

SECTION 23 22 13
STEAM AND CONDENSATE HEATING PIPING

PART 1 GENERAL

1.01 REFERENCE STANDARDS

- A. ASME B1.20.1 - Pipe Threads, General Purpose, Inch; 2013 (Reaffirmed 2018).
- B. ASME B16.1 - Gray Iron Pipe Flanges and Flanged Fittings: Classes 25, 125, and 250; 2020.
- C. ASME B16.3 - Malleable Iron Threaded Fittings: Classes 150 and 300; 2021.
- D. ASME B16.4 - Gray Iron Threaded Fittings: Classes 125 and 250; 2021.
- E. ASME B16.5 - Pipe Flanges and Flanged Fittings: NPS 1/2 Through NPS 24 Metric/Inch Standard; 2025.
- F. ASME B16.21 - Nonmetallic Flat Gaskets for Pipe Flanges; 2021.
- G. ASME B16.22 - Wrought Copper and Copper Alloy Solder-Joint Pressure Fittings; 2021.
- H. ASME B16.39 - Malleable Iron Threaded Pipe Unions: Classes 150, 250, and 300; 2025.
- I. ASME B18.2.1 - Square, Hex, Heavy Hex, and Askew Head Bolts and Hex, Heavy Hex, Hex Flange, Lobed Head, and Lag Screws (Inch Series); 2012 (Reaffirmed 2021).
- J. ASME B31.1 - Power Piping; 2024.
- K. ASME B31.9 - Building Services Piping; 2025.
- L. ASTM A53/A53M - Standard Specification for Pipe, Steel, Black and Hot-Dipped, Zinc-Coated, Welded and Seamless; 2022.
- M. ASTM A126 - Standard Specification for Gray Iron Castings for Valves, Flanges, and Pipe Fittings; 2004 (Reapproved 2023).
- N. ASTM A234/A234M - Standard Specification for Piping Fittings of Wrought Carbon Steel and Alloy Steel for Moderate and High Temperature Service; 2023a.
- O. ASTM A733 - Standard Specification for Welded and Seamless Carbon Steel and Austenitic Stainless Steel Pipe Nipples; 2016 (Reapproved 2022).
- P. ASTM B32 - Standard Specification for Solder Metal; 2020.
- Q. ASTM B88 - Standard Specification for Seamless Copper Water Tube; 2022.
- R. ASTM B813 - Standard Specification for Liquid and Paste Fluxes for Soldering of Copper and Copper Alloy Tube; 2016.
- S. ASTM B828 - Standard Practice for Making Capillary Joints by Soldering of Copper and Copper Alloy Tube and Fittings; 2023.
- T. MSS SP-58 - Pipe Hangers and Supports - Materials, Design, Manufacture, Selection, Application, and Installation; 2018, with Amendment (2019).

1.02 RELATED DOCUMENTS

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

1.03 SUMMARY

- A. This Section includes the following for LP steam and condensate piping:
 - 1. Pipe and fittings.
 - 2. Strainers.
 - 3. Steam traps.
 - 4. Thermostatic air vents and vacuum breakers.

1.04 DEFINITIONS

- A. LP Systems: Low-pressure piping operating at 15 psig or less as required by ASME B31.9.

1.05 PERFORMANCE REQUIREMENTS

- A. Components and installation shall be capable of withstanding the following maximum system design pressures and temperatures:
 - 1. LP Steam Piping: 125 psig
 - 2. Condensate Piping: 125 psig at 250 deg F.

1.06 SUBMITTALS

- A. Product Data: For each type of the following:
 - 1. Steam trap.
 - 2. Air vent and vacuum breaker.
- B. Shop Drawings: Detail, 1/4 inch equals 1 foot scale, and fabrication of pipe anchors, hangers, pipe.
- C. Qualification Data: For Installer.
- D. Welding certificates.
- E. Field quality-control test reports.
- F. Operation and Maintenance Data: For valves, steam traps, air vents, vacuum breakers, and meters to include in emergency, operation, and maintenance manuals.

1.07 QUALITY ASSURANCE

- A. Steel Support Welding: Qualify processes and operators according to AWS D1.1, "Structural Welding Code - Steel."
- B. Pipe Welding: Qualify processes and operators according to the following:
 - 1. Comply with provisions in ASME B31 Series, "Code for Pressure Piping."
 - 2. Certify that each welder has passed AWS qualification tests for welding processes involved and that certification is current.
- C. ASME Compliance: Comply with ASME B31.1, "Power Piping" and ASME B31.9, "Building Services Piping" for materials, products, and installation. Safety valves and pressure vessels shall bear the appropriate ASME label. Fabricate and stamp flash tanks to comply with ASME Boiler and Pressure Vessel Code: Section VIII, Division 1.

PART 2 PRODUCTS

2.01 COPPER TUBE AND FITTINGS

- A. Drawn-Temper Copper Tubing: ASTM B88, Type L ((ASTM B88M)), Type B, ASTM B88, Type M ((ASTM B88M)), Type C).
- B. Annealed-Temper Copper Tubing: ASTM B88, Type K ((ASTM B88M)), Type A).
- C. Wrought-Copper Fittings and Unions: ASME B16.22.

2.02 STEEL PIPE AND FITTINGS

- A. Steel Pipe: ASTM A53/A53M, black steel, plain ends, Type, Grade, and Schedule as indicated in Part 3 piping applications articles.
- B. Cast-Iron Threaded Fittings: ASME B16.4; Classes 125, 150, and 300 as indicated in Part 3 piping applications articles.

- C. Malleable-Iron Threaded Fittings: ASME B16.3; Classes 150 and 300 as indicated in Part 3 piping applications articles.
- D. Malleable-Iron Unions: ASME B16.39; Classes 150, 250, and 300 as indicated in Part 3 piping applications articles.
- E. Cast-Iron Threaded Flanges and Flanged Fittings: ASME B16.1, Classes 125 and 250 as indicated in Part 3 piping applications articles; raised ground face, and bolt holes spot faced.
- F. Wrought-Steel Fittings: ASTM A234/A234M, wall thickness to match adjoining pipe.
- G. Wrought-Steel Flanges and Flanged Fittings: ASME B16.5, including bolts, nuts, and gaskets of the following material group, end connections, and facings:
 - 1. Material Group: 1.1.
 - 2. End Connections: Butt welding.
 - 3. Facings: Raised face.
- H. Steel Pipe Nipples: ASTM A733, made of ASTM A53/A53M, black steel of same Type, Grade, and Schedule as pipe in which installed.

2.03 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 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.
- B. Flange Bolts and Nuts: ASME B18.2.1, carbon steel, unless otherwise indicated.
- C. Solder Filler Metals: ASTM B32, lead-free alloys. Include water-flushable flux according to ASTM B813.
- D. Brazing Filler Metals: AWS A5.8, BCuP Series, copper-phosphorus alloys for joining copper with copper; or BAg-1, silver alloy for joining copper with bronze or steel.
- E. Welding Filler Metals: Comply with AWS D10.12 (AWS D10.12M) for welding materials appropriate for wall thickness and chemical analysis of steel pipe being welded.
- F. Welding Materials: Comply with Section II, Part C, of ASME Boiler and Pressure Vessel Code for welding materials appropriate for wall thickness and for chemical analysis of pipe being welded.

2.04 DIELECTRIC FITTINGS

- A. Description: Combination fitting of copper alloy and ferrous materials with threaded, solder-joint, plain, or weld-neck end connections that match piping system materials.
- B. Insulating Material: Suitable for system fluid, pressure, and temperature.
- C. Dielectric Unions:
 - 1. Available Manufacturers: Subject to compliance with requirements, manufacturers offering products that may be incorporated into the Work include, but are not limited to, the following:
 - 2. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
 - a. Capitol Manufacturing Company.
 - b. Central Plastics Company.
 - c. Hart Industries, International Inc.
 - d. Watts Water Technologies, Inc.
 - e. Zurn Plumbing Products Group.
 - f. Or approved equal

3. Factory-fabricated union assembly, for 250-psig (1725-kPa) minimum working pressure at 180 deg F (82 deg C).

2.05 VALVES

- A. Gate, Globe, Check, and Ball Valves: Comply with requirements specified in Division 23 Section "General-Duty Valves for HVAC Piping."
- B. Stop-Check Valves:
 1. Available Manufacturers: Subject to compliance with requirements, manufacturers offering products that may be incorporated into the Work include, but are not limited to, the following:
 - a. Crane Co.
 - b. Jenkins Valves; a Crane Company.
 - c. Lunkenheimer Valves.
 - d. A.Y. McDonald Mfg. Co.
 - e. Or approved equal
 2. Body and Bonnet: Malleable iron.
 3. End Connections: Flanged.
 4. Disc: Cylindrical with removable liner and machined seat.
 5. Stem: Brass alloy.
 6. Operator: Outside screw and yoke with cast-iron handwheel.
 7. Packing: Polytetrafluoroethylene-impregnated packing with two-piece packing gland assembly.
 8. Pressure Class: 250.

2.06 STRAINERS

- A. Y-Pattern Strainers:
 1. Body: ASTM A126, Class B cast iron, with bolted cover and bottom drain connection.
 2. End Connections: Threaded ends for strainers NPS 2 (DN 50) and smaller; flanged ends for strainers NPS 2-1/2 (DN 65) and larger.
 3. Strainer Screen: Stainless-steel, 20 mesh strainer, and perforated stainless-steel basket with 50 percent free area.
 4. Tapped blowoff plug.
 5. CWP Rating: 250-psig (1725-kPa) working steam pressure.

2.07 STEAM TRAPS

- A. Thermostatic Traps:
 1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
 - a. Armstrong International, Inc.
 - b. Barnes & Jones, Inc.
 - c. Dunham-Bush, Inc.
 - d. Hoffman Specialty; Division of ITT Industries.
 - e. Spirax Sarco, Inc.
 - f. Sterling.
 - g. Or approved equal
 2. Body: Bronze angle-pattern body with integral union tailpiece and screw-in cap.
 3. Trap Type: Balanced-pressure.
 4. Bellows: Stainless steel or monel.
 5. Head and Seat: Replaceable, hardened stainless steel.
 6. Pressure Class: 125.
- B. Thermodynamic Traps:

1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
 - a. Armstrong International, Inc.
 - b. Barnes & Jones, Inc.
 - c. Dunham-Bush, Inc.
 - d. Hoffman Specialty; Division of ITT Industries.
 - e. Spirax Sarco, Inc.
 - f. Or approved equal
 2. Body: Stainless steel with screw-in cap.
 3. End Connections: Threaded.
 4. Disc and Seat: Stainless steel.
 5. Maximum Operating Pressure: 600 psig.
- C. Float and Thermostatic Traps:
1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
 - a. Armstrong International, Inc.
 - b. Barnes & Jones, Inc.
 - c. Dunham-Bush, Inc.
 - d. Hoffman Specialty; Division of ITT Industries.
 - e. Spirax Sarco, Inc.
 - f. Sterling.
 - g. Or approved equal
 2. Body and Bolted Cap: ASTM A126, cast iron.
 3. End Connections: Threaded.
 4. Float Mechanism: Replaceable, stainless steel.
 5. Head and Seat: Hardened stainless steel.
 6. Trap Type: Balanced pressure.
 7. Thermostatic Bellows: Stainless steel or monel.
 8. Thermostatic air vent capable of withstanding 45 deg F (25 deg C) of superheat and resisting water hammer without sustaining damage.
 9. Vacuum Breaker: Thermostatic with phosphor bronze bellows, and stainless steel cage, valve, and seat.
 10. Maximum Operating Pressure: 125 psig.

2.08 THERMOSTATIC AIR VENTS AND VACUUM BREAKERS

- A. Thermostatic Air Vents:
1. Available Manufacturers: Subject to compliance with requirements, manufacturers offering products that may be incorporated into the Work include, but are not limited to, the following:
 - a. Armstrong International, Inc.
 - b. Barnes & Jones, Inc.
 - c. Dunham-Bush, Inc.
 - d. Hoffman Specialty; Division of ITT Industries.
 - e. Spirax Sarco, Inc.
 - f. Sterling.
 - g. Or approved equal
 2. Body: Cast iron, bronze or stainless steel.
 3. End Connections: Threaded.
 4. Float, Valve, and Seat: Stainless steel.
 5. Thermostatic Element: Phosphor bronze bellows in a stainless-steel cage.
 6. Pressure Rating: 125 psig
 7. Maximum Temperature Rating: 350 deg F (177 deg C).

- B. Vacuum Breakers:
 - 1. Available Manufacturers: Subject to compliance with requirements, manufacturers offering products that may be incorporated into the Work include, but are not limited to, the following::
 - a. Armstrong International, Inc.
 - b. Dunham-Bush, Inc.
 - c. Hoffman Specialty; Division of ITT Industries.
 - d. Johnson Corporation (The).
 - e. Spirax Sarco, Inc.
 - f. Or approved equal
 - 2. Body: Cast iron, bronze, or stainless steel.
 - 3. End Connections: Threaded.
 - 4. Sealing Ball, Retainer, Spring, and Screen: Stainless steel.
 - 5. O-ring Seal: EPR.
 - 6. Pressure Rating: 125 psig.
 - 7. Maximum Temperature Rating: 350 deg F (177 deg C).
- C. Performance Ratings: Tested and rated according to ARI 410 and ASHRAE 33.
- D. Minimum Working-Pressure/Temperature Ratings: 15 psig, 400 deg F (204 deg C).
- E. Source Quality Control: Factory tested to 300 psig.
- F. Tubes: ASTM B 743 copper, minimum 0.049 inch thick.
- G. Fins: Aluminum minimum 0.010 inch thick.
- H. Headers: Seamless copper tube with brazed joints, prime coated
- I. Tube Type: Single or distributing as indicated.
- J. Frames: Galvanized-steel channel frame, minimum 0.079 inch thick for flanged mounting.
- K.

PART 3 EXECUTION

3.01 LP STEAM PIPING APPLICATIONS

- A. LP Steam Piping, NPS 2 (DN 50) and Smaller: Schedule 40, Type S, Grade B, steel pipe; Class 125 cast-iron fittings; and threaded joints.
- B. LP Steam Piping, NPS 2-1/2 (DN 65) and larger: Schedule 40, Type E, Grade B, steel pipe; Class 150 wrought-steel fittings, flanges, and flange fittings; and welded and flanged joints.
- C. Condensate piping above grade, NPS 2 (DN 50) and smaller, shall be:
 - 1. Schedule 80, Type S, Grade B, steel pipe; Class 125 cast-iron fittings; and threaded joints.
- D. Condensate piping above grade, NPS 2-1/2 (DN 65) and larger, shall be:
 - 1. Schedule 80, Type E, Grade B, steel pipe; Class 150 wrought-steel fittings, flanges, and flange fittings; and welded and flanged joints.

3.02 ANCILLARY PIPING APPLICATIONS

- A. Air-Vent Piping:
 - 1. Inlet: Same as service where installed.
 - 2. Outlet: Type K (A) annealed-temper copper tubing with soldered or flared joints.
- B. Vacuum-Breaker Piping: Outlet, same as service where installed.

3.03 VALVE APPLICATIONS

- A. Install shutoff duty valves at branch connections to steam supply mains, at steam supply connections to equipment, and at the outlet of steam traps.

3.04 PIPING INSTALLATION

- A. Drawing plans, schematics, and diagrams indicate general location and arrangement of piping systems. Use indicated piping locations and arrangements if such were 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 above ceilings unless otherwise indicated.
- C. Install piping indicated to be exposed and piping at right angles or parallel to building walls. Diagonal runs are prohibited unless specifically indicated otherwise.
- D. Install piping to permit valve servicing.
- E. Install piping free of sags and bends.
- F. Install fittings for changes in direction and branch connections.
- G. Install piping to allow application of insulation.
- H. Select system components with pressure rating equal to or greater than system operating pressure.
- I. Install groups of pipes parallel to each other, spaced to permit applying insulation and servicing of valves.
- J. Install steam supply piping at a minimum uniform grade of 0.2 percent downward in direction of steam flow.
- K. Install condensate return piping at a minimum uniform grade of 0.4 percent downward in direction of condensate flow.
- L. Reduce pipe sizes using eccentric reducer fitting installed with level side down.
- M. Install unions in piping, NPS 2 (DN 50) and smaller, adjacent to valves, at final connections of equipment, and elsewhere as indicated.
- N. Install flanges in piping, NPS 2-1/2 (DN 65) and larger, at final connections of equipment and elsewhere as indicated.
- O. Install strainers on supply side of control valves, traps, and elsewhere as indicated. Install NPS 3/4 (DN 20) nipple and full port ball valve in blowdown connection of strainers NPS 2 (DN 50) and larger. Match size of strainer blowoff connection for strainers smaller than NPS 2 (DN 50).
- P. Identify piping as specified in Division 23 Section "Identification for HVAC Piping and Equipment."

3.05 STEAM-TRAP INSTALLATION

- A. Install steam traps in accessible locations as close as possible to connected equipment.
- B. Install full-port ball valve, strainer, and union upstream from trap; install union, check valve, and full-port ball valve downstream from trap unless otherwise indicated.

3.06 HANGERS AND SUPPORTS

- A. Install hangers and supports according to Division 23 Section 23 05 29 "Hangers and Supports for HVAC Piping and Equipment." Comply with requirements below for maximum spacing.
- B. Seismic restraints are specified in Division 13 Section 13 48 00 "Sound, Vibration and Seismic Controls" for HVAC Piping and Equipment.
- C. Install the following pipe attachments:
 - 1. Adjustable steel clevis hangers for individual horizontal piping less than 20 feet long.

2. Pipe Roller: MSS SP-58, Type 44 for multiple horizontal piping 20 feet or longer, supported on a trapeze.
 3. Spring hangers to support vertical runs.
- D. Install hangers with the following maximum spacing and minimum rod sizes:
1. NPS 3/4 (DN 20): Maximum span, 9 feet; minimum rod size, 1/4 inch.
 2. NPS 1 (DN 25): Maximum span, 9 feet; minimum rod size, 1/4 inch.
 3. NPS 1-1/2 (DN 40): Maximum span, 12 feet; minimum rod size, 3/8 inch.
 4. NPS 2 (DN 50): Maximum span, 13 feet; minimum rod size, 3/8 inch.
 5. NPS 2-1/2 (DN 65): Maximum span, 14 feet; minimum rod size, 3/8 inch.
- E. Install hangers for drawn-temper copper piping with the following maximum spacing and minimum rod sizes:
1. NPS 1/2 (DN 15): Maximum span, 4 feet; minimum rod size, 1/4 inch.
 2. NPS 3/4 (DN 20): Maximum span, 5 feet; minimum rod size, 1/4 inch.
 3. NPS 1 (DN 25): Maximum span, 6 feet; minimum rod size, 1/4 inch.
 4. NPS 1-1/2 (DN 40): Maximum span, 8 feet; minimum rod size, 3/8 inch.
 5. NPS 2 (DN 50): Maximum span, 8 feet; minimum rod size, 3/8 inch.

3.07 PIPE JOINT CONSTRUCTION

- A. Join pipe and fittings according to the following requirements and Division 23 Sections specifying piping systems.
- B. Ream ends of pipes and tubes and remove burrs. Bevel plain ends of steel pipe.
- C. Remove scale, slag, dirt, and debris from inside and outside of pipe and fittings before assembly.
- D. Soldered Joints: Apply ASTM B813, water-flushable flux, unless otherwise indicated, to tube ends. Construct joints according to ASTM B828 or CDA's "Copper Tube Handbook," using lead-free solder alloy complying with ASTM B32.
- E. Brazed Joints: Construct joints according to AWS's "Brazing Handbook," "Pipe and Tube" chapter, using copper-phosphorus brazing filler metal complying with AWS A5.8.
- F. Threaded Joints: Thread pipe with tapered pipe threads according to ASME B1.20.1. Cut threads full and clean using sharp dies. Ream threaded pipe ends to remove burrs and restore full ID. Join pipe fittings and valves as follows:
 1. Apply appropriate tape or thread compound to external pipe threads unless dry seal threading is specified.
 2. Damaged Threads: Do not use pipe or pipe fittings with threads that are corroded or damaged. Do not use pipe sections that have cracked or open welds.
- G. Welded Joints: Construct joints according to AWS D10.12 (AWS D10.12M), using qualified processes and welding operators according to Part 1 "Quality Assurance" Article.
- H. Flanged Joints: Select appropriate gasket material, size, type, and thickness for service application. Install gasket concentrically positioned. Use suitable lubricants on bolt threads.

3.08 FIELD QUALITY CONTROL

- A. Prepare steam and condensate piping according to ASME B31.9, "Building Services Piping," and as follows:
 1. Leave joints, including welds, uninsulated and exposed for examination during test.
 2. Provide temporary restraints for expansion joints that cannot sustain reactions due to test pressure. If temporary restraints are impractical, isolate expansion joints from testing.
 3. Flush system with clean water. Clean strainers.

4. Isolate equipment from piping. If a valve is used to isolate equipment, its closure shall be capable of sealing against test pressure without damage to valve. Install blinds in flanged joints to isolate equipment.
- B. Perform the following tests on steam and condensate piping:
1. Use ambient temperature water as a testing medium unless there is risk of damage due to freezing. Another liquid that is safe for workers and compatible with piping may be used.
 2. Subject piping system to hydrostatic test pressure that is not less than 1.5 times the 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.
 3. 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.
- C. Prepare written report of testing.

END OF SECTION 23 22 13 23 22 13