall be increased and the new line laid below existing lines or structures. Where the existing lines or structures are of sufficient depth that the new lines, when laid, will have 6-inches of separating earth between them and other pipe or structure and 30-inches cover, the new lines may be laid above the existing lines.

b. Sub-Surface Explorations: Whenever necessary to determine the location of existing pipes, valves, or other underground structures, the Contractor shall examine all available records and shall make all explorations and excavations for such purpose. Where the locations of existing utilities are furnished by the Owner, they should be considered approximate only. The Contractor is responsible for locating and protecting all existing utilities whether shown on the drawings or not shown.

c. Protecting Underground and Surface Structures: Temporary support, adequate protection and maintenance of all underground and surface utility structures, drains, sewers, and other obstructions encountered in the progress of the work shall be furnished by the Contractor at his own expense under the direction of the Engineer.

d. Construction Equipment: Mechanical equipment may be used for trenching and excavating. However in places where the operation of same will cause damage to trees, shrubbery, pavements or existing structures, above or below ground, hand methods shall be employed. Where a main is installed along paved streets only rubber-tired equipment will be allowed for excavation and backfilling; the use of bulldozers or equipment on tracks will not be permitted. The Contractor will be responsible for any damage done to paved streets or lawns. Either air hammers or concrete saws should be used for cutting concrete pavement.

e. Unsuitable Conditions: No pipe shall be laid in water or unsuitable soils conditions. Unsuitable soil, as determined by the Engineer, shall be removed or replaced with an approved material.

f. Trench Water: At times when pipe laying is not in progress, the open ends of pipe shall be closed by approved means, and no trench water shall be permitted to enter the pipe.

g. Setting Valves and Boxes:

Valves and Fittings: Gate valves and pipe fittings shall be set and jointed to new pipe in the manner heretofore specified for cleaning, laying and jointing pipe.

Valve Boxes: Cast-iron valve boxes shall be firmly supported and maintained, centered and plumb, over the wrench nut of the gate valve and box cover flush with the surface of the finished pavement or at such other level as may be directed.

h. Cutting Pipe: Cutting of pipe for inserting fittings or closure pieces shall be done in a neat and workmanlike manner without damage to the pipe.

i. Dewatering: The Contractor shall provide all necessary pumps to dewater the site properly, shall provide all labor and materials required to keep any open excavation dewatered during construction and shall provide all necessary sheeting, bulkheads, drains, etc., so that construction operations may be performed under dry conditions. Discharge from pumps must be led to natural drainage channels, to drains, or to sewer.

j. Service Pipe: Service pipe shall have a minimum depth of 30 inches at all highway crossings and 18 inches elsewhere. The requirements for trenching and backfilling shall apply. Removal of pavements or sidewalk will not be permitted for water service lines. They may be installed by jacking, boring or pushing under sidewalks.

k. Casing: Steel casing shall be installed by either jacking or boring at the option of the Contractor. Any section damaged by the installation shall be removed from the casing leaving both ends free from splits or other rough edges which might damage the carrier pipe. All state highway crossings shall require steel casing.

l. Plugging Dead Ends: Standard plugs shall be inserted into the bells of all dead ends of pipes, tees, or crosses, and spigot ends shall be capped. Plugs or caps shall be jointed to the pipe or fittings in the appropriate manner.

m. Concrete Encasement and Specials: Provide concrete pipe encasements or special pipe supports as shown on the drawings or directed by the Engineer. Various pipe supports shall be as worked out in the field to suit local conditions and emergencies. Where, in the opinion of Engineer that pipe covering is inadequate, concrete encasement for protection shall be provided in accordance with the details on the approved drawings. Concrete encasements shall be made using concrete with a 28-day strength of 2000 psi and shall be to the dimensions indicated on the construction plans and as required by the applicable Department of Transportation or Public Health regulations. All other concrete needed to build and protect the pipe work shall be used at the direction of the Engineer.

n. Separation of Water Mains and Sewers: Water mains or sewer mains that are laid in the vicinity of each other shall meet the horizontal and vertical separations specified and shown in the Standard Drawings sections.

o. Backfilling: Backfill material shall be free from rocks or boulders or any other objectionable material and shall be placed in the trench and compacted simultaneously on both sides of the pipe for the full width of the trench, and to an elevation level with ground on either side to densities indicated previously in these specifications.

p. Repaving: Pavement removal, where required in the construction of this project, shall be done by the Contractor in a workmanlike manner. Care must be taken to make the saw cut in a straight line so the patch will be neat.

Asphalt paving shall be replaced as described in the applicable section of the specifications. Concrete driveways and pavement shall be replaced using concrete with high early strength so that traffic may be resumed quickly. Concrete must be finished to conform with existing pavement.

q. Clean-Up: Before final inspection and acceptance, the Contractor shall clean ditches, shape shoulders, and restore all disturbed areas, including street crossing, grass plots, to as good a condition as existed before work started. All trenches shall be leveled, and loose material removed from pavement gutters and sidewalks, employing hand labor, if necessary.

3. Anchorage of Bends, Tees, and Plugs

a. Thrust Backing Placement: Reaction or thrust backing shall be placed on all pipe lines two-inches in diameter or larger at all tees, plugs, caps and at bends deflecting 22-1/2 degrees or more, or movement shall be prevented by attaching metal rods or straps as approved by the Engineer.

b. Materials for Thrust Backing: Reaction, or thrust backing shall be of concrete that has a 28-day compressive strength of not less than 2000 psi. Reaction backing shall be placed in accordance with the details on he approved construction plans and standard details.

Backing shall be placed between solid ground and the fitting to be anchored. The backing shall, unless otherwise directed, be so placed that the pipe and fitting joints will be accessible for repairs. No extra payment will be made for this material but shall be included in the unit price bid for the various sizes of pipe.

In some cases, the Engineer may direct the Contractor to provide backing using cables and "deadman" anchors where the soil conditions will not support the normal concrete type as described above.

## TESTING AND INSPECTION

1. General

During construction and at the completion of the work, the Contractor shall make such tests as required in these specifications or as may be directed by the Engineer. The Engineer will observe the tests, but the Contractor shall furnish all apparatus required and shall pay all costs connected therewith unless otherwise stated in these specifications. Defective work shall be repaired immediately at the Contractor's expense.

In general, tests shall conform to usually accepted testing practices for the specific type and class of test. All data, observations and results will be carefully recorded, and the System Engineer will be furnished two signed copies of all data and reports. Project acceptance may be held contingent on receipt of satisfactory test reports.

2. Hydrostatic Tests of Pressure Pipework

a. Pressure During Test: After the pipe has been laid and backfilled as specified, each valved section of newly laid pipe shall, unless otherwise specified, be subjected to a hydrostatic pressure equal to the pressure rating of the pipe being tested, but not less than 150 psig. The Contractor shall record the testing by the use of a pressure recording gauge and after all testing is complete, the recordings shall be turned over to the Engineer for his files.

b. Duration of Pressure Test: The duration of each pressure test shall be at least 2 hours or until the line has been completely inspected for visible leaks.

c. Procedure: Each section of pipe shall be slowly filled with water and the specified test pressure, measured at the lowest point of elevation, shall be applied by means of a pump connected to the pipe in a satisfactory manner. The pump, pipe connection, gauges, meter and all necessary apparatus shall be furnished by the Contractor. The test shall be applied to each valved section in order to check the leakage through all valves.

d. Expelling Air Before Test: Before applying the specified test pressure, all air shall be expelled from the pipe. To accomplish this, taps shall be made, if necessary, at points of highest elevation, and afterwards tightly plugged.

e. Definition of Leakage: Leakage is defined as the quantity of water to be supplied into the newly laid pipe, or any valved section of it, necessary to maintain the specified leakage test pressure after the pipe has been filled with water and the air expelled.

f. Permissible Leakage: Suitable means shall be provided by the Contractor for determining the quantity of water lost by leakage under normal operating pressure. No pipe installation will be accepted until or unless this leakage (evaluation at specified pressure) is less than the figures stated below:

| PIPE SIZE | GAL=S/1000'/24 HRS | GAL=S 1000'/1 HR |
|---|---|---|
| 2" | 3.8 gal | 0.16 gal |
| 3" | 5.7 gal | 0.24 gal |
| 4" | 7.6 gal | 0.32 gal |
| 6" | 11.4 gal | 0.47 gal |
| 8" | 15.2 gal | 0.63 gal |
| 10" | 18.9 gal | 0.79 gal |
| 12" | 22.7 gal | 0.95 gal |

g. Variation From Permissible Leakage: Should any test of combined sections of pipe laid disclose leakage greater than the specified limit, the Contractor, shall, at his own expense, locate and repair the defective joints until the leakage is within the specified allowance.

h. Water for Testing: Water for testing shall be provided by the Contractor and at his expense. The Owner shall provide and install a metered connection at no charge.

I. Time for Making Test: Pipe may be subjected to hydrostatic pressure, inspected, and tested for leakage at any convenient time after partial completion of backfill. The Contractor may test the system with joints exposed or with backfilling complete at his option, however, not more than 300 feet of trench may be open at any time. The Engineer and the Utility Company shall be notified at least 24 hours before beginning testing.

3. Chlorination of Water Distribution Facilities

a. Disinfection: After the water distribution system has been hydrostatically tested to be satisfaction of the Engineer and the Utility Company, it shall be disinfected in accordance with AWWA Specification C-601 which provides for contact with a 50 ppm solution of chlorine remaining for twenty-four hours, with the chlorine residual of at least 10 ppm.

b. Chlorinating Valves and Flushing Hydrants: In the process of chlorinating water pipe, all valves or other appurtenances shall be operated while the pipe line is filled with the chlorinating agent.

c. Final Flushing and Test: Following chlorination, all treated water shall be thoroughly flushed from the newly laid pipe line at its extremities until the replacement water throughout its length shall, upon test, both chemically and bacteriologically, be approved by the Florida Department of Environmental Protection. The Contractor shall be responsible for arranging for the Test Samples.

d. Repetition of Procedure: Should the initial treatment, in the opinion of the Engineer, prove ineffective, the chlorination procedure shall be repeated until confirmed tests show that the water sampled conforms to the requirements stated above.

**END OF SECTION**

## PART 1 - GENERAL

The grinder pump used shall be an E/One GP 2010 or approved equivalent. The grinder pump shall include a check valve, HDPE (high density polyethylene) tank, and controls.

## PART 2 – ELECTRICAL REQUIREMENTS

The motor shall be rated for at least 1 hp at 1,725 rpm. The motor shall be fitted with capacitor starting and thermal protection. The motor shall be powered with 120/240V single phase electrical connections.

## PART 3 – DISCHARGE REQUIREMENTS

Pump discharge rates shall meet or exceed the following:

| Pressure (psig) | Discharge (gpm) |
|---|---|
| 0 | 15 |
| 40 | 11 |
| 60 | 9 |

## PART 4 – INSTALLATION

The grinder pump shall be installed as shown in project drawings. A licensed plumber will determine pump burial depth.

**END OF SECTION**

# 1. GENERAL

## 1.1. GENERAL DESCRIPTION OF WORK

1.1.1. The Contractor shall furnish and install all pipes, fittings, structures and accessories required for wastewater force main transmission, distribution and/or service lines in accordance with the requirements of the Construction Plans and related Contract Documents.

## 1.2. COMMONLY USED ACRONYMS

| | |
|---|---|
| ANSI | American National Standards Institute |
| ASME | American Society of Mechanical Engineers |
| ASSE | American Society of Safety Engineers |
| ASTM | American Society for Testing and Materials |
| AWWA | American Water Works Association |
| CA | Concrete Asbestos |
| CI | Cast Iron |
| DI | Ductile Iron |
| DIPS | Ductile Iron Pipe Standard |
| FAC | Florida Administrative Code |
| FDEP | Florida Department of Environmental Protection |
| FLG | Flange |
| HDPE | High-Density Polyethylene |
| MJ | Mechanical Joint |
| MSS | Manufacturer's Standardization Society |
| NSF | National Standards Foundation |
| OD | Outside Diameter |
| PVC | Polyvinyl Chloride |
| SBR | Styrene Butadiene Rubber |
| SF | Suction Flange |

## 1.3. QUALITY ASSURANCE

1.3.1. AWWA Standards – Construction materials and methods shall comply with the requirements of the latest published edition of American Water Works Association (AWWA) Standards. Applicable standards are listed herein these specifications; any other standards mentioned in the standards listed herein are incorporated by reference.

1.3.2. ASTM Standards – In addition, construction materials and methods shall also comply with the requirements of the latest published editions of the American Society for Testing and Materials (ASTM) Standards.

# 2. MATERIALS AND EQUIPMENT

## 2.1. GENERAL

2.1.1. All furnished pipe, fittings, and accessories shall be new and unused. Ductile Iron Pipe and fittings shall be epoxy lined unless shown otherwise on the plans and bid documents. All pipe, fittings and accessories shall be suitable and rated for appropriate pressure use.

## 2.2. DELIVERY, STORAGE, AND HANDLING

2.2.1. Certificates of Compliance with the Specifications may be required for all materials used on the Project. All materials are to be transported, stored, handled, and installed in accordance with the Manufacturer's recommendations to avoid physical damage. All materials shall be stored to prevent physical deterioration due to sun and weather. The Owner or its representative reserves the right to reject material which in any way does not meet the requirements of these Specifications.

## 2.3. FORCEMAINS

2.3.1. Polyvinyl Chloride Pipe (PVC) - PVC pipe shall meet the designations on the table below and shall be provided with push-on joints with the bell integrally cast into the pipe. PVC pipe shall be installed with elastomeric gaskets meeting ASTM Standard F477 and meet the requirements of the following table.

| PVC PIPE STANDARDS | | | | |
|---|---|---|---|---|
| **Standard** | **Nominal Size** | **Dimension Ratio** | **OD Classification** | **Pressure Rating (Psi)** |
| ASTM 2241 | 2" – 3" | SDR 21 | IPS | 200 |
| AWWA C900 | 4" – 6" | DR 25 | DIPS | **165** |
| AWWA C900 | 8" – 12" | **DR 18** | DIPS | **200** |
| AWWA C905 | 14" – 36" | **DR 18** | DIPS | **200** |

2.3.1.1. Markings - PVC pipe shall be marked to indicate the following:

2.3.1.1.1. Nominal pipe size and OD base.

2.3.1.1.2. Material Code Designation.

2.3.1.1.3. Dimension Ratio.

2.3.1.1.4. Pressure Class or Pressure Rating.

2.3.1.1.5. Manufacture's Name or Trademark.

2.3.1.1.6. Appropriate AWWA or ASTM Standard Number.

2.3.1.1.7. Date Pipe Was Manufactured.

2.3.1.2. Color Coding - Entire pipe shall be colored with green pigment.

2.3.2. Ductile Iron Pipe (DIP) - All ductile iron pipe shall be designed and manufactured in accordance with AWWA C150 and AWWA C151, respectively and shall meet the requirements of the table below. DIP shall have a design operating pressure of up to 150 psi, installed in Class 2 Trenching conditions. Pressure class or bedding class shall be increased as required by AWWA C151 for surface loads greater than indicated or operating pressures greater than 150 psi. DIP shall be installed as push-on joints unless otherwise noted on the plans. All DIP shall meet the requirements of the following table:

| **DIP PIPE STANDARDS** | | | |
|---|---|---|---|
| **Standard** | **Nominal Size** | **OD Classification** | **Pressure Rating (Psi)** |
| **AWWA C151** | 3" – 12" | DIPS | 350 |
| **AWWA C151** | 14" – 20" | DIPS | 250 |
| **AWWA C151** | 24" – 64" | DIPS | 200 |

2.3.2.1. Minimum Pipe Design Criteria –

2.3.2.1.1. The minimum internal design working pressure shall provide/ensure: (1) a 100-psi surge allowance, (2) a safety factor of 2, and (3) a total internal design pressure of 600 psi. No reduction of safety factor for transient pressures shall be allowed.

2.3.2.1.2. The external loads design criteria shall be a minimum of 4 foot depth of cover at 120 lbs. per

cubic feet soil weight, and live load based on one AASHTO H-20 truck load. The thickness design

of ductile iron pipe shall be in accordance with AWWA C150.

2.3.2.1.3. The horizontal deflection of epoxy lined ductile iron pipe resulting from external load conditions

shall not exceed three percent of the pipe diameter.

2.3.2.2. Joint Design –

2.3.2.2.1. General – Ductile Iron pipe and fittings shall be furnished with push-on joints, push-on restrained joints, and flanged joints, as required.

2.3.2.2.2. Push-on Joints – Push-on joints shall conform to AWWA C111. Unless otherwise specified, gasket material shall be standard styrene butadiene copolymer (SBR). Push-on joints shall be Fastite, as manufactured by American Cast Iron Pipe Company (ACIPCO), or equivalent. The pressure rating for push-on joints shall be a minimum of 350 psi or the specified pressure rating of the pipe, whichever is less.

2.3.2.2.3. Restrained Joints – Restrained joints shall be "Flex-Ring" restrained joints as manufactured by ACIPCO or equivalent. When restrained joints require factory welding, the Manufacturer shall qualify all welding procedures and welders used to produce the product per the requirements of a documented quality assurance system based on ANSI/AWS D11.2. Unless otherwise specified, gasket material shall be standard SBR. Restrained joints and restrained joint pipe shall have a working pressure rating of 350 psi for 3 to 16-inch sizes and 250 psi for 18 to 48-inch sizes. Ratings are for water pressure and must include a minimum safety factor of 2 to 1 in all sizes. The Manufacturer shall furnish test results showing that restrained joints in the sizes specified have been successfully tested to at least twice the specified pressure rating of the joint without leakage or failure. Tests shall be performed on pipe with nominal metal thickness less than or equal to that specified for the project.

2.3.2.2.4. Flanged Joints – Ductile iron pipe and fittings 3 to 54 inches for above ground service or in below ground pits shall have flanged joints and meet the following requirements:

2.3.2.2.4.1. Flanged ductile-iron pipe shall conform to current AWWA/ANSI Specification C115/A21.15 and C110/A21.10 with factory-applied screwed long hub flanges except as otherwise specified hereinafter. Flanges shall be fully machined faced and drilled after being screwed tight on the pipe, with flanges true to 90 degrees with the pipe axis and shall be flush with end of pipe conforming to ANSI B161.1, 125 pound std. or Class 250, for the purpose

intended. No welding of flanges or accessories in the field will be acceptable.

2.3.2.2.4.2. Full face type 1/16 inch thick red rubber ring gaskets shall conform to ANSI A21.11. Ring gaskets shall be of approved composition suitable for the required service.

2.3.2.3. Markings - Each ductile iron pipe section shall be marked to indicate the following:

2.3.2.3.1. Weight class or nominal thickness.

2.3.2.3.2. Letters DI or DUCTILE shall be cast or stamped on the pipe.

2.3.2.3.3. The Manufacturer's mark.

2.3.2.3.4. Country where cast.

2.3.2.3.5. Date in which the pipe was produced.

2.3.2.3.6. Date when pipe was lined.

2.3.2.4. All required markings shall be clear and legible; and all cast marks shall be on or near the bell. All letters

and numerals on pipe sizes 14-inch and larger shall be not less than 0.5-inch in height.

2.3.2.5. Color Code - Forcemain pipe shall have 3 green stripes (1/2 inch wide) with permanent ink along the entire length of pipe with the word "FORCE MAIN" in 3/4-inch tall letters every 21 inches along each stripe.

2.3.2.6. Interior Coating of Ductile Pipe - Ductile iron pipe, fittings and appurtenances including sleeves, couplings and joints, shall have the same type of lining as specified herein. Unless otherwise noted, minimum lining thickness (nominal dry film) shall be 40 mils. Interior lining shall be Protecto 401 as manufactured by Induron Coatings (Birmingham, AL); or Permox-CTF as manufactured by The Permite Corp. (Stone Mountain, GA).

2.3.2.6.1. Manufacturer's Qualifications –

2.3.2.6.1.1. Provide products from a company specializing in manufacture of high-performance epoxy coatings with a minimum 10 years of experience.

2.3.2.6.1.2. Materials shall be products of a single manufacturer or items standard with manufacture of specified coating materials.

2.3.2.6.1.3. Submit Manufacturer's certification that coatings comply with specified requirements and are suitable for intended application.

2.3.2.6.2. Applicator's Qualifications –

2.3.2.6.2.1. Engage a single installer licensed or approved by the Manufacturer with a minimum of three years' experience performing this type of lining installation and with documented skill and successful experience in the installation of ceramic epoxy lining to interior of ductile iron pipe and fittings.

2.3.2.6.2.2. Submit name and qualifications to Engineer.

2.3.2.6.2.3. Submit proof of license or approval of applicator by Manufacturer to Engineer.

2.3.2.6.3. Shop Surface Preparation –

2.3.2.6.3.1. All internal surfaces of ductile iron pipe and fittings shall be delivered to the application facility without asphalt or any other protective lining on the interior surface. All oils, small deposits of asphalt paint and grease shall be removed in accordance with NAPF 500-03-01 Solvent Cleaning prior to abrasive blasting.

2.3.2.6.3.2. Uniformly rotary-abrasive blast to a NAPF 500-03-04: Internal Pipe Surface Condition, full removal of annealing oxide layer. When viewed without magnification, the interior surfaces shall be free of all visible dirt, dust, annealing oxide, rust, mold release coating and other foreign mater. The surface shall contain a minimum angular anchor profile of 3.0 mils (76.2 microns).

2.3.2.6.3.3. Coat surface within eight hours of surface preparation.

2.3.2.6.4. High Voltage Holiday Detection – The lining system shall be high voltage discontinuity (spark) tested to determine the presence and number of discontinuities (holidays) in the lining. High voltage discontinuity (spark) testing shall be performed in accordance with ASTM D5162 or NACE SP0188. High voltage discontinuity (spark) testing shall be performed using a Tinker & Rasor model AP/W Holiday Detector (or approved equal) with a voltage

setting of 100 volts per mil thickness at minimum. Therefore, High Voltage holiday detection shall be performed at 4,000 volts minimum.

2.3.2.6.5. Prior to Shipment – Visually examine all ceramic epoxy lined pipe and fittings for film defects, including any runs, sags, and debris in the film. Shop repairs shall be made in accordance with the Manufacturer's instructions.

2.3.2.6.5.1. All ductile iron pipe and fitting linings shall be checked for thickness using a magnetic dry film thickness gauge. The thickness testing shall be in according with SSPC-PA2 film thickness rating.

2.3.2.6.5.2. The lining installer shall provide written verification that all pipe surfaces have been discontinuity tested as listed above. Verification shall be conducted by a NACE Certificated Coatings Inspector.

2.3.2.7. Exterior Coating of Ductile Iron Pipe – The options for protection of the exterior of ductile iron pipe, fittings, etc. shall consist of one of the following: (1) standard shop coating and annealing oxide layer, (2) standard coating and annealing oxide layer plus polyethylene-encasement, (3) epoxy coating, or (4) epoxy coating plus heat shrink sleeves. Options (1) and (2) are typically used for buried pipe. Option (3) is typically used for pipe that is exposed, above grade. Option (4) is typically used in exposed locations where the presence of corrosive conditions may be present (e.g. ARV vaults).

2.3.2.7.1. Standard Coating – Coating type and amount per the requirements of the pipe and appurtenance Manufacturer.

2.3.2.7.2. Encasement – DIP shall be encased in the specified polyethylene material as indicated on the project plans. DIP shall be encased in 4 mil HDCL or 8 mil LLD polyethylene material in accordance with ANSI/AWWA Standard C105, using Encasement Method A (tube wrapped).

2.3.2.7.2.1. Location Information – The installed locations of polyethylene encasement of the DIP shall be documented on the final as-built project plans.

2.3.2.7.3. Epoxy Exterior Coating –

2.3.2.7.3.1. Shop Surface Preparation – Abrasive blast to remove loose annealing oxides, all rust and other contaminants. All surfaces shall have a minimum surface profile of 1.5 mils.

2.3.2.7.3.2. Field Surface Preparation – All abraded areas shall be abrasive blasted to remove all loose rust and shall result in a surface preparation equal to that listed above. All edges shall be feathered. All other surfaces shall be abraded to provide a sufficient surface profile for the proposed finish coat(s).

2.3.2.7.3.3. Coating – Utilize products by Sherwin Williams, SherGlass FF Epoxy for exposed piping, either above grade or within underground vaults, pits, etc. For pipe remaining exposed above ground, top-coating with a urethane (Acrolon Ultra) for color and gloss retention is required. The table below does not include the standard shop applied primer coating.

| APPROVED COATING PRODUCTS | | | |
|---|---|---|---|
| **COAT** | **PRODUCT** | **COLOR** | **Dft** |
| **1st** | SherGlass FF Epoxy ** | White | 10.0-20.0 |
| **2nd** | SherGlass FF Epoxy ** | White | 10.0-20.0 |
| **Final** | Acrolon Ultra ** | Green | 2.0-3.0 |

* *Lining to be applied in a single coat*

** *Or approved equivalent*

2.3.2.7.3.4. Discontinuity Testing – After cure of the lining, all surfaces shall be high voltage holiday tested in accordance with NACE RPO 188 (latest edition) and the recommendations of the Manufacturer.

2.3.2.7.4. Heat Shrink Sleeves – Heat shrink sleeve shall consist of a cross-linked and pre-stretched sheet (coated with a protective heat-sensitive adhesive) which, upon heating, will shrink to its original length. The sleeve adhesive will achieve the corrosion protection by preventing moisture and air ingress to the pipe surface. Further, the adhesive shall act to hold and anchor the backing around the joint through adhesion to the substrate and the backing. Careful attention required concerning the compatibility of the sleeves with pipe coatings. AWWA C216 covers the material and application requirements of heat-shrinkable cross-linked polyolefin coatings for the exterior of special sections, connections, and fittings for steel pipelines.

2.3.3. Polyethylene Pipe (HDPE) - HDPE pipe shall meet the requirements of the table below and shall be high performance, high molecular weight, high density polyethylene pipe and shall conform to ASTM D 1248 (Type III C, Class C, Category 5). Minimum cell classification values shall be 345464C, as referenced in ASTM D 3350 - latest edition. All pipe resin shall be manufactured by the same company that manufactures the pipe itself in accordance with these specifications to ensure complete resin compatibility and total product accountability. The fittings shall be molded or manufactured from a polyethylene compound having a cell classification equal to or exceeding the compound used in the pipe. To ensure compatibility of polyethylene resins, all fittings supplied under this specification shall be of the same Manufacturer as the pipe being supplied.

| HDPE PIPE STANDARDS | | | | |
|---|---|---|---|---|
| **Standard** | Nominal Size | Dimension Ratio | OD Classification | Pressure Rating (Psi) |
| **AWWA C901** | 1.5" | DR 9 | CTS | 200 |
| **AWWA C901** | 2" | DR 9 | CTS | 200 |
| **AWWA C901** | 3" | DR 11 | IPS | 200 |
| **AWWA C906** | 4"+ | DR 11 | DIPS | 200 |

2.3.3.1. Quality Control - Refer to the following guidelines regarding quality control:

2.3.3.1.1. The resin used to manufacture the pipe shall be produced by the pipe Manufacturer, thus maintaining complete control of the pipe quality. The pipe shall contain no recycled compound except that generated in the Manufacturer's own plant from resin of the same specification and from the same raw material. The pipe shall be homogeneous throughout and free of visible cracks, holes, foreign inclusions, or other deleterious defects, and shall be identical in color, density, melt index, and other physical properties.

2.3.3.1.2. The Engineer may request, as part of the quality control records submittal, certification that the pipe produced is represented by the quality assurance testing. Additionally, test results from Manufacturer's testing or random Manufacturer's representation, may be cause for rejection of pipe represented by the testing. These tests may include density and flow rate measurements from samples taken at selected locations within the pipe wall and thermal stability determinations according to ASTM D 3350, 10.1.9.

2.3.3.1.2.1. Verification - The Owner or the specifying Engineer may request certified lab data to verify the physical properties of the materials supplied under this specification or may take random samples and have them tested by an independent laboratory.

2.3.3.1.2.2. Rejection - Polyethylene pipe and fittings may be rejected for failure to meet any of the requirements of this specification.

2.3.3.2. Color Coding –

2.3.3.2.1. Forcemain pipe shall have 3 green stripes (1/2 inch wide) with permanent ink along the entire length of pipe with the word "FORCE MAIN" in 3/4-inch tall letters every 21 inches along each stripe.

2.3.3.2.2. Entire pipe shall be colored with green pigment.

2.3.4. Stainless Steel Pipe and Fittings –

2.3.4.1. Stainless steel pipe and fittings shall be Schedule 10, 316 Stainless steel minimum, iron pipe size (IPS), of the nominal diameter shown on the Contract Plans. Transition to ductile iron pipe size (DIPS) outside diameter(s) shall be as shown on the Contract Plans. The stainless steel pipe and fittings shall be AISI 316L and comply with ASME/ANSI B 36.10, ASME/ANSI B36.19M, AWWA C220, latest editions and all applicable ASTM Standards.

2.3.4.2. All welded fabrication of pipe and fittings shall be in accordance with ANSI/AWS D10.4, latest edition. All welds shall be free from cold spots, pin holes, oxide inclusions, burrs, snags, rough projections and other defects. Welding shall be by AWS certified welders for austenitic chromium-nickel stainless steel pipe and tubing.

2.3.4.3. Flanged joints shall comply with AWWA/ANSI B16.5 Standards, latest edition.

2.3.5. Alternate Pipe Materials - The Owner may consider other pipe materials as appropriate for the needs of the Project. Alternate pipe materials identified during design and approved for use on the Project shall be noted on the Construction Plans.

## 2.4. FORCEMAIN APPURTENANCES

2.4.1. Forcemain Fittings for DIP and PVC - Ductile Iron Pipe Fittings – Forcemain fittings shall include Tees, Wyes, Bends, Reducers, and other appurtenances commonly used in pipe

construction. Fittings shall be ductile iron meeting AWWA Standard C110 or C153 with pressure ratings of not less than that specified for adjacent pipe. Fittings shall be constructed with mechanical joints, unless otherwise specified, and shall be supplied complete with low alloy bolts and nuts, EPR gaskets and other necessary parts required for field assembly.

Fittings shall be ceramic epoxy lined as specified herein for the adjacent pipe.

2.4.2. HDPE Pipe Fittings -

2.4.2.1. Mechanical connections of HDPE pipe (4 inch and larger) to ductile Iron or PVC piping, mechanical joint fittings, or valves shall be through a self-restraining, fusible mechanical joint adapter. Mechanical joint adapter shall be the same SDR rating as the pipe. Provide the mechanical joint adapter, including but not limited to longer tee bolts and all thread rods with nuts at the mechanical joint bell.

2.4.2.2. Mechanical connections of HDPE pipe sized under 4 inches to ductile iron or PVC piping, mechanical joint fittings, or valves shall be through the use of the above specified mechanical joint adapter if available. As an alternate, transition fittings of HDPE by male iron pipe threaded end installed by butt fusion may be used.

2.4.3. Pipe Couplings -

2.4.3.1. Pipe couplings shall be solid sleeve type with mechanical joints at each end containing a compression gasket. Couplings shall be ductile iron, 12 inches minimum in length, with low alloy bolts and nuts, and SBR gaskets. Rings and gaskets shall be sized to conform exactly to the requirements of the pipe Manufacturer.

2.4.3.2. For transition between asbestos cement and PVC or DI pipe types, Hymax 2000 Series, Romac Macro HP, Couplings, or approved equal, shall be used.

2.4.3.3. Polyethylene pipe and fittings may be joined using approved electro fusion couplings. Fittings shall be PE3408 HDPE. Electro fusion fittings shall have a pressure rating equal to the pipe.

2.4.4. Pipe Cut-In Sleeves - Cut-in sleeves shall be solid ductile iron, one end plain for insertion to female fitting, the other end flanged mechanical joint, furnished with loose attaching flange and fastener, nominal length of 20-21 inches. Specify pipe main size and type of pipe fabrication.

| **APPROVED MANUFACTURERS - PIPE CUT-IN SLEEVES** | | |
|---|---|---|
| **Manufacturer** | **Model** | **Application** |
| **Clow** | **F-1220** | **For centrifugally cast or sand cast pipe (special)** |
| **Clow** | **F-3459** | **For all classes of centrifugally cast pipe** |
| **Union Foundry** | **21-4520**<br>**21-4610**<br>**24-4800** | **MJ X PE**<br>**FLG X PE**<br>**MJ X FLG** |

| Others as approved by owner in writing |
|---|

2.4.5. Repair Clamps - Repair clamps shall not be used in the installation of new pipe except with the written permission of the Engineer. Repair clamps shall be full circle and selected based on the table below.

| REPAIR CLAMP SIZES | |
|---|---|
| Pipe Diameter | Repair Clamp Type |
| Up to 12" | Single Band |
| 14" and larger | Double Band |

2.4.5.1. Repair clamps shall be composed of stainless steel bands and bolts, DI lugs and full gridded virgin EPR compounded gasket.

2.4.5.2. Repair clamps shall be sized so that the OD of the existing pipe being repaired falls within the designated range for the clamp size. Repair clamps shall have ample length to give full gasketing at both ends.

| APPROVED MANUFACTURERS | |
|---|---|
| **Manufacturer** | **Model** |
| Ford | FS series (all SS) |
| Smith Blair | 226, 228 |
| Others as approved by Owner in writing. | |

*Note: See Manufacturer's catalog to complete model numbers by size.*

2.4.6. Pipe Restraints – Restraints shall have set or anchor screws used to secure body to pipe with torque limit break away head design.

| APPROVED MANUFACTURERS | |
|---|---|
| **Manufacturer** | **Model** |
| Smith Blair | Cam-Lock 111, 120 |
| Others as approved by Owner in writing | |

2.4.7. Expansion Joints –

2.4.7.1. Expansion joint fittings shall be used where specified on the Construction Plans. They shall be of the rigid or flexible type as specified, and manufactured of ductile iron in accordance with the DIP specification herein. They shall be capable of expanding or contracting to the extent

specified by the Engineer, but in no case less than 4-inches axially, and designed to prevent separation beyond the maximum extension without the use of external tie rods.

2.4.7.2. Expansion joint fittings shall be flanged or provided with restrained mechanical joints, individually pressure tested to a minimum of 350 psi against their own restraints, and internally coated on all exposed surfaces with a minimum of 15 millimeters of fusion bonded epoxy conforming to AWWA C116. They shall be capable of deflecting at least 15 degrees by means of an integral ball at each joint in the case of flexible types.

| APPROVED MANUFACTURERS | | |
|---|---|---|
| **Type** | **Manufacturer** | **Model** |
| Rigid | EBAA Iron, Inc. | EX-TEND 200 |
| Flexible | EBAA Iron, Inc. | Flex-Tend |
| Others as approved by Owner in writing | | |

2.4.8. Tapping Sleeves -

2.4.8.1. The minimum size tapping sleeve shall be 4 inches. Connection of 3-inch lines to existing pipes 4 inches and larger shall be made by a 4-inch tapping sleeve with appropriate reducing fitting. Tapping saddles shall be used for smaller connections.

2.4.8.2. Tapping sleeves shall be designed for a working pressure of 200 psig without leakage. Tapping sleeves shall be all stainless steel including stainless steel flange. The outlet branch connection shall have a recessed flanged face for connection of tapping valve with standard dimensions in accordance with Manufacturers Standardization Society (MSS) SP-60. A complete set of neoprene or other elastomer gaskets shall be furnished. Sleeves shall be furnished to fit ductile iron, cast-iron, cement-asbestos, Class 160 or C900/905 PVC pipe with side connection as shown on plans or specifications in standard pipe sizes. Sleeves shall be furnished with all necessary installation parts. All hardware shall be stainless steel.

| APPROVED MANUFACTURERS | |
|---|---|
| **Manufacturer** | **Model** |
| Ford | Fast |
| Mueller | H-304SS |
| JCM Industries | 432 |
| Romac | |
| Smith-Blair | 663, 665 |
| Others as approved by Owner in writing. | |

*Note: To specify exact fitting when ordering, confirm line outside diameter and material. Confirm compatibility of selected fitting with existing main material.*

2.4.9. Pipe Hangers And Supports - Hangers and supports shall be in compliance with Federal Specification WWH-171E, or Manufacturer's Standardization Society SP-69, or UL listed. Materials of construction shall be in accordance with the requirements outlined in the table below.

| APPROVED MATERIALS FOR CONSTRUCTION OF PIPE HANGERS AND SUPPORTS | |
|---|---|
| **Part I.D.** | **Material** |
| Clamps | Steel - Epoxy Coated or Galvanized<br>Cast Iron - Galvanized<br>Malleable Iron |
| Hanger Rods | Steel - Electro Galvanized<br>Steel - Stainless 304 |
| Roller Bases/Roller Stands | Cast Iron |
| Fasteners/Fittings | Galvanized Steel<br>Stainless |
| Hanger Rod Inserts | Steel - Cadmium Plated<br>Steel - Galvanized<br>Universal Concrete Insert - Cast Iron - Galvanized |
| Rod Attachments | Clevis - Forged Steel<br>Turnbuckle: 1) Forged Steel, 2) Malleable Iron<br>Sockets, Eye Nuts, Extension - Malleable Iron |
| Roller Bases/Roller Stands | Cast Iron |
| Rollers | Steel or Iron Core, Insulated from Structure |

| APPROVED MANUFACTURERS - PIPE HANGERS AND SUPPORTS | | |
|---|---|---|
| **Manufacturer** | **Part I.D.** | **Model No.** |
| Utility Pipe Sales | Clevis Hanger | 590 |
| | Socket Clamp | 224<br>246 |
| | **Concrete Inserts:** | |
| | CB-Universal | 282 |
| | Screen Insert | 152 |
| | **Rod Attachments:** | |
| | Eye Nut | 290 |
| | Forged Clevis | 299 |
| | Forged Turnbuckle | 230 |
| | Carbon Steel | 233 |
| | Couplings | 136 |
| | Socket Eye | 110R |
| | Extension | 157 |
| | **Pipe Rolls:** | |
| | Adjustable Swivel 174 | 174 |
| | Adjustable Steel Yoke 181 | 181 |
| | Pipe Roll with Base | 274 |
| | Pipe Roll and Plate | 277 |
| Others as approved by Owner in writing. | | |

**APPROVED MANUFACTURERS - PIPE HANGERS AND SUPPORTS**

**Manufacturer Part I.D. Model No.**

Utility Pipe Sales Clevis Hanger 590

2.4.10. Valves - All valves shall be manufactured in accordance with the current appropriate AWWA Standard.

2.4.10.1. Resilient Seated Gate Valves - Resilient seated gate valves shall be designed and fabricated in accordance with the current AWWA Standard C-509 or C-515. The basic design of the gate valves shall have a cast iron body, elastomer encapsulated iron disc, bronze stem and operating nuts with non-rising stem design. Valves 16-inches and larger shall be equipped with right angle gears (bevel gearing) for horizontal installation. The valve working pressure for all sizes shall be a minimum of 250 psig with a test pressure of 500 psig.

2.4.10.1.1. Materials And Construction - Valves shall open counterclockwise with a 2-inch square iron operating nut secured to the valve stem by a corrosion resistant Type 304 stainless steel nut that threads onto the valve stem. The valve stem shall be made of high tensile strength bronze and shall be of one piece construction sealed by O-Rings. The thrust collar shall be secured in place by a stuffing box or bonnet cover with a thrust washer located above the thrust collar. Valve construction shall be so that upper O-Rings can be replaced with the valve in service. The disc shall be cast iron encapsulated with an EPDM rubber material bonded in accordance with ASTM D429 and shall be secured to the threaded stem by a bronze nut. The disc shall effect a seal that is bubble-tight at 250 psig.

2.4.10.1.2. Body-Disc-Bonnet-Operating Nut Material - Cast ductile iron construction in accordance with current AWWA Standard C-509 and C-515 and AWWA Standard C-153. Body bolts shall be equipped with square or hex head bolts for easy removal.

2.4.10.1.3. Corrosion Resistant Coatings - All interior and exterior cast iron surfaces shall be coated with fusion bonded epoxy in accordance with AWWA Standard C-550.

2.4.10.1.4. Body Sizing - Valve body length shall be per ASME/ANSI B16.20 for the type of end connections specified. In the full open position, the valve internal bore shall be smooth and obstruction-free without cavities or projections that could accumulate solids. The internal cross-sectional area of the valve shall be approximately equal to the nominal cross-sectional area of the adjoining pipe.

2.4.10.1.5. End Connections -

2.4.10.1.5.1. Valves shall be furnished with mechanical joint end connections, complete with accessory kits, unless otherwise specified on the plans.

2.4.10.1.5.2. When flanged ends are specified they shall be flat face class 125, conforming to ASME/ANSI B16.1 with bolt holes straddling the vertical center line.

| APPROVED MANUFACTURERS - RESILIENT SEATED GATE VALVES | | | | | | |
|---|---|---|---|---|---|---|
| **Manufacturer & Specs** | | | **Valve Body Connections** | | | |
| | | | **Mechanical Joint** | **Flange & Mechanical Joint** | **Flanged End** | **Machanical Joint for Tapping** |
| | | | **(MJxMJ)** | **(FLGxMJ)** | **(FLGxFLG)** | **(MJxSF)** |
| **Clow** | C-509 | Size: | 2"-12" | 3"-12" | 2"-12" | 3"-12" |
| | | Model No: | F-6100 | F-6106 | F-6102 | F-6114 |
| | C-515 | Size: | 4"-48" | 4"-48" | 4"-48" | 4"-24" |
| | | Model No: | F-6100 | F-6106 | F-6102 | F-6114 |
| **Kennedy** | C-509 | Size: | 2"-12" | 3"-12" | 2"-12" | 4"-12" |
| | | Model No: | 8571SS | 8572SS | 8561ASS | 8950SS |
| | C-515 | Size: | 2"-12" | 3"-12" | 2"-12" | 4"-12" |
| | | Model No: | 7571SS | 7572SS | 7561SS | 7950SS |
| **M&H** | C-509 | Size: | 2"-12" | 3"-12" | 2"-12" | 4"-12" |
| | | Model No: | 4067-01 | 4067-13 | 4067-02 | 4751-01 |
| | C-515 | Size: | 2"-16" | 3"-16" | 2"-16" | 4"-16" |
| | | Model No: | 7571 | 7572 | 7561 | 7950 |
| Others as approved by Owner in writing. | | | | | | |

2.4.10.2. Resilient Seated Tapping (Gate) Valves - Resilient seated tapping gate valves shall be designed and fabricated in accordance with the specifications for resilient seated gate valves noted above.

2.4.10.2.1. Body Sizing - Valve body length shall be per ASME/ANSI B16.20 for tapping valves. Tapping valves shall conform to Specification AWWA C509 or C515, latest revision, covering gate valves except as modified for passage and clearance of tapping machine cutters. The opening through the valve shall be at least 1/4-inch larger than nominal valve diameter. Tapping valves shall allow full size shell cutters to be used.

2.4.10.2.2. End Connections - Valves shall be furnished with one end of the body with projecting face flange in accordance with specification MSS SP-60 for tapping valve/saddle connections to bolt to a standard tapping sleeve and the other end for mechanical joint.

2.4.10.3. Plug Valves –

2.4.10.3.1. Plug valves (Above Ground) shall be of the non-lubricated, 100 percent port eccentric type with resilient faced plugs with flanged ends, furnished with all necessary joint materials.

Valves are to be rated for 150 psi (non-shock working pressure), cast-iron body, nickel seat, and hard rubber Hycar coated plug with a flushing port. Valves shall be installed with the seat on the downstream side of the flow path, to provide a positive seal when closed. Valve shall include hand-wheels for operation. Valves shall be as manufactured by M&H Style 820 X-centric, Dezurik or approved equal. All interior and exterior ferrous surfaces shall be coated with fusion bonded epoxy in accordance with AWWA Standard C-550.

2.4.10.3.2. Plug valves shall have an allowable capacity equal to 100% of the adjacent pipe area, and shall allow pigging.

2.4.10.3.3. Operation: The construction of the valve shall be eccentric utilizing a quarter-turn manual operation, so that the opening movement of the valve results in the plug rising off the seat rather than sliding from its seat. Valves 16-inches and larger shall be equipped with right angle gears (bevel gearing) for horizontal installation.

2.4.10.3.4. Construction and Performance: Plug valves shall meet or exceed AWWA C504-80 and ANSI B16

1-1975 requirements.

2.4.10.4. Combination Air Release and Vacuum Valves –

2.4.10.4.1. General – Forcemains shall be laid so as to minimize the number of high points. Air release valves shall be installed at all high points in forcemains shown on the project plans. Exact locations of air release valves shall be field determined. In all cases, installation should be in the furthest downstream portion of each high point.

2.4.10.4.2. The valve shall be designed to operate with liquids carrying solid particles such as raw sewage. The air and vacuum air valve shall discharge air at high flow rates during the filling of the system and admit air into the forcemain at high flow rates during its drainage. High velocity air cannot blow the float shut. Sewage entry to the lower portion of the valve will cause the sealing of the valve. At any time during system operation, should internal pressure of the system fall below atmospheric pressure, air will re-enter the system.

2.4.10.4.3. Working pressure range: 3 – 230 psi. Testing Pressure: 360 psi.

2.4.10.4.4. The valve's design shall prevent any contact between sewage and the sealing mechanism by creating an air gap at the top of the valve, under all operating conditions.

2.4.10.4.5. The conical body shape shall be designed to maintain the maximum distance between the liquid and the sealing mechanism.

2.4.10.4.6. A spring-loaded joint is to be furnished between the stem and the upper float. Vibrations of the lower float will not unseal the automatic valve. Release of air will occur only after enough air accumulates.

2.4.10.4.7. The funnel-shaped lower body shall be designed to ensure that residue sewage matter will reenter the forcemain and will not remain in the valve.

2.4.10.4.8. Maintenance flushing shall be provided while the valve is under pressure, by opening a full port type 316 S.S. ball valve in the valve's lower body.

2.4.10.4.9. All inner metal parts of the valve shall be made of stainless steel SAE 316.

2.4.10.4.10. Maximum working temperature 203°F.

2.4.10.4.11. The valve shall be provided with an AWWA/ANSI C110 flanged joint at the base of the body.

2.4.10.4.12. The valve shall be furnished with an AWWA C517 resilient seat, cast iron eccentric plug valve with a hand wheel operated, worm gear actuator.

| APPROVED MANUFACTURERS | | |
|---|---|---|
| **Manufacturer** | **Size** | **Model** |
| ARI Flow Control Accessories | 2" | D-025 (plastic) |
| | 4" and Larger | D-023 (Stainless Steel) |
| Others as approved by Owner in writing. | | |

2.4.10.5. Horizontal Swing-Check Valves – These horizontal swing-check valves shall be the clear waterway type, designed and fabricated in accordance with the current AWWA Standard C508. Horizontal swing check valves shall be iron body, bronze mounted with flanged ends rated for operation at 125 psi. The cover shall be cast iron with cover bolts of rust-proofed steel. The seating surfaces shall be bronze, and the disc shall be ductile or grey iron. The shaft shall be stainless steel with corrosion resistant bearing(s) at each end. Where extended outside the body, the shaft shall be sealed with double O-rings. There shall be a grease fitting between the O-rings. The check valve shall be of the adjustable external spring-loaded type. The Contractor shall adjust the tension in the spring as necessary to prevent slamming of the valve upon closing. All interior and exterior ferrous surfaces shall be coated with fusion bonded epoxy in accordance with AWWA Standard C-550.

2.4.11. Valve Vaults and Boxes –

2.4.11.1. Valve boxes shall be provided for all direct buried valves. Use nominal (5 ¼) inch cast-iron, screw-type pipe shaft with cover and base casting. The box top shall be set at finished grade and encased with a concrete ring in unpaved areas. Each valve box shall be color coded and furnished with a drop-in cover marked "SEWER".

2.4.11.2. Valve Vaults or Chambers – All valves which are not designed for direct burial shall be installed in vaults, which shall be constructed from standard precast concrete manhole sections. They shall be sized to allow sufficient room for maintenance and repair in situ.

2.4.12. Line Stops - Line stops are to be used where specified to temporarily stop water flow without depressurizing the entire line. The line stop parts and installation equipment are to be rated at a minimum of 150 psig working pressure unless otherwise specified.

2.4.12.1. Materials And Construction - Tapping saddles shall have 360-degree clamping on the main. All tapping saddles shall be fabricated of 304 Stainless Steel. All bolts and fasteners are to be 304 Stainless Steel, and the saddle shall be installed with Buna-N or neoprene rubber full facing gasket. Epoxy coated body will be allowable.

2.4.12.1.1. The stopping device attaching nozzle to be vendor's standard with connecting threads or flange face, and the nozzle I.D. to be manufactured with a shelf to provide a position stop for the closure

plug.

2.4.12.1.2. The closure plug is to be fabricated carbon steel, ductile iron, or malleable iron with at least one Buna-N or neoprene O-Ring seal on the outside diameter.

2.4.12.2. Corrosion-Resistant Coatings - Non-stainless steel, permanently installed parts to have Manufacturer's standard red or black water-based epoxy coating on exterior. Fittings shall be ceramic epoxy lined as

specified herein for the adjacent pipe.

2.4.12.3. Connection - Tapping saddle shall be fabricated with dimensions to fit on concrete, steel, CA, PVC, CI, DI main as specified.

2.4.12.4. Installation - Temporary line stops shall only be installed by vendor personnel or Contractor Personnel trained and certified for installation by the vendor.

2.4.13. Valve Insertions –

| APPROVED MANUFACTURERS (MAIN SIZES 4-INCH - 42-INCH) | |
|---|---|
| **Manufacturer** | **Contact** |
| Hydra-Stop, Inc. | Phone: 800-538-7867 |
| JCM 440 | Phone: 800-527-8482 |
| Romac | Phone: 800-426-9341 |
| Others as approved by Owner in writing. | |

2.4.14. Location Aids - All new forcemain and service line installations shall include an approved method for locating lines from the ground surface after completion.

2.4.14.1. Tracer Wire - Tracer wire for forcemain lines shall be minimum 12 gauge copper with green PVC insulation for open trench installation. For trenchless installation, 8-gauge copper with green PVC insulation shall be used. Tracer wire systems shall be electrically continuous covering all mains and services within the project. Wire-to-wire connections shall be made with silicone-filled wire nuts. Wire-to-appurtenance attachments shall be made with lug-type terminals. Wire shall be secured to the top of each pipe joint with nylon ties or PVC tape placed on 10-foot intervals. Wire shall be secured to pipe with green colored PVC Tape.

| APPROVED MANUFACTURERS (TRACER WIRE SILICONE-FILLED WIRE NUT CONNECTORS) | |
|---|---|
| **Manufacturer** | **Model** |
| Ideal Industries | Twister® DB Plus |
| King Technology, Inc. | Failsafe™ |
| Others as approved by Owner in writing. | |

2.4.14.2. Curb Markers – Curb marker base material must be 30 ml. non-yellowing UVI plastic. UV resistant inks with a minimum 7 year rating will be used to decorate the marker surface. A clear urethane dome no less than 60 ml shall be applied to the surface. The dome must not yellow or pit. It must be self-healing and have a Durometer hardness of D-60. Marker must have a 12 year written warranty. Copy to be supplied by vendor. Marker must meet ADA minimum recommendations for slip resistance. Markers shall be as manufactured by DAS Manufacturing, Inc. or approved equal.

2.4.14.2.1. Curb Marker Adhesive - Adhesive must permanently affix markers to concrete, asphalt and cast iron. Adhesive must be ready to use requiring no special surface preparation. Adhesive must have a shelf life of at least one year. Adhesive must be black in color and remain resilient for a minimum of twelve years. Adhesive must be available in a 5 oz. Re-sealable Squeeze Tube.

2.4.14.2.2. Provide curb markers per the following table:

| CURB MARKER SPECIFICS | | | |
|---|---|---|---|
| **Type** | **Nominal Size** | **Color** | **Designation** |
| Sewer Valve | 2.5" | Green | #2.5 NSV |
| Sewer Service | 2.5" | Green | #2.5 NSW |

## 2.5. LOW PRESSURE SEWER SERVICE LINES

2.5.1. Service Laterals – Typical Low pressure sewer service laterals for a single family residences shall be 1 ½ inch green tubing with tracer wire (#12 gauge with green insulation). Larger services may be used if approved by the Owner. Services installed under the roadway shall be encased in 2 inch green PE/PVC tubing/piping. Piping shall be as specified herein.

## 3. EXECUTION

## 3.1. GENERAL

3.1.1. The Contractor shall provide all labor, equipment and materials as required to install all pipes, valves, fittings, and other appurtenances as indicated on the construction plans or as specified in the Contract documents.

## 3.2. SEWAGE FORCEMAIN LINE SEPARATION FROM POTABLE WATER LINES

3.2.1. New or relocated sanitary sewer forcemains must be laid to provide a horizontal separation of at least six feet, and preferably ten feet, between the outside of the sewer forcemain and the outside of the potable water pipe. In locations where it is not feasible to comply with this requirement the Contractor shall refer to the conflict details on the construction plans.

## 3.3. PIPE INSTALLATION

3.3.1. The Contractor shall utilize equipment and methods in accordance with pipe Manufacturer's requirements and standard construction practices to ensure pipe installation to line and grade as indicated.

3.3.1.1. Trench Excavation - Refer to Section 02221-"Trench Excavation Backfill and Compaction." Contractor shall maintain a minimum of 30 inches and maximum of 36 inches of cover below finished grade unless otherwise approved by the Owner or its representative in writing.

3.3.1.2. Alignment - Pipe shall be installed along the alignment indicated by the construction plans. Accomplish horizontal and vertical changes in alignment of pipe with bends or other appropriate fittings. Joint deflection shall not exceed the recommendations of the pipe Manufacturer.

3.3.1.3. Pipe Preparation - Offloading, handling and installation of pipe shall be in accordance with AWWA standards and applicable sections of this document. The Contractor shall clean the interior of all pipes, fittings, and joints prior to installation. Pipes shall be inspected for defects prior to installation. Damaged pipe shall be rejected and removed from the project.

3.3.1.4. Pipe Installation -

3.3.1.4.1. Install pipe only when weather and trench conditions are suitable. Do not lay pipe in water. Join pipe in accordance with Manufacturer's recommendations.

3.3.1.4.2. Provide initial backfill or anchoring as necessary to prevent displacement and preserve alignment

after establishing final position.

3.3.1.4.3. Encase force main pipe in steel casing or use ductile iron pipe when crossing under pipe, conduit, or structure when a 6-inch separation distance cannot be maintained. This protection shall extend a minimum of 5 feet beyond crossed structure.

3.3.1.5. Crossings - Where the crossing of a roadway, water body, rail, or other obstacle requires trenchless

installation, the materials and installation methods shall conform to Section 02300-"Horizontal

Directional Drilling" or Section 02310-"Jack and Bore", as applicable.

3.3.1.6. Protection - Prevent the introduction of foreign matter into the pipe at all times. Close open ends of pipe with water tight fitting closures or plugs. Do not let water fill trench, but include provisions to prevent flotation should water control measures prove inadequate. Remove water, sand, mud and other undesirable materials from trench before removal of pipe closure piece.

3.3.1.7. Cutting - PVC or PE pipe shall be cut in a neat workmanlike manner, and the spigot end shall be beveled per Manufacturer's recommendation. Ductile iron pipe shall be cut in accordance with Manufacturer's recommendation. Do not allow excessive heat to develop. Smooth and bevel cut end as per Manufacturer's recommendations. Use of pipe with damaged lining is unacceptable.

3.3.1.8. Closure Pieces - Closure pieces shall only be used where called for on plans. Closure may be accomplished with sleeve coupling as long as its length is such that gaskets are not less than 3 inches from pipe ends.

3.3.1.9. Restraints And Thrust Blocking - Mechanical joint restraints shall be furnished and installed for all forcemain line fittings and appurtenances. Restraints and thrust blocks are required for 90 degree bends, tapping sleeves, tees, dead-ends.

## 3.4. APPURTENANCE INSTALLATION

3.4.1. Valves - Valves shall be installed with operating stems vertical for valves 16 inch and smaller. For valves larger than 16 inches, the valve may be installed horizontally. Horizontal valves shall be provided with a right-angle gear drive and flush port piping to the lower clean-out. Extensions shall be provided if the valve operating nut is greater than 24 inches below finish grade. Valves shall be installed on a suitable bearing surface as shown on the project plan details, to prevent vertical displacement.

3.4.1.1. Air release valves shall be located and installed at the down-stream end of all high points as shown in the details and on the approved construction plans.

3.4.1.2. Check valves, complete with vaults if applicable, shall be installed at locations shown in the approved construction plans in accordance with the Manufacturer's instructions.

3.4.2. Valve Boxes - Valve boxes shall be centered on the valve. The earth shall be compacted around each valve box to a distance of 4 feet on all sides of box, or to undisturbed trench face if less than 4 feet. An 18-inch diameter by 4-inch thick collar shall be constructed and sloped to direct water away from the valve box. In lieu of the constructed collar, a 24-inch by 4-inch thick pre-cast, sloped, concrete collar may be used.

3.4.3. Tracer Wire - Tracer wire shall be installed on all new forcemains and on all new pressure sewer service lines. The tracer wire shall be placed directly above the pipe and electrically continuous throughout the project.

Tracer wire shall be secured to the pipe with PVC tape the same color as the wire insulation, at a maximum of 10-feet on center between tapings. The tracer wire shall be brought to the ground surface at each valve location in accordance with the details. Splices and/or connections in the tracer wire shall be installed with silicone-filled wire nuts designed for direct burial.

## 3.5. SERVICE LINE INSTALLATION

3.5.1. General - The Contractor shall install individual services with tracer wire from the new main to a convenient point on the right-of-way or property line for each house, building or unit that is proposed for service. New services for undeveloped lots shall be located 1 foot from the common property line. The installation of service lines shall be in accordance with the requirements for force main installation, (See Section 3.3 above).

3.5.2. Service Line Connections - Service lines shall be installed in accordance with the details. Tubing shall be installed in one continuous length from corporation stop to curb stop with no intermediate fittings. Service lines damaged after initial installation but before acceptance may be repaired by means of a single splice, except that no repair fittings will be permitted under any paving. Service taps shall be made with a tapping machine designed for the pipe material being tapped. Other types of tapping machines may be used upon prior approval by the Owner or its representative.

3.5.3. Long Service Lines - Unless otherwise noted on plans, HDPE pipe and tubing shall be installed at the shallowest depth that can safely and reasonably be achieved (but no less than 36 inches minimum). Depth shall take into account all utility conflicts, bend radius of the pipe, and bend radius of the drill stem. Where utilities cross under DOT, county and/or city roads, the service line shall be encased in accordance with these specifications and the typical details. The depth of cover shall comply with applicable permits and shall be

adequate to provide reasonable measures to avoid damage to the road surface and/or road base.

3.5.4. Tapping Saddles - Tapping saddles shall be either bronze or ductile iron with shop coat, with the exception of saddles for PE pipe. Saddles used to tap Class 160 PVC pipe shall be designed with mechanical features or stops to prevent over-tightening.

3.5.4.1. Materials And Construction - Tapping saddles shall have 360-degree clamping on the main. All tapping saddles shall be fabricated of 304 Stainless Steel. All bolts and fasteners are to be 304 Stainless Steel, and the saddle shall be installed with Buna-N or neoprene rubber full facing gasket. Epoxy coated body will be allowable.

## 3.6. TAPS ON PRESSURIZED LINES

Taps for service lines of 2-inch and smaller shall be made using a tapping saddle. The Contractor shall perform taps on pressurized lines for the installation of pipes other than service lines of 2-inch and smaller in accordance with these requirements:

3.6.1. Materials - All materials used for taps on pressurized lines shall meet the requirements of these specifications. Tapping sleeves shall be properly sized for the pipe being tapped. Resilient seated tapping valves shall be furnished with special end connections. All other material used to accomplish the tap shall meet the standards set forth by the relevant AWWA Standards.

3.6.2. Procedure - The Contractor shall notify the Owner or its representative three working days in advance of work. The Contractor shall in the presence of the Owner or its representative:

3.6.2.1. Expose the existing pipe at the location shown on the plans, and clean the section of the pipe to receive the tapping sleeve.

3.6.2.2. Check the tapping sleeve and valve for defects and make sure the gate fully retracts in the valve to allow the shell cutter free passage.

3.6.2.3. Assemble the tapping sleeve on the pipe, then install the tapping valve.

3.6.2.4. Hydrostatically pressure test the tapping sleeve and valve after it has been assembled on the pipe main using the test plug on the sleeve. The test shall be 150 psi minimum. The duration of the test shall be 15 minutes.

3.6.2.5. Pour a thrust block behind the tapping sleeve sufficient to withstand the pressure of the new line. Also, provide a concrete pad or suitable bearing surface sufficient to support the weight of the sleeve, valve, and tapping machine. Concrete shall be in place a minimum of 24 hours prior to testing the main installation.

3.6.2.6. Assemble an approved tapping machine and proceed to make the necessary cut-in accordance with

the recommendation of the tapping machine Manufacturer. Approved tapping machines shall be:

3.6.2.6.1. In good working condition.

3.6.2.6.2. Designed for and having a cutting bit for the pipe material to be cut.

3.6.2.6.3. Equipped with a depth of cut gauge.

3.6.2.6.4. Designed to capture the coupon.

3.6.2.6.5. Equipped with the Manufacturer's recommended diameter shell cutter for the tap to be made.

3.6.2.6.6. Tapping machine power head to be hydraulic or pneumatic drive; use of electric motor drives

expressly prohibited.

3.6.2.7. The following tapping chart may be used for field reference only:

| TAP SIZE REFERENCE CHART | | |
|---|---|---|
| **Nominal Main Size** | **Tapping Valve ID AWWA Standard** | **Tapping Machine Shell Cutter OD** |
| 2" | 2 1/8" | 1 ½" |
| 3" | 3 1/8" | 2 ½" |
| 4" | 4 ¼" | 3 ½" |
| 6" | 6 ¼" | 5 ½" |
| 8" | 8 ¼" | 7 ½" |
| 10" | 10 ¼" | 9 ½" |
| 12" | 12 ¼" | 11 ½" |
| 14" | 14 ¼" | Per Manufacturer's Recommendation |
| 16" | 16 ¼" | |

| | | |
|---|---|---|
| 18" | 18 ¼" | Contractor shall submit shop drawings for valves and tapping machine for approval prior to use. Per Manufacturer's Recommendation |
| 20" | 20 ¼" | |
| 24" | 24 ¼" | |

3.6.2.8. Tap coupon shall be given to the Owner or its representative. If the coupon is lost in the main, Contractor shall, at his expense, dismantle main to retrieve the coupon. Main will be reassembled, pressure tested as required at Contractor's expense.

## 4. ACCEPTANCE REQUIREMENTS

### 4.1. INSPECTION

4.1.1. Upon completion of the installation, the system shall be inspected to ascertain that valves, fittings, etc. are located in conformance with the plans, and confirm that all 'as-built' measurements have been accurately taken. The Owner or its representative shall observe all appropriate activities related to properly placing the line in service including flushing, pressure and leakage testing. Final connections shall be accomplished after final clearance of lines. Tracer wire shall be tested for continuity by the Contractor with the Owner or its representative present. The Contractor, with the Owner or its representative, shall make sure all main valves are open.

### 4.2. NEW FORCEMAIN CLEANING

4.2.1. All newly installed forcemain lines shall be flushed with potable water to remove any sediment, solids and/or foreign matter prior to testing. The Owner will make water available to the Contractor. Flushing shall be

conducted at a sufficient velocity to clear the pipe. Discharge of flushing water must be through a 2-inch diameter pipe (or larger) and must be controlled so as not to cause any property damage. Chlorinated water must be disposed of in an acceptable manner. Flush water source connection shall incorporate backflow preventer and meter when required by the Owner or its representative.

4.2.1.1. If flushing is unsuccessful in satisfactorily removing debris from the forcemain or for larger diameter lines (12" or larger) if designated on the plans, cleaning shall be performed by swabbing (pigging). Pipes shall be flushed and swabbed a minimum of 3 passes until line is clear. To facilitate this process, pigging launch stations and receiving pits shall be installed and incorporated into system.

### 4.3. PRESSURE/LEAKAGE TEST

4.3.1. General - All newly installed forcemain lines and appurtenances shall be pressure/leak tested to assure the strength of materials and quality of workmanship of the installation. Testing shall be conducted in accordance with the details and the requirements of AWWA Manual 23 for PVC and other flexible pipe or AWWA C600 for Ductile Iron Pipe. Leakage testing may be conducted concurrently with the pressure test.

4.3.2. Procedure -

4.3.2.1. Contractor shall notify the Owner or its representative three working days prior to a scheduled test. Tests are to be conducted in segments not to exceed three thousand (3,000) feet of

pipe. Water in the new line shall be pumped up to a pressure of 150 psi minimum. This pressure shall be maintained for a minimum of two (2) hours by pumping a quantifiable amount of water into the line and record the amount of water added during the test period. This represents the leakage.

4.3.2.2. Pressure/leakage tests shall be deemed acceptable when leakage does not exceed that determined by

the following formula:

| $L = SD\sqrt{P}/133,200$ | $L = ND\sqrt{P}/7,400$ | $L = ND\sqrt{P}/6,600$ |
|---|---|---|
| or 11.65 gpd/mi/inch/dia | for DI pipe 18' lengths | for PVC pipe 20' lengths |

Where:

L = Maximum leakage, in gallons per hour.

S = Length of pipe under test, in feet.

N = Number of pipe joints in segment under test.

D = Nominal internal diameter of pipe, in inches.

P = Average actual leakage test pressure, psig.

4.3.2.3. Record all data for submission with as-built plans.

4.3.2.4. The Owner or its representative shall be present during test.

4.3.2.5. Refit and replace all pipe not meeting the leakage requirements. Repair clamps are not permitted.

4.3.2.6. Repair all visible leaks regardless of the amount of leakage.

**4.4. OTHER CONNECTIONS**

4.4.1.1. After new system piping has been satisfactorily tested and cleared for use, make any approved additional connections to the pre-existing distribution system. When total system is approved for use, the Owner or its representative shall verify that the Contractor has opened all interior valves as required. Valves connecting new installations to Owner's existing distribution system shall then be opened by the Owner or its representative.

**END OF SECTION**

## PART 1 - GENERAL

### 1.0 RELATED DOCUMENTS

A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and Division 1 Specification Sections, apply to this Section.

### 1.1 SUMMARY

A. This Section includes the following:

1. Preparing and grading subgrades for slabs-on-grade, walks, pavements, and landscaping.
2. Excavating and backfilling for buildings and structures.
3. Subbase course for walks and pavements.
4. Excavating and backfilling trenches within building lines.
5. Pavement Crossings (Cased) for paved roadways.

B. Related Sections: The following Sections contain requirements that relate to this Section.

1. Division 2 Section "Site Clearing" for site stripping, grubbing, topsoil removal, and tree protection.

### 1.2 DEFINITIONS

A. Excavation consists of the removal of material encountered to subgrade elevations and the reuse or disposal of materials removed.

B. Subgrade: The uppermost surface of an excavation or the top surface of a fill or backfill immediately below subbase, drainage fill, or topsoil materials.

C. Borrow: Soil material obtained off-site when sufficient approved soil material is not available from excavations.

D. Subbase Course: The layer placed between the subgrade and base course in a paving system or the layer placed between the subgrade and surface of a pavement or walk.

E. Base Course: The layer placed between the subbase and surface pavement in a paving system.

F. Structures: Buildings, footings, foundations, retaining walls, slabs, tanks, curbs, mechanical and electrical appurtenances, or other man-made stationary features constructed above or below ground surface.

G. Utilities include on-site underground pipes, conduits, ducts, and cables, as well as underground services within building lines.

## 1.3 SUBMITTALS

A. General: Submit the following according to the Conditions of the Contract and Division 1 Specification Sections.

B. Test Reports: In addition to test reports required under field quality control, submit the following:

1. Laboratory analysis of each soil material proposed for fill and backfill from on-site and borrow sources.
2. One optimum moisture-maximum density curve for each soil material.
3. Report of actual unconfined compressive strength and/or results of bearing tests of each stratum tested.

## 1.4 QUALITY ASSURANCE

A. Testing and Inspection Service: Contractor will employ a qualified independent geotechnical engineering testing agency approved by the Engineer to classify proposed on-site and borrow soils to verify that soils comply with specified requirements and to perform required field and laboratory testing.

## 1.5 PROJECT CONDITIONS

A. Site Information: Data in the subsurface investigation report was used for the basis of the design and are available to the Contractor for information only. Conditions are not intended as representations or warranties of accuracy or continuity between soil borings. The Engineer/Owner will not be responsible for interpretations or conclusions drawn from this data by the Contractor.

B. Existing Utilities: Do not interrupt existing utilities serving facilities occupied by the Owner or others except when permitted in writing by the Engineer and then only after acceptable temporary utility services have been provided. Contractor is responsible for contacting all utility companies to obtain locations of all existing utilities or obstructions which he may encounter during construction. After location of utilities by the appropriate utility company, it is the Contractor's liability to protect all such utility lines, including service lines and appurtenances, and to replace at his own expense any which may be damaged by the Contractor's equipment or forces during construction of the Project.

C. Should uncharted, or incorrectly charted, piping or other utilities be encountered during excavation, consult utility owner immediately for directions. Cooperate with Owner, and utility companies in keeping respective services and facilities in operation. Contractor shall bear all costs of repairing damaged utilities to the satisfaction of utility owner.

D. Provide a minimum 48-hours' notice to the utility and Engineer and receive written notice to proceed before interrupting any utility.

E. Use of Explosives: The use of explosives is not permitted.

F. Protection of Persons and Property: Barricade open excavations occurring as part of this work and post with warning lights. While performing construction along the Gulf Power easement, temporary fencing will be required between construction area and dwellings where yards are fenced. This temporary fencing may be barricade fencing or other suitable material.

G. Operate warning lights as recommended by authorities having jurisdiction.

H. Perform excavation within drip-line of large trees to remain by hand, and protect the root system from damage or dry out in the manner prescribed in Division 2 specification sections.

## PART 2 - PRODUCTS

### 2.0 SOIL MATERIALS

A General: Soils used as fill shall be clean sands, similar to existing site soil, with less than 5% passing the number 200 sieve when existing subgrade conditions are considered wet as per the Owner and/or its representative. Soils as described above with less than 12% passing the number 200 sieve and meeting the requirements of Section 902-6 of the FDOT Specifications may be used when existing subgrade conditions are considered dry a per the Owner and/or its representative. The sand shall have a maximum dry density of at least 100 pounds per cubic foot according to the Modified Proctor compaction test, AASHOTO T-180, ASTM D1557. Provide approved borrow soil materials from off-site when sufficient satisfactory soil materials are not available from excavations. Provide laboratory certification that soils meet requirements of specifications.

B Cut: Where required, the site shall be excavated to the grades shown. Excavated material that is suitable shall be used in the fill sections of the site.

C Fill: In order to insure proper bond and prevent slipping between the original ground and fill, the surface of the original ground shall be scarified to a depth of at least three inches. Each layer of fill material shall be compacted until the required density is achieved.

If the Contractor elects to import any materials other than that excavated on site, then he will do so only with Engineer's approval and at his own expense, unless separate payment for such items are called for in these specifications.

D Backfill Materials: Satisfactory soils materials.

E Subbase Material: Naturally or artificially graded mixture of natural or crushed gravel, crushed stone, and natural or crushed sand, ASTM D2940, with at least 95 percent passing a 1-1/2-inch sieve and not more than 8 percent passing a No. 200 sieve.

F Bedding Material: Subbase or base materials with 100 percent passing a 1-inch sieve and not more than 8 percent passing a No. 200 sieve.

## PART 3 - EXECUTION

### 3.0 PREPARATION

A. Protect structures, utilities, sidewalks, pavements, and other facilities from damage caused by settlement, lateral movement, undermining, washout, and other hazards created by earthwork operations.

B. Protect subgrades and foundation soils against freezing temperatures or frost. Provide protective insulating materials as necessary.

C. Provide erosion control measures to prevent erosion or displacement of soils and discharge of soil-bearing water runoff or airborne dust to adjacent properties and walkways.

D. Tree protection is specified in the Division 2 Section "Site Clearing."

### 3.1 DEWATERING

A. Prevent surface water and subsurface or ground water from entering excavations, from ponding on prepared subgrades, and from flooding Project site and surrounding area.

B. Protect subgrades and foundation soils from softening and damage by rain or water accumulation.

C. The Contractor shall prevent the accumulation of water in excavated areas, and shall remove by pumping or other means any water which accumulates in the excavation. The Contractor shall prevent the accumulation of water in both structural and trench excavations and shall remove by well point system or by other means water which accumulates. The Contractor shall provide, install and operate a suitable and satisfactory dewatering system. The Contractor shall include the cost of this pumping equipment and work in the unit price bid for the work.

D. Establish and maintain temporary drainage ditches and other diversions outside excavation limits to convey rain water and water removed from excavations to collection or runoff areas. Do not use trench excavations as temporary drainage ditches.

### 3.2 EXCAVATION

A. Unclassified Excavation: Excavation is unclassified and includes excavation to required subgrade elevations regardless of the character of materials and obstructions encountered.

### 3.3 STABILITY OF EXCAVATIONS

A. Comply with local codes, ordinances, and requirements of authorities having jurisdiction to maintain stable excavations.

B. All excavation work shall conform to OSHA Publication "Excavations 2226", 1990 revision, and OSHA Excavation; Final Rule 29, CFR, Part 1926, October 31, 1989, or other applicable excavation safety standards. The Contractor's method of providing protective support to prevent cave-ins shall conform to OSHA requirements. Slope excavations, shoring and trench box usage in the field must be based on tabulated data and designed by the Contractor.

## 3.4 EXCAVATION FOR STRUCTURES

A Excavate to indicated elevations and dimensions within a tolerance of plus or minus 0.10 foot. Extend excavations a sufficient distance from structures for placing and removing concrete formwork, installing services and other construction, and for inspections.

1. Excavations for Footings and Foundations: Do not disturb bottom of excavation. Excavate by hand to final grade just before placing concrete reinforcement. Trim bottoms to required lines and grades to leave solid base to receive other work.
2. Excavations for Manholes, Catch Basins, and Other Facilities: Excavation shall be sufficient to leave at least 12 inches in the clear between their outer surfaces and the embankment of timber that may be used to protect them. Backfill of earth around manholes shall be thoroughly compacted sand or gravel at the expense of the Contractor. Excavation for all structures shall be made to the dimensions and elevations indicated on the drawings. Where the excavation is made below the indicated elevations, the excavation shall be restored to the proper elevation with concrete fill, or the heights of the walls and footings shall be furnished by the Contractor without extra compensation.

## 3.5 EXCAVATION FOR WALKS AND PAVEMENTS

A Excavate surfaces under walks and pavements to indicated cross sections, elevations, and grades.

## 3.6 EXCAVATION FOR UTILITY TRENCHES

A Excavate trenches to indicated slopes, lines, depths, and invert elevations.

B Excavate trenches to uniform widths to provide a working clearance on each side of pipe or conduit. Excavate trench walls vertically from trench bottom to 12 inches higher than top of pipe or conduit, unless otherwise indicated.

C Trench Bottoms: Excavate and shape trench bottoms to provide uniform bearing and support of pipes and conduit. Shape subgrade to provide continuous support for bells, joints, and barrels of pipes and for joints, fittings, and bodies of conduits. Remove stones and sharp

objects to avoid point loading.

1. For pipes or conduit less than 6 inches in nominal diameter, hand-excavate trench bottoms and support pipe and conduit on an undisturbed subgrade.
2. For pipes and conduit 6 inches or larger in nominal diameter, shape bottom of trench to support bottom 90 degrees of pipe circumference. Fill depressions with tamped sand backfill.
3. Except in water bearing earth, or where a granular, concrete, or other bedding course is to be used, mechanical excavation of trenches shall be stopped above the final invert grade elevation so that the pipe may be laid on a firm undisturbed native earth bed. If over excavation occurs, all loosened earth must be removed and the trench bottom brought back to grade with granular material well compacted to the satisfaction of the Engineer.
4. If there is not a good natural foundation it will be the responsibility of the Contractor to stop construction and notify the Engineer of the condition encountered. The Engineer will then instruct the Contractor as to the method or steps to be taken.

## 3.7 APPROVAL OF SUBGRADE

A. Notify Engineer when excavations have reached required subgrade.

B. When Engineer determines that unforeseen unsatisfactory soil is present, continue excavation and replace with compacted backfill or fill material as directed.

C. Reconstruct subgrades damaged by freezing temperatures, frost, rain, accumulated water, or construction activities, as directed by the Engineer.

## 3.8 UNAUTHORIZED EXCAVATION

A. Fill unauthorized excavation under foundations or wall footings by extending indicated bottom elevation of concrete foundation or footing to excavation bottom, without altering required top elevation. Lean concrete fill may be used to bring elevations to proper position when acceptable to the Engineer.

## 3.9 STORAGE OF SOIL MATERIALS

A. Stockpile excavated materials acceptable for backfill and fill soil materials, including acceptable borrow materials. Stockpile soil materials without intermixing. Place, grade, and shape stockpiles to drain surface water.

3. Stockpile soil materials away from edge of excavations. Do not store within drip line of remaining trees.

## 3.10 BACKFILL

A. Backfill excavations promptly, but not before completing the following:

3. Acceptance of construction below finish grade.
4. Surveying locations of underground utilities for record documents.
5. Testing, inspecting, and approval of underground utilities.
6. Concrete formwork removal.
7. Removal of trash and debris from excavation.
8. Removal of temporary shoring and bracing, and sheeting.
9. Installing permanent or temporary horizontal bracing on horizontally supported walls.

## 3.11 UTILITY TRENCH BACKFILL

A. Place and compact bedding course on rock and other unyielding bearing surfaces and to fill unauthorized excavations. Shape bedding course to provide continuous support for bells, joints, and barrels of pipes and for joints, fittings, and bodies of conduits.

B. Concrete backfill trenches that carry below or pass under footings and that are excavated within 18 inches of footings. Place concrete to level of bottom of footings.

C. Place and compact initial backfill of satisfactory soil material or subbase material, free of particles larger than 1 inch, to a height of 12 inches over the utility pipe or conduit.

1. Backfill shall be deposited in layers not to exceed 8 inches in thickness, moistened, and compacted to density equal to or greater than 100 % of the maximum density of Modified Proctor (ASTM D1557), to a minimum depth of 12 inches over the pipe. The remainder of the backfill shall be placed in 12 inch layers compacted to 95% maximum density unless the backfill is beneath paved or building areas in which case it shall be compacted to 100% of a Modified Proctor Test.
2. Carefully compact material under pipe haunches and bring backfill evenly up on both sides and along the full length of utility piping or conduit to avoid damage or displacement of utility system.

D. Fill voids with approved backfill materials as shoring and bracing, and sheeting is removed.

E. Place and compact final backfill of satisfactory soil material to final subgrade.

F. Install warning tape directly above utilities, no less than 12 inches below finished grade, except 6 inches below subgrade under pavements and slabs.

## 3.12 FILL

A. Preparation: Remove vegetation, topsoil, debris, wet, and unsatisfactory soil materials, obstructions, and deleterious materials from ground surface prior to placing fills.

1. Plow strip, or break up sloped surfaces steeper than 1 vertical to 4 horizontal so fill

material will bond with existing surface.

B. When subgrade or existing ground surface to receive fill has a density less than that required for fill, break up ground surface to depth required, pulverize, moisture-condition or aerate soil and recompact to required density.

C. Place fill material in layers to required elevations for each location listed below.

1 Under grass, use satisfactory excavated or borrow soil material.
2. Under walks and pavements, use subbase or base material, or satisfactory excavated or borrow soil material.
3. Under steps and ramps, use subbase material.
4. Under building slabs, use drainage fill material.
5. Under footings and foundations, use engineered fill.

## 3.13 MOISTURE CONTROL

A. Uniformly moisten or aerate subgrade and each subsequent fill or backfill layer before compaction to within 2 percent of optimum moisture content.

1. Do not place backfill or fill material on surfaces that are muddy, frozen, or contain frost or ice.
2. Remove and replace, or scarify and air-dry satisfactory soil material that is too wet to compact to specified density.

a. Stockpile or spread and dry removed wet satisfactory soil material.

## 3.14 COMPACTION

A. Unless otherwise stated in an attached Soils Report, the following conditions shall apply to this project:

1. Place backfill and fill material in layers at not more than the loose depth that can be compacted in accordance with the requirements of Section 02200, 3.14, A., 2. In areas of construction in FDOT right-of-way, backfill and fill shall be placed as required by FDOT standards of construction.
2. Place backfill and fill materials evenly on all sides of structures to required elevations. Place backfill and fill uniformly along the full length of each structure.

B. Percentage of Maximum Dry Density Requirements: Compact soil to not less than the following percentages of maximum dry density according to ASTM D 698 (Standard Proctor):

1. Under structures, building slabs, steps, and pavements, compact the top 12 inches below subgrade and each layer of backfill or fill material at 100 percent maximum dry density.

2. Under walkways, compact the top 6 inches below subgrade and each layer of backfill or fill material at 100 percent maximum dry density.
3. Under lawn or unpaved areas, compact the top 6 inches below subgrade and each layer of backfill or fill material at 92 percent maximum dry density.

4. Lawn or Unpaved Areas: Perform three in-place density tests every 1000 feet of trench length at the following depths; 6-inches above pipe, 18-inches above pipe, and 30 inches above pipe. Locations of the tests shall be randomly selected by the owners field representative.

## 3.15 GRADING

A. General: Uniformly grade areas to a smooth surface, free from irregular surface changes. Comply with compaction requirements and grade to cross sections, lines, and elevations indicated.

1. Provide a smooth transition between existing adjacent grades and new grades.
2. Cut out soft spots, fill low spots, and trim high spots to conform to required surface tolerances.

B. Site Grading: Slope grades to direct water away from buildings and to prevent ponding. Finish subgrades to required elevations within the following tolerances:

1. Lawn or Unpaved Areas: Plus or minus 0.10 foot.
2. Walks: Plus or minus 0.10 foot.
3. Pavements: Plus or minus 1/2 inch.

C. Grading Inside Building Lines: Finish subgrade to a tolerance of 1/2 inch when tested with a 10-foot straightedge.

## 3.16 SUBBASE AND BASE COURSES

A. Under pavements and walks, place subbase course material on prepared subgrades. Place base course material over subbases to pavements.

1. Compact subbase and base courses at optimum moisture content to required grades, lines, cross sections and thickness to not less than 100 percent of ASTM D 698 (Standard Proctor).
2. Shape subbase and base to required crown elevations and cross-slope grades.
3. When thickness of compacted subbase or base course is 6 inches or less, place materials in a single layer.
4. When thickness of compacted subbase or base course exceeds 6 inches, place materials in equal layers, with no layer more than 6 inches thick or less than 3 inches thick when compacted.

B. Pavement Shoulders: Place shoulders along edges of subbase and base course to prevent lateral movement. Construct shoulders at least 12 inches wide of acceptable soil materials and compact simultaneously with each subbase and base layer.

## 3.17 PAVEMENT CROSSINGS

A. The procedure for the crossings of roads shall be made by boring and casing where noted on the construction plans. The casing and equipment shall be placed in accordance with the FDOT permit and requirements. Steel pipe as specified in these specifications shall be used as casing where required. When the Contractor proposes to install pipe by means of boring and/or jacking, he shall submit to the Engineer for approval the method and equipment to be used. Where the boring and/or jacking is to be performed under highways, railroads, city streets or other areas not controlled by the Owner, the Contractor must coordinate and comply with the desires of the affected entity.

B. Pipe used for casing shall be wrought steel and have a minimum yield strength of 35,000 psi designed for E 72 loading. The casing shall have a wall thickness meeting the minimum requirements of the Florida Department of Transportation for steel casing bored and jacked into position. Ends shall be free from splits or other rough edges which might damage the carrier pipe. Skids or casing spacers shall be used on the carrier pipe to prevent damage to the pipe and bell joints. Skids shall be fastened securely to the carrier pipe with stainless steel strapping. If wooden skids are used, the wood shall be pressure-treated with a preservative.

C. In areas where open cuts are allowed, the edges shall be saw-cut. The backfilling and repaving shall be done in accordance with the applicable sections of these specifications and the construction drawings. At least one-half of the traveled portion of the roadway must be open to traffic at all times and adequate barricades and warning signs shall be provided.

## 3.18 FIELD QUALITY CONTROL

A. Testing Agency Services: Allow testing agency to inspect and test each subgrade and each fill or backfill layer. Do not proceed until test results for previously completed work verify compliance with requirements.

1. Perform field in-place density tests according to ASTM D1556 (sand cone method), ASTM D2167 (rubber balloon method), or ASTM D2937 (drive cylinder method), as applicable.

a. Field in-place density tests may also be performed by the nuclear method according to ASTM D2922, provided that calibration curves are periodically checked and adjusted to correlate to tests performed using ASTM D1556. With each density calibration check, check the calibration curves furnished with the moisture gauges according to ASTM D3017.

b. When field in-place density tests are performed using nuclear methods, make calibration checks of both density and moisture gauges at beginning of work, on each different type of material encountered, and at intervals as directed by the Engineer.

2. Paved Areas: Make at least one field density test of subgrade, base, and each compacted fill layer for every 10,000 square feet of paved area but in no case less than three tests. Tests shall be staged to ensure representative sampling.
3. Trench Backfill atop Pipe: In each compacted backfill layer, perform at least one field in-place density test for each 150 feet or less of trench, but no fewer than two tests.
4. Footing Subgrade: At footing subgrades, perform at least one test of each soil stratum to verify design bearing capacities. Subsequent verification and approval of other footing subgrades may be based on a visual comparison of each subgrade with related tested strata when acceptable to the Engineer.
5. Paved and Building Slab Areas: At subgrade and at each compacted fill and backfill layer, perform at least one field in-place density test for every 2,000 sq. ft. or less of paved area or building slab, but in no case fewer than three tests.
6. Foundation Wall Backfill: In each compacted backfill layer, perform at least one field in-place density test for each 100 feet or less of wall length, but no fewer than two tests along a wall face.
7. Lawn or Unpaved Areas: Perform three in-place density tests every 1000 feet of trench length at the following depths; 6-inches above pipe, 18-inches above pipe, and 30 inches above pipe. Locations of the tests shall be randomly selected by the owners filed representative.

B. When testing agency reports that subgrades, fills, or backfills are below specified density, scarify and moisten or aerate, or remove and replace soil to the depth required, recompact and retest until required density is obtained.

## 3.19 PROTECTION

A. Protecting Graded Areas: Protect newly graded areas from traffic, and erosion. Keep free of trash and debris.

B. Repair and re-establish grades to specified tolerances where completed or partially completed surfaces become eroded, rutted, settled, or lose compaction due to subsequent construction operations or weather conditions.

1. Scarify or remove and replace material to depth directed by the Engineer; reshape and recompact at optimum moisture content to the required density.

C. Settling: Where settling occurs during the Project correction period, remove finished

surfacing, backfill with additional approved material, compact, and reconstruct surfacing.

1. Restore appearance, quality, and condition of finished surfacing to match adjacent work, and eliminate evidence of restoration to the greatest extent possible.

## 3.20 OVERALL AREA GRADING FOR WHICH NO GRADES ARE INDICATED

A Within the limits of construction and outer limits of clearing and grubbing all holes and other depressions shall be filled, all mounds and ridges cut down, and the area brought to sufficiently uniform contour that the Owner's subsequent mowing operations will not be hindered by irregular terrain. This work shall be done regardless of whether the irregularities were the result of the Contractor's operations or originally existed. Permanent ponds or other permanent water areas, as so designated by the Engineer, will not be required to be filled.

## 3.21 DISPOSAL OF SURPLUS AND WASTE MATERIALS

A. Disposal: Remove surplus satisfactory soil and waste material, including unsatisfactory soil, trash, and debris, and legally dispose of it off the Owner's property.

**END OF SECTION**

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and apply to this Section.

B. Florida Department of Transportation, Standard Specifications for Highway Construction, latest edition. Work shall comply with requirements of FDOT Specs as modified herein.

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1.2 SUMMARY

A. This Section includes, but is not limited to, the following:

1. Protection of existing trees indicated to remain.
2. Removal of trees and other vegetation.
3. Clearing and grubbing.
4. Removing above-grade improvements.
5. Removing below-grade improvements.

B. Extent of clearing & grubbing shall remain in right-of-way or easements unless otherwise noted or instructed.

1.3 PROJECT CONDITIONS

Provide protection for all public land corners and monuments within the limits of construction. Any Monuments disturbed while performing the work will be replaced at the contractor's expense.

PART 2 - PRODUCTS (Not Applicable)

PART 3 - EXECUTION

3.1 SITE CLEARING

A. General: Remove trees, shrubs, grass, and other vegetation, improvements, or obstructions, as required, to permit installation of new construction. Remove similar items elsewhere on site or premises as specifically indicated. Removal includes digging out and off-site disposal of stumps and roots.

Carefully and cleanly cut minor roots and branches of trees indicated to remain in a manner where such roots and branches obstruct installation of new construction.

B. Clearing and Grubbing: Clear site of trees, shrubs, and other vegetation, except for those indicated to remain.

1. Completely remove all stumps within the roadway. Remove roots and other

debris to a depth of 12" below the ground surface.

2. Use only hand methods for grubbing inside drip line of trees indicated to remain.

3. Fill depressions caused by clearing and grubbing operations with satisfactory soil material, unless further excavation or earthwork is indicated in accordance with Section 2300.

C. Removal of Improvements: Remove existing above-grade and below-grade improvements as indicated and as necessary to facilitate new construction, and other work as indicated.

3.2 DISPOSAL OF WASTE MATERIALS

A. Burning: Burning is not permitted. Requests to burn will be considered on a case by case basis. If approved, Contractor is to acquire permits and provide copy to the Engineer.

C. Removal: Remove waste materials and unsuitable topsoil from property, and dispose of off site in a legal manner.

**END OF SECTION**

PART 1 - GENERAL

1.0 RELATED DOCUMENTS

A. Drawings and general provisions of Contract, including General and Supplementary Conditions and Division-1 Specification sections, apply to work of this section.

1.1 DESCRIPTION OF WORK:

A. Extent of grassing work is as specified or shown on the construction plans. Sodded areas disturbed during construction shall be re-sodded to match existing. All other areas disturbed during construction operations shall be seeded and mulched.

1.2 QUALITY ASSURANCE:

A. All seed used shall be labeled in accordance with U.S. Department of Agriculture Rules and Regulations under the Federal Seed Act in effect on the date of Invitation for Bids. All seed shall be furnished in sealed standard containers, unless exception is granted in writing by the Owner. Seed which has become wet, moldy, or otherwise damaged in transit or in storage shall not be used. Fertilizer shall be delivered to the site in the original, unopened containers, each bearing the manufacturer's guaranteed analysis. Any fertilizer which becomes caked or otherwise damaged, making it unsuitable for use, shall not be used. Seed, fertilizer and other grassing materials shall be stored under cover and protected from damage which would make them unacceptable for use.

PART 2 - PRODUCTS

2.0 TOPSOIL

A. If the quantity of existing stored or excavated topsoil is inadequate for planting, sufficient additional topsoil shall be furnished. Topsoil furnished shall be a natural, fertile, friable soil, possessing characteristics of representative productive soils in the vicinity. It shall be obtained from naturally well-drained areas. Topsoil shall be without admixture of subsoil and free from Johnson grass (Sorghum halepense), nut grass (Cyperus rotunduis) and objectionable weeds and toxic substances.

2.1 SOIL AMENDMENTS

A. Lime: Ground limestone (Dolomite) containing not less than 85 percent of total carbonates, and shall be ground to such a fineness that 50 percent will pass a 100-mesh sieve and 90 percent will pass a 20-mesh sieve.

B. Fertilizer: 16-16-16 formulation of which 60 percent of the nitrogen is in the urea-

formaldehyde form and shall conform to the applicable State Fertilizer laws. It shall be granulated so that 80 percent is held on a 16-mesh screen, uniform in composition, dry and free-flowing.

C. Mulch: Clean hay, fresh straw mulch or wood chips.

2.2 GRASS MATERIALS

A. Grass Seed: Federal Specifications JJJ-S-181 and shall satisfy the following requirements:

| | Min. % Pure Seed | Germination and Hard Seed | Max. % Weed Seed |
|---|---|---|---|
| Argentine Bahia | 95% | 80% (min) | |
| Pensacola Bahia | 95% | 80% (total) 40% (min) | |
| Bermuda | 95% | 85% (min) | |
| Rye | 95% | 90% (min) | |

Seed failing to meet the purity or germination requirements by no more than twenty-five percent may be used, but the quantity shall be increased to yield the required rate of pure live seed. Seed failing to meet the weed seed requirements shall not be used.

B. Sod: Sod shall be common Bermuda, Centipede, or matched to adjacent sod as applicable, unless otherwise specified elsewhere in the Contract Documents.

C. During the period between March 15 to October 15, the seed mixture shall be 30 pounds of Bahia and 30 pounds of hulled Bermuda. During the remainder of the year the moisture shall be 20 pounds each of Bahia, Bermuda and Rye grass seed.

PART 3 - EXECUTION

3.0 GRADING

A. Areas to be grassed shall be graded to remove depressions, undulations, and irregularities in the surface before grassing.

3.1 PLACING TOPSOIL

A. Areas to be grassed shall have a minimum topsoil cover of two inches. Topsoil shall not be placed when the subgrade is excessively wet, extremely dry or in a condition otherwise detrimental to the proposed planting or proper grading.

3.2 TILLAGE

A. The area to be grassed shall be thoroughly tilled to a depth of four inches using a plow and disc harrow or rotary tilling machinery until a suitable bed has been prepared and no clods or clumps remain larger than 1-1/2 inches in diameter.

## 3.3 APPLICATION OF FERTILIZER

A. Fertilizer shall be applied at the rate of 6 pounds per 1,000 square feet and shall be thoroughly incorporated into the top three to four inches of soil.

## 3.4 PLANTING SEEDS

A. All areas disturbed during construction shall be seeded as specified herein. Immediately before seeds are sown and after fertilizer and lime are applied, the ground shall be scarified as necessary and shall be raked until the surface is smooth, friable, and of uniformly fine texture. Areas to be grassed shall be seeded evenly with a mechanical spreader, raked lightly, rolled with a 200-pound roller, and watered with a fine spray. Seed shall be applied at the rate of 6 lbs/1000 square feet.

1. Seeded areas shall be mulched at the rate of not less than 1-1/2" loose measurement over all seeded areas. Spread by hand, blower, or other suitable equipment. Mulch shall be cut into the soil with equipment capable of cutting the mulch uniformly into the soil. Mulching shall be done within 24 hours of the time seeding is completed.

## 3.5 ROLLING

A. After seeding and mulching, a cultipacker, traffic roller, or other suitable equipment shall be used for rolling the grassed areas. Areas shall then be watered with a fine spray.

## 3.6 WINTER COVER

A. All areas to be grassed shall be protected against erosion at all times. For protection during Winter months (November 1st through March 31st) Italian rye grass shall be planted at the rate of four pounds per 1,000 square feet on all areas which are not protected by permanent grass.

## 3.7 PLANTING SOD

A. Match existing sod at the site unless otherwise required. The sod shall be live, fresh, and uninjured at the time of planting and shall have a thick mat of roots with enough adhering soil to assure growth. Apply sod within 24 hours of stripping. Do not plant dormant sod or if ground is frozen. Protect sod against drying and breaking of rolled strips.

B. Placement: Prepare the ground by loosening the soil. Place sod on the prepared soil to form a solid mass with tightly fitted joints. Ensure the butt ends and sides of sod strips do not overlap. Stagger strips to avoid a continuous downhill seam. Tamp or roll lightly to ensure contact with subgrade. Tamp the outer edges of the sodded area to produce a smooth contour. Work sifted soil into minor cracks between pieces of sod; remove excess to avoid smothering of adjacent grass. Water sod thoroughly with a fine spray immediately after planting.

C. Watering: Keep sod continuously moist to a depth below the root zone for three weeks after placement. If there is no water available to the site, the Contractor shall provide the water for the sod.

D. Maintenance: Maintain sod by watering, fertilizing, weeding, mowing, trimming, and other operations such as rolling, re-grading, and replanting as required to establish a lawn free of eroded or bare areas and acceptable to the Engineer. Where inspected work and materials do not comply with requirements, replace rejected work and continue maintenance until re-inspected by Engineer and found to be acceptable. Remove rejected materials promptly from the project site.

3.8 CLEAN-UP

A. All excess soil, excess grass materials, stones, pallets, and other waste shall be removed from the site daily and not allowed to accumulate. All paved areas shall be kept clean at all times.

3.9 MAINTENANCE

A. Maintenance of the grass shall continue until the Owner accepts the project for use. Prior to acceptance, maintenance shall include watering, mowing, replanting and other work necessary to produce a uniform stand of grass. If during the warranty period the grass fails to grow, producing bare areas, the Contractor will replant as necessary.

**END OF SECTION**

## SECTION 32007 ASPHALTIC CONCRETE PAVING FOR ROADS AND PARKING LOTS

## PART 1 GENERAL

### 1.01 RELATED SPECIFICATION SECTIONS:

A. Section 0000 - GENERAL REQUIREMENTS

### 1.02 SUMMARY

A. This section includes Asphaltic concrete paving, tack coat, and preservative seal for roads, parking lots, sidewalks, etc., but **excludes airfields.**

### 1.03 REFERENCES

A. Specific tests as provided herein:

1. AASHTO: American Association of State Highway Transportation Officials
2. ASTM: American Society for Testing of Materials
3. FDOT: Standard Specifications for Road and Bridge Construction (SSRBC)

**Note: References to "the Engineer" shall be read as " the Contracting Officer". SSRBC subsections referring to "Basis of Payment" do not apply.**

### 1.04 SUBMITTALS

A. Submit asphalt job mix formula for review by the Contracting Officer prior to placement of asphaltic concrete under this contract. State of Florida Department of Transportation mix S-1 is considered an acceptable mix for roads. **Airfields are not included.** State of Florida Department of Transportation mix S-3 is considered an acceptable mix for parking lots.

### 1.05 QUALITY ASSURANCE

A. Bituminous-concrete mixtures shall be sampled and tested for quality control during construction of the bituminous-concrete courses as follows:

| MATERIAL | REQUIREMENT | TEST METHOD | NUMBER OF TESTS |
|---|---|---|---|
| Uncompacted bituminous concrete mix | Sampling | ASTM D 979 | One for each mixture or day of operation |
| Asphalt | Cement content | ASTM D 2172 | |
| | Mechanical analysis extracted aggregates | AASHTO T 30 | |
| | Recovery of asphalt cement by Abson Method | ASTM D 1856 | |
| | Penetration of recovered asphalt cement | ASTM D 5 | |
| | Ductility of recovered asphalt cement | ASTM D 113 | |

| | | | |
|---|---|---|---|
| Compacted bituminous-concrete | Bulk density | AASHTO T 166 | Same as specified for uncompacted mix |
| Marshall samples | Marshall Stability and Flow Tests | ASTM D 1559 | |
| **In-place pavement** | Density and thickness | As specified | Three specimens for each 1000 square yards (or fraction thereof) of completed bituminous concrete course |

## 1.06 REGULATORY REQUIREMENTS

A. Conform to local (if any) and state requirements for paving work.

## 1.07 ENVIRONMENTAL REQUIREMENTS

A. Bituminous prime and tack coats shall be applied only when the ambient temperature in the shade is above 50 °F or when the temperature has not been below 35 °F for 12 hours immediately prior to application. Application may commence when the aggregate base course is dry or contains moisture not in excess of the amount that will permit uniform distribution and the required penetration.

B. Bituminous-concrete courses shall be constructed only when the ambient temperature is above 40 ° F and the underlying base course is dry.

## 1.08 SPREADING EQUIPMENT

A. Self-propelled electronically controlled type, unless other equipment is authorized by the Contracting Officer. Equip spreading equipment of the self-propelled electronically controlled type with hoppers, tamping or vibrating devices, distributing screws, electronically adjustable screeds, and equalizing devices. Capable of spreading hot bituminous mixtures without tearing, shoving, or gouging and to produce a finished surface of specified grade and smoothness. Operate spreaders, when laying mixture, at variable speeds between 5 and 45 feet per minute. Design spreader with a quick and efficient steering device; a forward and reverse traveling speed; and automatic devices to adjust to grade and confine the edges of the mixture to true lines. The use of a spreader that leaves indented areas or other objectionable irregularities in the fresh laid mix during operations is prohibited.

# PART 2 PRODUCTS

## 2.01 MATERIALS FOR BITUMINOUS CONCRETE

A. Aggregate for Bituminous-Concrete: Coarse aggregate shall conform to ASTM D 692. Fine aggregate shall conform to ASTM D 1073. The sand equivalent value shall be not less than 30.

B. Mineral Filler: Finely ground particles of limestone, hydrated lime or other mineral dust, free of foreign matter.

C. Asphalt Cement: The asphalt cement shall meet the requirements of ASTM D 3381, table 2, viscosity grade AC-20.

D. Bituminous Prime Coat: The bituminous prime coat shall be EPR-1 conforming to FDOT Specification Section 916-4.1.

E. Bituminous Tack Coat: The bituminous tack coat shall be rapid-curing cut-back asphalt conforming to ASTM D 2028, designation RC-70.

F. Job Mix Formulas: A job-mix formula for each bituminous-concrete mixture proposed for use in the work shall be submitted for approval prior to start of work.

## 2.02 PERFORMANCE REQUIREMENTS

A. Bituminous-concrete mixtures shall meet the performance requirements described when sampled, and tested. Calculations shall be made for density and voids analyses.

PERFORMANCE REQUIREMENTS

| TEST PROPERTY | S-1/S-3 |
|---|---|
| Number of compaction blows, each end of specimen | 45 to 55 |
| Marshall stability, pounds | 1500 minimum |
| Marshall flow, 1/100-inch units | 8 minimum<br>14 maximum |
| Percent air void | 3 minimum<br>5 maximum |
| Percent of voids in mineral aggregate (min) | 14 |

## 2.03 SOURCE QUALITY CONTROL

A. Provide mix design for asphalt under provisions of Section 01400.

B. Submit proposed mix design of each class of mix for review prior to commencement of work.

**2.04** AGGREGATE GRADATION

A. The submitted job mix shall be within the design range of the following table for base and surface courses:

Percentage By Weight Passing Square Mesh Sieves: Type S-1

| 1" | 3/4 | 1/2 | 3/8 | no. 4 | no.10 | no.16 | no.40 | no.80 | no.100 | no.200 |
|---|---|---|---|---|---|---|---|---|---|---|
| 100 | 95-100 | 88-100 | 75-93 | 47-75 | 31-53 | | 19-35 | 7-21 | 2-6 | |

Percentage By Weight Passing Square Mesh Sieves: Type S-3

| 1/2" | 3/8" | no. 4 | no. 10 | no.16 | no. 40 | no. 80 | no.100 | no. 200 |
|---|---|---|---|---|---|---|---|---|
| 100 | 88-100 | 60-90 | 40-70 | | 19-35 | 9-18 | | 2-6 |

## PART 3 EXECUTION

### 3.01 EXAMINATION

A. Verify base conditions.

B. Verify that compacted aggregate base course is dry and ready to support paving and imposed loads.

C. Verify gradients and elevations of base are correct.

### 3.02 SUBBASE

A. Section 02231 - Aggregate Base Course: Refer to section 02231 for the basis of work under this subsection.

### 3.03 PREPARATION - TACK COAT

A. Surface Preparation: Immediately before application of a bituminous prime coat to the aggregate base-course surface or other contact surface, loose material or other objectionable substances shall be removed.

B. Priming the Base Course Surface: The prime coat shall be uniformly applied to the prepared base course surface. The rate of application shall be within the range of 0.15 and 0.40 gallon per square yard of surface. The temperature of the bituminous material at the time of application shall be within the range of 105 and 180 degrees F. Excess prime-coat material shall be squeegeed from the surface. Areas missed by the bituminous prime coat distributor shall be treated with prime coat material by means of hand sprayers. Following the application of prime coat material, the surface shall be allowed to dry without being disturbed for a period of not less than 48 hours or longer as may be necessary. Blotting the prime coat with fine aggregate will not be permitted.

C. Priming Other Contact Surfaces: Contact surfaces of curbs, gutters, manholes, and other structures projecting into or abutting the pavement shall be coated with a thin, uniform coating of bituminous tack-coat material prior to the bituminous-concrete mixture being

placed against such structures. Following the application of the tack coat, the surface shall be allowed to dry until it is in a condition of tackiness to receive the bituminous-concrete mixture. Excess tack-coat material shall be squeegeed from the surface.

## 3.04 PLACING ASPHALT PAVEMENT - SINGLE COURSE

A. The bituminous-concrete mixture shall be placed on the prepared surface, uniformly spread and struck off. Bituminous-concrete courses shall be placed in layers of approximately equal thickness except that no layer shall be more than 2-inches thick after compaction.

B. Pavement Placing: Placing shall begin along the centerline of areas to be paved on a crowned section, at the high side of a section with a one-way slope and in the direction of the traffic flow. The mixture for each course shall be placed in strips not less than 10-feet wide. Progressive strip placement shall commence after rolling of the first strip. Rolling shall be extended to overlap the preceding strips. Placing the bituminous-concrete mixture shall be continuous.

C. Hand Placing: In areas where the use of machine spreading is not practicable, the mixture shall be spread and finished by the use of heated hand tools. The mixture shall be dumped on approved dump boards and distributed into place from the dump boards in a uniformly loose layer of a thickness that will, when compacted, conform to required grade and thickness. The mixture shall be dumped no faster than it can be handled properly by the shovelers and rakers.

D. Joints: Joints shall have the same texture, density, and smoothness as other sections of the course. Joints between old and new pavements, or between successive days' work, shall be made to ensure a continuous bond between the old and new sections of the pavement. Transverse joints in succeeding courses shall be offset at least 24 inches. The edge of the previously placed course shall be cut back to expose an even vertical surface over the full thickness of the course. Longitudinal joints in succeeding courses shall be offset at least 6 inches. When the edges of longitudinal joints are irregular or do not conform to the specifications, the edge shall be cut back to expose an even vertical surface over the full thickness of the course.

E. Machine Spreading: The range of temperatures of the mixtures at the time of spreading shall be between 275 degrees F and 300 degrees F. Bituminous concrete having temperatures less than minimum spreading temperature when dumped into the spreader will be rejected. Adjust spreader and regulate speed so that the surface of the course is smooth and continuous without tears and pulling, and of such depth that, when compacted, the surface conforms with the cross section, grade, and contour indicated. Unless otherwise directed, begin the placing along the centerline of areas to be paved on a crowned section or on the high side of areas with a one-way slope. Place mixture in consecutive adjacent strips having a minimum width of 10 feet, except where the edge lanes require strips less than 10 feet to complete the area. Construct longitudinal joints and edges to true line markings. Establish lines parallel to the centerline of the area to be paved, and place string lines coinciding with the established lines for the spreading machine to follow. Provide the number and location of the lines needed to accomplish

proper grade control. When specified grade and smoothness requirements can be met for initial lane construction by use of an approved long ski-type device and for subsequent lane construction by use of a short ski or shoe, in-place string lines for grade control may be omitted. Place mixture as nearly continuous as possible and adjust the speed of placing as needed to permit proper rolling. Follow the following table for minimum spreading temperatures:

F. Minimum Spreading Temperatures: Minimum temperature of the asphaltic concrete mixture at the point of placement shall be 275 degrees F. Temperature to be taken within five (5) feet of spreader. Placement of mixtures less than specified will not be allowed and any pavement not meeting this requirement will be rejected.

## 3.05 COMPACTION

A. General: Compaction shall commence as soon after placing as the bituminous-concrete mixture will bear the weight of the roller without undue displacement. During rolling, the wheels shall be kept moist with the minimum amount of water required to avoid picking up the bituminous-concrete mixture. In places not accessible to the rollers, the mixture shall be compacted with hot hand tampers.

B. Rolling Procedure: Rolling shall commence longitudinally at the extreme sides of lanes and proceed toward the center of the pavement, except on superelevated curves. Rolling on superelevated curves shall commence on the low side and progress to the high side, overlapping on successive trips by at least one-half the width of the rear wheel of the roller. Alternate trips of the roller shall be of slightly different lengths. Rollers shall move at a slow but uniform speed with the drive roll or wheel nearest the paver. Speed of the rollers shall not exceed 3 miles per hour for steel-wheeled rollers or 5 miles per hour for pneumatic-tired rollers.

C. Initial Rolling: The initial rolling shall immediately follow the rolling of the longitudinal joint and edges. Rollers shall be operated as close to the paver as possible without causing undue displacement. Preliminary tests of crown, grade and smoothness shall be made immediately after the initial rolling.

D. Second Rolling: The second rolling shall follow the initial rolling as closely as possible, while the mixture is hot and in condition suitable for proper compaction. Rolling shall be continuous (at least 3 complete coverages) after the initial rolling until the mixture has been compacted. Causing undue displacement will not be permitted.

E. Finish Rolling: Finish rolling shall be done while the mixture is warm enough for the removal of roller marks. Rolling shall continue until all roller marks are eliminated and the course has the specified density.

F. Patching Deficient Areas: Bituminous-concrete mixtures that become mixed with foreign material or that are defective, such as low areas or "bird-baths," shall be removed, replaced with fresh bituminous-concrete mixture to obtain the required grade and smoothness for the finished surface, and compacted to the specified density. Pavement

in deficient areas shall be removed to the full thickness of the bituminous-concrete course and so cut that the sides are perpendicular and parallel to the direction of traffic and the edges are vertical. Edges shall be sprayed with bituminous tack-coat material. Skin patching an area that has been rolled will not be permitted.

G. Protection of Pavement: After final rolling, vehicular traffic shall not be permitted on the pavement until the pavement has cooled and hardened and in no case sooner than 6 hours.

## 3.06 TOLERANCES

A. Flatness: Maximum variation of 1/4 inch measured with 25-foot straight edge.

B. Scheduled Compacted Thickness: Within 1/4 inch.

## 3.07 FIELD QUALITY CONTROL

A. Field testing will be performed under provisions of Section 01400.

B. Take samples and perform tests as listed herein.

C. Perform the following tests:

1. Density: For each 1000 tons of bituminous mixture placed, determine the representative laboratory density in accordance with ASTM D 1559. Samples for laboratory specimens shall be taken from trucks delivering mixture to the site; record in a manner approved by the Contracting Officer the project areas represented by the laboratory densities. From each representative area recorded, determine field density of pavement by densities of 4-inch diameter cores obtained from leveling, binder, and wearing courses; take three cores for each 1000 square yards or fraction thereof of course placed. Determine density of laboratory prepared specimens and cored samples in accordance with ASTM D 1188 or ASTM D 2726, as applicable. Separate pavement layers by sawing or other approved means. **Minimum Density shall be 96 % of the representative laboratory density**. Pavement with a density less than 96% will be rejected. No averaging of densities will be considered.

2. Thickness: Determine thickness of binder and wearing courses from samples taken for the field density tests. **The maximum allowable deficiency at any point shall not be more than 1/4-inch less than the thickness for the indicated course.** Average thickness of course or of combined courses shall be not less than the indicated thickness.

3. Smoothness: Straightedge test the compacted surface of leveling, binder, and wearing courses as work progresses. Apply straightedge parallel with and at right angles to the centerline after final rolling. Unevenness of leveling and binder courses shall not vary more than 1/4-inch in 10 feet; variations in the wearing course shall not vary more than 1/8-inch in 10 feet.

4. Finished Grades: Finish grades of each course placed shall not vary from the finish elevations, profiles, and cross sections indicated by more than 1/2 inch. Finished surface of the final wearing course shall be tested by running lines of levels at intervals

of 25 feet longitudinally and transversely to determine elevations of completed pavement. Within 45 days after completion of final placement, perform a level survey at the specified grid spacing and plot the results on a plan drawn to the same scale as the drawings. Elevations not in conformance with the specified tolerance shall be noted on the plan in an approved manner. The Contracting Officer will inform the Contractor in writing of paved areas that fail to meet the final grades indicated within the specified tolerances. Skin patching for correcting low areas is prohibited.

5. Finish Surface Texture of Wearing Course: Visually check final surface texture for uniformity and reasonable compactness and tightness. Final wearing course with a surface texture having undesirable irregularities such as segregation, cavities, pulls or tears, checking, excessive exposure of coarse aggregates, sand streaks, indentations, ripples, or lack of uniformity shall be removed and replaced with new materials.

D. Correction of deficiencies: All deficiencies will be corrected by removal and replacement of the deficient pavement. Limits of replacement will be determined by additional testing as required to define the area of deficiency. All testing will be the responsibility of the contractor. All replacement will be full lane width with a minimum length equal to the lane width.

**END OF SECTION**

SCOPE:

Provide all labor, materials, equipment and services of every nature necessary to complete all cast-in-place concrete work shown on the sitework drawings and herein specified, subject to the terms and conditions of the Contract. These specifications shall not apply to concrete used for construction of buildings.

RESPONSIBILITIES AND COOPERATION:

A. The Contractor shall be held responsible for all material meeting all requirements as herein specified, for the adequacy of all formwork, and for all workmanship.

B. The Contractor shall cooperate with all other trades, whether or not in his control, in permitting the forming and setting of sleeves, inserts, bolts, hangers, opening, or any other items that may be necessary.

C. The Contractor shall cooperate fully with the Engineer or his duly appointed representative. The Engineer shall be notified sufficiently in advance of all pours in order that he, or his representative, may inspect and approve the placement of all reinforcing steel, formwork, and the concreting operation.

D. Comply with provisions of following codes, specifications and standards, except where more stringent requirements are shown or specified:

1. ACI 302 "Guide for Concrete Floor and Slab Construction".
2. ACI 318 "Building Code Requirements for Reinforced Concrete".
3. Concrete Reinforcing Steel Institute, "Manual of Standard Practice".
4. ACI 350R "Concrete Sanitary Engineering Structures".

E. Employ, at Contractor's expense a testing laboratory acceptable to Engineer to perform material evaluation tests and to design concrete mixes.

F. Materials and installed work may require testing and retesting, as directed by Engineer, at anytime during progress of work. Allow free access to material stockpiles and facilities. Tests, not specifically indicated to be done at Owner's expense, including retesting of rejected materials and installed work, shall be done at Contractor's expense.

MATERIALS:

(All references to ASTM or other specifications indicate the latest edition.)

A. Portland Cement: ASTM C150, Type IS (MS) or IS-A (MS or Type II (the $C_3A$ content of the cement shall not be less than 8 percent).

B. Concrete Aggregate: ASTM C33.

1. Fine Aggregate: Natural sand. All sand shall react to ASTM Colorimetric Test for Organic

Matter, with a color not darker than the standard referenced color of ASTM C40.

2. Coarse Aggregate: Crushed stone, gravel, or other approved material (slag shall not be used) having clean, hard, durable, uncoated particles. Maximum size of aggregate shall pass through a 3/4" screen, except the maximum size aggregate for concrete in pile caps, footing, slabs-on-grade, or concrete with no reinforcing, may be
1-1/2". All to be graded from coarse to fine within limits required by ASTM C33. Dust or other fine particles in excess of 2% will not be permitted.

C. Water: Clean and free from deleterious substances.

D. Metal Reinforcing:

1. Bars shall be new conforming to ASTM A615, Grade 60. All reinforcing shall be bent cold and shall be free from scale, oil, dirt and structural defects. Fabrication shall be done in accordance with ACI Standard Practices. Store bars at least 6" above the ground. Submit 3 copies of mill tests of all steel before shipment is made.

2. Welded Wire Fabric: ASTM A185.

3. Wire for tying bars shall be 16 gauge annealed iron wire.

4. Accessories shall be chairs, bolsters, etc., standard with the fabricator and shall be sufficiently strong to maintain bars in position. Stainless steel or plastic tip accessories shall be used where accessory support is in the same plane as face of concrete surfaces which will remain exposed to view.

E. Premoulded Expansion Joints: ASTM D1751 or D1752 sizes to be as shown.

F. Joint-Sealing Materials: ASTM D1850 or Fed. Spec. SS-S-1401, except that all joints exposed to the weather shall be sealed with material conforming to Fed. Spec. SS-S-1401.

G. Concrete Admixtures:

1. Water Reducing Admixture: "Eucon WR-75" by The Euclid Chemical Company, "Pozzolith 200N" by Master Builders of "Plastocrete" by Sika Chemical Corporation. The admixture shall conform to ASTM C494, Type A, and not contain more chloride ions than are present in municipal drinking water.

2. Water Reducing, Retarding Admixture: "Eucon Retarder-75" by The Euclid Chemical Company, "Pozzolith 100 XR" by Master Builders or "Plastiment" by Sika Chemical Corporation. The admixture shall conform to ASTM C494, Type D, and not contain more chloride ions than are present in municipal drinking water.
3. High Range Water Reducing Admixture (Superplasticizer): "Eucon 37" by The Euclid Chemical Company of "Sikament" by Sika Chemical Corporation. The admixture shall

conform to ASTM C494, Type F or G,, and not contain more chloride ions than are present in municipal drinking water.

4. Non-Chloride Accelerator: "Accelguard 80" by The Euclid Chemical Company or approved equivalent. The admixture shall conform to ASTM C494, Type C or E, and not contain more chloride ions than are present in municipal drinking water.

5. Air Entraining Admixture: Conforming to ASTM C260.

6. Calcium Chloride: Calcium chloride or admixtures containing more than 0.1% chloride ions are not permitted.

7. Certification: Written conformance to above mentioned requirements and the chloride ion content will be required from the admixture manufacturer prior to mix design review by the Engineer.

H. Forms:

1. Plywood complying with U.S. Product Standard PS-1 "B-B (Concrete Form) Plywood", Class I, exterior grade or better, mill-oiled and edge-sealed shall be used for all formwork which will be in contact with all poured concrete, except as otherwise specified. Standard board lumber may be used for concrete below grade.

2. Form ties for walls shall be 1" breakback, crimped snap ties.

I. Curing and Sealing Compound: "Super Floor Coat" or "Super Pliocure" by The Euclid Chemical Company or "Masterseal 66" by Master Builders. The compound shall conform to Federal Specification TT-C-800A, 30% solids content minimum, and have test data from an independent laboratory indicating a maximum moisture loss of 0.030 grams per sq. cm. when applied at a coverage rate of 300 sq. ft. per gallon. Manufacturer's certification required.

J. Curing and Hardening Compound: "Eucosil" by The Euclid Chemical Company or "Curetox" by Toch Brothers. The compound shall be a sodium silicate type.

K. Bonding Compound: "Euco Weld" by The Euclid Chemical Company or "Weldcrete" by The Larsen Company. The compound shall be polyvinyl acetate, rewettable type.

L. Epoxy Adhesive: "Euco Epoxy #463 or #615" by The Euclid Chemical Company or "Sikadur Hi-Mod" by Sika Chemical Corporation. The compound shall be a two (2) component, 100% solids, 100% reactive compound suitable for use on dry or damp surfaces.

M. Epoxy Grout: High strength grout by The Euclid Chemical Company or approved equivalent.

N. Non-Shrink Grout: "Euco NS" (non-metallic) by The Euclid Chemical Company or "Masterflow

713" by (non-metallic) Master Builders. The grout shall conform to CRD-C-621-80, "Corps of Engineers Specification for Non-Shrink Grout".

CONCRETE:

A. Ready-Mixed Concrete: All concrete for this project shall be ready-mixed either central plant mixed or transit mixed. Equipment, mixing methods and materials must conform to ASTM C94 and application ASTM Standards as indicated under Materials. If directed by the Engineer, the Contractor shall employ an independent testing laboratory to inspect the mixing plant to insure conformance with ASTM C94.

B. Concrete Compressive Strengths: All concrete for foundations, retaining walls and slabs on grade shall achieve a compressive strength of 3,000 psi at 28 days.

C. Design Mix:

1. All mix designs shall be proportioned in accordance with Section 4.3 (field experience) or Section 4.4 (trial batches) of ACI 318-83. The concrete manufacturer, immediately after the award of this contract, shall have the mix designs prepared and shall submit them to the Engineer for approval. If trial batches are used, an independent laboratory, approved by the Engineer, shall be used. Concrete mixes shall be designed in accordance with ACI 211.1, "Recommended Practice for Selecting Proportions for Normal and Heavyweight Concrete".

2. If trial batches are used, the proposed mix design shall achieve an average strength 1200 psi greater than the specified strength (f'c). The laboratory shall prove each design mix by breaking 2 test cylinders at 7 days and 2 cylinders at 28 days in conformance with ASTM C39. The 7 day compressive strength must be in excess of 80% of the 28 day strength in excess of 115% of the specified 28 day strength for these test cylinders. The laboratory shall submit test reports to Contractor (2), Engineer (1), structural engineer (1), and concrete manufacturer (1).

3. The concrete design mixes will be reviewed and approved after 7 day test cylinder results, if contractor's time schedule requires.

4. The minimum cement content of all 3,000 psi concrete shall be 470 lbs. per cu. yd.

D. Field Testing: The Contractor shall have an independent testing laboratory conduct tests and submit reports promptly to the Engineer on the following field testing of concrete, without additional cost to the Owner.

1. Four standard test cylinders shall be made at the job site for each 50 cubic yards, or faction thereof, of each class of concrete placed each day. The procedures of sampling, making, curing and testing shall be in strict accordance with ASTM C172, C31, C192 and C39, latest editions, respectively, and shall be properly identified as to date, time, placement location and slump.

Slump tests shall be made at the same time cylinders are made in conformance with ASTM C143. Samples shall be made by the laboratory only.

2. Two cylinders are to be tested at 7 days and two cylinders at 28 days, unless otherwise directed. Laboratory shall submit 1 copy of report directly to the Engineer and 2 copies to the Contractor.

3. The strength level shall be considered satisfactory so long as the averages of all sets of three consecutive strength test results equal or exceed the specified strength f'c, and no individual test result falls below the specified strength f'c by more than 500 psi.

4. The testing service will make additional tests, of in-place concrete when test results indicate the required strength level has not been achieved and other characteristics have not been attained in the structure, as directed by the Engineer. The testing service may conduct tests to determine adequacy of concrete by cored cylinders complying with ASTM C42, or by other methods as directed. Contractor shall pay for such tests conducted, and any additional testing as may be required, when unacceptable concrete is verified.

E. Concrete Quality:

1. Air Content: All concrete exposed to freezing and thawing and/or required to be watertight shall have an air content of 4.5% to 7.5%.

2. Water-Cement Ratio: All concrete subjected to freezing and thawing shall have a maximum water-cement ratio 0.50.

3. Slump: All concrete containing the high range water reducing admixture (superplasticizer) shall have a maximum slump of 8" unless otherwise approved by the Engineer. The concrete shall arrive at the job site at a slump of 2" or 3", be verified, then the high range water reducing admixture added to increase the slump to the approved level. All other concrete shall have a maximum slump of 3" for slabs and 4" for other members.

4. Admixture Usage: All concrete shall contain the specified water reducing admixture or water reducing, retarding admixture and/or high range water reducing admixture (superplasticizer). All thin concrete slabs, less than 8" in thickness, placed at air temperatures below 50 degrees F shall contain the specified non-chloride accelerator. All concrete required to be air entrained shall contain an approved air entraining admixture. When air temperature exceed 85 degrees F and/or placing and humidity conditions dictate, the Engineer may require or approve the use of the water reducing, retarding admixture.

FORMWORK:

A. Design and construction of formwork shall be in accordance with ACI 347-78. Forms shall be sufficiently strong to carry the dead weight of the concrete as a liquid without deflection and tight enough to prevent leakage of mortar. Wood forms shall be thoroughly cleated together with corrosion resistant devices. Bevel strips shall be provided in form angles and in corners of boxes for chamfering of all corners. If any forms show bulge or deflection which in the opinion of the

Engineer is excessive, the concrete shall be removed and the work shall be rebuilt.

B. Before reinforcing is placed, the inside of wood forms for all exposed concrete shall be coated with plastic coating. Wood forms for concrete which will not be exposed shall be coated with form oil or plastic coating, or shall be thoroughly wetted.

C. Forms shall not be removed until members have acquired sufficient strength to safely support their own weight, or any weight which will be applied.

D. Where soil permits, excavation for footings shall be formed to exact dimensions of footings. Where soil does not permit straight and true excavations, the sides of the footings shall be formed. Bottom of all footings excavations to be mechanically tamped prior to placing concrete.

REINFORCEMENT:

A. Placing:

1. Metal reinforcement shall be accurately placed in accordance with the plans and shall be adequately supported and secured in position. Use concrete or clay brick for supporting reinforcement in slabs-on-grade and footings, when reinforcing is bars. Remove supports as pour progresses. Where welded wire fabric is used, pulled up reinforcing to center of member as concrete pour progresses.

2. Unless otherwise shown, all bars shall lap at least 24 diameters. Lap all welded wire fabric at least one full mesh and tie.

3. All slabs-on-grade shall be at least 4" thick, and shall be reinforced with 6 x 6-W1.4 x W1.4 welded wire fabric unless otherwise indicated.

B. Protection: Unless otherwise indicated, reinforcement shall have the following concrete protection:

| | |
|---|---|
| Footings | 3" clear, sides and bottom |
| Walls | 2-1/2" clear, top, bottom, sides |
| Slabs | 2" clear, top 3" clear, bottom |

PLACING CONCRETE:

A. Concrete shall be conveyed to the place of final deposit by methods which will prevent separation or loss of the materials. Equipment for shuting concrete shall be of such size and design as to insure a practically continuous flow of concrete at the delivery end.

B. Concrete shall be deposited as near as possible in its final position to avoid segregation due to handling or flowing. No concrete that has partially hardened or has been contaminated by foreign materials shall be deposited in the work nor shall retempered concrete be used, unless approved by the Engineer. Concrete in walls shall be poured with the use of a tremie and shall not be dropped

more than 8 feet.

C. When concreting is once started, it shall be carried on as a continuous operation until the placement of the section has been completed. The top surface shall be generally level. When construction joints are necessary, they shall be made as approved by the Engineer.

D. Where conditions make consolidating difficult or where reinforcement is congested, the specified high range water reducing admixture (superplasticizer) must be used. The concrete shall be plastic at all times and flow readily into the space between the bars.

E. Concrete shall be placed with the aid of mechanical vibrating equipment, placed in the concrete at the point of deposit, and in strict accordance with ACI 309, "Recommended Practice for Consolidation of Concrete". Lower frequency vibrators may be used with "flowing" concrete.

F. Where not practical in the opinion of the Engineer to use a mechanical vibrator, concrete shall be thoroughly compacted by puddling with suitable tools during the placing.

G. When air temperature has fallen or is expected to fall below 40 degrees F, heat all water and aggregates uniformly before mixing so that the concrete, at point of placement will have a temperature of not less than 50 degrees F nor more than 80 degrees F. Use only the specified non-chloride accelerator. Calcium chloride or admixtures containing more than 0.1% chloride ions are not permitted.

CURING AND PROTECTION:

A. All concrete shall be kept continuously moist and above 50 degrees F for seven days after placement. The temperature requirement may be reduced to three days if high early strength concrete is used.

B. All slabs shall be cured with the specified curing and hardening compound. The compounds must be applied immediately after final finishing.

FINISHING CONCRETE:

A. General: If after the removal of forms, there is any excessive honey-combing or other imperfections, the member shall be repaired by removal and replacement at no extra cost to the Owner.

B. Cast-in-Place Concrete: Except as otherwise specified, all fins and projections shall be removed and small voids filled by dry pack method. Groove top of cracks and cut out holes to sound concrete and clean off dust, dirt and loose particles. Dampen concrete surfaces and apply the specified bonding compound. Place dry pack after the bonding compound has dried. Mix dry pack consisting of one part portland cement to 2-1/2 parts fine aggregate passing a No. 16 mesh sieve, using only enough water as required for handling and placing. Compact dry-pack mixture in place and finish to match adjacent concrete. Keep patched areas continuously moist for not less than 72 hours. Hand rub all vertical surfaces above finish grade.

C. Finish for Sidewalks and Exterior Slabs: The surface of the concrete shall be screeded and shall then be hand finished with a wood float to produce a smooth gritty surface. Edges and joints shall be rounded with an edger to a radius of 1/4". Scored joints shall be provided at 5 to 6 feet on centers, unless otherwise shown. Expansion joints shall be provided at 30 foot intervals. Texture shall be a

approved by the Engineer from sample panels.

CONSTRUCTION JOINTS:

Joints not indicated on the plans shall be approved by the Engineer as to location so as to least impair the strength of the structure. Where a joint is to be made, the surface of the concrete shall be thoroughly cleaned and all laitance removed, by sandblasting if necessary. [Waterstops shall be installed in center of wall or slab at all construction joints. In addition,] Vertical joints shall be thoroughly wetted and slushed with a coat of neat cement grout immediately before placement of new concrete. All reinforcement shall be continued across or through construction joints.

WATERSTOPS:

Waterstops shall be either of those described below at the Contractor's option.

A. Made of Polyvinyl Chloride and of subzero grade, Plastigrip, Type W-6 as manufactured by Progress Unlimited, Inc., New York, or approved equivalent.

Polyvinyl chloride waterstops shall be 9" x 1/2" minimum and shall be produced from a compound, the base resin of which shall be virgin PVC. The compound shall not contain any reclaimed material whatsoever.

The waterstop shall have the following properties:

| | |
|---|---|
| 2,000 psi min. tensile strength | ASTM D412-51T |
| 350% min. elongation | ASTM D412-51T |
| -35 degrees F min. low temperature brittleness | ASTM D746-57T |
| 65-75 shore 'A' durometer hardness | ASTM D676-59T |
| 0.15 max. water absorption | ASTM D570-59T |

Splicing one section of waterstop to another shall be made by pressing the pieces to be joined against a metal plate heated to 420 degrees $^{+}$ 15 degrees F. The heated pieced shall then be immediately pressed together until cool. Speed is important at this point. The same technique shall be used in making all T's, crosses, X's and other fittings required. All splices and special connection pieces

shall be spliced in a manner such that any cross section shall be dense, homogenous and free of all porosity. All finished splices shall have a tensile strength of not less than 75% of the unspliced material.

B. Permeable grout tubes shall be composed of a reinforcing spiral, inner fiber membrane and an outer protective synthetic membrane. The tube shall be completely permeable for the injected sealing materials and impermeable for cement particles. The tubes shall be equal to INJECTO as distributed by De Neef America, Inc.

All materials shall be delivered to the site in undamaged, unopened packings bearing the manufacturer's original labels.

The polyurethane grout shall have the ability to react with water and will expand up to ten (10) times in volume.

The accelerator shall be able to control the reaction time from one (1) minute to one (1) hour.

After reaction, the polyurethane grout shall form a flexible closed cell polyurethane foam.

Mixing and handling of the chemical grout and the accelerator, which are not toxic and non hazardous under normal conditions, shall be in accordance with the recommendations of the manufacturer and all applicable safety codes and shall be performed in such a manner as to minimize hazard to personnel. It is the responsibility of the Contractor to provide appropriate protective measures to insure that chemicals or foam produced by said chemicals are under the control of the Contractor at all times.

Plastic or metal mixing tanks shall be used. Tanks of concrete or wood should not be used.

Hand operated, air driven or electrical positive displacement pumps can be used. Pressure of 150 to 250 psi is adequate.

The permeable grout tubes are required at all formed joints in concrete walls and slabs which separate habitable spaces, machinery and equipment areas from ground water or from water filled tanks, basins, flumes, manholes, etc. It shall also be placed in vertical joints in tank walls and in other joints as shown on the Drawings.

Submit manufacturer's instructions on placement of tubes and data on sealing materials for approval by Engineer.

LOAD TESTS:

In addition to all testing as previously specified, load tests, as directed by the Engineer, may be required at the expense of the Contractor, if there is evidence of faulty workmanship or violations of these specifications. Load tests shall be conducted as indicated in Chapter 20 of ACI Code 318-83.

REPAIR OF DEFECTIVE AREAS:

A. With prior approval of the Engineer, as to method and procedure, all repair of defective areas shall conform to ACI 301, Chapter 9, except that the specified bonding compound must be used.

B. All structural repairs shall be made with prior approval of the Engineer, as to method and procedure, using the specified epoxy adhesive and/or epoxy mortar.

**END OF SECTION**

SECTION 323116

TERMITE CONTROL

## PART 1 - GENERAL

1.1 RELATED DOCUMENTS

Drawings and general provisions of the Contract, including General and Supplementary Conditions and Division 1 Specification Sections, apply to this Section.

1.2 SUMMARY

A. This Section includes soil treatment with termiticide.

B. Related Sections include the Division 6 Section "Rough Carpentry" for wood preservative treatment by pressure process.

1.3 PERFORMANCE REQUIREMENTS

Service Life of Soil Treatment: Soil treatment by use of a termiticide that is effective for not less than five years against infestation of subterranean termites.

1.4 SUBMITTALS

A. Product Data: For termiticide. Include the EPA-Registered Label for termiticide products.

B. Product Certificates: For termite control products, signed by product manufacturer.

C. Qualification Data: For Installer of termite control products.

D. Soil Treatment Application Report: After application of termiticide is completed, submit report for Owner's record information, including the following:

1. Date and time of application.
2. Moisture content of soil before application.
3. Brand name and manufacturer of termiticide.
4. Quantity of undiluted termiticide used.
5. Dilutions, methods, volumes, and rates of application used.
6. Areas of application.
7. Water source for application.

E. Warranty: Special warranty specified in this Section.

F. Meeting Records: Minutes of pre-installation conference.

1.5 QUALITY ASSURANCE

A. Installer Qualifications: A specialist who is licensed according to regulations of authorities having jurisdiction to apply termite control treatment and products in jurisdiction where Project is located.

B. Regulatory Requirements: Formulate and apply termiticides according to the EPA Registered Label.

C. Source Limitations: Obtain termite control products through one source.

D. Pre installation Conference: Conduct conference at Project site to comply with requirements in Division 1 Section "Project Management and Coordination" to schedule application of termiticide products.

1.6 PROJECT CONDITIONS

Environmental Limitations: To ensure penetration, do not treat soil that is water saturated or frozen. Do not treat soil while precipitation is occurring. Comply with requirements of the EPA-Registered Label and requirements of authorities having jurisdiction.

1.7 COORDINATION

Coordinate soil treatment application with excavating, filling, grading, and concreting operations. Treat soil under footings, grade beams, and ground-supported slabs before construction.

1.8 WARRANTY

A. General Warranty: Special warranty specified in this Article shall not deprive Owner of other rights Owner may have under other provisions of the Contract Documents and shall be in addition to, and run concurrent with, other warranties made by Contractor under requirements of the Contract Documents.

B. Special Warranty:

1. Manufacturer's standard form, signed by Applicator and Contractor certifying that termite control work, consisting of applied soil termiticide treatment, will prevent infestation of subterranean termites. If subterranean termite activity or damage is discovered during warranty period, re-treat soil and repair or replace damage caused by termite infestation.
2. Warranty Period: Five years from date of Substantial Completion.

1.9 MAINTENANCE SERVICE

Continuing Service: Beginning at Substantial Completion, provide 12 months' continuing service including monitoring, inspection, and re-treatment for occurrences of termite activity. Provide a standard continuing service agreement. State services, obligations, conditions, and terms for agreement period; and terms for future renewal options.

## PART 2 - PRODUCTS

2.1 MANUFACTURERS

A. Available Products: Subject to compliance with requirements, products that may be incorporated into the Work include, but are not limited to, the following:

1. Bayer Corporation; Premise 75.
2. Dow AgroSciences LLC; Dursban TC.
3. FMC Corporation, Agricultural Products Group; Talstar, Prevail FT, or Torpedo.

2.2 SOIL TREATMENT

Termiticide: Provide an EPA-registered tenniticide complying with requirements of authorities having jurisdiction, in an aqueous solution formulated to prevent termite infestation. Provide quantity required for application at the label volume and rate for the maximum termiticide concentration allowed for each specific use, according to product's EPA-Registered Label.

## PART 3 - EXECUTION

### 3. I EXAMINATION

A. Examine substrates, areas, and conditions, with Applicator present, for compliance with requirements for moisture content of soil, interfaces with earthwork, slab and foundation work, landscaping, and other conditions affecting performance of termite control.

B. Proceed with application only after unsatisfactory conditions have been corrected.

### 3.2 PREPARATION

A. General: Comply with the most stringent requirements of authorities having jurisdiction and with manufacturer’s written instructions for preparation before beginning application of termite control treatment. Remove all extraneous sources of wood cellulose and other edible materials such as wood debris, tree stumps and roots, stakes, formwork, and construction waste wood from soil within and around foundations.

B. Soil Treatment Preparation: Remove foreign matter and impermeable soil materials that could decrease treatment effectiveness on areas to be treated. Loosen, rake, and level soil to be treated except previously compacted areas under slabs and footings. Termiticides may be applied before placing compacted fill under slabs if recommended in writing by termiticide manufacturer.

C. Fit filling hose connected to water source at the site with a backflow preventer, complying with requirements of authorities having jurisdiction.

### 3.3 APPLICATION, GENERAL

General: Comply with the most stringent requirements of authorities having jurisdiction and with manufacturer's EP A-Registered Label for products.

### 3.4 APPLYING SOIL TREATMENT

A. Application: Mix soil treatment tenniticide solution to a uniform consistency. Provide quantity required for application at the label volume and rate for the maximum specified concentration of termiticide, according to manufacturer's EPA-Registered Label, to the following so that a continuous horizontal and vertical termiticidal barrier or treated zone is established around and under building construction. Distribute treatment evenly.

1. Slabs-on-Grade and Basement Slabs: Under ground-supported slab construction, including footings, building slabs, and attached slabs as an overall treatment. Treat soil materials before concrete footings and slabs are placed.

2. Foundations: Adjacent soil including soil along the entire inside perimeter of foundation walls, along both sides of interior partition walls, around plumbing pipes and electric conduit penetrating the slab, and around interior column footers, piers, and chimney bases; also

along the entire outside perimeter, from grade to bottom of footing. Avoid soil washout around footings.

3. Masonry: Treat voids.

4. Penetrations: At expansion joints, control joints, and areas where slabs will be penetrated.

B. Avoid disturbance of treated soil after application. Keep off treated areas until completely dry.

C. Protect termiticide solution, dispersed in treated soils and fills, from being diluted until ground-supported slabs are installed. Use waterproof barrier according to EPA Registered Label instructions.

D. Post warning signs in areas of application.

E. Reapply soil treatment solution to areas disturbed by subsequent excavation, grading, landscaping, or other construction activities following application.

END OF SECTION