



Maine Medical Center

BEAN 2 SURGICAL SERVICES - #28061
BEAN 2 INPATIENT SERVICES - #28060
RICHARDS 2 INPATIENT SERVICES - #28059

Maine Medical Center
22 Bramhall Street
Portland, Maine 04102

PROJECT MANUAL

ISSUED FOR CONSTRUCTION

Volume 2 - Divisions 2 - 26

SMRT Project Nos. 08098/08099/08103

September 12, 2008



PROJECT MANUAL FOR:

**MAINE MEDICAL CENTER
BEAN 2 SURGICAL SERVICES - #28061
BEAN 2 INPATIENT SERVICES - #28060
RICHARDS 2 INPATIENT SERVICES - #28059**

Portland, Maine

SMRT Project Nos. 08098/08099/08103

DATED: September 12, 2008

Volume 2 - Divisions 2 - 26

Issued for Construction

TABLE OF CONTENTS - VOLUME 2

PART IV - SPECIFICATIONS (See Volume 1 for Division 1)

DIVISIONS 2 - 5

(Not Used)

DIVISION 6 - WOOD AND PLASTICS

061000 Rough Carpentry
064023 Interior Architectural Woodwork

DIVISION 7 - THERMAL AND MOISTURE PROTECTION

078413 Penetration Firestopping
079200 Joint Sealants

DIVISION 8 - DOORS AND WINDOWS

081113 Hollow Metal Doors and Frames
081416 Flush Wood Doors
083113 Access Doors and Frames
084243 ICU/CCU Entrances
087100 Door Hardware
088000 Glazing

DIVISION 9 - FINISHES

092900 Gypsum Board
093000 Tiling
095113 Acoustical Panel Ceilings
096516 Resilient Sheet Flooring
096519 Resilient Tile Flooring
096530 Resilient Base and Accessories
096816 Sheet Carpeting
099123 Interior Painting

DIVISION 10 - SPECIALTIES

102113 Toilet Compartments
102650 Impact-resistant Wall Protection
102800 Toilet Accessories
105113 Metal Lockers

DIVISIONS 11 - 14

(Not Used)

DIVISION 21 - FIRE SUPPRESSION

210500	Basic Fire Protection Materials and Methods
211000	Fire Suppression Sprinkler Systems

DIVISION 22 - PLUMBING

220000	Basic Plumbing Requirements
220500	Basic Plumbing Materials and Methods
220516	Pipe Expansion Fittings and Loops
220519	Meters and Gages
220529	Hangers and Supports
220553	Plumbing Identification
220701	Pipe Insulation
221116	Plumbing Piping
221119	Plumbing Specialties
224000	Plumbing Fixtures
226313	Medical Gas Piping

DIVISION 23 - HEATING, VENTILATING AND AIR CONDITIONING

230000	Basic Mechanical Requirements
230500	Basic Mechanical Materials and Methods
230529	Hangers and Supports
230548	Mechanical Vibration and Seismic Controls
230553	Mechanical Identification
230593	Testing, Adjusting and Balancing
230701	Duct Insulation
230703	Pipe Insulation
232113	Hydronic Piping
232213	Steam and Condensate Piping
232300	Refrigerant Piping
233113	Metal Ducts
233300	Duct Accessories
233600	Air Terminal Units
233713	Diffusers, Registers, and Grilles
238126	Split-System Air-Conditioning Units
238233	Radiators
238413	Humidifiers

DIVISION 26 - ELECTRICAL

(See drawings)

END OF TABLE OF CONTENTS

SECTION 061000

ROUGH CARPENTRY

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

- A. 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. Wood blocking and nailers.
 - 2. Plywood backing panels.

1.3 DEFINITIONS

- A. Dimension Lumber: Lumber of 2 inches nominal or greater but less than 5 inches nominal in least dimension.
- B. 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. RIS: Redwood Inspection Service.
 - 4. SPIB: The Southern Pine Inspection Bureau.
 - 5. WCLIB: West Coast Lumber Inspection Bureau.
 - 6. 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 and net amount of preservative retained.
 - 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 based on testing by a qualified independent testing agency.

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.

1.5 DELIVERY, STORAGE, AND HANDLING

- A. Stack lumber 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 PRODUCTS, GENERAL

- A. Lumber: DOC PS 20 and applicable rules of grading agencies indicated. If no grading agency is indicated, provide lumber that complies with the applicable rules of any rules-writing agency certified by the ALSC Board of Review. Provide lumber graded by an agency certified by the ALSC Board of Review to inspect and grade lumber under the rules indicated.
 1. Factory mark each piece of lumber with grade stamp of grading agency.
 2. 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.
 3. Provide dressed lumber, S4S, unless otherwise indicated.

2.2 WOOD-PRESERVATIVE-TREATED LUMBER

- A. Preservative Treatment by Pressure Process: AWPAC2.
 1. Preservative Chemicals: Acceptable to authorities having jurisdiction and containing no arsenic or chromium.
 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 lumber after treatment to a maximum moisture content of 19 percent. Do not use material that is warped or does not comply with requirements for untreated material.
- C. Mark lumber with treatment quality mark of an inspection agency approved by the ALSC Board of Review.
- D. Application: Treat items indicated on Drawings.

2.3 FIRE-RETARDANT-TREATED MATERIALS

- A. General: Comply with performance requirements in AWPAC27 (plywood).

1. Use Interior Type A, unless otherwise indicated.
- B. Identify fire-retardant-treated wood with appropriate classification marking of testing and inspecting agency acceptable to authorities having jurisdiction.
- C. Application: Treat items indicated on Drawings, and the following:
 1. Plywood backing panels.

2.4 MISCELLANEOUS LUMBER

- A. General: Provide miscellaneous lumber indicated and lumber for support or attachment of other construction, including the following:
 1. Blocking.
 2. Nailers.
 3. Rooftop equipment bases and support curbs.
- B. For items of dimension lumber size, provide No. 2 grade, kiln dried lumber of the following species:
 1. Spruce-pine-fir; NLGA.

2.5 PLYWOOD BACKING PANELS

- A. Telephone and Electrical Equipment Backing Panels: DOC PS 1, , fire-retardant treated, in thickness indicated or, if not indicated, not less than 3/4-inch nominal thickness.

2.6 FASTENERS

- A. General: Provide fasteners of size and type indicated that comply with requirements specified in this Article for material and manufacture.
 1. Where rough carpentry is exposed to weather, in ground contact, pressure-preservative treated, or in area of high relative humidity, provide fasteners with hot-dip zinc coating complying with ASTM A 153/A 153M.
- B. Nails, Brads, and Staples: ASTM F 1667.
- C. Power-Driven Fasteners: NES NER-272.
- D. Wood Screws: ASME B18.6.1.
- E. Lag Bolts: ASME B18.2.1.
- F. Bolts: Steel bolts complying with ASTM A 307, Grade A; with ASTM A 563 hex nuts and, where indicated, flat washers.

- G. 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.
1. 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. Securely attach rough carpentry work to substrate by anchoring and fastening as indicated, complying with the following:
1. NES NER-272 for power-driven fasteners.
 2. Table 2304.9.1, "Fastening Schedule," in ICC's International Building Code.
- C. 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; do not countersink nail heads, unless otherwise indicated.

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.
- C. Where wood-preserved-treated lumber is installed adjacent to metal decking, install continuous flexible flashing separator between wood and metal decking.

3.3 PROTECTION

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

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

END OF SECTION 061000

SECTION 064023

INTERIOR ARCHITECTURAL WOODWORK

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

- A. 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. Interior standing and running trim.
- 2. Interior wall panels.
- 3. Plastic-laminate cabinets.
- 4. Solid-surfacing-material.
- 5. Closet and utility shelving.

- B. Related Sections include the following:

- 1. Division 06 Section "Rough Carpentry" for wood furring, blocking, shims, and hanging strips required for installing woodwork and concealed within other construction before woodwork installation.

1.3 DEFINITIONS

- A. Interior architectural woodwork includes wood furring, blocking, shims, and hanging strips for installing woodwork items unless concealed within other construction before woodwork installation.

1.4 SUBMITTALS

- A. Product Data: For panel products, high-pressure decorative laminate, adhesive for bonding plastic laminate, solid-surfacing material, cabinet hardware and accessories.

- B. Shop Drawings: Show location of each item, dimensioned plans and elevations, large-scale details, attachment devices, and other components.

- 1. Show details full size.
- 2. Show locations and sizes of furring, blocking, and hanging strips, including concealed blocking and reinforcement specified in other Sections.
- 3. Show locations and sizes of cutouts and holes for faucets installed in countertops.

- C. Samples for Initial Selection:
 - 1. Plastic laminates.
 - 2. Thermoset decorative panels.
 - 3. Solid-surfacing materials.
 - 4. Solid polymer panels.

1.5 QUALITY ASSURANCE

- A. Fabricator Qualifications: Shop that employs skilled workers who custom-fabricate products similar to those required for this Project and whose products have a record of successful in-service performance.
- B. Quality Standard: Unless otherwise indicated, comply with AWI's "Architectural Woodwork Quality Standards" for grades of interior architectural woodwork indicated for construction, finishes, installation, and other requirements.

1.6 DELIVERY, STORAGE, AND HANDLING

- A. Do not deliver woodwork until painting and similar operations that could damage woodwork have been completed in installation areas. If woodwork must be stored in other than installation areas, store only in areas where environmental conditions comply with requirements specified in "Project Conditions" Article.

1.7 PROJECT CONDITIONS

- A. Environmental Limitations: Do not deliver or install woodwork until building is enclosed, wet work is complete, and HVAC system is operating and maintaining temperature and relative humidity at occupancy levels during the remainder of the construction period.
- B. Field Measurements: Where woodwork is indicated to fit to other construction, verify dimensions of other construction by field measurements before fabrication, and indicate measurements on Shop Drawings. Coordinate fabrication schedule with construction progress to avoid delaying the Work.
 - 1. Locate concealed framing, blocking, and reinforcements that support woodwork by field measurements before being enclosed, and indicate measurements on Shop Drawings.
 - 2. Established Dimensions: Where field measurements cannot be made without delaying the Work, establish dimensions and proceed with fabricating woodwork without field measurements. Provide allowance for trimming at site, and coordinate construction to ensure that actual dimensions correspond to established dimensions.

1.8 COORDINATION

- A. Coordinate sizes and locations of framing, blocking, furring, reinforcements, and other related units of Work specified in other Sections to ensure that interior architectural woodwork can be supported and installed as indicated.

PART 2 - PRODUCTS

2.1 MATERIALS

- A. General: Provide materials that comply with requirements of AWT's quality standard for each type of woodwork and quality grade specified, unless otherwise indicated.
- B. Wood Species and Cut for Transparent Finish: To Match Existing.
- C. Wood Products: Comply with the following:
 - 1. Medium-Density Fiberboard: ANSI A208.2, Grade MD, made with binder containing no urea formaldehyde.
 - 2. Particleboard: ANSI A208.1, Grade M-2.
- D. High-Pressure Decorative Laminate: NEMA LD 3, grades as indicated or, if not indicated, as required by woodwork quality standard.
 - 1. Manufacturer: Subject to compliance with requirements, manufacturer offering high-pressure decorative laminates that may be incorporated into the Work include the following:
 - a. Formica Corporation.
 - b. Panolam Industries International Incorporated. (Pionite)
 - c. Wilsonart International; Div. of Premark International, Inc.
 - 2. Colors and Patterns: As selected by Architect from manufacturer's full range.
- E. Solid Surfacing Material Countertops & Integral Sinks
 - 1. Manufacturer: Corian
 - 2. Grade: E.
 - 3. Solid-Surfacing-Material Thickness: 3/4 inch.
 - 4. Colors, Patterns, and Finishes: As selected by Architect from manufacturer's full range.

- F. Fabricate tops in one piece, unless otherwise indicated. Comply with solid-surfacing-material manufacturer's written recommendations for adhesives, sealers, fabrication, and finishing.
 - 1. Fabricate tops with shop-applied edges of materials and configuration indicated.
 - 2. Fabricate tops with shop-applied backsplashes.
- G. Install integral sink bowls in countertops in shop.
- H. Drill holes in countertops for plumbing fittings and soap dispensers in shop.

2.2 SHOP FINISHING

- A. Grade: Provide finishes of same grades as items to be finished.
- B. General: Finish architectural woodwork at fabrication shop as specified in this Section. Defer only final touchup, cleaning, and polishing until after installation.
- C. Provide shop finishing for wood casework and wall panels.
- D. Preparation for Finishing: Comply with referenced quality standard for sanding, filling countersunk fasteners, sealing concealed surfaces, and similar preparations for finishing architectural woodwork, as applicable to each unit of work.
 - 1. Backpriming: Apply one coat of sealer or primer, compatible with finish coats, to concealed surfaces of woodwork. Apply two coats to back of paneling and to end-grain surfaces. Concealed surfaces of plastic-laminate-clad woodwork do not require backpriming when surfaced with plastic laminate, backing paper, or thermoset decorative panels.
- E. Transparent Finish:
 - 1. Grade: Custom.
 - 2. AWI Finish System TR-5: Catalyzed vinyl.
 - 3. Staining: None required.
 - 4. Open Finish for Open-Grain Woods: Do not apply filler to open-grain woods.
 - 5. Sheen: Satin, 30-50 gloss units.

2.3 CABINET HARDWARE AND ACCESSORIES

- A. General: Provide cabinet hardware and accessory materials associated with architectural cabinets, except for items specified in Division 08 Section "Door Hardware (Scheduled by Describing Products)."
- B. Frameless Semi-concealed Hinges (European Type): BHMA A156.9, B01602, 270 degrees of opening, self-closing.
 - 1. Product: MEPLA SSP 70 T20, slide-on mounting, 30 mm cup. Provide nickel-plated steel cover caps.

- C. Wire Pulls: Back mounted, solid metal, 4 inches long, 5/16 inch in diameter.
- D. Recessed Pulls: Stainless steel recessed cabinet pull, 4-3/4 inches wide by 2-7/16 inches high by 5/8 inch deep with beveled edges. Provide NSF No. 731000004 or approved substitute.
- E. Adjustable Shelf Standards and Supports:
 - 1. Available Products: Knape & Vogt Mfg. Co.: No. 82 heavy-duty brackets, No. 182 Standards, color as selected by the Architect.
- F. Shelf Rests: BHMA A156.9, B04013; metal.
 - 1. Knape & Vogt Mfg. Co.: No. 255 nickel finish, 5/8" wide by 3/16" high Standards for shelving in casework, recess mount on 2" centers. Brackets shall be No. 256 series with nickel finish.
- G. Drawer Slides: BHMA A156.9, B05091; Heavy Duty, 100 pound: Side or bottom mounted; full-extension type; zinc-plated or epoxy, steel ball-bearing slides.
- H. Standard Counter Support Brackets: Provide the following
 - 1. Soffi-Steel Sytem L-Bracket by Grice Engineering, Inc.
- I. Aluminum Slides for Sliding Glass Doors: Roll Ezy ball-bearing track for sliding glass doors, Knape & Vogt #P992ZC. Zinc-plated steel with full ball-bearing carriers. Complete assemblies, each consisting of one upper channel, two shoes, two carriers and one lower track.
- J. Sliding Door Locks: Knape & Vogt #963 CHR, or approved substitute, ratchet lock for 1/4" glass, laps 3/4" to 3-3/8". May be keyed alike or with up to twelve key changes. Polished chrome finish.
- K. Door and Drawer Locks: Will be provided by the Owner to be installed as part of the work of this section. Owner will provide 20 locks.
 - 1. Provide epoxy adhesive to retain lock attachments in place.
- L. Grommets for Cable Passage through Countertops: 3-inch OD, black, molded-plastic grommets and matching plastic caps with slot for wire passage.
 - 1. Product: Provide No. 35-3" by Outwater Plastics, Woodridge, NJ, (800) 631-8375.
- M. Swivel Casters: Zinc-plated, all-purpose caster of single ball race construction, made of heavy gauge cold-rolled steel.
 - 1. Wheels: 3 inch diameter, soft rubber with non-marking tread.
 - 2. Brake: Standard wheel-locking brake.
 - 3. Load Capacity: 125 lbs.
 - 4. Available Products:
 - a. No. 760-30X by Payson Casters.

b. No. 1.03356.441 by Colson Casters.

- N. Exposed Hardware Finishes: For exposed hardware, provide finish that complies with BHMA A156.18 for BHMA finish number indicated.
1. Satin Chromium Plated: BHMA 626 for brass or bronze base; BHMA 652 for steel base.
 2. Satin Stainless Steel: BHMA 630.
- O. For concealed hardware, provide manufacturer's standard finish that complies with product class requirements in BHMA A156.9.

2.4 MISCELLANEOUS MATERIALS

- A. Furring, Blocking, Shims, and Hanging Strips: Softwood lumber, kiln dried to less than 15 percent moisture content.
- B. Anchors: Select material, type, size, and finish required for each substrate for secure anchorage. Provide nonferrous-metal or hot-dip galvanized anchors and inserts on inside face of exterior walls and elsewhere as required for corrosion resistance. Provide toothed-steel or lead expansion sleeves for drilled-in-place anchors.
- C. Adhesives, General: Do not use adhesives that contain urea formaldehyde.
- D. VOC Limits for Installation Adhesives and Glues: Use installation adhesives that comply with the following limits for VOC content when calculated according to 40 CFR 59, Subpart D (EPA Method 24):
1. Wood Glues: 30 g/L.
 2. Contact Adhesive: 250 g/L.
- E. Adhesive for Bonding Plastic Laminate: Contact cement.
1. Adhesive for Bonding Edges: Hot-melt adhesive or adhesive specified above for faces.

2.5 FABRICATION, GENERAL

- A. Interior Woodwork Grade: Unless otherwise indicated, provide Custom-grade interior woodwork complying with referenced quality standard.
- B. Wood Moisture Content: Comply with requirements of referenced quality standard for wood moisture content in relation to ambient relative humidity during fabrication and in installation areas.
- C. Sand fire-retardant-treated wood lightly to remove raised grain on exposed surfaces before fabrication.
- D. Fabricate woodwork to dimensions, profiles, and details indicated. Ease edges to radius indicated for the following:

1. Corners of Cabinets and Edges of Solid-Wood (Lumber) Members 3/4 Inch Thick or Less: 1/16 inch.
 2. Edges of Rails and Similar Members More Than 3/4 Inch Thick: 1/8 inch.
 3. Corners of Cabinets and Edges of Solid-Wood (Lumber) Members and Rails: 1/16 inch.
- E. Complete fabrication, including assembly and hardware application, to maximum extent possible before shipment to Project site. Disassemble components only as necessary for shipment and installation. Where necessary for fitting at site, provide ample allowance for scribing, trimming, and fitting.
1. Trial fit assemblies at fabrication shop that cannot be shipped completely assembled. Install dowels, screws, bolted connectors, and other fastening devices that can be removed after trial fitting. Verify that various parts fit as intended and check measurements of assemblies against field measurements indicated on Shop Drawings before disassembling for shipment.
- F. Shop-cut openings to maximum extent possible to receive hardware, appliances, plumbing fixtures, electrical work, and similar items. Locate openings accurately and use templates or roughing-in diagrams to produce accurately sized and shaped openings. Sand edges of cutouts to remove splinters and burrs.
1. Seal edges of openings in countertops with a coat of varnish.
- 2.6 INTERIOR STANDING AND RUNNING TRIM FOR TRANSPARENT FINISH
- A. Grade: Custom.
 - B. Wood Species and Cut: To Match Existing.
 - C. For trim items wider than available lumber, use veneered construction. Do not glue for width.
 - D. For rails wider or thicker than available lumber, use veneered construction. Do not glue for width or thickness.
 - E. Backout or groove backs of flat trim members and kerf backs of other wide, flat members, except for members with ends exposed in finished work.
- 2.7 FLUSH PANELING
- A. Plastic Laminate Paneling: Provide wall paneling consisting of horizontal grade plastic laminate adhered to 1/4 inch thick luan plywood.
 - B. Panel Trim: Trim stock by McMasters-Carr. Smooth aluminum trim, 3/8 by 5/16 inch by 6 feet long with dull finish. Product no. 8123873.

2.8 PLASTIC-LAMINATE CABINETS

- A. Grade: Custom.
- B. AWI Type of Cabinet Construction: Flush overlay without face frame.
- C. Component Materials:
 - 1. Body members - ends, bottom, divisions, rails and tops: .028" exterior laminate over 3/4 inch thick particleboard, interior Thermoset Decorative Overlay (melamine) with 3 mm PVC edging, all exposed and semi-exposed sides.
 - 2. Shelves: 3/4 inch thick particleboard, Thermoset Decorative Overlay (melamine) each side with 3 mm PVC edging. Provide laminate over plywood where shelf widths are required to meet AWI 400-G-8.
 - 3. Backs: 1/4 inch thick particleboard, Thermoset Decorative Overlay (melamine) each side.
 - 4. Drawer sides, backs and subfronts: 1/2" hardwood plywood or solid lumber.
 - 5. Drawer Bottoms: 1/4" hardwood plywood.
 - 6. Drawer Fronts: .028" exterior laminate over 3/4 inch thick particleboard, interior Thermoset Decorative Overlay (melamine) with 3 mm PVC edging.
 - 7. Cabinet Doors: .028" exterior laminate over 3/4 inch thick particleboard, interior Thermoset Decorative Overlay (melamine) with 3 mm PVC edging.
 - 8. Edging: Band all exposed edges with 3 mm PVC.
 - 9. Base Toe Kick: Hardwood plywood.
 - 10. Leveling Legs: Not allowed.
- D. Colors, Patterns, and Finishes: Provide materials and products that result in colors and textures of exposed laminate surfaces complying with the following requirements:
 - 1. As selected by Architect from laminate manufacturer's full range of colors, patterns and finishes.

2.9 SOLID-SURFACING-MATERIAL COUNTERTOPS

- A. Grade: Premium.
- B. Solid-Surfacing-Material Thickness: 3/4 inch.
- C. Colors, Patterns, and Finishes: Provide materials and products that result in colors of solid-surfacing material complying with the following requirements:
 - 1. As selected by Architect from manufacturer's full range.
- D. Fabricate tops in one piece, unless otherwise indicated. Comply with solid-surfacing-material manufacturer's written recommendations for adhesives, sealers, fabrication, and finishing.
 - 1. Fabricate tops with shop-applied edges of materials and configuration indicated.
 - 2. Fabricate tops with loose backsplashes for field application.

- E. Install integral sink bowls in countertops in shop.
- F. Drill holes in countertops for plumbing fittings and soap dispensers in shop.

2.10 CLOSET AND UTILITY SHELVING

- A. Grade: Custom.
- B. Shelf Material: 3/4-inch thermoset decorative panel with PVC or polyester edge banding.
- C. Wall Brackets: Knap & Vogt No. 182, twin slotted standards with No. 82 heavy-duty U-Brackets. Color as selected by Architect.

PART 3 - EXECUTION

3.1 PREPARATION

- A. Before installation, condition woodwork to average prevailing humidity conditions in installation areas.

3.2 INSTALLATION

- A. Grade: Install woodwork to comply with requirements for the same grade specified in Part 2 for fabrication of type of woodwork involved.
- B. Assemble woodwork and complete fabrication at Project site to comply with requirements for fabrication in Part 2, to extent that it was not completed in the shop.
- C. Install woodwork level, plumb, true, and straight. Shim as required with concealed shims. Install level and plumb (including tops) to a tolerance of 1/8 inch in 96 inches.
- D. Scribe and cut woodwork to fit adjoining work, refinish cut surfaces, and repair damaged finish at cuts.
- E. Anchor woodwork to anchors or blocking built in or directly attached to substrates. Secure with countersunk, concealed fasteners and blind nailing as required for complete installation. Use fine finishing nails for exposed fastening, countersunk and filled flush with woodwork and matching final finish if transparent finish is indicated.
- F. Standing and Running Trim: Install with minimum number of joints possible, using full-length pieces (from maximum length of lumber available) to greatest extent possible. Do not use pieces less than 36 inches long, except where shorter single-length pieces are necessary.
 - 1. Install standing and running trim with no more variation from a straight line than 1/8 inch in 96 inches.

- G. Paneling: Anchor paneling to supporting substrate with construction adhesive. Do not use face fastening, unless covered by trim.
 - 1. Install flush paneling with no more than 1/16 inch in 96-inch vertical cup or bow and 1/8 inch in 96-inch horizontal variation from a true plane.
- H. Cabinets: Install without distortion so 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 installation of hardware and accessory items as indicated.
 - 1. Install cabinets with no more than 1/8 inch in 96-inch sag, bow, or other variation from a straight line.
 - 2. Maintain veneer sequence matching of cabinets with transparent finish.
 - 3. Fasten wall cabinets through back, near top and bottom, at ends and not more than 16 inches o.c. with No. 10 wafer-head sheet metal screws through metal backing or metal framing behind wall finish.
- I. Countertops: Anchor securely by screwing through corner blocks of base cabinets or other supports into underside of countertop.
 - 1. Align adjacent solid-surfacing-material countertops and form seams to comply with manufacturer's written recommendations using adhesive in color to match countertop. Carefully dress joints smooth, remove surface scratches, and clean entire surface.
 - 2. Install countertops with no more than 1/8 inch in 96-inch sag, bow, or other variation from a straight line.
 - 3. Secure backsplashes to walls with adhesive.
 - 4. Calk space between backsplash and wall with sealant specified in Division 07 Section "Joint Sealants."

3.3 ADJUSTING AND CLEANING

- A. Repair damaged and defective woodwork, where possible, to eliminate functional and visual defects; where not possible to repair, replace woodwork. Adjust joinery for uniform appearance.
- B. Clean, lubricate, and adjust hardware.
- C. Clean woodwork on exposed and semiexposed surfaces. Touch up shop-applied finishes to restore damaged or soiled areas.

END OF SECTION 064023

SECTION 078413

PENETRATION FIRESTOPPING

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

- A. 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, unless specified elsewhere, through-penetration firestop systems for the following:
 - 1. Penetrations in fire-resistance-rated walls.
 - 2. Penetrations in smoke barriers.

1.3 SUBMITTALS

- A. Product Data: For each type of product indicated.
- B. Product Schedule: For each penetration firestopping system. Include location and design designation of qualified testing and inspecting agency.
 - 1. Where Project conditions require modification to a qualified testing and inspecting agency's illustration for a particular penetration firestopping condition, submit illustration, with modifications marked, approved by penetration firestopping manufacturer's fire-protection engineer as an engineering judgment or equivalent fire-resistance-rated assembly.
- C. Installer Certificates: From Installer indicating penetration firestopping has been installed in compliance with requirements and manufacturer's written recommendations.
- D. Product Test Reports: Based on evaluation of comprehensive tests performed by a qualified testing agency, for penetration firestopping.

1.4 QUALITY ASSURANCE

- A. Installer Qualifications: A firm experienced in installing penetration firestopping similar in material, design, and extent to that indicated for this Project, whose work has resulted in construction with a record of successful performance. Qualifications include having the necessary experience, staff, and training to install manufacturer's products per specified

requirements. Manufacturer's willingness to sell its penetration firestopping products to Contractor or to Installer engaged by Contractor does not in itself confer qualification on buyer.

- B. Fire-Test-Response Characteristics: Penetration firestopping shall comply with the following requirements:
 - 1. Penetration firestopping tests are performed by a qualified testing agency acceptable to authorities having jurisdiction.
 - 2. Penetration firestopping is identical to those tested per testing standard referenced in "Penetration Firestopping" Article. Provide rated systems complying with the following requirements:
 - a. Penetration firestopping products bear classification marking of qualified testing and inspecting agency.
 - b. Classification markings on penetration firestopping correspond to designations listed by the following:
 - 1) UL in its "Fire Resistance Directory."
- C. Preinstallation Conference: Conduct conference at Project site.
- D. Special Inspections: Allow for 1 of each type of firestopping system to be removed and inspected for conformance with approved submittals. All firestopping shall be inspected prior to the installation of ceilings.
- E. Above Ceiling review: Prior to the installation of ceilings, a review of construction completion shall be conducted for firestopping and other items that will not be visible when the ceilings have been installed.

1.5 PROJECT CONDITIONS

- A. Environmental Limitations: Do not install penetration firestopping when ambient or substrate temperatures are outside limits permitted by penetration firestopping manufacturers or when substrates are wet because of rain, frost, condensation, or other causes.
- B. Install and cure penetration firestopping per manufacturer's written instructions using natural means of ventilations or, where this is inadequate, forced-air circulation.

1.6 COORDINATION

- A. Coordinate construction of openings and penetrating items to ensure that penetration firestopping is installed according to specified requirements.
- B. Coordinate sizing of sleeves, openings, core-drilled holes, or cut openings to accommodate penetration firestopping.
- C. Notify Owner's testing agency at least seven days in advance of penetration firestopping installations; confirm dates and times on day preceding each series of installations.

PART 2 - PRODUCTS

2.1 MANUFACTURERS

- 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. Grace Construction Products.
 2. Hilti, Inc.
 3. Nelson Firestop Products.
 4. RectorSeal Corporation.
 5. Specified Technologies Inc.
 6. 3M Fire Protection Products.
 7. Tremco, Inc.; Tremco Fire Protection Systems Group.
 8. USG Corporation.

2.2 PENETRATION FIRESTOPPING

- A. Provide penetration firestopping that is produced and installed to resist spread of fire according to requirements indicated, resist passage of smoke and other gases, and maintain original fire-resistance rating of construction penetrated. Penetration firestopping systems shall be compatible with one another, with the substrates forming openings, and with penetrating items if any.
- B. Penetrations in Fire-Resistance-Rated Walls: Provide penetration firestopping with ratings determined per ASTM E 814 or UL 1479, based on testing at a positive pressure differential of 0.01-inch wg.
1. Fire-resistance-rated walls include fire partitions.
 2. F-Rating: Not less than the fire-resistance rating of constructions penetrated.
- C. Penetrations in Smoke Barriers: Provide penetration firestopping with ratings determined per UL 1479.
1. L-Rating: Not exceeding 5.0 cfm/sq. ft. of penetration opening at 0.30-inch wg at both ambient and elevated temperatures.
- D. W-Rating: Provide penetration firestopping showing no evidence of water leakage when tested according to UL 1479.
- E. Exposed Penetration Firestopping: Provide products with flame-spread and smoke-developed indexes of less than 25 and 450, respectively, as determined per ASTM E 84.
- F. VOC Content: Provide penetration firestopping that complies with the following limits for VOC content when calculated according to 40 CFR 59, Subpart D (EPA Method 24):
1. Architectural Sealants: 250 g/L.
 2. Sealant Primers for Nonporous Substrates: 250 g/L.

3. Sealant Primers for Porous Substrates: 775 g/L.
- G. Accessories: Provide components for each penetration firestopping system that are needed to install fill materials and to maintain ratings required. Use only those components specified by penetration firestopping manufacturer and approved by qualified testing and inspecting agency for firestopping indicated.
1. Permanent forming/damming/backing materials, including the following:
 - a. Slag-wool-fiber or rock-wool-fiber insulation.
 - b. Sealants used in combination with other forming/damming/backing materials to prevent leakage of fill materials in liquid state.
 - c. Fire-rated form board.
 - d. Fillers for sealants.
 2. Temporary forming materials.
 3. Substrate primers.
 4. Collars.
 5. Steel sleeves.

2.3 FILL MATERIALS

- A. General: Provide through-penetration firestop systems containing the types of fill materials as required by UL approved Through-Penetration Firestop System. Fill materials are those referred to in directories of the referenced testing and inspecting agencies as fill, void, or cavity materials.
- B. Cast-in-Place Firestop Devices: Factory-assembled devices for use in cast-in-place concrete floors and consisting of an outer metallic sleeve lined with an intumescent strip, a radial extended flange attached to one end of the sleeve for fastening to concrete formwork, and a neoprene gasket.
- C. Firestopping Track Systems: Head-of-wall drywall track system consisting of a slip track designed to allow an inflatable bag to be filled with cementitious fireproofing material to seal the track to deck condition a top of wall.
- D. Latex Sealants: Single-component latex formulations that do not re-emulsify after cure during exposure to moisture.
- E. Elastomeric Spray: Single component, water-based elastomeric compound.
- F. Firestop Devices: Factory-assembled collars formed from galvanized steel and lined with intumescent material sized to fit specific diameter of penetrant.
- G. Intumescent Composite Sheets: Rigid panels consisting of aluminum-foil-faced elastomeric sheet bonded to galvanized-steel sheet.
- H. Intumescent Putties: Nonhardening dielectric, water-resistant putties containing no solvents, inorganic fibers, or silicone compounds.

- I. Intumescent Wrap Strips: Single-component intumescent elastomeric sheets with aluminum foil on one side.
- J. Mortars: Prepackaged dry mixes consisting of a blend of inorganic binders, hydraulic cement, fillers, and lightweight aggregate formulated for mixing with water at Project site to form a nonshrinking, homogeneous mortar.
- K. Pillows/Bags: Reusable heat-expanding pillows/bags consisting of glass-fiber cloth cases filled with a combination of mineral-fiber, water-insoluble expansion agents, and fire-retardant additives. Where exposed, cover openings with steel-reinforcing wire mesh to protect pillows/bags from being easily removed.
- L. Silicone Foams: Multicomponent, silicone-based liquid elastomers that, when mixed, expand and cure in place to produce a flexible, nonshrinking foam.
- M. Silicone Sealants: Single-component, silicone-based, neutral-curing elastomeric sealants of grade indicated below:
 - 1. Grade: Pourable (self-leveling) formulation for openings in floors and other horizontal surfaces, and nonsag formulation for openings in vertical and sloped surfaces, unless indicated firestopping limits use of nonsag grade for both opening conditions.

2.4 MIXING

- A. For those products requiring mixing before application, comply with penetration firestopping manufacturer's written instructions for accurate proportioning of materials, water (if required), type of mixing equipment, selection of mixer speeds, mixing containers, mixing time, and other items or procedures needed to produce products of uniform quality with optimum performance characteristics for application indicated.

PART 3 - EXECUTION

3.1 EXAMINATION

- A. Examine substrates and conditions, with Installer present, for compliance with requirements for opening configurations, penetrating items, substrates, and other conditions affecting performance of the Work.
- B. Proceed with installation only after unsatisfactory conditions have been corrected.

3.2 PREPARATION

- A. Surface Cleaning: Clean out openings immediately before installing penetration firestopping to comply with manufacturer's written instructions and with the following requirements:

1. Remove from surfaces of opening substrates and from penetrating items foreign materials that could interfere with adhesion of penetration firestopping.
 2. Clean opening substrates and penetrating items to produce clean, sound surfaces capable of developing optimum bond with penetration firestopping. Remove loose particles remaining from cleaning operation.
 3. Remove laitance and form-release agents from concrete.
- B. Priming: Prime substrates where recommended in writing by manufacturer using that manufacturer's recommended products and methods. Confine primers to areas of bond; do not allow spillage and migration onto exposed surfaces.
- C. Masking Tape: Use masking tape to prevent penetration firestopping from contacting adjoining surfaces that will remain exposed on completion of the Work and that would otherwise be permanently stained or damaged by such contact or by cleaning methods used to remove stains. Remove tape as soon as possible without disturbing firestopping's seal with substrates.

3.3 INSTALLATION

- A. General: Install penetration firestopping to comply with manufacturer's written installation instructions and published drawings for products and applications indicated.
- B. Install forming materials and other accessories of types required to support fill materials during their application and in the position needed to produce cross-sectional shapes and depths required to achieve fire ratings indicated.
1. After installing fill materials and allowing them to fully cure, remove combustible forming materials and other accessories not indicated as permanent components of firestopping.
- C. Install fill materials for firestopping by proven techniques to produce the following results:
1. Fill voids and cavities formed by openings, forming materials, accessories, and penetrating items as required to achieve fire-resistance ratings indicated.
 2. Apply materials so they contact and adhere to substrates formed by openings and penetrating items.
 3. For fill materials that will remain exposed after completing the Work, finish to produce smooth, uniform surfaces that are flush with adjoining finishes.

3.4 IDENTIFICATION

- A. Identify penetration firestopping with preprinted metal or plastic labels. Attach labels permanently to surfaces adjacent to and within 6 inches of firestopping edge so labels will be visible to anyone seeking to remove penetrating items or firestopping. Use mechanical fasteners or self-adhering-type labels with adhesives capable of permanently bonding labels to surfaces on which labels are placed. Include the following information on labels:
1. The words "Warning - Penetration Firestopping - Do Not Disturb. Notify Building Management of Any Damage."

2. Contractor's name, address, and phone number.
3. Designation of applicable testing and inspecting agency.
4. Date of installation.
5. Manufacturer's name.
6. Installer's name.

3.5 FIELD QUALITY CONTROL

- A. Owner will engage a qualified testing agency to perform tests and inspections.
- B. Where deficiencies are found or penetration firestopping is damaged or removed because of testing, repair or replace penetration firestopping to comply with requirements.
- C. Proceed with enclosing penetration firestopping with other construction only after inspection reports are issued and installations comply with requirements.
- D. Reinstall firestopping materials that have been removed for inspection.

3.6 CLEANING AND PROTECTION

- A. Clean off excess fill materials adjacent to openings as the Work progresses by methods and with cleaning materials that are approved in writing by penetration firestopping manufacturers and that do not damage materials in which openings occur.
- B. Provide final protection and maintain conditions during and after installation that ensure that penetration firestopping is without damage or deterioration at time of Substantial Completion. If, despite such protection, damage or deterioration occurs, immediately cut out and remove damaged or deteriorated penetration firestopping and install new materials to produce systems complying with specified requirements.

END OF SECTION 078413

SECTION 079200

JOINT SEALANTS

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

- A. 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:

1. Silicone joint sealants.
2. Urethane joint sealants.
3. Latex joint sealants.

B. Related Sections:

1. Division 03 Section "Cast-in-place Concrete".
2. Division 04 Section "Unit Masonry" for masonry control and expansion joint fillers and gaskets.
3. Division 07 Section "Expansion Control" for building expansion joints.
4. Division 08 Section "Glazing" for glazing sealants.
5. Division 09 Section "Gypsum Board" for sealing perimeter joints.
6. Division 09 Section "Tiling" for sealing tile joints.

1.3 SUBMITTALS

- A. Product Data: For each joint-sealant product indicated.

- B. Samples for 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. Joint-Sealant Schedule: Include the following information:

1. Joint-sealant application, joint location, and designation.
2. Joint-sealant manufacturer and product name.
3. Joint-sealant formulation.
4. Joint-sealant color.

- D. Product Certificates: For each kind of joint sealant and accessory, from manufacturer.

- E. Product Test Reports: Based on evaluation of comprehensive tests performed by a qualified testing agency, indicating that sealants comply with requirements.

- F. Warranties: Sample of special warranties.

1.4 QUALITY ASSURANCE

- A. Installer Qualifications: An experienced installer who has specialized in installing joint sealants similar in material, design, and extent to those indicated for this Project and whose work has resulted in joint-sealant installations with a record of successful in-service performance.
- B. Source Limitations: Obtain each kind of joint sealant from single source from single manufacturer.
- C. Product Testing: Test joint sealants using a qualified testing agency.
 - 1. Testing Agency Qualifications: An independent testing agency qualified according to ASTM C 1021 to conduct the testing indicated.
 - 2. Test according to SWRI's Sealant Validation Program for compliance with requirements specified by reference to ASTM C 920 for adhesion and cohesion under cyclic movement, adhesion-in-peel, and indentation hardness.
- D. Mockups: Install sealant in mockups of masonry assemblies specified in other Sections that are indicated to receive joint sealants specified in this Section. Use materials and installation methods specified in this Section.

1.5 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. Where contaminants capable of interfering with adhesion have not yet been removed from joint substrates.

1.6 WARRANTY

- A. Special Installer's Warranty: Manufacturer's standard form in which Installer agrees to repair or replace joint sealants that do not comply with performance and other requirements specified in this Section within specified warranty period.
 - 1. Warranty Period: Two years from date of Substantial Completion.
- B. Special Manufacturer's Warranty: Manufacturer's standard form in which joint-sealant manufacturer agrees to furnish joint sealants to repair or replace those that do not comply with performance and other requirements specified in this Section within specified warranty period.

1. Warranty Period: 5 years from date of Substantial Completion.
- C. Special warranties specified in this article exclude deterioration or failure of joint sealants from the following:
1. Movement of the structure caused by structural settlement or errors attributable to design or construction resulting in stresses on the sealant exceeding sealant manufacturer's written specifications for sealant elongation and compression.
 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 joint-sealant manufacturer, based on testing and field experience.
- B. VOC Content of Interior Sealants: Provide sealants and sealant primers for use inside the weatherproofing system that comply with the following limits for VOC content when calculated according to 40 CFR 59, Part 59, Subpart D (EPA Method 24):
1. Architectural Sealants: 250 g/L.
 2. Sealant Primers for Nonporous Substrates: 250 g/L.
 3. Sealant Primers for Porous Substrates: 775 g/L.
- C. Stain-Test-Response Characteristics: Where sealants are specified to be nonstaining to porous substrates, provide products that have undergone testing according to ASTM C 1248 and have not stained porous joint substrates indicated for Project.
- D. Suitability for Contact with Food: Where sealants are indicated for joints that will come in repeated contact with food, provide products that comply with 21 CFR 177.2600.
- E. Colors of Exposed Joint Sealants: As selected by Architect from manufacturer's full range.

2.2 SILICONE JOINT SEALANTS

- A. Sealant Type 1: Single-Component, Nonsag, Neutral-Curing Silicone Joint Sealant; ASTM C 920, Type S, Grade NS, Class 100/50, for Use NT.
1. Products: Subject to compliance with requirements, available products that may be incorporated into the Work include, but are not limited to, the following:
 - a. Dow Corning Corporation; 790.

- b. GE Advanced Materials - Silicones; SilPruf LM SCS2700.
 - c. Pecora Corporation; 890.
 - d. Sika Corporation, Construction Products Division; SikaSil-C990.
 - e. Tremco Incorporated; Spectrem 1.
- B. Sealant Type 2: Not Used.
- C. Sealant Type 3: Single-Component, Nonsag, Traffic-Grade, Neutral-Curing Silicone Joint Sealant; ASTM C 920, Type S, Grade NS, Class 100/50, for Use T.
- 1. Products: Subject to compliance with requirements, available products that may be incorporated into the Work include, but are not limited to, the following:
 - a. Dow Corning Corporation; 790.
 - b. Pecora Corporation; 301 NS.
 - c. Tremco Incorporated; Spectrem 800.
- D. Sealant Type 4: Mildew-Resistant, Single-Component, Acid-Curing Silicone Joint Sealant: ASTM C 920, Type S, Grade NS, Class 25, for Use NT.
- 1. Products: Subject to compliance with requirements, available products that may be incorporated into the Work include, but are not limited to, the following:
 - a. Dow Corning Corporation; 786.
 - b. GE Advanced Materials - Silicones; Sanitary SCS1700.
 - c. Tremco Incorporated; Tremsil 200 Sanitary.

2.3 URETHANE JOINT SEALANTS

- A. Sealant Type 5: Multicomponent, Nonsag, Urethane Joint Sealant; ASTM C 920, Type M, Grade NS, Class 25, for Use NT.
- 1. Products: Subject to compliance with requirements, available products that may be incorporated into the Work include, but are not limited to, the following:
 - a. BASF Building Systems; Sonolastic NP 2.
 - b. Bostik, Inc.; Chem-Calk 500.
 - c. Pecora Corporation; Dynatrol II.
 - d. Sika Corporation, Construction Products Division; Sikaflex - 2c NS.
 - e. Tremco Incorporated; Vulkem 227.

2.4 LATEX JOINT SEALANTS

- A. Sealant Type 6: Latex Joint Sealant: Acrylic latex or siliconized acrylic latex, ASTM C 834, Type OP, Grade NF.
- 1. Products: Subject to compliance with requirements, available products that may be incorporated into the Work include, but are not limited to, the following:

- a. BASF Building Systems; Sonolac.
- b. Bostik, Inc.; Chem-Calk 600.
- c. Pecora Corporation; AC-20.
- d. Tremco Incorporated; Tremflex 834.

2.5 JOINT SEALANT BACKING

- A. General: Provide sealant backings of material that are nonstaining; are compatible with joint substrates, sealants, primers, and other joint fillers; and are approved for applications indicated by sealant manufacturer based on field experience and laboratory testing.
- B. Cylindrical Sealant Backings: ASTM C 1330, Type C (closed-cell material with a surface skin), 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. 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: Nonstaining, 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, 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 the following:
 - a. Concrete.
 - b. Masonry.
 - c. Unglazed surfaces of ceramic tile.
 - d. Exterior insulation and finish systems.
 3. Remove laitance and form-release agents from concrete.
 4. Clean nonporous joint substrate 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 the following:
 - a. Metal.
 - b. Glass.
 - c. Porcelain enamel.
 - d. Glazed surfaces of ceramic tile.
- B. Joint Priming: Prime joint substrates where recommended by joint-sealant manufacturer or as indicated by preconstruction joint-sealant-substrate tests 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 or primer 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. Install sealant backings of kind 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.
- D. Install bond-breaker tape behind sealants where sealant backings are not used between sealants and backs of joints.
- E. 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.
- F. Tooling of Nonsag Sealants: Immediately after sealant application and before skinning or curing begins, tool sealants according to requirements specified in subparagraphs 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.
 - 3. Provide concave joint profile per Figure 8A in ASTM C 1193, unless otherwise indicated.
 - 4. Provide flush joint profile where indicated per Figure 8B in ASTM C 1193.
 - 5. Provide recessed joint configuration of recess depth and at locations indicated per Figure 8C in ASTM C 1193.
 - a. Use masking tape to protect surfaces adjacent to recessed tooled joints.

3.4 CLEANING

- A. 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.

3.5 PROTECTION

- A. 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.

3.6 JOINT-SEALANT SCHEDULE

- A. Exterior Isolation and Contraction Joints in Cast-in-place Concrete Slabs.
 - 1. Silicone Joint Sealant: Sealant Type 3.
 - 2. Joint-Sealant Color: As selected by Architect from manufacturer's full range of colors.
- B. Exterior Control, Expansion, and Soft Joints in Masonry and Between Masonry and Adjacent Work.
 - 1. Silicone Joint Sealant: Sealant Type 1.
 - 2. Joint-Sealant Color: As selected by Architect from manufacturer's full range of colors.
- C. Exterior Control, Expansion, and Soft Joints Between Masonry and Metal Door Frames, Windows, Storefronts and Curtain Walls.
 - 1. Silicone Joint Sealant: Sealant Type 1.
 - 2. Joint-Sealant Color: As selected by Architect from manufacturer's full range of colors.
- D. Exterior Control, Expansion, and Soft Joints in Stone Work and Between Stone and Adjacent Work.
 - 1. Urethane Joint Sealant: Sealant Type 5.
 - 2. Joint-Sealant Color: As selected by Architect from manufacturer's full range of colors.
- E. Under Exterior Door Thresholds.
 - 1. Silicone Joint Sealant: Sealant Type 1.
 - 2. Joint-Sealant Color: As selected by Architect from manufacturer's full range of colors.
- F. Exterior Joints for Which No Other Sealant Type is Indicated.
 - 1. Silicone Joint Sealant: Sealant Type 1.
 - 2. Joint-Sealant Color: As selected by Architect from manufacturer's full range of colors.
- G. Interior Isolation and Contraction Joints in Cast-In-Place Concrete Slabs.
 - 1. Silicone Joint Sealant: Sealant Type 3.
 - 2. Joint-Sealant Color: As selected by Architect from manufacturer's full range of colors.
- H. Concealed Interior Perimeter Joints of Exterior Openings.
 - 1. Silicone Joint Sealant: Sealant Type 1.
 - 2. Joint-Sealant Color: As selected by Architect from manufacturer's full range of colors.
- I. Exposed Interior Perimeter Joints of Exterior Openings.

1. Silicone Joint Sealant: Sealant Type 1.
 2. Joint-Sealant Color: As selected by Architect from manufacturer's full range of colors.
- J. Perimeter Joints Between Interior Wall Surfaces and Frames of Interior Doors and Windows.
1. Latex Joint Sealant: Sealant Type 6.
 2. Joint-Sealant Color: As selected by Architect from manufacturer's full range of colors.
- K. Vertical Joints on Exposed Surfaces of Walls and Partitions.
1. Latex Joint Sealant: Sealant Type 6.
 2. Joint-Sealant Color: As selected by Architect from manufacturer's full range of colors.
- L. Joints between Plumbing Fixtures and Walls and Floors and Between Countertops and Walls.
1. Silicone Joint Sealant: Sealant Type 4.
 2. Joint-Sealant Color: As selected by Architect from manufacturer's full range of colors.
- M. Interior Joints for Which No Other Sealant is Indicated.
1. Latex Joint Sealant: Sealant Type 6.
 2. Joint-Sealant Color: As selected by Architect from manufacturer's full range of colors.

END OF SECTION 079200

SECTION 081113

HOLLOW METAL DOORS AND FRAMES

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

- A. 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:

- 1. Standard hollow metal doors and frames.

B. Related Sections:

- 1. Division 09 Section "Interior Painting" for field painting hollow metal doors and frames.
- 2. Division 26 Sections for electrical connections including conduit and wiring for door controls and operators.

1.3 DEFINITIONS

- A. Minimum Thickness: Minimum thickness of base metal without coatings.

- B. Standard Hollow Metal Work: Hollow metal work fabricated according to ANSI/SDI A250.8.

1.4 SUBMITTALS

- A. Product Data: For each type of product indicated. Include construction details, material descriptions, core descriptions, fire-resistance rating, and finishes.

B. Shop Drawings: Include the following:

- 1. Elevations of each door design.
- 2. Details of doors, including vertical and horizontal edge details and metal thicknesses.
- 3. Frame details for each frame type, including dimensioned profiles and metal thicknesses.
- 4. Locations of reinforcement and preparations for hardware.
- 5. Details of each different wall opening condition.
- 6. Details of anchorages, joints, field splices, and connections.
- 7. Details of accessories.

8. Details of removable stops, and glazing.
9. Details of conduit and preparations for power, signal, and control systems.

C. Other Action Submittals:

1. Schedule: Provide a schedule of hollow metal work prepared by or under the supervision of supplier, using same reference numbers for details and openings as those on Drawings. Coordinate with door hardware schedule.

D. Oversize Construction Certification: For assemblies required to be fire rated and exceeding limitations of labeled assemblies.

E. Product Test Reports: Based on evaluation of comprehensive tests performed by a qualified testing agency, for each type of hollow metal door and frame assembly.

1.5 QUALITY ASSURANCE

A. Source Limitations: Obtain hollow metal work from single source from single manufacturer.

B. Fire-Rated Door Assemblies: Assemblies complying with NFPA 80 that are listed and labeled by a qualified testing agency, for fire-protection ratings indicated, based on testing at as close to neutral pressure as possible according to UL 10B.

1. Oversize Fire-Rated Door Assemblies: For units exceeding sizes of tested assemblies, provide certification by a qualified testing agency that doors comply with standard construction requirements for tested and labeled fire-rated door assemblies except for size.

C. Fire-Rated, Borrowed-Light Frame Assemblies: Assemblies complying with NFPA 80 that are listed and labeled, by a testing and inspecting agency acceptable to authorities having jurisdiction, for fire-protection ratings indicated, based on testing according to NFPA 257 or UL 9. Label each individual glazed lite.

D. Smoke-Control Door Assemblies: Comply with NFPA 105 or UL 1784.

E. Preinstallation Conference: Conduct conference at Project site.

1. Inspect and discuss condition of substrate and other preparatory work performed by other trades.
2. Review tie-in to air barrier system.

1.6 DELIVERY, STORAGE, AND HANDLING

A. Deliver hollow metal work palletized, wrapped, or crated to provide protection during transit and Project-site storage. Do not use nonvented plastic.

1. Provide additional protection to prevent damage to finish of factory-finished units.

- B. Deliver welded frames with two removable spreader bars across bottom of frames, tack welded to jambs and mullions.
- C. Store hollow metal work under cover at Project site. Place in stacks of five units maximum in a vertical position with heads up, spaced by blocking, on minimum 4-inch- high wood blocking. Do not store in a manner that traps excess humidity.
 - 1. Provide minimum 1/4-inch space between each stacked door to permit air circulation.

1.7 PROJECT CONDITIONS

- A. Field Measurements: Verify actual dimensions of openings by field measurements before fabrication.

1.8 COORDINATION

- A. Coordinate installation of anchorages for hollow metal frames. Furnish setting drawings, templates, and directions for installing anchorages, including sleeves, concrete inserts, anchor bolts, and items with integral anchors. Deliver such items to Project site in time for installation.

PART 2 - PRODUCTS

2.1 MANUFACTURERS

- A. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
 - 1. Ceco Door Products; a United Dominion Company.
 - 2. Curries Company.
 - 3. Steelcraft; a division of Ingersoll-Rand.

2.2 MATERIALS

- A. Cold-Rolled Steel Sheet: ASTM A 1008/A 1008M, Commercial Steel (CS), Type B; suitable for exposed applications.
- B. Hot-Rolled Steel Sheet: ASTM A 1011/A 1011M, Commercial Steel (CS), Type B; free of scale, pitting, or surface defects; pickled and oiled.
- C. Metallic-Coated Steel Sheet: ASTM A 653/A 653M, Commercial Steel (CS), Type B; with minimum G60 or A60 metallic coating.
- D. Frame Anchors: ASTM A 591/A 591M, Commercial Steel (CS), 40Z coating designation; mill phosphatized.

- E. Inserts, Bolts, and Fasteners: Hot-dip galvanized according to ASTM A 153/A 153M.
- F. Powder-Actuated Fasteners in Concrete: Fastener system of type suitable for application indicated, fabricated from corrosion-resistant materials, with clips or other accessory devices for attaching hollow metal frames of type indicated.
- G. Grout: ASTM C 476, except with a maximum slump of 4 inches, as measured according to ASTM C 143/C 143M.
- H. Glazing: Comply with requirements in Division 08 Section "Glazing."
- I. Bituminous Coating: Cold-applied asphalt mastic, SSPC-Paint 12, compounded for 15-mil dry film thickness per coat. Provide inert-type noncorrosive compound free of asbestos fibers, sulfur components, and other deleterious impurities.

2.3 STANDARD HOLLOW METAL DOORS

- A. General: Provide doors of design indicated, not less than thickness indicated; fabricated with smooth surfaces, without visible joints or seams on exposed faces unless otherwise indicated. Comply with ANSI/SDI A250.8.
 - 1. Design: Flush panel.
 - 2. Core Construction: Manufacturer's standard kraft-paper honeycomb, polystyrene, polyurethane, polyisocyanurate, mineral-board, or vertical steel-stiffener core.
 - a. Fire Door Core: As required to provide fire-protection ratings indicated.
 - b. Thermal-Rated (Insulated) Doors: Where indicated, provide doors fabricated with thermal-resistance value (R-value) of not less than 10.0 deg F x h x sq. ft./Btu when tested according to ASTM C 1363.
 - 1) Locations: Exterior doors.
 - 3. Vertical Edges for Single-Acting Doors: Beveled edge.
 - a. Beveled Edge: 1/8 inch in 2 inches.
 - 4. Top and Bottom Edges: Closed with flush or inverted 0.042-inch- thick, end closures or channels of same material as face sheets.
 - 5. Tolerances: Comply with SDI 117, "Manufacturing Tolerances for Standard Steel Doors and Frames."
- B. Interior Doors: Face sheets fabricated from cold-rolled steel sheet. Provide doors complying with requirements indicated below by referencing ANSI/SDI A250.8 for level and model and ANSI/SDI A250.4 for physical performance level:
 - 1. Level 2 (18 ga faces) and Physical Performance Level B (Heavy Duty), Model 2 (Seamless).

- C. Hardware Reinforcement: Fabricate according to ANSI/SDI A250.6 with reinforcing plates from same material as door face sheets.
- D. Fabricate concealed stiffeners and hardware reinforcement from either cold- or hot-rolled steel sheet.

2.4 STANDARD HOLLOW METAL FRAMES

- A. General: Comply with ANSI/SDI A250.8 and with details indicated for type and profile.
- B. Interior Frames: Fabricated from cold-rolled steel sheet.
 - 1. Fabricate frames with mitered or coped corners.
 - 2. Fabricate frames as face welded unless otherwise indicated.
 - 3. Fabricate knocked-down, drywall slip-on frames for in-place gypsum board partitions.
 - 4. Frames for Level 2 Steel Doors: 0.053-inch- thick steel sheet.
 - 5. Frames for Wood Doors: 0.053-inch- thick steel sheet.
 - 6. Frames for Borrowed Lights: 0.053-inch- thick steel sheet.
- C. Hardware Reinforcement: Fabricate according to ANSI/SDI A250.6 with reinforcement plates from same material as frames.

2.5 FRAME ANCHORS

- A. Jamb Anchors:
 - 1. Masonry Type: Adjustable strap-and-stirrup or T-shaped anchors to suit frame size, not less than 0.042 inch thick, with corrugated or perforated straps not less than 2 inches wide by 10 inches long; or wire anchors not less than 0.177 inch thick.
 - 2. Stud-Wall Type: Designed to engage stud, welded to back of frames; not less than 0.042 inch thick.
 - 3. Compression Type for Drywall Slip-on Frames: Not acceptable.
 - 4. Postinstalled Expansion Type for In-Place Concrete or Masonry: Minimum 3/8-inch-diameter bolts with expansion shields or inserts. Provide pipe spacer from frame to wall, with throat reinforcement plate, welded to frame at each anchor location.
- B. Floor Anchors: Formed from same material as frames, not less than 0.042 inch thick, and as follows:
 - 1. Monolithic Concrete Slabs: Clip-type anchors, with two holes to receive fasteners.

2.6 STOPS AND MOLDINGS

- A. Moldings for Glazed Lites in Doors: Minimum 0.032 inch thick, fabricated from same material as door face sheet in which they are installed.

- B. Fixed Frame Moldings: Formed integral with hollow metal frames, a minimum of 5/8 inch high unless otherwise indicated.
- C. Loose Stops for Glazed Lites in Frames: Minimum 0.032 inch thick, fabricated from same material as frames in which they are installed.

2.7 ACCESSORIES

- A. Mullions and Transom Bars: Join to adjacent members by welding or rigid mechanical anchors.
- B. Ceiling Struts: Minimum 1/4-inch-thick by 1-inch- wide steel.
- C. Grout Guards: Formed from same material as frames, not less than 0.016 inch thick.

2.8 FABRICATION

- A. Fabricate hollow metal work to be rigid and free of defects, warp, or buckle. Accurately form metal to required sizes and profiles, with minimum radius for thickness of metal. Where practical, fit and assemble units in manufacturer's plant. To ensure proper assembly at Project site, clearly identify work that cannot be permanently factory assembled before shipment.
- B. Tolerances: Fabricate hollow metal work to tolerances indicated in SDI 117.
- C. Hollow Metal Doors:
 - 1. Exterior Doors: Provide weep-hole openings in bottom of exterior doors to permit moisture to escape. Seal joints in top edges of doors against water penetration.
 - 2. Glazed Lites: Factory cut openings in doors.
 - 3. Astragals: Provide overlapping astragal on one leaf of pairs of doors where required by NFPA 80 for fire-performance rating or where indicated. Extend minimum 3/4 inch beyond edge of door on which astragal is mounted.
 - 4. Full hinge cut-outs for non-handed doors will not be acceptable.
- D. Hollow Metal Frames: Where frames are fabricated in sections due to shipping or handling limitations, provide alignment plates or angles at each joint, fabricated of same thickness metal as frames.
 - 1. Welded Frames: Weld flush face joints continuously; grind, fill, dress, and make smooth, flush, and invisible.
 - 2. Sidelight Frames: Provide closed tubular members with no visible face seams or joints, fabricated from same material as door frame. Fasten members at crossings and to jambs by butt welding.
 - 3. Provide countersunk, flat- or oval-head exposed screws and bolts for exposed fasteners unless otherwise indicated.
 - 4. Grout Guards: Weld guards to frame at back of hardware mortises in frames to be grouted.

5. Floor Anchors: Weld anchors to bottom of jambs and mullions with at least four spot welds per anchor.
6. Jamb Anchors: Provide number and spacing of anchors as follows:
 - a. Masonry Type: Locate anchors not more than 18 inches from top and bottom of frame. Space anchors not more than 32 inches o.c. and as follows:
 - 1) Two anchors per jamb up to 60 inches high.
 - 2) Three anchors per jamb from 60 to 90 inches high.
 - 3) Four anchors per jamb from 90 to 120 inches high.
 - 4) Four anchors per jamb plus 1 additional anchor per jamb for each 24 inches or fraction thereof above 120 inches high.
 - b. Stud-Wall Type: Locate anchors not more than 18 inches from top and bottom of frame. Space anchors not more than 32 inches o.c. and as follows:
 - 1) Three anchors per jamb up to 60 inches high.
 - 2) Four anchors per jamb from 60 to 90 inches high.
 - 3) Five anchors per jamb from 90 to 96 inches high.
 - 4) Five anchors per jamb plus 1 additional anchor per jamb for each 24 inches or fraction thereof above 96 inches high.
 - 5) Two anchors per head for frames above 42 inches wide and mounted in metal-stud partitions.
 - c. Postinstalled Expansion Type: Locate anchors not more than 6 inches from top and bottom of frame. Space anchors not more than 26 inches o.c.
7. Door Silencers: Except on weather-stripped doors, drill stops to receive door silencers as follows. Keep holes clear during construction.
 - a. Single-Door Frames: Drill stop in strike jamb to receive three door silencers.
 - b. Double-Door Frames: Drill stop in head jamb to receive two door silencers.
- E. Fabricate concealed stiffeners, edge channels, and hardware reinforcement from either cold- or hot-rolled steel sheet.
- F. Hardware Preparation: Factory prepare hollow metal work to receive templated mortised hardware; include cutouts, reinforcement, mortising, drilling, and tapping according to the Door Hardware Schedule and templates furnished as specified in Division 08 Section "Door Hardware."
 1. Locate hardware as indicated, or if not indicated, according to ANSI/SDI A250.8.
 2. Reinforce doors and frames to receive nontemplated, mortised and surface-mounted door hardware.
 3. Comply with applicable requirements in ANSI/SDI A250.6 and ANSI/DHI A115 Series specifications for preparation of hollow metal work for hardware.
 4. Coordinate locations of conduit and wiring boxes for electrical connections with Division 26 Sections.

- G. Stops and Moldings: Provide stops and moldings around glazed lites where indicated. Form corners of stops and moldings with butted or mitered hairline joints.
 - 1. Single Glazed Lites: Provide fixed stops and moldings welded on secure side of hollow metal work.
 - 2. Multiple Glazed Lites: Provide fixed and removable stops and moldings so that each glazed lite is capable of being removed independently.
 - 3. Provide fixed frame moldings on outside of exterior and on secure side of interior doors and frames.
 - 4. Provide loose stops and moldings on inside of hollow metal work.
 - 5. Coordinate rabbet width between fixed and removable stops with type of glazing and type of installation indicated.

2.9 STEEL FINISHES

- A. Prime Finish: Apply manufacturer's standard primer immediately after cleaning and pretreating.
 - 1. Shop Primer: Manufacturer's standard, fast-curing, lead- and chromate-free primer complying with ANSI/SDI A250.10 acceptance criteria; recommended by primer manufacturer for substrate; compatible with substrate and field-applied coatings despite prolonged exposure.

PART 3 - EXECUTION

3.1 EXAMINATION

- A. Examine substrates, areas, and conditions, with Installer present, for compliance with requirements for installation tolerances and other conditions affecting performance of the Work.
- B. Examine roughing-in for embedded and built-in anchors to verify actual locations before frame installation.
- C. For the record, prepare written report, endorsed by Installer, listing conditions detrimental to performance of the Work.
- D. Proceed with installation only after unsatisfactory conditions have been corrected.

3.2 PREPARATION

- A. Remove welded-in shipping spreaders installed at factory. Restore exposed finish by grinding, filling, and dressing, as required to make repaired area smooth, flush, and invisible on exposed faces.
- B. Prior to installation, adjust and securely brace welded hollow metal frames for squareness, alignment, twist, and plumbness to the following tolerances:

1. Squareness: Plus or minus 1/16 inch, measured at door rabbet on a line 90 degrees from jamb perpendicular to frame head.
 2. Alignment: Plus or minus 1/16 inch, measured at jambs on a horizontal line parallel to plane of wall.
 3. Twist: Plus or minus 1/16 inch, measured at opposite face corners of jambs on parallel lines, and perpendicular to plane of wall.
 4. Plumbness: Plus or minus 1/16 inch, measured at jambs on a perpendicular line from head to floor.
- C. Drill and tap doors and frames to receive nontemplated, mortised, and surface-mounted door hardware.
- D. At exterior walls and masonry walls, coat inside of frame profile with bituminous coating to a thickness of 1/16 inch (1.5 mm).

3.3 INSTALLATION

- A. General: Install hollow metal work plumb, rigid, properly aligned, and securely fastened in place; comply with Drawings and manufacturer's written instructions.
- B. Hollow Metal Frames: Install hollow metal frames of size and profile indicated. Comply with ANSI/SDI A250.11.
1. Set frames accurately in position, plumbed, aligned, and braced securely until permanent anchors are set. After wall construction is complete, remove temporary braces, leaving surfaces smooth and undamaged.
 - a. At fire-protection-rated openings, install frames according to NFPA 80.
 - b. Where frames are fabricated in sections because of shipping or handling limitations, field splice at approved locations by welding face joint continuously; grind, fill, dress, and make splice smooth, flush, and invisible on exposed faces.
 - c. Install frames with removable glazing stops located on secure side of opening.
 - d. Install door silencers in frames before grouting.
 - e. Remove temporary braces necessary for installation only after frames have been properly set and secured.
 - f. Check plumbness, squareness, and twist of frames as walls are constructed. Shim as necessary to comply with installation tolerances.
 - g. Field apply bituminous coating to backs of frames that are filled with grout containing antifreezing agents.
 2. Floor Anchors: Provide floor anchors for each jamb and mullion that extends to floor, and secure with postinstalled expansion anchors.
 - a. Floor anchors may be set with powder-actuated fasteners instead of postinstalled expansion anchors if so indicated and approved on Shop Drawings.
 3. Masonry Walls: Coordinate installation of frames to allow for solidly filling space between frames and masonry with grout.

4. Concrete Walls: Solidly fill space between frames and concrete with grout. Take precautions, including bracing frames, to ensure that frames are not deformed or damaged by grout forces.
 5. In-Place Concrete or Masonry Construction: Secure frames in place with postinstalled expansion anchors. Countersink anchors, and fill and make smooth, flush, and invisible on exposed faces.
 6. Ceiling Struts: Extend struts vertically from top of frame at each jamb to overhead structural supports or substrates above frame unless frame is anchored to masonry or to other structural support at each jamb. Bend top of struts to provide flush contact for securing to supporting construction. Provide adjustable wedged or bolted anchorage to frame jamb members.
 7. Installation Tolerances: Adjust hollow metal door frames for squareness, alignment, twist, and plumb to the following tolerances:
 - a. Squareness: Plus or minus 1/16 inch, measured at door rabbet on a line 90 degrees from jamb perpendicular to frame head.
 - b. Alignment: Plus or minus 1/16 inch, measured at jambs on a horizontal line parallel to plane of wall.
 - c. Twist: Plus or minus 1/16 inch, measured at opposite face corners of jambs on parallel lines, and perpendicular to plane of wall.
 - d. Plumbness: Plus or minus 1/16 inch, measured at jambs at floor.
- C. Hollow Metal Doors: Fit hollow metal doors accurately in frames, within clearances specified below. Shim as necessary.
1. Non-Fire-Rated Standard Steel Doors:
 - a. Jambs and Head: 1/8 inch plus or minus 1/16 inch.
 - b. Between Edges of Pairs of Doors: 1/8 inch plus or minus 1/16 inch.
 - c. Between Bottom of Door and Top of Threshold: Maximum 3/8 inch.
 - d. Between Bottom of Door and Top of Finish Floor (No Threshold): Maximum 3/4 inch.
 2. Fire-Rated Doors: Install doors with clearances according to NFPA 80.
 3. Smoke-Control Doors: Install doors according to NFPA 105.
- D. Glazing: Comply with installation requirements in Division 08 Section "Glazing" and with hollow metal manufacturer's written instructions.
1. Secure stops with countersunk flat- or oval-head machine screws spaced uniformly not more than 9 inches o.c. and not more than 2 inches o.c. from each corner.

3.4 ADJUSTING AND CLEANING

- A. Final Adjustments: Check and readjust operating hardware items immediately before final inspection. Leave work in complete and proper operating condition. Remove and replace defective work, including hollow metal work that is warped, bowed, or otherwise unacceptable.

- B. Remove grout and other bonding material from hollow metal work immediately after installation.
- C. Prime-Coat Touchup: Immediately after erection, sand smooth rusted or damaged areas of prime coat and apply touchup of compatible air-drying, rust-inhibitive primer.
- D. Metallic-Coated Surfaces: Clean abraded areas and repair with galvanizing repair paint according to manufacturer's written instructions.

END OF SECTION 081113

SECTION 081416

FLUSH WOOD DOORS

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

- A. 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:

- 1. Solid-core doors with wood-veneer faces.
- 2. Factory finishing flush wood doors.
- 3. Factory fitting flush wood doors to frames and factory machining for hardware.
- 4. Factory glazing.

1.3 SUBMITTALS

- A. Product Data: For each type of door indicated. Include details of core and edge construction and trim for openings. Include factory-finishing specifications.
- B. Shop Drawings: Indicate location, size, and hand of each door; elevation of each kind of door; construction details not covered in Product Data; location and extent of hardware blocking; and other pertinent data.
 - 1. Indicate dimensions and locations of mortises and holes for hardware.
 - 2. Indicate dimensions and locations of cutouts.
 - 3. Indicate requirements for veneer matching.
 - 4. Indicate doors to be factory finished and finish requirements.
 - 5. Indicate fire-protection ratings for fire-rated doors.
- C. Samples for Verification:
 - 1. Factory finishes applied to actual door face materials, approximately 8 by 10 inches, for each material and finish. For each wood species and transparent finish, provide set of three samples showing typical range of color and grain to be expected in the finished work.
- D. Warranty: Sample of special warranty.

1.4 QUALITY ASSURANCE

- A. Source Limitations: Obtain flush wood doors from single manufacturer.
- B. Quality Standard: In addition to requirements specified, comply with AWI's "Architectural Woodwork Quality Standards Illustrated."
- C. Fire-Rated Wood Doors: Doors complying with NFPA 80 that are listed and labeled by a qualified testing agency, for fire-protection ratings indicated, based on testing at as close to neutral pressure as possible according to UL 10B.
 - 1. Oversize Fire-Rated Door Assemblies: For units exceeding sizes of tested assemblies, provide certification by a qualified testing agency that doors comply with standard construction requirements for tested and labeled fire-rated door assemblies except for size.
- D. Preinstallation Conference: Conduct conference at Project site.
 - 1. Inspect and discuss condition of substrate and other preparatory work performed by other trades.

1.5 DELIVERY, STORAGE, AND HANDLING

- A. Comply with requirements of referenced standard and manufacturer's written instructions.
- B. Package doors individually in plastic bags or cardboard cartons.
- C. Mark each door on bottom rail with opening number used on Shop Drawings.

1.6 PROJECT CONDITIONS

- A. Environmental Limitations: Do not deliver or install doors until spaces are enclosed and weathertight, wet work in spaces is complete and dry, and HVAC system is operating and maintaining ambient temperature and humidity conditions at occupancy levels during the remainder of the construction period.

1.7 WARRANTY

- A. Special Warranty: Manufacturer's standard form in which manufacturer agrees to repair or replace doors that fail in materials or workmanship within specified warranty period.
 - 1. Failures include, but are not limited to, the following:
 - a. Warping (bow, cup, or twist) more than 1/4 inch in a 42-by-84-inch section.
 - b. Telegraphing of core construction in face veneers exceeding 0.01 inch in a 3-inch span.

2. Warranty shall also include installation and finishing that may be required due to repair or replacement of defective doors.
3. Warranty Period for Solid-Core Interior Doors: Life of installation.

PART 2 - PRODUCTS

2.1 MANUFACTURERS

- A. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
 1. Algoma Hardwoods, Inc.
 2. Eggers Industries.
 3. Marshfield Door Systems, Inc.
 4. Mohawk Flush Doors, Inc.; a Masonite company.
 5. VT Industries Inc.

2.2 DOOR CONSTRUCTION, GENERAL

- A. WDMA I.S.1-A Performance Grade: Extra Heavy Duty.
- B. Particleboard-Core Doors:
 1. Particleboard: ANSI A208.1, Grade LD-1.
 2. Blocking: Provide wood blocking in particleboard-core doors as needed to eliminate through-bolting hardware.
- C. Structural-Composite-Lumber-Core Doors:
 1. Structural Composite Lumber: WDMA I.S.10.
 - a. Screw Withdrawal, Face: 700 lbf.
 - b. Screw Withdrawal, Edge: 400 lbf.
 2. Provide doors with structural-composite-lumber cores instead of particleboard cores for the following doors:
 - a. Doors indicated to receive exit devices.
 - b. Doors where oversized glass lites exceed more than 40 percent of the door surface area.
 - c. Doors where louvers exceed more than 40 percent of the door surface area.
- D. Fire-Protection-Rated Doors: Provide core specified or mineral core as needed to provide fire-protection rating indicated.
 1. Edge Construction: Provide edge construction with intumescent seals concealed by outer stile. Comply with specified requirements for exposed edges.

E. Mineral-Core Doors:

1. Core: Noncombustible mineral product complying with requirements of referenced quality standard and testing and inspecting agency for fire-protection rating indicated.
2. Blocking: Provide composite blocking with improved screw-holding capability approved for use in doors of fire-protection ratings indicated as needed to eliminate through-bolting hardware.
3. Edge Construction: At hinge stiles, provide laminated-edge construction with improved screw-holding capability and split resistance. Comply with specified requirements for exposed edges.

2.3 VENEERED-FACED DOORS FOR TRANSPARENT FINISH

A. Interior Solid-Core Doors:

1. Grade: Premium, with Grade A faces.
2. Species: Match existing.
3. Cut: Plain sliced (flat sliced).
4. Match between Veneer Leaves: Slip match.
5. Assembly of Veneer Leaves on Door Faces: Running match.
6. Pair and Set Match: Provide for doors hung in same opening.
7. Exposed Vertical Edges: Same species as faces.
8. Core: Particleboard except where structural composite lumber is required.
9. Construction: Five plies. Stiles and rails are bonded to core, then entire unit abrasive planed before veneering.

2.4 LIGHT FRAMES

A. Wood Beads for Light Openings in Wood Doors: Provide manufacturer's standard wood beads as follows unless otherwise indicated.

1. Wood Species: Same species as door faces.
2. Profile: Lipped tapered beads.
3. At wood-core doors with 20-minute fire-protection ratings, provide wood beads and metal glazing clips approved for such use.

B. Wood-Veneered Beads for Light Openings in Fire-Rated Doors: Manufacturer's standard wood-veneered noncombustible beads matching veneer species of door faces and approved for use in doors of fire-protection rating indicated. Include concealed metal glazing clips where required for opening size and fire-protection rating indicated.

2.5 FABRICATION

A. Factory fit doors to suit frame-opening sizes indicated. Comply with clearance requirements of referenced quality standard for fitting unless otherwise indicated.

1. Comply with requirements in NFPA 80 for fire-rated doors.

- B. Factory machine doors for hardware that is not surface applied. Locate hardware to comply with DHI-WDHS-3. Comply with final hardware schedules, door frame Shop Drawings, DHI A115-W series standards, and hardware templates.
 - 1. Coordinate with hardware mortises in metal frames to verify dimensions and alignment before factory machining.
 - 2. Metal Astragals: Factory machine astragals and formed-steel edges for hardware for pairs of fire-rated doors.
- C. Openings: Cut and trim openings through doors in factory.
 - 1. Light Openings: Trim openings with moldings of material and profile indicated.
 - 2. Glazing: Factory install glazing in doors indicated to be factory finished. Comply with applicable requirements in Division 08 Section "Glazing."
- D. Factory Glazing: Provide glazing for all doors. Provide glass as specified in Division 08 Section "Glazing." Install fire-rated glass as required by the glazing manufacturer.

2.6 FACTORY FINISHING

- A. General: Comply with referenced quality standard for factory finishing. Complete fabrication, including fitting doors for openings and machining for hardware that is not surface applied, before finishing.
 - 1. Finish faces, all four edges, edges of cutouts, and mortises. Stains and fillers may be omitted on bottom edges, edges of cutouts, and mortises.
- B. Finish doors at factory.
- C. Transparent Finish:
 - 1. Grade: Premium.
 - 2. Finish: WDMA TR-4 conversion varnish or TR-6 catalyzed polyurethane.
 - 3. Staining: None required.
 - 4. Effect: Open-grain finish.
 - 5. Sheen: Satin.

PART 3 - EXECUTION

3.1 EXAMINATION

- A. Examine doors and installed door frames before hanging doors.
 - 1. Verify that frames comply with indicated requirements for type, size, location, and swing characteristics and have been installed with level heads and plumb jambs.
 - 2. Reject doors with defects.

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

3.2 INSTALLATION

- A. Hardware: For installation, see Division 08 Section "Door Hardware."
- B. Installation Instructions: Install doors to comply with manufacturer's written instructions and the referenced quality standard, and as indicated.
 - 1. Install fire-rated doors in corresponding fire-rated frames according to NFPA 80.
- C. Factory-Fitted Doors: Align in frames for uniform clearance at each edge.
- D. Factory-Finished Doors: Restore finish before installation if fitting or machining is required at Project site.

3.3 ADJUSTING

- A. Operation: Rehang or replace doors that do not swing or operate freely.
- B. Finished Doors: Replace doors that are damaged or that do not comply with requirements. Doors may be repaired or refinished if work complies with requirements and shows no evidence of repair or refinishing.

END OF SECTION 081416

SECTION 083113

ACCESS DOORS AND FRAMES

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

- A. 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. Access doors and frames for walls and ceilings.
- B. Related Sections include the following:
 - 1. Division 23 Section "Air Duct Accessories" for heating and air-conditioning duct access doors.

1.3 SUBMITTALS

- A. Product Data: For each type of access door and frame indicated. Include construction details, materials, individual components and profiles, and finishes.
- B. Shop Drawings: Show fabrication and installation details of access doors and frames for each type of substrate. Include plans, elevations, sections, details, and attachments to other work.
- C. Samples: For each door face material, at least 3 by 5 inches in size, in specified finish.
- D. Access Door and Frame Schedule: Provide complete access door and frame schedule, including types, locations, sizes, latching or locking provisions, and other data pertinent to installation.

1.4 QUALITY ASSURANCE

- A. Source Limitations: Obtain access doors and frames through one source from a single manufacturer.
- B. Size Variations: Obtain Architect's acceptance of manufacturer's standard-size units, which may vary slightly from sizes indicated.

1.5 COORDINATION

- A. Verification: Determine specific locations and sizes for access doors needed to gain access to concealed plumbing, mechanical, or other concealed work, and indicate in the schedule specified in "Submittals" Article.

PART 2 - PRODUCTS

2.1 STEEL MATERIALS

- A. Steel Plates, Shapes, and Bars: ASTM A 36/A 36M.
- B. Steel Sheet: Uncoated cold-rolled steel sheet substrate complying with ASTM A 1008/A 1008M, Commercial Steel (CS), exposed.
- C. Steel Finishes: Comply with NAAMM's "Metal Finishes Manual for Architectural and Metal Products" for recommendations for applying and designating finishes.
1. Surface Preparation for Steel Sheet: Clean surfaces to comply with SSPC-SP 1, "Solvent Cleaning," to remove dirt, oil, grease, or other contaminants that could impair paint bond. Remove mill scale and rust, if present, from uncoated steel, complying with SSPC-SP 5/NACE No. 1, "White Metal Blast Cleaning," or SSPC-SP 8, "Pickling."
 2. Factory-Primed Finish: Apply shop primer immediately after cleaning and pretreating.

2.2 ACCESS DOORS AND FRAMES FOR WALLS AND CEILINGS

- 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:
1. Acudor Products, Inc.
 2. Babcock-Davis; A Cierra Products Co.
 3. Bar-Co, Inc. Div.; Alfab, Inc.
 4. Dur-Red Products.
 5. J. L. Industries, Inc.
 6. Karp Associates, Inc.
 7. Larsen's Manufacturing Company.
 8. Milcor Inc.
 9. Nystrom, Inc.
 10. Williams Bros. Corporation of America (The).
- B. Flush Access Doors and Frames with Exposed Trim: Fabricated from steel sheet.
1. Locations: Wall and ceiling surfaces.
 2. Door: Minimum 0.060-inch- thick sheet metal, set flush with exposed face flange of frame.
 3. Frame: Minimum 0.060-inch- thick sheet metal with 1-1/4-inch- wide, surface-mounted trim.

4. Hinges: Continuous piano.
5. Latch: Cam latch operated by screwdriver with interior release.

2.3 FABRICATION

- A. General: Provide access door and frame assemblies manufactured as integral units ready for installation.
- B. Metal Surfaces: For metal surfaces exposed to view in the completed Work, provide materials with smooth, flat surfaces without blemishes. Do not use materials with exposed pitting, seam marks, roller marks, rolled trade names, or roughness.
- C. Doors and Frames: Grind exposed welds smooth and flush with adjacent surfaces. Furnish attachment devices and fasteners of type required to secure access panels to types of supports indicated.
 1. Exposed Flanges: Nominal 1 to 1-1/2 inches wide around perimeter of frame.
 2. Provide mounting holes in frames for attachment of units to metal framing.
- D. Latching Mechanisms: Furnish number required to hold doors in flush, smooth plane when closed.

PART 3 - EXECUTION

3.1 INSTALLATION

- A. Comply with manufacturer's written instructions for installing access doors and frames.
- B. Set frames accurately in position and attach securely to supports with plane of face panels aligned with adjacent finish surfaces.
- C. Install doors flush with adjacent finish surfaces or recessed to receive finish material.

3.2 ADJUSTING AND CLEANING

- A. Adjust doors and hardware after installation for proper operation.
- B. Remove and replace doors and frames that are warped, bowed, or otherwise damaged.

END OF SECTION 083113

SECTION 084243

ICU/CCU ENTRANCES

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

- A. 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:

- 1. Interior, sliding, Intensive Care Unit/Critical Care Unit entrances.

- B. Related Sections:

- 1. Division 08 Section "Automatic Entrances" for automatic entrances.

1.3 DEFINITIONS

- A. AAADM: American Association of Automatic Door Manufacturers.

- B. IBC: International Building Code.

1.4 PERFORMANCE REQUIREMENTS

- A. Opening-Force Requirements:

- 1. Breakaway Device for Doors: Not more than 50 lbf required for a breakaway door or panel to open.

- 2. Accessible Interior Doors: Not more than 5 lbf to fully open door.

1.5 SUBMITTALS

- A. Product Data: For each type of product indicated. Include construction details, material descriptions, dimensions of individual components and profiles, and finishes for entrances.

- B. Shop Drawings: For automatic entrances. Include plans, elevations, sections, details, hardware mounting heights, and attachments to other work.

1. Include hardware schedule and indicate hardware types, functions, quantities, and locations.
- C. Samples for Verification: For each type of exposed finish required, in manufacturer's standard sizes.
- D. Product Certificates: For each type of emergency-exit entrance, from manufacturer.
- E. Product Test Reports: Based on evaluation of comprehensive tests performed by a qualified testing agency, for automatic entrances.
- F. Maintenance Data: For automatic entrances, safety devices, and control systems to include in maintenance manuals.
- G. Warranties: Sample of special warranties.

1.6 QUALITY ASSURANCE

- A. Manufacturer Qualifications: A manufacturer with company certificate issued by AAADM.
- B. Installer Qualifications: Manufacturer's authorized representative who is trained and approved for installation and maintenance of units required for this Project.
 1. Maintenance Proximity: Not more than two hours' normal travel time from Installer's place of business to Project site.
- C. Source Limitations for ICU Entrances: Obtain entrances from single source from single manufacturer.
- D. Emergency-Exit Door Requirements: Comply with requirements of authorities having jurisdiction for automatic entrances serving as a required means of egress.

1.7 PROJECT CONDITIONS

- A. Field Measurements: Verify actual dimensions of openings to receive automatic entrances by field measurements before fabrication.

1.8 COORDINATION

- A. Templates: Obtain templates for doors, frames, and other work specified to be factory prepared for installing entrances, and distribute to parties involved. Check Shop Drawings of other work to confirm that adequate provisions are made for locating and installing automatic entrances to comply with indicated requirements.
- B. Coordinate hardware with doors, frames, and related work to ensure proper size, thickness, hand, function, and finish. Coordinate hardware for entrances with hardware required for rest of Project.

1.9 WARRANTY

- A. Special Warranty: Manufacturer's standard form in which manufacturer agrees to repair or replace components of automatic entrances that fail in materials or workmanship within specified warranty period.
1. Failures include, but are not limited to, the following:
 - a. Structural failures including, but not limited to, excessive deflection.
 - b. Faulty operation of operators, controls, and hardware.
 - c. Deterioration of metals, metal finishes, and other materials beyond normal weathering and use.
 2. Warranty Period: Two years from date of Substantial Completion.
- B. Special Finish Warranty: Manufacturer's standard form in which manufacturer agrees to repair or replace components that show evidence of deterioration of factory-applied finishes within specified warranty period.
1. 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. Warranty Period: 20 years from date of Substantial Completion.

PART 2 - PRODUCTS

2.1 MATERIALS

- A. Aluminum: Alloy and temper recommended by manufacturer for type of use and finish indicated.
1. Extruded Bars, Rods, Profiles, and Tubes: ASTM B 221.
 2. Sheet and Plate: ASTM B 209.
- B. Steel Reinforcement: With manufacturer's standard corrosion-resistant primer complying with SSPC-PS Guide No. 12.00 applied immediately after surface preparation and pretreatment. Select surface preparation methods according to recommendations in SSPC-SP COM and prepare surfaces according to applicable SSPC standard.
1. Structural Shapes, Plates, and Bars: ASTM A 36/A 36M.
 2. Cold-Rolled Sheet and Strip: ASTM A 1008/A 1008M.
 3. Hot-Rolled Sheet and Strip: ASTM A 1011/A 1011M.
- C. Stainless-Steel Bars: ASTM A 276 or ASTM A 666, Type 304.

- D. Stainless-Steel Tubing: ASTM A 554, Grade MT 304.
- E. Stainless-Steel Sheet: ASTM A 240/A 240M or ASTM A 666, Type 304, stretcher-leveled standard of flatness, in entrance manufacturer's standard thickness.
- F. Glazing: As specified in Division 08 Section "Glazing."
- G. Sealants and Joint Fillers: As specified in Division 07 Section "Joint Sealants."
- H. Nonmetallic, Shrinkage-Resistant Grout: Premixed, nonmetallic, noncorrosive, nonstaining grout; complying with ASTM C 1107; of consistency suitable for application.
- I. Bituminous Paint: Cold-applied, asphalt-mastic paint complying with SSPC-Paint 12 requirements, except containing no asbestos; formulated for 30-mil thickness per coat.
- J. Fasteners and Accessories: Manufacturer's standard corrosion-resistant, nonstaining, nonbleeding fasteners and accessories compatible with adjacent materials.

2.2 SLIDING ICU ENTRANCES

- A. General: Provide manufacturer's standard sliding entrances including doors, framing, headers, carrier assemblies, roller tracks, and accessories required for a complete installation.
- B. Sliding ICU Entrance: Subject to compliance with requirements, provide products by one of the following:
 - 1. Configuration: Units with single-sliding door, with one operable leaf and sidelite and units with two sliding doors and one sidelite.
 - a. Emergency Breakaway Capability: Sliding leaves and sidelite.
 - 2. Mounting: Between jambs.
 - 3. Floor Track Configuration: Trackless across door opening and at sidelites.
 - 4. Smoke Rating: Doors must resist passage of smoke, provide positive latching mechanism.
 - 5. Finish: Finish framing, door(s) and header with high-performance organic finish (2-coat fluoropolymer).
 - 6. Color: As selected by Architect from full range of industry colors and color densities.

2.3 ENTRANCE COMPONENTS

- A. Framing Members: Manufacturer's standard extruded aluminum, minimum 0.125 inch thick and reinforced as required to support imposed loads.
 - 1. Nominal Size: 1-3/4 by 4-1/2 inches.
 - 2. Extruded Glazing Stops and Applied Trim: Minimum 0.062-inch wall thickness.

- B. Stile and Rail Doors: Manufacturer's standard 1-3/4-inch- thick, glazed doors with minimum 0.125-inch- thick, extruded-aluminum tubular stile and rail members. Mechanically fasten corners with reinforcing brackets that are welded, or incorporate concealed tie-rods that span full length of top and bottom rails.
 - 1. Glazing Stops and Gaskets: Square, snap-on, extruded-aluminum stops and manufacturer's standard preformed gaskets.
 - 2. Stile Design: Medium stile, 3-1/2-inch nominal width.
 - 3. Rail Design: 5-inch nominal height.
 - 4. Slide-swing panels shall include intermediate horizontal rail.
 - 5. Muntin Bars: Horizontal tubular rail member for each door; match stile design and finish.

- C. Sidelite: Manufacturer's standard 1-3/4-inch- deep sidelite with minimum 0.125-inch- thick, extruded-aluminum tubular stile and rail members matching door design and finish.
 - 1. Glazing Stops and Gaskets: Same materials and design as for stile and rail door.
 - 2. Glazing Stops and Gaskets: Square, snap-on, extruded-aluminum stops and manufacturer's standard preformed gaskets.
 - 3. Muntin Bars: Horizontal tubular rail members for each sidelite; match stile design.

- D. Headers: Fabricated from minimum 0.125-inch- thick, extruded aluminum and extending full width of automatic entrance units to conceal door operators and controls. Provide hinged or removable access panels for service and adjustment of door operators and controls. Secure panels to prevent unauthorized access.
 - 1. Mounting: Concealed, with one side of header flush with framing.
 - 2. Capacity: Capable of supporting doors up to 156lbs. without intermediate supports.

- E. Brackets and Reinforcements: Manufacturer's standard high-strength aluminum with nonstaining, nonferrous shims for aligning system components.

2.4 HARDWARE

- A. General: Provide units in sizes and types recommended by automatic entrance and hardware manufacturers for entrances and uses indicated. Finish exposed parts to match door finish.

- B. Positive latching shall be provided as follows:
 - 1. The slide swing panel shall be provided with positive latch that will latch this panel in place when closed. A lever handle shall be provided on each side of the sliding panel to unlock the door. The swing out sidelite shall be provided with positive latch that will latch this panel in place when closed. A lever handle shall be provided on exterior side of sidelite to unlock the panel.

- C. Thresholds: No threshold required "Trackless."

- D. Electrical Grounding: Electrical ground connection shall be provided at all SX panels.

2.5 FABRICATION

- A. General: Factory fabricate automatic entrance components to designs, sizes, and thicknesses indicated and to comply with indicated standards.
 - 1. Form aluminum shapes before finishing.
 - 2. Weld in concealed locations to greatest extent possible to minimize distortion or discoloration of finish. Remove weld spatter and welding oxides from exposed surfaces by descaling or grinding.
 - 3. Use concealed fasteners to greatest extent possible. Where exposed fasteners are required, use countersunk Phillips flat-head machine screws, finished to match framing, fabricated from stainless steel.
 - a. Where fasteners are subject to loosening or turning out from thermal and structural movements, wind loads, or vibration, use self-locking devices.
 - b. Reinforce members as required to receive fastener threads.
 - 4. Where aluminum will contact dissimilar metals, protect against galvanic action by painting contact surfaces with primer or by applying sealant or tape recommended by manufacturer for this purpose.
- B. Framing: Provide ICU entrances as prefabricated assemblies. Complete fabrication, assembly, finishing, hardware application, and other work before shipment to Project site.
 - 1. Fabricate tubular and channel frame assemblies with manufacturer's standard welded or mechanical joints. Provide subframes and reinforcement as required for a complete system to support required loads.
 - 2. Perform fabrication operations in manner that prevents damage to exposed finish surfaces.
 - 3. Form profiles that are sharp, straight, and free of defects or deformations.
 - 4. Provide components with concealed fasteners and anchor and connection devices.
 - 5. Fabricate components with accurately fitted joints with ends coped or mitered to produce hairline joints free of burrs and distortion.
 - 6. Fabricate exterior components to drain water passing joints and condensation and moisture occurring or migrating within system to the exterior.
 - 7. Provide anchorage and alignment brackets for concealed support of assembly from building structure.
- C. Doors: Factory fabricated and assembled in profiles indicated. Reinforce as required to support imposed loads and for installing hardware.
- D. Glazing: Fabricate framing with minimum glazing edge clearances for thickness and type of glazing indicated, according to GANA's "Glazing Manual."
- E. Hardware: Factory install hardware to greatest extent possible; remove only as required for final finishing operation and for delivery to and installation at Project site. Cut, drill, and tap for factory-installed hardware before applying finishes.

2.6 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 from damage by applying a strippable, temporary protective covering before shipping.
- C. Apply organic and anodic finishes to formed metal after fabrication unless otherwise indicated.
- 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.

2.7 ALUMINUM FINISHES

- A. Clear Anodic Finish: AAMA 611, AA-M12C22A31, Class II, 0.010 mm or thicker.

PART 3 - EXECUTION

3.1 EXAMINATION

- A. Examine conditions, with Installer present, for compliance with requirements for installation tolerances, header support, and other conditions affecting performance of automatic entrances.
- B. Proceed with installation only after unsatisfactory conditions have been corrected.

3.2 INSTALLATION

- A. General: Do not install damaged components. Fit frame joints to produce hairline joints free of burrs and distortion. Rigidly secure nonmovement joints. Seal joints watertight.
 - 1. Where aluminum will contact dissimilar metals, protect against galvanic action by painting contact surfaces with primer or by applying sealant or tape recommended by manufacturer for this purpose.
 - 2. Where aluminum will contact concrete or masonry, protect against corrosion by painting contact surfaces with bituminous paint.
- B. Entrances: Install ICU entrances plumb and true in alignment with established lines and grades without warp or rack of framing members and doors. Anchor securely in place.
 - 1. Install surface-mounted hardware using concealed fasteners to greatest extent possible.
 - 2. Set headers, carrier assemblies, tracks, operating brackets, and guides level and true to location with anchorage for permanent support.
- C. Glazing: Install glazing as specified in Division 08 Section "Glazing."

- D. Sealants: Comply with requirements specified in Division 07 Section "Joint Sealants".
 - 1. Seal perimeter of framing members with sealant.

3.3 ADJUSTING

- A. Adjust door operators, controls, and hardware for smooth and safe operation.
- B. Lubricate operating hardware and other moving parts as recommended by manufacturer.

3.4 CLEANING AND PROTECTION

- A. Clean glass and metal surfaces promptly after installation. Remove excess glazing and sealant compounds, dirt, and other substances. Repair damaged finish to match original finish.
 - 1. Comply with requirements in Division 08 Section "Glazing" for cleaning and maintaining glass.

3.5 DEMONSTRATION

- A. Engage a certified inspector to train Owner's maintenance personnel to adjust, operate, and maintain automatic entrances.

3.6 SCHEDULE

- A. Provide manual ICU doors with breakout panels for No. R2133.

END OF SECTION 084243

SECTION 087100

DOOR HARDWARE

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

- A. 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. Commercial door hardware for the following:
 - a. Swinging doors.
 - b. Other doors to the extent indicated.
2. Cylinders for doors specified in other Sections.
3. Electrified door hardware.

- B. Related Sections include the following:

1. Division 08 Section "Hollow Metal Doors and Frames" for door silencers provided as part of hollow-metal frames.
2. Division 08 Section "Flush Wood Doors" for integral intumescent seals provided as part of fire-rated labeled assemblies.
3. Division 08 Section "Overhead Coiling Doors" for door hardware provided as part of overhead door assemblies.
4. Division 08 Section "Intensive Care Unit/Critical Care Unit (ICU/CCU) Entrances" for entrance door hardware, except cylinders.
5. Division 26 Sections for connections to electrical power system and for low-voltage wiring work.
6. Division 28 Section "Access Control" for access control devices installed at door openings and provided as part of a security access system.
7. Division 28 Section "Fire Detection and Alarm" for connections to building fire alarm system.

- C. Products installed, but not furnished, under this Section include the following. Coordinating, and scheduling remain requirements of this Section.

1. Cylinders for locks specified in other Sections.
2. Permanent cores to be installed by Owner.
3. Selected door hardware as indicated in this section.

1.3 SUBMITTALS

- A. Product Data: Include construction and installation details, material descriptions, dimensions of individual components and profiles, and finishes.
- B. Shop Drawings: Details of electrified door hardware, indicating the following:
 - 1. Wiring Diagrams: Power, signal, and control wiring. Include the following:
 - a. System schematic.
 - b. Point-to-point wiring diagram.
 - c. Riser diagram.
 - d. Elevation of each door.
 - 2. Detail interface between electrified door hardware and fire alarm, access control, and security system.
 - 3. Operation Narrative: Describe the operation of doors controlled by electrified door hardware.
- C. Samples for Verification: Submit minimum 2-by-4-inch plate Samples of each type of finish required, except primed finish.
- D. Samples for Verification: For exposed door hardware of each type, in specified finish, full size. Tag with full description for coordination with the door hardware sets. Submit Samples before, or concurrent with, submission of the final door hardware sets.
 - 1. Samples will be returned to Contractor. Units that are acceptable and remain undamaged through submittal, review, and field comparison process may, after final check of operation, be incorporated into the Work, within limitations of keying requirements.
- E. Product Certificates: For electrified door hardware, signed by product manufacturer.
 - 1. Certify that door hardware approved for use on types and sizes of labeled fire doors complies with listed fire door assemblies.
- F. Product Test Reports: Based on evaluation of comprehensive tests performed by manufacturer and witnessed by a qualified testing agency, for locks, latches and closers.
- G. Maintenance Data: For each type of door hardware to include in maintenance manuals.
- H. Warranty: Special warranty specified in this Section.
- I. Other Action Submittals:
 - 1. Door Hardware Sets: Prepared by or under the supervision of Architectural Hardware Consultant, detailing fabrication and assembly of door hardware, as well as procedures and diagrams. Coordinate the final door hardware sets with doors, frames, and related work to ensure proper size, thickness, hand, function, and finish of door hardware.

- a. Format: Comply with scheduling sequence and vertical format in DHI's "Sequence and Format for the Hardware Schedule." Double space entries, and number and date each page.
 - b. Format: Use same scheduling sequence and format and use same door numbers as in the Contract Documents.
 - c. Content: Include the following information:
 - 1) Identification number, location, hand, fire rating, and material of each door and frame.
 - 2) Type, style, function, size, quantity, and finish of each door hardware item. Include description and function of each lockset and exit device.
 - 3) Complete designations of every item required for each door or opening including name and manufacturer.
 - 4) Fastenings and other pertinent information.
 - 5) Location of each door hardware set, cross-referenced to Drawings, both on floor plans and in door and frame schedule.
 - 6) Explanation of abbreviations, symbols, and codes contained in schedule.
 - 7) Mounting locations for door hardware.
 - 8) Door and frame sizes and materials.
 - 9) Description of each electrified door hardware function, including location, sequence of operation, and interface with other building control systems.
 - a) Sequence of Operation: Include description of component functions that occur in the following situations: authorized person wants to enter; authorized person wants to exit; unauthorized person wants to enter; unauthorized person wants to exit.
 - 10) List of related door devices specified in other Sections for each door and frame.
 - d. Submittal Sequence: Submit the final door hardware sets at earliest possible date, particularly where approval of the door hardware sets must precede fabrication of other work that is critical in Project construction schedule. Include Product Data, Samples, Shop Drawings of other work affected by door hardware, and other information essential to the coordinated review of the door hardware sets.
 - e. Submittal Sequence: Submit initial draft of final schedule along with essential Product Data to facilitate the fabrication of other work that is critical in Project construction schedule. Submit the final door hardware sets after Samples, Product Data, coordination with Shop Drawings of other work, delivery schedules, and similar information has been completed and accepted.
2. Keying Schedule: Prepared by or under the supervision of Architectural Hardware Consultant, detailing Owner's final keying instructions for locks. Include schematic keying diagram and index each key set to unique door designations.

1.4 QUALITY ASSURANCE

- A. Installer Qualifications: An experienced installer who has completed door hardware similar in material, design, and extent to that indicated for this Project and whose work has resulted in construction with a record of successful in-service performance.
- B. Architectural Hardware Consultant Qualifications: A person who is currently certified by DHI as an Architectural Hardware Consultant and who is experienced in providing consulting services for door hardware installations that are comparable in material, design, and extent to that indicated for this Project.
 - 1. Electrified Door Hardware Consultant Qualifications: A qualified Architectural Hardware Consultant who is experienced in providing consulting services for electrified door hardware installations.
- C. Source Limitations: Obtain each type and variety of door hardware from a single manufacturer, unless otherwise indicated.
 - 1. Provide electrified door hardware from same manufacturer as mechanical door hardware, unless otherwise indicated. Manufacturers that perform electrical modifications and that are listed by a testing and inspecting agency acceptable to authorities having jurisdiction are acceptable.
- D. Regulatory Requirements: Comply with provisions of the following:
 - 1. Where indicated to comply with accessibility requirements, comply with Americans with Disabilities Act (ADA), "Accessibility Guidelines for Buildings and Facilities (ADAAG)," as follows:
 - a. Handles, Pulls, Latches, Locks, and other Operating Devices: Shape that is easy to grasp with one hand and does not require tight grasping, tight pinching, or twisting of the wrist.
 - b. Door Closers: Comply with the following maximum opening-force requirements indicated:
 - 1) Interior Hinged Doors: 5 lbf applied perpendicular to door.
 - 2) Fire Doors: Minimum opening force allowable by authorities having jurisdiction.
 - c. Thresholds: Not more than 1/2 inch high. Bevel raised thresholds with a slope of not more than 1:2.
- E. Fire-Rated Door Assemblies: Assemblies complying with NFPA 80 that are listed and labeled by a testing and inspecting agency acceptable to authorities having jurisdiction, for fire ratings indicated, based on testing according to NFPA 252.
 - 1. Test Pressure: After 5 minutes into the test, neutral pressure level in furnace shall be established at 40 inches or less above the sill.

- F. Electrified Door Hardware: Listed and labeled as defined in NFPA 70, Article 100, by a testing agency acceptable to authorities having jurisdiction, and marked for intended use.
- G. Keying Conference: Conduct conference at Project site to comply with requirements in Division 01 Section "Project Management and Coordination." In addition to Owner, Construction Manager, and Architect, conference participants shall also include Installer's Architectural Hardware Consultant and Owner's security consultant. Incorporate keying conference decisions into final keying schedule after reviewing door hardware keying system including, but not limited to, the following:
 - 1. Function of building, flow of traffic, purpose of each area, degree of security required, and plans for future expansion.
 - 2. Preliminary key system schematic diagram.
 - 3. Requirements for key control system.
 - 4. Address for delivery of keys.
- H. Pre-installation Conference: Conduct conference at Project site to comply with requirements in Division 01 Section "Project Management and Coordination." Review methods and procedures related to electrified door hardware including, but not limited to, the following:
 - 1. Inspect and discuss electrical roughing-in and other preparatory work performed by other trades.
 - 2. Review sequence of operation for each type of electrified door hardware.
 - 3. Review and finalize construction schedule and verify availability of materials, Installer's personnel, equipment, and facilities needed to make progress and avoid delays.
 - 4. Review required testing, inspecting, and certifying procedures.
 - 5. Review keying schedule and owner's requirements for keying.

1.5 DELIVERY, STORAGE, AND HANDLING

- A. Inventory door hardware on receipt and provide secure lock-up for door hardware delivered to Project site.
- B. Tag each item or package separately with identification related to the final door hardware sets, and include basic installation instructions, templates, and necessary fasteners with each item or package.
- C. Deliver blank keys and permanent cores to Owner by registered mail or overnight package service.
 - 1. Richard Saklad, Maine Medical Center, Portland, ME

1.6 COORDINATION

- A. Templates: Distribute door hardware templates for doors, frames, and other work specified to be factory prepared for installing door hardware. Check Shop Drawings of other work to confirm that adequate provisions are made for locating and installing door hardware to comply with indicated requirements.

- B. Electrical System Roughing-in: Coordinate layout and installation of electrified door hardware with connections to power supplies, fire alarm system and detection devices, access control system, and security system.
- C. Existing Openings: Where new hardware components are scheduled for application to existing construction or where modifications to existing door hardware are required, field verify existing conditions and coordinate installation of door hardware to suit opening conditions and to provide for proper operation.

1.7 WARRANTY

- A. Special Warranty: Manufacturer's standard form in which manufacturer agrees to repair or replace components of door hardware that fail in materials or workmanship within specified warranty period.
 - 1. Failures include, but are not limited to, the following:
 - a. Structural failures including excessive deflection, cracking, or breakage.
 - b. Faulty operation of operators and door hardware.
 - c. Deterioration of metals, metal finishes, and other materials beyond normal weathering and use.
 - 2. Warranty Period: One year from date of Substantial Completion, except as follows:
 - a. Electromagnetic Locks: Five years from date of Substantial Completion.
 - b. Exit Devices: Two years from date of Substantial Completion.
 - c. Manual Closers: 10 years from date of Substantial Completion.

1.8 MAINTENANCE SERVICE

- A. Maintenance Tools and Instructions: Furnish a complete set of specialized tools and maintenance instructions as needed for Owner's continued adjustment, maintenance, and removal and replacement of door hardware.
- B. Maintenance Service: Beginning at Substantial Completion, provide [six] <Insert number> months' full maintenance by skilled employees of door hardware Installer. Include quarterly preventive maintenance, repair or replacement of worn or defective components, lubrication, cleaning, and adjusting as required for proper door hardware operation. Provide parts and supplies same as those used in the manufacture and installation of original products.

PART 2 - PRODUCTS

2.1 SCHEDULED DOOR HARDWARE

- A. General: Provide door hardware for each door to comply with requirements in this Section and door hardware sets indicated in Part 3 "Door Hardware Sets" Article.

1. Door Hardware Sets: Provide quantity, item, size, finish or color indicated, and named manufacturers' products.
 2. Sequence of Operation: Provide electrified door hardware function, sequence of operation, and interface with other building control systems indicated.
- B. Designations: Requirements for design, grade, function, finish, size, and other distinctive qualities of each type of door hardware are indicated in Part 3 "Door Hardware Sets" Article. Products are identified by using door hardware designations, as follows:
1. Named Manufacturers' Products: Manufacturer and product designation are listed for each door hardware type required for the purpose of establishing minimum requirements. Manufacturers' names are abbreviated in Part 3 "Door Hardware Sets" Article.
 2. References to BHMA Standards: Provide products complying with these standards and requirements for description, quality, and function.
- C. In other Part 2 articles where titles below introduce lists, the following requirements apply to product selection:
1. Available Manufacturers: Subject to compliance with requirements, manufacturers offering products that may be incorporated into the Work include, but are not limited to, manufacturers specified.

2.2 HINGES, GENERAL

- A. Quantity: Provide the following, unless otherwise indicated:
1. Two Hinges: For doors with heights up to 60 inches.
 2. Three Hinges: For doors with heights 61 to 90 inches.
 3. Four Hinges: For doors with heights 91 to 120 inches.
 4. For doors with heights more than 120 inches, provide 4 hinges, plus 1 hinge for every 30 inches of door height greater than 120 inches.
- B. Template Requirements: Except for hinges and pivots to be installed entirely (both leaves) into wood doors and frames, provide only template-produced units.
- C. Hinge Weight: Unless otherwise indicated, provide the following:
1. Entrance Doors: Heavy-weight hinges.
 2. Doors with Closers: Antifriction-bearing hinges.
 3. Interior Doors: Standard-weight hinges.
- D. Hinge Base Metal: Unless otherwise indicated, provide the following:
1. Exterior Hinges: Stainless steel, with stainless-steel pin.
 2. Interior Hinges: Steel, with steel pin.
 3. Hinges for Fire-Rated Assemblies: Steel, with steel pin.
- E. Hinge Options: Where indicated in door hardware sets or on Drawings:

1. Nonremovable Pins: Provide set screw in hinge barrel that, when tightened into a groove in hinge pin, prevents removal of pin while door is closed; for outswinging exterior doors and outswinging corridor doors with locks.
 2. Corners: Square.
- F. Electrified Functions for Hinges: Comply with the following:
1. Power Transfer: Concealed PTFE-jacketed wires, secured at each leaf and continuous through hinge knuckle.
 2. Available Product: ETW 4-1/2 x 4-1/2 by Hager.
- G. Fasteners: Comply with the following:
1. Machine Screws: For metal doors and frames. Install into drilled and tapped holes.
 2. Wood Screws: For wood doors and frames.
 3. Threaded-to-the-Head Wood Screws: For fire-rated wood doors.
 4. Screws: Phillips flat-head; machine screws (drilled and tapped holes) for metal doors and wood screws for wood doors and frames. Finish screw heads to match surface of hinges.

2.3 HINGES

- A. Butts and Hinges: BHMA A156.1.
- B. Template Hinge Dimensions: BHMA A156.7.
- C. Available Manufacturers:
 1. Hager Companies (HAG).
 2. McKinney Products Company; an ASSA ABLOY Group company (MCK).
 3. Stanley Commercial Hardware; Div. of The Stanley Works (STH).
- D. The following is a guide for hinge size and type required for this project.

	Manufacturer	Interior:	Exterior
1-3/4" Doors up to 3'-0" wide	Stanley	FBB179-4 1/2"	FBB191-4 1/2"
	Hager	BB1279-4 1/2"	BB1191-4 1/2"
	McKinney	TA-TB2714-4 1/2"	TA-TB2314-4 1/2"
1-3/4" Doors over 3'-0" wide	Stanley	FBB168-4 1/2"	FBB199-4 1/2"
	Hager	BB1168-4 1/2"	BB1199-4 1/2"
	McKinney	T4A-T4B3786-4 1/2"	T4A-T4B3386-4 1/2"

2.4 LOCKS AND LATCHES, GENERAL

- A. Latches and Locks for Means of Egress Doors: Comply with NFPA 101. Latches shall not require more than 15 lbf to release the latch. Locks shall not require use of a key, tool, or special knowledge for operation.
- B. Electrified Locking Devices: BHMA A156.25.
- C. Lock Trim:
 - 1. Levers: Cast.
 - 2. Escutcheons (Roses): Forged.
 - 3. Dummy Trim: Match lever lock trim and escutcheons.
- D. Lock Throw: Comply with testing requirements for length of bolts required for labeled fire doors, and as follows:
 - 1. Bored Locks: Minimum 1/2-inch latchbolt throw.
 - 2. Deadbolts: Minimum 1-inch bolt throw.
- E. Rabbeted Meeting Doors: Provide special rabbeted front and strike on locksets for rabbeted meeting stiles.
- F. Backset: 2-3/4 inches, unless otherwise indicated.
- G. Strikes: Manufacturer's standard strike with strike box for each latchbolt or lock bolt, with curved lip extended to protect frame, finished to match door hardware set, and as follows:
 - 1. Strikes for Bored Locks and Latches: BHMA A156.2.
 - 2. Strikes for Auxiliary Deadlocks: BHMA A156.5.

2.5 BORED LOCKS AND LATCHES

- A. Bored Locks: BHMA Grade 1; Series 4000.
 - 1. Provide one of the following manufacturers and designs:
 - a. Best: 93K Series
 - b. Schlage: D Series
- B. Lock Trim: Comply with the following:
 - 1. Lockset Designs: Provide the lockset design designated below or, if sets are provided by another manufacturer, provide designs that match those designated:
 - a. Best: 15 C
 - b. Schlage: Rhodes
- C. Lock Functions: Lock functions as indicated in the hardware schedule shall be as follows:

FUNCTION	SCHLAGE	BEST
----------	---------	------

(1) (utility, storage)	80	D
(2) (office)	53	AB
(3) (passage)	10	N
(4) (classroom)	70	R
(5) (entrance)	60	C
(6) (privacy)	40	L

D. Auxiliary Locks: BHMA Grade 1.

1. Hospital Push Pull Lock: Provide the following manufacturer and design:
 - a. Architectural Builders Hardware: 6011 Series Push Pull Latch.

2.6 SELF-CONTAINED ELECTRONIC LOCKS

A. General: Internal, battery-powered, self-contained electronic locks; consisting of complete lockset, motor-driven lock mechanism, and actuating device; enclosed in zinc-dichromate-plated, wrought-steel case. Provide key override, low-battery detection and warning, LED status indicators, and ability to program at the lock; type and function indicated.

1. Type: Bored.
2. Actuating Device: Digital keypad.
3. Faceplate Material: Wrought brass or stainless steel.
4. Trim: Match trim specified for mechanical locks.

B. Accessory: Card encoder and software.

C. Manufacturer:

1. Schlage Commercial Lock Division; an Ingersoll-Rand Company (SCH).

D. Product:

1. Schlage Pro Series Programmable Lock.

2.7 INDICATOR DOOR BOLT:

A. Where door bolts are listed in the hardware set numbers, provide Schlage B571-626.

2.8 EXIT DEVICES

A. Manufacturers: Subject to compliance with requirements, provide products by one of the following:

1. Von Duprin; an Ingersoll-Rand Company (VD).

B. Products: All exit devices for this project shall be one of the following:

1. 94 INpact Series by Von Duprin Division.
 2. 98 Series by Von Duprin Division.
- C. Exit Devices: BHMA A156.3, Grade 1.
- D. Exit Devices for Means of Egress Doors: Comply with NFPA 101. Exit devices shall not require more than 15 lbf to release the latch. Locks shall not require use of a key, tool, or special knowledge for operation.
- E. Panic Exit Devices: Listed and labeled by a testing and inspecting agency acceptable to authorities having jurisdiction, for panic protection, based on testing according to UL 305.
- F. Fire Exit Devices: Devices complying with NFPA 80 that are listed and labeled by a testing and inspecting agency acceptable to authorities having jurisdiction, for fire and panic protection, based on testing according to UL 305 and NFPA 252.
- G. Outside Trim: Lever; material and finish to match locksets, unless otherwise indicated.
- H. Top and Bottom Strikes: Where vertical rod exit devices are indicated for interior doors, provide standard surface-mounted top strike only.
- I. The following functions shall be required where specified:

FUNCTION	VON DUPRIN
A	99L
B	9447L-F
C	EL9927L-F x LBR with auxiliary fire latch

2.9 LOCK CYLINDERS

- A. Standard Lock Cylinders: BHMA A156.5, Grade 1.
- B. Cylinders: Manufacturer's standard tumbler type, constructed from brass or bronze, stainless steel, or nickel silver, and complying with the following:
1. Number of Pins: Seven.
 2. Mortise Type: Threaded cylinders with rings and straight- or clover-type cam.
 3. Rim Type: Cylinders with back plate, flat-type vertical or horizontal tailpiece, and raised trim ring.
 4. Bored-Lock Type: Cylinders with tailpieces to suit locks.
- C. Permanent Cores: Manufacturer's standard; finish face to match lockset; complying with the following:
1. Interchangeable Cores: Core insert, removable by use of a special key; usable with Best cylinders.

2.10 KEYING

- A. Keys and keying system will be coordinated with the Owner.

2.11 ELECTRIC STRIKES

- A. Standard: BHMA A156.31, Grade 1.

- B. General: Use fail-secure electric strikes with fire-rated devices.

1. In particular the electric strikes shall carry a listing under the category of "single point locks or latches" for use with single swing fire doors having a 3-hour (A) rating or less.
2. Provide solenoid actuated by a 24 VAC or DC current and face plate shall be in US 26D finish.
3. Manufacture of corrosion resistant metals with a cast stainless steel case and working parts, and stainless steel springs.
4. Provide horizontal adjustment for misalignment, and shall be reversible and capable of accepting locksets specified in the lock or exit device section of the specification.
5. Electric strikes shall fit a cutout in the frame not less than 9" high x 1 3/8" wide with a frame face cutout of 1 1/2" wide and 3 3/4" high.

- C. Available Manufacturers:

1. Adams Rite Manufacturing Co. (ARM).
2. Folger Adam Security Inc.; an ASSA ABLOY Group company (FAS).
3. HES, Inc.; an ASSA ABLOY Group company (HES).
4. Locknetics; an Ingersoll-Rand Company (LSE).

2.12 OPERATING TRIM

- A. Materials: Fabricate from stainless steel, unless otherwise indicated.

- B. Security Push-Pull: Provide Security pull-push plate set, No. 122L by Hager.

2.13 CLOSERS

- A. Accessibility Requirements: Where handles, pulls, latches, locks, and other operating devices are indicated to comply with accessibility requirements, comply with the U.S. Architectural & Transportation Barriers Compliance Board's "Americans with Disabilities Act (ADA), Accessibility Guidelines for Buildings and Facilities (ADAAG)."

1. Comply with the following maximum opening-force requirements:
 - a. Interior, Non-Fire-Rated Hinged Doors: 5 lbf applied perpendicular to door.
 - b. Fire Doors: Minimum opening force allowable by authorities having jurisdiction.

- B. Door Closers for Means of Egress Doors: Comply with NFPA 101. Door closers shall not require more than 30 lbf to set door in motion and not more than 15 lbf to open door to minimum required width.
- C. Surface Closers: BHMA A156.4, Grade 1. Provide type of arm required for closer to be located on non-public side of door, unless otherwise indicated.
- D. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
 - 1. Surface-Mounted Closers:
 - a. LCN Closers; an Ingersoll-Rand Company (LCN).
- E. Size of Units: Unless otherwise indicated, comply with manufacturer's written recommendations for size of door closers depending on size of door, exposure to weather, and anticipated frequency of use. Provide factory-sized closers, adjustable to meet field conditions and requirements for opening force.
 - 1. LCN: Interior: 4010 Series

2.14 AUTOMATIC DOOR OPERATORS

- A. Provide Horton Model 7100 Access Operator. No substitutions.
 - 1. Provide MC Linx interface for use with latch retraction exit devices.
- B. Provide actuating push plates, inside and outside where indicated.
- C. Combination Motion/Presence Sensors: Where indicated, provide self-contained units; consisting of both motion and presence sensors in a single metal or plastic housing; adjustable to provide detection field sizes and functions required by BHMA A156.10.
 - 1. Motion Sensor: K-band-frequency, microwave-scanner units; with relay hold time of not less than 2 to 10 seconds.
 - a. Provide capability for switching between bidirectional and unidirectional detection.
- D. Coordinate requirements with electrical contractor.

2.15 PROTECTIVE TRIM UNITS

- A. Size: 1-1/2 inches less than door width on push side and 1/2 inch less than door width on pull side, by height specified in door hardware sets.
- B. Fasteners: Manufacturer's standard machine or self-tapping screws.

- C. Metal Protective Trim Units: BHMA A156.6; beveled top and 2 sides; fabricated from the following material:
1. Material: 0.050-inch- thick stainless steel.
 2. Available Manufacturers:
 - a. Burns Manufacturing Incorporated (BM).
 - b. Don-Jo Mfg., Inc. (DJO).
 - c. Hager Companies (HAG).
 - d. IVES Hardware; an Ingersoll-Rand Company (IVS).
 - e. Rockwood Manufacturing Company (RM).
- D. Fabricate protection plates as follows:
1. Push Plates: 16" high by 8" wide.
 2. Kick Plates: 10" high by 1-1/2" less than door width for single doors and 1" less than door width for pairs of doors. Kick plates shall be applied to push side of all doors where noted.
 3. Armor Plates: 40" high by 1-1/2" less than door width for single doors and 1" less than door width for pairs of doors.

2.16 STOPS AND HOLDERS

- A. Stops and Bumpers: BHMA A156.16, Grade 1.
1. Provide wall stops for doors unless floor or other type stops are scheduled or indicated. Do not mount floor stops where they will impede traffic. Where floor or wall stops are not appropriate, provide overhead holders.
 2. Provide matching finishes for hardware units at each door or opening, to the greatest extent possible, and except as otherwise indicated. Reduce differences in color and textures as much as commercially possible where the base metal or metal forming process is different for individual units of hardware exposed at the same door or opening. In general, match items to the manufacturer's standard finish for the latch and lock set (or push-pull units if no latch-lock sets) for color and texture.
- B. Floor Stops: Where wall type bumpers cannot be used, provide dome type, floor mounted stops of the proper height as follows:
1. Available Products:
 - a. Ives - 436, 438
 - b. Door Controls - 3310X, 3320X
 - c. Rockwood - 440, 442
- C. Exterior doors striking masonry and doors specified to have door stops and holders, shall have cast bronze wall or floor type door stops with hook or staple type holders to selectively hold doors in open position. The following will be acceptable:
1. Available Products:

- a. Ives - 445, 446
- b. Door Controls - 3237X, 3347X
- c. Rockwood - 473, 477

- D. Electromagnetic Door Holders: Provided by others.
- E. Silencers for Metal Door Frames: BHMA A156.16, Grade 1; neoprene or rubber, minimum diameter 1/2 inch; fabricated for drilled-in application to frame.

2.17 DOOR GASKETING

- A. Standard: BHMA A156.22.
- B. General: Provide continuous weather-strip gasketing on exterior doors and provide smoke, light, or sound gasketing on interior doors where indicated or scheduled. Provide noncorrosive fasteners for exterior applications and elsewhere as indicated.
 - 1. Perimeter Gasketing: Apply to head and jamb, forming seal between door and frame. Basis-of-Design Product, No. A626A by National Guard Products or approved substitute.
 - 2. Meeting Stile Gasketing: Fasten to meeting stiles, forming seal when doors are closed. Basis-of-Design Product, No. 600A by National Guard Products or approved substitute.
 - 3. Door Bottoms: Apply to bottom of door, forming seal with threshold when door is closed. Basis-of-Design Product, No. 95WH by National Guard Products or approved substitute.
- C. Air Leakage: Not to exceed 0.50 cfm per foot of crack length for gasketing other than for smoke control, as tested according to ASTM E 283.
- D. Fire-Labeled Gasketing: Assemblies complying with NFPA 80 that are listed and labeled by a testing and inspecting agency acceptable to authorities having jurisdiction, for fire ratings indicated, based on testing according to NFPA 252.
 - 1. Test Pressure: After 5 minutes into the test, neutral pressure level in furnace shall be established at 40 inches or less above the sill.
 - 2. Basis-of-Design Product, No. 9440 by National Guard Products or approved substitute.
- E. Isolation Seals:
 - 1. Perimeter Gasketing: Apply to head and jamb, forming seal between door and frame. Basis-of-Design Product, No. 129NA by National Guard Products or approved substitute.
 - 2. Meeting Stile Gasketing: Fasten to meeting stiles, forming seal when doors are closed. Basis-of-Design Product, No. 115NA by National Guard Products or approved substitute.
 - 3. Door Bottoms: Apply to bottom of door, forming seal with threshold when door is closed. Basis-of-Design Product, No. 220NA by National Guard Products or approved substitute.
- F. Replaceable Seal Strips: Provide only those units where resilient or flexible seal strips are easily replaceable and readily available from stocks maintained by manufacturer.

2.18 THRESHOLDS

- A. Standard: BHMA A156.21.
- B. Thresholds for Means of Egress Doors: Comply with NFPA 101. Maximum 1/2 inch high.
- C. Manufacturer and Product:
 - 1. Provide No. 896 with door bottom sweep No. 95WH by National Guard Products or approved substitute.

2.19 FABRICATION

- A. Manufacturer's Nameplate: Do not provide products that have manufacturer's name or trade name displayed in a visible location except in conjunction with required fire-rated labels and as otherwise approved by Architect.
 - 1. Manufacturer's identification is permitted on rim of lock cylinders only.
- B. Base Metals: Produce door hardware units of base metal, fabricated by forming method indicated, using manufacturer's standard metal alloy, composition, temper, and hardness. Furnish metals of a quality equal to or greater than that of specified door hardware units and BHMA A156.18. Do not furnish manufacturer's standard materials or forming methods if different from specified standard.
- C. Fasteners: Provide door hardware manufactured to comply with published templates generally prepared for machine, wood, and sheet metal screws. Provide screws according to commercially recognized industry standards for application intended, except aluminum fasteners are not permitted. Provide Phillips flat-head screws with finished heads to match surface of door hardware, unless otherwise indicated.
 - 1. Concealed Fasteners: For door hardware units that are exposed when door is closed, except for units already specified with concealed fasteners. Do not use through bolts for installation where bolt head or nut on opposite face is exposed unless it is the only means of securely attaching the door hardware. Where through bolts are used on hollow door and frame construction, provide sleeves for each through bolt.
 - 2. Steel Machine or Wood Screws: For the following fire-rated applications:
 - a. Mortise hinges to doors.
 - b. Strike plates to frames.
 - c. Closers to doors and frames.
 - 3. Spacers or Sex Bolts: For through bolting of hollow-metal doors.
 - 4. Fasteners for Wood Doors: Comply with requirements in DHI WDHS.2, "Recommended Fasteners for Wood Doors."

2.20 FINISHES

- A. Standard: BHMA A156.18, as indicated in door hardware sets.
- B. Protect mechanical 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 doors and frames, with Installer present, for compliance with requirements for installation tolerances, labeled fire door assembly construction, wall and floor construction, and other conditions affecting performance.
- B. Examine roughing-in for electrical power systems to verify actual locations of wiring connections before electrified door hardware installation.
- C. Proceed with installation only after unsatisfactory conditions have been corrected.

3.2 PREPARATION

- A. Steel Doors and Frames: Comply with DHI A115 Series.
 - 1. Surface-Applied Door Hardware: Drill and tap doors and frames according to ANSI A250.6.
- B. Wood Doors: Comply with DHI A115-W Series.

3.3 INSTALLATION

- A. Mounting Heights: Mount door hardware units at heights indicated as follows unless otherwise indicated or required to comply with governing regulations.
 - 1. Standard Steel Doors and Frames: DHI's "Recommended Locations for Architectural Hardware for Standard Steel Doors and Frames."
 - 2. Wood Doors: DHI WDHS.3, "Recommended Locations for Architectural Hardware for Wood Flush Doors."
- B. Install each door hardware item to comply with manufacturer's written instructions. Where cutting and fitting are required to install door hardware onto or into surfaces that are later to be

painted or finished in another way, coordinate removal, storage, and reinstallation of surface protective trim units with finishing work specified in Division 09 Sections. Do not install surface-mounted items until finishes have been completed on substrates involved.

1. Set units level, plumb, and true to line and location. Adjust and reinforce attachment substrates as necessary for proper installation and operation.
 2. Drill and countersink units that are not factory prepared for anchorage fasteners. Space fasteners and anchors according to industry standards.
- C. Boxed Power Supplies: To be provided by Owner.
- D. Thresholds: Set thresholds for exterior and acoustical doors in full bed of sealant complying with requirements specified in Division 07 Section "Joint Sealants."

3.4 ADJUSTING

- A. Initial Adjustment: Adjust and check each operating item of door hardware and each door to ensure proper operation or function of every unit. Replace units that cannot be adjusted to operate as intended. Adjust door control devices to compensate for final operation of heating and ventilating equipment and to comply with referenced accessibility requirements.
1. Electric Strikes: Adjust horizontal and vertical alignment of keeper to properly engage lock bolt.
 2. Door Closers: Unless otherwise required by authorities having jurisdiction, adjust sweep period so that, from an open position of 70 degrees, the door will take at least 3 seconds to move to a point 3 inches from the latch, measured to the leading edge of the door.
- B. Occupancy Adjustment: Approximately six months after date of Substantial Completion, Installer's Architectural Hardware Consultant shall examine and readjust, including adjusting operating forces, each item of door hardware as necessary to ensure function of doors, door hardware, and electrified door hardware.

3.5 CLEANING AND PROTECTION

- A. Clean adjacent surfaces soiled by door hardware installation.
- B. Clean operating items as necessary to restore proper function and finish.
- C. Provide final protection and maintain conditions that ensure that door hardware is without damage or deterioration at time of Substantial Completion.

3.6 DEMONSTRATION

- A. Engage a factory-authorized service representative to train Owner's maintenance personnel to adjust, operate, and maintain door hardware and door hardware finishes. Refer to Division 01 Section "Demonstration and Training."

3.7 DOOR HARDWARE SETS

- A. The hardware sets listed below indicate the items of hardware required for each opening. It is the bidder's responsibility to accurately furnish the proper quantities, items, sizes, weights and functions as required by the plans and specifications. If an opening has, through error, been omitted from the following hardware sets, it shall be the bidder's responsibility to supply hardware of equivalent quality and quantity, as that which is specified for a comparable opening.

HW1 (Manual ICU Door)

Doors: R2133

Hardware: All hardware by door manufacturer, see specifications.

HW2 (Storage)

Doors: R2109, R2105, SS2085a, SS2085b, SS2065

Hardware: Hinges, Lockset (Storage Function), Closer(s), Stop, Flush Bolts at inactive leaf (where applicable).

HW2A (Storage, Card Access)

Doors: R2129, SS2085c, SS2014a, SS2014b

Hardware: Hinges, Lockset (Storage Function), Closer(s), Electric Strike to be activated by card reader (by others), Stop, Flush Bolts at inactive leaf (where applicable).

HW3 (Offices)

Doors: R2141, R2209, IS2013, IS2005, SS2006a

Hardware: Hinges, Lockset (Office Function), Stop.

HW4 (Patient rooms)

Doors: IS2061, IS2031

Hardware: Hinges, Hospital Latch (Passage Function), Kick Plate, Acoustical Gasket, Stop.

HW5 (Soiled Utility Rooms)

Doors: SS2090, SS2092

Hardware: Hinges, Hospital Latch (Passage Function), Closer, Armor Plate, Stop.

HW6 (Med Rooms)

Doors: R2138a, R2138b, R2216, IS2038

Hardware: Hinges, Lockset (Storage Function), Closer, Electric Strike to be activated by card reader (by others), Armor Plate, Stop.

HW7 (PACU/ASU, Push Pads, Card Access)

Doors: SS2001a

Hardware: Hinges, Lockset (Storage function), Power Door Operator (with 2 push pads), Closer, Electric Strike to be activated by card reader (by others), Push Plate, Pull, Armor Plate, Stop.

HW7A (PACU/ASU, Push Pads)

Doors: SS2001d, SS2001c

Hardware: Hinges, Lockset (Storage function), Power Door Operator (with 2 push pads), Closer, Push Plate, Pull, Armor Plate, Stop.

HW8 (Privacy/Toilet Rooms)

Doors: R2135, R2218a, R2119, IS2062, IS2030, IS2063, IS2035a, IS2035b, IS2003, SS2009

Hardware: Hinges, Lockset (Privacy Function), Stop.

HW9 (Cross Corridor)

Doors: IS2021b, SS2010a

Hardware: Hinges, Exit Device (Passage Function), Closer, Electromagnetic Door Holder, Stop.

HW10 (Cross Corridor, Push Pads)

Doors: SS2021a

Hardware: Hinges, Power Door Operator (with 2 push pads), Closers, Exit Device (Entrance Function), Push Plates, Pull, Armor Plate, Stops.

HW10A (Cross Corridor, Push Pads, Card Access)

Doors: SS2079, SS2077

Hardware: Hinges, Automatic Door Operator (with 1 push pad), Closers, Electric Strike to be activated by card reader (by others) or push pad (from secure side), Push Plates, Pull, Armor Plate, Stops.

Note: On non-secure side, Automatic Door Operator and Electronic Latch to be activated simultaneously by card reader (by others).

HW11 (Cross Corridor, Push Pads)

Doors: SS2001b

Hardware: Hinges, Lockset (Storage Function), Power Door Operator (with 2 push pads), Closers, Exit Device, Push Plates, Pull, Armor Plate, Stops.

HW12 (Cross Corridor, Double Egress)

Doors: R2208, SS2010b

Hardware: Hinges, Exit Device (Passage Function), Closers, Electromagnetic Door Holder, Stop.

Maine Medical Center, Portland, Maine
Bean 2 Surgical Services/ Bean 2 Inpatient Services/
Richards 2 Inpatient Services

Issued for Construction
9/12/08

HW13 (Closet, Pair)

Doors: IS2015

Hardware: Hinges, Heavy-Duty Magnetic Catch, Wire Pulls.

HW14 (Locker Rooms)

Doors: SS2064

Hardware: Hinges, Push Button Lockset (Storage Function), Closer, Kickplate, Stop.

END OF SECTION 087100

SECTION 088000

GLAZING

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

- A. 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 glazing for the following products and applications, including those specified in other Sections where glazing requirements are specified by reference to this Section:
 - 1. Doors.
 - 2. Glazed entrances.
 - 3. Decorative Architectural Glass

1.3 DEFINITIONS

- A. Glass Manufacturers: Firms that produce primary glass, fabricated glass, or both, as defined in referenced glazing publications.
- B. Glass Thicknesses: Indicated by thickness designations in millimeters according to ASTM C 1036.
- C. Interspace: Space between lites of an insulating-glass unit.

1.4 PERFORMANCE REQUIREMENTS

- A. General: Installed glazing systems shall withstand normal thermal movement and wind and impact loads (where applicable) without failure, including loss or glass breakage attributable to the following: defective manufacture, fabrication, or installation; failure of sealants or gaskets to remain watertight and airtight; deterioration of glazing materials; or other defects in construction.
- B. Delegated Design: Design glass, including comprehensive engineering analysis according to ICC's 2003 International Building Code by a qualified professional engineer, using the following design criteria:
 - 1. Vertical Glazing: For glass surfaces sloped 15 degrees or less from vertical, design glass to resist design wind pressure based on glass type factors for short-duration load.

2. Maximum Lateral Deflection: For glass supported on all four edges, limit center-of-glass deflection at design wind pressure to not more than 1/50 times the short-side length or 1 inch, whichever is less.
3. Differential Shading: Design glass to resist thermal stresses induced by differential shading within individual glass lites
4. Thermal Movements: Allow for thermal movements from ambient and surface temperature changes acting on glass framing members and glazing components.
 - a. Temperature Change: 120 deg F, ambient; 180 deg F, material surfaces.

1.5 SUBMITTALS

- A. Product Data: For each glass product and glazing material indicated.
- B. Glass Samples: For each type of the following products; 12 inches square.
 1. Wire Glass
 2. Tempered glass
 3. Decorative Architectural Glass
- C. Glazing Schedule: List glass types and thicknesses for each size opening and location. Use same designations indicated on Drawings.
- D. Delegated-Design Submittal: For glass indicated to comply with performance requirements and design criteria, including analysis data signed and sealed by the qualified professional engineer responsible for their preparation.
- E. Product Certificates: For glass and glazing products, from manufacturer.
- F. Product Test Reports: Based on evaluation of comprehensive tests performed by a qualified testing agency, for insulating glass.
- G. Preconstruction adhesion and compatibility test report.
- H. Warranties: Sample of special warranties.

1.6 QUALITY ASSURANCE

- A. Manufacturer Qualifications for Insulating-Glass Units with Sputter-Coated, Low-E Coatings: A qualified insulating-glass manufacturer who is approved by coated-glass manufacturer.
- B. Installer Qualifications: A qualified installer who employs glass installers for this Project who are certified under the National Glass Association's Certified Glass Installer Program.
- C. Glass Testing Agency Qualifications: A qualified independent testing agency accredited according to the NFRC CAP 1 Certification Agency Program.
- D. Sealant Testing Agency Qualifications: An independent testing agency qualified according to ASTM C 1021 to conduct the testing indicated.

- E. Source Limitations for Glass: Obtain insulating glass from single source from single manufacturer for each glass type.
- F. Source Limitations for Glazing Accessories: Obtain from single source from single manufacturer for each product and installation method.
- G. Glazing Publications: Comply with published recommendations of glass product manufacturers and organizations below, unless more stringent requirements are indicated. Refer to these publications for glazing terms not otherwise defined in this Section or in referenced standards.
 - 1. IGMA Publication for Insulating Glass: SIGMA TM-3000, "North American Glazing Guidelines for Sealed Insulating Glass Units for Commercial and Residential Use."
- H. Safety Glazing Labeling: Where safety glazing labeling is indicated, permanently mark glazing with certification label of the SGCC or another certification agency acceptable to authorities having jurisdiction or the manufacturer. Label shall indicate manufacturer's name, type of glass, thickness, and safety glazing standard with which glass complies.
- I. Insulating-Glass Certification Program: Permanently marked either on spacers or on at least one component lite of units with appropriate certification label of IGCC.

1.7 DELIVERY, STORAGE, AND HANDLING

- A. Protect glazing materials according to manufacturer's written instructions. Prevent damage to glass and glazing materials from condensation, temperature changes, direct exposure to sun, or other causes.
- B. Comply with insulating-glass manufacturer's written recommendations for venting and sealing units to avoid hermetic seal ruptures due to altitude change.

1.8 PROJECT CONDITIONS

- A. Environmental Limitations: Do not proceed with glazing when ambient and substrate temperature conditions are outside limits permitted by glazing material manufacturers and when glazing channel substrates are wet from rain, frost, condensation, or other causes.
 - 1. Do not install glazing sealants when ambient and substrate temperature conditions are outside limits permitted by sealant manufacturer or below 40 deg F.

1.9 WARRANTY

- A. Manufacturer's Special Warranty on Insulating Glass: Manufacturer's standard form in which insulating-glass manufacturer agrees to replace insulating-glass units that deteriorate within specified warranty period. Deterioration of insulating glass is defined as failure of hermetic seal under normal use that is not attributed to glass breakage or to maintaining and cleaning insulating glass contrary to manufacturer's written instructions. Evidence of failure is the obstruction of vision by dust, moisture, or film on interior surfaces of glass.

1. Warranty Period: 10 years from date of Substantial Completion.

PART 2 - PRODUCTS

2.1 GLASS PRODUCTS, GENERAL

- A. Thickness: Where glass thickness is indicated, it is a minimum. Provide glass lites in thicknesses as needed to comply with requirements indicated.
 1. Minimum Glass Thickness for Exterior Lites: Not less than 6.0 mm.
- B. Strength: Where float glass is indicated, provide annealed float glass, Kind HS heat-treated float glass, or Kind FT heat-treated float glass as needed to comply with "Performance Requirements" Article. Where heat-strengthened glass is indicated, provide Kind HS heat-treated float glass or Kind FT heat-treated float glass. Where fully tempered glass is indicated, provide Kind FT heat-treated float glass.
- C. Thermal and Optical Performance Properties: Provide glass with performance properties specified, as indicated in manufacturer's published test data, based on procedures indicated below:
 1. For monolithic-glass lites, properties are based on units with lites 6.0 mm thick.
 2. For laminated-glass lites, properties are based on products of construction indicated.
 3. For insulating-glass units, properties are based on units of thickness indicated for overall unit and for each lite.
 4. U-Factors: Center-of-glazing values, according to NFRC 100 and based on LBL's WINDOW 5.2 computer program, expressed as Btu/sq. ft. x h x deg F.
 5. Solar Heat-Gain Coefficient and Visible Transmittance: Center-of-glazing values, according to NFRC 200 and based on LBL's WINDOW 5.2 computer program.
 6. Visible Reflectance: Center-of-glazing values, according to NFRC 300.

2.2 GLASS PRODUCTS

- A. Float Glass: ASTM C 1036, Type I, Quality-Q3, Class I (clear) unless otherwise indicated.
- B. Heat-Treated Float Glass: ASTM C 1048; Type I; Quality-Q3; Class I (clear) unless otherwise indicated; of kind and condition indicated.
 1. Fabrication Process: By horizontal (roller-hearth) process with roll-wave distortion parallel to bottom edge of glass as installed unless otherwise indicated.
 2. For uncoated glass, comply with requirements for Condition A.
 3. For coated vision glass, comply with requirements for Condition C (other coated glass).
- C. Patterned Glass (Decorative Architectural Glass): ASTM C 1036, Type II, Class 1 (clear), Form 3; Quality-Q6.

1. Products: Subject to compliance with requirements, provide the following:
 - a. DAG-1: Skyline Design, Organics, Brambles.

2.3 WIRE GLASS

- A. Products: Subject to compliance with requirements, provide one of the following:
 1. Ashai Glass Co./Ama Glass Corp.
 2. Central Glass Co., Ltd.
 3. Nippon Sheet Glass Co., Ltd.
 4. Pilkington Glass Ltd.
- B. Wire glass: ASTM C 1036, Type II (patterned and wired glass, flat), Class 1 (clear), Quality q8 (glazing); 6.4 mm thick; of form and mesh pattern indicated below:
 1. Polished Wired Glass: Form 1 (wired, polished both sides), and as follows:
- C. Mesh square.

2.4 GLAZING GASKETS

- A. Dense Compression Gaskets: Molded or extruded gaskets of profile and hardness required to maintain watertight seal, made from one of the following:
 1. Neoprene complying with ASTM C 864.
 2. EPDM complying with ASTM C 864.
 3. Silicone complying with ASTM C 1115.
 4. Thermoplastic polyolefin rubber complying with ASTM C 1115.
- B. Soft Compression Gaskets: Extruded or molded, closed-cell, integral-skinned neoprene EPDM silicone or thermoplastic polyolefin rubber gaskets complying with ASTM C 509, Type II, black; of profile and hardness required to maintain watertight seal.
 1. Application: Use where soft compression gaskets will be compressed by inserting dense compression gaskets on opposite side of glazing or pressure applied by means of pressure-glazing stops on opposite side of glazing.

2.5 GLAZING SEALANTS

- A. General:
 1. Compatibility: Provide glazing sealants that are compatible with one another and with other materials they will contact, including glass products, seals of insulating-glass units, and glazing channel substrates, under conditions of service and application, as demonstrated by sealant manufacturer based on testing and field experience.
 2. Suitability: Comply with sealant and glass manufacturers' written instructions for selecting glazing sealants suitable for applications indicated and for conditions existing at time of installation.

3. VOC Content: For sealants used inside of the weatherproofing system, not more than 250 g/L when calculated according to 40 CFR 59, Subpart D.
 4. Colors of Exposed Glazing Sealants: As selected by Architect from manufacturer's full range.
- B. Glazing Sealant: Neutral-curing silicone glazing sealant complying with ASTM C 920, Type S, Grade NS, Class 100/50, Use NT.
1. Products: Subject to compliance with requirements, provide one of the following:
 - a. Dow Corning Corporation; 790.
 - b. GE Advanced Materials - Silicones; SilPruf LM SCS2700.
 - c. May National Associates, Inc.; Bondaflex Sil 290.
 - d. Pecora Corporation; 890.
 - e. Sika Corporation, Construction Products Division; SikaSil-C990.
 - f. Tremco Incorporated; Spectrem I.
- C. Glazing Sealants for Fire-Rated Glazing Products: Products that are approved by testing agencies that listed and labeled fire-resistant glazing products with which they are used for applications and fire-protection ratings indicated.

2.6 GLAZING TAPES

- A. Back-Bedding Mastic Glazing Tapes: Preformed, butyl-based, 100 percent solids elastomeric tape; nonstaining and nonmigrating in contact with nonporous surfaces; with or without spacer rod as recommended in writing by tape and glass manufacturers for application indicated; and complying with ASTM C 1281 and AAMA 800 for products indicated below:
1. AAMA 804.3 tape, where indicated.
 2. AAMA 806.3 tape, for glazing applications in which tape is subject to continuous pressure.
 3. AAMA 807.3 tape, for glazing applications in which tape is not subject to continuous pressure.
- B. Expanded Cellular Glazing Tapes: Closed-cell, PVC foam tapes; factory coated with adhesive on both surfaces; and complying with AAMA 800 for the following types:
1. AAMA 810.1, Type 1, for glazing applications in which tape acts as the primary sealant.
 2. AAMA 810.1, Type 2, for glazing applications in which tape is used in combination with a full bead of liquid sealant.

2.7 MISCELLANEOUS GLAZING MATERIALS

- A. General: Provide products of material, size, and shape complying with referenced glazing standard, requirements of manufacturers of glass and other glazing materials for application indicated, and with a proven record of compatibility with surfaces contacted in installation.
- B. Cleaners, Primers, and Sealers: Types recommended by sealant or gasket manufacturer.

- C. Setting Blocks: Elastomeric material with a Shore, Type A durometer hardness of 85, plus or minus 5.
- D. Spacers: Elastomeric blocks or continuous extrusions of hardness required by glass manufacturer to maintain glass lites in place for installation indicated.
- E. Edge Blocks: Elastomeric material of hardness needed to limit glass lateral movement (side walking).
- F. Cylindrical Glazing Sealant Backing: ASTM C 1330, Type O (open-cell material), of size and density to control glazing sealant depth and otherwise produce optimum glazing sealant performance.
- G. Perimeter Insulation for Fire-Resistive Glazing: Product that is approved by testing agency that listed and labeled fire-resistant glazing product with which it is used for application and fire-protection rating indicated.

2.8 FABRICATION OF GLAZING UNITS

- A. Fabricate glazing units in sizes required to fit openings indicated for Project, with edge and face clearances, edge and surface conditions, and bite complying with written instructions of product manufacturer and referenced glazing publications, to comply with system performance requirements.
- B. Clean-cut or flat-grind vertical edges of butt-glazed monolithic lites to produce square edges with slight chamfers at junctions of edges and faces.

2.9 MONOLITHIC-GLASS TYPES

- A. Tempered Glass: Clear fully tempered float glass.
 - 1. Thickness: 6.0 mm.
 - 2. Provide safety glazing labeling.

2.10 FIRE-PROTECTION-RATED GLAZING TYPES

- A. Fire Rated Glass: 45-minute, 60-minute and 90-minute (as required) fire-rated glazing; laminated ceramic glazing.
 - 1. Provide safety glazing labeling.

PART 3 - EXECUTION

3.1 EXAMINATION

- A. Examine framing, glazing channels, and stops, with Installer present, for compliance with the following:
 - 1. Manufacturing and installation tolerances, including those for size, squareness, and offsets at corners.
 - 2. Presence and functioning of weep systems.
 - 3. Minimum required face and edge clearances.
 - 4. Effective sealing between joints of glass-framing members.
- B. Proceed with installation only after unsatisfactory conditions have been corrected.

3.2 PREPARATION

- A. Clean glazing channels and other framing members receiving glass immediately before glazing. Remove coatings not firmly bonded to substrates.
- B. Examine glazing units to locate exterior and interior surfaces. Label or mark units as needed so that exterior and interior surfaces are readily identifiable. Do not use materials that will leave visible marks in the completed work.

3.3 GLAZING, GENERAL

- A. Comply with combined written instructions of manufacturers of glass, sealants, gaskets, and other glazing materials, unless more stringent requirements are indicated, including those in referenced glazing publications.
- B. Adjust glazing channel dimensions as required by Project conditions during installation to provide necessary bite on glass, minimum edge and face clearances, and adequate sealant thicknesses, with reasonable tolerances.
- C. Protect glass edges from damage during handling and installation. Remove damaged glass from Project site and legally dispose of off Project site. Damaged glass is glass with edge damage or other imperfections that, when installed, could weaken glass and impair performance and appearance.
- D. Apply primers to joint surfaces where required for adhesion of sealants, as determined by preconstruction testing.
- E. Install setting blocks in sill rabbets, sized and located to comply with referenced glazing publications, unless otherwise required by glass manufacturer. Set blocks in thin course of compatible sealant suitable for heel bead.
- F. Do not exceed edge pressures stipulated by glass manufacturers for installing glass lites.

- G. Provide edge blocking where indicated or needed to prevent glass lites from moving sideways in glazing channel, as recommended in writing by glass manufacturer and according to requirements in referenced glazing publications.
- H. Set glass lites in each series with uniform pattern, draw, bow, and similar characteristics.
- I. Set glass lites with proper orientation so that coatings face exterior or interior as specified.
- J. Where wedge-shaped gaskets are driven into one side of channel to pressurize sealant or gasket on opposite side, provide adequate anchorage so gasket cannot walk out when installation is subjected to movement.
- K. Square cut wedge-shaped gaskets at corners and install gaskets in a manner recommended by gasket manufacturer to prevent corners from pulling away; seal corner joints and butt joints with sealant recommended by gasket manufacturer.

3.4 TAPE GLAZING

- A. Position tapes on fixed stops so that, when compressed by glass, their exposed edges are flush with or protrude slightly above sightline of stops.
- B. Install tapes continuously, but not necessarily in one continuous length. Do not stretch tapes to make them fit opening.
- C. Cover vertical framing joints by applying tapes to heads and sills first and then to jambs. Cover horizontal framing joints by applying tapes to jambs and then to heads and sills.
- D. Place joints in tapes at corners of opening with adjoining lengths butted together, not lapped. Seal joints in tapes with compatible sealant approved by tape manufacturer.
- E. Do not remove release paper from tape until right before each glazing unit is installed.
- F. Apply heel bead of elastomeric sealant.
- G. Center glass lites in openings on setting blocks and press firmly against tape by inserting dense compression gaskets formed and installed to lock in place against faces of removable stops. Start gasket applications at corners and work toward centers of openings.
- H. Apply cap bead of elastomeric sealant over exposed edge of tape.

3.5 GASKET GLAZING (DRY)

- A. Cut compression gaskets to lengths recommended by gasket manufacturer to fit openings exactly, with allowance for stretch during installation.
- B. Insert soft compression gasket between glass and frame or fixed stop so it is securely in place with joints miter cut and bonded together at corners.
- C. Install gaskets so they protrude past face of glazing stops.

3.6 SEALANT GLAZING (WET)

- A. Install continuous spacers, or spacers combined with cylindrical sealant backing, between glass lites and glazing stops to maintain glass face clearances and to prevent sealant from extruding into glass channel and blocking weep systems until sealants cure. Secure spacers or spacers and backings in place and in position to control depth of installed sealant relative to edge clearance for optimum sealant performance.
- B. Force sealants into glazing channels to eliminate voids and to ensure complete wetting or bond of sealant to glass and channel surfaces.
- C. Tool exposed surfaces of sealants to provide a substantial wash away from glass.

3.7 STRUCTURAL SILICONE JOINTS

- A. Inspect insulating units, verifying proper placement and support of setting blocks. Clean edge of insulating unit to assure full adhesion of sealant.
- B. Verify silicone has been checked for compatibility with the seals of insulating glass units and glazing channel substrates and gaskets.
- C. Stabilize glass, fully retained to prevent movement during curing of the joint sealant.
- D. Install backer rod to permit proper depth of joint sealant.
- E. Schedule sealant operations during periods of minimal wind to prevent pick up of airborne dust. Gun silicone into joint under pressure without displacing backer rod, fully wetting surfaces for full adhesion, providing weather tight seal. Gun or tool silicone, providing smooth uniform joint without excess material on glass. Remove smears from glass, using methods that do not damage glass or sealant.

3.8 CLEANING AND PROTECTION

- A. Protect exterior glass from damage immediately after installation by attaching crossed streamers to framing held away from glass. Do not apply markers to glass surface. 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 substances immediately as recommended in writing 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 than once a month, for buildup of dirt, scum, alkaline deposits, or stains; remove as recommended in writing by glass manufacturer.
- D. Remove and replace glass that is broken, chipped, cracked, or abraded or that is damaged from natural causes, accidents, and vandalism, during construction period.

- E. Wash glass on both exposed surfaces in each area of Project not more than four days before date scheduled for inspections that establish date of Substantial Completion. Wash glass as recommended in writing by glass manufacturer.

END OF SECTION 088000

SECTION 092900

GYPSUM BOARD

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

- A. 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. Interior gypsum board.
- 2. Tile backing panels.

- B. Related Sections include the following:

- 1. Division 05 Section "Cold-Formed Metal Framing" for load-bearing steel framing that supports gypsum board.
- 2. Division 06 Section "Rough Carpentry" for wood framing and furring that supports gypsum board.
- 3. Division 06 Section "Sheathing" for gypsum sheathing.
- 4. Division 09 Section "Non-Structural Metal Framing" for non-structural framing and suspension systems that support gypsum board.
- 5. Division 09 Section "Tiling" for cementitious backer units installed as substrates for ceramic tile.
- 6. Division 09 painting Sections for primers applied to gypsum board surfaces.

1.3 SUBMITTALS

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

- B. Samples: For the following products:

- 1. Trim Accessories: Full-size Sample in 12-inch- long length for each trim accessory indicated.

1.4 QUALITY ASSURANCE

- A. Fire-Resistance-Rated Assemblies: For fire-resistance-rated assemblies, provide materials and construction identical to those tested in assembly indicated according to ASTM E 119 by an independent testing agency.

- B. STC-Rated Assemblies: For STC-rated assemblies, provide materials and construction identical to those tested in assembly indicated according to ASTM E 90 and classified according to ASTM E 413 by an independent testing agency.

1.5 STORAGE AND HANDLING

- A. Store materials inside under cover and keep them dry and protected against damage from weather, condensation, direct sunlight, construction traffic, and other causes. Stack panels flat to prevent sagging.

1.6 PROJECT CONDITIONS

- A. Environmental Limitations: Comply with ASTM C 840 requirements or gypsum board manufacturer's written recommendations, whichever are more stringent.
- B. Do not install interior products until installation areas are enclosed and conditioned.
- C. Do not install panels that are wet, those that are moisture damaged, and those that are mold damaged.
 - 1. Indications that panels are wet or moisture damaged include, but are not limited to, discoloration, sagging, or irregular shape.
 - 2. Indications that panels are mold damaged include, but are not limited to, fuzzy or splotchy surface contamination and discoloration.

PART 2 - PRODUCTS

2.1 PANELS, GENERAL

- A. Size: Provide in maximum lengths and widths available that will minimize joints in each area and that correspond with support system indicated.

2.2 INTERIOR GYPSUM BOARD

- A. General: Complying with ASTM C 36/C 36M or ASTM C 1396/C 1396M, as applicable to type of gypsum board indicated and whichever is more stringent.
 - 1. 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:
 - a. American Gypsum Co.
 - b. BPB America Inc.
 - c. G-P Gypsum.
 - d. Lafarge North America Inc.
 - e. National Gypsum Company.

- f. PABCO Gypsum.
- g. Temple.
- h. USG Corporation.

B. Type X:

- 1. Thickness: 5/8 inch.
- 2. Long Edges: Tapered.

C. Flexible Type: Manufactured to bend to fit radii and to be more flexible than standard regular-type gypsum board of same thickness.

- 1. Thickness: 1/4 inch.
- 2. Long Edges: Tapered.

D. High-Impact Type: Manufactured with Type X core, plastic film laminated to back side for greater resistance to through-penetration (impact resistance).

- 1. Core: 5/8 inch thick.
- 2. Plastic-Film Thickness: 0.010 inch.
- 3. Products: Subject to compliance with requirements, provide one of the following:
 - a. National Gypsum Company; Hi-Impact Brand Fire-Shield Gypsum Wallboard, Hi-Impact 1000.
 - b. United States Gypsum Co.; Fiberock Gypsum Fiber Panels Type AR.

E. Moisture- and Mold-Resistant Type: With moisture- and mold-resistant core and surfaces.

- 1. Core: 5/8 inch, Type X.
- 2. Long Edges: Tapered.

2.3 TILE BACKING PANELS

A. Glass-Mat, Water and Mold-Resistant Backing Board:

- 1. Complying with ASTM C1177/C 1177M.
 - a. Product: Subject to compliance with requirements, provide "DensArmor Plus Interior Guard" by G-P Gypsum.
- 2. Core: 5/8 inch, Type X.

2.4 TRIM ACCESSORIES

A. Interior Trim: ASTM C 1047.

- 1. Material:
 - a. Galvanized or aluminum-coated steel sheet or rolled zinc.

- b. Plastic where abutting exterior metal doors and windows.
- 2. Shapes:
 - a. Cornerbead.
 - b. LC-Bead: J-shaped; exposed long flange receives joint compound.
 - c. L-Bead: L-shaped; exposed long flange receives joint compound.
 - d. Expansion (control) joint.
 - e. Curved-Edge Cornerbead: With notched or flexible flanges.

2.5 JOINT TREATMENT MATERIALS

- A. General: Comply with ASTM C 475/C 475M.
- B. Joint Tape:
 - 1. Interior Gypsum Wallboard: Paper.
 - 2. Glass-Mat Gypsum Sheathing Board: 10-by-10 glass mesh.
 - 3. Tile Backing Panels: As recommended by panel manufacturer.
- C. Joint Compound for Interior Gypsum Wallboard: For each coat use formulation that is compatible with other compounds applied on previous or for successive coats.
 - 1. Prefilling: At open joints and damaged surface areas, use setting-type taping compound.
 - 2. Embedding and First Coat: For embedding tape and first coat on joints, fasteners, and trim flanges, use setting-type taping or drying-type, all-purpose compound.
 - a. Use setting-type taping with mold-resistant gypsum wallboard.
 - 3. Fill Coat: For second coat, use setting-type, sandable topping or drying-type, all-purpose compound.
 - 4. Finish Coat: For third coat, use drying-type, all-purpose compound.
 - 5. Skim Coat: For final coat of Level 5 finish, use drying-type, all-purpose compound.
- D. Joint Compound for Tile Backing Panels:
 - 1. Glass-Mat, Water and Mold-Resistant Backing Panel: As recommended by backing panel manufacturer.

2.6 AUXILIARY MATERIALS

- A. General: Provide auxiliary materials that comply with referenced installation standards and manufacturer's written recommendations.
- B. Laminating Adhesive: Adhesive or joint compound recommended for directly adhering gypsum panels to continuous substrate.
 - 1. Use adhesives that have a VOC content of 50 g/L or less when calculated according to 40 CFR 59, Subpart D (EPA Method 24).

- C. Steel Drill Screws: ASTM C 1002, unless otherwise indicated.
 - 1. Use screws complying with ASTM C 954 for fastening panels to steel members from 0.033 to 0.112 inch thick.
 - 2. For fastening cementitious backer units, use screws of type and size recommended by panel manufacturer.
- D. Sound Attenuation Blankets: ASTM C 665, Type I (blankets without membrane facing) produced by combining thermosetting resins with mineral fibers manufactured from glass, slag wool, or rock wool.
 - 1. Fire-Resistance-Rated Assemblies: Comply with mineral-fiber requirements of assembly.
- E. Acoustical Sealant: As specified in Division 07 Section "Joint Sealants."
 - 1. Provide sealants that have a VOC content of 250 g/L or less when calculated according to 40 CFR 59, Subpart D (EPA Method 24).
- F. Thermal Insulation: As specified in Division 07 Section "Thermal Insulation."
- G. Firestopping: As specified in Division 07 Section "Penetration Firestopping."

PART 3 - EXECUTION

3.1 EXAMINATION

- A. Examine areas and substrates, with Installer present, and including welded hollow-metal frames and framing, for compliance with requirements and other conditions affecting performance.
- B. Examine panels before installation. Reject panels that are wet, moisture damaged, and mold damaged.
- C. Proceed with installation only after unsatisfactory conditions have been corrected.

3.2 APPLYING AND FINISHING PANELS, GENERAL

- A. Comply with ASTM C 840.
- B. Install ceiling panels across framing to minimize the number of abutting end joints and to avoid abutting end joints in central area of each ceiling. Stagger abutting end joints of adjacent panels not less than one framing member.
- C. Install panels with face side out. Butt panels together for a light contact at edges and ends with not more than 1/16 inch of open space between panels. Do not force into place.
- D. Locate edge and end joints over supports, except in ceiling applications where intermediate supports or gypsum board back-blocking is provided behind end joints. Do not place tapered

edges against cut edges or ends. Stagger vertical joints on opposite sides of partitions. Do not make joints other than control joints at corners of framed openings.

- E. Form control and expansion joints with space between edges of adjoining gypsum panels.
- F. Cover both faces of support framing with gypsum panels in concealed spaces (above ceilings, etc.), except in chases braced internally.
 - 1. Unless concealed application is indicated or required for sound, fire, air, or smoke ratings, coverage may be accomplished with scraps of not less than 8 sq. ft. in area.
 - 2. Fit gypsum panels around ducts, pipes, and conduits.
 - 3. Where partitions intersect structural members projecting below underside of floor/roof slabs and decks, cut gypsum panels to fit profile formed by structural members; allow 1/4- to 3/8-inch- wide joints to install sealant.
- G. Isolate perimeter of gypsum board applied to non-load-bearing partitions at structural abutments, except floors. Provide 1/4- to 1/2-inch- wide spaces at these locations, and trim edges with edge trim where edges of panels are exposed. Seal joints between edges and abutting structural surfaces with acoustical sealant.
- H. Attachment to Steel Framing: Attach panels so leading edge or end of each panel is attached to open (unsupported) edges of stud flanges first.
- I. STC-Rated Assemblies: Seal construction at perimeters, behind control joints, and at openings and penetrations with a continuous bead of acoustical sealant. Install acoustical sealant at both faces of partitions at perimeters and through penetrations. Comply with ASTM C 919 and with manufacturer's written recommendations for locating edge trim and closing off sound-flanking paths around or through assemblies, including sealing partitions above acoustical ceilings.
- J. Install sound attenuation blankets before installing gypsum panels, unless blankets are readily installed after panels have been installed on one side.

3.3 APPLYING INTERIOR GYPSUM BOARD

- A. Install interior gypsum board in the following locations:
 - 1. Type X: Vertical surfaces, unless otherwise indicated.
 - 2. Flexible Type: Apply in double layer at curved assemblies.
 - 3. Moisture- and Mold-Resistant Type: As indicated on Drawings.
- B. Single-Layer Application:
 - 1. On ceilings, apply gypsum panels before wall/partition board application to greatest extent possible and at right angles to framing, unless otherwise indicated.
 - 2. On partitions/walls, apply gypsum panels vertically (parallel to framing), unless otherwise indicated or required by fire-resistance-rated assembly, and minimize end joints.

- a. Stagger abutting end joints not less than one framing member in alternate courses of panels.
 - b. At stairwells and other high walls, install panels horizontally, unless otherwise indicated or required by fire-resistance-rated assembly.
3. On Z-furring members, apply gypsum panels vertically (parallel to framing) with no end joints. Locate edge joints over furring members.
 4. Fastening Methods: Apply gypsum panels to supports with steel drill screws.
- C. Multilayer Application:
1. On ceilings, apply gypsum board indicated for base layers before applying base layers on walls/partitions; apply face layers in same sequence. Apply base layers at right angles to framing members and offset face-layer joints 1 framing member, 16 inches minimum, from parallel base-layer joints, unless otherwise indicated or required by fire-resistance-rated assembly.
 2. On partitions/walls, apply gypsum board indicated for base layers and face layers vertically (parallel to framing) with joints of base layers located over stud or furring member and face-layer joints offset at least one stud or furring member with base-layer joints, unless otherwise indicated or required by fire-resistance-rated assembly. Stagger joints on opposite sides of partitions.
 3. On Z-furring members, apply base layer vertically (parallel to framing) and face layer either vertically (parallel to framing) or horizontally (perpendicular to framing) with vertical joints offset at least one furring member. Locate edge joints of base layer over furring members.
 4. Fastening Methods: Fasten base layers and face layers separately to supports with screws.
- D. Curved Surfaces:
1. Install panels horizontally (perpendicular to supports) and unbroken, to extent possible, across curved surface plus 12-inch- long straight sections at ends of curves and tangent to them.
 2. For double-layer construction, fasten base layer to studs with screws 16 inches o.c. Center gypsum board face layer over joints in base layer, and fasten to studs with screws spaced 12 inches o.c.
- 3.4 APPLYING TILE BACKING PANELS
- A. Glass-Mat, Water and Mold-Resistant Backing Panel: Comply with manufacturer's written installation instructions and install at locations indicated to receive tile. Install with 1/4-inch gap where panels abut other construction or penetrations.
 - B. Where tile backing panels abut other types of panels in same plane, shim surfaces to produce a uniform plane across panel surfaces.

3.5 INSTALLING TRIM ACCESSORIES

- A. General: For trim with back flanges intended for fasteners, attach to framing with same fasteners used for panels. Otherwise, attach trim according to manufacturer's written instructions.
- B. Control Joints: Install control joints at locations indicated on Drawings or according to ASTM C 840 and in specific locations approved by Architect for visual effect.
- C. Interior Trim: Install in the following locations:
 - 1. Cornerbead: Use at outside corners.
 - 2. LC-Bead: Use at exposed panel edges.
 - 3. L-Bead: Use where indicated.
 - 4. Curved-Edge Cornerbead: Use at curved openings.

3.6 FINISHING GYPSUM BOARD

- A. General: Treat gypsum board joints, interior angles, edge trim, control joints, penetrations, fastener heads, surface defects, and elsewhere as required to prepare gypsum board surfaces for decoration. Promptly remove residual joint compound from adjacent surfaces.
- B. Prefill open joints and damaged surface areas.
- C. Apply joint tape over gypsum board joints, except those with trim having flanges not intended for tape.
- D. Gypsum Board Finish Levels: Finish panels to levels indicated below and according to ASTM C 840:
 - 1. Level 1: Ceiling plenum areas, concealed areas, and where indicated.
 - 2. Level 2: Where indicated on Drawings.
 - 3. Level 3: Where indicated on Drawings.
 - 4. Level 4: At panel surfaces that will be exposed to view, unless otherwise indicated.
 - a. Primer and its application to surfaces are specified in other Division 09 Sections.
 - 5. Level 5: At Skylight light wells.
 - a. Primer and its application to surfaces are specified in other Division 09 Sections.
- E. Glass-Mat Gypsum Sheathing Board: Finish according to manufacturer's written instructions for use as exposed soffit board.
- F. Glass-Mat, Water and Mold-Resistant Backing Panels: Finish according to manufacturer's written instructions.

3.7 PROTECTION

- A. Protect installed products from damage from weather, condensation, direct sunlight, construction, and other causes during remainder of the construction period.
- B. Remove and replace panels that are wet, moisture damaged, and mold damaged.
 - 1. Indications that panels are wet or moisture damaged include, but are not limited to, discoloration, sagging, or irregular shape.
 - 2. Indications that panels are mold damaged include, but are not limited to, fuzzy or splotchy surface contamination and discoloration.

END OF SECTION 092900

SECTION 093000

TILING

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

- A. 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:

- 1. Ceramic wall tile.

B. Related Sections:

- 1. Division 07 Section "Joint Sealants" for sealing of expansion, contraction, control, and isolation joints in tile surfaces.
- 2. Division 09 Section "Gypsum Board" for cementitious backer units.

1.3 DEFINITIONS

- A. General: Definitions in the ANSI A108 series of tile installation standards and in ANSI A137.1 apply to Work of this Section unless otherwise specified.

- B. ANSI A108 Series: ANSI A108.01, ANSI A108.02, ANSI A108.1A, ANSI A108.1B, ANSI A108.1C, ANSI A108.4, ANSI A108.5, ANSI A108.6, ANSI A108.8, ANSI A108.9, ANSI A108.10, ANSI A108.11, ANSI A108.12, ANSI A108.13, ANSI A108.14, ANSI A108.15, ANSI A108.16, and ANSI A108.17, which are contained in "American National Standard Specifications for Installation of Ceramic Tile."

- C. Module Size: Actual tile size plus joint width indicated.

- D. Face Size: Actual tile size, excluding spacer lugs.

1.4 SUBMITTALS

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

B. Samples for Verification:

- 1. Full-size units of each type and composition of tile and for each color and finish required.

- C. Product Certificates: For each type of product, signed by product manufacturer.
- D. Material Test Reports: For each tile-setting and -grouting product.

1.5 QUALITY ASSURANCE

- A. Source Limitations for Tile: Obtain tile of each type and color or finish from one source or producer.
 - 1. Obtain tile of each type and color or finish from same production run and of consistent quality in appearance and physical properties for each contiguous area.
- B. Source Limitations for Setting and Grouting Materials: Obtain ingredients of a uniform quality for each mortar, adhesive, and grout component from one manufacturer and each aggregate from one source or producer.

1.6 DELIVERY, STORAGE, AND HANDLING

- A. Deliver and store packaged materials in original containers with seals unbroken and labels intact until time of use. Comply with requirements in ANSI A137.1 for labeling tile packages.
- B. Store tile and cementitious materials on elevated platforms, under cover, and in a dry location.
- C. Store aggregates where grading and other required characteristics can be maintained and contamination can be avoided.
- D. Store liquid materials in unopened containers and protected from freezing.
- E. Handle tile that has temporary protective coating on exposed surfaces to prevent coated surfaces from contacting backs or edges of other units. If coating does contact bonding surfaces of tile, remove coating from bonding surfaces before setting tile.

1.7 PROJECT CONDITIONS

- A. Environmental Limitations: Do not install tile until construction in spaces is complete and ambient temperature and humidity conditions are maintained at the levels indicated in referenced standards and manufacturer's written instructions.

1.8 EXTRA MATERIALS

- A. Furnish extra materials that match and are from same production runs as products installed and that are packaged with protective covering for storage and identified with labels describing contents.
 - 1. Tile and Trim Units: Furnish quantity of full-size units equal to 3 percent of amount installed for each type, composition, color, pattern, and size indicated.

2. Grout: Furnish quantity of grout equal to 3 percent of amount installed for each type, composition, and color indicated.

PART 2 - PRODUCTS

2.1 PRODUCTS, GENERAL

- A. ANSI Ceramic Tile Standard: Provide tile that complies with ANSI A137.1 for types, compositions, and other characteristics indicated.
 1. Provide tile complying with Standard grade requirements unless otherwise indicated.
- B. ANSI Standards for Tile Installation Materials: Provide materials complying with ANSI A108.02, ANSI standards referenced in other Part 2 articles, ANSI standards referenced by TCA installation methods specified in tile installation schedules, and other requirements specified.
- C. Factory Blending: For tile exhibiting color variations within ranges, blend tile in factory and package so tile units taken from one package show same range in colors as those taken from other packages and match approved Samples.

2.2 TILE PRODUCTS

- A. Glazed Wall Tile (CT-1):
 1. Manufacturer: American Olean (wall tile)
 2. Module Size: 6 by 6 inches.
 3. Thickness: 5/16 inch.
 4. Face: Plain with cushion edges.
 5. Finish: Matte.
 6. Tile Color and Pattern: As selected by Architect from manufacturer's full range. Refer to finish schedule in construction drawings.
 7. Grout Color: As selected by Architect from manufacturer's full range.
 8. Trim Units: Coordinated with sizes and coursing of adjoining flat tile where applicable and matching characteristics of adjoining flat tile. Provide shapes as follows, selected from manufacturer's standard shapes:
 - a. Base for Thin-Set Mortar Installations: Straight, module size 6 by 6 inches.
 - b. Wainscot Cap for Thin-Set Mortar Installations: Surface bullnose, module size 6 by 6 inches.
 - c. External Corners for Thin-Set Mortar Installations: Surface bullnose, same size as adjoining flat tile.
 - d. Internal Corners: Field-buttet square corners. For coved base and cap use angle pieces designed to fit with stretcher shapes.

2.3 SETTING MATERIALS

- A. Latex-Portland Cement Mortar (Thin Set): ANSI A118.4.
1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
 - a. Bonsal American; an Oldcastle company.
 - b. Bostik, Inc.
 - c. C-Cure.
 - d. Laticrete International, Inc.
 - e. MAPEI Corporation.
 2. Provide prepackaged, dry-mortar mix containing dry, redispersible, vinyl acetate or acrylic additive to which only water must be added at Project site.
 3. Provide prepackaged, dry-mortar mix combined with acrylic resin liquid-latex additive at Project site.
 4. For wall applications, provide mortar that complies with requirements for nonsagging mortar in addition to the other requirements in ANSI A118.4.

2.4 GROUT MATERIALS

- A. Sand-Portland Cement Grout: ANSI A108.10, composed of white or gray cement and white or colored aggregate as required to produce color indicated.
- B. Polymer-Modified Tile Grout: ANSI A118.7.
1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
 - a. Bonsal American; an Oldcastle company.
 - b. Bostik, Inc.
 - c. C-Cure.
 - d. Laticrete International, Inc.
 - e. MAPEI Corporation.
 2. Polymer Type: Acrylic resin in liquid-latex form for addition to prepackaged dry-grout mix.

2.5 ELASTOMERIC SEALANTS

- A. General: Provide sealants, primers, backer rods, and other sealant accessories that comply with the following requirements and with the applicable requirements in Division 07 Section "Joint Sealants."
1. Use sealants that have a VOC content of 250 g/L or less when calculated according to 40 CFR 59, Subpart D (EPA Method 24).
 2. Use primers, backer rods, and sealant accessories recommended by sealant manufacturer.

- B. Colors: Provide colors of exposed sealants to match colors of grout in tile adjoining sealed joints unless otherwise indicated.

2.6 MIXING MORTARS AND GROUT

- A. Mix mortars and grouts to comply with referenced standards and mortar and grout manufacturers' written instructions.
- B. Add materials, water, and additives in accurate proportions.
- C. Obtain and use type of mixing equipment, mixer speeds, mixing containers, mixing time, and other procedures to produce mortars and grouts of uniform quality with optimum performance characteristics for installations indicated.

PART 3 - EXECUTION

3.1 EXAMINATION

- A. Examine substrates, areas, and conditions where tile will be installed, with Installer present, for compliance with requirements for installation tolerances and other conditions affecting performance of installed tile.
 - 1. Verify that substrates for setting tile are firm, dry, clean, free of coatings that are incompatible with tile-setting materials including curing compounds and other substances that contain soap, wax, oil, or silicone; and comply with flatness tolerances required by ANSI A108.01 for installations indicated.
 - 2. Verify that concrete substrates for tile floors installed with thin-set mortar comply with surface finish requirements in ANSI A108.01 for installations indicated.
 - a. Verify that surfaces that received a steel trowel finish have been mechanically scarified.
 - b. Verify that protrusions, bumps, and ridges have been removed by sanding or grinding.
 - 3. Verify that installation of grounds, anchors, recessed frames, electrical and mechanical units of work, and similar items located in or behind tile has been completed.
 - 4. Verify that joints and cracks in tile substrates are coordinated with tile joint locations; if not coordinated, adjust joint locations in consultation with Architect.
- B. Proceed with installation only after unsatisfactory conditions have been corrected.

3.2 PREPARATION

- A. Blending: For tile exhibiting color variations, verify that tile has been factory blended and packaged so tile units taken from one package show same range of colors as those taken from

other packages and match approved Samples. If not factory blended, either return to manufacturer or blend tiles at Project site before installing.

3.3 TILE INSTALLATION

- A. Comply with TCA's "Handbook for Ceramic Tile Installation" for TCA installation methods specified in tile installation schedules. Comply with parts of the ANSI A108 Series "Specifications for Installation of Ceramic Tile" that are referenced in TCA installation methods, specified in tile installation schedules, and apply to types of setting and grouting materials used.
- B. Extend tile work into recesses and under or behind equipment and fixtures to form complete covering without interruptions unless otherwise indicated. Terminate work neatly at obstructions, edges, and corners without disrupting pattern or joint alignments.
- C. 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 plates, collars, or covers overlap tile.
- D. Jointing Pattern: Lay tile in grid pattern unless otherwise indicated. Lay out tile work and center tile fields in both directions in each space or on each wall area. Lay out tile work to minimize the use of pieces that are less than half of a tile. Provide uniform joint widths unless otherwise indicated.
 - 1. For tile mounted in sheets, make joints between tile sheets same width as joints within tile sheets so joints between sheets are not apparent in finished work.
 - 2. Where adjoining tiles on floor, base, walls, or trim are specified or indicated to be same size, align joints.
 - 3. Where tiles are specified or indicated to be whole integer multiples of adjoining tiles on floor, base, walls, or trim, align joints unless otherwise indicated.
- E. Joint Widths: Unless otherwise indicated, install tile with the following joint widths:
 - 1. Glazed Wall Tile: 1/16 inch.
- F. Lay out tile wainscots to dimensions indicated or to next full tile beyond dimensions indicated.

3.4 CLEANING AND PROTECTING

- A. Cleaning: On completion of placement and grouting, clean all ceramic tile surfaces so they are free of foreign matter.
 - 1. Remove latex-portland cement grout residue from tile as soon as possible.
 - 2. Clean grout smears and haze from tile according to tile and grout manufacturer's written instructions but no sooner than 10 days after installation. Use only cleaners recommended by tile and grout manufacturers and only after determining that cleaners are safe to use by testing on samples of tile and other surfaces to be cleaned. Protect

metal surfaces and plumbing fixtures from effects of cleaning. Flush surfaces with clean water before and after cleaning.

3. Remove temporary protective coating by method recommended by coating manufacturer and that is acceptable to tile and grout manufacturer. Trap and remove coating to prevent drain clogging.
- B. Protect installed tile work with kraft paper or other heavy covering during construction period to prevent staining, damage, and wear. If recommended by tile manufacturer, apply coat of neutral protective cleaner to completed tile walls and floors.
- C. Prohibit foot and wheel traffic from tiled floors for at least seven days after grouting is completed.
- D. Before final inspection, remove protective coverings and rinse neutral protective cleaner from tile surfaces.

3.5 INTERIOR TILE INSTALLATION SCHEDULE

- A. Interior Wall Installations, Metal Studs or Furring:
 1. Tile Installation W244: Thin-set mortar on cementitious backer units or fiber cement underlayment; TCA W244.
 - a. Tile Type: Glazed wall tile.
 - b. Thin-Set Mortar: Latex- portland cement mortar.
 - c. Grout: Polymer-modified unsanded grout.

END OF SECTION 093000

SECTION 095113

ACOUSTICAL PANEL CEILINGS

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

- A. 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 acoustical panels and exposed suspension systems for ceilings.
- B. Related Sections include the following:
 - 1. Division 15 Section for sprinkler heads in acoustical ceilings.
 - 2. Division 15 Section for grilles, registers, and diffusers in acoustical ceilings.
 - 3. Division 16 Section for lighting fixtures in acoustical ceilings.
- C. Products furnished, but not installed under this Section, include anchors, clips, and other ceiling attachment devices to be cast in concrete at ceilings.

1.3 DEFINITIONS

- A. AC: Articulation Class.
- B. CAC: Ceiling Attenuation Class.
- C. LR: Light Reflectance coefficient.
- D. NRC: Noise Reduction Coefficient.

1.4 SUBMITTALS

- A. Product Data: For each type of product indicated.
- B. Samples for Verification: For each component indicated and for each exposed finish required, prepared on Samples of size indicated below.
 - 1. Acoustical Panel: Set of 6-inch- square Samples of each type, color, pattern, and texture.
 - 2. Exposed Suspension System Members, Moldings, and Trim: Set of 12-inch-long Samples of each type, finish, and color.

- C. Product Test Reports: Based on evaluation of comprehensive tests performed by a qualified testing agency, for each acoustical panel ceiling.
- D. Maintenance Data: For finishes to include in maintenance manuals.

1.5 QUALITY ASSURANCE

- A. Acoustical Testing Agency Qualifications: An independent testing laboratory, or an NVLAP-accredited laboratory, with the experience and capability to conduct the testing indicated. NVLAP-accredited laboratories must document accreditation, based on a "Certificate of Accreditation" and a "Scope of Accreditation" listing the test methods specified.
- B. Source Limitations: Obtain each type of acoustical ceiling panel and supporting suspension system through one source from a single manufacturer.
- C. Fire-Test-Response Characteristics: Provide acoustical panel ceilings that comply with the following requirements:
 - 1. Fire-Resistance Characteristics: Where indicated, provide acoustical panel ceilings identical to those of assemblies tested for fire resistance per ASTM E 119 by UL or another testing and inspecting agency acceptable to authorities having jurisdiction.
 - a. Fire-Resistance Ratings: Indicated by design designations from UL's "Fire Resistance Directory" or from the listings of another testing and inspecting agency.
 - b. Identify materials with appropriate markings of applicable testing and inspecting agency.
 - 2. Surface-Burning Characteristics: Provide acoustical panels with the following surface-burning characteristics complying with ASTM E 1264 for Class A materials as determined by testing identical products per ASTM E 84:
 - a. Flame Spread: 25 or less.
 - b. Smoke Developed: 50 or less.
- D. Seismic Standard: Provide acoustical panel ceilings designed and installed to withstand the effects of earthquake motions according to the following:
 - 1. Standard for Ceiling Suspension Systems Requiring Seismic Restraint: Comply with ASTM E 580.
 - 2. CISCA's Recommendations for Acoustical Ceilings: Comply with CISCA's "Recommendations for Direct-Hung Acoustical Tile and Lay-in Panel Ceilings--Seismic Zones 0-2."
 - 3. ASCE 7, "Minimum Design Loads for Buildings and Other Structures": Section 9, "Earthquake Loads."

1.6 DELIVERY, STORAGE, AND HANDLING

- A. Deliver acoustical panels, suspension system components, and accessories to Project site in original, unopened packages and store them in a fully enclosed, conditioned space where they will be protected against damage from moisture, humidity, temperature extremes, direct sunlight, surface contamination, and other causes.
- B. Before installing acoustical panels, permit them to reach room temperature and a stabilized moisture content.
- C. Handle acoustical panels carefully to avoid chipping edges or damaging units in any way.

1.7 PROJECT CONDITIONS

- A. Environmental Limitations: Do not install acoustical panel ceilings until spaces are enclosed and weatherproof, wet work in spaces is complete and dry, work above ceilings is complete, and ambient temperature and humidity conditions are maintained at the levels indicated for Project when occupied for its intended use.

1.8 COORDINATION

- A. Coordinate layout and installation of acoustical panels and suspension system with other construction that penetrates ceilings or is supported by them, including light fixtures, HVAC equipment, fire-suppression system, and partition assemblies.

1.9 EXTRA MATERIALS

- A. Furnish extra materials described below that match products installed and that are packaged with protective covering for storage and identified with labels describing contents.
 - 1. Acoustical Ceiling Panels: Full-size panels equal to 2.0 percent of quantity installed.
 - 2. Suspension System Components: Quantity of each exposed component equal to 2.0 percent of quantity installed.
 - 3. Hold-Down Clips: Equal to 2.0 percent of quantity installed.

PART 2 - PRODUCTS

2.1 ACOUSTICAL PANELS, GENERAL

- A. Acoustical Panel Standard: Provide manufacturer's standard panels of configuration indicated that comply with ASTM E 1264 classifications as designated by types, patterns, acoustical ratings, and light reflectances, 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 away from test surface per ASTM E 795.

- B. Acoustical Panel Colors and Patterns: Match appearance characteristics indicated for each product type.
 - 1. Where appearance characteristics of acoustical panels are indicated by referencing pattern designations in ASTM E 1264 and not manufacturers' proprietary product designations, provide products selected by Architect from each manufacturer's full range that comply with requirements indicated for type, pattern, color, light reflectance, acoustical performance, edge detail, and size.
- C. Broad Spectrum Antimicrobial Fungicide and Bactericide Treatment: Provide acoustical panels treated with manufacturer's standard antimicrobial formulation that inhibits fungus, mold, mildew, and gram-positive and gram-negative bacteria and showing no mold, mildew, or bacterial growth when tested according to ASTM D 3273 and evaluated according to ASTM D 3274 or ASTM G 21.
- D. Antimicrobial Fungicide Treatment: Provide acoustical panels with face and back surfaces coated with antimicrobial treatment consisting of manufacturer's standard formulation with fungicide added to inhibit growth of mold and mildew and showing no mold or mildew growth when tested according to ASTM D 3273 and evaluated according to ASTM D 3274 or ASTM G 21

2.2 ACOUSTICAL PANELS FOR ACOUSTICAL PANEL CEILING: (ACT-1)

- A. Available Products: Subject to compliance with requirements.
 - 1. Manufacturer: USG, Hamilton, MA 01982. (800) 887-8744
 - 2. Product: Frost Climaplus 414
- B. Classification: Provide panels complying with ASTM E 1264 for type, form, and pattern as follows:
 - 1. Type and Form: Type III, mineral base with painted finish; Form 4.
 - 2. Pattern: E (lightly textured).
- C. Color: Flat White.
- D. LR: Not less than 0.83.
- E. NRC: Not less than 0.70.
- F. CAC: Not less than 38.
- G. Edge/Joint Detail: Grid Profile A
- H. Thickness: 3/4 inch.
- I. Modular Size: 24 by 24 inches.

- J. Antimicrobial Treatment: Broad-spectrum fungicide and bactericide based.

2.3 METAL SUSPENSION SYSTEM FOR ACOUSTICAL PANEL CEILING: (ACT-1)

- A. Available Products: Subject to compliance with requirements:

- 1. USG; DXL Concealed.

- B. Concealed Steel Suspension System: Main and cross runners roll formed from fire-rated, double-web, hot-dipped galvanized steel according to ASTM A 653/A 653M, not less than G30 coating designation, with prefinished 15/16-inch wide metal caps on flanges.

- 1. Structural Classification: Intermediate-duty system.
 - 2. End Condition of Cross Runners: Override (stepped) or butt-edge type.
 - 3. Face Design: Concealed.
 - 4. Cap Material: Steel cold-rolled sheet.
 - 5. Cap Finish: Flat White.

2.4 METAL EDGE MOLDINGS AND TRIM

- A. Roll-Formed, Sheet-Metal Edge Moldings and Trim: Type and profile indicated or, if not indicated, manufacturer's standard moldings for edges and penetrations that comply with seismic design requirements; formed from sheet metal of same material, finish, and color as that used for exposed flanges of suspension system runners.

- 1. Provide manufacturer's standard edge moldings that fit acoustical panel edge details and suspension systems indicated and that match width and configuration of exposed runners, unless otherwise indicated.
 - 2. For circular penetrations of ceiling, provide edge moldings fabricated to diameter required to fit penetration exactly.

PART 3 - EXECUTION

3.1 EXAMINATION

- A. Examine substrates, areas, and conditions, including structural framing to which acoustical panel ceilings attach or abut, with Installer present, for compliance with requirements specified in this and other Sections that affect ceiling installation and anchorage and with requirements for installation tolerances and other conditions affecting performance of acoustical panel ceilings.

- 1. Proceed with installation only after unsatisfactory conditions have been corrected.

3.2 PREPARATION

- A. Measure each ceiling area and establish layout of acoustical panels to balance border widths at opposite edges of each ceiling. Avoid using less-than-half-width panels at borders, and comply with layout shown on reflected ceiling plans.

3.3 INSTALLATION

- A. General: Install acoustical panel ceilings to comply with ASTM C 636 and seismic design requirements indicated, per manufacturer's written instructions and CISCA's "Ceiling Systems Handbook."
- B. Suspend ceiling hangers from building's 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 structure or of ceiling suspension system.
 - 2. Splay hangers only where required to miss obstructions; offset resulting horizontal forces by bracing, countersplaying, or other equally effective means.
 - 3. Splay hangers only where required to miss obstructions; offset resulting horizontal forces by bracing, countersplaying, or other equally effective means.
 - 4. Where width of ducts and other construction within ceiling plenum produces hanger spacings that interfere with 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.
 - 5. Secure wire hangers to ceiling suspension members and to supports above with a minimum of three tight turns. Connect hangers directly either to structures or to inserts, eye screws, or other devices that are secure and appropriate for substrate and that will not deteriorate or otherwise fail due to age, corrosion, or elevated temperatures.
 - 6. Secure flat, angle, channel, and rod hangers to structure, including intermediate framing members, by attaching to inserts, eye screws, or other devices that are secure and appropriate for both structure to which hangers are attached and type of hanger involved. Install hangers in a manner that will not cause them to deteriorate or fail due to age, corrosion, or elevated temperatures.
 - 7. Do not support ceilings directly from permanent metal forms or floor deck. Fasten hangers to cast-in-place hanger inserts, postinstalled mechanical or adhesive anchors, or power-actuated fasteners that extend through forms into concrete.
 - 8. When steel framing does not permit installation of hanger wires at spacing required, install carrying channels or other supplemental support for attachment of hanger wires.
 - 9. Do not attach hangers to steel deck tabs.
 - 10. Do not attach hangers to steel roof deck. Attach hangers to structural members.
 - 11. Space hangers not more than 48 inches o.c. along each member supported directly from hangers, unless otherwise indicated; provide hangers not more than 8 inches from ends of each member.
 - 12. Size supplemental suspension members and hangers to support ceiling loads within performance limits established by referenced standards and publications.
- C. Secure bracing wires to ceiling suspension members and to supports with a minimum of four tight turns. Suspend bracing from building's structural members as required for hangers,

without attaching to permanent metal forms, steel deck, or steel deck tabs. Fasten bracing wires into concrete with cast-in-place or postinstalled anchors.

- D. Install edge moldings and trim of type indicated at perimeter of acoustical ceiling area and where necessary to conceal edges of acoustical panels.
 - 1. Screw attach moldings to substrate at intervals not more than 16 inches o.c. and not more than 3 inches from ends, leveling with ceiling suspension system to a tolerance of 1/8 inch in 12 feet. Miter corners accurately and connect securely.
 - 2. Do not use exposed fasteners, including pop rivets, on moldings and trim.
- E. Install suspension system runners so they are square and securely interlocked with one another. Remove and replace dented, bent, or kinked members.
- F. Install acoustical panels with undamaged edges and fit accurately into suspension system runners and edge moldings. Scribe and cut panels at borders and penetrations to provide a neat, precise fit.
 - 1. Arrange directionally patterned acoustical panels as follows:
 - a. As indicated on reflected ceiling plans.
 - 2. For square-edged panels, install panels with edges fully hidden from view by flanges of suspension system runners and moldings.
 - 3. For reveal-edged panels on suspension system runners, install panels with bottom of reveal in firm contact with top surface of runner flanges.
 - 4. Paint cut edges of panel remaining exposed after installation; match color of exposed panel surfaces using coating recommended in writing for this purpose by acoustical panel manufacturer.
 - 5. Install hold-down clips in areas within 10 feet of exterior doors or vestibule doors; space as recommended by panel manufacturer's written instructions, unless otherwise indicated or required.

3.4 CLEANING

- A. Clean exposed surfaces of acoustical panel ceilings, including trim, edge moldings, and suspension system members. Comply with manufacturer's written instructions for cleaning and touchup of minor finish damage. Remove and replace ceiling components that cannot be successfully cleaned and repaired to permanently eliminate evidence of damage.

END OF SECTION 095113

SECTION 096516

RESILIENT SHEET FLOORING

PART 1 - GENERAL

1.1 SUMMARY

A. This Section includes the following:

1. Vinyl sheet floor covering
2. Rubber sheet floor covering, with and without backing.

B. Related Sections include the following:

1. Division 09 Section "Resilient Base and Accessories" for resilient base, reducer strips, and other accessories installed with resilient floor coverings.
2. Division 09 Section "Resilient Tile Flooring" for resilient floor tile.

1.2 SUBMITTALS

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

B. Samples for Initial Selection: For each type of floor covering indicated.

1. Include similar Samples of installation accessories involving color selection.

C. Samples for Verification: In manufacturer's standard size, but not less than 6-by-9-inch sections of each different color and pattern of floor covering required.

1. For heat-welding bead, manufacturer's standard-size Samples, but not less than 9 inches long, of each color required.

D. Heat-Welded Seam Samples: For each flooring product and welding bead color and pattern combination required; with seam running lengthwise and in center of 6-by-9-inch sample applied to a rigid backing and prepared by Installer for this Project.

E. Qualification Data: For qualified Installer.

F. Maintenance Data: For floor coverings to include in maintenance manuals.

1.3 QUALITY ASSURANCE

A. Installer Qualifications: A qualified installer who employs workers for this Project who are competent in techniques required by manufacturer for floor covering installation and seaming method indicated.

1. Engage an installer who employs workers for this Project who are trained or certified by floor covering manufacturer for installation techniques required.
 - B. Fire-Test-Response Characteristics: As determined by testing identical products according to ASTM E 648 or NFPA 253 by a qualified testing agency.
 1. Critical Radiant Flux Classification: Class I, not less than 0.45 W/sq. cm.
 - C. Flooring system including floor covering material and adhesives shall have the ability to withstand water vapor transmission levels up to 3 lbs/24 hours per 1,000/sf and pH levels up to 9.
- 1.4 DELIVERY, STORAGE, AND HANDLING
- A. Store floor coverings and installation materials in dry spaces protected from the weather, with ambient temperatures maintained within range recommended by manufacturer, but not less than 50 deg F (10 deg C) or more than 90 deg F (32 deg C). Store rolls upright.
- 1.5 PROJECT CONDITIONS
- A. Maintain ambient temperatures within range recommended by manufacturer, but not less than 70 deg F (21 deg C) or more than 85 deg F (29 deg C), in spaces to receive floor coverings during the following time periods:
 1. 48 hours before installation.
 2. During installation.
 3. 48 hours after installation.
 - B. Until Substantial Completion, maintain ambient temperatures within range recommended by manufacturer, but not less than 55 deg F (13 deg C) or more than 95 deg F (35 deg C).
 - C. Close spaces to traffic during floor covering installation.
 - D. Close spaces to traffic for 48 hours after floor covering installation.
 - E. Install floor coverings after other finishing operations, including painting, have been completed.
- 1.6 EXTRA MATERIALS
- A. Furnish extra materials described below that match products installed and that are packaged with protective covering for storage and identified with labels describing contents.
 1. Furnish one (1) percent but not less than 10 linear feet, in roll form and in full roll width for each color, pattern, and type of floor covering installed.

PART 2 - PRODUCTS

2.1 SHEET VINYL FLOOR COVERING

A. Sheet Vinyl Flooring: (SV-1):

1. Manufacturer: Mannington Resilient Floors, Salem, NJ 08079. (800)-241-2262.
2. Product: Assurance II
3. Construction: Slip-Retardant Sheet Flooring
4. Description: Seamless, Class I commercial sheet vinyl with vinyl back complying with ASTM E 648 and ASTM E 662.
 - a. Seam Method: Recess scribe. Seam Treatment: Heat weld. Color of welding rods as selected by the Architect from manufacturer's full range of patterned and solid colors.
5. Gauge: 0.080" (2.0 mm)
6. Width: 6'-0" (2.0 m)
7. Maximum Square Yard Per Roll: 68.
8. Adhesives: As recommended by manufacturer.

B. Sheet Vinyl Flooring: (SV-2)

1. Manufacturer: Toli International.
2. Product: Mature Woods.
3. Description: Seamless, Class I commercial sheet vinyl with vinyl back complying with ASTM E 648 and ASTM E 662.
 - a. Seaming Method: Recess scribe. Seam Treatment: Heat weld. Color of welding rods as selected by the Architect from manufacturer's full range of patterned and solid colors.
4. Gauge: 0.080" (2.0 mm)
5. Width: 6-foot roll
6. Roll Length: 66'
7. Wear Layer Thickness: 0.51 mm (0.020").
8. Static load limit: ASTM F-970, 2500psi.
9. Adhesives: S-575 full spread, as recommended by manufacturer.
10. Color: As selected by Architect from full range of industry colors. Refer to finish schedule in construction drawings.

2.2 RUBBER SHEET FLOOR COVERING: (RUB-1)

A. Products: Subject to compliance with requirements, provide the following:

1. Nora Rubber Flooring, Freudenberg Building Systems, Inc.; Environcare 3.0

B. Installation Method: Adhered.

C. Traffic-Surface Texture: Smooth.

D. Roll Size: 48" width by 39.3' long.

- E. Thickness: .12" (3.0 mm)
- F. Seaming Method: Recess scribe. Seam Treatment: Heat Weld. Color of welding rods as selected by the Architect from Manufacturer's full range of patterned and solid colors.
- G. Color and Pattern: As selected by Architect from manufacturer's full range. Refer to finish schedule in construction documents.

2.3 RUBBER SHEET FLOOR COVERING: (RUB-2)

- A. Products: Subject to compliance with requirements, provide the following:
 - 1. Nora Rubber Flooring, Freudenberg Building Systems, Inc.; Environcare 3.0
- B. Material: Rubber wear layer. Acoustical backing to be provided at specified areas, refer to construction drawings.
- C. Installation Method: Adhered.
- D. Traffic-Surface Texture: Smooth.
- E. Roll Size: 48" width by 39.3' long.
- F. Thickness: .12" (3.0 mm)
- G. Seaming Method: Recess scribe. Seam Treatment: Heat Weld. Color of welding rods as selected by the Architect from Manufacturer's full range of patterned and solid colors.
- H. Color and Pattern: As selected by Architect from manufacturer's full range. Refer to finish schedule in construction documents.
- I. Accessories:
 - 1. Trowelable Leveling and Patching Compound: Latex-modified, hydraulic-cement-based formulation approved by floor covering manufacturer.
 - 2. Installation Adhesive: Water-resistant type recommended in writing by manufacturer for substrate and conditions indicated.
 - a. Use adhesive that has a VOC content of 60 g/L or less when calculated according to 40 CFR 59, Subpart D (EPA Method 24).
 - 3. VOC content: Provide products with VOC content not more than 150 g/L when calculated according to 40 CFR 59, Subpart D (EPA Method 24).

2.4 Fire-Test-Response Characteristics:

- 1. Critical Radiant Flux Classification: Class I, not less than 0.45 W/sq. cm per ASTM E 648.

2. ASTM E 662 (Smoke Generation) Maximum Specific Optical Density of 450 or less.

2.5 INSTALLATION MATERIALS

- A. Trowelable Leveling and Patching Compounds: Latex-modified, portland cement based or blended hydraulic cement based formulation provided or approved by floor covering manufacturer for applications indicated.
- B. Adhesives: Moisture and alkali -resistant type recommended by manufacturer to suit sheet vinyl floor covering and substrate conditions indicated; Armstrong "Next Generation" adhesives.
 1. Use adhesives that have a VOC content of 50 g/L or less when calculated according to 40 CFR 59, Subpart D (EPA Method 24).
- C. Welding Rods:
 1. Heat Weld Seams (**SV-1**): Mannington Commercial Heat-Welding Rods. Color to match the Mannington Commercial, Assurance II color specified, unless otherwise noted.
 2. Heat Weld Seams (**SV-2**): Color to match the Toli, Mature Wood color specified, unless otherwise noted.
 3. Heat Weld Seams (**RUB-1 & RUB-2**): Color to match the Nora Environcare color specified, unless otherwise noted.
- D. Integral-Flash-Cove-Base Accessories:
 1. Cap Strip: Square metal, Schluter Systems, L.P. (800)-472-4588.

PART 3 - EXECUTION

3.1 EXAMINATION

- A. Examine substrates, with Installer present, for compliance with requirements for installation tolerances, moisture content, and other conditions affecting performance.
 1. Verify that finishes of substrates comply with tolerances and other requirements specified in other Sections and that substrates are free of cracks, ridges, depressions, scale, and foreign deposits that might interfere with adhesion of floor coverings.
 2. Proceed with installation only after unsatisfactory conditions have been corrected.

3.2 PREPARATION

- A. Prepare substrates according to manufacturer's written recommendations to ensure adhesion of floor coverings.

- B. Concrete Substrates: Prepare according to ASTM F 710.
 - 1. Verify that substrates are dry and free of curing compounds, sealers, and hardeners.
 - 2. Remove substrate coatings and other substances that are incompatible with adhesives and that contain soap, wax, oil, or silicone, using mechanical methods recommended by manufacturer. Do not use solvents.
 - 3. Alkalinity and Adhesion Testing: Perform tests recommended by manufacturer. Proceed with installation only after substrates pass testing.
 - 4. Moisture Testing: Perform tests recommended by manufacturer and as follows. Proceed with installation only after substrates pass testing.
 - a. Perform anhydrous calcium chloride test, ASTM F 1869. Proceed with installation only after substrates have maximum moisture-vapor-emission rate of 3 lb of water/1000 sq. ft. (1.36 kg of water/92.9 sq. m) in 24 hours.
 - b. Perform relative humidity test using in situ probes, ASTM F 2170. Proceed with installation only after substrates have a maximum 75% relative humidity level measurement.
- C. Fill cracks, holes, and depressions in substrates with trowelable leveling and patching compound and remove bumps and ridges to produce a uniform and smooth substrate.
- D. Do not install floor covering until it is the same temperature as space where it is to be installed.
 - 1. Move resilient products and installation materials into spaces where they will be installed at least 48 hours in advance of installation.
- E. Sweep and vacuum clean substrates to be covered by resilient products immediately before installation.

3.3 INSTALLATION

- A. Unroll sheet vinyl floor coverings and allow them to stabilize before cutting and fitting.
- B. Lay out sheet vinyl floor coverings as follows:
 - 1. Maintain uniformity of floor covering direction.
 - 2. Minimize number of seams; place seams in inconspicuous and low-traffic areas, at least 6 inches (152 mm) away from parallel joints in floor covering substrates.
 - 3. Match edges of floor coverings for color shading at seams.
 - 4. Avoid cross seams.
- C. Scribe and cut floor coverings to butt neatly and tightly to vertical surfaces, permanent fixtures, and built-in furniture including cabinets, pipes, outlets, edgings, thresholds, and nosings.
- D. Extend floor coverings into toe spaces, door reveals, closets, and similar openings.
- E. Maintain reference markers, holes, or openings that are in place or marked for future cutting by repeating on floor coverings as marked on substrates. Use chalk or other nonpermanent marking device.

- F. Install floor coverings on covers for telephone and electrical ducts and similar items in installation areas. Maintain overall continuity of color and pattern with pieces of floor coverings installed on covers. Tightly adhere floor covering edges to substrates that abut covers and to cover perimeters.
- G. Adhere floor coverings to substrates using a full spread of adhesive applied to substrate to produce a completed installation without open cracks, voids, raising and puckering at joints, telegraphing of adhesive spreader marks, and other surface imperfections.
- H. Heat-Welded Seams: Comply with ASTM F 1516. Rout joints and use welding bead to permanently fuse sections into a seamless floor covering. Prepare, weld, and finish seams to produce surfaces flush with adjoining floor covering surfaces.
- I. Integral Flash Cove Base: Cove floor coverings 6 inches up vertical surfaces. Support floor coverings at horizontal and vertical junction by cove strip. Butt at top against cap strip.
 - 1. Install metal corners at inside and outside corners.

3.4 CLEANING AND PROTECTION

- A. Perform the following operations immediately after completing floor covering installation:
 - 1. Remove adhesive and other blemishes from floor covering surfaces.
 - 2. Sweep and vacuum floor coverings thoroughly.
 - 3. Damp-mop floor coverings to remove marks and soil.
 - a. Do not wash floor coverings until after time period recommended by manufacturer.
- B. Protect floor coverings from mars, marks, indentations, and other damage from construction operations and placement of equipment and fixtures during remainder of construction period. Use protection methods recommended in writing by manufacturer.
 - 1. Apply protective floor polish to surfaces that are free from soil, visible adhesive, and blemishes if recommended in writing by manufacturer.
 - 2. Cover floor coverings with undyed, untreated building paper until Substantial Completion.
 - 3. Do not move heavy and sharp objects directly over floor coverings. Place plywood or hardboard panels over floor coverings and under objects while they are being moved. Slide or roll objects over panels without moving panels.

END OF SECTION 096516

SECTION 096519

RESILIENT TILE FLOORING

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

- A. 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:
 - 1. Vinyl composition floor tile.
- B. Related Sections:
 - 1. Division 09 Section "Resilient Base and Accessories" for resilient base, reducer strips, and other accessories installed with resilient floor coverings.

1.3 SUBMITTALS

- A. Product Data: For each type of product indicated.
- B. Samples for Initial Selection: For each type of floor tile indicated.
- C. Product Schedule: For floor tile. Use same designations indicated on Drawings.
- D. Qualification Data: For qualified Installer.
- E. Maintenance Data: For each type of floor tile to include in maintenance manuals.

1.4 QUALITY ASSURANCE

- A. Installer Qualifications: A qualified installer who employs workers for this Project who are competent in techniques required by manufacturer for floor tile installation indicated.
 - 1. Engage an installer who employs workers for this Project who are trained or certified by manufacturer for installation techniques required.
- B. Fire-Test-Response Characteristics: As determined by testing identical products according to ASTM E 648 or NFPA 253 by a qualified testing agency.
 - 1. Critical Radiant Flux Classification: Class I, not less than 0.45 W/sq. cm.

1.5 DELIVERY, STORAGE, AND HANDLING

- A. Store floor tile and installation materials in dry spaces protected from the weather, with ambient temperatures maintained within range recommended by manufacturer, but not less than 50 deg F (10 deg C) or more than 90 deg F (32 deg C). Store floor tiles on flat surfaces.

1.6 PROJECT CONDITIONS

- A. Maintain ambient temperatures within range recommended by manufacturer, but not less than 70 deg F (21 deg C) or more than 95 deg F (35 deg C), in spaces to receive floor tile during the following time periods:
 - 1. 48 hours before installation.
 - 2. During installation.
 - 3. 48 hours after installation.
- B. Until Substantial Completion, maintain ambient temperatures within range recommended by manufacturer, but not less than 55 deg F (13 deg C) or more than 95 deg F (35 deg C).
- C. Close spaces to traffic during floor tile installation.
- D. Close spaces to traffic for 48 hours after floor tile installation.
- E. Install floor tile after other finishing operations, including painting, have been completed.

1.7 EXTRA MATERIALS

- A. Furnish extra materials that match products installed and that are packaged with protective covering for storage and identified with labels describing contents.
 - 1. Floor Tile: Furnish 1 box for every 50 boxes or fraction thereof, of each type, color, and pattern of floor tile installed.

PART 2 - PRODUCTS

2.1 VINYL COMPOSITION FLOOR TILE: (VCT-1, VCT-2, VCT-3)

- A. Products: Subject to compliance with requirements, provide the following:
 - 1. Armstrong World Industries, Inc.; Standard Excelon, Imperial Texture.
- B. Tile Standard: ASTM F 1066, Class 2, through-pattern tile.
- C. Wearing Surface: Smooth.
- D. Thickness: 0.125 inch (3.2 mm).
- E. Size: 12 by 12 inches (305 by 305 mm).

- F. Colors and Patterns: As selected by Architect from full range of industry colors. Patterns as detailed on Floor Finish drawings in Construction Drawings.

2.2 INSTALLATION MATERIALS

- A. Trowelable Leveling and Patching Compounds: Latex-modified, portland cement based or blended hydraulic-cement-based formulation provided or approved by manufacturer for applications indicated.
- B. Adhesives: Water-resistant type recommended by manufacturer to suit floor tile and substrate conditions indicated.
 - 1. Use adhesives that comply with the following limits for VOC content when calculated according to 40 CFR 59, Subpart D (EPA Method 24):
 - a. Vinyl Composition Floor Tile Adhesives: Not more than 50 g/L.
- C. Floor Polish: Provide protective liquid floor polish products as recommended by manufacturer.

PART 3 - EXECUTION

3.1 EXAMINATION

- A. Examine substrates, with Installer present, for compliance with requirements for maximum moisture content and other conditions affecting performance of the Work.
- B. Verify that finishes of substrates comply with tolerances and other requirements specified in other Sections and that substrates are free of cracks, ridges, depressions, scale, and foreign deposits that might interfere with adhesion of floor tile.
- C. Proceed with installation only after unsatisfactory conditions have been corrected.

3.2 PREPARATION

- A. Prepare substrates according to manufacturer's written instructions to ensure adhesion of resilient products.
- B. Concrete Substrates: Prepare according to ASTM F 710.
 - 1. Verify that substrates are dry and free of curing compounds, sealers, and hardeners.
 - 2. Remove substrate coatings and other substances that are incompatible with adhesives and that contain soap, wax, oil, or silicone, using mechanical methods recommended by manufacturer. Do not use solvents.
 - 3. Alkalinity and Adhesion Testing: Perform tests recommended by manufacturer. Proceed with installation only after substrates pass testing.
 - 4. Moisture Testing: Perform tests recommended by manufacturer and as follows. Proceed with installation only after substrates pass testing.

- a. Perform anhydrous calcium chloride test, ASTM F 1869. Proceed with installation only after substrates have maximum moisture-vapor-emission rate of 3 lb of water/1000 sq. ft. (1.36 kg of water/92.9 sq. m) in 24 hours.
 - b. Perform relative humidity test using in situ probes, ASTM F 2170. Proceed with installation only after substrates have a maximum 75% relative humidity level measurement.
- C. Fill cracks, holes, and depressions in substrates with trowelable leveling and patching compound and remove bumps and ridges to produce a uniform and smooth substrate.
- D. Do not install floor tiles until they are same temperature as space where they are to be installed.
1. Move resilient products and installation materials into spaces where they will be installed at least 48 hours in advance of installation.
- E. Sweep and vacuum clean substrates to be covered by resilient products immediately before installation.

3.3 FLOOR TILE INSTALLATION

- A. Comply with manufacturer's written instructions for installing floor tile.
- B. Lay out floor tiles from center marks established with principal walls, discounting minor offsets, so tiles at opposite edges of room are of equal width. Adjust as necessary to avoid using cut widths that equal less than one-half tile at perimeter.
1. Lay tiles square with room axis.
- C. Match floor tiles for color and pattern by selecting tiles from cartons in the same sequence as manufactured and packaged, if so numbered. Discard broken, cracked, chipped, or deformed tiles.
1. Lay tiles with grain running in one direction and in pattern of colors and sizes indicated.
- D. Scribe, cut, and fit floor tiles to butt neatly and tightly to vertical surfaces and permanent fixtures including built-in furniture, cabinets, pipes, outlets, and door frames.
- E. Extend floor tiles into toe spaces, door reveals, closets, and similar openings. Extend floor tiles to center of door openings.
- F. Maintain reference markers, holes, and openings that are in place or marked for future cutting by repeating on floor tiles as marked on substrates. Use chalk or other nonpermanent, nonstaining marking device.
- G. Install floor tiles on covers for telephone and electrical ducts, building expansion-joint covers, and similar items in finished floor areas. Maintain overall continuity of color and pattern between pieces of tile installed on covers and adjoining tiles. Tightly adhere tile edges to substrates that abut covers and to cover perimeters.

- H. Adhere floor tiles to flooring substrates using a full spread of adhesive applied to substrate to produce a completed installation without open cracks, voids, raising and puckering at joints, telegraphing of adhesive spreader marks, and other surface imperfections.

3.4 CLEANING AND PROTECTION

- A. Comply with manufacturer's written instructions for cleaning and protection of floor tile.
- B. Perform the following operations immediately after completing floor tile installation:
 - 1. Remove adhesive and other blemishes from exposed surfaces.
 - 2. Sweep and vacuum surfaces thoroughly.
 - 3. Damp-mop surfaces to remove marks and soil.
- C. Protect floor tile products from mars, marks, indentations, and other damage from construction operations and placement of equipment and fixtures during remainder of construction period.
- D. Floor Polish: Remove soil, visible adhesive, and surface blemishes from floor tile surfaces before applying liquid floor polish.
 - 1. Apply two coats.
- E. Cover floor tile until Substantial Completion.

END OF SECTION 096519

SECTION 096530

RESILIENT BASE AND ACCESSORIES

PART 1 - GENERAL

1.1 SUMMARY

- A. This Section includes the following:
 - 1. Resilient wall base.
 - 2. Molding accessories.
- B. Related Sections:
 - 1. Division 09 Section "Resilient Sheet Flooring" for resilient sheet floor coverings.
 - 2. Division 09 Section "Resilient Tile Flooring" for resilient floor tile.

1.2 SUBMITTALS

- A. Product Data: For each type of product indicated.
- B. Samples for Initial Selection: For each type of product indicated.
- C. Samples for Verification: For each type of product indicated, in manufacturer's standard-size Samples but not less than 12 inches (300 mm) long, of each resilient product color, texture, and pattern required.

1.3 QUALITY ASSURANCE

- A. Fire-Test-Response Characteristics: Provide resilient stair accessories with a critical radiant flux classification of Class I, not less than 0.45 W/sq. cm, as determined by testing identical products per ASTM E 648 by a testing and inspecting agency acceptable to authorities having jurisdiction.

1.4 DELIVERY, STORAGE, AND HANDLING

- A. Store resilient products and installation materials in dry spaces protected from the weather, with ambient temperatures maintained within range recommended by manufacturer, but not less than 50 deg F (10 deg C) or more than 90 deg F (32 deg C).

1.5 EXTRA MATERIALS

A. Furnish extra materials described below that match products installed and that are packaged with protective covering for storage and identified with labels describing contents.

1. Furnish one (1) 100-foot roll for each color, size and type of resilient wall base installed.

PART 2 - PRODUCTS

2.1 RESILIENT WALL BASE: (RB-1)

A. Rubber Wall Base: ASTM F 1861.

1. Manufacturer: Johnsonite, distributed by NRF Commercial Flooring Distributors, Augusta, Maine 04338. (Leah Cavalli, (800) 673-3478 x6091).

2. Description: Type TP (rubber, thermoplastic), Group I (solid, homogeneous), Top set type, Cove (base with toe), ribbed back, and rounded top, complying with performance and dimensional requirements of ASTM F-1861.

3. Minimum Thickness: 0.125 inch. (3.17 mm).

4. Height: 4 inches. (10.16 cm).

5. Lengths: Coils in manufacturer's longest standard length.

6. Finish: Matte.

7. Colors: As selected by Architect from full range of industry colors. Refer to finish schedule in construction drawings.

8. Outside Corners: pre-molded.

9. Inside Corners: pre-molded or job molded.

2.2 RESILIENT MOLDING ACCESSORY

A. Description: Provide carpet edge for glue-down applications, reducer strip for resilient floor covering, and transitions strips for tile and carpet.

1. Manufacturer: Johnsonite, distributed by NRF Commercial Flooring Distributors, Augusta, Maine 04338. (Leah Cavalli, (800) 673-3478x 6091).

2. Material: Rubber.

3. Profiles:

1. Resilient to carpet: CTA-XX-H.

2. Resilient to sheet vinyl: CTA-XX-X.

3. Carpet to sheet vinyl: CTA-XX-HT.

B. Colors: As selected by Architect from manufacturer's full range.

2.3 INSTALLATION MATERIALS

- A. Trowelable Leveling and Patching Compounds: Latex-modified, portland cement based or blended hydraulic cement based formulation provided or approved by resilient product manufacturers for applications indicated.
- B. Adhesives: Water-resistant type recommended by manufacturer to suit resilient products and substrate conditions indicated.
 - 1. Use adhesives that comply with the following limits for VOC content when calculated according to 40 CFR 59, Subpart D (EPA Method 24):
 - a. Adhesives: 50 g/L.
 - 2. Resilient Base: Johnsonite #960 Acrylic Cove Base Adhesive.
 - 3. Resilient Moldings: Johnsonite #945 Contact Bond Adhesive.
- C. Metal Edge Strips: Extruded aluminum with mill finish of width shown, of height required to protect exposed edges of tiles, and in maximum available lengths to minimize running joints.
- D. Floor Polish: Provide protective liquid floor polish products as recommended by resilient stair tread manufacturer.

END OF SECTION 096530

SECTION 096816

SHEET CARPETING

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

- A. 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. Tufted Textured Loop.

- B. Related Sections include the following:

- 1. Division 09 Section "Resilient Base and Accessories" for resilient wall base and accessories installed with carpet.

1.3 SUBMITTALS

- A. Product Data: For the following, including installation recommendations for each type of substrate:

- 1. Carpet: For each type indicated. Include manufacturer's written data on physical characteristics, durability, and fade resistance.

- B. Samples: For each of the following products and for each color and texture required. Label each Sample with manufacturer's name, material description, color, pattern, and designation indicated on Drawings and in schedules.

- 1. Carpet: 12-inch- square Sample.
 - 2. Carpet Seam: 6-inch Sample.

- C. Product Schedule: For carpet Use same designations indicated on Drawings.

- D. Maintenance Data: For carpet to include in maintenance manuals. Include the following:

- 1. Methods for maintaining carpet, including cleaning and stain-removal products and procedures and manufacturer's recommended maintenance schedule.

- 2. Precautions for cleaning materials and methods that could be detrimental to carpet.

- E. Warranties: Special warranties specified in this Section.

1.4 QUALITY ASSURANCE

- A. Installer Qualifications: An experienced installer who is certified by the Floor Covering Installation Board or who can demonstrate compliance with its certification program requirements.
- B. Fire-Test-Response Characteristics: Provide products with the critical radiant flux classification indicated in Part 2, as determined by testing identical products per ASTM E 648 by an independent testing and inspecting agency acceptable to authorities having jurisdiction.
- C. Provide products that comply with ASTM D 2859 *Standard Test Method for Ignition Characteristics of Finished Textile Floor Covering Materials*.

1.5 DELIVERY, STORAGE, AND HANDLING

- A. Comply with CRI 104, Section 5, "Storage and Handling."

1.6 PROJECT CONDITIONS

- A. Comply with CRI 104, Section 7.2, "Site Conditions; Temperature and Humidity" and Section 7.12, "Ventilation."
- B. Environmental Limitations: Do not install carpet until wet work in spaces is complete and dry, and ambient temperature and humidity conditions are maintained at the levels indicated for Project when occupied for its intended use.
- C. Do not install carpet over concrete slabs until slabs have cured, are sufficiently dry to bond with adhesive, and have pH range recommended by carpet manufacturer.
- D. Where demountable partitions or other items are indicated for installation on top of carpet, install carpet before installing these items.

1.7 WARRANTY

- A. Special Warranty for Carpet: Manufacturer's standard form in which manufacturer agrees to repair or replace components of carpet installation that fail in materials or workmanship within specified warranty period.
 - 1. Warranty does not include deterioration or failure of carpet due to unusual traffic, failure of substrate, vandalism, or abuse.
 - 2. Failures include, but are not limited to, more than 10 percent loss of face fiber, edge raveling, snags, runs, loss of tuft bind strength, excess static discharge, and delamination.
 - 3. Warranty Period: 10 years from date of Substantial Completion.

1.8 EXTRA MATERIALS

- A. Furnish extra materials described below, before installation begins, that match products installed and that are packaged with protective covering for storage and identified with labels describing contents.
 - 1. Carpet: Full-width rolls equal to 5 percent of amount installed for each type indicated, but not less than 10 sq. yd..

PART 2 - PRODUCTS

2.1 TUFTED TEXTURED LOOP CARPET: (CPT-1)

- A. Products: Subject to compliance with requirements, provide the following:
 - 1. Crossley, First Impressions 0313
 - a. Color: Great Tan 08604
- B. Fiber System: DSDN Solution Dyed Nylon.
- C. Dye Method: Solution Dyed
- D. Pile Characteristic: Tufted Textured Loop
- E. Pile Thickness: 0.177 inch.
- F. Gauge: 1/10 (39.4 rows/cm)
- G. Yarn Weight: 28 oz./sq. yd..
- H. Secondary Backing: Super-Lok (enriched latex backing)
- I. Width: 12 feet.
- J. Applied Soil-Resistance Treatment: Manufacturer's standard material.
- K. Antimicrobial Treatment: Manufacturer's standard material.
- L. Performance Characteristics: As follows:
 - 1. Flamability: Class 1, (Critical Radiant Flux not less than 0.45 W/sq. cm.)
 - 2. Electrostatic Propensity: Less than 3.0 kV per AATCC 134.
 - 3. Environmental Requirements: Provide carpet that complies with testing and product requirements of Carpet and Rug Institute's "Green Label Plus" program.

2.2 TUFTED TEXTURED LOOP CARPET: (CPT-2)

- M. Products: Subject to compliance with requirements, provide the following:
 - 1. Shaw Contract, Mosaique 50667
 - a. Color: TBD
- N. Fiber System: DSDN Solution Dyed Nylon.
- O. Dye Method: Solution Dyed
- P. Pile Characteristic: Tufted Textured Loop
- Q. Pile Thickness: 0.177 inch.
- R. Gauge: 1/10 (39.4 rows/cm)
- S. Yarn Weight: 28 oz./sq. yd..
- T. Secondary Backing: Super-Lok (enriched latex backing)
- U. Width: 12 feet.
- V. Applied Soil-Resistance Treatment: Manufacturer's standard material.
- W. Antimicrobial Treatment: Manufacturer's standard material.
- X. Performance Characteristics: As follows:
 - 1. Flamability: Class 1, (Critical Radiant Flux not less than 0.45 W/sq. cm.)
 - 2. Electrostatic Propensity: Less than 3.0 kV per AATCC 134.
 - 3. Environmental Requirements: Provide carpet that complies with testing and product requirements of Carpet and Rug Institute's "Green Label Plus" program.

2.3 INSTALLATION ACCESSORIES

- Y. Trowelable Leveling and Patching Compounds: Latex-modified, hydraulic-cement-based formulation provided or recommended by carpet manufacturer.
- Z. Adhesives: Water-resistant, mildew-resistant, nonstaining type to suit products and subfloor conditions indicated, that complies with flammability requirements for installed carpet and is recommended or provided by carpet manufacturer.
 - 1. VOC Limits: Provide adhesives with VOC content not more than 50g/L when calculated according to 40 CFR 59, Subpart D (EPA method 24).
- AA. Seam Adhesive: Hot-melt adhesive tape or similar product recommended by carpet manufacturer for sealing and taping seams and butting cut edges at backing to form secure seams and to prevent pile loss at seams.

PART 3 - EXECUTION

3.1 EXAMINATION

- A. Examine substrates, areas, and conditions, with Installer present, for compliance with requirements for maximum moisture content, alkalinity range, installation tolerances, and other conditions affecting carpet performance. Examine carpet for type, color, pattern, and potential defects.
- B. Concrete Subfloors: Verify that concrete slabs comply with ASTM F 710 and the following:
 - 1. Slab substrates are dry and free of curing compounds, sealers, hardeners, and other materials that may interfere with adhesive bond. Determine adhesion and dryness characteristics by performing bond and moisture tests recommended by carpet[**cushion**] manufacturer.
 - 2. Subfloor finishes comply with requirements specified in Division 03 Section "Cast-in-Place Concrete" for slabs receiving carpet.
 - 3. Subfloors are free of cracks, ridges, depressions, scale, and foreign deposits.
- C. Proceed with installation only after unsatisfactory conditions have been corrected.

3.2 PREPARATION

- A. General: Comply with CRI 104, Section 7.3, "Site Conditions; Floor Preparation," and with carpet manufacturer's written installation instructions for preparing substrates.
- B. Use trowelable leveling and patching compounds, according to manufacturer's written instructions, to fill cracks, holes, depressions, and protrusions in substrates. Fill or level cracks, holes and depressions 1/8 inch wide or wider, and protrusions more than 1/32 inch, unless more stringent requirements are required by manufacturer's written instructions.
- C. Remove coatings, including curing compounds, and other substances that are incompatible with adhesives and that contain soap, wax, oil, or silicone, without using solvents. Use mechanical methods recommended in writing by carpet manufacturer.
- D. Broom and vacuum clean substrates to be covered immediately before installing carpet.

3.3 INSTALLATION

- A. Comply with CRI 104 and carpet manufacturer's written installation instructions for the following:
 - 1. Direct-Glue-Down Installation: Comply with CRI 104, Section 9, "Direct Glue-Down Installation."

- B. Comply with carpet manufacturer's written recommendations for seam locations and direction of carpet; maintain uniformity of carpet direction and lay of pile. At doorways, center seams under the door in closed position.
- C. Do not bridge building expansion joints with carpet.
- D. Cut and fit carpet to butt tightly to vertical surfaces, permanent fixtures, and built-in furniture including cabinets, pipes, outlets, edgings, thresholds, and nosings. Bind or seal cut edges as recommended by carpet manufacturer.
- E. Extend carpet into toe spaces, door reveals, closets, open-bottomed obstructions, removable flanges, alcoves, and similar openings.
- F. Maintain reference markers, holes, and openings that are in place or marked for future cutting by repeating on finish flooring as marked on subfloor. Use nonpermanent, nonstaining marking device.
- G. Install pattern parallel to walls and borders to comply with CRI 104, Section 15, "Patterned Carpet Installations" and with carpet manufacturer's written recommendations.

3.4 CLEANING AND PROTECTING

- A. Perform the following operations immediately after installing carpet:
 - 1. Remove excess adhesive, seam sealer, and other surface blemishes using cleaner recommended by carpet manufacturer.
 - 2. Remove yarns that protrude from carpet surface.
 - 3. Vacuum carpet using commercial machine with face-beater element.
- B. Protect installed carpet to comply with CRI 104, Section 16, "Protection of Indoor Installations."
- C. Protect carpet against damage from construction operations and placement of equipment and fixtures during the remainder of construction period. Use protection methods indicated or recommended in writing by carpet manufacturer and carpet adhesive manufacturer.

END OF SECTION 096816

SECTION 099123

INTERIOR PAINTING

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

- A. 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 the application of paint systems on the following interior substrates:
 - 1. Steel.
 - 2. Wood.
 - 3. Gypsum board.
 - 4. Cotton or canvas insulation covering.
- B. Related Sections include the following:
 - 1. Division 05 Sections for shop priming of metal substrates with primers specified in this Section.
 - 2. Division 09 Section "Exterior Painting" for surface preparation and the application of paint systems on exterior substrates.
 - 3. Division 09 Section "Staining and Transparent Finishing" for surface preparation and the application of wood stains and transparent finishes on interior wood substrates.

1.3 SUBMITTALS

- A. Product Data: For each type of product indicated.
- B. Samples for Selection: For each type of topcoat product indicated.
- C. Product List: For each product indicated, include the following:
 - 1. Cross-reference to paint system and locations of application areas. Use same designations indicated on Drawings and in schedules.

1.4 QUALITY ASSURANCE

- A. Mockups: Apply benchmark samples of each paint system indicated and each color and finish selected to verify preliminary selections made under sample submittals and to demonstrate aesthetic effects and set quality standards for materials and execution.
 - 1. Architect will select one surface to represent surfaces and conditions for application of each paint system specified in Part 3.
 - a. Wall and Ceiling Surfaces: Provide samples of at least 100 sq. ft..
 - b. Other Items: Architect will designate items or areas required.
 - 2. Apply benchmark samples after permanent lighting and other environmental services have been activated.
 - 3. Final approval of color selections will be based on benchmark samples.
 - a. If preliminary color selections are not approved, apply additional benchmark samples of additional colors selected by Architect at no added cost to Owner.

1.5 DELIVERY, STORAGE, AND HANDLING

- A. Store materials not in use in tightly covered containers in well-ventilated areas with ambient temperatures continuously maintained at not less than 45 deg F.
 - 1. Maintain containers in clean condition, free of foreign materials and residue.
 - 2. Remove rags and waste from storage areas daily.

1.6 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.

1.7 EXTRA MATERIALS

- A. Furnish extra materials described below that are from same production run (batch mix) as materials applied and that are packaged for storage and identified with labels describing contents.
 - 1. Quantity: Furnish an additional 5 percent, but not less than 1 gal. of each material and color applied.

PART 2 - PRODUCTS

2.1 MANUFACTURERS

A. Manufacturers: Subject to compliance with requirements, provide the following:

1. ICI Paints, Strongsville, OH 44136. (440) 297-8000

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. VOC Content 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 CFR 59, Subpart D (EPA Method 24); these requirements do not apply to paints and coatings that are applied in a fabrication or finishing shop:

1. Flat Paints, Coatings, and Primers: VOC content of not more than 50 g/L.
2. Nonflat Paints, Coatings, and Primers: VOC content of not more than 150 g/L.
3. Anti-Corrosive and Anti-Rust Paints Applied to Ferrous Metals: VOC not more than 250 g/L.
4. Floor Coatings: VOC not more than 100 g/L.
5. Shellacs, Clear: VOC not more than 730 g/L.
6. Shellacs, Pigmented: VOC not more than 550 g/L.
7. Flat Topcoat Paints: VOC content of not more than 50 g/L.
8. Nonflat Topcoat Paints: VOC content of not more than 150 g/L.
9. Anti-Corrosive and Anti-Rust Paints Applied to Ferrous Metals: VOC not more than 250 g/L.
10. Floor Coatings: VOC not more than 100 g/L.
11. Shellacs, Clear: VOC not more than 730 g/L.
12. Shellacs, Pigmented: VOC not more than 550 g/L.
13. Primers, Sealers, and Undercoaters: VOC content of not more than 200 g/L.
14. Dry-Fog Coatings: VOC content of not more than 400 g/L.
15. Zinc-Rich Industrial Maintenance Primers: VOC content of not more than 340 g/L.
16. Pre-Treatment Wash Primers: VOC content of not more than 420 g/L.

C. Chemical Components of Field-Applied Interior Paints and Coatings: Provide topcoat paints and anti-corrosive and anti-rust paints applied to ferrous metals that comply with the following chemical restrictions; these requirements do not apply to paints and coatings that are applied in a fabrication or finishing shop:

1. 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).
 2. 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.
 - l. Dimethyl phthalate.
 - m. Ethylbenzene.
 - n. Formaldehyde.
 - 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. 1,1,1-trichloroethane.
 - y. Vinyl chloride.
- D. Colors: As selected by Architect from manufacturer's full range. Refer to finish schedule in construction drawings.

2.3 PRIMERS/SEALERS

- A. Interior Gypsum Board Primer: Factory-formulated latex-based primer for interior application.
 1. Benjamin Moore; Moorcraft Super Spec Latex Enamel Undercoater & Primer Sealer No. 253: Applied at a dry film thickness of not less than 1.2 mils.

2.4 METAL PRIMERS

- A. Interior Ferrous-Metal Primer: Factory-formulated quick-drying rust-inhibitive acrylic-based metal primer.
 1. Benjamin Moore; Moore's IronClad Latex Low Lustre Metal & Wood Enamel #363.

2.5 WOOD PRIMERS

- A. Interior Wood Primer for Acrylic-Enamel Finishes: Factory-formulated acrylic-latex-based interior wood primer.
 - 1. Benjamin Moore; Super Spec Latex Enamel Undercoater & Primer Sealer #253: Applied at a dry film thickness of not less than 1.5 mils.

2.6 LATEX PAINTS

- A. Interior Flat Acrylic Paint: Factory-formulated flat acrylic-emulsion latex paint for interior application.
 - 1. Benjamin Moore; Moorecraft Super Spec Latex Flat No. 275: Applied at a dry film thickness of not less than 1.2 mils.
- B. Interior Low-Luster Acrylic Enamel: Factory-formulated eggshell acrylic-latex interior enamel.
 - 1. Benjamin Moore; Moorcraft Super Spec Latex Eggshell Enamel No. 274: Applied at a dry film thickness of not less than 1.3 mils.
- C. Interior Semigloss Acrylic Enamel: Factory-formulated semigloss acrylic-latex enamel for interior application.
 - 1. Benjamin Moore; Moorcraft Super Spec Latex Semi-Gloss Enamel No. 276: Applied at a dry film thickness of not less than 1.2 mils.

2.7 POLYAMINE EPOXY

- A. Tnemec 273 Stranlok Mat-up, color as specified in drawings (EP-1)
- B. Tnemec Antimicrobial Coating System, color as specified in drawings (EP-2)

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. Wood: 15 percent.
 - 2. 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.
 - 1. Beginning coating application constitutes Contractor's acceptance of substrates and conditions.

3.2 PREPARATION

- A. Comply with manufacturer's written instructions and recommendations in "MPI Architectural Painting Specification Manual" applicable to substrates indicated.
- B. Remove plates, machined surfaces, and similar items already in place that are not to be painted. If removal is impractical or impossible because of size or weight of item, provide surface-applied protection before surface preparation and painting.
 - 1. After completing painting operations, use workers skilled in the trades involved to reinstall items that were removed. Remove surface-applied protection if any.
 - 2. Do not paint over labels of independent testing agencies or equipment name, identification, performance rating, or nomenclature plates.
- C. Clean substrates of substances that could impair bond of paints, including dirt, oil, grease, and incompatible paints and encapsulants.
 - 1. Remove incompatible primers and reprime substrate with compatible primers as required to produce paint systems indicated.
- D. Steel Substrates: Remove rust and loose mill scale. Clean using methods recommended in writing by paint manufacturer.
- E. Wood Substrates:
 - 1. Scrape and clean knots, and apply coat of knot sealer before applying primer.
 - 2. Sand surfaces that will be exposed to view, and dust off.
 - 3. Prime edges, ends, faces, undersides, and backsides of wood.
 - 4. After priming, fill holes and imperfections in the finish surfaces with putty or plastic wood filler. Sand smooth when dried.
- F. Gypsum Board Substrates: Do not begin paint application until finishing compound is dry and sanded smooth.
- G. Cotton or Canvas Insulation Covering Substrates: Remove dust, dirt, and other foreign material that might impair bond of paints to substrates.

3.3 APPLICATION

- A. Apply paints according to manufacturer's written instructions.
 - 1. Use applicators and techniques suited for paint and substrate indicated.
 - 2. Paint surfaces behind movable equipment and furniture same as similar exposed surfaces. Before final installation, paint surfaces behind permanently fixed equipment or furniture with prime coat only.
 - 3. Paint front and backsides of access panels, removable or hinged covers, and similar hinged items to match exposed surfaces.
- B. Tint each undercoat a lighter shade to facilitate identification of each coat if multiple coats of same material are to be applied. Tint undercoats to match color of topcoat, but provide sufficient difference in shade of undercoats to distinguish each separate coat.
- C. If undercoats or other conditions show through topcoat, apply additional coats until cured film has a uniform paint finish, color, and appearance.
- D. Apply paints to produce surface films without cloudiness, spotting, holidays, laps, brush marks, roller tracking, runs, sags, ropiness, or other surface imperfections. Cut in sharp lines and color breaks.
- E. Painting Mechanical and Electrical Work: Paint items exposed in equipment rooms and occupied spaces including, but not limited to, the following:
 - 1. Mechanical Work:
 - 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 cotton or canvas insulation covering or other paintable jacket material.
 - g. Mechanical equipment that is indicated to have a factory-primed finish for field painting.
 - 2. Electrical Work:
 - a. Switchgear.
 - b. Panelboards.
 - c. Electrical equipment that is indicated to have a factory-primed finish for field painting.

3.4 CLEANING AND PROTECTION

- A. At end of each workday, remove rubbish, empty cans, rags, and other discarded materials from Project site.

- B. After completing paint application, clean spattered surfaces. Remove spattered paints by washing, scraping, or other methods. Do not scratch or damage adjacent finished surfaces.
- C. Protect work of other trades against damage from paint application. Correct damage to work of other trades by cleaning, repairing, replacing, and refinishing, as approved by Architect, and leave in an undamaged condition.
- D. At completion of construction activities of other trades, touch up and restore damaged or defaced painted surfaces.

3.5 INTERIOR PAINTING SCHEDULE

- A. Gypsum Board: Provide the following finish systems over interior gypsum board surfaces:
 - 1. Ceilings and Soffits, Flat Acrylic Finish: Two finish coats over a primer.
 - a. Primer: Interior gypsum board primer.
 - b. Finish Coats: Interior flat acrylic paint.
 - 2. Walls, Low-Luster Acrylic-Enamel Finish: Two finish coats over a primer.
 - a. Primer: Interior gypsum board primer.
 - b. Finish Coats: Interior low-luster acrylic enamel.
 - 3. Provide polyamine epoxy where indicated.
- B. Wood: Provide the following paint finish systems over new interior wood surfaces:
 - 1. Semigloss Acrylic-Enamel Finish: Two finish coats over a wood undercoater.
 - a. Primer: Interior wood primer for acrylic-enamel and semigloss alkyd-enamel finishes.
 - b. Finish Coats: Interior semigloss acrylic enamel.
- C. Ferrous Metal: Provide the following finish systems over ferrous metal:
 - 1. Semigloss Acrylic-Enamel Finish: Two finish coats over a primer.
 - a. Primer: Interior ferrous-metal primer.
 - b. Finish Coats: Interior semigloss acrylic enamel.
- D. Cotton or Canvas Insulation-Covering Substrates: Including pipe and duct coverings.
 - 1. Flat Acrylic Finish: Two finish coats over a primer.
 - a. Primer: Interior gypsum board primer.
 - b. Finish Coats: Interior flat acrylic paint.

END OF SECTION 099123

SECTION 102113

TOILET COMPARTMENTS

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

- A. 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:

- 1. Solid polymer toilet compartments configured as toilet and urinal enclosures, floor mounted, overhead braced.

B. Related Sections:

- 1. Division 10 Section "Toilet, Bath, and Laundry Accessories" for toilet tissue dispensers, grab bars, purse shelves, and similar accessories.

1.3 SUBMITTALS

- A. Product Data: For each type of product indicated. Include construction details, material descriptions, dimensions of individual components and profiles, and finishes.

- B. Shop Drawings: For toilet compartments. Include plans, elevations, sections, details, and attachments to other work.

- 1. Show locations of cutouts for compartment-mounted toilet accessories.
- 2. Show locations of reinforcements for compartment-mounted grab bars.
- 3. Show locations of centerlines of toilet fixtures.
- 4. Show ceiling grid and overhead support or bracing locations.

- C. Samples for Initial Selection: For each type of unit indicated. Include Samples of hardware and accessories involving material and color selection.

- D. Samples for Verification: For the following products, in manufacturer's standard sizes unless otherwise indicated:

- 1. Each type of material, color, and finish required for units, prepared on 6-inch- (152-mm-) square Samples of same thickness and material indicated for Work.
- 2. Each type of hardware and accessory.

- E. Product Certificates: For each type of toilet compartment, from manufacturer.
- F. Maintenance Data: For toilet compartments to include in maintenance manuals.

1.4 QUALITY ASSURANCE

- A. Comply with requirements in GSA's CID-A-A-60003, "Partitions, Toilets, Complete."
- B. Surface-Burning Characteristics: As determined by testing identical products according to ASTM E 84, or another standard acceptable to authorities having jurisdiction, by a qualified testing agency. Identify products with appropriate markings of applicable testing agency.
 - 1. Flame-Spread Index: Class A or B 75 or less.
 - 2. Smoke-Developed Index: 450 or less.
- C. Regulatory Requirements: Comply with applicable provisions Americans with Disabilities Act Accessibility Guidelines (ADAAG) for toilet compartments designated as accessible.

1.5 PROJECT CONDITIONS

- A. Field Measurements: Verify actual locations of toilet fixtures, walls, columns, ceilings, and other construction contiguous with toilet compartments by field measurements before fabrication.

PART 2 - PRODUCTS

2.1 SOLID-POLYMER UNITS

- A. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
 - 1. Accurate Partitions Corporation.
 - 2. Ampco.
 - 3. Bradley Corporation; Mills Partitions.
 - 4. Capitol Partitions, Inc.
 - 5. Comtec Industries.
 - 6. General Partitions Mfg. Corp.
 - 7. Global Steel Products Corp.
 - 8. Metpar Corp.
 - 9. Santana Products, Inc.
 - 10. Sanymetal; a Crane Plumbing Company.
- B. Door, Panel, and Pilaster Construction: Solid, high-density polyethylene (HDPE) or polypropylene (PP) panel material, not less than 1 inch (25 mm) thick, seamless, with eased edges, and with homogenous color and pattern throughout thickness of material.

1. Color and Pattern: One color and pattern in each room as selected by Architect from manufacturer's full range of colors and patterns.
- C. Pilaster Shoes and Sleeves (Caps): Manufacturer's standard design; stainless steel.
- D. Brackets (Fittings):
 1. Full-Height (Continuous) Type: Manufacturer's standard design; stainless steel.
 2. Heat-Sink Strip: Manufacturer's standard continuous, extruded-aluminum strip fastened to exposed bottom edges of solid-polymer components to prevent burning.

2.2 ACCESSORIES

- A. Hardware and Accessories: Manufacturer's standard design, heavy-duty operating hardware and accessories.
 1. Material: Stainless steel.
 2. Hinges: Manufacturer's standard continuous, cam type that swings to a closed or partially open position.
 3. Latch and Keeper: Manufacturer's standard recessed latch unit designed for emergency access and with combination rubber-faced door strike and keeper. Provide units that comply with regulatory requirements for accessibility at compartments designated as accessible.
 4. Coat Hook: Manufacturer's standard combination hook and rubber-tipped bumper, sized to prevent in-swinging door from hitting compartment-mounted accessories.
 5. Door Bumper: Manufacturer's standard rubber-tipped bumper at out-swinging doors.
 6. Door Pull: Manufacturer's standard unit at out-swinging doors that complies with regulatory requirements for accessibility. Provide units on both sides of doors at compartments designated as accessible.
- B. Overhead Bracing: Manufacturer's standard continuous, extruded-aluminum head rail with antigrip profile and in manufacturer's standard finish.
- C. Anchorages and Fasteners: Manufacturer's standard exposed fasteners of stainless steel or chrome-plated steel or brass, finished to match the items they are securing, with theft-resistant-type heads. Provide sex-type bolts for through-bolt applications. For concealed anchors, use stainless steel, hot-dip galvanized steel, or other rust-resistant, protective-coated steel.

2.3 FABRICATION

- A. Ceiling-Hung Units: Provide manufacturer's standard corrosion-resistant anchoring assemblies with leveling adjustment nuts at pilasters for connection to structural support above finished ceiling. Provide assemblies that support pilasters from structure without transmitting load to finished ceiling. Provide sleeves (caps) at tops of pilasters to conceal anchorage.
- B. Door Size and Swings: Unless otherwise indicated, provide 24-inch- wide, in-swinging doors for standard toilet compartments and 36-inch- wide, out-swinging doors with a minimum 32-inch- wide, clear opening for compartments designated as accessible.

PART 3 - EXECUTION

3.1 INSTALLATION

- A. General: Comply with manufacturer's written installation instructions. Install units rigid, straight, level, and plumb. Secure units in position with manufacturer's recommended anchoring devices.
 - 1. Maximum Clearances:
 - a. Panels and Walls: 1 inch.
 - 2. Stirrup Brackets: Secure panels to walls and to pilasters with no fewer than three brackets attached at midpoint and near top and bottom of panel.
 - a. Locate wall brackets so holes for wall anchors occur in masonry or tile joints.
 - b. Align brackets at pilasters with brackets at walls.
- B. Ceiling-Hung Units: Secure pilasters to supporting structure and level, plumb, and tighten. Hang doors and adjust so bottoms of doors are level with bottoms of pilasters when doors are in closed position.

3.2 ADJUSTING

- A. Hardware Adjustment: Adjust and lubricate hardware according to hardware manufacturer's written instructions for proper operation. Set hinges on in-swinging doors to hold doors open approximately 30 degrees from closed position when unlatched. Set hinges on out-swinging doors and doors in entrance screens to return doors to fully closed position.

END OF SECTION 102113

SECTION 102650

IMPACT-RESISTANT WALL PROTECTION

PART 1 - GENERAL

1.1 SUMMARY

A. This Section includes the following:

1. Sheet Protective Wall Covering.
2. Chair Rails.
3. Corner Guards.
4. End Wall Guards.

B. Related Sections include the following:

1. Division 6 Section "Rough Carpentry" for wood blocking and grounds for surface-mounted wall guards, corner guards, and handrails.
2. Division 8 Section "Door Hardware" for stainless-steel and plastic mop, kick, armor, and push plates.

1.2 SUBMITTALS

A. Product Data: Include physical characteristics, such as durability, resistance to fading, and flame resistance, for each impact-resistant wall protection system component indicated.

B. Maintenance Data: For each impact-resistant wall protection system component to include in maintenance manuals specified in Division 1.

1. Include recommended methods and frequency for maintaining optimum condition of vinyl plastic covers under anticipated traffic and use conditions. Include precautions against using cleaning materials and methods that may be detrimental to vinyl plastic finishes and performance.

1.3 QUALITY ASSURANCE

A. Installer Qualifications: An experienced installer who has completed installation of impact-resistant wall protection system components similar in material, design, and extent to that indicated for this Project and whose work has resulted in construction with a record of successful in-service performance.

B. Source Limitations: Obtain each color, grade, finish, and type of impact-resistant wall protection system component from a single source with resources to provide components of consistent quality in appearance and physical properties.

- C. Product Options: Information on Drawings and in Specifications establishes requirements for systems aesthetic effects and performance characteristics. Aesthetic effects are indicated by dimensions, arrangements, alignment, and profiles of components and assemblies as they relate to sightlines, to one another, and to adjoining construction.
 - 1. Do not modify intended aesthetic effects, as judged solely by Architect, except with Architects approval.
- D. Fire-Test-Response Characteristics: Provide impact-resistant wall protection system components with the following surface-burning characteristics, as determined by testing materials identical to those required in this Section per ASTM E 84 by a testing and inspecting agency acceptable to authorities having jurisdiction. Identify impact-resistant wall protection system components with appropriate markings of applicable testing and inspecting agency.
 - 1. Flame Spread: 25 or less.
 - 2. Smoke Developed: 450 or less.
- E. Impact Strength: Provide impact-resistant wall protection system components with a minimum impact resistance of 25.4 ft-lbf/in. (1356 J/m) of width when tested according to ASTM D 256, Test Method A.

1.4 DELIVERY, STORAGE, AND HANDLING

- A. Store wall surface-protection materials in original undamaged packages and containers inside a well-ventilated area protected from weather, moisture, soiling, extreme temperatures, and humidity.
 - 1. Maintain room temperature within the storage area at not less than 70 deg F (21 deg C) during the period plastic materials are stored. Keep sheet material out of direct sunlight to avoid surface distortion.
 - 2. Store rigid plastic corner-guard covers in a vertical position, and rigid plastic wall guard and handrail covers in a horizontal position for a minimum of 72 hours, or until the plastic material attains the minimum room temperature of 70 deg F (21 deg C).

1.5 PROJECT CONDITIONS

- A. Environmental Limitations: Do not install wall surface-protection system components until the space is enclosed and weatherproof and ambient temperature within the building is maintained at not less than 70 deg F (21 deg C) for not less than 72 hours before beginning installation. Do not install rigid plastic wall surface-protection systems until that temperature has been attained and is stabilized.
- B. Field Measurements: Verify actual locations of walls, columns, and other construction contiguous with impact-resistant wall-protection units by field measurements before fabrication and indicate measurements on Shop Drawings.

1.6 WARRANTY

- A. Special Warranty: Manufacturer's standard form in which manufacturer agrees to repair or replace components of impact-resistant wall-protection units that fail in materials or workmanship within specified warranty period.
 - 1. Failures include, but are not limited to, the following:
 - a. Structural failures.
 - b. Deterioration of plastic and other materials beyond normal use.
 - 2. Warranty Period: Five years from date of Substantial Completion.

PART 2 - PRODUCTS

2.1 MANUFACTURERS

- A. Manufacturers: Subject to compliance with requirements, provide the following:
 - 1. Construction Specialties, Inc. (Acrovyn)

2.2 IMPACT-RESISTANT PROTECTIVE WALL COVERINGS: (PWC-1)

- A. Semirigid Sheet Wall Covering: Semirigid, embossed, fiber-backed, impact-resistant plastic sheets. Sheets shall comply with fire-test-response characteristics specified and be chemical and stain resistant. Provide manufacturer's standard; match moldings and trim as required.
 - 1. Manufacturer: Construction Specialties, Inc. (Acrovyn)
 - 2. Sheet Size: As required with fewest possible seams.
 - 3. Sheet Thickness: 0.060 inch (1.52 mm).
 - 4. Sheet Texture: Pebblette.
 - 5. Refer to the Room Finish Schedule and Floor Plans for locations to receive PWC.
 - 6. Adhesive: Type recommended by the manufacturer for use with material on the substrate indicated, non-flammable, low VOC.

2.3 CHAIR RAILS: (CR-1)

- A. Surface-Mounted, Resilient Plastic Chair Rail: Surface-mounted, resilient plastic chair rail assembly consisting of snap-on plastic cover installed over continuous aluminum retainer.
 - 1. Basis-of-Design Product: IPC 2700 (3" high, extends 1" from wall) or equal.
 - 2. Cover: Snap-on covers of .070" (1.8 mm) thickness shall be extruded from chemical and stain resistant polyvinyl chloride with the addition of impact modifiers. No plasticizers shall be added (plasticizers may aid in bacterial growth).
 - 3. Retainer: Continuous aluminum retainer of .060 (1.5 mm) thickness shall be fabricated from 6063-T5 aluminum, with a mill finish.
 - 4. Components:
 - a. Returns, inside corners and outside corners shall be made of injection molded thermoplastics.

- b. Fasteners: All mounting systems accessories appropriate for substrates indicated on the drawings shall be provided.
- 5. Finishes:
 - a. Vinyl Covers: Chair rail color to be selected by the architect from the IPC finish selection.
 - b. Molded Components: Inside corners, outside corners, returns and brackets shall be of a color and pattern matching the handrails. Surface shall have a pebblette texture.

2.4 CORNER GUARDS: (CG-1)

- A. Surface-Mounted, Resilient, Plastic Corner Guards: Assembly consisting of snap-on plastic cover installed over continuous retainer; including mounting hardware; fabricated with 90- or 135-degree turn to match wall condition.
 - 1. Manufacturer: Construction Specialties, Inc. (Acrovyn).
 - 2. Cover: Extruded rigid plastic, minimum 0.078-inch (2.0-mm) wall thickness; as follows:
 - a. Profile: Nominal 3-inch- (75-mm-) long leg and ¼-inch (6-mm) corner radius.
 - b. Height: CG1: 4 feet (1.2 m); CG3: 8 feet (2.4 m).
 - c. Color and Texture: As selected by Architect from manufacturer's full range.
 - 3. Retainer: Minimum 0.060-inch- (1.5-mm-) thick, 1-piece, extruded aluminum.
 - 4. Top and Bottom Caps: Prefabricated, injection-molded plastic; color matching cover; field adjustable for close alignment with snap-on cover.

2.5 END WALL GUARDS: (CG-2)

- A. Surface-Mounted, Resilient, Plastic End-Wall Guard: Assembly consisting of snap-on plastic cover installed over continuous retainer at each corner, with end of wall covered by semirigid, impact-resistant sheet wall covering; including mounting hardware.
 - 1. Manufacturer: Construction Specialties, Inc. (Acrovyn).
 - 2. Cover: Extruded rigid plastic, minimum 0.078-inch (2.0-mm) wall thickness; as follows:
 - a. Profile: Nominal 2-inch- (50-mm-) long leg and ¼-inch (6-mm) corner radius.
 - b. Height: 4 feet (1.2 m).
 - c. Color and Texture: As selected by Architect from manufacturer's full range.
 - 3. Retainer: Minimum 0.060-inch- (1.5-mm-) thick, 1-piece, extruded aluminum.
 - 4. Top and Bottom Caps: Prefabricated, injection-molded plastic; color matching cover; field adjustable for close alignment with snap-on cover.

2.6 FABRICATION

- A. General: Fabricate impact-resistant wall and door protection systems to comply with requirements indicated for design, dimensions, details, finish, and member sizes, including thicknesses of components.
- B. Preassemble components in the shop to greatest extent possible to minimize field assembly. Disassemble only as necessary for shipping and handling.
- C. Fabricate components with tight seams and joints with exposed edges rolled. Provide surfaces free of wrinkles, chips, dents, uneven coloration, and other imperfections. Fabricate members and fittings to produce flush, smooth, and rigid hairline joints.
- D. Brackets, Flanges, Fittings, and Anchors: Provide wall brackets, flanges, miscellaneous fittings, and anchors for interconnecting members to other construction.
- E. Provide inserts and other anchoring devices for connecting components. Fabricate anchoring devices to withstand imposed loads. Coordinate anchoring devices with the supporting structure.

2.9 FINISHES, GENERAL

- A. Protect mechanical finishes on exposed surfaces from damage by applying a strippable, temporary covering before shipping.
- A. 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.

PART 3 - EXECUTION

3.1 EXAMINATION

- A. Examine areas and conditions in which impact-resistant wall protection system components and impact-resistant wall covering materials will be installed.
 - 1. Complete finishing operations, including painting, before installing impact-resistant wall protection system components.
- B. Impact-Resistant Wall Covering Materials: Wall surfaces to receive impact-resistant wall covering materials shall be dry and free from dirt, grease, loose paint, and scale.
- C. Proceed with installation only after unsatisfactory conditions have been corrected.

3.2 PREPARATION

- A. General: Before installation, clean substrate to remove dust, debris, and loose particles.

3.3 INSTALLATION

- A. Install impact-resistant wall protection system components and wall padding level, plumb, and true to line without distortions.
 - 1. Do not use materials with chips, cracks, voids, stains, or other defects that might be visible in the finished Work.
- B. Install aluminum retainers, mounting brackets, and other accessories according to the manufacturer's written instructions.
 - 1. Where splices occur in horizontal runs of more than 20 feet (6.1 m), splice aluminum retainers and plastic covers at different locations along the run.

3.4 CLEANING

- A. General: Immediately on completion of installation, clean plastic covers and accessories using a standard ammonia-based household cleaning agent. Clean metal components according to the manufacturer's written instructions.
- B. Remove excess adhesive using methods and materials recommended by the manufacturer.
- C. Remove surplus materials, rubbish, and debris, resulting from installation, on completion of work and leave installation areas in neat, clean condition.

END OF SECTION 10265

SECTION 102800

TOILET ACCESSORIES

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

- A. 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. Toilet accessories.
- B. Owner-Furnished Material: As indicated in the Equipment/Accessories Legend, drawing G1002.

1.3 SUBMITTALS

- 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.
 - 5. Manufacturer's warranty.
- B. Samples: Full size, for each accessory item to verify design, operation, and finish requirements.
 - 1. Approved full-size Samples will be returned and may be used in the Work.
- C. 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.
- D. 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 NFPA 70, Article 100, by a testing agency acceptable to authorities having jurisdiction, and marked for intended use.

1.5 COORDINATION

- A. 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.
- B. Deliver inserts and anchoring devices set into concrete or masonry as required to prevent delaying the Work.

1.6 WARRANTY

- A. Special Mirror Warranty: Manufacturer's standard form in which manufacturer agrees to replace mirrors that develop visible silver spoilage defects and that fail in materials or workmanship within specified warranty period.
 - 1. Warranty Period: 15 years from date of Substantial Completion.

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), 0.0359-inch minimum nominal thickness.
- C. Galvanized Steel Sheet: ASTM A 653/A 653M, with G60 hot-dip zinc coating.
- D. Galvanized Steel Mounting Devices: ASTM A 153/A 153M, hot-dip galvanized after fabrication.
- E. 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.
- F. Mirrors: ASTM C 1503, Mirror Glazing Quality, clear-glass mirrors, nominal 6.0 mm thick.

2.2 TOILET ACCESSORIES

- 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:
1. A & J Washroom Accessories, Inc.
 2. American Specialties, Inc.
 3. Bobrick Washroom Equipment, Inc.
 4. Bradley Corporation.
 5. General Accessory Manufacturing Co. (GAMCO).
- B. Paper Towel (Folded) Dispenser (B):
1. Basis-of-Design Product: Bobrick Model B-262.
 2. Mounting: Surface mounted.
 3. Minimum Capacity: 400 C-fold or 525 multifold towels.
 4. Material and Finish: Stainless steel, No. 4 finish (satin).
 5. Lockset: Tumbler type.
 6. Refill Indicators: Pierced slots at sides or front.
- C. Toilet Tissue (Roll) Dispenser (E):
1. Basis-of-Design Product: Bobrick, No. B-2823.
 2. Description: Jumbo, double-roll dispenser.
 3. Mounting: Surface mounted.
 4. Operation: Noncontrol delivery with standard spindle.
 5. Capacity: Designed for 10-inch- diameter tissue rolls with 3-inch- diameter core.
 6. Material and Finish: Stainless steel, No. 4 finish (satin).
- D. Soap Dispenser (A): Provided by Owner, installed by Contractor.
- E. Grab Bars (F, G, OR Z): Where this designation is indicated, provide stainless-steel grab bar with closure plate complying with the following:
1. Basis-of-Design Product: Bradley No. B-5806 Series.
 2. Stainless-Steel Nominal Thickness: Minimum 0.05 inch.
 3. Mounting: Concealed with manufacturer's standard flanges and anchors.
 4. Gripping Surfaces: Manufacturer's standard smooth, No. 4, satin finish.
 5. Outside Diameter: 1-1/4 inches for medium-duty applications.
- F. Mirror Unit (D or N): Where this designation is indicated, provide mirror unit complying with the following:
1. Basis-of-Design Product: Bobrick No. B-165 2448 and B-165 2460.
 2. Stainless-Steel, Channel-Framed Mirror: Fabricate frame from stainless-steel channels in manufacturer's standard satin or bright finish with square corners mitered to hairline joints and mechanically interlocked.

- G. Shower Curtain Rod (C): Provided by owner, installed by owner. Shower curtains will also be by owner.
- H. Folding Bench (Y): Where this designation is indicated, provide heavy-duty hinged seat designed to fold up against wall when not in use with stainless-steel support braces, hinges, frame, and fasteners; of all-welded construction; and complying with the following:
 - 1. Basis-of-Design Product: Bobrick No. B-518.
 - 2. Configuration: L-shaped seat, designed for wheelchair access.
 - 3. Seat Material: Foam-padded, white vinyl seat.
- I. Robe Hook (K): Where this designation is indicated, provide robe hook complying with the following:
 - 1. Basis-of-Design Product: Similar to No. B-7671 by Bobrick.
 - 2. Single-Prong Unit: Stainless-steel, single-prong robe hook with rectangular wall bracket and backplate for concealed mounting.
- J. Mop and Broom Holder (V): Where this designation is indicated, provide mop and broom holder complying with the following:
 - 1. Basis-of-Design Product: Bobrick No. B-223 x 36.
 - 2. Mop and Broom Holder: 36-inch- long unit fabricated of minimum nominal 0.0375-inch- thick, stainless-steel hat channel with four spring-loaded, rubber, cam-type, mop/broom holders.
- K. Sanitary Napkin Disposal (Q): Where this designation is indicated, provide mop and broom holder complying with the following:
 - 1. Basis-of-Design Product: Bobrick, Contura Series, Model B-270.
 - 2. Mounting: Surface mounted.
 - 3. Door or Cover: Self-closing disposal-opening cover.
 - 4. Receptacle: Removable.
 - 5. Material and Finish: Stainless steel, No. 4 finish (satin).

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 re-supplying. 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 102800

SECTION 105113

METAL LOCKERS

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

- A. 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:
 - 1. Standard metal lockers.

1.3 SUBMITTALS

- A. Product Data: For each type of product indicated. Include construction details, material descriptions, dimensions of individual components and profiles, and finishes for each type of metal locker.
- B. Shop Drawings: For metal lockers. Include plans, elevations, sections, details, and attachments to other work.
 - 1. Show locker trim and accessories.
 - 2. Include locker identification system and numbering sequence.
- C. Samples for Selection: For units with factory-applied color finishes.
- D. Maintenance Data: For adjusting, repairing, and replacing locker doors and latching mechanisms to include in maintenance manuals.
- E. Warranty: Sample of special warranty.

1.4 QUALITY ASSURANCE

- A. Installer Qualifications: Manufacturer's authorized representative who is trained and approved for installation of units required for this Project.
- B. Source Limitations: Obtain metal lockers and accessories from single source from single manufacturer.

- C. Regulatory Requirements: Where metal lockers are indicated to comply with accessibility requirements, comply with the U.S. Architectural & Transportation Barriers Compliance Board's "Americans with Disabilities Act (ADA) and Architectural Barriers Act (ABA) Accessibility Guidelines for Buildings and Facilities".

1.5 DELIVERY, STORAGE, AND HANDLING

- A. Do not deliver metal lockers until spaces to receive them are clean, dry, and ready for their installation.

1.6 PROJECT CONDITIONS

- A. Field Measurements: Verify actual dimensions of recessed openings by field measurements before fabrication.

1.7 COORDINATION

- A. Coordinate sizes and locations of wood bases for metal lockers.
- B. Coordinate sizes and locations of framing, blocking, furring, reinforcements, and other related units of work specified in other Sections to ensure that metal lockers can be supported and installed as indicated.

1.8 WARRANTY

- A. Special Warranty: Manufacturer's standard form in which manufacturer agrees to repair or replace components of metal lockers that fail in materials or workmanship, excluding finish, within specified warranty period.
 - 1. Failures include, but are not limited to, the following:
 - a. Structural failures.
 - b. Faulty operation of latches and other door hardware.
 - 2. Damage from deliberate destruction and vandalism is excluded.
 - 3. Warranty Period for Knocked-Down Metal Lockers: Two years from date of Substantial Completion.

PART 2 - PRODUCTS

2.1 MATERIALS

- A. Cold-Rolled Steel Sheet: ASTM A 1008/A 1008M, Commercial Steel (CS), Type B, suitable for exposed applications.

- B. Metallic-Coated Steel Sheet: ASTM A 653/A 653M, Commercial Steel (CS), Type B; with A60 zinc-iron, alloy (galvannealed) coating designation.
- C. Steel Tube: ASTM A 500, cold rolled.
- D. Fasteners: Zinc- or nickel-plated steel, slotless-type, exposed bolt heads; with self-locking nuts or lock washers for nuts on moving parts.
- E. Anchors: Material, type, and size required for secure anchorage to each substrate.
 - 1. Provide nonferrous-metal or hot-dip galvanized anchors and inserts on inside face of exterior walls for corrosion resistance.
 - 2. Provide toothed-steel or lead expansion sleeves for drilled-in-place anchors.

2.2 STANDARD METAL LOCKERS

- A. Products: Subject to compliance with requirements, provide one of the following:
 - 1. Art Metal Products; Standard K.D. Lockers.
 - 2. DeBourgh Mfg. Co.; Worley Lockers.
 - 3. Hadrian Manufacturing Inc.; Emperor Lockers.
 - 4. List Industries Inc.; Standard Quiet KD Lockers.
 - 5. Lyon Workspace Products, LLC; Standard Lockers.
 - 6. Penco Products, Inc.; Vanguard Lockers.
 - 7. Republic Storage Systems Company; Standard Lockers.
- B. Locker Arrangement: Single tier; 12 by 15 by 72 inches.
- C. Material: Cold-rolled steel sheet.
- D. Body: Assembled by riveting or bolting body components together. Fabricate from unperforated steel sheet as follows:
 - 1. Tops, Bottoms, and Intermediate Dividers: 0.024-inch nominal thickness, with single bend at sides.
 - 2. Backs and Sides: 0.024-inch nominal thickness, with full-height, double-flanged connections.
 - 3. Shelves: 0.024-inch nominal thickness, with double bend at front and single bend at sides and back.
- E. Frames: Channel formed; fabricated from 0.060-inch nominal-thickness steel sheet; lapped and factory welded at corners; with top and bottom main frames factory welded into vertical main frames. Form continuous, integral door strike full height on vertical main frames.
 - 1. Cross Frames between Tiers: Channel formed and fabricated from same material as main frames; welded to vertical main frames.
 - 2. Frame Vents: Fabricate face frames with vents.

- F. Doors: One piece; fabricated from 0.060-inch nominal-thickness steel sheet; formed into channel shape with double bend at vertical edges and with right-angle single bend at horizontal edges.
1. Doors less than 12 inches wide may be fabricated from 0.048-inch nominal-thickness steel sheet.
 2. Reinforcement: Manufacturer's standard reinforcing angles, channels, or stiffeners for doors more than 15 inches wide; welded to inner face of doors.
 3. Stiffeners: Manufacturer's standard full-height stiffener fabricated from 0.048-inch nominal-thickness steel sheet; welded to inner face of doors.
 4. Door Style: Vented panel as follows:
 - a. Louvered Vents: No fewer than six louver openings at top and bottom for single-tier lockers.
- G. Hinges: Heavy-duty, minimum 0.0500-inch-thick steel, full loop, five or seven knuckle; tight pin; minimum 2 inches high. Weld to inside of door frame and attach to door with at least two factory-installed fasteners that are completely concealed and tamper resistant when door is closed.
1. Provide at least three hinges for each door more than 42 inches high and at least two hinges for each door 42 inches high or less.
- H. Recessed Door Handle and Latch: Stainless-steel cup with integral door pull, recessed so locking device does not protrude beyond face of door; pry and vandal resistant.
1. Multipoint Latching: Finger-lift latch control designed for use with built-in combination locks, built-in key locks, or padlocks; positive automatic latching and prelocking.
 - a. Latch Hooks: Equip doors less than 48 inches high with two latch hooks; fabricated from 0.105-inch nominal-thickness steel sheet; welded or riveted to full-height door strikes; with resilient silencer on each latch hook.
 - b. Latching Mechanism: Manufacturer's standard, rattle-free latching mechanism and moving components isolated to prevent metal-to-metal contact, and incorporating a prelocking device that allows locker door to be locked while door is open and then closed without unlocking or damaging lock or latching mechanism.
 2. Provide ADA compliant latch and latch lifter for 2 percent of lockers provided, unless noted otherwise. Mark ADA accessible lockers with appropriate identifying signage.
- I. Equipment: Equip each metal locker with identification plate and the following unless otherwise indicated:
1. One double-prong ceiling hook and two single-prong wall hooks. At ADA lockers provide hooks at heights appropriate for ADA accessibility.
- J. Accessories:
1. Continuous Sloping Tops: Fabricated from 0.036-inch nominal-thickness steel sheet.

- a. Closures: Vertical-end type.
 - b. Sloping-top corner fillers, mitered.
2. Filler Panels: Fabricated from 0.036-inch nominal-thickness steel sheet.
 3. Finished End Panels: Fabricated from 0.024-inch nominal-thickness steel sheet.
- K. Finish: Baked enamel or powder coat.
1. Color: As selected by Architect from manufacturer's full range.

2.3 FABRICATION

- A. Fabricate metal lockers square, rigid, and without warp and with metal faces flat and free of dents or distortion. Make exposed metal edges safe to touch and free of sharp edges and burrs.
1. Form body panels, doors, shelves, and accessories from one-piece steel sheet unless otherwise indicated.
 2. Provide fasteners, filler plates, supports, clips, and closures as required for complete installation.
- B. Fabricate each metal locker with an individual door and frame; individual top, bottom, and back; and common intermediate uprights separating compartments. Factory weld frame members of each metal locker together to form a rigid, one-piece assembly.
- C. Knocked-Down Construction: Fabricate metal lockers using nuts, bolts, screws, or rivets for nominal assembly at Project site.
- D. Accessible Lockers: Fabricate as follows:
1. Locate bottom shelf no lower than 15 inches above the floor.
 2. Where hooks or additional shelves are provided, locate no higher than 48 inches above the floor.
- E. Hooks: Manufacturer's standard ball-pointed type, aluminum or steel; zinc plated.
- F. Identification Plates: Manufacturer's standard, etched, embossed, or stamped aluminum plates, with numbers and letters at least 3/8 inch high.
- G. Continuous Sloping Tops: Fabricated in lengths as long as practical, without visible fasteners at splice locations; finished to match lockers.
1. Sloping-top corner fillers, mitered.
- H. Filler Panels: Fabricated in an unequal leg angle shape; finished to match lockers. Provide slip-joint filler angle formed to receive filler panel.
- I. Finished End Panels: Designed for concealing unused penetrations and fasteners, except for perimeter fasteners, at exposed ends of nonrecessed metal lockers; finished to match lockers.

1. Provide one-piece panels for double-row (back-to-back) locker ends.

2.4 STEEL SHEET FINISHES

- A. Factory finish steel surfaces and accessories except stainless-steel and chrome-plated surfaces.
- B. Baked-Enamel Finish: Immediately after cleaning, pretreating, and phosphatizing, apply manufacturer's standard thermosetting baked-enamel finish. Comply with paint manufacturer's written instructions for application, baking, and minimum dry film thickness.
- C. Powder-Coat Finish: Immediately after cleaning and pretreating, electrostatically apply manufacturer's standard, baked-polymer, thermosetting powder finish. Comply with resin manufacturer's written instructions for application, baking, and minimum dry film thickness.

PART 3 - EXECUTION

3.1 EXAMINATION

- A. Examine walls, floors, and support bases, with Installer present, for compliance with requirements for installation tolerances and other conditions affecting performance of the Work.
- B. Prepare written report, endorsed by Installer, listing conditions detrimental to performance of the Work.
- C. Proceed with installation only after unsatisfactory conditions have been corrected.

3.2 INSTALLATION

- A. General: Install level, plumb, and true; shim as required, using concealed shims.
 1. Anchor locker runs at ends and at intervals recommended by manufacturer, but not more than 36 inches o.c. Using concealed fasteners, install anchors through backup reinforcing plates, channels, or blocking as required to prevent metal distortion.
 2. Anchor single rows of metal lockers to walls near top and bottom of lockers.
- B. Knocked-Down Metal Lockers: Assemble with standard fasteners, with no exposed fasteners on door faces or face frames.
- C. Equipment and Accessories: Fit exposed connections of trim, fillers, and closures accurately together to form tight, hairline joints, with concealed fasteners and splice plates.
 1. Attach hooks with at least two fasteners.
 2. Identification Plates: Identify metal lockers with identification indicated on Drawings.
 - a. Attach plates to each locker door, near top, centered, with at least two aluminum rivets.

3. Attach filler panels with concealed fasteners. Locate filler panels where indicated on Drawings.
4. Attach sloping-top units to metal lockers, with closures at exposed ends.
5. Attach finished end panels with fasteners only at perimeter to conceal exposed ends of nonrecessed metal lockers.

3.3 ADJUSTING, CLEANING, AND PROTECTION

- A. Clean, lubricate, and adjust hardware. Adjust doors and latches to operate easily without binding.
- B. Protect metal lockers from damage, abuse, dust, dirt, stain, or paint. Do not permit use during construction.
- C. Touch up marred finishes, or replace metal lockers that cannot be restored to factory-finished appearance. Use only materials and procedures recommended or furnished by locker manufacturer.

END OF SECTION 105113

SECTION 210500

BASIC FIRE PROTECTION MATERIALS AND METHODS

PART 1 - 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.

1.2 SUMMARY

- A. This Section specifies the basic requirements for mechanical installations and includes requirements common to more than one section. It expands and supplements the requirements specified in sections of Division 1.
 - 1. Mechanical sleeve seals.
 - 2. Sleeves.
 - 3. Escutcheons.
 - 4. Grout.
 - 5. Demolition of Fire Protection Systems.
 - 6. Equipment installation requirements.
 - 7. Painting and finishing.
 - 8. Concrete bases.
 - 9. Supports and anchorages.
 - 10. Access panels and doors.
 - 11. Seismic Bracing.
- B. Related Sections include the following:
 - 1. Division 3 Section, "Cast-In-Place Concrete."
 - 2. Division 7 Section, "Firestopping."
 - 3. Division 8 Section, "Access Panels."
 - 4. Division 28 Section, "Fire Alarm."
 - 5. Division 9 Section, "Painting."

1.3 DEFINITIONS

- A. Complete and Operational System: A Fire Protection system that has been installed, tested, cleaned, signed-off by appropriate Authority and made operational. Completion of Owner training to be part of this requirement.
- B. Fire Protection Contractor: The project Contractor responsible for the installation of the Fire Protection systems and equipment.

- C. Finished Spaces: Spaces other than mechanical and electrical equipment rooms, furred spaces, pipe and duct shafts, unheated spaces immediately below roof, spaces above ceilings, unexcavated spaces, crawlspaces, and tunnels.
- D. Exposed, Interior Installations: Exposed to view indoors. Examples include finished occupied spaces and mechanical equipment rooms.
- E. Exposed, Exterior Installations: Exposed to view outdoors or subject to outdoor ambient temperatures and weather conditions. Examples include rooftop locations.
- F. Concealed, Interior Installations: Concealed from view and protected from physical contact by building occupants. Examples include above ceilings and in duct shafts.
- G. Concealed, Exterior Installations: Concealed from view and protected from weather conditions and physical contact by building occupants but subject to outdoor ambient temperatures. Examples include installations within unheated shelters.
- H. NFPA: National Fire Protection Association.
- I. AHJ: Authority Having Jurisdiction, parties responsible for the approval of materials and installations.

1.4 SUBMITTALS

- A. General: See Division 1 for general submittal and product substitution requirements.
 - 1. Pre-Construction Submittals: Submit the following items prior to commencing with installations.
 - a. Copies of permits required to perform the work.
 - b. Copies of certificates of registrations indicating compliance with the "Quality Assurance" paragraph that follows.
 - c. Supports and hangers.
 - d. Sleeves and sleeve seals.
 - e. Escutcheons.
 - f. Seismic bracing materials.
 - 2. Post-Construction Submittals: Submit the following items upon completion of the work.
 - a. Copies of final system sign-off and acceptance by the AHJ.

1.5 QUALITY ASSURANCE

- A. Installer Qualifications: All work shall be performed by qualified journeymen of their respective trades who are employed by a firm that can demonstrate successful experience with work similar in type, quality and extent to the work required by this project.
- B. Steel Support Welding: Qualify processes and operators according to AWS D1.1, "Structural Welding Code--Steel."
- C. Steel Pipe Welding: Qualify processes and operators according to ASME Boiler and Pressure Vessel Code: Section IX, "Welding and Brazing Qualifications."

1. Comply with provisions in ASME B31 Series, "Code for Pressure Piping."
 2. Certify that each welder has passed AWS qualification tests for welding processes involved and that certification is current.
- D. Electrical Characteristics for Mechanical Equipment: Equipment of higher electrical characteristics may be furnished provided such proposed equipment is approved in writing and connecting electrical services, circuit breakers, and conduit sizes are appropriately modified. If minimum energy ratings or efficiencies are specified, equipment shall comply with requirements.
- E. Listing and Approval: Unless otherwise required by the Owner's Insurance Underwriter, components intended for use in fire suppression systems shall be "listed" or "approved."
1. "Listed": UL Listed.
 2. "Approved": FMC Approved.

1.6 BASIS OF FIRE PROTECTION DESIGNS

- A. General: The following information is intended to provide an overview of the intent and operation of the project fire Protection systems. It is not intended that each and every project Fire Protection scope item be captured herein. The absence of a specific item or system in the descriptions below does not absolve the Fire Protection Contractor from providing the work identified by other Sections and the Drawings.
1. The Fire Protection Contractor shall provide complete and operational systems and installations.
- B. Fire Protection Systems Description:
1. Richards Second Floor: Provide wet-pipe sprinkler system.
 2. Bean Second Floor: Relocate existing sprinkler heads and/or branch piping as needed to accommodate the new floor plan.
 3. Design: Provide hydraulically designed systems if required by the Authorities Having Jurisdiction, or if required due to the magnitude of the piping rework. Otherwise, provide new installations that match current pipe sizing and NFPA 13 pipe schedule criteria.

1.7 CODES, STANDARDS AND AUTHORITIES

- A. General: The following listing is intended to identify the major Codes, Standards, and Authorities Having Jurisdiction, (AHJ's) for the project. This information is at least partially provided on the G-000 series Drawings as well. In the event that there is a discrepancy between the information contained herein and that on the G-000 Drawings, the information herein shall govern.
1. In the event that an item is included on the G-000 Drawings and is not listed herein, compliance with the requirements of said item is required.
 2. The exclusion of an applicable Code, Standard, or AHJ in the list below does not absolve the Contractor from meeting the requirements of said Code, Standard or AHJ.
- B. Codes: Work performed on the project must comply with the requirements of the following Codes:
1. International Building Code, 2006 Edition.

- C. Standards: Work performed on the project must comply with the requirements of the following Industry Standards:
 - 1. NFPA 13, "Standard for the Installation of Sprinkler Systems," 2002 Edition.
 - 2. NFPA 101, 2003 Edition.
 - 3. NFPA 24, "Standard for the Installation of Private Service Mains and Their Appurtenances," 2002 Edition.

- D. Authorities Having Jurisdiction: Work performed on the project must comply with the requirements of the following AHJ's:
 - 1. State Fire Marshal.
 - 2. Local Fire Department.
 - 3. Building Official.
 - 4. Owner's Insurance Underwriter.

1.8 DRAWINGS AND SPECIFICATIONS

- A. General: The drawings and specifications are complimentary.
 - 1. What is shown or noted on the drawings, but not mentioned in the specifications, automatically becomes a part of the specifications.
 - 2. What is noted in the specifications, but not shown on the drawings, automatically becomes a part of the drawings.
 - 3. Conflicts between the requirements of the drawings and the specifications must be brought to the immediate attention of the Architect/Engineer.
 - a. The more stringent requirement will apply, unless ruled otherwise by the Architect/Engineer.
 - b. When conflicts or discrepancies are noted, no work shall proceed until the conflict or discrepancy has been resolved by the Architect/Engineer.

- B. Fire Protection Drawings and 210500 Series Specification Sections: The Fire Protection Contractor shall bear the responsibility of determining full extent of work required by Contract Documents. The Fire Protection Contractor shall refer to site, architectural, structural, mechanical, electrical and other Drawings and Specification Sections that indicate types of construction with which work of this Section must be coordinated. The Fire Protection Contractor shall review the work with the General Contractor / Construction Manager to establish the extent of work for their trade, and to determine whether there will be any interference with the work of other trades. If the work is later found to include work required to complete and coordinate the work or another trade, or to interfere with the work of another trade then the changes required to complete the work or to eliminate the interference shall be made without additional cost to the Owner.
 - 1. The Drawings schematically indicate the order of connection of the various system components. Each and every nuance and detail is not indicated. Whether specifically shown or not, all items shall be connected in accordance with Code, the details provided, accepted trade practices, and the intent of the Contract Documents. Coordinate with the other trades.

- C. Exact locations of ceiling mounted items shall be as shown and detailed on the Architectural reflected ceiling plans.

- D. System components are identified throughout the Drawings for proper system operation. If any component is inadvertently omitted from the drawings, provide that component as per a similar location.

1.9 COORDINATION DRAWINGS

- A. General: Fire Protection Contractor to generate coordination drawings for the following portions of the facility:
 - 1. Entire Bean and Richards Building Second Floor renovation.
- B. Prepare a set of drawings in conjunction with the Mechanical Contractor(s). The Mechanical Contractor(s) will take the lead and initiate the generation of the drawings. Fire Protection work shall be subsequently applied to the drawings.
 - 1. Drawings are intended to prevent installation conflicts.
 - 2. Drawings to indicate sprinkler piping and heads, mechanical piping, ductwork, equipment and other system components in relation to each other, along with electrical fixtures, conduits, busses, cable trays, supports and structural members.
- C. Drawing Requirements: Drawings to be generated at 3/8-inch = 1-foot minimum scale and shall be ultimately delivered on reproducible media. Drawing size to be consistent with the SMRT design drawings.
 - 1. Drawings to be CADD generated or manually drafted.
 - 2. Drawings to be CADD generated.
 - a. CADD generated drawings shall be ultimately delivered in AutoCAD 2000 format on CD.
 - b. Drawings developed in 3D shall be “flattened” prior to delivery.

1.10 SUBSTITUTIONS

- A. General: See Division 1 for product substitution requirements.
 - 1. No substitute materials or equipment shall be incorporated in the work without the written approval of the Architect/Engineer.

1.11 FIRE PROTECTION SUBMITTALS

- A. General: Refer to Division 1 for submittal definitions, requirements and procedures.
- B. Submittal of shop drawings, certified performance data, and samples will be accepted only when submitted per Division 1. Data submitted from subcontractors and material suppliers directly to the Architect/Engineer will not be processed.
- C. When two or more items of the same material or equipment are required, they shall be products of the same manufacturer insofar as possible.
 - 1. This does not apply to raw or bulk materials such as pipe and fittings, etc.

1.12 RECORD DOCUMENTS

- A. General: Refer to Division 1 for requirements.
- B. As work progresses, mark Drawings to indicate revisions to fire protection systems.
- C. Mark specifications to indicate approved substitutions; Change Orders; actual equipment and materials used.
- D. At completion of work and prior to final request for payment, the Fire Protection Subcontractor shall submit a complete set of reproducible record drawings showing all systems as actually installed. Drawings submitted shall be in the following format:
 - 1. Re-issuances of the project shop drawings.
 - 2. Re-issuance of the project hydraulic calculations, with revisions as necessary to account for modifications since the time of shop drawing submittal.

1.13 OPERATION AND MAINTENANCE, (O&M) MANUALS

- A. General: Refer to Division 1 for procedures and requirements for preparation and submittal of O&M Manuals.
- B. Systems Descriptions: Provide description of function, normal operating characteristics and limitations, performance curves, engineering data and tests, and complete nomenclature and commercial numbers of all replaceable parts.
- C. Operating Procedures: Provide manufacturer's printed data, including start-up, break-in, routine and normal operating instructions; regulation control, stopping, shut-down, and emergency instructions; and summer and winter operating instructions.
- D. Maintenance Procedures: Provide for routine preventive maintenance and troubleshooting; disassembly, repair, and reassembly; aligning and adjusting instructions.
- E. Servicing Instructions: Provide instructions, lubrication charts and schedules.
- F. Product Data: Provide copies of all approved submittals.

1.14 OWNER TRAINING

- A. General: Refer to Division 1 for general requirements.

1.15 WARRANTIES

- A. Refer to Division 1 for project requirements for warranties. Individual warranties are required for each item of power driven or other mechanical equipment having moving parts, and wherever else specified in Division 21.
 - 1. Submit the warranties specified in Division 21 in a vinyl covered, three ring binder, tabulated and indexed for easy reference.

- B. Provide complete warranty information for each item, to include date of commencement; duration; and the names, addresses, and telephone numbers and procedures for filing claims and obtaining warranty services.
- C. Duration of warranties shall be not less than one year from the date of substantial completion of the facility unless prior approval has been granted in writing by the Architect/Engineer. If the manufacturer's warranty expires less than one year from the date of substantial completion, that warranty service and replacement of parts shall be provided by the mechanical subcontractor at no cost to the Owner.

1.16 DELIVERY, STORAGE AND HANDLING

- A. General: Refer to Division 1 for material procurement requirements.
- B. Deliver products to project properly identified with names, model numbers, types, grades, compliance labels, and similar information needed for distinct identifications; adequately packaged and protected to prevent damage during shipment, storage, and handling.
- C. Store equipment and materials at the site, unless off-site storage is authorized in writing. Protect stored equipment and materials from damage.
- D. Coordinate deliveries of mechanical materials and equipment to minimize construction site congestion. Limit each shipment of materials and equipment to the items and quantities needed for the smooth and efficient flow of installations.

1.17 DIVISION OF FIRE PROTECTION, FIRE ALARM AND ELECTRICAL RESPONSIBILITY

- A. General: Line voltage switches, fused switches, outlets, motor starters, power wiring and fuses necessary to connect and operate all electrically powered equipment specified herein will be furnished and installed as a part of the total project. Coordinate work with Division 26. The intent is to have a complete and operational system. The Fire Protection Contractor shall be responsible for furnishing and installing the equipment necessary to provide for the complete and operational system.
- B. Power Wiring: Wiring for equipment shall be furnished and installed as specified under Division 26.
- C. Alarm Wiring: Wiring for alarm devices shall be furnished and installed as specified under Division 28.

1.18 SEISMIC REQUIREMENTS

- A. General: Performance requirements to be used in the design of seismic controls are as identified herein;
 - 1. Seismic Design Category: B
 - 2. Seismic Hazard Use Group: I
 - 3. Building Seismic Importance Factor (I_e): 1.00

4. Refer to structural drawing SG001 for additional seismic information.
- B. Applicability: Seismic controls are required on Fire Protection systems.
 1. See Part 3 paragraph, "Seismic Restraint Installation" for exceptions.
- C. Applicability: Seismic Controls are not required on this project.
- a. New vs. Existing Construction: Where seismic controls are identified above as applicable to the project, install these controls on Fire Protection systems in areas of new building construction.

1.19 COORDINATION

- A. Arrange for pipe spaces, chases, slots, and openings in building structure during progress of construction, to allow for mechanical installations.
- B. Coordinate installation of required supporting devices and set sleeves in poured-in-place concrete and other structural components as they are constructed.
- C. Coordinate requirements for access panels and doors for fire protection items requiring access that are concealed behind finished surfaces. Access panels and doors are specified in Division 8 Section "Access Doors and Frames."
 1. The Fire Protection Contractor shall provide access panels per the requirements of Division 8 Sections. Installation of the panels to be as directed by the General Contractor / Construction Manager.

PART 2 - PRODUCTS

2.1 MANUFACTURERS

- A. Manufacturers: Subject to compliance with requirements, provide products by one of the manufacturers listed below.
- B. Mechanical Sleeve Seals:
 1. Advance Products & Systems, Inc.
 2. Calpico, Inc.
 3. Metraflex Co.
 4. Pipeline Seal and Insulator, Inc.
 5. Thunderline/Link-Seal.
- C. Pipe Identification Systems:
 1. Seaton Name Plate Co.
 2. Brady: Signmark Div.; W.H. Brady Co.
 3. Kolbi Industries, Inc.
- D. Equipment and System Nameplates:
 1. Central Sprinkler Corp.
 2. Reliable Automatic Sprinkler Co., Inc.

3. Viking Corp.
- E. Supports and Anchors:
 1. B-Line Systems, Inc.
 2. Carpenter & Patterson, Inc.
 3. Grinnell Corp.
 4. Fee & Mason Mfg. Co.
- F. Seismic Restraints:
 1. B-Line Systems, Inc.
 2. Loos & Co., Inc.; Cableware Technology Division.
 3. Mason Industries, Inc.
 4. TOLCO Incorporated.
 5. Grinnell Corp.

2.2 JOINING MATERIALS

- A. Refer to individual 210500 series Sections for special joining materials not listed below.
- B. Pipe-Flange Gasket Materials: Suitable for chemical and thermal conditions of piping system contents.
 1. ASME B16.21, nonmetallic, flat, asbestos-free, 1/8-inch maximum thickness unless thickness or specific material is indicated.
 - a. Full-Face Type: For flat-face, Class 125, cast-iron and cast-bronze flanges.
 - b. Narrow-Face Type: For raised-face, Class 250, cast-iron and steel flanges.
 2. AWWA C110, rubber, flat face, 1/8 inch thick, unless otherwise indicated; and full-face or ring type, unless otherwise indicated.
- C. Flange Bolts and Nuts: ASME B18.2.1, carbon steel, unless otherwise indicated.
- D. Plastic, Pipe-Flange Gasket, Bolts, and Nuts: Type and material recommended by piping system manufacturer, unless otherwise indicated.
- E. Solder Filler Metals: ASTM B 32, lead-free alloys. Include water-flushable flux according to ASTM B 813.
- F. Welding Filler Metals: Comply with AWS D10.12 for welding materials appropriate for wall thickness and chemical analysis of steel pipe being welded.

2.3 MECHANICAL SLEEVE SEALS

- A. Description: Modular sealing element unit, designed for field assembly, to fill annular space between pipe and sleeve.
 1. Sealing Elements: EPDM interlocking links shaped to fit surface of pipe. Include type and number required for pipe material and size of pipe.
 2. Pressure Plates: Plastic, include two for each sealing element.

3. Connecting Bolts and Nuts: Carbon steel with corrosion-resistant coating of length required to secure pressure plates to sealing elements. Include one for each sealing element.

2.4 SLEEVES

- A. Galvanized-Steel Sheet: 0.0239-inch minimum thickness; round tube closed with welded longitudinal joint.
- B. Steel Pipe: ASTM A 53, Type E, Grade B, Schedule 40, galvanized, plain ends.
- C. Cast Iron: Cast or fabricated "wall pipe" equivalent to ductile-iron pressure pipe, with plain ends and integral waterstop, unless otherwise indicated.
- D. Stack Sleeve Fittings: Manufactured, cast-iron sleeve with integral clamping flange. Include clamping ring and bolts and nuts for membrane flashing.
 1. Underdeck Clamp: Clamping ring with set screws.

2.5 ESCUTCHEONS

- A. Description: Manufactured wall and ceiling escutcheons and floor plates, with an ID to closely fit around pipe, and an OD that completely covers opening. Escutcheon finishes to be as follows:
 1. Finished area, exposed to view: Polished chrome-plated.
 2. Unfinished areas: Galvanized steel.

2.6 GROUT

- A. Description: ASTM C 1107, Grade B, non-shrink and non-metallic, dry hydraulic-cement grout.
 1. Characteristics: Post-hardening, volume-adjusting, non-staining, non-corrosive, nongaseous, and recommended for interior and exterior applications.
 2. Design Mix: 5000-psi, 28-day compressive strength.
 3. Packaging: Premixed and factory packaged.

2.7 ACCESS PANELS AND DOORS

- A. Panels and doors are to be furnished to provide access to items required in 13900 Series Sections and the Fire Protection Drawings. Panels and doors are to be furnished per the requirements of Division 8 Section, "Access Doors."

2.8 PIPE IDENTIFICATION SYSTEMS

- A. General: Provide Manufacturer's standard products.
 1. Lettering: Comply with ASME A13.1 for lettering size, colors, and viewing angles.

- B. Pipe Markers: Manufacturer's standard preprinted, semi-rigid snap-on, plastic color-coded pipe markers, ASME A13.1.

2.9 NAMEPLATES

- A. General: Provide factory pre-printed porcelain enameled, 20 gauge minimum, steel nameplates.
- B. Hydraulic Nameplates: Indicate the following:
 - 1. Area served.
 - 2. Design area, density, and occupancy classification.
 - 3. Flow and residual pressure required at the base of the riser.
 - 4. Inside hose stream demand.
 - 5. Outside hose stream demand.
- C. Ancillary Nameplates: Provide for the following:
 - 1. Drain locations.
 - 2. Inspector's Test Stations.
 - 3. Auxiliary Drains.
 - 4. Concealed Floor Control and General Sprinkler Zone Valve Assemblies.

2.10 SUPPORTS AND ANCHORS

- A. General: Provide Hangers, Supports and Anchors in accordance with NFPA 13, as specified herein, and as per the Manufacturer's Standardization Society Standard Practices, (MSS SP):
 - 1. MSS SP-58, "Pipe Hanger and Supports – Materials, Design and Manufacture."
 - 2. MSS SP-69, " Pipe Hanger and Supports – Selection and Application."
 - 3. MSS SP-89, " Pipe Hanger and Supports – Fabrication and Installation Practices."
- B. Material Compatibility: Provide hangers and supports which match the piping system material:
 - 1. Copper Piping Systems: Provide copper plated or non-metallic coated hangers and supports.
 - 2. CPVC Piping Systems: Provide non-metallic coated hangers and supports.
- C. Miscellaneous Materials:
 - 1. Structural Steel: ASTM A 36/A 36M, steel plates, shapes, and bars, black and galvanized.
 - 2. Bolts and Nuts: ASME B18.10 or ASTM A 183, steel, hex-head, track bolts and nuts.
 - 3. Washers: ASTM F 844, steel, plain, flat washers.
 - 4. Powder-Actuated Drive-Pin Fasteners: Powder-actuated-type, drive-pin attachments with pull-out and shear capacities appropriate for supported loads and building materials where used. Fasteners for fire protection systems include UL listing and FM approval.
 - 5. Mechanical-Anchor Fasteners: Insert-type attachments with pull-out and shear capacities appropriate for supported loads and building materials where used.
- D. Retaining Straps: Install retaining straps on c-clamp style structure attachments where seismic bracing is a project criteria.

2.11 SEISMIC CONTROLS

- A. General: Restraint systems for these items shall consist of tension and compression, (strut) components, or tension only, (cable) components. In either case, provide necessary ancillary appurtenances as required to meet seismic restrain design criteria. Each and every component is not identified herein.
 - 1. Systems and their components shall be provided by a single manufacturer.
 - 2. Components shall be intended and listed for use with each other, (do not mix and match components not intended for use with each other).
 - 3. Systems may include:
 - a. Attachments to structure.
 - b. Braces and other means of augmenting standard hanger and support assemblies.
 - 4. Restraint devices constructed of aluminum or cast iron materials are not acceptable.
- B. Strut Restraint Systems: Tension and Compression systems consisting of strut manufacturer's standard channel and attachments.
- C. Restraining Cable Systems: Galvanized steel aircraft cables with end connections made of steel assemblies that swivel to final installation angle and utilize two clamping bolts for cable engagement.

PART 3 - EXECUTION

3.1 FIRE PROTECTION DEMOLITION

- A. Disconnect, demolish, and remove Fire Protection systems, equipment, and components indicated to be removed.
 - 1. Piping to Be Removed: Remove portion of piping indicated to be removed and cap or plug remaining piping with same or compatible piping material.
 - 2. Equipment to Be Removed: Disconnect and cap services and remove equipment.
 - 3. Equipment to Be Removed and Reinstalled: Disconnect and cap services and remove, clean, and store equipment; when appropriate, reinstall, reconnect, and make equipment operational.

3.2 CUTTING AND PATCHING

- A. Refer to Division 1 Sections "Cutting and Patching" and "Selective Demolition" for general demolition requirements and procedures.
- B. Refer to Division 26 for requirements for cutting and patching electrical equipment, components, and materials.
- C. Do not endanger or damage installed Work through procedures and processes of cutting and patching.
- D. Arrange for repairs required to restore other work, because of damage caused as a result of fire protection installations.

- E. No additional compensation will be authorized for cutting and patching work that is necessitated by ill-timed, defective, or non-conforming installations.
- F. Perform cutting, fitting, and patching of fire protection equipment and materials required to:
 - 1. Uncover Work to provide for installation of ill-timed Work.
 - 2. Remove and replace defective Work.
 - 3. Remove and replace Work not conforming to requirements of the Contract Documents.
 - 4. Remove samples of installed Work as specified for testing.
 - 5. Upon written instructions from the Architect/Engineer, uncover and restore Work to provide for Architect/Engineer observation of concealed Work.
- G. Protect the structure, furnishings, finishes, and adjacent materials not indicated or scheduled to be removed.
- H. Provide and maintain temporary partitions or dust barriers adequate to prevent the spread of dust and dirt to adjacent areas.

3.3 GENERAL INSTALLATION REQUIREMENTS

- A. General: Coordinate equipment and materials for installation with other building components.
- B. Verify dimensions by field measurements.
- C. Arrange for chases, slots, and openings in other building components to allow for fire protection installations.
- D. Sequence, coordinate and integrate installations of fire protection materials and equipment for efficient flow of the work.
- E. Coordinate the cutting and patching of building components to accommodate the installation of fire protection equipment and materials. Refer to Division 1.
- F. Install mechanical equipment to facilitate maintenance and repair or replacement of equipment components. As much as practical, connect equipment for ease of disconnecting, with minimum of interference with other installations.
- G. Install access panels to allow access to equipment and other system components which require servicing or adjustment per the requirements of Division 8.
- H. Coordinate the installation of mechanical materials and equipment above ceilings with suspension system, lighting fixtures, and other installations.

3.4 PIPING SYSTEMS - COMMON REQUIREMENTS

- A. Install piping according to the following requirements and other 210500 series Sections specifying piping systems.

- B. 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.
- 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 to permit valve servicing.
- G. Install piping at indicated slopes.
- H. Install piping free of sags and bends.
- I. Install fittings for changes in direction and branch connections.
- J. Install piping to allow application of insulation.
- K. Select system components with pressure rating equal to or greater than system operating pressure.
- L. Install escutcheons for penetrations of walls, ceilings, and floors according to the following. Use One-piece escutcheons wherever possible in new construction. Split-casting units acceptable for installation on existing piping systems.
- M. Sleeves are not required for core-drilled holes.
- N. Install sleeves for pipes passing through concrete and masonry walls, gypsum-board partitions, and concrete floor and roof slabs.
 - 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. Extend cast-iron sleeve fittings below floor slab as required to secure clamping ring if ring is specified.
 - 2. Install sleeves in new walls and slabs as new walls and slabs are constructed.
 - 3. Install sleeves that are large enough to provide 1/4-inch annular clear space between sleeve and pipe or pipe insulation. Use the following sleeve materials:
 - a. Steel Pipe Sleeves: For pipes smaller than NPS 6.
 - b. Steel Sheet Sleeves: For pipes NPS 6 and larger, penetrating gypsum-board partitions.
 - c. Stack Sleeve Fittings: For pipes penetrating floors with membrane waterproofing. Secure flashing between clamping flanges. Install section of cast-iron soil pipe to extend sleeve to 2 inches above finished floor level. Refer to Division 7 Section "Sheet Metal Flashing and Trim" for flashing.

- 1) Seal space outside of sleeve fittings with grout.
4. Except for underground wall penetrations, seal annular space between sleeve and pipe or pipe insulation, using joint sealants appropriate for size, depth, and location of joint. Refer to Division 7 Section "Joint Sealants" for materials and installation.
- O. Aboveground, Exterior-Wall Pipe Penetrations: Seal penetrations using sleeves and mechanical sleeve seals. Select sleeve size to allow for 1-inch annular clear space between pipe and sleeve for installing mechanical sleeve seals.
 1. Install steel pipe for sleeves smaller than 6 inches in diameter.
 2. Install cast-iron "wall pipes" for sleeves 6 inches and larger in diameter.
 3. Mechanical Sleeve Seal Installation: Select type and number of sealing elements required for pipe material and size. Position pipe in center of sleeve. Assemble mechanical sleeve seals and install in annular space between pipe and sleeve. Tighten bolts against pressure plates that cause sealing elements to expand and make watertight seal.
- P. Underground, Exterior-Wall Pipe Penetrations: Install cast-iron "wall pipes" for sleeves. Seal pipe penetrations using mechanical sleeve seals. Select sleeve size to allow for 1-inch annular clear space between pipe and sleeve for installing mechanical sleeve seals.
 1. Mechanical Sleeve Seal Installation: Select type and number of sealing elements required for pipe material and size. Position pipe in center of sleeve. Assemble mechanical sleeve seals and install in annular space between pipe and sleeve. Tighten bolts against pressure plates that cause sealing elements to expand and make watertight seal.
- Q. Fire-Barrier Penetrations: Maintain indicated fire rating of walls, partitions, ceilings, and floors at pipe penetrations. Seal pipe penetrations with firestop materials. Refer to Division 7 Section "Through-Penetration Firestop Systems" for materials.

3.5 PIPING JOINT CONSTRUCTION

- A. Join pipe and fittings according to the following requirements and Division 22 Sections specifying piping systems.
- B. Ream ends of pipes and tubes and remove burrs. Bevel plain ends of steel pipe.
- C. Remove scale, slag, dirt, and debris from inside and outside of pipe and fittings before assembly.
- D. Soldered Joints: Apply ASTM B 813, water-flushable flux, unless otherwise indicated, to tube end. Construct joints according to ASTM B 828 or CDA's "Copper Tube Handbook," using lead-free solder alloy complying with ASTM B 32.
- E. 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 unless dry seal threading is specified.
 2. Damaged Threads: Do not use pipe or pipe fittings with threads that are corroded or damaged. Do not use pipe sections that have cracked or open welds.
- F. Welded Joints: Construct joints according to AWS D10.12, using qualified processes and welding operators according to Part 1 "Quality Assurance" Article.
- G. Flanged Joints: Select appropriate gasket material, size, type, and thickness for service application. Install gasket concentrically positioned. Use suitable lubricants on bolt threads.

3.6 PIPING CONNECTIONS

- A. Make connections according to the following, unless otherwise indicated:
1. Install unions, in piping NPS 2 and smaller, adjacent to each valve and at final connection to each piece of equipment.
 2. Install flanges, in piping NPS 2-1/2 and larger, adjacent to flanged valves and at final connection to each piece of equipment.
 3. Dry Piping Systems: Install dielectric unions and flanges to connect piping materials of dissimilar metals.
 4. Wet Piping Systems: Install dielectric coupling and nipple fittings to connect piping materials of dissimilar metals.

3.7 EQUIPMENT INSTALLATION - COMMON REQUIREMENTS

- A. Install equipment to allow maximum possible headroom unless specific mounting heights are not indicated.
- B. Install equipment level and plumb, parallel and perpendicular to other building systems and components in exposed interior spaces, unless otherwise indicated.
- C. Install fire protection equipment to facilitate service, maintenance, and repair or replacement of components. Connect equipment for ease of disconnecting, with minimum interference to other installations. Extend grease fittings to accessible locations.
- D. Install equipment to allow right of way for piping installed at required slope.

3.8 CLEAN CONSTRUCTION MEASURES

- A. General: Take care during construction to maintain the integrity and cleanliness of pipe and equipment systems.
- B. Exposed ends of piping systems and equipment connection ports shall be capped, plugged, or otherwise covered during construction.

3.9 PAINTING

- A. Painting of mechanical systems, equipment, and components is specified in Division 9 Section "Painting."
- B. Damage and Touchup: Repair marred and damaged factory-painted finishes with materials and procedures to match original factory finish.
- C. Sprinkler Heads: Painting of sprinkler heads and their fusible link is prohibited.
 - 1. Provide protective coverings on sprinkler heads where general area painting is taking place.
 - 2. Remove coverings once painting is complete.
 - 3. Replace heads which may have inadvertently been painted.

3.10 CONCRETE BASES

- A. Concrete Bases: Anchor equipment to concrete base according to equipment manufacturer's written instructions and according to seismic codes at Project.
 - 1. Construct concrete bases of dimensions indicated, but not less than 4 inches larger in both directions than supported unit.
 - 2. Install dowel rods to connect concrete base to concrete floor. Unless otherwise indicated, install dowel rods on 18-inch centers around the full perimeter of the base.
 - 3. Install epoxy-coated anchor bolts for supported equipment that extend through concrete base, and anchor into structural concrete floor.
 - 4. Place and secure anchorage devices. Use supported equipment manufacturer's setting drawings, templates, diagrams, instructions, and directions furnished with items to be embedded.
 - 5. Install anchor bolts to elevations required for proper attachment to supported equipment.
 - 6. Install anchor bolts according to anchor-bolt manufacturer's written instructions.
 - 7. Use 3000-psi, 28-day compressive-strength concrete and reinforcement as specified in Division 3 Section "Cast-in-Place Concrete."

3.11 ERECTION OF METAL SUPPORTS AND ANCHORAGES

- A. Refer to Division 5 Section "Metal Fabrications" for structural steel.
- B. Cut, fit, and place miscellaneous metal supports accurately in location, alignment, and elevation to support and anchor mechanical materials and equipment.
- C. Field Welding: Comply with AWS D1.1.

3.12 ERECTION OF WOOD SUPPORTS AND ANCHORAGES

- A. Cut, fit, and place wood grounds, nailers, blocking, and anchorages to support, and anchor mechanical materials and equipment.

- B. Select fastener sizes that will not penetrate members if opposite side will be exposed to view or will receive finish materials. Tighten connections between members. Install fasteners without splitting wood members.
- C. Attach to substrates as required to support applied loads.
- D. Elevator Protection: Provide fire sprinkler coverage for elevators per the following. Coordinate installations with the fire alarm contractor.
 - 1. Elevator Pits: Install a sidewall head in each elevator pit. Include a head guard. Install heads no more than 2-feet above the pit floor. Supply these heads from the lowest adjacent level sprinkler system. Provide a local, accessible, supervised shut-off valve on this dedicated supply. Minimize the amount of piping within the elevator shaft.
 - a. Exception: Sprinkler coverage at the pit level is not required for non-hydraulic elevators, (i.e., no combustible hydraulic fluid).
 - 2. Elevator Machine Rooms: Install intermediate temperature sprinkler heads in these spaces. Coordinate with the fire alarm contractor to insure that sprinkler temperature ratings exceed those of heat detectors within the space. Supply these heads from the adjacent level sprinkler system. Provide a local, accessible, supervised shut-off valve on this dedicated supply.
 - 3. Tops of Elevator Shafts: Install intermediate temperature upright or pendent sprinkler heads in these spaces. Coordinate with the fire alarm contractor to insure that sprinkler temperature ratings exceed those of heat detectors within the space. Supply these heads from the highest adjacent level sprinkler system. Provide a local, accessible, supervised shut-off valve on this dedicated supply. Minimize the amount of piping within the elevator shaft.
 - a. Sprinkler and Smoke Detector Clarification: Sprinklers are required where smoke detectors are located at the tops of elevator shafts for elevator recall, per the requirements of NFPA 72.
 - b. Exception: Sprinklers are not required where ALL of the following conditions are satisfied;
 - 1) Elevator shaft is 2-hour rated.
 - 2) Elevator is passenger type.
 - 3) Elevator cab meets maximum flame/smoke ratings of ASME A17.1.
 - 4) Smoke detectors DO NOT exist at the tops of the shaft for elevator recall.

3.13 GROUTING

- A. Mix and install grout for mechanical equipment base bearing surfaces, pump and other equipment base plates, and anchors.
 - 1. Clean surfaces that will come into contact with grout.
 - 2. Provide forms as required for placement of grout.
 - 3. Avoid air entrapment during placement of grout.
 - 4. Place grout, completely filling equipment bases.
 - 5. Place grout on concrete bases and provide smooth bearing surface for equipment.
 - 6. Place grout around anchors.
 - 7. Cure placed grout.

3.14 SUPPORT AND ANCHORAGE INSTALLATION

- A. General: Comply with NFPA 13, MSS SP-69 and MSS SP-89. Install hangers, supports, clamps, and attachments as required to properly support piping from building structure.
- B. Install building attachments within concrete slabs or attach to structural steel. Space attachments within maximum piping span length indicated in MSS SP-69. Install additional attachments at concentrated loads, including valves, flanges, guides, strainers, and expansion joints, 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.
- C. Install powder-actuated drive-pin fasteners 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.
- D. Install mechanical-anchor fasteners in concrete after concrete is placed and completely cured. Install fasteners according to manufacturer's written instructions.
- E. Install hangers and supports complete with necessary inserts, bolts, rods, nuts, washers, and other accessories.
- F. Load Distribution: Install hangers and supports so that piping live and dead loads and stresses from movement will not be transmitted to connected equipment.
- G. Open Web Joist Attachments: Where systems are supported via attachments to open web steel joints, connections to the joists shall be made at joist panel points. Connections and loading shall also be made concentrically.
- H. Pipe Slopes: Install hangers and supports to provide indicated pipe slopes and so maximum pipe deflections allowed by ASME B31.9, "Building Services Piping," is not exceeded.
- I. Support Spacing: Install piping supports at the following maximum spacing intervals using the minimum threaded rod sizes indicated;

Nominal Pipe Size (inches)	Max. Sch. 10, 30 & 40 Steel Pipe Span (feet)	Max. CPVC Pipe Span (feet)	Min. Rod Dia. (inches)
1	12	-	3/8
1-1/4	12	-	3/8
1-1/2	15	-	3/8
2	15	-	3/8
2-1/2	15	-	3/8
3	15	-	3/8
4	15	-	3/8
6	15	-	1/2
8	15	-	1/2

3.15 IDENTIFICATION SYSTEMS INSTALLATION

- A. Nameplates: Install nameplates using corrosion resistant fasteners.
 - 1. Secure hydraulic nameplates directly to the riser valve which they apply.
 - 2. Install miscellaneous nameplates adjacent to the item being identified.
 - a. For identification of items that are concealed, (i.e.; above a ceiling) install the nameplate in a clearly visible location.
- B. Pipe Identification: Install pipe identification markers on fire protection system mains only, (not required on branch piping). Markers to be located as follows;
 - 1. At 50-foot intervals-max., 25-foot in congested areas.
 - 2. Adjacent to each system valve.
 - 3. At either side of wall or floor penetration.
 - 4. Behind access panels.

3.16 SEISMIC CONTROLS INSTALLATION

- A. See 230548.

3.17 START UP AND TESTING

- A. General: The Fire Protection Contractor is responsible for startup of all equipment provided in 210500 Series Sections.

3.18 FINAL CLEANING

- A. General: Refer to Division 1 for general requirements regarding final cleaning.

END OF SECTION 210500

SECTION 211000

FIRE SUPPRESSION SPRINKLER SYSTEMS

PART 1 - 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. The requirements of Section 210500, "Basic Fire Protection Materials and Methods" apply to work defined by this Section.

1.2 SUMMARY

- A. This Section includes the following fire-suppression systems inside the building:
 - 1. Sprinkler Systems.
- B. Related Sections include the following:
 - 1. Division 21 Section "Water Distribution" for piping outside the building.
 - 2. Division 28 Section "Fire Alarm" for alarm device wiring.

1.3 DEFINITIONS

- A. AHJ: Authorities Having Jurisdiction.
- B. CPVC: Chlorinated polyvinyl chloride plastic.
- C. CR: Chlorosulfonated polyethylene synthetic rubber.
- D. High-Pressure Piping System: Fire-suppression piping system designed to operate at working pressure higher than standard 175 psig.
- E. PE: Polyethylene plastic.
- F. Underground Service-Entrance Piping: Underground service piping below the building.

1.4 SYSTEM DESCRIPTIONS

- A. Wet-Pipe Sprinkler System: Automatic sprinklers are attached to piping containing water and that is connected to water supply. Water discharges immediately from sprinklers when they are opened. Sprinklers open when heat melts fusible link or destroys frangible device. Hose connections are included if indicated.

1.5 PERFORMANCE REQUIREMENTS

- A. Standard Piping System Component Working Pressure: Listed for at least 175 psig.
- B. Fire-suppression system designs and installations shall be approved by Authorities Having Jurisdiction.
 - 1. State Fire Marshal's Office.
 - 2. Local Fire Department.
 - 3. Owner's Insurance Underwriter.
 - 4. Water Supply Authority.
- C. Water Supply Performance: The Installing Contractor shall conduct a hydrant flow test to serve as the basis for hydraulically calculated systems.
- D. Sprinkler Systems:
 - 1. System pipe-line velocities shall be limited to a maximum of 25 feet per second.
 - 2. Margin of Safety for Available Water Flow and Pressure: System design to include a 10 psig minimum cushion between required supplies and available water performance.
 - 3. Sprinkler Occupancy Hazard Classifications:
 - a. Automobile Parking Areas: Ordinary Hazard, Group 1.
 - b. Building Service Areas: Ordinary Hazard, Group 1.
 - c. Electrical Equipment Rooms: Ordinary Hazard, Group 1.
 - d. General Storage Areas: Ordinary Hazard, Group 1.
 - e. Mechanical Equipment Rooms: Ordinary Hazard, Group 1.
 - f. Office and Public Areas: Light Hazard.
 - 4. Minimum Density for Automatic-Sprinkler Piping Design:
 - a. Light-Hazard Occupancy: 0.10 gpm over 1500-sq. ft. area.
 - b. Ordinary-Hazard, Group 1 Occupancy: 0.15 gpm over 1500-sq. ft. area.
 - c. Ordinary-Hazard, Group 2 Occupancy: 0.20 gpm over 1500-sq. ft. area.
 - 5. Maximum Protection Area per Sprinkler:
 - a. Light-Hazard Occupancy: 225 sf per sprinkler.
 - 1) Exception: Shell spaces being provided with temporary upright head coverage which will ultimately be converted to pendent finished ceiling coverage: 130 sf per sprinkler.
 - b. Ordinary-Hazard, Group 1 Occupancy: 130 sf per sprinkler.
 - c. Ordinary-Hazard, Group 2 Occupancy: 130 sf per sprinkler.
 - 6. Total Combined Hose-Stream Demand Requirement: According to NFPA 13, unless otherwise indicated:
 - a. Light-Hazard Occupancies: 100 gpm for 30 minutes.
 - b. Ordinary-Hazard Occupancies: 250 gpm for 60 to 90 minutes.

1.6 SUBMITTALS

- A. General: See Division 1 for general submittal and product substitution requirements.

- B. For sprinkler systems that are part of a combined sprinkler-standpipe system, common sprinkler and standpipe submittals are allowed, providing that these submittals meet the requirements of this section.
- C. Pre-Construction Submittals: Submit the following items prior to commencing with installations.
1. Flow Test Results: The Contractor shall perform a hydrant flow test in the immediate vicinity of the project. At a minimum, test results shall include the following:
 - a. Flow and Gauge hydrant ID numbers and locations in relation to the project.
 - b. Hydrant elevations in relation to the finished floor elevation of the project.
 - c. Static and residual pressure readings.
 - d. Flow at residual pressure.
 - e. Date, time, weather, and testing agency.
 2. Product Data: For the following:
 - a. Piping materials, including sprinkler specialty fittings.
 - b. Valves, including listed fire-protection valves, unlisted general-duty valves, and specialty valves and trim.
 - c. Air compressors, including electrical data.
 - d. Excess-pressure pumps, including electrical data.
 - e. Sprinklers, escutcheons, and guards. Include sprinkler flow characteristics, mounting, finish, and other pertinent data.
 - f. Fire department connections, including type; number, size, and arrangement of inlets; caps and chains; size and direction of outlet; escutcheon and marking; and finish.
 - g. Alarm devices, including electrical data.
 3. Shop Drawings: Sprinkler system layout drawings which include information as required by NFPA 13. Drawings shall be approved by the Authorities Having Jurisdiction prior to being submitted to the Architect. Drawings shall be generated at 1/8-inch per foot minimum scale. Information to be shown includes, but is not limited to the following:
 - a. Pipe size, location and elevation.
 - b. Sprinkler head locations and types.
 - c. Seismic brace details and locations, (where bracing is required by Section 210500).
 - d. At least one building section which indicates fire suppression pipe and component location.
 - e. Hydraulic reference points.
 - f. Remote area, including performance data.
 - g. Hanger details.
- D. Post-Construction Submittals: Submit the following items upon completion of systems installations.
1. NFPA 13 "Contractor's Material and Test Certificate for Aboveground Piping"
 2. NFPA 13 "Contractor's Material and Test Certificate for Underground Piping."
 3. Operation and Maintenance Data: Include approved product submittals and as-built shop drawings in O&M manuals, (see Section 210500).

1.7 QUALITY ASSURANCE

- A. Installer Qualifications: Installer's responsibilities include designing, fabricating, and installing fire-suppression systems.

1. Contractor to hold a sprinkler installer license in the project State.
 2. Contractor's designer to be NICET Level IV Certified or a Registered Professional Fire Protection Engineer.
- B. Welding: Qualify processes and operators according to ASME Boiler and Pressure Vessel Code: Section IX.
- C. NFPA Standards: Fire-suppression-system equipment, specialties, accessories, installation, and testing shall comply with the most recent editions of the following Standards.
1. NFPA 13, "Installation of Sprinkler Systems."
 2. NFPA 24, "Installation of Private Fire Service Mains and Their Appurtenances."
- D. Listing and Approval: Unless otherwise required by the Owner's Insurance Underwriter, components intended for use in fire suppression systems shall be "listed" or "approved."
1. "Listed": UL Listed.
 2. "Approved": FM Approved.
- 1.8 COORDINATION
- A. Coordinate layout and installation of sprinklers with other construction that penetrates ceilings, including light fixtures, HVAC equipment, and partition assemblies.

1.9 EXTRA MATERIALS

- A. Furnish extra materials described below that match products installed and that are packaged with protective covering for storage and identified with labels describing contents.
1. Sprinkler Cabinets: Finished, wall-mounting, steel cabinet with hinged cover, with space for minimum of six spare sprinklers plus sprinkler wrench. Include number of sprinklers required by NFPA 13 and sprinkler wrench. Include separate cabinet with sprinklers and wrench for each type of sprinkler on Project.

PART 2 - PRODUCTS

2.1 MANUFACTURERS

- A. Manufacturers: Subject to compliance with requirements, provide products by one of the manufacturers listed below.
- B. Grooved-Joint Piping Systems:
1. Anvil International, Inc.
 2. Central Sprinkler Corp.
 3. Star Pipe Products; Star Fittings Div.
 4. Victaulic Co. of America.
 5. Shurjoint Piping Products

- C. Flexible Piping:
 - 1. Flex Head Industries.

- D. Specialty Test and Drain Valves:
 - 1. Central Sprinkler Corp.
 - 2. Fire-End and Croker Corp.
 - 3. Viking Corp.
 - 4. Victaulic Co. of America.
 - 5. Shurjoint Piping Products

- E. Gate Valves with Wall Indicator Posts:
 - 1. Grinnell Fire Protection.
 - 2. McWane, Inc.; Kennedy Valve Div.
 - 3. NIBCO.
 - 4. Stockham.

- F. Check and Gate Valves:
 - 1. Clow Valve Co.
 - 2. Crane Co.; Crane Valve Group; Crane Valves.
 - 3. Crane Co.; Crane Valve Group; Jenkins Valves.
 - 4. Hammond Valve.
 - 5. Milwaukee Valve Company.
 - 6. Mueller Company.
 - 7. NIBCO.
 - 8. Red-White Valve Corp.
 - 9. United Brass Works, Inc.

- G. Indicating Type Butterfly Valves:
 - 1. Central Sprinkler Corp.
 - 2. Grinnell Fire Protection.
 - 3. McWane, Inc.; Kennedy Valve Div.
 - 4. Milwaukee Valve Company.
 - 5. NIBCO.
 - 6. Victaulic Co. of America.

- H. Backflow Preventers:
 - 1. Ames Co., Inc.
 - 2. CMB Industries, Inc.; Febco Backflow Preventers.
 - 3. Conbraco Industries, Inc.
 - 4. Watts Industries, Inc.; Water Products Div.
 - 5. Zurn Industries, Inc.; Wilkins Div.

- I. Alarm Check Valves:
 - 1. Central Sprinkler Corp.
 - 2. Globe Fire Sprinkler Corporation.
 - 3. Grinnell Fire Protection.
 - 4. Reliable Automatic Sprinkler Co., Inc.
 - 5. Star Sprinkler Inc.
 - 6. Victaulic Co. of America.
 - 7. Viking Corp.

- J. Sprinkler Heads:
 - 1. Central Sprinkler Corp.
 - 2. Globe Fire Sprinkler Corporation.
 - 3. Grinnell Fire Protection.
 - 4. Reliable Automatic Sprinkler Co., Inc.
 - 5. Star Sprinkler Inc.
 - 6. Viking Corp.

- K. Fire Department Connections:
 - 1. Central Sprinkler Corp.
 - 2. Elkhart Brass Mfg. Co., Inc.
 - 3. Fire-End and Croker Corp.
 - 4. Fire Protection Products, Inc.
 - 5. Guardian Fire Equipment Incorporated.
 - 6. Potter-Roemer; Fire-Protection Div.
 - 7. Reliable Automatic Sprinkler Co., Inc.

- L. Water Motor Gongs:
 - 1. Central Sprinkler Corp.
 - 2. Globe Fire Sprinkler Corporation.
 - 3. Grinnell Fire Protection.
 - 4. Reliable Automatic Sprinkler Co., Inc.
 - 5. Star Sprinkler Inc.
 - 6. Viking Corp.

- M. Electric Bells; Flow, Pressure and Supervisory Switches:
 - 1. ADT Security Services, Inc.
 - 2. Grinnell Fire Protection.
 - 3. ITT McDonnell & Miller.
 - 4. Potter Electric Signal Company.
 - 5. System Sensor.
 - 6. Viking Corp.

- N. Pressure Gauges:
 - 1. AGF Manufacturing Co.
 - 2. AMETEK, Inc.; U.S. Gauge.
 - 3. Brecco Corporation.
 - 4. Dresser Equipment Group; Instrument Div.
 - 5. Marsh Bellofram.
 - 6. WIKA Instrument Corporation.

2.2 DUCTILE-IRON PIPE AND FITTINGS

- A. Mechanical-Joint, Ductile-Iron Pipe: AWWA C151, with mechanical-joint bell end and plain end.
 - 1. Mechanical-Joint, Ductile-Iron Fittings: AWWA C110, ductile- or gray-iron standard pattern.

2. Glands, Gaskets, and Bolts: AWWA C111, ductile- or gray-iron gland, rubber gasket, and steel bolts and nuts.
 3. Lining: Pipe and fittings to have a hydraulically applied internal cement lining.
- B. Restraints: As per the Water Authority, NFPA 13, NFPA 24 and the Drawings. Restraints shall consist of clamps, tie rods, concrete thrust blocks, and combinations thereof.

2.3 STEEL PIPE AND FITTINGS

- A. Threaded-End, Schedule 40 Steel Pipe: ASTM A 53/A 53M, ASTM A 135, or ASTM A 795, hot-dip galvanized where indicated and with factory- or field-formed threaded ends.
1. Cast-Iron Threaded Flanges: ASME B16.1.
 2. Malleable-Iron Threaded Fittings: ASME B16.3.
 3. Gray-Iron Threaded Fittings: ASME B16.4.
 4. Steel Threaded Pipe Nipples: ASTM A 733, made of ASTM A 53/A 53M or ASTM A 106, Schedule 40, seamless steel pipe hot-dip galvanized where indicated. Include ends matching joining method.
 5. Steel Threaded Couplings: ASTM A 865 hot-dip galvanized-steel pipe where indicated.
- B. Grooved-End, Schedule 30 Steel Pipe: ASTM A 135 or ASTM A 795, with wall thickness less than Schedule 40 and equal to or greater than Schedule 30; or ASTM A 795 and ASME B36.10M, Schedule 30 wrought-steel pipe hot-dip galvanized where indicated; with factory- or field-formed, roll-grooved ends.
1. Grooved-End Fittings: UL-listed, ASTM A 536, ductile-iron casting with OD matching steel-pipe OD.
 2. Grooved-End-Pipe Couplings: UL 213 and AWWA C606, flexible and rigid pattern, unless otherwise indicated; gasketed fitting matching steel-pipe OD. Include ductile-iron housing with keys matching steel-pipe and fitting grooves, prelubricated rubber gasket listed for use with housing, and steel bolts and nuts.
 - a. Where intended for dry-pipe service, coupling assembly shall be UL listed for such service.
- C. Grooved-End, Schedule 10 Steel Pipe: ASTM A 135 or ASTM A 795, Schedule 10 in NPS 5 and smaller; and NFPA 13-specified wall thickness in NPS 6 to NPS 10; with factory- or field-formed, roll-grooved ends.
1. Grooved-End Fittings: UL-listed, ASTM A 536, ductile-iron casting with OD matching steel-pipe OD.
 2. Grooved-End-Pipe Couplings: UL 213 and AWWA C606, flexible and rigid pattern, unless otherwise indicated; gasketed fitting matching steel-pipe OD. Include ductile-iron housing with keys matching steel-pipe and fitting grooves, prelubricated rubber gasket listed for use with housing, and steel bolts and nuts.
 - a. Where intended for dry-pipe service, coupling assembly shall be UL listed for such service.

2.4 COPPER TUBE AND FITTINGS

- A. Soft Copper Tube: ASTM B 88, Type K, water tube, annealed temper; with plain ends.

1. Copper fittings: ASME B16.18, cast-copper-alloy or ASME B16.22, wrought-copper, solder-joint pressure type. Furnish only wrought-copper fittings if indicated.
 2. Brazing Filler Metals: AWS A5.8, BCuP-3 or BCuP-4.
- B. Plain-End, Hard Copper Tube: ASTM B 88, Type K, water tube, drawn temper.
1. Copper Fittings: ASME B16.18, cast-copper-alloy or ASME B16.22, wrought-copper, solder-joint pressure type. Furnish only wrought-copper fittings if indicated.
 2. Bronze Flanges: ASME B16.24, Class 150, with solder-joint end. Furnish Class 300 flanges if required to match tubing system.
 3. Copper Unions: MSS SP-123, cast-copper-alloy, hexagonal-stock body with ball-and-socket metal-to-metal seating surfaces, and solder-joint or threaded ends.
- C. Grooved-End, Hard Copper Tube: ASTM B 88, Type K, water tube, drawn temper; with factory- or field-formed, roll-grooved ends.
1. Grooved-End Copper Fittings: ASTM B 75, copper tube or ASTM B 584, bronze casting. Fittings may have ends factory or field expanded to steel-pipe OD if required for copper tube systems using grooved-end-pipe couplings.
 2. Grooved-End-Tube Couplings: UL 213, rigid pattern, unless otherwise indicated; gasketed fitting equivalent to AWWA C606, but made to match copper-tube OD. Include ductile-iron housing with keys matching steel-pipe and fitting grooves, rubber gasket listed for use with housing, and steel bolts and nuts. Use grooved-end-pipe couplings for tube and fitting that have expanded ends.

2.5 FLEXIBLE CONNECTOR ASSEMBLIES

- A. General: Flexible hose assemblies intended specifically for use in fire sprinkler applications. Assemblies shall include necessary components with which they are listed for use. Components may include, but not be limited to the following:
1. Mounting and restrain brackets.
 2. Ceiling grid brackets.
 3. Duct mounting blocks.
- B. Flexible connectors shall have materials suitable for system fluid. Include 175-psig minimum working-pressure rating and ends according to the following:
1. NPS 1: Threaded.
- C. Stainless-Steel-Hose/Stainless-Steel Pipe, Flexible Connectors: Corrugated, stainless-steel, inner tubing covered with stainless-steel wire braid. Include stainless-steel nipples or flanges, welded to hose.

2.6 CORROSION-PROTECTIVE ENCASEMENT FOR PIPING

- A. Encasement for Underground Metal Piping: ASTM A 674 or AWWA C105, PE film, 0.008-inch minimum thickness, tube or sheet.

2.7 SPRINKLER SPECIALTY FITTINGS

- A. Sprinkler specialty fittings shall be UL listed or FMG approved, with 175-psig minimum working-pressure rating, and made of materials compatible with piping.
- B. Sprinkler Drain and Alarm Test Fittings: Cast- or ductile-iron body; with threaded or locking-lug inlet and outlet, test valve, and orifice and sight glass.

2.8 LISTED FIRE-PROTECTION VALVES

- A. General: Valves shall be UL listed or FMG approved, with 175-psig minimum pressure rating.
- B. Gate Valves with Wall Indicator Posts:
 - 1. Gate Valves: UL 262, cast-iron body, bronze mounted, with solid disc, nonrising stem, operating nut, and flanged ends.
 - 2. Indicator Posts: UL 789, horizontal-wall type, cast-iron body, with hand wheel, extension rod, locking device, and cast-iron barrel.
- C. Check Valves NPS 2 and Larger: UL 312, swing type, cast-iron body with flanged or grooved ends.
 - 1. Valve body to include a ball drip port where automatic upstream drainage is required.
- D. Gate Valves: UL 262, OS&Y type.
 - 1. NPS 2 and Smaller: Bronze body with threaded ends.
 - 2. NPS 2-1/2 and Larger: Cast-iron body with flanged ends.
- E. Indicating Type Butterfly Valves: UL 1091, with integral indicating device and ends matching connecting piping.
 - 1. Indicator: Electrical, 115-V ac, prewired, 2-circuit, supervisory switch] [Electrical, 115-V ac, prewired, 2-circuit, supervisory switch.
 - 2. NPS 2 and Smaller: Ball or butterfly valve with bronze body and threaded ends.
 - 3. NPS 2-1/2 and Larger: Butterfly valve with cast- or ductile-iron body; wafer type or with flanged or grooved ends.

2.9 UNLISTED GENERAL-DUTY VALVES

- A. Ball Valves NPS 2 and Smaller: MSS SP-110, 2-piece copper-alloy body with chrome-plated brass ball, 600-psig minimum CWP rating, blowout-proof stem, and threaded ends.
- B. Check Valves NPS 2 and Smaller: MSS SP-80, Type 4, Class 125 minimum, swing type with bronze body, nonmetallic disc, and threaded ends.
- C. Gate Valves NPS 2 and Smaller: MSS SP-80, Type 2, Class 125 minimum, with bronze body, solid wedge, and threaded ends.

- D. Globe Valves NPS 2 and Smaller: MSS SP-80, Type 2, Class 125 minimum, with bronze body, nonmetallic disc, and threaded ends.

2.10 BACKFLOW PREVENTERS

- A. General: ASSE Standard, bronze, cast-iron, steel, or stainless-steel body with flanged ends.
 - 1. End Option: Where allowed by the local water authority, grooved end backflow preventers for 2-1/2-inch and larger applications are acceptable.
 - 2. Interior Lining: AWWA C550 or FDA-approved, epoxy coating for backflow preventers having cast-iron or steel body.
 - 3. Interior Components: Corrosion-resistant materials.
- B. Configuration: Provide horizontal units unless otherwise called for on the Drawings. Where vertical or alternate configuration type units are provided, these units must be designed, constructed, and listed for such usage. Approval must be provided by the local water authority for the use of these units.
- C. Supervision: Backflow Preventer shut-off valves shall be equipped with supervisory switches.
- D. Double-Check Detector Assembly Backflow Preventers: ASSE 1048, FM approved or UL listed, and suitable for continuous pressure application. Include outside screw and yoke gate valves on inlet and outlet, and strainer on inlet. Include test cocks; two positive-seating check valves; and bypass with displacement-type water meter, valves, and double-check backflow preventer.
 - 1. Pressure Loss: 5 psig maximum, at system maximum design flow.

2.11 SPECIALTY VALVES

- A. Alarm Check Valves, General: UL listed or FMG approved, cast- or ductile-iron body with flanged or grooved ends, and 175-psig minimum pressure rating.
 - 1. Main Alarm Option: A flow switch located downstream of the alarm valve may be used in lieu of the pressure switch and retarding chamber listed below if the flow switch can be set to mitigate false alarms caused by municipal system pressure fluctuations.
- B. Wet-Pipe Alarm Check Valves: UL 193, designed for horizontal or vertical installation, with bronze grooved seat with O-ring seals, single-hinge pin, and latch design. Include trim sets for bypass, drain, electrical sprinkler alarm switch, pressure gages, retarding chamber, and fill-line attachment with strainer.
 - 1. Drip Cup Assembly: Pipe to main drain piping.
- C. Automatic Drain Valves: UL 1726, NPS 3/4, ball-check device with threaded ends.
 - a.

2.12 SPRINKLERS

- A. General: Sprinklers shall be UL listed or FMG approved, with 175-psig minimum pressure rating.

1. Sprinklers shall be quick response type, K=5.6, 155°F rated, nominal ½-inch orifice, unless otherwise stated.
 - a. Option: Contractor may propose the use of sprinkler heads with alternate K factor and orifice sizes, pending available project flow and pressure requirements can satisfy their requirements.
 2. Not Allowed: Sprinklers which employ O-ring seals and sprinklers recently involved in the recent Central Sprinkler recall.
- B. Heat Responsive Elements shall comply with the following:
1. UL 199, for nonresidential applications.
 2. UL 1626, for residential applications.
 3. UL 1767, for early-suppression, fast-response applications.
- C. Recessed pendent type with matching push-on escutcheon plate:
1. Finish: White enamel.
 2. Escutcheon: White enamel.
 3. Fusible Link: Glass bulb type, temperature rated for the specific hazard.
- D. Concealed pendent type with matching push-on cover plate:
1. Finish: Rough bronze.
 2. Cover: White enamel.
 3. Fusible Link: Glass bulb type, temperature rated for the specific hazard.
- E. Standard upright type.
1. Finish: Rough bronze.
 2. Fusible Link: Glass bulb type, temperature rated for the specific hazard.
- F. Recessed horizontal sidewall type with matching push-on escutcheon plate.
1. Finish: White enamel.
 2. Escutcheon: White enamel.
 3. Fusible Link: Glass bulb type, temperature rated for the specific hazard.
- G. Dry Barrel Type, recessed pendent or horizontal type with matching push-on escutcheon plate. Dry barrel to be a minimum of 24-inches long. Coordinate exact length with construction requirements.
1. Finish: White enamel.
 2. Escutcheon: White enamel.
 3. Fusible Link: Solder type, temperature rated for the specific hazard.
- H. Sprinkler Guards: Wire-cage type, including fastening device for attaching to sprinkler.
- I. Sprinkler Cabinets: As furnished by the same manufacturer as the heads.

2.13 ALARM DEVICES

- A. General: Alarm-device types shall match piping and equipment connections.
- B. Water-Flow Indicator: UL 346, electrical-supervision, paddle-operated-type, water-flow detector with 250-psig pressure rating and designed for horizontal or vertical installation.

Include two single-pole, double-throw circuit switches for isolated alarm and auxiliary contacts, 7 A, 125-V ac and 0.25 A, 24-V dc; complete with factory-set, field-adjustable retard element to prevent false signals and tamperproof cover that sends signal if removed.

- C. Pressure Switch: UL 753, electrical-supervision-type, water-flow switch with retard feature. Include single-pole, double-throw, normally closed contacts and design that operates on rising pressure and signals water flow.
- D. Valve Supervisory, (Tamper) Switch: UL 753, electrical, single-pole, double-throw switch with normally closed contacts. Include design that signals controlled valve is in other than fully open position.

2.14 PRESSURE GAGES

- A. Description: UL 393, 3-1/2- to 4-1/2-inch- diameter, dial pressure gage with range of 0 to 250 psig minimum.
 - 1. Water System Piping: Include caption "WATER" or "AIR/WATER" on dial face.
 - 2. Air System Piping: Include retard feature and caption "AIR" or "AIR/WATER" on dial face.

PART 3 - EXECUTION

3.1 PREPARATION

- A. Perform fire-hydrant flow test according to NFPA 13 and NFPA 291. Use results for system design calculations required in Part 1 "Quality Assurance" Article.
 - 1. The Architect can provide a standard report form if requested.
- B. Report test results promptly and in writing.

3.2 EARTHWORK

- A. Refer to Division 31 "Earthwork" for excavating, trenching, and backfilling.

3.3 EXAMINATION

- A. Examine roughing-in for hose connections and stations to verify actual locations of piping connections before installation.
- B. Examine walls and partitions for suitable thicknesses, fire- and smoke-rated construction, framing for hose-station cabinets, and other conditions where hose connections and stations are to be installed.
- C. Proceed with installation only after unsatisfactory conditions have been corrected.

3.4 PIPING APPLICATIONS, GENERAL

- A. Shop weld pipe joints where welded piping is indicated.
- B. Do not use welded joints for galvanized-steel pipe.
- C. Flanges, flanged fittings, unions, nipples, and transition and special fittings with finish and pressure ratings same as or higher than system's pressure rating may be used in aboveground applications, unless otherwise indicated.
- D. Above Ground Piping between Fire Department Connections and Check Valves: Schedule 40 galvanized steel pipe with grooved ends; grooved-end fittings; grooved-end-pipe couplings; and grooved joints.
- E. Service-Entrance Piping, (Underground and up to point of connection to the system backflow preventer): Cement-lined ductile-iron, mechanical-joint pipe and fittings and restrained joints.
 - 1. Include corrosion-protective encasement where required by local water authorities.
- F. Standard-Pressure, Wet-Pipe Systems, 175-psig Maximum Working Pressure:
 - 1. NPS 2 and Smaller: Threaded-end, black, schedule 40 steel pipe; cast- or malleable-iron threaded fittings; and threaded joints.
 - 2. NPS 2-1/2 and Larger: Grooved-end, black, schedule 10 steel pipe with roll-grooved ends; grooved-end fittings; grooved-end-pipe couplings; and grooved joints.
 - a. Threadable Light wall piping systems not allowed.

3.5 VALVE APPLICATIONS

- A. Drawings indicate valve types to be used. Where specific valve types are not indicated, the following requirements apply:
 - 1. Listed Fire-Protection Valves: UL listed and FMG approved for applications where required by NFPA Standards.
 - a. Shutoff Duty: Use butterfly, or gate valves.
 - 2. Unlisted General-Duty Valves: For applications where UL-listed and FMG-approved valves are not required by NFPA Standards.
 - a. Shutoff Duty: Use ball, butterfly, or gate valves.
 - b. Throttling Duty: Use ball or globe valves.

3.6 JOINT CONSTRUCTION

- A. Refer to Section 210500, "Basic Fire Protection Materials and Methods" for basic piping joint construction.
- B. Threaded Joints: Do not thread pipe with wall thickness less than Schedule 40.
- C. Grooved Joints: Assemble joints with listed coupling and gasket, lubricant, and bolts.

1. Steel Pipe: Square-cut or roll-groove piping as indicated. Use grooved-end fittings and rigid, grooved-end-pipe couplings, unless otherwise indicated.
 2. Dry-Pipe Systems: Use fittings and gaskets listed for dry-pipe service.
- D. Dissimilar-Metal Piping Joints: Construct joints using dielectric fittings compatible with both piping materials.
1. NPS 2 and Smaller: Use dielectric unions, couplings, or nipples.
 2. NPS 2-1/2 to NPS 4: Use dielectric flanges.
 3. NPS 5 and Larger: Use dielectric flange insulation kits.

3.7 PIPING INSTALLATION

- A. Refer to Section 210500, "Basic Fire Protection Materials and Methods" for basic piping installation.
- B. Locations and Arrangements: Drawing plans, schematics, and diagrams indicate general location and arrangement of piping. Install piping as indicated, as far as practical.
1. Deviations from approved working plans for piping require written approval from authorities having jurisdiction. File written approval with Architect before deviating from approved working plans.
- C. Use approved fittings to make changes in direction, branch takeoffs from mains, and reductions in pipe sizes.
- D. Install unions adjacent to each valve in pipes NPS 2 and smaller. Unions are not required on flanged devices or in piping installations using grooved joints.
- E. Install flanges or flange adapters on valves, apparatus, and equipment having NPS 2-1/2 and larger connections.
- F. Install "Inspector's Test Stations" in sprinkler system piping, complete with shutoff valve, sized and located according to NFPA 13, the local Fire Department, and the Drawings.
- G. Install sprinkler piping with drains for complete system drainage.
- H. Install ball drip valves to drain piping between fire department connections and check valves. Drain to floor drain or outside building.
- I. Install alarm devices in piping systems.
- J. Hangers and Supports: Comply with NFPA 13 for hanger materials.
1. Install sprinkler system piping according to NFPA 13.
- K. Seismic Restraints: Install piping according to NFPA 13 to protect from earthquake damage.
- L. Install pressure gages on riser or feed main, at each sprinkler test connection. Include pressure gages with connection not less than NPS 1/4 and with soft metal seated globe valve, arranged

for draining pipe between gage and valve. Install gages to permit removal, and install where they will not be subject to freezing.

- M. Fill wet-pipe systems with water.
- N. Fill glycol systems with glycol.

3.8 VALVE INSTALLATION

- A. Install listed fire-protection valves, unlisted general-duty valves, specialty valves and trim, controls, and specialties according to NFPA Standards and authorities having jurisdiction.
- B. Install listed fire-protection shutoff valves supervised-open, located to control sources of water supply except from fire department connections. Install permanent identification signs indicating portion of system controlled by each valve.
- C. Install backflow preventers in accessible locations with a minimum of 3-feet of clearance space in front. Install units at 36 – 48-inches above finished floor.
- D. Specialty Valves:
 - 1. Alarm Check Valves: Install in vertical position for proper direction of flow, including bypass check valve and retarding chamber drain-line connection.

3.9 SPRINKLER APPLICATIONS

- A. Drawings indicate sprinkler types to be used. Where specific types are not indicated, use the following sprinkler types:
 - 1. Rooms without Ceilings: Upright sprinklers.
 - a. Install guards on heads located in Mechanical and storage rooms.
 - 2. Rooms with Suspended Ceilings: Recessed pendent sprinklers.
 - 3. Rooms with Hard Drywall, (or similar) Ceilings: Concealed sprinklers.
 - 4. Wall Mounting: Sidewall sprinklers. Use recessed sidewalls in finished spaces.
 - 5. Spaces Subject to Freezing: Glycol system.

3.10 SPRINKLER INSTALLATION

- A. General: Install sprinklers in obvious patterns with other ceiling mounted devices, (lights, diffusers, etc.). Do not “randomly” install sprinkler heads in hard ceilings.
 - 1. Refer to the Drawings for other sprinkler placement requirements, (Fire Protection and/or Architectural reflected ceiling plans).
 - 2. Install sprinklers centered in suspended ceiling tiles.
- B. Upright Heads: Install heads using a 1x1/2-inch reducer, 1-inch nipple and 1-inch tee. Do not use a branch size x 1/2-inch tee to supply heads.

- C. Pendent Heads: Install pendent heads using 1-inch arm overs, or return bends. Directly dropping off branch lines is unacceptable.
 - 1. Option: Where allowed by AHJ's, pendent heads may be supplied using 1-inch flexible hose and mounting assemblies in lieu of arm overs.

3.11 CONNECTIONS

- A. Drawings indicate general arrangement of piping, fittings, and specialties.
- B. Install piping adjacent to equipment to allow service and maintenance.
- C. Connect water-supply piping to fire-suppression piping. Include a backflow preventer.
- D. Install ball drip valves at each check valve for fire department connection. Drain to floor drain or outside building.
- E. Connect piping to specialty valves, hose valves, specialties, fire department connections, and accessories.
- F. Electrical Connections: Power wiring, bonding and grounding to be performed by the Electrical Contractor per Division 26 Sections.
- G. Alarm Connections: Fire Alarm wiring to be performed by the Fire Alarm Contractor per Division 28 Sections.

3.12 FIELD QUALITY CONTROL

- A. Perform the following field tests and inspections and prepare test reports:
 - 1. Leak Test: After installation, charge system and test for leaks. Repair leaks and retest until no leaks exist.
 - 2. Test and adjust controls and safeties. Replace damaged and malfunctioning controls and equipment.
 - 3. Energize circuits to electrical equipment and devices.
 - 4. Start and run excess-pressure pumps.
 - 5. Start and run air compressors.
 - 6. Flush, test, and inspect sprinkler systems according to NFPA 13, "Systems Acceptance" Chapter.
 - 7. Coordinate with fire alarm tests. Operate as required.
 - 8. Verify that equipment hose threads are same as local fire department equipment.
- B. Report test results promptly and in writing to Architect and authorities having jurisdiction.

3.13 CLEANING AND PROTECTION

- A. Clean dirt and debris from sprinklers.

- B. Remove and replace sprinklers with paint other than factory finish.
- C. Protect sprinklers from damage until Substantial Completion.

END OF SECTION 211000

SECTION 220000

BASIC PLUMBING REQUIREMENTS

PART 1 - 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.

1.2 SUMMARY

- A. This Section specifies the basic requirements for mechanical installations and includes requirements common to more than one section. It expands and supplements the requirements specified in sections of Division 1.
- B. Related Sections include the following:
 - 1. Section 210500, "Basic Fire Protection Materials and Methods" for Fire Protection Contractor coordination drawing requirements.
 - 2. Section 220553, "Plumbing Identification" for valve tag schedules.

1.3 DEFINITIONS

- A. Complete and Operational System: A Mechanical system that has been installed, tested, cleaned, signed-off by appropriate Authority and made operational. Completion of Owner training to be part of this requirement.
- B. Plumbing Contractor: The project Contractor responsible for the installation of the Plumbing systems and equipment.

1.4 SUBMITTALS

- A. General: See Division 1 for general submittal and product substitution requirements.
- B. Pre-Construction Submittals: Submit the following items prior to commencing with installations.
 - 1. Coordination Drawings.
 - 2. Schedule of Mechanical Submittals and Closeout Procedures.
- C. During Construction: Submit at earliest possible date but not later than 50% completion of mechanical work as determined by schedule of values.
 - 1. Operation and Maintenance Manual Table of Contents.

2. Schedule of Mechanical Submittals and Closeout Procedures with updated current status information.

D. Post Construction: Submit the following at least fifteen (15) days before requesting site review for Substantial Completion.

1. Project Record Documents; as-builts.
2. Operation and Maintenance manuals.
3. Warranties.
4. Completed Schedule of Mechanical Submittals and Closeout Procedures.

1.5 QUALITY ASSURANCE

A. Installer Qualifications: All work shall be performed by qualified journeymen of their respective trades who are employed by a firm that can demonstrate successful experience with work similar in type, quality and extent to the work required by this project.

1.6 BASIS OF PLUMBING DESIGNS

A. General: The following information is intended to provide an overview of the intent and operation of the project Plumbing systems. It is not intended that each and every project Plumbing scope item be captured herein. The absence of a specific item or system in the descriptions below does not absolve the Mechanical Contractor(s) from providing the work identified by other Sections and the Drawings.

1.

B. Plumbing Systems Description:

1. General: The following systems shall be installed:

- a. Domestic cold, hot, re-circulated hot, and (emergency) tempered water.
- b. Sanitary waste, vent and indirect waste.

2. Domestic water supply shall be from the existing hospital system.

3. Plumbing Fixtures:

- a. Fixtures shall be commercial grade vitreous china with chrome plated brass faucets/flush valves.

1.7 CODES, STANDARDS AND AUTHORITIES

A. General: The following listing is intended to identify the major Codes, Standards, and Authorities Having Jurisdiction, (AHJ's) for the project. This information is at least partially provided on the G-000 series Drawings as well. In the event that there is a discrepancy between the information contained herein and that on the G-000 Drawings, the information herein shall govern.

1. In the event that an item is included on the G-000 Drawings and is not listed herein, compliance with the requirements of said item is required.
 2. The exclusion of an applicable Code, Standard, or AHJ in the list below does not absolve the Contractor from meeting the requirements of said Code, Standard or AHJ.
- B. Codes: Work performed on the project must comply with the requirements of the following Codes:
1. International Building Code 2006
 2. International Mechanical Code 2006
 3. State of Maine Internal Plumbing Rules
- C. Standards: Work performed on the project must comply with the requirements of the following Industry Standards:
1. ASME – American Society of Mechanical Engineers
 2. ANSI – American National Standards Institute
 3. ASHRAE – American Society of Heating, Refrigerating, and Air Conditioning Engineers
 4. ARI – American Refrigeration Institute
 5. ASTM – American Society of Testing and Materials
 6. NEBB – National Environmental Balancing Bureau
 7. NFPA – National Fire Protection Association
 8. SMACNA - Sheet Metal and Air Conditioning Contractors’ National Association Duct Construction
 9. UL - Underwriters’ Laboratories
 - 10.
- D. Authorities Having Jurisdiction: Work performed on the project must comply with the requirements of the following AHJ’s:
1. State of Maine Plumbing Code Inspector.
 2. City of Portland Code Enforcement Officer.
 3. City of Portland Water District.
 4. State of Maine Fire Marshall.

1.8 DRAWINGS AND SPECIFICATIONS

- A. General: The drawings and specifications are complimentary.
1. What is shown or noted on the drawings, but not mentioned in the specifications, automatically becomes a part of the specifications.
 2. What is noted in the specifications, but not shown on the drawings, automatically becomes a part of the drawings.
 3. Conflicts between the requirements of the drawings and the specifications must be brought to the immediate attention of the Architect/Engineer.
 - a. The more stringent requirement will apply, unless ruled otherwise by the Architect/Engineer.
 - b. When conflicts or discrepancies are noted, no work shall proceed until the conflict or discrepancy has been resolved by the Architect/Engineer.
- B. Mechanical Drawings and Division 22 Specification Sections: The Mechanical Contractor shall bear the responsibility of determining full extent of work required by Contract Documents. The Mechanical Contractor shall refer to site, architectural, structural, electrical and other Drawings

and Specification Sections that indicate types of construction with which work of this Section must be coordinated. The Mechanical Contractor shall review the work with the General Contractor / Construction Manager to establish the extent of work for their trade, and to determine whether there will be any interference with the work of other trades. If the work is later found to include work required to complete and coordinate the work or another trade, or to interfere with the work of another trade then the changes required to complete the work or to eliminate the interference shall be made without additional cost to the Owner.

1. The Drawings schematically indicate the order of connection of the various system components. Each and every nuance and detail is not indicated. Whether specifically shown or not, all items shall be connected in accordance with Code, the details provided, accepted trade practices, and the intent of the Contract Documents. Coordinate with the other trades.
- C. Exact locations of ceiling mounted items shall be as shown and detailed on the Architectural reflected ceiling plans.
- D. System components (thermostats, sensors, volume dampers, access doors, etc.) are identified throughout the Drawings for proper system operation. If any component is inadvertently omitted from the drawings, provide that component as per a similar location.

1.9 COORDINATION DRAWINGS

- A. General: Plumbing Contractor(s) to generate coordination drawings for the following portions of the facility:
 1. Entire Emergency Department addition and renovation.
- B. Prepare a set of drawings in conjunction with the Fire Protection Contractor. In the event that Plumbing and HVAC work is performed by separate Contractors, the HVAC Contractor shall take the lead and initiate the generation of the drawings. Plumbing and Fire Protection work shall be subsequently applied to the drawings.
 1. Drawings are intended to prevent installation conflicts.
 2. Drawings to indicate piping, ductwork, equipment and other system components in relation to each other, along with electrical fixtures, conduits, busses, cable trays, supports and structural members.
- C. Drawing Requirements: Drawings to be generated at 3/8-inch = 1-foot minimum scale and shall be ultimately delivered on reproducible media. Drawing size to be consistent with the SMRT design drawings.
 1. Drawings to be CADD generated.

1.10 SUBSTITUTIONS

- A. General: See Division 1 for product substitution requirements.
 1. No substitute materials or equipment shall be incorporated in the work without the written approval of the Architect/Engineer.
- B. Substitute materials and equipment submitted for approval must fit within the spaces available with neither substantial alteration nor increased pressure drops or friction losses.

- C. Approval of substitute materials or equipment by the Architect/Engineer shall not relieve the contractor from his responsibility to provide a complete and operational mechanical system.
- D. The Architect/Engineer's decision as to the equality or acceptability of proposed substitutions for the materials and equipment specified shall be final.
 - 1. Any additional costs incurred by such substitutions, including additional costs to other trades, or engineering design costs, shall be borne by the Contractor. This includes costs associated with the design and installation of infrastructure and support systems to facilitate a proposed substitution. This cost will be borne by the Mechanical Contractor.

1.11 SCHEDULE OF MECHANICAL SUBMITTALS AND CLOSEOUT PROCEDURES

- A. General: In conjunction with submittal scheduling requirements detailed in Section 013200, prepare a separate Schedule of Mechanical Submittals and Closeout Procedures.
- B. Schedule shall list the following information for each required submittal:
 - 1. Specification Section number and title.
 - 2. Product Name or Description of Work Covered.
 - 3. Submittal Tracking Number.
 - 4. Required submission relative to construction:
 - a. Pre-construction (prior to fabrication/installation of product).
 - b. During construction.
 - c. Post-construction.
 - 5. Submittal Status:
 - a. NC: Final Approval Not Complete
 - b. A: Approved.
 - 6. Owner Training: Indicate if Owner Training is required.
 - a. NC: Training not performed or not completed.
 - b. A: Approved/Training Completed.
 - 7. Spare Materials and Parts.

1.12 MECHANICAL SUBMITTALS

- A. General: Refer to Division 1 for submittal definitions, requirements and procedures.
- B. Submittal of shop drawings, certified performance data, and samples will be accepted only when submitted per Division 1. Data submitted from subcontractors and material suppliers directly to the Architect/Engineer will not be processed.
- C. Submittals for each mechanical trade shall be complete, including all items for which submission and approval is required, and each sheet containing performance data shall be clearly highlighted and marked for the appropriate model or type of equipment to be reviewed. Intended use shall be written on each submittal sheet for each different type of equipment or material to be reviewed (i.e. valves for domestic water or heating hot water, etc.). Incomplete or unmarked submittals WILL BE RETURNED to the Contractor without action.

- D. Submittals shall be organized by specification Section and shall be clearly labeled. Submittals for Plumbing items covered by a “shared” Mechanical specification Section, (i.e., hangers and supports, insulation) shall be separate and clearly labeled as to the trade intended.
 - 1. Unclear and/or mixed submittals will not be processed.
- E. When two or more items of the same material or equipment are required, (i.e., plumbing fixtures, pumps, valves, air handling units, fans, diffusers, registers and grilles.) they shall be products of the same manufacturer insofar as possible.
 - 1. This does not apply to raw or bulk materials such as pipe and fittings, sheet metal, etc.

1.13 RECORD DOCUMENTS

- A. General: Refer to Division 1 for requirements.
- B. As work progresses, mark Drawings to indicate revisions to piping and ductwork, size and location including locations dampers and other control devices, filters, boxes and similar units requiring periodic maintenance or repair; actual equipment locations, dimensioned for column lines; mains and branches of piping systems, with valves and control devices located and numbered; Change Orders; concealed control system devices.
- C. Mark specifications to indicate approved substitutions; Change Orders; actual equipment and materials used.
- D. At completion of work and prior to final request for payment, the Mechanical Subcontractor(s) shall submit a complete set of reproducible record drawings showing all systems as actually installed. Drawings submitted shall be in the following format:
 - 1. CADD generated.
 - a. SMRT design Drawing files may be available as a starting point for CADD generated drawings. A release form will need to be signed to facilitate this.
 - b. CADD generated drawings shall be ultimately delivered in AutoCAD 2005 format on CD.
 - 2. Valve Tags: Record drawings to include valve tag markers which correspond to the valve tag chart provided under the O&M Manual Section.

1.14 OPERATION AND MAINTENANCE, (O&M) MANUALS

- A. General: Refer to Division 1 for procedures and requirements for preparation and submittal of O&M Manuals.
- B. Table of Contents: Prepare Table of Contents of O&M Manual and submit in accordance with Section 1.4.
- C. Systems Descriptions: Provide description of function, normal operating characteristics and limitations, performance curves, engineering data and tests, and complete nomenclature and commercial numbers of all replaceable parts.

- D. Operating Procedures: Provide manufacturer's printed data, including start-up, break-in, routine and normal operating instructions; regulation control, stopping, shut-down, and emergency instructions; and summer and winter operating instructions.
- E. Maintenance Procedures: Provide for routine preventive maintenance and troubleshooting; disassembly, repair, and reassembly; aligning and adjusting instructions.
- F. Servicing Instructions: Provide instructions, lubrication charts and schedules.
- G. Product Data: Provide copies of all approved submittals.
- H. Valve Schedules: Include valve tag charts in the O&M Manuals. Valve tag charts are as per Section 220553, "Mechanical Identification."

1.15 OWNER TRAINING

- A. General: Refer to Division 1 for general requirements.

1.16 WARRANTIES

- A. Refer to Division 1 for project requirements for warranties. Individual warranties are required for each item of power driven or other mechanical equipment having moving parts, and wherever else specified in Division 22.
 - 1. Submit the warranties specified in Division 22 in a vinyl covered, three ring binder, tabulated and indexed for easy reference.
- B. Provide complete warranty information for each item, to include date of commencement; duration; and the names, addresses, and telephone numbers and procedures for filing claims and obtaining warranty services.
- C. Duration of warranties shall be not less than one year from the date of substantial completion of the facility unless prior approval has been granted in writing by the Architect/Engineer. If the manufacturer's warranty expires less than one year from the date of substantial completion, that warranty service and replacement of parts shall be provided by the mechanical subcontractor at no cost to the Owner.

1.17 DELIVERY, STORAGE AND HANDLING

- A. General: Refer to Division 1 for material procurement requirements.
- B. Deliver products to project properly identified with names, model numbers, types, grades, compliance labels, and similar information needed for distinct identifications; adequately packaged and protected to prevent damage during shipment, storage, and handling.
- C. Store equipment and materials at the site, unless off-site storage is authorized in writing. Protect stored equipment and materials from damage.

- D. Coordinate deliveries of mechanical materials and equipment to minimize construction site congestion. Limit each shipment of materials and equipment to the items and quantities needed for the smooth and efficient flow of installations.

1.18 ENERGY EFFICIENCY

- A. All equipment shall have minimum efficiency as described in ASHRAE Standard 90.1-1999, January 1, 1999 requirements. All equipment suppliers must be aware of the requirements and submitted equipment shall meet these minimum requirements.

1.19 REFRIGERANTS AND OTHER HAZARDOUS MATERIALS

- A. The Plumbing Contractor shall be responsible for the capture, removal, and disposal of materials resulting from the Work.
 - 1. Comply with the requirements of applicable Codes, Standards and Authorities.

1.20 DIVISION OF MECHANICAL AND ELECTRICAL RESPONSIBILITY

- A. General: Line voltage switches, fused switches, outlets, motor starters, power wiring and fuses necessary to connect and operate all electrically powered equipment specified herein will be furnished and installed as a part of the total project. Coordinate work with Division 26. The intent is to have a complete and operational system. The Mechanical Contractor shall be responsible for furnishing and installing the equipment necessary to provide for the complete and operational system.
- B. Motor Starters: Where not specified in Division 22, shall be furnished and installed under Division 26.
- C. Power Wiring: Wiring for equipment shall be furnished and installed as specified under Division 26.
- D. Temperature Control Wiring: Wiring and interlocks shall be furnished and installed under Division 23.
- E. Disconnect Switches: Where not specified in Division 22, shall be furnished and installed under Division 26.

1.21 TEMPORARY HEATING

- A. Refer to Division 1 requirements regarding temporary facilities during construction.
- B. The Plumbing Contractor shall provide necessary heating equipment, fuel sources, water treatment, and related items as necessary to meet the intent of the requirements.

PART 2 - PRODUCTS – NOT USED

PART 3 - EXECUTION

3.1 START UP AND TESTING

- A. General: Contractor shall provide all fuel for startup and testing of all equipment provided in this section. Refer to Division 1 for responsibility of electrical power.
- B. The Plumbing Contractor is responsible for startup of all equipment provided in Division 22 Sections.
- C. The Plumbing Contractor shall verify that systems are complete and operational before commencing with balancing work.
- D. Prior to balancing, ensure the following conditions:
 - 1. Systems are started and operating in a safe and normal condition.
 - 2. Temperature control systems are installed complete and operable.
 - 3. Proper thermal overload protection is in place for electrical equipment.
 - 4. Plumbing systems are flushed, filled and vented.
 - 5. Proper strainer baskets are cleaned and in place.
 - 6. Service and balance valves are open.
- E. Power Outage Test: Entire control system and all mechanical equipment shall be run through a simulated site power outage with emergency generator operation and shall regain standard operation sequences when normal power is restored.
- F. Owner Witness of Test: The Owner shall witness final power outage test. entire control system and all mechanical equipment shall pass power outage test prior to Owner witness.

3.2 FINAL CLEANING

- A. General: Refer to Division 1 for general requirements regarding final cleaning.
- B. Refer to Division 22 Section, "Testing, Adjusting and Balancing" for requirements of cleaning filters, strainers, and other mechanical systems prior to final acceptance.

END OF SECTION 220000

SECTION 220500

BASIC PLUMBING MATERIALS AND METHODS

PART 1 - 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. The requirements of Section 220000, "Basic Plumbing Requirements" apply to work defined by this Section.

1.2 SUMMARY

- A. This Section includes the following:
 - 1. Piping materials and installation instructions common to most piping systems.
 - 2. Transition fittings.
 - 3. Dielectric fittings.
 - 4. Mechanical sleeve seals.
 - 5. Sleeves.
 - 6. Escutcheons.
 - 7. Grout.
 - 8. Mechanical demolition.
 - 9. Equipment installation requirements common to equipment sections.
 - 10. Painting and finishing.
 - 11. Concrete bases.
 - 12. Supports and anchorages.
 - 13. Access panels and doors.
 - 14. Motors for Plumbing Equipment
- B. Related Sections include the following:
 - 1. Division 3 Section, "Cast-In-Place Concrete."
 - 2. Division 7 Section, "Firestopping."
 - 3. Division 8 Section, "Access Panels."
 - 4. Division 9 Section, "Painting."

1.3 DEFINITIONS

- A. Finished Spaces: Spaces other than mechanical and electrical equipment rooms, furred spaces, pipe and duct shafts, unheated spaces immediately below roof, spaces above ceilings, unexcavated spaces, crawlspaces, and tunnels.

- B. Exposed, Interior Installations: Exposed to view indoors. Examples include finished occupied spaces and mechanical equipment rooms.
- C. Exposed, Exterior Installations: Exposed to view outdoors or subject to outdoor ambient temperatures and weather conditions. Examples include rooftop locations.
- D. Concealed, Interior Installations: Concealed from view and protected from physical contact by building occupants. Examples include above ceilings and in duct shafts.
- E. Concealed, Exterior Installations: Concealed from view and protected from weather conditions and physical contact by building occupants but subject to outdoor ambient temperatures. Examples include installations within unheated shelters.
- F. The following are industry abbreviations for plastic materials:
 - 1. ABS: Acrylonitrile-butadiene-styrene plastic.
 - 2. CPVC: Chlorinated polyvinyl chloride plastic.
 - 3. PE: Polyethylene plastic.
 - 4. PVC: Polyvinyl chloride plastic.
- G. The following are industry abbreviations for rubber materials:
 - 1. EPDM: Ethylene-propylene-diene terpolymer rubber.
 - 2. NBR: Acrylonitrile-butadiene rubber.

1.4 SUBMITTALS

- A. General: See Division 1 for general submittal and product substitution requirements.
- B. Pre-Construction Submittals: Submit the following items prior to commencing with installations.
 - 1. Product Data: For transition fittings, dielectric fittings, mechanical sleeve seals, escutcheons.
 - 2. Welding certificates.

1.5 QUALITY ASSURANCE

- A. Steel Support Welding: Qualify processes and operators according to AWS D1.1, "Structural Welding Code--Steel."
- B. Steel Pipe Welding: Qualify processes and operators according to ASME Boiler and Pressure Vessel Code: Section IX, "Welding and Brazing Qualifications."
 - 1. Comply with provisions in ASME B31 Series, "Code for Pressure Piping."
 - 2. Certify that each welder has passed AWS qualification tests for welding processes involved and that certification is current.
- C. Electrical Characteristics for Plumbing Equipment: Equipment of higher electrical characteristics may be furnished provided such proposed equipment is approved in writing and connecting electrical services, circuit breakers, and conduit sizes are appropriately modified. If

minimum energy ratings or efficiencies are specified, equipment shall comply with requirements.

1.6 DELIVERY, STORAGE, AND HANDLING

- A. Deliver pipes and tubes with factory-applied end caps. Maintain end caps through shipping, storage, and handling to prevent pipe end damage and to prevent entrance of dirt, debris, and moisture.
- B. Store plastic pipes protected from direct sunlight. Support to prevent sagging and bending.

1.7 COORDINATION

- A. Arrange for pipe spaces, chases, slots, and openings in building structure during progress of construction, to allow for mechanical installations.
- B. Coordinate installation of required supporting devices and set sleeves in poured-in-place concrete and other structural components as they are constructed.
- C. Coordinate requirements for access panels and doors for mechanical items requiring access that are concealed behind finished surfaces. Access panels and doors are specified in Division 8 Section "Access Doors and Frames."
 - 1. Provide access panels per the requirements of Division 8 Sections. Installation of the panels to be as directed by the General Contractor / Construction Manager.
- D. Coordinate features of motors, installed units, and accessory devices. Provide motors that are:
 - 1. Designed and labeled for use with variable frequency controllers, and suitable for use throughout speed range without overheating.

PART 2 - PRODUCTS

2.1 MANUFACTURERS

- A. Manufacturers: Subject to compliance with requirements, provide products by one of the manufacturers listed below.
- B. AWWA Transition Couplings:
 - 1. Cascade Waterworks Mfg. Co.
 - 2. Dresser Industries, Inc.; DMD Div.
 - 3. Ford Meter Box Company, Incorporated (The); Pipe Products Div.
 - 4. JCM Industries.
 - 5. Smith-Blair, Inc.
 - 6. Viking Johnson.
- C. Plastic-to-Metal Transition Fittings:
 - 1. Eslon Thermoplastics.

- D. Plastic-to-Metal Transition Adaptors:
 - 1. Thompson Plastics, Inc.

- E. Plastic-to-Metal Transition Unions:
 - 1. NIBCO, Inc.

- F. Flexible Transition Couplings for Underground Non-pressure Drainage Piping:
 - 1. Cascade Waterworks Mfg. Co.
 - 2. Fernco, Inc.
 - 3. Mission Rubber Company.
 - 4. Plastic Oddities, Inc.

- G. Dielectric Unions:
 - 1. Capitol Manufacturing Co.
 - 2. Central Plastics Company.
 - 3. Eclipse, Inc.
 - 4. Epco Sales, Inc.
 - 5. Hart Industries, International, Inc.
 - 6. Watts Industries, Inc.; Water Products Div.
 - 7. Zurn Industries, Inc.; Wilkins Div.

- H. Dielectric Flanges:
 - 1. Capitol Manufacturing Co.
 - 2. Central Plastics Company.
 - 3. Epco Sales, Inc.
 - 4. Watts Industries, Inc.; Water Products Div.

- I. Dielectric Flange Kits:
 - 1. Advance Products & Systems, Inc.
 - 2. Calpico, Inc.
 - 3. Central Plastics Company.
 - 4. Pipeline Seal and Insulator, Inc.

- J. Dielectric Couplings:
 - 1. Calpico, Inc.
 - 2. Lochinvar Corp.

- K. Dielectric Nipples:
 - 1. Perfection Corp.
 - 2. Precision Plumbing Products, Inc.
 - 3. Sioux Chief Manufacturing Co., Inc.
 - 4. Victaulic Co. of America.

- L. Mechanical Sleeve Seals:
 - 1. Advance Products & Systems, Inc.
 - 2. Calpico, Inc.
 - 3. Metraflex Co.
 - 4. Pipeline Seal and Insulator, Inc.
 - 5. Thunderline/Link-Seal

2.2 PIPE, TUBE, AND FITTINGS

- A. Refer to individual Division 22 piping Sections for pipe, tube, and fitting materials and joining methods.
- B. Pipe Threads: ASME B1.20.1 for factory-threaded pipe and pipe fittings.

2.3 JOINING MATERIALS

- A. Refer to individual Division 22 piping Sections for special joining materials not listed below.
- B. Pipe-Flange Gasket Materials: Suitable for chemical and thermal conditions of piping system contents.
 - 1. ASME B16.21, nonmetallic, flat, asbestos-free, 1/8-inch maximum thickness unless thickness or specific material is indicated.
 - a. Full-Face Type: For flat-face, Class 125, cast-iron and cast-bronze flanges.
 - b. Narrow-Face Type: For raised-face, Class 250, cast-iron and steel flanges.
 - 2. AWWA C110, rubber, flat face, 1/8 inch thick, unless otherwise indicated; and full-face or ring type, unless otherwise indicated.
- C. Flange Bolts and Nuts: ASME B18.2.1, carbon steel, unless otherwise indicated.
- D. Plastic, Pipe-Flange Gasket, Bolts, and Nuts: Type and material recommended by piping system manufacturer, unless otherwise indicated.
- E. Solder Filler Metals: ASTM B 32, lead-free alloys. Include water-flushable flux according to ASTM B 813.
- F. Brazing Filler Metals: AWS A5.8, BCuP Series, copper-phosphorus alloys for general-duty brazing, unless otherwise indicated; and AWS A5.8, BAg1, silver alloy for refrigerant piping, unless otherwise indicated.
- G. Welding Filler Metals: Comply with AWS D10.12 for welding materials appropriate for wall thickness and chemical analysis of steel pipe being welded.
- H. Solvent Cements for Joining Plastic Piping:
 - 1. ABS Piping: ASTM D 2235.
 - 2. CPVC Piping: ASTM F 493.
 - 3. PVC Piping: ASTM D 2564. Include primer according to ASTM F 656.
 - 4. PVC to ABS Piping Transition: ASTM D 3138.
- I. Fiberglass Pipe Adhesive: As furnished or recommended by pipe manufacturer.

2.4 TRANSITION FITTINGS

- A. AWWA Transition Couplings: Same size as, and with pressure rating at least equal to and with ends compatible with, piping to be joined.
 - 1. Underground Piping NPS 1-1/2 and Smaller: Manufactured fitting or coupling.
 - 2. Underground Piping NPS 2 and Larger: AWWA C219, metal sleeve-type coupling.
 - 3. Aboveground Pressure Piping: Pipe fitting.
- B. Plastic-to-Metal Transition Fittings: One-piece fitting with manufacturer's Schedule 80 equivalent dimensions; one end with threaded brass insert, and one solvent-cement-joint end.
- C. Plastic-to-Metal Transition Adaptors: One-piece fitting with manufacturer's SDR 11 equivalent dimensions; one end with threaded brass insert, and one solvent-cement-joint end.
- D. Plastic-to-Metal Transition Unions: MSS SP-107, four-part union. Include brass end, solvent-cement-joint end, rubber O-ring, and union nut.
- E. Flexible Transition Couplings for Underground Nonpressure Drainage Piping: ASTM C 1173 with elastomeric sleeve, ends same size as piping to be joined, and corrosion-resistant metal band on each end.

2.5 DIELECTRIC FITTINGS

- A. Description: Combination fitting of copper alloy and ferrous materials with threaded, solder-joint, plain, or weld-neck end connections that match piping system materials.
- B. Insulating Material: Suitable for system fluid, pressure, and temperature.
- C. Dielectric Unions: Factory-fabricated, union assembly, for 250-psig minimum working pressure at 180 deg F.
- D. Dielectric Flanges: Factory-fabricated, companion-flange assembly, for 150- or 300-psig minimum working pressure as required to suit system pressures.
- E. Dielectric-Flange Kits: Companion-flange assembly for field assembly. Include flanges, full-face- or ring-type neoprene or phenolic gasket, phenolic or polyethylene bolt sleeves, phenolic washers, and steel backing washers.
 - 1. Separate companion flanges and steel bolts and nuts shall have 150- or 300-psig minimum working pressure where required to suit system pressures.
- F. Dielectric Couplings: Galvanized-steel coupling with inert and noncorrosive, thermoplastic lining; threaded ends; and 300-psig minimum working pressure at 225 deg F.
- G. Dielectric Nipples: Electroplated steel nipple with inert and noncorrosive, thermoplastic lining; plain, threaded, or grooved ends; and 300-psig minimum working pressure at 225 deg F.

2.6 MECHANICAL SLEEVE SEALS

- A. Description: Modular sealing element unit, designed for field assembly, to fill annular space between pipe and sleeve.
 - 1. Sealing Elements: EPDM interlocking links shaped to fit surface of pipe. Include type and number required for pipe material and size of pipe.
 - 2. Pressure Plates: Plastic, include two for each sealing element.
 - 3. Connecting Bolts and Nuts: Carbon steel with corrosion-resistant coating of length required to secure pressure plates to sealing elements. Include one for each sealing element.

2.7 SLEEVES

- A. Galvanized-Steel Sheet: 0.0239-inch minimum thickness; round tube closed with welded longitudinal joint.
- B. Steel Pipe: ASTM A 53, Type E, Grade B, Schedule 40, galvanized, plain ends.
- C. Cast Iron: Cast or fabricated "wall pipe" equivalent to ductile-iron pressure pipe, with plain ends and integral waterstop, unless otherwise indicated.
- D. Stack Sleeve Fittings: Manufactured, cast-iron sleeve with integral clamping flange. Include clamping ring and bolts and nuts for membrane flashing.
 - 1. Underdeck Clamp: Clamping ring with set screws.

2.8 ESCUTCHEONS

- A. Description: Manufactured wall and ceiling escutcheons and floor plates, with an ID to closely fit around pipe, tube, and insulation of insulated piping and an OD that completely covers opening. Escutcheon finishes to be as follows:
 - 1. Finished area, exposed to view: Polished chrome-plated.
 - 2. Unfinished areas: Rough brass or similar finish.
- B. One-Piece, Deep-Pattern Type: Deep-drawn, box-shaped brass.
- C. One-Piece, Cast-Brass Type: With set screw.
- D. Split-Casting, Cast-Brass Type: With concealed hinge and set screw.
- E. One-Piece, Stamped-Steel Type: With set screw or spring clips.
- F. Split-Plate, Stamped-Steel Type: With concealed hinge, set screw or spring clips.
- G. One-Piece, Floor-Plate Type: Cast-iron floor plate.
- H. Split-Casting, Floor-Plate Type: Cast brass with concealed hinge and set screw.

2.9 GROUT

- A. Description: ASTM C 1107, Grade B, non-shrink and non-metallic, dry hydraulic-cement grout.
 - 1. Characteristics: Post-hardening, volume-adjusting, non-staining, non-corrosive, nongaseous, and recommended for interior and exterior applications.
 - 2. Design Mix: 5000-psi, 28-day compressive strength.
 - 3. Packaging: Premixed and factory packaged.

2.10 ACCESS PANELS AND DOORS

- A. Panels and doors are to be furnished to provide access to items required in Division 22 Sections and the Mechanical Drawings. Panels and doors are to be furnished per the requirements of Division 8 Section, "Access Doors."

2.12 PIPE EXPANSION FITTINGS AND LOOPS

- A. Application: When the length of a piping run and the temperature range that the piping will experience will require expansion compensation refer to the ASHRAE 2000 Handbook – HVAC Systems and Equipment and ASME B31.9 for the proper application of expansion compensation.

PART 3 - EXECUTION

3.1 MECHANICAL DEMOLITION

- A. Disconnect, demolish, and remove mechanical systems, equipment, and components indicated to be removed.
 - 1. Piping to Be Removed: Remove portion of piping indicated to be removed and cap or plug remaining piping with same or compatible piping material.
 - 2. Piping to Be Abandoned in Place: Drain piping and cap or plug piping with same or compatible piping material.
 - 3. Equipment to Be Removed: Disconnect and cap services and remove equipment.
 - 4. Equipment to Be Removed and Reinstalled: Disconnect and cap services and remove, clean, and store equipment; when appropriate, reinstall, reconnect, and make equipment operational.
 - 5. Equipment to Be Removed and Salvaged: Disconnect and cap services and remove equipment and deliver to Owner.
- B. If pipe, insulation, or equipment to remain is damaged in appearance or is unserviceable, remove damaged or unserviceable portions and replace with new products of equal capacity and quality.

3.2 CUTTING AND PATCHING

- A. Refer to Division 1 Sections "Cutting and Patching" and "Selective Demolition" for general demolition requirements and procedures.

- B. Refer to Division 16 26 for requirements for cutting and patching electrical equipment, components, and materials.
- C. Do not endanger or damage installed Work through procedures and processes of cutting and patching.
- D. Arrange for repairs required to restore other work, because of damage caused as a result of mechanical installations.
- E. No additional compensation will be authorized for cutting and patching work that is necessitated by ill-timed, defective, or non-conforming installations.
- F. Perform cutting, fitting, and patching of mechanical equipment and materials required to:
 - 1. Uncover Work to provide for installation of ill-timed Work.
 - 2. Remove and replace defective Work.
 - 3. Remove and replace Work not conforming to requirements of the Contract Documents.
 - 4. Remove samples of installed Work as specified for testing.
 - 5. Upon written instructions from the Architect/Engineer, uncover and restore Work to provide for Architect/Engineer observation of concealed Work.
- G. Protect the structure, furnishings, finishes, and adjacent materials not indicated or scheduled to be removed.
- H. Provide and maintain temporary partitions or dust barriers adequate to prevent the spread of dust and dirt to adjacent areas.

3.3 ROUGH-IN

- A. General: Verify final locations for rough-ins with field measurements and with the requirements of the actual equipment and fixtures to be connected. Refer to equipment and fixture specifications in Divisions 2 through 26, and to approved shop drawings, for rough-in requirements.

3.4 GENERAL INSTALLATION REQUIREMENTS

- A. General: Coordinate equipment and materials for installation with other building components.
- B. Verify dimensions by field measurements.
- C. Arrange for chases, slots, and openings in other building components to allow for mechanical installations.
- D. Coordinate the installation of required supporting devices.
 - 1. Support suspended equipment from walls or from structural frames. Do not support equipment from metal roof deck.

- E. Sequence, coordinate and integrate installations of mechanical materials and equipment for efficient flow of the work.
- F. Coordinate the cutting and patching of building components to accommodate the installation of mechanical equipment and materials. Refer to Division 1.
- G. Install mechanical equipment to facilitate maintenance and repair or replacement of equipment components. As much as practical, connect equipment for ease of disconnecting, with minimum of interference with other installations.
- H. Install access panels to allow access to equipment and other system components which require servicing or adjustment per the requirements of Division 8.
- I. Coordinate the installation of mechanical materials and equipment above ceilings with suspension system, lighting fixtures, and other installations.

3.5 PIPING SYSTEMS - COMMON REQUIREMENTS

- A. Install piping according to the following requirements and Division 22 Sections specifying piping systems.
- B. 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.
- 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 to permit valve servicing.
- G. Install piping at indicated slopes.
- H. Install piping free of sags and bends.
- I. Install fittings for changes in direction and branch connections.
- J. Install piping to allow application of insulation.
- K. Select system components with pressure rating equal to or greater than system operating pressure.

- L. Install escutcheons for penetrations of walls, ceilings, and floors according to the following. Use One-piece escutcheons where ever possible in new construction. Split-casting units acceptable for installation on existing piping systems.
1. Piping with Fitting or Sleeve Protruding from Wall: Deep-pattern type.
 2. Chrome-Plated Piping: Cast-brass type with polished chrome-plated finish.
 3. Insulated Piping: Stamped-steel type with spring clips.
 4. Bare Piping at Wall and Floor Penetrations in Finished Spaces: Cast-brass type with polished chrome-plated finish.
 5. Bare Piping at Ceiling Penetrations in Finished Spaces: Cast-brass type with polished chrome-plated finish.
 6. Bare Piping in Unfinished Service Spaces and Equipment Rooms: Cast-brass type with rough-brass finish.
 7. Bare Piping at Floor Penetrations in Equipment Rooms: Floor-plate type.
- M. Sleeves are not required for core-drilled holes. When installing a pipe thru a core-drilled hole core drill the hole to provide for the 1" annular space around the pipe and use a mechanical sleeve seal as indicated in paragraphs O and P below.
- N. Install sleeves for pipes passing through concrete and masonry walls, gypsum-board partitions, and concrete floor and roof slabs.
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. Extend cast-iron sleeve fittings below floor slab as required to secure clamping ring if ring is specified.
 2. Install sleeves in new walls and slabs as new walls and slabs are constructed.
 3. Install sleeves that are large enough to provide 1/4-inch annular clear space between sleeve and pipe or pipe insulation. Use the following sleeve materials:
 - a. Steel Pipe Sleeves: For pipes smaller than NPS 6.
 - b. Steel Sheet Sleeves: For pipes NPS 6 and larger, penetrating gypsum-board partitions.
 - c. Stack Sleeve Fittings: For pipes penetrating floors with membrane waterproofing. Secure flashing between clamping flanges. Install section of cast-iron soil pipe to extend sleeve to 2 inches above finished floor level. Refer to Division 7 Section "Sheet Metal Flashing and Trim" for flashing.
 - 1) Seal space outside of sleeve fittings with grout.
 4. Except for underground wall penetrations, seal annular space between sleeve and pipe or pipe insulation, using joint sealants appropriate for size, depth, and location of joint. Refer to Division 7 Section "Joint Sealants" for materials and installation.
- O. Aboveground, Exterior-Wall Pipe Penetrations: Seal penetrations using sleeves and mechanical sleeve seals. Select sleeve size to allow for 1-inch annular clear space between pipe and sleeve for installing mechanical sleeve seals.
1. Install steel pipe for sleeves smaller than 6 inches in diameter.
 2. Install cast-iron "wall pipes" for sleeves 6 inches and larger in diameter.
 3. Mechanical Sleeve Seal Installation: Select type and number of sealing elements required for pipe material and size. Position pipe in center of sleeve. Assemble mechanical sleeve seals and install in annular space between pipe and sleeve. Tighten

bolts against pressure plates that cause sealing elements to expand and make watertight seal.

- P. Underground, Exterior-Wall Pipe Penetrations: Install cast-iron "wall pipes" for sleeves. Seal pipe penetrations using mechanical sleeve seals. Select sleeve size to allow for 1-inch annular clear space between pipe and sleeve for installing mechanical sleeve seals.
 - 1. Mechanical Sleeve Seal Installation: Select type and number of sealing elements required for pipe material and size. Position pipe in center of sleeve. Assemble mechanical sleeve seals and install in annular space between pipe and sleeve. Tighten bolts against pressure plates that cause sealing elements to expand and make watertight seal.
- Q. Fire-Barrier Penetrations: Maintain indicated fire rating of walls, partitions, ceilings, and floors at pipe penetrations. Seal pipe penetrations with firestop materials. Refer to Division 7 Section "Through-Penetration Firestop Systems" for materials.

3.6 PIPING JOINT CONSTRUCTION

- A. Join pipe and fittings according to the following requirements and Division 22 Sections specifying piping systems.
- B. Ream ends of pipes and tubes and remove burrs. Bevel plain ends of steel pipe.
- C. Remove scale, slag, dirt, and debris from inside and outside of pipe and fittings before assembly.
- D. Soldered Joints: Apply ASTM B 813, water-flushable flux, unless otherwise indicated, to tube end. Construct joints according to ASTM B 828 or CDA's "Copper Tube Handbook," using lead-free solder alloy complying with ASTM B 32.
- E. Brazed Joints: Construct joints according to AWS's "Brazing Handbook," "Pipe and Tube" Chapter, using copper-phosphorus brazing filler metal complying with AWS A5.8.
- F. 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 unless dry seal threading is specified.
 - 2. Damaged Threads: Do not use pipe or pipe fittings with threads that are corroded or damaged. Do not use pipe sections that have cracked or open welds.
- G. Welded Joints: Construct joints according to AWS D10.12, using qualified processes and welding operators according to Part 1 "Quality Assurance" Article.
- H. Flanged Joints: Select appropriate gasket material, size, type, and thickness for service application. Install gasket concentrically positioned. Use suitable lubricants on bolt threads.

- I. Plastic 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. CPVC Piping: Join according to ASTM D 2846/D 2846M Appendix.
 - 4. PVC Pressure Piping: Join schedule number ASTM D 1785, PVC pipe and PVC socket fittings according to ASTM D 2672. Join other-than-schedule-number PVC pipe and socket fittings according to ASTM D 2855.
 - 5. PVC Nonpressure Piping: Join according to ASTM D 2855.
 - 6. PVC to ABS Nonpressure Transition Fittings: Join according to ASTM D 3138 Appendix.
- J. Plastic Pressure Piping Gasketed Joints: Join according to ASTM D 3139.
- K. Plastic Nonpressure Piping Gasketed Joints: Join according to ASTM D 3212.
- L. PE Piping Heat-Fusion Joints: Clean and dry joining surfaces by wiping with clean cloth or paper towels. Join according to ASTM D 2657.
 - 1. Plain-End Pipe and Fittings: Use butt fusion.
 - 2. Plain-End Pipe and Socket Fittings: Use socket fusion.
- M. Fiberglass Bonded Joints: Prepare pipe ends and fittings, apply adhesive, and join according to pipe manufacturer's written instructions.

3.7 PIPING CONNECTIONS

- A. Make connections according to the following, unless otherwise indicated:
 - 1. Install unions, in piping NPS 2 and smaller, adjacent to each valve and at final connection to each piece of equipment.
 - 2. Install flanges, in piping NPS 2-1/2 and larger, adjacent to flanged valves and at final connection to each piece of equipment.
 - 3. Dry Piping Systems: Install dielectric unions and flanges to connect piping materials of dissimilar metals.
 - 4. Wet Piping Systems: Install dielectric coupling and nipple fittings to connect piping materials of dissimilar metals.

3.8 EQUIPMENT INSTALLATION - COMMON REQUIREMENTS

- A. Install equipment to allow maximum possible headroom unless specific mounting heights are not indicated.
- B. Install equipment level and plumb, parallel and perpendicular to other building systems and components in exposed interior spaces, unless otherwise indicated.

- C. Install mechanical equipment to facilitate service, maintenance, and repair or replacement of components. Connect equipment for ease of disconnecting, with minimum interference to other installations. Extend grease fittings to accessible locations.
- D. Install equipment to allow right of way for piping installed at required slope.

3.9 CLEAN CONSTRUCTION MEASURES

- A. General: Take care during construction to maintain the integrity and cleanliness of duct, pipe and equipment systems.
- B. Ductwork must be capped during construction, dust and debris in ductwork is not acceptable. Interior of ductwork and air systems must be completely cleaned.
- C. Exposed ends of piping systems and equipment/fixture connection ports shall be capped, plugged, or otherwise covered during construction.

3.10 PAINTING

- A. Painting of mechanical systems, equipment, and components is specified in Division 9 Section "Painting."
- B. Damage and Touchup: Repair marred and damaged factory-painted finishes with materials and procedures to match original factory finish.

3.11 CONCRETE BASES

- A. Concrete Bases: Anchor equipment to concrete base according to equipment manufacturer's written instructions and according to seismic codes at Project.
 - 1. Place and secure anchorage devices. Use supported equipment manufacturer's setting drawings, templates, diagrams, instructions, and directions furnished with items to be embedded.
 - 2. Install anchor bolts to elevations required for proper attachment to supported equipment.
 - 3. Install anchor bolts according to anchor-bolt manufacturer's written instructions.
 - 4. Use 3000-psi, 28-day compressive-strength concrete and reinforcement as specified in Division 3 Section "Cast-in-Place Concrete."

3.12 ERECTION OF METAL SUPPORTS AND ANCHORAGES

- A. Refer to Division 5 Section "Metal Fabrications" for structural steel.
- B. Cut, fit, and place miscellaneous metal supports accurately in location, alignment, and elevation to support and anchor mechanical materials and equipment.
- C. Field Welding: Comply with AWS D1.1.

3.13 GROUTING

- A. Mix and install grout for mechanical equipment base bearing surfaces, pump and other equipment base plates, and anchors.
- B. Clean surfaces that will come into contact with grout.
- C. Provide forms as required for placement of grout.
- D. Avoid air entrapment during placement of grout.
- E. Place grout, completely filling equipment bases.
- F. Place grout on concrete bases and provide smooth bearing surface for equipment.
- G. Place grout around anchors.
- H. Cure placed grout.

END OF SECTION 220500

SECTION 220516

PIPE EXPANSION FITTINGS AND LOOPS

PART 1 - 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.

1.2 SUMMARY

- A. This Section includes the following pipe expansion joints and expansion compensation devices for mechanical piping systems:
 1. Rubber expansion joints.
 2. Flexible-hose expansion joints.
 3. Pipe bends and loops.
 4. Alignment guides and anchors.
 5. Swing joints.

1.3 DEFINITIONS

- A. BR: Butyl rubber.
- B. Buna-N: Nitrile rubber.
- C. CR: Chlorosulfonated polyethylene synthetic rubber.
- D. CSM: Chlorosulfonyl-polyethylene rubber.
- E. EPDM: Ethylene-propylene-diene terpolymer rubber.
- F. NR: Natural rubber.
- G. PTFE: Polytetrafluoroethylene plastic.

1.4 PERFORMANCE REQUIREMENTS

- A. Compatibility: Products shall be suitable for piping system fluids, materials, working pressures, and temperatures.
- B. Capability: Products shall absorb 200 percent of maximum axial movement between anchors.

1.5 SUBMITTALS

- A. Product Data: For each type of pipe expansion joint and alignment guide indicated.
- B. Shop Drawings: Signed and sealed by a qualified professional engineer.
 - 1. Design Calculations: Calculate requirements for thermal expansion of piping systems and for selecting and designing expansion joints, loops, and bends.
 - 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.
- C. Product Certificates: For each type of pipe expansion joint, signed by product manufacturer.
- D. Welding certificates.
- E. Operation and Maintenance Data: For pipe expansion joints to include in emergency, operation, and maintenance manuals.

1.6 QUALITY ASSURANCE

- A. Welding: Qualify procedures and personnel according to the following:
 - 1. Steel Shapes and Plates: AWS D1.1, "Structural Welding Code - Steel."
 - 2. Welding to Piping: ASME Boiler and Pressure Vessel Code: Section IX.

PART 2 - PRODUCTS

2.1 MANUFACTURERS

- A. In other Part 2 articles where titles below introduce lists, the following requirements apply to product selection:
 - 1. Available Manufacturers: Subject to compliance with requirements, manufacturers offering products that may be incorporated into the Work include, but are not limited to, manufacturers specified.
 - 2. Manufacturers: Subject to compliance with requirements, provide products by one of the manufacturers specified.

2.2 EXPANSION JOINTS

- A. Rubber Expansion Joints: ASTM F 1123, fabric-reinforced rubber with external control rods and complying with FSA's "Technical Handbook: Non-Metallic Expansion Joints and Flexible Pipe Connectors."

1. Spherical Type: Multiple spheres.
 - a. Minimum Pressure and Temperature Ratings for NPS 1-1/2 to NPS 4: 150 psig at 220 deg F.
 - b. Minimum Pressure and Temperature Ratings for NPS 5 and NPS 6: 140 psig at 200 deg F.
 2. Material: BR.
 3. End Connections: Full-faced, integral, steel flanges with steel retaining rings.
- B. Flexible-Hose Expansion Joints: Manufactured assembly with two flexible-metal-hose legs joined by long-radius, 180-degree return bend or center section of flexible hose; with inlet and outlet elbow fittings, corrugated-metal inner hoses, and double braided outer sheaths.
1. Flexible-Hose Expansion Joints for Steel Piping: Carbon-steel fittings with threaded end connections for NPS 2 and smaller and weld end connections for NPS 2-1/2 and larger.
 - a. NPS 2 and Smaller: Stainless steel hoses and double-braid, stainless steel sheaths with 700 psig at 70 deg F and 515 psig at 600 deg F ratings.
 - b. NPS 2-1/2 to NPS 6: Stainless steel hoses and double-braid, stainless steel sheaths with 275 psig at 70 deg F and 200 psig at 600 deg F ratings.

2.3 ALIGNMENT GUIDES

- A. Description: Steel, factory fabricated, with bolted two-section outer cylinder and base for alignment of piping and two-section guiding spider for bolting to pipe.
 - a. Basis of Design: Metraflex pre-insulated series, 6" movement design.

2.4 MATERIALS FOR ANCHORS

- A. Steel Shapes and Plates: ASTM A 36/A 36M.
- B. Bolts and Nuts: ASME B18.10 or ASTM A 183, steel, hex head.
- C. Washers: ASTM F 844, steel, plain, flat washers.

PART 3 - EXECUTION

3.1 EXPANSION-JOINT INSTALLATION

- A. Install manufactured, nonmetallic expansion joints according to FSA's "Technical Handbook: Non-Metallic Expansion Joints and Flexible Pipe Connectors."
- B. Install expansion joints of sizes matching size of piping in which they are installed.
- C. Install alignment guides to allow expansion and to avoid end-loading and torsional stress.

3.2 PIPE BEND AND LOOP INSTALLATION

- A. Attach pipe bends and loops to anchors.
 - 1. Steel Anchors: Attach by welding. Comply with ASME B31.9 and ASME Boiler and Pressure Vessel Code: Section IX, "Welding and Brazing Qualifications."

3.3 SWING CONNECTIONS

- A. Connect risers and branch connections to mains with at least three pipe fittings, including tee in main.
- B. Connect mains and branch connections to terminal units with at least four pipe fittings, including tee in main.

3.4 ALIGNMENT-GUIDE INSTALLATION

- A. Install guides on piping adjoining pipe expansion joints and bends and loops.
- B. Attach guides to pipe and secure to building structure.

3.5 ANCHOR INSTALLATION

- A. 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.
- B. Fabricate and install steel anchors by welding steel shapes, plates, and bars to piping and to structure. Comply with ASME B31.9 and AWS D1.1.
- C. Install pipe anchors according to expansion-joint manufacturer's written instructions if expansion joints or compensators are indicated..

END OF SECTION 220516

SECTION 220519

METERS AND GAGES

PART 1 - 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. The requirements of Section 220000, "Basic Plumbing Requirements" apply to work defined by this Section.
- C. The requirements of Section 220500, "Basic Plumbing Materials and Methods" apply to work defined by this Section.

1.2 SUMMARY

- A. This Section includes the following meters and gages for mechanical systems:
 - 1. Thermometers.
 - 2. Gages.
- B. Related Sections include the following:
 - 1. Division 22, Section 221116 "Plumbing Piping and Specialties" for domestic and fire-protection water service meters inside the building.
 - 2. Division 23, Section 231123 "Fuel Gas Piping" for gas meters inside the building.

1.3 DEFINITIONS

- A. CR: Chlorosulfonated polyethylene synthetic rubber.
- B. EPDM: Ethylene-propylene-diene terpolymer rubber.

1.4 SUBMITTALS

- A. General: See Division 1 for general submittal and product substitution requirements.
- B. Product Data: For each type of product indicated include performance curves.
- C. Shop Drawings: Schedule for thermometers and gages indicating manufacturer's number, scale range, and location for each.

PART 2 - PRODUCTS

2.1 MANUFACTURERS

- A. Manufacturers: Subject to compliance with requirements, provide products by one of the manufacturers listed below.
- B. Metal-case, liquid-in-glass thermometers:
 - 1. Terice, H. O. Co.
 - 2. Weksler Instruments Operating Unit; Dresser Industries; Instrument Div.
- C. Bimetallic-actuated dial thermometers
 - 1. Ashcroft Commercial Instrument Operations; Dresser Industries; Instrument Div.
 - 2. Terice, H. O. Co.
 - 3. Weksler Instruments Operating Unit; Dresser Industries; Instrument Div.
- D. Thermowells
 - 1. Ashcroft Commercial Instrument Operations; Dresser Industries; Instrument Div.
 - 2. Terice, H. O. Co.
 - 3. Weksler Instruments Operating Unit; Dresser Industries; Instrument Div.
- E. Pressure gages
 - 1. Ashcroft Commercial Instrument Operations; Dresser Industries; Instrument Div.
 - 2. Terice, H. O. Co.
 - 3. Weksler Instruments Operating Unit; Dresser Industries; Instrument Div.

2.2 METAL-CASE, LIQUID-IN-GLASS THERMOMETERS

- A. Case: Die-cast aluminum, 9 inches long.
- B. Tube: Red or blue reading, organic-liquid filled, with magnifying lens.
- C. Tube Background: Satin-faced, nonreflective aluminum with permanently etched scale markings.
- D. Window: Plastic.
- E. Connector: Adjustable type, 180 degrees in vertical plane, 360 degrees in horizontal plane, with locking device.
- F. Stem: Copper-plated steel, aluminum, or brass for thermowell installation and of length to suit installation.

- G. Accuracy: Plus or minus 1 percent of range or plus or minus 1 scale division to maximum of 1.5 percent of range.

2.3 BIMETALLIC-ACTUATED DIAL THERMOMETERS

- A. Description: Direct-mounting, bimetallic-actuated dial thermometers complying with ASME B40.3.
- B. Case: Liquid-filled type, stainless steel with 3-inch diameter.
- C. Element: Bimetal coil.
- D. Dial: Satin-faced, nonreflective aluminum with permanently etched scale markings.
- E. Pointer: Red or other dark-color metal.
- F. Window: Glass.
- G. Ring: Stainless steel.
- H. Connector: Adjustable angle type.
- I. Stem: Metal, for thermowell installation and of length to suit installation.
- J. Accuracy: Plus or minus 1 percent of range or plus or minus 1 scale division to maximum of 1.5 percent of range.

2.4 THERMOWELLS

- A. Manufacturers: Same as manufacturer of thermometer being used or see list of acceptable manufacturers above.
- B. Description: Pressure-tight, socket-type metal fitting made for insertion into piping and of type, diameter, and length required to hold thermometer.

2.5 PRESSURE GAGES

- A. Direct Mounting, Dial-Type Pressure Gages: Indicating-dial type complying with ASME B40.100.
 - 1. Case: Liquid-filled type, plastic, 6-inch diameter.
 - 2. Pressure-Element Assembly: Bourdon tube, unless otherwise indicated.
 - 3. Pressure Connection: Brass, NPS 1/4, bottom-outlet type unless back-outlet type is indicated.
 - 4. Movement: Mechanical, with link to pressure element and connection to pointer.
 - 5. Dial: Satin-faced, nonreflective aluminum with permanently etched scale markings.
 - 6. Pointer: Red or other dark-color metal.
 - 7. Window: Plastic.

8. Ring: Plastic.
 9. Accuracy: Grade 2A, plus or minus 1/2 percent of middle half scale.
 10. Pressure Range: 0 to 100 psig of pressure.
 11. Range for Fluids under Pressure: Two times operating pressure.
- B. Pressure-Gage Fittings:
1. Valves: NPS 1/4 brass or stainless steel needle type.
 2. Snubbers: ASME B40.5, NPS 1/4 brass bushing with corrosion-resistant, porous-metal disc of material suitable for system fluid and working pressure.

PART 3 - EXECUTION

3.1 THERMOMETER APPLICATIONS

- A. Install liquid-in-glass thermometers in the following locations:
1. Inlet and outlet of each water heater.
- B. Install bimetallic-actuated dial thermometers in the following locations:
1. Inlet and outlet of each thermal storage tank.
- C. Install liquid-filled-case-type, bimetallic-actuated dial thermometers at suction and discharge of each pump.
- D. Provide the following temperature ranges for thermometers:
1. Domestic Hot Water: 30 to 180 deg F, with 2-degree scale divisions
 2. Domestic Cold Water: 0 to 100 deg F, with 2-degree scale divisions
 3. Heating Hot Water: 30 to 240 deg F, with 2-degree scale divisions

3.2 GAGE APPLICATIONS

- A. Install liquid-filled-case-type pressure gages at suction and discharge of each pump.

3.3 INSTALLATIONS

- A. Install direct-mounting thermometers and adjust vertical and tilted positions.
- B. Install thermowells with socket extending a minimum of 2 inches into fluid or one-third of diameter of pipe and in vertical position in piping tees where thermometers are indicated.
- C. Install direct-mounting pressure gages in piping tees with pressure gage located on pipe at most readable position.

3.4 CONNECTIONS

- A. Install meters and gages adjacent to machines and equipment to allow service and maintenance for meters, gages, machines, and equipment.

3.5 ADJUSTING

- A. Adjust faces of meters and gages to proper angle for best visibility.

END OF SECTION 220519

SECTION 220529

HANGERS AND SUPPORTS

PART 1 - 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. The requirements of Section 220000, "Basic Plumbing Requirements" apply to work defined by this Section.
- C. The requirements of Section 220500, "Basic Plumbing Materials and Methods" apply to work defined by this Section.

1.2 SUMMARY

- A. This Section includes hangers and supports for mechanical system piping and equipment.
- B. Related Sections include the following:
 - 1. Division 5 Section "Metal Fabrications" for materials for attaching hangers and supports to building structure.
 - 2. Division 21 Sections on fire-suppression piping for fire-suppression pipe hangers.
 - 3. Division 22 Section "Mechanical Vibration Controls and Seismic Restraints" for vibration isolation and seismic restraint devices.

1.3 DEFINITIONS

- A. MSS: Manufacturers Standardization Society for the Valve and Fittings Industry.
- B. Terminology: As defined in MSS SP-90, "Guidelines on Terminology for Pipe Hangers and Supports."

1.4 PERFORMANCE REQUIREMENTS

- A. Design channel support systems for piping to support multiple pipes capable of supporting combined weight of supported systems, system contents, and test water.
- B. Design heavy-duty steel trapezes for piping to support multiple pipes capable of supporting combined weight of supported systems, system contents, and test water.
- C. Design seismic restraint hangers and supports for piping and equipment.

- D. Design and obtain approval from authorities having jurisdiction for seismic restraint hangers and supports for piping and equipment.

1.5 SUBMITTALS

- A. Product Data: For each type of pipe hanger, channel support system component, and thermal-hanger shield insert indicated.
- B. Shop Drawings: Signed and sealed by a qualified professional engineer for multiple piping supports and trapeze hangers. Include design calculations and indicate size and characteristics of components and fabrication details.
- C. Welding Certificates: Copies of certificates for welding procedures and operators.

1.6 QUALITY ASSURANCE

- A. Welding: Qualify processes and operators according to ASME Boiler and Pressure Vessel Code: Section IX, "Welding and Brazing Qualifications."
- B. Engineering Responsibility: Design and preparation of Shop Drawings and calculations for each multiple pipe support and trapeze by a qualified professional engineer.
- C. Engineering Responsibility: Design and preparation of Shop Drawings and calculations for each multiple pipe support, trapeze, and seismic restraint by a qualified professional engineer.
 - 1. 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 hangers and supports that are similar to those indicated for this Project in material, design, and extent.

PART 2 - PRODUCTS

2.1 MANUFACTURERS

- 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. Pipe Hangers:
 - a. AAA Technology and Specialties Co., Inc.
 - b. B-Line Systems, Inc.
 - c. Carpenter & Patterson, Inc.
 - d. Empire Tool & Manufacturing Co., Inc.

- e. Globe Pipe Hanger Products, Inc.
- f. Grinnell Corp.
- g. GS Metals Corp.
- h. Michigan Hanger Co., Inc.
- i. National Pipe Hanger Corp.
- j. PHD Manufacturing, Inc.
- k. PHS Industries, Inc.
- l. Piping Technology & Products, Inc.

2. Channel Support Systems:

- a. B-Line Systems, Inc.
- b. Grinnell Corp.; Power-Strut Unit.
- c. GS Metals Corp.
- d. Michigan Hanger Co., Inc.; O-Strut Div.
- e. National Pipe Hanger Corp.
- f. Thomas & Betts Corp.
- g. Unistrut Corp.
- h. Wesanco, Inc.

3. Thermal-Hanger Shield Inserts:

- a. Carpenter & Patterson, Inc.
- b. Michigan Hanger Co., Inc.
- c. PHS Industries, Inc.
- d. Pipe Shields, Inc.
- e. Rilco Manufacturing Co., Inc.
- f. Value Engineered Products, Inc.

4. Powder-Actuated Fastener Systems:

- a. Gunnebo Fastening Corp.
- b. Hilti, Inc.
- c. ITW Ramset/Red Head.
- d. Masterset Fastening Systems, Inc.

2.2 MANUFACTURED UNITS

- A. Pipe Hangers, Supports, and Components: MSS SP-58, factory-fabricated components. Refer to "Hanger and Support Applications" Article in Part 3 for where to use specific hanger and support types.
 - 1. Galvanized, Metallic Coatings: For piping and equipment that will not have field-applied finish.
 - 2. Nonmetallic Coatings: On attachments for electrolytic protection where attachments are in direct contact with copper tubing.
- B. Channel Support Systems: MFMA-2, factory-fabricated components for field assembly.

1. Coatings: Manufacturer's standard finish, unless bare metal surfaces are indicated.
 2. Nonmetallic Coatings: On attachments for electrolytic protection where attachments are in direct contact with copper tubing.
- C. Thermal-Hanger Shield Inserts: 100-psi minimum compressive-strength insulation, encased in sheet metal shield.
1. Material for Cold Piping: ASTM C 552, Type I cellular glass or water-repellent-treated, ASTM C 533, Type I calcium silicate with vapor barrier.
 2. Material for Cold Piping: ASTM C 552, Type I cellular glass with vapor barrier.
 3. Material for Cold Piping: Water-repellent-treated, ASTM C 533, Type I calcium silicate with vapor barrier.
 4. Material for Hot Piping: ASTM C 552, Type I cellular glass or water-repellent-treated, ASTM C 533, Type I calcium silicate.
 5. Material for Hot Piping: ASTM C 552, Type I cellular glass.
 6. Material for Hot Piping: Water-repellent-treated, ASTM C 533, Type I calcium silicate.
 7. For Trapeze or Clamped System: Insert and shield cover entire circumference of pipe.
 8. For Clevis or Band Hanger: Insert and shield cover lower 180 degrees of pipe.
 9. Insert Length: Extend 2 inches beyond sheet metal shield for piping operating below ambient air temperature.

2.3 MISCELLANEOUS MATERIALS

- A. Powder-Actuated Drive-Pin Fasteners: Powder-actuated-type, drive-pin attachments with pull-out and shear capacities appropriate for supported loads and building materials where used.
- B. Mechanical-Anchor Fasteners: Insert-type attachments with pull-out and shear capacities appropriate for supported loads and building materials where used.
- C. Structural Steel: ASTM A 36/A 36M, steel plates, shapes, and bars, black and galvanized.
- D. Grout: ASTM C 1107, Grade B, factory-mixed and -packaged, nonshrink and nonmetallic, dry, hydraulic-cement grout.
 1. Characteristics: Post hardening and volume adjusting; recommended for both interior and exterior applications.
 2. Properties: Nonstaining, noncorrosive, and nongaseous.
 3. Design Mix: 5000-psi, 28-day compressive strength.

PART 3 - EXECUTION

3.1 HANGER AND SUPPORT APPLICATIONS

- A. Specific hanger requirements are specified in Sections specifying equipment and systems.
- B. Comply with MSS SP-69 for pipe hanger selections and applications that are not specified in piping system Specification Sections.

- C. Horizontal-Piping Hangers and Supports: Unless otherwise indicated and except as specified in piping system Specification 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 120 to 450 deg F pipes, NPS 4 to NPS 16, 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 24, requiring clamp flexibility and up to 4 inches of insulation.
 4. Steel Pipe Clamps (MSS Type 4): For suspension of cold and hot pipes, NPS 1/2 to NPS 24, if little or no insulation is required.
 5. Pipe Hangers (MSS Type 5): For suspension of pipes, NPS 1/2 to NPS 4, to allow off-center closure for hanger installation before pipe erection.
 6. Adjustable Swivel Split- or Solid-Ring Hangers (MSS Type 6): For suspension of noninsulated stationary pipes, NPS 3/4 to NPS 8.
 7. Adjustable Steel Band Hangers (MSS Type 7): For suspension of noninsulated stationary pipes, NPS 1/2 to NPS 8.
 8. Adjustable Band Hangers (MSS Type 9): For suspension of noninsulated stationary pipes, NPS 1/2 to NPS 8.
 9. Adjustable Swivel-Ring Band Hangers (MSS Type 10): For suspension of noninsulated stationary pipes, NPS 1/2 to NPS 2.
 10. Split Pipe-Ring with or without Turnbuckle-Adjustment Hangers (MSS Type 11): For suspension of noninsulated stationary pipes, NPS 3/8 to NPS 8.
 11. Extension Hinged or Two-Bolt Split Pipe Clamps (MSS Type 12): For suspension of noninsulated stationary pipes, NPS 3/8 to NPS 3.
 12. U-Bolts (MSS Type 24): For support of heavy pipe, NPS 1/2 to NPS 30.
 13. Clips (MSS Type 26): For support of insulated pipes not subject to expansion or contraction.
 14. 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.
 15. 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 and with U-bolt to retain pipe.
 16. Adjustable Pipe Saddle Supports (MSS Type 38): For stanchion-type support for pipes, NPS 2-1/2 to NPS 36, if vertical adjustment is required, with steel pipe base stanchion support and cast-iron floor flange.
 17. 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.
 18. Adjustable Roller Hangers (MSS Type 43): For suspension of pipes, NPS 2-1/2 to NPS 20, from single rod if horizontal movement caused by expansion and contraction might occur.
 19. 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.
 20. Pipe Roll and Plate Units (MSS Type 45): For support of pipes, NPS 2 to NPS 24, if small horizontal movement caused by expansion and contraction might occur and vertical adjustment is not necessary.
 21. Adjustable Pipe Roll and Base Units (MSS Type 46): For support of pipes, NPS 2 to NPS 30, if vertical and lateral adjustment during installation might be required in addition to expansion and contraction.

- D. Vertical-Piping Clamps: Unless otherwise indicated and except as specified in piping system Specification Sections, install the following types:
1. Extension Pipe or Riser Clamps (MSS Type 8): For support of pipe risers, NPS 3/4 to NPS 20.
 2. Carbon- or Alloy-Steel Riser Clamps (MSS Type 42): For support of pipe risers, NPS 3/4 to NPS 20, if longer ends are required for riser clamps.
- E. Hanger-Rod Attachments: Unless otherwise indicated and except as specified in piping system Specification 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.
 3. Swivel Turnbuckles (MSS Type 15): For use with MSS Type 11, split pipe rings.
 4. Malleable-Iron Sockets (MSS Type 16): For attaching hanger rods to various types of building attachments.
 5. Steel Weldless Eye Nuts (MSS Type 17): For 120 to 450 deg F piping installations.
- F. Building Attachments: Unless otherwise indicated and except as specified in piping system Specification 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-joint 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. Top-Beam Clamps (MSS Type 25): For top of beams if hanger rod is required tangent to flange edge.
 8. Side-Beam Clamps (MSS Type 27): For bottom of steel I-beams.
 9. Steel-Beam Clamps with Eye Nuts (MSS Type 28): For attaching to bottom of steel I-beams for heavy loads.
 10. Linked-Steel Clamps with Eye Nuts (MSS Type 29): For attaching to bottom of steel I-beams for heavy loads, with link extensions.
 11. Malleable Beam Clamps with Extension Pieces (MSS Type 30): For attaching to structural steel.
 12. 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.
 13. Side-Beam Brackets (MSS Type 34): For sides of steel or wooden beams.
 14. Plate Lugs (MSS Type 57): For attaching to steel beams if flexibility at beam is required.

15. Horizontal Travelers (MSS Type 58): For supporting piping systems subject to linear horizontal movement where head-room is limited.
- G. Saddles and Shields: Unless otherwise indicated and except as specified in piping system Specification 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 by manufacturer to prevent crushing insulation.
 3. Thermal-Hanger Shield Inserts: For supporting insulated pipe, 360-degree insert of high-density, 100-psi minimum compressive-strength, water-repellent-treated calcium silicate or cellular-glass pipe insulation, same thickness as adjoining insulation with vapor barrier and encased in 360-degree sheet metal shield.
- H. Spring Hangers and Supports: Unless otherwise indicated and except as specified in piping system Specification Sections, install the following types:
1. Restraint-Control Devices (MSS Type 47): Where indicated to control piping movement.
 2. Spring Cushions (MSS Type 48): For light loads if vertical movement does not exceed 1-1/4 inches.
 3. Spring-Cushion Roll Hangers (MSS Type 49): For equipping Type 41 roll hanger with springs.
 4. Spring Sway Braces (MSS Type 50): To retard sway, shock, vibration, or thermal expansion in piping systems.
 5. Variable-Spring Hangers (MSS Type 51): Preset to indicated load and limit variability factor to 25 percent to absorb expansion and contraction of piping system from hanger.
 6. Variable-Spring Base Supports (MSS Type 52): Preset to indicated load and limit variability factor to 25 percent to absorb expansion and contraction of piping system from base support.
 7. Variable-Spring Trapeze Hangers (MSS Type 53): Preset to indicated load and limit variability factor to 25 percent to absorb expansion and contraction of piping system from trapeze support.
 8. Constant Supports: For critical piping stress and if necessary to avoid transfer of stress from one support to another support, critical terminal, or connected equipment. Include auxiliary stops for erection, hydrostatic test, and load-adjustment capability. These supports include the following types:
 - a. Horizontal (MSS Type 54): Mounted horizontally.
 - b. Vertical (MSS Type 55): Mounted vertically.
 - c. Trapeze (MSS Type 56): Two vertical-type supports and one trapeze member.

3.2 HANGER AND SUPPORT INSTALLATION

- A. Pipe Hanger and Support Installation: Comply with MSS SP-69 and MSS SP-89. Install hangers, supports, clamps, and attachments as required to properly support piping from building structure.

- B. Channel Support System Installation: Arrange for grouping of parallel runs of piping and support together on field-assembled channel systems.
 - 1. Field assemble and install according to manufacturer's written instructions.
- C. Heavy-Duty Steel Trapeze Installation: Arrange for grouping of parallel runs of horizontal piping and support together on field-fabricated, heavy-duty trapezes.
 - 1. Pipes of Various Sizes: Support together and space trapezes for smallest pipe size or install intermediate supports for smaller diameter pipes as specified above for individual pipe hangers.
 - 2. Field fabricate from ASTM A 36/A 36M, steel shapes selected for loads being supported. Weld steel according to AWS D-1.1.
- D. Install building attachments within concrete slabs or attach to structural steel. Space attachments within maximum piping span length indicated in MSS SP-69. Install additional attachments at concentrated loads, including valves, flanges, guides, strainers, and expansion joints, 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.
- E. Install powder-actuated drive-pin fasteners 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.
- F. Install mechanical-anchor fasteners in concrete after concrete is placed and completely cured. Install fasteners according to manufacturer's written instructions.
- G. Install hangers and supports complete with necessary inserts, bolts, rods, nuts, washers, and other accessories.
- 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. Load Distribution: Install hangers and supports so that piping live and dead loads and stresses from movement will not be transmitted to connected equipment.
- J. Pipe Slopes: Install hangers and supports to provide indicated pipe slopes and so maximum pipe deflections allowed by ASME B31.9, "Building Services Piping," is not exceeded.
- K. Insulated Piping: Comply with the following:
 - 1. Attach clamps and spacers to piping.
 - a. Use thermal-hanger shield insert with clamp sized to match OD of insert.
 - b. Do not exceed pipe stress limits according to ASME B31.9.
 - 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 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 inserts.
6. Insert Material: Length at least as long as protective shield.
7. Thermal-Hanger Shields: Install with insulation same thickness as piping insulation.

3.3 EQUIPMENT SUPPORTS

- A. Fabricate structural-steel stands to suspend equipment from structure above or to support equipment above floor.
- B. Grouting: Place grout under supports for equipment and make smooth bearing surface.

3.4 METAL FABRICATION

- A. Cut, drill, and fit miscellaneous metal fabrications for heavy-duty steel trapezes 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 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 contours of welded surfaces match adjacent contours.

3.5 ADJUSTING

- A. Hanger Adjustment: Adjust hangers to distribute loads equally on attachments and to achieve indicated slope of pipe.

3.6 PAINTING

- A. Touching Up: Cleaning and touchup painting of field welds, bolted connections, and abraded areas of shop paint on miscellaneous metal are specified in Division 9 Section "Painting."
- B. Galvanized Surfaces: Clean welds, bolted connections, and abraded areas and apply galvanizing-repair paint to comply with ASTM A 780.

END OF SECTION 220529

SECTION 220553

PLUMBING IDENTIFICATION

PART 1 - 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. The requirements of Section 220000, "Basic Plumbing Requirements" apply to work defined by this Section.
- C. The requirements of Section 220500, "Basic Plumbing Materials and Methods" apply to work defined by this Section.

1.2 SUMMARY

- A. This Section includes the following mechanical identification materials and their installation:
 - 1. Equipment nameplates.
 - 2. Equipment markers.
 - 3. Equipment signs.
 - 4. Access panel and door markers.
 - 5. Pipe markers.
 - 6. Stencils.
 - 7. Valve tags.
 - 8. Valve schedules.
 - 9. Warning tags.

1.3 SUBMITTALS

- A. Product Data: For each type of product indicated.
- B. Samples: For color, letter style, and graphic representation required for each identification material and device.
- C. Valve numbering scheme.
- D. Valve Schedules: For each piping system. Furnish extra copies (in addition to mounted copies) to include in maintenance manuals.

1.4 QUALITY ASSURANCE

- A. ASME Compliance: Comply with ASME A13.1, "Scheme for the Identification of Piping Systems," for letter size, length of color field, colors, and viewing angles of identification devices for piping.

1.5 COORDINATION

- A. Coordinate installation of identifying devices with completion of covering and painting of surfaces where devices are to be applied.
- B. Coordinate installation of identifying devices with location of access panels and doors.
- C. Install identifying devices before installing acoustical ceilings and similar concealment.

PART 2 - PRODUCTS

2.1 MANUFACTURERS

- A. Manufacturers: Subject to compliance with requirements, provide products by one of the manufacturers listed below.
- B. Identification Systems:
 - 1. Seaton Name Plate Co.
 - 2. Brady: Signmark Div.; W.H. Brady Co.
 - 3. Kolbi Industries, Inc.

2.2 EQUIPMENT IDENTIFICATION DEVICES

- A. Equipment Nameplates: Metal, with data engraved or stamped, for permanent attachment on equipment.
 - 1. Data:
 - a. Manufacturer, product name, model number, and serial number.
 - b. Capacity, operating and power characteristics, and essential data.
 - c. Labels of tested compliances.
 - 2. Location: Accessible and visible.
 - 3. Fasteners: As required to mount on equipment.
- B. Equipment Markers: Engraved, color-coded laminated plastic. Include contact-type, permanent adhesive.
 - 1. Terminology: Match schedules as closely as possible.
 - 2. Data:
 - a. Name and plan number.
 - b. Equipment service.

- c. Design capacity.
 - d. Other design parameters such as pressure drop, entering and leaving conditions, and speed.
3. Size: 2-1/2 by 4 inches for control devices, dampers, and valves; 4-1/2 by 6 inches for equipment.
- C. Equipment Signs: ASTM D 709, Type I, cellulose, paper-base, phenolic-resin-laminate engraving stock; Grade ES-2, black surface, black phenolic core, with white melamine subcore, unless otherwise indicated. Fabricate in sizes required for message. Provide holes for mechanical fastening.
1. Data: Instructions for operation of equipment and for safety procedures.
 2. Engraving: Manufacturer's standard letter style, of sizes and with terms to match equipment identification.
 3. Thickness: 1/16 inch for units up to 20 sq. in. or 8 inches in length, and 1/8 inch for larger units.
 4. Fasteners: Self-tapping, stainless-steel screws or contact-type, permanent adhesive.
- D. Access Panel and Door Markers: 1/16-inch- thick, engraved laminated plastic, with abbreviated terms and numbers corresponding to identification. Provide 1/8-inch center hole for attachment.
1. Fasteners: Self-tapping, stainless-steel screws or contact-type, permanent adhesive.

2.3 PIPING IDENTIFICATION DEVICES

- A. Manufactured Pipe Markers, General: Preprinted, color-coded, with lettering indicating service, and showing direction of flow.
1. Colors: Comply with ASME A13.1, unless otherwise indicated.
 2. Lettering: Use piping system terms indicated and abbreviate only as necessary for each application length.
 3. Pipes with OD, Including Insulation, Less Than 6 Inches: Full-band pipe markers extending 360 degrees around pipe at each location.
 4. Pipes with OD, Including Insulation, 6 Inches and Larger: Either full-band or strip-type pipe markers at least three times letter height and of length required for label.
 5. Arrows: Integral with piping system service lettering to accommodate both directions; or as separate unit on each pipe marker to indicate direction of flow.
- B. Pretensioned Pipe Markers: Precoiled semirigid plastic formed to cover full circumference of pipe and to attach to pipe without adhesive.
- C. Shaped Pipe Markers: Preformed semirigid plastic formed to partially cover circumference of pipe and to attach to pipe with mechanical fasteners that do not penetrate insulation vapor barrier.
- D. Self-Adhesive Pipe Markers: Plastic with pressure-sensitive, permanent-type, self-adhesive back.

- E. Plastic Tape: Continuously printed, vinyl tape at least 3 mils thick with pressure-sensitive, permanent-type, self-adhesive back.
 - 1. Width for Markers on Pipes with OD, Including Insulation, Less Than 6 Inches: 3/4 inch minimum.
 - 2. Width for Markers on Pipes with OD, Including Insulation, 6 Inches or Larger: 1-1/2 inches minimum.

2.4 STENCILS

- A. Stencils: Prepared with letter sizes according to ASME A13.1 for piping; minimum letter height of 1-1/4 inches for ducts; and minimum letter height of 3/4 inch for access panel and door markers, equipment markers, equipment signs, and similar operational instructions.
 - 1. Stencil Material: Metal or fiberboard.
 - 2. Stencil Paint: Exterior, gloss, alkyd enamel black, unless otherwise indicated. Paint may be in pressurized spray-can form.
 - 3. Identification Paint: Exterior, alkyd enamel in colors according to ASME A13.1, unless otherwise indicated.

2.5 VALVE TAGS

- A. Valve Tags: Stamped or engraved with 1/4-inch letters for piping system abbreviation and 1/2-inch numbers, with numbering scheme approved by Architect. Provide 5/32-inch hole for fastener.
 - 1. Material: 0.0375-inch-thick stainless steel.
 - 2. Valve-Tag Fasteners: Brass wire-link or beaded chain; or S-hook.

2.6 VALVE SCHEDULES

- A. Valve Schedules: For each piping system, on standard-size bond paper. Tabulate valve number, piping system, system abbreviation (as shown on valve tag), location of valve (room or space), normal-operating position (open, closed, or modulating), and variations for identification. Mark valves for emergency shutoff and similar special uses.
 - 1. Valve-Schedule Frames: Glazed display frame for removable mounting on masonry walls for each page of valve schedule. Include mounting screws.
 - 2. Frame: Extruded aluminum.
 - 3. Glazing: ASTM C 1036, Type I, Class 1, Glazing Quality B, 2.5-mm, single-thickness glass.

2.7 WARNING TAGS

- A. Warning Tags: Preprinted or partially preprinted, accident-prevention tags; of plasticized card stock with matte finish suitable for writing.

1. Size: 3 by 5-1/4 inches minimum.
2. Fasteners: Brass grommet and wire.
3. Nomenclature: Large-size primary caption such as DANGER, CAUTION, or DO NOT OPERATE.
4. Color: Yellow background with black lettering.

PART 3 - EXECUTION

3.1 APPLICATIONS, GENERAL

- A. Products specified are for applications referenced in other Division 22 Sections. If more than single-type material, device, or label is specified for listed applications, selection is Installer's option.

3.2 EQUIPMENT IDENTIFICATION

- A. Install and permanently fasten equipment nameplates on each major item of mechanical equipment that does not have nameplate or has nameplate that is damaged or located where not easily visible. Locate nameplates where accessible and visible. Include nameplates for the following general categories of equipment:
 1. Fuel-burning units, including boilers, furnaces, heaters, stills, and absorption units.
 2. Pumps, compressors, chillers, condensers, and similar motor-driven units.
 3. Heat exchangers, coils, evaporators, cooling towers, heat recovery units, and similar equipment.
 4. Fans, blowers, primary balancing dampers, and mixing boxes.
 5. Packaged HVAC central-station and zone-type units.
- B. Install equipment markers with permanent adhesive on or near each major item of mechanical equipment. Data required for markers may be included on signs, and markers may be omitted if both are indicated.
 1. Letter Size: Minimum 1/4 inch for name of units if viewing distance is less than 24 inches, 1/2 inch for viewing distances up to 72 inches, and proportionately larger lettering for greater viewing distances. Include secondary lettering two-thirds to three-fourths the size of principal lettering.
 2. Data: Distinguish among multiple units, indicate operational requirements, indicate safety and emergency precautions, warn of hazards and improper operations, and identify units.
 3. Locate markers where accessible and visible. Include markers for the following general categories of equipment:
 - a. Main control and operating valves, including safety devices and hazardous units such as gas outlets.
 - b. Fire department hose valves and hose stations.
 - c. Meters, gages, thermometers, and similar units.
 - d. Fuel-burning units, including boilers, furnaces, heaters, stills, and absorption units.

- e. Pumps, compressors, chillers, condensers, and similar motor-driven units.
 - f. Heat exchangers, coils, evaporators, cooling towers, heat recovery units, and similar equipment.
 - g. Fans, blowers, primary balancing dampers, and mixing boxes.
 - h. Packaged HVAC central-station and zone-type units.
 - i. Tanks and pressure vessels.
 - j. Strainers, filters, humidifiers, water-treatment systems, and similar equipment.
- C. Stenciled Equipment Marker Option: Stenciled markers may be provided instead of laminated-plastic equipment markers, at Installer's option, if lettering larger than 1 inch high is needed for proper identification because of distance from normal location of required identification.
- D. Install equipment signs with screws or permanent adhesive on or near each major item of mechanical equipment. Locate signs where accessible and visible.
- 1. Identify mechanical equipment with equipment markers in the following color codes:
 - a. Green: For cooling equipment and components.
 - b. Yellow: For heating equipment and components.
 - c. Green and Yellow: For combination cooling and heating equipment and components.
 - d. Brown: For energy-reclamation equipment and components.
 - 2. Letter Size: Minimum 1/4 inch for name of units if viewing distance is less than 24 inches, 1/2 inch for viewing distances up to 72 inches, and proportionately larger lettering for greater viewing distances. Include secondary lettering two-thirds to three-fourths the size of principal lettering.
 - 3. Data: Distinguish among multiple units, indicate operational requirements, indicate safety and emergency precautions, warn of hazards and improper operations, and identify units.
 - 4. Include signs for the following general categories of equipment:
 - a. Main control and operating valves, including safety devices and hazardous units such as gas outlets.
 - b. Fuel-burning units, including boilers, furnaces, heaters, stills, and absorption units.
 - c. Pumps, compressors, chillers, condensers, and similar motor-driven units.
 - d. Heat exchangers, coils, evaporators, cooling towers, heat recovery units, and similar equipment.
 - e. Fans, blowers, primary balancing dampers, and mixing boxes.
 - f. Packaged HVAC central-station and zone-type units.
 - g. Tanks and pressure vessels.
 - h. Strainers, filters, humidifiers, water-treatment systems, and similar equipment.
- E. Stenciled Equipment Sign Option: Stenciled signs may be provided instead of laminated-plastic equipment signs, at Installer's option, if lettering larger than 1 inch high is needed for proper identification because of distance from normal location of required identification.
- F. Install access panel markers with screws on equipment access panels.

3.3 PIPING IDENTIFICATION

- A. Install manufactured pipe markers indicating service on each piping system. Install with flow indication arrows showing direction of flow.
 - 1. Pipes with OD, including insulation, less than 6 Inches: Pre-tensioned pipe markers. Use size to ensure a tight fit.
 - 2. Pipes with OD, Including Insulation, 6 Inches and Larger: Shaped pipe markers. Use size to match pipe and secure with fasteners.

- B. Stenciled Pipe Marker Option: Stenciled markers may be provided instead of manufactured pipe markers, at Installer's option. Install stenciled pipe markers with painted, color-coded bands or rectangles complying with ASME A13.1 on each piping system.
 - 1. Identification Paint: Use for contrasting background.
 - 2. Stencil Paint: Use for pipe marking.

- C. Locate pipe markers and color bands where piping is exposed or above accessible ceilings in finished spaces; machine rooms; accessible maintenance spaces such as shafts, tunnels, and plenums; and exterior nonconcealed 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 through walls, floors, ceilings, and nonaccessible 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 along each run. Reduce intervals to 25 feet in areas of congested piping and equipment.
 - 7. On piping above removable acoustical ceilings. Omit intermediately spaced markers.

3.4 VALVE-TAG INSTALLATION

- A. Valve-Tag Application Schedule: Tag valves according to size, shape, and color scheme and with captions similar to those indicated in the following:
 - 1. Valve-Tag Size and Shape:
 - a. Cold Water: 1-1/2 inches round.
 - b. Hot Water: 1-1/2 inches round.
 - c. Fire Protection: 1-1/2 inches round.
 - d. Gas: 1-1/2 inches round.

 - 2. Valve-Tag Color:
 - a. Cold Water: Blue.
 - b. Hot Water: Orange.

- c. Fire Protection: Red.
- d. Gas: Yellow.

3. Letter Color:

- a. Cold Water: Black.
- b. Hot Water: Black.
- c. Fire Protection: Black.
- d. Gas: Black.

3.5 VALVE-SCHEDULE INSTALLATION

- A. Mount valve schedule on wall in accessible location in each major equipment room.

3.6 WARNING-TAG INSTALLATION

- A. Write required message on, and attach warning tags to, equipment and other items where required.

3.7 ADJUSTING

- A. Relocate mechanical identification materials and devices that have become visually blocked by other work.

3.8 CLEANING

- A. Clean faces of mechanical identification devices and glass frames of valve schedules.

END OF SECTION 220553

SECTION 220701

PIPE INSULATION

PART 1 - 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. The requirements of Section 220000, "Basic Plumbing Requirements" apply to work defined by this Section.
- C. The requirements of Section 220500, "Basic Plumbing Materials and Methods" apply to work defined by this Section.

1.2 SUMMARY

- A. This Section includes preformed, rigid and flexible pipe insulation; insulating cements; field-applied jackets; accessories and attachments; and sealing compounds.
- B. Related Sections include the following:
 - 1. Division 7, Section 078413 "Firestopping" for firestopping materials and requirements for penetrations through fire and smoke barriers.
 - 2. Section 230701 "Duct Insulation" for insulation for ducts and plenums.
 - 3. Section 220702 "Equipment Insulation" for insulation materials and application for pumps, tanks, hydronic specialties, and other equipment.
 - 4. Pipe insulation shields and protection saddles, see appropriate piping section.

1.3 SUBMITTALS

- A. General: See Division 1 for general submittal and product substitution requirements.
- B. Pre-Construction Submittals: Submit the following items prior to commencing with installations.
 - 1. Product Data: Identify thermal conductivity, thickness, and jackets (both factory and field applied, if any), for each type of product indicated.
 - 2. Shop Drawings: Show fabrication and installation details for the following:
 - a. Application of protective shields, saddles, and inserts at pipe hangers for each type of insulation and hanger.
 - b. Attachment and covering of heat trace inside insulation.
 - c. Insulation application at pipe expansion joints for each type of insulation.
 - d. Insulation application at elbows, fittings, flanges, valves, and specialties for each type of insulation.

- e. Removable insulation at piping specialties and equipment connections.
- f. Application of field-applied jackets.

1.4 QUALITY ASSURANCE

- A. Installer Qualifications: Skilled mechanics who have successfully completed an apprenticeship program or another craft training program certified by the U.S. Department of Labor, Bureau of Apprenticeship and Training.
- B. Fire-Test-Response Characteristics: As determined by testing materials identical to those specified in this Section according to ASTM E 84, by a testing and inspecting agency acceptable to authorities having jurisdiction. Factory label insulation and jacket materials and sealer and cement material containers with appropriate markings of applicable testing and inspecting agency.
 - 1. Insulation Installed Indoors: Flame-spread rating of 25 or less, and smoke-developed rating of 50 or less.
 - 2. Insulation Installed Outdoors: Flame-spread rating of 75 or less, and smoke-developed rating of 150 or less.

1.5 DELIVERY, STORAGE, AND HANDLING

- A. Packaging: Ship insulation materials in containers marked by manufacturer with appropriate ASTM specification designation, type and grade, and maximum use temperature.

1.6 COORDINATION

- A. Coordinate size and location of supports, hangers, and insulation shields specified in the appropriate piping section.
- B. Coordinate clearance requirements with piping Installer for insulation application.

1.7 SCHEDULING

- A. Schedule insulation application after testing piping systems and, where required. Insulation application may begin on segments of piping that have satisfactory test results.

PART 2 - PRODUCTS

2.1 MANUFACTURERS

- A. Manufacturers: Subject to compliance with requirements, provide products by one of the manufacturers listed below.
- B. Fiber Glass Insulation:

1. CertainTeed Manson.
2. Knauf FiberGlass GmbH.
3. Owens-Corning Fiberglas Corp.
4. Schuller International, Inc. / Johns Manville Insulations

C. Flexible Elastomeric Thermal Insulation:

1. Armstrong World Industries, Inc.
2. Rubatex Corp.

2.2 INSULATION MATERIALS

A. Fiber Glass Insulation: Glass fibers bonded with a thermosetting resin complying with the following:

1. Thermal conductivity: 0.23 Btu*in/(hr*sq ft*degree F) at 75 degrees F.
2. Preformed Pipe Insulation: Comply with ASTM C 547, Type 1, with factory-applied, all-purpose, vapor-retarder jacket complying with ASTM C 1136. Based on Johns Manville Micro-Lok.
3. Blanket Insulation: Comply with ASTM C 553, Type II, without facing.
4. Fire-Resistant Adhesive: Comply with MIL-A-3316C in the following classes and grades:
 - a. Class 1, Grade A for bonding glass cloth and tape to unfaced glass-fiber insulation, for sealing edges of glass-fiber insulation, and for bonding lagging cloth to unfaced glass-fiber insulation.
 - b. Class 2, Grade A for bonding glass-fiber insulation to metal surfaces.
5. Vapor-Retarder Mastics: Fire- and water-resistant, vapor-retarder mastic for indoor applications. Comply with MIL-C-19565C, Type II.

B. Flexible Elastomeric Thermal Insulation: Closed-cell, sponge- or expanded-rubber materials. Comply with ASTM C 534, Type I for tubular materials and Type II for sheet materials.

1. Thermal conductivity: 0.27 Btu*in/(hr*sq ft*degree F) at 75 degrees F.
2. Adhesive: As recommended by insulation material manufacturer.
3. Ultraviolet-Protective Coating: As recommended by insulation manufacturer.
4. Based on Armstrong AP Armaflex.

C. Prefabricated Thermal Insulating Fitting Covers: Comply with ASTM C 450 for dimensions used in preforming insulation to cover valves, elbows, tees, and flanges.

2.3 FIELD-APPLIED JACKETS

A. General: ASTM C 921, Type 1, unless otherwise indicated.

- B. Foil and Paper Jacket: Laminated, glass-fiber-reinforced, flame-retardant kraft paper and aluminum foil.
 - 1. PVC jackets are available in several colors. Colored jackets may be used to replace field painting.
- C. Standard PVC Fitting Covers: Factory-fabricated fitting covers manufactured from 20-mil-thick, high-impact, ultraviolet-resistant PVC.
 - 1. Shapes: 45- and 90-degree, short- and long-radius elbows, tees, valves, flanges, reducers, end caps, soil-pipe hubs, traps, mechanical joints, and P-trap and supply covers for lavatories for the disabled.
 - 2. Adhesive: As recommended by insulation material manufacturer.
- D. Aluminum Jacket: Aluminum roll stock, ready for shop or field cutting and forming to indicated sizes. Comply with ASTM B 209, 3003 alloy, H-14 temper.
 - 1. Finish and Thickness: Corrugated finish, 0.010 inch thick.
 - 2. Moisture Barrier: 1-mil- thick, heat-bonded polyethylene and kraft paper.
 - 3. Elbows: Preformed, 45- and 90-degree, short- and long-radius elbows; same material, finish, and thickness as jacket.

2.4 ACCESSORIES AND ATTACHMENTS

- A. Glass Cloth and Tape: Comply with MIL-C-20079H, Type I for cloth and Type II for tape. Woven glass-fiber fabrics, plain weave, presized a minimum of 8 oz./sq. yd..
 - 1. Tape Width: 4 inches.
- B. Bands: 3/4 inchwide, in one of the following materials compatible with jacket:
 - 1. Stainless Steel: ASTM A 666, Type 304; 0.020 inchthick.
 - 2. Galvanized Steel: 0.005 inchthick.
- C. Wire: 0.080-inch, nickel-copper alloy; 0.062-inch, soft-annealed, stainless steel; or 0.062-inch, soft-annealed, galvanized steel.

2.5 VAPOR RETARDERS

- A. Mastics: Materials recommended by insulation material manufacturer that are compatible with insulation materials, jackets, and substrates.

PART 3 - EXECUTION

3.1 EXAMINATION

- A. Examine substrates and conditions for compliance with requirements for installation and other conditions affecting performance of insulation application.

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

3.2 PREPARATION

- A. Surface Preparation: Clean and dry pipe and fitting surfaces. Remove materials that will adversely affect insulation application.

3.3 GENERAL APPLICATION REQUIREMENTS

- A. Apply insulation materials, accessories, and finishes according to the manufacturer's written instructions; with smooth, straight, and even surfaces; free of voids throughout the length of piping, including fittings, valves, and specialties.
- B. Refer to schedules at the end of this Section for materials, forms, jackets, and thicknesses required for each piping system.
- C. Use accessories compatible with insulation materials and suitable for the service. Use accessories that do not corrode, soften, or otherwise attack insulation or jacket in either wet or dry state.
- D. Apply insulation with longitudinal seams at top and bottom of horizontal pipe runs.
- E. Apply 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. Seal joints and seams with vapor-retarder mastic on insulation indicated to receive a vapor retarder.
- H. Keep insulation materials dry during application and finishing.
- I. Apply insulation with tight longitudinal seams and end joints. Bond seams and joints with adhesive recommended by the insulation material manufacturer.
- J. Apply insulation with the least number of joints practical.
- K. Apply insulation over fittings, valves, and specialties, with continuous thermal and vapor-retarder integrity, unless otherwise indicated. Refer to special instructions for applying insulation over fittings, valves, and specialties.
- L. Hangers and Anchors: Where vapor retarder is indicated, seal penetrations in insulation at hangers, supports, anchors, and other projections with vapor-retarder mastic.
 - 1. Apply insulation continuously through hangers and around anchor attachments.
 - 2. For insulation application where vapor retarders are indicated, extend insulation on anchor legs at least 12 inches from point of attachment to pipe and taper insulation ends. Seal tapered ends with a compound recommended by the insulation material manufacturer to maintain vapor retarder.

3. Install insert materials and apply insulation to tightly join the insert. Seal insulation to insulation inserts with adhesive or sealing compound recommended by the insulation material manufacturer.
 4. Cover inserts with jacket material matching adjacent pipe insulation. Install shields over jacket, arranged to protect the jacket from tear or puncture by the hanger, support, and shield.
- M. Insulation Terminations: For insulation application where vapor retarders are indicated, taper insulation ends. Seal tapered ends with a compound recommended by the insulation material manufacturer to maintain vapor retarder.
- N. Apply adhesives and mastics at the manufacturer's recommended coverage rate.
- O. Apply insulation with integral jackets as follows:
1. Pull jacket tight and smooth.
 2. Circumferential Joints: Cover with 3-inch-wide strips, of same material as insulation jacket. Secure strips with adhesive and outward clinching staples along both edges of strip and spaced 4 inches o.c.
 3. Longitudinal Seams: Overlap jacket seams at least 1-1/2 inches. Apply 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 4 inches o.c.
 - a. Exception: Do not staple longitudinal laps on insulation having a vapor retarder.
 4. Vapor-Retarder Mastics: Where vapor retarders are indicated, apply mastic on seams and joints and at ends adjacent to flanges, unions, valves, and fittings.
 5. At penetrations in jackets for thermometers and pressure gages, fill and seal voids with vapor-retarder mastic.
- P. Roof Penetrations: Apply insulation for interior applications to a point even with top of roof flashing.
1. Seal penetrations with vapor-retarder mastic.
 2. Apply insulation for exterior applications tightly joined to interior insulation ends.
 3. Extend metal jacket of exterior insulation outside roof flashing at least 2 inches below top of roof flashing.
 4. Seal metal jacket to roof flashing with vapor-retarder mastic.
- Q. Exterior Wall Penetrations: For penetrations of below-grade exterior walls, terminate insulation flush with mechanical sleeve seal. Seal terminations with vapor-retarder mastic.
- R. Interior Wall and Partition Penetrations: Apply insulation continuously through walls and floors.
- S. Fire-Rated Wall and Partition Penetrations: Apply insulation continuously through penetrations of fire-rated walls and partitions.
1. Firestopping and fire-resistive joint sealers are specified in Division 7 "Firestopping."

- T. Floor Penetrations: Apply insulation continuously through floor assembly.
 - 1. For insulation with vapor retarders, seal insulation with vapor-retarder mastic where floor supports penetrate vapor retarder.

3.4 FIBER GLASS INSULATION APPLICATION

- A. Apply insulation to straight pipes and tubes as follows:
 - 1. Secure each layer of preformed pipe insulation to pipe with wire, tape, or bands without deforming insulation materials.
 - 2. Where vapor retarders are indicated, seal longitudinal seams and end joints with vapor-retarder mastic. Apply vapor retarder to ends of insulation at intervals of 15 to 20 feet to form a vapor retarder between pipe insulation segments.
 - 3. For insulation with factory-applied jackets, secure laps with outward clinched staples at 6 inches o.c.
 - 4. For insulation with factory-applied jackets with vapor retarders, do not staple longitudinal tabs but secure tabs with additional adhesive as recommended by the insulation material manufacturer and seal with vapor-retarder mastic.
- B. Apply insulation to flanges as follows:
 - 1. Apply preformed pipe insulation to outer diameter of pipe flange.
 - 2. Make width of insulation segment the same as overall width of the flange and bolts, plus twice the thickness of the 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. Apply canvas jacket material with manufacturer's recommended adhesive, overlapping seams at least 1 inch, and seal joints with vapor-retarder mastic.
- C. Apply insulation to fittings and elbows as follows:
 - 1. Apply premolded insulation sections of the same material as straight segments of pipe insulation when available. Secure according to manufacturer's written instructions.
 - 2. When premolded insulation elbows and fittings are not available, apply mitered sections of pipe insulation, or glass-fiber blanket insulation, to a thickness equal to adjoining pipe insulation. Secure insulation materials with wire, tape, or bands.
 - 3. Cover fittings with standard PVC fitting covers.
- D. Apply insulation to valves and specialties as follows:
 - 1. Apply premolded insulation sections of the same material as straight segments of pipe insulation when available. Secure according to manufacturer's written instructions.
 - 2. When premolded insulation sections are not available, apply glass-fiber blanket insulation to valve body. Arrange insulation to permit access to packing and to allow valve operation without disturbing insulation. For check valves, arrange insulation for access to stainer basket without disturbing insulation.
 - 3. Apply insulation to flanges as specified for flange insulation application.

4. Use preformed standard PVC fitting covers for valve sizes where available. Secure fitting covers with manufacturer's attachments and accessories. Seal seams with tape and vapor-retarder mastic.
5. For larger sizes where PVC fitting covers are not available, seal insulation with canvas jacket and sealing compound recommended by the insulation material manufacturer.

3.5 FLEXIBLE ELASTOMERIC THERMAL INSULATION APPLICATION

A. Apply insulation to straight pipes and tubes as follows:

1. Follow manufacturer's written instructions for applying insulation.
2. Seal longitudinal seams and end joints with manufacturer's recommended adhesive. Cement to avoid openings in insulation that will allow passage of air to the pipe surface.

B. Apply insulation to flanges as follows:

1. Apply pipe insulation to outer diameter of pipe flange.
2. Make width of insulation segment the same as overall width of the flange and bolts, plus twice the thickness of the 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 the same thickness as pipe insulation.
4. Secure insulation to flanges and seal seams with manufacturer's recommended adhesive. Cement to avoid openings in insulation that will allow passage of air to the pipe surface.

C. Apply insulation to fittings and elbows as follows:

1. Apply mitered sections of pipe insulation.
2. Secure insulation materials and seal seams with manufacturer's recommended adhesive. Cement to avoid openings in insulation that will allow passage of air to the pipe surface.

D. Apply insulation to valves and specialties as follows:

1. Apply preformed valve covers manufactured of the same material as pipe insulation and attached according to the manufacturer's written instructions.
2. Apply cut segments of pipe and sheet insulation to valve body. Arrange insulation to permit access to packing and to allow valve operation without disturbing insulation. For check valves, fabricate removable sections of insulation arranged to allow access to strainer basket.
3. Apply insulation to flanges as specified for flange insulation application.
4. Secure insulation to valves and specialties and seal seams with manufacturer's recommended adhesive. Cement to avoid openings in insulation that will allow passage of air to the pipe surface.
5. surface.

3.6 FIELD-APPLIED JACKET APPLICATION

- A. Apply glass-cloth jacket, where indicated, directly over bare insulation or insulation with factory-applied jackets.
 - 1. Apply jacket smooth and tight to surface with 2-inch overlap at seams and joints.
 - 2. Embed glass cloth between two 0.062-inch-thick coats of jacket manufacturer's recommended adhesive.
 - 3. Completely encapsulate insulation with jacket, leaving no exposed raw insulation.
- B. Foil and Paper Jackets: Apply foil and paper jackets where indicated.
 - 1. Draw jacket material smooth and tight.
 - 2. Apply lap or joint strips with the same material as jacket.
 - 3. Secure jacket to insulation with manufacturer's recommended adhesive.
 - 4. Apply jackets 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-retarder mastic.
- C. Apply Aluminum jacket where indicated, 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.

3.7 FINISHES

- A. Glass-Cloth Jacketed Insulation: Paint insulation finished with glass-cloth jacket as specified in Division 9 Section "Painting."
- B. Flexible Elastomeric Thermal Insulation: After adhesive has fully cured, apply two coats of the insulation manufacturer's recommended protective coating.

3.8 PIPING SYSTEM APPLICATIONS

- A. Insulation materials and thicknesses are specified in schedules at the end of this Section.
- B. Items Not Insulated: Unless otherwise indicated, do not apply insulation to the following systems, materials, and equipment:
 - 1. Flexible connectors.
 - 2. Vibration-control devices.
 - 3. Fire-suppression piping.
 - 4. Drainage piping located in crawl spaces, unless otherwise indicated.
 - 5. Below-grade piping, unless otherwise indicated.
 - 6. Chrome-plated pipes and fittings, unless potential for personnel injury.
 - 7. Air chambers, unions, strainers, check valves, plug valves, and flow regulators.

8. Flanges and unions at equipment on hot piping systems conveying fluids 140 degrees F or less. Bevel and seal ends of insulation.

3.9 INSULATION APPLICATION SCHEDULE, GENERAL

- A. Refer to insulation application schedules for required insulation materials, vapor retarders, and field-applied jackets.
- B. Application schedules identify piping system and indicate pipe size ranges and material, thickness, and jacket requirements.

3.10 INTERIOR INSULATION APPLICATION SCHEDULE

- A. Service: Domestic hot and recirculated hot water.
 1. Operating Temperature: 60 to 140 deg F.
 2. Insulation Material: Fiberglass with jacket.
 3. Insulation Thickness: Apply the following insulation thicknesses:
 - a. Piping up to 1 1/4": 0.5" thickness.
 - b. Piping 1-1/4" and greater: 1" thickness.
 4. Vapor Retarder Required: No.
 5. Finish: None.
- B. Service: Domestic cold water.
 1. Operating Temperature: 35 to 60 deg F.
 2. Insulation Material: Fiberglass with jacket.
 3. Insulation Thickness: Apply the following insulation thicknesses:
 - a. Piping up to 1 1/4": 0.5" thickness.
 - b. Piping 1-1/4" and greater: 1" thickness.
 4. Vapor Retarder Required: Yes.
 5. Finish: None.
- C. Service: Storm drain piping.
 1. Operating Temperature: 32 to 100 deg F.
 2. Insulation Material: Fiberglass with jacket.
 3. Insulation Thickness: Apply the following insulation thicknesses:
 - a. All horizontal run of pipe above grade from roof drain: 1/2" thickness.
 4. Vapor Retarder Required: yes.
 5. Finish: none.
- D. Service: Roof drain bodies.
 1. Operating Temperature: 32 to 100 deg F.
 2. Insulation Material: Flexible elastomeric.
 3. Insulation Thickness: 1" thick.
 4. Vapor Retarder Required: No.

5. Finish: none.
- E. Service: Condensate drain piping from cooling coils.
1. Operating Temperature: 35 to 75 deg F.
 2. Insulation Material: Fiberglass with jacket.
 3. Insulation Thickness: ½".
 4. Vapor Retarder Required: Yes.
 5. Finish: none.

END OF SECTION 220701

SECTION 221116

PLUMBING PIPING

PART 1 - 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. The requirements of Section 220000, "Basic Plumbing Requirements" apply to work defined by this Section.
- C. The requirements of Section 220500, "Basic Plumbing Materials and Methods" apply to work defined by this Section.

1.2 SUMMARY

- A. This Section includes the following piping systems to a point 10-feet outside the building wall, unless otherwise noted;
 - 1. Water Supply Piping.
 - a. Domestic Cold, Hot and Recirculated Hot Water.
 - b.
 - c. Tempered Water.
 - 2. Drainage, Waste and Vent, (DWV).
 - a. Sanitary Waste and Vent.
 - b.
 - c. Indirect Waste.
 - d.
- B. Related Sections include the following:
 - 1. Division 33 Sections for site utility service piping to a point 10-feet outside the building.
 - 2. Division 7, Section 072700 "Through-Penetration Firestop Systems" for materials and methods for sealing pipe penetrations through fire and smoke barriers.
 - 3. Division 7, Section 079200 "Joint Sealants" for materials and methods for sealing pipe penetrations through exterior walls.
 - 4. Section 220701, "Pipe Insulation" for system insulation requirements.
 - 5. Section 220516, "Pipe Expansion Fittings and Loops" for in-line expansion compensation.
 - 6. Section 220519, "Meters and Gauges" for thermometers, pressure gages, and fittings.
 - 7. Section 221119, "Plumbing Specialties" for water distribution piping specialties.

1.3 DEFINITIONS

- A. PVC: Polyvinyl chloride plastic.
- B. EPDM: Ethylene-propylene-diene terpolymer.
- C. CLDI: Cement Lined Ductile Iron.
- D. DWV: Drainage, Waste and Vent piping systems.
- E. PP: Polypropylene.

1.4 PERFORMANCE REQUIREMENTS

- A. Provide components and installations capable of producing piping systems with the following minimum working pressure ratings, unless otherwise noted.
 - 1. Water Supply Systems, Above Ground: 125 psig.
 - 2. Water Supply Systems, Below Ground: 150 psig.
 - 3. DWV, (Gravity) Systems: 10 foot of head of water.

1.5 SUBMITTALS

- A. General: See Division 1 for general submittal and product substitution requirements.
- B. Pre-Construction Submittals: Submit the following items prior to commencing with installations.
 - 1. Product Data: For pipe, tube, fittings, valves and couplings.
 - 2. Product Data: For pipe, tube, fittings, couplings, valves and water meters.
- C. Submittals During Construction: Submit the following items at the intervals indicated.
 - I. Pressure test results after system rough-ins.
 - a. Test results to include Plumbing Inspector sign-off.
 - b. If systems are tested in portions, submit results as each portion is tested.
- D. Post Construction Submittals: Submit the following items upon completion of system installations.
 - 1. Water Disinfection statement and final water quality test results.
 - 2. Final Plumbing Inspector Sign-off.

1.6 QUALITY ASSURANCE

- A. Piping materials shall bear label, stamp, or other markings of specified testing agency.
- B. Comply with NSF 14, "Plastics Piping System Components and Related Materials," for plastic, potable domestic water piping and components. Include marking "NSF-pw" on piping.
- C. Comply with NSF 14, "Plastics Piping Systems Components and Related Materials," for plastic piping components. Include marking with "NSF-dwv" for plastic drain, waste, and vent piping;

"NSF-drain" for plastic drain piping; "NSF-tubular" for plastic continuous waste piping; and "NSF-sewer" for plastic sewer piping.

- D. Comply with NSF 61, "Drinking Water System Components - Health Effects; Sections 1 through 9," for potable domestic water piping and components.

PART 2 - PRODUCTS

2.1 MANUFACTURERS

- A. Manufacturers: Subject to compliance with requirements, provide products by one of the manufacturers listed below.
- B. No-hub Couplings:
1. Husky Technologies.
 2. Ideal; A Gates Group Company.
 3. Tyler Pipe Co.
 4. Charlotte Pipe and Foundry.
- C. Ball Valves:
1. Conbraco Industries, Inc.; Apollo Div.
 2. Crane Co.; Crane Valve Group; Jenkins Valves.
 3. Crane Co.; Crane Valve Group; Stockham Div.
 4. NIBCO INC.
 5. Watts Industries, Inc.; Water Products Div.
 6. Hammond Valve.
 7. Milwaukee Valve Company.
- D. Gate Valves:
1. Crane Co.; Crane Valve Group; Stockham Div.
 2. Grinnell Corporation.
 3. Hammond Valve.
 4. Milwaukee Valve Company.
 5. NIBCO INC.
 6. Watts Industries, Inc.; Water Products Div.
- E. Butterfly Valves:
1. Crane Co.; Crane Valve Group; Stockham Div.
 2. Grinnell Corporation.
 3. Hammond Valve.
 4. Milwaukee Valve Company.
 5. NIBCO INC.
 6. Watts Industries, Inc.; Water Products Div.
- F. Globe Valves:
1. Crane Co.; Crane Valve Group; Stockham Div.
 2. Grinnell Corporation.
 3. Hammond Valve.

4. Milwaukee Valve Company.
5. NIBCO INC.

G. Swing Check Valves:

1. Crane Co.; Crane Valve Group; Stockham Div.
2. Grinnell Corporation.
3. Hammond Valve.
4. Milwaukee Valve Company.
5. NIBCO INC.
6. Watts Industries, Inc.; Water Products Div.

H. Polypropylene, (PP) DWV Piping Systems, (Single Wall):

1. Zurn Industries, Inc.
2. George Fischer / Fuseal.
3. Enfield Industrial Corp.

2.2 PIPING MATERIALS

- A. Refer to Part 3 "Pipe and Fitting Applications" Article for applications of pipe, tube, fitting, and joining materials.
- B. Transition Couplings for Aboveground Pressure Piping: Coupling or other manufactured fitting the same size as, with pressure rating at least equal to and ends compatible with, piping to be joined.

2.3 DUCTILE IRON PIPE AND FITTINGS

- A. Cement-Lined, Mechanical-Joint, Ductile-Iron Pipe, (CLDI): AWWA C151, with mechanical-joint, bell- and plain-spigot ends, AWWA C205 cement-mortar lining.
 1. Mechanical-Joint, Ductile-Iron Fittings: AWWA C110, ductile- or gray-iron standard pattern, AWWA C205 cement-mortar lining.
 - a. Glands, Gaskets, and Bolts: AWWA C111, ductile- or gray-iron glands, rubber gaskets, and steel bolts.
- B. Cement-Lined, Push-on-Joint, Ductile-Iron Pipe, (CLDI): AWWA C151, with push-on-joint, bell- and plain-spigot ends, AWWA C205 cement-mortar lining.
 1. Push-on-Joint, Ductile-Iron Fittings: AWWA C110, ductile- or gray-iron standard pattern, AWWA C205 cement-mortar lining.
 - a. Gaskets: AWWA C111, rubber.
 - b. Restraints: push-on joints to include pipe clamp and tie-rod reinforcement.

2.4 COPPER TUBE AND FITTINGS

- A. Soft Copper Tube: ASTM B 88, Type K, water tube, annealed temper.
 - 1. Copper Pressure Fittings: ASME B16.18, cast-copper-alloy or ASME B16.22, wrought-copper, solder-joint fittings. Furnish wrought-copper fittings if indicated.
 - 2. Bronze Flanges: ASME B16.24, Class 150, with solder-joint ends. Furnish Class 300 flanges if required to match piping.
 - 3. Copper Unions: MSS SP-123, cast-copper-alloy, hexagonal-stock body, with ball-and-socket, metal-to-metal seating surfaces, and solder-joint or threaded ends.

- B. Hard Copper Tube: ASTM B 88, Type L, water tube, drawn temper.
 - 1. Copper Pressure Fittings: ASME B16.18, cast-copper-alloy or ASME B16.22, wrought-copper, solder-joint fittings. Furnish wrought-copper fittings if indicated.
 - 2. Bronze Flanges: ASME B16.24, Class 150, with solder-joint ends. Furnish Class 300 flanges if required to match piping.
 - 3. Copper Unions: MSS SP-123, cast-copper-alloy, hexagonal-stock body, with ball-and-socket, metal-to-metal seating surfaces, and solder-joint or threaded ends.
 - 4. Copper, Grooved-End Fittings: ASTM B 75 copper tube or ASTM B 584 bronze castings.
 - a. Grooved-End-Tube Couplings: Copper-tube dimensions and design similar to AWWA C606. Include ferrous housing sections, gasket suitable for hot water, and bolts and nuts.

- C. Copper DWV Tube: ASTM B 306, drainage tube, drawn temper.
 - 1. Copper Drainage Fittings: ASME B16.23, cast copper or ASME B16.29, wrought copper, solder-joint fittings.

2.5 CAST-IRON SOIL PIPE AND FITTINGS

- A. Hub-and-Spigot Pipe and Fittings: ASTM A 74, Service class.
 - 1. Gaskets: ASTM C 564, rubber.

- B. Hubless Pipe and Fittings: ASTM A 888 or CISPI 301.
 - 1. Couplings: ASTM C 1277 assembly of metal housing, corrosion-resistant fasteners, and ASTM C 564 rubber sleeve with integral, center pipe stop.
 - a. Heavy-Duty, Type 304, Stainless-Steel Couplings: ASTM A 666, Type 304, stainless-steel shield; stainless-steel bands; and sleeve.
 - 1) NPS 1-1/2 to NPS 4: 3-inch wide shield with 4 bands.
 - 2) NPS 5 to NPS 10: 4-inch wide shield with 6 bands.

2.6 PVC PIPE AND FITTINGS

- A. PVC Schedule 40 Pipe: ASTM D 1785.

1. PVC Socket Fittings: ASTM D 2665, socket type, made to ASTM D 3311, drain, waste, and vent patterns.

2.7 STEEL PIPING

- A. Steel Pipe: ASTM A 53, Type E or S, Grade A or B, Schedule 40, galvanized. Include ends matching joining method.
 1. Steel Pipe Nipples: ASTM A 733, made of ASTM A 53 or ASTM A 106, Schedule 40, galvanized, seamless steel pipe. Include ends matching joining method.
 2. Malleable-Iron Unions: ASME B16.39; Class 150; hexagonal-stock body with ball-and-socket, metal-to-metal, bronze seating surface; and female threaded ends.
 3. Cast-Iron, Threaded, Drainage Fittings: ASME B16.12, galvanized.
 4. Cast-Iron Flanges: ASME B16.1, Class 125.
 5. Cast-Iron, Flanged Fittings: ASME B16.1, Class 125, galvanized.
 6. Steel-Piping, Grooved-End Fittings: ASTM A 47 galvanized, malleable-iron casting; ASTM A 106, galvanized steel pipe; or ASTM A 536, galvanized, ductile-iron casting; with dimensions matching steel pipe.
 - a. Steel-Piping, Keyed Couplings: AWWA C606, for steel-pipe dimensions. Include ferrous housing sections, gasket suitable for water, and bolts and nuts.

2.8 VALVES

- A. Balancing and drain valves are specified in Division 22 Section "Plumbing Specialties."
- B. Refer to Part 3 "Valve Applications" Article for applications of valve types.
- C. General Requirements:
 1. Valve Pressure and Temperature Ratings: Not less than indicated and as required for system pressures and temperatures.
 2. Valve Sizes: Same as upstream pipe, unless otherwise indicated.
 3. Handwheel: For valves other than quarter-turn types.
 4. Lever Handle: For quarter-turn valves NPS 6 and smaller.
 5. Extended Valve Stems: On insulated valves.
 6. Valve Flanges: ASME B16.1 for cast-iron valves, ASME B16.5 for steel valves, and ASME B16.24 for bronze valves.
 7. Valve Grooved Ends: AWWA C606, NPS 2-1/2 (DN 65) and larger.
 8. Solder Joint: With sockets according to ASME B16.18.
 - a. Caution: Use solder with melting point below 840 deg F for angle, check, gate, and globe valves; below 421 deg F for ball valves.
 9. Threaded: With threads according to ASME B1.20.1.
 10. Valve Bypass and Drain Connections: MSS SP-45.
- D. Ball Valves:
 1. MSS SP-110, 600# W.O.G., forged brass, two piece body, hard chrome plated forged brass ball, standard or full port, true adjustable packing nut, (O-ring only type stem seal not acceptable) blow-out proof stem.
 2. Acceptable end connections;

- a. Threaded for NPS 4 and smaller.
 - b. Soldered for NPS 3 and smaller.
 - c. Flanged or grooved for NPS 4 and larger.
3. Basis of Design: Apollo 70 Series.
- E. Gate Valves:
1. MSS SP-80, Class 125, bronze body, bronze trim, rising stem, hand wheel, inside screw, solid wedge disc.
 2. Acceptable end connections;
 - a. Soldered for NPS 3 and smaller.
- F. Butterfly Valves:
1. MSS SP-67, CWP Rating, Cast or Ductile Iron Body, disc, (nickel-plated ductile iron, elastomer coated ductile iron, or aluminum bronze) resilient replaceable EPDM seat, 10 position handle, one or two piece stem.
 2. Acceptable end connections;
 - a. Flanged or grooved for NPS 2-1/2 and larger.
- G. Globe Valves:
1. MSS SP-80, Class 125, bronze body, bronze trim, bronze disc.
 2. Acceptable end connections;
 - a. Soldered for NPS 3 and smaller.
- H. Swing Check Valves:
1. Up to NPS 3: MSS SP-80, Class 125, bronze body and cap, bronze swing disc with rubber seat.
 2. NPS 4 and larger: MSS SP-71, Class 125, iron body, bronze swing disc, renewable disc seal and seat.
 3. Acceptable end connections;
 - a. Soldered for NPS 3 and smaller.
 - b. Flanged or grooved for NPS 4 and larger.

PART 3 - EXECUTION

3.1 PIPE AND FITTING APPLICATIONS

- A. Water Supply Piping, Aboveground:
1. Hard copper tube, Type L; copper pressure fittings; lead-free soldered joints.
 - a. Option for NPS 2-1/2 and larger: Hard copper tube, Type L with grooved ends; copper grooved-end fittings and couplings; and grooved joints.
- B. DWV Gravity Piping, Aboveground:
1. Service weight cast iron soil pipe; hubless cast iron fittings; no-hub coupled joints.
 2. Option: 2-inch and smaller drain and vent lines may be installed using Copper tube, Type DWV; copper drainage fittings, soldered joints.

3.2 VALVE APPLICATIONS

- A. Drawings indicate valve types to be used. Where specific valve types are not indicated, the following requirements apply:
 - 1. Shutoff Duty: Use ball or gate valves for piping NPS 2 and smaller. Use butterfly or gate valves for piping NPS 2-1/2 and larger.
 - 2. Throttling Duty: Use ball or globe valves for piping NPS 2 and smaller. Use butterfly valves for piping NPS 2-1/2 and larger.
 - 3. Directional Duty: Use swing check valves.
 - 4. Hot-Water-Piping, Balancing Duty: Memory-stop balancing valves.
 - 5. Drain Duty: Hose-end drain valves.
- B. Cast-iron, grooved-end valves may be used with grooved-end piping.
- C. Install shutoff valve close to water main on each branch and riser serving plumbing fixtures or equipment, on each water supply to equipment, and on each water supply to plumbing fixtures that do not have supply stops. Use ball or gate valves for piping NPS 2 and smaller. Use butterfly or gate valves for piping NPS 2-1/2 and larger.
- D. Install drain valves for equipment at base of each water riser, at low points in horizontal piping, and where required to drain water piping.
 - 1. Install hose-end drain valves at low points in water mains, risers, and branches.
 - 2. Install stop-and-waste drain valves where indicated.
- E. Install balancing valve in each hot-water circulation return branch. Set balancing valves partly open to restrict but not stop flow. Balancing valves are specified in Division 22 Section "Plumbing Specialties."

3.3 PIPING INSTALLATION

- A. Basic piping installation requirements are specified in Division 22 Section "Basic Mechanical Materials and Methods."
- B. Install domestic water piping level with 0.25 percent slope downward toward drain and plumb.
- C. Rough-in domestic water piping for water-meter installation according to utility company's requirements.
- D. 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."
- E. Make changes in direction for DWV 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 2 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.

- F. Install DWV piping at the following minimum slopes, unless otherwise indicated:
 - 1. Horizontal drainage piping, NPS 3-inch and smaller: ¼-inch per foot downward in direction of flow.
 - 2. Horizontal drainage piping, NPS 4-inch and larger: 1/8-inch per foot downward in direction of flow.
 - 3. Vent Piping: 1/8-inch per foot down toward vertical fixture vent or toward vent stack.
- G. Install PVC DWV piping according to ASTM D 2665.
- H. Do not enclose, cover, or put piping into operation until it is inspected and approved by authorities having jurisdiction.

3.4 JOINT CONSTRUCTION

- A. Basic piping joint construction requirements are specified in Division 22 Section "Basic Mechanical Materials and Methods."
- B. Soldered Joints: Use ASTM B 813, water-flushable, lead-free flux; ASTM B 32, lead-free-alloy solder; and ASTM B 828 procedure, unless otherwise indicated.
- C. Grooved Joints: Assemble joints with grooved-end-pipe or grooved-end-tube coupling housing, gasket, lubricant, and bolts according to coupling and fitting manufacturer's written instructions.
- D. Cast-Iron, Soil-Piping Joints: Make joints according to CISPI's "Cast Iron Soil Pipe and Fittings Handbook," Chapter IV, "Installation of Cast Iron Soil Pipe and Fittings."
 - 1. Gasketed Joints: Make with rubber gasket matching class of pipe and fittings.
 - 2. Hubless Joints: Make with rubber gasket and sleeve or clamp.
- E. PVC Nonpressure Piping Joints: Join piping according to ASTM D 2665.

3.5 HANGER AND SUPPORT INSTALLATION

- A. Seismic-restraint devices are specified in Division 22 Section "Mechanical Vibration and Seismic Controls."
- B. Pipe hanger and support devices are specified in Division 22 Section "Hangers and Supports." Install the following:
 - 1. Vertical Piping: MSS Type 8 or Type 42, clamps.
 - 2. Individual, Straight, Horizontal Piping Runs: According to the following:
 - 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: MSS Type 49, spring cushion rolls, if indicated.

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. Install supports according to Division 22 Section "Hangers and Supports."
- D. Support vertical piping and tubing at base and at each floor.
- E. Rod diameter may be reduced 1 size for double-rod hangers, to a minimum of 3/8 inch.
- F. 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.
- G. Install supports for vertical steel piping every 15 feet.
- H. 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.
- I. Install supports for vertical copper tubing every 10 feet.
- J. 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: 60 inches with 3/8-inch rod.
 2. NPS 3: 60 inches with 1/2-inch rod.
 3. NPS 4 and NPS 5: 60 inches with 5/8-inch rod.
 4. NPS 6: 60 inches with 3/4-inch rod.
 5. Spacing for 10-foot lengths may be increased to 10 feet. Spacing for fittings is limited to 60 inches.
- K. Install supports for vertical cast-iron soil piping every 15 feet.

- L. Support piping and tubing not listed above according to MSS SP-69 and manufacturer's written instructions.

3.6 CONNECTIONS

- A. Drawings indicate general arrangement of piping, fittings, and specialties.
- B. Install piping adjacent to equipment and machines to allow 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 provision made by the Fire Protection Contractor on the combined fire/domestic service entrance. Coordinated exact configuration requirements with the Fire Protection Contractor.
- E. Connect domestic water piping to the following:
 - 1. Plumbing Fixtures: Cold- and hot-water supply piping in sizes indicated, but not smaller than required by plumbing code. Refer to Division 22 Section "Plumbing Fixtures."
 - 2. 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.
- F. Connect DWV piping to exterior sanitary and storm piping. Use transition fitting to join dissimilar piping materials.
- G. 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. Refer to Division 22 Section "Plumbing Fixtures."
 - 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. Refer to Division 22 Section "Plumbing Specialties."
 - 4. 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 and larger.
- H. Connect interior storm drainage piping to exterior storm drainage piping. Use transition fitting to join dissimilar piping materials.
- I. Connect storm drainage piping to roof drains and storm drainage specialties.

3.7 FIELD QUALITY CONTROL

- A. Inspect domestic water piping as follows:

1. Do not enclose, cover, or put piping into operation until it has been inspected and approved by authorities having jurisdiction.
 2. 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:
 - a. Roughing-in Inspection: Arrange for inspection of piping before concealing or closing-in after roughing-in and before setting fixtures.
 - b. Final Inspection: Arrange final inspection for authorities having jurisdiction to observe tests specified below and to ensure compliance with requirements.
 3. Reinspection: If authorities having jurisdiction find that piping will not pass test or inspection, make required corrections and arrange for reinspection.
 4. Reports: Prepare inspection reports and have them signed by authorities having jurisdiction.
- B. Test domestic water piping as follows:
1. Fill domestic water piping. Check components to determine that they are not air bound and that piping is full of water.
 2. 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.
 3. 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.
 4. 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 to stand for four hours. Leaks and loss in test pressure constitute defects that must be repaired.
 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.
- C. Inspect DWV piping as follows:
1. 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.
 - a. Roughing-in Inspection: Arrange for inspection of piping before concealing or closing-in after roughing-in and before setting fixtures.
 - b. Final Inspection: Arrange for final inspection by authorities having jurisdiction to observe tests specified below and to ensure compliance with requirements.
 2. Reinspection: If authorities having jurisdiction find that piping will not pass test or inspection, make required corrections and arrange for reinspection.
 3. Reports: Prepare inspection reports and have them signed by authorities having jurisdiction.
- D. Test DWV 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. 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. 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.

3.8 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 flow of hot water in each branch.
 - b. Adjust calibrated balancing valves to flows indicated.
5. Remove plugs used during testing of piping and plugs used 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.

3.9 CLEANING

- A. General: Clean interior of domestic water piping system. Remove dirt and debris as work progresses.
- B. Clean and disinfect potable and non-potable domestic water piping as follows:

1. Purge new piping and parts of existing domestic water piping that have been altered, extended, or repaired before using.
 2. Use purging and disinfecting procedures prescribed by authorities having jurisdiction or, if methods are not prescribed, procedures described in either AWWA C651 or AWWA C652 or as 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. Submit water samples in sterile bottles to authorities having jurisdiction. Repeat procedures if biological examination shows contamination.
 3. Prepare and submit reports of purging and disinfecting activities.
- C. Protect drains during remainder of construction period to avoid clogging with dirt and debris and to prevent damage from traffic and construction work.
- D. Place plugs in ends of uncompleted piping at end of day and when work stops.
- 3.10 PROTECTION
- A. Exposed PVC Piping: Protect plumbing vents exposed to sunlight with two coats of water-based latex paint.

END OF SECTION 221116

SECTION 221119

PLUMBING SPECIALTIES

PART 1 - 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. The requirements of Section 220000, "Basic Plumbing Requirements" apply to work defined by this Section.
- C. The requirements of Section 220500, "Basic Plumbing Materials and Methods" apply to work defined by this Section.

1.2 SUMMARY

- A. This Section includes the following plumbing specialties:
 - 1. Backflow preventers.
 - 2. Water meters.
 - 3. Water regulators.
 - 4. Balancing valves.
 - 5. Water filters.
 - 6. Thermostatic water mixing valves.
 - 7. Strainers.
 - 8. Outlet boxes.
 - 9. Exterior wall hydrants.
 - 10. Trap seal primer valves.
 - 11. Drain valves.
 - 12. Backwater valves.
 - 13. Miscellaneous piping specialties.
 - 14. Cleanouts.
 - 15. Floor, trench and roof drains.
 - 16. Emergency Equipment.
- B. Related Sections include the following:
 - 1. Section 220519, "Meters and Gages" for water meters, (other than at municipal entrances), thermometers, and pressure gages.

1.3 DEFINITIONS

- A. ABS: Acrylonitrile-butadiene-styrene plastic.
- B. PE: Polyethylene plastic.
- C. PUR: Polyurethane plastic.
- D. PVC: Polyvinyl chloride plastic.

1.4 PERFORMANCE REQUIREMENTS

- A. Provide components and installation capable of producing piping systems with following minimum working-pressure ratings, unless otherwise indicated:
 - 1. Water Supply Systems, Above Ground: 125 psig.
 - 2. Water Supply Systems, Below Ground: 150 psig.
 - 3. DWV, (Gravity) Systems: 10 foot of head of water.

1.5 SUBMITTALS

- A. General: See Division 1 for general submittal and product substitution requirements.
- B. Pre-Construction Submittals: Submit the following items prior to commencing with installations.
 - 1. Product Data, including wiring diagrams for electrically and battery powered items.
 - a. Backflow preventers and water regulators.
 - b. Balancing valves, water filters, and strainers.
 - c. Thermostatic water mixing valves.
 - d. Water hammer arresters, air vents, and trap seal primer valves and systems.
 - e. Drain valves, hose bibbs, and wall hydrants.
 - f. Outlet boxes.
 - g. Backwater valves, cleanouts, floor drains, open receptors, trench drains, and roof drains.
 - h. Interceptors.
 - i. Emergency equipment.
- C. Post Construction Submittals: Submit the following items upon completion of system installations.
 - 1. Maintenance Data: For plumbing specialties to include in maintenance manuals. Include the following:
 - a. Backflow preventers and water regulators.
 - b. Water filters.
 - c. Thermostatic water mixing valves.
 - d. Trap seal primer valves and systems.
 - e. Wall hydrants.
 - f. Interceptors.
 - g. Emergency equipment.

1.6 QUALITY ASSURANCE

- A. Product Options: Drawings indicate size, profiles, and dimensional requirements of plumbing specialties and are based on the specific system indicated. Refer to Division 1 Section "Product Requirements."
- B. Plumbing specialties shall bear label, stamp, or other markings of specified testing agency.
- C. Electrical Components, Devices, and Accessories: Listed and labeled as defined in NFPA 70, Article 100, by a testing agency acceptable to authorities having jurisdiction, and marked for intended use.
- D. ASME Compliance: Comply with ASME B31.9, "Building Services Piping," for piping materials and installation.
- E. NSF Compliance:
 - 1. Comply with NSF 14, "Plastics Piping Components and Related Materials," for plastic domestic water piping components. Include marking "NSF-dwv" on plastic drain, waste, and vent piping.
 - 2. Comply with NSF 61, "Drinking Water System Components--Health Effects, Sections 1 through 9," for potable domestic water plumbing specialties.

1.7 EXTRA MATERIALS

- A. Furnish extra materials described below that match products installed and that are packaged with protective covering for storage and identified with labels describing contents.
 - 1. Water Filter Cartridges: Equal to 200 percent of amount installed for each type and size indicated.
 - 2. Operating Key Handles: Equal to 100 percent of amount installed for each key-operated hose bibb and hydrant installed.

PART 2 - PRODUCTS

2.1 MANUFACTURERS

- A. Manufacturers: Subject to compliance with requirements, provide products by one of the manufacturers listed below.
- B. Backflow Preventers:
 - 1. Ames Co., Inc.
 - 2. CMB Industries, Inc.; Febco Backflow Preventers.
 - 3. Conbraco Industries, Inc.
 - 4. Watts Industries, Inc.; Water Products Div.
 - 5. Zurn Industries, Inc.; Wilkins Div.
- C. Water Meters: Provide units by manufacturers dictated by the local water authority. In the absence of such direction, provide units by:

1. Badger Meter, Inc.
 2. Invensys North American Water.
 3. Mueller Company.
 4. ABB.
- D. Water Pressure Regulators:
1. Cla-Val Co.
 2. Conbraco Industries, Inc.
 3. Watts Industries, Inc.; Water Products Div.
 4. Zurn Industries, Inc.; Wilkins Div.
- E. Automatic Flow-Control Valves:
1. Flow Design, Inc.
 2. Griswold Controls.
 3. Hayes Fluid Controls
- F. Water Filters:
1. CUNO, Incorporated.
 2. Filtrine Manufacturing Company; Drinking Water Division.
 3. Osmonics.
 4. Pall Corporation.
 5. U.S. Filter; Filterite Div.
 6. Watts Industries, Inc.; Water Products Div.
- G. Thermostatic Water Mixing Valves:
1. Lawler Manufacturing Company, Inc.
 2. Leonard Valve Company.
 3. Mark Controls Corp.; Powers Process Controls.
 4. Symmons Industries, Inc.
 5. Armstrong-Lynnwood, Inc.; Rada.
- H. Outlet Boxes:
1. Acorn Engineering Company.
 2. Gray, Guy Manufacturing Co., Inc.
 3. IPS Corporation.
 4. Symmons Industries, Inc.
- I. Exterior Wall Hydrants:
1. Smith, Jay R. Mfg. Co.
 2. Tyler Pipe; Wade Div.
 3. Watts Industries, Inc.; Drainage Products Div.
 4. Zurn Industries, Inc.
- J. Trap Seal Primer Valves:
1. Precision Plumbing Products, Inc.
 2. Smith, Jay R. Mfg. Co.
 3. Tyler Pipe; Wade Div.
 4. Watts Industries, Inc.

5. Zurn Industries, Inc.

K. Backwater Valves:

1. Josam Co.
2. Smith, Jay R. Mfg. Co.
3. Watts Industries, Inc.; Drainage Products Div.
4. Zurn Industries, Inc.; Specification Drainage Operation.

L. Water Hammer Arresters:

1. Josam Co.
2. Precision Plumbing Products, Inc.
3. Sioux Chief Manufacturing Co., Inc.
4. Watts Industries, Inc.
5. Smith, Jay R. Mfg. Co.
6. Zurn Industries, Inc.; Wilkins Div.

M. Hose Bibbs, Wall Hydrants:

1. Chicago Faucet Co.
2. T & S Brass and Bronze Works, Inc.
3. Royal Brass Mfg. Co.

N. Cleanouts; Floor, Trench, and Roof Drains:

1. Watts Industries, Inc.
2. Smith, Jay R. Mfg. Co.
3. Zurn Industries, Inc.; Wilkins Div.
4. Josam Co.
5. Tyler Pipe; Wade Div.

O. Interceptors:

1. Josam Co.
2. MIFAB Manufacturing, Inc.
3. Rockford Sanitary Systems, Inc.
4. Smith, Jay R. Mfg. Co.
5. Tyler Pipe, Wade Div.
6. Watts Industries, Inc., Drainage Products Div.
7. Zurn Industries, Inc.

P. Emergency Equipment:

1. Encon Safety Products.
2. Guardian Equipment Co. / Leonard Water Temperature Controls.
3. Haws Corporation.

2.2 BACKFLOW PREVENTERS

A. General: ASSE standard, backflow preventers.

1. NPS 2 and Smaller: Bronze body with threaded ends.
2. NPS 2-1/2 and Larger: Bronze, cast-iron, steel, or stainless-steel body with flanged ends.

- a. Interior Lining: AWWA C550 or FDA-approved, epoxy coating for backflow preventers having cast-iron or steel body.
3. Interior Components: Corrosion-resistant materials.
4. Exterior Finish: Polished chrome plate if used in chrome-plated piping system.
5. Strainer: Provide strainer on inlet. Include draw off valve with cap and chain.
 - a. Exception: Where backflow preventers are located immediately downstream of a water meter and strainer, a strainer is not required at the backflow preventer, unless specifically required by the applicable water authority.
- B. Reduced-Pressure-Principle Backflow Preventers: ASSE 1013, suitable for continuous pressure application. Include outside screw and yoke gate valves on inlet and outlet, and strainer on inlet; test cocks; and pressure-differential relief valve with ASME A112.1.2 air-gap fitting located between two positive-seating check valves.
 1. Pressure Loss: 12 psig maximum, through middle 1/3 of flow range.

2.3 WATER PRESSURE REGULATORS

- A. General: ASSE 1003, water regulators, rated for initial working pressure of 150 psig minimum. Include integral factory-installed or separate field-installed, Y-pattern strainer.
 1. NPS 2 and Smaller: Bronze body with threaded ends.
 - a. General-Duty Service: Single-seated, direct operated, unless otherwise indicated.
 - b. Booster Heater Water Supply: Single-seated, direct operated with integral bypass.
 2. NPS 2-1/2 and Larger: Bronze or cast-iron body with flanged ends. Include AWWA C550 or FDA-approved, interior epoxy coating for regulators with cast-iron body.
 - a. Type: Single-seated, direct operated.
 - b. Type: Pilot-operated, single- or double-seated, cast-iron-body main valve, with bronze-body pilot valve.
 3. Interior Components: Corrosion-resistant materials.
 4. Exterior Finish: Polished chrome plate if used in chrome-plated piping system.
- B. Basis of Design: As scheduled on the Drawings.

2.4 AUTOMATIC FLOW-CONTROL VALVES

- A. General: Brass body, factory set to maintain constant flow with plus or minus 5 percent over system pressure fluctuations, and equipped with a readout kit including flow meter, probes, hoses, flow charts, and carrying case. Each valve shall have an identification tag attached by chain, and be factory marked with the zone identification, valve number, and flow rate. Valve shall be line size and one of the following designs:

1. Combination assemblies, including bronze ball valve and brass alloy control valve, with stainless-steel piston and spring, fitted with pressure and temperature test valves, and designed for 300 psig at 250 deg F.

2.5 WATER FILTERS

- A. General: Cartridge-type assemblies suitable for potable water. Include housing, fittings, filter cartridges, and cartridge end caps.
- B. Wall-Mounting Type: Housing head section with threaded inlet and outlet, mounting bracket, and removable lower section for 10-inch- long filter cartridge.
 1. Housing Material: Plastic, 125-psig minimum operating pressure.
 2. Cartridge: Wound- or molded-fiber filter media, 10 inches, 10-micron-particulate removable rating.
- C. Floor-Mounting Type: Stainless-steel housing rated at 150-psig minimum operating pressure.
 1. Base Section: Floor-mounting section with inlet and outlet connections and removable top section for one or more 10-micron-particulate, removable-rating cartridges.
 2. Connections, NPS 2 and Smaller: Threaded.
 3. Connections, NPS 2-1/2 and Larger: Flanged.
 4. Cartridges: Wound- or molded-fiber filter media.

2.6 THERMOSTATIC WATER MIXING VALVES

- A. General: ASSE 1017, manually adjustable, thermostatic water mixing valve with bronze body. Include check stop and union on hot- and cold-water-supply inlets, adjustable temperature setting, and thermometer.
 1. Type: Bimetal thermostat, operation and pressure rating 125 psig minimum.
- B. Manifolded (High-Low), Thermostatic Water Mixing-Valve Assemblies: Factory-fabricated unit consisting of parallel arrangement of thermostatic water mixing valves.
 1. Arrangement: One large-flow, thermostatic water mixing valve with flow-control valve, pressure regulator, inlet and outlet pressure gages, and one small-flow, thermostatic water mixing valve with flow-control valve. Include outlet thermometer, factory- or field-installed inlet and outlet valves, and other indicated options.
 - a. Acceptable Alternate: Assemblies which meet scheduled flow range and pressure drop requirements need not be high-low style. The intent of the units is to meet the entire flow range and pressure constraints.
 2. Basis of Design: As scheduled on the drawings.

2.7 STRAINERS

- A. Strainers: Y-pattern, unless otherwise indicated, and full size of connecting piping. Include ASTM A 666, Type 304, stainless-steel screens with 3/64-inch round perforations, unless otherwise indicated.
 - 1. Pressure Rating: 125-psig minimum steam working pressure, unless otherwise indicated.
 - 2. NPS 2 and Smaller: Bronze body, with female threaded ends.
 - 3. NPS 2-1/2 and Larger: Cast-iron body, with interior AWWA C550 or FDA-approved, epoxy coating and flanged ends.
 - 4. Y-Pattern Strainers: Screwed screen retainer with centered blowdown.
 - a. Drain: Factory- or field-installed, hose-end drain valve.
 - 5. T-Pattern Strainers: Malleable-iron or ductile-iron body with grooved ends; access end cap with drain plug and access coupling with rubber gasket.
 - 6. Basket Strainers: Bolted flange or clamp cover, and basket with lift-out handle.
 - a. Type: Duplex with bronze or stainless-steel diverter valve and two baskets.
 - b. Drain: Factory- or field-installed, hose-end drain valve.
- B. Drainage Basket Strainers: Non-pressure-rated, cast-iron or coated-steel body; with bolted flange or clamp cover and drain with plug.
 - 1. Basket: Bronze or stainless steel with 1/8- or 3/16-inch- diameter holes and lift-out handle.
 - 2. Female threaded ends for NPS 2 and smaller, and flanged ends for NPS 2-1/2 and larger.

2.8 OUTLET BOXES

- A. General: Recessed-mounting outlet boxes with supply fittings complying with ASME A112.18.1M. Include box with faceplate, services indicated for equipment connections, and wood-blocking reinforcement.
- B. Icemaker Outlet Boxes: With hose connection and the following:
 - 1. Box and Faceplate: Stainless steel.
 - 2. Shutoff Fitting: Hose bibb.
 - 3. Supply Fitting: NPS 1/2 gate, globe, or ball valve and NPS 1/2 copper, water tubing.
 - 4. Basis of Design: As scheduled on the Drawings.
- C. Reinforcement: 2-by-4-inch fire-retardant-treated-wood blocking between studs. Fire-retardant-treated-wood blocking is specified in Division 6 Section "Rough Carpentry."

2.9 TRAP SEAL PRIMER VALVES

- A. Supply-Type Trap Seal Primer Valves: ASSE 1018, water-supply-fed type, with the following characteristics:
 - 1. 125-psig minimum working pressure.

2. Bronze body with atmospheric-vented drain chamber.
3. Inlet and Outlet Connections: NPS 1/2 threaded, union, or solder joint.
4. Gravity Drain Outlet Connection: NPS 1/2 threaded or solder joint.
5. Finish: Chrome plated, or rough bronze for units used with pipe or tube that is not chrome finished.

B. Trap Seal Primer System: Factory-fabricated, automatic-operation assembly for wall mounting with the following:

1. Piping: NPS 3/4, ASTM B 88, Type L; copper, water tubing inlet and manifold with number of NPS 1/2 outlets as indicated.
2. Cabinet: Steel box with stainless-steel cover.
3. Electric Controls: 24-hour timer, solenoid valve, and manual switch for 120-V ac power.
4. Water Hammer Arrester: ASSE 1010.
5. Vacuum Breaker: ASSE 1001.

2.10 DRAIN VALVES

A. Hose-End Drain Valves: MSS SP-110, NPS 3/4 ball valve, rated for 400-psig minimum CWP. Include two-piece, copper-alloy body with standard port, chrome-plated brass ball, replaceable seats and seals, blowout-proof stem, and vinyl-covered steel handle.

1. Inlet: Threaded or solder joint.
2. Outlet: Short-threaded nipple with ASME B1.20.7, garden-hose threads and cap.

B. Stop-and-Waste Drain Valves: MSS SP-110, ball valve, rated for 200-psig minimum CWP or MSS SP-80, Class 125, gate valve; ASTM B 62 bronze body, with NPS 1/8 side drain outlet and cap.

2.11 BACKWATER VALVES

A. Horizontal Backwater Valves: ASME A112.14.1, cast-iron body, with removable bronze swing-check valve and threaded or bolted cover.

1. Extension: ASTM A 74, Service class; full-size, cast-iron, soil-pipe extension to field-installed cleanout at floor, instead of cover.

2.12 WATER HAMMER ARRESTERS

A. General: ASSE 1010 or PDI-WH 201, piston type with pressurized metal-tube cushioning chamber. Sizes indicated are based on ASSE 1010, Sizes AA and A through F or PDI-WH 201, Sizes A through F.

2.13 MISCELLANEOUS PIPING SPECIALTIES

- A. Open End Drains, (or "Stand Drains"): Shop or field fabricate from ASTM A 74, Service class, hub-and-spigot, cast-iron, soil-pipe fittings. Include P-trap, backwater valve, hub-and-spigot riser section; and increaser fitting, joined with ASTM C 564, rubber gaskets.
- B. Deep-Seal Traps: Cast-iron or bronze casting, with inlet and outlet matching connected piping and cleanout trap seal primer valve connection.
 - 1. NPS 2: 4-inch- minimum water seal.
 - 2. NPS 2-1/2 and Larger: 5-inch- minimum water seal.
- C. Fixed Air-Gap Fittings: Manufactured cast-iron or bronze drainage fitting with semiopen top with threads or device to secure drainage inlet piping in top and bottom spigot or threaded outlet larger than top inlet. Include design complying with ASME A112.1.2 that will provide fixed air gap between installed inlet and outlet piping.
- D. Wall Accessible Cleanouts: Line type with lacquered cast iron body, gas and water tight tapered thread plug, and round stainless steel access cover secured with machine screw.
 - 1. Basis of Design: Zurn #Z-1441.
- E. Finished Floor Cleanouts: Lacquered cast iron body with anchor flange, reversible clamping collar, adjustable threaded top assembly, and round, gasketed cover.
 - 1. Cover to be scored in unfinished and service areas.
 - 2. Cover to be depressed to receive floor finish material in finished spaces.
 - 3. Basis of Design: Zurn #Z-1400.

2.14 FLOOR DRAINS

- A. General: ASME A112.21.2M; Provide trap primer inlet connections on drain bodies unless otherwise scheduled.
 - 1. Where drains do not require trap primers, install a threaded plug in the primer inlet port. Plug to be of a dielectrically compatible material.
 - 2. Basis of Design: As scheduled on the Drawings.
- B. Floor Drains:
 - 1. Body Material: Cast Iron.
 - 2. Seepage Flange and Clamping Device: Required for interior application.
 - 3. Anchor Flange: Required for exterior application.
 - 4. Exposed Surfaces and Interior Lining: As scheduled.
 - 5. Outlet Style: Hub and Spigot for slab-on-grade applications. No-hub for above grade applications.
 - 6. Sediment Bucket and Grate Variations: As scheduled.

2.15 EMERGENCY EQUIPMENT

- A. General: Comply with ANSI Z358.1, "Emergency Eyewash and Shower Equipment." In as much as possible, provide water tempering equipment and fixtures as supplied by the same manufacture or pair of manufacturers as listed in paragraph 2.01.

- B. Water Tempering Equipment: Thermostatic mixing valve assembly with fail-cold bypass. Valves shall be specifically manufactured for use with emergency fixtures.
 - 1. Water supplied to plumbed emergency Fixtures to be 85°F, +/- 5°F.
 - 2. Minimum flow range for valves serving showers: 20-30 gpm.
 - 3. Minimum flow range for valves serving eye/face washes: 3-5 gpm.
 - 4. Basis of Design: As scheduled on the Drawings.
- C. Emergency Fixtures: Fixtures may include; Showers, combination shower & eye/fash wash units, and eye/face wash units. Units shall be barrier free and shall include stay open style activation.
 - 1. Basis of Design: As scheduled on the Drawings.
- D. Drain Piping: Provide drain piping for eye/face wash units as well as the eye/face wash portion of combination units, where drain ports are supplied as part of the fixture.
 - 1. Exposed Piping Application: Steel pipe and fittings, schedule 40, galvanized. Include galvanized steel escutcheons where piping penetrates finished walls.
 - 2. Concealed Piping Applications: Copper tube and fittings, type DWV.
- E. Signage: Provide signage for each unit, as supplied by the same manufacturer as the fixtures. Signage to be as per ANSI Z358.1.
- F. Test Equipment: Provide the following test equipment for the project where shower or combination units are included. Test equipment to be furnished by the same manufacturer as the fixtures.
 - 1. Test curtain chute.
 - 2. 5 gallon collection bucket.

PART 3 - EXECUTION

3.1 INSTALLATION

- A. Refer to Division 22 Section "Basic Mechanical Materials and Methods" for piping joining materials, joint construction, and basic installation requirements.
- B. 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 not acceptable for this application.
 - 3. Do not install bypass piping around backflow preventers.
- C. Install pressure regulators with inlet and outlet shutoff valves and balance valve bypass. Install pressure gages on inlet and outlet.

- D. Install high-low thermostatic mixing valves which serve as “master” hot water system mixers, with circulated hot water connections, as per manufacturer’s written instructions.
 - 1. Where alternate “master” mixing valves are provided, and do not include circulated hot water connections, piping configurations at these valves shall be as per manufacturer’s written instructions to insure proper function.
- E. Install strainers on supply side of each control valve, pressure regulator, and solenoid valve.
- F. Install interior hose bibs 18-inches above finished floors.
- G. Install exterior wall hydrants 18-inches above finished grade.
- H. Install 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.
- I. Drain Valve Application: Install hose end drain valves at the base of system risers.
 - 1. Acceptable Alternate: For ¾-inch supply risers which serve only one story above, stop-and-waste shut-off valves may be used in lieu of shut-off valves and separate drain valves.
- J. Storm Drain Expansion Fittings: Provide where piping connected to a roof drain does not immediately offset to the horizontal and run for more than 5 feet.
- K. 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.
- L. Install cleanout deck plates with top flush with finished floor, for floor cleanouts for piping below floors.
- M. Install cleanout wall access covers, of types indicated, with frame and cover flush with finished wall, for cleanouts located in concealed piping.
- N. Install flashing flange and clamping device with each stack and cleanout passing through floors with waterproof membrane.
- O. 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.
- P. Install roof drains at low points of roof areas according to roof membrane manufacturer's written installation instructions.
1. Install roof-drain flashing collar or flange so no leakage occurs between drain and adjoining roofing. Maintain integrity of waterproof membranes where penetrated.
 2. Position roof drains for easy access and maintenance.
- Q. Install interceptors, including trapping, venting, and flow-control fitting, according to authorities having jurisdiction and with clear space for servicing.
- R. Fasten wall-hanging plumbing specialties securely to supports attached to building substrate if supports are specified and to building wall construction if no support is indicated.
- S. Fasten recessed-type plumbing specialties to reinforcement built into walls.
- T. Install wood-blocking reinforcement for wall-mounting and recessed-type plumbing specialties.
- U. Install individual shutoff valve in each water supply to plumbing specialties. Use ball, gate, or globe valve if specific valve is not indicated. Install shutoff valves in accessible locations. Refer to Division 22 Section "Valves" for general-duty ball, butterfly, check, gate, and globe valves.
- V. Install air vents at piping high points. Include ball, gate, or globe valve in inlet and drain piping from outlet to floor drain.
- W. Install traps on plumbing specialty drain outlets. Omit traps on indirect wastes unless trap is indicated.
- X. Install escutcheons at wall, floor, and ceiling penetrations in exposed finished locations and within cabinets and millwork. Use deep-pattern escutcheons if required to conceal protruding pipe fittings.
- 3.2 CONNECTIONS
- A. Piping installation requirements are specified in other Division 22 Sections. Drawings indicate general arrangement of piping, fittings, and specialties.
 - B. Install piping adjacent to equipment to allow service and maintenance.

- C. Holding Tank Connections: Connect piping, flow-control fittings, and accessories.
 - 1. Holding Tanks: Connect inlet and outlet to unit, and flow-control fitting and vent to unit inlet piping. Install valve on outlet of automatic drawoff-type unit.
- D. Emergency Fixture Drains: Unless otherwise indicated on the plans, connect to fixture drain ports and spill drain piping to nearest drain. Where local drains do not exist, terminate drain piping at 18-inches above the finished floor with a down turned elbow.

3.3 PROTECTION

- A. Protect drains during remainder of construction period to avoid clogging with dirt and debris and to prevent damage from traffic and construction work.
- B. Place plugs in ends of uncompleted piping at end of each day or when work stops.

END OF SECTION 221119

SECTION 224000

PLUMBING FIXTURES

PART 1 - 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. The requirements of Section 220000, "Basic Plumbing Requirements" apply to work defined by this Section.
- C. The requirements of Section 220500, "Basic Plumbing Materials and Methods" apply to work defined by this Section.

1.2 SUMMARY

- A. This Section includes plumbing fixtures and related components.
- B. Related Sections include the following:
 - 1. Section 221119, "Plumbing Specialties" for water distribution piping specialties.

1.3 DEFINITIONS

- A. Accessible Fixture: Plumbing fixture that can be approached, entered, and used by people with disabilities.
- B. Fitting: Device that controls flow of water into or out of plumbing fixture. Fittings specified in this Section include supplies and stops, faucets and spouts, shower heads and tub spouts, drains and tailpieces, and traps and waste pipes. Piping and general-duty valves are included where indicated.
- C. ADA: Americans with Disabilities Act.

1.4 SUBMITTALS

- A. Pre-Construction Submittals: Submit the following items prior to commencing with the installations.
 - 1. Product Data: Include selected fixture and trim, fittings, accessories, appliances, appurtenances, equipment, and supports and indicate materials and finishes, dimensions, construction details, and flow-control rates for each type of fixture indicated.
 - 2. Shop Drawings: Diagram power, signal, and control wiring and differentiate between manufacturer-installed and field-installed wiring.

- B. Post Construction Submittals: Submit the following items upon completion of system installations.
 - 1. Maintenance Data: For plumbing fixtures to include in maintenance manuals.

1.5 QUALITY ASSURANCE

- A. Source Limitations: Obtain plumbing fixtures, faucets, and other components of each category through one source from a single manufacturer.
 - 1. Exception: If fixtures, faucets, or other components are not available from a single manufacturer, obtain similar products from other manufacturers specified for that category.
- B. Electrical Components, Devices, and Accessories: Listed and labeled as defined in NFPA 70, Article 100, by a testing agency acceptable to authorities having jurisdiction, and marked for intended use.
- C. Regulatory Requirements: Comply with requirements in ICC A117.1, "Accessible and Usable Buildings and Facilities"; Public Law 90-480, "Architectural Barriers Act"; and Public Law 101-336, "Americans with Disabilities Act"; about plumbing fixtures for people with disabilities.
- D. Regulatory Requirements: Comply with requirements in Public Law 102-486, "Energy Policy Act," about water flow and consumption rates for plumbing fixtures.
- E. NSF Standard: Comply with NSF 61, "Drinking Water System Components--Health Effects," for fixture materials that will be in contact with potable water.
- F. Select combinations of fixtures and trim, faucets, fittings, and other components that are compatible.
- G. Comply with the following applicable standards and other requirements specified for plumbing fixtures:
 - 1. Hand Sinks: NSF 2 construction.
 - 2. Plastic Shower Enclosures: ANSI Z124.2.
 - 3. Slip-Resistant Bathing Surfaces: ASTM F 462.
 - 4. Stainless-Steel Fixtures Other Than Service Sinks: ASME A112.19.3M.
 - 5. Vitreous-China Fixtures: ASME A112.19.2M.
 - 6. Water-Closet, Flush Valve, Tank Trim: ASME A112.19.5.
- H. Comply with the following applicable standards and other requirements specified for lavatory and sink faucets:
 - 1. Backflow Protection Devices for Faucets with Hose-Thread Outlet: ASME A112.18.3M.
 - 2. Faucets: ASME A112.18.1M.
 - 3. Hose-Connection Vacuum Breakers: ASSE 1011.
 - 4. Hose-Coupling Threads: ASME B1.20.7.
 - 5. Integral, Atmospheric Vacuum Breakers: ASSE 1001.
 - 6. NSF Materials: NSF 61.
 - 7. Pipe Threads: ASME B1.20.1.

8. Sensor-Actuated Faucets and Electrical Devices: UL 1951.
 9. Supply and Drain Fittings: ASME A112.18.1M.
- I. Comply with the following applicable standards and other requirements specified for bathtub and shower faucets:
1. Backflow Protection Devices for Hand-Held Showers: ASME A112.18.3M.
 2. Combination, Pressure-Equalizing and Thermostatic-Control Antiscald Faucets: ASSE 1016.
 3. Faucets: ASME A112.18.1M.
 4. Hand-Held Showers: ASSE 1014.
 5. High-Temperature-Limit Controls for Thermal-Shock-Preventing Devices: ASTM F 445.
 6. Hose-Coupling Threads: ASME B1.20.7.
 7. Manual-Control Antiscald Faucets: ASTM F 444.
 8. Pipe Threads: ASME B1.20.1.
 9. Pressure-Equalizing-Control Antiscald Faucets: ASTM F 444 and ASSE 1016.
 10. Sensor-Actuated Faucets and Electrical Devices: UL 1951.
 11. Thermostatic-Control Antiscald Faucets: ASTM F 444 and ASSE 1016.
- J. Comply with the following applicable standards and other requirements specified for miscellaneous fittings:
1. Atmospheric Vacuum Breakers: ASSE 1001.
 2. Brass and Copper Supplies: ASME A112.18.1M.
 3. Manual-Operation Flushometers: ASSE 1037.
 4. Plastic Tubular Fittings and Piping: ASTM F 409.
 5. Sensor-Operation Flushometers: ASSE 1037 and UL 1951.
 6. Tubular Brass Drainage Fittings and Piping: ASME A112.18.1M.
- K. Comply with the following applicable standards and other requirements specified for miscellaneous components:
1. Floor Drains: ASME A112.21.1M.
 2. Grab Bars: ASTM F 446.
 3. Hose-Coupling Threads: ASME B1.20.7.
 4. Off-Floor Fixture Supports: ASME A112.6.1M.
 5. Pipe Threads: ASME B1.20.1.
 6. Plastic Shower Receptors: ANSI Z124.2.
 7. Plastic Toilet Seats: ANSI Z124.5.
 8. Supply and Drain Protective Shielding Guards: ICC A117.1.

1.6 COORDINATION

- A. Coordinate roughing-in and final plumbing fixture locations, and verify that fixtures can be installed to comply with original design and referenced standards.

1.7 EXTRA MATERIALS

- A. Furnish extra materials described below that match products installed and that are packaged with protective covering for storage and identified with labels describing contents.
1. Faucet Washers and O-Rings: Equal to 10 percent of amount of each type and size installed.
 2. Faucet Cartridges and O-Rings: Equal to 5 percent of amount of each type and size installed.
 3. Faucet, Laminar-Flow Fittings: Equal to 10 percent of amount of each type and size installed, but not less than 2 of each type and size.
 4. Faucet, Flow-Control Fittings: Equal to 10 percent of amount of each type and size installed.
 5. Supply, Flow-Control Fittings: Equal to 5 percent of amount of each type and size installed.
 6. Shower, Flow-Control Fittings: Equal to 5 percent of amount of each type and size installed.
 7. Flushometer Valve, Repair Kits: Equal to 10 percent of amount of each type installed, but not less than 12 of each type.
 8. Provide hinged-top wood or metal box, or individual metal boxes, with separate compartments for each type and size of extra materials listed above.
 9. Toilet Seats: Equal to 5 percent of amount of each type installed.

PART 2 - PRODUCTS

2.1 MANUFACTURERS

- A. Manufacturers: Subject to compliance with requirements, provide products by one of the manufacturers listed below.
- B. Commercial Cast Brass Faucets:
1. Chicago Faucet Co.
 2. Symmons Industries, Inc.
 3. T&S Brass and Bronze Works.
 4. Speakman Co.
- C. Shower Heads and Trim:
1. Symmons Industries, Inc.
 2. Powers Process Controls.
 3. Leonard Valve Co.
- D. Flush Valves:
1. Sloan Valve Co.
 2. Zurn Industries, Inc.
 3. Toto, USA.
- E. Toilet Seats:
1. Church Seat Co.

2. Bemis Mfg. Co.
 3. Beneke.
 4. Kohler Co.
- F. Protective Shielding Guards, (Under counter Insulation Kits):
1. Truebro, Inc.
 2. McGuire/Pro Wrap.
 3. Plumberex Specialty Products, Inc.
- G. Fixture Carriers and Supports:
1. Zurn Industries, Inc.
 2. J.R. Smith Mfg. Co.
 3. Josam Co.
 4. Watts Drainage.
 5. Mifab.
- H. Supply Stops:
1. Chicago Faucet Co.
 2. McGuire Mfg. Co.
- I. Vitreous China Fixtures:
1. American Standard, Inc.
 2. Crane Plumbing/Fiat Products.
 3. Kohler Co.
 4. Eljer Mfg. Co.
- J. Pre-fabricated Plastic Shower Cabinets:
1. Acryline USA, Inc.
 2. Aqua Bath.
 3. Aquarius by Praxis Industries.
 4. Lasco Bathware.
- K. Stainless Steel Sinks:
1. Just Mfg. Co.
 2. Elkay Mfg. Co.
 3. Kindred.
 4. Advance Tabco.
- L. Molded Stone and Plastic Basins:
1. Fiat Products.
 2. Swan.

2.2 FIXTURES, GENERAL

- A. General fixture, faucet and related item requirements are listed below. Refer to the "Plumbing Fixture Schedule" on the Drawings for the basis of design for each item.
- B. Accessibility: Fixtures and items that are required to be accessible are tagged as such in the Plumbing Fixture Schedule on the Drawings.

2.3 FAUCETS

- A. General: Include hot- and cold-water indicators; coordinate faucet inlets with supplies and fixture holes and outlet with spout and fixture receptor.
 - 1. Maximum Flow Rate, (unless otherwise indicated):
 - a. Sinks, Bathtubs, Showers: 2.5 gpm.
 - b. Lavatories: 0.5 gpm
 - 2. Body Material: Cast brass
 - 3. Finish: Polished chrome plate
 - 4. Vacuum Breaker: Required for service sinks, basins, science and laboratory sinks.
 - a. Required at any sink faucet which has exposed hose thread end(s).
 - 5. Operation Mechanism: Self closing push-button handle(s), lever handles, electric-sensor, battery-operated sensor.

2.4 FLUSHOMETERS

- A. General: Cast-brass body with corrosion-resistant internal components, non-hold-open feature, control stop with check valve, vacuum breaker, and copper or brass tubing, and polished chrome-plated finish on exposed parts.
 - 1. Internal Design: Diaphragm operation.
 - 2. Style: Exposed, unless noted otherwise.
 - 3. Inlet Size: NPS 1.
 - a. NPS $\frac{3}{4}$ acceptable for urinals if scheduled as such.
 - 4. Trip Mechanism: hard-wired, electric-sensor.
 - 5. Consumption:
 - a. Water Closets: 1.6 gal./flush.
 - 6. Tailpiece Size: Diameter scheduled, length to top of bowl.

2.5 TOILET SEATS

- A. General: Solid plastic, open front, without cover, self sustaining check hinges.
 - 1. Color: White.
 - 2. Size: Elongated, unless otherwise noted.

2.6 PROTECTIVE SHIELDING GUARDS

- A. General: Manufactured insulation and plastic covering for water supply, trap and drain piping and complying with ADA requirements.

2.7 FIXTURE SUPPORTS

- A. Water-Closet Support: Water-closet combination carrier designed for accessible and standard mounting heights, (see schedule). Include single or double, vertical or horizontal, hub-and-spigot or hubless waste fitting as required for piping arrangement; faceplates; couplings with

gaskets; feet; and fixture bolts and hardware matching fixture. Include additional extension coupling, faceplate, and feet for installation in wide pipe space.

- B. Lavatory and Sink Supports: Lavatory carrier with concealed arms and tie rod. Include steel uprights with feet.

2.8 BEDPAN WASHERS

- A. Bedpan Washer: Wall-mounting, hand-held, hand control with 48-inch-long rubber or vinyl hose, wall bracket and hook, self-closing valve, and spray nozzle. Include loose-key supply stop; wall-mounting, atmospheric vacuum breaker; and polished, chrome-plated finish on metal parts exposed after installation.

2.9 SUPPLY STOPS

- A. General: Cast brass or copper, chrome plated angle style with chrome plated escutcheon and loose key operator.
1. Lavatory Supplies: NPS 3/8.
 2. Sink and Tank Style Water Closet Supplies: NPS 1/2.

2.10 WATER CLOSETS

- A. General: Commercial, vitreous-china fixture, siphon jet design, 1.6 gal./flush.
1. Mounting: Wall hung and floor mounted.
 2. Outlet: Back or floor.
 3. Flush style: Flush valve or tank.
 - a. Pressure assist: Tank to be equipped with pressurized tank.
 4. Color: White.

2.11 URINALS

- A. General: Wall hung, back-outlet, vitreous-china fixture designed for flushometer valve operation, wash out design, 1.0 gal./flush.
1. Color: White.

2.12 LAVATORIES

- A. General: Wall hung or self rimming counter mount vitreous-china fixture.
1. Color: White.

2.13 PRE-FABRICATED SHOWER CABINETS

- A. General: Acrylic plastic or fiberglass shower enclosure with slip-resistant bathing surface complying with ASTM F 462 and shower rod with curtain.
1. Cabinet Configuration: One-piece surround.

2. Color: White.
3. Drain: Grid, NPS 2.
4. Accessibility Options: Include grab bars and bench meeting applicable accessibility requirements for units designated as accessible in the Plumbing Fixture Schedule on the Drawings.
 - a. Threshold: ½-inch maximum lip allowed at front entrance to the cabinet.

2.14 GENERAL USE SINKS

- A. General: Commercial, counter mount, self rimming, sound deadening fixture.
 1. Material: 18 gauge, type 304 stainless steel.

2.15 SERVICE FIXTURES

- A. Mop Service Basins: Flush-to-wall, floor-mounting precast terrazzo or plastic basin with rim guards.
 1. Drain: NPS 3. grid.
 2. Accessories: Mop hanger, splash guards, faucet hose attachment.

2.16 CLINICAL SINKS

- A. General: Wall-mounting, back-outlet, vitreous-china, flushing-rim service sink.
 1. Rim Guard: Stainless steel on front and also on sides if flat rim.

PART 3 - EXECUTION

3.1 EXAMINATION

- A. Examine roughing-in for water soil and for waste piping systems and supports to verify actual locations and sizes of piping connections and that locations and types of supports match those indicated, before plumbing fixture installation. Use manufacturer's roughing-in data if roughing-in data are not indicated.
- B. Examine walls, floors, and cabinets for suitable conditions where fixtures are to be installed.
- C. Proceed with installation only after unsatisfactory conditions have been corrected.

3.2 FIXTURE INSTALLATION

- A. Assemble fixtures, trim, fittings, and other components according to manufacturers' written instructions.
- B. For wall-hanging fixtures, install off-floor supports affixed to building substrate.

1. Use carrier supports with waste fitting and seal for back-outlet fixtures.
 2. Use carrier supports without waste fitting for fixtures with tubular waste piping.
 3. Use chair-type carrier supports with rectangular steel uprights for accessible fixtures.
- C. Install back-outlet, wall-hanging fixtures onto waste fitting seals and attach to supports.
- D. Install floor-mounting fixtures on closet flanges or other attachments to piping or building substrate.
- E. Install wall-hanging fixtures with tubular waste piping attached to supports.
- F. Install floor-mounting, back-outlet water closets attached to building floor substrate and wall bracket and onto waste fitting seals.
- G. Install counter-mounting fixtures in and attached to casework.
- H. Install fixtures level and plumb according to manufacturers' written instructions and roughing-in drawings.
- I. 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. Exception: Use ball, gate, or globe valve if stops are not specified with fixture.
- J. Install trap and tubular waste piping on drain outlet of each fixture to be directly connected to sanitary drainage system.
- K. Install tubular waste piping on drain outlet of each fixture to be indirectly connected to drainage system.
- L. Install protective shielding guards on exposed under counter supply and waste piping at fixtures identified as accessible and at other locations scheduled.
- M. Install flushometer valves for accessible water closets and urinals with handle mounted on wide side of compartment. Install other actuators in locations that are easy for people with disabilities to reach.
- N. Install tanks for accessible, tank-type water closets with lever handle mounted on wide side of compartment.
- O. Install toilet seats on water closets.
- P. Install faucet-spout fittings with specified flow rates and patterns in faucet spouts if faucets are not available with required rates and patterns. Include adapters if required.
- Q. Install water-supply, flow-control fittings with specified flow rates in fixture supplies at stop valves.

- R. 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.
- S. Install shower, flow-control fittings with specified maximum flow rates in shower arms.
- T. Install traps on fixture outlets.
 - 1. Exception: Omit trap on fixtures with integral traps.
 - 2. Exception: Omit trap on indirect wastes, unless otherwise indicated.
- U. Install escutcheons at piping wall ceiling penetrations in exposed, finished locations and within cabinets and millwork. Use deep-pattern escutcheons if required to conceal protruding fittings. Refer to Division 22 Section "Basic Mechanical Materials and Methods" for escutcheons.
- V. Set shower receptors, and service basins in leveling bed of cement grout. Refer to Division 22 Section "Basic Mechanical Materials and Methods" for grout.
- W. Seal joints between fixtures and walls, floors, and counters using sanitary-type, one-part, mildew-resistant, silicone sealant. Match sealant color to fixture color. Refer to Division 7 Section "Joint Sealants" for sealant and installation requirements.

3.3 CONNECTIONS

- A. Piping installation requirements are specified in other Division 22 Sections. Drawings indicate general arrangement of piping, fittings, and specialties.
- B. Connect water supplies from water distribution piping to fixtures.
- C. Connect drain piping from fixtures to drainage piping.
- D. Supply and Waste Connections to Plumbing Fixtures: Connect fixtures with water supplies, stops, risers, traps, and waste piping. Use size fittings required to match fixtures. Connect to plumbing piping.
- E. Supply and Waste Connections to Fixtures and Equipment Specified in Other Sections: Connect fixtures and equipment with water supplies, stops, risers, traps, and waste piping specified. Use size fittings required to match fixtures and equipment. Connect to plumbing piping.
- F. Ground equipment.
 - 1. Tighten electrical connectors and terminals according to manufacturer's published torque-tightening values. If manufacturer's torque values are not indicated, use those specified in UL 486A and UL 486B.

3.4 FIELD QUALITY CONTROL

- A. Verify that installed fixtures are categories and types specified for locations where installed.

- B. Check that fixtures are complete with trim, faucets, fittings, and other specified components.
- C. Inspect installed fixtures for damage. Replace damaged fixtures and components.
- D. Test installed fixtures after water systems are pressurized for proper operation. Replace malfunctioning fixtures and components, then retest. Repeat procedure until units operate properly.
- E. Install fresh batteries in sensor-operated mechanisms.

3.5 ADJUSTING

- A. Operate and adjust faucets and controls. Replace damaged and malfunctioning fixtures, fittings, and controls.
- B. Adjust water pressure at faucets, shower valves, and flushometer valves to produce proper flow and stream.
- C. Replace washers and seals of leaking and dripping faucets and stops.

3.6 CLEANING

- A. Clean fixtures, faucets, and other fittings with manufacturers' recommended cleaning methods and materials. Do the following:
 - 1. Remove faucet spouts and strainers, remove sediment and debris, and reinstall strainers and spouts.
 - 2. Remove sediment and debris from drains.

3.7 PROTECTION

- A. Provide protective covering for installed fixtures and fittings.
- B. Do not allow use of fixtures for temporary facilities unless approved in writing by Owner.

END OF SECTION 224000

SECTION 226313

MEDICAL GAS PIPING

PART 1 - 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. The requirements of Section 220000, "Basic Plumbing Requirements" apply to work defined by this Section.
- C. The requirements of Section 220500, "Basic Plumbing Materials and Methods" apply to work defined by the Section.

1.2 SUMMARY

- A. This Section includes medical gas piping and related specialties for the following medical gas systems:
 - 1. Medical gas pressure systems:
 - a. Oxygen piping, designated "O2 - Oxygen."
 - b. Medical compressed-air piping, designated "MA - Medical Air."
 - 2. Medical gas suction systems:
 - a. Medical-surgical vacuum piping, designated "MV - Medical Vacuum."
- B. Related Sections include the following:
 - 1. Division 7, Section 078413 "Through-Penetration Firestop Systems" for materials and methods for sealing pipe penetrations through fire and smoke barriers.
 - 2. Division 7, Section 079200 "Joint Sealants" for materials and methods for sealing pipe penetrations through exterior walls.
 - 3. Division 22 Section "Meters and Gages" for thermometers and pressure gages.

1.3 DEFINITIONS

- A. ACR: Air conditioning and refrigeration.
- B. CR: Chlorosulfonated polyethylene synthetic rubber.
- C. D.I.S.S.: Diameter-index safety system.
- D. NPS: Nominal pipe size.

- E. PTFE: Polytetrafluoroethylene plastic.
- F. TFE: Tetrafluoroethylene plastic.
- G. WAGD: Waste anesthetic gas disposal.

1.4 PERFORMANCE REQUIREMENTS

- A. General: Provide medical gas and vacuum piping systems that comply with the following NFPA 99 level categories:
 - 1. Level 1: For entire facility with systems where failure of medical gas supply would be immediate and direct life-safety threat to patients. Air and vacuum equipment arrangement must be duplex or redundant.

1.5 SUBMITTALS

- A. Product Data: For the following:
 - 1. Medical gas tubes and fittings.
 - 2. Medical gas valves and valve boxes.
 - 3. Medical gas manifolds.
 - 4. Medical gas service connections and pressure control panels.
 - 5. Alarm system components.
- B. Shop Drawings: Diagram power, signal, and control wiring.
- C. Coordination Drawings: For medical gas systems. Include relationship to other services that serve same work area.
- D. Brazing Certificates: As required by ASME Boiler and Pressure Vessel Code, Section IX, or AWS B2.2.
- E. Piping Material Certification: Signed by Installer certifying that medical gas piping materials comply with NFPA 99 requirements.
- F. Certificates of Shop Inspection and Data Report for Bulk Medical Gas Storage Tanks: As required by ASME Boiler and Pressure Vessel Code.
- G. Qualification Data: For testing agency.
- H. Field quality-control Test and Certification Reports.
- I. Operation and Maintenance Data: For medical gas piping and specialties to include in emergency, operation, and maintenance manuals. Include data for the following:
 - 1. Medical gas service connections and pressure control panels.
 - 2. Alarm system.

1.6 QUALITY ASSURANCE

- A. Testing Agency Qualifications: An independent testing agency, with the experience and capability to conduct the testing indicated, that is a member company of the Medical Gas Professional Healthcare Organization or is a nationally recognized testing laboratory (NRTL) as defined by OSHA in 29 CFR 1910.7, and that is acceptable to authorities having jurisdiction.
- B. Brazing: Qualify processes and operators according to ASME Boiler and Pressure Vessel Code: Section IX, "Welding and Brazing Qualifications," or AWS B2.2, "Standard for Brazing Procedure and Performance Qualification."
- C. Electrical Components, Devices, and Accessories: Listed and labeled as defined in NFPA 70, Article 100, by testing agency acceptable to authorities having jurisdiction, and marked for intended use.
- D. ASME Compliance: Fabricate and label bulk medical gas storage tanks to comply with ASME Boiler and Pressure Vessel Code: Section VIII, "Pressure Vessels."
- E. Comply with NFPA 70, "National Electrical Code."
- F. Comply with NFPA 99-2002 edition, "Health Care Facilities," for materials, installation, testing and certification.
- G. Comply with UL 498, "Attachment Plugs and Receptacles," for electrical service connections.
- H. Contamination of existing piping systems caused by faulty workmanship or procedures shall be corrected to the Owner's satisfaction at the Contractor's expense and at no additional cost to the owner.

1.7 EXTRA MATERIALS

- A. Furnish extra materials described below that match products installed and that are packaged with protective covering for storage and identified with labels describing contents.
 - 1. Quick-Connect Service Connections: Furnish complete noninterchangeable medical gas pressure outlets and suction inlets.
 - a. Oxygen Service Connections: Equal to 5 percent of amount installed.
 - b. Medical Air Service Connections: Equal to 5 percent of amount installed, but no fewer than <5 units.
 - c. Medical Vacuum Service Connections: Equal to 5 percent of amount installed.
 - d. Medical Vacuum Slide Brackets: Equal to 5 percent of amount installed,

PART 2 - PRODUCTS

2.1 MANUFACTURERS

- A. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
1. Allied Healthcare Products, Inc.; Chemetron Div.
 2. Amico Corporation.
 3. BeaconMedaes.
 4. Squire-Cogswell/Aeros Instruments.

2.2 PIPES, TUBES, AND FITTINGS

- A. General: Sizes indicated on the drawings are nominal pipe/tube size, (NPS).

Nominal Pipe/Tube Size, (NPS)	Actual O.D. / ACR Designation (inches)
1/2	5/8
3/4	7/8
1	1-1/8
1-1/4	1-3/8
1-1/2	1-5/8
2	2-1/8
2-1/2	2-5/8
3	3-1/8

- B. Hard Copper Tube: ASTM B 819, Type K or L, seamless, drawn-temper, medical gas tube that has been factory cleaned, purged, and sealed for oxygen service. Include standard color marking "OXY," "MED," "OXY/MED," "OXY/ACR," or "ACR/MED" in green for Type K tube and blue for Type L tube.
1. Fittings: Factory cleaned, purged, and bagged for oxygen service according to ASTM B 819 or field cleaned, purged, and bagged as specified in "Preparation" Article in Part 3.
 - a. Copper Pressure Fittings: ASME B16.22, wrought-copper solder-joint pressure type or MSS SP-73, wrought copper with dimensions for brazed joints.
 - b. Cast-Copper-Alloy Flanges: ASME B16.24, Class 300.
 - c. Copper Unions: ASME B16.22 or MSS SP-123.
- C. Memory-Metal Couplings: Nickel-titanium, shape-memory-alloy, cryogenic compression fitting for joining copper tube without heat.

1. Cleaning: Factory cleaned, purged, and bagged for oxygen service according to ASTM B 819 or field cleaned, purged, and sealed or bagged as specified in "Preparation" Article in Part 3.
- D. Flexible Pipe Connectors: Corrugated-bronze inner tubing with bronze wire-braid covering and ends brazed to inner tubing.
 1. Cleaning: Factory cleaned, purged, and sealed or bagged for oxygen service according to ASTM B 819 or field cleaned, purged, and sealed or bagged as specified in "Preparation" Article in Part 3.
 2. Working-Pressure Rating: 200 psig minimum.
 3. End Connections NPS 2 and Smaller: Threaded copper pipe or plain-end copper tube.
 4. End Connections NPS 2-1/2 and Larger: Flanged copper alloy.

2.3 JOINING MATERIALS

- A. Refer to Division 22 Section "Basic Mechanical Materials and Methods" for joining materials not in this Section.
- B. Brazing Filler Metals: AWS A5.8, BCuP series alloys. Flux is prohibited unless used with bronze fittings.
- C. Threaded-Joint Tape: PTFE.
- D. Gasket Material: ASME B16.21, nonmetallic, flat, asbestos free, and suitable for oxygen service.

2.4 MEDICAL GAS VALVES

- A. Valves, General: Factory cleaned for oxygen service and bagged. Color-coded handles and identification labels shall be provided with each valve.
 1. Exception: Factory cleaning and bagging are not required for valves for WAGD service.
- B. Copper-Alloy Ball Valves: MSS SP-110, 3-piece-body, full-port ball valve rated for 300-psig minimum working pressure; with chrome-plated brass ball, PTFE or TFE seats, blowout-proof stem, threaded or solder-joint ends, and locking-type handle designed for quarter turn between opened and closed positions.
- C. Bronze Check Valves: Straight-through-pattern, spring-loaded ball check valve; designed for 300-psig minimum working pressure.
- D. Zone Valves: MSS SP-110, 3-piece-body, full-port copper-alloy ball valve rated for 300-psig minimum working pressure; with chrome-plated brass ball, PTFE or TFE seats, blowout-proof stem, threaded or solder-joint ends, and handle designed for quarter turn between opened and closed positions.
 1. Include union-type body with bolted swing-away center section.

2. Include factory-installed ASTM B 819, Type K or L, copper-tube extensions with pressure gage for pressure systems and vacuum gage for vacuum systems.
- E. Zone Valve Boxes: Formed steel for recessed mounting, with holes for medical gas piping and anchors. Include boxes for single- or multiple-valve installation with pressure gage and in sizes to permit manual operation of valves.
1. Interior Finish: Factory-applied white enamel.
 2. Cover Plate: Anodized aluminum with frangible or removable windows.
 3. Valve-Box Windows: Clear or tinted transparent plastic with labeling that includes rooms served, according to NFPA 99.
 - a. Inlet: Factory-installed, NPS 1 or NPS 1-1/4, ASTM B 819, copper tubing with NPS 1 minimum ball valve and plugged inlet.
 - b. Safety Valve: Bronze-body, pressure relief valve set at 75 or 80 psig. Safety valve may be separate for installation in oxygen piping system.
 - c. Instrumentation: Pressure gage.
- F. Safety Valves: Bronze body with settings to match system requirements.
1. Pressure Relief Valves: ASME construction, poppet type.
 2. Vacuum Relief Valves: Specialty manufacturer's option.
- G. Pressure Regulators: Bronze body and trim; spring-loaded, diaphragm-operated, relieving type; manual pressure-setting adjustment; rated for 250-psig minimum inlet pressure; and capable of controlling delivered air pressure within 0.5 psig for each 10-psig inlet pressure.

2.5 MEDICAL GAS SERVICE CONNECTIONS

- A. Connection Devices: For specific medical gas pressure and vacuum services listed. Include roughing-in assemblies, finishing assemblies, and cover plates. Individual cover plates are not required if service connection is in multiple unit or assembly with cover plate. Furnish recessed-type units made for concealed piping, unless otherwise indicated.
1. Roughing-in Assembly:
 - a. Steel outlet box for recessed mounting and concealed piping.
 - b. Brass-body outlet block with secondary check valve that will prevent gas flow when primary valve is removed.
 - c. Double seals that will prevent gas leakage.
 - d. ASTM B 819, Type K, NPS 3/8 (1/2" O.D.) copper inlet or outlet tube brazed to valve with gas-service marking and tube-end dust cap.
 2. Finishing Assembly:
 - a. Brass housing with primary check valve.
 - b. Double seals that will prevent gas leakage.
 - c. Cover plate with gas-service label.

3. Quick-Connect Service Connections: With keyed indexing to prevent interchange between services, constructed to permit one-handed connection and removal of equipment, and with positive-locking ring that retains equipment stem in valve during use. Include the following:
 - a. Oxygen Service Connections: Keyed oxygen outlet.
 - b. Medical Air Service Connections: Keyed medical air outlet.
 - c. Medical Vacuum Service Connections: Keyed medical vacuum suction inlet.
 - d. Medical Vacuum Slide Brackets: With pattern matching medical vacuum service connection.
4. Wall Outlet Service Connection Cover Plates: One piece, stainless steel, with NAAMM AMP 503, No. 4 finish and permanent, color-coded, medical gas identifying label matching corresponding outlets.
5. Vacuum Bottle-Slide Brackets: Bottle-slide and mounting assembly matching pattern of vacuum inlet. Include one slide bracket for each wall-mounting vacuum inlet unless no slide bracket requirement is indicated.

2.6 MEDICAL GAS ALARM SYSTEM

- A. Medical Gas Alarm System, General: Compatible alarm panels, remote sensing devices, and other related components as required by NFPA 99 for Level 1 medical gas alarm systems. Refer to Division 22 Section "Medical Air and Vacuum Equipment" for air compressors and vacuum pumps. Power wiring is specified in Division 26 Sections.
- B. Components: Designed for continuous service and to operate on power supplied from 120-V ac power source to alarm panels and with connections for 24- or 12-V ac low-voltage wiring to remote sensing devices. Include step-down transformers if required.
- C. Pressure and Vacuum Switches or Pressure Transducer Sensors: Continuous line monitoring with electrical connections for alarm system.
 1. Low-Pressure Switches: 0- to 100-psig operating range.
 2. High-Pressure Switches: Up to 250-psig operating range.
 3. Vacuum Switches: 0- to 30-in. Hg range.
- D. Medical Gas Alarm Panels: Factory wired with audible and color-coded visible signals to indicate specified functions.
 1. Mounting: Recessed installation.
 2. Enclosures: Fabricated from minimum 0.047-inch-thick steel or minimum 0.05-inch-thick aluminum, with knockouts for electrical and piping connections.
 3. Area Alarm Panels: Separate trouble alarm signals; pressure and vacuum gages; and indicators for oxygen, medical air, and medical vacuum. Alarms signal when the following conditions exist:
 - a. Oxygen: Pressure drops below 40 psig or rises above 60 psig.
 - b. Medical Air: Pressure drops below 40 psig or rises above 60 psig.
 - c. Medical Vacuum: Vacuum drops below 12 in. Hg

- d. Nitrous Oxide: Pressure drops below 40 psig or rises above 60 psig.

2.7 TEST GAS

- A. Description: Oil-free dry nitrogen complying with CGA P-9, for purging and testing of piping.

2.8 IDENTIFICATION

- A. Refer to Division 22 Section "Mechanical Identification" for identification of piping, valves, gages, alarms, and specialties and for labels for bulk medical gas storage tanks.

2.9 MEDICAL GAS SERVICE UNITS

- A. Medical Gas Service Units, OR#21: Ceiling-mounting units with medical gas service connections as specified in Part 2 "Medical Gas Service Connections" Article. Include labels indicating services, and the following:
 - 1. Ceiling-Mounting Plate: Manufacturer's standard, field-fabricated plate or roughing-in assembly complying with unit manufacturer's written instructions.
 - 2. Exposed Surfaces: Minimum 0.0375-inch- thick stainless steel with NAAMM AMP 503, No. 4 directional polish.
 - 3. Servicing: Include access panels or means of removing shroud.
 - 4. Blank cover plates for cutouts not having service connections.
 - 5. ASTM B 819, Type K or L, NPS 3/8 (5/8" O.D.) copper-tube extensions for connection to medical gas systems.
 - 6. Service Connections: Type and number indicated.
 - 7. Dust Covers: For medical gas service connection.
- B. Fixed Hose Service Assemblies, OR#21: Individual, concealed hose connection with stainless-steel face plates, steel mounting boxes, factory- or field-fabricated mounting brackets, and color-coded service hoses with retractor device and service connections matching hoses. Hose retractors shall be Mercury Medical # 69-206-14 or Owner approved equal. Include 72 inches of conductive CR 1/4- or 5/16-inch- ID medical gas hoses rated for 200-psig minimum working pressure, and the following service hose connections:
 - 1. Oxygen Hose: [Quick-connect] [D.I.S.S.] outlet. Confirm with Owner.
 - 2. Medical Air Hose: [Quick-connect] [D.I.S.S.] outlet. Confirm with Owner.
 - 3. Nitrous Oxide Hose: [Quick-connect] [D.I.S.S.] outlet. Confirm with Owner.
 - 4. Medical Vacuum Hose: [Quick-connect] [D.I.S.S.] inlet. Confirm with Owner.
 - 5. WAGD Hose: [Quick-connect] [D.I.S.S.] inlet. Confirm with Owner.
 - 6. Power: L5-20R, locking-type, 20-A, single, power receptacle. Confirm with Div 26.

PART 3 - EXECUTION

3.1 PREPARATION

A. Interruption of Existing Medical Gas Service:

1. Contractor shall not interrupt medical gas service to occupied facilities. Under no conditions shall medical gas service valves (existing or new) be closed by the Contractor.
2. Owner shall be responsible for isolating portions of existing systems and closing service valves as required; including verifying proper service valve or zone valve labeling, and exact areas and rooms controlled.

B. Medical Gas System Isolation:

1. Total isolation between new systems and existing systems shall be maintained until all new piping is tested for leaks and tested for cross connections per NFPA 99 by the Contractor.

C. Cleaning of Piping: If precleaned piping must be recleaned because of exposure, perform the following procedures:

1. Clean medical gas tube and fittings, valves, gages, and other components of oil, grease, and other readily oxidizable materials as required for oxygen service according to CGA G-4.1, "Cleaning Equipment for Oxygen Service."
2. Wash medical gas piping and components in hot, alkaline-cleaner-water solution of sodium carbonate or trisodium phosphate in proportion of 1 lbof chemical to 3 gal.of water.
 - a. Scrub to ensure complete cleaning.
 - b. Rinse with clean, hot water to remove cleaning solution.

3.2 PIPING APPLICATIONS

A. General: Use pipe, tube, fittings, and joining methods for medical gas piping systems according to the following applications:

B. Joining New to Existing Copper Tubes NPS 2 (2-1/8" O.D.) and Smaller: Use memory-metal couplings.

C. Joining of Dissimilar Metal Piping: Use dielectric fittings. Refer to Division 22Section "Basic Mechanical Materials and Methods" for dielectric fitting types.

1. NPS 2 and Smaller: Use dielectric unions.
2. NPS 2-1/2 to NPS 4: Use dielectric flanges.

D. Specialty and Equipment Flanged Connections: Use cast-copper-alloy companion flange with gasket and brazed joint for connection to copper tube.

- E. Interior Medical Gas Pressure Piping: Use hard copper tube, copper pressure fittings, and brazed joints.
- F. Interior Medical Gas Piping at Pressures Greater Than 200 psig: Use ASTM B 819, Type K, hard copper tube, copper pressure fittings, and brazed joints.
- G. Interior Medical Vacuum Piping: Use hard copper tube, copper pressure fittings, and brazed joints.

3.3 MEDICAL GAS VALVE APPLICATIONS

- A. Drawings indicate medical gas valve types to be used. If specific valve types are not indicated, the following requirements apply:
 - 1. Medical Gas Pressure Piping:
 - a. Shutoff Valves NPS 3 and Smaller: Copper-alloy ball valve.
 - b. Check Valves NPS 3 and Smaller: Bronze.
 - 2. Medical Vacuum Piping:
 - a. Shutoff Valves NPS 3 and Smaller: Copper-alloy ball valve.
 - b. Check Valves NPS 3 and Smaller: Bronze.
 - 3. Zone Valves: With copper-tube extensions and gauge.

3.4 PIPING INSTALLATION

- A. Refer to Division 22 Section "Basic Mechanical Materials and Methods" for basic piping installation.
- B. Install supports and anchors according to Division 22 Section "Hangers and Supports" with spacing according to NFPA 99.
- C. Install thermometers and pressure gages according to Division 22 Section "Meters and Gages."
- D. Purge medical gas piping, using oil-free dry nitrogen, after installing piping but before connecting to service connections, alarms, and gages.

3.5 MEDICAL GAS VALVE INSTALLATION

- A. Refer to Division 22 Section "Basic Mechanical Materials and Methods" for basic piping and valve installation.
- B. Install valves in locations required by and according to NFPA 99.
- C. Install valves as required for phasing, purging, and testing. Remove handles or lock open as required.

- D. Install shutoff valve at each connection to and from medical gas specialties and equipment.
- E. Install check valves to maintain correct direction of fluid flow to and from medical gas specialties and equipment.
- F. Install valve boxes recessed in wall and anchored to substrate. Single boxes may be used for multiple valves that serve same area or function.
- G. Install zone valves and gages in valve boxes. Rotate valves to angle that prevents closure of cover when valve is in closed position.
 - 1. Pressure System Valves: Install pressure gage downstream from valve.
 - 2. Suction System Valves: Install vacuum gage upstream from valve.
- H. Install pressure safety and vacuum relief valves where recommended by specialty manufacturers.
- I. Install pressure regulators in piping to reduce pressure.
- J. Install automatic drain valves for specialties and medical air and vacuum equipment that require draining.

3.6 JOINT CONSTRUCTION

- A. Refer to Division 22 Section "Basic Mechanical Materials and Methods" for basic piping joint construction.
- B. Brazed Joints: Use silver- or copper-phosphorus-composition filler metal and comply with CDA's "Copper Tube Handbook," Section VII, "Braze Joints"; or AWS D10.13, "Recommended Practices for the Brazing of Copper Pipe and Tubing for Medical Gas Systems."
- C. Arrange for coupling manufacturer's authorized representative to join new copper tube to existing copper tube with memory-metal couplings.
- D. Join new copper tube to existing copper tube with memory-metal couplings. Follow coupling manufacturer's product-specific procedure.

3.7 ELECTRICAL SERVICE CONNECTION INSTALLATION

- A. Install electrical service connections, of types indicated, in medical gas service units.

3.8 MEDICAL GAS ALARM SYSTEM INSTALLATION

- A. Install medical gas alarm system components in locations required by and according to NFPA 99 and manufacturer's written instructions.
- B. Install medical gas alarm panels and computer interface cabinet where indicated.

3.9 CONNECTIONS

- A. Drawings indicate general arrangement of piping, fittings, and specialties.
- B. Install piping adjacent to specialties and equipment to allow service and maintenance.
- C. Connect medical gas piping to specialties, equipment, and accessories.
 - 1. Connection NPS 2 and Smaller: With shutoff valve and copper union.
 - 2. Connection NPS 2-1/2 and Larger: With shutoff valve and cast-copper-alloy flange.
- D. Ground specialties and equipment according to Division 26 Section "Grounding and Bonding."
- E. Connect wiring according to Division 26 Section "Conductors and Cables."
- F. Tighten electrical connectors and terminals according to manufacturer's published torque-tightening values. If manufacturer's torque values are not indicated, use those specified in UL 486A and UL 486B.

3.10 LABELING AND IDENTIFICATION

- A. Install identifying labels and devices for medical gas piping systems according to NFPA 99. Refer to Division 22 Section "Mechanical Identification" for labeling and identification materials.
- B. Captions and Color-Coding: Use the following or similar medical gas captions and color-coding for medical gas piping products where required by NFPA 99:
 - 1. Oxygen: White letters on green background or green letters on white background.
 - 2. Medical Air: Black letters on yellow background.
 - 3. Medical Vacuum: Black letters on white background.
- C. Label medical gas systems operating at other-than-standard pressure with system operating pressure.

3.11 FIELD QUALITY CONTROL

- A. Testing Agency: Contractor shall engage a qualified independent testing and inspecting agency to perform the following field tests and inspections and prepare test reports. The Testing Agency shall be approved by the Owner.
 - 1. Inspect, test, and certify completed medical gas systems according to requirements in NFPA 99. Inspect, test, and certify each medical gas piping system, including specialties, service connections, alarm system, safety devices, and source equipment.
 - 2. Inspect, test, and Re-Certify zones or portions of the existing medical gas and vacuum systems downstream of where connections or modifications to the existing systems are made.

3. Provide oil-free dry nitrogen, medical gases, materials, and equipment required for testing.
4. Level 1 Pressure Medical Gas Testing: Use oil-free dry nitrogen, unless otherwise indicated, and perform procedures and tests as indicated in NFPA 99 performance and testing paragraphs for piped gas systems. Include the following:
 - a. Performance Testing:
 - 1) Blow Down: Clear piping before connecting service connections or outlets.
 - 2) Initial Pressure Tests: Subject each piping section to test pressure of 1.5 times system working pressure, but not less than 150 psig, before attaching system components, after installing station outlets with test caps (if supplied) in place, and before concealing piping system. Maintain test until joints are examined for leaks by means of soapy water. Repair leaks with new materials and retest systems.
 - 3) Cross-Connection Tests: Determine that no cross connections of piping systems exist. Disconnect all systems except system to be checked. Pressurize system to 50 psig. Verify that gas flow from service connections and outlets is only from system being checked. Repeat for each system. Verify correct labeling.
 - 4) Purge Tests: Perform heavy intermittent purging of piping and full-flow purging of service connections.
 - 5) Standing-Pressure Tests: Install assembled system components after testing individual systems as specified above. Subject systems to 24-hour standing-pressure test at 20 percent above normal line pressure. Verify that pressure differences comply with required calibration. Repair leaks with new materials and retest systems.
 - b. System Verification:
 - 1) Cross-Connection Tests: Repeat cross-connection test above or perform alternate tests with each gas at different pressure.
 - 2) Flow Tests: Perform flow test at each outlet.
 - 3) Valve Tests: Verify proper valve operation.
 - 4) Alarm Tests: Operate systems and verify proper warning indication of each medical gas piping system function.
 - 5) Piping Purity Tests: Test for dew point and hydrocarbons as compared to source gas.
 - 6) Final Tie-End Tests: Verify that above tests have been successfully performed.
 - 7) Operational Pressure Tests: Use designated system gases and test for pressure and flow.
 - 8) Medical Gas Concentration Tests: Test each gas for required concentration.
 - 9) Labeling: Verify correct labeling.
5. Level 1 Vacuum System Testing: Use oil-free dry nitrogen, unless otherwise indicated, and perform procedures and tests as indicated in NFPA 99 performance and testing paragraphs for piped vacuum systems. Include the following:
 - a. Blow Down: Clear piping before connecting service connections or inlets.

- b. Initial Pressure Tests: Subject each piping section to test pressure not less than 150 psig before attaching system components, after installing station outlets with test caps (if supplied) in place, and before concealing piping system. Maintain test until joints are examined for leaks by means of soapy water. Repair leaks with new materials and retest systems.
 - c. Initial Cross-Connection Tests: Determine that no cross connections of piping systems exist. Disconnect all systems except system to be checked. Pressurize system to 50 psig. Verify that gas flow from service connections and outlets is only from system being checked. Repeat for each system. Verify correct labeling.
 - d. Standing-Pressure Tests: Install assembled system components after testing individual systems as specified above. Subject systems to 24-hour standing-pressure test at not less than 60 psig.
 - e. Final Cross-Connection Tests: Repeat cross-connection test above or perform alternate tests with each system at different pressure.
 - f. Vacuum Tests: Verify functional operation of components.
 - g. Valve Tests: Verify proper valve operation.
 - h. Alarm Tests: Operate systems and verify proper warning indication of each medical gas piping system function.
 - i. Labeling: Verify correct labeling.
- B. Testing Certification: Certify that specified tests, inspections, and procedures have been performed and certify report results. Include the following:
1. Inspections performed.
 2. Procedures, materials, and gases used.
 3. Test methods used.
 4. Results of tests.

3.12 DEMONSTRATION

- A. Engage a factory-authorized service representative to train Owner's maintenance personnel to adjust, operate, and maintain medical gas alarm system. Refer to Division 1 Section "Closeout Procedures."

END OF SECTION 226313

SECTION 230000

BASIC MECHANICAL REQUIREMENTS

PART 1 - 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.

1.2 SUMMARY

- A. This Section specifies the basic requirements for mechanical installations and includes requirements common to more than one section. It expands and supplements the requirements specified in sections of Division 1.
- B. Related Sections include the following:
 - 1. Section 210500, "Basic Fire Protection Materials and Methods" for Fire Protection Contractor coordination drawing requirements.
 - 2. Section 230553, "Mechanical Identification" for valve tag schedules.

1.3 DEFINITIONS

- A. Complete and Operational System: A Mechanical system that has been installed, tested, cleaned, signed-off by appropriate Authority and made operational. Completion of Owner training to be part of this requirement.
- B. Mechanical Contractor: The project Contractor responsible for the installation of the Mechanical systems and equipment. This designation refers to the Contractor who performs HVAC and/or Plumbing work.

1.4 SUBMITTALS

- A. General: See Division 1 for general submittal and product substitution requirements.
- B. Pre-Construction Submittals: Submit the following items prior to commencing with installations.
 - 1. Coordination Drawings.
 - 2. Schedule of Mechanical Submittals and Closeout Procedures.
- C. During Construction: Submit at earliest possible date but not later than 50% completion of mechanical work as determined by schedule of values.
 - 1. Operation and Maintenance Manual Table of Contents.

2. Schedule of Mechanical Submittals and Closeout Procedures with updated current status information.

D. Post Construction: Submit the following at least fifteen (15) days before requesting site review for Substantial Completion.

1. Project Record Documents; as-builts.
2. Operation and Maintenance manuals.
3. Warranties.
4. Completed Schedule of Mechanical Submittals and Closeout Procedures.

1.5 QUALITY ASSURANCE

A. Installer Qualifications: All work shall be performed by qualified journeymen of their respective trades who are employed by a firm that can demonstrate successful experience with work similar in type, quality and extent to the work required by this project.

1.6 BASIS OF MECHANICAL DESIGNS

A. General: The following information is intended to provide an overview of the intent and operation of the project Mechanical systems. It is not intended that each and every project Mechanical scope item be captured herein. The absence of a specific item or system in the descriptions below does not absolve the Mechanical Contractor(s) from providing the work identified by other Sections and the Drawings.

1. The Mechanical Contractor(s) shall provide a complete and operational systems and installations.

B. HVAC Systems Description:

1. The existing ventilation systems including ductwork, diffusers, terminal boxes, and exhaust systems will be modified to accommodate the revised floor plan.
2. All existing terminal boxes that are not being replaced will be rebuilt (Bean 2 only) and receive new controls.
3. The existing air handling unit serving Bean 2 will be replaced and increased in size under a separate project. A new supply and return branch duct accommodating the increased airflow will be routed from the unit to the area of the OR's. The duct will route through existing patient rooms. To accommodate the new duct, existing branch ductwork may have to be shortened and diffusers relocated. Two patient rooms will require new, relocated VAV boxes.
4. New smoke dampers will be required to accommodate the new limits of the smoke compartments.
5. The two existing OR suites, #22 and #23 will receive all new controls including temperature, humidity and pressure indicating sensors.
6. The new expanded OR suite, #21, will receive a new terminal box, humidifier, critical environment diffusers, and all new controls.
7. Richards second floor will require new diffusers on existing branch ductwork.
8. A new office in Richards second floor will require fin tube radiation and a ductless split AC unit.
9. The new telemetry room in Richards second floor will require a ductless split AC unit.

C. Plumbing Systems Description

1. New plumbing fixtures will be provided to accommodate the revised floor plan.
2. Existing plumbing chases will be reused to the extent possible.

D. Medical Gas Systems Description

1. Medical gas will be revised to accommodate the new programming.
2. New medical gas alarms will be provided in PACU.
3. New medical gas alarms will be provided for the OR suites and the patient rooms.
4. New medical gas alarm will be provided for Richards second floor.
5. New medical gas service valves will be provided on Bean 2 and Richards 2 to accommodate future work.
6. New medical gas zone valves will be provided for Richards 2.
7. New medical zone valves will be provided for OR#22.

E. Fire Protection Systems Description

1. Bean 2: existing sprinkler heads will be relocated to accommodate the revised floor plan.
2. Richards 2: A new sprinkler system will be provided to the entire floor.

1.7 CODES, STANDARDS AND AUTHORITIES

A. General: The following listing is intended to identify the major Codes, Standards, and Authorities Having Jurisdiction, (AHJ's) for the project. This information is at least partially provided on the G-000 series Drawings as well. In the event that there is a discrepancy between the information contained herein and that on the G-000 Drawings, the information herein shall govern.

1. In the event that an item is included on the G-000 Drawings and is not listed herein, compliance with the requirements of said item is required.
2. The exclusion of an applicable Code, Standard, or AHJ in the list below does not absolve the Contractor from meeting the requirements of said Code, Standard or AHJ.

B. Codes: Work performed on the project must comply with the requirements of the following Codes:

1. International Building Code, 2006.
2. International Mechanical Code, 2006.
3. Maine State Internal Plumbing Code, most recent edition.
4. International Energy Conservation Code, 2003.
5. Maine Oil and Solid Fuel Board Rules.

C. Standards: Work performed on the project must comply with the requirements of the following Industry Standards:

1. NFPA 90A
2. NFPA 101

D. Authorities Having Jurisdiction: Work performed on the project must comply with the requirements of the following AHJ's:

1. City of Portland Code Enforcement Officer.

2. City of Portland Water District.
3. State of Maine Fire Marshall.

1.8 DRAWINGS AND SPECIFICATIONS

- A. General: The drawings and specifications are complimentary.
 1. What is shown or noted on the drawings, but not mentioned in the specifications, automatically becomes a part of the specifications.
 2. What is noted in the specifications, but not shown on the drawings, automatically becomes a part of the drawings.
 3. Conflicts between the requirements of the drawings and the specifications must be brought to the immediate attention of the Architect/Engineer.
 - a. The more stringent requirement will apply, unless ruled otherwise by the Architect/Engineer.
 - b. When conflicts or discrepancies are noted, no work shall proceed until the conflict or discrepancy has been resolved by the Architect/Engineer.
- B. Mechanical Drawings and Division 23 Specification Sections: The Mechanical Contractor shall bear the responsibility of determining full extent of work required by Contract Documents. The Mechanical Contractor shall refer to site, architectural, structural, electrical and other Drawings and Specification Sections that indicate types of construction with which work of this Section must be coordinated. The Mechanical Contractor shall review the work with the General Contractor / Construction Manager to establish the extent of work for their trade, and to determine whether there will be any interference with the work of other trades. If the work is later found to include work required to complete and coordinate the work or another trade, or to interfere with the work of another trade then the changes required to complete the work or to eliminate the interference shall be made without additional cost to the Owner.
 1. The Drawings schematically indicate the order of connection of the various system components. Each and every nuance and detail in not indicated. Whether specifically shown or not, all items shall be connected in accordance with Code, the details provided, accepted trade practices, and the intent of the Contract Documents. Coordinate with the other trades.
- C. Exact locations of ceiling mounted items shall be as shown and detailed on the Architectural reflected ceiling plans.
- D. System components (thermostats, sensors, volume dampers, access doors, etc.) are identified throughout the Drawings for proper system operation. If any component is inadvertently omitted from the drawings, provide that component as per a similar location.

1.9 COORDINATION DRAWINGS

- A. General: Mechanical Contractor(s) to generate coordination drawings for the following portions of the facility:
 1. The entire second floor remodel.
- B. Prepare a set of drawings in conjunction with the Fire Protection Contractor. In the event that Plumbing and HVAC work is performed by separate Contractors, the HVAC Contractor shall

take the lead and initiate the generation of the drawings. Plumbing and Fire Protection work shall be subsequently applied to the drawings.

1. Drawings are intended to prevent installation conflicts.
 2. Drawings to indicate piping, ductwork, equipment and other system components in relation to each other, along with electrical fixtures, conduits, busses, cable trays, supports and structural members.
- C. Drawing Requirements: Drawings to be generated at 1/4-inch = 1-foot minimum scale and shall be ultimately delivered on reproducible media. Drawing size to be consistent with the SMRT design drawings.
1. Drawings to be CADD generated, in AutoCAD 2003 format on CD.

1.10 TRANSITIONS AND OFFSETS BEYOND THE SCOPE OF WORK

- A. Check drawings of other trades to verify spaces in which work will be installed. Establish exact locations of piping and ducts in such a manner as to conform to structure, avoid obstructions, and keep openings and passageways clear. Lines that must pitch, or that must have a constant elevation, shall have the right-of-way over lines not so restricted. Maintain maximum headroom. If space conditions appear inadequate, notify the A/E before proceeding with the work. Make reasonable modifications in the work without extra cost as needed to prevent conflict with work of other trades and for proper execution of the work.
- B. If the total additional weight of sheet metal or piping materials (including associated fittings, hangers, seismic restraints and insulation) required for ductwork transitions, ductwork offsets and piping offsets which are not indicated or inferred on the contract documents exceeds seven percent (7%) of the total weight of the ductwork or piping system, the amount exceeding this percentage may be considered to be beyond the requirements of these documents.
- C. In order for additional compensation to be considered for transitions and offsets in excess of the amount stated in Paragraph B above, the Contractor shall submit to the A/E a detailed take-off of all materials indicated on the contract documents. The Contractor shall also submit a separate take-off along with coordination drawings or marked-up contract drawings with yellow highlighting indicating specifically the transitions and offsets considered to be "extra work." Additional compensation will only be considered if take-offs and drawings are received by the A/E four weeks in advance of the fabrication of conflicting work in the area of concern so that the A/E may be able to determine ways to minimize or eliminate the extra work.

1.11 SUBSTITUTIONS

- A. General: See Division 1 for product substitution requirements.
1. No substitute materials or equipment shall be incorporated in the work without the written approval of the Architect/Engineer.
- B. Substitute materials and equipment submitted for approval must fit within the spaces available with neither substantial alteration nor increased pressure drops or friction losses.

- C. Approval of substitute materials or equipment by the Architect/Engineer shall not relieve the contractor from his responsibility to provide a complete and operational mechanical system.
- D. The Architect/Engineer's decision as to the equality or acceptability of proposed substitutions for the materials and equipment specified shall be final.
 - 1. Any additional costs incurred by such substitutions, including additional costs to other trades, or engineering design costs, shall be borne by the Contractor. This includes costs associated with the design and installation of infrastructure and support systems to facilitate a proposed substitution. This cost will be borne by the Mechanical Contractor.

1.12 SCHEDULE OF MECHANICAL SUBMITTALS AND CLOSEOUT PROCEDURES

- A. General: In conjunction with submittal scheduling requirements detailed in Section 013200, prepare a separate Schedule of Mechanical Submittals and Closeout Procedures.
- B. Schedule shall list the following information for each required submittal:
 - 1. Specification Section number and title.
 - 2. Product Name or Description of Work Covered.
 - 3. Submittal Tracking Number.
 - 4. Required submission relative to construction:
 - a. Pre-construction (prior to fabrication/installation of product).
 - b. During construction.
 - c. Post-construction.
 - 5. Submittal Status:
 - a. NC: Final Approval Not Complete
 - b. A: Approved.
 - 6. Owner Training: Indicate if Owner Training is required.
 - a. NC: Training not performed or not completed.
 - b. A: Approved/Training Completed.
 - 7. Spare Materials and Parts.

1.13 MECHANICAL SUBMITTALS

- A. General: Refer to Division 1 for submittal definitions, requirements and procedures.
- B. Submittal of shop drawings, certified performance data, and samples will be accepted only when submitted per Division 1. Data submitted from subcontractors and material suppliers directly to the Architect/Engineer will not be processed.
- C. Submittals for each mechanical trade shall be complete, including all items for which submission and approval is required, and each sheet containing performance data shall be clearly highlighted and marked for the appropriate model or type of equipment to be reviewed. Intended use shall be written on each submittal sheet for each different type of equipment or material to be reviewed (i.e. valves for domestic water or heating hot water, etc.). Incomplete or unmarked submittals WILL BE RETURNED to the Contractor without action.

- D. Submittals shall be organized by specification Section and shall be clearly labeled. Submittals for HVAC and Plumbing items covered by a “shared” Mechanical specification Section, (i.e., hangers and supports, insulation) shall be separate and clearly labeled as to the trade intended.
 - 1. Unclear and/or mixed submittals will not be processed.
- E. When two or more items of the same material or equipment are required, (i.e., plumbing fixtures, pumps, valves, air handling units, fans, diffusers, registers and grilles.) they shall be products of the same manufacturer insofar as possible.
 - 1. This does not apply to raw or bulk materials such as pipe and fittings, sheet metal, etc.

1.14 RECORD DOCUMENTS

- A. General: Refer to Division 1 for requirements.
- B. As work progresses, mark Drawings to indicate revisions to piping and ductwork, size and location including locations dampers and other control devices, filters, boxes and similar units requiring periodic maintenance or repair; actual equipment locations, dimensioned for column lines; mains and branches of piping systems, with valves and control devices located and numbered; Change Orders; concealed control system devices.
- C. Mark specifications to indicate approved substitutions; Change Orders; actual equipment and materials used.
- D. At completion of work and prior to final request for payment, the Mechanical Subcontractor(s) shall submit a complete set of reproducible record drawings showing all systems as actually installed. Drawings submitted shall be in the following format:
 - 1. Neatly hand marked up copies of SMRT design drawings.
 - 2. CADD generated.
 - a. SMRT design Drawing files may be available as a starting point for CADD generated drawings. A release form will need to be signed to facilitate this.
 - b. CADD generated drawings shall be ultimately delivered in AutoCAD 2003 format on CD.
 - 3. Valve Tags: Record drawings to include valve tag markers which correspond to the valve tag chart provided under the O&M Manual Section.

1.15 OPERATION AND MAINTENANCE, (O&M) MANUALS

- A. General: Refer to Division 1 for procedures and requirements for preparation and submittal of O&M Manuals.
- B. Table of Contents: Prepare Table of Contents of O&M Manual and submit in accordance with Section 1.4.
- C. Systems Descriptions: Provide description of function, normal operating characteristics and limitations, performance curves, engineering data and tests, and complete nomenclature and commercial numbers of all replaceable parts.

- D. Operating Procedures: Provide manufacturer's printed data, including start-up, break-in, routine and normal operating instructions; regulation control, stopping, shut-down, and emergency instructions; and summer and winter operating instructions.
- E. Maintenance Procedures: Provide for routine preventive maintenance and troubleshooting; disassembly, repair, and reassembly; aligning and adjusting instructions.
- F. Servicing Instructions: Provide instructions, lubrication charts and schedules.
- G. Product Data: Provide copies of all approved submittals.
- H. Valve Schedules: Include valve tag charts in the O&M Manuals. Valve tag charts are as per Section 230553, "Mechanical Identification."

1.16 OWNER TRAINING

- A. General: Refer to Division 1 for general requirements.

1.17 WARRANTIES

- A. Refer to Division 1 for project requirements for warranties. Individual warranties are required for each item of power driven or other mechanical equipment having moving parts, and wherever else specified in Division 23.
 - 1. Submit the warranties specified in Division 23 in a vinyl covered, three ring binder, tabulated and indexed for easy reference.
- B. Provide complete warranty information for each item, to include date of commencement; duration; and the names, addresses, and telephone numbers and procedures for filing claims and obtaining warranty services.
- C. Duration of warranties shall be not less than one year from the date of substantial completion of the facility unless prior approval has been granted in writing by the Architect/Engineer. If the manufacturer's warranty expires less than one year from the date of substantial completion, that warranty service and replacement of parts shall be provided by the mechanical subcontractor at no cost to the Owner.

1.18 DELIVERY, STORAGE AND HANDLING

- A. General: Refer to Division 1 for material procurement requirements.
- B. Deliver products to project properly identified with names, model numbers, types, grades, compliance labels, and similar information needed for distinct identifications; adequately packaged and protected to prevent damage during shipment, storage, and handling.
- C. Store equipment and materials at the site, unless off-site storage is authorized in writing. Protect stored equipment and materials from damage.

- D. Coordinate deliveries of mechanical materials and equipment to minimize construction site congestion. Limit each shipment of materials and equipment to the items and quantities needed for the smooth and efficient flow of installations.

1.19 ENERGY EFFICIENCY

- A. All equipment shall have minimum efficiency as described in ASHRAE Standard 90.1-1999, January 1, 1999 requirements. All equipment suppliers must be aware of the requirements and submitted equipment shall meet these minimum requirements.

1.20 REFRIGERANTS AND OTHER HAZARDOUS MATERIALS

- A. The Mechanical Contractor shall be responsible for the capture, removal, and disposal of materials resulting from the Work.
 - 1. Comply with the requirements of applicable Codes, Standards and Authorities.

1.21 DIVISION OF MECHANICAL AND ELECTRICAL RESPONSIBILITY

- A. General: Line voltage switches, fused switches, outlets, motor starters, power wiring and fuses necessary to connect and operate all electrically powered equipment specified herein will be furnished and installed as a part of the total project. Coordinate work with Division 26. The intent is to have a complete and operational system. The Mechanical Contractor shall be responsible for furnishing and installing the equipment necessary to provide for the complete and operational system.
- B. Motor Starters: Where not specified in Division 23, shall be furnished and installed under Division 16.
- C. Power Wiring: Wiring for equipment shall be furnished and installed as specified under Division 26.
- D. Temperature Control Wiring: Wiring and interlocks shall be furnished and installed under Division 23.
- E. Disconnect Switches: Where not specified in Division 23, shall be furnished and installed under Division 26.

1.22 TEMPORARY HEATING

- A. Refer to Division 1 requirements regarding temporary facilities during construction.
- B. The Mechanical Contractor shall provide necessary heating equipment, fuel sources, water treatment, and related items as necessary to meet the intent of the requirements.

PART 2 - PRODUCTS – NOT USED

PART 3 - EXECUTION

3.1 START UP AND TESTING

- A. General: Contractor shall provide all fuel for startup and testing of all equipment provided in this section. Refer to Division 1 for responsibility of electrical power.
- B. The Mechanical Contractor is responsible for startup of all equipment provided in Division 23 Sections.
- C. The Mechanical Contractor shall verify that systems are complete and operational before commencing with balancing work.
- D. Prior to balancing, ensure the following conditions:
 - 1. Systems are started and operating in a safe and normal condition.
 - 2. Temperature control systems are installed complete and operable.
 - 3. Proper thermal overload protection is in place for electrical equipment.
 - 4. Final filters are clean and in place.
 - 5. Duct systems are clean of debris.
 - 6. Fans and pumps are rotating correctly.
 - 7. Air outlets are installed and connected.
 - 8. Duct system leakage is minimized.
 - 9. Hydronic systems are flushed, filled and vented.
 - 10. Proper strainer baskets are cleaned and in place.
 - 11. Service and balance valves are open.
- E. Power Outage Test: Entire control system and all mechanical equipment shall be run through a simulated site power outage with emergency generator operation and shall regain standard operation sequences when normal power is restored.
- F. Owner Witness of Test: The Owner shall witness final power outage test. Entire control system and all mechanical equipment shall pass power outage test prior to Owner witness.

3.2 FUNCTIONAL TESTING

- A. General: The entirety of the Mechanical Equipment and Controls System shall be tested for functional performance for specified operation and control sequences.

3.3 FINAL CLEANING

- A. General: Refer to Division 1 for general requirements regarding final cleaning.
- B. Refer to Division 23 Section, "Testing, Adjusting and Balancing" for requirements of cleaning filters, strainers, and other mechanical systems prior to final acceptance.

END OF SECTION 230000

SECTION 230500

BASIC MECHANICAL MATERIALS AND METHODS

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. The requirements of Section 230000, "Basic Mechanical Requirements" apply to work defined by this Section.

1.2 SUMMARY

- A. This Section includes the following:
 - 1. Piping materials and installation instructions common to most piping systems.
 - 2. Transition fittings.
 - 3. Dielectric fittings.
 - 4. Mechanical sleeve seals.
 - 5. Sleeves.
 - 6. Escutcheons.
 - 7. Grout.
 - 8. Mechanical demolition.
 - 9. Equipment installation requirements common to equipment sections.
 - 10. Painting and finishing.
 - 11. Concrete bases.
 - 12. Supports and anchorages.
 - 13. Access panels and doors.
 - 14. Motors for Mechanical Equipment
 - 15. Roof mounted pipe stands.
- B. Related Sections include the following:
 - 1. Division 3 Section, "Cast-In-Place Concrete."
 - 2. Division 7 Section, "Firestopping."
 - 3. Division 8 Section, "Access Panels."
 - 4. Division 9 Section, "Painting."

1.3 DEFINITIONS

- A. Finished Spaces: Spaces other than mechanical and electrical equipment rooms, furred spaces, pipe and duct shafts, unheated spaces immediately below roof, spaces above ceilings, unexcavated spaces, crawlspaces, and tunnels.

- B. Exposed, Interior Installations: Exposed to view indoors. Examples include finished occupied spaces and mechanical equipment rooms.
- C. Exposed, Exterior Installations: Exposed to view outdoors or subject to outdoor ambient temperatures and weather conditions. Examples include rooftop locations.
- D. Concealed, Interior Installations: Concealed from view and protected from physical contact by building occupants. Examples include above ceilings and in duct shafts.
- E. Concealed, Exterior Installations: Concealed from view and protected from weather conditions and physical contact by building occupants but subject to outdoor ambient temperatures. Examples include installations within unheated shelters.
- F. The following are industry abbreviations for plastic materials:
 - 1. ABS: Acrylonitrile-butadiene-styrene plastic.
 - 2. CPVC: Chlorinated polyvinyl chloride plastic.
 - 3. PE: Polyethylene plastic.
 - 4. PVC: Polyvinyl chloride plastic.
- G. The following are industry abbreviations for rubber materials:
 - 1. EPDM: Ethylene-propylene-diene terpolymer rubber.
 - 2. NBR: Acrylonitrile-butadiene rubber.

1.4 SUBMITTALS

- A. General: See Division 1 for general submittal and product substitution requirements.
- B. Pre-Construction Submittals: Submit the following items prior to commencing with installations.
 - 1. Product Data: For transition fittings, dielectric fittings, mechanical sleeve seals, escutcheons.
 - 2. Welding certificates.

1.5 QUALITY ASSURANCE

- A. Steel Support Welding: Qualify processes and operators according to AWS D1.1, "Structural Welding Code--Steel."
- B. Steel Pipe Welding: Qualify processes and operators according to ASME Boiler and Pressure Vessel Code: Section IX, "Welding and Brazing Qualifications."
 - 1. Comply with provisions in ASME B31 Series, "Code for Pressure Piping."
 - 2. Certify that each welder has passed AWS qualification tests for welding processes involved and that certification is current.
- C. Electrical Characteristics for Mechanical Equipment: Equipment of higher electrical characteristics may be furnished provided such proposed equipment is approved in writing and connecting electrical services, circuit breakers, and conduit sizes are appropriately modified. If

minimum energy ratings or efficiencies are specified, equipment shall comply with requirements.

1.6 DELIVERY, STORAGE, AND HANDLING

- A. Deliver pipes and tubes with factory-applied end caps. Maintain end caps through shipping, storage, and handling to prevent pipe end damage and to prevent entrance of dirt, debris, and moisture.
- B. Store plastic pipes protected from direct sunlight. Support to prevent sagging and bending.

1.7 COORDINATION

- A. Arrange for pipe spaces, chases, slots, and openings in building structure during progress of construction, to allow for mechanical installations.
- B. Coordinate installation of required supporting devices and set sleeves in poured-in-place concrete and other structural components as they are constructed.
- C. Coordinate requirements for access panels and doors for mechanical items requiring access that are concealed behind finished surfaces. Access panels and doors are specified in Division 8 Section "Access Doors and Frames."
 - 1. Provide access panels per the requirements of Division 8 Sections. Installation of the panels to be as directed by the General Contractor / Construction Manager.
- D. Coordinate features of motors, installed units, and accessory devices. Provide motors that are:
 - 1. Designed and labeled for use with variable frequency controllers, and suitable for use throughout speed range without overheating.

PART 2 - PRODUCTS

2.1 MANUFACTURERS

- A. Manufacturers: Subject to compliance with requirements, provide products by one of the manufacturers listed below.
- B. AWWA Transition Couplings:
 - 1. Cascade Waterworks Mfg. Co.
 - 2. Dresser Industries, Inc.; DMD Div.
 - 3. Ford Meter Box Company, Incorporated (The); Pipe Products Div.
 - 4. JCM Industries.
 - 5. Smith-Blair, Inc.
 - 6. Viking Johnson.

- C. Plastic-to-Metal Transition Fittings:
 - 1. Eslon Thermoplastics.
- D. Plastic-to-Metal Transition Adaptors:
 - 1. Thompson Plastics, Inc.
- E. Plastic-to-Metal Transition Unions:
 - 1. NIBCO, Inc.
- F. Flexible Transition Couplings for Underground Non-pressure Drainage Piping:
 - 1. Cascade Waterworks Mfg. Co.
 - 2. Fernco, Inc.
 - 3. Mission Rubber Company.
 - 4. Plastic Oddities, Inc.
- G. Dielectric Unions:
 - 1. Capitol Manufacturing Co.
 - 2. Central Plastics Company.
 - 3. Eclipse, Inc.
 - 4. Epco Sales, Inc.
 - 5. Hart Industries, International, Inc.
 - 6. Watts Industries, Inc.; Water Products Div.
 - 7. Zurn Industries, Inc.; Wilkins Div.
- H. Dielectric Flanges:
 - 1. Capitol Manufacturing Co.
 - 2. Central Plastics Company.
 - 3. Epco Sales, Inc.
 - 4. Watts Industries, Inc.; Water Products Div.
- I. Dielectric Flange Kits:
 - 1. Advance Products & Systems, Inc.
 - 2. Calpico, Inc.
 - 3. Central Plastics Company.
 - 4. Pipeline Seal and Insulator, Inc.
- J. Dielectric Couplings:
 - 1. Calpico, Inc.
 - 2. Lochinvar Corp.
- K. Dielectric Nipples:
 - 1. Perfection Corp.
 - 2. Precision Plumbing Products, Inc.
 - 3. Sioux Chief Manufacturing Co., Inc.
 - 4. Victaulic Co. of America.
- L. Mechanical Sleeve Seals:
 - 1. Advance Products & Systems, Inc.
 - 2. Calpico, Inc.
 - 3. Metraflex Co.

4. Pipeline Seal and Insulator, Inc.
 5. Thunderline/Link-Seal
- M. Roof mounted pipe stands
1. Miro Industries, basis of design: Model 6-H
- 2.2 PIPE, TUBE, AND FITTINGS
- A. Refer to individual Division 23 piping Sections for pipe, tube, and fitting materials and joining methods.
- B. Pipe Threads: ASME B1.20.1 for factory-threaded pipe and pipe fittings.
- 2.3 JOINING MATERIALS
- A. Refer to individual Division 23 piping Sections for special joining materials not listed below.
- B. Pipe-Flange Gasket Materials: Suitable for chemical and thermal conditions of piping system contents.
1. ASME B16.21, nonmetallic, flat, asbestos-free, 1/8-inch maximum thickness unless thickness or specific material is indicated.
 - a. Full-Face Type: For flat-face, Class 125, cast-iron and cast-bronze flanges.
 - b. Narrow-Face Type: For raised-face, Class 250, cast-iron and steel flanges.
 2. AWWA C110, rubber, flat face, 1/8 inch thick, unless otherwise indicated; and full-face or ring type, unless otherwise indicated.
- C. Flange Bolts and Nuts: ASME B18.2.1, carbon steel, unless otherwise indicated.
- D. Plastic, Pipe-Flange Gasket, Bolts, and Nuts: Type and material recommended by piping system manufacturer, unless otherwise indicated.
- E. Solder Filler Metals: ASTM B 32, lead-free alloys. Include water-flushable flux according to ASTM B 813.
- F. Brazing Filler Metals: AWS A5.8, BCuP Series, copper-phosphorus alloys for general-duty brazing, unless otherwise indicated; and AWS A5.8, BAgl, silver alloy for refrigerant piping, unless otherwise indicated.
- G. Welding Filler Metals: Comply with AWS D10.12 for welding materials appropriate for wall thickness and chemical analysis of steel pipe being welded.
- H. Solvent Cements for Joining Plastic Piping:
1. ABS Piping: ASTM D 2235.
 2. CPVC Piping: ASTM F 493.
 3. PVC Piping: ASTM D 2564. Include primer according to ASTM F 656.

4. PVC to ABS Piping Transition: ASTM D 3138.

1. Fiberglass Pipe Adhesive: As furnished or recommended by pipe manufacturer.

2.4 TRANSITION FITTINGS

A. AWWA Transition Couplings: Same size as, and with pressure rating at least equal to and with ends compatible with, piping to be joined.

1. Underground Piping NPS 1-1/2 and Smaller: Manufactured fitting or coupling.
2. Underground Piping NPS 2 and Larger: AWWA C219, metal sleeve-type coupling.
3. Aboveground Pressure Piping: Pipe fitting.

B. Plastic-to-Metal Transition Fittings: One-piece fitting with manufacturer's Schedule 80 equivalent dimensions; one end with threaded brass insert, and one solvent-cement-joint end.

C. Plastic-to-Metal Transition Adaptors: One-piece fitting with manufacturer's SDR 11 equivalent dimensions; one end with threaded brass insert, and one solvent-cement-joint end.

D. Plastic-to-Metal Transition Unions: MSS SP-107, four-part union. Include brass end, solvent-cement-joint end, rubber O-ring, and union nut.

E. Flexible Transition Couplings for Underground Nonpressure Drainage Piping: ASTM C 1173 with elastomeric sleeve, ends same size as piping to be joined, and corrosion-resistant metal band on each end.

2.5 DIELECTRIC FITTINGS

A. Description: Combination fitting of copper alloy and ferrous materials with threaded, solder-joint, plain, or weld-neck end connections that match piping system materials.

B. Insulating Material: Suitable for system fluid, pressure, and temperature.

C. Dielectric Unions: Factory-fabricated, union assembly, for 250-psig minimum working pressure at 180 deg F.

D. Dielectric Flanges: Factory-fabricated, companion-flange assembly, for 150- or 300-psig minimum working pressure as required to suit system pressures.

E. Dielectric-Flange Kits: Companion-flange assembly for field assembly. Include flanges, full-face- or ring-type neoprene or phenolic gasket, phenolic or polyethylene bolt sleeves, phenolic washers, and steel backing washers.

1. Separate companion flanges and steel bolts and nuts shall have 150- or 300-psig minimum working pressure where required to suit system pressures.

F. Dielectric Couplings: Galvanized-steel coupling with inert and noncorrosive, thermoplastic lining; threaded ends; and 300-psig minimum working pressure at 225 deg F.

- G. Dielectric Nipples: Electroplated steel nipple with inert and noncorrosive, thermoplastic lining; plain, threaded, or grooved ends; and 300-psig minimum working pressure at 225 deg F.

2.6 MECHANICAL SLEEVE SEALS

- A. Description: Modular sealing element unit, designed for field assembly, to fill annular space between pipe and sleeve.
 - 1. Sealing Elements: EPDM interlocking links shaped to fit surface of pipe. Include type and number required for pipe material and size of pipe.
 - 2. Pressure Plates: Plastic, include two for each sealing element.
 - 3. Connecting Bolts and Nuts: Carbon steel with corrosion-resistant coating of length required to secure pressure plates to sealing elements. Include one for each sealing element.

2.7 SLEEVES

- A. Galvanized-Steel Sheet: 0.0239-inch minimum thickness; round tube closed with welded longitudinal joint.
- B. Steel Pipe: ASTM A 53, Type E, Grade B, Schedule 40, galvanized, plain ends.
- C. Cast Iron: Cast or fabricated "wall pipe" equivalent to ductile-iron pressure pipe, with plain ends and integral waterstop, unless otherwise indicated.
- D. Stack Sleeve Fittings: Manufactured, cast-iron sleeve with integral clamping flange. Include clamping ring and bolts and nuts for membrane flashing.
 - 1. Underdeck Clamp: Clamping ring with set screws.

2.8 ESCUTCHEONS

- A. Description: Manufactured wall and ceiling escutcheons and floor plates, with an ID to closely fit around pipe, tube, and insulation of insulated piping and an OD that completely covers opening. Escutcheon finishes to be as follows:
 - 1. Finished area, exposed to view: Polished chrome-plated.
 - 2. Unfinished areas: Rough brass or similar finish.
- B. One-Piece, Deep-Pattern Type: Deep-drawn, box-shaped brass.
- C. One-Piece, Cast-Brass Type: With set screw.
- D. Split-Casting, Cast-Brass Type: With concealed hinge and set screw.
- E. One-Piece, Stamped-Steel Type: With set screw or spring clips.
- F. Split-Plate, Stamped-Steel Type: With concealed hinge, set screw or spring clips.
- G. One-Piece, Floor-Plate Type: Cast-iron floor plate.

- H. Split-Casting, Floor-Plate Type: Cast brass with concealed hinge and set screw.

2.9 GROUT

- A. Description: ASTM C 1107, Grade B, non-shrink and non-metallic, dry hydraulic-cement grout.
 - 1. Characteristics: Post-hardening, volume-adjusting, non-staining, non-corrosive, nongaseous, and recommended for interior and exterior applications.
 - 2. Design Mix: 5000-psi, 28-day compressive strength.
 - 3. Packaging: Premixed and factory packaged.

2.10 ACCESS PANELS AND DOORS

- A. Panels and doors are to be furnished to provide access to items required in Division 23 Sections and the Mechanical Drawings. Panels and doors are to be furnished per the requirements of Division 8 Section, "Access Doors."

2.11 MOTORS FOR MECHANICAL EQUIPMENT

- A. Motor Characteristics:
 - 1. Motors 1/2 HP and Larger: Three phase.
 - 2. Motors Smaller Than 1/2 HP: Single phase.
 - 3. Frequency Rating: 60 Hz.
 - 4. Voltage Rating: NEMA standard voltage selected to operate on nominal circuit voltage to which motor is connected.
 - 5. Service Factor: 1.15 for open dripproof motors; 1.0 for totally enclosed motors.
 - 6. Duty: Continuous duty at ambient temperature of 105 deg F and at altitude of 3300 feet above sea level.
 - 7. 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.
 - 8. Enclosure: Open dripproof.

- B. Polyphase Motors:
 - 1. Description: NEMA MG 1, Design B, medium induction motor.
 - 2. Efficiency: Premium efficiency.
 - 3. Stator: Copper windings, unless otherwise indicated.
 - a. Multispeed motors shall have separate winding for each speed.
 - 4. Rotor: Squirrel cage, unless otherwise indicated.
 - 5. Bearings: Double-shielded, prelubricated ball bearings suitable for radial and thrust loading.
 - 6. Temperature Rise: Match insulation rating, unless otherwise indicated.
 - 7. Insulation: Class F, unless otherwise indicated.
 - 8. Code Letter Designation:

- a. Motors 15 HP and Larger: NEMA starting Code F or G.
 - b. Motors Smaller Than 15 HP: Manufacturer's standard starting characteristic.
 9. Enclosure: Cast iron for motors 7.5 hp and larger; rolled steel for motors smaller than 7.5 hp.
 - a. Finish: Gray enamel.
 - C. Polyphase Motors with Additional Requirements:
 1. Motors Used with Variable Frequency Controllers: Ratings, characteristics, and features coordinated with and approved by controller manufacturer.
 - a. Designed with critical vibration frequencies outside operating range of controller output.
 - b. Temperature Rise: Matched to rating for Class B insulation.
 - c. Insulation: Class H.
 - d. Thermal Protection: Comply with NEMA MG 1 requirements for thermally protected motors.
 - D. Single-Phase Motors:
 1. Type: One of the following, to suit starting torque and requirements of specific motor application:
 - a. Permanent-split capacitor.
 - b. Split-phase start, capacitor run.
 - c. Capacitor start, capacitor run.
 2. Shaded-Pole Motors: For motors 1/20 hp and smaller only.
 3. 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.
 4. Bearings: Ball type for belt-connected motors and other motors with high radial forces on motor shaft; sealed, prelubricated-sleeve type for other single-phase motors.
 5. Source Quality Control: Perform the following tests on each motor according to NEMA MG 1:
 - a. Measure winding resistance.
 - b. Read no-load current and speed at rated voltage and frequency.
 - c. Measure locked rotor current at rated frequency.
 - d. Perform high-potential test.
- 2.13 ROOF MOUNTED PIPE STANDS
- A. Provide clevis hanger pipe support hanger to support roof mounted HVAC piping. The pipe stand shall accommodate the pipe sizes as shown on the drawings.
 - B. Install the pipe stands per manufacturer's recommendations, but space no greater than 10 feet apart.
- 2.14 PIPE EXPANSION FITTINGS AND LOOPS
- A. Application: When the length of a piping run and the temperature range that the piping will experience will require expansion compensation refer to the ASHRAE 2000 Handbook –

HVAC Systems and Equipment and ASME B31.9 for the proper application of expansion compensation.

PART 3 - EXECUTION

3.1 CUTTING AND PATCHING

- A. Refer to Division 1 Sections "Cutting and Patching" and "Selective Demolition" for general demolition requirements and procedures.
- B. Refer to Division 26 for requirements for cutting and patching electrical equipment, components, and materials.
- C. Do not endanger or damage installed Work through procedures and processes of cutting and patching.
- D. Arrange for repairs required to restore other work, because of damage caused as a result of mechanical installations.
- E. No additional compensation will be authorized for cutting and patching work that is necessitated by ill-timed, defective, or non-conforming installations.
- F. Perform cutting, fitting, and patching of mechanical equipment and materials required to:
 - 1. Uncover Work to provide for installation of ill-timed Work.
 - 2. Remove and replace defective Work.
 - 3. Remove and replace Work not conforming to requirements of the Contract Documents.
 - 4. Remove samples of installed Work as specified for testing.
 - 5. Upon written instructions from the Architect/Engineer, uncover and restore Work to provide for Architect/Engineer observation of concealed Work.
- G. Protect the structure, furnishings, finishes, and adjacent materials not indicated or scheduled to be removed.
- H. Provide and maintain temporary partitions or dust barriers adequate to prevent the spread of dust and dirt to adjacent areas.

3.2 ROUGH-IN

- A. General: Verify final locations for rough-ins with field measurements and with the requirements of the actual equipment and fixtures to be connected. Refer to equipment and fixture specifications in Divisions 2 through 26, and to approved shop drawings, for rough-in requirements.

3.3 GENERAL INSTALLATION REQUIREMENTS

- A. General: Coordinate equipment and materials for installation with other building components.
- B. Verify dimensions by field measurements.
- C. Arrange for chases, slots, and openings in other building components to allow for mechanical installations.
- D. Coordinate the installation of required supporting devices.
 - 1. Support suspended equipment from walls or from structural frames. Do not support equipment from metal roof deck.
- E. Sequence, coordinate and integrate installations of mechanical materials and equipment for efficient flow of the work.
- F. Coordinate the cutting and patching of building components to accommodate the installation of mechanical equipment and materials. Refer to Division 1.
- G. Install mechanical equipment to facilitate maintenance and repair or replacement of equipment components. As much as practical, connect equipment for ease of disconnecting, with minimum of interference with other installations.
- H. Install access panels to allow access to equipment and other system components which require servicing or adjustment per the requirements of Division 8.
- I. Coordinate the installation of mechanical materials and equipment above ceilings with suspension system, lighting fixtures, and other installations.

3.4 PIPING SYSTEMS - COMMON REQUIREMENTS

- A. Install piping according to the following requirements and Division 23 Sections specifying piping systems.
- B. 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.
- 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 to permit valve servicing.
- G. Install piping at indicated slopes.

- H. Install piping free of sags and bends.
- I. Install fittings for changes in direction and branch connections.
- J. Install piping to allow application of insulation.
- K. Select system components with pressure rating equal to or greater than system operating pressure.
- L. Install escutcheons for penetrations of walls, ceilings, and floors according to the following. Use One-piece escutcheons wherever possible in new construction. Split-casting units acceptable for installation on existing piping systems.
 - 1. Piping with Fitting or Sleeve Protruding from Wall: Deep-pattern type.
 - 2. Chrome-Plated Piping: Cast-brass type with polished chrome-plated finish.
 - 3. Insulated Piping: Stamped-steel type with spring clips.
 - 4. Bare Piping at Wall and Floor Penetrations in Finished Spaces: Cast-brass type with polished chrome-plated finish.
 - 5. Bare Piping at Ceiling Penetrations in Finished Spaces: Cast-brass type with polished chrome-plated finish.
 - 6. Bare Piping in Unfinished Service Spaces and Equipment Rooms: Cast-brass type with rough-brass finish.
 - 7. Bare Piping at Floor Penetrations in Equipment Rooms: Floor-plate type.
- M. Sleeves are not required for core-drilled holes. When installing a pipe thru a core-drilled hole core drill the hole to provide for the 1" annular space around the pipe and use a mechanical sleeve seal as indicated in paragraphs O and P below.
- N. Install sleeves for pipes passing through concrete and masonry walls, gypsum-board partitions, and concrete floor and roof slabs.
 - 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. Extend cast-iron sleeve fittings below floor slab as required to secure clamping ring if ring is specified.
 - 2. Install sleeves in new walls and slabs as new walls and slabs are constructed.
 - 3. Install sleeves that are large enough to provide 1/4-inch annular clear space between sleeve and pipe or pipe insulation. Use the following sleeve materials:
 - a. Steel Pipe Sleeves: For pipes smaller than NPS 6.
 - b. Steel Sheet Sleeves: For pipes NPS 6 and larger, penetrating gypsum-board partitions.
 - c. Stack Sleeve Fittings: For pipes penetrating floors with membrane waterproofing. Secure flashing between clamping flanges. Install section of cast-iron soil pipe to extend sleeve to 2 inches above finished floor level. Refer to Division 7 Section "Sheet Metal Flashing and Trim" for flashing.
 - 1) Seal space outside of sleeve fittings with grout.
 - 4. Except for underground wall penetrations, seal annular space between sleeve and pipe or pipe insulation, using joint sealants appropriate for size, depth, and location of joint. Refer to Division 7 Section "Joint Sealants" for materials and installation.

- O. Aboveground, Exterior-Wall Pipe Penetrations: Seal penetrations using sleeves and mechanical sleeve seals. Select sleeve size to allow for 1-inch annular clear space between pipe and sleeve for installing mechanical sleeve seals.
 - 1. Install steel pipe for sleeves smaller than 6 inches in diameter.
 - 2. Install cast-iron "wall pipes" for sleeves 6 inches and larger in diameter.
 - 3. Mechanical Sleeve Seal Installation: Select type and number of sealing elements required for pipe material and size. Position pipe in center of sleeve. Assemble mechanical sleeve seals and install in annular space between pipe and sleeve. Tighten bolts against pressure plates that cause sealing elements to expand and make watertight seal.

- P. Underground, Exterior-Wall Pipe Penetrations: Install cast-iron "wall pipes" for sleeves. Seal pipe penetrations using mechanical sleeve seals. Select sleeve size to allow for 1-inch annular clear space between pipe and sleeve for installing mechanical sleeve seals.
 - 1. Mechanical Sleeve Seal Installation: Select type and number of sealing elements required for pipe material and size. Position pipe in center of sleeve. Assemble mechanical sleeve seals and install in annular space between pipe and sleeve. Tighten bolts against pressure plates that cause sealing elements to expand and make watertight seal.

- Q. Fire-Barrier Penetrations: Maintain indicated fire rating of walls, partitions, ceilings, and floors at pipe penetrations. Seal pipe penetrations with firestop materials. Refer to Division 7 Section "Through-Penetration Firestop Systems" for materials.

3.5 PIPING JOINT CONSTRUCTION

- A. Join pipe and fittings according to the following requirements and Division 23 Sections specifying piping systems.
- B. Ream ends of pipes and tubes and remove burrs. Bevel plain ends of steel pipe.
- C. Remove scale, slag, dirt, and debris from inside and outside of pipe and fittings before assembly.
- D. Soldered Joints: Apply ASTM B 813, water-flushable flux, unless otherwise indicated, to tube end. Construct joints according to ASTM B 828 or CDA's "Copper Tube Handbook," using lead-free solder alloy complying with ASTM B 32.
- E. Brazed Joints: Construct joints according to AWS's "Brazing Handbook," "Pipe and Tube" Chapter, using copper-phosphorus brazing filler metal complying with AWS A5.8.
- F. 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 unless dry seal threading is specified.
 - 2. Damaged Threads: Do not use pipe or pipe fittings with threads that are corroded or damaged. Do not use pipe sections that have cracked or open welds.

- G. Welded Joints: Construct joints according to AWS D10.12, using qualified processes and welding operators according to Part 1 "Quality Assurance" Article.
- H. Flanged Joints: Select appropriate gasket material, size, type, and thickness for service application. Install gasket concentrically positioned. Use suitable lubricants on bolt threads.
- I. Plastic 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. CPVC Piping: Join according to ASTM D 2846/D 2846M Appendix.
 - 4. PVC Pressure Piping: Join schedule number ASTM D 1785, PVC pipe and PVC socket fittings according to ASTM D 2672. Join other-than-schedule-number PVC pipe and socket fittings according to ASTM D 2855.
 - 5. PVC Nonpressure Piping: Join according to ASTM D 2855.
 - 6. PVC to ABS Nonpressure Transition Fittings: Join according to ASTM D 3138 Appendix.
- J. Plastic Pressure Piping Gasketed Joints: Join according to ASTM D 3139.
- K. Plastic Nonpressure Piping Gasketed Joints: Join according to ASTM D 3212.
- L. PE Piping Heat-Fusion Joints: Clean and dry joining surfaces by wiping with clean cloth or paper towels. Join according to ASTM D 2657.
 - 1. Plain-End Pipe and Fittings: Use butt fusion.
 - 2. Plain-End Pipe and Socket Fittings: Use socket fusion.
- M. Fiberglass Bonded Joints: Prepare pipe ends and fittings, apply adhesive, and join according to pipe manufacturer's written instructions.

3.6 PIPING CONNECTIONS

- A. Make connections according to the following, unless otherwise indicated:
 - 1. Install unions, in piping NPS 2 and smaller, adjacent to each valve and at final connection to each piece of equipment.
 - 2. Install flanges, in piping NPS 2-1/2 and larger, adjacent to flanged valves and at final connection to each piece of equipment.
 - 3. Dry Piping Systems: Install dielectric unions and flanges to connect piping materials of dissimilar metals.
 - 4. Wet Piping Systems: Install dielectric coupling and nipple fittings to connect piping materials of dissimilar metals.

3.7 EQUIPMENT INSTALLATION - COMMON REQUIREMENTS

- A. Install equipment to allow maximum possible headroom unless specific mounting heights are not indicated.
- B. Install equipment level and plumb, parallel and perpendicular to other building systems and components in exposed interior spaces, unless otherwise indicated.
- C. Install mechanical equipment to facilitate service, maintenance, and repair or replacement of components. Connect equipment for ease of disconnecting, with minimum interference to other installations. Extend grease fittings to accessible locations.
- D. Install equipment to allow right of way for piping installed at required slope.

3.8 CLEAN CONSTRUCTION MEASURES

- A. General: Take care during construction to maintain the integrity and cleanliness of duct, pipe and equipment systems.
- B. Ductwork must be capped during construction, dust and debris in ductwork is not acceptable. Interior of ductwork and air systems must be completely cleaned.
- C. Exposed ends of piping systems and equipment/fixture connection ports shall be capped, plugged, or otherwise covered during construction.

3.9 PAINTING

- A. Painting of mechanical systems, equipment, and components is specified in Division 9 Section "Painting."
- B. Damage and Touchup: Repair marred and damaged factory-painted finishes with materials and procedures to match original factory finish.

3.10 CONCRETE BASES

- A. Concrete Bases: Anchor equipment to concrete base according to equipment manufacturer's written instructions and according to seismic codes at Project.
 - 1. Construct concrete bases of dimensions indicated, but not less than 4 inches larger in both directions than supported unit.
 - 2. Install dowel rods to connect concrete base to concrete floor. Unless otherwise indicated, install dowel rods on 18-inch centers around the full perimeter of the base.
 - 3. Install epoxy-coated anchor bolts for supported equipment that extend through concrete base, and anchor into structural concrete floor.
 - 4. Place and secure anchorage devices. Use supported equipment manufacturer's setting drawings, templates, diagrams, instructions, and directions furnished with items to be embedded.
 - 5. Install anchor bolts to elevations required for proper attachment to supported equipment.
 - 6. Install anchor bolts according to anchor-bolt manufacturer's written instructions.

7. Use 3000-psi, 28-day compressive-strength concrete and reinforcement as specified in Division 3 Section "Cast-in-Place Concrete."

3.11 ERECTION OF METAL SUPPORTS AND ANCHORAGES

- A. Refer to Division 5 Section "Metal Fabrications" for structural steel.
- B. Cut, fit, and place miscellaneous metal supports accurately in location, alignment, and elevation to support and anchor mechanical materials and equipment.
- C. Field Welding: Comply with AWS D1.1.

3.12 ERECTION OF WOOD SUPPORTS AND ANCHORAGES

- A. Cut, fit, and place wood grounds, nailers, blocking, and anchorages to support, and anchor mechanical materials and equipment.
- B. Select fastener sizes that will not penetrate members if opposite side will be exposed to view or will receive finish materials. Tighten connections between members. Install fasteners without splitting wood members.
- C. Attach to substrates as required to support applied loads.

3.13 GROUTING

- A. Mix and install grout for mechanical equipment base bearing surfaces, pump and other equipment base plates, and anchors.
- B. Clean surfaces that will come into contact with grout.
- C. Provide forms as required for placement of grout.
- D. Avoid air entrapment during placement of grout.
- E. Place grout, completely filling equipment bases.
- F. Place grout on concrete bases and provide smooth bearing surface for equipment.
- G. Place grout around anchors.
- H. Cure placed grout.

END OF SECTION 230500

SECTION 230529

HANGERS AND SUPPORTS

PART 1 - 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. The requirements of Section 230000, "Basic Mechanical Requirements" apply to work defined by this Section.
- C. The requirements of Section 230500, "Basic Mechanical Materials and Methods" apply to work defined by this Section.

1.2 SUMMARY

- A. This Section includes hangers and supports for mechanical system piping and equipment.
- B. Related Sections include the following:
 - 1. Division 5 Section "Metal Fabrications" for materials for attaching hangers and supports to building structure.
 - 2. Division 21 Sections on fire-suppression piping for fire-suppression pipe hangers.
 - 3. Division 23 Section "Mechanical Vibration Controls and Seismic Restraints" for vibration isolation and seismic restraint devices.

1.3 DEFINITIONS

- A. MSS: Manufacturers Standardization Society for the Valve and Fittings Industry.
- B. Terminology: As defined in MSS SP-90, "Guidelines on Terminology for Pipe Hangers and Supports."

1.4 PERFORMANCE REQUIREMENTS

- A. Design channel support systems for piping to support multiple pipes capable of supporting combined weight of supported systems, system contents, and test water.
- B. Design heavy-duty steel trapezes for piping to support multiple pipes capable of supporting combined weight of supported systems, system contents, and test water.
- C. Design seismic restraint hangers and supports for piping and equipment.

- D. Design and obtain approval from authorities having jurisdiction for seismic restraint hangers and supports for piping and equipment.

1.5 SUBMITTALS

- A. Product Data: For each type of pipe hanger, channel support system component, and thermal-hanger shield insert indicated.
- B. Shop Drawings: Signed and sealed by a qualified professional engineer for multiple piping supports and trapeze hangers. Include design calculations and indicate size and characteristics of components and fabrication details.
- C. Welding Certificates: Copies of certificates for welding procedures and operators.

1.6 QUALITY ASSURANCE

- A. Welding: Qualify processes and operators according to ASME Boiler and Pressure Vessel Code: Section IX, "Welding and Brazing Qualifications."
- B. Engineering Responsibility: Design and preparation of Shop Drawings and calculations for each multiple pipe support and trapeze by a qualified professional engineer.
- C. Engineering Responsibility: Design and preparation of Shop Drawings and calculations for each multiple pipe support, trapeze, and seismic restraint by a qualified professional engineer.
 - 1. 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 hangers and supports that are similar to those indicated for this Project in material, design, and extent.

PART 2 - PRODUCTS

2.1 MANUFACTURERS

- 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. Pipe Hangers:
 - a. AAA Technology and Specialties Co., Inc.
 - b. B-Line Systems, Inc.
 - c. Carpenter & Patterson, Inc.
 - d. Empire Tool & Manufacturing Co., Inc.

- e. Globe Pipe Hanger Products, Inc.
- f. Grinnell Corp.
- g. GS Metals Corp.
- h. Michigan Hanger Co., Inc.
- i. National Pipe Hanger Corp.
- j. PHD Manufacturing, Inc.
- k. PHS Industries, Inc.
- l. Piping Technology & Products, Inc.

2. Channel Support Systems:

- a. B-Line Systems, Inc.
- b. Grinnell Corp.; Power-Strut Unit.
- c. GS Metals Corp.
- d. Michigan Hanger Co., Inc.; O-Strut Div.
- e. National Pipe Hanger Corp.
- f. Thomas & Betts Corp.
- g. Unistrut Corp.
- h. Wesanco, Inc.

3. Thermal-Hanger Shield Inserts:

- a. Carpenter & Patterson, Inc.
- b. Michigan Hanger Co., Inc.
- c. PHS Industries, Inc.
- d. Pipe Shields, Inc.
- e. Rilco Manufacturing Co., Inc.
- f. Value Engineered Products, Inc.

4. Powder-Actuated Fastener Systems:

- a. Gunnebo Fastening Corp.
- b. Hilti, Inc.
- c. ITW Ramset/Red Head.
- d. Masterset Fastening Systems, Inc.

2.2 MANUFACTURED UNITS

- A. Pipe Hangers, Supports, and Components: MSS SP-58, factory-fabricated components. Refer to "Hanger and Support Applications" Article in Part 3 for where to use specific hanger and support types.
 - 1. Galvanized, Metallic Coatings: For piping and equipment that will not have field-applied finish.
 - 2. Nonmetallic Coatings: On attachments for electrolytic protection where attachments are in direct contact with copper tubing.
- B. Channel Support Systems: MFMA-2, factory-fabricated components for field assembly.

1. Coatings: Manufacturer's standard finish, unless bare metal surfaces are indicated.
 2. Nonmetallic Coatings: On attachments for electrolytic protection where attachments are in direct contact with copper tubing.
- C. Thermal-Hanger Shield Inserts: 100-psi minimum compressive-strength insulation, encased in sheet metal shield.
1. Material for Cold Piping: ASTM C 552, Type I cellular glass or water-repellent-treated, ASTM C 533, Type I calcium silicate with vapor barrier.
 2. Material for Hot Piping: ASTM C 552, Type I cellular glass or water-repellent-treated, ASTM C 533, Type I calcium silicate.
 3. For Trapeze or Clamped System: Insert and shield cover entire circumference of pipe.
 4. For Clevis or Band Hanger: Insert and shield cover lower 180 degrees of pipe.
 5. Insert Length: Extend 2 inches beyond sheet metal shield for piping operating below ambient air temperature.

2.3 MISCELLANEOUS MATERIALS

- A. Powder-Actuated Drive-Pin Fasteners: Powder-actuated-type, drive-pin attachments with pull-out and shear capacities appropriate for supported loads and building materials where used.
- B. Mechanical-Anchor Fasteners: Insert-type attachments with pull-out and shear capacities appropriate for supported loads and building materials where used.
- C. Structural Steel: ASTM A 36/A 36M, steel plates, shapes, and bars, black and galvanized.
- D. Grout: ASTM C 1107, Grade B, factory-mixed and -packaged, nonshrink and nonmetallic, dry, hydraulic-cement grout.
1. Characteristics: Post hardening and volume adjusting; recommended for both interior and exterior applications.
 2. Properties: Nonstaining, noncorrosive, and nongaseous.
 3. Design Mix: 5000-psi, 28-day compressive strength.

PART 3 - EXECUTION

3.1 HANGER AND SUPPORT APPLICATIONS

- A. Specific hanger requirements are specified in Sections specifying equipment and systems.
- B. Comply with MSS SP-69 for pipe hanger selections and applications that are not specified in piping system Specification Sections.
- C. Horizontal-Piping Hangers and Supports: Unless otherwise indicated and except as specified in piping system Specification 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 120 to 450 deg F pipes, NPS 4 to NPS 16, 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 24, requiring clamp flexibility and up to 4 inches of insulation.
 4. Steel Pipe Clamps (MSS Type 4): For suspension of cold and hot pipes, NPS 1/2 to NPS 24, if little or no insulation is required.
 5. Pipe Hangers (MSS Type 5): For suspension of pipes, NPS 1/2 to NPS 4, to allow off-center closure for hanger installation before pipe erection.
 6. Adjustable Swivel Split- or Solid-Ring Hangers (MSS Type 6): For suspension of noninsulated stationary pipes, NPS 3/4 to NPS 8.
 7. Adjustable Steel Band Hangers (MSS Type 7): For suspension of noninsulated stationary pipes, NPS 1/2 to NPS 8.
 8. Adjustable Band Hangers (MSS Type 9): For suspension of noninsulated stationary pipes, NPS 1/2 to NPS 8.
 9. Adjustable Swivel-Ring Band Hangers (MSS Type 10): For suspension of noninsulated stationary pipes, NPS 1/2 to NPS 2.
 10. Split Pipe-Ring with or without Turnbuckle-Adjustment Hangers (MSS Type 11): For suspension of noninsulated stationary pipes, NPS 3/8 to NPS 8.
 11. Extension Hinged or Two-Bolt Split Pipe Clamps (MSS Type 12): For suspension of noninsulated stationary pipes, NPS 3/8 to NPS 3.
 12. U-Bolts (MSS Type 24): For support of heavy pipe, NPS 1/2 to NPS 30.
 13. Clips (MSS Type 26): For support of insulated pipes not subject to expansion or contraction.
 14. 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.
 15. 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 and with U-bolt to retain pipe.
 16. Adjustable Pipe Saddle Supports (MSS Type 38): For stanchion-type support for pipes, NPS 2-1/2 to NPS 36, if vertical adjustment is required, with steel pipe base stanchion support and cast-iron floor flange.
 17. 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.
 18. Adjustable Roller Hangers (MSS Type 43): For suspension of pipes, NPS 2-1/2 to NPS 20, from single rod if horizontal movement caused by expansion and contraction might occur.
 19. 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.
 20. Pipe Roll and Plate Units (MSS Type 45): For support of pipes, NPS 2 to NPS 24, if small horizontal movement caused by expansion and contraction might occur and vertical adjustment is not necessary.
 21. Adjustable Pipe Roll and Base Units (MSS Type 46): For support of pipes, NPS 2 to NPS 30, if vertical and lateral adjustment during installation might be required in addition to expansion and contraction.
- D. Vertical-Piping Clamps: Unless otherwise indicated and except as specified in piping system Specification Sections, install the following types:

1. Extension Pipe or Riser Clamps (MSS Type 8): For support of pipe risers, NPS 3/4 to NPS 20.
 2. Carbon- or Alloy-Steel Riser Clamps (MSS Type 42): For support of pipe risers, NPS 3/4 to NPS 20, if longer ends are required for riser clamps.
- E. Hanger-Rod Attachments: Unless otherwise indicated and except as specified in piping system Specification 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.
 3. Swivel Turnbuckles (MSS Type 15): For use with MSS Type 11, split pipe rings.
 4. Malleable-Iron Sockets (MSS Type 16): For attaching hanger rods to various types of building attachments.
 5. Steel Weldless Eye Nuts (MSS Type 17): For 120 to 450 deg F piping installations.
- F. Building Attachments: Unless otherwise indicated and except as specified in piping system Specification 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-joint 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. Top-Beam Clamps (MSS Type 25): For top of beams if hanger rod is required tangent to flange edge.
 8. Side-Beam Clamps (MSS Type 27): For bottom of steel I-beams.
 9. Steel-Beam Clamps with Eye Nuts (MSS Type 28): For attaching to bottom of steel I-beams for heavy loads.
 10. Linked-Steel Clamps with Eye Nuts (MSS Type 29): For attaching to bottom of steel I-beams for heavy loads, with link extensions.
 11. Malleable Beam Clamps with Extension Pieces (MSS Type 30): For attaching to structural steel.
 12. 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.
 13. Side-Beam Brackets (MSS Type 34): For sides of steel or wooden beams.
 14. Plate Lugs (MSS Type 57): For attaching to steel beams if flexibility at beam is required.
 15. Horizontal Travelers (MSS Type 58): For supporting piping systems subject to linear horizontal movement where headroom is limited.

- G. Saddles and Shields: Unless otherwise indicated and except as specified in piping system Specification 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 by manufacturer to prevent crushing insulation.
 3. Thermal-Hanger Shield Inserts: For supporting insulated pipe, 360-degree insert of high-density, 100-psi minimum compressive-strength, water-repellent-treated calcium silicate or cellular-glass pipe insulation, same thickness as adjoining insulation with vapor barrier and encased in 360-degree sheet metal shield.
- H. Spring Hangers and Supports: Unless otherwise indicated and except as specified in piping system Specification Sections, install the following types:
1. Restraint-Control Devices (MSS Type 47): Where indicated to control piping movement.
 2. Spring Cushions (MSS Type 48): For light loads if vertical movement does not exceed 1-1/4 inches.
 3. Spring-Cushion Roll Hangers (MSS Type 49): For equipping Type 41 roll hanger with springs.
 4. Spring Sway Braces (MSS Type 50): To retard sway, shock, vibration, or thermal expansion in piping systems.
 5. Variable-Spring Hangers (MSS Type 51): Preset to indicated load and limit variability factor to 25 percent to absorb expansion and contraction of piping system from hanger.
 6. Variable-Spring Base Supports (MSS Type 52): Preset to indicated load and limit variability factor to 25 percent to absorb expansion and contraction of piping system from base support.
 7. Variable-Spring Trapeze Hangers (MSS Type 53): Preset to indicated load and limit variability factor to 25 percent to absorb expansion and contraction of piping system from trapeze support.
 8. Constant Supports: For critical piping stress and if necessary to avoid transfer of stress from one support to another support, critical terminal, or connected equipment. Include auxiliary stops for erection, hydrostatic test, and load-adjustment capability. These supports include the following types:
 - a. Horizontal (MSS Type 54): Mounted horizontally.
 - b. Vertical (MSS Type 55): Mounted vertically.
 - c. Trapeze (MSS Type 56): Two vertical-type supports and one trapeze member.

3.2 HANGER AND SUPPORT INSTALLATION

- A. Pipe Hanger and Support Installation: Comply with MSS SP-69 and MSS SP-89. Install hangers, supports, clamps, and attachments as required to properly support piping from building structure.
- B. Channel Support System Installation: Arrange for grouping of parallel runs of piping and support together on field-assembled channel systems.
1. Field assemble and install according to manufacturer's written instructions.

- C. Heavy-Duty Steel Trapeze Installation: Arrange for grouping of parallel runs of horizontal piping and support together on field-fabricated, heavy-duty trapezes.
 - 1. Pipes of Various Sizes: Support together and space trapezes for smallest pipe size or install intermediate supports for smaller diameter pipes as specified above for individual pipe hangers.
 - 2. Field fabricate from ASTM A 36/A 36M, steel shapes selected for loads being supported. Weld steel according to AWS D-1.1.
- D. Install building attachments within concrete slabs or attach to structural steel. Space attachments within maximum piping span length indicated in MSS SP-69. Install additional attachments at concentrated loads, including valves, flanges, guides, strainers, and expansion joints, 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.
- E. Install powder-actuated drive-pin fasteners 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.
- F. Install mechanical-anchor fasteners in concrete after concrete is placed and completely cured. Install fasteners according to manufacturer's written instructions.
- G. Install hangers and supports complete with necessary inserts, bolts, rods, nuts, washers, and other accessories.
- 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. Load Distribution: Install hangers and supports so that piping live and dead loads and stresses from movement will not be transmitted to connected equipment.
- J. Pipe Slopes: Install hangers and supports to provide indicated pipe slopes and so maximum pipe deflections allowed by ASME B31.9, "Building Services Piping," is not exceeded.
- K. Insulated Piping: Comply with the following:
 - 1. Attach clamps and spacers to piping.
 - a. Use thermal-hanger shield insert with clamp sized to match OD of insert.
 - b. Do not exceed pipe stress limits according to ASME B31.9.
 - 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 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.
5. Insert Material: Length at least as long as protective shield.
6. Thermal-Hanger Shields: Install with insulation same thickness as piping insulation.

3.3 EQUIPMENT SUPPORTS

- A. Fabricate structural-steel stands to suspend equipment from structure above or to support equipment above floor.
- B. Grouting: Place grout under supports for equipment and make smooth bearing surface.

3.4 METAL FABRICATION

- A. Cut, drill, and fit miscellaneous metal fabrications for heavy-duty steel trapezes 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 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 contours of welded surfaces match adjacent contours.

3.5 ADJUSTING

- A. Hanger Adjustment: Adjust hangers to distribute loads equally on attachments and to achieve indicated slope of pipe.

3.6 PAINTING

- A. Touching Up: 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. Touching Up: Cleaning and touchup painting of field welds, bolted connections, and abraded areas of shop paint on miscellaneous metal are specified in Division 9 Section "Painting."
- C. Galvanized Surfaces: Clean welds, bolted connections, and abraded areas and apply galvanizing-repair paint to comply with ASTM A 780.

END OF SECTION 230529

SECTION 230548

MECHANICAL VIBRATION AND SEISMIC CONTROLS

PART 1 - 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. The requirements of Section 230000, "Basic Mechanical Requirements" apply to work defined by the Section.
- C. The requirements of Section 230500, "Basic Mechanical Materials and Methods" apply to work defined by the Section.

1.2 SUMMARY

- A. This Section includes the following:
 - 1. Vibration Isolators.
 - 2. Duct and Pipe Isolators.
 - 3. Roof Curb Rails.
 - 4. Vibration Isolation Equipment Bases.
 - 5. Seismic Restraint Devices.
- B. Related Sections include the following:
 - 1. Section 230500, "Basic Mechanical Materials and Methods" for thermal expansion compensation in piping systems.
 - 2. Section 230529, "Hangers and Supports" for piping, duct, and equipment hangers and supports as well as requirements for strut components.

1.3 DEFINITIONS

- A. A_v : Effective peak velocity related acceleration coefficient.
- B. OSHPD: Office of Statewide Health Planning & Development for the State of California. OSHPD assigns a unique anchorage preapproval "R" number to each seismic restraint it tests. The number describes a specific device applied as tested.
- C. Withstand: The term "withstand" means "the unit will remain in place without separation of any parts from the device when subjected to the seismic forces specified."
- D. Withstand: The term "withstand" means "the unit will remain in place without separation of any parts from the device when subjected to the seismic forces specified and the unit will be fully operational after the seismic event."

1.4 PERFORMANCE REQUIREMENTS

- A. Applicable Code: International Building Code 2006.
- B. General: Performance requirements to be used in the design of seismic controls shall use design forces calculated as follows:
 - 1. Seismic Design Category: B
 - 2. Seismic Hazard Use Group: I
 - 3. Building Seismic Importance Factor (I_e): 1.00
 - 4. Refer to structural drawing SG001 for additional seismic information.
- C. Applicability: Seismic controls are required on Mechanical systems.
 - 1. See Part 3 paragraph, "Seismic Controls Installation" for exceptions.

1.5 SUBMITTALS

- A. General: See Division 1 for general submittal and product substitution requirements.
- B. Pre-Construction Submittals: Submit the following items prior to commencing with installations.
 - 1. Product Data: Include load deflection curves for each vibration isolation device.
 - 2. Shop Drawings: Signed and sealed by a qualified professional engineer where required by applicable Code. Include the following:
 - a. Design Calculations: Calculate requirements for selecting vibration isolators and seismic restraints and for designing vibration isolation bases.
 - b. Riser Supports: Include riser diagrams and calculations showing anticipated expansion and contraction at each support point, initial and final loads on building structure, spring deflection changes, and seismic loads. Include certification that riser system has been examined for excessive stress and that none will exist.
 - c. Vibration Isolation Base Details: Detail fabrication, including anchorages and attachments to structure and to supported equipment. Include auxiliary motor slides and rails, base weights, equipment static loads, power transmission, component misalignment, and cantilever loads.
 - d. Seismic-Restraint Details: Detail fabrication and attachment of seismic restraints and snubbers. Show anchorage details and indicate quantity, diameter, and depth of penetration of anchors.
 - e. Submittals for Interlocking Snubbers: Include load deflection curves up to 1/2-inch deflection in x, y, and z planes.
 - 3. Welding certificates.
 - 4. Manufacturer Seismic Qualification Certification: Submit certification that all specified equipment will withstand seismic forces identified in "Performance Requirements" Article above. Include the following:
 - a. Basis for Certification: Indicate whether withstand certification is based on actual test of assembled components or on calculations.
 - b. Dimensioned Outline Drawings of Equipment Unit: Identify center of gravity and locate and describe mounting and anchorage provisions.
 - c. Detailed description of equipment anchorage devices on which the certification is based and their installation requirements.

1.6 QUALITY ASSURANCE

- A. Seismic-restraint devices shall have horizontal and vertical load testing and analysis performed according to OSHPD and shall bear anchorage pre-approval "R" number, from OSHPD or another agency acceptable to authorities having jurisdiction, showing maximum seismic-restraint ratings. Ratings based on independent testing are preferred to ratings based on calculations. If pre-approved ratings are not available, submittals based on independent testing are preferred. Calculations (including combining shear and tensile loads) to support seismic-restraint designs must be signed and sealed by a qualified professional engineer. Testing and calculations must include both shear and tensile loads and 1 test or analysis at 45 degrees to the weakest mode.
- B. Welding: Qualify procedures and personnel according to AWS D1.1, "Structural Welding Code--Steel."

1.7 COORDINATION

- A. Coordinate size and location of concrete bases. Cast anchor-bolt inserts into base. Concrete, reinforcement, and formwork requirements are specified in Division 3.
- B. Coordinate installation of roof curbs, equipment supports, and roof penetrations. These items are specified in Division 7 Section "Roof Accessories."

PART 2 - PRODUCTS

2.1 MANUFACTURERS

- A. Manufacturers: Subject to compliance with requirements, provide products by one of the manufacturers listed below.
- B. Vibration Isolators:
 - 1. Ace Mounting Co., Inc.
 - 2. Amber/Booth Company, Inc.
 - 3. B-Line Systems, Inc.
 - 4. Isolation Technology, Inc.
 - 5. Kinetics Noise Control, Inc.
 - 6. Mason Industries, Inc.
 - 7. Vibration Mountings & Controls/Korfund.
- C. Duct and Pipe Vibration Isolators
 - 1. Mason Industries, Inc.
 - 2. Mason-Mercer, (Mason Industries, Inc. – Mercer Rubber Co.)
 - 3. The Metraflex Co.
 - 4. Amber/Booth Company, Inc.
- D. Vibration Isolation Roof Curb Rails:
 - 1. Amber/Booth Company, Inc.

2. Isolation Technology, Inc.
 3. Kinetics Noise Control, Inc.
 4. Mason Industries, Inc.
 5. Vibration Mountings & Controls/Korfund.
- E. Vibration Isolation Equipment Bases:
1. Amber/Booth Company, Inc.
 2. Isolation Technology, Inc.
 3. Kinetics Noise Control, Inc.
 4. Mason Industries, Inc.
 5. Vibration Mountings & Controls/Korfund.
- F. Seismic Restraint Devices:
1. Amber/Booth Company, Inc.
 2. B-Line Systems, Inc.
 3. Kinetics Noise Control, Inc.
 4. Loos & Co., Inc.; Cableware Technology Division.
 5. Mason Industries, Inc.
 6. TOLCO Incorporated.
 7. Unistrut Diversified Products Co.; Wayne Manufacturing Division.
 8. Vibration Mountings & Controls/Korfund.

2.2 VIBRATION ISOLATORS

- A. General: The following applies to items specified in the paragraphs below.
1. Minimum static deflections are identified in the schedule at the end of Part 3.
 2. Vibration Isolators which have a seismic function as well, (those which incorporate limit stops and/or snubbers) shall not be constructed of aluminum or cast iron materials.
- B. Elastomeric Grommet, (Bushing): Oil- and water-resistant elastomer, bolt-isolating bushing.
1. Material: Bridge Bearing Neoprene.
 2. Basis of Design: Mason Industries, Inc. Type HG.
- C. Elastomeric Isolator Pads: Oil- and water-resistant elastomer, arranged in single or multiple layers, molded with a non-slip pattern, factory cut to sizes that match requirements of supported equipment.
1. Material: Standard neoprene.
 2. Shims, (between multiple layers): 16 ga. Steel.
 3. Basis of Design: Mason Industries, Inc. Types W, SW & layered combinations thereof.
- D. Elastomeric Isolator Pads & Plates: Oil- and water-resistant elastomer, arranged in single or multiple layers, molded with a non-slip pattern and galvanized steel baseplates of sufficient stiffness for uniform loading over pad area, and factory cut to sizes that match requirements of supported equipment.
1. Material: Standard neoprene or bridge-bearing neoprene, complying with AASHTO M 251.
 2. Shims, (between multiple layers): 16 ga. Steel.
 3. Basis of Design: Mason Industries, Inc. Type SWM & layered combinations thereof.

- E. Elastomeric Mounts (Mason Spec. A): Double-deflection type, with molded, oil-resistant neoprene isolator elements with factory-drilled, encapsulated top plate for bolting to equipment and with baseplate for bolting to structure. Color-code or otherwise identify to indicate capacity range.
 - 1. Vibration Isolating Material: Neoprene.
 - 2. Basis of Design: Mason Industries, Inc. Type ND.

- F. Restrained Elastomeric Mounts: All-directional elastomeric mountings with seismic restraint.
 - 1. Materials: Cast-ductile-iron housing containing two separate and opposing, molded, bridge-bearing neoprene elements that prevent central threaded sleeve and attachment bolt from contacting the casting during normal operation.
 - 2. Shock-absorbing materials: Neoprene.
 - 3. Basis of Design: Mason Industries, Inc. Type BR.

- G. Spring Isolators (Mason Spec. B): Freestanding, laterally stable, open-spring isolators.
 - 1. Outside Spring Diameter: Not less than 80 percent of the compressed height of the spring at rated load.
 - 2. Minimum Additional Travel: 50 percent of the required deflection at rated load.
 - 3. Lateral Stiffness: More than 80 percent of the rated vertical stiffness.
 - 4. Overload Capacity: Support 200 percent of rated load, fully compressed, without deformation or failure.
 - 5. Baseplates: Factory drilled for bolting to structure and bonded to 1/4-inch- thick, elastomeric isolator pad attached to baseplate underside. Baseplates shall limit floor load to 100 psig.
 - 6. Top Plate and Adjustment Bolt: Threaded top plate with adjustment bolt and cap screw to fasten and level equipment.
 - 7. Basis of Design: Mason Industries, Inc. Type SFLH.

- H. Restrained Spring Isolators (Mason Spec. D): Freestanding, steel, open-spring isolators with seismic restraint.
 - 1. Housing: Steel with resilient vertical-limit stops to prevent spring extension due to wind loads or if weight is removed; factory-drilled baseplate bonded to 1/4-inch- thick, elastomeric isolator pad attached to baseplate underside; and adjustable equipment mounting and leveling bolt that acts as blocking during installation.
 - 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 the rated vertical stiffness.
 - 5. Overload Capacity: Support 200 percent of rated load, fully compressed, without deformation or failure.
 - 6. Basis of Design: Mason Industries, Inc. Type SLR.

- I. Housed Spring Isolators: Housed spring isolator with integral seismic snubbers.
 - 1. Housing: Ductile-iron or steel housing to provide all-directional seismic restraint.
 - 2. Base: Factory drilled for bolting to structure.

3. Snubbers: Vertically adjustable to allow a maximum of 1/4-inch travel before contacting a resilient collar.
 4. Basis of Design: Mason Industries, Inc. Type SSLFH.
- J. Elastomeric Hangers: Double-deflection type, with molded, oil-resistant rubber or neoprene isolator elements bonded to steel housings with threaded connections for hanger rods. Color-code or otherwise identify to indicate capacity range.
1. Basis of Design: Mason Industries, Inc. Type HD & WHD.
- K. Spring Hangers (Mason Spec. F): Combination coil-spring and elastomeric-insert hanger with spring and insert in compression.
1. 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.
 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 the rated vertical stiffness.
 5. Overload Capacity: Support 200 percent of rated load, fully compressed, without deformation or failure.
 6. Elastomeric Element: Molded, oil-resistant rubber or neoprene. Steel-washer-reinforced cup to support spring and bushing projecting through bottom of frame.
 7. Basis of Design: Mason Industries, Inc. Type 30N.
- L. Spring Hangers with Vertical-Limit Stop (Mason Specs. G & H): Combination coil-spring and elastomeric-insert hanger with spring and insert in compression and with a vertical-limit stop.
1. 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.
 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 the rated vertical stiffness.
 5. Overload Capacity: Support 200 percent of rated load, fully compressed, without deformation or failure.
 6. Elastomeric Element: Molded, oil-resistant neoprene.
 7. Adjustable Vertical Stop: Steel washer with neoprene washer "up-stop" on lower threaded rod.
 8. Basis of Design: Mason Industries, Inc. Type PC30N.

2.3 DUCT AND PIPE ISOLATORS

- A. General: Hanger isolators listed in above are applicable to duct and piping applications as well as suspended equipment. Additionally, items identified below are specific to duct and piping installations.

- B. Thrust Limits (Mason Spec. I): Combination coil spring and elastomeric insert with spring and insert in tension, and with a load stop. Include rod and angle-iron brackets for attaching to equipment.
1. Frame: Steel, fabricated for connection to threaded rods and to allow for a maximum of 30 degrees of angular rod misalignment without binding or reducing isolation efficiency.
 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 the rated vertical stiffness.
 5. Overload Capacity: Support 200 percent of rated load, fully compressed, without deformation or failure.
 6. Elastomeric Element: Molded, oil-resistant neoprene.
 7. Coil Spring: Factory set and field adjustable for a maximum of 1/4-inch movement at start and stop.
 8. Basis of Design: Mason Industries, Inc. Types WBD.
- C. Pipe Riser Resilient Support (Mason Spec. R): All-directional, acoustical pipe anchor consisting of 2 steel tubes separated by a minimum of 1/2-inch- thick, 60-durometer neoprene. Include steel and neoprene vertical-limit stops arranged to prevent vertical travel in both directions. Design support for a maximum load on the isolation material of 500 psig and for equal resistance in all directions.
1. Basis of Design: Mason Industries, Inc. Type ADAH.
- D. Resilient Pipe Guides (Mason Spec. S): Telescopic arrangement of 2 steel tubes separated by a minimum of 1/2-inch- thick, 60-durometer neoprene. Factory set guide height with a shear pin to allow vertical motion due to pipe expansion and contraction. Shear pin shall be removable and reinsertable to allow for selection of pipe movement. Guides shall be capable of motion to meet location requirements.
1. Basis of Design: Mason Industries, Inc. Type VSGH.
- E. Acoustical Wall, Ceiling or Floor Seal (Mason Spec Q): Split steel sleeve held in place by stainless steel band clamps. Isolating material between sleeve and service pipe to be closed cell neoprene sponge.
1. Basis of Design: Mason Industries, Inc. Type SWS.
 2. Acceptable Option: Field fabricated seals consisting of sheet metal sleeve, stainless steel band clamps, and mineral wool or fiberglass isolating packing.
 - a. Seal ends of wool with silicone sealant.
- F. Molded Rubber Pipe Expansion Joint (Mason Spec. O): Double sphere shaped with steel flanged end connections; peroxide or sulfur cured EPDM cover, reinforced with multiple layers of Kevlar or nylon cord; molded reinforcing ring. Unit to be designed to allow for tensile, compressive, angular and transverse movement. Units to be rated for minimum continuing operating pressures of 250psig at 170°F and 215 psig at 250°F.
1. Control Rods: Rods or cables and associated hardware as recommended by unit manufacturer.
 2. Basis of Design: Mason Industries, Inc. – Mercer Rubber Co. Type SFDEJ.
- G. Stainless Steel Hose (Mason Spec. P): Type 321 corrugated stainless steel hose with overbraid; Male NPT ends for 2-inch and smaller, 150# flanged for 2-1/2-inch and larger.

1. Basis of Design: Mercer Rubber Co. Type BSS-GU-MN & BSS-GU-RF-150.
 2. Acceptable Option: Bronze corrugated hose with overbraid; for use with copper piping systems; soldered ends.
 - a. Basis of Design: Mercer Rubber Co. Type BBF.
- H. Molded Rubber Duct Expansion Joint: Flexible duct connectors constructed of natural rubber or synthetic liner, nylon or steel reinforced as necessary to meet operating pressures and/or vacuum conditions; 304 stainless steel bands or flanged end connections.
1. Basis of Design: Mercer Rubber Co. Duct Type Expansion Joints.
 2. Acceptable Option: Expansion Joints fabricated by the ductwork supplier as acceptable pending performance standards are equal to Basis of Design.

2.4 SEISMIC-RESTRAINT DEVICES

- A. General: Certain items identified in paragraphs above have seismic control capabilities in addition to vibration isolation, (duct thrust restraints, restrained mounts and springs, etc.). The items identified in the following paragraphs are components specific to seismic control.
1. Base Mounted Equipment: Items identified above and herein comprise restraint systems for base mounted equipment.
 2. Suspended Equipment, Piping and Ductwork Restraint Systems: Restraint systems for these items shall consist of tension and compression, (strut) components, or tension only, (cable) components. In either case, provide necessary ancillary appurtenances as required to meet seismic restrain design criteria. Each and every component is not identified herein.
 - a. Systems and their components shall be provided by a single manufacturer.
 - b. Components shall be intended and listed for use with each other, (do not mix and match components not intended for use with each other).
 - c. Systems may include:
 - 1) Attachments to structure.
 - 2) Braces and other means of augmenting standard hanger and support assemblies.
 - 3) Threaded rod stiffeners.
 - d. Restraint devices constructed of aluminum or cast iron materials are not acceptable.
- B. Strut Restraint Systems: Strut components, (channel support systems) are as identified in Section 230529, "Hangers and Supports."
1. Basis of Design: As manufactured by B-Line Systems, Inc.
- C. Restraining Cable Systems: Galvanized steel aircraft cables with end connections made of steel assemblies that swivel to final installation angle and utilize two clamping bolts for cable engagement.
1. Basis of Design: As manufactured by Mason Industries, Inc.
- D. Resilient Isolation Washers and Bushings: 1-piece, molded, bridge-bearing neoprene complying with AASHTO M 251, with a flat washer face.
1. Basis of Design: Mason Industries, Inc. Types PB & HG.

- E. Seismic Snubbers: Factory fabricated using welded structural-steel shapes and plates, anchor bolts, and replaceable resilient isolation washers and bushings.
 - 1. Anchor bolts for attaching to concrete shall be seismic-rated, drill-in, and stud-wedge or female-wedge type.
 - 2. Resilient Isolation Washers and Bushings: 1-piece, molded, bridge-bearing neoprene complying with AASHTO M 251.
 - 3. Basis of Design: Mason Industries, Inc. Types Z-1225 & Z-1011.
- F. Anchor Bolts: Seismic-rated, drill-in, and stud-wedge or female-wedge type. Select anchor bolts with strength required for anchor and as tested according to ASTM E 488/E 488M.
 - 1. Basis of Design: Mason Industries, Inc. Types SAS & SAB.

2.5 FACTORY FINISHES

- A. Manufacturer's standard prime-coat finish ready for field painting.
- B. Finish: Manufacturer's standard paint applied to factory-assembled and -tested equipment before shipping.
 - 1. Powder coating on springs and housings.
 - 2. All hardware shall be electro-galvanized. Hot-dip galvanize metal components for exterior use.
 - 3. Baked enamel for metal components on isolators for interior use.
 - 4. Color-code or otherwise mark vibration isolation and seismic-control devices to indicate capacity range.

PART 3 - EXECUTION

3.1 EQUIPMENT VIBRATION ISOLATOR APPLICATION

- A. General: Provide vibration isolation in accordance with the schedule at the end of this Section.
 - 1. Exception: See Section 230548 for isolators to be furnished directly with roof mounted equipment.
 - 2. Seismic Controls: Vibration isolators identified in the schedule at the end of this Section may include limit stops which serve seismic functions. Where additional, or independent snubbers and restraints are required, these items are identified in the schedule.

3.2 EXAMINATION

- A. Examine areas and equipment to receive vibration isolation and seismic-control devices for compliance with requirements, installation tolerances, and other conditions affecting performance.
- B. Examine roughing-in of reinforcement and cast-in-place anchors to verify actual locations before installation.
- C. Proceed with installation only after unsatisfactory conditions have been corrected.

3.3 EQUIPMENT INSTALLATION, GENERAL

- A. Install roof curbs, equipment supports, and roof penetrations as specified in Division 7 Section "Roof Accessories."
- B. Base mounted equipment / isolation assemblies to be secured to structure. "Free floating" equipment is not acceptable.
 - 1. Install resilient bolt isolation washers on equipment anchor bolts.
- C. Fill concrete inertia bases, after installing base frame, with 3000-psi concrete; trowel to a smooth finish.
 - 1. Cast-in-place concrete materials and placement requirements are specified in Division 3.
- D. Concrete Bases: Anchor equipment to concrete base according to supported equipment manufacturer's written instructions for seismic codes at Project site.
- E. Support Equipment: Install isolators on support equipment that is part of an isolated system. "Isolated systems" are identified by whether or not a major piece of system equipment is isolated in the schedule at the end of this Section.
 - 1. Base Mounted Support Equipment: Types W, SW & SWM, (match major equipment type).
 - 2. Suspended Support Equipment: Types HD & WHD.

3.4 DUCT AND PIPING SYSTEMS INSTALLATION

- A. General: Piping and ductwork systems shall be supported in accordance with their respective Sections as well as the requirements of Section 230529, "Hangers and Supports." In addition to those requirements, described herein are requirements to address vibration and seismic forces.
- B. Connections to Equipment, General: Piping and Duct connections to isolated pieces of Mechanical equipment shall include the following means of limiting vibration transmissions to the piping and ductwork.
 - 1. Equipment Connections: Install duct and pipe isolators at the inlet and outlet connections to each piece of isolated equipment. Exact locations of isolators as detailed on the Drawings.
 - a. Types SFDEJ, BSS-GU-MN, BSS-GU-RF-150, BBF & Duct Type.
 - 2. Suspended Piping and Ductwork Either Side: Isolate pipe and duct runs leading to and/or away from each piece of isolated equipment for a distance of 50 feet. Pipe and duct support isolator types to match those used on the isolated equipment. Minimum static deflection to be one-half that of the equipment isolator.
 - a. Ducts and pipes serving equipment isolated by elastomeric pads or mounts;
 - 1) Seismic & Non Seismic Applications: Types HD & WHD.
 - b. Ducts and pipes serving equipment isolated by springs;
 - 1) Seismic Application: Type PC30N.
 - 2) Non-Seismic Application: Type 30N.
 - 3. Wall, Floor and Hard Ceiling Penetrations: Where services leading to and/or away from isolated equipment penetrate walls, floors and/or hard ceilings within 50 feet of the equipment, the wall and/or floor penetrations shall be acoustically isolated.
 - a. Type SWS.

- 1) Exception: Where walls and/or floors penetrated are fire rated, provide a sleeve and appropriate fire stopping in lieu of this acoustical isolator. Fire Stopping is specified in Division 7.
 4. Riser Isolation: Isolation of vertical riser-through-floor penetrations within 50 feet of isolated equipment shall be accomplished via using pairs of isolators which transmit riser load from a heavy duty riser clamp, (welded to the pipe) or welded attachments.
 - a. Risers servicing equipment isolated by elastomeric pads or mounts;
 - 1) Types W & SW with a steel plate between the isolator and riser clamp.
 - b. Risers servicing equipment isolated by springs;
 - 1) Type SLR.
 5. Base of Riser and Horizontal Floor Supported Services: Isolation of floor supported piping and ductwork within 50 feet of isolated equipment shall be accomplished via using pairs of isolators which transmit load from a service –supporting cross member. Pipe and duct support isolator types to match those used on the isolated equipment. Minimum static deflection to also match that of the equipment isolator.
 - a. Ducts and pipes serving equipment isolated by elastomeric pads or mounts;
 - 1) Types HD & WHD.
 - b. Ducts and pipes serving equipment isolated by springs;
 - 1) Type SLR.
- C. Common Support Requirements: Where piping is intended to be installed on a common, (trapeze) rack, the following shall apply;
1. Do not install isolated and non-isolated services on the same rack.
 2. Rack isolation shall be of a type and meet the requirements of the most stringent isolation
 3. Services shall be clipped on to the rack, (or attached via guides if the plans specifically call for this). Neoprene isolators shall be installed between the pipe and the rack/clip.

3.5 SEISMIC CONTROLS INSTALLATION

- A. General: Install seismic bracing to limit movement of equipment, piping and ductwork in all directions. Provide stiffeners or otherwise augment standard supports at brace locations to accommodate seismic forces imposed.
1. Threaded hanger rod at brace locations shall be capable of supporting both standard working loads as well as seismic tensile and compressive loads.
 - a. Where rod length exceeds allowable unbraced rod length, provide standard 12 gauge strut rod stiffeners and clamp reinforcements over the entire length of the rod.
 - b. The maximum allowable unbraced length or rods shall not exceed 18-inches for 3/8-inch rod and 24-inches for 1/2 through 7/8-inch rod. Installing contractor to verify maximum unbraced rod lengths allowable via calculations.
- B. Equipment Controls, General: Certain seismic control requirements are satisfied by components identified in the vibration isolation schedule at the end of this Section, (limit stops and housings). The installations contained herein are required in addition to those items.
1. Controls must not overload building structural components. Attach controls to major building structural elements such as beams, columns and concrete floors. Avoid attaching to open joints and lighter weight elements.

- C. Base-Mounted Vibration Isolated Equipment: Install seismic snubbers on isolated equipment. Locate snubbers as close as possible to vibration isolators and bolt to equipment base and supporting structure.
1. Number of snubbers required: (4) per base.
 2. Types Z-1225 & Z-1011.
 3. Acceptable Alternate: Provide Housed spring isolators in lieu of open springs and snubbers.
 - a. Type SSLFH.
- D. Base-Mounted Non-Isolated Equipment: Install seismic controls on non-isolated equipment which is not specifically addressed by the "Support Equipment" paragraph above.
1. Option #1: Equipment bolt holes are adequate to resist seismic forces;
 - a. Install an epoxy compound in the void space between each bolt and bolt hole, or
 - b. weld a steel washer, centered over each bolt hole to limit bolt movement, or
 - c. Install a neoprene grommet around each bolt, Type HG.
 2. Option #2: Equipment bolt holes are adequate to resist seismic forces;
 - a. Weld bolt angles onto the side of the equipment base, minimum (2) per side.
 - b. Bolt each angle to structure (2) places.
 3. Option #3: Equipment bolt holes are adequate to resist seismic forces, no tensile loading or overturning moment present, (small loads). Controls do not need to be attached to the equipment.
 - a. Bolt angles to structure, minimum (2) per side.
 - b. Install a neoprene pad between each angle and the equipment, Type W or SW.
- E. Suspended Vibration Isolated Equipment: Brace equipment at a minimum of (4) points using cable restraints.
1. Install cable with ½-inch of slack to accommodate isolator motion.
 2. Provide stiffeners on hanger rods if calculations dictate.
- F. Suspended Non-Isolated Equipment: Non-isolated equipment which is not specifically addressed by the "Support Equipment" paragraph above shall be restrained with taut cable or strut type restraint systems, installed at a minimum of (4) places.
1. Exception: In-line VAV boxes which are "hard ducted" may be treated simply as ductwork.
 2. Provide stiffeners on hanger rods if calculations dictate.
- G. Piping and Ductwork Controls, General: Install sway bracing on pipe and duct systems.
1. Bracing to consist of tension only cable systems where piping or ductwork includes vibration isolated hangers.
 - a. Install cable with ½-inch of slack to accommodate isolator motion.
 - b. Provide stiffeners on hanger rods if calculation dictate.
 2. Where piping or ductwork does not include vibration isolated hangers and supports, tension only cable or tension-and-compression strut systems may be used.
 - a. Install cable systems taut.
 - b. Provide stiffeners on hanger rods if calculation dictate.
 3. Multiple Piping Application: At trapeze anchor locations, shackle piping to trapeze.
 4. Cable Systems, General: Install cables so they do not bend across sharp edges of adjacent equipment or building structure.
 5. Strut Systems, General: Install steel angles or channel, sized to prevent buckling, clamped with ductile-iron clamps to hanger rods for trapeze and individual pipe hangers.

- H. Piping and Ductwork General Brace Location Requirements: Each straight run of piping or ductwork shall include a minimum of (2) transverse and (1) longitudinal brace.
1. If the overall length of the run exceeds maximum brace spacing identified below, than additional bracing must be installed.
 2. Transverse brace locations shall include the ends of each straight run.
 3. A transverse brace within 2-feet of a 90° bend may meet the spacing requirements of a longitudinal brace in the adjacent 90° section to the order of half the maximum allowable longitudinal spacing minus 2 feet.
 4. Install a transverse brace within 2-feet of each pipe drop or rise to an equipment connection.
 5. Install a transverse brace within 2 times the duct width of each drop or rise to an equipment connection.
 6. Exceptions: Bracing of pipe and ductwork systems is not required under the following circumstances. These exceptions do not apply to natural gas, propane, fuel oil, toxic or corrosive gases.
 - a. Piping suspended by individual hangers where the distance from top-of-pipe to the underside of supporting structure is 12-inches or less.
 - b. Piping in mechanical equipment rooms which is smaller than 1-1/4-inch diameter.
 - c. Piping in all other areas which is smaller than 2-1/2-inch diameter.
 - d. Ducts suspended by individual hangers where the distance from top-of-duct to the underside of supporting structure is 12-inches or less.
 - e. Ducts which have a cross-sectional area less than 6 square feet.
- I. Copper and Steel Piping Systems (Welded, Soldered, Brazed, Grooved, or Threaded): Install bracing in accordance with the following maximum spacing:
1. Transverse Brace Spacing: 50 feet.
 2. Longitudinal Braces: Install at 80 foot intervals, maximum.
- J. Plastic Piping Systems (Cemented or Fused): Install bracing in accordance with the following maximum spacing:
1. Transverse Brace Spacing: 25 feet.
 2. Longitudinal Braces: Install at 40 foot intervals, maximum.
- K. Cast Iron Piping Systems (Hubless): Install bracing in accordance with the following maximum spacing:
1. Transverse Brace Spacing: 25 feet.
 2. Longitudinal Braces: Install at 40 foot intervals, maximum.
- L. Ductwork: Install bracing in accordance with the following maximum spacing:
1. Transverse Brace Spacing: 40 feet.
 2. Longitudinal Braces: Install at 80 foot intervals, maximum.

3.6 FIELD QUALITY CONTROL

- A. Testing: Perform the following field quality-control testing:
1. Isolator seismic-restraint clearance.
 2. Isolator deflection.
 3. Snubber minimum clearances.

3.7 ADJUSTING

- A. Adjust isolators after piping systems have been filled and equipment is at operating weight.
- B. Adjust limit stops on restrained spring isolators to mount equipment at normal operating height. After equipment installation is complete, adjust limit stops so they are out of contact during normal operation.
- C. Attach thrust limits at centerline of thrust and adjust to a maximum of 1/4-inch movement during start and stop.
- D. Adjust active height of spring isolators.
- E. Torque anchor bolts according to equipment manufacturer's written recommendations to resist seismic forces.
- F. Adjust seismic restraints to permit free movement of equipment within normal mode of operation.
- G. Adjust snubbers according to manufacturer's written recommendations.

3.8 CLEANING

- A. After completing equipment installation, inspect vibration isolation and seismic-control devices. Remove paint splatters and other spots, dirt, and debris.

3.9 VIBRATION ISOLATION SCHEDULE

END OF SECTION 230548

SECTION 230553

MECHANICAL IDENTIFICATION

PART 1 - 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. The requirements of Section 230000, "Basic Mechanical Requirements" apply to work defined by this Section.
- C. The requirements of Section 230500, "Basic Mechanical Materials and Methods" apply to work defined by this Section.

1.2 SUMMARY

- A. This Section includes the following mechanical identification materials and their installation:
 - 1. Equipment nameplates.
 - 2. Equipment markers.
 - 3. Equipment signs.
 - 4. Access panel and door markers.
 - 5. Pipe markers.
 - 6. Duct markers.
 - 7. Stencils.
 - 8. Valve tags.
 - 9. Valve schedules.
 - 10. Warning tags.

1.3 SUBMITTALS

- A. Product Data: For each type of product indicated.
- B. Samples: For color, letter style, and graphic representation required for each identification material and device.
- C. Valve numbering scheme.
- D. Valve Schedules: For each piping system. Furnish extra copies (in addition to mounted copies) to include in maintenance manuals.

1.4 QUALITY ASSURANCE

- A. ASME Compliance: Comply with ASME A13.1, "Scheme for the Identification of Piping Systems," for letter size, length of color field, colors, and viewing angles of identification devices for piping.

1.5 COORDINATION

- A. Coordinate installation of identifying devices with completion of covering and painting of surfaces where devices are to be applied.
- B. Coordinate installation of identifying devices with location of access panels and doors.
- C. Install identifying devices before installing acoustical ceilings and similar concealment.

PART 2 - PRODUCTS

2.1 MANUFACTURERS

- A. Manufacturers: Subject to compliance with requirements, provide products by one of the manufacturers listed below.
- B. Identification Systems:
 - 1. Seaton Name Plate Co.
 - 2. Brady: Signmark Div.; W.H. Brady Co.
 - 3. Kolbi Industries, Inc.

2.2 EQUIPMENT IDENTIFICATION DEVICES

- A. Equipment Nameplates: Metal, with data engraved or stamped, for permanent attachment on equipment.
 - 1. Data:
 - a. Manufacturer, product name, model number, and serial number.
 - b. Capacity, operating and power characteristics, and essential data.
 - c. Labels of tested compliances.
 - 2. Location: Accessible and visible.
 - 3. Fasteners: As required to mount on equipment.
- B. Equipment Markers: Engraved, color-coded laminated plastic. Include contact-type, permanent adhesive.
 - 1. Terminology: Match schedules as closely as possible.
 - 2. Data:
 - a. Name and plan number.
 - b. Equipment service.

- c. Design capacity.
 - d. Other design parameters such as pressure drop, entering and leaving conditions, and speed.
3. Size: 2-1/2 by 4 inches for control devices, dampers, and valves; 4-1/2 by 6 inches for equipment.
- C. Equipment Signs: ASTM D 709, Type I, cellulose, paper-base, phenolic-resin-laminate engraving stock; Grade ES-2, black surface, black phenolic core, with white melamine subcore, unless otherwise indicated. Fabricate in sizes required for message. Provide holes for mechanical fastening.
1. Data: Instructions for operation of equipment and for safety procedures.
 2. Engraving: Manufacturer's standard letter style, of sizes and with terms to match equipment identification.
 3. Thickness: 1/8 inch, unless otherwise indicated.
 4. Thickness: 1/16 inch for units up to 20 sq. in. or 8 inches in length, and 1/8 inch for larger units.
 5. Fasteners: Self-tapping, stainless-steel screws or contact-type, permanent adhesive.
- D. Access Panel and Door Markers: 1/16-inch- thick, engraved laminated plastic, with abbreviated terms and numbers corresponding to identification. Provide 1/8-inch center hole for attachment.
1. Fasteners: Self-tapping, stainless-steel screws or contact-type, permanent adhesive.

2.3 PIPING IDENTIFICATION DEVICES

- A. Manufactured Pipe Markers, General: Preprinted, color-coded, with lettering indicating service, and showing direction of flow.
1. Colors: Comply with ASME A13.1, unless otherwise indicated.
 2. Lettering: Use piping system terms indicated and abbreviate only as necessary for each application length.
 3. Pipes with OD, Including Insulation, Less Than 6 Inches: Full-band pipe markers extending 360 degrees around pipe at each location.
 4. Pipes with OD, Including Insulation, 6 Inches and Larger: Either full-band or strip-type pipe markers at least three times letter height and of length required for label.
 5. Arrows: Integral with piping system service lettering to accommodate both directions; or as separate unit on each pipe marker to indicate direction of flow.
- B. Pretensioned Pipe Markers: Precoiled semirigid plastic formed to cover full circumference of pipe and to attach to pipe without adhesive.
- C. Shaped Pipe Markers: Preformed semirigid plastic formed to partially cover circumference of pipe and to attach to pipe with mechanical fasteners that do not penetrate insulation vapor barrier.
- D. Self-Adhesive Pipe Markers: Plastic with pressure-sensitive, permanent-type, self-adhesive back.

- E. Plastic Tape: Continuously printed, vinyl tape at least 3 mils thick with pressure-sensitive, permanent-type, self-adhesive back.
 - 1. Width for Markers on Pipes with OD, Including Insulation, Less Than 6 Inches: 3/4 inch minimum.
 - 2. Width for Markers on Pipes with OD, Including Insulation, 6 Inches or Larger: 1-1/2 inches minimum.

2.4 DUCT IDENTIFICATION DEVICES

- A. Duct Markers: Engraved, color-coded laminated plastic. Include direction of airflow and duct service (such as supply, return, and exhaust). Include contact-type, permanent adhesive.

2.5 STENCILS

- A. Stencils: Prepared with letter sizes according to ASME A13.1 for piping; minimum letter height of 1-1/4 inches for ducts; and minimum letter height of 3/4 inch for access panel and door markers, equipment markers, equipment signs, and similar operational instructions.
 - 1. Stencil Material: Metal or fiberboard.
 - 2. Stencil Paint: Exterior, gloss, alkyd enamel black, unless otherwise indicated. Paint may be in pressurized spray-can form.
 - 3. Identification Paint: Exterior, alkyd enamel in colors according to ASME A13.1, unless otherwise indicated.

2.6 VALVE TAGS

- A. Valve Tags: Stamped or engraved with 1/4-inch letters for piping system abbreviation and 1/2-inch numbers, with numbering scheme approved by Owner. Provide 5/32-inch hole for fastener.
 - 1. Material: 0.032-inch-thick brass.
 - 2. Valve-Tag Fasteners: Brass wire-link or beaded chain; or S-hook.

2.7 VALVE SCHEDULES

- A. Valve Schedules: For each piping system, on standard-size bond paper. Tabulate valve number, piping system, system abbreviation (as shown on valve tag), location of valve (room or space), normal-operating position (open, closed, or modulating), and variations for identification. Mark valves for emergency shutoff and similar special uses.
 - 1. Valve-Schedule Frames: Glazed display frame for removable mounting on masonry walls for each page of valve schedule. Include mounting screws.
 - 2. Frame: Extruded aluminum.
 - 3. Glazing: ASTM C 1036, Type I, Class 1, Glazing Quality B, 2.5-mm, single-thickness glass.

2.8 WARNING TAGS

- A. Warning Tags: Preprinted or partially preprinted, accident-prevention tags; of plasticized card stock with matte finish suitable for writing.
 - 1. Size: 3 by 5-1/4 inches minimum.
 - 2. Fasteners: Brass grommet and wire.
 - 3. Nomenclature: Large-size primary caption such as DANGER, CAUTION, or DO NOT OPERATE.
 - 4. Color: Yellow background with black lettering.

PART 3 - EXECUTION

3.1 APPLICATIONS, GENERAL

- A. Products specified are for applications referenced in other Division 23 Sections. If more than single-type material, device, or label is specified for listed applications, selection is Installer's option.

3.2 EQUIPMENT IDENTIFICATION

- A. Install and permanently fasten equipment nameplates on each major item of mechanical equipment that does not have nameplate or has nameplate that is damaged or located where not easily visible. Locate nameplates where accessible and visible. Include nameplates for the following general categories of equipment:
 - 1. Fuel-burning units, including boilers, furnaces, heaters, stills, and absorption units.
 - 2. Pumps, compressors, chillers, condensers, and similar motor-driven units.
 - 3. Heat exchangers, coils, evaporators, cooling towers, heat recovery units, and similar equipment.
 - 4. Fans, blowers, primary balancing dampers, and mixing boxes.
 - 5. Packaged HVAC central-station and zone-type units.
- B. Install equipment markers with permanent adhesive on or near each major item of mechanical equipment. Data required for markers may be included on signs, and markers may be omitted if both are indicated.
 - 1. Letter Size: Minimum 1/4 inch for name of units if viewing distance is less than 24 inches, 1/2 inch for viewing distances up to 72 inches, and proportionately larger lettering for greater viewing distances. Include secondary lettering two-thirds to three-fourths the size of principal lettering.
 - 2. Data: Distinguish among multiple units, indicate operational requirements, indicate safety and emergency precautions, warn of hazards and improper operations, and identify units.
 - 3. Locate markers where accessible and visible. Include markers for the following general categories of equipment:

- a. Main control and operating valves, including safety devices and hazardous units such as gas outlets.
 - b. Fire department hose valves and hose stations.
 - c. Meters, gages, thermometers, and similar units.
 - d. Fuel-burning units, including boilers, furnaces, heaters, stills, and absorption units.
 - e. Pumps, compressors, chillers, condensers, and similar motor-driven units.
 - f. Heat exchangers, coils, evaporators, cooling towers, heat recovery units, and similar equipment.
 - g. Fans, blowers, primary balancing dampers, and mixing boxes.
 - h. Packaged HVAC central-station and zone-type units.
 - i. Tanks and pressure vessels.
 - j. Strainers, filters, humidifiers, water-treatment systems, and similar equipment.
- C. Install equipment signs with screws or permanent adhesive on or near each major item of mechanical equipment. Locate signs where accessible and visible.
1. Identify mechanical equipment with equipment markers in the following color codes:
 - a. Green: For cooling equipment and components.
 - b. Yellow: For heating equipment and components.
 - c. Green and Yellow: For combination cooling and heating equipment and components.
 - d. Brown: For energy-reclamation equipment and components.
 2. Letter Size: Minimum 1/4 inch for name of units if viewing distance is less than 24 inches, 1/2 inch for viewing distances up to 72 inches, and proportionately larger lettering for greater viewing distances. Include secondary lettering two-thirds to three-fourths the size of principal lettering.
 3. Data: Distinguish among multiple units, indicate operational requirements, indicate safety and emergency precautions, warn of hazards and improper operations, and identify units.
 4. Include signs for the following general categories of equipment:
 - a. Main control and operating valves, including safety devices and hazardous units such as gas outlets.
 - b. Fuel-burning units, including boilers and heaters.
 - c. Pumps, compressors, chillers, condensers, and similar motor-driven units.
 - d. Heat exchangers, coils, evaporators, cooling towers, heat recovery units, and similar equipment.
 - e. Fans, blowers, primary balancing dampers, and mixing boxes.
 - f. Packaged HVAC central-station and zone-type units.
 - g. Tanks and pressure vessels.
 - h. Strainers, filters, humidifiers, water-treatment systems, and similar equipment.
- D. Install access panel markers with screws on equipment access panels.

3.3 PIPING IDENTIFICATION

- A. Install manufactured pipe markers indicating service on each piping system. Install with flow indication arrows showing direction of flow.
 - 1. Pipes with OD, Including Insulation, Less Than 6 Inches: Self-adhesive pipe markers. Use color-coded, self-adhesive plastic tape, at least 3/4 inch wide, lapped at least 1-1/2 inches at both ends of pipe marker, and covering full circumference of pipe.
 - 2. Pipes with OD, Including Insulation, 6 Inches and Larger: Self-adhesive pipe markers. Use color-coded, self-adhesive plastic tape, at least 1-1/2 inches wide, lapped at least 3 inches at both ends of pipe marker, and covering full circumference of pipe.

3.4 DUCT IDENTIFICATION

- A. Install duct markers with permanent adhesive on air ducts in the following color codes:
 - 1. Green: For cold-air supply ducts.
 - 2. Yellow: For hot-air supply ducts.
 - 3. Blue: For exhaust-, outside-, relief-, return-, and mixed-air ducts.
 - 4. ASME A13.1 Colors and Designs: For hazardous material exhaust.
 - 5. Letter Size: Minimum 1/4 inch for name of units if viewing distance is less than 24 inches, 1/2 inch for viewing distances up to 72 inches, and proportionately larger lettering for greater viewing distances. Include secondary lettering two-thirds to three-fourths the size of principal lettering.
- B. Locate markers near points where ducts enter into concealed spaces and at maximum intervals of 50 feet in each space where ducts are exposed or concealed by removable ceiling system.

3.5 VALVE-TAG INSTALLATION

- A. Install tags on valves and control devices in piping systems, except check valves; valves within factory-fabricated equipment units; plumbing fixture supply stops; shutoff valves; faucets; convenience and lawn-watering hose connections; and HVAC terminal devices and similar roughing-in connections of end-use fixtures and units. List tagged valves in a valve schedule.
- B. Valve-Tag Application Schedule: Tag valves according to size, shape, and color scheme and with captions similar to those indicated in the following:
 - 1. Valve-Tag Size and Shape:
 - a. Cold Water: 1-1/2 inches, round.
 - b. Hot Water: 1-1/2 inches, round.
 - c. Fire Protection: 1-1/2 inches, round.
 - d. Gas: 1-1/2 inches, round.
 - e. Steam: 1-1/2 inches, round.
 - 2. Valve-Tag Color:
 - a. Cold Water: Blue.
 - b. Hot Water: Black.
 - c. Fire Protection: Red.

- d. Gas: Yellow.
- e. Steam: Green

3. Letter Color:

- a. Cold Water: White.
- b. Hot Water: White.
- c. Fire Protection: White.
- d. Gas: White.
- e. Steam: White.

3.6 VALVE-SCHEDULE INSTALLATION

- A. Mount valve schedule on wall in accessible location in each major equipment room.

3.7 WARNING-TAG INSTALLATION

- A. Write required message on, and attach warning tags to, equipment and other items where required.

3.8 ADJUSTING

- A. Relocate mechanical identification materials and devices that have become visually blocked by other work.

3.9 CLEANING

- A. Clean faces of mechanical identification devices and glass frames of valve schedules.

END OF SECTION 230553

SECTION 230593

TESTING, ADJUSTING, AND BALANCING

PART 1 - 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. The requirements of Section 230000, "Basic Mechanical Requirements" apply to work defined by this Section.
- C. The requirements of Section 230500, "Basic Mechanical Materials and Methods" apply to work defined by the Section.

1.2 SUMMARY

- A. This Section includes TAB to produce design objectives for the following:
 - 1. Air Systems:
 - a. Constant-volume air systems.
 - b. Variable-air-volume systems.
 - 2. Hydronic Piping Systems:
 - a. Variable-flow systems.
 - 3. HVAC equipment quantitative-performance settings.
 - 4. Space pressurization testing and adjusting.
 - 5. Reporting results of activities and procedures specified in this Section.

1.3 DEFINITIONS

- A. Adjust: To regulate fluid flow rate and air patterns at the terminal equipment, such as to reduce fan speed or adjust a damper.
- B. Balance: To proportion flows within the distribution system, including submains, branches, and terminals, according to indicated quantities.
- C. Barrier or Boundary: Construction, either vertical or horizontal, such as walls, floors, and ceilings that are designed and constructed to restrict the movement of airflow, smoke, odors, and other pollutants.

- D. Draft: A current of air, when referring to localized effect caused by one or more factors of high air velocity, low ambient temperature, or direction of airflow, whereby more heat is withdrawn from a person's skin than is normally dissipated.
 - E. NC: Noise criteria.
 - F. Procedure: An approach to and execution of a sequence of work operations to yield repeatable results.
 - G. RC: Room criteria.
 - H. Report Forms: Test data sheets for recording test data in logical order.
 - I. Smoke-Control System: An engineered system that uses fans to produce airflow and pressure differences across barriers to limit smoke movement.
 - J. Smoke-Control Zone: A space within a building that is enclosed by smoke barriers and is a part of a zoned smoke-control system.
 - K. Static Head: The pressure due to the weight of the fluid above the point of measurement. In a closed system, static head is equal on both sides of the pump.
 - L. Suction Head: The height of fluid surface above the centerline of the pump on the suction side.
 - M. System Effect: A phenomenon that can create undesired or unpredicted conditions that cause reduced capacities in all or part of a system.
 - N. System Effect Factors: Allowances used to calculate a reduction of the performance ratings of a fan when installed under conditions different from those presented when the fan was performance tested.
 - O. TAB: Testing, adjusting, and balancing.
 - P. Terminal: A point where the controlled medium, such as fluid or energy, enters or leaves the distribution system.
 - Q. Test: A procedure to determine quantitative performance of systems or equipment.
 - R. Testing, Adjusting, and Balancing (TAB) Firm: The entity responsible for performing and reporting TAB procedures.
- 1.4 SUBMITTALS
- A. Qualification Data: Within 30 days from Contractor's Notice to Proceed, submit 4 copies of evidence that TAB firm and this Project's TAB team members meet the qualifications specified in "Quality Assurance" Article.
 - B. Contract Documents Examination Report: Within 45 days from Contractor's Notice to Proceed, submit 4 copies of the Contract Documents review report as specified in Part 3.

- C. Strategies and Procedures Plan: Within 90 days from Contractor's Notice to Proceed, submit 4 copies of TAB strategies and step-by-step procedures as specified in Part 3 "Preparation" Article. Include a complete set of report forms intended for use on this Project.
- D. Certified TAB Reports: Submit two copies of reports prepared, as specified in this Section, on approved forms certified by TAB firm.
- E. Warranties specified in this Section.

1.5 QUALITY ASSURANCE

- A. TAB Firm Qualifications: Engage a TAB firm certified by either AABC or NEBB.
- B. TAB Conference: Meet with Owner's and Architect's representatives on approval of TAB strategies and procedures plan to develop a mutual understanding of the details. Ensure the participation of TAB team members, equipment manufacturers' authorized service representatives, HVAC controls installers, and other support personnel. Provide seven days' advance notice of scheduled meeting time and location.
 - 1. Agenda Items: Include at least the following:
 - a. Submittal distribution requirements.
 - b. The Contract Documents examination report.
 - c. TAB plan.
 - d. Work schedule and Project-site access requirements.
 - e. Coordination and cooperation of trades and subcontractors.
 - f. Coordination of documentation and communication flow.
- C. Certification of TAB Reports: Certify TAB field data reports. This certification includes the following:
 - 1. Review field data reports to validate accuracy of data and to prepare certified TAB reports.
 - 2. Certify that TAB team complied with approved TAB plan and the procedures specified and referenced in this Specification.
- D. TAB Report Forms: Use standard forms from NEBB's "Procedural Standards for Testing, Adjusting, and Balancing of Environmental Systems.
- E. Instrumentation Type, Quantity, and Accuracy: As described in NEBB's "Procedural Standards for Testing, Adjusting, and Balancing of Environmental Systems," Section II, "Required Instrumentation for NEBB Certification."
- F. Instrumentation Calibration: Calibrate instruments at least every six months or more frequently if required by instrument manufacturer.
 - 1. Keep an updated record of instrument calibration that indicates date of calibration and the name of party performing instrument calibration.

1.6 PROJECT 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.

1.7 COORDINATION

- A. Coordinate the efforts of factory-authorized service representatives for systems and equipment, HVAC controls installers, and other mechanics to operate HVAC systems and equipment to support and assist TAB activities.
- B. Notice: Provide seven days' advance notice for each test. Include scheduled test dates and times.
- C. Perform TAB after leakage and pressure tests on air and water distribution systems have been satisfactorily completed.

1.8 WARRANTY

- A. Special Guarantee: Provide a guarantee on NEBB forms stating that NEBB will assist in completing requirements of the Contract Documents if TAB firm fails to comply with the Contract Documents. Guarantee shall include the following provisions:
 - 1. The certified TAB firm has tested and balanced systems according to the Contract Documents.
 - 2. Systems are balanced to optimum performance capabilities within design and installation limits.

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.
 - 1. Contract Documents are defined in the General and Supplementary Conditions of Contract.
 - 2. Verify that balancing devices, such as test ports, gage cocks, thermometer wells, flow-control devices, balancing valves and fittings, and manual volume dampers, are required by the Contract Documents. Verify that quantities and locations of these balancing devices are accessible and appropriate for effective balancing and for efficient system and equipment operation.

- B. Examine approved submittal data of HVAC systems and equipment.
- C. Examine Project Record Documents described in Division 1 Section "Project Record Documents."
- 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 equipment performance data including fan and pump curves. 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. Calculate system effect factors to reduce performance ratings of HVAC equipment when installed under conditions different from those presented when the equipment was performance tested at the factory. To calculate system effects for air systems, use tables and charts found in AMCA 201, "Fans and Systems," Sections 7 through 10; or in SMACNA's "HVAC Systems--Duct Design," Sections 5 and 6. Compare this data with the design data and installed conditions.
- F. Examine system and equipment installations to verify that they are complete and that testing, cleaning, adjusting, and commissioning specified in individual Sections have been performed.
- G. Examine system and equipment test reports.
- H. Examine HVAC system and equipment installations to verify that indicated balancing devices, such as test ports, gage cocks, thermometer wells, flow-control devices, balancing valves and fittings, and manual volume dampers, are properly installed, and that their locations are accessible and appropriate for effective balancing and for efficient system and equipment operation.
- I. Examine systems for functional deficiencies that cannot be corrected by adjusting and balancing.
- J. Examine HVAC equipment to ensure that clean filters have been installed, bearings are greased, belts are aligned and tight, and equipment with functioning controls is ready for operation.
- K. Examine terminal units, such as variable-air-volume boxes, to verify that they are accessible and their controls are connected and functioning.
- L. Examine plenum ceilings used for supply air to verify that they are airtight. Verify that pipe penetrations and other holes are sealed.
- M. Examine strainers for clean screens and proper perforations.
- N. Examine three-way valves for proper installation for their intended function of diverting or mixing fluid flows.
- O. Examine heat-transfer coils for correct piping connections and for clean and straight fins.
- P. Examine system pumps to ensure absence of entrained air in the suction piping.

- Q. Examine equipment for installation and for properly operating safety interlocks and controls.
- R. Examine automatic temperature system components to verify the following:
 - 1. Dampers, valves, and other controlled devices are operated by the intended controller.
 - 2. Dampers and valves are in the position indicated by the controller.
 - 3. Integrity of valves and dampers for free and full operation and for tightness of fully closed and fully open positions. This includes dampers in mixing boxes, and variable-air-volume terminals.
 - 4. Automatic modulating and shutoff valves, including two-way valves and three-way mixing and diverting valves, are properly connected.
 - 5. Thermostats and humidistats are located to avoid adverse effects of sunlight, drafts, and cold walls.
 - 6. Sensors are located to sense only the intended conditions.
 - 7. Sequence of operation for control modes is according to the Contract Documents.
 - 8. Controller set points are set at indicated values.
 - 9. Interlocked systems are operating.
 - 10. Changeover from heating to cooling mode occurs according to indicated values.
- S. 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 system readiness 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 NEBB's "Procedural Standards for Testing, Adjusting, and Balancing of Environmental Systems and this Section.
- B. Cut insulation, ducts, pipes, and equipment cabinets for installation of test probes to the minimum extent necessary to allow adequate performance of procedures. After testing and

balancing, close probe holes and patch insulation with new materials identical to those removed. Restore vapor barrier and finish according to insulation Specifications for this Project.

- C. Mark equipment and balancing device settings with paint or other suitable, permanent identification material, including damper-control positions, valve position indicators, fan-speed-control levers, and similar controls and devices, 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 outside-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. Check for proper sealing of air duct system.

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 fan static pressures to determine actual static pressure as follows:
 - a. Measure outlet static pressure as far downstream from the fan as practicable 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 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.
 2. Measure static pressure across each component that makes up an air-handling unit, rooftop unit, and other air-handling and -treating equipment.
 - a. Simulate dirty filter operation and record the point at which maintenance personnel must change filters.
 3. Measure static pressures entering and leaving other devices such as sound traps, heat recovery equipment, and air washers, under final balanced conditions.
 4. Compare design data with installed conditions to determine variations in design static pressures versus actual static pressures. Compare actual system effect factors with calculated system effect factors to identify where variations occur. Recommend corrective action to align design and actual conditions.
 5. Obtain approval from Architect for adjustment of fan speed higher or lower than indicated speed. Make required adjustments to pulley sizes, motor sizes, and electrical connections to accommodate fan-speed changes.
 6. 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 modes 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 static pressure at a point downstream from the balancing damper and adjust volume dampers until the proper static pressure is achieved.
 - 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. 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 terminal 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 terminal outlets and inlets for each space to indicated airflows within specified tolerances of indicated values. Make adjustments using 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 VARIABLE-AIR-VOLUME SYSTEMS

- A. Compensating for Diversity: When the total airflow of all terminal units is more than the indicated airflow of the fan, place a selected number of terminal units at a maximum set-point airflow condition until the total airflow of the terminal units equals the indicated airflow of the fan. Select the reduced airflow terminal units so they are distributed evenly among the branch ducts.
- B. Pressure-Independent, Variable-Air-Volume Systems: After the fan systems have been adjusted, adjust the variable-air-volume systems as follows:
 1. Set outside-air dampers at minimum, and return- and exhaust-air dampers at a position that simulates full-cooling load.
 2. Select the terminal unit that is most critical to the supply-fan airflow and static pressure. Measure static pressure. Adjust system static pressure so the entering static pressure for the critical terminal unit is not less than the sum of terminal-unit manufacturer's recommended minimum inlet static pressure plus the static pressure needed to overcome terminal-unit discharge system losses.
 3. Measure total system airflow. Adjust to within indicated airflow.
 4. Set terminal units at maximum airflow and adjust controller or regulator to deliver the designed maximum airflow. Use terminal-unit manufacturer's written instructions to make this adjustment. When total airflow is correct, balance the air outlets downstream from terminal units as described for constant-volume air systems.
 5. Set terminal units at minimum airflow and adjust controller or regulator to deliver the designed minimum airflow. Check air outlets for a proportional reduction in airflow as described for constant-volume air systems.
 - a. If air outlets are out of balance at minimum airflow, report the condition but leave outlets balanced for maximum airflow.
 6. Remeasure the return airflow to the fan while operating at maximum return airflow and minimum outside airflow. Adjust the fan and balance the return-air ducts and inlets as described for constant-volume air systems.
 7. Measure static pressure at the most critical terminal unit and adjust the static-pressure controller at the main supply-air sensing station to ensure that adequate static pressure is maintained at the most critical unit.
 8. Record the final fan performance data.

3.7 GENERAL PROCEDURES FOR HYDRONIC SYSTEMS

- A. Prepare test reports with pertinent design data and number in sequence starting at pump to end of system. Check the sum of branch-circuit flows against approved pump flow rate. Correct variations that exceed plus or minus 5 percent.

- B. Prepare schematic diagrams of systems' "as-built" piping layouts.
- C. Prepare hydronic systems for testing and balancing according to the following, in addition to the general preparation procedures specified above:
 - 1. Open all manual valves for maximum flow.
 - 2. Check expansion tank liquid level.
 - 3. Check makeup-water-station pressure gage for adequate pressure for highest vent.
 - 4. Check flow-control valves for specified sequence of operation and set at indicated flow.
 - 5. Set differential-pressure control valves at the specified differential pressure. Do not set at fully closed position when pump is positive-displacement type unless several terminal valves are kept open.
 - 6. Set system controls so automatic valves are wide open to heat exchangers.
 - 7. Check pump-motor load. If motor is overloaded, throttle main flow-balancing device so motor nameplate rating is not exceeded.
 - 8. Check air vents for a forceful liquid flow exiting from vents when manually operated.

3.8 PROCEDURES FOR HYDRONIC SYSTEMS

- A. Measure water flow at pumps. Use the following procedures, except for positive-displacement pumps:
 - 1. Verify impeller size by operating the pump with the discharge valve closed. Read pressure differential across the pump. Convert pressure to head and correct for differences in gage heights. Note the point on manufacturer's pump curve at zero flow and verify that the pump has the intended impeller size.
 - 2. Check system resistance. With all valves open, read pressure differential across the pump and mark pump manufacturer's head-capacity curve. Adjust pump discharge valve until indicated water flow is achieved.
 - 3. Verify pump-motor brake horsepower. Calculate the intended brake horsepower for the system based on pump manufacturer's performance data. Compare calculated brake horsepower with nameplate data on the pump motor. Report conditions where actual amperage exceeds motor nameplate amperage.
 - 4. Report flow rates that are not within plus or minus 5 percent of design.
- B. Set calibrated balancing valves, if installed, at calculated presettings.
- C. Measure flow at all stations and adjust, where necessary, to obtain first balance.
 - 1. System components that have Cv rating or an accurately cataloged flow-pressure-drop relationship may be used as a flow-indicating device.
- D. Measure flow at main balancing station and set main balancing device to achieve flow that is 5 percent greater than indicated flow.
- E. Adjust balancing stations to within specified tolerances of indicated flow rate as follows:
 - 1. Determine the balancing station with the highest percentage over indicated flow.

2. Adjust each station in turn, beginning with the station with the highest percentage over indicated flow and proceeding to the station with the lowest percentage over indicated flow.
 3. Record settings and mark balancing devices.
- F. Measure pump flow rate and make final measurements of pump amperage, voltage, rpm, pump heads, and systems' pressures and temperatures including outdoor-air temperature.
- G. Measure the differential-pressure control valve settings existing at the conclusions of balancing.

3.9 PROCEDURES FOR VARIABLE-FLOW HYDRONIC SYSTEMS

- A. Balance systems with automatic two- and three-way control valves by setting systems at maximum flow through heat-exchange terminals and proceed as specified above for hydronic systems.
- B. Confirm that the automatic flow control valves have the correct inlet pressure.

3.10 PROCEDURES FOR HEAT-TRANSFER COILS

- A. Water Coils: Measure the following data for each 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.

3.11 PROCEDURES FOR TEMPERATURE MEASUREMENTS

- A. During TAB, report the need for adjustment in temperature regulation within the automatic temperature-control system.
- B. Measure indoor wet- and dry-bulb temperatures every other hour for a period of two successive eight-hour days, in each separately controlled zone, to prove correctness of final temperature settings. Measure when the building or zone is occupied.
- C. Measure outside-air, wet- and dry-bulb temperatures.

3.12 PROCEDURES FOR SPACE PRESSURIZATION MEASUREMENTS AND ADJUSTMENTS

- A. Before testing for space pressurization, observe the space to verify the integrity of the space boundaries. Verify that windows and doors are closed and applicable safing, gaskets, and

- sealants are installed. Report deficiencies and postpone testing until after the reported deficiencies are corrected.
- B. Measure, adjust, and record the pressurization of each room, each zone, and each building by adjusting the supply, return, and exhaust airflows to achieve the indicated conditions.
 - C. Measure space pressure differential where pressure is used as the design criteria, and measure airflow differential where differential airflow is used as the design criteria for space pressurization.
 - 1. For pressure measurements, measure and record the pressure difference between the intended spaces at the door with all doors in the space closed. Record the high-pressure side, low-pressure side, and pressure difference between each adjacent space.
 - 2. For applications with cascading levels of space pressurization, begin in the most critical space and work to the least critical space.
 - 3. Test room pressurization first, then zones, and finish with building pressurization.
 - D. To achieve indicated pressurization, set the supply airflow to the indicated conditions and adjust the exhaust and return airflow to achieve the indicated pressure or airflow difference.
 - E. For spaces with pressurization being monitored and controlled automatically, observe and adjust the controls to achieve the desired set point.
 - 1. Compare the values of the measurements taken to the measured values of the control system instruments and report findings.
 - 2. Check the repeatability of the controls by successive tests designed to temporarily alter the ability to achieve space pressurization. Test overpressurization and underpressurization, and observe and report on the system's ability to revert to the set point.
 - 3. For spaces served by variable-air-volume supply and exhaust systems, measure space pressurization at indicated airflow and minimum airflow conditions.
 - F. In spaces that employ multiple modes of operation, such as normal mode and emergency mode or occupied mode and unoccupied mode, measure, adjust, and record data for each operating mode.
 - G. Record indicated conditions and corresponding initial and final measurements. Report deficiencies.
 - H. The following rooms shall be tested and adjusted to ensure they maintain negative pressurization:
 - 1. Isolation Exam Room F1051, -0.02" w.c. in relation to Exit Room F1052.
 - 2. Isolation Exam Room F1053, -0.02" w.c. in relation to Exit Room F1052.
 - 3. Exit Room F1052, -0.02" w.c. in relation to Corridor F1045.
 - 4. Decontamination Room F1073, -0.02" w.c. in relation to Isolation Exam Room F1071.
 - 5. Isolation Exam Room F1071, -0.02" w.c. in relation to Exit Room F1072.
 - 6. Exit Room F1072, -0.02" w.c. in relation to Corridor F1076.

3.13 TEMPERATURE-CONTROL VERIFICATION

- A. Verify that controllers are calibrated and commissioned.
- B. Check transmitter and controller locations and note conditions that would adversely affect control functions.
- C. Record controller settings and note variances between set points and actual measurements.
- D. Check the operation of limiting controllers (i.e., high- and low-temperature controllers).
- E. Check free travel and proper operation of control devices such as damper and valve operators.
- F. Check the sequence of operation of control devices. Note air pressures and device positions and correlate with airflow and water flow measurements. Note the speed of response to input changes.
- G. Check the interaction of electrically operated switch transducers.
- H. Check the interaction of interlock and lockout systems.
- I. Record voltages of power supply and controller output. Determine whether the system operates on a grounded or nongrounded power supply.
- J. Note operation of electric actuators using spring return for proper fail-safe operations.

3.14 TOLERANCES

- A. Set HVAC system airflow and water flow rates within the following tolerances:
 - 1. Supply, Return, and Exhaust Fans and Equipment with Fans: Plus 5 to plus 10 percent.
 - 2. Air Outlets and Inlets: 0 to minus 10 percent.
 - 3. Heating-Water Flow Rate: 0 to minus 10 percent.
 - 4. Cooling-Water Flow Rate: 0 to minus 5 percent.

3.15 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: As Work progresses, prepare 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.

3.16 FINAL REPORT

- A. General: Typewritten, or computer printout in letter-quality font, on standard bond paper, in three-ring binder, tabulated and divided into sections by tested and balanced systems.
- B. Include a certification sheet in front of binder signed and sealed by the certified testing and balancing engineer.
 - 1. Include a list of instruments used for procedures, along with proof of calibration.
- C. Final Report Contents: In addition to certified field report data, include the following:
 - 1. Pump curves.
 - 2. Fan curves.
 - 3. Manufacturers' test data.
 - 4. Field test reports prepared by system and equipment installers.
 - 5. Other information relative to equipment performance, but do not include Shop Drawings and Product Data.
- D. General Report Data: In addition to form titles and entries, include the following data in the final report, as applicable:
 - 1. Title page.
 - 2. Name and address of TAB firm.
 - 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 firm 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, type size, and fittings.
 - 14. Notes to explain why certain final data in the body of reports varies from indicated values.
 - 15. Test conditions for fans and pump performance forms including the following:
 - a. Settings for outside-, 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.
- E. 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 outside, supply, return, and exhaust airflows.
 - 2. Water and steam flow rates.
 - 3. Duct, outlet, and inlet sizes.
 - 4. Pipe and valve sizes and locations.
 - 5. Terminal units.
 - 6. Balancing stations.
 - 7. Position of balancing devices.
- F. Air-Handling Unit Test Reports: For air-handling units with coils, include the following:
- 1. Unit Data: Include the following:
 - a. Unit identification.
 - b. Location.
 - c. Make and type.
 - d. Model number and unit size.
 - e. Manufacturer's serial number.
 - f. Unit arrangement and class.
 - g. Discharge arrangement.
 - h. Sheave make, size in inches, and bore.
 - i. Sheave dimensions, center-to-center, and amount of adjustments in inches.
 - j. Number of belts, make, and size.
 - k. Number of filters, type, and size.
 - 2. Motor Data:
 - a. Make and frame type and size.
 - b. Horsepower and rpm.
 - c. Volts, phase, and hertz.
 - d. Full-load amperage and service factor.
 - e. Sheave make, size in inches, and bore.
 - f. Sheave dimensions, center-to-center, and amount of adjustments in inches.
 - 3. Test Data (Indicated and Actual Values):
 - a. Total airflow rate in cfm.
 - b. Total system static pressure in inches wg.
 - c. Fan rpm.
 - d. Discharge static pressure in inches wg.
 - e. Filter static-pressure differential in inches wg.
 - f. Preheat coil static-pressure differential in inches wg.
 - g. Cooling coil static-pressure differential in inches wg.

- h. Heating coil static-pressure differential in inches wg.
- i. Outside airflow in cfm.
- j. Return airflow in cfm.
- k. Outside-air damper position.
- l. Return-air damper position.
- m. Vortex damper position.

G. Apparatus-Coil Test Reports:

1. Coil Data:

- a. System identification.
- b. Location.
- c. Coil type.
- d. Number of rows.
- e. Fin spacing in fins per inch o.c.
- f. Make and model number.
- g. Face area in sq. ft..
- h. Tube size in NPS.
- i. Tube and fin materials.
- j. Circuiting arrangement.

2. Test Data (Indicated and Actual Values):

- a. Airflow rate in cfm.
- b. Average face velocity in fpm.
- c. Air pressure drop in inches wg.
- d. Outside-air, wet- and dry-bulb temperatures in deg F.
- e. Return-air, wet- and dry-bulb temperatures in deg F.
- f. Entering-air, wet- and dry-bulb temperatures in deg F.
- g. Leaving-air, wet- and dry-bulb temperatures in deg F.
- h. Water flow rate in gpm.
- i. Water pressure differential in feet of head or psig.
- j. Entering-water temperature in deg F.
- k. Leaving-water temperature in deg F.
- l. Refrigerant expansion valve and refrigerant types.
- m. Refrigerant suction pressure in psig.
- n. Refrigerant suction temperature in deg F.
- o. Inlet steam pressure in psig.

H. Fan Test Reports: For supply, return, and exhaust fans, include the following:

1. Fan Data:

- a. System identification.
- b. Location.
- c. Make and type.
- d. Model number and size.
- e. Manufacturer's serial number.
- f. Arrangement and class.

- g. Sheave make, size in inches, and bore.
 - h. Sheave dimensions, center-to-center, and amount of adjustments in inches.
2. Motor Data:
- a. Make and frame type and size.
 - b. Horsepower and rpm.
 - c. Volts, phase, and hertz.
 - d. Full-load amperage and service factor.
 - e. Sheave make, size in inches, and bore.
 - f. Sheave dimensions, center-to-center, and amount of adjustments in inches.
 - g. Number of belts, make, and size.
3. Test Data (Indicated and Actual Values):
- a. Total airflow rate in cfm.
 - b. Total system static pressure in inches wg.
 - c. Fan rpm.
 - d. Discharge static pressure in inches wg.
 - e. Suction static pressure in inches wg.
- I. Round and Rectangular Duct Traverse Reports: Include a diagram with a grid representing the duct cross-section and record the following:
1. Report Data:
- a. System and air-handling unit number.
 - b. Location and zone.
 - c. Traverse air temperature in deg F.
 - d. Duct static pressure in inches wg.
 - e. Duct size in inches.
 - f. Duct area in sq. ft..
 - g. Indicated airflow rate in cfm.
 - h. Indicated velocity in fpm.
 - i. Actual airflow rate in cfm.
 - j. Actual average velocity in fpm.
 - k. Barometric pressure in psig.
- J. Air-Terminal-Device Reports:
1. Unit Data:
- a. System and air-handling unit identification.
 - b. Location and zone.
 - c. Test apparatus used.
 - d. Area served.
 - e. Air-terminal-device make.
 - f. Air-terminal-device number from system diagram.
 - g. Air-terminal-device type and model number.
 - h. Air-terminal-device size.

- i. Air-terminal-device effective area in sq. ft..
 2. Test Data (Indicated and Actual Values):
 - a. Airflow rate in cfm.
 - b. Air velocity in fpm.
 - c. Preliminary airflow rate as needed in cfm.
 - d. Preliminary velocity as needed in fpm.
 - e. Final airflow rate in cfm.
 - f. Final velocity in fpm.
 - g. Space temperature in deg F.
- K. System-Coil Reports: For reheat coils and water coils of terminal units, include the following:
 1. Unit Data:
 - a. System and air-handling unit identification.
 - b. Location and zone.
 - c. Room or riser served.
 - d. Coil make and size.
 - e. Flowmeter type.
 2. Test Data (Indicated and Actual Values):
 - a. Airflow rate in cfm.
 - b. Entering-water temperature in deg F.
 - c. Leaving-water temperature in deg F.
 - d. Water pressure drop in feet of head or psig.
 - e. Entering-air temperature in deg F.
 - f. Leaving-air temperature in deg F.
- L. Heat-Exchanger/Converter Test Reports: For hot-water heat exchangers, include the following:
 1. Unit Data:
 - a. Unit identification.
 - b. Location.
 - c. Service.
 - d. Make and type.
 - e. Model and serial numbers.
 - f. Ratings.
 2. Steam Test Data (Indicated and Actual Values):
 - a. Entering-steam temperature in deg F.
 - b. Entering-steam pressure in feet of head or psig.
 3. Secondary Water Test Data (Indicated and Actual Values):
 - a. Entering-water temperature in deg F.

- b. Leaving-water temperature in deg F.
 - c. Entering-water pressure in feet of head or psig.
 - d. Water pressure differential in feet of head or psig.
 - e. Water flow rate in gpm.
- M. 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 and serial numbers.
 - f. Water flow rate in gpm.
 - g. Water pressure differential in feet of head or psig.
 - h. Required net positive suction head in feet of head or psig.
 - i. Pump rpm.
 - j. Impeller diameter in inches.
 - 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.
 - 2. Test Data (Indicated and Actual Values):
 - a. Static head in feet of head or psig.
 - b. Pump shutoff pressure in feet of head or psig.
 - c. Actual impeller size in inches.
 - d. Full-open flow rate in gpm.
 - e. Full-open pressure in feet of head or psig.
 - f. Final discharge pressure in feet of head or psig.
 - g. Final suction pressure in feet of head or psig.
 - h. Final total pressure in feet of head or psig.
 - i. Final water flow rate in gpm.
 - j. Voltage at each connection.
 - k. Amperage for each phase.
- N. Instrument Calibration Reports:
- 1. Report Data:
 - a. Instrument type and make.
 - b. Serial number.
 - c. Application.
 - d. Dates of use.
 - e. Dates of calibration.

3.17 INSPECTIONS

A. Initial Inspection:

1. After testing and balancing are complete, operate each system and randomly check measurements to verify that the system is operating according to the final test and balance readings documented in the Final Report.
2. Randomly check the following for each system:
 - a. Measure airflow of at least 10 percent of air outlets.
 - b. Measure water flow of at least 5 percent of terminals.
 - c. Measure room temperature at each thermostat/temperature sensor. Compare the reading to the set point.
 - d. Measure sound levels at two locations.
 - e. Measure space pressure of at least 10 percent of locations.
 - f. Verify that balancing devices are marked with final balance position.
 - g. Note deviations to the Contract Documents in the Final Report.

B. Final Inspection:

1. After initial inspection is complete and evidence by random checks verifies that testing and balancing are complete and accurately documented in the final report, request that a final inspection be made by Architect.
2. TAB firm test and balance engineer shall conduct the inspection in the presence of Architect.
3. Architect shall randomly select measurements documented in the final report to be rechecked. The rechecking shall be limited to either 10 percent of the total measurements recorded, or the extent of measurements that can be accomplished in a normal 8-hour business day.
4. If the rechecks yield measurements that differ from the measurements documented in the final report by more than the tolerances allowed, the measurements shall be noted as "FAILED."
5. If the number of "FAILED" measurements is greater than 10 percent of the total measurements checked during the final inspection, the testing and balancing shall be considered incomplete and shall be rejected.
6. TAB firm shall recheck all measurements and make adjustments. Revise the final report and balancing device settings to include all changes and resubmit the final report.
7. Request a second final inspection. If the second final inspection also fails, Owner shall contract the services of another TAB firm to complete the testing and balancing in accordance with the Contract Documents and deduct the cost of the services from the final payment.

3.18 ADDITIONAL TESTS

- A. Within 90 days of completing TAB, perform additional testing and balancing 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 testing, inspecting, and adjusting during near-peak summer and winter conditions.

END OF SECTION 230593

SECTION 230701

DUCT INSULATION

PART 1 - 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. The requirements of Section 230000, "Basic Mechanical Requirements" apply to work defined by this Section.
- C. The requirements of Section 230500, "Basic Mechanical Materials and Methods" apply to work defined by this Section.

1.2 SUMMARY

- A. This Section includes semi-rigid and flexible duct, plenum, and breeching insulation; insulating cements; field-applied jackets; accessories and attachments; and sealing compounds.
- B. Related Sections include the following:
 - 1. Division 7 Section "Firestopping" for firestopping materials and requirements for penetrations through fire and smoke barriers.
 - 2. Section 230702 "Equipment Insulation" for insulation materials and application for pumps, tanks, hydronic specialties, and other equipment.
 - 3. Section 230703 "Pipe Insulation" for insulation for piping systems.

1.3 SUBMITTALS

- A. General: See Division 1 for general submittal and product substitution requirements.
- B. Pre-construction Shop Drawings: Show fabrication and installation details for metal ducts as follows prior to commencing with fabrication and installation:
 - 1. Product Data: Identify thermal conductivity, thickness, and jackets (both factory and field applied, if any), for each type of product indicated.
 - 2. Shop Drawings: Show fabrication and installation details for the following:
 - a. Application of field-applied jackets.
 - b. Applications at linkages for control devices.

1.4 QUALITY ASSURANCE

- A. Installer Qualifications: Skilled mechanics who have successfully completed an apprenticeship program or another craft training program certified by the U.S. Department of Labor, Bureau of Apprenticeship and Training.
- B. Fire-Test-Response Characteristics: As determined by testing materials identical to those specified in this Section according to ASTM E 84, by a testing and inspecting agency acceptable to authorities having jurisdiction. Factory label insulation and jacket materials and sealer and cement material containers with appropriate markings of applicable testing and inspecting agency.
 - 1. Insulation Installed Indoors: Flame-spread rating of 25 or less, and smoke-developed rating of 50 or less.
 - 2. Insulation Installed Outdoors: Flame-spread rating of 75 or less, and smoke-developed rating of 150 or less.

1.5 DELIVERY, STORAGE, AND HANDLING

- A. Packaging: Ship insulation materials in containers marked by manufacturer with appropriate ASTM specification designation, type and grade, and maximum use temperature.

1.6 COORDINATION

- A. Coordinate clearance requirements with duct installer for insulation application.

1.7 SCHEDULING

- A. Schedule insulation application after testing duct systems. Insulation application may begin on segments of ducts that have satisfactory test results.

PART 2 - PRODUCTS

2.1 MANUFACTURERS

- A. Manufacturers: Subject to compliance with requirements, provide products by one of the manufacturers listed below.
- B. Fiber Glass Insulation:
 - 1. CertainTeed.
 - 2. Knauf FiberGlass.
 - 3. Owens-Corning Fiberglas Corp.
 - 4. Schuller International, Inc. / Johns Manville Insulations
 - 5. Schuller International, Inc.

2.2 INSULATION MATERIALS

- A. Fiber Glass Board Thermal Insulation: Glass fibers bonded with a thermosetting resin. Comply with ASTM C 612, Type IB, without facing and with all-service jacket (FSK) manufactured from kraft paper, reinforcing scrim, aluminum foil, and vinyl film. 'K' value: 0.24 Btu*in/(hr*sqft*degree F) at 75 degree F. Based on Johns Manville 800 Series Spin-Glas.
- B. Fiberglass Blanket Thermal Insulation: Glass fibers bonded with a thermosetting resin. Comply with ASTM C 553, Type II, without facing and with all-service jacket (FSK) manufactured from kraft paper, reinforcing scrim, aluminum foil, and vinyl film. 'K' value: 0.29 Btu*in/(hr*sqft*degree F) at 75 degree F. Based on Johns Manville Microlite.
- C. Rigid Polyisocyanurate Insulation: Closed cell polyisocyanurate core bonded to a tri-lam foil facer on both sides. Comply with ASTM C 1289, Type I, Class 1. 'K' value: 0.17 Btu*in/(hr*sqft*degree F) at 75 degree F. Based on Johns Manville ISO 3 Foil Face.

2.3 FIELD-APPLIED JACKETS

- A. General: ASTM C 921, Type 1, unless otherwise indicated.
- B. Foil and Paper Jacket: Laminated, glass-fiber-reinforced, flame-retardant kraft paper and aluminum foil.
- C. Weatherproofing Jacket: Flexible self-adhering weatherproofing system for insulated duct. Based on MFM Building Products Flex Clad 400, color selected by Architect.
- D. Aluminum Jacket: Deep corrugated sheets manufactured from aluminum alloy complying with ASTM B 209, and having an integrally bonded moisture barrier over entire surface in contact with insulation. Metal thickness and corrugation dimensions are scheduled at the end of this Section.
 - 1. Finish: Smooth finish.
 - 2. Moisture Barrier: 1-mil- thick, heat-bonded polyethylene and kraft paper.

2.4 ACCESSORIES AND ATTACHMENTS

- A. Glass Cloth and Tape: Comply with MIL-C-20079H, Type I for cloth and Type II for tape. Woven glass-fiber fabrics, plain weave, presized a minimum of 8 oz./sq. yd..
 - 1. Tape Width: 4 inches.
- B. Bands: 3/4 inch wide, in one of the following materials compatible with jacket:
 - 1. Stainless Steel: ASTM A 666, Type 304; 0.020 inch thick.
 - 2. Galvanized Steel: 0.005 inch thick.
 - 3. Aluminum: 0.007 inch thick.
 - 4. Brass: 0.010 inch thick.
 - 5. Nickel-Copper Alloy: 0.005 inch thick.

- C. Wire: 0.080-inch, nickel-copper alloy; 0.062-inch, soft-annealed, stainless steel; or 0.062-inch, soft-annealed, galvanized steel.
- D. Weld-Attached Anchor Pins and Washers: Copper-coated steel pin for capacitor-discharge welding and galvanized speed washer. Pin length sufficient for insulation thickness indicated.
 - 1. Welded Pin Holding Capacity: 100 lb for direct pull perpendicular to the attached surface.
- E. Adhesive-Attached Anchor Pins and Speed Washers: Galvanized steel plate, pin, and washer manufactured for attachment to duct and plenum with adhesive. Pin length sufficient for insulation thickness indicated.
 - 1. Adhesive: Recommended by the anchor pin manufacturer as appropriate for surface temperatures of ducts, plenums, and breechings; and to achieve a holding capacity of 100 lb for direct pull perpendicular to the adhered surface.
- F. Self-Adhesive Anchor Pins and Speed Washers: Galvanized steel plate, pin, and washer manufactured for attachment to duct and plenum with adhesive. Pin length sufficient for insulation thickness indicated.

2.5 VAPOR RETARDERS

- A. Mastics: Materials recommended by insulation material manufacturer that are compatible with insulation materials, jackets, and substrates.

PART 3 - EXECUTION

3.1 EXAMINATION

- A. Examine substrates and conditions for compliance with requirements for installation and other conditions affecting performance of insulation application.
- B. Proceed with installation only after unsatisfactory conditions have been corrected.

3.2 PREPARATION

- A. Surface Preparation: Clean and dry surfaces to receive insulation. Remove materials that will adversely affect insulation application.

3.3 GENERAL APPLICATION REQUIREMENTS

- A. Apply insulation materials, accessories, and finishes according to the manufacturer's written instructions; with smooth, straight, and even surfaces; and free of voids throughout the length of ducts and fittings.

- B. Refer to schedules at the end of this Section for materials, forms, jackets, and thicknesses required for each duct system.
- C. Use accessories compatible with insulation materials and suitable for the service. Use accessories that do not corrode, soften, or otherwise attack insulation or jacket in either wet or dry state.
- D. Apply multiple layers of insulation with longitudinal and end seams staggered.
- E. Seal joints and seams with vapor-retarder mastic on insulation indicated to receive a vapor retarder.
- F. Keep insulation materials dry during application and finishing.
- G. Apply insulation with tight longitudinal seams and end joints. Bond seams and joints with adhesive recommended by the insulation material manufacturer.
- H. Apply insulation with the least number of joints practical.
- I. Apply insulation over fittings and specialties, with continuous thermal and vapor-retarder integrity, unless otherwise indicated.
- J. Hangers and Anchors: Where vapor retarder is indicated, seal penetrations in insulation at hangers, supports, anchors, and other projections with vapor-retarder mastic. Apply insulation continuously through hangers and around anchor attachments.
- K. Insulation Terminations: For insulation application where vapor retarders are indicated, seal ends with a compound recommended by the insulation material manufacturer to maintain vapor retarder.
- L. Apply insulation with integral jackets as follows:
 - 1. Pull jacket tight and smooth.
 - 2. Joints and Seams: Cover with tape and vapor retarder as recommended by insulation material manufacturer to maintain vapor seal.
 - 3. Vapor-Retarder Mastics: Where vapor retarders are indicated, apply mastic on seams and joints and at ends adjacent to duct flanges and fittings.
- M. Cut insulation according to manufacturer's written instructions to prevent compressing insulation to less than 75 percent of its nominal thickness.
- N. Install vapor-retarder mastic on ducts and plenums scheduled to receive vapor retarders.
 - 1. Ducts with Vapor Retarders: Overlap insulation facing at seams and seal with vapor-retarder mastic and pressure-sensitive tape having same facing as insulation. Repair punctures, tears, and penetrations with tape or mastic to maintain vapor-retarder seal.
 - 2. Ducts without Vapor Retarders: Overlap insulation facing at seams and secure with outward clinching staples and pressure-sensitive tape having same facing as insulation.

- O. Roof Penetrations: Apply insulation for interior applications to a point even with top of roof flashing.
 - 1. Seal penetrations with vapor-retarder mastic.
 - 2. Apply insulation for exterior applications tightly joined to interior insulation ends.
 - 3. Seal insulation to roof flashing with vapor-retarder mastic.
- P. Interior Wall and Partition Penetrations: Apply insulation continuously through walls and partitions, except fire-rated walls and partitions.
- Q. Fire-Rated Wall and Partition Penetrations: Terminate insulation at fire/smoke damper sleeves for fire-rated wall and partition penetrations.
- R. Floor Penetrations: Terminate insulation at underside of floor assembly and at floor support at top of floor.
 - 1. For insulation indicated to have vapor retarders, taper termination and seal insulation ends with vapor-retarder mastic.

3.4 FIBER GLASS INSULATION APPLICATION

- A. Blanket Applications for Ducts and Plenums: Secure blanket insulation with adhesive and anchor pins and speed washers.
 - 1. Install anchor pins and speed washers on sides and bottom of horizontal ducts and sides of vertical ducts as follows:
 - a. On duct sides with dimensions larger than 24 inches. Space 16 inches o.c. each way, and 3 inches maximum from insulation joints. Apply additional pins and clips to hold insulation tightly against surface at cross bracing.
 - b. Anchor pins may be omitted from top surface of horizontal, rectangular ducts and plenums.
 - c. Do not overcompress insulation during installation.
 - 2. Impale insulation over anchors and attach speed washers.
 - 3. 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. 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 segment with 1/2-inch staples, 1 inch o.c., and cover with pressure-sensitive tape having same facing as insulation.
 - 5. Overlap unfaced blankets a minimum of 2 inches on longitudinal seams and end joints. Secure with steel band at end joints and spaced a maximum of 18 inches o.c.
 - 6. Apply insulation on rectangular duct elbows and transitions with a full insulation segment for each surface. Apply 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 the insulation surface with 6-inch-wide strips of the same material used to insulate duct. Secure on alternating sides of stiffener, hanger, and flange with anchor pins spaced 6 inches o.c.

8. Apply vapor-retarder mastic to open joints, breaks, and punctures for insulation indicated to receive vapor retarder.
 9. Terminate insulation around duct access doors and seal insulation edges.
- B. Board Applications for Ducts and Plenums: Secure board insulation with adhesive and anchor pins and speed washers.
1. Apply adhesives according to manufacturer's recommended coverage rates per square foot, 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. Space anchor pins as follows:
 - a. On duct sides with dimensions 18 inches and smaller, 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 16 inches o.c. each way, and 3 inches maximum from insulation joints. Apply additional pins and clips to hold insulation tightly against surface at cross bracing.
 - c. Anchor pins may be omitted from top surface of horizontal, rectangular ducts and plenums.
 - d. Do not overcompress insulation during installation.
 4. 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.
 5. 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 segment with 1/2-inch staples, 1 inch o.c., and cover with pressure-sensitive tape having same facing as insulation.
 6. Apply insulation on rectangular duct elbows and transitions with a full insulation segment for each surface. Groove and score insulation to fit as closely as possible to outside and inside radius of elbows. Apply 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 the insulation surface with 6-inch- wide strips of the same material used to insulate duct. Secure on alternating sides of stiffener, hanger, and flange with anchor pins spaced 6 inches o.c.
 8. Apply vapor-retarder mastic to open joints, breaks, and punctures for insulation indicated to receive vapor retarder.
 9. Terminate insulation around duct access doors and seal insulation edges.

3.5 FIELD-APPLIED JACKET APPLICATION

- A. Apply glass-cloth jacket, where indicated, directly over bare insulation or insulation with factory-applied jackets.
1. Apply jacket smooth and tight to surface with 2-inch overlap at seams and joints.
 2. Embed glass cloth between two 0.062-inch- thick coats of jacket manufacturer's recommended adhesive.
 3. Completely encapsulate insulation with jacket, leaving no exposed raw insulation.

3.6 DUCT SYSTEM APPLICATIONS

- A. Insulation materials and thicknesses are specified in schedules at the end of this Section.
- B. Materials and thicknesses for systems listed below are specified in schedules at the end of this Section.
- C. Insulate the following plenums and duct systems:
 - 1. Supply ductwork.
 - 2. Return and relief ductwork in mechanical rooms and in unconditioned space.
 - 3. Exhaust ductwork within 10 feet of exterior opening.
 - 4. Outdoor exposed supply and return ductwork.
 - 5. Outdoor air intake and combustion air ductwork.
- D. Items Not Insulated: Unless otherwise indicated, do not apply insulation to the following systems, materials, and equipment:
 - 1. Metal ducts with duct liner.
 - 2. Factory-insulated flexible ducts.
 - 3. Factory-insulated plenums, casings, terminal boxes, and filter boxes and sections.
 - 4. Flexible connectors.
 - 5. Vibration-control devices.
 - 6. Testing agency labels and stamps.
 - 7. Nameplates and data plates.
 - 8. Access panels and doors in air-distribution systems.
 - 9. Preinsulated ductwork.

3.7 INDOOR DUCT AND PLENUM APPLICATION SCHEDULE

- A. Service: Rectangular and round, supply-air ducts, above ceilings, concealed, in mechanical rooms, and in unconditioned space.
 - 1. Material: Fiberglass blanket above ceilings and in concealed areas. Fiberglass board in mechanical spaces.
 - 2. Thickness: 1 ½ inches.
 - 3. Number of Layers: one.
 - 4. Factory-Applied Jacket: FSK. Vapor retarder required on ducts conveying air below ambient temperature.
- B. Service: Rectangular and round, return-air and relief air ducts, in mechanical rooms and in unconditioned space. Exhaust and relief ducts within 10' of exterior opening.
 - 1. Material: Fiberglass board.
 - 2. Thickness: 1 inch.
 - 3. Number of Layers: one.
 - 4. Factory-Applied Jacket: FSK.

- C. Service: Rectangular and round, outside-air intake / combustion air ducts.
 - 1. Material: Fiberglass blanket above ceilings and in concealed areas. Fiberglass board in mechanical spaces.
 - 2. Thickness: 2 inches.
 - 3. Number of Layers: one.
 - 4. Field-Applied Jacket: FSK.
 - 5. Vapor Retarder Required.

- D. Service: Outside air and relief/exhaust air plenums.
 - 1. Material: Fiberglass board.
 - 2. Thickness: 2 inches.
 - 3. Number of Layers: one.
 - 4. Field-Applied Jacket: FSK.
 - 5. Vapor Retarder Required.

END OF SECTION 230701

SECTION 230703

PIPE INSULATION

PART 1 - 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. The requirements of Section 230000, "Basic Mechanical Requirements" apply to work defined by this Section.
- C. The requirements of Section 230500, "Basic Mechanical Materials and Methods" apply to work defined by this Section.

1.2 SUMMARY

- A. This Section includes preformed, rigid and flexible pipe insulation; insulating cements; field-applied jackets; accessories and attachments; and sealing compounds.
- B. Related Sections include the following:
 - 1. Division 7, Section 078413 "Firestopping" for firestopping materials and requirements for penetrations through fire and smoke barriers.
 - 2. Section 230701 "Duct Insulation" for insulation for ducts and plenums.
 - 3. Section 230702 "Equipment Insulation" for insulation materials and application for pumps, tanks, hydronic specialties, and other equipment.
 - 4. Pipe insulation shields and protection saddles, see appropriate piping section.

1.3 SUBMITTALS

- A. General: See Division 1 for general submittal and product substitution requirements.
- B. Pre-Construction Submittals: Submit the following items prior to commencing with installations.
 - 1. Product Data: Identify thermal conductivity, thickness, and jackets (both factory and field applied, if any), for each type of product indicated.
 - 2. Shop Drawings: Show fabrication and installation details for the following:
 - a. Application of protective shields, saddles, and inserts at pipe hangers for each type of insulation and hanger.
 - b. Attachment and covering of heat trace inside insulation.
 - c. Insulation application at pipe expansion joints for each type of insulation.
 - d. Insulation application at elbows, fittings, flanges, valves, and specialties for each type of insulation.

- e. Removable insulation at piping specialties and equipment connections.
- f. Application of field-applied jackets.

1.4 QUALITY ASSURANCE

- A. Installer Qualifications: Skilled mechanics who have successfully completed an apprenticeship program or another craft training program certified by the U.S. Department of Labor, Bureau of Apprenticeship and Training.
- B. Fire-Test-Response Characteristics: As determined by testing materials identical to those specified in this Section according to ASTM E 84, by a testing and inspecting agency acceptable to authorities having jurisdiction. Factory label insulation and jacket materials and sealer and cement material containers with appropriate markings of applicable testing and inspecting agency.
 - 1. Insulation Installed Indoors: Flame-spread rating of 25 or less, and smoke-developed rating of 50 or less.
 - 2. Insulation Installed Outdoors: Flame-spread rating of 75 or less, and smoke-developed rating of 150 or less.

1.5 DELIVERY, STORAGE, AND HANDLING

- A. Packaging: Ship insulation materials in containers marked by manufacturer with appropriate ASTM specification designation, type and grade, and maximum use temperature.

1.6 COORDINATION

- A. Coordinate size and location of supports, hangers, and insulation shields specified in the appropriate piping section.
- B. Coordinate clearance requirements with piping Installer for insulation application.

1.7 SCHEDULING

- A. Schedule insulation application after testing piping systems and, where required. Insulation application may begin on segments of piping that have satisfactory test results.

PART 2 - PRODUCTS

2.1 MANUFACTURERS

- A. Manufacturers: Subject to compliance with requirements, provide products by one of the manufacturers listed below.
- B. Fiber Glass Insulation:

1. CertainTeed.
 2. Knauf FiberGlass.
 3. Owens-Corning Fiberglas Corp.
 4. Schuller International, Inc. / Johns Manville Insulations
- C. Cellular-Glass Insulation:
1. Pittsburgh-Corning Corp.
- D. Flexible Elastomeric Thermal Insulation:
1. Armstrong World Industries, Inc.
 2. Rubatex Corp.
- E. Closed-Cell Phenolic-Foam Insulation:
1. Kooltherm Insulation Products, Ltd.
- F. Calcium Silicate Insulation:
1. Owens-Corning Fiberglas Corp.
 2. Pabco.
 3. Schuller International, Inc. / Johns Manville Insulations

2.2 INSULATION MATERIALS

- A. Fiber Glass Insulation: Glass fibers bonded with a thermosetting resin complying with the following:
1. Thermal conductivity: 0.23 Btu*in/(hr*sq ft*degree F) at 75 degrees F.
 2. Preformed Pipe Insulation: Comply with ASTM C 547, Type 1, with factory-applied, all-purpose, vapor-retarder jacket complying with ASTM C 1136. Based on Johns Manville Micro-Lok.
 3. Blanket Insulation: Comply with ASTM C 553, Type II, without facing.
 4. Fire-Resistant Adhesive: Comply with MIL-A-3316C in the following classes and grades:
 - a. Class 1, Grade A for bonding glass cloth and tape to unfaced glass-fiber insulation, for sealing edges of glass-fiber insulation, and for bonding lagging cloth to unfaced glass-fiber insulation.
 - b. Class 2, Grade A for bonding glass-fiber insulation to metal surfaces.
 5. Vapor-Retarder Mastics: Fire- and water-resistant, vapor-retarder mastic for indoor applications. Comply with MIL-C-19565C, Type II.
- B. Cellular-Glass Insulation: Inorganic, foamed or cellulated glass, annealed, rigid, hermetically sealed cells, incombustible.
1. Preformed Pipe Insulation, without Jacket: Comply with ASTM C 552, Type II, Class 1.
 2. Preformed Pipe Insulation, with Jacket: Comply with ASTM C 552, Type II, Class 2.

3. Thermal conductivity: 0.32 Btu*in/(hr*sq ft*degree F) at 75 degrees F.
 4. Based on Pittsburgh Corning Foamglas.
- C. Flexible Elastomeric Thermal Insulation: Closed-cell, sponge- or expanded-rubber materials. Comply with ASTM C 534, Type I for tubular materials and Type II for sheet materials.
1. Thermal conductivity: 0.27 Btu*in/(hr*sq ft*degree F) at 75 degrees F.
 2. Adhesive: As recommended by insulation material manufacturer.
 3. Ultraviolet-Protective Coating: As recommended by insulation manufacturer.
 4. Based on Armstrong AP Armaflex.
- D. Closed-Cell Phenolic-Foam Insulation: Preformed pipe insulation of rigid, expanded, closed-cell structure. Comply with ASTM C 1126, Type III, Grade 1.
- E. Prefabricated Thermal Insulating Fitting Covers: Comply with ASTM C 450 for dimensions used in preforming insulation to cover valves, elbows, tees, and flanges.

2.3 FIELD-APPLIED JACKETS

- A. General: ASTM C 921, Type 1, unless otherwise indicated.
- B. PVC Jacket: High-impact, ultraviolet-resistant PVC; 20 mils thick; roll stock ready for shop or field cutting and forming.
1. Adhesive: As recommended by insulation material manufacturer.
 2. PVC Jacket Color: White or gray.
- C. Standard PVC Fitting Covers: Factory-fabricated fitting covers manufactured from 20-mil-thick, high-impact, ultraviolet-resistant PVC.
1. Shapes: 45- and 90-degree, short- and long-radius elbows, tees, valves, flanges, reducers, end caps, soil-pipe hubs, traps, mechanical joints, and P-trap and supply covers for lavatories for the disabled.
 2. Adhesive: As recommended by insulation material manufacturer.
- D. Aluminum Jacket: Aluminum roll stock, ready for shop or field cutting and forming to indicated sizes. Comply with ASTM B 209, 3003 alloy, H-14 temper.
1. Finish and Thickness: Smooth finish, 0.010 inch thick.
 2. Moisture Barrier: 1-mil- thick, heat-bonded polyethylene and kraft paper.
 3. Elbows: Preformed, 45- and 90-degree, short- and long-radius elbows; same material, finish, and thickness as jacket.

2.4 ACCESSORIES AND ATTACHMENTS

- A. Glass Cloth and Tape: Comply with MIL-C-20079H, Type I for cloth and Type II for tape. Woven glass-fiber fabrics, plain weave, presized a minimum of 8 oz./sq. yd..
1. Tape Width: 4 inches.

- B. Bands: 3/4 inch wide, in one of the following materials compatible with jacket:
1. Stainless Steel: ASTM A 666, Type 304; 0.020 inch thick.
 2. Galvanized Steel: 0.005 inch thick.
 3. Aluminum: 0.007 inch thick.
 4. Brass: 0.010 inch thick.
 5. Nickel-Copper Alloy: 0.005 inch thick.
- C. Wire: 0.080-inch, nickel-copper alloy; 0.062-inch, soft-annealed, stainless steel; or 0.062-inch, soft-annealed, galvanized steel.

2.5 VAPOR RETARDERS

- A. Mastics: Materials recommended by insulation material manufacturer that are compatible with insulation materials, jackets, and substrates.

PART 3 - EXECUTION

3.1 EXAMINATION

- A. Examine substrates and conditions for compliance with requirements for installation and other conditions affecting performance of insulation application.
- B. Proceed with installation only after unsatisfactory conditions have been corrected.

3.2 PREPARATION

- A. Surface Preparation: Clean and dry pipe and fitting surfaces. Remove materials that will adversely affect insulation application.

3.3 GENERAL APPLICATION REQUIREMENTS

- A. Apply insulation materials, accessories, and finishes according to the manufacturer's written instructions; with smooth, straight, and even surfaces; free of voids throughout the length of piping, including fittings, valves, and specialties.
- B. Refer to schedules at the end of this Section for materials, forms, jackets, and thicknesses required for each piping system.
- C. Use accessories compatible with insulation materials and suitable for the service. Use accessories that do not corrode, soften, or otherwise attack insulation or jacket in either wet or dry state.
- D. Apply insulation with longitudinal seams at top and bottom of horizontal pipe runs.
- E. Apply 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. Seal joints and seams with vapor-retarder mastic on insulation indicated to receive a vapor retarder.
- H. Keep insulation materials dry during application and finishing.
- I. Apply insulation with tight longitudinal seams and end joints. Bond seams and joints with adhesive recommended by the insulation material manufacturer.
- J. Apply insulation with the least number of joints practical.
- K. Apply insulation over fittings, valves, and specialties, with continuous thermal and vapor-retarder integrity, unless otherwise indicated. Refer to special instructions for applying insulation over fittings, valves, and specialties.
- L. Hangers and Anchors: Where vapor retarder is indicated, seal penetrations in insulation at hangers, supports, anchors, and other projections with vapor-retarder mastic.
 - 1. Apply insulation continuously through hangers and around anchor attachments.
 - 2. For insulation application where vapor retarders are indicated, extend insulation on anchor legs at least 12 inches from point of attachment to pipe and taper insulation ends. Seal tapered ends with a compound recommended by the insulation material manufacturer to maintain vapor retarder.
 - 3. Install insert materials and apply insulation to tightly join the insert. Seal insulation to insulation inserts with adhesive or sealing compound recommended by the insulation material manufacturer.
 - 4. Cover inserts with jacket material matching adjacent pipe insulation. Install shields over jacket, arranged to protect the jacket from tear or puncture by the hanger, support, and shield.
- M. Insulation Terminations: For insulation application where vapor retarders are indicated, taper insulation ends. Seal tapered ends with a compound recommended by the insulation material manufacturer to maintain vapor retarder.
- N. Apply adhesives and mastics at the manufacturer's recommended coverage rate.
- O. Apply insulation with integral jackets as follows:
 - 1. Pull jacket tight and smooth.
 - 2. Circumferential Joints: Cover with 3-inch- wide strips, of same material as insulation jacket. Secure strips with adhesive and outward clinching staples along both edges of strip and spaced 4 inches o.c.
 - 3. Longitudinal Seams: Overlap jacket seams at least 1-1/2 inches. Apply 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 4 inches o.c.
 - a. Exception: Do not staple longitudinal laps on insulation having a vapor retarder.

4. Vapor-Retarder Mastics: Where vapor retarders are indicated, apply mastic on seams and joints and at ends adjacent to flanges, unions, valves, and fittings.
 5. At penetrations in jackets for thermometers and pressure gages, fill and seal voids with vapor-retarder mastic.
- P. Roof Penetrations: Apply insulation for interior applications to a point even with top of roof flashing.
1. Seal penetrations with vapor-retarder mastic.
 2. Apply insulation for exterior applications tightly joined to interior insulation ends.
 3. Extend metal jacket of exterior insulation outside roof flashing at least 2 inches below top of roof flashing.
 4. Seal metal jacket to roof flashing with vapor-retarder mastic.
- Q. Exterior Wall Penetrations: For penetrations of below-grade exterior walls, terminate insulation flush with mechanical sleeve seal. Seal terminations with vapor-retarder mastic.
- R. Interior Wall and Partition Penetrations: Apply insulation continuously through walls and floors.
- S. Fire-Rated Wall and Partition Penetrations: Apply insulation continuously through penetrations of fire-rated walls and partitions.
1. Firestopping and fire-resistive joint sealers are specified in Division 7 Section 072700 "Firestopping."
- T. Floor Penetrations: Apply insulation continuously through floor assembly.
1. For insulation with vapor retarders, seal insulation with vapor-retarder mastic where floor supports penetrate vapor retarder.

3.4 FIBER GLASS INSULATION APPLICATION

- A. Apply insulation to straight pipes and tubes as follows:
1. Secure each layer of preformed pipe insulation to pipe with wire, tape, or bands without deforming insulation materials.
 2. Where vapor retarders are indicated, seal longitudinal seams and end joints with vapor-retarder mastic. Apply vapor retarder to ends of insulation at intervals of 15 to 20 feet to form a vapor retarder between pipe insulation segments.
 3. For insulation with factory-applied jackets, secure laps with outward clinched staples at 6 inches o.c.
 4. For insulation with factory-applied jackets with vapor retarders, do not staple longitudinal tabs but secure tabs with additional adhesive as recommended by the insulation material manufacturer and seal with vapor-retarder mastic.
- B. Apply insulation to flanges as follows:
1. Apply preformed pipe insulation to outer diameter of pipe flange.

2. Make width of insulation segment the same as overall width of the flange and bolts, plus twice the thickness of the 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. Apply canvas jacket material with manufacturer's recommended adhesive, overlapping seams at least 1 inch, and seal joints with vapor-retarder mastic.

C. Apply insulation to fittings and elbows as follows:

1. Apply premolded insulation sections of the same material as straight segments of pipe insulation when available. Secure according to manufacturer's written instructions.
2. When premolded insulation elbows and fittings are not available, apply mitered sections of pipe insulation, or glass-fiber blanket insulation, to a thickness equal to adjoining pipe insulation. Secure insulation materials with wire, tape, or bands.
3. Cover fittings with standard PVC fitting covers.

D. Apply insulation to valves and specialties as follows:

1. Apply premolded insulation sections of the same material as straight segments of pipe insulation when available. Secure according to manufacturer's written instructions.
2. When premolded insulation sections are not available, apply glass-fiber blanket insulation to valve body. Arrange insulation to permit access to packing and to allow valve operation without disturbing insulation. For check valves, arrange insulation for access to stainer basket without disturbing insulation.
3. Apply insulation to flanges as specified for flange insulation application.
4. Use preformed standard PVC fitting covers for valve sizes where available. Secure fitting covers with manufacturer's attachments and accessories. Seal seams with tape and vapor-retarder mastic.
5. For larger sizes where PVC fitting covers are not available, seal insulation with canvas jacket and sealing compound recommended by the insulation material manufacturer.

3.5 CELLULAR-GLASS INSULATION APPLICATION

A. Apply insulation to straight pipes and tubes as follows:

1. Secure each layer of insulation to pipe with wire, tape, or bands without deforming insulation materials.
2. Where vapor retarders are indicated, seal longitudinal seams and end joints with vapor-retarder mastic.
3. For insulation with factory-applied jackets, secure laps with outward clinched staples at 6 inches o.c.
4. For insulation with factory-applied jackets with vapor retarders, do not staple longitudinal tabs but secure tabs with additional adhesive as recommended by the insulation material manufacturer and seal with vapor-retarder mastic.

B. Apply insulation to flanges as follows:

1. Apply preformed pipe insulation to outer diameter of pipe flange.

2. Make width of insulation segment the same as overall width of the flange and bolts, plus twice the thickness of the 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 the same thickness as pipe insulation.
4. Apply canvas jacket material with manufacturer's recommended adhesive, overlapping seams at least 1 inch, and seal joints with vapor-retarder mastic.

C. Apply insulation to fittings and elbows as follows:

1. Apply premolded insulation sections of the same material as straight segments of pipe insulation when available. Secure according to manufacturer's written instructions.
2. When premolded sections of insulation are not available, apply mitered sections of cellular-glass insulation. Secure insulation materials with wire, tape, or bands.
3. Cover fittings with standard PVC fitting covers.
4. Cover fittings with heavy PVC fitting covers. Overlap PVC covers on pipe insulation jackets at least 1 inch at each end. Secure fitting covers with manufacturer's attachments and accessories. Seal seams with tape and vapor-retarder mastic.

D. Apply insulation to valves and specialties as follows:

1. Apply premolded segments of cellular-glass insulation or glass-fiber blanket insulation to valve body. Arrange insulation to permit access to packing and to allow valve operation without disturbing insulation. For check valves, arrange insulation for access to stainer basket without disturbing insulation.
2. Apply insulation to flanges as specified for flange insulation application.
3. Use preformed standard PVC fitting covers for valve sizes where available. Secure fitting covers with manufacturer's attachments and accessories. Seal seams with tape and vapor-retarder mastic.

3.6 FLEXIBLE ELASTOMERIC THERMAL INSULATION APPLICATION

A. Apply insulation to straight pipes and tubes as follows:

1. Follow manufacturer's written instructions for applying insulation.
2. Seal longitudinal seams and end joints with manufacturer's recommended adhesive. Cement to avoid openings in insulation that will allow passage of air to the pipe surface.

B. Apply insulation to flanges as follows:

1. Apply pipe insulation to outer diameter of pipe flange.
2. Make width of insulation segment the same as overall width of the flange and bolts, plus twice the thickness of the 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 the same thickness as pipe insulation.
4. Secure insulation to flanges and seal seams with manufacturer's recommended adhesive. Cement to avoid openings in insulation that will allow passage of air to the pipe surface.

- C. Apply insulation to fittings and elbows as follows:
 - 1. Apply mitered sections of pipe insulation.
 - 2. Secure insulation materials and seal seams with manufacturer's recommended adhesive. Cement to avoid openings in insulation that will allow passage of air to the pipe surface.

- D. Apply insulation to valves and specialties as follows:
 - 1. Apply preformed valve covers manufactured of the same material as pipe insulation and attached according to the manufacturer's written instructions.
 - 2. Apply cut segments of pipe and sheet insulation to valve body. Arrange insulation to permit access to packing and to allow valve operation without disturbing insulation. For check valves, fabricate removable sections of insulation arranged to allow access to strainer basket.
 - 3. Apply insulation to flanges as specified for flange insulation application.
 - 4. Secure insulation to valves and specialties and seal seams with manufacturer's recommended adhesive. Cement to avoid openings in insulation that will allow passage of air to the pipe surface.

- E. FIELD-APPLIED JACKET APPLICATION
 - 1. Apply PVC jacket where indicated, with 1-inch overlap at longitudinal seams and end joints. Seal with manufacturer's recommended adhesive.
 - 2.
 - 3. Apply metal jacket where indicated, 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.

3.7 FINISHES

- A. Flexible Elastomeric Thermal Insulation: After adhesive has fully cured, apply two coats of the insulation manufacturer's recommended protective coating.

3.8 PIPING SYSTEM APPLICATIONS

- A. Insulation materials and thicknesses are specified in schedules at the end of this Section.

- B. Items Not Insulated: Unless otherwise indicated, do not apply insulation to the following systems, materials, and equipment:
 - 1. Flexible connectors.
 - 2. Vibration-control devices.
 - 3. Fire-suppression piping.
 - 4. Drainage piping located in crawl spaces, unless otherwise indicated.
 - 5. Below-grade piping, unless otherwise indicated.
 - 6. Chrome-plated pipes and fittings, unless potential for personnel injury.
 - 7. Air chambers, unions, strainers, check valves, plug valves, and flow regulators.

8. Flanges and unions at equipment on hot piping systems conveying fluids 140 degrees F or less. Bevel and seal ends of insulation.

3.9 INSULATION APPLICATION SCHEDULE, GENERAL

- A. Refer to insulation application schedules for required insulation materials, vapor retarders, and field-applied jackets.
- B. Application schedules identify piping system and indicate pipe size ranges and material, thickness, and jacket requirements.

3.10 INSULATION APPLICATION SCHEDULE

- A. Service: Domestic hot and recirculated hot water.
 1. Operating Temperature: 60 to 140 deg F.
 2. Insulation Material: Fiberglass with factory kraft jacket above ceilings and in concealed areas. Fiberglass with pvc jacket in mechanical spaces.
 3. Insulation Thickness: Apply the following insulation thicknesses:
 - a. Piping up to 1 1/4": 0.5" thickness.
 - b. Piping 1-1/4" and greater: 1" thickness.
 4. Vapor Retarder Required: No.
 5. Finish: None.
- B. Service: Domestic cold water.
 1. Operating Temperature: 35 to 60 deg F.
 2. Insulation Material: Fiberglass Fiberglass with factory kraft jacket above ceilings and in concealed areas. Fiberglass with PVC jacket in mechanical spaces.
 3. Insulation Thickness: Apply the following insulation thicknesses:
 - a. Piping up to 1 1/4": 0.5" thickness.
 - b. Piping 1-1/4" and greater: 1" thickness.
 4. Vapor Retarder Required: Yes.
 5. Finish: None.
- C. Service: Refrigerant suction and hot-gas piping.
 1. Operating Temperature: 40 to 60 deg F (2 to 10 deg C).
 2. Insulation Material: Flexible elastomeric.
 3. Insulation Thickness: Apply the following insulation thicknesses:
 - a. All piping: 1" thickness.
 4. Finish:
 - a. Indoors: none.
 - b. Outdoors: weather-resistant protective finish equal to field applied, vinyl/acrylic water based, Rubatex Armaflex Protective Coating.

- D. Service: Heating hot-water supply and return.
1. Operating Temperature: 100 to 200 deg F.
 2. Insulation Material: Fiberglass with FSK jacket.
 3. Insulation Thickness: Apply the following insulation thicknesses:
 - a. Piping up to 4": 1.0" thickness.
 - b. Piping 4" and greater: 1.5" thickness.
 4. Vapor Retarder Required: No.
 5. Finish: none.
 - E. Service: Low Pressure Steam (up to 15 psig) and condensate.
 1. Operating Temperature: 212 to 250 deg F.
 2. Insulation Material: Fiberglass with jacket.
 3. Insulation Thickness: Apply the following insulation thicknesses:
 - a. Piping up to 1": 1.5" thickness.
 - b. Piping 1.25" and greater: 2.0" thickness.
 4. Vapor Retarder Required: No.
 5. Finish: None

END OF SECTION 230703

SECTION 232113

HYDRONIC PIPING AND SPECIALTIES

PART 1 - 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. The requirements of Section 230000, "Basic Mechanical Requirements" apply to work defined by this Section.
- C. The requirements of Section 230500, "Basic Mechanical Materials and Methods" apply to work defined by the Section.

1.2 SUMMARY

- A. This Section includes piping, general-duty valves, special-duty valves, and hydronic specialties for hot-water heating, chilled-water cooling, and condenser water systems; makeup water for these systems; blowdown drain lines; and condensate drain piping.
- B. Related Sections include the following:
 - 1. Division 7, Section 078413 "Through-Penetration Firestop Systems" for materials and methods for sealing pipe penetrations through fire and smoke barriers.
 - 2. Division 7, Section 079200 "Joint Sealants" for materials and methods for sealing pipe penetrations through exterior walls.
 - 3. Division 23, Section 230500 "Basic Mechanical Materials and Methods" for general piping materials and installation requirements.
 - 4. Division 23, Section 230519 "Meters and Gages" for thermometers, flow meters, and pressure gages.
 - 5. Division 23, Section 230553 "Mechanical Identification" for labeling and identifying hydronic piping.
 - 6. Division 23, Section 230900 "HVAC Instrumentation and Controls" for temperature-control valves and sensors.

1.3 DEFINITIONS

- A. CPVC: Chlorinated polyvinyl chloride.
- B. CWP: Cold working pressure.
- C. EPDM: Ethylene-propylene-diene terpolymer rubber.

- D. NBR: Acrylonitrile-butadiene rubber.
- E. PTFE: Polytetrafluoroethylene plastic.
- F. PVC: Polyvinyl chloride
- G. TFE: Tetrafluoroethylene plastic.

1.4 SUBMITTALS

- A. Product Data: For each type of general-duty valve indicated. Include body, seating, and trim materials; valve design; pressure and temperature classifications; end connections; arrangement; dimensions; and required clearances. Include list indicating valve and its application. Include rated capacities; shipping, installed, and operating weights; furnished specialties; and accessories
- B. Product Data: For each type of special-duty valve indicated. Include flow and pressure drop curves based on manufacturer's testing for diverting fittings, calibrated balancing valves, and automatic flow-control valves.
- C. Shop Drawings: Detail fabrication of pipe anchors, hangers, special pipe support assemblies, alignment guides, expansion joints and loops, and their attachment to the building structure. Detail location of anchors, alignment guides, and expansion joints and loops.
- D. Welding Certificates: Copies of certificates for welding procedures and personnel.
- E. Field Test Reports: Written reports of tests specified in Part 3 of this Section. Include the following:
 - 1. Test procedures used.
 - 2. Test results that comply with requirements.
 - 3. Failed test results and corrective action taken to achieve requirements.
- F. Maintenance Data: For hydronic specialties and special-duty valves to include in maintenance manuals specified in Division 1.
- G. Water Analysis: Submit a copy of the water analysis to illustrate water quality available at Project site.

1.5 QUALITY ASSURANCE

- A. Welding: Qualify processes and operators according to the ASME Boiler and Pressure Vessel Code: Section IX, "Welding and Brazing Qualifications."
- B. ASME Compliance: Comply with ASME B31.9, "Building Services Piping," for materials, products, and installation. Safety valves and pressure vessels shall bear the appropriate ASME label. Fabricate and stamp air separators and expansion tanks to comply with the ASME Boiler and Pressure Vessel Code, Section VIII, Division 1.

- C. ASME Compliance: ASME B31.9 for building services piping valves.
- D. ASME Compliance for Ferrous Valves: ASME B16.10 and ASME B16.34 for dimension and design criteria.

1.6 COORDINATION

- A. Coordinate layout and installation of hydronic piping and suspension system components with other construction, including light fixtures, HVAC equipment, fire-suppression-system components, and partition assemblies.
- B. Coordinate pipe sleeve installations for foundation wall penetrations.
- C. Coordinate piping installation with roof curbs, equipment supports, and roof penetrations. Roof specialties are specified in Division 7 Sections.
- D. Coordinate pipe fitting pressure classes with products specified in related Sections.
- E. Coordinate size and location of concrete bases. Cast anchor-bolt inserts into base. Concrete, reinforcement, and formwork requirements are specified in Division 3 Sections.
- F. Coordinate installation of pipe sleeves for penetrations through exterior walls and floor assemblies. Coordinate with requirements for firestopping specified in Division 7, Section 07841 "Through-Penetration Firestop Systems" for fire and smoke wall and floor assemblies.

1.7 DELIVERY, STORAGE, AND HANDLING

- A. Prepare valves for shipping as follows:
 - 1. Protect internal parts against rust and corrosion.
 - 2. Protect threads, flange faces, grooves, and weld ends.
 - 3. Set angle, gate, and globe valves closed to prevent rattling.
 - 4. Set ball and plug valves open to minimize exposure of functional surfaces.
 - 5. Set butterfly valves closed or slightly open.
 - 6. Block check valves in either closed or open position.
- B. Use the following precautions during storage:
 - 1. Maintain valve end protection.
 - 2. Store valves indoors and maintain at higher than ambient dew-point temperature. If outdoor storage is necessary, store valves off the ground in watertight enclosures.
- C. Use sling to handle large valves; rig sling to avoid damage to exposed parts. Do not use handwheels or stems as lifting or rigging points.

1.8 EXTRA MATERIALS

- A. Water Treatment Chemicals: Furnish sufficient chemicals for initial system startup and for preventive maintenance for one year from date of Substantial Completion.

PART 2 - PRODUCTS

2.1 MANUFACTURERS

- 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. General-Duty Valves:
 - a. Crane Co.; Crane Valve Group; Crane Valves.
 - b. Crane Co.; Crane Valve Group; Jenkins Valves.
 - c. Crane Co.; Crane Valve Group; Stockham Div.
 - d. Hammond Valve.
 - e. Milwaukee Valve Company.
 - f. NIBCO INC.
 - g. Red-White Valve Corp.
2. Grooved Mechanical-Joint Fittings and Couplings:
 - a. Grinnell Corporation.
 - b. Victaulic Company of America.
 - c. Shurjoint Piping Products
3. Calibrated Balancing Valves:
 - a. Armstrong Pumps, Inc.
 - b. Danfoss
 - c. Flow Design, Inc.
 - d. Griswold Controls.
 - e. ITT Bell & Gossett; ITT Fluid Technology Corp.
 - f. Taco, Inc.
4. Pre-assembled coil piping kits:
 - a. Flow Design, Inc.
 - b. Griswold Controls
 - c. Hayes Fluid Controls
5. Automatic Flow-Control Valves:
 - a. Flow Design, Inc.
 - b. Griswold Controls.
 - c. Hayes Fluid Controls

2.2 PIPING MATERIALS

- A. General: Refer to Part 3 "Piping Applications" Article for applications of pipe and fitting materials.

2.3 COPPER TUBE AND FITTINGS

- A. Drawn-Temper Copper Tubing: ASTM B 88, Type L.
- B. Annealed-Temper Copper Tubing: ASTM B 88, Type K.
- C. DWV Copper Tubing: ASTM B 306, Type DWV.
- D. Wrought-Copper Fittings: ASME B16.22.
- E. Wrought-Copper Unions: ASME B16.22.
- F. Solder Filler Metals: ASTM B 32, 95-5 tin antimony.
- G. Brazing Filler Metals: AWS A5.8, Classification BAg-1 (silver).

2.4 STEEL PIPE AND FITTINGS

- A. Steel Pipe, NPS 2 and Smaller: ASTM A 53, Type S (seamless) or Type F (furnace-butt welded), Grade B, Schedule 40, black steel, plain ends.
- B. Steel Pipe, NPS 2-1/2 through NPS 12: ASTM A 53, Type E (electric-resistance welded), Grade B, Schedule 40, black steel, plain ends.
 - 1. Steel Pipe Nipples: ASTM A 733, made of ASTM A 53, Schedule 40, black steel; seamless for NPS 2 and smaller and electric-resistance welded for NPS 2-1/2 and larger.
- C. Cast-Iron Threaded Fittings: ASME B16.4; Classes 125 and 250.
- D. Malleable-Iron Threaded Fittings: ASME B16.3, Classes 150 and 300.
- E. Malleable-Iron Unions: ASME B16.39; Classes 150, 250, and 300.
- F. Cast-Iron Pipe Flanges and Flanged Fittings: ASME B16.1, Classes 25, 125, and 250; raised ground face, and bolt holes spot faced.
- G. Wrought-Steel Fittings: ASTM A 234/A 234M, wall thickness to match adjoining pipe.
- H. Wrought Cast- and Forged-Steel Flanges and Flanged Fittings: ASME B16.5, including bolts, nuts, and gaskets of the following material group, end connections, and facings:
 - 1. Material Group: 1.1.
 - 2. End Connections: Butt-welding.
 - 3. Facings: Raised face.

- I. Grooved Mechanical-Joint Fittings: ASTM A 536, Grade 65-45-12 ductile iron; ASTM A 47, Grade 32510 malleable iron; ASTM A 53, Type F, E, or S, Grade B fabricated steel; or ASTM A 106, Grade B steel fittings with grooves or shoulders designed to accept grooved end couplings.
 - J. Grooved Mechanical-Joint Couplings: Ductile- or malleable-iron housing and synthetic rubber gasket of central cavity pressure-responsive design; with nuts, bolts, locking pin, locking toggle, or lugs to secure grooved pipe and fittings.
 - K. Flexible Connectors: Stainless-steel bellows with woven, flexible, bronze, wire-reinforcing protective jacket; 150-psig minimum working pressure and 250 deg F maximum operating temperature. Connectors shall have flanged or threaded-end connections to match equipment connected and shall be capable of 3/4-inch misalignment.
 - L. Spherical, Rubber, Flexible Connectors: Fiber-reinforced rubber body with steel flanges drilled to align with Classes 150 and 300 steel flanges; operating temperatures up to 250 deg F and pressures up to 150 psig.
 - M. Welding Materials: Comply with Section II, Part C, of the ASME Boiler and Pressure Vessel Code for welding materials appropriate for wall thickness and for chemical analysis of pipe being welded.
 - N. Gasket Material: Thickness, material, and type suitable for fluid to be handled; and design temperatures and pressures.
- 2.5 SPECIAL-DUTY VALVES
- A. Refer to Part 3 "Valve Applications" Article for applications of each valve.
 - B. Calibrated Balancing Valves, NPS 2 and Smaller: Bronze body, ball type, 125-psig working pressure, 250 deg F maximum operating temperature, and having threaded ends. Valves shall have calibrated orifice or venturi, connections for portable differential pressure meter with integral seals, and be equipped with a memory stop to retain set position.
 - C. Calibrated Balancing Valves, NPS 2-1/2 and Larger: Cast-iron or steel body, ball type, 125-psig working pressure, 250 deg F maximum operating temperature, and having flanged or grooved connections. Valves shall have calibrated orifice or venturi, connections for portable differential pressure meter with integral seals, and be equipped with a memory stop to retain set position.
 - D. Pressure-Reducing Valves: Diaphragm-operated, bronze or brass body with low inlet pressure check valve, inlet strainer removable without system shutdown, and noncorrosive valve seat and stem. Select valve size, capacity, and operating pressure to suit system. Valve shall be factory set at operating pressure and have capability for field adjustment.
 - E. Safety Valves: Diaphragm-operated, bronze or brass body with brass and rubber, wetted, internal working parts; shall suit system pressure and heat capacity and shall comply with the ASME Boiler and Pressure Vessel Code, Section IV.

- F. Automatic Flow-Control Valves: Gray-iron body, factory set to maintain constant flow with plus or minus 5 percent over system pressure fluctuations, and equipped with a readout kit including flow meter, probes, hoses, flow charts, and carrying case. Each valve shall have an identification tag attached by chain, and be factory marked with the zone identification, valve number, and flow rate. Valve shall be line size and one of the following designs:
1. Gray-iron or brass body, designed for 175 psig at 200 deg F with stainless-steel piston and spring.
 2. Brass or ferrous-metal body, designed for 300 psig at 250 deg F with corrosion-resistant, tamperproof, self-cleaning, piston-spring assembly easily removable for inspection or replacement.
 3. Combination assemblies, including bronze ball valve and brass alloy control valve, with stainless-steel piston and spring, fitted with pressure and temperature test valves, and designed for 300 psig at 250 deg F.

2.6 PRE-ASSEMBLED COIL PIPING KITS

A. General:

1. Automatic flow control valve cartridges shall automatically control flow rates with $\pm 5\%$ accuracy over an operating pressure differential range of at least 14 times the minimum required for control.
2. Valve internal control mechanism shall consist of a stainless steel one-piece cartridge with segmented port design and full travel linear coil spring.
3. Manufacturer shall be able to provide certified independent laboratory tests verifying accuracy of performance.
4. All flow control valve cartridges shall be warranted by the manufacturer for five years from date of sale.

B. Terminal unit piping kits

1. Valves shall have an ASTM brass alloy body, rated at no less than 300 psi at 250 degrees F.
2. Valves shall have a one-piece body to include a handle ball valve, removable Y-strainer, a flow control cartridge assembly, dual pressure/temperature test ports, drain valve with hose bib adapter and cap, and a union end.
3. 2-way automatic control valve – Provided by Control Contractor.
4. Piping kits shall contain braided stainless steel over a synthetic polymer liner for all terminal units that contain fans. Hoses shall meet or exceed all flame and smoke spread ratings as required by code.
5. Piping kits shall contain all components shown on the coil piping schematics on the drawings.

2.7 HYDRONIC SPECIALTIES

- A. Manual Air Vent: Bronze body and nonferrous internal parts; 150-psig working pressure; 225 deg F operating temperature; manually operated with screwdriver or thumbscrew; with NPS 1/8 discharge connection and NPS 1/2 inlet connection.

- B. Automatic Air Vent: Designed to vent automatically with float principle; bronze body and nonferrous internal parts; 150-psig working pressure; 240 deg F operating temperature; with NPS 1/4 discharge connection and NPS 1/2 inlet connection.
- C. Y-Pattern Strainers: 125-psig working pressure; cast-iron body (ASTM A 126, Class B), flanged ends for NPS 2-1/2 and larger, threaded connections for NPS 2 and smaller, bolted cover, perforated stainless-steel basket, and bottom drain connection.
- D. Flexible Connectors: Stainless-steel bellows with woven, flexible, bronze, wire-reinforcing protective jacket; 150-psig minimum working pressure and 250 deg F maximum operating temperature. Connectors shall have flanged- or threaded-end connections to match equipment connected and shall be capable of 3/4-inch misalignment.
- E. Spherical, Rubber, Flexible Connectors: Fiber-reinforced rubber body with steel flanges drilled to align with Classes 150 and 300 steel flanges; operating temperatures up to 250 deg F and pressures up to 150 psig.

2.8 VALVES, GENERAL

- A. Refer to Part 3 "Valve Applications" Article for applications of valves.
- B. Bronze Valves: NPS 2 and smaller with threaded ends, unless otherwise indicated.
- C. Ferrous Valves: NPS 2-1/2 and larger with flanged ends, unless otherwise indicated.
- D. Valve Pressure and Temperature Ratings: Not less than indicated and as required for system pressures and temperatures.
- E. Valve Sizes: Same as upstream pipe, unless otherwise indicated.
- F. Valve Actuators:
 - 1. Handwheel: For valves other than quarter-turn types.
 - 2. Lever Handle: For quarter-turn valves NPS 6 and smaller, except plug valves.
- G. Extended Valve Stems: On insulated valves.
- H. Valve Flanges: ASME B16.1 for cast-iron valves, ASME B16.5 for steel valves, and ASME B16.24 for bronze valves.
- I. Valve Grooved Ends: AWWA C606.
 - 1. Solder Joint: With sockets according to ASME B16.18.
 - a. Caution: Use solder with melting point below 840 deg F for angle, check, gate, and globe valves; below 421 deg F for ball valves.
 - 2. Threaded: With threads according to ASME B1.20.1.
- J. Valve Bypass and Drain Connections: MSS SP-45.

2.9 COPPER-ALLOY BALL VALVES

- A. MSS SP-110, Two-Piece, Copper-Alloy Ball Valves: Bronze body with large-port, chrome-plated bronze ball; PTFE or TFE seats; and 600-psig minimum CWP rating and blowout-proof stem. O-ring only stem seals shall not be acceptable.
 - 1. Basis of Design: Hammond 8501/8511.

2.10 FERROUS-ALLOY BUTTERFLY VALVES

- A. Ferrous-Alloy Butterfly Valves, General: MSS SP-67, Type I, for tight shutoff, with bronze disc and lining suitable for potable water, EPDM seats, unless otherwise indicated.
- B. Wafer-Type Flangeless, 200-psig CWP Rating, Ferrous-Alloy Butterfly Valves: Wafer type with two-piece stainless steel stem, dead end rated at no less than 150 psig.
 - 1. Basis of Design: Hammond 6100.
- C. Lug-Type Single-Flange, 200-psig CWP Rating, Ferrous-Alloy Butterfly Valves: Wafer-lug type with two-piece stainless steel stem, dead end rated at no less than 150 psig.
 - 1. Basis of Design: Hammond 6200.
- D. Grooved-End, 175-psig CWP Rating, Ferrous-Alloy Butterfly Valves: Ductile-iron or steel body with grooved or shouldered ends.
 - 1. Basis of Design: Hammond 5100.

2.11 BRONZE CHECK VALVES

- A. MSS SP-80 Type 4, Class 125, Bronze, Swing Check Valves: Bronze body with nonmetallic disc and bronze seat.
 - 1. Basis of Design: Hammond IB 940/945.

2.12 GRAY-IRON SWING CHECK VALVES

- A. MSS SP-71 Type I, Class 125, 175-psig CWP Rating, Grooved-End, Swing Check Valves: Gray-iron, metal seats, ductile-iron body with grooved or shouldered ends.

2.13 SPRING-LOADED, LIFT-DISC CHECK VALVES

- A. FCI 74-1, Type II, Class 125, Compact-Wafer, Lift-Disc Check Valves: Compact-wafer style with cast-iron shell with diameter made to fit within bolt circle; spring-loaded bronze or alloy disc and bronze or alloy seat

2.14 BRONZE GATE VALVES

- A. MSS SP-80 Type 2, Class 125, Bronze Gate Valves: Bronze body with rising stem and bronze solid wedge union-ring bonnet, and ferrous-alloy handwheel.
 - 1. Basis of Design: Hammond IB 617/635.

2.15 CAST-IRON GATE VALVES

- A. Cast-Iron Gate Valves, General: MSS SP-70, Type I.
- B. MSS SP-70, Type 1, Class 125, OS&Y, Bronze-Mounted, Cast-Iron Gate Valves: Cast-iron body with bronze trim, rising stem, and solid-wedge disc.

2.16 BRONZE GLOBE VALVES

- A. MSS SP-80, Type 2, Class 125, Bronze Globe Valves: Bronze body with PTFE or TFE disc union-ring bonnet and ferrous-alloy handwheel.
 - 1. Basis of Design: Hammond IB 416T/423.

2.17 CAST-IRON GLOBE VALVES

- A. MSS SP-85 Type I, Class 125, Cast-Iron Globe Valves: Gray-iron body with bronze seats.
 - 1. Basis of Design: Hammond IR 116.

PART 3 - EXECUTION

3.1 PIPING APPLICATIONS

- A. Hot and Chilled Water: Aboveground, NPS ½ to NPS 2” use Type L drawn-temper copper tubing with soldered joints. Below ground or within slabs, use Type K annealed-temper copper tubing with brazed joints. Use the fewest possible joints belowground and within slabs.
- B. Hot and Chilled Water, NPS 2-1/2 and Larger: Schedule 40 steel pipe with welded and flanged joints or grooved mechanical-joint couplings.
- C. Condensate Drain Lines: Type L drawn-temper copper tubing with soldered joints.

3.2 VALVE APPLICATIONS

- A. General-Duty Valve Applications: Unless otherwise indicated, use the following valve types:
 - 1. Shutoff Duty: Gate, ball, and butterfly valves.
 - 2. Throttling Duty: Globe, ball, and butterfly valves.
 - 3. Pump Discharge: Spring-loaded, lift-disc check valves.
- B. Install shutoff duty valves at each branch connection to supply mains, at supply connection to each piece of equipment, unless only one piece of equipment is connected in the branch line. Install throttling duty valves at each branch connection to return mains, at return connections to each piece of equipment, and elsewhere as indicated.
- C. Install pre-assembled coil piping kits with automatic balancing valves in the return water line of each heating or cooling element and elsewhere as required to facilitate system balancing.

- D. Install pre-assembled coil piping kits with automatic balancing valves at each VAV terminal unit, radiant heating panel terminal.
- E. Install check valves at each pump discharge and elsewhere as required to control flow direction.
- F. Install safety valves on hot-water generators and elsewhere as required by the ASME Boiler and Pressure Vessel Code. Install safety-valve discharge piping, without valves, to floor. Comply with the ASME Boiler and Pressure Vessel Code, Section VIII, Division 1, for installation requirements.
- G. Install pressure-reducing valves on hot-water generators and elsewhere as required to regulate system pressure.
- H. 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.
- I. Chilled-Water and Heating Water Piping: Use the following types of valves:
 - 1. Ball Valves, NPS 2 and Smaller: Two-piece, 600-psig CWP rating, copper alloy.
 - 2. Butterfly Valves, NPS 2-1/2 and Larger: Wafer or Lug-Type, 200-psig CWP rating, ferrous alloy, with EPDM liner.
 - 3. Grooved-End, Ductile-Iron Butterfly Valves, NPS 2-1/2 and Larger: 300-psig CWP rating.
 - 4. Swing Check Valves, NPS 2 and Smaller: Type 4, Class 125, bronze.
 - 5. Swing Check Valves, NPS 2-1/2 and Larger: Type I, Class 125, gray iron.
 - 6. Spring-Loaded, Lift-Disc Check Valves, NPS 2 and Smaller: Type IV, Class 125 minimum.
 - 7. Spring-Loaded, Lift-Disc Check Valves, NPS 2-1/2 and Larger: Type II, Class 125, cast iron.
 - 8. Gate Valves, NPS 2 and Smaller: Type 2, Class 125, bronze.
 - 9. Gate Valves, NPS 2-1/2 and Larger: Type I, Class 125, OS&Y, bronze-mounted cast iron.
 - 10. Globe Valves, NPS 2 and Smaller: Type 2, Class 125, bronze.
 - 11. Globe Valves, NPS 2-1/2 and Larger: Type I, Class 125, bronze-mounted cast iron.
- J. Select valves, except wafer and flangeless types, with the following end connections:
 - 1. For Copper Tubing, NPS 2 and Smaller: Solder-joint or threaded ends, except provide valves with threaded ends for heating hot water and steam services.
 - 2. For Copper Tubing, NPS 2-1/2 to NPS 4: Flanged ends.
 - 3. For Copper Tubing, NPS 5 and Larger: Flanged ends.
 - 4. For Steel Piping, NPS 2 and Smaller: Threaded ends.
 - 5. For Steel Piping, NPS 2-1/2 to NPS 4: Flanged ends.
 - 6. For Steel Piping, NPS 5 and Larger: Flanged ends.
 - 7. For Grooved-End, Steel Piping: Valve ends may be grooved.

3.3 PIPING INSTALLATIONS

- A. Refer to Division 23 Section "Basic Mechanical Materials and Methods" for basic piping installation requirements.

- B. Install groups of pipes parallel to each other, spaced to permit applying insulation and servicing of valves.
- C. Install drains, consisting of a tee fitting, NPS 3/4 ball valve, and short NPS 3/4 threaded nipple with cap, at low points in piping system mains and elsewhere as required for system drainage.
- D. Install piping at a uniform grade of 0.2 percent upward in direction of flow.
- E. Reduce pipe sizes using eccentric reducer fitting installed with level side up.
- F. Unless otherwise indicated, install branch connections to mains using tee fittings in main pipe, with the takeoff coming out the bottom of the main pipe. For up-feed risers, install the takeoff coming out the top of the main pipe.
- G. Install strainers on supply side of each control valve, pressure-reducing valve, solenoid valve, in-line pump, and elsewhere as indicated. Install NPS 3/4 nipple and ball valve in blowdown connection of strainers NPS 2 and larger. Match size of strainer blowoff connection for strainers smaller than NPS 2.
- H. Anchor piping for proper direction of expansion and contraction.

3.4 VALVE INSTALLATION

- A. Piping installation requirements are specified in other Division 23 Sections. Drawings indicate general arrangement of piping, fittings, and specialties.
- B. Install valves with unions or flanges at each piece of equipment arranged to allow service, maintenance, and equipment removal without system shutdown.
- C. Locate valves for easy access and provide separate support where necessary.
- D. Install valves in horizontal piping with stem at or above center of pipe.
- E. Install valves in position to allow full stem movement.
- F. Install check valves for proper direction of flow and as follows:
 - 1. Swing Check Valves: In horizontal position with hinge pin level.
 - 2. Dual-Plate Check Valves: In horizontal or vertical position, between flanges.
 - 3. Lift Check Valves: With stem upright and plumb.

3.5 HANGERS AND SUPPORTS

- A. Hanger, support, and anchor devices are specified in Division 23, Section 230529 "Hangers and Supports." Comply with requirements below for maximum spacing of supports.
- B. Install the following pipe attachments:
 - 1. Adjustable steel clevis hangers for individual horizontal piping less than 20 feet long.

2. Adjustable roller hangers and spring hangers for individual horizontal piping 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. On plastic pipe, install pads or cushions on bearing surfaces to prevent hanger from scratching pipe.
- C. Install hangers for steel piping with the following maximum spacing and minimum rod sizes:
1. NPS 3/4: Maximum span, 7 feet; minimum rod size, 1/4 inch.
 2. NPS 1: Maximum span, 7 feet; minimum rod size, 1/4 inch.
 3. NPS 1-1/2: Maximum span, 9 feet; minimum rod size, 3/8 inch.
 4. NPS 2: Maximum span, 10 feet; minimum rod size, 3/8 inch.
 5. NPS 2-1/2: Maximum span, 11 feet; minimum rod size, 3/8 inch.
 6. NPS 3: Maximum span, 12 feet; minimum rod size, 3/8 inch.
 7. NPS 4: Maximum span, 14 feet; minimum rod size, 1/2 inch.
 8. NPS 6: Maximum span, 17 feet; minimum rod size, 1/2 inch.
 9. NPS 8: Maximum span, 19 feet; minimum rod size, 5/8 inch.
- D. Install hangers for drawn-temper copper piping with the following maximum spacing and minimum rod sizes:
1. NPS 3/4: Maximum span, 5 feet; minimum rod size, 1/4 inch.
 2. NPS 1: Maximum span, 6 feet; minimum rod size, 1/4 inch.
 3. NPS 1-1/2: Maximum span, 8 feet; minimum rod size, 3/8 inch.
 4. NPS 2: Maximum span, 8 feet; minimum rod size, 3/8 inch.
 5. NPS 2-1/2: Maximum span, 9 feet; minimum rod size, 3/8 inch.
 6. NPS 3: Maximum span, 10 feet; minimum rod size, 3/8 inch.
- E. Support vertical runs at roof, at each floor, and at 10-foot intervals between floors.

3.6 JOINT CONSTRUCTION

- A. Refer to Division 23, Section 230500 "Basic Mechanical Materials and Methods" for joint construction requirements for soldered and brazed joints in copper tubing; threaded, welded, and flanged joints in steel piping; and solvent-welded joints for PVC and CPVC piping.
- B. Valve Grooved Joints: Assemble joints with keyed coupling housing, gasket, lubricant, and bolts according to coupling and fitting manufacturer's written instructions.
- C. Valve Soldered Joints: Use ASTM B 813, water-flushable, lead-free flux; ASTM B 32, lead-free-alloy solder; and ASTM B 828 procedure, unless otherwise indicated.

3.7 HYDRONIC SPECIALTIES INSTALLATION

- A. Install manual air vents at high points in piping, at heat-transfer coils, and elsewhere as required for system air venting.

3.8 TERMINAL EQUIPMENT CONNECTIONS

- A. Size for supply and return piping connections shall be same as for equipment connections.
- B. Install control valves in accessible locations close to connected equipment.
- C. Install bypass piping with globe valve around control valve. If multiple, parallel control valves are installed, only one bypass is required.
- D. Install ports for pressure and temperature gages at coil inlet connections.

3.9 CHEMICAL TREATMENT

- A. Fill system and perform initial chemical treatment.

3.10 FIELD QUALITY CONTROL

- A. Prepare hydronic piping according to ASME B31.9 and as follows:
 - 1. Leave joints, including welds, uninsulated and exposed for examination during test.
 - 2. Provide temporary restraints for expansion joints that cannot sustain reactions due to test pressure. If temporary restraints are impractical, isolate expansion joints from testing.
 - 3. Flush system with clean water. Clean strainers.
 - 4. Isolate equipment from piping. If a valve is used to isolate equipment, its closure shall be capable of sealing against test pressure without damage to valve. Install blinds in flanged joints to isolate equipment.
 - 5. Install safety valve, set at a pressure no more than one-third higher than test pressure, to protect against damage by expanding liquid or other source of overpressure during test.
- B. Perform the following tests on hydronic piping:
 - 1. Use ambient temperature water as a testing medium unless there is risk of damage due to freezing. Another liquid that is safe for workers and compatible with piping may be used.
 - 2. While filling system, use vents installed at high points of system to release trapped air. Use drains installed at low points for complete draining of liquid.
 - 3. Check expansion tanks to determine that they are not air bound and that system is full of water.
 - 4. Subject piping system to hydrostatic test pressure that is not less than 1.5 times the design pressure. Test pressure shall not exceed maximum pressure for any vessel, pump, valve, or other component in system under test. Verify that stress due to pressure at bottom of vertical runs does not exceed either 90 percent of specified minimum yield strength or 1.7 times "SE" value in Appendix A of ASME B31.9, "Building Services Piping."
 - 5. After hydrostatic test pressure has been applied for at least 10 minutes, examine piping, joints, and connections for leakage. Eliminate leaks by tightening, repairing, or replacing components, and repeat hydrostatic test until there are no leaks.
 - 6. Prepare written report of testing.

3.11 ADJUSTING

- A. Mark calibrated nameplates of pump discharge valves after hydronic system balancing has been completed, to permanently indicate final balanced position.
- B. Perform these adjustments before operating the system:
 - 1. Open valves to fully open position. Close coil bypass valves.
 - 2. Check pump for proper direction of rotation.
 - 3. Set automatic fill valves for required system pressure.
 - 4. Check air vents at high points of system and determine if all are installed and operating freely (automatic type), or bleed air completely (manual type).
 - 5. Set temperature controls so all coils are calling for full flow.
 - 6. Check operation of automatic bypass valves.
 - 7. Lubricate motors and bearings.

3.12 CLEANING

- A. Flush hydronic-piping systems with clean water. Remove and clean or replace strainer screens. After cleaning and flushing hydronic-piping systems, but before balancing, remove disposable fine-mesh strainers in pump suction diffusers.

END OF SECTION 232113

SECTION 232213

STEAM AND CONDENSATE PIPING AND SPECIALTIES

PART 1 - 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. The requirements of Section 230000, "Basic Mechanical Requirements" apply to work defined by this Section.
- C. The requirements of Section 230500, "Basic Mechanical Materials and Methods" apply to work defined by the Section.

1.2 SUMMARY

- A. This Section includes steam and condensate piping, valves and specialties for systems up to 125 psig, inside the building.
- B. Related Sections include the following:
 - 1. Division 230000 Section "Basic Mechanical Requirements."
 - 2. Division 230500 Section "Basic Mechanical Materials and Methods" for general piping materials and installation requirements.
 - 3. Division 230529 Section "Hangers and Supports" for pipe supports, product descriptions, and installation requirements. Hanger and support spacing is specified in this Section.
 - 4. Division 230516 Section "Pipe Expansion Fittings and Loops."
 - 5. Division 230519 Section "Meters and Gages" for thermometers, flow meters, and pressure and vacuum gages.
 - 6. Division 230553 Section "Mechanical Identification" for labeling and identifying steam and condensate piping.
 - 7. Division 235313 Section "Feedwater Equipment."
 - 8. Division 230900 Section "HVAC Instrumentation and Controls" for temperature-control valves and sensors.

1.3 DEFINITIONS

- A. High Pressure Systems: Steam systems operating at 15 psig or more.
- B. Low Pressure Systems: Steam systems operating at less than 15 psig.

- C. CWP: Cold working pressure.
- D. SWP: Steam working pressure.

1.4 SYSTEM DESCRIPTION

- A. Steam and condensate piping for this Project is 5 psig steam used to feed the duct mounted humidifier panel (H-15).

1.5 SUBMITTALS

- A. General: See Division 1 for general submittal and product substitution requirements.
- B. Pre-construction Shop Drawings: Show material, fabrication and installation details for the following prior to commencing with fabrication and installation:
 - 1. Data on pipe materials, pipe fittings, valves and accessories.
 - 2. For each type of valve and special duty valve include: body, seating, and trim material: valve design pressure and temperature classifications; end connections, arrangement, dimensions, and required clearances. Include list indicating valve and its application.
 - 3. For each type of steam trap indicated, include: rated capacities, accessories, operating weights, and accessories.
 - 4. Shop Drawings: Detail flash tank assemblies and fabrication of pipe anchors, hangers, special pipe support assemblies, alignment guides, and expansion joints and loops and their attachment to the building structure. Include dimensions, weights, loadings, required clearances, method of field assembly, components, and location and size of each field connection.
 - 5. Welding Certificates: Copies of certificates for welding procedures and personnel.
- C. Post Construction:
 - 1. Field Test Reports: Written reports of tests specified in Part 3 of this Section. Include the following:
 - a. Test procedures used.
 - b. Test results that comply with requirements.
 - c. Failed test results and corrective action taken to achieve requirements.
 - 2. Maintenance Data: For steam traps, vacuum breakers, and meters to include in maintenance manuals specified in Division 1.

1.6 QUALITY ASSURANCE

- A. Welding: Qualify processes and operators according to the ASME Boiler and Pressure Vessel Code: Section IX, "Welding and Brazing Qualifications."
- B. ASME Compliance: Comply with ASME B31.9, "Building Services Piping," for materials, products, and installation. Safety valves and pressure vessels shall bear the appropriate ASME label. Fabricate and stamp flash tanks to comply with the ASME Boiler and Pressure Vessel Code, Section VIII, Division 1.

- C. ASME Compliance: ASME B31.9 for building services piping valves.
- D. ASME Compliance for Ferrous Valves: ASME B16.10 and ASME B16.34 for dimension and design criteria.

1.7 COORDINATION

- A. Coordinate layout and installation of steam and condensate piping and suspension system components with other construction, including, but not limited to, ductwork, hydronic piping, plumbing piping, fire-suppression-system components, light fixtures, and partition assemblies.
- B. Coordinate pipe sleeve installation for foundation wall penetrations.
- C. Coordinate piping installation with roof curbs, equipment supports, and roof penetrations. Roof specialties are specified in Division 7 Sections.
- D. Coordinate pipe fitting pressure classes with products specified in related Sections.
- E. Coordinate size and location of concrete bases. Cast anchor-bolt inserts into bases. Concrete, reinforcement, and formwork requirements are specified in Division 3 Sections.
- F. Coordinate installation of pipe sleeves for penetrations through exterior walls and floor assemblies. Coordinate with requirements for firestopping specified in Division 7 Section "Through-Penetration Firestop Systems" for fire and smoke wall and floor assemblies.

1.8 DELIVERY, STORAGE, AND HANDLING

- A. Prepare valves for shipping as follows:
 - 1. Protect internal parts against rust and corrosion.
 - 2. Protect threads, flange faces, grooves, and weld ends.
 - 3. Set angle, gate, and globe valves closed to prevent rattling.
 - 4. Block check valves in either closed or open position.
- B. Use the following precautions during storage:
 - 1. Maintain valve end protection.
 - 2. Store valves indoors and maintain at higher than ambient dew-point temperature. If outdoor storage is necessary, store valves off the ground in watertight enclosures.
- C. Use sling to handle large valves; rig sling to avoid damage to exposed parts. Do not use handwheels or stems as lifting or rigging points.

PART 2 - PRODUCTS

2.1 MANUFACTURERS

A. Manufacturers: Subject to compliance with requirements, provide products by one of the following:

1. Gaskets:
 - a. Flexitallic
2. Valves (typical):
 - a. Crane Co.; Crane Valve Group; Crane Valves.
 - b. Crane Co.; Crane Valve Group; Jenkins Valves.
 - c. Crane Co.; Crane Valve Group; Stockham Div.
 - d. Hammond Valve.
 - e. Kitz Corporation of America.
 - f. Milwaukee Valve Company.
 - g. NIBCO INC.
 - h. Powell, Wm. Co.
 - i. Red-White Valve Corp.
 - j. Walworth Co.
3. Safety Valves:
 - a. Armstrong International, Inc.
 - b. Kunkle Inds. Inc.; Kunkle Valve Division.
 - c. Spirax Sarco, Inc.
4. Pressure-Reducing Valves:
 - a. Armstrong International, Inc.
 - b. ITT Hoffman; ITT Fluid Technology Corp.
 - c. Spence Engineering Company, Inc.
 - d. Spirax Sarco, Inc.
5. Steam Traps:
 - a. Armstrong International, Inc.
 - b. Barnes & Jones, Inc.
 - c. ITT Hoffman; ITT Fluid Technology Corp.
 - d. Spirax Sarco, Inc.
6. Air Vents and Vacuum Breakers:
 - a. Armstrong International, Inc.
 - b. Barnes & Jones, Inc.
 - c. ITT Hoffman; ITT Fluid Technology Corp.

- d. Spirax Sarco, Inc.
- 7. Strainers:
 - a. Armstrong International, Inc.
 - b. Barnes & Jones, Inc.
 - c. ITT Hoffman; ITT Fluid Technology Corp.
 - d. Spirax Sarco, Inc.
- 8. Flash Tanks:
 - a. Penn Separator
 - b. Cemline

2.2 PIPING MATERIALS

- A. General: Refer to Part 3 piping application articles for applications of pipe and fitting materials.

2.3 STEEL PIPE AND FITTINGS

- A. Steel Pipe, NPS 2 and Smaller: ASTM A 53, Type S (seamless), Grade A, Schedules 40 and 80, black steel, plain ends.
- B. Steel Pipe, NPS 2-1/2 through NPS 12: ASTM A 53, Type E (electric-resistance welded), Grade A, Schedules 40 and 80, black steel, plain ends.
 - 1. Steel Pipe Nipples: ASTM A 733, made of ASTM A 53, Schedules 40 and 80, black steel; seamless for NPS 2 and smaller and electric-resistance welded for NPS 2-1/2 and larger.
- C. Cast-Iron Threaded Fittings: ASME B16.4; Classes 125, 150, and 300.
- D. Malleable-Iron Threaded Fittings: ASME B16.3; Classes 150 and 300.
- E. Malleable-Iron Unions: ASME B16.39; Classes 150, 250, and 300.
- F. Cast-Iron Threaded Flanges and Flanged Fittings: ASME B16.1, Classes 125 and 250; raised ground face, and bolt holes spot faced.
- G. Wrought-Steel Fittings: ASTM A 234/A 234M, wall thickness to match adjoining pipe.
- H. Wrought-Steel Flanges and Flanged Fittings: ASME B16.5, including bolts, nuts, and gaskets of the following material group, end connections, and facings:
 - 1. Material Group: 1.1.
 - 2. End Connections: Butt-welding.
 - 3. Facings: Raised face.

- I. Flexible Connectors: Stainless-steel bellows with woven, flexible, bronze, wire-reinforcing protective jacket; 150-psig minimum working pressure and 250 deg F maximum operating temperature. Connectors shall have flanged or threaded-end connections to match equipment connected and shall be capable of 3/4-inch misalignment.
- J. Welding Materials: Comply with Section II, Part C, of the ASME Boiler and Pressure Vessel Code for welding materials appropriate for wall thickness and for chemical analysis of pipe being welded.

2.4 GASKETS

- A. Gasket Material: Spiral wound ring gaskets, 304 stainless steel inner ring and winding material.
- B. Gaskets shall be suitable for fluid type, design temperature of fluid, and design pressure class of system.
 - 1. Basis of Design: Flexitallic Style CG.

2.5 VALVES, GENERAL

- A. Refer to Part 3 "Valve Applications" Article for applications of valves.
- B. Bronze Valves: NPS 2 and smaller with threaded ends, unless otherwise indicated.
- C. Ferrous Valves: NPS 2-1/2 and larger with flanged ends, unless otherwise indicated.
- D. Valve Pressure and Temperature Ratings: Not less than indicated and as required for system pressures and temperatures.
- E. Valve Sizes: Same as upstream pipe, unless otherwise indicated.
- F. Valve Actuators:
 - 1. Handwheel: For valves other than quarter-turn types.
 - 2. Lever Handle: For quarter-turn valves NPS 6 and smaller.
- G. Extended Valve Stems: On insulated valves.
- H. Valve Flanges: ASME B16.1 for cast-iron valves, ASME B16.5 for steel valves, and ASME B16.24 for bronze valves.
- I. Threaded: With threads according to ASME B1.20.1.
- J. Valve Bypass and Drain Connections: MSS SP-45.

2.6 GATE VALVES

- A. MSS SP-80, Class 125, Bronze Gate Valves: Bronze body with rising stem and bronze solid wedge, union-ring bonnet, and ferrous-alloy handwheel.
 - 1. Basis of Design: Crane Figure No. 428.

- D. MSS SP-70, Class 125, OS&Y, Bronze-Mounted, Cast-Iron Gate Valves: Cast-iron body with bronze trim, rising stem, and solid-wedge disc.
 - 1. Basis of Design: Crane Figure No. 465.

2.7 GLOBE VALVES

- A. MSS SP-80, Class 125, Bronze Globe Valves: Bronze body with bronze disc and renewable seat, union-ring bonnet, and ferrous-alloy handwheel.
 - 1. Basis of Design: Crane Figure No. 1.
- D. MSS SP-85, Class 125, Cast-Iron Globe Valves: Gray-iron body with bronze seats.
 - 1. Basis of Design: Crane Figure No. 351.

2.8 CHECK VALVES

- A. MSS SP-80, Class 125, Bronze, Swing Check Valves: Bronze body with bronze disc and seat.
 - 1. Basis of Design: Crane Figure No. 37.
- D. MSS SP-71, Class 125, Gray-iron, Swing Check Valves with bronze trim.
 - 1. Basis of Design: Crane Figure No. 373.

2.9 STEAM TRAPS

- A. Float and Thermostatic Traps: ASTM A 126, cast-iron body and bolted cap; renewable, stainless-steel float mechanism with renewable, hardened stainless-steel head and seat; maximum operating pressure of 125 psig; balanced-pressure, stainless-steel or monel thermostatic bellow element. Trap internals shall be completely serviceable without disturbing the piping. Integral thermostatic air vent capable of withstanding 45 deg F of superheat and resisting water hammer without sustaining damage.
 - 1. Basis of Design: Spirax-Sarco FT.
- B. Inverted Bucket Traps: Cast-iron body and cap, pressure rated for 250 psig; stainless-steel head and seat; stainless-steel valve retainer, lever, and guide pin assembly; and stainless steel bucket.
 - 1. Strainer: Integral stainless-steel inlet strainer within the trap body.
 - 2. Air Vent: Stainless-steel thermostatic vent.
 - 3. Basis of Design: Spirax-Sarco B Series.

2.10 THERMOSTATIC AIR VENTS

- A. Quick Vents: Cast-iron or brass body, with balanced-pressure, stainless-steel or monel thermostatic bellows and stainless-steel heads and seats.
- B. Float Vents: Cast-iron or brass body, seamless brass float, balanced-pressure thermostatic bellows, and replaceable stainless-steel seat, float, and head.

2.11 VACUUM BREAKERS

- A. Vacuum Breakers: 150-psig steam working pressure, 365 deg F maximum operating temperature, brass or stainless-steel body, and stainless-steel retainer, spring, and ball; with plain or threaded outlet.
1. Basis of Design: Spirax-Sarco VB14, VB21.

2.12 STRAINERS

- A. Y-Pattern Strainers: NPS 2 and smaller: 250-psig working steam pressure; ASTM A 126, Class B cast-iron body, threaded connections, tapped blowoff connection and plug.
1. No. 60 (fine) stainless steel mesh for all steam service upstream of control valves and pressure reducing valves.
 2. No. 20 (standard) stainless steel mesh for all other steam and condensate services.
 3. Basis of Design: Spirax-Sarco IT.
- B. Y-Pattern Strainers: NPS 2-1/2 and larger; 125-psig working steam pressure; Cast-iron body; flanged connections, tapped blowoff connection and plug.
1. 3/64" (fine) stainless steel mesh for all steam service upstream of control valves and pressure reducing valves.
 2. 1/8" (standard) stainless steel mesh for all other steam and condensate services.
 3. Basis of Design: Spirax-Sarco CI-125.

PART 3 - EXECUTION

3.1 LOW PRESSURE STEAM PIPING APPLICATIONS

- A. Steam Piping, NPS 2 and Smaller: Schedule 40 steel pipe, with threaded joints using Class 150 malleable-iron fittings.
- B. Steam Piping, NPS 2-1/2 through NPS 12: Schedule 40 steel pipe, with welded joints using Schedule 40 wrought-steel welding fittings and Class 150 wrought-steel flanges.
- C. Condensate Piping, NPS 2 and Smaller: Schedule 80 steel pipe, with threaded joints using Class 300 malleable-iron fittings.
- D. Condensate Piping, NPS 2-1/2 through NPS 12: Schedule 80 steel pipe, with welded joints using Schedule 80 wrought-steel welding fittings and Class 300 wrought-steel flanges.

3.2 STEAM AND CONDENSATE VALVE APPLICATIONS

- A. General-Duty Valve Applications: Unless otherwise indicated, use the following valve types:
1. Shutoff Service: Gate valves.
 2. Throttling Service: Globe valves.
 3. Pump Discharge: Spring-loaded, lift-disc check valves.

- B. Install shutoff-duty valves at each branch connection to supply mains, at inlet connection to each steam trap, and elsewhere as indicated.
- C. 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.
- D. Low-Pressure Steam Piping: Use the following types of valves:
 - 1. Swing Check Valves, NPS 2 and Smaller: Class 125, bronze.
 - 2. Swing Check Valves, NPS 2-1/2 and Larger: Class 125, gray iron.
 - 3. Gate Valves, NPS 2 and Smaller: Class 125, bronze.
 - 4. Gate Valves, NPS 2-1/2 and Larger: Class 125, OS&Y, bronze-mounted cast iron.
 - 5. Globe Valves, NPS 2 and Smaller: Class 125, bronze.
 - 6. Globe Valves, NPS 2-1/2 and Larger: Class 125, bronze-mounted cast iron.
- E. Steam Condensate Piping: Use the following types of valves:
 - 1. Swing Check Valves, NPS 2 and Smaller: Class 125, bronze.
 - 2. Swing Check Valves, NPS 2-1/2 and Larger: Class 125, gray iron.
 - 3. Gate Valves, NPS 2 and Smaller: Class 125, bronze.
 - 4. Gate Valves, NPS 2-1/2 and Larger: Class 125, OS&Y, bronze-mounted cast iron.
 - 5. Globe Valves, NPS 2 and Smaller: Class 125, bronze.
 - 6. Globe Valves, NPS 2-1/2 and Larger: Class 125 bronze-mounted cast iron.
- F. Select valves with the following end connections:
 - 1. For Steel Piping, NPS 2 and Smaller: Threaded ends.
 - 2. For Steel Piping, NPS 2-1/2 and Larger: Flanged ends.

3.3 EXAMINATION

- A. Examine piping system for compliance with requirements for installation tolerances and other conditions affecting performance.
 - 1. Proceed with installation only after unsatisfactory conditions have been corrected.
- B. Examine valve interior for cleanliness, freedom from foreign matter, and corrosion. Remove special packing materials, such as blocks, used to prevent disc movement during shipping and handling.
- C. Operate valves in positions from fully open to fully closed. Examine guides and seats made accessible by such operations.
- D. Examine threads on valve and mating pipe for form and cleanliness.
- E. Examine mating flange faces for conditions that might cause leakage. Check bolting for proper size, length, and material. Verify that gasket is of proper size, that its material composition is suitable for service, and that it is free from defects and damage.
- F. Do not attempt to repair defective valves; replace with new valves.

3.4 LOW PRESSURE STEAM-TRAP APPLICATIONS

- A. Float and Thermostatic Traps: Heating equipment, including heat exchangers and coils, main and riser drip legs.
- B. Size low pressure steam traps for twice the maximum condensate flow rate at 0.5 psig differential.

3.5 PIPING INSTALLATIONS

- A. Refer to Division 22 Section "Basic Mechanical Materials and Methods" for basic piping installation requirements.
- B. Install groups of pipes parallel to each other, spaced to permit applying insulation and servicing of valves.
- C. Install drains, consisting of a tee fitting, NPS 3/4 ball valve, and short NPS 3/4 threaded nipple with cap, at low points in piping system mains and elsewhere as required for system drainage.
- D. Install steam supply piping at a uniform grade of 0.2 percent downward in direction of steam flow.
- E. Install condensate return piping at a uniform grade of 0.4 percent downward in direction of condensate flow.
- F. Reduce pipe sizes using eccentric reducer fitting installed with level side down.
- G. Unless otherwise indicated, install branch connections to steam mains using 45-degree fittings in main pipe, with the takeoff coming out the top of the main pipe. Use of 90-degree tee fittings is permissible if 45-degree fittings are impractical. If length of branch takeoff is less than 10 feet, pitch branch line down toward mains at a 0.4 percent grade.
- H. Install unions in piping NPS 2 and smaller adjacent to each valve, at final connections of each piece of equipment, and elsewhere as indicated.
- I. Install flanges in piping NPS 2-1/2 and larger at final connections of each piece of equipment and elsewhere as indicated.
- J. Install strainers on supply side of each control valve, pressure-reducing valve, solenoid valve, traps, and elsewhere as indicated. Install NPS 3/4 nipple and ball valve in blowdown connection of strainers NPS 2 and larger. Match size of strainer blowoff connection for strainers smaller than NPS 2.
- K. Anchor and guide piping for proper direction of expansion and contraction.
- L. Install drip legs at low points and natural drainage points such as ends of mains, bottoms of risers, and ahead of pressure regulators, control valves, isolation valves, pipe bends, and expansion joints.

1. On straight runs with no natural drainage points, install drip legs at intervals not exceeding 300 feet where pipe is pitched down in direction of steam flow and a maximum of 150 feet where pipe is pitched up in direction of steam flow.
2. Size drip legs at vertical risers same size as pipe and extend beyond rise. Size drip legs at other locations same diameter as main. In steam mains NPS 6 and larger, dirt leg size can be reduced, but to no less than NPS 4.
3. Install gate valve at drip legs, dirt pockets, and strainer blowdowns to allow removal of dirt and scale.
4. Install steam traps close to drip legs.

3.6 STEAM-TRAP INSTALLATION

- A. Install steam traps in accessible locations as close as possible to connected equipment, but not more than 48 inches from connected equipment.
 1. Unless otherwise indicated, install gate valve, strainer, and union upstream from trap; install union, check valve, and gate valve downstream from trap.

3.7 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 check valves for proper direction of flow and as follows:
 1. Swing Check Valves: In horizontal position with hinge pin level.
 2. Dual-Plate Check Valves: In horizontal or vertical position, between flanges.
 3. Lift Check Valves: With stem upright and plumb.

3.8 PRESSURE-REDUCING VALVE INSTALLATION

- A. Install pressure-reducing valves in readily accessible location for maintenance and inspection.
- B. Install pressure-reducing valves in accordance with manufacturer's installation instructions.

3.9 SAFETY VALVE INSTALLATIONS

- A. Install safety valves according to ASME B31.1. Pipe safety valve discharge without valves to atmosphere at safe location outside building. Support safety valves independent of piping. Install drip-pan elbow fitting adjacent to safety valve and pipe drain connection to nearest floor drain.

3.10 HANGERS AND SUPPORTS

- A. Hanger, support, and anchor devices are specified in Division 23 Section "Hangers and Supports."
 - 1. Hangers for pipe sizes NPS 3 and smaller: MSS SP-69 Type 1, adjustable carbon steel clevis hangers.
 - 2. Hangers for pipe sizes NPS 4 and larger: MSS-SP-69 Type 41, adjustable steel yoke, cast iron roller, double hanger, with MSS SP-69 Type 39 steel pipe covering protection saddle.
 - 3. Multiple or Trapeze Hangers: Steel channels with welded spacers, hanger rods, pipe rolls and saddles as required.
 - a. Submit proposed arrangement and anchoring details for approval.
 - 4. Wall Support: Welded Steel bracket.
 - 5. Vertical Support: Steel riser clamp.
 - 6. Hanger Rods: Mild steel, threaded both ends or continuous threaded.
- B. Install hangers with the following maximum spacing and minimum rod sizes:
 - 1. NPS 3/4: Maximum span, 7 feet; minimum rod size, 3/8 inch.
 - 2. NPS 1: Maximum span, 7 feet; minimum rod size, 3/8 inch.
 - 3. NPS 1-1/4: Maximum span, 7 feet; minimum rod size, 3/8 inch.
 - 4. NPS 1-1/2: Maximum span, 9 feet; minimum rod size, 3/8 inch.
 - 5. NPS 2: Maximum span, 10 feet; minimum rod size, 3/8 inch.
 - 6. NPS 2-1/2: Maximum span, 11 feet; minimum rod size, 1/2 inch.
 - 7. NPS 3: Maximum span, 12 feet; minimum rod size, 1/2 inch.
 - 8. NPS 4: Maximum span, 14 feet; minimum rod size, 5/8 inch.
 - 9. NPS 6: Maximum span, 17 feet; minimum rod size, 3/4 inch.
- C. Support vertical runs at roof, at each floor, and at 10-foot intervals between floors.

3.11 PIPE JOINT CONSTRUCTION

- A. Refer to Division 23 Section "Basic Mechanical Materials and Methods" for joint construction requirements for threaded, welded, and flanged joints.

3.12 TERMINAL EQUIPMENT CONNECTIONS

- A. Size for supply and return piping connections shall be same as for equipment connections.
- B. Install traps and control valves in accessible locations close to connected equipment.
- C. Install bypass piping with globe valve around control valve. If multiple parallel control valves are installed, only one bypass is required.
- D. Install vacuum breaker downstream from control valve and bypass and close to coil inlet connection.

- E. Install ports for pressure and temperature gages at coil inlet connections.
- F. Install a drip leg at coil outlet.

3.13 FIELD QUALITY CONTROL

- A. Prepare steam and condensate piping according to ASME B31.9 and as follows:
 - 1. Leave joints, including welds, uninsulated and exposed for examination during test.
 - 2. Flush system with clean water. Clean strainers.
 - 3. Isolate equipment from piping. If a valve is used to isolate equipment, its closure shall be capable of sealing against test pressure without damage to valve. Install blinds in flanged joints to isolate equipment.
 - 4. Install safety valve, set at a pressure no more than one-third higher than test pressure, to protect against damage by expanding liquid or other source of overpressure during test.
- B. Perform the following tests on steam and condensate piping:
 - 1. Use ambient temperature water as a testing medium unless there is risk of damage due to freezing. Another liquid that is safe for workers and compatible with piping may be used.
 - 2. While filling system, use vents installed at high points of system to release trapped air. Use drip legs installed at low points for complete draining of liquid.
 - 3. Subject piping system to hydrostatic test pressure that is not less than 1.5 times the design pressure. Test pressure shall not exceed maximum pressure for any vessel, pump, valve, or other component in system under test. Verify that stress due to pressure at bottom of vertical runs does not exceed either 90 percent of specified minimum yield strength or 1.7 times "SE" value in Appendix A of ASME B31.9, "Building Services Piping."
 - 4. After hydrostatic test pressure has been applied for at least 10 minutes, examine piping, joints, and connections for leakage. Eliminate leaks by tightening, repairing, or replacing components, and repeat hydrostatic test until there are no leaks.
 - 5. Prepare written report of testing.

3.14 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.
- B. Mark calibrated nameplates of pump discharge valves after steam and condensate system balancing has been completed, to permanently indicate final balanced position.
- C. Perform these adjustments before operating the system:
 - 1. Open valves to fully open position. Close coil bypass valves.
 - 2. Set temperature controls so all coils are calling for full flow.
 - 3. Check operation of automatic bypass valves.

3.15 CLEANING

- A. Flush steam and condensate piping with clean water. Remove and clean or replace strainer screens.

END OF SECTION 232213

SECTION 232300

REFRIGERANT PIPING

PART 1 - 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. The requirements of Section 230000, "Basic Mechanical Requirements" apply to work defined by this Section.
- C. The requirements of Section 230500, "Basic Mechanical Materials and Methods" apply to work defined by the Section.

1.2 SUMMARY

- A. This Section includes refrigerant piping used for air-conditioning applications.
- B. Related Sections include the following:
 - 1. Division 7 Section "Roof Accessories" for roof curbs, piping supports, and roof penetration boots.
 - 2. Division 7, Section 078413 "Through-Penetration Firestop Systems" for materials and methods for sealing pipe penetrations through fire and smoke barriers.
 - 3. Division 7, Section 079200 "Joint Sealants" for materials and methods for sealing pipe penetrations through exterior walls.
 - 4. Division 23 Section "Hangers and Supports" for pipe supports and installation requirements.
 - 5. Division 23 Section "Mechanical Identification" for labeling and identifying refrigerant piping.
 - 6. Division 23 Section "Meters and Gages" for thermometers and pressure gages.
 - 7. Division 23 Section "HVAC Instrumentation and Controls" for thermostats, controllers, automatic-control valves, and sensors.

1.3 SUBMITTALS

- A. Product Data: For each type of valve and refrigerant piping specialty indicated. Include pressure drop, based on manufacturer's test data, for thermostatic expansion valves, solenoid valves, and pressure-regulating valves.
- 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 relationship between piping and equipment.

1. Refrigerant piping indicated is schematic only. Size piping and design the actual piping layout, including oil traps, double risers, specialties, and pipe and tube sizes, to ensure proper operation and compliance with warranties of connected equipment.
- C. Welding Certificates: Copies of certificates for welding procedures and personnel.
- D. Field Test Reports: Indicate and interpret test results for compliance with performance requirements.
- E. Maintenance Data: For refrigerant valves and piping specialties to include in maintenance manuals specified in Division 1.

1.4 QUALITY ASSURANCE

- A. Welding: Qualify procedures and personnel according to ASME Boiler and Pressure Vessel Code: Section IX; "Welding and Brazing Qualifications."
- B. ASHRAE Standard: Comply with ASHRAE 15, "Safety Code for Mechanical Refrigeration."
- C. ASME Standard: Comply with ASME B31.5, "Refrigeration Piping."
- D. UL Standard: Provide products complying with UL 207, "Refrigerant-Containing Components and Accessories, Nonelectrical"; or UL 429, "Electrically Operated Valves."

1.5 COORDINATION

- A. Coordinate layout and installation of refrigerant piping and suspension system components with other construction, including light fixtures, HVAC equipment, fire-suppression-system components, and partition assemblies.
- B. Coordinate pipe sleeve installations for foundation wall penetrations.
- C. Coordinate installation of roof curbs, equipment supports, and roof penetrations. These items are specified in Division 7 Section "Roof Accessories."
- D. Coordinate pipe sleeve installations for penetrations in exterior walls and floor assemblies. Coordinate with requirements for firestopping specified in Division 7 Section "Through-Penetration Firestop Systems" for materials and methods for sealing pipe penetrations through fire and smoke barriers.
- E. Coordinate pipe fitting pressure classes with products specified in related Sections.

1.6 EXTRA MATERIALS

- A. Furnish extra materials described below that match products installed and that are packaged with protective covering for storage and identified with labels describing contents.
 - 1. Refrigeration Oil Test Kits: Two each, containing everything required to conduct one test.
 - 2. Refrigerant: Two containers each, with 20 lb of refrigerant.

PART 2 - PRODUCTS

2.1 MANUFACTURERS

- 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. Refrigerants:
 - a. Allied Signal, Inc./Fluorine Products; Genetron Refrigerants.
 - b. DuPont Company; Fluorochemicals Div.
 - c. Elf Atochem North America, Inc.; Fluorocarbon Div.
 - d. ICI Americas Inc./ICI KLEA; Fluorochemicals Bus.
 - 2. Refrigerant Valves and Specialties:
 - a. Climate & Industrial Controls Group; Parker-Hannifin Corp.; Refrigeration & Air Conditioning Division.
 - b. Danfoss Electronics, Inc.
 - c. Emerson Electric Company; Alco Controls Div.
 - d. Henry Valve Company.
 - e. Sporlan Valve Company.

2.2 COPPER TUBE AND FITTINGS

- A. Drawn-Temper Copper Tube: ASTM B 280, Type ACR.
- B. Annealed-Temper Copper Tube: ASTM B 280, Type ACR.
- C. Wrought-Copper Fittings: ASME B16.22.
- D. Wrought-Copper Unions: ASME B16.22.
- E. Brazing Filler Metals: AWS A5.8, Classification BAg-1 (silver) or BAg-2 (silver).

- F. Flexible Connectors: 500-psig (3450-kPa) minimum operating pressure; seamless tin-bronze core, high-tensile bronze-braid covering, and solder-joint end connections; dehydrated, pressure tested, minimum 7 inches (180mm) long

2.3 STEEL PIPE AND FITTINGS

- A. Steel Pipe: ASTM A 53, Schedule 40, seamless black steel.
- B. Wrought-Steel Fittings: ASTM A 234/A 234M, for welded joints.
- C. Steel Flanges and Flanged Fittings: ASME B16.5, steel, including bolts, nuts, and gaskets, butt-welded end connection, and raised face.
- D. Flanged Unions: 400-psig (2760-kPa) working pressure, 330 deg F (165 deg C) maximum operating temperature; 2 brass tailpiece adapters for solder-end connections to copper tubing; forged-steel flanges for NPS 1 to NPS 1-1/2 (DN 25 to DN 40) and ductile iron for NPS 2 to NPS 3 (DN 50 to DN 80) with 4 plated-steel bolts, with silicon bronze nuts and fiber gasket; and having factory-applied, rust-resistant coating on flanges and bolts.
- E. Flexible connectors: 500-psig (3450-kPa) minimum operating pressure; stainless-steel core and high-tensile stainless-steel-braid covering; dehydrated, pressure tested, minimum 7 inches (180 mm) long.
 - 1. NPS 2 (DN 50) and Smaller: With thread-end connections.
 - 2. NPS 2-1/2 (DN 65) and Larger: With flanged-end connections.

2.4 VALVES

- A. Diaphragm Packless Valves: 500-psig (3450-kPa) working pressure and 275 deg F (135 deg C) working temperature; globe design with straight-through or angle pattern; forged-brass or bronze body and bonnet, phosphor bronze and stainless-steel diaphragms, rising stem and handwheel, stainless-steel spring, nylon seat disc, and with solder-end connections.
- B. Packed-Angle Valves: 500-psig (3450-kPa) working pressure and 275 deg F (135 deg C) working temperature; forged-brass or bronze body, forged-brass seal caps with copper gasket, back seating, rising stem and seat, molded stem packing, and with solder-end connections.
- C. Check Valves Smaller Than NPS 1 (DN 25): 400-psig (2760-kPa) operating pressure and 285 deg F (141 deg C) operating temperature; cast-brass body, with removable piston, polytetrafluoroethylene seat, and stainless-steel spring; globe design. Valve shall be straight-through pattern, with solder-end connections.
- D. Check Valves, NPS 1 (DN 25) and Larger: 400-psig (2760-kPa) operating pressure and 285 deg F (141 deg C) operating temperature; cast-bronze body, with cast-bronze or forged-brass bolted bonnet; floating piston with mechanically retained polytetrafluoroethylene seat disc. Valve shall be straight-through or angle pattern, with solder-end connections.

- E. Service Valves: 500-psig (3450-kPa) pressure rating; forged-brass body with copper stubs, brass caps, removable valve core, integral ball check valve, and with solder-end connections.
- F. Solenoid Valves: Comply with ARI 760; 250 deg F (121 deg C) temperature rating and 400-psig (2760-kPa) working pressure; forged brass, with polytetrafluoroethylene valve seat, 2-way, straight-through pattern, and solder-end connections; manual operator; fitted with suitable NEMA 250 enclosure of type required by location, with 1/2-inch (16-GRC) conduit adapter and 24-V, normally closed holding coil.
- G. Pressure-Regulating Valves: Comply with ARI 770; pilot operated, forged brass or cast bronze, stainless-steel bottom spring, pressure-gage tappings, 24-V dc standard coil, and wrought-copper fittings for solder-end connections; suitable for refrigerant specified.
- H. Pressure-Regulating Valves: Comply with ARI 770; direct acting, brass; with pilot operator, stainless-steel diaphragm, standard coil, and solder-end connection; suitable for refrigerant specified.
- I. Pressure Relief Valves: Straight-through or angle pattern, brass body and disc, neoprene seat, and factory sealed and ASME labeled for standard pressure setting.
- J. Thermostatic Expansion Valves: Comply with ARI 750; brass body with stainless-steel parts; thermostatic-adjustable, modulating type; size and operating characteristics as recommended by manufacturer of evaporator, and factory set for superheat requirements; solder-end connections; with sensing bulb, distributor having side connection for hot-gas bypass line, and external equalizer line.
- K. Hot-Gas Bypass Valve: Pulsating-dampening design, stainless-steel bellows and polytetrafluoroethylene valve seat; adjustable; sized for capacity equal to last step of compressor unloading; with solder-end connections.

2.5 REFRIGERANT PIPING SPECIALITIES

- A. Straight- or Angle-Type Strainers: 500-psig (3450-kPa) working pressure; forged-brass or steel body with stainless-steel wire or brass-reinforced Monel screen of 80 to 100 mesh in liquid lines up to 1-1/8 inches (30 mm), 60 mesh in larger liquid lines, and 40 mesh in suction lines; with screwed cleanout plug and solder-end connections.
- B. Moisture/Liquid Indicators: 500-psig (3450-kPa) maximum working pressure and 200 deg F (93 deg C) operating temperature; all-brass body with replaceable, polished, optical viewing window with color-coded moisture indicator; with solder-end connections.
- C. Replaceable-Core Filter-Dryers: 500-psig (3450-kPa) maximum working pressure; heavy gage protected with corrosion-resistant-painted steel shell, flanged ring and spring, ductile-iron cover plate with steel cap screws; wrought-copper fittings for solder-end connections; with replaceable-core kit, including gaskets and the following:
 - 1. Filter Cartridge: Pleated media with integral end rings, stainless-steel support, ARI 730 rated for capacity.

2. Filter-Dryer Cartridge: Pleated media with solid-core sieve with activated alumina, ARI 730 rated for capacity.
 3. Wax Removal Cartridge: Molded, bonded core of activated charcoal and desiccant with integral gaskets.
- D. Permanent Filter-Dryer: 350-psig (2410-kPa) maximum operating pressure and 225 deg F (107 deg C) maximum operating temperature; steel shell and wrought-copper fittings for solder-end connections; molded-felt core surrounded by desiccant.
- E. Mufflers: 500-psig (3450-kPa) operating pressure, welded-steel construction with fusible plug; sized for refrigeration capacity.

2.6 RECEIVERS

- A. Receivers, 6-Inch (150-mm) Diameter and Smaller: ARI 495, UL listed, steel, brazed, 400-psig (2760-kPa) pressure rating, with tappings for inlet, outlet, and pressure relief valve.
- B. Receivers Larger Than 6-Inch (150-mm) Diameter: ARI 495, welded steel, tested and stamped according to ASME Boiler and Pressure Vessel Code: Section VIII; 400-psig (2760-kPa) pressure rating, with tappings for liquid inlet and outlet valves, pressure relief valve, and liquid-level indicator.

2.7 REFRIGERANTS

- A. ASHRAE 34, R-123: Dichlorotrifluoroethane.
- B. ASHRAE 34, R-134a: Tetrafluoroethane.
- C. ASHRAE 34, R-22: Monochlorodifluoromethane.
- D. ASHRAE 34, R-500: Azeotrope.

PART 3 - EXECUTION

3.1 PIPING APPLICATIONS

- A. Aboveground, within Building: Type ACR drawn-copper tubing

3.2 VALVE APPLICATIONS

- A. Install diaphragm packless or packed-angle valves in suction and discharge lines of compressor, for gage taps at hot-gas bypass regulators, on each side of strainers.
- B. Install check valves in compressor discharge lines and in condenser liquid lines on multiple condenser systems.

- C. Install packed-angle valve in liquid line between receiver shutoff valve and thermostatic expansion valve for system charging.
- D. Install diaphragm packless or packed-angle valves on each side of strainers and dryers, in liquid and suction lines at evaporators, and elsewhere as indicated.
- E. Install a full-sized, three-valve bypass around each dryer.
- F. Install solenoid valves upstream from each expansion valve and hot-gas bypass valve.
 - 1. Install solenoid valves in horizontal lines with coil at top.
 - 2. Electrical wiring for solenoid valves is specified in Division 26 Sections. Coordinate electrical requirements and connections.
- G. Install thermostatic expansion valves as close as possible to evaporator.
 - 1. If refrigerant distributors are used, install them directly on expansion-valve outlet.
 - 2. Install valve so diaphragm case is warmer than bulb.
 - 3. 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.
 - 4. If external equalizer lines are required, make connection where it will reflect suction-line pressure at bulb location.
- H. Install pressure regulating and pressure relief valves as required by ASHRAE 15. Pipe pressure relief valve discharge to outside.

3.3 SPECIALTY APPLICATIONS

- A. Install liquid indicators in liquid line leaving condenser, in liquid line leaving receiver, and on leaving side of liquid solenoid valves.
- B. Install strainers immediately upstream from each automatic valve, including expansion valves, solenoid valves, hot-gas bypass valves, and compressor suction valves.
- C. Install strainers in main liquid line where multiple expansion valves with integral strainers are used.
- D. Install strainers in suction line of steel pipe.
- E. Install moisture-liquid indicators in liquid lines between filter-dryers and thermostatic expansion valves and in liquid line to receiver.
- F. Install pressure relief valves on ASME receivers; pipe discharge to outdoors.
- G. Install replaceable-core filter-dryers in vertical liquid line adjacent to receivers and before each solenoid valve.
- H. Install permanent filter-dryers in low-temperature systems, in systems using hermetic compressors, and before each solenoid valve.

- I. Install solenoid valves in liquid line of systems operating with single pump-out or pump-down compressor control, in liquid line of single or multiple evaporator systems, and in oil bleeder lines from flooded evaporators to stop flow of oil and refrigerant into suction line when system shuts down.
- J. Install receivers, sized to accommodate pump-down charge, on systems 5 tons (17.5 kW) and larger and on systems with long piping runs.
- K. Install flexible connectors at or near compressors.

3.4 PIPING INSTALLATION

- A. Install refrigerant piping according to ASHRAE 15.
- B. Basic piping installation requirements are specified in Division 23 Section "Basic Mechanical Materials and Methods."
- C. Install piping as short and direct as possible, with a minimum number of joints, elbows, and fittings.
- D. Arrange piping to allow inspection and service of compressor and other equipment. Install valves and specialties in accessible locations to allow for service and inspection.
- E. Install piping with adequate clearance between pipe and adjacent walls and hangers or between pipes for insulation installation. Use sleeves through floors, walls, or ceilings, sized to permit installation of full-thickness insulation.
- F. Belowground, install copper tubing in protective conduit. Vent conduit outdoors.
- G. Install copper tubing in rigid or flexible conduit in locations where copper tubing will be exposed to mechanical injury.
- H. 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.
- I. Install bypass around moisture-liquid indicators in lines larger than NPS 2 (DN 50).
- J. Install unions to allow removal of solenoid valves, pressure-regulating valves, and expansion valves and at connections to compressors and evaporators.
- K. When brazing, 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.

- L. Hanger, support, and anchor products are specified in Division 23 Section "Hangers and Supports."
- M. Install the following pipe attachments:
 - 1. Adjustable steel clevis hangers for individual horizontal runs less than 20 feet (6.0 m) long.
 - 2. Roller hangers and spring hangers for individual horizontal runs 20 feet (6.0 m) or longer.
 - 3. Pipe rollers for multiple horizontal runs 20 feet (6.0 m) or longer, supported by a trapeze.
 - 4. Spring hangers to support vertical runs.
- N. Install hangers for copper tubing with the following maximum spacing and minimum rod sizes:
 - 1. NPS 1/2 (DN 15): Maximum span, 60 inches (1500 mm); minimum rod size, 1/4 inch (6.4 mm).
 - 2. NPS 5/8 (DN 18): Maximum span, 60 inches (1500 mm); minimum rod size, 1/4 inch (6.4 mm).
 - 3. NPS 1 (DN 25): Maximum span, 72 inches (1800 mm); minimum rod size, 1/4 inch (6.4 mm).
 - 4. NPS 1-1/4 (DN 32): Maximum span, 96 inches (2400 mm); minimum rod size, 3/8 inch (9.5 mm).
 - 5. NPS 1-1/2 (DN 40): Maximum span, 96 inches (2400 mm); minimum rod size, 3/8 inch (9.5 mm).
- O. Install hangers for steel piping with the following maximum spacing and minimum rod sizes:
 - 1. NPS 1/2 (DN 15): Maximum span, 84 inches (2100 mm); minimum rod size, 1/4 inch (6.4 mm).
 - 2. NPS 3/4 (DN 20): Maximum span, 84 inches (2100 mm); minimum rod size, 1/4 inch (6.4 mm).
 - 3. NPS 1 (DN 25): Maximum span, 84 inches (2100 mm); minimum rod size, 1/4 inch (6.4 mm).
 - 4. NPS 1-1/2 (DN 40): Maximum span, 108 inches (2700 mm); minimum rod size, 3/8 inch (9.5 mm).
- P. Support vertical runs at each floor.

3.5 PIPE JOINT CONSTRUCTION

- A. Braze joints according to Division 23 Section "Basic Mechanical Materials and Methods."
- B. Fill pipe and fittings with an inert gas (nitrogen or carbon dioxide) during brazing to prevent scale formation.

3.6 FIELD QUALITY CONTROL

- A. Test and inspect refrigerant piping according to ASME B31.5, Chapter VI.

1. Test refrigerant piping, specialties, and receivers. Isolate compressor, condenser, evaporator, and safety devices from test pressure.
2. Test high- and low-pressure side piping of each system at not less than the lower of the design pressure or the setting of pressure relief device protecting high and low side of system.
 - a. System shall maintain test pressure at the manifold gage throughout duration of test.
 - b. Test joints and fittings by brushing a small amount of soap and glycerine solution over joint.
 - c. Fill system with nitrogen to raise a test pressure of 150 psig (1035 kPa) or higher as required by authorities having jurisdiction.
 - d. Remake leaking joints using new materials, and retest until satisfactory results are achieved.

3.7 ADJUSTING

- A. Adjust thermostatic expansion valve to obtain proper evaporator superheat requirements.
- B. Adjust high- and low-pressure switch settings to avoid short cycling in response to fluctuating suction pressure.
- C. Adjust set-point temperature of the conditioned air 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. Check compressor oil level above center of sight glass.
 3. Open compressor suction and discharge valves.
 4. Open refrigerant valves, except bypass valves that are used for other purposes.
 5. Check compressor-motor alignment, and lubricate motors and bearings.

3.8 CLEANING

- A. Before installing copper tubing other than Type ACR, clean tubing and fittings with trichloroethylene.
- B. Replace core of filter-dryer after system has been adjusted and design flow rates and pressures are established.

3.9 SYSTEM CHARGING

- A. Charge system using the following procedures:
 1. Install core in filter-dryer after leak test but before evacuation.

2. Evacuate entire refrigerant system with a vacuum pump to a vacuum of 500 micrometers (67 Pa). 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 (14 kPa).
4. Charge system with a new filter-dryer core in charging line. Provide full-operating charge.

END OF SECTION

SECTION 233113

METAL DUCTS

PART 1 - 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. The requirements of Section 230000, "Basic Mechanical Requirements" apply to work defined by this Section.
- C. The requirements of Section 230500, "Basic Mechanical Materials and Methods" apply to work defined by the Section.

1.2 SUMMARY

- A. This Section includes metal ducts for supply, return, outside, and exhaust air distribution systems in pressure classes from minus 2 to plus 6 inch w.g.. Metal ducts include the following:
 - 1. Rectangular ducts and fittings.
 - 2. Single-wall, round spiral and longitudinal seam ducts and formed fittings.
 - 3. Double-wall, round spiral-seam ducts and formed fittings.
- B. Related Sections include the following:
 - 1. Division 7, "Through-Penetration Fire Stop Systems" for materials and methods for sealing duct penetrations through fire and smoke barriers.
 - 2. Division 7, "Joint Sealants" for materials and methods for sealing duct penetrations through exterior walls.
 - 3. Section 233300 "Duct Accessories" for dampers, sound control devices, duct mounting access doors and panels, turning vanes, and flexible ducts.

1.3 DEFINITIONS

- A. FRP: Fiberglass reinforced plastic.
- B. NUSIG: National Uniform Seismic Installation Guidelines.
- C. SMACNA – Sheet Metal and Air Conditioning Contractors' National Association, Inc. – latest edition.

1.4 SYSTEM DESCRIPTION

- A. Duct system design, as indicated, has been used to select size and type of air-moving and -distribution equipment and other air system components. Changes to layout or configuration of duct system must be specifically approved in writing by Architect. Accompany requests for layout modifications with calculations showing that the proposed layout will provide original design results without increasing system total pressure.

1.5 SUBMITTALS

- A. General: See Division 1 for general submittal and product substitution requirements.
- B. Pre-construction Shop Drawings: Show fabrication and installation details for metal ducts in the basement Mechanical Room 0100 and Mechanical Penthouse 4100 as follows prior to commencing with fabrication and installation:
 - 1. CAD-generated and drawn to 1/4 inch equals 1 foot. Include the following information:
 - a. Fabrication, assembly, and installation, including plans, elevations, sections, components, and attachments to other work.
 - b. Duct layout indicating sizes and pressure classes.
 - c. Elevations of top and bottom of ducts.
 - d. Dimensions of main duct runs from building grid lines.
 - 2. Metal gages.
 - 3. Fittings.
 - 4. Reinforcement and spacing.
 - 5. Seam and joint construction.
 - 6. Penetrations through fire-rated and other partitions.
 - 7. Equipment installation based on equipment being used on Project.
 - 8. Duct accessories, including access doors and panels.
 - 9. Hangers and supports, including methods for duct and building attachment, vibration isolation, and seismic restraints.
- C. Field quality-control test reports.

1.6 QUALITY ASSURANCE

- A. NFPA Compliance:
 - 1. NFPA 90A, "Installation of Air Conditioning and Ventilating Systems."
- B. Welding: Qualify procedures and personnel according to AWS D9.1, "Sheet Metal Welding Code," for joint and seam welding.

PART 2 - PRODUCTS

2.1 MANUFACTURERS

- 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. Transverse joints
 - a. Ductmate Industries, Inc.
 - b. Nexus Inc.
 - c. Ward Industries, Inc.
 - 2. Round and flat-oval duct and fittings
 - a. McGill AirFlow Corporation.
 - b. SEMCO Incorporated.
 - c. Monroe Metal Mfg. Co.
 - 3. Duct joints – round ducts
 - a. Ductmate Industries, Inc.
 - b. Lindab Inc
 - 4. Double-wall duct and fittings
 - a. McGill AirFlow Corporation.
 - b. SEMCO Incorporated.
 - 5. Cable Duct Hangers
 - a. GRIPPLE “Hang Fast”

2.2 SHEET METAL MATERIALS

- A. 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: Lock-forming quality; complying with ASTM A 653/A 653M and having G90coating designation; ducts shall have mill-phosphatized finish for surfaces exposed to view.
- C. Aluminum Alloy Sheets: Type 3003-H14 comply with requirements of ASTM B209.
- D. Stainless Steel: ASTM A 480/, Type 316, and having a No. 2D finish for concealed ducts and No 4 for exposed ducts.
- E. Reinforcement Shapes and Plates: Galvanized-steel reinforcement where installed on galvanized sheet metal ducts.

2.3 SEALANT MATERIALS

- A. Water-Based Joint and Seam Sealant: Flexible, adhesive sealant, resistant to UV light when cured, UL 723 listed, and complying with NFPA requirements for Class 1 ducts.
- B. Flanged Joint Mastic: One-part, acid-curing, silicone, elastomeric joint sealant complying with ASTM C 920, Type S, Grade NS, Class 25, Use O.
- C. Flange Gaskets: Butyl rubber or EPDM polymer with polyisobutylene plasticizer.

2.4 HANGERS AND SUPPORTS

- A. Building Attachments: Concrete inserts, powder-actuated fasteners, or structural-steel fasteners appropriate for construction materials to which hangers are being attached.
 - 1. Exception: Do not use powder actuated concrete fasteners for lightweight aggregate concretes or for slabs less than 4 inches thick.
- B. Hanger Materials: Galvanized sheet steel or threaded steel rod.
 - 1. Hangers Installed in Corrosive Atmospheres: Electrogalvanized, all-thread rods or galvanized rods with threads painted with zinc-chromate primer after installation.
 - 2. Strap and Rod Sizes: Comply with SMACNA's "HVAC Duct Construction Standards--Metal and Flexible" for steel sheet width and thickness and for steel rod diameters.
 - 3. Galvanized-steel straps attached to aluminum ducts shall have contact surfaces painted with zinc-chromate primer.
- C. Duct Attachments: Sheet metal screws, blind rivets, or self-tapping metal screws; compatible with duct materials.
- D. Trapeze and Riser Supports: Steel shapes complying with ASTM A 36/A 36M.
 - 1. Supports for Galvanized Steel Ducts: Galvanized-steel shapes and plates.
 - 2. Supports for Stainless Steel Ducts: Stainless-steel support materials.
 - 3. Supports for Aluminum Ducts: Aluminum support materials unless materials are electrolytically separated from ducts.
- E. Gripple cable hanging system:
 - 1. At contractor's option, ductwork shall be properly suspended or supported from the building structure utilizing an approved cable hanging system. The duct hanging system shall comprise a pre-formed cable sling and the load rated fastener for cable length adjustment. The hanger system for ductwork shall be in accordance with Figs 4.1 through 4.8 and tables 4.1 through 4.3 of the 1995 SMACNA Duct Construction Standards Manual. Hanger system shall be load rated and incorporate a 5 to 1 safety factor, and be plenum rated. Stress distribution saddles shall be applied at corners on rectangular duct as required by the manufacturer.

2.5 RECTANGULAR DUCT FABRICATION

- A. Fabricate ducts, elbows, transitions, offsets, branch connections, and other construction according to SMACNA's "HVAC Duct Construction Standards--Metal and Flexible" and complying with requirements for metal thickness, reinforcing types and intervals, tie-rod applications, and joint types and intervals.
 - 1. Lengths: Fabricate rectangular ducts in lengths appropriate to reinforcement and rigidity class required for pressure class.
 - 2. Deflection: Duct systems shall not exceed deflection limits according to SMACNA's "HVAC Duct Construction Standards--Metal and Flexible."
- B. Transverse Joints: Prefabricated slide-on joints and components constructed using manufacturer's guidelines for material thickness, reinforcement size and spacing, and joint reinforcement.
- C. Formed-On Flanges: Construct according to SMACNA's "HVAC Duct Construction Standards--Metal and Flexible," Figure 1-4, using corner, bolt, cleat, and gasket details.
- D. Cross Breaking or Cross Beading: Cross break or cross bead duct sides 19 inches and larger and 0.0359 inch thick or less, with more than 10 sq. ft. of non-braced panel area unless ducts are lined.

2.6 ROUND DUCT AND FITTING FABRICATION

- A. Manufacture in accordance with SMACNA HVAC Duct Construction Standards and as indicated. Provide duct material, gauges, reinforcement, and sealing for operating pressures indicated.
- B. All duct and fittings shall be manufactured by a company whose primary business is the manufacture of spiral duct and fittings and who has been in business for at least 10 years. All spiral duct and fittings shall be manufactured by the same firm and shall be as shown on the contract drawings.
- C. Round, Spiral Lock Seam Ducts: Fabricate supply ducts of galvanized steel according to SMACNA's "HVAC Duct Construction Standards - Metal and Flexible."
- D. Duct Joints:
 - 1. Ducts up to 20 Inches in Diameter: Interior, center-beaded slip coupling, sealed before and after fastening, attached with sheet metal screws.
 - 2. Ducts 21 to 72 Inches in Diameter: Three-piece, gasketed, flanged joint consisting of two internal flanges with sealant and one external closure band with gasket.
 - 3. Ducts Larger Than 72 Inches in Diameter: Companion angle flanged joints per SMACNA "HVAC Duct Construction Standards--Metal and Flexible," Figure 3-2.
 - 4. Round Ducts: Prefabricated connection system consisting of two roll-formed galvanized steel mating flanges with an integral sealant, galvanized steel closure ring, and neoprene gasket. Manufacture ducts according to connection system manufacturer's tolerances.

- E. Branch connections shall be made with 90 degree conical and 45 degree straight taps. All branch connections shall be made as separate fittings. Fabricate to comply with SMACNA's "HVAC Duct Construction Standards--Metal and Flexible," with metal thicknesses specified for longitudinal-seam straight ducts.
- F. Diverging-Flow Fittings: Fabricate with reduced entrance to branch taps and with no excess material projecting from fitting onto branch tap entrance.
- G. Fabricate elbows using die-formed, gored, pleated, or mitered construction. Bend radius of die-formed, gored, and pleated elbows shall be 1-1/2 times duct diameter. Unless elbow construction type is indicated, fabricate elbows as follows:
 - 1. The following fittings are not acceptable:
 - a. Adjustable elbows.
 - b. Square-throated, radiused heel elbows.
 - 2. Mitered-Elbow Radius and Number of Pieces: Welded construction complying with SMACNA's "HVAC Duct Construction Standards - Metal and Flexible.
 - 3. Round Mitered Elbows: Welded construction with the following metal thickness for pressure classes from minus 2 to plus 2 inch w.g.:
 - a. Ducts 3 to 36 Inches in Diameter: 0.034 inch.
 - b. Ducts 37 to 50 Inches in Diameter: 0.040 inch.
 - c. Ducts 52 to 60 Inches in Diameter: 0.052 inch.
 - d. Ducts 62 to 84 Inches in Diameter: 0.064 inch.
 - 4. Round Mitered Elbows: Welded construction with the following metal thickness for pressure classes from 2- to 10-inch w.g.:
 - a. Ducts 3 to 26 Inches in Diameter: 0.034 inch.
 - b. Ducts 27 to 50 Inches in Diameter: 0.040 inch.
 - c. Ducts 52 to 60 Inches in Diameter: 0.052 inch.
 - d. Ducts 62 to 84 Inches in Diameter: 0.064 inch.
 - 5. 90-Degree, 2-Piece, Mitered Elbows: Use only for supply systems or for material-handling Class A or B exhaust systems and only where space restrictions do not permit using radius elbows. Fabricate with single-thickness turning vanes.
 - 6. Round Elbows 12 Inches and Less in Diameter: Fabricate die-formed elbows for 45- and 90-degree elbows and pleated elbows for 30, 45, 60, and 90 degrees only. Fabricate nonstandard bend-angle configurations or nonstandard diameter elbows with gored construction.
 - 7. Round Elbows 9 through 14 Inches in Diameter: Fabricate gored or pleated elbows for 30, 45, 60, and 90 degrees unless space restrictions require mitered elbows. Fabricate nonstandard bend-angle configurations or nonstandard diameter elbows with gored construction.
 - 8. Round Elbows Larger Than 14 Inches in Diameter: Fabricate gored elbows unless space restrictions require mitered elbows.
 - 9. Die-Formed Elbows for Sizes through 12 Inches in Diameter and pressures through 10-inch w.g.: 24 gauge with 2-piece welded construction.
 - 10. Round Gored-Elbow Metal Thickness: Same as non-elbow fittings specified above.

11. Flat-Oval Elbow Metal Thickness: Same as longitudinal-seam flat-oval duct specified above.
12. Pleated Elbows for Sizes through 14 Inches in Diameter and Pressures through 10-Inch w.g.: 0.022 inch.

2.7 DOUBLE-WALL DUCT AND FITTING FABRICATION

- A. Manufacture in accordance with SMACNA HVAC Duct Construction Standards and as indicated. Provide duct material, gauges, reinforcement, and sealing for operating pressures indicated.
- B. All duct and fittings shall be manufactured by a company whose primary business is the manufacture of spiral duct and fittings and who has been in business for at least 10 years. All spiral duct and fittings shall be manufactured by the same firm and shall be as shown on the contract drawings.
- C. Ducts: Fabricate double-wall (insulated) ducts with an outer shell and an inner duct. Dimensions indicated are for inner ducts.
 1. Outer Shell: Base metal thickness on outer-shell dimensions. Fabricate outer-shell in metal thickness specified for single-wall duct.
 2. Insulation: 1-inch- thick fibrous glass, unless otherwise indicated. Terminate insulation where double-wall duct connects to single-wall duct or uninsulated components, and reduce outer shell diameter to inner duct diameter.
 - a. Thermal Conductivity (k-Value): 0.26 at 75 deg F mean temperature.
 3. Maintain concentricity of inner duct to outer shell by mechanical means. Prevent dislocation of insulation by mechanical means.
- D. Fittings: Fabricate double-wall (insulated) fittings with an outer shell and an inner duct.

2.8 CASING AND PLENUM CONSTRUCTION:

- A. Comply with SMACNA 1995 HVAC/DCS, Chapter 6 unless specified otherwise.
- B. Sheet metal for casings and plenums less than 10 feet height or width shall be 18-gauge galvanized steel. Casings and plenums 10 feet or greater width or height shall be 16 gauge. In coil sections, humidifier sections, and outdoor intake plenums or ducts, sheet metal shall be G90 coated galvanized steel Provide continuous 2"x2"x3/16" steel angle framing on 18" centers to support the sheet metal work. Fasten lapped type seams to framing on 4" centers or standing type seams to framing on 12" centers. Provide supplementary continuous 2"x2"x3/16" steel angle bracing on horizontal surfaces to prevent deformation under system operating and "upset" pressures. Fasten sheet metal to backup angle framing and bracing with No. 8 minimum size hardened steel sheet metal screws.
- C. All casing on the suction side of the fan shall be 2" water gauge pressure classification. Casing on fan discharge shall be of the designated pressure class.

- D. Seal all joints, seams, connections, and abutments to the building structure with joint sealant as specified below. Surfaces shall be suitably cleaned of oil, dust, dirt, rust, and moisture to receive sealant.
- E. Provide 24"x72" man access doors in each plenum section allow access to floor drains and other equipment inside the plenum.
- F. At sheet metal connections to building construction, use steel angles fastened to the sheet metal by sheet metal screws, attached using anchor bolts embedded in the wall or slab, with sealant under the angle, angles 2"x2"x3/16" minimum.
- G. All welds on casing interiors shall be painted.
- H. Close-off or safing sheets and strips shall be of G90 galvanized steel of thickness not less than that of the duct widths and shall be securely attached with all joints sealed. Close-off or safing sheets shall not be used for structural support of equipment.
- I. Casings and plenums shall be constructed to withstand 133% of the rated pressure without structural failure. Wall and roof deflections at the rated pressure shall not exceed 1/8" per foot of width.
- J. Pipe penetrations of casings and plenums shall be sealed to prevent air leakage and condensation movement through the seal.
- K. Casings and plenums for negative pressures greater than 3" water gauge shall be constructed in accordance with SMACNA Rectangular Industrial Duct Construction Standards, Latest Edition.

2.9 ACCESS DOORS IN CASINGS AND PLENUMS:

- A. Construct in accordance with SMACNA 1995 HVAC/DCS, Fig. 6-12 for casings containing fans, coils, filters, etc. Doors shall be double-wall insulated type and shall be equipped with three heavy duty zinc plated steel strap type T-hinges and two heavy duty zinc plated steel latches with lever handle on outside and inside.
- B. Doors shall be double gasketed.
- C. Latches shall have lever handle and stud to accommodate door thickness with inside beveled flange to work against door frame to give compression. Latch escutcheon shall be sponge rubber gasketed.
- D. Walk-in access doors in casing and plenum walls shall be minimum 20" x 72" size.
- E. Manufacturer: Ruskin "SMACNA Standard", Ventfabrics "Ventlok", Air Balance Series FSA, or approved Ductmate Industries, Inc.

PART 3 - EXECUTION

3.1 DUCT APPLICATIONS

- A. Static-Pressure Classes: Unless otherwise indicated, construct ducts according to the following:
 - 1. Supply Ducts (before Air Terminal Units): 2-inch w.g.
 - 2. Supply Ducts (after Air Terminal Units): 1-inch w.g.
 - 3. Return Ducts (Negative Pressure): 2-inch w.g.
 - 4. Exhaust Ducts (Negative Pressure): 2-inch w.g.
 - 5. Exhaust Ducts (Positive Pressure): 1-inch w.g.
- B. All ducts shall be galvanized steel except as follows:
 - 1. Shower/Locker Room Exhaust Ducts: Aluminum or Type 304 stainless steel.

3.2 DUCT INSTALLATION

- A. Construct and install ducts according to SMACNA's "HVAC Duct Construction Standards--Metal and Flexible," unless otherwise indicated.
- B. Install round and flat oval ducts in lengths not less than 12 feet unless interrupted by fittings.
- C. Install ducts with fewest possible joints.
- D. Install fabricated fittings for changes in directions, size, and shape and for connections.
- E. Install couplings tight to duct wall surface with a minimum of projections into duct. Secure couplings with sheet metal screws. Install screws at intervals of 12 inches, with a minimum of three screws in each coupling.
- F. Install ducts, unless otherwise indicated, vertically and horizontally and parallel and perpendicular to building lines; avoid diagonal runs.
- G. Install ducts with a clearance of 1 inch, plus allowance for insulation thickness.
- H. Conceal ducts from view in finished spaces. Do not encase horizontal runs in solid partitions unless specifically indicated.
- I. Coordinate layout with suspended ceiling, fire- and smoke-control dampers, lighting layouts, and similar finished work.
- J. Seal all joints and seams. Apply sealant to male end connectors before insertion, and afterward to cover entire joint and sheet metal screws.
- K. Electrical Equipment Spaces: Route ducts to avoid passing through transformer vaults and electrical equipment spaces and enclosures.
- L. Non Fire Rated Partition Penetrations: Where ducts pass through interior partitions and exterior walls and are exposed to view, conceal spaces between construction openings and ducts or duct

insulation with sheet metal flanges of same metal thickness as ducts. Overlap openings on 4 sides by at least 1-1/2 inches.

- M. Fire Rated Partition Penetrations: Where ducts pass through interior partitions and exterior walls, install appropriately rated fire dampers, sleeves, and fire stopping sealant. Fire and smoke dampers are specified in Division 23 Section "Duct Accessories." Fire stopping materials and installation methods are specified in Division 7 Section "Through Penetration Fire stop Systems."
- N. Install ducts with hangers and braces designed to withstand, without damage to equipment, seismic force required by applicable building codes. Refer to SMACNA's "Seismic Restraint Manual: Guidelines for Mechanical Systems."
- O. Protect duct interiors from the elements and foreign materials until building is enclosed. During construction, provide temporary closures of metal or taped polyethylene on open ductwork to prevent construction dust and debris from entering the ductwork system.
- P. Paint interiors of metal ducts that do not have duct liner, for 24 inches upstream of registers and grilles. Apply one coat of flat, black, latex finish coat over a compatible galvanized-steel primer. Paint materials and application requirements are specified in Division 9 painting Sections.

3.3 SEAM AND JOINT SEALING

- A. Seal duct seams and joints according to SMACNA's "HVAC Duct Construction Standards--Metal and Flexible" for duct pressure classes as outlined below.
 - 1. Supply Ducts – pressure classes equal to or lower than 2-inch w.g.:
 - a. For ducts located in conditioned spaces: seal transverse joints.
 - b. For ducts located in unconditioned spaces: seal all transverse joints and longitudinal seams.
 - c. For ducts located outdoors: seal all transverse joints, longitudinal seams and duct wall penetrations.
 - 2. Return Ducts, all pressure classes:
 - a. For ducts located in conditioned spaces: seal transverse joints.
 - b. For ducts located in unconditioned spaces: seal all transverse joints and longitudinal seams.
 - c. For ducts located outdoors: seal all transverse joints, longitudinal seams and duct wall penetrations.
 - 3. Exhaust ducts:
 - a. For ducts located in conditioned spaces: seal all transverse joints and longitudinal seams.
 - b. For ducts located in unconditioned spaces: seal all transverse joints only.
- B. Seal ducts before external insulation is applied.

3.4 HANGING AND SUPPORTING

- A. Support horizontal ducts within 24 inches of each elbow and within 48 inches of each branch intersection.
- B. Support vertical ducts at maximum intervals of 16 feet and at each floor.
- C. Install upper attachments to structures with an allowable load not exceeding one-fourth of failure (proof-test) load.
- D. Install concrete inserts before placing concrete.
- E. Install powder-actuated concrete fasteners after concrete is placed and completely cured.
 - 1. Do not use powder-actuated concrete fasteners for lightweight-aggregate concretes or for slabs less than 4 inches thick.

3.5 CONNECTIONS

- A. Make connections to equipment with flexible connectors according to Division 23 Section "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 FIELD QUALITY CONTROL

- A. Ductwork constructed to greater than 2" w.g. class shall be leak tested.
- B. Perform the following field tests and inspections according to SMACNA's "HVAC Air Duct Leakage Test Manual" and prepare test reports:
 - 1. Disassemble, reassemble, and seal segments of systems to accommodate leakage testing and for compliance with test requirements.
 - 2. Conduct tests at static pressures equal to maximum design pressure of system or section being tested. Do not pressurize systems above maximum design operating pressure. Give seven days' advance notice for testing.
 - 3. Maximum Allowable Leakage: Comply with requirements for Leakage Class 3 for round and flat-oval ducts, Leakage Class 12 for rectangular ducts in pressure classes lower than and equal to 2-inch w.g. (both positive and negative pressures), and Leakage Class 6 for pressure classes from 2- to 10-inch w.g.. In no case shall duct leakage exceed amounts specified in the applicable energy code.
 - 4. Remake leaking joints and retest until leakage is equal to or less than maximum allowable.

3.7 CLEANING NEW SYSTEMS

- A. Mark position of dampers and air-directional mechanical devices before cleaning, and perform cleaning before air balancing.
- B. Use service openings, as required, for physical and mechanical entry and for inspection.
 - 1. Create other openings to comply with duct standards.
 - 2. Disconnect flexible ducts as needed for cleaning and inspection.
 - 3. Remove and reinstall ceiling sections to gain access during the cleaning process.
- C. Vent vacuuming system to the outside. Include filtration to contain debris removed from HVAC systems, and locate exhaust down wind and away from air intakes and other points of entry into building.
- D. Clean the following metal duct systems by removing surface contaminants and deposits:
 - 1. Air outlets and inlets (registers, grilles, and diffusers).
 - 2. Supply, return, and exhaust fans including fan housings, plenums (except ceiling supply and return plenums), scrolls, blades or vanes, shafts, baffles, dampers, and drive assemblies.
 - 3. Air-handling unit internal surfaces and components including mixing box, coil section, condensate drain pans, humidifiers, filters and filter sections, and condensate collectors and drains.
 - 4. Coils and related components.
 - 5. Return-air ducts, dampers, and actuators except in ceiling plenums and mechanical equipment rooms.
 - 6. Supply-air ducts, dampers, actuators, and turning vanes.
- E. Mechanical Cleaning Methodology:
 - 1. Clean metal duct systems using mechanical cleaning methods that extract contaminants from within duct systems and remove contaminants from building.
 - 2. Use vacuum-collection devices that are operated continuously during cleaning. Connect vacuum device to downstream end of duct sections so areas being cleaned are under negative pressure.
 - 3. Use mechanical agitation to dislodge debris adhered to interior duct surfaces without damaging integrity of metal ducts, duct liner, or duct accessories.
 - 4. Clean fibrous-glass duct liner with HEPA vacuuming equipment; do not permit duct liner to get wet.
 - 5. Clean coils and coil drain pans according to NADCA 1992. Keep drain pan operational. Rinse coils with clean water to remove latent residues and cleaning materials; comb and straighten fins.
- F. Cleanliness Verification:
 - 1. Visually inspect metal ducts for contaminants.
 - 2. Where contaminants are discovered, re-clean and reinspect ducts.

Maine Medical Center, Portland, Maine
Bean 2 Surgical Services/ Bean 2 Inpatient Services/
Richards 2 Inpatient Services

Issued for Construction
9/12/08

END OF SECTION 233113

SECTION 233300

DUCT ACCESSORIES

PART 1 - 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. The requirements of Section 230000, "Basic Mechanical Requirements" apply to work defined by this Section.
- C. The requirements of Section 230500, "Basic Mechanical Materials and Methods" apply to work defined by the Section.

1.2 SUMMARY

- A. This Section includes the following:

- 1. Backdraft dampers.
- 2. Volume dampers.
- 3. Motorized control dampers.
- 4. Fire dampers.
- 5. Ceiling fire dampers.
- 6. Smoke dampers.
- 7. Combination fire and smoke dampers.
- 8. Duct silencers.
- 9. Turning vanes.
- 10. Duct-mounting access doors.
- 11. Flexible connectors.
- 12. Flexible ducts.
- 13. Duct accessory hardware.

- B. Related Sections include the following:

- 1. Division 28, Section 283100 "Fire Alarm" for duct-mounting fire and smoke detectors.
- 2. Division 23, Section 230900 "HVAC Instrumentation and Controls" for electric damper actuators.

1.3 SUBMITTALS

- A. Product Data: For the following:

- 1. Backdraft dampers.

2. Volume dampers.
3. Motorized control dampers.
4. Fire dampers.
5. Ceiling fire dampers.
6. Smoke dampers.
7. Combination fire and smoke dampers.
8. Duct silencers.
9. Turning vanes.
10. Duct-mounting access doors.
11. Flexible connectors.
12. Flexible ducts.

B. Shop Drawings: Detail equipment assemblies and indicate dimensions, weights, loads, required clearances, method of field assembly, components, and location and size of each field connection.

1. Special fittings.
2. Manual-volume damper installations.
3. Motorized-control damper installations.
4. Fire-damper, smoke-damper, and combination fire- and smoke-damper installations, including sleeves and duct-mounting access doors.
5. Wiring Diagrams: Power, signal, and control wiring.

1.4 QUALITY ASSURANCE

A. Comply with NFPA 90A, "Installation of Air Conditioning and Ventilating Systems,".

PART 2 - PRODUCTS

2.1 MANUFACTURERS

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. Backdraft dampers
 - a. Air Balance, Inc.
 - b. American Warming and Ventilating.
 - c. CESCO Products.
 - d. Duro Dyne Corp.
 - e. Greenheck.
 - f. Prefco Products, Inc.
 - g. Ruskin Company.
 - h. Vent Products Company, Inc.

2. Volume dampers
 - a. Air Balance, Inc.
 - b. American Warming and Ventilating.
 - c. Flexmaster U.S.A., Inc.
 - d. McGill AirFlow Corporation.
 - e. Nailor Industries Inc.
 - f. Ruskin Company.
 - g. Vent Products Company, Inc.
3. Motorized control dampers
 - a. Air Balance, Inc.
 - b. American Warming and Ventilating.
 - c. CESCO Products.
 - d. Duro Dyne Corp.
 - e. Greenheck.
 - f. McGill AirFlow Corporation.
 - g. Nailor Industries Inc.
 - h. Ruskin Company.
 - i. Vent Products Company, Inc.
4. Fire dampers
 - a. Air Balance, Inc.
 - b. CESCO Products.
 - c. Greenheck.
 - d. McGill AirFlow Corporation.
 - e. Nailor Industries Inc.
 - f. Prefco Products, Inc.
 - g. Ruskin Company.
 - h. Vent Products Company, Inc.
5. Combination fire and smoke dampers
 - a. Air Balance, Inc.
 - b. CESCO Products.
 - c. Greenheck.
 - d. Nailor Industries Inc.
 - e. Ruskin Company.
6. Duct silencers
 - a. Industrial Noise Control, Inc.
 - b. McGill AirFlow Corporation.
 - c. Ruskin Company.
 - d. Vibro-Acoustics.
7. Manufactured turning vanes
 - a. Ductmate Industries, Inc.
 - b. Duro Dyne Corp.
 - c. METALAIRE, Inc.
8. Duct-mounting access doors – rectangular
 - a. American Warming and Ventilating.
 - b. CESCO Products.
 - c. Ductmate Industries, Inc.
 - d. Flexmaster U.S.A., Inc.
 - e. Greenheck.
 - f. McGill AirFlow Corporation.
 - g. Nailor Industries Inc.

- h. Ventfabrics, Inc.
- 9. Duct-mounting access doors – round
 - a. Ductmate Industries, Inc.
 - b. Flexmaster U.S.A., Inc.
- 10. Pressure-relief access door
 - a. American Warming and Ventilating.
 - b. CESCO Products.
 - c. Ductmate Industries, Inc.
 - d. Greenheck.
 - e. KEES, Inc.
 - f. McGill AirFlow Corporation.
 - g. Nexus PDQ.
- 11. Flexible connectors
 - a. Ductmate Industries, Inc.
 - b. Duro Dyne Corp.
 - c. Ventfabrics, Inc.
- 12. Flexible ducts
 - a. Flexmaster U.S.A., Inc.
 - b. Hart & Cooley, Inc.
 - c. McGill AirFlow Corporation.

2.2 SHEET METAL MATERIALS

- A. Comply with SMACNA's "HVAC Duct Construction Standards--Metal and Flexible" for acceptable materials, material thicknesses, and duct construction methods, unless otherwise indicated.
- B. Galvanized Sheet Steel: Lock-forming quality; complying with ASTM A 653 and having G60 coating designation; ducts shall have mill-phosphatized finish for surfaces exposed to view.
- C. Stainless Steel: ASTM A 480/A 480M.
- D. Aluminum Sheets: ASTM B 209, alloy 3003, temper H14; with mill finish for concealed ducts and standard, 1-side bright finish for exposed ducts.
- E. Extruded Aluminum: ASTM B 221, alloy 6063, temper T6.
- F. Reinforcement Shapes and Plates: Galvanized-steel reinforcement where installed on galvanized sheet metal ducts; compatible materials for aluminum and stainless-steel ducts.
- 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.

2.3 BACKDRAFT DAMPERS

- A. Description: Multiple-blade, parallel action gravity balanced, with center-pivoted blades of maximum 6-inch width, with sealed edges, assembled in rattle-free manner with 90-degree stop,

steel ball bearings, and axles; adjustment device to permit setting for varying differential static pressure.

- B. Frame: 0.063-inch- thick extruded aluminum, with welded corners and mounting flange.
- C. Blades: 0.025-inch- thick, roll-formed aluminum.
- D. Blade Seals: Neoprene.
- E. Blade Axles: Nonferrous.
- F. Tie Bars and Brackets: Aluminum.
- G. Return Spring: Adjustable tension.

2.4 VOLUME DAMPERS

- A. General Description: Factory fabricated, with required hardware and accessories. Stiffen damper blades for stability. Include locking device to hold single-blade dampers in a fixed position without vibration. Close duct penetrations for damper components to seal duct consistent with pressure class.
 - 1. Pressure Classes of 3-Inch wg or Higher: End bearings or other seals for ducts with axles full length of damper blades and bearings at both ends of operating shaft.
- B. Standard Volume Dampers: Multiple- or single-blade, parallel- or opposed-blade design as indicated, standard leakage rating, with linkage outside airstream, and suitable for horizontal or vertical applications.
 - 1. Steel Frames: Hat-shaped, galvanized sheet steel channels, minimum of 0.064 inch thick, with mitered and welded corners; frames with flanges where indicated for attaching to walls and flangeless frames where indicated for installing in ducts.
 - 2. Roll-Formed Steel Blades: 0.064-inch- thick, galvanized sheet steel.
 - 3. Aluminum Frames: Hat-shaped, 0.10-inch- thick, aluminum sheet channels; frames with flanges where indicated for attaching to walls; and flangeless frames where indicated for installing in ducts.
 - 4. Roll-Formed Aluminum Blades: 0.10-inch- thick aluminum sheet.
 - 5. Extruded-Aluminum Blades: 0.050-inch- thick extruded aluminum.
 - 6. Blade Axles: Nonferrous.
 - 7. Bearings: Oil-impregnated bronze.
 - 8. Tie Bars and Brackets: Galvanized steel.
- C. Low-Leakage Volume Dampers: Multiple- or single-blade, parallel- or opposed-blade design as indicated, low-leakage rating, with linkage outside airstream, and suitable for horizontal or vertical applications.
 - 1. Aluminum Frames: Hat-shaped, 0.10-inch- thick, aluminum sheet channels; frames with flanges where indicated for attaching to walls and flangeless frames where indicated for installing in ducts.
 - 2. Roll-Formed Aluminum Blades: 0.10-inch- thick aluminum sheet.

3. Extruded-Aluminum Blades: 0.050-inch- thick extruded aluminum.
 4. Blade Axles: Nonferrous.
 5. Bearings: Oil-impregnated bronze thrust or ball.
 6. Blade Seals: Neoprene.
 7. Jamb Seals: Cambered aluminum.
 8. Tie Bars and Brackets: Galvanized steel.
- D. Jackshaft: 1-inch- diameter, galvanized-steel pipe rotating within pipe-bearing assembly mounted on supports at each mullion and at each end of multiple-damper assemblies.
1. Length and Number of Mountings: Appropriate to connect linkage of each damper in multiple-damper assembly.
- E. Quadrants, in General:
1. Maximum Dimension of Blades 10" or Less: Quadrant with dial regulator and locking nuts, round end spring-in bearing, and square end damper bearing.
 - a. Manufacturer: Duro-Dyne Series KS or approved Ventfabrics.
 2. Maximum Dimension of Blades 11" to 20": Quadrant with dial regulator and locking nut, round end spring-in bearing, and square end bearing.
 - a. Manufacturer: Duro-Dyne Series KSR or approved Ventfabrics.
 3. Maximum Dimension of Blades over 20": Locking quadrant and 1/2" square rod with damper bearings.
 - a. Manufacturer: Duro-Dyne Series KS-12 "Shaft-Loc" or approved Ventfabrics.
 4. Include elevated platform for insulated duct mounting.
- F. Quadrants for Dampers in Ducts Concealed Behind Walls and Above Non-Removable Ceilings:
1. Damper regulator shall be cast into a box for flush mounting in ceilings. Cover telescopes into base to allow for expansion. Cover shall be secured by two screws which can be easily removed for adjustment of the damper. The regulator shall be made to accommodate 3/8" and 1/2" square rod. The cover shall be prime coated for field painting.
 - a. Manufacturer: Ventfabrics No. 666, or Young Regulator No. 301.
 2. Include elevated platform for insulated duct mounting.

2.5 MOTORIZED CONTROL DAMPERS

- A. General Description: AMCA-rated, parallel or opposed-blade design as appropriate for the application; minimum of 0.1084-inch- thick, galvanized-steel frames with holes for duct mounting; minimum of 0.0635-inch- thick, galvanized-steel damper blades with maximum blade width of 8 inches.
1. Secure blades to 1/2-inch- diameter, zinc-plated axles using zinc-plated hardware, with nylon blade bearings, blade-linkage hardware of zinc-plated steel and brass, ends sealed against spring-stainless-steel blade bearings, and thrust bearings at each end of every blade.
 2. Operating Temperature Range: From minus 40 to plus 200 deg F.
 3. Provide parallel- or opposed-blade design with inflatable seal blade edging, or replaceable rubber seals, rated for leakage at less than 10 cfm per sq. ft. of damper area,

at differential pressure of 4-inch wg when damper is being held by torque of 50 in. x lbf;
when tested according to AMCA 500D.

2.6 FIRE DAMPERS

- A. Fire dampers shall be labeled according to UL 555.
- B. Fire Rating: 1-1/2 hours.
- C. Frame: Curtain type with blades outside airstream or multiple-blade type, as appropriate for the application; fabricated with roll-formed, 0.034-inch- thick galvanized steel; with mitered and interlocking corners.
- D. Mounting Sleeve: Factory- or field-installed, galvanized sheet steel.
 - 1. Minimum Thickness: 0.052 or 0.138 inch thick as indicated and of length to suit application.
 - 2. Exceptions: Omit sleeve where damper frame width permits direct attachment of perimeter mounting angles on each side of wall or floor, and thickness of damper frame complies with sleeve requirements.
- E. Mounting Orientation: Vertical or horizontal as indicated.
- F. Blades: Roll-formed, interlocking, 0.034-inch- thick, galvanized sheet steel. In place of interlocking blades, use full-length, 0.034-inch- thick, galvanized-steel blade connectors.
- G. Horizontal Dampers: Include blade lock and stainless-steel closure spring.
- H. Fusible Links: Replaceable, 165 deg F rated.

2.7 COMBINATION FIRE AND SMOKE DAMPERS

- A. General Description: Labeled according to UL 555S. Combination fire and smoke dampers shall be labeled according to UL 555 for 1-1/2-hour rating.
- B. Fusible Links: Replaceable, 165 deg F rated.
- C. Frame and Blades: 0.064-inch- thick, galvanized sheet steel.
- D. Mounting Sleeve: Factory-installed, 0.052-inch- thick, galvanized sheet steel; length to suit wall or floor application.
- E. Dampers shall have not more than 0.10" w.c. pressure drop.
- F. Damper Motors: Modulating and two-position action.
 - 1. Permanent-Split-Capacitor or Shaded-Pole Motors: With oil-immersed and sealed gear trains.
 - 2. Spring-Return Motors: Equip with an integral spiral-spring mechanism where indicated. Enclose entire spring mechanism in a removable housing designed for service or

- adjustments. Size for running torque rating of 150 in. x lbf and breakaway torque rating of 150 in. x lbf.
3. Outdoor Motors and Motors in Outside-Air Intakes: Equip with O-ring gaskets designed to make motors weatherproof. Equip motors with internal heaters to permit normal operation at minus 40 deg F.
 4. Nonspring-Return Motors: For dampers larger than 25 sq. ft., size motor for running torque rating of 150 in. x lbf and breakaway torque rating of 300 in. x lbf.
 5. Electrical Connection: 115 V, single phase, 60 Hz.
- G. Heat Closure: The fire/smoke damper shall include a heat-actuated release device to permit controlled closure through the actuator and shall be manually resettable after release.
- H. Blade Positioner Indicator: Each damper shall be equipped with an end switch package that includes two position indicator switches linked directly to the damper to remotely indicate damper blade position. Wiring from the damper motor to circuit in fire alarm control panel shall be by controls contractor.
- I. Duct Smoke Detector: The fire/smoke damper shall be provided with a photoelectronic type smoke detector mounted on the outside of the sleeve with a sensing tube that traverses the air stream. Detector shall be factory-mounted for a single-point electrical service connection.

2.8 DUCT SILENCERS

- A. General Description: Factory-fabricated and -tested, round or rectangular silencers with performance characteristics and physical requirements as indicated.
- B. Fire Performance: Adhesives, sealants, packing materials, and accessory materials shall have fire ratings not exceeding 25 for flame-spread index and 50 for smoke-developed index when tested according to ASTM E 84.
- C. Rectangular Units: Fabricate casings with a minimum of 0.034-inch- thick, solid galvanized sheet metal for outer casing and 0.022-inch- thick, ASTM A 653, G90, perforated galvanized sheet metal for inner casing.
- D. Round Units:
1. Outer Casings:
 - a. ASTM A 653/A 653M, G90, galvanized sheet steel.
 - b. Up to 24 Inches in Diameter: 0.034 inch thick.
 - c. 26 through 40 Inches in Diameter: 0.040 inch thick.
 - d. 42 through 52 Inches in Diameter: 0.052 inch thick.
 - e. 54 through 60 Inches in Diameter: 0.064 inch thick.
 - f. Casings fabricated of spiral lock-seam duct may be one size thinner than that indicated.
 2. Interior Casing, Partitions, and Baffles:
 - a. ASTM A 653/A 653M, G90, galvanized sheet steel.

- b. At least 0.034 inch thick and designed for minimum aerodynamic losses.
- E. Sheet Metal Perforations: 1/8-inch diameter for inner casing and baffle sheet metal.
- F. Fill Material: Inert and vermin-proof fibrous material, packed under not less than 5 percent compression.
 - 1. Erosion Barrier: Polymer bag enclosing fill and heat-sealed before assembly.
- G. Fabricate silencers to form rigid units that will not pulsate, vibrate, rattle, or otherwise react to system pressure variations.
 - 1. Do not use nuts, bolts, or sheet metal screws for unit assemblies.
 - 2. Lock form and seal or continuously weld joints.
 - 3. Suspended Units: Factory-installed suspension hooks or lugs attached to frame in quantities and spaced to prevent deflection or distortion.
 - 4. Reinforcement: Cross or trapeze angles for rigid suspension.
- H. Source Quality Control:
 - 1. Acoustic Performance: Test according to ASTM E 477.
 - 2. Record acoustic ratings, including dynamic insertion loss and self-noise power levels with an airflow of at least 2000-fpm face velocity.
 - 3. Leak Test: Test units for airtightness at 200 percent of associated fan static pressure or 6-inch wg static pressure, whichever is greater.

2.9 TURNING VANES

- A. Fabricate to comply with SMACNA's "HVAC Duct Construction Standards--Metal and Flexible" for vanes and vane runners. Vane runners shall automatically align vanes.
- B. Manufactured Turning Vanes: Fabricate 1-1/2-inch- wide, single-vane, curved blades of galvanized sheet steel set 3/4 inch o.c.; support with bars perpendicular to blades set 2 inches o.c.; and set into vane runners suitable for duct mounting.
- C. Acoustic Turning Vanes: Fabricate airfoil-shaped aluminum extrusions with perforated faces and fibrous-glass fill.

2.10 DUCT-MOUNTING ACCESS DOORS

- A. General Description: Fabricate doors airtight and suitable for duct pressure class.
- B. Door: Double wall, duct mounting, and rectangular; fabricated of galvanized sheet metal with insulation fill and thickness as indicated for duct pressure class. Include vision panel where indicated. Include 1-by-1-inch butt or piano hinge and cam latches.
 - 1. Frame: Galvanized sheet steel, with bend-over tabs and foam gaskets.
 - 2. Provide number of hinges and locks as follows:

- a. Less Than 12 Inches Square: Secure with two sash locks.
 - b. Up to 18 Inches Square: Two hinges and two sash locks.
 - c. Up to 24 by 48 Inches: Three hinges and two compression latches with outside.
 - d. Sizes 24 by 48 Inches and Larger: One additional hinge.
- C. Door: Double wall, duct mounting, and round; fabricated of galvanized sheet metal with insulation fill and 1-inch thickness. Include cam latches.
1. Frame: Galvanized sheet steel, with spin-in notched frame.
- D. Pressure Relief Access Door: Single or Double wall and duct mounting; fabricated of galvanized sheet metal with insulation fill and thickness as indicated for duct pressure class. Include vision panel where indicated, latches, and retaining chain.
1. Frame: Galvanized sheet steel, with bend-over tabs and foam gaskets.
- E. Seal around frame attachment to duct and door to frame with neoprene or foam rubber.
- F. Insulation: 1-inch- thick, fibrous-glass or polystyrene-foam board.

2.11 FLEXIBLE CONNECTORS

- A. General Description: Flame-retardant or noncombustible fabrics, coatings, and adhesives complying with UL 181, Class 1.
- B. 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. Select metal compatible with ducts.
- C. 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.
- D. 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.
- E. High-Temperature System, Flexible Connectors: Glass fabric coated with silicone rubber.
1. Minimum Weight: 16 oz./sq. yd..
 2. Tensile Strength: 285 lbf/inch in the warp and 185 lbf/inch in the filling.
 3. Service Temperature: Minus 67 to plus 500 deg F.

- F. High-Corrosive-Environment System, Flexible Connectors: Glass fabric with chemical-resistant coating.
 - 1. Minimum Weight: 14 oz./sq. yd..
 - 2. Tensile Strength: 450 lbf/inch in the warp and 340 lbf/inch in the filling.
 - 3. Service Temperature: Minus 67 to plus 500 deg F.

2.12 FLEXIBLE DUCTS

- A. General: Flexible duct, including connectors, shall comply with UL181, Class I, and NFPA 90A and shall have acoustical performance acceptable to the Architect. Duct shall be used for connections between rigid duct and outlets. Duct shall not be more than 5' long, containing a net 90 degree of bends for acoustical reasons, and without intermediate joints. Installed duct shall not erode, delaminate or impart loose fibers or odors into the air stream. Internal working pressure shall be 6"w.g. positive and 4"w.g. negative.
- B. Materials: Flexible duct assembly shall consist of a strong and puncture resistant polymer inner liner and a high strength duct wall, mechanically locked together with a corrosive resistant galvanized helix to form a solid performing UL-181, Class 1 flexible duct, without the use of glue or adhesives.
- C. Insulation and Vapor Barrier: The factory-fabricated flexible duct shall have blanket-type insulation, having a C Factor of not more than 0.23. The insulation shall be sheathed with a vapor barrier having a maximum permeability of 0.05 perm per ASTM E96, Procedure A. The vapor barrier jacket on the flexible duct shall be sealed to vapor barrier on the connecting sheet metal ducts. Joints shall be airtight slip joints sealed and secured with a clamp.
- D. Clamps: 175-lb test 6/6 nylon locking draw band at each end.
 - 1. Manufacturer: Panduit SLT10-LH-L, Ideal "Snaplock" or Ventlock "Suretite" No. 670.
- E. Test reports from an independent laboratory showing that flexible ducts meet the performance specifications stated below. If manufacturer other than that specified is submitted, provide acoustical performance ratings for each size flexible duct. Acoustical performance testing shall be performed by an independent laboratory. The specified insertion loss and radiated noise reduction of flexible duct should be met when tested with a 10 foot length of straight duct at 2,500 feet per minute velocity.

INSERTION LOSS (dB)

Duct Dia. in.	Air Velocity	Octave Band Center Frequency (Hz)					
		125	250	500	1000	2000	4000
6	2500 fpm	7	31	40	38	40	27
8	2500 fpm	12	29	36	35	38	22
12	2500 fpm	21	28	29	33	26	12

RADIATED NOISE REDUCTION (dB)

Ductr Dia. in.	Air Velocity	Octave Band Center Frequency (Hz)					
		125	250	500	1000	2000	4000
6	2500 fpm	5	8	7	8	11	15
8	2500 fpm	10	7	7	8	10	13

12 2500 fpm 9 6 6 5 9 13

- F. Manufacturer: Flexmaster U.S.A., Inc. Type 8M or approved.

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 APPLICATION AND 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. Provide 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 on exhaust fans or exhaust ducts nearest to outside and where indicated.
- D. Provide balancing dampers at points on supply, return, and exhaust systems where branches lead from larger ducts as required for air balancing. Install at a minimum of two duct widths from branch takeoff. . Provide a damper in the duct to each supply and exhaust opening, except ducts at outlet of any terminal unit which serves a single diffuser; also in each branch duct where the pressure loss is lower than other branch ducts leading from the same trunk duct; elsewhere as shown.
- E. Provide test holes at fan inlets and outlets and elsewhere as indicated.
- F. Install fire and smoke dampers, with fusible links, according to manufacturer's UL-approved written instructions.
- G. Install duct silencers rigidly to ducts.
- H. Install duct access doors to allow for inspecting, adjusting, and maintaining accessories and terminal units as follows:
 - 1. On both sides of duct coils.
 - 2. Downstream from volume dampers, turning vanes in return ducts, and equipment.

3. Adjacent to fire or smoke dampers, providing access to reset or reinstall fusible links.
 4. To interior of ducts for cleaning; before and after each change in direction, at maximum 50-foot spacing.
 5. On sides of ducts where adequate clearance is available.
- I. Install the following sizes for duct-mounting, rectangular access doors:
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.
- J. Install the following sizes for duct-mounting, round access doors:
1. One-Hand or Inspection Access: 8 inches in diameter.
 2. Two-Hand Access: 10 inches in diameter.
 3. Head and Hand Access: 12 inches in diameter.
 4. Head and Shoulders Access: 18 inches in diameter.
 5. Body Access: 24 inches in diameter.
- K. Install the following sizes for duct-mounting, pressure relief access doors:
1. One-Hand or Inspection Access: 7 inches in diameter.
 2. Two-Hand Access: 10 inches in diameter.
 3. Head and Hand Access: 13 inches in diameter.
 4. Head and Shoulders Access: 19 inches in diameter.
- L. Label access doors according to Division 23 Section "Mechanical Identification."
- M. Install flexible connectors immediately adjacent to equipment in ducts associated with fans and motorized equipment supported by vibration isolators.
- N. For fans developing static pressures of 5-inch wg and higher, cover flexible connectors with loaded vinyl sheet held in place with metal straps.
- O. Connect terminal units to supply ducts directly. Do not use flexible ductwork.
- P. Connect all supply diffusers to low pressure ducts with maximum 60-inch lengths of flexible duct clamped or strapped in place.
- Q. Connect all return grilles and exhaust grilles to low pressure ducts with maximum 60-inch lengths of flexible duct clamped or strapped in place.
- R. Connect flexible ducts to metal ducts with draw bands.
- S. Install duct test holes where indicated and required for testing and balancing purposes.

3.2 ADJUSTING

- A. Adjust duct accessories for proper settings.
- B. Adjust fire and smoke dampers for proper action.
- C. Damper Positions: Contractor shall set and lock all dampers in the "Full Open" position prior to balancing work.
 - 1. Final positioning of manual-volume dampers is specified in Division 23, Section 230593 "Testing, Adjusting, and Balancing."

END OF SECTION 233300

SECTION 233600

AIR TERMINAL UNITS

PART 1 - 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. The requirements of Section 230000, "Basic Mechanical Requirements" apply to work defined by this Section.
- C. The requirements of Section 230500, "Basic Mechanical Materials and Methods" apply to work defined by this Section.

1.2 SUMMARY

- A. This Section includes the following:
 - 1. Single-duct air terminal units.

1.3 SUBMITTALS

- A. Product Data: For each type of product indicated, include rated capacities, furnished specialties, sound-power ratings, and accessories.
- B. Shop Drawings: Detail equipment assemblies and indicate dimensions, required clearances, method of field assembly, components, and location and size of each field connection.
 - 1. Include a schedule showing unique model designation, room location, model number, size, and accessories furnished.
- C. Coordination Drawings: Reflected ceiling plans, drawn to scale, on which the following items are shown and coordinated with each other, based on input from installers of the items involved:
 - 1. Ceiling suspension assembly members.
 - 2. Method of attaching hangers to building structure.
 - 3. Size and location of initial access modules for acoustical tile.
 - 4. Ceiling-mounted items including lighting fixtures, diffusers, grilles, speakers, sprinklers, access panels, and special moldings.
- D. Operation and Maintenance Data: For air terminal units to include in emergency, operation, and maintenance manuals. In addition to items specified in Division 1 Section "Closeout Procedures," include the following:

1. Instructions for resetting minimum and maximum air volumes.
2. Instructions for adjusting software set points.

1.4 QUALITY ASSURANCE

- A. Product Options: Drawings indicate size, profiles, and dimensional requirements of air terminal units and are based on the specific system indicated. Refer to Division 1 Section "Product Requirements."
- B. NFPA Compliance: Install air terminal units according to NFPA 90A, "Standard for the Installation of Air Conditioning and Ventilating Systems."

1.5 COORDINATION

- A. Coordinate layout and installation of air terminal units and suspension system with other construction that penetrates ceilings or is supported by them, including light fixtures, HVAC equipment, fire-suppression system, and partition assemblies.

PART 2 - PRODUCTS

2.1 MANUFACTURERS

- 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. Single-Duct Air Terminal Units
 - a. Enviro-tec.
 - b. Krueger.
 - c. Nailor Industries of Texas Inc.
 - d. Price Industries.
 - e. Titus.
 - f. Trane

2.2 SINGLE-DUCT AIR TERMINAL UNITS

- A. Configuration: Volume-damper assembly inside unit casing with control components located inside a protective metal shroud.
- B. Casing: 0.034-inch steel.
 1. Casing Lining: 3/4-inch thick, coated, fibrous-glass duct liner complying with ASTM C 1071; secured with adhesive. Cover liner with nonporous foil.

2. Casing Lining: Adhesive attached, 3/4-inch- thick, polyurethane foam insulation complying with UL 181 erosion requirements, and having a maximum flame-spread index of 25 and a maximum smoke-developed index of 50, for both insulation and adhesive, when tested according to ASTM E 84.
 3. Air Inlet: Round stub connection or S-slip and drive connections for duct attachment.
 4. Air Outlet: S-slip and drive connections .
 5. Access: Removable panels for access to dampers and other parts requiring service, adjustment, or maintenance; with airtight gasket.
- C. Regulator Assembly: Extruded-aluminum or galvanized-steel components; key damper blades onto shaft with nylon-fitted pivot points located inside unit casing.
1. Automatic Flow-Control Assembly: Combined spring rates shall be matched for each volume-regulator size with machined dashpot for stable operation.
 2. Factory-calibrated and field-adjustable assembly with shaft extension for connection to externally mounted control actuator.
- D. Volume Damper: Galvanized steel with peripheral gasket and self-lubricating bearings.
1. Maximum Damper Leakage: ARI 880 rated, 2 percent of nominal airflow at 3-inch wg inlet static pressure.
 2. Damper Position: Normally open.
- E. Attenuator Section: 0.034-inch steel sheet metal.
1. Lining: 1/2-inch thick, coated, fibrous-glass duct liner complying with ASTM C 1071; secured with adhesive. Cover liner with nonporous foil.
 2. Lining: Adhesive attached, 3/4-inch- thick, polyurethane foam insulation complying with UL 181 erosion requirements, and having a maximum flame-spread index of 25 and a maximum smoke-developed index of 50, for both insulation and adhesive, when tested according to ASTM E 84.
- F. Hot-Water Heating Coil: Copper tube, mechanically expanded into aluminum-plate fins; leak tested underwater to 200 psig; and factory installed.
- G. Pneumatic Controls: Units shall be controlled by a pneumatic differential pressure reset volume controller. Controller shall be capable of pressure independent operation down to 0.03 inches W.G. differential pressure and shall be factory set to the specified airflow (CFM). Controller shall not exceed 11.5 scim (standard cubic inches per minute) air consumption at 20 PSIG. Bidirectional damper operators and room sensor shall be provided with the temperature controls specified in Division 23 Section "HVAC Instrumentation and Controls".
- 2.3 SOURCE QUALITY CONTROL
- A. Identification: Label each air terminal unit with plan number, nominal airflow, maximum and minimum factory-set airflows, coil type, and ARI certification seal.
 - B. Verification of Performance: Rate air terminal units according to ARI 880.

PART 3 - EXECUTION

3.1 INSTALLATION

- A. Install air terminal units level and plumb. Maintain sufficient clearance for normal service and maintenance.

3.2 CONNECTIONS

- A. Piping installation requirements are specified in other Division 23 Sections. Drawings indicate general arrangement of piping, fittings, and specialties.
- B. Install piping adjacent to air terminal units to allow service and maintenance.
- C. Hot-Water Piping: In addition to requirements in Division 23 Section "Hydronic Piping," connect heating coils to supply with shutoff valve, strainer, control valve, and union or flange; and to return with balancing valve and union or flange.
- D. Connect ducts to air terminal units according to Division 23 Section "Metal Ducts."

3.3 FIELD QUALITY CONTROL

- A. Perform the following field tests and inspections and prepare test reports:
 - 1. After installing air terminal units and after electrical circuitry has been energized, test for compliance with requirements.
 - 2. Leak Test: After installation, fill water coils and test for leaks. Repair leaks and retest until no leaks exist.
 - 3. Operational Test: After electrical circuitry has been energized, start units to confirm proper motor rotation and unit operation.
 - 4. Test and adjust controls and safeties. Replace damaged and malfunctioning controls and equipment.
- B. Remove and replace malfunctioning units and retest as specified above.

3.4 STARTUP SERVICE

- A. Engage a factory-authorized service representative to perform startup service.
 - 1. Complete installation and startup checks according to manufacturer's written instructions and do the following:
 - a. Verify that inlet duct connections are as recommended by air terminal unit manufacturer to achieve proper performance.
 - b. Verify that controls and control enclosure are accessible.
 - c. Verify that control connections are complete.
 - d. Verify that nameplate and identification tag are visible.

- e. Verify that controls respond to inputs as specified.

3.5 DEMONSTRATION

- A. Engage a factory-authorized service representative to train Owner's maintenance personnel to adjust, operate, and maintain air terminal units. Refer to Division 1 Section "Closeout Procedures."

END OF SECTION 233600

SECTION 233713

DIFFUSERS, REGISTERS, AND GRILLES

PART 1 - 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. The requirements of Section 230000, "Basic Mechanical Requirements" apply to work defined by this Section.
- C. The requirements of Section 230500, "Basic Mechanical Materials and Methods" apply to work defined by the Section.

1.2 SUMMARY

- A. This Section includes ceiling- and wall-mounted diffusers, registers, and grilles.
- B. Related Sections include the following:
 - 1. Division 8, Section 089000 "Louvers and Vents" for fixed and adjustable louvers and wall vents, whether or not they are connected to ducts.
 - 2. Division 23, Section 233300 "Duct Accessories" for fire and smoke dampers and volume-control dampers not integral to diffusers, registers, and grilles.

1.3 SUBMITTALS

- A. Product Data: For each 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.

PART 2 - PRODUCTS

2.1 MANUFACTURERS

- 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. Grilles and registers – adjustable bar
 - a. Anemostat; a Mestek Company.
 - b. Krueger.
 - c. Price Industries.
 - d. Titus.
 2. Grilles and registers – fixed face
 - a. Anemostat; a Mestek Company.
 - b. Krueger.
 - c. Price Industries.
 - d. Titus.
 3. Linear slot diffuser
 - a. Anemostat; a Mestek Company.
 - b. Krueger.
 - c. Price Industries.
 - d. Titus.

2.2 GRILLES AND REGISTERS

A. Adjustable Bar Grille:

1. Material: Steel.
2. Finish: Baked enamel, color selected by Architect.
3. Face Blade Arrangement: Fixed horizontal spaced 3/4 inch apart.
4. Frame: 1 inch wide.
5. Mounting: As scheduled.

2.3 CEILING DIFFUSER OUTLETS

A. Rectangular and Square Ceiling Diffusers:

1. Material: Steel.
2. Finish: As scheduled.
3. Face Size: 24 by 24 inches.
4. Face Style: Architectural Louvered.
5. Mounting: As required for ceiling system.
6. Pattern: Adjustable.

2.4 LINEAR SLOT OUTLETS

A. Linear Slot Diffuser:

1. Material - Shell: Steel, insulated.
2. Material - Pattern Controller and Tees: Aluminum.

3. Finish - Face and Shell: Baked enamel, black.
4. Finish - Pattern Controller: Baked enamel, black.
5. Finish - Tees: Baked enamel, white.
6. Slot Width: 1 inch.
7. Number of Slots: Two.
8. Length: 48 inches.
9. Accessories: T-bar slot.

2.5 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 EXAMINATION

- A. Examine areas where diffusers, registers, and grilles are to be installed for compliance with requirements for installation tolerances and other conditions affecting performance of equipment.
- B. Proceed with installation only after unsatisfactory conditions have been corrected.

3.2 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 practicable. 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.
- D. Frames for diffusers, registers and grilles shall be selected to match the ceiling type. Air devices installed in a suspended acoustic tile ceiling shall be provided with a lay-in metal panel matched to the air device finish and material and shall fit in the grid dimensions. Cutting ceiling tiles for installation is not acceptable.

3.3 ADJUSTING

- A. After installation, adjust diffusers, registers, and grilles to air patterns indicated, or as directed, before starting air balancing.

Maine Medical Center, Portland, Maine
Bean 2 Surgical Services/ Bean 2 Inpatient Services/
Richards 2 Inpatient Services

Issued for Construction
9/12/08

END OF SECTION 233713

SECTION 238126

SPLIT-SYSTEM AIR-CONDITIONING UNITS

PART 1 - 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. The requirements of Section 230000, "Basic Mechanical Requirements" apply to work defined by this Section.
- C. The requirements of Section 230500, "Basic Mechanical Materials and Methods" apply to work defined by the Section.

1.2 SUMMARY

- A. This Section includes split-system air-conditioning and heat pump units consisting of separate evaporator-fan and compressor-condenser components. Units are designed for exposed or concealed mounting, and may be connected to ducts.

1.3 SUBMITTALS

- A. Product Data: Include rated capacities, furnished specialties, and accessories for each type of product indicated. Include performance data in terms of capacities, outlet velocities, static pressures, sound power characteristics, motor requirements, and electrical characteristics.
- B. Shop Drawings: Diagram power, signal, and control wiring.
- C. Samples for Initial Selection: For units with factory-applied color finishes.
- D. Field quality-control test reports.
- E. Operation and Maintenance Data: For split-system air-conditioning units to include in emergency, operation, and maintenance manuals.
- F. Warranty: Special warranty specified in this Section.

1.4 QUALITY ASSURANCE

- A. Product Options: Drawings indicate size, profiles, and dimensional requirements of split-system units and are based on the specific system indicated. Refer to Division 1 Section "Product Requirements."

- B. Electrical Components, Devices, and Accessories: Listed and labeled as defined in NFPA 70, Article 100, by a testing agency acceptable to authorities having jurisdiction, and marked for intended use.

1.5 COORDINATION

- A. Coordinate size and location of concrete bases for units. Cast anchor-bolt inserts into bases. Concrete, reinforcement, and formwork are specified in Division 3 Section "Cast-in-Place Concrete."
- B. Coordinate size, location, and connection details with roof curbs, equipment supports, and roof penetrations specified in Division 7 Section "Roof Accessories."

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: Five years from date of Substantial Completion.

1.7 EXTRA MATERIALS

- A. Furnish extra materials described below that match products installed and that are packaged with protective covering for storage and identified with labels describing contents.
 - 1. Filters: One set of filters for each unit.
 - 2. Fan Belts: One set of belts for each unit.

PART 2 - PRODUCTS

2.1 MANUFACTURERS

- 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. Carrier Air Conditioning; Div. of Carrier Corporation.
 - 2. Evcon Industries, Inc.
 - 3. First Co.
 - 4. Friedrich Air Conditioning Company.
 - 5. Koldwave, Inc.
 - 6. Lennox Industries Inc.
 - 7. Mitsubishi Electric Sales Canada, Inc.

8. Mitsubishi Electronics America, Inc.; HVAC Division.
9. Mitsubishi Heavy Industries America, Inc.; Air-Conditioning & Refrigeration Division, Inc.
10. Sanyo Fisher (U.S.A.) Corp..
11. Tadiran Electronic Industries Inc.; Appliance Division.
12. Trane Company (The); Unitary Products Group.
13. York International Corp.

2.2 WALL-MOUNTING, EVAPORATOR-FAN COMPONENTS

- A. Cabinet: Enameled steel with removable panels on front and ends in color selected by Architect, and discharge drain pans with drain connection.
- B. Refrigerant Coil: Copper tube, with mechanically bonded aluminum fins, complying with ARI 210/240, and with thermal-expansion valve.
- C. 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.
- D. Fan: Direct drive, centrifugal fan.
- E. Comply with requirements in Division 23, Section 230500 Basic Mechanical Materials and Methods, "Motors for Mechanical Equipment."
 1. Special Motor Features: Multitapped, multispeed with internal thermal protection and permanent lubrication.
- F. Filters: Permanent, cleanable.

2.3 CEILING-MOUNTING, EVAPORATOR-FAN COMPONENTS

- A. Cabinet: Enameled steel with removable panels on front and ends in color selected by Architect, and discharge drain pans with drain connection.
- B. Refrigerant Coil: Copper tube, with mechanically bonded aluminum fins, complying with ARI 210/240, and with thermal-expansion valve.
- C. 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.
- D. Fan: Direct drive, centrifugal fan and integral condensate pump.
- E. Comply with requirements in Division 23, Section 230500 Basic Mechanical Materials and Methods, "Motors for Mechanical Equipment."

1. Special Motor Features: Multitapped, multispeed with internal thermal protection and permanent lubrication.

F. Filters: Permanent, cleanable.

2.4 AIR-COOLED, COMPRESSOR-CONDENSER COMPONENTS

A. 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.

B. Compressor: Hermetically sealed with crankcase heater and mounted on vibration isolation. Compressor motor shall have thermal- and current-sensitive overload devices, start capacitor, relay, and contactor.

1. Compressor Type: Rotary .

2. Variable speed compressor motor with manual-reset high-pressure switch and automatic-reset low-pressure switch.

C. Refrigerant Coil: Copper tube, with mechanically bonded aluminum fins, complying with ARI 210/240, and with liquid subcooler.

D. Fan: Aluminum-propeller type, directly connected to motor.

E. Motor: DC, permanently lubricated, with integral thermal-overload protection.

F. Low Ambient Kit: Permits operation down to 45 deg F (7 deg C).

G. Mounting Base: Polyethylene.

2.5 ACCESSORIES

A. Control equipment and sequence of operation are specified in Division 23 Sections "HVAC Instrumentation and Controls" and "Sequence of Operation."

B. Thermostat: Low voltage with sub-base to control compressor and evaporator fan.

C. Thermostat: Wired option, 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.

D. Automatic-reset timer to prevent rapid cycling of compressor.

- E. 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.

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-mounting compressor-condenser components on equipment supports specified in Division 7 Section "Roof Accessories." Anchor units to supports with removable, cadmium-plated fasteners.
- D. Install seismic restraints.
- E. Install compressor-condenser components on restrained, spring isolators with a minimum static deflection of 1 inch (25 mm). Refer to Division 23 Section "Mechanical Vibration Controls and Seismic Restraints."
- F. Install and connect precharged refrigerant tubing to component's quick-connect fittings. Install tubing to allow access to unit.

3.2 CONNECTIONS

- A. Piping installation requirements are specified in other Division 23 Sections. Drawings indicate general arrangement of piping, fittings, and specialties.
 - 1. Water Coil Connections: Comply with requirements in Division 23 Section "Hydronic Piping." Connect to supply and return coil with shutoff-duty valve and union or flange on the supply connection and with throttling-duty valve and union or flange on the return connection.
 - 2. Remote Water-Cooled Condenser Connections: Comply with requirements in Division 23 Section "Hydronic Piping." Connect to supply and return with shutoff-duty valve and union or flange on the supply connection and with throttling-duty valve and union or flange on the return connection.
 - 3. Steam Coil Connections: Comply with requirements in Division 23 Section "Steam and Condensate Piping." Connect to steam piping with shutoff valve and union or flange; for condensate piping, starting from the coil connection, connect with union or flange, strainer, trap, and shutoff valve.
- B. Install piping adjacent to unit to allow service and maintenance.
- C. Ground equipment according to Division 26 Section "Grounding and Bonding."

- D. Electrical Connections: Comply with requirements in Division 26 Sections for power wiring, switches, and motor controls.

3.3 FIELD QUALITY CONTROL

- A. Manufacturer's Field Service: Engage a factory-authorized service representative to inspect, test, and adjust field-assembled components and equipment installation, including connections, and to assist in field testing. Report results in writing.
- B. Perform the following field tests and inspections and prepare test reports:
 - 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.

3.4 STARTUP SERVICE

- A. Engage a factory-authorized service representative to perform startup service.
 - 1. Complete installation and startup checks according to manufacturer's written instructions.

3.5 DEMONSTRATION

- A. Engage a factory-authorized service representative to train Owner's maintenance personnel to adjust, operate, and maintain units. Refer to Division 1 Section "Closeout Procedures."

END OF SECTION

SECTION 238233

RADIATORS

PART 1 - 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. The requirements of Section 230000, "Basic Mechanical Requirements" apply to work defined by this Section.
- C. The requirements of Section 230500, "Basic Mechanical Materials and Methods" apply to work defined by the Section.

1.2 SUMMARY

- A. This Section includes the following:
 - 1. Finned-tube radiators.

1.3 SUBMITTALS

- A. Product Data: Include specialties and accessories for each radiator type.
- B. Shop Drawings: Show the following:
 - 1. Plans, elevations, sections, and details.
 - 2. Details of custom-fabricated enclosures indicating dimensions.
 - 3. Required clearances.
 - 4. Location and size of each field connection.
 - 5. Enclosure joints, corner pieces, access doors, and other accessories.
 - 6. Method of attaching hangers to building structure.
 - 7. Unit schedules to include rated capacities, furnished specialties, and accessories.
- C. Samples for Initial Selection: Manufacturer's color charts showing the full range of colors available for units with factory-applied color finishes.
- D. Maintenance Data: For radiators to include in maintenance manuals specified in Division 1.

PART 2 - PRODUCTS

2.1 MANUFACTURERS

- 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. Finned-Tube Radiators:
 - a. Sterling Heating Equipment.
 - b. Dunham-Bush, Inc.
 - c. Engineered Air.
 - d. Haydon Corp.
 - e. Rosemex Products.
 - f. Slant/Fin.
 - g. Trane Company (The); North American Commercial Group.

2.2 FINNED-TUBE RADIATORS

- A. Heating Elements: Seamless copper tubing suitable for soldered fittings, mechanically expanded into evenly spaced aluminum fins.
 - 1. Tube Diameter: **NPS 3/4 (DN 20)**
 - 2. Fin Size: **3-1/4 by 3-1/4 inches (100 by 100 mm)**
- B. Element Hangers: Ball-bearing cradle type with unrestricted longitudinal movement on enclosure brackets.
- C. Enclosures: :Enameled steel with easily jointed components for wall-to-wall installation, rigidly supported on wall- or floor-mounting brackets.
 - 1. Enclosures 18 Inches (450 mm) and Less in Height: 0.0478-inch- (1.2-mm-) thick steel.
 - 2. Enclosures More Than 18 Inches (450 mm) in Height: 0.0598-inch- (1.5-mm-) thick steel.
 - 3. Support Brackets: Locate at maximum 36-inch (1000-mm) spacing.
 - 4. Finish: Factory-applied baked enamel in manufacturer's standard color.
 - 5. Damper: Knob-operated internal damper at enclosure outlet, if not thermostatically controlled.
 - 6. Access Doors: Factory made, permanently hinged with Allen-head camlock fastener, minimum size 6 by 7 inches (150 by 175 mm), integral with enclosure for otherwise inaccessible valves.
 - 7. Enclosure Style: Sloped top
- D. Capacity: As scheduled, based on 65 deg F (18 deg C) entering air temperature, 170 deg F (82 deg C) average water temperature.

2.3 SOURCE QUALITY CONTROL

- A. Factory test and rate baseboard radiators according to Hydronics Institute's "Testing and Rating Standard for Baseboard Radiation."
- B. Factory test and rate finned-tube radiators according to Hydronics Institute's "Testing and Rating Standard for Finned-Tube (Commercial) Radiation."

PART 3 - EXECUTION

3.1 INSTALLATION

- A. Install radiators level and plumb.
- B. Install finned-tube radiators as follows:
 - 1. Unless otherwise indicated, center heating elements and enclosure under windows.
 - 2. Unless otherwise indicated, install enclosure continuously from wall to wall.
 - 3. Unless otherwise indicated, install enclosure continuously around corners, using outside and inside corner fittings.
 - 4. Join sections with splicer plates and filler piece to provide continuous enclosure.
 - 5. Install access doors for access to valves and other fittings.
 - 6. Install air-seal gasketing between wall and enclosure mounting channel.
 - 7. Terminate enclosures with manufacturer's end caps.

3.2 CONNECTIONS

- A. Piping installation requirements are specified in other Division 23 Sections. Drawings indicate general arrangement of piping, fittings, and specialties.
- B. Connect hot-water units and components to piping according to Division 23 Section "Hydronic Piping."
- C. Install shutoff valve on inlet and balancing valve on outlet.
- D. Connect steam units and components to piping according to Division 23 Section "Steam and Condensate Piping."
 - 1. Install shutoff valve on inlet; install steam trap and shutoff valve on outlet.

3.3 CLEANING

- A. After completing system installation, including outlet fittings and devices, inspect for damage to exposed finish. Repair damaged finish to match original finish.

END OF SECTION

SECTION 238413

HUMIDIFIERS

PART 1 - 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. The requirements of Section 230000, "Basic Mechanical Requirements" apply to work defined by this Section.
- C. The requirements of Section 230500, "Basic Mechanical Materials and Methods" apply to work defined by the Section.

1.2 SUMMARY

- A. This Section includes the following type of humidifiers:
 - 1. humidifiers for application on ducted HVAC systems.

1.3 SUBMITTALS

- A. Product Data: Include rated capacities, operating weights, furnished specialties, and accessories.
- B. Shop Drawings: Detail fabrication and installation of humidifiers. Include piping details, plans, elevations, sections, details of components, and dispersion tubes.
 - 1. Wiring Diagrams: Power, signal, and control wiring. Differentiate between manufacturer-installed and field-installed wiring.
 - 2. Coordination Drawings: Detail humidifiers and adjacent equipment. Show support locations, type of support, weight on each support, and required clearances.
- C. Maintenance Data: For humidifiers to include in maintenance manuals specified in Division 1.

1.4 QUALITY ASSURANCE

- A. Electrical Components, Devices, and Accessories: Listed and labeled as defined in NFPA 70, Article 100, by a testing agency acceptable to authorities having jurisdiction, and marked for intended use.
- B. Comply with ARI 610, "Standard for Central System Humidifiers for Residential Applications."

- C. Comply with ARI 640, "Standard for Commercial and Industrial Humidifiers."

1.5 EXTRA MATERIALS

- A. Furnish extra materials described below that match products installed and that are packaged with protective covering for storage and identified with labels describing contents.

- 1. Supply one replacement cylinder with each humidifier.

1.6 COORDINATION

- A. Coordinate location and installation of humidifiers in ducts and air-handling units. Revise locations and elevations to suit field conditions and to ensure proper humidifier operation.

PART 2 - PRODUCTS

2.1 MANUFACTURERS

- 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. Humidifier Dispersion Panel:
 - a. Armstrong International, Inc.
 - b. Dri-Steem, Inc.
 - c. Nortec Industries, Inc.
 - d. Pure Humidifier Co.

2.2 HUMIDIFIER DISPERSION PANEL

- A. Dispersion Tube: Duct-mounting, single- or manifold-grid tube extending across entire width of duct; connected to heat-exchanger housing with flexible hose and equipped with mounting brackets for both ends of tube.

- B. Dispersion Tube: Inverted U-tube when humidifier is directly mounted under the duct.

- C. Optional Accessories: Include the following:

- 1. Duct-mounted, high-limit humidistat.
 - 2. Airflow switch to prevent humidifier operation when there is no airflow.
 - 3. VAV control offset package.

PART 3 - EXECUTION

3.1 EXAMINATION

- A. Examine ducts, air-handling units, and conditions for compliance with requirements for installation tolerances and other conditions affecting performance.
- B. Examine roughing-in for piping systems to verify actual locations of piping connections before humidifier panel installation.
- C. Proceed with installation only after unsatisfactory conditions have been corrected.

3.2 HUMIDIFIER INSTALLATION

- A. Install with required clearance for service and maintenance.
- B. Seal humidifier dispersion-tube duct penetrations with flange.
- C. Install dispersion tubes pitched to drain condensate back to housing.
- D. Install drip leg upstream from steam trap, a minimum of 12 inches for proper operation of trap.

3.3 FIELD QUALITY CONTROL

- A. Manufacturer's Field Service: Engage a factory-authorized service representative to inspect field-assembled components and equipment installation, including piping and electrical connections. Report results in writing.
 - 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 unit operation. Remove malfunctioning units, replace with new units, and retest.
 - 3. Test and adjust controls and safeties. Replace damaged and malfunctioning controls and equipment.

3.4 DEMONSTRATION

- A. Engage a factory-authorized service representative to train Owner's maintenance personnel to adjust, operate, and maintain humidifiers.
 - 1. Train Owner's maintenance personnel on procedures and schedules for starting and stopping, troubleshooting, servicing, and maintaining equipment and schedules.
 - 2. Review data in maintenance manuals. Refer to Division 1 Section "Contract Closeout."
 - 3. Review data in maintenance manuals. Refer to Division 1 Section "Operation and Maintenance Data."
 - 4. Schedule training with Owner, through Architect, with at least seven days' advance notice.

Maine Medical Center, Portland, Maine
Bean 2 Surgical Services/ Bean 2 Inpatient Services/
Richards 2 Inpatient Services

Issued for Construction
9/12/08

END OF SECTION 238413