

SECTION 23 2216 - STEAM PIPING SPECIALTIES

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 (Low Pressure) and HP (High Pressure) steam and condensate piping:
 - 1. Butterfly valves.
 - 2. Check valves.
 - 3. Chainwheels.
 - 4. Strainers.
 - 5. Safety valves.
 - 6. Pressure regulating/reducing valves.
 - 7. Sound attenuators.
 - 8. Steam traps.
 - 9. Thermostatic air vents and vacuum breakers.
 - 10. Pressure gages and gage attachments.
 - 11. Condensate receiver sets.
 - 12. Drip pan elbows.
 - 13. Steam and condensate meters.

1.3 DEFINITIONS AND CAMPUS STEAM SYSTEM INFORMATION

- A. HP Steam Systems: High-pressure piping operating at more than 15 psig as required by ASME B31.1.
- B. LP Steam Systems: Low-pressure piping operating at 15 psig or less as required by ASME B31.9.
- C. For the Evanston campus, central steam is distributed at 150 psig (known as the "Campus Line"), and at 230 psig. These are distinct piping systems but they both originate from the same high pressure header in the CUP. Steam is and needs to be metered and reduced in pressure after entrance of each building as required. On the condensate return side, there is high pressure condensate return and pumped condensate return.
- D. For the Chicago campus, central steam is distributed at 170 psig. Steam is and needs to be metered and reduced in pressure after entrance of each building as required.
- E. Both campus's utilize direct buried piping and piping run through tunnels.

1.4 PERFORMANCE REQUIREMENTS

- A. Components and installation shall be capable of withstanding the following minimum working pressures and temperatures:
1. HP Steam Piping: **XXX** psig and **XXXF**.
 2. LP Steam Piping: **XX** psig and 300F.
 3. LP Condensate Piping: **XX** psig at 250 deg F.
 4. HP Condensate Piping: **XX** psig at **XXX** deg F.
 5. Blowdown-Drain Piping: Equal to pressure of the piping system to which it is attached.
 6. Air-Vent and Vacuum-Breaker Piping: Equal to pressure of the piping system to which it is attached.
 7. 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. All valves and chainwheels.
 2. Steam traps.
 3. Air vents and vacuum breakers.
 4. Meters, gages, and gage attachments.
 5. Strainers.
 6. Condensate receiver sets.
 7. Drip pan elbows.
 8. Sound attenuators.
- B. Shop Drawings: Detail condensate receiver set installations, steam pressure reducing valve and station assemblies, and sound attenuator installations.
- C. Field quality-control test reports.
- D. Operation and Maintenance Data: For all valves, steam traps, air vents, vacuum breakers, strainers, condensate receiver sets, sound attenuators, and meters to include in emergency, operation, and maintenance manuals.
- E. Coordination Drawings (For Use Amongst the Contractors and For Owner Reference, Not for Engineer Approval): Piping layout, drawn to scale, on which the following items are shown and coordinated with each other, using input from installers of the items involved:
1. Other building services.
 2. Lighting.
 3. Structural members.
 4. Supports.
- F. Welding certificates (For Information).
- G. Field quality-control test reports (For Information).
- H. Delegated-Design Submittal (For Use Amongst the Contractors and For Owner Reference, Not for Engineer Approval):

1. Design calculations and detailed fabrication and assembly of pipe anchors and alignment guides, hangers and supports for multiple pipes, expansion joints and loops, and attachments of the same to the building structure.
2. Locations of pipe anchors and alignment guides and expansion joints and loops.
3. Locations of and details for penetration and firestopping for fire- and smoke-rated wall and floor and ceiling assemblies.

- I. Northwestern University Maintenance Requirement Forms, see Division 01.

1.6 QUALITY ASSURANCE

- A. 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.
- 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. Steel Support Welding: Qualify procedures and personnel according to AWS D1.1/D1.1M, "Structural Welding Code, Steel."
- D. Piping materials shall bear label, stamp, or other markings of specified testing agency.
- E. Comply with FM Global requirements for pressure vessels and piping and for pressure relief devices.

PART 2 - PRODUCTS

2.1 HIGH-PERFORMANCE BUTTERFLY VALVES

- A. Class 300, Single-Flange, Triple Offset, High-Performance Butterfly Valves:
 1. Manufacturers: Subject to compliance with requirements, provide products by the following:
 - a. Zwick.
 2. Description:
 - a. Standard: MSS SP-68.
 - b. CWP Rating: 720 psig at 100 deg F.
 - c. Body Design: Triple offset, lug type; suitable for bidirectional dead-end service at rated pressure without use of downstream flange.
 - d. Body Material: Carbon steel or stainless steel as called for in PART 3.
 - e. Seat: Metal.
 - f. Stem: Stainless steel; offset from seat plane.
 - g. Disc: Stainless steel/ENP.

h. Service: Bidirectional.

2.2 CHECK VALVES

A. Up To and Including 2 Inch:

1. Class 800:

a. Manufacturers:

- 1) Kitz (Preferred).
- 2) Aloyco.
- 3) Smith.

b. Description: ASME B16.34, Class 800, ASTM A105/A105M forged steel body, conventional port, horizontal type, bolted bonnet, piston check, spiral wound gasket, 13 percent chromium stainless steel hard faced seats, threaded or socket weld ends to match adjacent piping.

B. Over 2 Inch:

1. Class 150:

a. Manufacturers:

- 1) Crane Valves; 147.
- 2) Smith.
- 3) Velan; F-0114C-02TY.

b. Description: ASME B16.34, Class 150, ASTM A216/A216M Grade WCB cast steel body, bolted bonnet, swing check, 13 percent chromium stainless steel hard faced seats, flanged ends.

c. Accessories (Where Indicated):

- 1) Tapped drain hole(s).

2. Class 300:

a. Manufacturers:

- 1) Crane Valves; 159.
- 2) Smith.

b. Description: ASME B16.34, Class 300, ASTM A216/A216M Grade WCB cast steel body, bolted bonnet, swing check, 13 percent chromium stainless steel hard faced seats, flanged ends.

c. Accessories (Where Indicated):

- 1) Tapped drain hole(s).

2.3 CHAINWHEELS

- A. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
1. Babbitt Steam Specialty Co.
 2. Roto Hammer Industries.
 3. Trumbull Industries.
- B. Description: Valve actuation assembly with sprocket rim, brackets, and chain.
1. Brackets: Type, number, size, and fasteners required to mount actuator on valve.
 2. Attachment: For connection to valve stems.
 3. Sprocket Rim with Chain Guides: Ductile iron, of type and size required for valve. Include zinc coating.
 4. Chain: Hot-dip, galvanized steel, of size required to fit sprocket rim and long enough to reach from particular valve height to 3' from finished floor.

2.4 STRAINERS

- A. Manufacturers: Subject to compliance with requirements, provide products by the following:
1. Keckley.
- B. LP 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: 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 working steam pressure.
- C. LP 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.
- D. HP Y-Pattern Strainers:
1. ASME, Class 600, cast carbon or cast alloy steel or stainless steel models, properly outfitted for the duty and with suitable end connections.
- E. HP Basket Strainers:

1. ASME, Class 600, cast carbon steel or stainless steel with bolted bonnet, properly outfitted for the duty and with suitable end connections. ValvSource/Spence 150V2 or approved equal by Mueller or Sarco.

2.5 SAFETY VALVES

A. LP Bronze Safety Valves:

1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
 - a. Kunkle Valve; a Pentair 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.

B. LP Cast-Iron Safety Valves:

1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
 - a. Kunkle Valve; a Pentair 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.

C. HP Safety Valves:

1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
 - a. Kunkle Valve; a Pentair Company.
 - b. Spirax Sarco, Inc.

2. ASME, cast steel or stainless steel, Series 300/600/900 by Kunkle, or equal form Sarco, properly outfitted for specific project duty.
3. Size and Capacity: As required for equipment according to ASME Boiler and Pressure Vessel Code.

2.6 PRESSURE REGULATING VALVES

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

1. Fisher 92B

B. Description: Single seated, normally closed, pilot operated, packless type, with stainless steel diaphragms, hardened seats and discs, and stainless steel stems.

C. Factory set for inlet and outlet pressures indicated.

D. Rated for specific project application as far as maximum working pressures and temperatures.

E. Limit inlet velocity to 10,000 FPM, and exit velocity to 30,000 FPM.

F. Maximum sound Pressure Level: 92 dBA.

G. Pilot: Externally-mounted for valves 6" and larger, and top or externally-mounted for 5" and smaller.

H. Body: Cast iron or ductile iron for LP, cast steel or ductile iron for HP.

I. End Connections: Threaded connections for valves NPS 2 and smaller and flanged connections for valves NPS 2-1/2 and larger.

J. Trim: Hardened stainless steel.

K. Head and Seat: Replaceable, main head stem guide fitted with flushing and pressure-arresting device cover over pilot diaphragm.

L. Gaskets: Non-asbestos materials.

2.7 SOUND ATTENUATORS

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

1. Fisher, Whisperdisc.
2. Spirax Sarco, 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 up to 300 psig steam maximum working pressure, containing a deflector assembly and acoustic packing of stainless steel.

- D. Muffling orifice(s): 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.

2.8 STEAM TRAPS

- A. Manufacturers: Subject to compliance with requirements, provide products by the following:
 - 1. Armstrong.
- B. LP 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: Armstrong – Models as commonly used on campus. Confirm with EVENG shop.
- C. LP 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: Armstrong – Models as commonly used on campus. Confirm with EVENG shop.
- D. HP Float and Thermostatic Steam Traps:
 - 1. Cast steel body and cover, non-asbestos gasket, ends as needed, stainless steel heads, seats and thermostatic air vent.
 - 2. Basis of Design: Armstrong – Models as commonly used on campus. Confirm with EVENG shop.
- E. HP Inverted Bucket Steam Traps:
 - 1. Cast steel or stainless steel, connections as required, stainless steel bucket, renewable hardened stainless steel head and seat.
 - 2. Basis of Design: Armstrong models as commonly used on Campus, confirm with HVAC Shop.
- F. LP and HP Thermodynamic Traps (To be used to drip/drain all mains):
 - 1. ASTM A743 GR. CA40F 420F, stainless steel, 600 psig PMO, NPT connections.
 - 2. Spirax Sarco TD-52.

2.9 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.
 - 4. Watson McDaniel.

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. Basis of Design: Cast bronze Armstrong TV-2's for lower pressures, stainless steel Armstrong TTF's for higher pressures.

C. Vacuum Breakers:

1. Body: Stainless steel.
2. End Connections: Threaded.
3. Stainless steel fitted.
4. Basis of Design: Watson McDaniel WVBSS.

2.10 PRESSURE GAGES

A. Direct-Mounted, Metal-Case, Dial-Type Pressure Gages:

1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
 - a. Terrice, H. O. Co.
 - b. Weiss Instruments, Inc.
 - c. Weksler.
2. Standard: ASME B40.100.
3. Case: Sealed type(s); cast aluminum, stainless or drawn steel; 4-1/2-inch nominal diameter.
4. Pressure-Element Assembly: Bourdon tube unless otherwise indicated.
5. Pressure Connection: Brass, with NPS 1/4 or NPS 1/2 (DN 8 or DN 15), ASME B1.20.1 pipe threads and bottom-outlet type unless back-outlet type is indicated.
6. Movement: Mechanical, with link to pressure element and connection to pointer.
7. Dial: Non-reflective aluminum with permanently etched scale markings graduated in psi and kPa.
8. Pointer: Dark-colored metal.
9. Window: Glass.
10. Ring: Stainless steel.
11. Accuracy: Grade A, plus or minus 1 percent full scale.

2.11 GAGE ATTACHMENTS

- A. Snubbers: ASME B40.100, brass; with NPS 1/4 or NPS 1/2 (DN 8 or DN 15), ASME B1.20.1 pipe threads and porous-metal-type surge-dampening device. Include extension for use on insulated piping.
- B. Siphons: Loop-shaped section of stainless-steel or steel pipe with NPS 1/4 or NPS 1/2 (DN 8 or DN 15) pipe threads.
- C. Valves: Brass ball, with NPS 1/4 or NPS 1/2 (DN 8 or DN 15), ASME B1.20.1 pipe threads.

2.12 STEAM CONDENSATE RECEIVER SET WITH DUPLEX CENTRIFUGAL PUMPS AND FLOOR-MOUNTED RECEIVER (FOR NORMAL DUTY)

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

1. ITT Hoffman.

B. Description: Factory-fabricated, packaged, electric-driven pumps; with receiver, pumps, controls, low inlet, and accessories suitable for operation with steam condensate.

1. Electrical Components, Devices, and Accessories: Listed and labeled as defined in NFPA 70, by a qualified testing agency, and marked for intended location and application.

2. ASME Compliance: Fabricate and label steam condensate receivers to comply with ASME Boiler and Pressure Vessel Code: Section VIII, Division 1.

C. Configuration: Duplex floor-mounted pump with receiver and float switches; rated to pump 200 deg F steam condensate.

D. Receiver:

1. Floor mounted.

2. Primed and painted or coated steel.

3. Externally adjustable float switches.

4. Flanges for pump mounting.

5. Water-level gage and dial thermometer.

6. Pressure gage at pump discharge.

7. Bronze fitting isolation valve between pump and receiver.

8. Inlet vent and an overflow.

9. Cast-iron inlet strainer with self-cleaning bronze screen and large dirt pocket.

10. Inlet centerline no higher than 7" above mounting surface.

E. Pumps:

1. Centrifugal, close coupled, vertical design.

2. Permanently aligned.

3. Bronze fitted.

4. Replaceable bronze case ring.

5. Mechanical seals rated at 250 deg F.

6. Mounted on receiver flange.

7. Each pump sized for maximum load.

8. NPSH: Maximum 2'.

F. Motors:

1. Comply with NEMA designation, temperature rating, service factor, and efficiency requirements for motors specified in Section 23 0513 "Motors."

2. Enclosure: TEFC.

3. Efficiency: Meet in force energy code.

4. NEMA Design: To suit installation location.

5. Service Factor: Manufacturer's standard.

6. RPM: 1800 maximum.

G. Control Panel:

1. Factory wired between pumps and float switches, for single external electrical connection.
2. Provide fused, control-power transformer if voltage exceeds 230 V ac.
3. NEMA 250 enclosure (as properly suited for installation location) with hinged door and grounding lug, mounted on pump.
4. Motor controller for each pump.
5. Electrical pump alternator to operate pumps in lead-lag sequence and allow both pumps to operate on receiver high level.
6. Manual lead-lag control to override electrical pump alternator and manually select the lead pump.
7. Momentary-contact "TEST" push button on cover for each pump.
8. Numbered terminal strip.
9. Disconnect switch.

2.13 DRIP PAN ELBOWS

- A. ASTM A126 CL B cast iron, with female NPT connections up thru 4" and ANSI 125 flanges for 6" and 8" sizes. Pipe and support as shown on drawings.

2.14 STEAM AND STEAM CONDENSATE METERS

- A. Steam - All buildings that purchase steam from Northwestern University, or are research facilities with a steam turndown ratio less than 15:1, shall have a direct measurement of steam. Steam flow shall be measured using a differential pressure flow meter. Condensate meters shall also be provided in these buildings.
 1. All buildings where steam is not directly measured shall have condensate metered to determine the steam usage.
 2. Steam flow meters shall measure volumetric flow. The flow processor shall input the volumetric flow rate, and utilize internal steam tables and a static steam pressure sensor to determine the mass flow rate of the steam. The flow processor shall assume that the steam is saturated.
- B. Steam Condensate - Condensate shall be measured using a positive displacement type meter for pipe sizes less than 1", and a vortex shedding flow meter for pipe sizes 1" and greater. Flow Switches shall be installed on all condensate receiver drain pipes. Provide a valved (removable/lockable handle) meter bypass and a bleed-off drain pipes sizes greater than 1".
- C. Flow meters used to measure Energy Consumption or Mass Flow require a flow processor to input the flow meter and pressure sensors (steam), calculate the Energy Consumption or Mass Flow, and send a pulse output signal to the BAS that represents the results of this calculation. Spare flow processor analog outputs shall be used to output real-time flow rate and steam pressure. The Northwestern FMO Instrumentation Specialist shall define the ranges of these output(s) for proper scaling of the 4-20mA signal.
- D. Differential pressure steam flow meters to be InFlow MacroFlow, McCrometer V-Cone, or approved equal. Features and performance data as follows:
 1. Pipe sizes: 1/2" to 30".
 2. Factory tested accuracy: $\pm 0.5\%$.
 3. Repeatability: $\pm 0.1\%$.
 4. Turndown: 30:1.
 5. Input power: 24 VDC or 120 VAC.

6. Output signal: Frequency output.
 7. Wetted parts: Stainless steel.
 8. Body: Carbon steel.
 9. Connection: ANSI 300 flanged.
 10. Install requirements: 3 diameters upstream and downstream.
 11. Transmitters: Two DP transmitters, Rosemount 3051 CD or Foxboro IDP10, with pipe mounting brackets, support pipes, and factory calibrated with certificates.
 12. Other: No moving parts.
 13. Steam usage: Pressure input used to calculate mass flow.
 14. Special: Three valve manifold per transmitter, and flow processor for mass flow calculation.
- E. Positive displacement impeller type condensate meters shall be Data Industrial BR-250 Tee Flow Sensor with conduit adaptor, or approved equal. Features and performance data as follows:
1. Pipe sizes: < 1".
 2. Maximum fluid temperature: 300F.
 3. Accuracy: $\pm 1.0\%$.
 4. Repeatability: $\pm 0.7\%$.
 5. Rangeability: 60:1.
 6. Output signal: Frequency output, and include factory calibrated transmitters.
 7. Body: Bronze.
 8. Connection: NPT.
 9. Interface: Data Industrial Model 320 with pulse signal input to BAS.
 10. Special: Three valve manifold per transmitter, and flow processor for mass flow calculation.
- F. Vortex Shedding Flow Meter with Integral Pressure and Temperature Measurement:
1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
 - a. Onicon.
 - b. Krohne.
 2. Description:
 - a. Mass flow measurement corrected for density using vortex shedder body with integral piezoelectric pressure sensors and 1000-ohm platinum RTD.
 - b. Meter NPS 1/2 through NPS 12.
 - c. Each meter shall be factory calibrated at five points from Zero to 250 fps and tagged accordingly against the manufacturer's flow standards. The manufacturer shall provide a certificate of calibration for meter.
 - d. Each meter shall be programmed using project-specific application data.
 - e. Meter shall include integral diagnostics to verify installation conditions and proper operation.
 3. Performance:
 - a. Volumetric Flow Accuracy for Liquid: Within 0.75 percent of reading for Reynolds numbers 20000 and larger.
 - b. Volumetric Flow Accuracy for Steam and Gas: Within 1 percent of reading for Reynolds numbers 20000 and larger.

- c. Mass Flow Accuracy for Steam and Gas: Within 1.5 percent of reading for Reynolds numbers 20000 and larger.
 - d. Repeatability: Within 0.1 percent.
 - e. Long-Term Stability: Within 0.1 percent per year.
 - f. Ambient Temperature: Minus 40 to plus 185 deg F.
 - g. Process Temperature: Minus 40 to plus 464 deg F.
 - h. Pressure: Equal to flange rating.
4. Output Signals:
- a. Analog Current Signal of Flow Rate:
 - 1) Two-wire, 4- to 20-mA dc current source.
 - 2) Signal capable of operating into 1000-ohm load.
 - b. Analog Current Signals for Pressure and Temperature: Separate 4- to 20-mA signals for gage pressure and temperature.
 - c. Digital Signal:
 - 1) Pulse output for flow totalization. Two wire, scaled pulse, 0.5 Hz, 100 mA at 30-V dc.
 - 2) Protocol: compatible with project DDC/BAS, see Section 25 0000.
5. Operator Interface:
- a. Keypad.
 - b. Digital Display: Two-line digital display of alphanumerical characters. The meter shall display flow rate, flow totalization, pressure, temperature, and support field programming of all parameters.
6. Construction:
- a. Material: Type 316L stainless steel.
 - b. Connection: Class 300 flange.
 - c. Enclosure:
 - 1) Epoxy-painted cast aluminum.
 - 2) Removable screw-on cover.
 - 3) NEMA 250, Type 6.
 - 4) Electrical Connection: Screw terminals.
 - 5) Conduit Connection: Two, 1/2-inch trade size.
7. Upstream Flow Straightener:
- a. Meter manufacturer shall provide flow straightener where required by installation to comply with manufacturer's installation recommendations.
 - b. Straightener shall be wafer type, constructed of Type 304 stainless steel, designed to be installed between field-installed flanges.
 - c. Straightener size shall match meter size.

PART 3 - EXECUTION

3.1 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 material 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.
- E. Drip Pan Elbows: Pipe per drip pan elbow and safety valve manufacturer's instructions, coordinate with GC for roof penetrations.
- F. As detailed on drawings, install manual pressure relief assemblies to allow safer access to system components for servicing. Assemblies to be made up of tees, nipples, ball valves, and strainers with nipple and cap.

3.2 VALVE APPLICATIONS

- A. Install shutoff duty valves at branch connections to steam supply mains, at steam supply connections to equipment, at the outlet of steam traps, and as shown or noted on the drawings.
- B. Install safety valves at pressure-reducing stations and elsewhere as required by ASME Boiler and Pressure Vessel Code. Comply with ASME Boiler and Pressure Vessel Code: Section VIII, Division 1, for installation requirements.
- C. Install check valves at traps as detailed and as otherwise required to control flow direction.
- D. For anything over 3" and 75 psi, the first isolation valves off of mains to be high performance, triple offset butterfly valves. Downstream from these points for isolation, non-high performance valves may be used.
- E. Add chainwheels to valves 6" or larger and mounted 8 feet above the floor or higher. Provide gear operators for valves 8" and larger.

3.3 PIPING INSTALLATION

- A. Install piping to permit valve servicing.
- B. 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.
- C. Install valves according to Section 23 0523 "General Duty Valves for HVAC" and per this section.

- D. Install unions in piping, NPT 1-1/4 and smaller, adjacent to valves, at final connections of equipment, and elsewhere as indicated.
- E. Install flanges in piping, NPS 1-1/2 and larger, at final connections of equipment and elsewhere as indicated.
- F. Install shutoff valve immediately upstream of each dielectric fitting.
- G. Install strainers on supply side of control valves, pressure-reducing valves, traps, and elsewhere as indicated. Install NPS 3/4 nipple and full port ball valve in blowdown connection of strainers NPS 2 and larger. Match size of strainer blowoff connection for strainers smaller than NPS 2.

3.4 STEAM-TRAP INSTALLATION

- A. Install steam traps as shown and as required in accessible locations as close as possible to connected equipment. Minimum of 14" unobstructed space around traps required.
- B. Provide test port downstream of each steam trap assembly. The test port assembly is to consist of a tee, nipple, ball valve, and nipple plug. The test port assembly is to be before the check.
- C. 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. Install two full-port ball valves, union, and strainer upstream of trap; and check valve, union, and two full-port ball valves after trap.
- D. All low points and drip legs in steam lines and the bottom of down feed risers shall have traps of proper size.
- E. Return ends of all equipment where steam is condensed, shall have traps of proper size and type.
- F. Install traps as shown and as detailed.
- G. Install traps with isolation valves and unions on both sides. Ahead of each high pressure drip, 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, isolation valve, nipple and threaded cap for 2-1/2" and larger.
- H. 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.

3.5 PRESSURE REGULATING/REDUCING VALVE INSTALLATION (AND OTHER RELATED PIPING AND SPECIALTIES)

- A. Install pressure regulating/reducing valves in accessible location for maintenance and inspection.
- B. Install gate or butterfly valves on both sides of pressure-reducing valves. A warmup line shall be provided around butterfly valves where used in this application.
- C. Install unions or flanges on both sides of pressure-reducing valves having threaded or flanged end connections respectively.

- D. Install pressure gages on high and low-pressure sides of pressure-reducing valves (after the bypass connections) according to Division 23 Section "Meters and Gages for HVAC Piping" and this section.
- E. Install strainers upstream for pressure-reducing valves. Install strainers with blow-off valves on side.
- F. Install safety valves downstream from pressure-reducing valve stations.
- 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. Install bypass piping around pressure regulating/reducing valves with globe valve equal in size to the pressure regulating/reducing valve seat ring, unless indicated otherwise.
- J. Avoid abrupt changes in pipe size. Use eccentric reducers upstream and concentric increasers downstream of the PRVs.

3.6 AIR VENT AND VACUUM BREAKER INSTALLATION

- A. Install as detailed and according to device manufacturer's instructions.

3.7 STEAM OR CONDENSATE METER INSTALLATION

- A. Install meters with lengths of straight pipe upstream and downstream according to meter manufacturer's instructions.
- B. Provide data acquisition wiring. See Section 25 0000.

3.8 SAFETY VALVE INSTALLATION

- 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.
- D. Install exhaust head with drain to waste, on vents equal to or larger than NPS 2-1/2.

3.9 CONDENSATE RECEIVER SET INSTALLATION

- A. Install as detailed and according to device manufacturer's instructions.
- B. Coordinate any venting through roof with GC.

3.10 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.

3.11 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:
 - 1. Use ambient temperature water as a testing medium unless there is risk of damage due to freezing. Another liquid that is safe for workers and compatible with piping may be used.
 - 2. Subject piping system to hydrostatic test pressure that is not less than 1.5 times the working pressure. Test pressure shall not exceed maximum pressure for any vessel, pump, valve, or other component in system under test. Verify that stress due to pressure at bottom of vertical runs does not exceed 90 percent of specified minimum yield strength.
 - 3. After hydrostatic test pressure has been applied for at least 10 minutes, examine piping, joints, and connections for leakage. Eliminate leaks by tightening, repairing, or replacing components, and repeat hydrostatic test until there are no leaks.
- C. Prepare written report of testing.

END OF SECTION 23 2213

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