

SECTION 23 22 13 - STEAM AND CONDENSATE HEATING PIPING

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

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

1.2 SUMMARY

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

1.3 DEFINITIONS

- A. HP Systems: High-pressure piping operating at more than 15 psig (104 kPa) as required by ASME B31.1.
- B. LP Systems: Low-pressure piping operating at 15 psig (104 kPa) or less as required by ASME B31.9

1.4 PERFORMANCE REQUIREMENTS

- A. Components and installation shall be capable of withstanding the following minimum working pressures and temperatures:
 - 1. HP Steam Piping: 125 psig
 - 2. LP Steam Piping: 15 psig
 - 3. Condensate Piping: 15 psig at 250 deg F
 - 4. Makeup-Water Piping: 80 psig at 150 deg F.
 - 5. Air-Vent and Vacuum-Breaker Piping: Equal to pressure of the piping system to which it is attached.
 - 6. Safety-Valve-Inlet and -Outlet Piping: Equal to pressure of the piping system to which it is attached.

1.5 SUBMITTALS

- A. Product Data: For each type of the following:
 - 1. Pressure-reducing and safety valve.
 - 2. Steam trap.
 - 3. Air vent and vacuum breaker.
 - 4. Meter.
- B. Shop Drawings: Detail, 3/8 inch equals 1 foot scale, fabrication of pipe anchors, hangers, pipe, multiple pipes, alignment guides, and expansion joints and loops and their attachment to the building structure. Detail locations of anchors, alignment guides, and expansion joints and loops
- C. Prepare general layout drawings as follows:
 - a. Minimum 3/8 inch scale piping layout with fittings, valves and equipment, use single line for pipe sizes 3 inches and smaller and double line for pipe sizes 4 inches and greater.
 - b. Minimum 3/8 inch scale double line layout and sections including for coordination drawings.
 - c. Indicate location of hangers, supports, guides and anchors, expansion joints, loops, drains, vents and sleeves.
- D. Steam piping layout:
 - a. Prepare steam piping shop drawings.
- E. Qualification Data: For Installer.
- F. Welding certificates.
- G. Field quality-control test reports.
- H. Operation and Maintenance Data: For valves, safety valves, pressure-reducing valves, steam traps, air vents, vacuum breakers, and meters to include in emergency, operation, and maintenance manuals.

1.6 QUALITY ASSURANCE

- A. Installer Qualifications:
- B. Steel Support Welding: Qualify processes and operators according to AWS D1.1, "Structural Welding Code - Steel."
- C. 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.

- D. 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
- E. Steel Pipe Welding:
1. Qualify processes and operators according to ASME Boiler and Pressure Vessel Code: Section IX, "Welding and Brazing Qualifications."
 2. Welders shall be qualified for all required pipe sizes, material, wall thickness, and position in accordance with the American Society of Mechanical Engineering (ASME) Section IX, boiler and pressure Vessel Code
 3. Copies of the certified welder qualification reports shall be maintained by the responsible welding agency and the company performing the welding, and shall be submitted to the owner and/or Inspector upon request.
 4. All defective welds shall be chipped out and repaired at no cost to the Owner, based on procedure to be specified at the time.
 5. The contractor shall bear the cost of reinspection of the repaired welds and the inspection of two (2) additional welds, as selected by the owner, for each failed weld.
 6. Field Procedures:
 - a. Clean pipe free from rust, scale and oxide.
 - b. Bevel pipe on each end per acceptable procedures.
 - c. Contractor is responsible for preparation of pipe in accordance with ASME B 31.1, Chapter V and for visual inspection during the welding operation and for all required welding examinations with certified welding inspector(s), in accordance with ANSI/AWS B.1.10-86 or latest issue section 3.1, 3.1.1, 3.1.2, and 3.1.3.

PART 2 - PRODUCTS

2.1 STEEL PIPE AND FITTINGS

- A. Steel Pipe: ASTM A 53/A 53M, 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 and 150 as indicated in Part 3 piping applications articles.
- C. Malleable-Iron Threaded Fittings: ASME B16.3; Classes 150 as indicated in Part 3 piping applications articles.
- D. Malleable-Iron Unions: ASME B16.39; Classes 150 and 250 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 A 234/A 234M, 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 A 733, made of ASTM A 53/A 53M, black steel of same Type, Grade, and Schedule as pipe in which installed.
- I. Stainless-Steel Bellows, Flexible Connectors:
 - 1. Body: Stainless-steel bellows with woven, flexible, bronze, wire-reinforced, protective jacket.
 - 2. End Connections: Threaded or flanged to match equipment connected.
 - 3. Performance: Capable of 3/4-inch (20-mm) misalignment.
 - 4. CWP Rating: 150-psig (1035-kPa).
 - 5. Maximum Operating Temperature: 250 deg F (121 deg C).

2.2 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.
 - c. For high pressure steam and condensate – Garlock, Style 9800 only
 - d. For low pressure steam and condensate - Klinger C4430
 - e. For joints of dissimilar metals, provide isolating gaskets, sleeves and washers between flanges, bolts and nuts. Gaskets shall be similar to Dupont Teflon.
- B. Flange Bolts and Nuts: ASME B18.2.1, carbon steel, unless otherwise indicated.
- C. 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.
- D. 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.

2.3 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. 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.
 - 2. Factory-fabricated union assembly, for 250-psig (1725-kPa) minimum working pressure at 180 deg F (82 deg C).

2.4 STRAINERS

- A. Y-Pattern Strainers:
 - 1. Low pressure steam, low pressure condensate and pumped condensate systems of steel construction 15 psig and below:
 - a. Working pressure: To 250 psig wsp @ 406°F. Sizes 1/4 inch to 2 inches: ANSI 250 lb Class:
 - 1) Connections: Threaded.
 - 2) Body:
 - a) Cast iron, ASTM A 126, Class B.
 - b) With machined seat for screen retention.
 - c) Galvanized as required to match connecting piping.
 - 3) Cover: Cast iron gasketed.
 - 4) Screen:
 - a) 3/64 inch perforations.
 - b) 304 stainless steel, ASTM 240.
 - c) Free area not less than 2.5 times inlet area.
 - 5) Blowoff outlet: With female MPT tapping.
 - 6) Mueller Model No. 11 BC.
 - b. Working pressure: For sizes 2-1/2 inches to 12 inches: To 250 psig wsp @ 450°F. For sizes 14 inches to 24 inches: To 200 psig wsp @ 406°F.

- 1) Connections: Flanged.
 - 2) Body:
 - a) Cast iron, ASTM A 126, Class B.
 - b) With machined seat for screen retention.
 - c) Galvanized as required to match connecting piping.
 - 3) Cover flange:
 - a) Cast iron, ASTM A 126, Class B.
 - b) With machined seat for screen retention.
 - c) With female tapped NPT blowoff connection.
 - d) With EPDM o-ring seal.
 - 4) Screen:
 - a) To 8 inches: 3/64 inch perforations.
 - b) 10 inches and larger: 1/16 inch perforations.
 - c) 304 stainless steel, ASTM 240.
 - d) Free area not less than 2.5 times inlet area.
 - 5) Blowoff outlet: With female NPT tapping.
 - 6) Mueller Model No. 752,
2. High pressure steam and high pressure condensate return systems of steel construction in excess of 15 psig to 100 psig.
- a. Working pressure: To 450 psig @ 650°F.
 - 1) Sizes 1/4 inch to 2 inches: ANSI Class 300.
 - 2) Connections: Threaded.
 - 3) Body:
 - a) Ductile iron, ASTM A 536, Grade 65-45-12.
 - b) With tapered self-aligning seat.
 - c) Galvanized as required to match connecting piping.
 - 4) Cap: Ductile iron, gasketed.
 - 5) Screen:
 - a) 3/64 inch perforations.
 - b) 304 stainless steel, ASTM 240.
 - c) Free area not less than 2.5 times inlet area.
 - 6) Blowoff outlet: With female NPT tapping.
 - 7) Mueller Model No. 251-DI.
 - b. Working pressure to 150 psig @ 565°F, ANSI Class 150:
 - 1) Sizes 1/2 inch to 12 inches:
 - a) Connections: Flanged or butt welded to match piping system.

- b) Body: Carbon steel, ASTM A 216, Grade WCB. With machined seat for screen retention cover.
 - c) Cover: Carbon steel, ASTM A 216, Grade WCB. With machined seat for screen retention. With female tapped NPT blowoff connection. With non-asbestos gasket.
 - d) Screen: To 4 inches: 1/32 inch perforations. 5 inches and larger: 3/64 inch perforations. 304 stainless steel, ASTM 240. Free area not less than 4 times inlet area.
 - e) Blowoff outlet: With female NPT tapping.
 - f) Mueller Model No. 761 for ANSI Class 150.
3. High pressure steam and high pressure condensate systems of steel construction in excess of 100 psig:
- a. Working pressure to 150 psig @ 565°F, ANSI Class 150 and 300 psig @ 838°F, ANSI Class 300:
 - 1) Sizes 1/2 inch to 12 inches:
 - a) Connections: Flanged to butt welded to match piping system/
 - b) Body: Carbon steel, ASTM A216, Grade WCB. With machined seat for screen retention.
 - c) Cover: Carbon steel, ASTM A216, Grade WCB. With machined seat for screen retention. With female tapped NPT blowoff connection. With non-asbestos gasket.
 - d) Screen: To 4 inches: 1/32 inch perforations. 5 inches and larger: 3/64 inch perforations. 304 stainless steel, ASTM 240. Free area not less than 4 times inlet area.
 - e) Blowoff outlet: With female NPT tapping.
 - f) Mueller Model No. 761 for ANSI Class 150. Mueller model No. 762 for ANSI Class 300.

2.5 SAFETY VALVES

A. Bronze Safety Valves:

- 1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
 - a. Armstrong International, Inc.
 - b. Kunkle Valve; a Tyco International Ltd. Company.
 - c. Spirax Sarco, Inc.
 - d. Watts Water Technologies, Inc
 - e. Leslie.
- 2. Disc Material: Forged copper alloy.
- 3. End Connections: Threaded inlet and outlet.
- 4. Spring: Fully enclosed steel spring with adjustable pressure range and positive shutoff, factory set and sealed.
- 5. Pressure Class: 250.

6. Drip-Pan Elbow: Cast iron and having threaded inlet and outlet with threads complying with ASME B1.20.1.
7. Size and Capacity: As required for equipment according to ASME Boiler and Pressure Vessel Code.

2.6 STEAM PRESSURE-REDUCING STATION

- A. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
 1. Spence
 2. Spirax- Sarco
- B. Provide single stage PRV stations where indicated and as scheduled on drawings. Each station shall consist of steam pressure reducing valves, strainers, relief valves, isolation gate valves, globe style bypass valves, pressure gauges etc. as detailed.
- C. Regulators shall be single seated, flanged, ASA 250 lb.; cast iron body, stainless steel diaphragm, stainless steel metal disc, stainless steel stem, and carbon steel main spring. Valves shall be normally closed type and designed for dead end service. Steam velocity through the valve shall be limited to 7,000 fpm. Valve shall have stellited seat ring and plug.

2.7 STEAM TRAPS

- A. Thermostatic Traps:
 1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
 - a. Armstrong International, Inc.
 - b. Hoffman Specialty; Division of ITT Industries.
 - c. Spirax Sarco, Inc.
 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. Maximum allowable Pressure: 125 psig up to 353 deg F.
 7. The maximum operating pressure is to be selected for the intended service
- B. Thermodynamic Traps:
 1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
 - a. Armstrong International, Inc.
 - b. Hoffman Specialty; Division of ITT Industries.
 - c. Spirax Sarco, Inc.
 2. Body: Stainless steel with screw-in cap.

3. End Connections: Threaded.
4. Disc and Seat: Stainless steel.
5. Maximum allowable Pressure: 600 psig (4140 kPa).to 800 def F.
6. The maximum operating pressure is to be selected for the intended service.

C. Float and Thermostatic Traps:

1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
 - a. Armstrong International, Inc.
 - b. Hoffman Specialty; Division of ITT Industries.
 - c. Spirax Sarco, Inc.
2. Body and Bolted Cap: ASTM A 126, 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 allowable Pressure: 125 psig (860 kPa) up to 450 deg F.
11. The maximum operating pressure is to be selected for the intended service.

D. Inverted Bucket Traps:

1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
 - a. Armstrong International, Inc.
 - b. Barnes & Jones, Inc.
 - c. Hoffman Specialty; Division of ITT Industries.
 - d. Spirax Sarco, Inc.
2. Body and Cap: Cast iron.
3. End Connections: Threaded.
4. Head and Seat: Stainless steel.
5. Valve Retainer, Lever, and Guide Pin Assembly: Stainless steel.
6. Bucket: Brass or stainless steel.
7. Strainer: Integral stainless-steel inlet strainer within the trap body.
8. Air Vent: Stainless-steel thermostatic vent.
9. Maximum allowable Pressure: 250 psig (1725 kPa).
10. The maximum operating pressure is to be selected for the intended service.

2.8 THERMOSTATIC AIR VENTS AND VACUUM BREAKERS

A. Thermostatic Air Vents:

1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
 - a. Armstrong International, Inc.
 - b. Hoffman Specialty; Division of ITT Industries.
 - c. Spirax Sarco, Inc.
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. Maximum allowable Pressure: : 125 psig (861 kPa).
7. The maximum operating pressure is to be selected for the intended service.
8. Maximum Temperature Rating: 350 deg F (177 deg C).

B. Vacuum Breakers:

1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
 - a. Armstrong International, Inc.
 - b. Hoffman Specialty; Division of ITT Industries.
 - c. Spirax Sarco, Inc.
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 (861 kPa).
7. Maximum Temperature Rating: 350 deg F (177 deg C).

2.9 PIPE FLANGE GASKET MATERIALS

- A. Flange gaskets shall be one-piece ring type 1/16 inch thick (minimum) except as noted, suitable for temperature, pressure (operating and test) and service of system.
1. For high pressure steam and condensate – Garlock, Style 9800 only
 2. For low pressure steam and condensate - Klinger C4430
 3. For joints of dissimilar metals, provide isolating gaskets, sleeves and washers between flanges, bolts and nuts. Gaskets shall be similar to Dupont Teflon.
 4. Full-Face Type: For flat-face, Class 125, cast iron and cast bronze flanges.
 5. Narrow Face Type: For raised face, class 250, cast iron flanges.

2.10 RING SPACERS AND TEST BLANKS:

- A. Provide between flanges where shown on drawing or where necessary to isolate equipment from the piping system, in accordance with B 3.1.1, Chapter VI, section 137.2.4. Ring spacers to be replaced by test blanks during hydrostatic testing and/or during chemical cleaning for equipment isolation.

- B. Size and rating to match companion flanges.

PART 3 - EXECUTION

3.1 STEAM PIPING APPLICATIONS

- A. High pressure steam system, in excess of 100 psig to 225 psig, total temperature below 450 deg F:
 - 1. Material shall be steel in accordance with ASTM A53 Grade B seamless.
 - 2. Wall thickness shall be:
 - a. To 2 inch: Schedule 40, socket weld ends only.
 - b. 2-1/2 inch to 10 inch: Schedule 40, butt weld ends only.
 - c. 12 inch to 24 inch: 0.375 inch wall thickness, butt weld ends only.
- B. High pressure steam system, in excess of 15 psig to 100 psig total temperature not exceeding 450 deg F:
 - 1. Material shall be steel in accordance with ASTM A53 Grade B seamless.
 - 2. Wall thickness shall be:
 - a. To 2 inch: Schedule 40, socket weld ends only.
 - b. 2-1/2 inch to 10 inch: Schedule 40, butt weld ends only.
 - c. 12 inch to 24 inch: 0.375 inch wall thickness, butt weld ends only.
- C. Low pressure steam system, 15 psig or below:
 - 1. Material shall be steel in accordance with ASTM A53 Grade B seamless.
 - 2. Wall thickness shall be:
 - a. To 2 inch: Schedule 80 with threaded ends, or Schedule 40 with socket welds.
 - b. 2-1/2 inch to 10 inch: Schedule 40, butt weld ends only.
 - c. 12 inch to 24 inch: 0.375 inch wall thickness, butt weld ends only.
- D. High pressure condensate return system, above 100 psig:
 - 1. Material shall be steel in accordance with ASTM A53 Grade B seamless.
 - 2. Wall thickness shall be:
 - a. To 2 inch: Schedule 80, socket weld ends only.
 - b. 2-1/2 inch to 10 inch: Schedule 80, butt weld ends only.
 - c. 12 inch and larger: Schedule 80, butt weld ends only.
- E. High pressure condensate return system, between 15 psig and 100 psig:
 - 1. Material shall be steel in accordance with ASTM A53 Grade B seamless.
 - 2. Wall thickness shall be:
 - a. To 2 inch: Schedule 80, socket weld ends only.

- b. 2-1/2 inch to 10 inch: Schedule 80, butt weld ends only.
 - c. 12 inch and larger: 0.375 wall thickness, butt weld ends only.
- F. Low pressure condensate return system, below 15 psig:
- 1. Material shall be steel in accordance with ASTM A53 Grade B seamless.
 - 2. Wall thickness shall be:
 - a. To 2 inch: Schedule 80 with threaded ends, or Schedule 40 with socket welds.
 - b. 2-1/2 inch to 10 inch: Schedule 40, butt weld ends only.
 - c. 12 inch and larger: 0.375 wall thickness, butt weld ends only.
- G. Pumped condensate return system:
- 1. Material shall be steel in accordance with ASTM A53 Grade B seamless.
 - 2. Wall thickness shall be:
 - a. To 2 inch: Schedule 80 with threaded ends, or Schedule 80 with socket welds.
 - b. 2-1/2 inch to 10 inch: Schedule 40, butt weld ends only.
 - c. 12 inch and larger: 0.375 wall thickness, butt weld ends only.

3.2 ANCILLARY PIPING APPLICATIONS

- A. Air-Vent Piping:
- 1. Inlet: Same as service where installed.
 - 2. Outlet: Type K annealed-temper copper tubing with soldered or flared joints.
- B. Vacuum-Breaker Piping: Outlet, same as service where installed.
- C. Safety-Valve-Inlet and -Outlet Piping: Same materials and joining methods as for piping specified for the service in which safety valve is installed.

3.3 LP STEAM-TRAP APPLICATIONS

- A. Thermostatic Traps: Convectors and finned-tube radiation.
- B. Float and Thermostatic Traps: Steam main and riser drip legs, laundry equipment, kitchen equipment, heat exchangers, and heating coils.
- C. As indicated on the drawings.

3.4 HP STEAM-TRAP APPLICATIONS

- A. Thermostatic Traps: Convectors and finned-tube radiation.
- B. Inverted Bucket Traps: Steam main and riser drip legs, and laundry equipment.

- C. Float and Thermostatic Traps: Kitchen equipment, heat exchangers, and heating coils.
- D. Thermodynamic Traps: Steam main and riser drip legs, and heat tracer lines.
- E. As indicated on the drawings

3.5 VALVE APPLICATIONS

- A. General-Duty Valve Applications: Unless otherwise indicated, use the following valve types:
 - 1. Shutoff Duty: Gate and ball valves.
 - 2. Throttling Duty: Globe and ball valves
- B. Install shutoff duty valves at branch connections to steam supply mains, at steam supply connections to equipment, and at the outlet of steam traps.
- C. Install safety valves on pressure-reducing stations and elsewhere as required by ASME Boiler and Pressure Vessel Code. Install safety-valve discharge piping to safe termination point in accordance with building codes , without valves, as indicated on Drawings. Comply with ASME Boiler and Pressure Vessel Code: Section VIII, Division 1, for installation requirements.

3.6 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, 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 free of sags and bends.
- G. Install fittings for changes in direction and branch connections.
- H. Install piping to allow application of insulation.

- I. Select system components with pressure rating equal to or greater than system operating pressure.
- J. Install groups of pipes parallel to each other, spaced to permit applying insulation and servicing of valves.
- K. Install drains, consisting of a tee fitting, NPS 3/4 (DN 20) full port-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.
- L. Install steam supply piping at a minimum uniform grade of 0.2 percent downward in direction of steam flow.
- M. Install condensate return piping at a minimum uniform grade of 0.4 percent downward in direction of condensate flow.
- N. Reduce pipe sizes using eccentric reducer fitting installed with level side down.
- O. Install branch connections to mains using tee fittings in main pipe, with the branch connected to top of main pipe.
- P. Install valves according to Division 23 Section "General-Duty Valves for HVAC Piping."
- Q. Install unions in piping, NPS 2 (DN 50) and smaller, adjacent to valves, at final connections of equipment, and elsewhere as indicated.
- R. Install flanges in piping, NPS 2-1/2 (DN 65) and larger, at final connections of equipment and elsewhere as indicated.
- S. Install strainers on supply side of control valves, pressure-reducing 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).
- T. Install expansion loops, expansion joints, anchors, and pipe alignment guides as specified in Division 23 Section "Expansion Fittings and Loops for HVAC Piping."
 - 1. Install piping to permit free expansion and contraction without damaging piping, equipment, or construction.
 - 2. Provide expansion joints, offsets, expansion loops, anchors, guides and supports to permit expansion, within stress limits of ANSI Code for Pressure Piping for temperature range of 40 deg F to minimum of 20 deg F above maximum system temperature.
 - 1) Steam piping shall be cold-sprung.
 - 2) Piping up to 1-1/2 inch: Cold-sprung 100 percent of expansion.
 - 3) Piping 2 inch and larger: Cold-sprung 50 percent of expansion.
 - 3. Install anchors and guides on both sides of expansion loops, zees, etc., to provide safe installation and trouble-free operation

- U. Identify piping as specified in Division 23 Section "Identification for HVAC Piping and Equipment."
- V. Install drip legs at low points and natural drainage points such as ends of mains, bottoms of risers, and ahead of pressure regulators, and control valves.
 - 1. Drips: Provide as follows:
 - a. Steam piping:
 - 1) Maximum 75 foot intervals.
 - 2) At bottom of vertical lines.
 - 3) At rising points in piping.
 - 2. Provide drain valves where condensate may be pocketed.
 - 3. Provide drip points with dirt pockets, the same size as piping, with removable caps. Welded piping shall have ends with flange. Screwed piping shall have caps screwed, made up with graphite.
 - 4. Dirt pockets; Provide full size of riser, 12 inches long at bottom of each riser, end of mains, ends of headers, ahead of pressure regulators, control valves, isolation valves, changes of direction, pipe loops, expansion joints, and as noted
 - 5. Connect drips to condensate return and refer to drip detail.
 - 6. . Pitch steam, condensate return and drip piping for gravity drainage.
- W. Provide three elbow type swing joints on steam and condensate return connections to equipment and piping systems.
- X. .Provide riser shutoff valves in runout to each steam and condensate return riser.
- Y. Install ring spacers and test blanks as required for hydrostatic testing

3.7 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.

3.8 PRESSURE-REDUCING VALVE INSTALLATION

- A. Install pressure-reducing valves in accessible location for maintenance and inspection.
- B. Install bypass piping around pressure-reducing valves, with globe valve equal in size to area of pressure-reducing valve seat ring, unless otherwise indicated.
- C. Install gate valves on both sides of pressure-reducing valves.

- D. Install unions or flanges on both sides of pressure-reducing valves having threaded- or flanged-end connections respectively.
- E. Install pressure gages on low-pressure side of pressure-reducing valves after the bypass connection according to Division 23 Section "Meters and Gages for HVAC Piping."
- F. On two-stage pressure-reducing stations, install drip trap and pressure gage upstream from second stage pressure-reducing valve
- G. Install strainers upstream for pressure-reducing valve.
- H. Install safety valve downstream from pressure-reducing valve station.
- I. Install noise suppressor as per manufacturers requirements

3.9 SAFETY VALVE INSTALLATION

- A. Install safety valves according to ASME B31.1, Power Piping and ASME B31.9, Building Services Piping.
- B. Pipe safety-valve discharge without valves to atmosphere outside the building.
- C. Install drip-pan elbow fitting adjacent to safety valve and pipe drain connection to nearest floor drain.
- D. Install exhaust head with drain to waste, on vents equal to or larger than NPS 2-1/2 (DN 65).

3.10 HANGERS AND SUPPORTS

- A. Install hangers and supports according to Division 23 Section "Hangers and Supports for HVAC Piping and Equipment." Comply with requirements below for maximum spacing.
- B. Seismic restraints are specified in Division 23 Section "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 (6 m) long.
 - 2. Adjustable roller hangers and spring hangers for individual horizontal piping 20 feet (6 m) or longer.
 - 3. Pipe Roller: MSS SP-58, Type 44 for multiple horizontal piping 20 feet (6 m) or longer, supported on a trapeze.
 - 4. 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 (2.7 m); minimum rod size, 1/4 inch (6.4 mm).
 2. NPS 1 (DN 25): Maximum span, 9 feet (2.7 m); minimum rod size, 1/4 inch (6.4 mm).
 3. NPS 1-1/2 (DN 40): Maximum span, 12 feet (3.7 m); minimum rod size, 3/8 inch (10 mm).
 4. NPS 2 (DN 50): Maximum span, 13 feet (4 m); minimum rod size, 3/8 inch (10 mm).
 5. NPS 2-1/2 (DN 65): Maximum span, 14 feet (4.3 m); minimum rod size, 3/8 inch (10 mm).
 6. NPS 3 (DN 80): Maximum span, 15 feet (4.6 m); minimum rod size, 3/8 inch (10 mm).
 7. NPS 4 (DN 100): Maximum span, 17 feet (5.2 m); minimum rod size, 1/2 inch (13 mm).
 8. NPS 6 (DN 150): Maximum span, 21 feet (6.4 m); minimum rod size, 1/2 inch (13 mm).
 9. NPS 8 (DN 200): Maximum span, 24 feet (7.3 m); minimum rod size, 5/8 inch (16 mm).
 10. NPS 10 (DN 250): Maximum span, 26 feet (8 m); minimum rod size, 3/4 inch (19 mm).
 11. NPS 12 (DN 300): Maximum span, 30 feet (9.1 m); minimum rod size, 7/8 inch (22 mm).
- 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, 6 feet (1.2 m); minimum rod size, 1/4 inch (6.4 mm).
 2. NPS 3/4 (DN 20): Maximum span, 7 feet (1.5 m); minimum rod size, 1/4 inch (6.4 mm).
 3. NPS 1 (DN 25): Maximum span, 8 feet (1.8 m); minimum rod size, 1/4 inch (6.4 mm).
 4. NPS 1-1/2 (DN 40): Maximum span, 10 feet (2.4 m); minimum rod size, 3/8 inch (10 mm).
 5. NPS 2 (DN 50): Maximum span, 11 feet (2.4 m); minimum rod size, 3/8 inch (10 mm).
 6. NPS 2-1/2 (DN 65): Maximum span, 13 feet (2.7 m); minimum rod size, 3/8 inch (10 mm).
 7. NPS 3 (DN 80): Maximum span, 14 feet (3 m); minimum rod size, 3/8 inch (10 mm).
- F. Support vertical runs at roof, at each floor, and at 10-foot (3-m) intervals between floors
- G. Vertical piping:
1. Base elbow support: Provide bearing plate on structural support, similar to F&S Manufacturing Co. Fig. 720 or 721.
 2. Provide guides at every third floor but not exceed:
 3. 25 ft for piping to 2 inch.
 4. 36 ft for piping 2-1/2 inch to 12 inch.

5. 50 ft for piping 14 inch and larger.
6. Top support: Provide special hanger or saddle in horizontal connection and make provisions for expansion.
7. Intermediate supports: Steel pipe clamp at floor. Bolt and weld to pipe with extension ends bearing on structural steel or bearing plates.
8. For multiple pipes, coordinate guides, bearing plates and accessory steel.

3.11 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. 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.
- E. 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.
- F. Flanged Joints: Select appropriate gasket material, size, type, and thickness for service application. Install gasket concentrically positioned. Use suitable lubricants on bolt threads.

3.12 TERMINAL EQUIPMENT CONNECTIONS

- A. Size for supply and return piping connections shall be the same as or larger than equipment connections.
- B. Install traps and control valves in accessible locations close to connected equipment.
- C. Install bypass piping with globe valve around control valve. If parallel control valves are installed, only one bypass is required.
- D. Install vacuum breakers downstream from control valve, close to coil inlet connection.
- E. Install a drip leg at coil outlet.

- F. Install ports for pressure and temperature gages at coil inlet connections.
- G. Install a drip leg at coil outlet.
- H. Equipment piping and connections: Provide steam, condensate return, drip and vent piping connections as noted and as recommended by equipment manufacturer. Verify location, number and size of connections.
 - 1. Domestic hot water heaters: Install temperature regulators supplied under Plumbing Sections of the specification.
 - 2. Heating coils: Locate condensate return traps so as not to be subject to freezing.
 - 3. Boiler plant equipment: Refer to Section "Boilers, Feedwater Equipment and Related Apparatus" and to the drawings for requirements.
 - 4. Laboratory, kitchen, laundry and medical equipment: Provide steam, condensate return, drip and vent piping for equipment using steam: As noted and in accordance with requirements of equipment manufacturer.
 - a. Verify exact location, number and size of equipment connections in accordance with drawings and specifications for purchased equipment.
 - b. Provide globe valve in each steam connection.
 - c. In each return connection, provide globe valve at equipment, trap, strainer, upstream of trap and check valve and gate valve on trap discharge.
 - d. Exposed, uninsulated steam, return and drip piping, valves, strainers and traps shall be chromium plated.
 - e. Pressure reducing valves: Provide single-stage, self-contained PRV in steam connections to equipment as noted. Provide strainer at inlet. Exposed pressure reducing valves and strainers shall be chromium plated.
- I. Steam and water mixing unit connections: Provide steam piping connected to unit.
 - 1. In steam connection, provide the following:
 - a. Globe valve.
 - b. Single-stage, self-contained pressure reducing valve. Maximum outlet pressure: 5 psig.
 - c. Strainer at inlet to pressure reducing valve.
 - 2. Exposed piping, valves, pressure valves and strainers shall be chromium plated.
 - 3. Chromium plated valves shall be heat resisting composition cone handle.
- J. Condensate cooler:
 - 1. Connect cooling water to valved outlet provided under Plumbing work. Discharge to floor drain, or as shown on the drawings.
- K. Direct radiation: Provide valves at supply end of each radiation element as noted and in accessible locations. Valves shall be readily accessible. Provide thermostatic traps as noted. Pitch down in direction of steam flow. Provide 1/8 inch key operated air vent at top of each element.

- L. Unit heaters: Provide control valves and traps as noted.

3.13 FIELD QUALITY CONTROL

- A. Prepare steam and condensate piping according to ASME B31.1, "Power Piping" and 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 4 hours, 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