

SECTION 15050 - MECHANICAL 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 includes the following basic mechanical materials and methods to complement other Division 15 Sections.

1. Piping materials and installation instructions common to most piping systems.
2. Concrete base construction requirements.
3. Escutcheons.
4. Dielectric fittings.
5. Flexible connectors.
6. Mechanical sleeve seals.
7. Equipment nameplate data requirements.
8. Labeling and identifying mechanical systems and equipment is specified in Division 15 Section "Mechanical Identification."
9. Nonshrink grout for equipment installations.
10. Field-fabricated metal and wood equipment supports.
11. Installation requirements common to equipment specification sections.
12. Mechanical demolition.
13. Cutting and patching.
14. Touchup painting and finishing.

- B. Pipe and pipe fitting materials are specified in Division 15 piping system Sections.

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, crawl spaces, 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. NP: Nylon plastic.
 - 4. PE: Polyethylene plastic.
 - 5. PVC: Polyvinyl chloride plastic.
- G. The following are industry abbreviations for rubber materials:
 - 1. CR: Chlorosulfonated polyethylene synthetic rubber.
 - 2. EPDM: Ethylene propylene diene terpolymer rubber.

1.4 SUBMITTALS

- A. Product Data Book: Submit product data for all Division 15 items in a single reinforced 3-ring binder. Organize product data by specification section number. Provide table of contents showing the following:
 - 1. Specification Section
 - 2. Description of item
 - 3. Submission number (1st submission, 2nd submission, etc.)
 - 4. Submittal status (Approved, Revise and Resubmit, etc.)
- B. Product Data: For dielectric fittings, flexible connectors, mechanical sleeve seals, and identification materials and devices.
- C. Shop Drawings: Detail fabrication and installation for metal and wood supports and anchorage for mechanical materials and equipment.
- D. Coordination Drawings: For access panel and door locations.
- E. Coordination Drawings: Detail major elements, components, and systems of mechanical equipment and materials in relationship with other systems, installations, and building components. Show space requirements for installation and access. Indicate if sequence and coordination of installations are important to efficient flow of the Work. Include the following:
 - 1. Planned piping layout, including valve and specialty locations and valve-stem movement.
 - 2. Clearances for installing and maintaining insulation.
 - 3. Clearances for servicing and maintaining equipment, accessories, and specialties, including space for disassembly required for periodic maintenance.
 - 4. Equipment and accessory service connections and support details.
 - 5. Exterior wall and foundation penetrations.
 - 6. Fire-rated wall and floor penetrations.
 - 7. Sizes and location of required concrete pads and bases.
 - 8. Scheduling, sequencing, movement, and positioning of large equipment into building during construction.
 - 9. Floor plans, elevations, and details to indicate penetrations in floors, walls, and ceilings and their relationship to other penetrations and installations.

10. Reflected ceiling plans to coordinate and integrate installation of air outlets and inlets, light fixtures, communication system components, sprinklers, and other ceiling-mounted items.

F. Samples: Of color, lettering style, and other graphic representation required for each identification material and device.

1.5 QUALITY ASSURANCE

A. Comply with ASME A13.1 for lettering size, length of color field, colors, and viewing angles of identification devices.

B. Equipment Selection: Equipment of higher electrical characteristics, physical dimensions, capacities, and ratings may be furnished provided such proposed equipment is approved in writing and connecting mechanical and electrical services, circuit breakers, conduit, motors, bases, and equipment spaces are increased. Additional costs shall be approved in advance by appropriate Contract Modification for these increases. If minimum energy ratings or efficiencies of equipment are specified, equipment must meet design and commissioning 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 prevent entrance of dirt, debris, and moisture.

B. Protect stored pipes and tubes from moisture and dirt. Elevate above grade. Do not exceed structural capacity of floor, if stored inside.

C. Protect flanges, fittings, and piping specialties from moisture and dirt.

D. Store plastic pipes protected from direct sunlight. Support to prevent sagging and bending.

1.7 SEQUENCING AND SCHEDULING

A. Coordinate mechanical equipment installation with other building components.

B. Arrange for pipe spaces, chases, slots, and openings in building structure during progress of construction to allow for mechanical installations.

C. Coordinate installation of required supporting devices and set sleeves in poured-in-place concrete and other structural components, as they are constructed.

D. Sequence, coordinate, and integrate installations of mechanical materials and equipment for efficient flow of the Work. Coordinate installation of large equipment requiring positioning before closing in building.

E. Coordinate connection of mechanical systems with exterior underground and overhead utilities and services. Comply with requirements of governing regulations, franchised service companies, and controlling agencies.

- F. Coordinate requirements for access panels and doors if mechanical items requiring access are concealed behind finished surfaces. Access panels and doors are specified in Division 8 Section "Access Doors."
- G. Coordinate installation of identifying devices after completing covering and painting, if devices are applied to surfaces. Install identifying devices before installing acoustical ceilings and similar concealment.

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. Dielectric Unions:
 - a. Capitol Manufacturing Co.
 - b. Central Plastics Co.
 - c. Eclipse, Inc.; Rockford-Eclipse Div.
 - d. Epco Sales Inc.
 - e. Hart Industries International, Inc.
 - f. Watts Industries, Inc.; Water Products Div.
 - g. Zurn Industries, Inc.; Wilkins Div.
 - 2. Dielectric Flanges:
 - a. Capitol Manufacturing Co.
 - b. Central Plastics Co.
 - c. Epco Sales Inc.
 - d. Watts Industries, Inc.; Water Products Div.
 - 3. Dielectric-Flange Insulating Kits:
 - a. Calpico, Inc.
 - b. Central Plastics Co.
 - 4. Dielectric Couplings:
 - a. Calpico, Inc.
 - b. Lochinvar Corp.
 - 5. Dielectric Nipples:
 - a. Grinnell Corp.; Grinnell Supply Sales Co.
 - b. Perfection Corp.
 - c. Victaulic Co. of America.
 - 6. Metal, Flexible Connectors:

- a. ANAMET Industrial, Inc.
- b. Central Sprink, Inc.
- c. Flexicraft Industries.
- d. Flex-Weld, Inc.
- e. Grinnell Corp.; Grinnell Supply Sales Co.
- f. Hyspan Precision Products, Inc.
- g. McWane, Inc.; Tyler Pipe; Gustin-Bacon Div.
- h. Mercer Rubber Co.
- i. Metraflex Co.
- j. Proco Products, Inc.
- k. Uniflex, Inc.

7. Rubber, Flexible Connectors:

- a. General Rubber Corp.
- b. Mercer Rubber Co.
- c. Metraflex Co.
- d. Proco Products, Inc.
- e. Red Valve Co., Inc.
- f. Uniflex, Inc.

8. Mechanical Sleeve Seals:

- a. Calpico, Inc.
- b. Metraflex Co.
- c. Thunderline/Link-Seal.

2.2 PIPE AND PIPE FITTINGS

- A. Refer to individual Division 15 piping Sections for pipe 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 15 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.
 - 1. Alloy Sn95 or Alloy Sn94: Approximately 95 percent tin and 5 percent silver, with 0.10 percent lead content.
 - 2. Alloy E: Approximately 95 percent tin and 5 percent copper, with 0.10 percent maximum lead content.
 - 3. Alloy HA: Tin-antimony-silver-copper zinc, with 0.10 percent maximum lead content.
 - 4. Alloy HB: Tin-antimony-silver-copper nickel, with 0.10 percent maximum lead content.
 - 5. Alloy Sb5: 95 percent tin and 5 percent antimony, with 0.20 percent maximum lead content.
- F. Brazing Filler Metals: AWS A5.8.
 - 1. BCuP Series: Copper-phosphorus alloys.
 - 2. BAg1: Silver alloy.
- 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: Manufacturer's standard solvent cements for the following:
 - 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. Plastic Pipe Seals: ASTM F 477, elastomeric gasket.
- J. Flanged, Ductile-Iron Pipe Gasket, Bolts, and Nuts: AWWA C110, rubber gasket, carbon-steel bolts and nuts.
- K. Couplings: Iron-body sleeve assembly, fabricated to match OD of plain-end, pressure pipes.
 - 1. Sleeve: ASTM A 126, Class B, gray iron.
 - 2. Followers: ASTM A 47 malleable iron or ASTM A 536 ductile iron.
 - 3. Gaskets: Rubber.
 - 4. Bolts and Nuts: AWWA C111.
 - 5. Finish: Enamel paint.

2.4 DIELECTRIC FITTINGS

- A. General: Assembly or fitting with insulating material isolating joined dissimilar metals, to prevent galvanic action and stop corrosion.
- B. Description: Combination of copper alloy and ferrous; threaded, solder, plain, and weld-neck end types and matching piping system materials.
- C. Insulating Material: Suitable for system fluid, pressure, and temperature.

SECTION 15050 - MECHANICAL MATERIALS AND METHODS

- D. Dielectric Unions: Factory-fabricated, union assembly, for 250-psig minimum working pressure at 180 deg F.
- E. Dielectric Flanges: Factory-fabricated, companion-flange assembly, for 150- or 300-psig minimum working pressure as required to suit system pressures.
- F. Dielectric-Flange Insulation Kits: Field-assembled, companion-flange assembly, full-face or ring type. Components include neoprene or phenolic gasket, phenolic or polyethylene bolt sleeves, phenolic washers, and steel backing washers.
 - 1. Provide separate companion flanges and steel bolts and nuts for 150- or 300-psig minimum working pressure as required to suit system pressures.
- G. Dielectric Couplings: Galvanized-steel coupling with inert and noncorrosive, thermoplastic lining; threaded ends; and 300-psig minimum working pressure at 225 deg F.
- H. 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.

2.5 FLEXIBLE CONNECTORS

- A. General: Fabricated from materials suitable for system fluid and that will provide flexible pipe connections. Include 125-psig minimum working-pressure rating, unless higher working pressure is indicated, and ends according to the following:
 - 1. 2-Inch NPS and Smaller: Threaded.
 - 2. 2-1/2-Inch NPS and Larger: Flanged.
 - 3. Option for 2-1/2-Inch NPS and Larger: Grooved for use with keyed couplings.
- B. Bronze-Hose, Flexible Connectors: Corrugated, bronze, inner tubing covered with bronze wire braid. Include copper-tube ends or bronze flanged ends, braze welded to hose.
- C. Stainless-Steel-Hose/Steel Pipe, Flexible Connectors: Corrugated, stainless-steel, inner tubing covered with stainless-steel wire braid. Include steel nipples or flanges, welded to hose.
- D. 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.
- E. Rubber, Flexible Connectors: CR or EPDM elastomer rubber construction, with multiple plies of NP fabric, molded and cured in hydraulic presses. Include 125-psig minimum working-pressure rating at 220 deg F. Units may be straight or elbow type, unless otherwise indicated.

2.6 MECHANICAL SLEEVE SEALS

- A. Description: Modular design, with interlocking rubber links shaped to continuously fill annular space between pipe and sleeve. Include connecting bolts and pressure plates.

2.7 PIPING SPECIALTIES

- A. Sleeves: The following materials are for wall, floor, slab, and roof penetrations:

SECTION 15050 - MECHANICAL MATERIALS AND METHODS

1. Steel Sheet Metal: 0.0239-inch minimum thickness, galvanized, round tube closed with welded longitudinal joint.
 2. Steel Pipe: ASTM A 53, Type E, Grade A, Schedule 40, galvanized, plain ends.
 3. Cast Iron: Cast or fabricated "wall pipe" equivalent to ductile-iron pressure pipe, with plain ends and integral waterstop, unless otherwise indicated.
 4. Stack Sleeve Fittings: Manufactured, cast-iron sleeve with integral clamping flange. Include clamping ring and bolts and nuts for membrane flashing.
 - a. Underdeck Clamp: Clamping ring with set screws.
 5. PVC: Manufactured, permanent, with nailing flange for attaching to wooden forms.
 6. PVC Pipe: ASTM D 1785, Schedule 40.
 7. PE: Manufactured, reusable, tapered, cup shaped, smooth outer surface, with nailing flange for attaching to wooden forms.
- B. Escutcheons: Manufactured wall, ceiling, and floor plates; deep-pattern type if required to conceal protruding fittings and sleeves.
1. ID: Closely fit around pipe, tube, and insulation of insulated piping.
 2. OD: Completely cover opening.
 3. Cast Brass: One piece, with set screw.
 - a. Finish: Rough brass.
 - b. Finish: Polished chrome-plate.
 4. Cast Brass: Split casting, with concealed hinge and set screw.
 - a. Finish: Rough brass.
 - b. Finish: Polished chrome-plate.
 5. Stamped Steel: One piece, with set screw and chrome-plated finish.
 6. Stamped Steel: One piece, with spring clips and chrome-plated finish.
 7. Stamped Steel: Split plate, with concealed hinge, set screw, and chrome-plated finish.
 8. Stamped Steel: Split plate, with concealed hinge, spring clips, and chrome-plated finish.
 9. Stamped Steel: Split plate, with exposed-rivet hinge, set screw, and chrome-plated finish.
 10. Stamped Steel: Split plate, with exposed-rivet hinge, spring clips, and chrome-plated finish.
 11. Cast-Iron Floor Plate: One-piece casting.

2.8 IDENTIFYING DEVICES AND LABELS

- A. General: Manufacturer's standard products of categories and types required for each application as referenced in other Division 15 Sections. If more than one type is specified for application, selection is Installer's option, but provide one selection for each product category.
- B. Equipment Nameplates: Metal nameplate with operational data engraved or stamped; permanently fastened to equipment.
1. Data: Manufacturer, product name, model number, serial number, capacity, operating and power characteristics, labels of tested compliances, and similar essential data.
 2. Location: Accessible and visible location.

SECTION 15050 - MECHANICAL MATERIALS AND METHODS

- C. Stencils: Standard stencils, prepared for required applications with letter sizes complying with recommendations of ASME A13.1 for piping and similar applications, but not less than 1-1/4-inch- high letters for ductwork and not less than 3/4-inch- high letters for access door signs and similar operational instructions.
1. Material: Fiberboard.
 2. Material: Brass.
 3. Stencil Paint: Standard exterior-type stenciling enamel; black, unless otherwise indicated; either brushing grade or pressurized spray-can form and grade.
 4. Identification Paint: Standard identification enamel of colors indicated or, if not otherwise indicated for piping systems, comply with ASME A13.1 for colors.
- D. Snap-on Plastic Pipe Markers: Manufacturer's standard preprinted, semirigid, snap on, color-coded, complying with ASME A13.1.
- E. Pressure-Sensitive Pipe Markers: Manufacturer's standard preprinted, permanent adhesive, color-coded, pressure-sensitive vinyl, complying with ASME A13.1.
- F. Plastic Duct Markers: Manufacturer's standard color-coded, laminated plastic. Comply with the following color code:
1. Green: Cold air.
 2. Yellow: Hot air.
 3. Yellow/Green or Green: Supply air.
 4. Blue: Exhaust, outside, return, and mixed air.
 5. For hazardous exhausts, use colors and designs recommended by ASME A13.1.
 6. Nomenclature: Include the following:
 - a. Direction of airflow.
 - b. Duct service.
 - c. Duct origin.
 - d. Duct destination.
 - e. Design cubic feet per meter.
- G. Engraved Plastic-Laminate 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.
1. Fabricate in sizes required for message.
 2. Engraved with engraver's standard letter style, of sizes and with wording to match equipment identification.
 3. Punch for mechanical fastening.
 4. Thickness: 1/16 inch, unless otherwise indicated.
 5. Thickness: 1/8 inch, unless otherwise indicated.
 6. Thickness: 1/16 inch, for units up to 20 sq. in. or 8 inches long; 1/8 inch for larger units.
 7. Fasteners: Self-tapping stainless-steel screws or contact-type permanent adhesive.
- H. Plastic Equipment Markers: Color-coded, laminated plastic. Comply with the following color code:
1. Green: Cooling equipment and components.
 2. Yellow: Heating equipment and components.
 3. Yellow/Green: Combination cooling and heating equipment and components.
 4. Brown: Energy reclamation equipment and components.
 5. Blue: Equipment and components that do not meet any criteria above.

SECTION 15050 - MECHANICAL MATERIALS AND METHODS

6. For hazardous equipment, use colors and designs recommended by ASME A13.1.
7. Nomenclature: Include the following, matching terminology on schedules as closely as possible:
 - a. Name and plan number.
 - b. Equipment service.
 - c. Design capacity.
 - d. Other design parameters such as pressure drop, entering and leaving conditions, and rpm.
8. Size: Approximate 2-1/2 by 4 inches for control devices, dampers, and valves; and 4-1/2 by 6 inches for equipment.
- I. Lettering and Graphics: Coordinate names, abbreviations, and other designations used in mechanical identification, with corresponding designations indicated. Use numbers, lettering, and wording indicated for proper identification and operation/maintenance of mechanical systems and equipment.
 1. Multiple Systems: If multiple systems of same generic name are indicated, provide identification that indicates individual system number and service such as "Boiler No. 3," "Air Supply No. 1H," or "Standpipe F12."

2.9 GROUT

- A. Nonshrink, Nonmetallic Grout: ASTM C 1107, Grade B.
 1. Characteristics: Post-hardening, volume-adjusting, dry, hydraulic-cement grout, nonstaining, noncorrosive, nongaseous, and recommended for interior and exterior applications.
 2. Design Mix: 5000-psig, 28-day compressive strength.
 3. Packaging: Premixed and factory packaged.

PART 3 - EXECUTION

3.1 PIPING SYSTEMS - COMMON REQUIREMENTS

- A. General: Install piping as described below, unless piping Sections specify otherwise. Individual Division 15 piping Sections specify unique piping installation requirements.
- B. General Locations and Arrangements: 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 at indicated slope.
- D. Install components with pressure rating equal to or greater than system operating pressure.
- E. Install piping in concealed interior and exterior locations, except in equipment rooms and service areas.

SECTION 15050 - MECHANICAL MATERIALS AND METHODS

- F. Install piping free of sags and bends.
- G. Install exposed interior and exterior piping at right angles or parallel to building walls. Diagonal runs are prohibited, unless otherwise indicated.
- H. Install piping tight to slabs, beams, joists, columns, walls, and other building elements. Allow sufficient space above removable ceiling panels to allow for ceiling panel removal.
- I. Install piping to allow application of insulation plus 1-inch clearance around insulation.
- J. Locate groups of pipes parallel to each other, spaced to permit valve servicing.
- K. Install fittings for changes in direction and branch connections.
- L. Install couplings according to manufacturer's written instructions.
- M. Install pipe escutcheons for pipe penetrations of concrete and masonry walls, wall board partitions, and suspended ceilings according to the following:
 - 1. Chrome-Plated Piping: Cast brass, one piece, with set screw, and polished chrome-plated finish. Use split-casting escutcheons if required, for existing piping.
 - 2. Uninsulated Piping Wall Escutcheons: Cast brass or stamped steel, with set screw.
 - 3. Uninsulated Piping Floor Plates in Utility Areas: Cast-iron floor plates.
 - 4. Insulated Piping: Cast brass or stamped steel; with concealed hinge, spring clips, and chrome-plated finish.
 - 5. Piping in Utility Areas: Cast brass or stamped steel, with set-screw or spring clips.
- N. Sleeves are not required for core drilled holes.
- O. Permanent sleeves are not required for holes formed by PE removable sleeves.
- P. Install sleeves for pipes passing through concrete and masonry walls, and concrete floor and roof slabs.
- Q. 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. Build sleeves into new walls and slabs as work progresses.
 - 3. Install sleeves large enough to provide 1/4-inch annular clear space between sleeve and pipe or pipe insulation. Use the following sleeve materials:
 - a. PVC Pipe Sleeves: For pipes smaller than 6-inch NPS.
 - b. Steel Pipe Sleeves: For pipes smaller than 6-inch NPS.
 - c. Steel, Sheet-Metal Sleeves: For pipes 6-inch NPS and larger, penetrating gypsum-board partitions.
 - d. Stack Sleeve Fittings: For pipes penetrating floors with membrane waterproofing. Secure flashing between clamping flanges. Install section of cast-iron soil pipe to

SECTION 15050 - MECHANICAL MATERIALS AND METHODS

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 nonshrink, nonmetallic grout.
 4. Except for underground wall penetrations, seal annular space between sleeve and pipe or pipe insulation, using elastomeric joint sealants. Refer to Division 7 Section "Joint Sealants" for materials.
 5. Use Type S, Grade NS, Class 25, Use O, neutral-curing silicone sealant, unless otherwise indicated.
- R. Aboveground, Exterior-Wall, Pipe Penetrations: Seal penetrations using sleeves and mechanical sleeve seals. Size sleeve 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 in diameter and larger.
 3. Assemble and install mechanical sleeve seals according to manufacturer's written instructions. Tighten bolts that cause rubber sealing elements to expand and make watertight seal.
- S. Underground, Exterior-Wall, Pipe Penetrations: Install cast-iron "wall pipes" for sleeves. Seal pipe penetrations using mechanical sleeve seals. Size sleeve for 1-inch annular clear space between pipe and sleeve for installing mechanical sleeve seals.
1. Assemble and install mechanical sleeve seals according to manufacturer's written instructions. Tighten bolts that cause rubber sealing elements to expand and make watertight seal.
- T. Fire-Barrier Penetrations: Maintain indicated fire rating of walls, partitions, ceilings, and floors at pipe penetrations. Seal pipe penetrations with firestopping materials. Refer to Division 7 Section "Firestopping" for materials.
- U. Verify final equipment locations for roughing-in.
- V. Refer to equipment specifications in other Sections of these Specifications for roughing-in requirements.
- W. Piping Joint Construction: Join pipe and fittings as follows and as specifically required in individual piping specification Sections:
1. Ream ends of pipes and tubes and remove burrs. Bevel plain ends of steel pipe.
 2. Remove scale, slag, dirt, and debris from inside and outside of pipe and fittings before assembly.
 3. Soldered Joints: Construct joints according to AWS's "Soldering Manual," Chapter "The Soldering of Pipe and Tube"; or CDA's "Copper Tube Handbook."
 4. Soldered Joints: Construct joints according to AWS's "Soldering Manual," Chapter "The Soldering of Pipe and Tube."
 5. Soldered Joints: Construct joints according to CDA's "Copper Tube Handbook."
 6. Brazed Joints: Construct joints according to AWS's "Brazing Handbook," Chapter "Pipe and Tube."
 7. 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:

SECTION 15050 - MECHANICAL MATERIALS AND METHODS

- a. Note internal length of threads in fittings or valve ends, and proximity of internal seat or wall, to determine how far pipe should be threaded into joint.
 - b. Apply appropriate tape or thread compound to external pipe threads, unless dry seal threading is specified.
 - c. Align threads at point of assembly.
 - d. Tighten joint with wrench. Apply wrench to valve end into which pipe is being threaded.
 - e. 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.
8. Welded Joints: Construct joints according to AWS D10.12, "Recommended Practices and Procedures for Welding Low Carbon Steel Pipe," using qualified processes and welding operators according to "Quality Assurance" Article.
 9. Flanged Joints: Align flange surfaces parallel. Select appropriate gasket material, size, type, and thickness for service application. Install gasket concentrically positioned. Assemble joints by sequencing bolt tightening to make initial contact of flanges and gaskets as flat and parallel as possible. Use suitable lubricants on bolt threads. Tighten bolts gradually and uniformly using torque wrench.
 10. Plastic Piping Solvent-Cement Joints: Clean and dry joining surfaces by wiping with clean cloth or paper towels. Join pipe and fittings according to the following:
 - a. Comply with ASTM F 402 for safe-handling practice of cleaners, primers, and solvent cements.
 - b. ABS Piping: ASTM D 2235 and ASTM D 2661.
 - c. CPVC Piping: ASTM D 2846 and ASTM F 493.
 - d. PVC Pressure Piping: ASTM D 2672.
 - e. PVC Nonpressure Piping: ASTM D 2855.
 - f. PVC to ABS Nonpressure Transition Fittings: Procedure and solvent cement according to ASTM D 3138.
 11. Plastic Piping Heat-Fusion Joints: Clean and dry joining surfaces by wiping with clean cloth or paper towels. Join according to ASTM D 2657 procedures and manufacturer's written instructions.
 - a. Plain-End Pipe and Fittings: Use butt fusion.
 - b. Plain-End Pipe and Socket Fittings: Use socket fusion.
- X. Piping Connections: Make connections according to the following, unless otherwise indicated:
1. Install unions, in piping 2-inch NPS and smaller, adjacent to each valve and at final connection to each piece of equipment with 2-inch NPS or smaller threaded pipe connection.
 2. Install flanges, in piping 2-1/2-inch NPS and larger, adjacent to flanged valves and at final connection to each piece of equipment with flanged pipe connection.
 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.

3.2 EQUIPMENT INSTALLATION - COMMON REQUIREMENTS

- A. Install equipment to provide maximum possible headroom, if mounting heights are not indicated.

- B. Install equipment according to approved submittal data. Portions of the Work are shown only in diagrammatic form. Refer conflicts to Architect.
- C. Install equipment level and plumb, parallel and perpendicular to other building systems and components in exposed interior spaces, unless otherwise indicated.
- D. 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.
- E. Install equipment giving right of way to piping installed at required slope.
- F. Install flexible connectors on equipment side of shutoff valves, horizontally and parallel to equipment shafts if possible.

3.3 LABELING AND IDENTIFYING

- A. Piping Systems: Install pipe markers on each system. Include arrows showing normal direction of flow.
 - 1. Stenciled Markers: According to ASME A13.1.
 - 2. Plastic markers, with application systems. Install on insulation segment if required for hot, uninsulated piping.
 - 3. Locate pipe markers as follows if piping is exposed in finished spaces, machine rooms, and accessible maintenance spaces, such as shafts, tunnels, plenums, and exterior nonconcealed locations:
 - a. Near each valve and control device.
 - b. Near each branch, excluding short takeoffs for fixtures and terminal units. Mark each pipe at branch, if flow pattern is not obvious.
 - c. Near locations if pipes pass through walls, floors, ceilings, or enter nonaccessible enclosures.
 - d. At access doors, manholes, and similar access points that permit view of concealed piping.
 - e. Near major equipment items and other points of origination and termination.
 - f. Spaced at maximum of 50-foot intervals along each run. Reduce intervals to 25 feet in congested areas of piping and equipment.
 - g. On piping above removable acoustical ceilings, except omit intermediately spaced markers.
- B. Equipment: Install engraved plastic-laminate sign or equipment marker on or near each major item of mechanical equipment.
 - 1. Lettering Size: Minimum 1/4-inch- high lettering for name of unit if viewing distance is less than 24 inches, 1/2-inch- high lettering for distances up to 72 inches, and proportionately larger lettering for greater distances. Provide secondary lettering two-thirds to three-fourths of size of principal lettering.
 - 2. Text of Signs: Provide name of identified unit. Include text to distinguish between multiple units, inform user of operational requirements, indicate safety and emergency precautions, and warn of hazards and improper operations.
- C. Duct Systems: Identify air supply, return, exhaust, intake, and relief ducts with duct markers; or provide stenciled signs and arrows, showing duct system service and direction of flow.

SECTION 15050 - MECHANICAL MATERIALS AND METHODS

1. Location: In each space, if ducts are exposed or concealed by removable ceiling system, locate signs near points where ducts enter into space and at maximum intervals of 50 feet.
- D. Adjusting: Relocate identifying devices as necessary for unobstructed view in finished construction.
- 3.4 PAINTING AND FINISHING
- A. Refer to Division 9 Section "Painting" for paint materials, surface preparation, and application of paint.
- B. Apply paint to exposed piping according to the following, unless otherwise indicated:
1. Interior, Ferrous Piping: Use semigloss, acrylic-enamel finish. Include finish coat over enamel undercoat and primer.
 2. Interior, Galvanized-Steel Piping: Use semigloss, acrylic-enamel finish. Include two finish coats over galvanized metal primer.
 3. Interior, Ferrous Supports: Use semigloss, acrylic-enamel finish. Include finish coat over enamel undercoat and primer.
 4. Exterior, Ferrous Piping: Use semigloss, acrylic-enamel finish. Include two finish coats over rust-inhibitive metal primer.
 5. Exterior, Galvanized-Steel Piping: Use semigloss, acrylic-enamel finish. Include two finish coats over galvanized metal primer.
 6. Exterior, Ferrous Supports: Use semigloss, acrylic-enamel finish. Include two finish coats over rust-inhibitive metal primer.
- C. Do not paint piping specialties with factory-applied finish.
- D. Damage and Touchup: Repair marred and damaged factory-painted finishes with materials and procedures to match original factory finish.
- 3.5 CONCRETE BASES
- A. Construct concrete bases of dimensions indicated, but not less than 4 inches larger in both directions than supported unit. Follow supported equipment manufacturer's setting templates for anchor bolt and tie locations. Use 3000-psi, 28-day compressive-strength concrete and reinforcement as specified in Division 3 Section "Cast-in-Place Concrete."
- 3.6 ERECTION OF METAL SUPPORTS AND ANCHORAGE
- A. Cut, fit, and place miscellaneous metal supports accurately in location, alignment, and elevation to support and anchor mechanical materials and equipment.
- B. Field Welding: Comply with AWS D1.1, "Structural Welding Code--Steel."
- 3.7 ERECTION OF WOOD SUPPORTS AND ANCHORAGE
- A. Cut, fit, and place wood grounds, nailers, blocking, and anchorage to support and anchor mechanical materials and equipment.

SECTION 15050 - MECHANICAL MATERIALS AND METHODS

- 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.

3.8 DEMOLITION

- A. Disconnect, demolish, and remove Work specified in Division 15 Sections.
- B. If pipe, ductwork, insulation, or equipment to remain is damaged or disturbed, remove damaged portions and install new products of equal capacity and quality.
- C. Accessible Work: Remove indicated exposed pipe and ductwork in its entirety.
- D. Work Abandoned in Place: Cut and remove underground pipe a minimum of 2 inches beyond face of adjacent construction. Cap and patch surface to match existing finish.
- E. Removal: Remove indicated equipment from Project site.
- F. Temporary Disconnection: Remove, store, clean, reinstall, reconnect, and make operational equipment indicated for relocation.

3.9 CUTTING AND PATCHING

- A. Cut, channel, chase, and drill floors, walls, partitions, ceilings, and other surfaces necessary for mechanical installations. Perform cutting by skilled mechanics of trades involved.
- B. Repair cut surfaces to match adjacent surfaces.

3.10 GROUTING

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

END OF SECTION 15050

SECTION 15067 - 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.

1.2 SUMMARY

- A. This Section includes the following hangers and supports for HVAC system piping and equipment:

1. Steel pipe hangers and supports.
2. Trapeze pipe hangers.
3. Fiberglass pipe hangers.
4. Metal framing systems.
5. Fiberglass strut systems.
6. Thermal-hanger shield inserts.
7. Fastener systems.
8. Pipe stands.
9. Equipment supports.

- B. Related Sections include the following:

1. Division 5 Section "Metal Fabrications" for structural-steel shapes and plates for trapeze hangers for pipe and equipment supports.
2. Division 13 Section "Fire-Suppression Piping" for pipe hangers for fire-protection piping.
3. Division 15 Section "Vibration and Seismic Controls for HVAC Piping and Equipment" for vibration isolation devices.
4. Division 15 Section "Expansion Fittings and Loops for HVAC Piping" for pipe guides and anchors.
5. Division 15 Section(s) "Metal Ducts" for duct hangers and supports.

1.3 DEFINITIONS

- A. MSS: Manufacturers Standardization Society for The Valve and Fittings Industry Inc.
- B. Terminology: As defined in MSS SP-90, "Guidelines on Terminology for Pipe Hangers and Supports."

1.4 PERFORMANCE REQUIREMENTS

- A. Design supports for multiple pipes, including pipe stands, capable of supporting combined weight of supported systems, system contents, and test water.
- B. Design equipment supports capable of supporting combined operating weight of supported equipment and connected systems and components.

- C. Design seismic-restraint hangers and supports for piping and equipment.

1.5 SUBMITTALS

- A. Product Data: For the following:

1. Steel pipe hangers and supports.
2. Fiberglass pipe hangers.
3. Thermal-hanger shield inserts.
4. Powder-actuated fastener systems.

- B. Shop Drawings: Show fabrication and installation details and include calculations for the following:

1. Trapeze pipe hangers. Include Product Data for components.
2. Metal framing systems. Include Product Data for components.
3. Fiberglass strut systems. Include Product Data for components.
4. Pipe stands. Include Product Data for components.
5. Equipment supports.

- C. Welding certificates.

1.6 QUALITY ASSURANCE

- A. Welding: Qualify procedures and personnel according to AWS D1.1, "Structural Welding Code—Steel"

- B. Welding: Qualify procedures and personnel according to the following:

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

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 STEEL PIPE HANGERS AND SUPPORTS

- A. Description: MSS SP-58, Types 1 through 58, factory-fabricated components. Refer to Part 3 "Hanger and Support Applications" Article for where to use specific hanger and support types.

- B. Available Manufacturers:

1. AAA Technology & Specialties Co., Inc.
2. Bergen-Power Pipe Supports.
3. B-Line Systems, Inc.; a division of Cooper Industries.
4. Carpenter & Paterson, Inc.
5. Empire Industries, Inc.
6. ERICO/Michigan Hanger Co.
7. Globe Pipe Hanger Products, Inc.
8. Grinnell Corp.
9. GS Metals Corp.
10. National Pipe Hanger Corporation.
11. PHD Manufacturing, Inc.
12. PHS Industries, Inc.
13. Piping Technology & Products, Inc.
14. Tolco Inc.

- C. Galvanized, Metallic Coatings: Pregalvanized or hot dipped.
- D. Nonmetallic Coatings: Plastic coating, jacket, or liner.
- E. Padded Hangers: Hanger with fiberglass or other pipe insulation pad or cushion for support of bearing surface of piping.

2.3 TRAPEZE PIPE HANGERS

- A. Description: MSS SP-69, Type 59, shop- or field-fabricated pipe-support assembly made from structural-steel shapes with MSS SP-58 hanger rods, nuts, saddles, and U-bolts.

2.4 FIBERGLASS PIPE HANGERS

- A. Clevis-Type, Fiberglass Pipe Hangers: Similar to MSS Type 1, steel pipe hanger except hanger is made of fiberglass and continuous-thread rod and nuts are made of polyurethane or stainless steel.

1. Available Manufacturers:

- a. B-Line Systems, Inc.; a division of Cooper Industries.
- b. Champion Fiberglass, Inc.
- c. Cope, T. J., Inc.; Tyco International, Ltd.
- d. Seasafe, Inc.
- e. Unistrut Corp.; Tyco International, Ltd.
- f. Wesanco, Inc.

- B. Strap-Type, Fiberglass Pipe Hangers: Made of fiberglass loop with stainless-steel continuous-thread rod, nuts, and support hook.

1. Available Manufacturers:

- a. Plasti-Fab, Inc.

2.5 METAL FRAMING SYSTEMS

- A. Description: MFMA-3, shop- or field-fabricated pipe-support assembly made of steel channels and other components.
- B. Available Manufacturers:
 - 1. B-Line Systems, Inc.; a division of Cooper Industries.
 - 2. ERICO/Michigan Hanger Co.; ERISTRUT Div.
 - 3. GS Metals Corp.
 - 4. Power-Strut Div.; Tyco International, Ltd.
 - 5. Thomas & Betts Corporation.
 - 6. Tolco Inc.
 - 7. Unistrut Corp.; Tyco International, Ltd.
- C. Coatings: Manufacturer's standard finish, unless bare metal surfaces are indicated.
- D. Nonmetallic Coatings: Plastic coating, jacket, or liner.

2.6 FIBERGLASS STRUT SYSTEMS

- A. Description: Shop- or field-fabricated pipe-support assembly, similar to MFMA-3, made of fiberglass channels and other components.
- B. Available Manufacturers:
 - 1. B-Line Systems, Inc.; a division of Cooper Industries.
 - 2. Champion Fiberglass, Inc.
 - 3. Cope, T. J., Inc.; Tyco International Ltd.
 - 4. Seasafe, Inc.

2.7 THERMAL-HANGER SHIELD INSERTS

- A. Description: 100-psig- (690-kPa-) minimum, compressive-strength insulation insert encased in sheet metal shield.
- B. Available Manufacturers:
 - 1. Carpenter & Paterson, Inc.
 - 2. ERICO/Michigan Hanger Co.
 - 3. PHS Industries, Inc.
 - 4. Pipe Shields, Inc.
 - 5. Rilco Manufacturing Company, Inc.
 - 6. Value Engineered Products, Inc.
- C. Insulation-Insert Material for Cold Piping: ASTM C 552, Type II cellular glass with vapor barrier.
- D. Insulation-Insert Material for Hot Piping: ASTM C 552, Type II cellular glass.
- E. For Trapeze or Clamped Systems: Insert and shield shall cover entire circumference of pipe.
- F. For Clevis or Band Hangers: Insert and shield shall cover lower 180 degrees of pipe.

- G. Insert Length: Extend 2 inches (50 mm) beyond sheet metal shield for piping operating below ambient air temperature.

2.8 FASTENER SYSTEMS

- A. Powder-Actuated Fasteners: Threaded-steel stud, for use in hardened portland cement concrete with pull-out, tension, and shear capacities appropriate for supported loads and building materials where used.

- 1. Available Manufacturers:

- a. Hilti, Inc.
- b. ITW Ramset/Red Head.
- c. Masterset Fastening Systems, Inc.
- d. MKT Fastening, LLC.
- e. Powers Fasteners.

- B. Mechanical-Expansion Anchors: Insert-wedge-type stainless steel, for use in hardened portland cement concrete with pull-out, tension, and shear capacities appropriate for supported loads and building materials where used.

- 1. Available Manufacturers:

- a. B-Line Systems, Inc.; a division of Cooper Industries.
- b. Empire Industries, Inc.
- c. Hilti, Inc.
- d. ITW Ramset/Red Head.
- e. MKT Fastening, LLC.
- f. Powers Fasteners.

2.9 PIPE STAND FABRICATION

- A. Pipe Stands, General: Shop or field-fabricated assemblies made of manufactured corrosion-resistant components to support roof-mounted piping.

- B. Compact Pipe Stand: One-piece plastic unit with integral-rod-roller, pipe clamps, or V-shaped cradle to support pipe, for roof installation without membrane penetration.

- 1. Available Manufacturers:

- a. ERICO/Michigan Hanger Co.
- b. MIRO Industries.

- C. Low-Type, Single-Pipe Stand: One-piece stainless-steel base unit with plastic roller, for roof installation without membrane penetration.

- 1. Available Manufacturers:

- a. MIRO Industries.

- D. High-Type, Single-Pipe Stand: Assembly of base, vertical and horizontal members, and pipe support, for roof installation without membrane penetration.

1. Available Manufacturers:
 - a. ERICO/Michigan Hanger Co.
 - b. MIRO Industries.
 - c. Portable Pipe Hangers.
 2. Base: Stainless steel.
 3. Vertical Members: Two or more cadmium-plated-steel or stainless-steel, continuous-thread rods.
 4. Horizontal Member: Cadmium-plated-steel or stainless-steel rod with plastic or stainless-steel, roller-type pipe support.
- E. High-Type, Multiple-Pipe Stand: Assembly of bases, vertical and horizontal members, and pipe supports, for roof installation without membrane penetration.
1. Available Manufacturers:
 - a. Portable Pipe Hangers.
 2. Bases: One or more plastic.
 3. Vertical Members: Two or more protective-coated-steel channels.
 4. Horizontal Member: Protective-coated-steel channel.
 5. Pipe Supports: Galvanized-steel, clevis-type pipe hangers.
- F. Curb-Mounting-Type Pipe Stands: Shop- or field-fabricated pipe support made from structural-steel shape, continuous-thread rods, and rollers for mounting on permanent stationary roof curb.

2.10 EQUIPMENT SUPPORTS

- A. Description: Welded, shop- or field-fabricated equipment support made from structural-steel shapes.

2.11 MISCELLANEOUS MATERIALS

- A. Structural Steel: ASTM A 36/A 36M, steel plates, shapes, and bars; black and galvanized.
- B. Grout: ASTM C 1107, factory-mixed and -packaged, dry, hydraulic-cement, nonshrink and nonmetallic grout; suitable for interior and exterior applications.
 1. Properties: Nonstaining, noncorrosive, and nongaseous.
 2. Design Mix: 5000-psi (34.5-MPa), 28-day compressive strength.

PART 3 - EXECUTION

3.1 HANGER AND SUPPORT APPLICATIONS

- A. Specific hanger and support requirements are specified in Sections specifying piping systems and equipment.

- B. Comply with MSS SP-69 for pipe hanger selections and applications that are not specified in piping system Sections.
- C. Use hangers and supports with galvanized, metallic coatings for piping and equipment that will not have field-applied finish.
- D. Use nonmetallic coatings on attachments for electrolytic protection where attachments are in direct contact with copper tubing.
- E. Use padded hangers for piping that is subject to scratching.
- F. Horizontal-Piping Hangers and Supports: Unless otherwise indicated and except as specified in piping system Sections, install the following types:
 - 1. Adjustable, Steel Clevis Hangers (MSS Type 1): For suspension of noninsulated or insulated stationary pipes, NPS 1/2 to NPS 30 (DN 15 to DN 750).
 - 2. Yoke-Type Pipe Clamps (MSS Type 2): For suspension of 120 to 450 deg F (49 to 232 deg C) pipes, NPS 4 to NPS 16 (DN 100 to DN 400), requiring up to 4 inches (100 mm) of insulation.
 - 3. Carbon- or Alloy-Steel, Double-Bolt Pipe Clamps (MSS Type 3): For suspension of pipes, NPS 3/4 to NPS 24 (DN 20 to DN 600), requiring clamp flexibility and up to 4 inches (100 mm) of insulation.
 - 4. Steel Pipe Clamps (MSS Type 4): For suspension of cold and hot pipes, NPS 1/2 to NPS 24 (DN 15 to DN 600), if little or no insulation is required.
 - 5. Pipe Hangers (MSS Type 5): For suspension of pipes, NPS 1/2 to NPS 4 (DN 15 to DN 100), 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 (DN 20 to DN 200).
 - 7. Adjustable, Steel Band Hangers (MSS Type 7): For suspension of noninsulated stationary pipes, NPS 1/2 to NPS 8 (DN 15 to DN 200).
 - 8. Adjustable Band Hangers (MSS Type 9): For suspension of noninsulated stationary pipes, NPS 1/2 to NPS 8 (DN 15 to DN 200).
 - 9. Adjustable, Swivel-Ring Band Hangers (MSS Type 10): For suspension of noninsulated stationary pipes, NPS 1/2 to NPS 2 (DN 15 to DN 50).
 - 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 (DN 10 to DN 200).
 - 11. Extension Hinged or 2-Bolt Split Pipe Clamps (MSS Type 12): For suspension of noninsulated stationary pipes, NPS 3/8 to NPS 3 (DN 10 to DN 80).
 - 12. U-Bolts (MSS Type 24): For support of heavy pipes, NPS 1/2 to NPS 30 (DN 15 to DN 750).
 - 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 (DN 100 to DN 900), 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 (DN 100 to DN 900), 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 (DN 65 to DN 900), 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 (DN 25 to DN 750), from 2 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 (DN 65 to DN 500), 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 (DN 50 to DN 1050), 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 (DN 50 to DN 600), 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 (DN 50 to DN 750), if vertical and lateral adjustment during installation might be required in addition to expansion and contraction.
- G. Vertical-Piping Clamps: Unless otherwise indicated and except as specified in piping system Sections, install the following types:
1. Extension Pipe or Riser Clamps (MSS Type 8): For support of pipe risers, NPS 3/4 to NPS 20 (DN 20 to DN 500).
 2. Carbon- or Alloy-Steel Riser Clamps (MSS Type 42): For support of pipe risers, NPS 3/4 to NPS 20 (DN 20 to DN 500), if longer ends are required for riser clamps.
- H. Hanger-Rod Attachments: Unless otherwise indicated and except as specified in piping system Sections, install the following types:
1. Steel Turnbuckles (MSS Type 13): For adjustment up to 6 inches (150 mm) for heavy loads.
 2. Steel Clevises (MSS Type 14): For 120 to 450 deg F (49 to 232 deg C) 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 (49 to 232 deg C) piping installations.
- I. Building Attachments: Unless otherwise indicated and except as specified in piping system Sections, install the following types:
1. Steel or Malleable Concrete Inserts (MSS Type 18): For upper attachment to suspend pipe hangers from concrete ceiling.
 2. Top-Beam C-Clamps (MSS Type 19): For use under roof installations with bar-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:

SECTION 15067 - HANGERS AND SUPPORTS

- a. Light (MSS Type 31): 750 lb (340 kg).
 - b. Medium (MSS Type 32): 1500 lb (680 kg).
 - c. Heavy (MSS Type 33): 3000 lb (1360 kg).
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.
- J. Saddles and Shields: Unless otherwise indicated and except as specified in piping system Sections, install the following types:
1. Steel Pipe-Covering Protection Saddles (MSS Type 39): To fill interior voids with insulation that matches adjoining insulation.
 2. Protection Shields (MSS Type 40): Of length recommended in writing by manufacturer to prevent crushing insulation.
 3. Thermal-Hanger Shield Inserts: For supporting insulated pipe.
- K. Spring Hangers and Supports: Unless otherwise indicated and except as specified in piping system 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 (32 mm).
 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.
- L. Comply with MSS SP-69 for trapeze pipe hanger selections and applications that are not specified in piping system Sections.
- M. Comply with MFMA-102 for metal framing system selections and applications that are not specified in piping system Sections.
- N. Use powder-actuated fasteners or mechanical-expansion anchors instead of building attachments where required in concrete construction.

3.2 HANGER AND SUPPORT INSTALLATION

- A. Steel Pipe Hanger Installation: Comply with MSS SP-69 and MSS SP-89. Install hangers, supports, clamps, and attachments as required to properly support piping from building structure.
- B. Trapeze Pipe Hanger Installation: Comply with MSS SP-69 and MSS SP-89. Arrange for grouping of parallel runs of horizontal piping and support together on field-fabricated trapeze pipe hangers.
 - 1. Pipes of Various Sizes: Support together and space trapezes for smallest pipe size or install intermediate supports for smaller diameter pipes as specified 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 D1.1.
- C. Fiberglass Pipe Hanger Installation: Comply with applicable portions of MSS SP-69 and MSS SP-89. Install hangers and attachments as required to properly support piping from building structure.
- D. Metal Framing System Installation: Arrange for grouping of parallel runs of piping and support together on field-assembled metal framing systems.
- E. Fiberglass Strut System Installation: Arrange for grouping of parallel runs of piping and support together on field-assembled fiberglass struts.
- F. Thermal-Hanger Shield Installation: Install in pipe hanger or shield for insulated piping.
- G. Fastener System Installation:
 - 1. Install powder-actuated fasteners for use in lightweight concrete or concrete slabs less than 4 inches (100 mm) thick in concrete after concrete is placed and completely cured. Use operators that are licensed by powder-actuated tool manufacturer. Install fasteners according to powder-actuated tool manufacturer's operating manual.
 - 2. Install mechanical-expansion anchors in concrete after concrete is placed and completely cured. Install fasteners according to manufacturer's written instructions.
- H. Pipe Stand Installation:
 - 1. Pipe Stand Types except Curb-Mounting Type: Assemble components and mount on smooth roof surface. Do not penetrate roof membrane.
 - 2. Curb-Mounting-Type Pipe Stands: Assemble components or fabricate pipe stand and mount on permanent, stationary roof curb. Refer to Division 7 Section "Roof Accessories" for curbs.
- I. Install hangers and supports complete with necessary inserts, bolts, rods, nuts, washers, and other accessories.
- J. Equipment Support Installation: Fabricate from welded-structural-steel shapes.
- K. 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.
- L. Install lateral bracing with pipe hangers and supports to prevent swaying.

SECTION 15067 - HANGERS AND SUPPORTS

- M. Install building attachments within concrete slabs or attach to structural steel. Install additional attachments at concentrated loads, including valves, flanges, and strainers, **NPS 2-1/2 (DN 65)]** and larger and at changes in direction of piping. Install concrete inserts before concrete is placed; fasten inserts to forms and install reinforcing bars through openings at top of inserts.
- N. Load Distribution: Install hangers and supports so piping live and dead loads and stresses from movement will not be transmitted to connected equipment.
- O. Pipe Slopes: Install hangers and supports to provide indicated pipe slopes and so maximum pipe deflections allowed by ASME B31.1 (for power piping) and ASME B31.9 (for building services piping) are not exceeded.
- P. Insulated Piping: Comply with the following:
1. Attach clamps and spacers to piping.
 - a. Piping Operating above Ambient Air Temperature: Clamp may project through insulation.
 - b. Piping Operating below Ambient Air Temperature: Use thermal-hanger shield insert with clamp sized to match OD of insert.
 - c. Do not exceed pipe stress limits according to ASME B31.1 for power piping and ASME B31.9 for building services piping.
 2. Install MSS SP-58, Type 39, protection saddles if insulation without vapor barrier is indicated. Fill interior voids with insulation that matches adjoining insulation.
 - a. Option: Thermal-hanger shield inserts may be used. Include steel weight-distribution plate for pipe NPS 4 (DN 100) and larger if pipe is installed on rollers.
 3. Install MSS SP-58, Type 40, protective shields on cold piping with vapor barrier. Shields shall span an arc of 180 degrees.
 - a. Option: Thermal-hanger shield inserts may be used. Include steel weight-distribution plate for pipe NPS 4 (DN 100) 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 (DN 8 to DN 90): 12 inches (305 mm) long and 0.048 inch (1.22 mm) thick.
 - b. NPS 4 (DN 100): 12 inches (305 mm) long and 0.06 inch (1.52 mm) thick.
 - c. NPS 5 and NPS 6 (DN 125 and DN 150): 18 inches (457 mm) long and 0.06 inch (1.52 mm) thick.
 - d. NPS 8 to NPS 14 (DN 200 to DN 350): 24 inches (610 mm) long and 0.075 inch (1.91 mm) thick.
 - e. NPS 16 to NPS 24 (DN 400 to DN 600): 24 inches (610 mm) long and 0.105 inch (2.67 mm) thick.
 5. Pipes NPS 8 (DN 200) 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 overhead or to support equipment above floor.
- B. Grouting: Place grout under supports for equipment and make smooth bearing surface.
- C. Provide lateral bracing, to prevent swaying, for equipment supports.

3.4 METAL FABRICATIONS

- A. Cut, drill, and fit miscellaneous metal fabrications for trapeze pipe hangers and equipment supports.
- B. Fit exposed connections together to form hairline joints. Field weld connections that cannot be shop welded because of shipping size limitations.
- C. Field Welding: Comply with AWS D1.1 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 Adjustments: Adjust hangers to distribute loads equally on attachments and to achieve indicated slope of pipe.
- B. Trim excess length of continuous-thread hanger and support rods to 1-1/2 inches.

3.6 PAINTING

- A. Touch 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 minimum dry film thickness of 2.0 mils (0.05 mm).
- B. Galvanized Surfaces: Clean welds, bolted connections, and abraded areas and apply galvanizing-repair paint to comply with ASTM A 780.

END OF SECTION 15062

SECTION 15077 – 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.

1.2 SUMMARY

- A. Section Includes:
 - 1. Equipment labels.
 - 2. Pipe labels.
 - 3. Duct labels.
 - 4. Stencils.
 - 5. Valve 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. Equipment Label Schedule: Include a listing of all equipment to be labeled with the proposed content for each label.
- D. Valve numbering scheme.
- E. Valve Schedules: For each piping system to include in maintenance manuals.

1.4 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 locations of access panels and doors.
- C. Install identifying devices before installing acoustical ceilings and similar concealment.

PART 2 - PRODUCTS

2.1 EQUIPMENT LABELS

- A. Metal Labels for Equipment:

1. **Material and Thickness:** Stainless steel, 0.025-inch (0.64-mm) minimum thickness, and having predrilled or stamped holes for attachment hardware.
 2. **Minimum Label Size:** Length and width vary for required label content, but not less than 2-1/2 by 3/4 inch (64 by 19 mm).
 3. **Minimum Letter Size:** 1/4 inch (6.4 mm) for name of units if viewing distance is less than 24 inches (600 mm), 1/2 inch (13 mm) for viewing distances up to 72 inches (1830 mm), and proportionately larger lettering for greater viewing distances. Include secondary lettering two-thirds to three-fourths the size of principal lettering.
 4. **Fasteners:** Stainless-steel rivets or self-tapping screws.
 5. **Adhesive:** Contact-type permanent adhesive, compatible with label and with substrate.
- B. **Plastic Labels for Equipment:**
1. **Material and Thickness:** Multilayer, multicolor, plastic labels for mechanical engraving, 1/8 inch (3.2 mm) thick, and having predrilled holes for attachment hardware.
 2. **Letter Color:** Black.
 3. **Background Color:** White.
 4. **Maximum Temperature:** Able to withstand temperatures up to 160 deg F (71 deg C).
 5. **Minimum Label Size:** Length and width vary for required label content, but not less than 2-1/2 by 3/4 inch (64 by 19 mm).
 6. **Minimum Letter Size:** 1/4 inch (6.4 mm) for name of units if viewing distance is less than 24 inches (600 mm), 1/2 inch (13 mm) for viewing distances up to 72 inches (1830 mm), and proportionately larger lettering for greater viewing distances. Include secondary lettering two-thirds to three-fourths the size of principal lettering.
 7. **Fasteners:** Stainless-steel rivets or self-tapping screws.
 8. **Adhesive:** Contact-type permanent adhesive, compatible with label and with substrate.
- C. **Label Content:** Include equipment's Drawing designation or unique equipment number, Drawing numbers where equipment is indicated (plans, details, and schedules), plus the Specification Section number and title where equipment is specified.
- D. **Equipment Label Schedule:** For each item of equipment to be labeled, on 8-1/2-by-11-inch (A4) bond paper. Tabulate equipment identification number and identify Drawing numbers where equipment is indicated (plans, details, and schedules), plus the Specification Section number and title where equipment is specified. Equipment schedule shall be included in operation and maintenance data.
- ## 2.2 PIPE LABELS
- A. **General Requirements for Manufactured Pipe Labels:** Preprinted, color-coded, with lettering indicating service, and showing flow direction.
- B. **Pretensioned Pipe Labels:** Precoiled, semirigid plastic formed to partially cover circumference of pipe and to attach to pipe without fasteners or adhesive.
- C. **Self-Adhesive Pipe Labels:** Printed plastic with contact-type, permanent-adhesive backing.
- D. **Pipe Label Contents:** Include identification of piping service using same designations or abbreviations as used on Drawings, pipe size, and an arrow indicating flow direction.
1. **Flow-Direction Arrows:** Integral with piping system service lettering to accommodate both directions, or as separate unit on each pipe label to indicate flow direction.
 2. **Lettering Size:** At least 1-1/2 inches (38 mm) high.

2.3 DUCT LABELS

- A. **Material and Thickness:** Multilayer, multicolor, plastic labels for mechanical engraving, 1/16 inch (1.6 mm) thick, and having predrilled holes for attachment hardware.
- B. **Letter Color:** Black.
- C. **Background Color:** White.
- D. **Maximum Temperature:** Able to withstand temperatures up to 160 deg F (71 deg C).
- E. **Minimum Label Size:** Length and width vary for required label content, but not less than 2-1/2 by 3/4 inch (64 by 19 mm).
- F. **Minimum Letter Size:** 1/4 inch (6.4 mm) for name of units if viewing distance is less than 24 inches (600 mm), 1/2 inch (13 mm) for viewing distances up to 72 inches (1830 mm), and proportionately larger lettering for greater viewing distances. Include secondary lettering two-thirds to three-fourths the size of principal lettering.
- G. **Fasteners:** Stainless-steel rivets or self-tapping screws.
- H. **Adhesive:** Contact-type permanent adhesive, compatible with label and with substrate.
- I. **Duct Label Contents:** Include identification of duct service using same designations or abbreviations as used on Drawings, duct size, and an arrow indicating flow direction.
 - 1. **Flow-Direction Arrows:** Integral with duct system service lettering to accommodate both directions, or as separate unit on each duct label to indicate flow direction.
 - 2. **Lettering Size:** At least 1-1/2 inches (38 mm) high.

2.4 STENCILS

- A. **Stencils:** Prepared with letter sizes according to ASME A13.1 for piping; minimum letter height of 1-1/4 inches (32 mm) for ducts; and minimum letter height of 3/4 inch (19 mm) for access panel and door labels, equipment labels, and similar operational instructions.
 - 1. **Stencil Material:** Fiberboard or metal.
 - 2. **Stencil Paint:** Exterior, gloss, acrylic enamel black unless otherwise indicated. Paint may be in pressurized spray-can form.
 - 3. **Identification Paint:** Exterior, acrylic 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 (6.4-mm) letters for piping system abbreviation and 1/2-inch (13-mm) numbers.
 - 1. **Tag Material:** Stainless steel, 0.025-inch (0.64-mm) minimum thickness, and having predrilled or stamped holes for attachment hardware.
 - 2. **Fasteners:** Brass wire-link or beaded chain; or S-hook.
- B. **Valve Schedules:** For each piping system, on 8-1/2-by-11-inch (A4) 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-tag schedule shall be included in operation and maintenance data.

PART 3 - EXECUTION

3.1 PREPARATION

- A. Clean piping and equipment surfaces of substances that could impair bond of identification devices, including dirt, oil, grease, release agents, and incompatible primers, paints, and encapsulants.

3.2 EQUIPMENT LABEL INSTALLATION

- A. Install or permanently fasten labels on each major item of mechanical equipment.
- B. Locate equipment labels where accessible and visible.

3.3 PIPE LABEL INSTALLATION

- A. Locate pipe labels where piping is exposed or above accessible ceilings in finished spaces; machine rooms; accessible maintenance spaces such as shafts, tunnels, and plenums; and exterior exposed locations as follows:
 1. Near each valve and control device.
 2. Near each branch connection, excluding short takeoffs for fixtures and terminal units. Where flow pattern is not obvious, mark each pipe at branch.
 3. Near penetrations through walls, floors, ceilings, and inaccessible enclosures.
 4. At access doors, manholes, and similar access points that permit view of concealed piping.
 5. Near major equipment items and other points of origination and termination.
 6. Spaced at maximum intervals of 50 feet (15 m) along each run. Reduce intervals to 25 feet (7.6 m) in areas of congested piping and equipment.
 7. On piping above removable acoustical ceilings. Omit intermediately spaced labels.

3.4 DUCT LABEL INSTALLATION

- A. Install self-adhesive duct labels with permanent adhesive on air ducts in the following color codes:
- B. Stenciled Duct Label Option: Stenciled labels, showing service and flow direction, may be provided instead of plastic-laminated duct labels, at Installer's option, if lettering larger than 1 inch (25 mm) high is needed for proper identification because of distance from normal location of required identification.
- C. Locate labels near points where ducts enter into concealed spaces and at maximum intervals of 50 feet (15 m) in each space where ducts are exposed or concealed by removable ceiling system.

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; 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 subparagraphs:

END OF SECTION 15077

SECTION 15080 - MECHANICAL 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.

1.2 SUMMARY

- A. This Section includes mechanical insulation for duct, equipment, and pipe, including the following:

- 1. Insulation Materials:

- a. Phenolic Foam.
 - b. Cellular glass.
 - c. Flexible elastomeric.
 - d. Mineral fiber.

- 2. Fire-rated insulation systems.
 - 3. Insulating cements.
 - 4. Adhesives.
 - 5. Mastics.
 - 6. Lagging adhesives.
 - 7. Sealants.
 - 8. Factory-applied jackets.
 - 9. Field-applied fabric-reinforcing mesh.
 - 10. Field-applied cloths.
 - 11. Field-applied jackets.
 - 12. Tapes.
 - 13. Securements.
 - 14. Corner angles.

- B. Related Sections include the following:

- 1. Division 2 Section "Hydronic Distribution" for loose-fill pipe insulation in underground piping outside the building.

1.3 DEFINITIONS

- A. ASJ: All-service jacket.
- B. FSK: Foil, scrim, kraft paper.
- C. FSP: Foil, scrim, polyethylene.
- D. PVDC: Polyvinylidene chloride.

- E. SSL: Self-sealing lap.

1.4 SUBMITTALS

- A. Product Data: For each type of product indicated, identify thermal conductivity, thickness, and jackets (both factory and field applied, if any).
- B. Shop Drawings: Show details for the following:
 - 1. Application of protective shields, saddles, and inserts at hangers for each type of insulation and hanger.
 - 2. Insulation application at pipe expansion joints for each type of insulation.
 - 3. Insulation application at elbows, fittings, flanges, valves, and specialties for each type of insulation.
 - 4. Removable insulation at piping specialties, equipment connections, and access panels.
 - 5. Application of field-applied jackets.
 - 6. Application at linkages of control devices.
 - 7. Field application for each equipment type.
- C. Installer Certificates: Signed by Contractor certifying that installers comply with requirements.
- D. Material Test Reports: From a qualified testing agency acceptable to authorities having jurisdiction indicating, interpreting, and certifying test results for compliance of insulation materials, sealers, attachments, cements, and jackets, with requirements indicated. Include dates of tests and test methods employed.
- E. Field quality-control inspection reports.

1.5 QUALITY ASSURANCE

- A. Installer Qualifications: Skilled mechanics who have successfully completed an apprenticeship program or another craft training program certified by the Department of Labor, Bureau of Apprenticeship and Training.
- B. Fire-Test-Response Characteristics: Insulation and related materials shall have fire-test-response characteristics indicated, as determined by testing identical products per ASTM E 84, by a testing and inspecting agency acceptable to authorities having jurisdiction. Factory label insulation and jacket materials and adhesive, mastic, and cement material containers, with appropriate markings of applicable testing and inspecting agency.
 - 1. Insulation Installed Indoors: Flame-spread index of 25 or less, and smoke-developed index of 50 or less.
 - 2. Insulation Installed Outdoors: Flame-spread index of 75 or less, and smoke-developed index of 150 or less.

1.6 DELIVERY, STORAGE, AND HANDLING

- A. Packaging: Insulation material containers shall be marked by manufacturer with appropriate ASTM standard designation, type and grade, and maximum use temperature.

1.7 COORDINATION

- A. Coordinate size and location of supports, hangers, and insulation shields specified in Division 15 Section "Hangers and Supports."
- B. Coordinate clearance requirements with piping Installer for piping insulation application, duct Installer for duct insulation application, and equipment Installer for equipment insulation application. Before preparing piping and ductwork Shop Drawings, establish and maintain clearance requirements for installation of insulation and field-applied jackets and finishes and for space required for maintenance.

1.8 SCHEDULING

- A. Schedule insulation application after pressure testing systems. Insulation application may begin on segments that have satisfactory test results.
- B. Complete installation and concealment of plastic materials as rapidly as possible in each area of construction.

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 Products: Subject to compliance with requirements, products that may be incorporated into the Work include, but are not limited to, products specified.
 - 2. Products: Subject to compliance with requirements, provide one of the products specified.
 - 3. 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.
 - 4. Manufacturers: Subject to compliance with requirements, provide products by one of the manufacturers specified.

2.2 INSULATION MATERIALS

- A. Refer to Part 3 schedule articles for requirements about where insulating materials shall be applied.
- B. Products shall not contain asbestos, lead, mercury, or mercury compounds.
- C. Products that come in contact with stainless steel shall have a leachable chloride content of less than 50 ppm when tested according to ASTM C 871.
- D. Insulation materials for use on austenitic stainless steel shall be qualified as acceptable according to ASTM C 795.
- E. Foam insulation materials shall not use CFC or HCFC blowing agents in the manufacturing process.

- F. Cellular Glass: Inorganic, incombustible, foamed or cellulated glass with annealed, rigid, hermetically sealed cells. Factory-applied jacket requirements are specified in Part 2 "Factory-Applied Jackets" Article.
1. Available Products:
 - a. ACS.
 - b. Pittsburgh Corning Corporation; Foamglas Super K.
 2. Preformed Pipe Insulation without Jacket: Comply with ASTM C 552, Type II, Class 1.
 3. Preformed Pipe Insulation with Factory-Applied ASJ: Comply with ASTM C 552, Type II, Class 2.
 4. Factory fabricate shapes according to ASTM C 450 and ASTM C 585.
- G. Flexible Elastomeric: Closed-cell, sponge- or expanded-rubber materials. Comply with ASTM C 534, Type I for tubular materials and Type II for sheet materials.
1. Available Products:
 - a. Aeroflex USA Inc.; Aerocel.
 - b. Armacell LLC; AP Armaflex.
 - c. RBX Corporation; Insul-Sheet 1800 and Insul-Tube 180.
- H. Mineral-Fiber Blanket Insulation: Mineral or glass fibers bonded with a thermosetting resin. Comply with ASTM C 553, Type II and ASTM C 1290, Type III with factory-applied FSK jacket. Factory-applied jacket requirements are specified in Part 2 "Factory-Applied Jackets" Article.
1. Available Products:
 - a. CertainTeed Corp.; Duct Wrap.
 - b. Johns Manville; Microlite.
 - c. Knauf Insulation; Duct Wrap.
 - d. Owens Corning; All-Service Duct Wrap.
- I. Mineral-Fiber Board Insulation: Mineral or glass fibers bonded with a thermosetting resin. Comply with ASTM C 612, Type IA or Type IB. For equipment applications, provide insulation with factory-applied ASJ. Factory-applied jacket requirements are specified in Part 2 "Factory-Applied Jackets" Article.
1. Available Products:
 - a. CertainTeed Corp.; Commercial Board.
 - b. Johns Manville; 800 Series Spin-Glas.
 - c. Knauf Insulation; Insulation Board.
 - d. Owens Corning; Fiberglas 700 Series.
- J. Mineral-Fiber, Preformed Pipe Insulation:
1. Available Products:
 - a. Johns Manville; Micro-Lok.
 - b. Knauf Insulation; 1000(Pipe Insulation.
 - c. Owens Corning; Fiberglas Pipe Insulation.
 2. Type I, 850 deg F (454 deg C) Materials: Mineral or glass fibers bonded with a thermosetting resin. Comply with ASTM C 547, Type I, Grade A, with factory-applied

ASJ. Factory-applied jacket requirements are specified in Part 2 "Factory-Applied Jackets" Article.

2.3 FIRE-RATED INSULATION SYSTEMS

A. Fire-Rated Blanket: High-temperature, flexible, blanket insulation with FSK jacket that is UL tested and certified to provide a 1 or 2-hour fire rating, as required.

1. Products:

- a. CertainTeed Corp.; FlameChek.
- b. Johns Manville; Firetemp Wrap.
- c. Thermal Ceramics; FireMaster Duct Wrap.
- d. 3M; Fire Barrier Wrap Products.

2.4 INSULATING CEMENTS

A. Mineral-Fiber Insulating Cement: Comply with ASTM C 195.

B. Expanded or Exfoliated Vermiculite Insulating Cement: Comply with ASTM C 196.

C. Mineral-Fiber, Hydraulic-Setting Insulating and Finishing Cement: Comply with ASTM C 449/C 449M.

2.5 ADHESIVES

A. Materials shall be compatible with insulation materials, jackets, and substrates and for bonding insulation to itself and to surfaces to be insulated, unless otherwise indicated.

B. Cellular-Glass Adhesive: Solvent-based resin adhesive, with a service temperature range of minus 75 to plus 300 deg F (minus 59 to plus 149 deg C).

C. Flexible Elastomeric Adhesive: Comply with MIL-A-24179A, Type II, Class I.

D. Mineral-Fiber Adhesive: Comply with MIL-A-3316C, Class 2, Grade A.

E. ASJ Adhesive, and FSK Jacket Adhesive: Comply with MIL-A-3316C, Class 2, Grade A for bonding insulation jacket lap seams and joints.

F. PVC Jacket Adhesive: Compatible with PVC jacket.

1. Products:

2.6 MASTICS

A. Materials shall be compatible with insulation materials, jackets, and substrates; comply with MIL-C-19565C, Type II.

B. Vapor-Barrier Mastic: Solvent based; suitable for indoor use on below ambient services.

1. Products:

- a. Childers Products, Division of ITW; CP-30.
 - b. Foster Products Corporation, H. B. Fuller Company; 30-35.
 - c. ITW TACC, Division of Illinois Tool Works; CB-25.
 - d. Marathon Industries, Inc.; 501.
 - e. Mon-Eco Industries, Inc.; 55-10.
2. Water-Vapor Permeance: ASTM F 1249, 0.05 perm (0.03 metric perm) at 35-mil (0.9-mm) dry film thickness.
 3. Service Temperature Range: 0 to 180 deg F (Minus 18 to plus 82 deg C).
 4. Solids Content: ASTM D 1644, 44 percent by volume and 62 percent by weight.
 5. Color: White.

2.7 LAGGING ADHESIVES

- A. Description: Comply with MIL-A-3316C Class I, Grade A and shall be compatible with insulation materials, jackets, and substrates.
1. Fire-resistant, water-based lagging adhesive and coating for use indoors to adhere fire-resistant lagging cloths over duct, equipment, and pipe insulation.
 2. Service Temperature Range: Minus 50 to plus 180 deg F (Minus 46 to plus 82 deg C).
 3. Color: White.

2.8 SEALANTS

A. Joint Sealants:

1. Joint Sealants for Cellular-Glass, Products:
 - a. Childers Products, Division of ITW; CP-76.
 - b. Pittsburgh Corning Corporation; Pittseal 444.
2. Materials shall be compatible with insulation materials, jackets, and substrates.
3. Permanently flexible, elastomeric sealant.
4. Service Temperature Range: Minus 100 to plus 300 deg F (Minus 73 to plus 149 deg C).
5. Color: White or gray.

B. FSK and Metal Jacket Flashing Sealants:

1. Materials shall be compatible with insulation materials, jackets, and substrates.
2. Fire- and water-resistant, flexible, elastomeric sealant.
3. Service Temperature Range: Minus 40 to plus 250 deg F (Minus 40 to plus 121 deg C).
4. Color: Aluminum.

C. ASJ Flashing Sealants, and Vinyl, PVDC, and PVC Jacket Flashing Sealants:

1. Materials shall be compatible with insulation materials, jackets, and substrates.
2. Fire- and water-resistant, flexible, elastomeric sealant.
3. Service Temperature Range: Minus 40 to plus 250 deg F (Minus 40 to plus 121 deg C).
4. Color: White.

2.9 FACTORY-APPLIED JACKETS

- A. Insulation system schedules indicate factory-applied jackets on various applications. When factory-applied jackets are indicated, comply with the following:
1. ASJ: White, kraft-paper, fiberglass-reinforced scrim with aluminum-foil backing; complying with ASTM C 1136, Type I.
 2. ASJ-SSL: ASJ with self-sealing, pressure-sensitive, acrylic-based adhesive covered by a removable protective strip; complying with ASTM C 1136, Type I.
 3. FSK Jacket: Aluminum-foil, fiberglass-reinforced scrim with kraft-paper backing; complying with ASTM C 1136, Type II.
 4. FSP Jacket: Aluminum-foil, fiberglass-reinforced scrim with polyethylene backing; complying with ASTM C 1136, Type II.

2.10 FIELD-APPLIED FABRIC-REINFORCING MESH

- A. Woven Glass-Fiber Fabric for Pipe Insulation: Approximately 2 oz./sq. yd. (68 g/sq. m) with a thread count of 10 strands by 10 strands/sq. inch (4 strands by 4 strands/sq. mm) for covering pipe and pipe fittings.
- B. Woven Glass-Fiber Fabric for Duct and Equipment Insulation: Approximately 6 oz./sq. yd. (203 g/sq. m) with a thread count of 5 strands by 5 strands/sq. inch (2 strands by 2 strands/sq. mm) for covering equipment.

2.11 FIELD-APPLIED CLOTHS

- A. Woven Glass-Fiber Fabric: Comply with MIL-C-20079H, Type I, plain weave, and presized a minimum of 8 oz./sq. yd. (271 g/sq. m).

2.12 FIELD-APPLIED JACKETS

- A. Field-applied jackets shall comply with ASTM C 921, Type I, unless otherwise indicated.
- B. FSK Jacket: Aluminum-foil-face, fiberglass-reinforced scrim with kraft-paper backing.
- C. PVC Jacket: High-impact-resistant, UV-resistant PVC complying with ASTM D 1784, Class 16354-C; thickness 20 mil; roll stock ready for shop or field cutting and forming. Thickness is indicated in field-applied jacket schedules.
1. Adhesive: As recommended by jacket material manufacturer.
 2. Color: White.
 3. Factory-fabricated fitting covers to match jacket if available; otherwise, field fabricate.
 - a. Shapes: 45- and 90-degree, short- and long-radius elbows, tees, valves, flanges, unions, reducers, end caps, soil-pipe hubs, traps, mechanical joints, and P-trap and supply covers for lavatories.
 4. Factory-fabricated tank heads and tank side panels.
- D. Metal Jacket:

1. Aluminum Jacket: Comply with ASTM B 209 (ASTM B 209M), Alloy 3003, 3005, 3105 or 5005, Temper H-14.
 - a. Sheet and roll stock ready for shop or field sizing.
 - b. Thickness: 0.020" Smooth.
 - c. Moisture Barrier for Indoor Applications: 1-mil- thick, heat-bonded polyethylene and kraft paper.
 - d. Moisture Barrier for Outdoor Applications: 3-mil- thick, heat-bonded polyethylene and kraft paper.
 - e. Factory-Fabricated Fitting Covers:
 - 1) Same material, finish, and thickness as jacket.
 - 2) Preformed 2-piece or gore, 45- and 90-degree, short- and long-radius elbows.
 - 3) Tee covers.
 - 4) Flange and union covers.
 - 5) End caps.
 - 6) Beveled collars.
 - 7) Valve covers.
 - 8) Field fabricate fitting covers only if factory-fabricated fitting covers are not available.

2.13 TAPES

- A. ASJ Tape: White vapor-retarder tape matching factory-applied jacket with acrylic adhesive, complying with ASTM C 1136 and UL listed.
 1. Width: 3 inches.
 2. Thickness: 11.5 mils.
 3. Adhesion: 90 ounces force/inch in width.
 4. Elongation: 2 percent.
 5. Tensile Strength: 40 lbf/inch in width.
 6. ASJ Tape Disks and Squares: Precut disks or squares of ASJ tape.
- B. FSK Tape: Foil-face, vapor-retarder tape matching factory-applied jacket with acrylic adhesive; complying with ASTM C 1136 and UL listed.
 1. Width: 3 inches.
 2. Thickness: 6.5 mils.
 3. Adhesion: 90 ounces force/inch in width.
 4. Elongation: 2 percent.
 5. Tensile Strength: 40 lbf/inch in width.
 6. FSK Tape Disks and Squares: Precut disks or squares of FSK tape.
- C. PVC Tape: White vapor-retarder tape matching field-applied PVC jacket with acrylic adhesive. Suitable for indoor and outdoor applications.
 1. Width: 2 inches.
 2. Thickness: 6 mils.
 3. Adhesion: 64 ounces force/inch in width.
 4. Elongation: 500 percent.
 5. Tensile Strength: 18 lbf/inch in width.
- D. Aluminum-Foil Tape: Vapor-retarder tape with acrylic adhesive and UL listed.

1. Width: 2 inches.
2. Thickness: 3.7 mils.
3. Adhesion: 100 ounces force/inch in width.
4. Elongation: 5 percent.
5. Tensile Strength: 34 lbf/inch in width.

2.14 SECUREMENTS

A. Bands:

1. Aluminum: ASTM B 209, Alloy 3003, 3005, 3105, or 5005; Temper H-14, 0.020 inch thick, 3/4 inch wide with wing or closed seal.
2. Springs: Twin spring set constructed of stainless steel with ends flat and slotted to accept metal bands. Spring size determined by manufacturer for application.

B. Insulation Pins and Hangers:

1. Capacitor-Discharge-Weld Pins: Copper- or zinc-coated steel pin, fully annealed for capacitor-discharge welding, 0.106-inch- diameter shank, length to suit depth of insulation indicated.
2. Insulation-Retaining Washers: Self-locking washers formed from 0.016-inch- thick, galvanized-steel sheet, with beveled edge sized as required to hold insulation securely in place but not less than 1-1/2 inches in diameter.
 - a. Protect ends with capped self-locking washers incorporating a spring steel insert to ensure permanent retention of cap in exposed locations.

C. Staples: Outward-clinching insulation staples, nominal 3/4-inch- wide, stainless steel or Monel.

D. Wire: 0.080-inch nickel-copper alloy.

2.15 CORNER ANGLES

- A. PVC Corner Angles: 30 mils thick, minimum 1 by 1 inch, PVC according to ASTM D 1784, Class 16354-C. White or color-coded to match adjacent surface.
- B. Aluminum Corner Angles: 0.040 inch thick, minimum 1 by 1 inch, aluminum according to ASTM B 209, Alloy 3003, 3005, 3105 or 5005; Temper H-14.

PART 3 - EXECUTION

3.1 EXAMINATION

- A. Examine substrates and conditions for compliance with requirements for installation and other conditions affecting performance of insulation application.
 1. Verify that systems and equipment to be insulated have been tested and are free of defects.
 2. Verify that surfaces to be insulated are clean and dry.
 3. 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.
- B. Mix insulating cements with clean potable water; if insulating cements are to be in contact with stainless-steel surfaces, use demineralized water.

3.3 COMMON INSTALLATION REQUIREMENTS

- A. Install insulation materials, accessories, and finishes with smooth, straight, and even surfaces; free of voids throughout the length of equipment, ducts and fittings, and piping including fittings, valves, and specialties.
- B. Install insulation materials, forms, vapor barriers or retarders, jackets, and thicknesses required for each item of equipment, duct system, and pipe system as specified in insulation system schedules.
- C. Install accessories compatible with insulation materials and suitable for the service. Install accessories that do not corrode, soften, or otherwise attack insulation or jacket in either wet or dry state.
- D. Install insulation with longitudinal seams at top and bottom of horizontal runs.
- E. Install multiple layers of insulation with longitudinal and end seams staggered.
- F. Do not weld brackets, clips, or other attachment devices to piping, fittings, and specialties.
- G. Keep insulation materials dry during application and finishing.
- H. Install insulation with tight longitudinal seams and end joints. Bond seams and joints with adhesive recommended by insulation material manufacturer.
- I. Install insulation with least number of joints practical.
- J. Where vapor barrier is indicated, seal joints, seams, and penetrations in insulation at hangers, supports, anchors, and other projections with vapor-barrier mastic.
 - 1. Install insulation continuously through hangers and around anchor attachments.
 - 2. For insulation application where vapor barriers are indicated, extend insulation on anchor legs from point of attachment to supported item to point of attachment to structure. Taper and seal ends at attachment to structure with vapor-barrier mastic.
 - 3. Install insert materials and install insulation to tightly join the insert. Seal insulation to insulation inserts with adhesive or sealing compound recommended by insulation material manufacturer.
 - 4. Cover inserts with jacket material matching adjacent pipe insulation. Install shields over jacket, arranged to protect jacket from tear or puncture by hanger, support, and shield.
- K. Apply adhesives, mastics, and sealants at manufacturer's recommended coverage rate and wet and dry film thicknesses.
- L. Install insulation with factory-applied jackets as follows:
 - 1. Draw jacket tight and smooth.

2. Cover circumferential joints with 3-inch- wide strips, of same material as insulation jacket. Secure strips with adhesive and outward clinching staples along both edges of strip, spaced 4 inches o.c.
 3. Overlap jacket longitudinal seams at least 1-1/2 inches. Install insulation with longitudinal seams at bottom of pipe. Clean and dry surface to receive self-sealing lap. Staple laps with outward clinching staples along edge at 4 inches o.c.
 - a. For below ambient services, apply vapor-barrier mastic over staples.
 4. Cover joints and seams with tape as recommended by insulation material manufacturer to maintain vapor seal.
 5. Where vapor barriers are indicated, apply vapor-barrier mastic on seams and joints and at ends adjacent to duct and pipe flanges and fittings.
- M. Cut insulation in a manner to avoid compressing insulation more than 75 percent of its nominal thickness.
- N. Finish installation with systems at operating conditions. Repair joint separations and cracking due to thermal movement.
- O. Repair damaged insulation facings by applying same facing material over damaged areas. Extend patches at least 4 inches beyond damaged areas. Adhere, staple, and seal patches similar to butt joints.
- P. For above ambient services, do not install insulation to the following:
1. Vibration-control devices.
 2. Testing agency labels and stamps.
 3. Nameplates and data plates.
 4. Manholes.
 5. Handholes.
 6. Cleanouts.

3.4 PENETRATIONS

- A. Insulation Installation at Roof Penetrations: Install insulation continuously through roof penetrations.
1. Seal penetrations with flashing sealant.
 2. For applications requiring only indoor insulation, terminate insulation above roof surface and seal with joint sealant. For applications requiring indoor and outdoor insulation, install insulation for outdoor applications tightly joined to indoor insulation ends. Seal joint with joint sealant.
 3. Extend jacket of outdoor insulation outside roof flashing at least 2 inches below top of roof flashing.
 4. Seal jacket to roof flashing with flashing sealant.
- B. Insulation Installation at Below-Grade Exterior Wall Penetrations: Terminate insulation flush with sleeve seal. Seal terminations with flashing sealant.
- C. Insulation Installation at Aboveground Exterior Wall Penetrations: Install insulation continuously through wall penetrations.
1. Seal penetrations with flashing sealant.

2. For applications requiring only indoor insulation, terminate insulation inside wall surface and seal with joint sealant. For applications requiring indoor and outdoor insulation, install insulation for outdoor applications tightly joined to indoor insulation ends. Seal joint with joint sealant.
 3. Extend jacket of outdoor insulation outside wall flashing and overlap wall flashing at least 2 inches.
 4. Seal jacket to wall flashing with flashing sealant.
- D. Insulation Installation at Interior Wall and Partition Penetrations (That Are Not Fire Rated): Install insulation continuously through walls and partitions.
- E. Insulation Installation at Fire-Rated Wall and Partition Penetrations: Install insulation continuously through penetrations of fire-rated walls and partitions. Terminate insulation at fire damper sleeves for fire-rated wall and partition penetrations. Externally insulate damper sleeves to match adjacent insulation and overlap duct insulation at least 2 inches.
1. Firestopping and fire-resistive joint sealers are specified in Division 7 Section "Through-Penetration Firestop Systems."
- F. Insulation Installation at Floor Penetrations:
1. Duct: Install insulation continuously through floor penetrations that are not fire rated. For penetrations through fire-rated assemblies, terminate insulation at fire damper sleeves and externally insulate damper sleeve beyond floor to match adjacent duct insulation. Overlap damper sleeve and duct insulation at least 2 inches.
 2. Pipe: Install insulation continuously through floor penetrations.
 3. Seal penetrations through fire-rated assemblies according to Division 7 Section "Through-Penetration Firestop Systems."
- 3.5 DUCT AND PLENUM INSULATION INSTALLATION
- A. Blanket Insulation Installation on Ducts and Plenums: Secure with adhesive and insulation pins.
1. Apply adhesives according to manufacturer's recommended coverage rates per unit area, for 50 percent coverage of duct and plenum surfaces.
 2. Apply adhesive to entire circumference of ducts and to all surfaces of fittings and transitions.
 3. Install capacitor-discharge-weld pins and speed washers on sides and bottom of horizontal ducts and sides of vertical ducts as follows:
 - a. On duct sides with dimensions 18 inches and smaller, place pins along longitudinal centerline of duct. Space 3 inches maximum from insulation end joints, and 16 inches o.c.
 - b. On duct sides with dimensions larger than 18 inches, place pins 16 inches o.c. each way, and 3 inches maximum from insulation joints. Install additional pins to hold insulation tightly against surface at cross bracing.
- 3.6 EQUIPMENT, TANK, AND VESSEL INSULATION INSTALLATION
- A. Secure insulation with adhesive and anchor pins and speed washers.
1. Apply adhesives according to manufacturer's recommended coverage rates per unit area, for 50 percent coverage of tank and vessel surfaces.

2. Groove and score insulation materials to fit as closely as possible to equipment, including contours. Bevel insulation edges for cylindrical surfaces for tight joints. Stagger end joints.
 3. Protect exposed corners with secured corner angles.
 4. Install adhesively attached or self-sticking insulation hangers and speed washers on sides of tanks and vessels as follows:
 - a. Do not weld anchor pins to ASME-labeled pressure vessels.
 - b. Select insulation hangers and adhesive that are compatible with service temperature and with substrate.
 - c. On tanks and vessels, maximum anchor-pin spacing is 3 inches from insulation end joints, and 16 inches o.c. in both directions.
 - d. Do not overcompress insulation during installation.
 - e. Cut and miter insulation segments to fit curved sides and domed heads of tanks and vessels.
 - f. Impale insulation over anchor pins and attach speed washers.
 - g. 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. Secure each layer of insulation with stainless-steel or aluminum bands. Select band material compatible with insulation materials.
 6. Where insulation hangers on equipment and vessels are not permitted or practical and where insulation support rings are not provided, install a girdle network for securing insulation. Stretch prestressed aircraft cable around the diameter of vessel and make taut with clamps, turnbuckles, or breather springs. Place one circumferential girdle around equipment approximately 6 inches from each end. Install wire or cable between two circumferential girdles 12 inches o.c. Install a wire ring around each end and around outer periphery of center openings, and stretch prestressed aircraft cable radially from the wire ring to nearest circumferential girdle. Install additional circumferential girdles along the body of equipment or tank at a minimum spacing of 48 inches o.c. Use this network for securing insulation with tie wire or bands.
 7. Stagger joints between insulation layers at least 3 inches.
 8. Install insulation in removable segments on equipment access doors, manholes, handholes, and other elements that require frequent removal for service and inspection.
 9. Bevel and seal insulation ends around manholes, handholes, ASME stamps, and nameplates.
 10. For equipment with surface temperatures below ambient, apply mastic to open ends, joints, seams, breaks, and punctures in insulation.
- B. Flexible Elastomeric Thermal Insulation Installation for Tanks and Vessels: Install insulation over entire surface of tanks and vessels.
1. Apply 100 percent coverage of adhesive to surface with manufacturer's recommended adhesive.
 2. Seal longitudinal seams and end joints.
- C. Insulation Installation on Pumps:
1. Fabricate metal boxes lined with insulation. Fit boxes around pumps and coincide box joints with splits in pump casings. Fabricate joints with outward bolted flanges. Bolt flanges on 6-inch centers, starting at corners. Install 3/8-inch- diameter fasteners with wing nuts. Alternatively, secure the box sections together using a latching mechanism.
 2. Fabricate boxes from galvanized steel, at least 0.040 inch thick.
 3. For below ambient services, install a vapor barrier at seams, joints, and penetrations. Seal between flanges with replaceable gasket material to form a vapor barrier.

3.7 GENERAL PIPE INSULATION INSTALLATION

- A. Requirements in this Article generally apply to all insulation materials except where more specific requirements are specified in various pipe insulation material installation articles.
- B. Insulation Installation on Fittings, Valves, Strainers, Flanges, and Unions:
1. Install insulation over fittings, valves, strainers, flanges, unions, and other specialties with continuous thermal and vapor-retarder integrity, unless otherwise indicated.
 2. Insulate pipe elbows using preformed fitting insulation or mitered fittings made from same material and density as adjacent pipe insulation. Each piece shall be butted tightly against adjoining piece and bonded with adhesive. Fill joints, seams, voids, and irregular surfaces with insulating cement finished to a smooth, hard, and uniform contour that is uniform with adjoining pipe insulation.
 3. Insulate tee fittings with preformed fitting insulation or sectional pipe insulation of same material and thickness as used for adjacent pipe. Cut sectional pipe insulation to fit. Butt each section closely to the next and hold in place with tie wire. Bond pieces with adhesive.
 4. Insulate valves using preformed fitting insulation or sectional pipe insulation of same material, density, and thickness as used for adjacent pipe. Overlap adjoining pipe insulation by not less than two times the thickness of pipe insulation, or one pipe diameter, whichever is thicker. For valves, insulate up to and including the bonnets, valve stuffing-box studs, bolts, and nuts. Fill joints, seams, and irregular surfaces with insulating cement.
 5. Insulate strainers using preformed fitting insulation or sectional pipe insulation of same material, density, and thickness as used for adjacent pipe. Overlap adjoining pipe insulation by not less than two times the thickness of pipe insulation, or one pipe diameter, whichever is thicker. Fill joints, seams, and irregular surfaces with insulating cement. Insulate strainers so strainer basket flange or plug can be easily removed and replaced without damaging the insulation and jacket. Provide a removable reusable insulation cover. For below ambient services, provide a design that maintains vapor barrier.
 6. Insulate flanges and unions using a section of oversized preformed pipe insulation. Overlap adjoining pipe insulation by not less than two times the thickness of pipe insulation, or one pipe diameter, whichever is thicker.
 7. Cover segmented insulated surfaces with a layer of finishing cement and coat with a mastic. Install vapor-barrier mastic for below ambient services and a breather mastic for above ambient services. Reinforce the mastic with fabric-reinforcing mesh. Trowel the mastic to a smooth and well-shaped contour.
 8. For services not specified to receive a field-applied jacket except for flexible elastomeric, install fitted PVC cover over elbows, tees, strainers, valves, flanges, and unions. Terminate ends with PVC end caps. Tape PVC covers to adjoining insulation facing using PVC tape.
 9. Stencil or label the outside insulation jacket of each union with the word "UNION." Match size and color of pipe labels.
- C. Insulate instrument connections for thermometers, pressure gages, pressure temperature taps, test connections, flow meters, sensors, switches, and transmitters on insulated pipes, vessels, and equipment. Shape insulation at these connections by tapering it to and around the connection with insulating cement and finish with finishing cement, mastic, and flashing sealant.
- D. Install removable insulation covers at locations indicated. Installation shall conform to the following:

1. Make removable flange and union insulation from sectional pipe insulation of same thickness as that on adjoining pipe. Install same insulation jacket as adjoining pipe insulation.
2. When flange and union covers are made from sectional pipe insulation, extend insulation from flanges or union long at least two times the insulation thickness over adjacent pipe insulation on each side of flange or union. Secure flange cover in place with stainless-steel or aluminum bands. Select band material compatible with insulation and jacket.
3. Construct removable valve insulation covers in same manner as for flanges except divide the two-part section on the vertical center line of valve body.
4. When covers are made from block insulation, make two halves, each consisting of mitered blocks wired to stainless-steel fabric. Secure this wire frame, with its attached insulation, to flanges with tie wire. Extend insulation at least 2 inches over adjacent pipe insulation on each side of valve. Fill space between flange or union cover and pipe insulation with insulating cement. Finish cover assembly with insulating cement applied in two coats. After first coat is dry, apply and trowel second coat to a smooth finish.
5. Unless a PVC jacket is indicated in field-applied jacket schedules, finish exposed surfaces with a metal jacket.

3.8 CELLULAR-GLASS INSULATION INSTALLATION

A. Insulation Installation on Straight Pipes and Tubes:

1. Secure each layer of insulation to pipe with wire or bands and tighten bands without deforming insulation materials.
2. Where vapor barriers are indicated, seal longitudinal seams, end joints, and protrusions with vapor-barrier mastic and joint sealant.
3. For insulation with factory-applied jackets on above ambient services, secure laps with outward clinched staples at 6 inches o.c.
4. For insulation with factory-applied jackets on below ambient services, do not staple longitudinal tabs but secure tabs with additional adhesive as recommended by insulation material manufacturer and seal with vapor-barrier mastic and flashing sealant.

B. Insulation Installation on Pipe Flanges:

1. Install preformed pipe insulation to outer diameter of pipe flange.
2. Make width of insulation section same as overall width of flange and bolts, plus twice the thickness of pipe insulation.
3. Fill voids between inner circumference of flange insulation and outer circumference of adjacent straight pipe segments with cut sections of cellular-glass block insulation of same thickness as pipe insulation.
4. Install jacket material with manufacturer's recommended adhesive, overlap seams at least 1 inch, and seal joints with flashing sealant.

C. Insulation Installation on Pipe Fittings and Elbows:

1. Install preformed sections of same material as straight segments of pipe insulation when available. Secure according to manufacturer's written instructions.
2. When preformed sections of insulation are not available, install mitered sections of cellular-glass insulation. Secure insulation materials with wire or bands.

D. Insulation Installation on Valves and Pipe Specialties:

1. Install preformed sections of cellular-glass insulation to valve body.

2. Arrange insulation to permit access to packing and to allow valve operation without disturbing insulation.
3. Install insulation to flanges as specified for flange insulation application.

3.9 FLEXIBLE ELASTOMERIC INSULATION INSTALLATION

- A. Seal longitudinal seams and end joints with manufacturer's recommended adhesive to eliminate openings in insulation that allow passage of air to surface being insulated.
- B. Insulation Installation on Pipe Flanges:
 1. Install pipe insulation to outer diameter of pipe flange.
 2. Make width of insulation section same as overall width of flange and bolts, plus twice the thickness of pipe insulation.
 3. Fill voids between inner circumference of flange insulation and outer circumference of adjacent straight pipe segments with cut sections of sheet insulation of same thickness as pipe insulation.
 4. Secure insulation to flanges and seal seams with manufacturer's recommended adhesive to eliminate openings in insulation that allow passage of air to surface being insulated.
- C. Insulation Installation on Pipe Fittings and Elbows:
 1. Install mitered sections of pipe insulation.
 2. Secure insulation materials and seal seams with manufacturer's recommended adhesive to eliminate openings in insulation that allow passage of air to surface being insulated.
- D. Insulation Installation on Valves and Pipe Specialties:
 1. Install preformed valve covers manufactured of same material as pipe insulation when available.
 2. When preformed valve covers are not available, install cut sections of pipe and sheet insulation to valve body. Arrange insulation to permit access to packing and to allow valve operation without disturbing insulation.
 3. Install insulation to flanges as specified for flange insulation application.
 4. Secure insulation to valves and specialties and seal seams with manufacturer's recommended adhesive to eliminate openings in insulation that allow passage of air to surface being insulated.

3.10 MINERAL-FIBER INSULATION INSTALLATION

- A. Insulation Installation on Straight Pipes and Tubes:
 1. Secure each layer of preformed pipe insulation to pipe with wire or bands and tighten bands without deforming insulation materials.
 2. Where vapor barriers are indicated, seal longitudinal seams, end joints, and protrusions with vapor-barrier mastic and joint sealant.
 3. For insulation with factory-applied jackets on above ambient surfaces, secure laps with outward clinched staples at 6 inches o.c.
 4. For insulation with factory-applied jackets on below ambient surfaces, do not staple longitudinal tabs but secure tabs with additional adhesive as recommended by insulation material manufacturer and seal with vapor-barrier mastic and flashing sealant.
- B. Insulation Installation on Pipe Flanges:

1. Install preformed pipe insulation to outer diameter of pipe flange.
 2. Make width of insulation section same as overall width of flange and bolts, plus twice the thickness of pipe insulation.
 3. Fill voids between inner circumference of flange insulation and outer circumference of adjacent straight pipe segments with mineral-fiber blanket insulation.
 4. Install jacket material with manufacturer's recommended adhesive, overlap seams at least 1 inch, and seal joints with flashing sealant.
- C. Insulation Installation on Pipe Fittings and Elbows:
1. Install preformed sections of same material as straight segments of pipe insulation when available.
 2. When preformed insulation elbows and fittings are not available, install mitered sections of pipe insulation, to a thickness equal to adjoining pipe insulation. Secure insulation materials with wire or bands.
- D. Insulation Installation on Valves and Pipe Specialties:
1. Install preformed sections of same material as straight segments of pipe insulation when available.
 2. When preformed sections are not available, install mitered sections of pipe insulation to valve body.
 3. Arrange insulation to permit access to packing and to allow valve operation without disturbing insulation.
 4. Install insulation to flanges as specified for flange insulation application.
- E. Blanket Insulation Installation on Ducts and Plenums: Secure with adhesive and insulation pins.
1. Apply adhesives according to manufacturer's recommended coverage rates per unit area, for 50 percent coverage of duct and plenum surfaces.
 2. Apply adhesive to entire circumference of ducts and to all surfaces of fittings and transitions.
 3. Install capacitor-discharge-weld pins and speed washers on sides and bottom of horizontal ducts and sides of vertical ducts as follows:
 - a. On duct sides with dimensions 18 inches and smaller, place pins along longitudinal centerline of duct. Space 3 inches maximum from insulation end joints, and 16 inches o.c.
 - b. On duct sides with dimensions larger than 18 inches, place pins 16 inches o.c. each way, and 3 inches maximum from insulation joints. Install additional pins to hold insulation tightly against surface at cross bracing.
 - c. Pins may be omitted from top surface of horizontal, rectangular ducts and plenums.
 - d. Do not overcompress insulation during installation.
 - e. Impale insulation over pins and attach speed washers.
 - f. Cut excess portion of pins extending beyond speed washers or bend parallel with insulation surface. Cover exposed pins and washers with tape matching insulation facing.
 4. For ducts and plenums with surface temperatures below ambient, install a continuous unbroken vapor barrier. Create a facing lap for longitudinal seams and end joints with insulation by removing 2 inches (50 mm) from 1 edge and 1 end of insulation segment. Secure laps to adjacent insulation section with 1/2-inch (13-mm) outward-clinching staples, 1 inch (25 mm) o.c. Install vapor barrier consisting of factory- or field-applied jacket, adhesive, vapor-barrier mastic, and sealant at joints, seams, and protrusions.

- a. Repair punctures, tears, and penetrations with tape or mastic to maintain vapor-barrier seal.
 - b. Install vapor stops for ductwork and plenums operating below 50 deg F (10 deg C) at 18-foot (5.5-m) intervals. Vapor stops shall consist of vapor-barrier mastic applied in a Z-shaped pattern over insulation face, along butt end of insulation, and over the surface. Cover insulation face and surface to be insulated a width equal to 2 times the insulation thickness but not less than 3 inches (75 mm).
5. Overlap unfaced blankets a minimum of 2 inches on longitudinal seams and end joints. At end joints, secure with steel bands spaced a maximum of 18 inches o.c.
 6. Install insulation on rectangular duct elbows and transitions with a full insulation section for each surface. Install insulation on round and flat-oval duct elbows with individually mitered gores cut to fit the elbow.
 7. Insulate duct stiffeners, hangers, and flanges that protrude beyond insulation surface with 6-inch- wide strips of same material used to insulate duct. Secure on alternating sides of stiffener, hanger, and flange with pins spaced 6 inches o.c.
- F. Board Insulation Installation on Ducts and Plenums: Secure with adhesive and insulation pins.
1. Apply adhesives according to manufacturer's recommended coverage rates per unit area, for 50 percent coverage of duct and plenum surfaces.
 2. Apply adhesive to entire circumference of ducts and to all surfaces of fittings and transitions.
 3. Install capacitor-discharge-weld pins and speed washers on sides and bottom of horizontal ducts and sides of vertical ducts as follows:
 - a. On duct sides with dimensions 18 inches and smaller, place pins along longitudinal centerline of duct. Space 3 inches maximum from insulation end joints, and 16 inches o.c.
 - b. On duct sides with dimensions larger than 18 inches, space pins 16 inches o.c. each way, and 3 inches maximum from insulation joints. Install additional pins to hold insulation tightly against surface at cross bracing.
 - c. Pins may be omitted from top surface of horizontal, rectangular ducts and plenums.
 - d. Do not overcompress insulation during installation.
 - e. Cut excess portion of pins extending beyond speed washers or bend parallel with insulation surface. Cover exposed pins and washers with tape matching insulation facing.
 4. For ducts and plenums with surface temperatures below ambient, install a continuous unbroken vapor barrier. Create a facing lap for longitudinal seams and end joints with insulation by removing 2 inches (50 mm) from 1 edge and 1 end of insulation segment. Secure laps to adjacent insulation section with 1/2-inch (13-mm) outward-clinching staples, 1 inch (25 mm) o.c. Install vapor barrier consisting of factory- or field-applied jacket, adhesive, vapor-barrier mastic, and sealant at joints, seams, and protrusions.
 - a. Repair punctures, tears, and penetrations with tape or mastic to maintain vapor-barrier seal.
 - b. Install vapor stops for ductwork and plenums operating below 50 deg F (10 deg C) at 18-foot (5.5-m) intervals. Vapor stops shall consist of vapor-barrier mastic applied in a Z-shaped pattern over insulation face, along butt end of insulation, and over the surface. Cover insulation face and surface to be insulated a width equal to 2 times the insulation thickness but not less than 3 inches (75 mm).
 5. Install insulation on rectangular duct elbows and transitions with a full insulation section for each surface. Groove and score insulation to fit as closely as possible to outside and

inside radius of elbows. Install insulation on round and flat-oval duct elbows with individually mitered gores cut to fit the elbow.

6. Insulate duct stiffeners, hangers, and flanges that protrude beyond insulation surface with 6-inch- wide strips of same material used to insulate duct. Secure on alternating sides of stiffener, hanger, and flange with pins spaced 6 inches o.c.

3.11 FIELD-APPLIED JACKET INSTALLATION

- A. Where glass-cloth jackets are indicated, install directly over bare insulation or insulation with factory-applied jackets.

1. Draw 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 lagging adhesive.
3. Completely encapsulate insulation with coating, leaving no exposed insulation.

- B. Where FSK jackets are indicated, install as follows:

1. Draw jacket material smooth and tight.
2. Install lap or joint strips with same material as jacket.
3. Secure jacket to insulation with manufacturer's recommended adhesive.
4. Install jacket with 1-1/2-inch laps at longitudinal seams and 3-inch- wide joint strips at end joints.
5. Seal openings, punctures, and breaks in vapor-retarder jackets and exposed insulation with vapor-barrier mastic.

- C. Where PVC jackets are indicated, install with 1-inch overlap at longitudinal seams and end joints; for horizontal applications, install with longitudinal seams along top and bottom of tanks and vessels. Seal with manufacturer's recommended adhesive.

1. Apply two continuous beads of adhesive to seams and joints, one bead under lap and the finish bead along seam and joint edge.

- D. Where metal jackets are indicated, install with 2-inch overlap at longitudinal seams and end joints. Overlap longitudinal seams arranged to shed water. Seal end joints with weatherproof sealant recommended by insulation manufacturer. Secure jacket with stainless-steel bands 12 inches o.c. and at end joints.

3.12 FIRE-RATED INSULATION SYSTEM INSTALLATION

- A. Where fire-rated insulation system is indicated, secure system to ducts and duct hangers and supports to maintain a continuous UL-listed fire rating.

- B. Insulate duct access panels and doors to achieve same fire rating as duct.

- C. Install firestopping at penetrations through fire-rated assemblies. Fire-stop systems are specified in Division 7 Section "Through-Penetration Firestop Systems."

3.13 FINISHES

- A. Duct, Equipment, and Pipe Insulation with ASJ, Glass-Cloth, or Other Paintable Jacket Material: Paint jacket with paint system identified below and as specified in Division 9 painting Sections. Paint only those items in exposed, public areas.

1. Flat Acrylic Finish: Two finish coats over a primer that is compatible with jacket material and finish coat paint. Add fungicidal agent to render fabric mildew proof.
 - a. Finish Coat Material: Interior, flat, latex-emulsion size.
- B. Flexible Elastomeric Thermal Insulation: After adhesive has fully cured, apply two coats of insulation manufacturer's recommended protective coating.
- C. Color: Final color as selected by Architect. Vary first and second coats to allow visual inspection of the completed Work.
- D. Do not field paint aluminum or stainless-steel jackets.

3.14 FIELD QUALITY CONTROL

- A. Testing Agency: Engage a qualified independent inspecting agency to perform field inspections and prepare inspection reports.
- B. All insulation applications will be considered defective Work if sample inspection reveals noncompliance with requirements. Remove defective Work.
- C. Install new insulation and jackets to replace insulation and jackets removed for inspection. Repeat inspection procedures after new materials are installed.

3.15 DUCT INSULATION SCHEDULE, GENERAL

- A. Plenums and Ducts Requiring Insulation:
 1. Indoor, concealed supply and outdoor air.
 2. Indoor, exposed supply and outdoor air.
 3. Indoor, concealed return located in nonconditioned space.
 4. Indoor, exposed return located in nonconditioned space.
 5. Indoor, concealed oven and warewash exhaust.
 6. Indoor, exposed oven and warewash exhaust.
 7. Indoor, concealed exhaust air.
 8. Indoor, exposed exhaust air.
 9. Outdoor, concealed supply and return.
 10. Outdoor, exposed supply and return.
- B. Items Not Insulated:
 1. Metal ducts with duct liner of sufficient thickness to comply with energy code and ASHRAE/IESNA 90.1.
 2. Factory-insulated flexible ducts.
 3. Factory-insulated plenums and casings.
 4. Flexible connectors.
 5. Vibration-control devices.
 6. Factory-insulated access panels and doors.

3.16 INDOOR DUCT AND PLENUM INSULATION SCHEDULE

- A. Concealed, round and flat-oval, supply-air duct insulation shall be the following:
 1. Mineral-Fiber Blanket: 2 inches thick and 1.5-lb/cu. ft. nominal density.

SECTION 15080 - MECHANICAL INSULATION

- B. Concealed, round and flat-oval, return-air duct insulation shall be the following:
 - 1. Mineral-Fiber Blanket: 2 inches thick and 1.5-lb/cu. ft. nominal density.
- C. Concealed, round and flat-oval, outdoor-air duct insulation shall be the following:
 - 1. Mineral-Fiber Blanket: 2 inches thick and 1.5-lb/cu. ft. nominal density.
- D. Concealed, round and flat-oval, exhaust-air duct insulation shall be the following:
 - 1. Mineral-Fiber Blanket: 2 inches thick and 1.5-lb/cu. ft. nominal density.
- E. Concealed, rectangular, supply-air duct insulation shall be the following:
 - 1. Mineral-Fiber Blanket: 2 inches thick and 1.5-lb/cu. ft. nominal density.
- F. Concealed, rectangular, return-air duct insulation shall be the following:
 - 1. Mineral-Fiber Blanket: 2 inches thick and 1.5-lb/cu. ft. nominal density.
- G. Concealed, rectangular, outdoor-air duct insulation shall be the following:
 - 1. Mineral-Fiber Blanket: 2 inches thick and 1.5-lb/cu. ft. nominal density.
- H. Concealed, rectangular, exhaust-air duct insulation shall be the following:
 - 1. Mineral-Fiber Blanket: 2 inches thick and 1.5-lb/cu. ft. nominal density.
- I. Concealed, return-air plenum insulation shall be the following:
 - 1. Mineral-Fiber Blanket: 2 inches thick and 1.5-lb/cu. ft. nominal density.
 - 2. Mineral-Fiber Board: 1-1/2 inches thick and 2-lb/cu. ft. nominal density.
- J. Exposed, round and flat-oval, supply-air duct insulation shall be the following:
 - 1. Double wall insulated duct.
- K. Exposed, round and flat-oval, return-air duct insulation shall be the following:
 - 1. Mineral-Fiber Blanket: 2 inches thick and 1.5-lb/cu. ft. nominal density.
 - 2. Insulation not required in conditioned spaces.
- L. Exposed, round and flat-oval, outdoor-air duct insulation shall be the following:
 - 1. Mineral-Fiber Blanket: 2 inches thick and 1.5-lb/cu. ft. nominal density.
- M. Exposed, round and flat-oval, exhaust-air duct insulation shall be the following:
 - 1. Mineral-Fiber Blanket: 2 inches thick and nominal density.
 - 2. Insulation not required in conditioned spaces.
- N. Exposed, rectangular, supply-air duct insulation shall be the following:
 - 1. Mineral-Fiber Blanket: 2 inches thick and 1.5-lb/cu. ft. nominal density.
 - 2. For rectangular ducts in public spaces, use double-wall insulated duct.
- O. Exposed, rectangular, return-air duct insulation shall be the following:
 - 1. Mineral-Fiber Blanket: 2 inches thick and nominal density.
 - 2. Insulation not required in conditioned spaces.
- P. Exposed, rectangular, outdoor-air duct insulation shall be the following:
 - 1. Mineral-Fiber Blanket: 2 inches thick and 1.5-lb/cu. ft. nominal density.
- Q. Exposed, rectangular, exhaust-air duct insulation shall be the following:
 - 1. Mineral-Fiber Blanket: 2 inches thick and 1.5-lb/cu. ft. nominal density.
 - 2. Insulation not required in conditioned spaces.

- R. Exposed, return-air plenum insulation shall be the following:
 - 1. Mineral-Fiber Blanket: 2 inches thick and 1.5-lb/cu. ft. nominal density.
 - 2. Mineral-Fiber Board: 1-1/2 inches thick and 2-lb/cu. ft. nominal density.

3.17 ABOVEGROUND, OUTDOOR DUCT AND PLENUM INSULATION SCHEDULE

- A. Insulation materials and thicknesses are identified below. If more than one material is listed for a duct system, selection from materials listed is Contractor's option.
- B. Round, flat-oval, and rectangular supply-air duct insulation shall be the following:
 - 1. Flexible Elastomeric: 3 layers, each 1" thick.
- C. Round, flat-oval, and rectangular return-air duct insulation shall be the following:
 - 1. Flexible Elastomeric: 3 layers, each 1" thick.

3.18 EQUIPMENT INSULATION SCHEDULE

- A. Insulation materials and thicknesses are identified below. If more than one material is listed for a type of equipment, selection from materials listed is Contractor's option.
- B. Insulate indoor and outdoor equipment in paragraphs below that is not factory insulated.
- C. Chillers: Insulate cold surfaces on chillers, including, but not limited to, evaporator bundles, suction piping, compressor inlets, tube sheets, water boxes, and nozzles with the following:
 - 1. Flexible Elastomeric: 1 inch thick.
- D. Heat-exchanger (water-to-water for cooling service) insulation shall be the following:
 - 1. Flexible Elastomeric: 1 inch thick.
- E. Chilled-water pump insulation shall be the following:
 - 1. Cellular Glass: 3 inches thick.
 - 2. Phenolic Foam: 2 inches thick.
- F. Condenser-water pump insulation shall be the following:
 - 1. Not applicable.
- G. Domestic water pump insulation shall be the following:
 - 1. Not applicable.
- H. Heating-hot-water pump insulation shall be the following:
 - 1. Cellular Glass: 3 inches thick.
- I. Chilled-water expansion/compression tank insulation shall be the following:
 - 1. Flexible Elastomeric: 1 inch thick.
- J. Chilled-water air-separator insulation shall be the following:
 - 1. Flexible Elastomeric: 1 inch thick.
- K. Domestic hot-water storage tank insulation shall be the following:
 - 1. Mineral-Fiber Board: 4 inches thick and 2-lb/cu. ft. nominal density.

L. Thermal storage tank (brine, water, ice) insulation shall be the following:

1. Cellular Glass: 4 inches thick.

3.19 PIPING INSULATION SCHEDULE, GENERAL

A. Acceptable preformed pipe and tubular insulation materials and thicknesses are identified for each piping system and pipe size range. If more than one material is listed for a piping system, selection from materials listed is Contractor's option.

B. Items Not Insulated: Unless otherwise indicated, do not install insulation on the following:

1. Fire-suppression piping.
2. Drainage piping located in crawl spaces.
3. Below-grade piping.
4. Chrome-plated pipes and fittings unless there is a potential for personnel injury.

3.20 INDOOR PIPING INSULATION SCHEDULE

A. Domestic Cold Water:

1. Insulation shall be the following:
 - a. Mineral-Fiber Pipe Insulation, Type I: 1/2 inch thick.

B. Domestic Hot and Recirculated Hot Water:

1. Insulation shall be the following:
 - a. Mineral-Fiber Pipe Insulation, Type I: 1 inch thick.

C. Domestic Chilled Water (Potable):

1. All Pipe Sizes: Insulation shall be the following:
 - a. Mineral-Fiber Pipe Insulation, Type I: 1 inch thick.

D. Stormwater and Overflow:

1. All Pipe Sizes: Insulation shall be the following:
 - a. Mineral-Fiber Pipe Insulation, Type I: 1 inch thick.
2. Insulation required only on horizontal runs.

E. Roof Drain and Overflow Drain Bodies:

1. All Pipe Sizes: Insulation shall be the following:
 - a. Mineral-Fiber Pipe Insulation, Type I: 1 inch thick.

F. Condensate and Equipment Drain Water below 60 Deg F:

1. All Pipe Sizes: Insulation shall be the following:
 - a. Flexible Elastomeric: 3/4 inch thick.

G. Floor Drains, Traps, and Sanitary Drain Piping within 10 Feet of Drain Receiving Condensate and Equipment Drain Water below 60 Deg F:

1. All Pipe Sizes: Insulation shall be the following:
 - a. Mineral-Fiber Pipe Insulation, Type I: 1 inch thick.
- H. Chilled Water and Brine, above 40 Deg F:
1. NPS 4 DN 100 and Smaller: Insulation shall be the following:
 - a. Cellular Glass: 1-1/2 inches thick.
 - b. Phenolic Foam: 1 inch thick.
 2. NPS 6 (DN 150) to NPS 12 (DN300): Insulation shall be the following:
 - a. Cellular Glass: 2 inches thick.
 - b. Phenolic Foam: 1 ½ inches thick.
 3. NPS 14 (DN350) and Larger: Insulation shall be the following:
 - a. Cellular Glass: 2 - ½ inches thick.
 - b. Phenolic Foam: 2 inches thick.
- I. Condenser-Water Supply and Return:
1. No insulation.
- J. Heating-Hot-Water Supply and Return, 200 Deg F and below:
1. Insulation shall be the following:
 - a. Mineral-Fiber, Preformed Pipe, Type I: 2 inches thick.
- K. Refrigerant Suction and Hot-Gas Piping:
1. All Pipe Sizes: Insulation shall be the following:
 - a. Flexible Elastomeric: 3/4 inch thick.
- 3.21 OUTDOOR, ABOVEGROUND PIPING INSULATION SCHEDULE
- A. Domestic Water Piping:
1. All Pipe Sizes: Insulation shall be the following:
 - a. Mineral-Fiber Pipe Insulation, Type I: 1 inch thick.
- B. Domestic Hot and Recirculated Hot Water:
1. All Pipe Sizes: Insulation shall be the following:
 - a. Mineral-Fiber Pipe Insulation, Type I: 1 inches thick.
- C. Chilled Water and Brine:
1. All Pipe Sizes: Insulation shall be the following:
 - a. Cellular Glass: Refer to interior schedule for thickness.

- b. Phenolic Foam: Refer to interior schedule for thickness.
- D. Condenser-Water Supply and Return:
 - 1. All Pipe Sizes: Insulation not required.
- E. Heating-Hot-Water Supply and Return, 200 Deg F and below:
 - 1. All Pipe Sizes: Insulation shall be the following:
 - a. Mineral-Fiber Pipe Insulation, Type I: 1 ½ inches thick.
- F. Refrigerant Suction and Hot-Gas Piping:
 - 1. All Pipe Sizes: Insulation shall be the following:
 - a. Flexible Elastomeric: 1 inch thick.

3.22 OUTDOOR, UNDERGROUND PIPING INSULATION SCHEDULE

- A. Loose-fill insulation, for belowground piping, is specified in Division 2 piping distribution Sections.
- B. Chilled Water, All Sizes: Use pre-insulated pipe system.
- C. Condenser-Water Supply and Return, All Sizes: Insulation not required. Provide anti corrosion coating as specified in Hydronic Piping Specification.
- D. Heating-Hot-Water Supply and Return, All Sizes, 200 Deg F and below: Use pre-insulated pipe system.

3.23 INDOOR, FIELD-APPLIED JACKET SCHEDULE

- A. Install jacket over insulation material. For insulation with factory-applied jacket, install the field-applied jacket over the factory-applied jacket.
- B. If more than one material is listed, selection from materials listed is Contractor's option.
- C. Ducts and Plenums, Concealed:
 - 1. None.
- D. Ducts and Plenums, Exposed:
 - 1. None.
- E. Equipment, Concealed:
 - 1. None.
- F. Equipment, Exposed, up to 48 Inches in Diameter or with Flat Surfaces up to 72 Inches:
 - 1. None.

- G. Equipment, Exposed, Larger Than 48 Inches in Diameter or with Flat Surfaces Larger Than 72 Inches:
 - 1. None.
- H. Piping, Concealed:
 - 1. ASJ – factory.
- I. Piping, Exposed:
 - 1. PVC: 20 mils thick.

3.24 OUTDOOR, FIELD-APPLIED JACKET SCHEDULE

- A. Install jacket over insulation material. For insulation with factory-applied jacket, install the field-applied jacket over the factory-applied jacket.
- B. If more than one material is listed, selection from materials listed is Contractor's option.
- C. Ducts and Plenums, Concealed:
 - 1. Painted Aluminum, Smooth: 0.020 inch thick.
- D. Ducts and Plenums, Exposed:
 - 1. Painted Aluminum, Smooth: 0.020 inch thick.
- E. Equipment, Concealed:
 - 1. PVC: 20 mils thick.
- F. Equipment, Exposed:
 - 1. Aluminum, Smooth: 0.020 inch thick.
- G. Piping, Concealed:
 - 1. PVC: 20 mils thick.
- H. Piping, Exposed:
 - 1. Aluminum, Smooth: 0.020 inch thick.

3.25 UNDERGROUND, FIELD-INSTALLED INSULATION JACKET

- A. For underground direct-buried piping applications, install underground direct-buried jacket over insulation material.

END OF SECTION 15080

SECTION 15110 - VALVES

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 general-duty valves:

1. Bronze angle valves.
2. Cast-iron angle valves.
3. Copper-alloy ball valves.
4. Ferrous-alloy ball valves.
5. Ferrous-alloy butterfly valves.
6. Bronze check valves.
7. Gray-iron swing check valves.
8. Ferrous-alloy wafer check valves.
9. Spring-loaded, lift-disc check valves.
10. Bronze gate valves.
11. Cast-iron gate valves.
12. Bronze globe valves.
13. Cast-iron globe valves.
14. Chainwheel actuators.

- B. Related Sections include the following:

1. Division 2 piping Sections for general-duty and specialty valves for site construction piping.
2. Division 15 Section "Mechanical Identification" for valve tags and charts.
3. Division 15 piping Sections for specialty valves applicable to those Sections only.

1.3 DEFINITIONS

- A. The following are standard abbreviations for valves:

1. CWP: Cold working pressure.
2. EPDM: Ethylene-propylene-diene terpolymer rubber.
3. NBR: Acrylonitrile-butadiene rubber.
4. PTFE: Polytetrafluoroethylene plastic.
5. SWP: Steam working pressure.
6. TFE: Tetrafluoroethylene plastic.

1.4 SUBMITTALS

- A. Product Data: For each type of 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.

1.5 QUALITY ASSURANCE

- A. ASME Compliance: ASME B31.1 for power piping valves and ASME B31.9 for building services piping valves.
 - 1. Exceptions: Domestic hot- and cold-water, sanitary waste, and storm drainage piping valves unless referenced.
- B. ASME Compliance for Ferrous Valves: ASME B16.10 and ASME B16.34 for dimension and design criteria.
- C. NSF Compliance: NSF 61 for valve materials for potable-water service.

1.6 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.

PART 2 - PRODUCTS

2.1 MANUFACTURERS

- A. In other Part 2 articles where subparagraph titles below introduce lists, the following requirements apply for 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, the manufacturers specified.

2. Manufacturers: Subject to compliance with requirements, provide products by the manufacturers specified.

2.2 VALVES, GENERAL

- A. Refer to Part 3 "Valve Applications" Article for applications of valves.
- B. Bronze Valves: NPS 2 (DN 50) and smaller with threaded ends, unless otherwise indicated.
- C. Ferrous Valves: NPS 2-1/2 (DN 65) 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. Chainwheel: For attachment to valves, of size and mounting height, as indicated in the "Valve Installation" Article in Part 3.
 2. Gear Drive: For quarter-turn valves NPS 8 (DN 200) and larger.
 3. Handwheel: For valves other than quarter-turn types.
 4. Lever Handle: For quarter-turn valves NPS 6 (DN 150) 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 (454 deg C) for angle, check, gate, and globe valves; below 421 deg F (216 deg C) for ball valves.
 2. Threaded: With threads according to ASME B1.20.1.
- J. Valve Bypass and Drain Connections: MSS SP-45.

2.3 BRONZE ANGLE VALVES

- A. Manufacturers:
 1. Type 2, Bronze Angle Valves with Nonmetallic Disc:
 - a. Crane Co.
 - b. Grinnell Corporation.
 - c. Hammond Valve.
 - d. NIBCO INC.
- B. Bronze Angle Valves, General: MSS SP-80, with ferrous-alloy handwheel.
- C. Type 2, Class 150, Bronze Angle Valves: Bronze body with nonmetallic PTFE or TFE disc.

2.4 CAST-IRON ANGLE VALVES

A. Manufacturers:

1. Type II, Cast-Iron Angle Valves with Metal Seats:

- a. Crane Co.
- b. NIBCO INC.

B. Cast-Iron Angle Valves, General: MSS SP-85, Type II.

C. Class 125, Cast-Iron Angle Valves: Bronze mounted with gray-iron body and bronze seats.

2.5 COPPER-ALLOY BALL VALVES

A. Manufacturers:

1. Two-Piece, Copper-Alloy Ball Valves:

- a. Conbraco Industries, Inc.; Apollo Div.
- b. Crane Co.
- c. Grinnell Corporation.
- d. Hammond Valve.
- e. Jamesbury, Inc.
- f. Kitz Corporation of America.
- g. Legend Valve & Fitting, Inc.
- h. Milwaukee Valve Company.
- i. NIBCO INC.
- j. Red-White Valve Corp.
- k. Watts Industries, Inc.; Water Products Div.

2. Safety-Exhaust, Copper-Alloy Ball Valves:

- a. Conbraco Industries, Inc.; Apollo Div.
- b. Grinnell Corporation.
- c. Hammond Valve.
- d. Jamesbury, Inc.
- e. Milwaukee Valve Company.
- f. NIBCO INC.

B. Copper-Alloy Ball Valves, General: MSS SP-110.

C. Two-Piece, Copper-Alloy Ball Valves: Brass or bronze body with full-port, chrome-plated bronze ball; PTFE or TFE seats; and 600-psig minimum CWP rating and blowout-proof stem.

D. Safety-Exhaust, Copper-Alloy Ball Valves: Two-piece bronze body with exhaust vent opening, chrome-plated ball with vent, blowout-proof stem, locking handle, and working pressure rating of 600-psig CWP.

2.6 FERROUS-ALLOY BALL VALVES

A. Manufacturers:

1. Conbraco Industries, Inc.; Apollo Div.

2. Crane Co.
3. Hammond Valve.
4. Jamesbury, Inc.
5. Kitz Corporation of America.
6. Milwaukee Valve Company.
7. NIBCO INC.

B. Ferrous-Alloy Ball Valves, General: MSS SP-72, with flanged ends.

C. Ferrous-Alloy Ball Valves: Class 150, full port.

2.7 FERROUS-ALLOY BUTTERFLY VALVES

A. Manufacturers:

1. Single-Flange, Ferrous-Alloy Butterfly Valves:

- a. Bray International, Inc.
- b. Crane Co.
- c. Grinnell Corporation.
- d. Hammond Valve.
- e. Kitz Corporation of America.
- f. Legend Valve & Fitting, Inc.
- g. Metraflex Co.
- h. Milwaukee Valve Company.
- i. Mueller.
- j. NIBCO INC.
- k. Red-White Valve Corp.
- l. Tyco International.
- m. Watts Industries.

2. Grooved-End, Ductile-Iron Butterfly Valves:

- a. Grinnell Corporation.
- b. Hammond Valve.
- c. Milwaukee Valve Company.
- d. Mueller.
- e. NIBCO INC.
- f. Victaulic Co. of America.

B. Ferrous-Alloy Butterfly Valves, General: MSS SP-67, Type I, for tight shutoff, with disc and lining suitable for potable water, unless otherwise indicated.

C. Single-Flange, 150-psig (1035-kPa) CWP Rating, Ferrous-Alloy Butterfly Valves: Wafer-lug type with one- or two-piece stem.

D. Grooved-End, 175-psig (1207-kPa) CWP Rating, Ferrous-Alloy Butterfly Valves: Ductile-iron or steel body with grooved or shouldered ends.

2.8 BRONZE CHECK VALVES

A. Manufacturers:

1. Type 2, Bronze, Horizontal Lift Check Valves with Nonmetallic Disc:

- a. Crane Co.

2. Type 2, Bronze, Vertical Lift Check Valves with Nonmetallic Disc:
 - a. Grinnell Corporation.
 - b. Kitz Corporation of America.
 - c. Milwaukee Valve Company.
 3. Type 4, Bronze, Swing Check Valves with Nonmetallic Disc:
 - a. Crane Co.
 - b. Grinnell Corporation.
 - c. Hammond Valve.
 - d. Milwaukee Valve Company.
 - e. NIBCO INC.
 - f. Red-White Valve Corp.
 - g. Watts Industries.
- B. Bronze Check Valves, General: MSS SP-80.
- C. Type 2, Class 150, Bronze, Horizontal Lift Check Valves: Bronze body with nonmetallic disc and bronze seat.
- D. Type 2, Class 150, Bronze, Vertical Lift Check Valves: Bronze body with nonmetallic disc and bronze seat.
- E. Type 4, Class 150, Bronze, Swing Check Valves: Bronze body with nonmetallic disc and bronze seat.
- 2.9 GRAY-IRON SWING CHECK VALVES
- A. Manufacturers:
1. Type II, Gray-Iron Swing Check Valves with Composition to Metal Seats:
 - a. Crane Co.
 - b. Mueller Co.
 - c. Watts Industries.
 2. Grooved-End, Ductile-Iron Swing Check Valves:
 - a. Grinnell Corporation.
 - b. Mueller Co.
 - c. Victaulic Co. of America.
- B. Gray-Iron Swing Check Valves, General: MSS SP-71.
- C. Type II, Class 125, gray-iron, swing check valves with composition to metal seats.
- D. 175-psig (1207-kPa) CWP Rating, Grooved-End, Swing Check Valves: Ductile-iron body with grooved or shouldered ends.
- 2.10 FERROUS-ALLOY WAFER CHECK VALVES
- A. Manufacturers:

1. Dual-Plate, Ferrous-Alloy, Wafer Check Valves:
 - a. Crane Co.
 - b. Grinnell Corporation.
 - c. Metraflex Co.
 - d. Mueller.
 - e. NIBCO INC.
 - f. Red-White Valve Corp.
 - g. Watts Industries.
- B. Ferrous-Alloy Wafer Check Valves, General: API 594, spring loaded.
- C. Dual-Plate, Class 125 or 150, Ferrous-Alloy, Wafer-Lug Check Valves: Single-flange body.

2.11 SPRING-LOADED, LIFT-DISC CHECK VALVES

- A. Manufacturers:
 1. Type II, Compact-Wafer, Lift-Disc Check Valves:
 - a. Grinnell Corporation.
 - b. Hammond Valve.
 - c. Metraflex Co.
 - d. Milwaukee Valve Company.
 - e. Mueller.
 - f. NIBCO INC.
 2. Type IV, Threaded Lift-Disc Check Valves:
 - a. Grinnell Corporation.
 - b. Legend Valve & Fitting, Inc.
 - c. Metraflex Co.
 - d. Milwaukee Valve Company.
 - e. Mueller.
 - f. NIBCO INC.
 - g. Watts Industries.
- B. Lift-Disc Check Valves, General: FCI 74-1, with spring-loaded bronze or alloy disc and bronze or alloy seat.
- C. 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.
- D. Type IV, Class 150, Threaded Lift-Disc Check Valves: Threaded style with bronze shell and threaded ends.

2.12 BRONZE GATE VALVES

- A. Manufacturers:
 1. Type 2, Bronze, Rising-Stem, Solid-Wedge Gate Valves:
 - a. Crane Co.
 - b. Grinnell Corporation.
 - c. Hammond Valve.
 - d. Kitz Corporation of America.

- e. Milwaukee Valve Company.
- f. NIBCO INC.
- g. Red-White Valve Corp.

- B. Bronze Gate Valves, General: MSS SP-80, with ferrous-alloy handwheel.
- C. Type 2, Class 150, Bronze Gate Valves: Bronze body with rising stem and bronze solid wedge.

2.13 CAST-IRON GATE VALVES

A. Manufacturers:

- 1. Type I, Cast-Iron, Nonrising-Stem Gate Valves:
 - a. Crane Co.
 - b. Grinnell Corporation.
 - c. Hammond Valve.
 - d. Kitz Corporation of America.
 - e. Legend Valve & Fitting, Inc.
 - f. Milwaukee Valve Company.
 - g. NIBCO INC.
 - h. Red-White Valve Corp.
 - i. Watts Industries.

- B. Cast-Iron Gate Valves, General: MSS SP-70, Type I.
- C. Class 125, NRS, Bronze-Mounted, Cast-Iron Gate Valves: Cast-iron body with bronze trim, nonrising stem, and solid-wedge disc.

2.14 BRONZE GLOBE VALVES

A. Manufacturers:

- 1. Type 1, Bronze Globe Valves with Metal Disc:
 - a. Crane Co.
 - b. Grinnell Corporation.
 - c. Hammond Valve.
 - d. Kitz Corporation of America.
 - e. Legend Valve & Fitting, Inc.
 - f. Milwaukee Valve Company.
 - g. NIBCO INC.
 - h. Red-White Valve Corp.
- 2. Type 2, Bronze Globe Valves with Nonmetallic Disc:
 - a. Crane Co.
 - b. Grinnell Corporation.
 - c. Hammond Valve.
 - d. Kitz Corporation of America.
 - e. Milwaukee Valve Company.
 - f. NIBCO INC.
 - g. Red-White Valve Corp.

- B. Bronze Globe Valves, General: MSS SP-80, with ferrous-alloy handwheel.

- C. Type 1, Class 125, Bronze Globe Valves: Bronze body with bronze disc.
- D. Type 2, Class 150, Bronze Globe Valves: Bronze body with nonmetallic PTFE or TFE disc.

2.15 CAST-IRON GLOBE VALVES

A. Manufacturers:

- 1. Type I, Cast-Iron Globe Valves with Metal Seats:
 - a. Crane Co.
 - b. Grinnell Corporation.
 - c. Hammond Valve.
 - d. Kitz Corporation of America.
 - e. Milwaukee Valve Company.
 - f. NIBCO INC.
 - g. Red-White Valve Corp.

B. Cast-Iron Globe Valves, General: MSS SP-85.

C. Type I, Class 125, Cast-Iron Globe Valves: Gray-iron body with bronze seats.

2.16 CHAINWHEEL ACTUATORS

A. Manufacturers:

- 1. Babbitt Steam Specialty Co.
- 2. Roto Hammer Industries, Inc.

B. Description: Valve actuation assembly with sprocket rim, brackets, and chain.

- 1. Sprocket Rim with Chain Guides: Ductile iron, of type and size required for valve. Include zinc coating on exterior applications.
- 2. Brackets: Type, number, size, and fasteners required to mount actuator on valve.
- 3. Chain: Hot-dip, galvanized steel, of size required to fit sprocket rim.

PART 3 - EXECUTION

3.1 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.

3.2 VALVE APPLICATIONS

- A. Refer to piping Sections for specific valve applications. If valve applications are not indicated, use the following:
 1. Shutoff Service: Ball, butterfly, gate, or plug valves.
 2. Throttling Service: Angle, ball, butterfly, or globe valves.
 3. Pump Discharge: Spring-loaded, lift-disc check valves.
- B. If valves with specified SWP classes or CWP ratings are not available, the same types of valves with higher SWP class or CWP ratings may be substituted.
- C. Chilled-Water Piping: Use the following types of valves:
 1. Angle Valves, NPS 2 (DN 50) and Smaller: Type 2, Class 150, bronze.
 2. Angle Valves, NPS 2-1/2 (DN 65) and Larger: Type II, Class 125, cast iron.
 3. Ball Valves, NPS 2 (DN 50) and Smaller: Two-piece, 600-psig (4140-kPa) CWP rating, copper alloy.
 4. Ball Valves, NPS 2-1/2 (DN 65) and Larger: Class 150, ferrous alloy.
 5. Butterfly Valves, NPS 2-1/2 (DN 65) and Larger: Single-flange, 150-psig (1035-kPa) CWP rating, ferrous alloy, with Buta-N liner.
 6. Grooved-End, Ductile-Iron Butterfly Valves, NPS 2-1/2 (DN 65) and Larger: 300-psig (2070-kPa) CWP rating.
 7. Lift Check Valves, NPS 2 (DN 50) and Smaller: Type 2, Class 150, horizontal or vertical, bronze.
 8. Swing Check Valves, NPS 2 (DN 50) and Smaller: Type 4, Class 150, bronze.
 9. Swing Check Valves, NPS 2-1/2 (DN 65) and Larger: Type II, Class 125, gray iron.
 10. Grooved-End, Ductile-Iron, Swing Check Valves, NPS 2-1/2 (DN 65) and Larger: 175-psig (1207-kPa) CWP rating.
 11. Wafer Check Valves, NPS 2-1/2 (DN 65) and Larger: Dual-plate, wafer, Class 125 or 150 ferrous alloy.
 12. Spring-Loaded, Lift-Disc Check Valves, NPS 2 (DN 50) and Smaller: Type IV, Class 150.
 13. Spring-Loaded, Lift-Disc Check Valves, NPS 2-1/2 (DN 65) and Larger: Type II, Class 125, cast iron.
 14. Gate Valves, NPS 2 (DN 50) and Smaller: Type 2, Class 150, bronze.
 15. Gate Valves, NPS 2-1/2 (DN 65) and Larger: Type I, Class 125, NRS, bronze-mounted cast iron.
 16. Globe Valves, NPS 2 (DN 50) and Smaller: Type 2, Class 150, bronze.
 17. Globe Valves, NPS 2-1/2 (DN 65) and Larger: Type I, Class 125, bronze-mounted cast iron.
- D. Condenser Water Piping: Use the following types of valves:
 1. Ball Valves, NPS 2 and Smaller: Two-piece, 600-psig CWP rating, copper alloy.
 2. Ball Valves, NPS 2-1/2 and Larger: Class 150, ferrous alloy.

3. Butterfly Valves, NPS 2-1/2 and Larger: Single-flange, 150-psig CWP rating, ferrous alloy, with Buta-N liner.
 4. Grooved-End, Ductile-Iron Butterfly Valves, NPS 2-1/2 and Larger: 300-psig CWP rating.
 5. Lift Check Valves, NPS 2 and Smaller: Type 2, Class 150, horizontal or vertical, bronze.
 6. Swing Check Valves, NPS 2 and Smaller: Type 4, Class 150, bronze.
 7. Swing Check Valves, NPS 2-1/2 and Larger: Type II, Class 125, gray iron.
 8. Grooved-End, Ductile-Iron, Swing Check Valves, NPS 2-1/2 and Larger: 175-psig CWP rating.
 9. Wafer Check Valves, NPS 2-1/2 and Larger: Dual-plate, wafer, Class 125 or 150, ferrous alloy.
 10. Spring-Loaded, Lift-Disc Check Valves, NPS 2 and Smaller: Type IV, Class 150.
 11. Spring-Loaded, Lift-Disc Check Valves, NPS 2-1/2 and Larger: Type II, Class 125, cast iron.
 12. Gate Valves, NPS 2 and Smaller: Type 2, Class 150, bronze.
 13. Gate Valves, NPS 2-1/2 and Larger: Type I, Class 125, NRS, bronze-mounted cast iron.
 14. Globe Valves, NPS 2 and Smaller: Type 2, Class 150, bronze.
 15. Globe Valves, NPS 2-1/2 and Larger: Type I, Class 125, bronze-mounted cast iron.
- E. Domestic Water Piping: Use the following types of valves:
1. Angle Valves, NPS 2 and Smaller: Type 2, Class 150, bronze.
 2. Angle Valves, NPS 2-1/2 and Larger: Type II, Class 125, cast iron.
 3. Ball Valves, NPS 2 and Smaller: Two-piece, 600-psig CWP rating, copper alloy.
 4. Ball Valves, NPS 2-1/2 and Larger: Class 150, ferrous alloy.
 5. Butterfly Valves, NPS 2-1/2 and Larger: Single-flange, 150-psig CWP rating, ferrous alloy, with EPDM liner.
 6. Grooved-End, Ductile-Iron Butterfly Valves, NPS 2-1/2 and Larger: 300-psig CWP rating.
 7. Lift Check Valves, NPS 2 and Smaller: Type 2, Class 150, horizontal or vertical, bronze.
 8. Swing Check Valves, NPS 2 and Smaller: Type 4, Class 125, bronze.
 9. Swing Check Valves, NPS 2-1/2 and Larger: Type II, Class 125, gray iron.
 10. Grooved-End, Ductile-Iron, Swing Check Valves, NPS 2-1/2 and Larger: 175-psig CWP rating.
 11. Wafer Check Valves, NPS 2-1/2 and Larger: Dual-plate, wafer, Class 125 or 150, ferrous alloy.
 12. Spring-Loaded, Lift-Disc Check Valves, NPS 2 and Smaller: Type IV, Class 150.
 13. Spring-Loaded, Lift-Disc Check Valves, NPS 2-1/2 and Larger: Type II, Class 125, cast iron.
 14. Gate Valves, NPS 2 and Smaller: Type 2, Class 150, bronze.
 15. Gate Valves, NPS 2-1/2 and Larger: Type I, Class 125, NRS, bronze-mounted cast iron.
 16. Globe Valves, NPS 2 and Smaller: Type 2, Class 150, bronze.
 17. Globe Valves, NPS 2-1/2 and Larger: Type I, Class 125, bronze-mounted cast iron.
- F. Heating Water Piping: Use the following types of valves:
1. Angle Valves, NPS 2 and Smaller: Type 2, Class 150, bronze.
 2. Angle Valves, NPS 2-1/2 and Larger: Type II, Class 125, cast iron.
 3. Ball Valves, NPS 2 and Smaller: Two-piece, 600-psig CWP rating, copper alloy.
 4. Ball Valves, NPS 2-1/2 and Larger: Class 150, ferrous alloy.
 5. Butterfly Valves, NPS 2-1/2 and Larger: Single-flange, 150-psig CWP rating, ferrous alloy, with EPDM liner.
 6. Grooved-End, Ductile-Iron Butterfly Valves, NPS 2-1/2 and Larger: 300-psig CWP rating.
 7. Lift Check Valves, NPS 2 and Smaller: Type 2, Class 150, horizontal vertical, bronze.
 8. Swing Check Valves, NPS 2 and Smaller: Type 4, Class 150, bronze.
 9. Swing Check Valves, NPS 2-1/2 and Larger: Type II, Class 125, gray iron.
 10. Grooved-End, Ductile-Iron, Swing Check Valves, NPS 2-1/2 and Larger: 175-psig CWP rating.

11. Wafer Check Valves, NPS 2-1/2 and Larger: Dual-plate, wafer, Class 125 or 150, ferrous alloy.
12. Spring-Loaded, Lift-Disc Check Valves, NPS 2 and Smaller: Type IV, Class 150.
13. Spring-Loaded, Lift-Disc Check Valves, NPS 2-1/2 and Larger: Type II, Class 125, cast iron.
14. Gate Valves, NPS 2 and Smaller: Type 2, Class 150, bronze.
15. Gate Valves, NPS 2-1/2 and Larger: Type I, Class 125, NRS, bronze-mounted cast iron.
16. Globe Valves, NPS 2 and Smaller: Type 2, Class 150, bronze.
17. Globe Valves, NPS 2-1/2 and Larger: Type I, Class 125, bronze-mounted cast iron.

G. Sanitary Waste and Storm Drainage Piping: Use the following types of valves:

1. Ball Valves, NPS 2 and Smaller: Two-piece, 600-psig CWP rating, copper alloy.
2. Ball Valves, NPS 2-1/2 and Larger: Class 150, ferrous alloy.
3. Swing Check Valves, NPS 2 and Smaller: Type 4, Class 150, bronze.
4. Swing Check Valves, NPS 2-1/2 and Larger: Type I or II, Class 125, gray iron.
5. Grooved-End, Ductile-Iron, Swing Check Valves, NPS 2-1/2 and Larger: 175-psig minimum CWP rating.
6. Gate Valves, NPS 2 and Smaller: Type 2, Class 150, bronze.
7. Gate Valves, NPS 2-1/2 and Larger: Type I, Class 125, NRS, bronze-mounted cast iron.
8. Globe Valves, NPS 2 and Smaller: Type 2, Class 150, bronze.
9. Globe Valves, NPS 2-1/2 and Larger: Type I, Class 125, cast iron.

H. 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.
2. For Copper Tubing, NPS 2-1/2 (DN65) and larger: Flanged ends.
3. For Steel Piping, NPS 2 and Smaller: Threaded ends.
4. For Steel Piping, NPS 2-1/2 (DN65) and larger: Flanged ends.
5. For Grooved-End, Copper Tubing and Steel Piping: Valve ends may be grooved. Do not use for steam or steam condensate piping.

3.3 VALVE INSTALLATION

- A. Piping installation requirements are specified in other Division 15 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 chainwheel operators on valves and larger and more than 96 inches above floor. Extend chains to 60 inches above finished floor elevation.
- G. 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.

3.4 JOINT CONSTRUCTION

- A. Refer to Division 15 Section "Basic Mechanical Materials and Methods" for basic piping joint construction.
- B. Grooved Joints: Assemble joints with keyed coupling housing, gasket, lubricant, and bolts according to coupling and fitting manufacturer's written instructions.
- C. 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.

3.5 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.

END OF SECTION 15110

SECTION 15140 - DOMESTIC WATER 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.

1.2 SUMMARY

- A. This Section includes domestic water piping inside the building.
- B. Water meters will be furnished and installed by utility company.
- C. Related Sections include the following:
 - 1. Division 2 Section "Water Distribution" for water-service piping outside the building from source to the point where water-service piping enters the building.
 - 2. Division 15 Section "Plumbing Specialties" for water distribution piping specialties.

1.3 PERFORMANCE REQUIREMENTS

- A. Provide components and installation capable of producing domestic water piping systems with 80 psig, unless otherwise indicated.

1.4 SUBMITTALS

- A. Product Data: For pipe, tube, fittings, and couplings.
- B. Water Samples: Specified in Part 3 "Cleaning" Article.
- C. Field quality-control test reports.

1.5 QUALITY ASSURANCE

- A. Piping materials shall bear label, stamp, or other markings of specified testing agency.
- B. 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 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.

2.2 STEEL PIPE AND FITTINGS

- A. Steel Pipe: ASTM A 53/A 53M, Type E or S, Grade B, Schedule 40, galvanized. Include ends matching joining method.
1. Steel Pipe Nipples: ASTM A 733, made of ASTM A 53/A 53M 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. Gray-Iron, Threaded Fittings: ASME B16.4, Class 125, galvanized, standard pattern.
 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/A 47M, galvanized, malleable-iron casting; ASTM A 106, galvanized steel pipe; or ASTM A 536, galvanized, ductile-iron casting; with dimensions matching steel pipe.
 - a. Grooved-End-Pipe Couplings: AWWA C606, for steel-pipe dimensions. Include ferrous housing sections, gasket suitable for water, and bolts and nuts.
 7. Steel-Piping, Expansion Joints: Compound, galvanized steel fitting with telescoping body and slip-pipe section. Include packing rings, packing, limit rods, chrome-plated finish on slip-pipe sections, and flanged ends.
 8. Steel-Piping, Double Expansion Joints: Compound, galvanized steel fitting with telescoping body and two slip-pipe sections. Include packing rings, packing, limit rods, chrome-plated finish on slip-pipe sections, and flanged ends.

2.3 COPPER TUBE AND FITTINGS

- A. Soft Copper Tube: ASTM B 88, Type K (ASTM B 88M, Type A), 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 (ASTM B 88M, Type B), 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 (ASTM B 75M) 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.

2.4 PVC PIPE AND FITTINGS

- A. PVC Schedule 40 Pipe: ASTM D1785.
 - 1. PVC Schedule 40 Fittings: ASTM D2466, socket type.

2.5 VALVES

- A. Bronze and cast-iron, general-duty valves are specified in Division 15 Section "Valves."
- B. Balancing and drain valves are specified in Division 15 Section "Plumbing Specialties."

PART 3 - EXECUTION**3.1 EXCAVATION**

- A. Excavating, trenching, and backfilling are specified in Division 2 Section "Earthwork."

3.2 PIPE AND FITTING APPLICATIONS

- A. Transition and special fittings with pressure ratings at least equal to piping rating may be used in applications below, unless otherwise indicated.
- B. Flanges may be used on aboveground piping, unless otherwise indicated.
- C. Grooved joints may be used on aboveground grooved-end piping.
- D. Fitting Option: Extruded-tee connections and brazed joints may be used on aboveground copper tubing.
- E. Underground, Water-Service Piping on Service Side of Water Meter: Refer to Division 2 Section "Water Distribution."
- F. Underground, water-service piping on house side of water meter. Use any of the following piping materials:
 - 1. PVC Schedule 40 Pipe: ASTM D1785.
 - a. PVC Schedule 40 Fittings: ASTM D2466, socket type.
 - 2. Soft copper tube, type K (type A); copper pressure fittings; and soldered joints.
- G. Under-Building-Slab, Domestic Water Piping on House Side of Water Meter, NPS 4 (DN 100) and Smaller: Soft copper tube, Type K (Type A); copper pressure fittings; and soldered joints.
- H. Aboveground Domestic Water Piping: Use any of the following piping materials for each size range:
 - 1. NPS 3 (DN 80) and Smaller: Hard copper tube, Type L (Type B); copper pressure fittings; and soldered joints.
 - 2. NPS 4 to NPS 6 (DN 100 to DN 150): Hard copper tube, Type L (Type B); copper pressure fittings; and soldered joints.
 - 3. NPS 4 to NPS 8 (DN 100 to DN 200): Hard copper tube, Type L (Type B) with grooved ends; copper grooved-end fittings; grooved-end-tube couplings; and grooved joints.
 - 4. NPS 8 to NPS 12 (DN 200 to DN 300): Steel pipe; gray-iron, threaded fittings; and threaded joints.

5. NPS 8 to NPS 12 (DN 200 to DN 300): Steel pipe with grooved ends; steel-piping, grooved-end fittings; grooved-end-pipe couplings; and grooved joints.

3.3 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 bronze ball or gate valves for piping NPS 2 (DN 50) and smaller. Use cast-iron butterfly or gate valves with flanged ends for piping NPS 2-1/2 (DN 65) and larger.
 2. Throttling Duty: Use bronze ball or globe valves for piping NPS 2 (DN 50) and smaller. Use cast-iron butterfly valves with flanged ends for piping NPS 2-1/2 (DN 65) and larger.
 3. Hot-Water-Piping, Balancing Duty: Memory-stop balancing valves.
 4. 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 (DN 50) and smaller. Use butterfly or gate valves for piping NPS 2-1/2 (DN 65) 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 calibrated balancing valves in each hot-water circulation return branch and discharge side of each pump and circulator. Set calibrated balancing valves partly open to restrict but not stop flow. Calibrated balancing valves are specified in Division 15 Section "Plumbing Specialties."

3.4 PIPING INSTALLATION

- A. Basic piping installation requirements are specified in Division 15 Section "Basic Mechanical Materials and Methods."
- B. Install under-building-slab copper tubing according to CDA's "Copper Tube Handbook."
- C. Install cast-iron sleeve with water stop and mechanical sleeve seal at each service pipe penetration through foundation wall. Select number of interlocking rubber links required to make installation watertight. Sleeves and mechanical sleeve seals are specified in Division 15 Section "Basic Mechanical Materials and Methods."
- D. Install shutoff valve, hose-end drain valve, strainer, pressure gage, and test tee with valve, inside the building at each domestic water service entrance.
- E. Install water-pressure regulators downstream from shutoff valves. Water-pressure regulators are specified in Division 15 Section "Plumbing Specialties."
- F. Install domestic water piping level and plumb.

- G. Rough-in domestic water piping for water-meter installation according to utility company's requirements.

3.5 JOINT CONSTRUCTION

- A. Basic piping joint construction requirements are specified in Division 15 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. Extruded-Tee Connections: Form tee in copper tube according to ASTM F 2014. Use tool designed for copper tube; drill pilot hole, form collar for outlet, dimple tube to form seating stop, and braze branch tube into collar.

3.6 HANGER AND SUPPORT INSTALLATION

- A. Pipe hanger and support devices are specified in Division 15 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 (30 m) and Less: MSS Type 1, adjustable, steel clevis hangers.
 - b. Longer Than 100 Feet (30 m): MSS Type 43, adjustable roller hangers.
 - c. Longer Than 100 Feet (30 m): MSS Type 49, spring cushion rolls, if indicated.
 3. Multiple, Straight, Horizontal Piping Runs 100 Feet (30 m) or Longer: MSS Type 44, pipe rolls. Support pipe rolls on trapeze.
 4. Base of Vertical Piping: MSS Type 52, spring hangers.
- B. Install supports according to Division 15 Section "Hangers and Supports."
- C. Support vertical piping and tubing at base and at each floor.
- D. Rod diameter may be reduced 1 size for double-rod hangers, to a minimum of 3/8 inch (10 mm).
- E. Install hangers for steel piping with the following maximum horizontal spacing and minimum rod diameters:
 1. NPS 4 and NPS 5 (DN 100 and DN 125): 12 feet (3.7 m) with 5/8-inch (16-mm) rod.
 2. NPS 6 (DN 150): 12 feet (3.7 m) with 3/4-inch (19-mm) rod.
 3. NPS 8 to NPS 12 (DN 200 to DN 300): 12 feet (3.7 m) with 7/8-inch (22-mm) rod.
- F. Install supports for vertical steel piping every 15 feet (4.5 m).
- G. Install hangers for copper tubing with the following maximum horizontal spacing and minimum rod diameters:
 1. NPS 3/4 (DN 20) and Smaller: 60 inches (1500 mm) with 3/8-inch (10-mm) rod.
 2. NPS 1 and NPS 1-1/4 (DN 25 and DN 32): 72 inches (1800 mm) with 3/8-inch (10-mm) rod.
 3. NPS 1-1/2 and NPS 2 (DN 40 and DN 50): 96 inches (2400 mm) with 3/8-inch (10-mm) rod.
 4. NPS 2-1/2 (DN 65): 108 inches (2700 mm) with 1/2-inch (13-mm) rod.

5. NPS 3 to NPS 5 (DN 80 to DN 125): 10 feet (3 m) with 1/2-inch (13-mm) rod.
 6. NPS 6 (DN 150): 10 feet (3 m) with 5/8-inch (16-mm) rod.
 7. NPS 8 (DN 200): 10 feet (3 m) with 3/4-inch (19-mm) rod.
- H. Install supports for vertical copper tubing every 10 feet (3 m).
- I. Support piping and tubing not listed above according to MSS SP-69 and manufacturer's written instructions.

3.7 CONNECTIONS

- A. Drawings indicate general arrangement of piping, fittings, and specialties.
- B. 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 water-service piping with shutoff valve, and extend and connect to the following:
1. Booster Pumps: Cold-water suction and discharge piping.
 2. Water Heaters: Cold-water supply and hot-water outlet piping in sizes indicated, but not smaller than sizes of water heater connections.
 3. Plumbing Fixtures: Cold- and hot-water supply piping in sizes indicated, but not smaller than required by plumbing code. Refer to Division 15 Section "Plumbing Fixtures."
 4. Equipment: Cold- and hot-water supply piping as indicated, but not smaller than equipment connections. Provide shutoff valve and union for each connection. Use flanges instead of unions for NPS 2-1/2 (DN 65) and larger.

3.8 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 (345 kPa) 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.

3.9 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.

3.10 CLEANING

- A. Clean and disinfect 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 (50 mg/L) 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 (200 mg/L) 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.
- B. Prepare and submit reports of purging and disinfecting activities.
- C. Clean interior of domestic water piping system. Remove dirt and debris as work progresses.

END OF SECTION 15140

SECTION 15150 - SANITARY WASTE AND VENT 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.

1.2 SUMMARY

- A. This Section includes the following for soil, waste, and vent piping inside the building:
 - 1. Pipe, tube, and fittings.
 - 2. Special pipe fittings.
 - 3. Encasement for underground metal piping.
- B. Related Sections include the following:
 - 1. Division 15 Section "Chemical-Waste Piping" for chemical-waste and vent piping systems.

1.3 DEFINITIONS

- A. EPDM: Ethylene-propylene-diene terpolymer rubber.
- B. PE: Polyethylene plastic.
- C. PVC: Polyvinyl chloride plastic.

1.4 PERFORMANCE REQUIREMENTS

- A. Components and installation shall be capable of withstanding the following minimum working pressure, unless otherwise indicated:
 - 1. Soil, Waste, and Vent Piping: 10-foot head of water.

1.5 SUBMITTALS

- A. Product Data: For pipe, tube, fittings, and couplings.
- B. Shop Drawings:
 - 1. Solvent Drainage System: Include plans, elevations, sections, and details.
- C. Field quality-control inspection and test reports.

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 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.

PART 2 - PRODUCTS

2.1 PIPING MATERIALS

- A. Refer to Part 3 "Piping Applications" Article for applications of pipe, tube, fitting, and joining materials.

2.2 HUB-AND-SPIGOT, CAST-IRON SOIL PIPE AND FITTINGS

- A. Pipe and Fittings: ASTM A 74, Service class.
- B. Gaskets: ASTM C 564, rubber.
- C. Lead and Oakum: ASTM B 29, pure lead and oakum or hemp fiber.

2.3 HUBLESS CAST-IRON SOIL PIPE AND FITTINGS

- A. Pipe and Fittings: ASTM A 888 or CISPI 301.
- B. Shielded Couplings: ASTM C 1277 assembly of metal shield or housing, corrosion-resistant fasteners, and rubber sleeve with integral, center pipe stop.
 - 1. Standard, Shielded, Stainless-Steel Couplings: CISPI 310, with stainless-steel corrugated shield; stainless-steel bands and tightening devices; and ASTM C 564, rubber sleeve.
 - 2. Heavy-Duty, Shielded, Stainless-Steel Couplings: With stainless-steel shield, stainless-steel bands and tightening devices, and ASTM C 564, rubber sleeve.
- C. Rigid, Unshielded Couplings: ASTM C 1461, sleeve-type, reducing- or transition-type mechanical coupling molded from ASTM C 1440, TPE material with corrosion-resistant-metal tension band and tightening mechanism on each end.

2.4 PVC PIPE AND FITTINGS

- A. Solid-Wall PVC Pipe: ASTM D 2665, drain, waste, and vent.
 - 1. PVC Socket Fittings: ASTM D 2665, socket type, made to ASTM D 3311, drain, waste, and vent patterns.

2.5 SPECIAL PIPE FITTINGS

- A. Sovent Drainage System Fittings: ASME B16.45 or ASSE 1043, cast-iron aerator and deaerator fittings.
- B. Flexible, Nonpressure Pipe Couplings: Comply with ASTM C 1173, elastomeric, sleeve-type, reducing or transition pattern. Include shear ring, ends of same sizes as piping to be joined, and corrosion-resistant-metal tension band and tightening mechanism on each end.
 - 1. Sleeve Materials:
 - a. For Cast-Iron Soil Pipes: ASTM C 564, rubber.
 - b. For Plastic Pipes: ASTM F 477, elastomeric seal or ASTM D 5926, PVC.
 - c. For Dissimilar Pipes: ASTM D 5926, PVC or other material compatible with pipe materials being joined.
- C. Shielded Nonpressure Pipe Couplings: ASTM C 1460, elastomeric or rubber sleeve with full-length, corrosion-resistant outer shield and corrosion-resistant-metal tension band and tightening mechanism on each end.
- D. Expansion Joints: Two or three-piece, ductile-iron assembly consisting of telescoping sleeve(s) with gaskets and restrained-type, ductile-iron, bell-and-spigot end sections complying with AWWA C110 or AWWA C153. Select and assemble components for expansion indicated. Include AWWA C111, ductile-iron glands, rubber gaskets, and steel bolts.
- E. Wall-Penetration Fittings: Compound, ductile-iron coupling fitting with sleeve and flexing sections for up to 20-degree deflection, gaskets, and restrained-joint ends complying with AWWA C110 or AWWA C153. Include AWWA C111, ductile-iron glands, rubber gaskets, and steel bolts.
- F. Tubular Fittings: ASTM F 409, PVC drainage-pattern tube and tubular fittings with ends as required for application.

2.6 ENCASUREMENT FOR UNDERGROUND METAL PIPING

- A. Description: ASTM A 674 or AWWA C105, high-density, crosslaminated PE film of 0.004-inch (0.10-mm) minimum thickness.
- B. Form: tube.
- C. Color: Black.

PART 3 - EXECUTION**3.1 EXCAVATION**

- A. Refer to Division 2 Section "Earthwork" for excavating, trenching, and backfilling.

3.2 PIPING APPLICATIONS

- A. Flanges and unions may be used on aboveground pressure piping, unless otherwise indicated.

SECTION 15150 - SANITARY WASTE AND VENT PIPING

- B. Piping installed in building plenums shall meet requirements of materials within ducts or plenums (ceiling spaces used as supply or return air plenums) and shall have a flame-spread index of not more than 25 and a smoke-developed rating of not more than 50 when tested in accordance with the test for Surface Burning Characteristics of Materials.
- C. Aboveground, soil and waste piping NPS 4 (DN 100) and smaller shall be any of the following:
 - 1. Service class, cast-iron soil pipe and fittings; gaskets; and compression joints.
 - 2. Hubless cast-iron soil pipe and fittings; standard, shielded, stainless-steel couplings; and hubless-coupling joints.
 - 3. Solid-wall PVC pipe, PVC socket fittings, and solvent-cemented joints.
- D. Aboveground, soil and waste piping NPS 5 (DN 125) and larger shall be any of the following:
 - 1. Service class, cast-iron soil pipe and fittings; gaskets; and compression joints.
 - 2. Hubless cast-iron soil pipe and fittings; standard, shielded, stainless-steel couplings; and hubless-coupling joints.
 - 3. Solid-wall PVC pipe, PVC socket fittings, and solvent-cemented joints.
- E. Aboveground, vent piping all sizes shall be any of the following:
 - 1. Service class, cast-iron soil pipe and fittings; gaskets; and compression joints.
 - 2. Hubless cast-iron soil pipe and fittings; standard, shielded, stainless-steel couplings; and hubless-coupling joints.
 - 3. Solid-wall PVC pipe, PVC socket fittings, and solvent-cemented joints.
- F. Above and belowground, solvent drainage system with soil, waste, and vent piping materials indicated.
- G. Underground, soil, waste, and vent piping all sizes shall be any of the following:
 - 1. Service class, cast-iron soil piping; gaskets; and gasketed joints.
 - 2. Hubless cast-iron soil pipe and fittings; heavy-duty shielded, cast-iron couplings; and hubless-coupling joints.
 - 3. Solid wall PVC pipe, PVC socket fittings, and solvent-cemented joints.

3.3 PIPING INSTALLATION

- A. Sanitary sewer piping outside the building is specified in Division 2 Section "Sanitary Sewerage."
- B. Basic piping installation requirements are specified in Division 15 Section "Basic Mechanical Materials and Methods."
- C. Install cleanouts at grade and extend to where building sanitary drains connect to building sanitary sewers.
- D. Install cast-iron sleeve with water stop and mechanical sleeve seal at each service pipe penetration through foundation wall. Select number of interlocking rubber links required to make installation watertight. Sleeves and mechanical sleeve seals are specified in Division 15 Section "Basic Mechanical Materials and Methods."
- E. 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."

SECTION 15150 - SANITARY WASTE AND VENT PIPING

1. Install encasement on underground piping according to ASTM A 674 or AWWA C105.
- F. Make changes in direction for soil and waste drainage and vent piping using appropriate branches, bends, and long-sweep bends. Sanitary tees and short-sweep 1/4 bends may be used on vertical stacks if change in direction of flow is from horizontal to vertical. Use long-turn, double Y-branch and 1/8-bend fittings if 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.
- G. Lay buried building drainage piping beginning at low point of each system. Install true to grades and alignment indicated, with unbroken continuity of invert. Place hub ends of piping upstream. Install required gaskets according to manufacturer's written instructions for use of lubricants, cements, and other installation requirements. Maintain swab in piping and pull past each joint as completed.
- H. Install soil and waste drainage and vent piping at the following minimum slopes, unless otherwise indicated:
 1. Building Sanitary Drain: 2 percent downward in direction of flow for piping NPS 3 (DN 80) and smaller; 1 percent downward in direction of flow for piping NPS 4 (DN 100) and larger.
 2. Horizontal Sanitary Drainage Piping: 2 percent downward in direction of flow.
 3. Vent Piping: 1 percent down toward vertical fixture vent or toward vent stack.
- I. Install engineered soil and waste drainage and vent piping systems as follows:
 1. Combination Waste and Vent: Comply with standards of authorities having jurisdiction.
 2. Solvent Drainage System: Comply with ASSE 1043 and solvent fitting manufacturer's written installation instructions.
 3. Reduced-Size Venting: Comply with standards of authorities having jurisdiction.
- J. Sleeves are not required for cast-iron soil piping passing through concrete slabs-on-grade if slab is without membrane waterproofing.
- K. Install PVC soil and waste drainage and vent piping according to ASTM D 2665.
- L. Install underground PVC soil and waste drainage piping according to ASTM D 2321.
- M. 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 15 Section "Basic Mechanical Materials and Methods."
- B. Join hub-and-spigot, cast-iron soil piping with gasket joints according to CISPI's "Cast Iron Soil Pipe and Fittings Handbook" for compression joints.
- C. Join hub-and-spigot, cast-iron soil piping with calked joints according to CISPI's "Cast Iron Soil Pipe and Fittings Handbook" for lead and oakum calked joints.

SECTION 15150 - SANITARY WASTE AND VENT PIPING

- D. Join hubless cast-iron soil piping according to CISPI 310 and CISPI's "Cast Iron Soil Pipe and Fittings Handbook" for hubless-coupling joints.
- E. Grooved Joints: Assemble joint with keyed coupling, gasket, lubricant, and bolts according to coupling and fitting manufacturer's written instructions.
- F. PVC Nonpressure Piping Joints: Join piping according to ASTM D 2665.

3.5 VALVE INSTALLATION

- A. General valve installation requirements are specified in Division 15 Section "Valves."
- B. Backwater Valves: Install backwater valves in piping subject to sewage backflow.
 - 1. Horizontal Piping: Horizontal backwater valves.
 - 2. Floor Drains: Drain outlet backwater valves, unless drain has integral backwater valve.
 - 3. Install backwater valves in accessible locations.
 - 4. Backwater valve are specified in Division 15 Section "Plumbing Specialties."

3.6 HANGER AND SUPPORT INSTALLATION

- A. Pipe hangers and supports are specified in Division 15 Section "Hangers and Supports." Install the following:
 - 1. Vertical Piping: MSS Type 8 or Type 42, clamps.
 - 2. Install individual, straight, horizontal piping runs according to the following:
 - a. 100 Feet (30 m) and Less: MSS Type 1, adjustable, steel clevis hangers.
 - b. Longer Than 100 Feet (30 m): MSS Type 43, adjustable roller hangers.
 - c. Longer Than 100 Feet (30 m), if Indicated: MSS Type 49, spring cushion rolls.
 - 3. Multiple, Straight, Horizontal Piping Runs 100 Feet (30 m) or Longer: MSS Type 44, pipe rolls. Support pipe rolls on trapeze.
 - 4. Base of Vertical Piping: MSS Type 52, spring hangers.
- B. Install supports according to Division 15 Section "Hangers and Supports."
- C. Support vertical piping and tubing at base and at each floor.
- D. Rod diameter may be reduced 1 size for double-rod hangers, with 3/8-inch (10-mm) minimum rods.
- E. Install hangers for cast-iron soil piping with the following maximum horizontal spacing and minimum rod diameters:
 - 1. NPS 1-1/2 and NPS 2 (DN 40 and DN 50): 60 inches (1500 mm) with 3/8-inch (10-mm) rod.
 - 2. NPS 3 (DN 80): 60 inches (1500 mm) with 1/2-inch (13-mm) rod.
 - 3. NPS 4 and NPS 5 (DN 100 and DN 125): 60 inches (1500 mm) with 5/8-inch (16-mm) rod.
 - 4. NPS 6 (DN 150): 60 inches (1500 mm) with 3/4-inch (19-mm) rod.
 - 5. NPS 8 to NPS 12 (DN 200 to DN 300): 60 inches (1500 mm) with 7/8-inch (22-mm) rod.

- F. Install supports for vertical cast-iron soil piping every 15 feet (4.5 m).
- G. Install hangers for PVC piping with the following maximum horizontal spacing and minimum rod diameters:
 - 1. NPS 1-1/2 and NPS 2 (DN 40 and DN 50): 48 inches (1200 mm) with 3/8-inch (10-mm) rod.
 - 2. NPS 3 (DN 80): 48 inches (1200 mm) with 1/2-inch (13-mm) rod.
 - 3. NPS 4 and 5 (DN 100 and 125): 48 inches (1200 mm) with 5/8-inch (16-mm) rod.
 - 4. NPS 6 (DN 150): 48 inches (1200 mm) with 3/4-inch (19-mm) rod.
 - 5. NPS 8 to NPS 12 (DN 200 to DN 300): 48 inches (1200 mm) with 7/8-inch (22-mm) rod.
- H. Install supports for vertical PVC piping every 48 inches (1200 mm).
- I. Support piping and tubing not listed above according to MSS SP-69 and manufacturer's written instructions.

3.7 CONNECTIONS

- A. Drawings indicate general arrangement of piping, fittings, and specialties.
- B. Connect soil and waste piping to exterior sanitary sewerage piping. Use transition fitting to join dissimilar piping materials.
- C. Connect drainage and vent piping to the following:
 - 1. Plumbing Fixtures: Connect drainage piping in sizes indicated, but not smaller than required by plumbing code.
 - 2. Plumbing Fixtures and Equipment: Connect atmospheric vent piping in sizes indicated, but not smaller than required by authorities having jurisdiction.
 - 3. Plumbing Specialties: Connect drainage and vent piping in sizes indicated, but not smaller than required by plumbing code.
 - 4. Equipment: Connect drainage piping as indicated. Provide shutoff valve, if indicated, and union for each connection. Use flanges instead of unions for connections NPS 2-1/2 (DN 65) and larger.

3.8 FIELD QUALITY CONTROL

- A. During installation, notify authorities having jurisdiction at least 24 hours before inspection must be made. Perform tests specified below in presence of authorities having jurisdiction.
 - 1. Roughing-in Inspection: Arrange for inspection of piping before concealing or closing-in after roughing-in and before setting fixtures.
 - 2. Final Inspection: Arrange for final inspection by authorities having jurisdiction to observe tests specified below and to ensure compliance with requirements.
- B. Reinspection: If authorities having jurisdiction find that piping will not pass test or inspection, make required corrections and arrange for reinspection.
- C. Reports: Prepare inspection reports and have them signed by authorities having jurisdiction.
- D. Test sanitary drainage and vent piping according to procedures of authorities having jurisdiction or, in absence of published procedures, as follows:

SECTION 15150 - SANITARY WASTE AND VENT PIPING

1. Test for leaks and defects in new piping and parts of existing piping that have been altered, extended, or repaired. If testing is performed in segments, submit separate report for each test, complete with diagram of portion of piping tested.
2. Leave uncovered and unconcealed new, altered, extended, or replaced drainage and vent piping until it has been tested and approved. Expose work that was covered or concealed before it was tested.
3. Roughing-in Plumbing Test Procedure: Test drainage and vent piping, except outside leaders, on completion of roughing-in. Close openings in piping system and fill with water to point of overflow, but not less than 10-foot head of water (30 kPa). From 15 minutes before inspection starts to completion of inspection, water level must not drop. Inspect joints for leaks.
4. Finished Plumbing Test Procedure: After plumbing fixtures have been set and traps filled with water, test connections and prove they are gastight and watertight. Plug vent-stack openings on roof and building drains where they leave building. Introduce air into piping system equal to pressure of 1-inch wg (250 Pa). Use U-tube or manometer inserted in trap of water closet to measure this pressure. Air pressure must remain constant without introducing additional air throughout period of inspection. Inspect plumbing fixture connections for gas and water leaks.
5. Repair leaks and defects with new materials and retest piping, or portion thereof, until satisfactory results are obtained.
6. Prepare reports for tests and required corrective action.

3.9 CLEANING

- A. Clean interior of piping. Remove dirt and debris as work progresses.
- B. Protect drains during remainder of construction period to avoid clogging with dirt and debris and to prevent damage from traffic and construction work.
- C. Place plugs in ends of uncompleted piping at end of day and when work stops.

3.10 PROTECTION

- A. Exposed PVC Piping: Protect plumbing vents exposed to sunlight with two coats of water-based latex paint.

END OF SECTION 15150

SECTION 15300

PIPES, VALVES AND FITTINGS FOR FIRE PROTECTION SYSTEMS

PART 1 GENERAL

1.1 SECTION INCLUDES

- A. Scope of work:
 - 1. All areas as indicated on the drawings are to be protected by an automatic suppression system, of type as indicated.
 - 2. Wet pipe.
- B. Contractor shall be responsible for designing the distribution systems and sizing of the systems by hydraulic calculation; and shall provide the necessary engineering drawings and calculations to obtain acceptance of all authorities having jurisdiction.

1.2 RELATED SECTIONS

- A. Section 07840 - Firestopping.
- B. Section 08310 - Access Doors and Panels.
- C. Section 15050 - Basic Mechanical Methods and Materials.
- D. Section 15060 - Hangers and Supports.
- E. Section 15500 - Piping Specialties.

1.3 REFERENCES

- A. ASTM International (ASTM) A536 - Standard Specification for Ductile Iron Castings.
- B. Manufacturers Standardization Society of the Valve and Fittings Industry (MSS) SP-127 Bracing for Piping Systems Seismic-Wind-Dynamic Design, Selection, Application.
- C. NFPA 13 - Installation of sprinkler systems.
- D. NFPA 72 - Installation, maintenance and use of protective signaling devices.

1.4 SYSTEM DESCRIPTION

- A. System components to be UL listed/FM approved and labeled.
- B. System components to be to be rated for minimum operating pressure of 175 psig.
- C. Pipe, Valves, and Fittings - Grooved products for steel and copper fire protection systems shall be used. Refer to Section 15050 - Basic Materials and Methods and Section 15500 - Piping Specialties.
- D. Products shall be UL/ULC listed and FM approved. Materials shall be installed in accordance with current NFPA Standards, local Rating Bureau and/or local Fire Marshall requirements.
- E. Incorporate in construction pipe hangers and supports to manufacturer's recommendations utilizing manufacturer's regular production components, parts and assemblies. Refer to Section 15060 - Hangers and Supports.

1.5 SUBMITTALS

- A. Submit under provisions of Section 01300.
- B. [Product Data]: Manufacturer's data sheets on each product to be used, including:
 - 1. Preparation instructions and recommendations.
 - 2. Installation methods.
- C. Certifications:
 - 1. Product certificates signed by manufacturer certifying materials comply with specified performance characteristics and criteria and physical requirements. Certificates shall be furnished only as required by specific codes, upon request.
- D. Shop Drawings:
 - 1. Submit shop drawings and [Product Data] grouped to include complete submittals of related systems, products, and accessories in a single submittal.
- E. Closeout Submittals:
 - 1. Warranty: Warranty documents.
 - 2. Operation and Maintenance Data: Operation and maintenance data for installed products in accordance with Division 1 Closeout Submittals (Maintenance Data and Operation Data) Section. Include methods for maintaining installed products, and precautions against cleaning materials and methods detrimental to finishes and performance.

1.6 QUALITY ASSURANCE

- A. Installer Qualifications:
 - 1. Fire Protection Contractor shall be licensed by the State in which the project is located authorized to furnish and install fire protection systems.
 - 2. Contractor shall obtain all necessary permits and licenses pertaining to this Division (expense borne by the Contractor) and comply with Municipal and State Codes, Laws, Ordinances and Regulations, and the requirements of the National Fire protection Association, and pay all fees and sales taxes as required, and post all bonds incident thereto.
- B. Conduct pre-installation meeting to verify project requirements, coordinate with other trades, and establish condition and completeness of substrate. Review manufacturer's installation instructions and manufacturer's warranty requirements.

1.7 DEFINITION

- A. "Piping" includes all pipe, fittings, valves, hangers, and other supports and accessories related to such piping.
- B. "Concealed" means hidden from sight in chases, furred spaces, shafts, hung ceilings, embedded in construction, in crawl spaces or buried.
- C. "Exposed" means not installed underground or "concealed" as defined above.
- D. "Fire Protection Work" is all of the work Indicated or required by the Contract Documents.
- E. "Or equivalent" means to possess the same performance qualities and characteristics and fulfill the utilitarian function without any decrease in quality, durability or longevity.
- F. "Provide" means the Contractor shall "furnish and install" work and/or equipment.
- G. "FPC" means the Fire Protection Contractor.

1.8 DELIVERY, STORAGE, AND HANDLING

- A. Store products in manufacturer's unopened packaging until ready for installation.
- B. Store and dispose of solvent-based materials, and materials used with solvent-based materials, in accordance with requirements of local authorities having jurisdiction.

1.9 PROJECT CONDITIONS

- A. Maintain environmental conditions (temperature, humidity, and ventilation) within limits recommended by manufacturer for optimum results. Do not install products under environmental conditions outside manufacturer's absolute limits.

1.10 WARRANTY

- A. Contractor shall guarantee, in writing, that all work installed shall be free from any and all defects in workmanship and materials; that all apparatus shall develop capacities and characteristics specified; and that if, during the period of one year, or as otherwise specified, from the date of substantial completion, any defects in workmanship, material or performance appear, the Contractor shall, without cost to the Owner, remedy such defects within a reasonable time as specified in notice from the Owner's Representative. In default thereof, the Owner's Representative shall have the work done and charge the cost of the work to the Contractor.
- B. Furnish manufacturers written warranties for all equipment, stating effective date of Warranty, to the Owner's Representative.

PART 2 PRODUCTS

2.1 MANUFACTURERS

- A. Acceptable Manufacturer: Manufacturers shall meet or exceed NFPA and local authority requirements.

2.2 MANUFACTURED UNITS

- A. Grooved Butterfly Valve: Gruzlok Figure AE-7722-3A, 2 to 10 inches (51 mm to 254 mm). 300 PSI (2.1 MPa) rated UL/FM approved grooved-end with two (2) switches; one is a supervisory switch and the other is an auxiliary switch. Tamper resistant screws shall be provided to attach the cover of the actuator. Or Equal.
- B. Check Valves: Gruzlok Figure 78FP, 2 to 12 inches (51 to 305 mm): 300 PSI (2.1 MPa) rated, UL/ULC listed and FM approved grooved-end.
- C. Couplings for Fire Protection Systems - Gruzlok UL/ULC listed and/or FM approved. Figure 7000 (Flexible) and 7400 (Rigidlok) Grade "E" EPDM Type A, "C" Style Gaskets (DRI-SEAL), Type E EPDM, or Flush Gap Gasket. Or Equal.
- D. Grooved Fittings for Fire Protection Piping Systems: Gruzlok Fire-Rite short pattern fittings, 90 degree elbows and tees in 2 to 8 inches (51 mm to 203 mm) or Gruzlok standard pattern fittings, 2 to 12 inches (51 to 305 mm). Cast ductile conforms to ASTM A-536 Ductile Iron to Grade 65-45-12. Fittings are painted to industry specification and are available galvanized. Fire-RiteSYMBOL 212 fittings are UL/ULC listed and FM approved. Or Equal.

2.3 SPRINKLER HEADS

- A. Manufacturer:
 1. Viking, Central, Reliable, Tyco or equal.

2. Type: Shall be determined by a licensed fire sprinkler designer and approved by architect for coordination of ceiling construction types.

2.4 PIPING

- A. Steel Piping:
 1. Refer to Section 15050 for fire protection piping material.

2.5 ACCESS PANELS

- A. Provide access panels as required by Section 08310 - Access Doors and Panels.

2.6 FIRESTOPPING MATERIALS

- A. Provide fire stopping assemblies as required by Section 07840 - Firestopping.

2.7 EQUIPMENT SUPPORTS

- A. Fabricate equipment supports not provided by equipment manufacturer from structural grade steel meeting requirements of Section 05120 Structural Steel. Submit calculations with shop drawings.

2.8 EQUIPMENT ANCHOR BOLTS AND TEMPLATES

- A. Provide templates to ensure accurate location of anchor bolts.

PART 3 EXECUTION

3.1 EXAMINATION

- A. Do not begin installation until substrates have been properly prepared.
- B. If substrate preparation is the responsibility of another installer, notify Architect of unsatisfactory preparation before proceeding.
- C. Contractor shall verify and obtain fire flow test data required for design.

3.2 PREPARATION

- A. Clean surfaces thoroughly prior to installation.
- B. Prepare surfaces using the methods recommended by the manufacturer for achieving the best result for the substrate under the project conditions.
- C. Provide openings as necessary to permit installation of piping or any other part of work under this Section.
- D. Provide sleeves for piping penetrating floor and masonry walls.
- E. This Contractor shall be responsible for establishing sizes and locations of all openings and lintels in new work and to transmit this information to the Contractor whose work is involved at such time as to avoid cutting and patching.
- F. All patching shall match adjacent surfaces.
- G. Contractor shall inspect and take note of existing conditions along with the Owner's Representative to avoid disputes regarding the condition of existing surface before work began.

- H. Openings through existing concrete shall be core-drilled or saw cut.

3.3 INSTALLATION

- A. Install in accordance with manufacturer's instructions.
- B. Provide access panels for access to equipment, valves, or other specialties installed behind wall or above ceiling surfaces.
- C. Lay-in acoustical tee bar ceilings and snap-in removable metal pan ceilings shall be considered adequate for access.
- D. Fire Protection Contractor shall sublet installation work to subcontractors specifically skilled in the construction of the surfaces involved.
- E. Contractor shall confer with the other Project Contractors with respect to access panel locations and shall, wherever practicable, group devices in such a manner so as to eliminate as many panels as possible.
- F. Contractor shall remove all markings and labels from access panels.
- G. Cutting or drilling thru structural beams or joists is not permitted.
- H. Provide all openings and set all sleeves in cooperation with Contractors whose work is affected thereby.
- I. Caulk opening between pipe and sleeve with fire barrier sealant.
- J. In event holes must be provided through reinforced concrete, they shall be carefully drilled so as to avoid spalling and unnecessary damage of weakening of any structural member; chopping or breaking out will not be permitted.
- K. Obtain Architect's approval before providing openings through concrete or masonry in place and then proceed as directed.
- L. Contractor shall be responsible for damage to finished work resulting from cutting or drilling required because of neglect of Contractor to provide accurate and sufficient information.
- M. Penetrations through fire and/or smoke rated construction shall be sealed to maintain the rating of the construction in which they occur.
- N. Comply with the manufacturer's requirements for proper installation of fire stop materials to obtain the required fire and/or smoke rating.

3.4 SPRINKLER HEADS

- A. Locate sprinkler heads, main piping and valves as indicated on the drawings.
- B. Install sprinkler heads to coordinate with all lights, grilles and any other obstructions in ceiling.
- C. Center sprinkler heads in ceiling tile and provide piping offsets as required.
- D. Where ceiling is to be painted or sprayed, apply paper cover over sprinkler heads to ensure the head and escutcheons do not get coated. Remove protective paper cover after painting or spraying is completed.

- E. Provide mountable metal box of spare heads with proper wrench for head replacement.

3.5 TESTS AND INSPECTIONS

- A. Contractor shall be responsible for testing and certification of systems and ordering inspections as required by authorities having jurisdiction.
- B. All tests shall be conducted in the presence of and to the satisfaction of the Owner or an authorized representative.
- C. Inspections shall be made by the Owner's authorized representative and inspectors having jurisdiction.

3.6 PROTECTION

- A. After all tests have been made and the systems pronounced to be satisfactory, the Contractor shall go over all work and clean equipment, fixtures, and related appurtenances and piping, and leave them clean and in complete working order at final completion of the project.
- B. Protect installed products until completion of project.
- C. Touch-up, repair or replace damaged products before Substantial Completion.

END OF SECTION

SECTION 15410 - 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.

1.2 SUMMARY

- A. This Section includes plumbing fixtures and related components.
- B. Related Sections include the following:
 - 1. Division 15 Section "Emergency Plumbing Fixtures."
 - 2. Division 15 Section "Drinking Fountains and Water Coolers."
 - 3. Division 15 Section "Plumbing Specialties" for backflow preventers and specialty fixtures not in this Section.

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.

1.4 SUBMITTALS

- A. 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.
- B. Shop Drawings: Diagram power, signal, and control wiring and differentiate between manufacturer-installed and field-installed wiring.
- C. Maintenance Data: For plumbing fixtures to include in maintenance manuals specified in Division 1.

1.5 QUALITY ASSURANCE

- A. Source Limitations: Obtain plumbing fixtures, faucets, and other components of each category through one source from a single manufacturer.

SECTION 15410 - PLUMBING FIXTURES

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 U.S. Architectural & Transportation Barriers Compliance Board's "Uniform Federal Accessibility Standards (UFAS), 1985-494-187" about plumbing fixtures for people with disabilities.
- E. Regulatory Requirements: Comply with requirements in Public Law 102-486, "Energy Policy Act," about water flow and consumption rates for plumbing fixtures.
- F. NSF Standard: Comply with NSF 61, "Drinking Water System Components--Health Effects," for fixture materials that will be in contact with potable water.
- G. Select combinations of fixtures and trim, faucets, fittings, and other components that are compatible.
- H. Comply with the following applicable standards and other requirements specified for plumbing fixtures:
 1. Enameled, Cast-Iron Fixtures: ASME A112.19.1M.
 2. Hand Sinks: NSF 2 construction.
 3. Porcelain-Enameled, Formed-Steel Fixtures: ASME A112.19.4M.
 4. Slip-Resistant Bathing Surfaces: ASTM F 462.
 5. Stainless-Steel Fixtures Other Than Service Sinks: ASME A112.19.3M.
 6. Vitreous-China Fixtures: ASME A112.19.2M.
 7. Water-Closet, Flush Valve, Tank Trim: ASME A112.19.5.
 8. Water-Closet, Flushometer Tank Trim: ASSE 1037.
- I. Comply with the following applicable standards and other requirements specified for lavatory and sink faucets:
 1. Backflow Protection Devices for Faucets with Side Spray: ASME A112.18.3M.
 2. Backflow Protection Devices for Faucets with Hose-Thread Outlet: ASME A112.18.3M.
 3. Diverter Valves for Faucets with Hose Spray: ASSE 1025.
 4. Faucet Hose: ASTM D 3901.
 5. Faucets: ASME A112.18.1M.
 6. Hose-Connection Vacuum Breakers: ASSE 1011.
 7. Hose-Coupling Threads: ASME B1.20.7.
 8. Integral, Atmospheric Vacuum Breakers: ASSE 1001.
 9. NSF Materials: NSF 61.
 10. Pipe Threads: ASME B1.20.1.
 11. Sensor-Actuated Faucets and Electrical Devices: UL 1951.
 12. Supply and Drain Fittings: ASME A112.18.1M.
- J. 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.
- K. 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. Sensor-Operation Flushometers: ASSE 1037 and UL 1951.
 5. Tubular Brass Drainage Fittings and Piping: ASME A112.18.1M.
- L. Comply with the following applicable standards and other requirements specified for miscellaneous components:
1. Disposers: ASSE 1008 and UL 430.
 2. Floor Drains: ASME A112.21.1M.
 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.

PART 2 - PRODUCTS

2.1 MANUFACTURERS

- A. For fixture descriptions in other Part 2 articles where the subparagraph titles "Manufacturers" introduce a list of manufacturers, the following requirements apply for product selection:
1. Manufacturers: Subject to compliance with requirements, provide products by the manufacturers specified in other Part 2 articles.

2.2 LAVATORY FAUCETS

- A. Lavatory Faucet,: Include hot- and cold-water indicators; coordinate faucet inlets with supplies and fixture holes and outlet with spout and fixture receptor.
 - 1. Available Manufacturers:
 - a. American Standard.
 - b. T & S Brass.
 - c. Kohler.
 - d. Chicago.
 - 2. Refer to Plumbing Schedule for specification standards.

2.3 BATHTUB FAUCETS

- A. Bathtub Faucet: Include hot- and cold-water indicators; tub spout; and shower head, arm, and flange. Coordinate faucet inlets with supplies and outlet with diverter valve.
 - 1. Manufacturers:
 - a. American Standard.
 - b. T & S Brass.
 - c. Kohler.
 - d. Chicago.
 - 2. Refer to Plumbing Schedule for specification standards.

2.4 SHOWER FAUCETS

- A. Shower Faucet: Include hot- and cold-water indicators; tub spout; and shower head, arm, and flange. Coordinate faucet inlets with supplies and outlet with diverter valve.
 - 1. Manufacturers:
 - a. American Standard.
 - b. T & S Brass.
 - c. Kohler.
 - d. Chicago.
 - 2. Refer to Plumbing Schedule for specification standards.

2.5 SINK FAUCETS

- A. Sink Faucet: Include hot- and cold-water indicators; coordinate faucet inlets with supplies and fixture holes and outlet with spout and fixture receptor.
 - 1. Manufacturers:
 - a. American Standard.
 - b. T & S Brass.
 - c. Kohler.
 - d. Chicago.
 - 2. Refer to Plumbing Schedule for specification standards.

2.6 FLUSHOMETERS

- A. Flushometer: 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. Manufacturers:
 - a. Sloan, Royal.
 - b. Zurn, Aquafush, AT.
 - 2. Refer to Plumbing Schedule for specification standards.

2.7 TOILET SEATS

- A. Toilet Seat: Solid plastic.
 - 1. Manufacturers:
 - a. Church.
 - b. American Standard.
 - c. Olsenite.
 - 2. Refer to Plumbing Schedule for specification standards.

2.8 PROTECTIVE SHIELDING GUARDS

- A. Protective Shielding Guard: Manufactured, plastic covering for hot- and cold-water supplies and trap and drain piping and complying with ADA requirements.
 - 1. Manufacturers:
 - a. Plumerer.
 - b. Truebro.

- c. McGuire.
- d. Engineered Brass.

2.9 FIXTURE SUPPORTS

- A. **Water-Closet Support:** Water-closet combination carrier designed for accessible or standard mounting height, as required. 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.

1. **Manufacturers:**

- a. Josam.
- b. Mifab.
- c. Smith.
- d. Wade.
- e. Zurn.

- B. **Urinal Support:** Type I, urinal carrier with fixture support plates and coupling with seal and fixture bolts and hardware matching fixture. Include steel uprights with feet.

1. **Manufacturers:**

- a. Josam.
- b. Mifab.
- c. Smith.
- d. Wade.
- e. Zurn.

2. **Accessible Fixture Support:** Include rectangular steel uprights.

- C. **Lavatory Support:** Type II, lavatory carrier with concealed arms and tie rod. Include steel uprights with feet.

1. **Manufacturers:**

- a. Josam.
- b. Mifab.
- c. Smith.
- d. Wade.
- e. Zurn.

2. **Accessible Fixture Support:** Include rectangular steel uprights.

- D. Sink Support: Type II, sink carrier with hanger plate, bearing studs, and tie rod. Include steel uprights with feet.
 - 1. Manufacturers:
 - a. Josam.
 - b. Mifab.
 - c. Smith.
 - d. Wade.
 - e. Zurn.

2.10 WATER CLOSETS

- A. Water Closets,: Accessible and standard, wall hung and floor mounted, vitreous-china fixture designed for gravity-type tank, flushometer tank, or flushometer valve operation.
 - 1. Products:
 - a. American Standard, Inc.
 - b. Crane Plumbing/Fiat Products.
 - c. Kohler Co.
 - d. Eljer Plumbingware.
 - 2. Refer to Plumbing Schedule for Specification Standards.

2.11 URINALS

- A. Urinals,: Accessible and standard Wall-hanging, bottom-outlet, vitreous-china fixture designed for flushometer valve operation.
 - 1. Products:
 - a. American Standard.
 - b. Crane Plumbing/Fiat Products.
 - c. Kohler Co.
 - d. Eljer Plumbingware.
 - 2. Refer to Plumbing Schedule for Specification Standards.

2.12 LAVATORIES

- A. Lavatories: Accessible and standard, Wall-hanging, vitreous-china fixture.
 - 1. Products:
 - a. American Standard, Inc.
 - b. Crane Plumbing/Fiat Products.
 - c. Kohler Co.
 - d. Eljer Plumbingware.
 - 2. Refer to Plumbing Schedule for Specification Standards.
- B. Lavatories: Accessible and Standard Counter-mounting, vitreous-china fixture.
 - 1. Products:
 - a. American Standard, Inc.

- b. Crane Plumbing/Fiat Products.
- c. Kohler Co.
- d. Eljer Plumbingware Div.
2. Refer to Plumbing Schedule for Specification Standards.

2.13 KITCHEN SINKS

- A. Kitchen Sinks: Counter-mounting, stainless-steel fixture.
 1. Products:
 - a. Elkay Manufacturing Co.
 - b. Just Manufacturing Co.
 - c. Kohler Co.
 - d. Sterling Plumbing Group, Inc.
 2. Refer to Plumbing Schedule for Specifications Standards.
- B. Bar Sinks: Single-compartment, counter-mounting, stainless-steel fixture.
 1. Products:
 - a. Elkay Manufacturing Co.
 - b. Federal Home Products Div.
 - c. Just Manufacturing Co.
 - d. Kohler Co.
 - e. Sterling Plumbing Group, Inc.
 2. Refer to Plumbing Schedule for Specifications Standards.

2.14 SERVICE BASINS

- A. Service Basins,: Flush-to-wall, floor-mounting precast terrazzo basin with rim guard.
 1. Available Products:
 2. Products:
 - a. Acorn Engineering Co.
 - b. Crane Plumbing/Fiat Products.
 - c. Precast Terrazzo Enterprises, Inc.
 - d. Stern-Williams Co., Inc.
 3. Refer to Plumbing Schedule for Specification Standards.

2.15 WASH FOUNTAINS

- A. Wash Fountains,: Accessible, Circular, semi-circular, and flush-to-wall freestanding-design and wall-hung, wash-up fixture.
 1. Products:
 - a. Acorn Engineering Co.
 - b. Bradley Corporation.
 - c. Intersan Manufacturing Co.
 2. Refer to Plumbing Schedule for Specification Standards.

2.16 SERVICE SINKS

- A. Service Sinks.: Trap-standard- and wall-mounting, enameled, cast iron with roll-rim sink with plain or two faucet holes in back and rim guard on front and sides.
 - 1. Products:
 - a. Kohler Co.
 - b. Eljer Plumbingware.
 - c. Crane Plumbing/Fiat Products.
 - 2. Refer to Plumbing Schedule for Specification Standards.

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. Refer to Division 15 Section "Valves" for general-duty valves.
- 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 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.
 - M. Install tanks for accessible, tank-type water closets with lever handle mounted on wide side of compartment.
 - N. Install toilet seats on water closets.
 - O. 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.
 - P. Install water-supply, flow-control fittings with specified flow rates in fixture supplies at stop valves.
 - Q. 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.
 - R. Install shower, flow-control fittings with specified maximum flow rates in shower arms.
 - S. Install traps on fixture outlets.
 1. Exception: Omit trap on fixtures with integral traps.
 2. Exception: Omit trap on indirect wastes, unless otherwise indicated.
 - T. Install disposer in outlet of sinks indicated to have disposer. Install switch where indicated or in wall adjacent to sink if location is not 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 15 Section "Basic Mechanical Materials and Methods" for escutcheons.
 - V. Set bathtubs, shower receptors, and service basins in leveling bed of cement grout. Refer to Division 15 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 15 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 15410

SECTION 15415 - DRINKING FOUNTAINS AND WATER COOLERS

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:

- 1. Drinking fountains.
- 2. Water coolers.
- 3. Fixture supports.

1.3 DEFINITIONS

- A. Accessible: Fixture that can be approached and used by people with disabilities.
- B. Fitting: Device that controls flow of water into or out of fixture.
- C. Fixture: Drinking fountain or water cooler, unless one is specifically indicated.
- D. Water Cooler: Electrically powered fixture for generating and delivering cooled drinking water.

1.4 SUBMITTALS

- A. Product Data: Include rated capacities; shipping, installed, and operating weights; furnished specialties; and accessories for each type of fixture indicated.
- B. Shop Drawings: Diagram power, signal, and control wiring and differentiate between manufacturer-installed and field-installed wiring.

1.5 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. 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 fixtures for people with disabilities.
- C. Regulatory Requirements: Comply with requirements in the U.S. Architectural & Transportation Barriers Compliance Board's "Uniform Federal Accessibility Standards (UFAS), 1985-494-187" about fixtures for people with disabilities.

SECTION 15415 - DRINKING FOUNTAINS AND WATER COOLERS

- D. NSF Standard: Comply with NSF 61, "Drinking Water System Components--Health Effects," for fixture materials that will be in contact with potable water.
- E. ARI Standard: Comply with ARI 1010, "Self-Contained, Mechanically Refrigerated Drinking-Water Coolers," for water coolers and with ARI's "Directory of Certified Drinking Water Coolers" for type and style classifications.

1.6 COORDINATION

- A. Coordinate roughing-in and final fixture locations, and verify that fixtures can be installed to comply with original design and referenced standards.

PART 2 - PRODUCTS

2.1 MANUFACTURERS

- A. For fixture descriptions in other Part 2 articles where the subparagraph titles "Manufacturers" introduce a list of manufacturers and their products or manufacturers only, the following requirements apply for product selection:
 - 1. Manufacturers: Subject to compliance with requirements, provide products by the manufacturers specified in other Part 2 articles.

2.2 WATER COOLERS

- A. Water Coolers,: Accessible, ARI 1010, pressure with bubbler fixture.
 - 1. Products:
 - a. Elkay Manufacturing Co.
 - b. Halsey Taylor.
 - c. Haws Corporation.
 - d. Oasis Corp.
 - 2. Refer to Plumbing Schedule for specification standards.

2.3 FIXTURE SUPPORTS

- A. Off-Floor, Plumbing Fixture Supports: ASME A112.6.1M, water-cooler carriers. Include vertical, steel uprights with feet and tie rods and bearing plates with mounting studs matching fixture to be supported.
 - 1. Manufacturers:
 - a. Josam Co.
 - b. Smith.
 - c. Watts Industries, Inc.; Watts Drainage Products Div.
 - d. Zurn Specifications Drainage Operation.
 - 2. Type I: Hanger-type carrier with two vertical uprights.
 - 3. Type II: Bilevel, hanger-type carrier with three vertical uprights.
 - 4. Supports for Accessible Fixtures: Include rectangular, vertical, steel uprights instead of steel pipe uprights.

PART 3 - EXECUTION

3.1 EXAMINATION

- A. Examine roughing-in for water and waste piping systems to verify actual locations of piping connections before fixture installation. Verify that sizes and locations of piping and types of supports match those indicated.
- B. Examine walls and floors for suitable conditions where fixtures are to be installed.
- C. Proceed with installation only after unsatisfactory conditions have been corrected.

3.2 APPLICATIONS

- A. Use carrier off-floor supports for wall-hanging fixtures, unless otherwise indicated.
- B. Use mounting frames for recessed water coolers, unless otherwise indicated.
- C. Set freestanding and pedestal drinking fountains on floor.
- D. Use chrome-plated brass or copper tube, fittings, and valves in locations exposed to view. Plain copper tube, fittings, and valves may be used in concealed locations.

3.3 INSTALLATION

- A. Install off-floor supports affixed to building substrate and attach wall-hanging fixtures, unless otherwise indicated.
- B. Install mounting frames affixed to building construction and attach recessed water coolers to mounting frames, unless otherwise indicated.
- C. Install fixtures level and plumb.
- D. Install water-supply piping with shutoff valve on supply to each fixture to be connected to water distribution piping. Use ball, gate, or globe valve. Install valves in locations where they can be easily reached for operation. Refer to Division 15 Section "Valves" for general-duty valves.
- E. Install trap and waste piping on drain outlet of each fixture to be connected to sanitary drainage system.
- F. Install pipe escutcheons at wall penetrations in exposed, finished locations. Use deep-pattern escutcheons where required to conceal protruding pipe fittings. Refer to Division 15 Section "Basic Mechanical Materials and Methods" for escutcheons.
- G. Seal joints between fixtures and walls and floors 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.

SECTION 15415 - DRINKING FOUNTAINS AND WATER COOLERS

3.4 CONNECTIONS

- A. Piping installation requirements are specified in other Division 15 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. 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.

3.5 FIELD QUALITY CONTROL

- A. Water-Cooler Testing: After electrical circuitry has been energized, test for compliance with requirements. Test and adjust controls and safeties.
- B. Repair or replace malfunctioning units. Retest as specified above after repairs or replacements are made.
- C. Report test results in writing.

3.6 ADJUSTING

- A. Adjust fixture flow regulators for proper flow and stream height.
- B. Adjust water-cooler temperature settings.

3.7 CLEANING

- A. After completing fixture installation, inspect unit. Remove paint splatters and other spots, dirt, and debris. Repair damaged finish to match original finish.
- B. Clean fixtures, on completion of installation, according to manufacturer's written instructions.

END OF SECTION 15415

SECTION 15430 - 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.

1.2 SUMMARY

- A. This Section includes the following plumbing specialties:

1. Backflow preventers.
2. Dishwasher air-gap fittings.
3. Water regulators.
4. Balancing valves.
5. Thermostatic water mixing valves.
6. Water tempering valves.
7. Strainers.
8. Outlet boxes.
9. Washer-supply outlets.
10. Hose stations.
11. Key-operation hydrants.
12. Wheel-handle wall hydrants.
13. Nondraining nonfreeze post hydrants.
14. Trap seal primer valves.
15. Drain valves.
16. Backwater valves.
17. Miscellaneous piping specialties.
18. Sleeve penetration systems.
19. Flashing materials.
20. Cleanouts.
21. Floor drains.
22. Trench drains.
23. Roof drains.
24. Grease interceptors.
25. Oil interceptors.
26. Solids interceptors.

1.3 DEFINITIONS

- A. The following are industry abbreviations for plastic piping materials:

1. ABS: Acrylonitrile-butadiene-styrene plastic.
2. PE: Polyethylene plastic.
3. PUR: Polyurethane plastic.
4. 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. Domestic Water Piping: 125 psig (860 kPa).
 2. Sanitary Waste and Vent Piping: 10-foot head of water (30 kPa).
 3. Storm Drainage Piping: 10-foot head of water (30 kPa).

1.5 SUBMITTALS

- A. Product Data: Include rated capacities and shipping, installed, and operating weights. Indicate materials, finishes, dimensions, required clearances, and methods of assembly of components; and piping and wiring connections for the following:
1. Backflow preventers and water regulators.
 2. Balancing valves and strainers.
 3. Thermostatic water mixing valves and water tempering valves.
 4. Water hammer arresters, air vents, and trap seal primer valves and systems.
 5. Drain valves, hose bibbs, hydrants, and hose stations.
 6. Outlet boxes and washer-supply outlets.
 7. Backwater valves, cleanouts, floor drains, open receptors, trench drains, and roof drains.
 8. Air-admittance valves, vent caps, vent terminals, and roof flashing assemblies.
 9. Grease interceptors, oil interceptors, and solids interceptors.
 10. Sleeve penetration systems.
- B. Shop Drawings: Diagram power, signal, and control wiring.
- C. Field test reports.
- D. Maintenance Data: For plumbing specialties to include in maintenance manuals. Include the following:
1. Backflow preventers and water regulators.
 2. Thermostatic water mixing valves and water tempering valves.
 3. Trap seal primer valves and systems.
 4. Hose stations and hydrants.
 5. Grease interceptors, oil interceptors, and solids interceptors.

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-pw" on plastic potable-water piping and "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. 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. In other Part 2 articles where subparagraph titles below introduce lists, the following requirements apply for 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, the manufacturers specified.
 2. Manufacturers: Subject to compliance with requirements, provide products by the manufacturers specified.

2.2 BACKFLOW PREVENTERS

- A. Available Manufacturers:
- B. Manufacturers:
1. B & K Industries, Inc.
 2. Cla-Val Co.
 3. Conbraco Industries, Inc.
 4. Mueller Co.; Hersey Meters Div.
 5. Park Equipment.
 6. Watts Industries, Inc.; Water Products Div.
 7. Zurn Industries, Inc.; Wilkins Div.
- C. General: ASSE standard, backflow preventers.
1. NPS 2 (DN 50) and Smaller: Bronze body with threaded ends.
 2. NPS 2-1/2 (DN 65) 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: On inlet, if indicated.
- D. Pipe-Applied, Atmospheric-Type Vacuum Breakers: ASSE 1001, with floating disc and atmospheric vent.
- E. Hose-Connection Vacuum Breakers: ASSE 1011, nickel plated, with nonremovable and manual drain features, and ASME B1.20.7, garden-hose threads on outlet. Units attached to rough-bronze-finish hose connections may be rough bronze.
- F. Intermediate Atmospheric-Vent Backflow Preventers: ASSE 1012, suitable for continuous pressure application. Include inlet screen and two independent check valves with intermediate atmospheric vent.
- G. 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 (83 kPa) maximum, through middle 1/3 of flow range.
- H. Double-Check Backflow Prevention Assemblies: ASSE 1015, suitable for continuous pressure application. Include shutoff valves on inlet and outlet, and strainer on inlet; test cocks; and two positive-seating check valves.
 1. Pressure Loss: 5 psig (35 kPa) maximum, through middle 1/3 of flow range.
- I. Antisiphon-Pressure-Type Vacuum Breakers: ASSE 1020, suitable for continuous pressure application. Include shutoff valves, spring-loaded check valve, spring-loaded floating disc, test cocks, and atmospheric vent.
 1. Pressure Loss: 5 psig (35 kPa) maximum, through middle 1/3 of flow range.
- J. Dual-Check-Valve-Type Backflow Preventers: ASSE 1024, suitable for continuous pressure application. Include union inlet and two independent check valves.
- K. Dual-Check-Valve-Type Backflow Preventers: ASSE 1032, suitable for continuous pressure application for carbonated beverage dispensers. Include stainless-steel body; primary and secondary checks; ball check; intermediate atmospheric-vent port for relieving carbon dioxide; and threaded ends, NPS 3/8 (DN 10).
- L. Laboratory Faucet Vacuum Breakers: ASSE 1035, suitable for continuous pressure application and chrome plated; consisting of primary and secondary checks; intermediate vacuum breaker; and threaded ends, NPS 1/4 or NPS 3/8 (DN 8 or DN 10) as required.
- M. Reduced-Pressure Detector Assembly Backflow Preventers: ASSE 1047, 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; pressure-differential relief valve with ASME A112.1.2 air-gap fitting located between two positive-seating check valves; and bypass with displacement-type water meter, valves, and reduced-pressure backflow preventer.
 1. Pressure Loss: 12 psig (83 kPa) maximum, through middle 1/3 of flow range.
- N. 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 (35 kPa) maximum, through middle 1/3 of flow range.
- O. Hose-Connection Backflow Preventers: ASSE 1052, suitable for at least 3-gpm (0.19-L/s) flow and applications with up to 10-foot head of water (30-kPa) back pressure. Include two check valves; intermediate atmospheric vent; and nonremovable, ASME B1.20.7, garden-hose threads on outlet.
- P. Back-Siphonage Backflow Vacuum Breakers: ASSE 1056, suitable for continuous pressure and backflow applications. Include shutoff valves, check valve, test cocks, and vacuum vent.

2.3 DISHWASHER AIR-GAP FITTINGS

- A. Description: ASSE 1021, fitting suitable for use with domestic dishwashers and for deck mounting; with plastic body, chrome-plated brass cover; and capacity of at least 5 gpm (0.32 L/s); and inlet pressure of at least 5 psig (35 kPa) at temperature of at least 140 deg F (60 deg C). Include 5/8-inch- (16-mm-) ID inlet and 7/8-inch- (22-mm-) ID outlet hose connections.
- B. Hoses: Rubber and suitable for temperature of at least 140 deg F (60 deg C).
1. Inlet Hose: 5/8-inch- (16-mm-) ID and 48 inches long.
 2. Outlet Hose: 7/8-inch- (22-mm-) ID and 48 inches long.

2.4 WATER REGULATORS

- A. Available Manufacturers:
1. Cla-Val Co.
 2. Conbraco Industries, Inc.
 3. Watts Industries, Inc.; Water Products Div.
 4. Zurn Industries, Inc.; Wilkins Div.
- B. General: ASSE 1003, water regulators, rated for initial working pressure of 150 psig (1035 kPa) minimum. Include integral factory-installed or separate field-installed, Y-pattern strainer.
1. NPS 2 (DN 50) 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 (DN 65) 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.

2.5 BALANCING VALVES

- A. Calibrated Balancing Valves: Adjustable, with two readout ports and memory setting indicator. Include manufacturer's standard hoses, fittings, valves, differential pressure meter, and carrying case.
1. Available Manufacturers:
 - a. Amtrol, Inc.
 - b. Flow Design, Inc.
 - c. ITT Industries; Bell & Gossett Div.
 - d. Watts Industries, Inc.; Water Products Div.
 2. NPS 2 (DN 50) and Smaller: Bronze body with brass ball, adjustment knob, calibrated nameplate, and threaded or solder-joint ends.
 3. NPS 2 (DN 50) and Smaller: Bronze, Y-pattern body with adjustment knob and threaded ends.
 4. NPS 2-1/2 (DN 65) and Larger: Cast-iron, Y-pattern body with bronze disc and flanged or grooved ends.
- B. Memory-Stop Balancing Valves, NPS 2 (DN 50) and Smaller: MSS SP-110, ball valve, rated for 400-psig (2760-kPa) minimum CWP. Include two-piece, copper-alloy body with standard or full-port, chrome-plated brass ball, replaceable seats and seals, threaded or solder-joint ends, and vinyl-covered steel handle with memory-stop device.
1. Available Manufacturers:
 - a. Conbraco Industries, Inc.
 - b. Crane Co.
 - c. Grinnell Corporation.
 - d. Hammond Valve.
 - e. Milwaukee Valve Company.
 - f. NIBCO INC.
 - g. Red-White Valve Corp.

2.6 THERMOSTATIC WATER MIXING VALVES

- A. Manufacturers:
 1. Bradley.
 2. Lawler Manufacturing Company, Inc.
 3. Leonard Valve Company.
 4. Powers.
 5. Symmons Industries, Inc.
 6. T & S Brass and Bronze Works, Inc.
- B. 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. Refer to plumbing schedules for further information.

2.7 WATER TEMPERING VALVES

- A. Available Manufacturers:

- B. Manufacturers:
1. Heat-Timer Corporation.
 2. Holby Valve Co., Inc.
 3. Sparco, Inc.
 4. Watts Industries, Inc.; Water Products Div.
- C. General: Manually adjustable, thermostatically controlled water tempering valve; bronze body; and adjustable temperature setting.
- D. System Water Tempering Valves: Piston or discs controlling both hot- and cold-water flow, capable of limited antiscald protection. Include threaded inlets and outlet.
1. Finish: [**Rough bronze**] [**Chrome plated**].
- E. Limited-Volume, Water Tempering Valves: Solder-joint inlets and NPS 3/4 (DN 20) maximum outlet.

2.8 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 (1.2-mm) round perforations, unless otherwise indicated.
1. Pressure Rating: 125-psig (860-kPa) minimum steam working pressure, unless otherwise indicated.
 2. NPS 2 (DN 50) and Smaller: Bronze body, with female threaded ends.
 3. NPS 2-1/2 (DN 65) 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.

2.9 OUTLET BOXES

- A. Available Manufacturers:
1. Acorn Engineering Company.
 2. Gray, Guy Manufacturing Co., Inc.
 3. Oatey.
 4. Symmons Industries, Inc.
 5. Zurn Industries, Inc.; Jonespec Div.
- B. 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.
- C. Clothes Washer Outlet Boxes: With hot- and cold-water hose connections and drain. Refer to plumbing schedules for further information.
- D. Icemaker Outlet Boxes: With hose connection. Refer to plumbing schedules for further information.

- E. Reinforcement: 2-by-4-inch (38-by-89-mm) fire-retardant-treated-wood blocking between studs. Fire-retardant-treated-wood blocking is specified in Division 6 Section "Rough Carpentry."

2.10 HOSE STATIONS

- A. Available Manufacturers:
 - 1. Leonard Valve Company.
 - 2. Strahman Valves, Inc.
 - 3. T & S Brass and Bronze Works, Inc.
- B. General: Assembly with fitting complying with ASME A112.18.1M and hose-connection outlet with threads complying with ASME B1.20.7. Refer to plumbing schedules for further information.

2.11 KEY-OPERATION HYDRANTS

- A. Available Manufacturers:
 - 1. Josam Co.
 - 2. Simmons Manufacturing Co.
 - 3. Smith, Jay R. Mfg. Co.
 - 4. Tyler Pipe; Wade Div.
 - 5. Watts Industries, Inc.
 - 6. Woodford Manufacturing Co.
 - 7. Zurn Industries.
- B. General: ASME A112.21.3M, key-operation hydrant with pressure rating of 125 psig (860 kPa). Refer to plumbing schedule for further information.

2.12 WHEEL-HANDLE WALL HYDRANTS

- A. Available Manufacturers:
 - 1. B & K Industries, Inc.
 - 2. NIBCO INC.
 - 3. Sioux Chief Manufacturing Co., Inc.
 - 4. Watts Industries, Inc.; Water Products Div.
 - 5. Woodford Manufacturing Co.
 - 6. Zurn Industries, Inc.; Jonespec Div.
- B. Refer to plumbing schedule for further information.

2.13 NONDRAINING NONFREEZE POST HYDRANTS

- A. General: All-metal lever operation with nondraining water-storage reservoir, designed without drain and to be freezeproof with components of at least length required for burial of valve and water storage reservoir below frost line. Refer to plumbing schedule for further information.

2.14 TRAP SEAL PRIMER VALVES

- A. Supply-Type Trap Seal Primer Valves: ASSE 1018, water-supply-fed type, with the following characteristics:

1. Available Manufacturers:
 - a. Josam Co.
 - b. MIFAB Manufacturing, Inc.
 - c. Precision Plumbing Products, Inc.
 - d. Smith.
 - e. Wade.
 - f. Watts Industries, Inc.
 - g. Zurn Industries.
 2. 125-psig (860-kPa) minimum working pressure.
 3. Bronze body with atmospheric-vented drain chamber.
 4. Inlet and Outlet Connections: NPS 1/2 (DN 15) threaded, union, or solder joint.
 5. Gravity Drain Outlet Connection: NPS 1/2 (DN 15) threaded or solder joint.
 6. Finish: Chrome plated, or rough bronze for units used with pipe or tube that is not chrome finished.
- B. Drainage-Type Trap Seal Primer Valves: ASSE 1044, fixture-trap, waste-drainage-fed type, with the following characteristics:
1. Chrome-plated, cast-brass, NPS 1-1/4 (DN 32) minimum, lavatory P-trap with NPS 3/8 (DN 10) minimum, trap makeup connection.
- C. 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 (DN 20, ASTM B 88M, Type B); copper, water tubing inlet and manifold with number of NPS 1/2 (DN 15) 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.

2.15 DRAIN VALVES

- A. Hose-End Drain Valves: MSS SP-110, NPS 3/4 (DN 20) ball valve, rated for 400-psig (2760-kPa) 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. Hose-End Drain Valve: MSS SP-80, gate valve, Class 125, ASTM B 62 bronze body, with NPS 3/4 (DN 20) threaded or solder-joint inlet and ASME B1.20.7, garden-hose threads on outlet and cap. Hose bibbs are prohibited for this application.
- C. Stop-and-Waste Drain Valves: MSS SP-110, ball valve, rated for 200-psig (1380-kPa) minimum CWP or MSS SP-80, Class 125, gate valve; ASTM B 62 bronze body, with NPS 1/8 (DN 6) side drain outlet and cap.

2.16 BACKWATER VALVES

- A. Available Manufacturers:

1. Josam Co.
 2. Smith, Jay R. Mfg. Co.
 3. Watts Industries, Inc.; Drainage Products Div.
 4. Zurn Industries, Inc.; Specification Drainage Operation.
- B. Horizontal Backwater Valves: ASME A112.14.1, cast-iron body, with removable bronze swing-check valve and threaded or bolted cover.
1. Closed-Position Check Valve: Factory assembled or field modified to hang closed unless subject to backflow condition.
 2. Open-Position Check Valve: Factory assembled or field modified to hang open for airflow.
 3. Extension: ASTM A 74, Service class; full-size, cast-iron, soil-pipe extension to field-installed cleanout at floor, instead of cover.
- C. Drain Outlet Backwater Valves: Cast-iron or bronze body, with removable ball float, threaded inlet, and threaded or spigot outlet for installation in bottom outlet of floor drain.
- 2.17 MISCELLANEOUS PIPING SPECIALTIES
- A. Water Hammer Arresters: ASSE 1010 or PDI-WH 201, metal-bellows type with pressurized metal cushioning chamber. Sizes indicated are based on ASSE 1010 or PDI-WH 201, Sizes A through F.
1. Available Manufacturers:
 - a. Josam Co.
 - b. Smith, Jay R. Mfg. Co.
 - c. Tyler Pipe; Wade Div.
 - d. Zurn Industries, Inc.; Specification Drainage Operation.
- B. Water Hammer Arresters: 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.
1. Available Manufacturers:
 - a. Josam Co.
 - b. Precision Plumbing Products, Inc.
 - c. Sioux Chief Manufacturing Co., Inc.
 - d. Watts Industries, Inc.
 - e. Zurn Industries, Inc.
- C. Hose Bibbs: Bronze body with replaceable seat disc complying with ASME A112.18.1M for compression-type faucets. Include NPS 1/2 or NPS 3/4 (DN 15 or DN 20) threaded or solder-joint inlet, of design suitable for pressure of at least 125 psig (860 kPa); integral nonremovable, drainable hose-connection vacuum breaker; and garden-hose threads complying with ASME B1.20.7 on outlet.
1. Finish for Equipment Rooms: Rough bronze, or chrome or nickel plated.
 2. Finish for Service Areas: Rough bronze.
 3. Finish for Finished Rooms: Chrome or nickel plated.
 4. Operation for Equipment Rooms: Wheel handle or operating key.
 5. Operation for Service Areas: Operating key.
 6. Operation for Finished Rooms: Operating key.

7. Include operating key with each operating-key hose bibb.
 8. Include wall flange with each chrome- or nickel-plated hose bibb.
- D. Air Vents: Float type for automatic air venting.
1. Bolted Construction: Bronze body with replaceable, corrosion-resistant metal float and stainless-steel mechanism and seat; threaded NPS 3/8 (DN 10) minimum inlet; 125-psig (860-kPa) minimum pressure rating at 140 deg F (60 deg C); and threaded vent outlet.
 2. Welded Construction: Stainless-steel body with corrosion-resistant metal float, stainless-steel mechanism and seat, threaded NPS 3/8 (DN 10) minimum inlet, 150-psig (1035-kPa) minimum pressure rating, and threaded vent outlet.
- E. Air-Admittance Valves: Plastic housing with mechanical-operation sealing diaphragm, designed to admit air into drainage and vent piping and to prevent transmission of sewer gas into building.
1. Available Manufacturers:
 - a. B & K Industries, Inc.
 - b. IPS Corporation.
 - c. J & B Products.
 - d. Oatey.
 - e. Sioux Chief Manufacturing Co., Inc.
 2. Stack Vent Valve: ASSE 1050, designed for installation as terminal on soil, waste, and vent stacks, instead of stack vent extending through roof, in NPS 2 to NPS 4 (DN 50 to DN 100).
 3. Fixture Vent Valve: ASSE 1051, designed for installation on waste piping, instead of vent connection, for single fixture, in NPS 1-1/4 to NPS 2 (DN 32 to DN 50).
- F. Roof Flashing Assemblies: Manufactured assembly made of 4-lb/sq. ft., 0.0625-inch- thick, lead flashing collar and skirt extending at least 8 inches from pipe with galvanized steel boot reinforcement, and counterflashing fitting.
1. Available Manufacturers:
 2. Manufacturers:
 - a. Acorn Engineering Company; Elmdor/Stoneman Div.
 3. Open-Top Vent Cap: Without cap.
 4. Low-Silhouette Vent Cap: With vandal-proof vent cap.
 5. Extended Vent Cap: With field-installed, vandal-proof vent cap.
- G. Open Drains: Shop or field fabricate from ASTM A 74, Service class, hub-and-spigot, cast-iron, soil-pipe fittings. Include P-trap, hub-and-spigot riser section; and where required, increaser fitting, joined with ASTM C 564, rubber gaskets.
- H. 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 (DN 50): 4-inch- (100-mm-) minimum water seal.
 2. NPS 2-1/2 (DN 65) and Larger: 5-inch- (125-mm-) minimum water seal.
- I. Floor-Drain Inlet Fittings: Cast iron, with threaded inlet and threaded or spigot outlet, and trap seal primer valve connection.

- J. **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.
- K. **Stack Flashing Fittings:** Counterflashing-type, cast-iron fitting, with bottom recess for terminating roof membrane, and with threaded or hub top for extending vent pipe.
- L. **Vent Caps:** Cast-iron body with threaded or hub inlet and vandal-proof design. Include vented hood and set-screws to secure to vent pipe.
- M. **Vent Terminals:** Commercially manufactured, shop- or field-fabricated, frost-proof assembly constructed of galvanized steel, copper, or lead-coated copper. Size to provide 1-inch (25-mm) enclosed air space between outside of pipe and inside of flashing collar extension, with counterflashing.
- N. **Expansion Joints:** ASME A112.21.2M, assembly with cast-iron body with bronze sleeve, packing gland, and packing; of size and end types corresponding to connected piping.
- O. **Downspout Boots:** ASTM A 48 (ASTM A 48M), gray-iron casting, with NPS 4 (DN 100) outlet; shop-applied bituminous coating; and inlet size to match downspout.
- P. **Downspout Boots:** ASTM A 74, Service class, hub-and-spigot, cast-iron soil pipe.
- Q. **Conductor Nozzles:** Bronze body with threaded inlet for connected conductor size, and bronze wall flange with mounting holes.
 - 1. **Finish:** Nickel bronze.

2.18 SLEEVE PENETRATION SYSTEMS

- A. **Available Manufacturers:**
 - 1. ProSet Systems, Inc.
- B. **Description:** UL 1479, through-penetration firestop assembly consisting of sleeve and stack fitting with firestopping plug.
 - 1. **Sleeve:** Molded PVC plastic, of length to match slab thickness and with integral nailing flange on one end for installation in cast-in-place concrete slabs.
 - 2. **Stack Fitting:** ASTM A 48 (ASTM A 48M), gray-iron, hubless-pattern, wye-branch stack fitting with neoprene O-ring at base and gray-iron plug in thermal-release harness in branch. Include PVC protective cap for plug.
 - a. **Special Coating:** Include corrosion-resistant interior coating on fittings for plastic chemical waste and vent stacks.

2.19 FLASHING MATERIALS

- A. **Lead Sheet:** ASTM B 749, Type L51121, copper bearing, with the following minimum weights and thicknesses, unless otherwise indicated:
 - 1. **General Use:** 4-lb/sq. ft. (20-kg/sq. m), 0.0625-inch (1.6-mm) thickness.

2. Vent Pipe Flashing: 3-lb/sq. ft. (15-kg/sq. m), 0.0469-inch (1.2-mm) thickness.
 3. Burning: 6-lb/sq. ft. (30-kg/sq. m), 0.0938-inch (2.4-mm) thickness.
- B. Copper Sheet: ASTM B 152 (ASTM B 152M), of the following minimum weights and thicknesses, unless otherwise indicated:
1. General Applications: 12 oz./sq. ft. (3.7 kg/sq. m or 0.41-mm thickness).
 2. Vent Pipe Flashing: 8 oz./sq. ft. (2.5 kg/sq. m or 0.27-mm thickness).
- C. Zinc-Coated Steel Sheet: ASTM A 653/A 653M, with 0.20 percent copper content and 0.04-inch (1.01-mm) minimum thickness, unless otherwise indicated. Include G90 (Z275) hot-dip galvanized, mill-phosphatized finish for painting if indicated.
- D. Elastic Membrane Sheet: ASTM D 4068, flexible, chlorinated polyethylene, 40-mil (1.01-mm) minimum thickness.
- E. Fasteners: Metal compatible with material and substrate being fastened.
- F. Metal Accessories: Sheet metal strips, clamps, anchoring devices, and similar accessory units required for installation; matching or compatible with material being installed.
- G. Solder: ASTM B 32, lead-free alloy.
- H. Bituminous Coating: SSPC-Paint 12, solvent-type, bituminous mastic.

2.20 CLEANOUTS

- A. Cleanouts,: Comply with ASME A112.3.1.
1. Application: Floor cleanout and wall cleanout.
 2. Manufacturer:
 - a. Josam Co.
 - b. Smith.
 - c. Wade.
 - d. Zurn.
 3. Refer to Plumbing Schedule for Specification Standards.

2.21 FLOOR DRAINS

- A. Floor Drains,: Comply with ASME A112.3.1.
1. Application: Floor drain.
 2. Manufacturer:
 - a. Josam Co.
 - b. MiFab.
 - c. Smith.
 - d. Wade Div.
 - e. Zurn Industries.
 3. Refer to Plumbing Schedule for Specification Standards.

2.22 TRENCH DRAINS

- A. Trench Drains: Comply with ASME A112.3.1.
 - 1. Manufacturer:
 - a. Josam Co.
 - b. Smith.
 - c. Wade Div.
 - d. Zurn Industries.
 - 2. Refer to Plumbing Schedule for Specification Standards.

2.23 ROOF DRAINS

- A. Roof Drains,: Comply with ASME A112.3.1.
 - 1. Application: Roof drain.
 - 2. Manufacturer:
 - a. Josam Co.
 - b. Smith.
 - c. Wade Div.
 - d. Zurn Industries.
 - 3. Refer to Plumbing Schedule for Specification Standards.

PART 3 - EXECUTION

3.1 INSTALLATION

- A. Refer to Division 15 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 strainers on supply side of each control valve, pressure regulator, and solenoid valve.
- E. Install draining-type ground and ground post hydrants with 1 cu. yd. of crushed gravel around drain hole.
 - 1. Set ground hydrants with box flush with grade.
 - 2. Set post hydrants in concrete paving or in 1 cu. ft. of concrete block at grade.

- F. 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.
- G. Install backwater valves in building drain piping. For interior installation, provide cleanout deck plate flush with floor and centered over backwater valve cover, and of adequate size to remove valve cover for servicing.
- H. Install expansion joints on vertical risers, stacks, and conductors if indicated.
- I. 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 (DN 100). Use NPS 4 (DN 100) 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 (15 m) for piping NPS 4 (DN 100) and smaller and 100 feet (30 m) for larger piping.
 - 4. Locate at base of each vertical soil and waste stack.
- J. Install cleanout deck plates with top flush with finished floor, for floor cleanouts for piping below floors.
- K. Install cleanout wall access covers, of types indicated, with frame and cover flush with finished wall, for cleanouts located in concealed piping.
- L. Install flashing flange and clamping device with each stack and cleanout passing through floors with waterproof membrane.
- M. Install vent flashing sleeves on stacks passing through roof. Secure over stack flashing according to manufacturer's written instructions.
- N. 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 (750 mm) or Less: Equivalent to 1 percent slope, but not less than 1/4-inch (6.35-mm) total depression.
 - b. Radius, 30 to 60 Inches (750 to 1500 mm): Equivalent to 1 percent slope.
 - c. Radius, 60 Inches (1500 mm) or Larger: Equivalent to 1 percent slope, but not greater than 1-inch (25-mm) total depression.
 - 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.
- O. 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.

- P. Install interceptors, including trapping, venting, and flow-control fitting, according to authorities having jurisdiction and with clear space for servicing.
1. Above-Floor Installation: Set unit with bottom resting on floor, unless otherwise indicated.
 2. Flush with Floor Installation: Set unit and extension, if required, with cover flush with finished floor.
 3. Recessed Floor Installation: Set unit in receiver housing having bottom or cradle supports, with receiver housing cover flush with finished floor.
 4. Install cleanout immediately downstream from interceptors not having integral cleanout on outlet.
 5. Coordinate oil-interceptor storage tank and gravity drain with Division 2 Section "Fuel-Oil Distribution."
- Q. 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.
- R. Fasten recessed-type plumbing specialties to reinforcement built into walls.
- S. Install wood-blocking reinforcement for wall-mounting and recessed-type plumbing specialties.
- T. 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 15 Section "Valves" for general-duty ball, butterfly, check, gate, and globe valves.
- U. Install air vents at piping high points. Include ball, gate, or globe valve in inlet.
- V. Install traps on plumbing specialty drain outlets. Omit traps on indirect wastes unless trap is indicated.
- W. 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 15 Sections. Drawings indicate general arrangement of piping, fittings, and specialties.
- B. Install piping adjacent to equipment to allow service and maintenance.
- C. Connect plumbing specialties to piping specified in other Division 15 Sections.
- D. Ground equipment.
- E. 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.
- F. Connect plumbing specialties and devices that require power according to Division 16 Sections.
- G. Interceptor Connections: Connect piping, flow-control fittings, and accessories.
1. Grease Interceptors: 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.

2. Oil Interceptors: Connect inlet, outlet, vent, and gravity drawoff piping to unit; flow-control fitting and vent to unit inlet piping; and gravity drawoff and suction piping to oil storage tank.
3. Solids Interceptors: Connect inlet and outlet.

3.3 FLASHING INSTALLATION

- A. Fabricate flashing from single piece unless large pans, sumps, or other drainage shapes are required. Join flashing according to the following if required:
 1. Lead Sheets: Burn joints of lead sheets 6-lb/sq. ft. (30-kg/sq. m), 0.0938-inch (2.4-mm) thickness or thicker. Solder joints of lead sheets 4-lb/sq. ft. (20-kg/sq. m), 0.0625-inch (1.6-mm) thickness or thinner.
 2. Copper Sheets: Solder joints of copper sheets.
- B. Install sheet flashing on pipes, sleeves, and specialties passing through or embedded in floors and roofs with waterproof membrane.
 1. Pipe Flashing: Sleeve type, matching pipe size, with minimum length of 10 inches (250 mm), and skirt or flange extending at least 8 inches (200 mm) around pipe.
 2. Sleeve Flashing: Flat sheet, with skirt or flange extending at least 8 inches (200 mm) around sleeve.
 3. Embedded Specialty Flashing: Flat sheet, with skirt or flange extending at least 8 inches (200 mm) around specialty.
- C. Set flashing on floors and roofs in solid coating of bituminous cement.
- D. Secure flashing into sleeve and specialty clamping ring or device.
- E. Install flashing for piping passing through roofs with counterflashing or commercially made flashing fittings, according to Division 7 Section "Sheet Metal Flashing and Trim."
- F. Extend flashing up vent pipe passing through roofs and turn down into pipe, or secure flashing into cast-iron sleeve having calking recess.
- G. Fabricate and install flashing and pans, sumps, and other drainage shapes.

3.4 LABELING AND IDENTIFYING

- A. Equipment Nameplates and Signs: Install engraved plastic-laminate equipment nameplate or sign on or near each backflow preventer thermostatic water mixing valve water tempering valve grease interceptor and oil interceptor.
 1. Text: Distinguish among multiple units, inform operator of operational requirements, indicate safety and emergency precautions, and warn of hazards and improper operations, in addition to identifying unit.
 2. Refer to Division 15 Section "Basic Mechanical Materials and Methods Mechanical Identification" for nameplates and signs.

3.5 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.

3.6 DEMONSTRATION

- A. Engage a factory-authorized service representative to train Owner's maintenance personnel to adjust, operate, and maintain equipment. Refer to Division 1 Section "Closeout Procedures."

END OF SECTION 15430

SECTION 15485 - ELECTRIC WATER HEATERS

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 electric water heaters:
 - 1. Flow-control, instantaneous electric water heaters.
 - 2. Light-commercial electric water heaters.
 - 3. Water heater accessories.

1.3 SUBMITTALS

- A. Product Data: For each type and size of water heater indicated. Include rated capacities, operating characteristics, furnished specialties, and accessories.
- B. Shop Drawings: Diagram power, signal, and control wiring.
- C. Product Certificates: For each type of commercial and instantaneous electric water heater, signed by product manufacturer.
- D. Source quality-control test reports.
- E. Field quality-control test reports.
- F. Operation and Maintenance Data: For electric water heaters to include in emergency, operation, and maintenance manuals.
- G. Warranty: Special warranty specified in this Section.

1.4 QUALITY ASSURANCE

- A. Source Limitations: Obtain same type of electric water heaters through one source from a single manufacturer.
- B. Product Options: Drawings indicate size, profiles, and dimensional requirements of electric water heaters and are based on the specific system indicated. Refer to Division 1 Section "Product Requirements."
- 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: Where indicated, fabricate and label commercial water heater storage tanks to comply with ASME Boiler and Pressure Vessel Code: Section VIII, Division 1.
- E. Comply with NSF 61, "Drinking Water System Components - Health Effects; Sections 1 through 9," for all components that will be in contact with potable water.

1.5 COORDINATION

- A. Coordinate size and location of concrete bases with Architectural and Structural Drawings.

1.6 WARRANTY

- A. Manufacturer's standard form in which manufacturer agrees to repair or replace components of electric water heaters that fail in materials or workmanship within specified warranty period.
 - 1. Failures include, but are not limited to, the following:
 - a. Structural failures including storage tank and supports.
 - b. Faulty operation of controls.
 - c. Deterioration of metals, metal finishes, and other materials beyond normal use.

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. Manufacturers: Subject to compliance with requirements, provide products by one of the manufacturers specified.

2.2 LIGHT-COMMERCIAL ELECTRIC WATER HEATERS

- A. Description: Comply with UL 174 for household, storage electric water heaters.
 - 1. Manufacturers:
 - a. Lochinvar Corporation.
 - b. Ruud Water Heater Div.; Rheem Manufacturing Company.
 - c. Smith, A. O. Water Products Company.
 - d. State Industries, Inc.
 - 2. Storage-Tank Construction: Steel, vertical arrangement.
 - a. Tappings: ASME B1.20.1 pipe thread.
 - b. Pressure Rating: 150 psig (1035 kPa).
 - c. Interior Finish: Comply with NSF 61 barrier materials for potable-water tank linings, including extending lining material into tappings.
 - 3. Factory-Installed Storage-Tank Appurtenances:
 - a. Anode Rod: Replaceable magnesium.

- b. Dip Tube: Provide unless cold-water inlet is near bottom of tank.
- c. Drain Valve: ASSE 1005.
- d. Insulation: Comply with ASHRAE/IESNA 90.1 or ASHRAE 90.2.
- e. Jacket: Steel with enameled finish.
- f. Heat Trap Fittings: Inlet type in cold-water inlet and outlet type in hot-water outlet.
- g. Heating Elements: Two; electric, screw-in immersion type; wired for simultaneous operation, unless otherwise indicated.
- h. Temperature Control: Adjustable thermostat for each element.
- i. Safety Control: High-temperature-limit cutoff device or system.
- j. Relief Valve: ASME rated and stamped and complying with ASME PTC 25.3 for combination temperature and pressure relief valves. Include relieving capacity at least as great as heat input, and include pressure setting less than water heater working-pressure rating. Select relief valve with sensing element that extends into storage tank.

- 4. Special Requirements: NSF 5 construction with legs for off-floor installation.

2.3 WATER HEATER ACCESSORIES

- A. Combination Temperature and Pressure Relief Valves: ASME rated and stamped and complying with ASME PTC 25.3. Include relieving capacity at least as great as heat input, and include pressure setting less than water heater working-pressure rating. Select relief valves with sensing element that extends into storage tank.
- B. Water Heater Mounting Brackets: Water heater manufacturer's factory-fabricated steel bracket for wall mounting and capable of supporting water heater and water.
- C. Drain Pans: Corrosion-resistant metal with raised edge. Include dimensions not less than base of water heater and include drain outlet not less than NPS 3/4 (DN 20).
- D. Piping-Type Heat Traps: Field-fabricated piping arrangement according to ASHRAE/IESNA 90.1 or ASHRAE 90.2.
- E. Shock Absorbers: ASSE 1010 or PDI WH 201, Size A water hammer arrester.

2.4 SOURCE QUALITY CONTROL

- A. Hydrostatically test water heater storage tanks before shipment to minimum of one and one-half times pressure rating.
- B. Prepare test reports.

PART 3 - EXECUTION

3.1 WATER HEATER INSTALLATION

- A. Install water heaters on concrete bases.
 - 1. Exception: Omit concrete bases for commercial water heaters if installation on stand, bracket, suspended platform, or direct on floor is indicated.

2. Concrete base construction requirements are specified in Division 15 Section "Basic Mechanical Materials and Methods."
 - B. Install water heaters level and plumb, according to layout drawings, original design, and referenced standards. Maintain manufacturer's recommended clearances. Arrange units so controls and devices needing service are accessible.
 - C. Install combination temperature and pressure relief valves in top portion of storage tanks. Use relief valves with sensing elements that extend into tanks. Extend commercial-water-heater relief-valve outlet, with drain piping same as domestic water piping in continuous downward pitch, and discharge by positive air gap onto closest floor drain.
 - D. Install combination temperature and pressure relief valves in water piping for water heaters without storage. Extend water-heater relief-valve outlet, with drain piping same as domestic water piping in continuous downward pitch, and discharge by positive air gap onto closest floor drain.
 - E. Install water-heater drain piping as indirect waste to spill by positive air gap into open drains or over floor drains. Install hose-end drain valves at low points in water piping for water heaters that do not have tank drains. Refer to Division 15 Section "Plumbing Specialties" for hose-end drain valves.
 - F. Install thermometer on outlet piping of water heaters.
 - G. Install thermometers on inlet and outlet piping of household, collector-to-tank, solar-electric water heaters. Refer to Division 15 Section "Meters and Gages" for thermometers.
 - H. Assemble and install inlet and outlet piping manifold kits for multiple water heaters. Fabricate, modify, or arrange manifolds for balanced water flow through each water heater. Include shutoff valve, thermometer in each water heater inlet and outlet, and throttling valve in each water heater outlet. Refer to Division 15 Section "Valves" for general-duty valves.
 - I. Install piping-type heat traps on inlet and outlet piping of water heater storage tanks without integral or fitting-type heat traps.
 - J. Fill water heaters with water.

3.2 CONNECTIONS

- A. Piping installation requirements are specified in other Division 15 Sections. Drawings indicate general arrangement of piping, fittings, and specialties.
- B. Install piping adjacent to water heaters to allow service and maintenance. Arrange piping for easy removal of water heaters.
- C. Ground equipment according to Division 16 Section "Grounding and Bonding."
- D. Connect wiring according to Division 16 Section "Conductors and Cables."

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 connections. Report results in writing.
- B. **Perform the following field tests and inspections and prepare test reports:**
 - 1. **Leak Test:** After installation, test for leaks. Repair leaks and retest until no leaks exist.
 - 2. **Operational Test:** After electrical circuitry has been energized, confirm proper operation.
 - 3. **Test and adjust controls and safeties.** Replace damaged and malfunctioning controls and equipment.
- C. **Remove and replace water heaters that do not pass tests and inspections and retest as specified above.**

3.4 DEMONSTRATION

- A. Engage a factory-authorized service representative to train Owner's maintenance personnel to adjust, operate, and maintain electric water heaters. Refer to Division 1 Section "Closeout Procedures."

END OF SECTION 15485

SECTION 15734 - VERTICAL FAN COIL 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.

1.2 SUMMARY

- A. This section includes constant volume, vertical fan coil units for indoor installations.
- B. Related Sections include the following:
 - 1. Division 15 Section *Vibration Isolators* for vibration isolators not an integral part of vertical fan coil units specified in this section.

1.3 SUBMITTALS

- A. Product Data: For each type of vertical fan coil unit indicated, include the following:
 - 1. Complete fan performance curves with system operating conditions indicated shall be tested in an AMCA Registered Chamber.
 - 2. Fan sound power rating shall be tested in an AMCA Registered Chamber.
 - 3. Certified coil performance ratings with system operating conditions indicated.
 - 4. Motor ratings, electrical characteristics, and motor and fan accessories.
 - 5. Material gages and finishes.
- B. Field Quality Control Test Reports: From manufacturer.

1.4 QUALITY ASSURANCE

- A. Source Limitations: Obtain vertical fan coil units through one source from a single manufacturer.
- B. Product Options: Drawings indicate size, profiles, and dimensional requirements of vertical fan coil units and are based on the specific system indicated. Refer to Division 1 Section "Product Requirements."
- 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. NFPA Compliance: Vertical fan coil units and components shall be designed, fabricated, and installed in compliance with NFPA 90A. "Installation of Air Conditioning and Ventilating Systems."
- E. Agency Certification: Vertical fan coil units and their components shall be factory tested in accordance with UL 1995 and shall be sent to ETL for testing.
- F. Comply with NFPA 70.

1.5 COORDINATION

- A. Coordinate size and location of structural steel support members.

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. Filters: **(One)** set(s) for each vertical fan coil unit.
 - 2. Fan Belts: **(One)** set(s) for each vertical fan coil 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. Greenheck
 - 2. Carrier
 - 3. York

4. Trane
5. McQuay

2.2 MANUFACTURED UNITS

- A. Vertical fan coil units shall be factory assembled and consist of fans, motor and drive assembly, coils, filters, stainless steel condensate pans, and accessories.

2.3 CABINET

- A. Materials: Formed double wall insulated panels, fabricated to allow removal for access to internal parts and components, with joints between sections gasketed.
 6. Outside Casing: 18 gauge, galvanized steel (G90)
 7. Inside Casing: 18 gauge, galvanized steel (G90)
 8. Utility Lugs: For lifting unit and fastening to permanent structure, 8 gauge, galvanized steel (G90)
- B. Cabinet Insulation: Comply with NFPA 90A or NFPA 90B
 1. Materials: Fiber glass insulation
 2. Thickness: 1 inch (25 mm)
 3. Density: 1-1/2 (3) pounds per cubic foot.
 4. Thermal Conductivity (k-Value): 0.26 at 75°F (0.037 at 24°C) mean temperature.
 5. Fire-Hazard Classification: Maximum flame spread index of 25 and smoke developed index of 50, when tested according to ASTM C 411.
 6. Location and Application: Encased between outside and inside casing.
- C. Access Panels: Same materials and finishes as cabinet complete with threaded screw fasteners and gaskets. Inspection and access panels shall be sized and located to allow periodic maintenance and inspections. Provide access panels in the following locations:
 1. Fan Section: Inspection and access panels
 2. Coil Section: Inspection panel
 3. Filter Section: Inspection and access panels to allow periodic removal and installation of filters.
- D. Condensate Drain Pans: Formed sections of stainless steel sheet complying with requirements in ASHRAE 62. Fabricate pans with slopes in two planes to collect condensate from cooling coils (including coil piping connections and return bends) when units are operating at maximum catalogued face velocity across cooling coil.
 1. Double Wall Construction: Fill space between walls with 1 inch, 1-1/2 pound fiber glass insulation.
 2. Drain Connections: Main and auxiliary on same side of fan.
- E. Nameplate Mylar: Permanently affixed to cabinet. Include model, make, and serial number identification.

2.4 FAN SECTION

- A. Fan Section Construction: Belt driven centrifugal fans consisting of housing, wheel, fan shaft, bearings, motor drive assembly, and support structure and equipped with formed steel channel base for integral mounting of fan, motor, and casing panels. Mount fan with interior (**spring**) vibration isolation.
- B. Centrifugal Fan Housings: Formed and reinforced steel panels to make curved scroll housings with shaped cutoff, spun metal inlet bell, and access panels or doors to allow entry to internal parts and components.
 1. Panel Bracing: Steel angle or channel iron member supports for mounting and supporting fan scroll, wheel, motor, and accessories.
 2. Horizontal Flanged Split Housing: Bolted construction.
 3. Drive Frame: Rail mounted, heavy gauge steel to allow frame to slide for easy belt tensioning.
- C. Fan Assemblies: Statically and dynamically balanced and designed for continuous operation at maximum rated fan speed and motor horsepower.
- D. Forward Curved Fan Wheels: Galvanized steel and/or aluminum/painted steel construction with inlet flange, backplate, and shallow blades with inlet and tip curved forward in direction of

airflow and mechanically secured to flange and backplate; cast-steel hub swaged to backplate and fastened to shaft with set screws.

- E. Shafts: Statically and dynamically balanced and designed for continuous operation at maximum rated fan speed and motor horsepower, with final alignment and belt adjustment made after installation.
 - 1. Turned, ground, and polished **hot rolled** steel with keyway. Ship with a protective coating of lubricating oil.
 - 2. Designed to operate at no more than 70 percent of first critical speed at top of fan's speed range.
- F. Pre-lubricated and Sealed Shaft Bearings: Self-aligning, pillow block type ball bearings.
 - 1. Ball-Bearing Rating Life: ABMA 9, L_{10} of 100,000 hours.
- G. Belt Drives: Factory mounted, with final alignment and belt adjustment made after installation and with 1.5 service factor based on fan motor.
 - 1. Pulleys: Mechanical cast iron with split, tapered bushing dynamically balanced at factory.
 - 2. Motor Pulleys: Adjustable pitch. Select pulley so pitch adjustment is at the middle of adjustment range at fan design conditions.
 - 3. Belts: Oil resistant, static free
 - 4. Motor Mount: Adjustable for belt tensioning
- H. Fan Section Source Quality Control:
 - 1. Factory test fan performance for flow rate, pressure, power, air density, rotation speed, and efficiency. Establish ratings according to AMCA 210, "Laboratory Methods of Testing Fans for Rating."
- I. Inlet/Outlet duct collars: Galvanized collars at each inlet and outlet of the unit. Flexible duct connection isolating discharge of scroll from discharge of fan.

2.5 MOTORS

- A. General: Comply with requirements in Division 15 Section *Motors*, matched with fan load.
- B. Noise Rating: Quiet
- C. Maximum Ambient Temperature Rating: 120°F (40°C).

2.6 COILS

- A. Design and construct to facilitate removal and replacement of coil for maintenance and to ensure full airflow through coils.
- B. Water Coils: (**Continuous circuit coil fabricated according to ARI 410**) (**Self-draining coil fabricated according to ARI 410**).
 - 1. Piping Connections: Sweat
 - 2. Tubes: Copper, .016 inch tube thickness
 - 3. Fins: Aluminum, minimum of .005 inch thickness
 - 4. Fin and Tube Joint: Mechanical bond
 - 5. Headers: Seamless copper tube with brazed joints
 - 6. Frames: Galvanized steel channel frame
 - 7. Ratings: Design tested and rated according to ARI 410
 - a. Working Pressure Ratings: 250 psig (kPa), 300°F (°C)
 - 8. Source Quality Control: Test to 500 psig (kPa) underwater (2000 psig ultimate strength)
- C. Refrigerant Coils: Coil designed for use with R-410a refrigerant, fabricated according to ARI 410. Connected with soldered fittings
 - 1. Capacity Reduction: Circuit for **single** control
 - 2. Tubes: Copper
 - 3. Fins: Aluminum, minimum of .005 inch thickness
 - 4. Fin and Tube Joint: Mechanical bond
 - 5. Suction and Distributor: Seamless copper tube with brazed joints
 - 6. Frames: 16 gauge, galvanized steel channel frame
 - 7. Ratings: Design tested and rated in accordance to UL (UL recognized)
 - a. Working Pressure Rating: 250 psig
 - 8. Source Quality Control: 500 psig underwater (2000 psig ultimate strength)
- E. Electrical Heating Coils, Controls, and Accessories: Comply with UL1995.

1. Casing Assembly: Galvanized steel frame
2. Heating Elements: Open coil resistance wire of 80 percent nickel and 2- percent chromium supported and insulated by floating ceramic bushings recessed into casing openings, fastened to supporting brackets, and mounted in galvanized steel frame.
3. Over-Temperature Protection: Disk type, automatically resetting thermal cutout, safety device, serviceable through terminal box without removing heater from duct or unit.
 - a. Secondary Protection: Load carrying, manually resetting or manually replaceable, thermal cutouts, factory wired in series with each heater stage.

2.7 FILTER SECTION

- A. Filters: Comply with NFPA 90A
- B. Filter Section: Provide filter holding frames arranged for vertical orientations, with access panels on both sides of unit. Filters shall be removable from both sides.
- C. Extended Surface, Disposable Panel Filters: Factory fabricated, dry, extended surface filters with holding frames.
 1. Media: Fibrous material formed into deep-V shape.
 2. Media and Media Grid Frame: Non-Flammable cardboard.

PART 3 – EXECUTION

3.1 EXAMINATION

- A. Examine areas and conditions for compliance with requirements for installation tolerances and other conditions affecting performance.
- B. Examine roughing-in of steam, hydronic, direct expansion and condensate drainage piping systems and electrical services to verify actual locations of connections before installation.
- C. Proceed with installation only after unsatisfactory conditions have been corrected.

3.2 INSTALLATION

- A. Install vertical fan coil units with the following vibration control devices. Vibration control devices are specified in Division 15 Section "Mechanical Vibration and Seismic Controls."
 1. Units with Internally Isolated Fans: Secure units to anchor bolts installed in concrete bases. Mounting units on a neoprene pad will help prevent possible vibration.
- B. Arrange installation of units to provide access space around vertical fan coil units for service and maintenance.

3.3 CONNECTIONS

- A. Piping installation requirements are specified in other Division 15 Sections. Drawings indicate general arrangement of piping, fittings, and specialties.
- B. Install piping adjacent to machine to allow service and maintenance.
- C. Connect piping to vertical fan coil units mounted on vibration isolators with flexible connectors.
- D. Connect condensate drain pans, to drainage piping. Extend to nearest equipment or floor drain. Construct deep trap at connection to drain pan and install cleanouts at changes in direction.
- E. Hot and Chilled Water Piping: Comply with applicable requirements in Division 15 Section "Hydronic Piping." Connect to supply and return coil tapplings with shutoff or balancing valve and union or flange at each connection.
- F. Steam and Condensate Piping: Comply with applicable requirements in Division 15 Section "Steam and Condensate Piping." Connect to supply and return coil tapplings with shutoff valve and union or flange at each connection.
- G. Refrigerant Piping: Comply with applicable requirements in Division 15 Section "Refrigerant Piping." Connect to supply and return coil tapplings with shutoff valve and union or flange at each connection.
- H. Duct installation and connection requirements are specified in other Division 15 Sections. Drawings indicate general arrangement of ducts and duct accessories.
- I. Electrical: Comply with applicable requirements in Division 16 Sections for power wiring, switches, and motor controls.
- J. Ground equipment according to Division 16 Section "Grounding and Bonding."

- K. 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. 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, fill water and steam coils with water and test coils and connections for leaks. Repair leaks and retest until no leaks exist.
 2. Charge refrigerant coils with refrigerant and test for leaks. Repair leaks and retest until no leaks exist.
 3. Fan Operational Test: After electrical circuitry has been energized, start units to confirm proper motor rotation and unit operation. Remove malfunctioning units, replace with new units, and retest.

3.5 STARTUP SERVICE

- A. Engage a factory authorized service representative to perform startup service.
- B. Final checks before startup. Perform the following:
 1. Verify that unit is secure on mountings and supporting devices; and that connections to piping, ducts, and electrical systems are complete. Verify that proper thermal overload protection is installed in motors, starters, and disconnect switches.
 2. Perform cleaning and adjusting specified in this section.
 3. Disconnect fan drive from motor, verify proper motor rotation direction, and verify free fan wheel rotation and smooth bearing operations. Reconnect fan drive system, align belts and install belt guards.
 4. Lubricate bearings, pulleys, belts, and other moving parts with factory recommended lubricants.
 5. Comb coil fins for parallel orientation.
 6. Install clean filters.
 7. Verify that manual and automatic volume control and fire and smoke dampers in connected duct systems are in fully open position.
- C. Starting procedures for vertical fan coil units include the following:
 1. Energize motor, verify proper operation of motor, drive system, and fan wheel. Adjust fan to indicated rpm.
 2. Measure and record motor electrical values for voltage and amperage.

Refer to Division 15 Section "Testing, Adjusting, and Balancing" for low profile vertical fan coil system testing, adjusting and balancing.

3.6 CLEANING

- A. Clean vertical fan coil units internally, on completion of installation, according to manufacturer's written instructions. Clean fan interiors to remove foreign material and construction dirt and dust. Vacuum clean fan wheels, cabinets, and coils entering air face.
- B. After completing system installation and testing, adjusting, and balancing vertical fan coil and air distribution systems, clean filter housings and install new filters

3.7 DEMONSTRATION

- A. Engage a factory authorized service representative to train owner's maintenance personnel to adjust, operate, and maintain vertical fan coil units. Refer to Division 1 Section *Closeout Procedures and Demonstration and Training*.

END OF SECTION 15700

SECTION 15736 – DUCT-FREE SPLIT SYSTEMS

Part 1 – General

1.01 RELATED DOCUMENTS

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

1.02 SUMMARY

- A. This Section includes Inverter Driven variable capacity, heat pump air conditioning split system.
 - 1. Wall-mounted indoor units
 - 2. Ceiling-mounted indoor units
 - 3. Outdoor condensing units

1.03 SUBMITTALS

- A. Product Data: Include rated capacities, operating characteristics, furnished specialties, and accessories
- 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. Wiring Diagrams: Power, signal, and control wiring.
 - 2. Dimensioned outline drawings of equipment unit: Identify center of gravity and locate and describe mounting and anchorage provisions.
 - 3. Detailed description of equipment anchorage devices on which the certification is based and their installation requirements.
- C. Operation and Maintenance Data: For computer-room air-conditioning units to include in emergency, operation, and maintenance manuals.

1.04 QUALITY ASSURANCE

- A. The units shall be listed by Electrical Laboratories (ETL) and bear the ETL label.
- B. All wiring shall be in accordance with the National Electric Code (NEC).
- C. The shall be rated in accordance with Air Conditioning Refrigeration Institute's (ARI) Standard 210 and bear the ARI label
- D. The system will be produced in an ISO 9001 and ISO 14001 facility, which are standards set by the International Standard Organization (ISO). The system shall be factory tested for safety and function.
- E. The outdoor unit will be factory charged for a length of 33 feet of refrigerant with R410A refrigerant.
- F. A dry air holding charge shall be provided in the evaporator.

1.05 DELIVERY, STORAGE AND HANDLING

- A. Unit shall be stored and handled according to the manufacturer's recommendations.

1.06 WARRANTY

- A. Wall-mount units and associated condensing units:
 - 1. Units shall have a (5) year manufacturer's warranty from date of installation.
 - 2. Compressor shall have a (7) year manufacturer's warranty from date of installation
 - 3. Units shall have a (1) year limited labor warranty from date of installation.
- B. Ceiling Cassette indoor units and associated condensing units:
 - 1. Units shall have a (1) year manufacturer's warranty from date of installation.
 - 2. Compressor shall have a (6) year manufacturer's warranty from date of installation
 - 3. Units shall have a (1) year limited labor warranty from date of installation.

- C. During the stated period, should any part fail due to defects in material and/or workmanship, it shall be repaired or replaced. Manufacturer's labor warranty shall only cover the first year. Extended warranties are for parts only.

Part 2 – Performance

2.01 MANUFACTURERS

- A. Daikin AC, contact Perry Mechanical Systems 956-683-1458
- B. Samsung
- C. Sanyo
- D. TRANE
- E. CARRIER
- F. YORK

2.02 PERFORMANCE

- A. The system performance shall be in accordance with ARI 210/240 test conditions as shown in the performance table below.
- B. The cooling performance is based on 80°F DB / 67°F WB for the indoor unit and 95°F DB / 75°F WB for the outdoor unit and 25 feet of piping.
- C. The heating performance is based on 70°F DB / 60°F WB for the indoor unit and 47°F DB / 43°F WB for the outdoor unit and 25 feet of piping.

2.03 INDOOR UNIT – WALL MOUNT (3/4-ton to 2-ton)

General:

The indoor unit shall be factory assembled and pre-wired with all necessary electronic and refrigerant controls. Both liquid and suction lines must be individually insulated between the outdoor and indoor units. The unit shall have a self diagnostic function, 3-minute time delay mechanism, and have a factory pre-charge of R410A adequate for 33 feet of total length.

A. Unit Cabinet:

- 1. The indoor unit shall have a white, "flat screen" finish.
- 2. The drain and refrigerant piping shall be accessible from six (6) positions for flexible installation (right side, right back, and right bottom; and left side, left back, and left bottom).
- 3. The cabinet shall be supplied with a mounting plate to be installed onto a wall for securely mounting the cabinet.
- 4. The cabinet includes an "intelligent-eye" motion sensor capable of setting back the set point temperature for energy savings. This feature may be disengaged on the wireless remote controller.

B. Fan:

- 1. The evaporator fan shall be an assembly consisting of a direct-driven fan by a single motor.
- 2. The fan shall be statically and dynamically balanced and operate on a motor with permanent lubricated bearings.
- 3. Provide an auto-swing louver for adjustable air flow both vertically and horizontally via the wireless remote control furnished with each system.
- 4. The indoor fan shall offer a choice of three speeds, High, Medium, and Low.

C. Filter:

- 1. The return air filter provided will be a mildew proof, removable and washable filter.

D. Coil:

- 1. The evaporator coil shall be a nonferrous, aluminum fin on copper tube heat exchanger.
- 2. All tube joints shall be brazed with silver alloy or phoscopper.
- 3. All coils shall be factory pressure tested.
- 4. A condensate pan shall be provided under the coil with a drain connection.

E. Electrical:

1. The outdoor unit shall be powered with 208/230 volts, 1 phase, and 60 hertz power. The indoor unit shall received 208/230 volt, 1 phase, 60 hertz power from the outdoor unit.
 2. The allowable voltage range shall be 187 volts to 253 volts.
- F. Control:
1. The unit shall have a wireless remote infra-red controller capable to operate the system. It shall have Automatic Operation, Dry Operation and Fan Only Operation.
 2. The infrared remote controller shall consist of an On/Off Power switch, Mode Selector, Silent Button (for outdoor unit), Fan Setting, Swing Louver, On/Off Timer Setting, Temperature Adjustment, "Intelligent Eye" sensor, Home Leave Operation, Powerful Operation.
 - i. On/Off switch power the system on or off mode.
 - ii. Mode selector shall operate the system in auto, cool, heat, fan or dry operation
 - iii. Silent shall operation shall lower the sound level of the outdoor unit by slowing the inverter driven fan speed.
 - iv. Fan setting shall provide high, medium or low fan speed.
 - v. Swing louver shall adjust the airflow (horizontal and vertical) blades.
 - vi. On/Off timer is used for automatically switching the unit on or off.
 - vii. Temperature adjustment allows for the increase or decrease of the desired temperature.
 - viii. Intelligent eye provides an infrared sensor which detects movement and adjusts the temperature by 3.6°F up or down depending on operating mode.
 - ix. Home leave operation allows you to record your favorite temperature and airflow setting and allow the system to set back by 3°F.
 - x. Powerful operation allows quick cool down or heating up in the desired space to achieve maximum desired temperature in the shortest allowable time period.
 3. The infrared remote control shall perform Fault Diagnostic functions which may be system related, indoor unit or outdoor unit related depending on the fault code. Temperature range on the remote control shall be 64°F to 90°F in cooling mode and 50°F to 86°F in heating mode.
 4. The indoor unit microprocessor has the capability to receive and process commands via return air temperature and indoor coil temperature sensors enabled by commands from the remote control.
 5. The system has automatic restart capability after a power failure has occurred.
- G. A condensate pump shall be provided and field wired to the indoor unit where scheduled.
- 2.04 OUTDOOR UNIT (3/4-ton to 2-ton) FOR USE WITH WALL MOUNT INDOOR UNIT
- General:
- The outdoor unit shall be specifically matched to the corresponding indoor unit size. The outdoor unit shall be complete factory assembled and pre-wired with all necessary electronic and refrigerant controls.
- A. Unit Cabinet:
- The cabinet shall be Ivory White with a finished powder coated backed enamel paint.
- B. Fan
1. The fan shall be a direct drive, propeller type fan.
 2. The motor shall be inverter drive, permanently lubricated type bearings, inherent.
 3. The fan shall be capable of operating in "silent operation" which lowers the outdoor fan speed in either cool, heat or auto modes.
 4. A fan guard is provided on the outdoor unit to prevent contact with fan operation.
 5. Airflow shall be horizontal discharge.
- C. Coil
1. The outdoor coil shall be nonferrous construction with corrugated fin tube.
 2. Refrigerant flow from the condenser will be controlled via a metering device.

3. A corrosion resistant coil fin tube shall be provided. Coating shall be an acrylic resin and hydrophilic film, epoxy coating or Copper tube/ Copper fin.
- D. Compressor:
1. The compressor shall be rotary swing inverter-driven compressor.
 2. The outdoor unit shall have an accumulator, four-way reversing valve.
 3. The compressor shall have an internal thermal overload.
- E. Electrical:
1. The electrical power requirement is 208/230 volt, 1-phase, and 60 Hz power.
 2. The voltage range limitations shall be a minimum of 187 volts and a maximum of 253 volts.
 3. The outdoor shall be controlled by a microprocessor located in the outdoor and indoor units via commands from the infrared remote controller.
 4. Electrical power (208/230 volt) shall be provided to the indoor unit via the outdoor unit.
- F. The operating range in cooling mode shall be 14°F DB to 115°F DB.
- G. The operating range in heating mode shall be 0°F DB to 64°F DB.

2.05 INDOOR UNIT – CEILING CASSETTE UNIT (2-ton to 3-1/2 ton)

A. General:

The Daikin indoor unit shall be a ceiling cassette fan coil unit, operable with R410A refrigerant, equipped with an electronic expansion valve, for installation into the ceiling cavity equipped with an air panel grille. It shall use a four-way air distribution type, ivory white, impact resistant, and washable decoration panel. The supply air is distributed via motorized louvers which can be horizontally and vertically adjusted from 0° to 90°. Computerized PID control shall be used to maintain room temperature within 1°F. The Unit shall also be equipped with a programmed drying mechanism that dehumidifies while inhibiting changes in room temperature when used with Daikin remote control BRC1C71 or BRC1D71.

B. Indoor Unit:

1. The Daikin indoor unit shall be completely factory assembled and tested. Included in the unit is factory wiring, piping, electronic proportional expansion valve, control circuit board, fan motor thermal protector, flare connections, condensate drain pan, condensate drain pump, self-diagnostics, auto-restart function, 3-minute fused time delay, and test run switch.
2. Indoor unit and refrigerant pipes will be charged with dehydrated air prior to shipment from the factory.
3. Both refrigerant lines shall be insulated from the outdoor unit.
4. The 4-way supply air flow shall be capable of field modification to 3-way and 2-way airflow to accommodate various installation configurations including corner installations.
5. Return air shall be through the concentric panel, which includes a resin net mold resistant filter.
6. The indoor units shall be equipped with a condensate pan and condensate pump. The condensate pump shall provide up to 21" of lift.
7. The indoor units shall be equipped with a return air thermistor.
8. The indoor unit will be separately powered with 208~230V/1-phase/60Hz.
9. The voltage range will be 253 volts maximum and 187 volts minimum.

C. Unit Cabinet:

1. The cabinet shall be space saving and shall be located into the ceiling.
2. Three auto-swing positions shall be available to choose, which include standard, draft prevention and ceiling stain prevention.
3. The airflow of the unit shall have the ability to shut down one or two sides allowing for simpler corner installation.
4. Fresh air intake shall be possible by field cutting as described in Installation manual.
5. A branch duct knockout shall exist for branch ducting supply air.

6. The cabinet shall be constructed with sound absorbing foamed polystyrene and polyethylene insulation.
 7. Optional high efficiency air filters are available for each model unit.
- D. Fan:
1. The fan shall be direct-drive turbo fan type with statically and dynamically balanced impeller with high and low fan speeds available.
 2. The fan motor shall operate on 208/230 volts, 1 phase, 60 hertz with a motor output of 0.12 HP.
 3. The air flow rate shall be available in high and low settings.
 4. The fan motor shall be thermally protected.
- E. Filter:
1. The return air shall be filtered by means of a washable long-life filter with mildew proof resin.
- F. Coil:
1. Coils shall be of the direct expansion type constructed from copper tubes expanded into aluminum fins to form a mechanical bond.
 2. The coil shall be of a waffle louver fin and high heat exchange, rifled bore tube design to ensure highly efficient performance.
 3. The coil shall be a 2 row cross fin copper evaporator coil with 17 FPI design completely factory tested.
 4. The refrigerant connections shall be flare connections and the condensate shall be 1 -1/4 inch outside diameter PVC.
 5. A condensate pan shall be located under the coil.
 6. A condensate pump with a 21 inch lift shall be located below the coil in the condensate pan with a built in safety alarm.
 7. A thermistor shall be located on the liquid and gas line to facilitate Superheat control and PID temperature control logic.
- G. Electrical:
1. A separate power supply shall be required of 208/230 volts, 1 phase, 60 hertz. The acceptable voltage range shall be 187 to 253 volts.
 2. Transmission (control) wiring between the indoor and outdoor unit shall be a maximum of 3,280 feet (total 6,560 feet).
 3. Transmission (control) wiring between the indoor and remote controller shall be a maximum distance of 1,640 feet.
- H. Control:
1. The unit shall have factory controls provided to perform input functions necessary to operate the system.
 2. A full array of Fault Diagnostics shall be accessible via the Wired Remote Controller.
- I. Accessories Required:
1. Remote "in-room" sensor kit (KRCS01-1).
 - i. A wall mounted, hard wired remote sensor kit is required for ceiling-embedded type fan coils. The sensor for detecting the temperature shall be placed away from the indoor unit (branch wiring shall be included in the kit.)
- 2.05 OUTDOOR UNIT (2-ton to 3-1/2 ton) FOR USE WITH CEILING CASSETTES
- A. General: The outdoor condensing unit is designed specifically for use with matched capacity SkyAir series indoor evaporator units of the ceiling cassette style.
1. The outdoor unit shall be factory assembled and pre-wired with all necessary electronic and refrigerant controls. The refrigeration circuit of the condensing unit shall consist of a scroll compressor, motors, fans, condenser coil, electronic expansion valve, solenoid valves, 4 way valve, distribution headers, capillaries, filters, shut off valves, oil separators, service ports, liquid receivers and accumulators.
 2. Both liquid and suction lines must be individually insulated between the outdoor and indoor units.

3. The outdoor unit can be wired and piped with outdoor unit access from left, right, front or rear.
 4. The sound pressure dB(A) at rated conditions shall be a value of 58 decibels at 3 feet from the front of the unit. The outdoor unit shall be capable of operating at further reduced noise during night time.
 5. The system will automatically restart operation after a power failure and will not cause any settings to be lost, thus eliminating the need for re-programming.
 6. The outdoor unit shall be modular in design and should allow for side-by-side installation with minimum spacing.
 7. The following safety devices shall be included on the condensing unit; high pressure switch, control circuit fuses, crankcase heaters, fusible plug, high pressure switch, overload relay, inverter overload protector, thermal protectors for compressor and fan motors, over current protection for the inverter and anti-recycling timers. To ensure the liquid refrigerant does not flash when supplying to the various fan coil units, the circuit shall be provided with a sub-cooling feature.
 8. The operating range in cooling mode shall be 23°F DB to 115°F DB
 9. The operating range in heating mode shall be 0°F DB to 64°F DB
- B. Unit Cabinet:
1. The outdoor unit model shall be completely weather proof and corrosion resistant. The unit shall be constructed from rust-proofed mild steel panels coated with a baked enamel finish.
- C. Fan:
1. The condensing unit shall consist of two propeller type, direct-drive fan 70 W motors that have multiple speed operation via a DC inverter type.
 2. The condensing unit fan motor shall have multiple speed operation of the DC inverter type.
 3. The fan shall be a horizontal discharge configuration with an air flow of 3,740 cfm.
 4. The fan motor shall have inherent protection and permanently lubricated bearings and be mounted.
 5. The fan motor shall be provided with a fan guard to prevent contact with moving parts.
- D. Condenser Coil:
1. The condenser coil shall be manufactured from copper tubes expanded into aluminum fins to form a mechanical bond.
 2. The coil shall be of a waffle louver fin and high heat exchanger, rifled bore tube design to ensure highly efficient performance.
 3. The coils shall be complete with corrosion treatment of an acrylic resin type. The thickness of the coating must be between 2.0 to 3.0 microns. Alternative corrosion treatment shall be epoxy coated coils or Copper tube/Copper fin.
- E. Compressor:
1. The scroll compressor shall be variable speed (PAM inverter) controlled which is capable of changing the speed to follow the variations in total cooling load as determined by the suction gas pressure as measured in the condensing unit.
 2. The inverter driven compressor in each condensing unit shall be of highly efficient reluctance DC, hermetically sealed scroll type with a maximum speed of 6,480 rpm.
 3. Neodymium magnets shall be adopted in the rotor construction to yield a higher torque and efficiency in the compressor instead of the normal ferrite magnet type. At complete stop of the compressor, the neodymium magnets will position the rotor into the optimum position for a low torque start.
 4. The capacity control range shall be 24% to 100%, with 20 individual capacity steps.
 5. Each compressor shall be equipped with a crankcase heater, high pressure safety switch, and internal thermal overload protector.
 6. The compressor shall be mounted to avoid the transmission of vibration.

F. Electrical:

1. The power supply to the outdoor unit shall be 208/230 volts, 1 phase, 60 hertz with a voltage range from 187 volts to 253 volts.
2. The control voltage between the indoor and outdoor unit shall be 16VDC non-shielded 2 conductor cable.
3. The control wiring shall be a two-wire multiplex transmission system, making it possible to connect multiple indoor units to one outdoor unit with one 2-conductor wire, thus simplifying the wiring operation.