

## SECTION 23 22 13 - STEAM AND CONDENSATE HEATING PIPING

### PART 1 - GENERAL

#### 1.1 SYSTEM DESIGN REQUIREMENTS

- A. Steam Supply:
  - 1. High pressure steam will be supplied to buildings from a central distribution system in accordance with Manual Part 3.4.
  - 2. Steam Pressure Classifications:
    - a. Low pressure steam: 15 psig and under.
    - b. Medium pressure steam: 16 psig to 100 psig.
    - c. High pressure steam: Above 100 psig.
  - 3. At each building reduce steam to 15 psig, unless other pressures are required for special equipment.
  - 4. Design pressure reducing stations with two valves in parallel for two-step control (capus pressure to medium pressure, medium pressure to low pressure) for minimum summer and maximum winter loads. Size valves for 1/3 and 2/3 capacity.
  - 5. Provide globe valve by-pass for manual control. Size the by-pass valve so that if left unattended in an open position, the steam flow through the by-pass does not exceed the capacity of the safety relief valve selected.
  - 6. Install air vents in all steam condensate piping high points.
  - 7. Install drains in all steam condensate low points.
- B. Process and Humidification Steam: all secondary steam systems shall utilize clean steam generators supplied by domestic water from ion exchange water softeners.
- C. Condensate Return Systems
  - 1. Condensate return shall be gravity return throughout the building.
  - 2. Where gravity return is impossible, condensate shall be pumped via pumping traps or steam motivated condensate pumps.
- D. Expansion loops are preferred over mechanical expansion devices. Where expansion loops are not practical, provide bellows type expansion devices, not mechanical seal types.
- E. Flash Tanks: Do not discharge condensate drip traps above 15 psig into condensate return mains or condensate pump receivers. Design discharge into a flash tank vented into the low pressure side of the system and drip through a low pressure F & T trap to a condensate return main or receiver.
- F. Welding process in accordance with Section 23 20 00.
- G. Provide remote emergency shut-off valve for auto-claves and similar devices) outside of sterilizer housing. Shutoff to be accessible by user, and labeled "EMERGENCY SHUT-OFF".

#### 1.2 QUALITY ASSURANCE

- A. Regulatory Requirements: Comply with the provisions of the following:
  - 1. ASME B31.9 Building Services Piping for materials, products, and installation. Safety valves and pressure vessels shall bear the appropriate ASME label.
  - 2. ASME "Boiler and Pressure Vessel Code", Section IX, "Welding and Brazing Qualification" for qualifications for welding processes and operators.
  - 3. UMC Compliance: Fabricate and install steam and condensate piping in accordance with IAPMO "Uniform Mechanical Code."

## PART 2 - PRODUCTS

### 2.1 MANUFACTURERS

- A. Acceptable Manufacturers: Subject to compliance with requirements, provide products by the following:
1. Pressure Reducing Valves:
    - a. Spence Engineering Co., Inc. (preferred),
    - b. Fisher Controls International, Inc.,
    - c. Hoffman Specialty ITT
  2. Condensate Return Systems:
    - a. Johnson, (preferred)
    - b. Armstrong Pumping Station,
    - c. Watson McDaniel,
  3. Steam Traps; F&T, Inverted Bucket:
    - a. Armstrong Machine Works (preferred)
    - b. Hoffman Specialty ITT
    - c. Spirax Sarco.
  4. Steam Traps Radiator Thermostatic Bellows:
    - a. Armstrong Machine Works (preferred)
    - b. Hoffman Specialty ITT
    - c. Spirax Sarco.
  5. Steam Relief Valves:
    - a. Kunkle Valve Co., Inc., (preferred)
    - b. Spence
    - c. Watts Regulator Co.
  6. Gaskets: Non-asbestos, spiral wound only.
    - a. Flexitalic (Preferred)
    - b. Garloc
  7. Strainers:
    - a. Armstrong, (Preferred)
    - b. Fisher,
    - c. ITT,
    - d. Hoffman,
    - e. Spirax Sarco.
  8. Buried Piping or piping exposed to weather: As specified in Section 23 20 00.

### 2.2 MATERIALS, GENERAL

- A. Steam Piping – in weather protected areas:
1. High and Medium Pressure Steam Piping, (above 15 psig):
    - a. Piping 2 Inches and Under:
      - 1) Pipe: ASTM A53, Grade B, Schedule 40 seamless, black steel, plain ends.
      - 2) Fittings: Cast iron, Class 300.
      - 3) Joints: Screwed above ground.
    - b. Piping 2-1/2 Inches and Over:
      - 1) Pipe: Schedule 40 seamless, black steel, beveled ends.
      - 2) Fittings: Schedule 40, seamless, black steel, butt weld type.
      - 3) Flanges: 150 lb. forged steel, welded neck or SORF types.
  2. Low Pressure Steam Piping (Below 15 psig):
    - a. Piping 2 Inches and Under:
      - 1) Pipe: ASTM A53, Schedule 40, black steel.
      - 2) Fittings: Screwed, cast-iron, 125 lb.; welded, forged steel socket weld type, 150 lb.
      - 3) Joints: Screwed, above ground.
    - b. Piping 2-1/2 Inches and Over:
      - 1) Pipe: ASTM A53, Schedule 40, black steel, beveled ends.
      - 2) Fittings: Schedule 40 steel, butt weld type.

- 3) Flanges: 150 lb. forged steel, weld neck type.
- B. Condensate Piping– in weather protected areas:
1. High and Medium Pressure Steam Condensate, (above 15 psig):
    - a. Piping 2 Inches and Under:
      - 1) Pipe: ASTM A53, Schedule 80 seamless, black steel, threaded or plain ends.
      - 2) Fittings: Cast iron, threaded, 125 lb.
    - b. Piping 2-1/2 Inches and Over:
      - 1) Pipe: ASTM A53, Schedule 80 seamless, black steel, plain ends.
      - 2) Fittings: Schedule 80, seamless, black iron, butt weld type.
      - 3) Flanges: 150 lb. forged steel, welding neck or SORF types
  2. Low Pressure Condensate Piping (less than 15 psig):
    - a. Piping 2 Inches and Under:
      - 1) Pipe: ASTM A53, Schedule 80, black steel, threaded, and coupled.
      - 2) Fittings: Screwed, cast-iron, 125 lb.; welded, forged steel socket weld type, 125 lb.
      - 3) Joints: Screwed, above ground.
    - b. Piping 2-1/2 Inches and Over:
      - 1) Pipe: ASTM A53, Schedule 80, black steel, beveled ends.
      - 2) Fittings: Schedule 80 steel, butt weld type.
      - 3) Flanges: 150 lb. forged steel, weld neck type.
- C. Clean Steam Piping:
1.
    - a. Piping 2 Inches and Under:
      - 1) Pipe: ASTM A53, Schedule 80, Type 316 stainless steel ,threaded, and coupled.
      - 2) Fittings: Screwed, Type 316 stainless steel 125 lb.; welded, forged steel socket weld type, 125 lb.
      - 3) Joints: Screwed, above ground.
    - b. Piping 2-1/2 Inches and Over:
      - 1) Pipe: ASTM A53, Schedule 80, Type 316 stainless steel, beveled ends.
      - 2) Fittings: Schedule 80, Type 316 stainless steel butt weld type.
      - 3) Flanges: 150 lb. Type 316 stainless steel, weld neck type
  2. Ball Valves: Full-ported, three-piece valves with threaded connections, type 316 stainless steel body and ball, TFE seats and seals.
- D. Clean Condensate Piping
1. Type 316 stainless steel tubing with butt-weld fittings.
  2. Ball Valves: Full-ported, three-piece valves with threaded connections, type 316 stainless steel body and ball, TFE seats and seals.
- E. Safety Valves:
1. Bronze Safety Valves: Cast-bronze or forged copper body, rated for design pressure, forged copper-alloy disc; fully enclosed, cadmium-plated steel spring - and positive shutoff. Inlet and outlet shall be threaded for valves two inches and below. Larger valves shall be flanged.
  2. Cast Iron Safety Valves: Cast-iron body, rated for design pressure; forged copper-alloy disc and nozzle; fully enclosed, cadmium-plated steel spring and positive shutoff; Inlet and outlet shall be threaded for valves two inches and below. Larger valves shall be flanged.
  3. Stop-Check Valves Class 125 for 5 psig and below. Class 250 for higher pressures. Threaded bronze swing-checks for 5 psig and below, 2-inch and below pipe diameter. On higher pressure applications use wafer, ball-check, or spring-loaded types per system design
- F. Pressure Reducing Valves:
1. Valve Characteristics: Pilot-actuated, diaphragm type, with adjustable pressure range and positive shutoff; cast-iron or bronze body with flanged end connections, hardened stainless-steel trim, and replaceable head and seat. Provide main head stem guide fitted with flushing and pressure-arresting device. Provide dirt cover over pilot diaphragm.

- G. Sound Diffractors:
  - 1. Flanged, cast steel body, rated design pressure.
  
- H. Steam Traps:
  - 1. Steam Traps: 15 psig and less:
    - a. Thermostatic Traps: Cast-brass, angle-pattern body with integral union tailpiece and screw-in cap; maximum operating pressure of 25 psig; balanced-pressure, stainless-steel or monel diaphragm or bellows element and renewable, hardened stainless-steel head and seat. Provide an external Y strainer with blow-down rated for service.
    - b. Float and Thermostatic Traps: ASTM A278, Class 30, cast-iron body and bolted cap; renewable, stainless-steel float mechanism with renewable, hardened stainless-steel head and seat; balanced-pressure, thermostatic air vent made with stainless-steel or monel bellows, and stainless-steel head and seat. Provide an external Y strainer with blow-down rated for service.
    - c. Inverted Bucket Traps: ASTM A278, cast-iron body and cap, pressure rated for 25 psig; stainless-steel head and seat; stainless-steel valve retainer, lever, and guide pin assembly; brass or stainless-steel bucket. Provide an external Y strainer with blow-down rated for service.
  - 2. Steam Traps: 16 psig to 125 psig:
    - a. Thermostatic Traps: Class 125, bronze angle-pattern body with integral union tailpiece and screw-in cap; balanced-pressure, stainless-steel or monel bellows element and renewable, hardened stainless-steel head and seat. Provide an external Y strainer with blow-down rated for service.
    - b. Float and Thermostatic Traps: ASTM A126, cast-iron body and bolted cap; renewable, stainless-steel float mechanism with renewable, hardened stainless-steel head and seat; maximum operating pressure of 125 psig; balanced-pressure, thermostatic air vent made of stainless-steel or monel bellows, and stainless-steel head and seat. Provide an external Y strainer with blow-down rated for service.
    - c. Inverted Bucket Traps: Cast-iron body and cap, pressure rated for 125 psig; stainless-steel head and seat; stainless steel valve retainer, lever, and guide pin assembly; brass or stainless-steel bucket. Provide an external Y strainer with blow-down rated for service.
    - d. Disk Traps: Applications 100 psig and over.
  
- I. Air Vents:
  - 1. Quick Vents: Cast-iron or brass body, with balanced-pressure, stainless-steel or monel thermostatic bellows, and stainless-steel heads and seats.
  - 2. Float Vents: Cast-iron or brass body, seamless brass float, balanced-pressure, thermostatic bellows, and replaceable stainless-steel seat, float, and head.
  
- J. Strainers:
  - 1. Wye Pattern Strainers: Minimum 125 psig steam working pressure, cast-iron body conforming to ASTM A278, Class 30; Grade 18-8 stainless-steel screen, 20 mesh for 2-inch and smaller, and manufacturer recommended perforations for 2-1/2 inch and larger; tapped blow-off plug.
  - 2. Basket Strainers: Minimum 125 psig steam working pressure, cast-iron body conforming to ASTM A278-93, Class 30; Grade 18-8 stainless-steel screen, flanged end connections, bolted cover.
  
- K. Condensate Cooler:
  - 1. ASME constructed welded steel for 150 psig working pressure. Steel shell with bronze heads, and copper tube bundle. Condensate in shell, water in tubes construction. Fabricate with tapping for vents, low-pressure steam and condensate outlets, high-pressure condensate inlet, air vent, safety valve, and legs. Provide saddles and support on steel pipe stand.
  
- L. Condensate Movers:
  - 1. Pumpless condensate system prepiped and skid-mounted:

- a. System to include condensate receiver, pumping chamber, all stainless steel, single spring mechanism, inlet and discharge type 304 stainless steel spring loaded check valves, isolation valve, motive steam y-strainer, isolation valves, pressure gauge and site glass assembly.
- b. Provide with battery operated cycle counter, motive steam pressure regulating valve and thermostatic air vent.

## PART 3 - EXECUTION

### 3.1 INSTALLATION, GENERAL

#### A. Piping Installation:

1. Seal pipe penetrations at building walls, valve pits, etc., with link-seal type mechanical seal with sleeve in concrete to assure watertight penetrations at exterior foundation penetrations.
2. Route piping in orderly manner, plumb and parallel to building structure. Maintain gradient. Install piping free of sags or bends and with ample space between piping to permit proper insulation applications.
3. Install piping tight to slabs, beams, joists, columns, walls, and other permanent elements of the building. Provide space to permit insulation applications, with 1 inch clearance outside the insulation. Allow sufficient space above removable ceiling panels to allow for panel removal.
4. Locate groups of pipes parallel to each other, spaced to permit applying insulation and servicing of valves.
5. Install piping to conserve building space and in such a manner that it will not interfere with use of space, other work or equipment.
6. Install piping to allow for expansion and contraction without stressing pipe, joints, or connected equipment.
7. Provide access panels or doors where valves and fittings are not exposed. Coordinate size and location of access doors as per prints.
8. Sloping:
  - a. Install steam piping at a uniform grade of one inch in 40 feet, in direction of flow. Use eccentric reducers to maintain bottom of pipe level.
  - b. Install steam condensate piping at a uniform grade of one inch in 40 feet. Install drip trap assembly at low points and before control valves. Run condensate lines from trap to nearest condensate receiver. Provide loop vents over trapped sections.
9. Where pipe support members are welded to structural building framing; scrape, brush clean, and apply one coat of zinc rich primer to welding.
10. Install branch connections to supply mains using 45 degree fittings in main with take-off out the top of the main. Use of 90 degree "tee" fittings is permissible, where the use of 45 degree fittings are not practical. Where the length of a branch take-off is less than 10 feet, pitch branch line down toward mains, 1/2 inch per 10 feet.
11. Install flanges on valves, apparatus and equipment having 2-1/2 inch and larger connections.
12. Install flexible connectors at inlet and discharge connections to pumps and other vibration producing equipment.
13. Install strainers on the supply side of each control valve, pressure regulating valve, solenoid valve, traps, and elsewhere as indicated. Install 3/4 inch NPS nipple and ball valve in blow down connection of strainers 2 inch and larger. Use same size nipple and valve as blow-off connection of strainer.
14. Drip Legs:
  - a. Install drip legs at low points and natural drainage points in the system, such as at the ends on mains, bottoms of risers, and ahead of pressure regulators, control valves, isolation valves, pipe bends and expansion joints.
  - b. On straight runs with no natural drainage points, install drip legs at intervals not exceeding 200 feet where pipe is pitched down in the direction of steam flow and a maximum of 150 feet where the pipe is pitched up so that condensate flow is opposite of steam flow.
  - c. Drip leg diameter: Same diameter as the main up to 4 inch pipe size, 4 inches in diameter for mains up to 8 inches and 1/2 of the diameter on the main thereafter.

- d. Drip leg lengths: At least 1-1/2 times the diameter of the main, but never less than 10 inches for systems with supervised warm-up. For systems with automatic warm-up, the drip lengths shall be a minimum of 28 inches in length.
      - e. Install steam traps close to drip legs.
    15. Install unions downstream of valves and at equipment or apparatus connections. Install dielectric unions where joining dissimilar materials.
    16. Terminal Equipment Connections:
      - a. Size pipe for supply and return same size as equipment connections.
      - b. Install bypass piping with globe valve around control valve. Install only one bypass where multiple parallel control valves are installed.
      - c. Install vacuum breaker downstream from control valve and bypass, and close to coil inlet connections.
      - d. Pipe outlet from coils to drip legs and trap.
- B. Valves:
  1. Install valves with stems upright or horizontal, not inverted. Install valves in position to allow full stem movement. Locate valves for easy access.
  2. Provide extended valve stems where insulation is specified.
  3. Provide valves same size as line size.
  4. Install gate valves for shut-off and to isolate equipment, part of systems, or vertical risers.
  5. Install globe valves for throttling, bypass, or manual flow control services.
  6. Install drains at low points in mains, risers, and branch lines consisting of a tee fitting, 3/4 inch ball valve, and short 3/4 inch threaded nipple and cap.
  7. Install gate valves on drop legs, dirt pockets, and strainer blowdowns to allow removal of dirt and scale
- C. Safety Valves:
  1. Pipe discharge from safety valves to atmosphere outside the building.
  2. Install drip-pan elbow fitting adjacent to safety valve.
  3. Pipe drain connection to nearest floor drain.
- D. Pressure Reducing Stations:
  1. Pressure reducing stations shall have two valves sized for 1/3 and 2/3 capacity of the calculated total steam load. Switch-over between valves shall be via manual gate valves.
  2. Each branch of the pressure reducing station shall include a swing-joint to accommodate component removal.
  3. Install pressure-reducing valves in accessible location for maintenance and inspection.
  4. Install bypass around each reducing valve, with globe valve equal in size to area of reducing valve seat ring.
  5. Install gate valves and unions or flanged connection around each reducing valve.
  6. Install full size strainer with blow down upstream of each reducing valve
  7. Install 4½-inch pressure gauge, 0 to 200 psi on inlet side and 0 to 60 psi on medium pressure load side of station. Provide anti-siphon loop or “pig-tail” and steam-rated gauge cock. Install pressure gauges where they are clearly visible from the operating level of the reducing station.
  8. Control of pressure reducing stations shall have PRVs with pilot positioners and shall fail closed. Pressure reducing station failure shall also have appropriate alarms connected to the Building Automation System.
- E. Steam Traps:
  1. Install traps at all low points or where condensate is trapped. Install steam traps in accessible locations close to connected equipment and drip legs. Maximum allowable distance from equipment is 4 feet.
  2. Install gate valves, strainer, and union upstream from trap; install union, check valve, and gate valve downstream from trap.
  3. Applications 15 psig and less:
    - a. Thermostatic Traps: Install on convectors and finned-tube radiation.

- b. Float and Thermostatic Traps: Install on steam main and riser drip legs, laundry equipment, kitchen equipment, heat exchangers, and coils, or systems with modulated steam supply.
- c. Inverted Bucket Traps: Install on steam mains and riser drip legs.
- 4. Applications 16 psig to 125 psig:
  - a. Thermostatic Traps: Install on convectors and finned-tube radiation.
  - b. Inverted Bucket Traps: Install on steam main and riser drip legs, laundry equipment, kitchen equipment, heat exchangers, and coils.
  - c. Thermodynamic Traps: Install on steam mains, riser drip legs, and heat tracer lines.

F. Flash Tanks:

- 1. Pitch condensate lines towards flash tank.
- 2. If more than one condensate line discharges into flash tank, install a swing check valve in each line.
- 3. Install thermostatic air vent at the top of the tank.
- 4. Install an inverted bucket or float and thermostatic trap at the low pressure condensate outlet, sized for triple the condensate load.
- 5. Install a safety relief valve at the tank top.
- 6. Install a pressure gage, gate valve, and swing check valve on the low pressure (flash) steam outlet.

G. Identification:

- 1. Label piping, valves, and equipment as specified in Section 23 05 53.

3.2 TESTING, CLEANING AND CERTIFICATION

- A. Clean and flush system, with clear water, of all dirt, metal chips, sand, and foreign matter. After flushing, remove, clean, and replace all strainer baskets or screens. Inspect each run of each system for completing of joints, support, accessory items, and obvious leaks.

- B. Examine and inspect piping in accordance with ANSI B31.9, Chapter VI.

C. Leak Testing:

- 1. Provide temporary equipment for testing, including pumps and gages. Test piping system before insulation is installed, wherever feasible, and remove control devices before testing. Subject entire steam supply and return piping systems to leak tests, either as a whole, or in sections; but leave no part untested.
- 2. Leak test steam supply and return piping systems complying with ANSI B31.9
- 3. Fill piping systems with clear water, vent all air and pressurize at 150% of design pressure, (but not less than 25 psi) for 2 hours. Test fails if leakage is observed, or pressure drop exceeds 5% of test pressure.
- 4. Notify Project Manager at least 5 days before performing leak tests.
- 5. Repair piping systems which fail required piping test, by disassembly and reinstallation, using new materials to the extent required to overcome leakage. Do not use chemicals, stop-leak compounds, mastics or other temporary repair methods.
- 6. Drain test water from piping systems after testing and repair work has been completed.

- D. Treating: Upon completion, fill, clean, and chemically treat systems. Refer to Section 23 25 00 for chemical treatment of systems.

- E. Certification: Prepare written report of testing, indicating locations of leaks corrected, method used to correct leaks, number of tests required, and certification that system is leak free.

3.3 COMMISSIONING (DEMONSTRATION)

- A. Provide 4 hours of instruction on steam system. Include operation and maintenance and locations of the following as a minimum:

1. Location of traps.
2. Location of strainers and blow down valves.
3. Location of safety and relief valves.
4. System drain valves.
5. System fill and associated devices.

**END OF SECTION 23 22 13**