

## SECTION 232213 - 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. Flash tanks.
  - 4. Safety valves.
  - 5. Pressure-reducing valves.
  - 6. Building automatic steam valves.
  - 7. Steam traps.
  - 8. Thermostatic air vents and vacuum breakers.
  - 9. Steam and condensate meters.

#### 1.3 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.

#### 1.4 PERFORMANCE REQUIREMENTS

- A. Components and installation shall be capable of withstanding the following minimum working pressures and temperatures:

Verify minimum working pressure and temperature for systems in subparagraphs below.

- 1. HP Steam Piping: 90 psig
- 2. LP Steam Piping: 15 psig
- 3. Condensate Piping: 35 psig at 250 deg F.
- 4. Blowdown-Drain Piping: Equal to pressure of the piping system to which it is attached.
- 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. Flash tank.
  5. Meter.
- B. Shop Drawings: Detail flash tank assemblies and 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.

Retain paragraph below if procedures for welder certification are retained in "Quality Assurance" Article.

- C. Welding certificates.
- D. Field quality-control test reports.
- E. 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. 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.

Retain applicable codes in paragraph below: B31.1 for HP steam system and B31.9 for LP steam system.

- B. 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 air separators and expansion tanks to comply with ASME Boiler and Pressure Vessel Code: Section VIII, Division 01.
- C. Piping materials shall bear label, stamp, or other markings of specified testing agency.

## PART 2 - PRODUCTS

### 2.1 COPPER TUBE AND FITTINGS

- A. Drawn-Temper Copper Tubing: ASTM B 88, Type L (ASTM B 88M, Type B).

- B. Annealed-Temper Copper Tubing: ASTM B 88, Type K (ASTM B 88M, Type A).
- C. Wrought-Copper Fittings and Unions: ASME B16.22.

## 2.2 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, 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.C. 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.D. Wrought-Steel Fittings: ASTM A 234/A 234M, wall thickness to match adjoining pipe.~~
- ~~G.E. 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.F. 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.~~

## 2.3 JOINING MATERIALS

- A. Gaskets:
  - 1. Suitable for chemical and thermal conditions of piping system contents.
  - 2. Anti-Seize compound, if required, shall be Loctite C5-A Copper Based or approved equal.
  - 3. High Pressure Steam Piping: Flexitallic spiral wound gaskets Class 150, ASME B16.20 with 304 SS metal winding strip and Flexicarb flexible graphite filler material; or approved equal.
  - 4. Low Pressure Steam and Condensate Piping: Flexitallic spiral wound gaskets Class 150, ASME B16.20 with 304 SS metal winding strip and Flexicarb flexible graphite filler material, Graphonic corrugated metal gaskets Class 150 with 316 SS metal core and flexible graphite sealing element; or approved equal.

- B. Join Sealers:
  - 1. Use a pipe compound approved for the type of service.
  - 2. All purpose PTFE soft-set thread sealing compound. Jomar Gimmie The White Stuff, Rectorseal No. 5, or approved equal.
- C. Flange Bolts and Nuts: Unless required otherwise, conform to ASTM A-354 Grade BD and SAE J-429 Grade 8 for steam and condensate application.
- D. Welding Filler Metals: Comply with AWS D10.12 for welding materials appropriate for wall thickness and chemical analysis of steel pipe being welded.
- E. 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.

## 2.4 VALVES

- A. Gate, Globe, Check, Ball, and Butterfly Valves: Comply with requirements specified in Division 23 Section "General-Duty Valves for HVAC Piping."
- B. Stop-Check Valves:
  - 1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
    - a. Crane Co.
    - b. Jenkins Valves; a Crane Company.
    - c. Lunkenheimer Valves.
  - 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.

## 2.5 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 (DN 50) and smaller; flanged ends for strainers NPS 2-1/2 (DN 65) and larger.

3. Strainer Screen: Monel metal or stainless-steel, 0.033" dia. for steam and 0.045" for condensate. Free area through the screen shall be at least 2-1/2 times the pipe area in which it is installed.
4. CWP Rating: 250-psig (1725 kPa) 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 (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. CWP Rating: 250-psig (1725 kPa) working steam pressure.

## 2.6 FLASH TANKS

- A. Shop or factory fabricated of welded steel according to ASME Boiler and Pressure Vessel Code, for 150-psig (1035-kPa) rating; and bearing ASME label. Fabricate with tappings for low-pressure steam and condensate outlets, high-pressure condensate inlet, air vent, safety valve, and legs.

## 2.7 SAFETY VALVES

Valves in paragraph and subparagraphs below are available in NPS 1/2 through NPS 2-1/2 (DN 15 through DN 65).

A. Bronze Safety Valves:

1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
  - a. Kunkle Valve; a Tyco International Ltd. Company; Fig. #6010
  - b. Spirax Sarco, Inc.
  - c. Spence
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.

Valves in paragraph and subparagraphs below are available in NPS 1-1/2 through NPS 6 (DN 40 through DN 150).

B. Cast-Iron Safety Valves:

1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
  - a. Kunkle Valve; a Tyco International Ltd. Company; Fig. #6252
  - b. Spirax Sarco, Inc.
  - c. Spence
2. Disc Material: Forged copper alloy with bronze nozzle.
3. End Connections: Raised-face flanged inlet and threaded or flanged outlet connections.
4. Spring: Fully enclosed cadmium-plated 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, outlet, and drain, with threads complying with ASME B1.20.1.
7. Exhaust Head: Cast iron and having threaded inlet and drain, with threads complying with ASME B1.20.1.
8. Size and Capacity: As required for equipment according to ASME Boiler and Pressure Vessel Code.

2.8 PRESSURE-REDUCING VALVES

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

1. Spence Engineering Company; Type ED.
2. Spirax Sarco, Inc.; Model 25P.
3. Armstrong International, Inc; Model GP-2000

Schedule pressure-reducing valves and include size, capacity, minimum length of straight pipe on both sides of valve, and inlet and outlet pressures. Select pressure-reducing valves to develop no more than 85 dBA at an elevation of 3 feet (1 m) above adjacent floor and at 3 feet (1 m) in any direction. Use Schedule 80 minimum for piping inlet and outlet connections to pressure-reducing valves, to achieve the required sound level, or use sound attenuators.

PRV station for absorption chillers shall be of duplex, 1/3 and 2/3, configuration with the large valve to be the lead.

- B. Description: Single seated, normally closed, pilot operated, packless type, with stainless steel or bronze diaphragms, hardened seats and discs, and stainless steel stems.
- C. Factory set for inlet and outlet pressures indicated.
- D. Rated for working pressure of 150 psi steam at 400 degree F.
- E. Limit inlet velocity to 10,000 FPM, and exit velocity to 30,000 FPM.

- F. Pilot: Externally-mounted for valves 6" and larger, and top or externally-mounted for 5" and smaller.
- G. Body: Cast iron.
- H. End Connections: Threaded connections for valves NPS 2 (DN 50) and smaller and flanged connections for valves NPS 2-1/2 (DN 65) and larger.
- I. Trim: Hardened stainless steel.
- J. Head and Seat: Replaceable, main head stem guide fitted with flushing and pressure-arresting device cover over pilot diaphragm.
- K. Gaskets: Non-asbestos materials.

## 2.9 BUILDING AUTOMATIC STEAM VALVES

- A. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
  - 1. Valvcon
  - 2. Bray.
- B. High performance butterfly valve, lug-type, ANSI Class 150, suitable for continuous duty in 90 psi steam at 400°F, carbon steel body, stainless steel shaft, stainless steel or nickel plated steel disc, PTFE seat with titanium/stainless steel ring, and full bi-directional on dead-end service.
- C. Valves shall be equipped with 24V or 120V electric actuator, 2 position with speed control board programmed for 90 minute open and 30 minute close, internal heater kit, hand wheel manual overdrive, external position indicator, and auxiliary limit switches for open and close feedback.
- D. Valves shall be installed according to manufacturer recommendations with actuator mounted at a 90 degree angle to prevent actuator overheating.

## 2.10 SOUND ATTENUATORS

- A. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
  - 1. Spence Engineering Company.
  - 2. Spirax Sarco, Inc.
  - 3. Armstrong International, Inc.
- B. Description: Dissipative reactive type to provide maximum sound attenuation for each individual application, with minimal pressure drop.

- C. Noise suppressor: Consist of a welded steel expanded outlet shell suitable for 150 psig steam maximum working pressure, containing a deflector assembly and acoustic packing of corrosion resistant material.
- D. Muffling orifice: Consist of a steel plate with primary orifices to which is welded a stainless steel plate with secondary orifices.
- E. Acoustic blankets: Teflon coated fiberglass jacket with fiberglass insulation.

## 2.11 STEAM TRAPS

- A. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
  - 1. Armstrong.
  - 2. Illinois.
  - 3. Spirax Sarco.
- B. Float and Thermostatic Steam Traps:
  - 1. Cast iron body and cover, non-asbestos gasket, screwed ends, stainless steel heads, seats and thermostatic air vent.
  - 2. Basis of Design: Spirax Sarco Model FT 15 - FT 125, FTB Super Capacity Series.
- C. Inverted Bucket Steam Traps:
  - 1. Cast iron body and cover, threaded connections, stainless steel bucket, renewable hardened stainless steel head and seat.
  - 2. Basis of Design: Spirax Sarco Model B.
- D. Balanced Pressure Thermostatic Traps:
  - 1. Self adjusting to all pressures within their operating range, heavy cast brass body with male union inlet connection, stainless steel thermostatic element and valve head, and stainless steel replaceable valve seat.
  - 2. Basis of Design: Spirax Sarco Model TA, TH.

## 2.12 THERMOSTATIC AIR VENTS AND VACUUM BREAKERS

- A. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
  - 1. Armstrong International, Inc.
  - 2. Hoffman Specialty; Division of ITT Industries.
  - 3. Spirax Sarco, Inc.
- 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.

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.

## 2.13 STEAM METERS

- A. Manufacturers: Rosemount 3051SF DP Flowmeters, with Compact Orifice plate for sizes less than 10" and Annubar for sizes 10" and above.
- B. Steam meters and necessary control equipment will be provided by the MSU Power and Water Department for installation by the Contractor.

## 2.14 CONDENSATE METERS

- A. Description: A programmable relay provided by the MSU Power and Water Department shall be installed on condensate pumps. One duplex receptacle shall be wired to each pump motor starter for testing purposes.
- B. For buildings with multiple condensate pump locations, a Yokogawa ADMAG AFX Magnetic Flowmeter shall be installed in the building condensate return line leaving the building. MSU Power and Water Department will supply the Flowmeter and control equipment for installation by the Contractor.

## 2.15 STEAM CONDENSATE CONDUCTIVITY METER

- A. A conductivity/temperature meter/alarm system shall be installed, and connected to the Energy Monitoring and Control System to indicate the presence of any lower purity water entering the steam condensate system, condensate temperature, and fault condition of the meter itself. The system shall consist of a sensor (conductivity cell) mounted in the condensate piping and a meter, wall mounted in an accessible location near the sensor.
- B. Sensor (conductivity cell) shall have titanium-palladium or stainless steel electrodes and integral automatic temperature compensation, referenced to 25degree C. The cell shall be mounted in the condensate line with a threaded fitting in a section of the condensate piping system which, either by selection or design, is flooded with condensate at all times, and in accordance with manufacturers specifications. The cell shall be retractable for ease of

maintenance, and test ports shall be provided adjacent to the cell mounting for water sampling and meter/cell calibration. Meter to cell cable length shall not exceed manufacturer's specifications. Sensor Range: 1 - 200 degree S/cm (.01 cell constant, accuracy  $\pm 0.5\%$  of reading, temperature compensation -15 to 200degree C).

- C. Meter shall have a NEMA 4X (IP65) enclosure with chemically resistant finish. Indicator lamps on the meter face or control panel shall indicate fault/alarm relay status. The unit shall be equipped with 2 independent, scalable output (4-20ma) signals providing condensate conductivity (1-20 degree S/cm) and temperature, local display, adjustable alarm relay setpoints, dedicated fault relay, and designed for 115 V. 60 Hz. operation. Meter to DDC panel cable length shall not exceed 750ft.
- D. For building specific applications, the cell shall be mounted at the point where the condensate piping exits the building.
- E. Conductivity meter shall be Rosemount Analytical Model 54eC with model (402-11-31-60-61) retractable conductivity cell, TBI Bailey Model TB84TE100000 with model TB260.01111011002 retractable conductivity cell, or approved equal. (Approval by MSU Central Control, to insure compatibility with existing metering and monitoring systems).

## PART 3 - EXECUTION

### 3.1 LP STEAM PIPING APPLICATIONS

Retain at least one pipe material in paragraphs below for each service required for Project. Services are specified separately to allow different pipe materials and joining methods for each. If materials and methods are the same for multiple services, combine the requirements by editing the paragraph titles. To allow the Contractor to choose among various pipe materials, retain multiple materials for each required service. The change point for pipe materials and joining methods is specified, in this master, where the pipe size changes from NPS 2 to NPS 2-1/2 (DN 50 to DN 65).

If Project includes steam and condensate piping with pressure ranges both higher and lower than 15 psig (104 kPa), retain this Article and the following "HP Steam Piping Applications" Article and identify the pressure range of steam piping on Drawings; use similar designations. If pressure range for systems on Project is limited to 15 psig (104 kPa) and lower, or is limited to higher than 15 psig (104 kPa), retain only the appropriate Article and omit pressure designations on Drawings.

- 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 **ES**, 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: 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: Schedule 80, Type **ES**, Grade B, steel pipe; Class 150 wrought-steel fittings, flanges, and flange fittings; and welded and flanged joints.

- E. Condensate piping below grade, NPS 2 (DN 50) and smaller: Schedule 80, Type S, Grade B, steel pipe; Class 125 cast-iron fittings; and threaded joints.
- F. Condensate piping below grade, NPS 2-1/2 (DN 65) and larger: Schedule 80, Type **ES**, 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 (DN 50) and Smaller: Schedule 40, Type S, Grade B, steel pipe; Class 125 cast-iron fittings; and threaded joints.
- B. HP Steam Piping, NPS 2-1/2 (DN 65) and larger: Schedule 40, Type **ES**, 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: 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: Schedule 80, Type **ES**, Grade B, steel pipe; Class 150 wrought-steel fittings, flanges, and flange fittings; and welded and flanged joints.
- E. Condensate piping below grade, NPS 2 (DN 50) and smaller: Schedule 80, Type S, Grade B, steel pipe; Class 125 cast-iron fittings; and threaded joints.
- F. Condensate piping below grade, NPS 2-1/2 (DN 65) and larger: Schedule 80, Type **ES**, 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.
- B. Air-Vent Piping:
  - 1. Inlet: Same as service where installed.
  - 2. Outlet: Type K annealed-temper copper tubing with soldered or flared joints.
- C. Vacuum-Breaker Piping: Outlet, same as service where installed.
- D. Safety-Valve-Inlet and -Outlet Piping: Same materials and joining methods as for piping specified for the service in which safety valve is installed.

### 3.4 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.
- B. Install safety valves on pressure-reducing stations and elsewhere as required by ASME Boiler and Pressure Vessel Code. Install safety-valve discharge piping, without valves, to nearest floor drain or as indicated on Drawings. Comply with ASME Boiler and Pressure Vessel Code: Section VIII, Division 1, for installation requirements.

### 3.5 PIPING INSTALLATION

- A. Refer to Division 23 Section "Common Work Results for HVAC" for basic installation requirements.
- B. 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.
- C. Install steam supply piping at a minimum uniform grade of 0.2 percent downward in direction of steam flow.
- D. Install condensate return piping at a minimum uniform grade of 0.4 percent downward in direction of condensate flow.
- E. Reduce pipe sizes using eccentric reducer fitting installed with level side down.
- F. Install branch connections to mains using tee fittings in main pipe, with the branch connected to top of main pipe, at a 45degree angle.
- G. Install valves according to Division 23 Section "General-Duty Valves for HVAC Piping."
- H. Install unions in piping, NPS 2 and smaller, adjacent to valves, at final connections of equipment, and elsewhere as indicated.
- I. Install flanges in piping, NPS 2-1/2 and larger, at final connections of equipment and elsewhere as indicated.
- J. 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 ballgate~~ 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).
- K. Strainers are not required for fin tube radiation and convectors.
- L. Strainers ahead of steam pressure regulating and control valves shall be mounted on the side and have blow-off valves.

- M. Install strainers installed ahead of traps on steam main drip legs.
- N. Identify piping as specified in Division 23 Section "Identification for HVAC Piping and Equipment."
- O. 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. On straight runs with no natural drainage points, install drip legs at intervals not exceeding 150 feet.
  - 2. Size drip legs same size as main. In steam mains NPS 6 (DN 150) and larger, drip leg size can be reduced, but to no less than NPS 4 (DN 100).
  - 3. Install dirt pockets of the drip legs and strainer blow downs with gate valves to remove dirt and scale.
- P. Flash Tank:
  - 1. Pitch condensate piping down toward flash tank.
  - 2. If more than one condensate pipe discharges into flash tank, install a check valve in each line.
  - 3. Install thermostatic air vent at tank top.
  - 4. Install safety valve at tank top.
  - 5. Install ~~full port ballgate~~ valve, and swing check valve on condensate outlet.
  - 6. Install inverted bucket or float and thermostatic trap at low-pressure condensate outlet, sized for three times the calculated heat load.
  - 7. Install pressure gage on low-pressure steam outlet according to Division 23 Section "Meters and Gages for HVAC Piping."

### 3.6 STEAM-TRAP INSTALLATION

- A. Install steam traps in accessible locations as close as possible to connected equipment.
- B. Install ~~full port ballgate~~ valve, strainer, and union upstream from trap; install union, check valve, and ~~full port ballgate~~ valve downstream from trap unless otherwise indicated.
- C. All low points and drip legs in steam lines and the bottom of down feed risers shall have inverted bucket traps of proper size.
- D. Return ends of all equipment where steam is condensed, shall have traps of proper size and type.
- E. Heating and ventilating units, heating coils, forced flow units, water heaters, unit heaters, and convertors: Install float and thermostatic type.
- F. Make-up air unit heating coils: Install double seated F&T trap or two full size F&T traps for 100% redundancy.
- G. Unit heaters without control valves: Install inverted bucket type of proper size.

- H. Convectors and finned tube radiation: Install balanced pressure thermostatic type.
- I. Steam refrigeration machines: Install float and thermostatic type sized for 100% redundancy.
- J. Use Armstrong inverted bucket traps in steam tunnels.
- K. Install traps with rising stem gate valves and unions on both sides. Ahead of each trap, install a dirt pocket not less than 8 inches long and fitted with threaded reducer, 1" rising stem valve, nipple and a threaded cap on the bottom for 2" and smaller; and with welded cap, 1" thread-o-let, rising stem valve, nipple and threaded cap for 2-1/2" and larger.
- L. Steam trap of temperature-regulated equipment must not be located at less than 14" below the bottom of the coil outlet, and condensate discharge from the trap must flow by gravity, without any lifts in the piping, to the condensate receiver.

### 3.7 PRESSURE-REDUCING VALVE INSTALLATION

- A. Install pressure-reducing valves in accessible location for maintenance and inspection.
- B. Install gate valves on both sides of pressure-reducing valves.
- C. Install unions or flanges on both sides of pressure-reducing valves having threaded- or flanged-end connections respectively.
- D. 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."
- E. Install strainers upstream for pressure-reducing valve. Install strainers with blow-off valves on side.
- F. Install safety valve downstream from pressure-reducing valve station.
- G. Install steam noise suppressor on each pressure reducing valve.
- H. Provide straight run of pipe on sides of the PRVs, at least 10 pipe diameters to the inlet and 20 pipe diameters of expanded line size from the outlet.
- I. Avoid abrupt changes in pipe size. Use eccentric reducers upstream and concentric increasers downstream of the PRVs.

### 3.8 STEAM OR CONDENSATE METER INSTALLATION

- A. Install meters with lengths of straight pipe upstream and downstream according to steam meter manufacturer's instructions.

### 3.9 SAFETY VALVE INSTALLATION

Retain ASME B31.1 in first paragraph below for HP systems; retain ASME B31.9 for LP systems; retain both for combination HP and LP systems.

- A. Install safety valves according to ASME B31.1, "Power Piping" and/or 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.

### 3.10 HANGERS AND SUPPORTS

Piping support must account for expansion and contraction, vibration, dead load of piping and its contents.

- 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. 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.

Verify actual supported loads for hanger sizes and spacing. Consult structural engineer. Spacing and sizes in first two paragraphs and associated subparagraphs below are from the 2000 ASHRAE HANDBOOK - "HVAC Systems and Equipment."

- C. 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).
  12. NPS 14 (DN 350): Maximum span, 32 feet (9.8 m); minimum rod size, 1 inch (25 mm).
  13. NPS 16 (DN 400): Maximum span, 35 feet (10.7 m); minimum rod size, 1 inch (25 mm).
  14. NPS 18 (DN 450): Maximum span, 37 feet (11.3 m); minimum rod size, 1-1/4 inches (32 mm).
  15. NPS 20 (DN 500): Maximum span, 39 feet (11.9 m); minimum rod size, 1-1/4 inches (32 mm).
- D. 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 (1.2 m); minimum rod size, 1/4 inch (6.4 mm).
  2. NPS 3/4 (DN 20): Maximum span, 5 feet (1.5 m); minimum rod size, 1/4 inch (6.4 mm).
  3. NPS 1 (DN 25): Maximum span, 6 feet (1.8 m); minimum rod size, 1/4 inch (6.4 mm).
  4. NPS 1-1/2 (DN 40): Maximum span, 8 feet (2.4 m); minimum rod size, 3/8 inch (10 mm).
  5. NPS 2 (DN 50): Maximum span, 8 feet (2.4 m); minimum rod size, 3/8 inch (10 mm).
  6. NPS 2-1/2 (DN 65): Maximum span, 9 feet (2.7 m); minimum rod size, 3/8 inch (10 mm).
  7. NPS 3 (DN 80): Maximum span, 10 feet (3 m); minimum rod size, 3/8 inch (10 mm).
- E. Support vertical runs at roof, at each floor, and at 10-foot (3-m) intervals between floors.

### 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. Soldered Joints: Apply ASTM B 813, water-flushable flux, unless otherwise indicated, to tube ends. Construct joints according to ASTM B 828 or CDA's "Copper Tube Handbook," using lead-free solder alloy complying with ASTM B 32.
- 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.
- I. Welded Steel Pipe:
  1. All welding shall be done in accordance with the ANSI B-31.1 and the ASME welding code.
  2. Pipe ends on welded pipe lines shall be suitably beveled to permit butt-welding.
  3. All welds shall be of sound metal thoroughly fused to the base metal and penetrating to the bottom of the joints.
  4. Use welding bends in changing pipe directions. Mitered joints will not be accepted.
  5. Welders shall be experienced in the type of work to be done. Any welder, who, in the opinion of the Architect/Engineer or Construction Representative, is not competent to perform the work required, shall be dismissed from the job. At no time shall any welder not approved by the Architect/Engineer be allowed to weld pipe on the project.
  6. All welders shall be certified under the procedure of the ANSI B-31.1 and the ASME Welding Code, Section 9, for the thickness and type of high pressure piping and equipment they work on. Tests shall be conducted by Hartford Insurance Co., or equivalent certifying agency. The Engineer shall be sent a copy of the certification of all welders employed on the project.

### 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 vacuum breakers downstream from control valve, close to coil inlet connection.
- D. Install a drip leg at coil outlet.

### 3.13 FIELD QUALITY CONTROL

- A. Prepare steam and condensate piping according to ASME B31.1, "Power Piping" and/or 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:

Procedures in subparagraphs below are paraphrased from ASME B31.9.

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 232213