

## **PART 1 - GENERAL**

These standards apply to the installation of steam and condensate pipe, fittings, hangers, supports, anchors, valves, steam traps, meters, safety valves, vacuum breakers, and pressure reducing or regulating valves inside building.

### **1.01      DESIGN CRITERIA**

#### **A. Drawings and Specifications:**

1. Indicate unit dimensions, weight loading, required clearances, electrical characteristics and connection requirements on drawings.
2. All steam systems shall be designed for a two pipe system, where steam and condensate are in separate pipes. One-pipe systems are not allowed.
3. Include equipment schedules (PRV stations, heat exchangers, condensate pumping, traps, safety/relief valves, flash tanks, separators, meters, etc.): Identification tag, capacities, Balancing requirements, electrical requirements, weights, etc.
4. Indicate control valves and DDC control panel locations.
5. The steam piping systems are separated in to two categories:
  - a. Low Pressure Steam up to 15 psig
  - b. High Pressure Steam over 15 psig
6. Provide Steam and Condensate flow diagram (PRV stations, heat exchangers, condensate pumps, piping distribution, sizes, traps, pressures, flow, etc.) with flow rates indicated. Include high and low pressure steam and condensate systems. Combining multiple pressures in systems is not allowed. In general, existing systems are designed as 125 psig max design for primary steam and routed to secondary systems (terminal, concourses, satellites), which vary from 35 psig to 5 psig. Secondary systems should be designed to fit with existing pressures or new secondary systems shall be designed in the ranges listed above. Direct high pressure systems shall not be designed unless approved by MUST.
7. Provide valves and unions or flanges at each piece of equipment arranged to allow servicing, maintenance, and equipment removal without system shutdown.
8. Provide isolation valves on all equipment with hose-end drain valves.

9. Piping shall be provided with complete drainage of system with valves (capped) at low points, minimum allowable size of drain valves is 1" Steam and condensate piping shall be sloped (0.25"/12") in the direction of the steam flow.
10. Provide drip legs at all low points and in vicinity of equipment, control valves, expansion joints, bends, isolation valves etc.). Drip legs shall be spaced not more than 300 ft apart. Drip legs shall be provided by a tee, pipe taps are not allowed.
11. Provide floor drains or sinks (with trap primers) near equipment for drainage, and relief valve discharge.
12. Safety Valves and Vents: Extend piping through roof. All vent piping shall be insulated for personnel protection.
13. Provide equalizing by-pass valve at all main steam system isolation valves.
14. Relief Valves: Pipe to floor sink.
15. Steam Traps: In general, use Float and Thermostatic type for 35 psig and less, Bucket type for applications and pressures up to 125 psig. Thermodynamic traps for applications and pressures up to 500 psig. Different traps may be required by application and configuration of system: attend MUST for approval prior to revising trap applications, listed above.
16. Shutoff Valves: Locate them at accessible location. Valves 6" and larger shall be provided with a warm-up by-pass valve. Placement of valves in vertical runs shall be avoided.
17. Expansion: Indicate pipe expansion loops, joints, guides and anchors. Anchors shall be provided to limit line movement to maximum 8".
18. When computing piping system expansion, use proper temperature difference. Minimum temperature shall be 50 deg F and maximum temperature shall be 360 deg F.
19. Expansion loops are preferred method of handling thermal expansion/contraction in straight runs, where expansion loops are not possible consult with the F&I Mechanical Department for alternative methods.
20. Provide complete pipe stress analysis and pipe support calculations.
21. Pressure test piping at 150 percent of maximum operating pressure or at 175 psig minimum, whichever is greater.

22. Packaged equipment with integral safeties, valves, controls, pumps, traps, flash tanks, etc. are not allowed, with the exception of condensate pumps and semi-instantaneous water heaters. Design each system to include all standard requirements for each component, see 200300 Basic Materials and Methods, 200400 Valves, 200700 Insulation, and other sections to reference complete standards.
23. Numbered brass tag specified to be connected to the valve with a brass jack chain. Tags shall be at least 2 inch round or square with stamped, black-filled lettering. In addition to numbers, tags will be lettered to indicate fluid carried through the valve [e.g., “steam”]. Numbers will be keyed to the mechanical construction drawings.)
24. Steam traps shall be installed 1 to 1.5 feet below steam coil outlet to provide condensate head on the trap.
25. Designs shall ensure condensate is delivered the entire way to supply boilers.
26. All steam and condensate system components shall be sized to accommodate start up conditions.

**B. Design:**

1. Equipment Capacity: Condensate unit pump and receiver should be sized with 10 to 15-percent extra flow capacity.
2. All steam piping shall be designed to meet requirements of ASME B31.1.
3. Steam Piping: Main steam service piping should be sized with 10 to 15-percent extra capacity. Use standard weight steel piping and fittings.
4. Condensate Piping (gravity): Condensate piping should be sized with 10 to 15-percent extra capacity. Use heavy weight steel piping and fittings.
5. Pumped Condensate Piping: Size pumped condensate piping with future capacity provided at condensate pumping. Use heavy weight steel piping and fittings.
6. Central Plant (CMP#1) and distribution piping: Use 80 – 85 psig steam service, design at 125 psig.
7. High/Medium Steam: Maximum Velocity = 8,000 to 10,000 fpm, 1.0 psig/100 ft maximum pressure drop.
8. Low Pressure Steam: Maximum Velocity = 5,000 fpm, 0.5 psig/100 ft maximum pressure drop.

9. Condensate Piping: Maximum Velocity = 3,000 fpm, 0.25 psig/100 ft maximum pressure drop.
10. Expansion Compensation: Design piping, including mains, branches, risers and run-outs, with sufficient offsets to allow for free expansion and contraction, and sufficient to prevent leaks and over-stressing of piping system. Provide expansion compensators where required when offsets are not adequate for free expansion and contraction, in accessible locations to allow for servicing or replacement.
11. All steam and condensate piping systems shall be designed to meet ASME B31.1 Power Piping.
12. For all steam and condensate piping system provide dye penetrant inspection for at least 25% of field welds and 10% of shop welds. If any of the welds do not pass the test all remaining welds shall be inspected.
13. Traps: Except as otherwise indicated, provide traps with continuous flow capacity of 150 percent of the condensing rate of the connected equipment. Where heat exchangers are indicated, provide traps with two times maximum equipment condensing rate. Do not provide traps with less than 3/4-inch pipe connection. Size inverted bucket type traps with capacity of three times maximum condensing rate of equipment or piping served. Refer to MUST for thermodynamic trap sizing requirements.
14. All steam traps shall be numbered per 200300.
15. Controls: Direct Digital Controls shall be utilized. Valve actuators (heat exchangers) shall be pneumatic utilizing plant compressed air system or if approved by AV/F&I electric/electronic under DDC control. Provide steam flow meter (at each high/medium pressure main branch) and condensate flow meter connected to DDC system.
16. Extend steam condensate vent to outdoors.
17. Vibration Isolation and Seismic Restraints: Provide vibration isolation with seismic restraints. Secure unit, components and accessories in accordance with seismic requirements per code.
18. Do Not Use the following:
  - a. Grooved piping, valves, fittings.
  - b. Dielectric Unions.
  - c. Steam Heating Coils.

- d. Packaged equipment with appurtenances that do not comply with these standards and integrated controls. Use built up systems designed for the project.
- e. 2-1/2" or 5" pipes or valves shall not be used.

## **PART 2 - PRODUCTS**

### **2.01      PIPING**

- A. Steam Piping: ASTM A53, Standard weight (Schedule 40), Grade B, electric resistance welded or seamless, black steel.
- B. Condensate Piping: ASTM A53, Heavy weight (Schedule 80), Grade B, electric resistance welded or seamless, black steel.

### **2.02      FITTINGS**

- A. 2-inch and Smaller: Malleable iron, ANSI B16.11/ASTM A105-II, threaded, (Class 300).
- B. 2-1/2-inch and Larger: Seamless Steel, ASME/ANSI B16.9, ASTM A234, grade WPB, butt-weld (schedule to match pipe).
- C. Gaskets: Spiral wound

### **2.03      UNDERGROUND STEAM AND CONDENSATE PIPING**

Provide piping in accessible utilidor or tunnel. Do not use direct-buried piping, manufactured conduit system or pre-insulated piping.

### **2.04      HEAT EXCHANGER**

- A. Manufacturers: Armstrong, Bell and Gossett, Taco, or approved equal.
- B. 150 psi ASME construction with steel shell designed for U-tube bundle complete with cast iron bonnet, seamless copper tubing.
- C. Steam size fouling factor of 0.0005 and Water size fouling factor of 0.001.
- D. Control valves must be fail closed type.

### **2.05      CONDENSATE RECEIVER AND PUMP UNIT**

- A. Manufacturers: Aurora, Spirax-Sarco, Peerless, Armstrong, or approved equal.

- B. Duplex pumping unit mounted on cast iron receiver with NEMA 4 control panel, switches, indicators, level controls and pump alternator.
- C. Appurtenances such as valves, gauges, strainers, thermometers, etc. are to comply with other sections of these standards and be compatible with 200920 Building Automation Systems.

**2.06      EXPANSION JOINTS**

- A. Manufacturers: Flexonics, Metraflex, Proco, or approved equal.
- B. Stainless steel corrugated bellows, internal sleeve, and external cover. Suitable for pressures up to 300 psig and temperatures up to 500°F.

**2.07      VACUUM BREAKERS**

Provide check valves.

**2.08      SAFETY VALVES**

- A. Manufacturers: Crane, Watts, B & G, Armstrong, Spirax-Sarco, or approved equal.
- B. Cast iron body, ASME tested and certified valves, including lifting levers. Provide valves with capacities based on ASME ratings at indicated accumulation and pressure setting.

**2.09      PRESSURE REDUCING VALVES**

- A. Manufacturers: Leslie, Spirax-Sarco, Armstrong, or approved equal.
- B. Fluids Controls Institute (FCI) Standard FCI 79-1. Provide cast iron body, ASME tested and certified valves, including lifting levers. Provide valves with capacities based on ASME ratings at indicated accumulation and pressure setting, valves must be fail closed type. Include drip pan elbow on each safety valve.
- C. External Sensor: Provide single-seat valves either spring-loaded or designed for weight and levers. Include ports to allow connecting external piping to sense downstream pressure. Fabricate with high strength iron body.
- D. Pilot Operated: Fabricate body with ductile nodular iron. Locate main valve diaphragm below main valve; mount pilot above main valve and connect directly to main valve body without pipe nipples. Cover pilot diaphragm to protect diaphragm against dirt and spot accumulation. Fit main valve stem with deflector seal to prevent pressure buildup in upper diaphragm chamber.
- E. Design unit to operate by sensing compressed air with external pilot.

**2.10      VALVES**

See Section 204000 “Valves.”

**2.11      METERING**

See Section 200920 “Direct Digital Controls.”

**2.12      STEAM AIR VENTS**

- A. Manufacturers: Hoffman, Spirax-Sarco, Armstrong, or approved equal.
- B. Float type thermostatic or high-pressure thermostatic vent.

**2.13      STRAINERS**

- A. Manufacturers: Hoffman, Spirax-Sarco, Armstrong, Watts, or approved equal.
- B. All strainers shall be rated for 250 psig steam pressure.
- C. Y-Pattern, cast-iron body, flanged ends for 2-1/2-inch and larger, threaded connections for 2-inch and smaller, bolted cover, perforated Type 304 stainless-steel screen, and blow-down drain connection.
- D. Provide with capped blow-down valve.

**2.14      CHECK VALVES**

- A. Manufacturers: Stockham, Mueller, Conbraco-Apollo, Spirax-Sarco, Armstrong, or approved equal.
- B. All check valves shall be rated for a minimum 250 psig steam pressure.
- C. Y-pattern swing check, bronze body, bronze or brass disc, Class 300, threaded connections for 2-inch and smaller.
- D. Horizontal Check Valve: Ferro-steel body, bronze or cast iron disc, Class 250, flanged ends, bolted cap for 2-1/2-inch and larger.

**2.15      STEAM TRAPS**

- A. Manufacturers: Armstrong, Hoffman, Spirax-Sarco, or approved equal.
- B. Comply with Fluid Controls Institute (FCI) Standard FCI 69-1 (Pressure Rating Standard for Steam Traps). Bodies shall be manufactured to allow removal of cap and mechanism without disturbing pipe connections. Include heat treated steel valve and valve seat:

1. Float and Thermostatic: Compressed non-asbestos gasket and stainless steel valve retainer, lever, and guide pin assembly. Stainless steel bucket and automatic corrosion resistant air vent. Cast iron or semi steel bodies.
2. Inverted Bucket: Copper gasket, stainless steel lever mechanism, and brass bucket; vertical stabilizer tube thread into inlet opening and capped with solid baffle disc designed to prevent inrush of condensate from impinging on bucket. Cast iron or semi steel bodies.

**2.16      FLASH TANKS**

- A. Manufacturers: Ace/Buehler, Wood, Penn Separator, Armstrong, Spirax-Sarco, or approved equal.
- B. ASME, 150 psig, cylindrical vertical welded steel tank with internal sparging tube.

**2.17      DOMESTIC HOT WATER HEATER**

- A. Manufacturers: Aerco, Model SWDW or equal by: Patterson-Kelly, Ace Boiler, or approved equal.
- B. ASME BPV VIII Div. 1, Packaged, semi-instantaneous type with integral temperature controller, double wall construction, steam in stainless steel tubes water in shell, cross flow, floating coil design, Insulation per ASHRAE 90.1, P/T relief valve, controls (Temp. +/- 5 degrees F.), 5-150 psig steam supply, control valves must be fail closed type and accessories.
- C. When heaters are used for more than 60 gpm requirements - refer to 2.04 heat exchanger with ASME 150 psig storage tanks.

**2.18      EXPANSION TANK**

- A. Manufacturers: Amtrol, Taco, Bell & Gossett, or approved equal.
- B. ASME labeled, FDA approved for potable water system.

**PART 3 - EXECUTION**

**SAFETY**

Steam Piping, Condensate Piping and relief or vent piping shall be insulated and jacketed.

FACILITIES AND INFRASTRUCTURE  
MECHANICAL SYSTEM STANDARDS

**SECTION 232200 STEAM AND CONDENSATE SYSTEM** POS SEA-TAC INTERNATIONAL AIRPORT

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END OF SECTION