

Appendix D3020.2:

STEAM AND CONDENSATE PIPING SPECIALTIES: FOR REFERENCE ONLY

PART 1 – GENERAL

1.01 SUMMARY

- A. Design teams are to utilize this sample steam specification as a minimum guideline to incorporate applicable steam requirements into their project. The project design team is entirely responsible for ensuring all steam standards and specifications are applicable to their individual project.
- B. Section Includes:
 - 1. Part One - System Description.
 - 2. Part Two – Design Requirements.
 - 3. Part Three - Steam Specialties, Related Equipment, and Acceptable Manufacturers
 - 4. Part Four - Installation Requirements.
 - 5. Part Five – Installer (Contractor) Qualification Requirements

1.02 SYSTEM DESCRIPTION

- A. The University of Colorado Central Power Plant supplies high-pressure, saturated steam to the campus community through a system of inter-connected tunnels and direct-bury piping. The steam pressure in the mains runs at approximately 140 psig and may potentially be raised as future need arises. For this reason, before pressure is reduced for consumer use, we use valves, fittings, pipe, and flanges that are designed to safely carry pressures of at least 250 psig steam at 406°F.
- B. Steam pressure is generally regulated in each individual building and may include multiple pressure reductions, depending on the equipment being serviced. Typical reduced pressures vary from 65 to 5 psig. Steam uses in buildings include direct radiant heating, forced air heating using steam fan coils, heating hot water generation, domestic hot water generation, autoclaving and sterilization, chilled water generation, humidification, food service preparation and clean-up, laundry processes, filter cleaning, drying, and other miscellaneous processes. In addition, the Central Power Plant uses high-pressure steam to generate all campus electrical needs.
- C. Condensate generated by the various steam uses on campus is returned to the Central Power Plant by both gravity return systems and pumped systems.

- D. Space in tunnels and mechanical rooms has become extremely limited and it is a University requirement that pipe routing and equipment location be reviewed by a Utility Services representative, ideally during the design phase but definitely before installation begins. This is not limited to only steam piping and equipment, but all mechanical installations that impact accessibility to, and maintainability of, steam equipment. It is also critical that mechanical work performed on *any* system [plumbing, electrical, telecommunication, etc.] that involves the “abandonment” of any equipment, wiring, cabling, piping, etc. include the removal of these items to allow for the future use of the space.
- E. The campus steam system and all steam sub-systems are under the direct control of the Facilities Management Utility Services Group. Steam and condensate valves are to be operated by Facilities Operations Steam personnel *only*. This is a serious rule and is regarded as such by the University. Any work that either directly or indirectly impacts the system must be approved by, and coordinated with, a Utility Services representative. Meetings scheduled with Facilities Management personnel for site visits, inspections, spec/print reviews, etc. must be made 72 hours in advance and attended in a timely manner. Failure to show for an appointment may result in lost time being charged to the job. The 72-hour notification requirement may be waived as urgency dictates and time permits.

PART 2 – DESIGN REQUIREMENTS

2.01 AIR VENTS

- A. Air Vents are not required on high points in steam systems.

2.02 ANTI-SEIZE

- A. Specify anti-seize for flange bolts only.

2.03 CONDENSATE COOLERS

- A. Due to the use of pressure-powered condensate pumps and the desire to return condensate to the Central Power Plant at as high a temperature as possible, condensate coolers are no longer approved for use on the CU Boulder campus.

2.04 CONDENSATE PUMPS

- A. The pump package shall be provided to the University of Colorado according to the schedule and based on the following specifications:
 - 1. The condensate pump package shall have a capacity of _____ lbs/hr, with fully redundant capabilities. That is, each pump package shall be capable of pumping _____ lbs/hr, with the ability to fully isolate each pump and/or package from the system.

2. The pump package shall have the above stated capacity of _____ lbs/hr, with a motive pressure (air or steam) of _____ PSIG, and a system back pressure of _____ PSIG.
3. Each pump and receiver in the package shall be an ASME 150# rated vessel.
4. The package must be a low-profile with a maximum of a 18" trip point from the floor.
5. The pumps shall sense level and activate via an electrode probe-style mechanism (no mechanical float mechanism), utilizing a pin-style Warrick relay.
6. The probe mechanism shall have a third probe for high level alarm, utilizing a two-position switch.
7. Each pump package shall have its own control panel.
8. Each panel shall incorporate an electronic cycle counter and a high level alarm contact. Signal for cycle count and high level alarm shall be sent to a Andover control system.
10. Each pump shall utilize a 3-way pneumatic actuated ball valve for the motive force. Ball valve shall be carbon steel body x stainless steel trim.
11. Each pump shall have an isolation valve on the condensate inlet and outlet.
 - a. 3" and above – 150# lugged style high performance gear operated steam rated butterfly valve.
 - b. 2" and below – full port forged steel ball valve with stainless steel ball and stem, rated for 250 psig WSP.
12. Each pump shall have a check valve on the condensate inlet and outlet.
 - a. 3" and above – Durabla model WLC CI/BR wafer body check.
 - b. 2" and below – Durabla model WLC wafer style, stainless steel construction. Check valves shall be Durabla wafer style (no substitutes).
13. Each pump shall have a rising-stem, class 800, forged steel gate valve with a steel strainer and steam regulator for the steam supply. The strainer must also have a forged steel ball valve for blowdown, all ball valves, if utilized, shall be full port carbon steel body x stainless steel ball and stem.
14. Pump tanks shall be Armstrong 300 or 400 series tanks ASME rated at 150#.
15. Each tank (pumps and receivers) must be individually drainable, utilizing forged steel ball valves.

16. Each pump trap must have high pressure gauge glass assembly and pressure gauge assembly (gauge, siphon and ¼” carbon steel isolation ball valve).
17. All pipe 2” and smaller shall be threaded ASTM type A106 seamless black steel – schedule 80.
18. All steam pipe 2 ½” and larger shall be welded ASTM type A106 seamless black steel – schedule 40.
19. All condensate pipe 2 ½” and larger be welded ASTM type A106 seamless black steel – schedule 80.
20. 250 lb malleable iron unions with brass seats and 2000 psig forged steel fittings shall be used in all threaded applications.
21. 150 psig raised face, steel weld neck flanged and steel butt weld fittings shall be used in all welded applications.
22. All flange gaskets shall be spiral-wound where the windings are manufactured with type304SS with non-asbestos filler and the outer ring (gauge ring) is manufactured with carbon steel.
23. All threaded fittings will be assembled with 100% virgin Teflon tape. No pipe joint compound will be permitted.
24. Pump packages shall be pre-fabricated on a stand with leveling pads and all interconnecting piping.
25. All components, pieces and parts, whether or not they are specifically shown or indicated on the submittal, shall be in accordance with all University of Colorado – Boulder standard mechanical specifications.

Acceptable Manufactures:

- a. Armstrong
- b. or prior approval equivalent

2.05 EXPANSION JOINTS

A. Design

1. The expansion joint shall be designed for ANSI 300 rating for steam (250 psig at 406°F) and ANSI 150 for condensate.
2. Expansion joint shall be (single/double) slip design and furnished with an anchor base. Welded ends unless otherwise approved by Utility Services.

3. The stuffing box shall have integral and external guide surfaces. The guide shall have low friction, non-metallic inserts.
4. The expansion joint shall have 2' minimum diameter packing cylinders welded in place to allow packing to be injected under full line pressure. The packing cylinder tip shall incorporate a "check valve effect" tip design to prevent the blow back of packing while adding packing to the expansion joint at full line pressure.
5. The packing friction force of the expansion joint shall not exceed 1,000 Lbs. Per inch of expansion joint nominal diameter.
6. All circumferential body welds shall be of the butt weld type.
7. Externally pressured bellows joints shall be reviewed on a case by case basis with approval of Utility Services only.
8. Internally pressured bellows are not acceptable for steam applications.

B. Materials

1. The stuffing box and body shall be machined from A106 or equivalent heavy wall mechanical tubing, of seamless pipe.
2. The slip shall be machined from ASME A106 schedule 80 seamless pipe. All slips are to be machined and ground to achieve a 16RMS finish before plating. Plating shall consist of 1 mil minimum of industrial hard chrome over 1 mil minimum of crack free hard chrome.
3. Expansion joint shall be factory packed for the intended service with Flake Graphite Injectable Packing. The stuffing box packing area in contact with the slip shall be at least 15 times the nominal diameter of the expansion joint. Spare packing plugs are to be furnished with each expansion order.

C. Insulation Blankets

1. A two piece removable reusable insulation blanket is to be provided with the expansion joint to cover the expansion joint body and slip, and is to incorporate access to the packing cylinders without removal of the body portion of the blanket.
2. The inner and outer covers are to be made from Silicone Impregnated Nomex Cloth. An Inconel wire mesh liner is to be attached to the inner cover.

Approved Manufacturers

- a. Advanced Thermal Systems
- b. Or approved equal

D. Guides

1. All pipe guides shall be fabricated by a supplier regularly engaged in the manufacture of these items.
2. Pipe guides shall utilize ½” thick low friction graphite on both the upper and lower backing plates of each assembly. The guides shall have sufficient contact surface between the upper and lower assemblies to ensure the loading does not exceed 300 psi.
3. Steel components shall be fabricated from ASTM A36 steel or equivalent.
4. Pipe guides shall accommodate as a minimum the insulation thickness specified for the mating pipe.
5. The upper assembly shall be attached to the pipeline by field welding. The lower assembly shall be attached to the structural support by field welding or bolting as shown on the plans.
6. All guides shall be constructed to allow a minimum 8” of axial movement and maximum + or- 1/16” of lateral and 1/8” vertical up movement.
7. The graphite shall be epoxy bonded to the backing plate for all applications. If service conditions exceed 350 degree F the graphite shall be both epoxy bonded and mechanically attached.

Approved Manufactures:

- a. Advanced Thermal Systems
- b. Or approved equal

2.06 FITTINGS

A. Elbows, tees, reducers, couplings, crosses:

1. Specify forged steel threaded for 2” and below. All 2 1/2” and above shall be schedule 40 seamless, butt-welded steel conforming to ASTM A234 standard, rated for 2000 psig.
2. Only Teflon tape allowed.

B. Unions:

1. Specify 250 lb malleable iron with brass seats, ground-joint, unions for all pipe sizes 2” and below.
2. Unions need to be installed with correct flow, correct side of isolation valve, and be accessible.

3. Pipe lengths need to be cut correctly, so that pipe-fittings are not in a bind.

C. Flanges:

1. Specify raised-face, welding neck flanges conforming to ASTM A181 standard. Specify 150 lb. flange for pressures of 100 psig or less and 300 lb. flange for pressures exceeding 100 psig. Flange bolts shall be hexhead, Grade 8, no substitutions. Sized such that no more than 1/2" of bolt protrudes beyond the end of the nut when fully torqued. Stud bolts will not be permitted.
2. Flanges must match in ratings and when assembled, they must be aligned correctly.

2.07 GASKETS

- A. Specify spiral-wound gaskets where the windings are manufactured with Type 304 stainless steel with non-asbestos filler and the outer ring [gauge ring] is manufactured with carbon steel. No other gaskets will be permitted.

2.08 GAUGES, PRESSURE

- A. Specify a 4" dry gage with 1/4" MPT connection. Use 0-15 gage for operating pressures of 7 psig or less, 0-30 gage for pressures of 8-15 psig, 0-60 gage for pressures of 16-30 psig, 0-100 gage for pressures of 31-50 psig, and 0-200 gage for pressures greater than 50 psig. Gauge must be supplied with an anti-siphon tube [pigtail] and an approved ball valve for isolation. Isolation valve must go before anti-siphon tube.

2.09 HOT WATER CONVERTERS / HEAT EXCHANGER

A. Instantaneous Water Heater

1. The instantaneous water heater shall operate on water differential using the feed forward principle. A temperature control device with capillary system shall not be acceptable.
2. The water controlling valve of the unit shall be mounted integral to the heat exchanger without the use of connecting piping.
3. The instantaneous water heater shall be pre-piped with only steam, water, and condensate hookups necessary.
4. The controlling valve of the instantaneous water heater shall fail in the closed position, to prevent overheating and scalding.
5. The instantaneous water heater shall have easy access to the individual tubes without moving the heater from its installed position.

6. The shell of the heat exchanger shall be carbon steel and designed for a maximum allowable pressure of 150 psig.
7. The tubes shall be admiralty brass.
8. The water controlling valve body shall be bronze with stainless steel internals.
9. The maximum water pressure drop shall not exceed 10 psi.
10. Outlet water temperature shall be controlled to within plus or minus 5° f.
11. A mixing valve shall be installed for over-temperature protection on the hot water side. A bypass shall be installed along with isolation valves and unions for maintenance on mix valve without shutting down the unit. On 442 Digi flow units a bypass over safety valve will not be allowed.
12. Operational steam pressure shall be 2-15 psig.
13. Operational water pressure shall be 20-125 psig.
14. The instantaneous water heater package shall have a capacity of _____ gpm.
15. All pipe 2" and smaller, shall be threaded ASTM A106 seamless black steel, schedule 80.
16. All steam pipe 2½" and larger, shall be welded ASTM A106 seamless black steel, schedule 40.
17. All condensate pipe 2½" and larger, shall be welded ASTM A106 Grade B seamless black steel, schedule 80.
18. All copper to be type K.
19. 250 lb malleable iron unions with brass seats, and 2000 lb. forged steel fittings shall be used in all threaded applications.
20. 150 psig. raised face, steel weld neck flanged, and steel butt weld fittings shall be used in all welded applications.
21. All flanged gaskets shall be spiral-wound where the windows are manufactured with type 304SS, with non-asbestos filler, and the outer ring (gauge ring) is manufactured with carbon steel.
22. All threaded fittings will be assembled with 100% virgin Teflon tape. No pipe joint compound will be permitted.
23. All gate valves shall be class 800 Forged steel with rising stem.

24. All ball valves shall be Apollo full port, with stainless steel trim.
25. Steam traps shall be Armstrong inverted bucket traps.
26. Package to be assembled with unions and valves, so equipment can be worked on without shutting system down.
27. Instantaneous water heater packages shall be pre-fabricated on a stand, with leveling pads, and all interconnecting piping.
28. All components, pieces, and parts, whether or not they are specifically shown or indicated on the submittal, shall be in accordance with all University of Colorado, Boulder, standard mechanical specifications.
29. The instantaneous water heater shall have a one year guarantee against defective material, or faulty workmanship.

Acceptable Manufacturers

- a. Armstrong Flo-rite
- b. Leslie Constantemp

B. Heating Hot Water Converters:

1. Specify tube and shell design where water circulates in the tubes and steam in the jacket. The design need not require double-wall tubes for heating hot water.

2.10 INSULATION JACKETS, REMOVABLE / REUSEABLE

- A. Removable insulation jackets are to be specified for use on the following: all pressure-powered condensate pumps, all pressure regulators, traps 1" and larger, gate/globe/butterfly valves 2" and larger, and strainers 2" and larger.

2.11 MAIN STEAM METERS

2.12 GENERAL

- A. Project Engineer of Record shall submit to Utility Services the projected Maximum, Minimum, and Normal operating conditions of each service.
- B. All main (primary) meter applications shall be on the high pressure side (before the PRV station of the building).
- C. Project Engineer of Record shall submit building annual consumption projections.
- D. Units
 1. Steam shall be in Klbs/h for and Klbs for consumption projection

2.13 UTILITY SERVICES METER PANEL (UMP)

- A. All meter panels shall be in accordance with the University of Colorado Boulder Utility Standard No. EO-100-A latest revision for integration into the Utility Control System (UCS). Coordinate UMP with all other utility main meters (ie chilled water, domestic work, and electric).
- B. Meter Panel shall house flow computers (totalizers) and Advanced Metering Infrastructure (AMI) Gateways devices.
- C. The UCS gateway (Master) device shall reside in the meter panel.
 - 1. Gateway device shall be industrial grade with internal firewall.

Acceptable manufacturers:
 - a. MOXA Mgate Model #3170 (or approved equal).
 - 2. All meters (chilled water, electrical, steam, domestic water) shall communicate via a dedicated RS-485 network utilizing ModBus RTU Protocol.
- D. One dedicated IP connection shall be installed for the UMP
- E. A dedicated 115V circuit shall be supplied for the UMP.

2.14 FLOW COMPUTER/TOTALIZER:

- A. Kessler-Ellis Products (KEP) ES-749 flow computer shall be connected to all steam meters. The KEP shall be panel mount type and installed in UMP. The KEP ES-769 is an acceptable alternate when auxiliary inputs are required for the application (such as net metering or trap monitoring).
- B. The KEP flow computer will receive the analog flow signal as an input from the steam meter
- C. Outputs: The KEP will send a temperature or pressure compensated steam peak demand (klbs/hr) and total consumption (klbs) output via Modbus RTU Protocol to the UCS Gateway device (Master) located in the UMP over a dedicated RS485 communication trunk. All wiring and terminations are to be completed by Temperature Control or Electrical Contractor (approval required), including installation of KEP, wiring of meter components to KEP, wiring of KEP to UCS, setup, and KEP programming.
- D. No substitutions

2.15 METERS

A. Differential Pressure Meter:

1. Meter shall be sized to meet EOR minimum, maximum, and normal operating parameter. Turndown ration shall be no less than 30:1.
2. All steam meters shall be pressure compensated unless approved otherwise by Utility Services.
3. Meter flow rate range and size shall be verified by UCB Facilities Operations, Utility Services. Meter shall have 300 psi rated flanges.
4. All steam meter installations shall be in accordance with the University of Colorado Boulder Utility Standard No. EO-102-A latest revision.
5. Approved Manufacturers:
 - a. Veris, Inc. – Accelabar
 - b. McCrometer – Vcone
 - c. UCB Utility Services Approved Equal

B. Differential Pressure Transmitters (DP) for Steam Meters:

1. Pressure transmitters shall be in accordance with Utility Services Meter Standard Detail Drawing ##-####. Specify remote mount heads for low clearance installations.
2. All transmitters shall be Hart capable, no exceptions:
3. General: Two-wire smart DP cell type transmitter, 4-20 mA or 1-5 Vdc user-selectable linear or square root output, adjustable span and zero, stainless steel wetted parts.
4. All transmitters for meter installations shall be in accordance with the University of Colorado Boulder Utility Standard No. EO-103-A latest revision
5. Manufacturers
 - a. Rosemount or approved equal.

C. Vortex Meter:

1. Specify inline vortex meter for constant flow steam services (Approval required by Utility Services). Meter flow rate range and size shall be verified by UCB Facilities Operations, Utility Services. Meter shall have 300 psi rated flanges. Vortex meters are not acceptable for main steam service without Utility Services pre-approval.

D. Condensate Meter:

1. When primary flow measurement cannot be achieved, than an electromagnetic flow meter shall be used. All condensate meters require approval of Utility Services.
2. Meter shall consist of a full-bore body with encapsulated and rigidly retained set of coils.
3. Meter electronics shall be capable of remote mounting.
4. Meter shall be supplied with pulse and analog (4-20 mA) outputs.
5. Meter shall be capable of measuring fluids with conductivity greater than or equal to 5.0 uS/cm².
6. Electronic cycle counters are not an acceptable measurement device for primary billing.
7. The piping and flow tube of the meter must be full at all times. The meter shall be mounted in such a way to provide a wet leg as required.

E. Meter Submittals

1. All main (primary) steam service meters shall be approved by Utility Services prior to purchase and installation.

2.12 NUTS AND BOLTS

- A. Nuts and bolts to be no less than grade 8. No substitutions.

2.13 PIPING

- A. Pipe size: Size to allow not greater than 8,000 FPM (feet/minute) based on maximum load.
1. HPS no greater than 10,000 FPM.
 2. LPS no greater than 8,000 FPM.

3. Humidification no greater than 6,000 FPM.

2.14 REGULATORS / PRV's

- A. When steam load exceeds 5,500 lbs/hr a S-transfer system is to be used (25%-100%). There must also be a redundant 100% valve with separate PRA in case any part of S-transfer fails.

2.15 SEALS, MECHANICAL

- A. Any piping penetrations through tunnel walls or lids, or through building foundations, must be sealed with a mechanical seal that is both expandable and water-tight. In addition, the penetration must be sealed on the exterior with a water-tight, non-shrink grout.

2.16 STRAINERS

- A. Specify a cast iron #250 Y-type strainer with stainless steel mesh or screen basket for all screwed applications [2" and below]. Strainer must have a threaded fitting for use as a blowdown. All strainer blowdowns shall be ball valves with a short pipe nipple-sch 80 on the outlet side.
- B. Specify a cast steel Y-type strainer with stainless steel mesh or screen basket for all flanged applications. Strainer must have a threaded fitting for use as a blowdown. All strainer blowdowns shall be ball valves with a short pipe nipple-sch 80 on the outlet side.
 - 1. Cast Steel HPS 15 psi + Above
 - 2. Cast Iron LPS 15 psi + Below

2.17 TRAPS

- A. Inverted Bucket: All Applications that are fed by a modulating control valve must use the "LV" (large vent) model. Sizing shall be as follows:
 - 2 to 1 @ .5 psi for 0-15 psi
 - 2 to 1 @ 2 psi for 16-30 psi
 - 3 to 1 @ 1/2 of maximum pressure drop above 30 psi
 - 3 to 1 at operating pressure differential on constant pressure
- B. Thermostatic traps used only for air vents and direct steam radiation.

PART 3 – STEAM SPECIALTIES, RELATED EQUIPMENT, AND ACCEPTABLE PRODUCT MANUFACTURERS

*Please note: the term “approved equal” refers to approval by the University of Colorado at Boulder, Facilities Management Steam Shop for low pressure steam and hydronic systems and Utility Services for metering, high pressure steam, and condensate systems *only*, no exceptions.

3.01 AIR VENTS

- A. Use balanced-pressure type with stainless steel bellows, valve, and seat.
- B. Acceptable Manufacturers:
 - 1. Spirax/Sarco
 - 2. Armstrong
 - 3. Hoffman ITT
 - 4. Approved equal

3.02 ANTI-SEIZE

- A. Use only 100% virgin teflon tape for all threaded pipe fittings. No thread sealing compound or “pipe dope” will be permitted.
- B. Use a metal-based [typically nickel] anti-seize with a 2000-degree rating for all flange bolts.
- C. Acceptable Manufacturers, metal-based anti-seize:
 - 1. Permatex
 - 2. Approved equal

3.03 CONDENSATE COOLERS

- A. Acceptable Manufacturers: none

3.04 CONDENSATE PUMPS

- A. Use probe style, pressure-powered pump with compressed air as the motive medium.
- B. Acceptable Manufacturers:
 - 1. Johnson Liqui-Mover
 - 2. Armstrong

3.05 EXPANSION JOINTS

- A. Use bellows style expansion joints where the bellows are designed in accordance with sections C1-C8 of the Standards of Expansion Joint Manufacturers Association.
- B. Acceptable Manufacturers:
 - 1. Pathway CTU
 - 2. Approved equal

3.06 FITTINGS

- A. Elbows, tees, reducers, couplings, crosses:
 - 1. Use forged steel for threaded fittings. 2000 Lb.
 - 2. Use schedule 40 seamless, butt-welded steel conforming to ASTM A234 standard for welded fittings.
- B. Unions:
 - 1. 250 lb malleable iron with brass seats.
- C. Flanges:
 - 1. Use raised-face, welding neck flanges conforming to ASTM A181 standard or slip-on, raised face with approval.
 - 2. Acceptable Manufacturers:
 - a. Ladish
 - b. Grinnel
 - c. Bonney Forge
 - d. Approved equal

3.07 GASKETS

- A. Use spiral-wound gaskets where the windings are manufactured with Type 304 stainless steel with non-asbestos filler and the outer ring [gauge ring] is manufactured with carbon steel. No other gaskets will be permitted.
- B. Acceptable Manufacturers:
 - 1. Flexitallic
 - 2. Garlock
 - 3. Lamons

4. Approved equal

3.08 GAUGES, PRESSURE

- A. Use 4" dry gage with 1/4" MPT connection. Rated for steam with stainless steel intervals.
- B. Acceptable Manufacturers:
 1. U.S. Gauge
 2. Winters LF
 3. Trerice 700 Series
 4. WIKA 23 X .59 Series

3.09 HOT WATER CONVERTERS / HEAT EXCHANGERS

- A. Domestic Hot Water Converters:
- B. Instantaneous Hot Water Converter: Use a feed-forward design that utilizes pressure for control rather than temperature. Tube design can be either be straight-through or helical but helical design must have Hastelloy seats.
 1. Tube and Shell style Hot Water Converters:
 - a. Use type with single-wall tube construction where steam is in the tube bundle and water in the jacket.
- C. Heating Hot Water Converters:
 1. Use tube and shell style with single-wall tube construction where steam is in the tube bundle and water in the jacket.
 2. Acceptable Manufacturers, Instantaneous Hot Water Converters:
 - a. Armstrong Flo-Rite
 - b. Leslie Constantemp
 3. Acceptable Manufacturers, Tube and Shell Hot Water Converters:
 - a. Bell & Gossett
 - b. Armstrong Pump
 - c. Approved equal

3.10 INSULATION JACKETS, REMOVABLE / REUSEABLE

- A. Use jacket with teflon-coated fiberglass cloth, #6 density fiberglass, stainless steel hardware, Velcro tabs, and Nomex drawcords.

- B. Acceptable Manufacturers:
 - 1. Insultech by Shannon Enterprises
 - 2. Approved equal

3.11 METERS

- A. Steam Meters:
 - 1. Acceptable Manufacturer, differential pressure Steam Meter: Veris Accelabar, McCrometer V-Cone, or approved equivalent.
 - 2. Acceptable Manufacturer, Inline Vortex Steam Meters: Emco, Onicon, Yokogawa, Sierra Instruments, or approved equivalent.
- B. Condensate Meters:
 - 1. Use a cycle counter for pressure-powered condensate pumps.
 - 2. Cadillac CMAG Flanged ends

3.12 PIPING

- A. Steam Piping:
 - 1. Use only ASTM type A106 seamless black steel pipe. All welded applications shall be schedule 40 and all threaded applications must be schedule 80.
- B. Condensate Piping:
 - 1. Use only ASTM type A106 seamless black steel pipe. All condensate piping must be schedule 80.
 - 2. Stainless steel pipe may be substituted with prior approval by the USB, Facilities Management, Steam Shop only, no exceptions.
- C. Direct-Bury Underground Piping:
 - 1. Acceptable Manufacturers, Direct-Bury Piping:
 - a. Ricwil/ Perma-Pipe
 - b. Approved equal

3.13 REGULATORS / PRV's

- A. Use Leslie Model GPK with Leslie Airmate or Armstrong GD2000K with Armstrong air loading control panel.

- B. All valves 1-1/2" and larger to have minimum 250 lb flange connections; all valves 1-1/4" and smaller to use threaded connections.

3.14 SEALS, MECHANICAL

- A. Use a mechanical seal that is heat-rated, expandable, and water-tight.
- B. Acceptable Manufacturers:
 - 1. Link-Seal Model "T" [silicone] by Thunderline
 - 2. Approved equal

3.15 STRAINERS

- A. Use cast steel rated steel, 250 lb. Y-type strainer with stainless steel mesh or screen basket for all screwed applications. Strainer must have a threaded fitting for use as a blowdown.
- B. Use a cast steel Y-type strainer with stainless steel mesh or screen basket for all flanged applications. Strainer must have a threaded fitting for use as a blowdown.
- C. Acceptable Manufacturers:
 - 1. Spirax/Sarco
 - 2. Leslie
 - 3. Armstrong
 - 4. Approved equal

3.16 TRAPS

- A. Float and Thermostatic Traps:
 - 1. Trap must be fully modulating type suitable for continuous operation with a cast iron body and cover. Internal parts must be fully accessible without disturbing piping. Float, air vent, head, seat, and valve mechanism shall be manufactured of stainless steel. An integral vacuum breaker is required.
- B. Inverted Bucket Traps:
 - 1. For design loads exceeding 600 lbs./hr. of condensate, use a trap with a cast iron body and cover where internal parts are fully accessible without disturbing piping.
 - 2. The bucket and lever mechanism shall be stainless steel and the valve and seat must be chromed steel that has been hardened, ground, and lapped.

3. Use a Armstrong 2011 S.S. inverted bucket trap for all drips.

C. Thermostatic Radiator Traps:

1. Due to the goal of reducing spare parts inventory, only three thermostatic radiator trap models are utilized on campus.
2. Acceptable Manufacturer, Float and Thermostatic Trap:
 - a. Armstrong only
3. Acceptable Manufacturer, Inverted Bucket Trap with Cast Iron Body:
 - a. Armstrong only
4. Acceptable Manufacturers, Inverted Bucket Trap with Stainless Steel Body:
 - a. Spirax/Sarco Model UIB30
 - b. Armstrong Model 2011 p.c.
5. Acceptable Manufacturer, Thermostatic Radiator Trap:
 - a. Tunstall Model TA

3.17 VACUUM BREAKERS

- A. Use hardened ball check valve design with all working parts manufactured from stainless steel.
- A. Acceptable Manufacturers:
 1. Barnes and Jones
 2. Approved equal

3.18 VALVES

- A. Butterfly Valves:
 1. Use only high-performance, steam-rated, lug-style wafer [between flanges] body with gear-driven actuator.
 2. Acceptable Manufacturers, Butterfly Valves:
 - a. Keystone
 - b. DeZurik
 - c. Jamesbury
 - d. Vanessa
 3. Acceptable Manufacturers, Gate Valves / Class 800: [no Nibco, Red-White, or Toyo]
 - a. Vogt

- b. Bonney Forge
 - c. Anvil
 - d. Approved equal
4. Acceptable Manufacturers, Globe Valves / Class 800: [no Nibco, Red-White, or Toyo]
 - a. Vogt
 - b. Bonney Forge
 - c. Anvil
 - d. Approved equal
 5. Acceptable Manufacturers, Ball Valves:
 - a. Apollo Model 73A-Size-64
 - b. Spirax/Sarco Model M10S
 - c. Approved equal
 6. Acceptable Manufacturers, Swing Check Valves:
 - a. Crane
 - b. Stockham
 - c. Mueller
 - d. Milwaukee
 - e. Approved equal
 7. Acceptable Manufacturers, Spring Check Valves:
 - a. Durabla Model SCV 750 CWP / 500 WSP
 - b. Armstrong
 - c. Approved equal
 8. Acceptable Manufacturers, Wafer Check Valve:
 - a. Durabla
 - b. Spirax/Sarco Model DCV 4
 - c. Mueller
 - d. Marlin
 - e. Approved equal
 9. Acceptable Manufacturers, Radiator Control Valves:
 - a. Ammark
 - b. American Steam
 10. Acceptable Manufacturers, Safety Relief Valves:
 - a. Leslie
 - b. Spence
 - c. Kunkle

B. Gate Valves:

1. Use rising-stem Class 800 forged steel [A105] valve with spiral-wound top gasket.

- C. Globe Valves:
 - 1. Specifications are the same as for gate valves.
- D. Ball Valves:
 - 1. Use only Carbon Steel ball valve with S.S. trim Apollo model #73A.
- E. Check Valves:
 - 1. Swing check valves must be bronze-bodied, Class 300 [300 psi WSP] with bronze disc and stainless steel hinge pin.
 - 2. Spring check valves must be stainless steel construction and rated at 300 psi WSP or better.
 - 3. Wafer check valves are designed to fit between two flanges. They must be manufactured stainless construction [body, disc, spring, and spring retainer] and have an opening rate of 1/2 psi or less.
- F. Radiator Control Valves:
 - 1. Use a chrome-plated, bronze-bodied, steam-rated valve with a thermostatically actuated controller where the thermostat is integral to the controller.
- G. Safety Relief Valves:
 - 1. Use a steam-rated safety relief valve that has a cast iron body, a bolted bonnet design, seats lapped to optical flatness, and dual control rings. The valve must have bronze semi-nozzle trim.
- H. If piping run is longer than 10', the pipe size must be increased one pipe size larger.

PART 4 – INSTALLATION REQUIREMENTS

4.01 AIR VENTS

- A. Do not install on posi-pressure control systems (steam coils). Pipe relief discharge to floor.

4.02 ANTI-SEIZE

- A. Use on all bolts and cap screws.

4.03 CONDENSATE PUMP

- A. All welds to be done by a ASME certified welder.
- B. Threads on pipe to be cut correctly not allowing more than 3-1/2 turns and/or 2-1/2 by hand.
- C. Pumps to be leveled and plumb.
- D. All equipment should be set for ease of maintenance.
- E. Vent piping to be taken to an outside location. 1st Choice would be the roof.
- F. All piping should be individually hung to secure.
- G. Motive steam should have drip trap.
- H. Air lines will use black pipe or rigid copper.

4.04 EXPANSION JOINTS

- A. All weld to be done shall be done by a certified welder.
- B. Expansion joints to be properly anchored according to drawings.
- C. Guides to be spaced per manufactures recommendation.

4.05 HOT WATER CONVERTERS/HEAT EXCHANGES

- A. Unit must be piped for ease of tube removal.
- B. Unit must be set at a height for ease of maintenance.
- C. Feed forward units must have thermal loops. (18" minimum)
- D. Feed forward units with recirc must have a diverting valve installed.
- E. Condensate to be returned by gravity.
- F. Isolation valves on all piping to unit.
- G. Vacuum breaker must be installed after unit and before trap.

4.06 PRESSURE REDUCING STATION

- A. Support piping on each side of reducing valve using pipe saddles (for full wrap of insulation).
- B. Install drip traps on the high and low sides of reducing station (see detail on drips for proper piping).

- C. Install strainers with blowdown valves before all regulating valves and traps.
- D. Install gauges, isolation valve, and pigtail on high and low side of station.
- E. Use a high-performance butterfly valve with gear operator (lug style) on 2.5" pipe and larger. Use a forged steel gate valve on 2" and smaller pipe.
- F. Use a concentric reducer on the outlet of the regulator.
- G. Use ½" pipe for the control piping between GPK and low pressure steam main.
- H. Mount Leslie AF-2 Airmate where it is accessible. Use rigid copper to pipe from the airmate to the GPK.
- I. Mount safety relief valve where it is accessible.
- J. Mount drip pan elbow as close to safety relief valve as possible. Use a flange or a union (depending on size) for ease of replacing valve if needed.
- K. Drain from drip pan shall be run to a floor drain with a union at the drip pan for ease of removal if necessary.
- L. Apply anti-seize on all bolts.
- M. Use Teflon tape only on all threaded joints.
- N. Use only spiral wound gaskets on flanges.
- O. All welding being performed to be done by an ASME certified welder.
- P. Use 250# steam rated ball valves on all blowdowns. See standards for required valve.
- Q. Pilot lines need to be run with slope down away from GPK.
- R. All pressure reducing valves to have unions or flanges on each side for ease of removal.
- S. See Appendix Diagram A.

4.07 TESTING

- A. All new steam and condensate piping shall be hydrostatically tested to 1 ½ times the operating pressure of the system, or 100 psig, whichever is higher. The test must hold TEST pressure for a minimum time period of two hours.
- B. Must inspect all piping – welded, threaded and any type of soldering before piping can be insulated. Systems must be inspected by UCB Steam Shop before operation.

4.08 TRAPS

- A. All traps to be installed with unions and isolation valves for ease of removal.
- B. All traps to be installed below equipment.
- C. Check valves on inlet of all bucket traps (see drawing)
- D. Test tee's after trap to point down.
- E. See Diagram for Main Drip Appendix A.

PART 5 – INSTALLER (CONTRACTOR) QUALIFICATION REQUIREMENTS

5.01 QUALIFICATION

- A. Any Journeyman Steamfitter working on jobsite shall be licensed by “City and County of Denver.” The license must be carried on their person at all times while on the jobsite, and be available for inspection by UCB staff at anytime.

5.02 ALLOWABLE JOURNEYMAN/APPRENTICE RATIOS

- A. The installer (contractor) may use apprentice steamfitters on the jobsite. At no time shall the ratio of two apprentices to one journeyman be exceeded on the jobsite.

5.03 WELDER QUALIFICATIONS AND QUALIFICATONS AND PROCEDURES FOR STEAM AND CONDENSTE PIPING

- A. UCB may ask for welding certifications at any time.
- B. Welder must be certified in SMAW-E6010, E7018, which falls under Section IX of the ASME code, Boiler and Pressure Vessel (welding and brazing), ASME B31 and Appendix B31.1 2007, Power Piping Welding Procedures.

5.04 WELD INSPECTION

- A. Weld will be visually inspected by UCB personnel. If weld does not meet UCB Standards (visually), then Contractor may be required to X-ray weld or “cut out” weld for further inspection. Contractor will be responsible for costs associated with X-raying or removal and re-welding.

END OF SECTION