

## SECTION 232113 - HYDRONIC PIPING

### PART 1 - GENERAL

#### 1.1 SUMMARY

- A. Section includes pipe and fitting materials and joining methods for the following:

1. Steel pipe and fittings.
2. Joining materials.
3. Dielectric fittings.

#### 1.2 ACTION SUBMITTALS

- A. Product Data: For each type of the following:

1. Pipe and tube.
2. Fittings.
3. Joining materials.
4. Transition fittings.

#### 1.3 INFORMATIONAL SUBMITTALS

#### 1.4 QUALITY ASSURANCE

- A. ASME Compliance: Comply with ASME B31.9, "Building Services Piping," for materials, products, and installation.

### PART 2 - PRODUCTS

#### 2.1 PERFORMANCE REQUIREMENTS

- A. Hydronic piping components and installation shall be capable of withstanding the following minimum working pressure and temperature unless otherwise indicated:
- B. Copper pipe to be used on systems 3" and smaller. Steel pipes to be used on 3-1/2" and larger.
- C. Supply/return headers:
1. Designed in "reverse return" configuration.
  2. Sized based on a water velocity of less than 4 ft/s.
- D. Provide calculations and assumptions for sizing circulating pumps in compliance with Chapter 43 of the ASHRAE Handbook, HVAC Systems and Equipment.

1. Hot-Water Heating Piping: 150 psig (kPa) at 180 deg F (82 deg C).
2. Makeup-Water Piping: 150 psig (1034 kPa at 150 deg F (66 deg C).
3. Blowdown-Drain Piping: 200 deg F (93 deg C).
4. Air-Vent Piping: 200 deg F (93 deg C).
5. Safety-Valve-Inlet and -Outlet Piping: Equal to the pressure of the piping system to which it is attached.

## 2.2 COPPER TUBE AND FITTINGS

- A. Tube in "Drawn-Temper Copper Tube" Paragraph below is generally available in NPS 1/8 to NPS 12 (DN 6 to DN 300). Drawn-temper copper tube is commonly referred to as "hard" copper tube. Drawn-Temper Copper Tubing: ASTM B88, Type M (ASTM B88M, Type C).
- B. Tube in "Annealed-Temper Copper Tube" Paragraph below is generally available in NPS 1/8 to NPS 12 (DN 6 to DN 300). Annealed-temper copper tubing is commonly referred to as "soft" copper tube. Annealed-Temper Copper Tubing: ASTM B88, Type K (ASTM B88M, Type A).
- C. DWV Copper Tubing: ASTM B306, Type DWV.
- D. Grooved, Mechanical-Joint, Copper Tube Appurtenances.
  1. Grooved-End Copper Fittings: ASTM B75 (ASTM B75M), copper tube or ASTM B584, bronze casting.
  2. Grooved-End-Tube Couplings: To fit copper-tube dimensions; rigid pattern unless otherwise indicated; gasketed fitting. EPDM-rubber gasket rated for minimum 230 deg F (110 deg C) for use with ferrous housing, and steel bolts and nuts; 300 psig (2060 kPa) minimum CWP pressure rating.

## 2.3 STEEL PIPE AND FITTINGS

- A. Steel Pipe: ASTM A53/A53M, black steel with plain ends; welded and seamless, Grade B, and wall thickness as indicated in "Piping Applications" Article.
- B. Cast-Iron Threaded Fittings: ASME B16.4; Classes 125 and 250 as indicated in "Piping Applications" Article.
- C. Malleable-Iron Threaded Fittings: ASME B16.3, Classes 150 and 300 as indicated in "Piping Applications" Article.
- D. Malleable-Iron Unions: ASME B16.39; Classes 150, 250, and 300 as indicated in "Piping Applications" Article.
- E. Cast-Iron Pipe Flanges and Flanged Fittings: ASME B16.1, Classes 25, 125, and 250; raised ground face, and bolt holes spot faced as indicated in "Piping Applications" Article.
- F. Wrought Cast- and Forged-Steel Flanges and Flanged Fittings: ASME B16.5, including bolts, nuts, and gaskets of the following material group, end connections, and facings:
  1. Material Group: 1.1.

2. End Connections: Butt welding.
3. Facings: Raised face.

G. Grooved Mechanical-Joint Fittings and Couplings:

1. Joint Fittings: ASTM A536, Grade 65-45-12 ductile iron; ASTM A47/A47M, Grade 32510 malleable iron; ASTM A53/A53M, Type F, E, or S, Grade B fabricated steel; or ASTM A106/A106M, Grade B steel fittings with grooves or shoulders constructed to accept grooved-end couplings; with nuts, bolts, locking pin, locking toggle, or lugs to secure grooved pipe and fittings.
2. Couplings: Ductile- or malleable-iron housing and EPDM or nitrile gasket of central cavity pressure-responsive design; with nuts, bolts, locking pin, locking toggle, or lugs to secure grooved pipe and fittings.

H. Plain-End Mechanical-Joint Couplings:

1. Housing: ASTM A-536 Grade 65-45-12 segmented ductile iron or type 304 stainless steel.
2. Housing Coating: None.
3. Gasket: EPDM NBR.
4. Sealing Mechanism: Double-lip sealing system or carbon steel case-hardened jaws.
5. Bolts, hex nuts, washers, or lock bars based on manufacturer's design.
6. Minimum Pressure Rating: Equal to that of the joined pipes.

## 2.4 JOINING MATERIALS

A. 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 (3.2-mm) maximum thickness unless otherwise 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.

B. Flange Bolts and Nuts: ASME B18.2.1, carbon steel, unless otherwise indicated.

C. Plastic, Pipe-Flange Gasket, Bolts, and Nuts: Type and material recommended by piping system manufacturer unless otherwise indicated.

D. Solder Filler Metals: ASTM B32, lead-free alloys. Include water-flushable flux according to ASTM B813.

E. Brazing Filler Metals: AWS A5.8/A5.8M, BCuP Series, copper-phosphorus alloys for joining copper with copper; or BAg-1, silver alloy for joining copper with bronze or steel.

F. Welding Filler Metals: Comply with AWS D10.12M/D10.12 for welding materials appropriate for wall thickness and chemical analysis of steel pipe being welded.

## 2.5 DIELECTRIC FITTINGS

- A. General Requirements: Assembly of copper alloy and ferrous materials with separating nonconductive insulating material. Include end connections compatible with pipes to be joined.
- B. Dielectric Unions:
  - 1.
  - 2. Description:
    - a. Standard: ASSE 1079.
    - b. Pressure Rating: 150 psig (1035 kPa) <Insert value>.
    - c. End Connections: Solder-joint copper alloy and threaded ferrous.
  - 3. t.

## PART 3 - EXECUTION

### 3.1 PIPING APPLICATIONS

- A. Hot-water heating piping, aboveground, NPS 3 (DN 50) and smaller, shall be the following:
  - 1. Type M (Type C), drawn-temper copper tubing, wrought-copper fittings, and soldered] brazed pressure-seal joints.
  - 2. [.
- B. Hot-water heating piping, aboveground, NPS 3-1/2 (DN 65) and larger, shall be the following:
  - 1. Schedule 40 steel pipe; grooved, mechanical joint coupling and fittings; and grooved, mechanical joints.
  - 2. Schedule 40 steel pipe, plain-end mechanical-coupled joints.
- C. Hot-Water Heating Piping Installed Belowground and within Slabs: Type K (Type A), drawn-temper copper tubing, wrought-copper fittings, and soldered joints. Use the fewest possible joints.
- D. Makeup-water piping installed aboveground shall be the following:
  - 1. Type M (Type C), drawn-temper copper tubing, wrought-copper fittings, and soldered joints.
- E. Makeup-Water Piping Installed Belowground and within Slabs: Type K (Type A), annealed-temper copper tubing, wrought-copper fittings, and soldered joints. Use the fewest possible joints.
- F. Condensate-Drain Piping, Copper: Type M (Type C), drawn-temper copper tubing, wrought-copper fittings, and soldered joints.
- G. Condensate-Drain Piping, PVC: Schedule 40 PVC plastic pipe and fittings and solvent-welded joints.

- H. Blowdown-Drain Piping: Same materials and joining methods as for piping specified for the service in which blowdown drain is installed.
- I. Air-Vent Piping:
  - 1. Inlet: Same as service where installed with metal-to-plastic transition fittings for plastic piping systems according to piping manufacturer's written instructions.
- J. Safety-Valve-Inlet and -Outlet Piping for Hot-Water Piping: Same materials and joining methods as for piping specified for the service in which safety valve is installed with metal-to-plastic transition fittings for plastic piping systems according to piping manufacturer's written instructions.

### 3.2 INSTALLATION OF PIPING

- A. Drawing plans, schematics, and diagrams indicate general location and arrangement of piping systems. Indicated locations and arrangements are used to size pipe and calculate friction loss, expansion, and other design considerations. Install piping as indicated unless deviations to layout are approved on Coordination Drawings.
- B. Install piping in concealed locations unless otherwise indicated and except in equipment rooms and service areas.
- C. Install piping indicated to be exposed and piping in equipment rooms and service areas at right angles or parallel to building walls. Diagonal runs are prohibited unless specifically indicated otherwise.
- D. Install piping above accessible ceilings to allow sufficient space for ceiling panel removal.
- E. Install piping to permit valve servicing.
- F. Install piping at indicated slopes.
- G. Install piping free of sags and bends.
- H. Install fittings for changes in direction and branch connections.
- I. Install piping to allow application of insulation.
- J. Select system components with pressure rating equal to or greater than system operating pressure.
- K. Install groups of pipes parallel to each other, spaced to permit applying insulation and servicing of valves.
- L. Install drains, consisting of a tee fitting, **NPS 3/4 (DN 20)** ball valve, and short **NPS 3/4 (DN 20)** threaded nipple with cap, at low points in piping system mains and elsewhere as required for system drainage.
- M. Install piping at a uniform grade of 0.2 percent upward in direction of flow.

- N. Reduce pipe sizes using eccentric reducer fitting installed with level side up.
- O. Install branch connections to mains using tee fittings in main pipe, with the branch connected to the bottom of the main pipe. For up-feed risers, connect the branch to the top of the main pipe.
- P. Install valves according to the following:
  - 1. Section 230523.12 "Ball Valves for HVAC Piping."
  - 2. Section 230523.14 "Check Valves for HVAC Piping."
  - 3. Section 230523.15 "Gate Valves for HVAC Piping."
- Q. Install unions in piping, **NPS 3 (DN 50)** and smaller, adjacent to valves, at final connections of equipment, and elsewhere as indicated.
- R. Install flanges in piping, **NPS 3-1/2 (DN 65)** and larger, at final connections of equipment and elsewhere as indicated.
- S. Install shutoff valve immediately upstream of each dielectric fitting.
- T. Comply with requirements in Section 230516 "Expansion Fittings and Loops for HVAC Piping" for installation of expansion loops, expansion joints, anchors, and pipe alignment guides.
- U. Comply with requirements in Section 230553 "Identification for HVAC Piping and Equipment" for identifying piping.
- V. Install sleeves for piping penetrations of walls, ceilings, and floors. Comply with requirements for sleeves specified in Section 230517 "Sleeves and Sleeve Seals for HVAC Piping."
- W. Install sleeve seals for piping penetrations of concrete walls and slabs. Comply with requirements for sleeve seals specified in Section 230517 "Sleeves and Sleeve Seals for HVAC Piping."

### 3.3 JOINT CONSTRUCTION

- A. Ream ends of pipes and tubes and remove burrs. Bevel plain ends of steel pipe.
- B. Remove scale, slag, dirt, and debris from inside and outside of pipe and fittings before assembly.
- C. Soldered Joints: Apply ASTM B813, water-flushable flux, unless otherwise indicated, to tube end. Construct joints according to ASTM B828 or CDA's "Copper Tube Handbook," using lead-free solder alloy complying with ASTM B32.
- D. Brazed Joints: Construct joints according to AWS's "Brazing Handbook," "Pipe and Tube" Chapter, using copper-phosphorus brazing filler metal complying with AWS A5.8/A5.8M.
- E. Threaded Joints: Thread pipe with tapered pipe threads according to ASME B1.20.1. Cut threads full and clean using sharp dies. Ream threaded pipe ends to remove burrs and restore full ID. Join pipe fittings and valves as follows:

1. Apply appropriate tape or thread compound to external pipe threads unless dry seal threading is specified.
  2. Damaged Threads: Do not use pipe or pipe fittings with threads that are corroded or damaged. Do not use pipe sections that have cracked or open welds.
- F. Flanged Joints: Select appropriate gasket material, size, type, and thickness for service application. Install gasket concentrically positioned. Use suitable lubricants on bolt threads.
- G. Grooved Joints: Assemble joints with coupling and gasket, lubricant, and bolts. Cut or roll grooves in ends of pipe based on pipe and coupling manufacturer's written instructions for pipe wall thickness. Use grooved-end fittings and rigid, grooved-end-pipe couplings.
- H. Plain-End Mechanical-Coupled Joints: Prepare, assemble, and test joints in accordance with manufacturer's written installation instructions.
- I. Mechanically Formed, Copper-Tube-Outlet Joints: Use manufacturer-recommended tools and procedure, and brazed joints.

### 3.4 INSTALLATION OF DIELECTRIC FITTINGS

### 3.5 INSTALLATION OF HANGERS AND SUPPORTS

- A. Comply with requirements in Section 230529 "Hangers and Supports for HVAC Piping and Equipment" for hangers, supports, and anchor devices.
- B. Install hangers for copper tubing and steel piping, with maximum horizontal spacing and minimum rod diameters, to comply with MSS-58, locally enforced codes, and authorities having jurisdiction requirements, whichever are most stringent.
- C. Install hangers for plastic piping, with maximum horizontal spacing and minimum rod diameters, to comply with manufacturer's written instructions, locally enforced code, and authorities having jurisdiction requirements, whichever are most stringent.
- D. Support vertical runs of copper tubing and steel piping to comply with MSS-58, locally enforced codes, and authorities having jurisdiction requirements, whichever are most stringent.

### 3.6 TERMINAL EQUIPMENT CONNECTIONS

- A. Sizes for supply and return piping connections shall be the same as or larger than equipment connections.
- B. Install control valves in accessible locations close to connected equipment.
- C. Install bypass piping with globe valve around control valve. If parallel control valves are installed, only one bypass is required.
- D. Install ports for pressure gages and thermometers at coil inlet and outlet connections. Comply with requirements in Section 230519 "Meters and Gauges for HVAC Piping."

### 3.7 IDENTIFICATION

- A. Identify system components. Comply with requirements for identification materials and installation in Section 230553 "Identification for HVAC Piping and Equipment."

### 3.8 FIELD QUALITY CONTROL

- A. Prepare hydronic piping according to ASME B31.9 and as follows:
  - 1. Leave joints, including welds, uninsulated and exposed for examination during test.
  - 2. Provide temporary restraints for expansion joints that cannot sustain reactions due to test pressure. If temporary restraints are impractical, isolate expansion joints from testing.
  - 3. Flush hydronic piping systems with clean water; then remove and clean or replace strainer screens.
  - 4. Isolate equipment from piping. If a valve is used to isolate equipment, its closure shall be capable of sealing against test pressure without damage to valve. Install blinds in flanged joints to isolate equipment.
  - 5. Install safety valve, set at a pressure no more than one-third higher than test pressure, to protect against damage by expanding liquid or other source of overpressure during test.
- B. Perform the following tests on hydronic piping:
  - 1. Use ambient temperature water as a testing medium unless there is risk of damage due to freezing. Another liquid that is safe for workers and compatible with piping may be used.
  - 2. While filling system, use vents installed at high points of system to release air. Use drains installed at low points for complete draining of test liquid.
  - 3. Isolate expansion tanks and determine that hydronic system is full of water.
  - 4. Subject piping system to hydrostatic test pressure that is not less than 1.5 times the system's working pressure. Test pressure shall not exceed maximum pressure for any vessel, pump, valve, or other component in system under test. Verify that stress due to pressure at bottom of vertical runs does not exceed 90 percent of specified minimum yield strength or 1.7 times the "SE" value in Appendix A in ASME B31.9, "Building Services Piping."
  - 5. After hydrostatic test pressure has been applied for at least 10 minutes, examine piping, joints, and connections for leakage. Eliminate leaks by tightening, repairing, or replacing components, and repeat hydrostatic test until there are no leaks.
  - 6. Prepare written report of testing.
- C. Perform the following before operating the system:
  - 1. Open manual valves fully.
  - 2. Inspect pumps for proper rotation.
  - 3. Set makeup pressure-reducing valves for required system pressure.
  - 4. Inspect air vents at high points of system and determine if all are installed and operating freely (automatic type), or bleed air completely (manual type).
  - 5. Set temperature controls so all coils are calling for full flow.
  - 6. Inspect and set operating temperatures of hydronic equipment, such as boilers, chillers, cooling towers, to specified values.
  - 7. Verify lubrication of motors and bearings.



END OF SECTION 232113