

## **SECTION 23 22 13 – STEAM AND CONDENSATE HEATING PIPING**

### **GENERAL**

#### **1.1 SUMMARY**

- A. This Section includes pipe and fitting materials, joining methods, and specialties for LP and HP steam and condensate piping:
  - 1. Pipe and fittings.
  - 2. Strainers.
  - 3. Steam traps.
  - 4. Thermostatic air vents and vacuum breakers.

#### **1.2 DEFINITIONS**

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

#### **1.3 SUBMITTALS**

- A. Product Data: For each type of the following:
  - 1. Steam trap.
  - 2. Air vent and vacuum breaker.
- B. Qualification Data: For Installer.
- C. Welding certificates.
- D. Field quality-control test reports.
- E. Operation and Maintenance Data: For valves, traps, and strainers to include in emergency, operation, and maintenance manuals.

#### **1.4 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.

## 1.5 COORDINATION

- A. Coordinate layout and installation of piping with steam and condensate equipment and with other installations.

## PART 2 - PRODUCTS

### 2.1 STEEL PIPE AND FITTINGS

- A. Steel Pipe: ASTM A 53, 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 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.

## 2.2 JOINING MATERIALS

- A. Pipe-Flange Gasket Material: Flexible spiral wound metal gasket, type suitable for 125 psig steam service. Suitable for chemical and thermal conditions of piping system contents. Flexitallic or Garlock manufacturers.
  - 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.
- B. Flange Bolts and Nuts: ASME B18.2.1, carbon steel, unless otherwise indicated.
- C. Welding Filler Metals: Comply with AWS D10.12 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 VALVES

- A. Gate, globe, check, ball, and butterfly valves are specified in Division 23 Section "General-Duty Valves".
- B. Refer to Part 3 "Valve Applications" Article for specific uses and applications for each valve specified.

## 2.4 STRAINERS

- A. Y-Pattern Strainers:
  - 1. Body: ASTM A 126, Class B cast iron, with bolted cover and bottom drain connection.
  - 2. End Connections: Threaded ends for strainers NPS 2 and smaller; flanged ends for strainers NPS 2-1/2 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 working steam pressure.
- B. Basket Strainers:
  - 1. Body: ASTM A 126, Class B cast iron, with bolted cover and bottom drain connection.
  - 2. End Connections: Threaded ends for strainers NPS 2 and smaller; flanged ends for strainers NPS 2-1/2 and larger.
  - 3. Strainer Screen: Stainless steel, 20 mesh strainer, and perforated stainless steel basket with 50 percent free area.
  - 4. CWP Rating: 250 psig working steam pressure.

## 2.5 STEAM TRAPS

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

1. Armstrong International, Inc.
2. Dunham-Bush, Inc.
3. Hoffman Specialty; Division of ITT Industries.
4. Spirax Sarco, Inc.
5. Sterling.

- B. Float and Thermostatic Traps:

1. Body and Bolted Cap: ASTM A 126, cast iron.
2. End Connections: Threaded.
3. Float Mechanism: Replaceable, stainless steel.
4. Head and Seat: Hardened stainless steel.
5. Trap Type: Balanced pressure.
6. Thermostatic Bellows: Stainless steel or monel.
7. Thermostatic air vent capable of withstanding 45 deg F of superheat and resisting water hammer without sustaining damage.
8. Vacuum Breaker: Thermostatic with phosphor bronze bellows, and stainless steel cage, valve, and seat.
9. Maximum Operating Pressure: 125 psig.

- C. Inverted Bucket Traps:

1. Body and Cap: Cast iron.
2. End Connections: Threaded.
3. Head and Seat: Stainless steel.
4. Valve Retainer, Lever, and Guide Pin Assembly: Stainless steel.
5. Bucket: Brass or stainless steel.
6. Strainer: Integral stainless steel inlet strainer within the trap body.
7. Air Vent: Stainless steel thermostatic vent.
8. Pressure Rating: 250 psig.

## 2.6 THERMOSTATIC AIR VENTS AND VACUUM BREAKERS

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

1. Armstrong International, Inc.
2. Dunham-Bush, Inc.
3. Hoffman Specialty; Division of ITT Industries.
4. Spirax Sarco, Inc.
5. Sterling.

B. Thermostatic Air Vents:

1. Body: Cast iron, bronze or stainless steel.
2. End Connections: Threaded.
3. Float, Valve, and Seat: Stainless steel.
4. Thermostatic Element: Phosphor bronze bellows in a stainless steel cage.
5. Pressure Rating: 125 psig .
6. Maximum Temperature Rating: 350 deg F.

C. Vacuum Breakers:

1. Body: Cast iron, bronze, or stainless steel.
2. End Connections: Threaded.
3. Sealing Ball, Retainer, Spring, and Screen: Stainless steel.
4. O-ring Seal: EPR.
5. Pressure Rating: 125 psig.
6. Maximum Temperature Rating: 350 deg F.

PART 3 - EXECUTION

3.1 LP STEAM PIPING APPLICATIONS

- A. LP Steam Piping, 2-Inch NPS 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 through NPS 12: 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 and smaller, shall be 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 and larger, shall be Schedule 80, Type E, Grade B, steel pipe; Class 150 wrought steel fittings, flanges, and flange fittings; and welded and flanged joints.

3.2 HP STEAM PIPING APPLICATIONS

- A. HP Steam Piping, NPS 2: Schedule 80, Type S, Grade B, steel pipe; Class 125 cast iron fittings; and threaded joints.
- B. HP Steam Piping, NPS 2-1/2 through NPS 12: Schedule 80, 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 and smaller, shall be 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 and larger, shall be Schedule 80, Type E, Grade B, steel pipe; Class 150 wrought steel fittings, flanges, and flange fittings; and welded and flanged joints.

### 3.3 ANCILLARY PIPING APPLICATIONS

- A. Blowdown-Drain Piping: Same materials and joining methods as for piping specified for the service in which blowdown drain is installed.

### 3.4 VALVE APPLICATIONS

- A. General-Duty Valve Applications: Refer to Division 23 Section "General-Duty Valves." Unless otherwise indicated, use the following valve types:
  - 1. Shutoff Duty: Gate valves or butterfly valves.
  - 2. Throttling Duty: Globe valves.
- B. Install shutoff duty valves at each branch connection to supply mains, at steam supply connections to equipment, and at the outlet of steam traps.

### 3.5 STEAM TRAP APPLICATIONS

- A. Float and Thermostatic Traps: LP steam system.
- B. Inverted Bucket Traps: Steam main and riser drip legs for LP and HP steam systems.

### 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 full port ball valve, and short NPS 3/4 threaded nipple with cap, at low points in piping system mains and elsewhere as required for system drainage.
- L. Install steam supply piping at a uniform grade of 0.2 percent downward in direction of flow.
- M. Install condensate return piping at a uniform grade of 0.5 percent downward in direction of flow.
- N. Reduce pipe sizes using eccentric reducer fitting installed with level side down.
- O. Install branch connections to steam mains using 45 degree fittings in main with takeoff out top of main. Use of 90 degree tee fittings is permissible where 45 degree fittings are impractical. Where length of branch takeoff is less than 10 feet, pitch branch line down toward mains at 0.4 percent slope.
- P. Install unions in piping, NPS 2 and smaller, adjacent to valves, at final connections of equipment, and elsewhere as indicated.
- Q. Install flanges in piping, NPS 2-1/2 and larger, at final connections of equipment and elsewhere as indicated.
- R. Install strainers on supply side of each control valve, traps, and elsewhere as indicated. Install 3/4 inch NPS nipple and ball valve in blow-down connection of strainers 2 inch NPS and larger. Match size of strainer blowoff connection for strainers smaller than NPS 2. Provide gate valve with close nipple and pipe cap at blowdown connection.
- S. Install drip legs at low points and natural drainage points such as ends of mains, bottoms of risers, and ahead of control valves, isolation valves, pipe bends, and expansion joints.
  - 1. Drip leg is to be same size as steam line. Provide gate valve at bottom of drip leg to allow removal of dirt and scale.
  - 2. Equip drip legs, dirt pockets, and strainer blow-downs with gate valves to allow removal of dirt and scale.
  - 3. Install steam traps close to drip legs.

### 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 HANGERS AND SUPPORTS

- A. Install hangers and supports according to Division 23 Section "Hangers and Supports for Mechanical Piping and Equipment." Comply with requirements below for maximum spacing.
- B. Seismic restraints are specified in Division 23 Section "Vibration and Seismic Controls for Mechanical Piping and Equipment."
- C. Install the following pipe attachments:
  - 1. Adjustable steel clevis hangers for individual horizontal runs less than 20 feet in length.
  - 2. Adjustable roller hangers and spring hangers for individual horizontal runs 20 feet or longer.
  - 3. Pipe Roller: MSS SP-58, Type 44 for multiple horizontal runs 20 feet 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: Maximum span, 9 feet; minimum rod size, 3/8 inch.
  - 2. NPS 1: Maximum span, 9 feet; minimum rod size, 3/8 inch.
  - 3. NPS 1-1/2: Maximum span, 12 feet; minimum rod size, 3/8 inch.
  - 4. NPS 2: Maximum span, 13 feet; minimum rod size, 3/8 inch.
  - 5. NPS 2-1/2: Maximum span, 14 feet; minimum rod size, 3/8 inch.
  - 6. NPS 3: Maximum span, 15 feet; minimum rod size, 3/8 inch.
  - 7. NPS 4: Maximum span, 17 feet; minimum rod size, 1/2 inch.
- E. Support vertical runs at each floor or at maximum spacing of 10-foot intervals, whichever is less.

### 3.9 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.

### 3.10 TERMINAL EQUIPMENT CONNECTIONS

- A. Install traps and control valves in accessible locations close to connected equipment.
- B. Install bypass piping with globe valve around control valve. Where multiple, parallel control valves are installed, only one bypass is required.
- C. Install vacuum breaker downstream from control valve and bypass, and close to coil inlet connection.
- D. Install pressure gage at coil inlet connections.
- E. Install a drip leg at coil outlet with steam trap located at least 18-inches below coil outlet.

### 3.11 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. Flush entire systems, including all dead legs, with clean water. Clean strainers.
  - 3. Isolate equipment that is not subjected to test pressure from piping. If a valve is used to isolate equipment, its closure shall be capable of sealing against test pressure without damage to valve. Install blinds in flanged joints to isolate equipment
  - 4. Install relief valve set at a pressure no more than one-third higher than test pressure, to protect against damage by expanding liquid or other source of overpressure during test.
- B. Perform the following tests on steam and condensate piping:
  - 1. Notify Owner's Representative a minimum of 10 working days prior to testing. Test to be witnessed by Owner's Representative.

2. Use ambient temperature water as testing medium, unless there is risk of damage due to freezing. Another liquid that is safe for workers and compatible with piping system components may be used for condensate piping .
3. Use traps installed at the high points of system to release trapped air while filling system. Use drip legs installed at low points for complete removal of liquid.
4. Subject piping system to hydrostatic test pressure that is not less than 1.5 times the design pressure. Test pressure shall not exceed maximum pressure for any vessel, pump, valve, or other component in system under test. Verify that stress due to pressure at bottom of vertical runs does not exceed either 90 percent of specified minimum yield strength.
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 as appropriate, and repeat hydrostatic test until there are no leaks.

C. Prepare written report of testing.

### 3.12 CLEANING

A. Preparation:

1. System shall be operational prior to cleaning.
2. Make temporary piping connections, furnish temporary pumps, and temporary bypass filter as required to properly accomplish cleaning entire system.
3. Place all manual, pressure regulating and control valves serving the system in open position during cleaning so that circulation through the system is obtained during cleaning. Isolate and bypass steam pressure regulating station.
4. Verify that electric power is available and of the correct characteristics for any cleaning equipment.

B. Cleaning Sequence:

1. Initial Flush:
  - a. Completely fill the system with fresh water and circulate (1<sup>st</sup> filling) at 6 feet per second for 4-hour minimum.
  - b. Initial flushing shall be sufficient to remove all contaminants such as cuttings, filings, loose rust and scale, welding and soldering, residue and debris.
  - c. Drain the entire system and refill with fresh water (2<sup>nd</sup> filling).
2. Cleaning Flush (all systems):
  - a. Use concentrated chemical cleaner in piping system(s). Cleaner shall be a phosphate wetting agent combined with an alkaline surfactant with a sodium carbonate type alkalinity supplement introduced as necessary to produce 600 ppm of phenolphthalein alkalinity. Chemicals shall be nontoxic.

- b. Circulate the solution at 6 feet per second for the recommended time period corresponding to the fluid temperature.
  - 1) Partially close and reopen all manual valves twice during the flushing duration.
- c. Test solution for proper concentration and document results.
- d. Completely drain the entire system.
- e. Refill the system with fresh water (3<sup>rd</sup> filling). Then, with the circulation pump running at 6 feet per second:
  - 1) Open one or more drains as far downstream from the fill point as is possible. Be sure the makeup is sufficient to keep up with the drain so as to maintain full system.
  - 2) Partially close and reopen all manual valves twice during the flushing duration.
  - 3) Blowdown all strainers, dead legs and low points in the system.
  - 4) Continue to flush the system in this manner until the drain water is of the same clarity as the makeup water and testing reveals no further traces of cleaning solution (minimum 1 hour). Document the results.
- f. Following the fresh water flush, drain the entire systems. Blow out the steam and condensate piping with compressed air including dead legs and low points. Do not connect the condensate piping to the central system without approval by the Owner's Representative.
  - 1) Clean all strainers.
- 3. Upon completion of cleaning and chemical treatment addition, tag the system so that tag is plainly visible as follows: **"THIS SYSTEM HAS BEEN CHEMICALLY CLEANED AND TREATED."**
- 4. Field Reports: Submit field report indicating analysis of system's water after cleaning and after chemical treatment.

**END OF SECTION 23 22 13**