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BuildingName
The Description of the Project
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SPECIFICATION DIVISION 33

NUMBER SECTION DESCRIPTION

END OF CONTENTS TABLE

DIVISION 33 UTILITIES

SECTION 336330 - UTILITY TUNNELS - STEAM & CONDENSATE DISTRIBUTION SYSTEMS

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

A. Drawings and general provisions of the Contract, Standard General and Supplementary General Conditions, Division 01 Specification Sections, and other applicable Specification Sections, in particular the Related Sections listed below, apply to this Section.

B. Related Sections:

1. Section 017823 - Operation and Maintenance Manuals
2. Section 09110 - Tunnels - Quality Assurance & Quality Control

1.2 SUMMARY

A. This Section includes all utility tunnel steam and condensate distribution systems, including but not limited to:

1. Low pressure steam and condensate systems (nominal 5 to 15 psig
2. High pressure steam and condensate systems(nominal 60 psig)
3. Pumped condensate Piping System Insulation
4. Hangers, Supports and Anchors
5. Valves
6. Condensate Recovery/Return Units
   a. Electric Pumped
   b. Mechanical Pressure Powered Pumps
7. Pressure Reducing Valves and Stations
8. Expansion Joints
9. Steam & Condensate Specialties
   a. Strainers for Trap Stations and PRV Stations
   b. Inverted Bucket Traps
10. Thermometers and Gauges
11. Steam and Condensate Meters

1.3 SUBMITTALS

A. Shop Drawings Submit the following project specific items for approval in compliance with Division 1:

1. Product Data: Include manufacturer, catalog illustrations, model, rated capacities, performance, dimensions, component sizes, roughin requirements, materials of construction, and operating and maintenance clearance requirements.
2. Provide data sheets for all products listed in this section including flanges, gaskets, unions, hangers, di-electric protection method, thermal hanger shield inserts, di-electric fittings, flexible metal hose, flexible connectors, and seal sleeve systems.
3. Submit all submittals for a given system or component at the same time.

B. Installation, Operation and Maintenance Manuals

C. Test and Evaluation Reports

D. Source Quality Control Submittals

E. Site Quality Control Submittals

F. Certificates

G. Manufacturer Reports

H. Special Procedure Submittals

I. Qualification Statements

J. Delegated Design Submittals

K. Warranty Documentation

L. Record Documentation

M. As-Built Drawings

N. Test Reports

O. Travelers Turnover Documents - Refer to Part 3.4.

1.4 QUALITY ASSURANCE

A. Manufacturers and Products: The products and manufacturers specified in this Section establish the standard of quality for the Work. Subject to compliance with all requirements, provide specified products from the manufacturers named in Part 2.

B. Reference Standards: Products in this section shall be built, tested, and installed in compliance with the specified quality assurance standards; latest editions, unless noted otherwise.

1. All piping, unless noted otherwise, shall comply with ANSI Standard B31.9 - Building Service Piping.
2. All steam piping above 15 psig, and all steam condensate piping shall comply with ANSI Standard B31.1 - Power Piping.
3. Mill certifications indicating country of origin and compliance to ASTM/ANSI/NSF and other required compliance standards verified by independent third party based in the United States, shall be promptly provided whenever requested.

C. Qualifications

1. Manufacturers
2. Suppliers
3. Fabricators
4. Installers / Applicators / Erectors
5. Testing Agencies
6. Licensed Professionals

1.5 DELIVERY, STORAGE, AND HANDLING

A. Store materials and equipment raised off the floor on pallets and protected with coverings to prevent damage due to weather and construction activities. Store in areas that prevent damage due to freezing and extreme temperatures or sunlight. Arrange coverings to provide air circulation to avoid damage from condensation or chemical build-up. Protect from damage, dirt and debris at all times.

1.6 WARRANTY

A. Provide a complete warranty for parts and labor for a minimum of one year from the date of Substantial Completion.

PART 2 - PRODUCTS

2.1 PIPE SYSTEM

A. Steam Pipe – (HPS & LPS):

1. For piping through 2”:
   a. Pipe: Black Steel, Schedule 80s/Extra-Heavy ASTM A53, seamless, Grade B.
   b. Fittings: Extra-heavy weight, Forged steel, ASTM A181, ANSI B16.11.
2. Joints: Screwed.
   a.
3. For piping 2-1/2” or larger:
   a. Pipe: Black Steel, Schedule 40s/Standard, ASTM A53, ERW, grade B.
   b. Fittings: Schedule 40s/Standard (STD), long radius (1.5 radius), butt welded, black steel, ASTM A234 WPB
   c. Joints: Butt welded. Flanged ASTM A181, 150#, forged steel at valves, and equipment.

B. Steam Condensate Pipe (gravity or pumped):

1. For piping through 2”:
   a. Pipe: Black Steel, Schedule 80s/Extra-Heavy ASTM A53, seamless, Grade B.
   b. Fittings: X-heavy weight, Forged steel, ASTM A181, ANSI B16.11.
   c. Joints: Screwed.
2.
3. For piping 2-1/2” or larger:
   a. Pipe: Black Steel, Schedule 80s/Extra-Strong (XS), ASTM A53, seamless, Grade B.
   b. Fittings: Extra-Strong, long radius (1.5 radius), butt welded, black steel, ASTM A234 WPB
   c. Joints: Butt welded. Flanged ASTM A181, 150#, forged steel at valves, and equipment.

C. Joints:

1. Screwed Joints: Tapered thread, ASME B1.20.1, joined with compatible compound or sealant tape applied to male thread only.
2.
3. Welded Joints: Comply with Section II, Part C, ASME Boiler and Pressure Vessel Code for welding materials appropriate for the wall thickness and chemical analysis of the pipe being welded. Pipe and fittings shall be beveled and butt welded.
4.
5. Flanged Joints:
   a. Provide 150# raised forged steel flanges conforming to ANSI B16.5.

b. Flanges must conform to ASTM A105/ASME SA105.
c. Comply with the respective ASME B31.1 or B31.9 piping standard.

6. Gaskets shall conform to respective ANSI Standards B16.20, B16.21. Gaskets in steam and condensate lines shall be "FLEXTALLIC", 316L Style CGI – Flexible Graphite Filler (SEL) or "Garlock" Flexseal Spiral Wound Gasket with graphite filler. Spiral wound gaskets will incorporate an inner and outer ring. Gasket faces shall be anti-seized prior to installation.
7. Flange Bolts and Nuts: Provide ASTM A193 B7 bolts and studs with ASTM A194 grade 2H heavy hex nuts. Apply anti-seize compound to threads prior to installation.

2.2 INSULATION

A. General:

1. Steam and Condensate piping including butterfly valves conveying fluids at temperatures above 110F (Hot Service). NOTE: VALVES TO BE INSULATED AFTER SUCCESSFUL HYDROTEST.
2. All insulation materials shall be asbestos free.
3. Flame spread classification (ASTM E84, NFPA 255): No greater than value listed.
4. Smoke density classification (ASTM E84, NFPA 255): No greater than value listed.

B. Piping Insulation Fiberglass

1. Fiberglass insulation with factory-applied vapor barrier jacket with self-sealing laps. ASTM C547 Class 1 insulation. Vapor barrier jacket: laminated white Kraft paper, aluminum foil, glass fiber reinforcement.
2. Approved Manufacturers: Johns-Manville, Knauf, Owens/Corning.
3. Required thickness:

C. Fiberglass Piping Insulation Thickness Table

		Nominal Pipe Size (inches)				
Piping System Fluid	Temp Range (°F)	<1.0"	1.0"	1.5"-4.0"	6"	8" & above
High Pressure Steam (HPS) (60# & above)	251 - 350	3.0	4.0	4.5	4.5	4.5
Low Pressure Steam (LPS) (0-15#)	201 - 250	2.5	2.5	2.5	3.0	3.0
Condensate	Any	1.5	1.5	2.0	2.0	2.0

D. Pipe Insulation High Temperature Aerogel

1. Material: Flexible Silica Aerogel blanket suitable for applications up to 1,200 °F (650°C).
2. Compliant to ASTM C1728, Type 3, Grade 1A.
3. Density: 10-15 lb/ft3.
4. Meets ASTM E84 Smoke/Flame Index.

5. Hold each layer of Aerogel insulation in place with staples, tape, or wire. Use minimum of 4 loops of 18-gauge stainless steel wire per 5-foot length for final layer. Twist and press the ends of the wire into the insulation to prevent projections.
6. Approved Manufacturers: Aspen Pyrogel XTE, Armacell - Armagel-HT
7. Required thickness:

E. Aerogel Piping Insulation Thickness Table (mm)

		Nominal Pipe Size (inches)				
Piping System Fluid	Temp Range (°F)	<1.0"	1.0"	1.5"-4.0"	6"	8" & above
High Pressure Steam (HPS) (60# & above)	251 - 350	30	30	40	50	50
Low Pressure Steam (LPS) (0-15#)	201 - 250	20	25	40	40	40
Condensate	Any	15	15	20	20	20

F. Aluminum Jacketing

1. Jacketing shall be 0.016-inch thick stucco embossed aluminum complete with integrally bonded polycraft moisture barrier held in place with aluminum screws; elbow covers to be prefabricated.
2. Fasten jacketing with aluminum screws at a minimum 6-inch spacing. .
3. Acceptable manufacturers:
   a. Childers; Ell-Jacs; or Approved equal
4. Joint sealant shall be aluminum pigmented butyl polymer.
5. Acceptable products are as follows:
   a. Foster Div., Amchem Product Inc., "Elastolar Sealant, Aluminum 95-44", Childers "Chil-Joint CP-70" or Approved equal

G. Piping Insulation Specialties

1. Expansion Joints Insulation: Expansion joints shall be insulated with prefabricated insulation blankets, installed in a manner to allow for the repacking of the joints without removing blanket. Hold blankets in place with permanently attached Velcro fasteners.
2. Removable Insulation Jackets: Where indicated on drawings, provide removable insulation jackets with ceramic impregnated fiberglass or Aerogel High Temperature insulation, flexible fabric jacket and velcro fasteners.
3. Manufacturer: ESI - Q Master; Insulation Technologies Inc.

2.3 HANGERS, SUPPORTS AND ANCHORS (BOTH STEAM AND CONDENSATE):

A. General

1. Provide pipe hangers, supports and accessories for the proper support of all piping.

2. Pipe hangers, supports and accessories shall be sized to allow uninterrupted pipe insulation thickness.

B. Equipment

1. Slides
   a. Only use manufactured guides – site built guides are not acceptable unless otherwise approved by Utilities
   b. 1/2" Thick graphite on both upper and lower assemblies
   c. Graphite to have a compressive strength of 2000 psi
   d. Temperature range of -20 degrees F to 750 degrees F
   e. Epoxy boned to steel assembles to withstand 350 degrees F
   f. Designed to accommodate axial and/or lateral movement of the pipe system
   g. Designed to accommodate pipe insulation
2. Guides
   a. Only use manufactured guides – site built guides are not acceptable unless otherwise approved by Utilities
   b. 1/2" Thick graphite on both upper and lower assemblies
   c. Graphite to have a compressive strength of 2000 psi
   d. Temperature range of -20 degrees F to 750 degrees F
   e. Epoxy boned to steel assembles to withstand 350 degrees F
   f. Guides to allow a maximum of 1/16” lateral movement
   g. Designed to accommodate pipe insulation
3. Anchors
   a. Anchors shall be engineered and detail on drawing to meet specific needs of that pipe section.
   b. Manufactures: Anvil, ATS

2.4 VALVES

A. General

1. Valves shall be repack-able under pressure whether open or closed.
2. Unless noted otherwise, valves shall be rated for a minimum of 125#WSP (working steam pressure)/ 250# WOG (cold water, oil, gas).
3. Unless noted otherwise, all butterfly valves shall be full lug construction, suitable for bi-directional dead end service, and have open position memory stop.
4. Manually operated butterfly valves less than 4” shall be lever operated
5. Manually operated butterfly valves 2-1/2" and larger shall have enclosed worm gear operators with position indicators.
6. Gear operated valves shall be provided with self-locking gears. The actuator mounting bracket shall be rigidly dowel pinned to the body to absorb torque loads and shall be centered by machined register between bracket and body.
7. Valve actuator handle size shall be provided with manufacturers approved smallest available handle diameter to prevent obstruction of tunnel corridor.
8. Provide extended valve stems for insulated piping.
9. Valves shall be same size as piping unless otherwise indicated.

B. Steam and Condensate Valves 2" or Smaller (through 60 psig)

1. Gate Valve – Forged steel body with stainless steel trim
2. ANSI Class 150 OS&Y Bolted Bonnet ASTM A 105 steel body, 13 Chrome Trim, hard-faced seats, graphite packing.
3. Valves shall have threaded connection
4. Manufactures:
5. Crane Co.; Crane Valve Group; Crane Valves.
6. Vogt.
7. Stockholm
8. Smith

C. Steam Valves 2-1/2" or Larger (through 60 psig) - Metal to Metal Seated Butterfly Valves

1. Lug style with 150# flange connection in accordance with the latest edition of ASME B16.5, Body Length according to API 609 Table 2 (A).
2. ASTM A216 Gr. WCB Cast Carbon Steel Body
3. 316 Solid One Piece Stainless Steel Disc
4. Body Mounted ASTM A240 Tp. 316
5. Ti/Graphite Stainless Steel Seal Ring
6. A564 H1150D Stainless Steel Shaft
7. ASTM A439 Tp. D2 Ni-Resist Body
8. Bushing with Integral Graphite Bearing Protectors; Flexible Graphite Gaskets; Die Formed Flexible Graphite
9. Packing; ASTM F738 Cl C3 Stainless Steel Studs; ASTM F836 Cl A4 Stainless Steel Nuts
10. Tapped Holes for Lifting Eyebolts
11. Leak Tested to API 598
12. Manufacturers: Adams WAK-A9, Crane Flowseal MS, ABZ Extreme 6000 Series, Weir Tricentric, Zwick Tri-Con, Vanessa Series 30,000.

D. Condensate valves 2-1/2" and larger (through 60 psig)

1. Lug style with 150# flange connection in accordance with the latest edition of ASME B16.5, Body Length according to API 609 Table 2 (A).
2. ASTM A216 Gr. WCB Cast Carbon Steel Body with stainless disc
3. High performance butterfly valve, RTFE seated
4. Adjustable packing gland with Teflon/SS packing seal
5. Manufacture: Jamesbury Series 800, Nibco High Performance Butterfly Valve

E. Check Valves

1. Steam Trap Assemblies:
   a. 316 stainless steel body, trim and spring; Vitron seat material; Class 150; and Inconel spring.
   b. Manufacturer: “The Connector” by Check-All Mfg. Company,

2.5 CONDENSATE RETURN UNITS

A. Electric - Single-Stage, Centrifugal Pumps With Elevated Receiver

1. General
   a. Provide packaged condensate return unit of size and capacity indicated.

b. Factory-fabricated, packaged, electric-driven pumps; with receiver, pumps, controls, 150# flanged connections and accessories suitable for operation with steam condensate.
c. Electrical Components, Devices, and Accessories: Listed and labeled as defined in NFPA 70.
d. ASME Compliance: Fabricate and label steam condensate receivers to comply with ASME Boiler and Pressure Vessel Code: Section VIII, Division 1.
e. Configuration: Duplex floor-mounted pump with elevated receiver, float switches, and connecting piping; rated to pump 212 deg F steam condensate.

2. Receiver:
   a. Mounted on fabricated-steel supports.
   b. Cast iron or Welded steel 1/4" minimum.
   c. Externally adjustable float switches.
   d. Water-level gage and dial thermometer.
   e. Pressure gage at pump discharge.
   f. Bronze isolation valves between receiver and pumps.
   g. Lifting eyebolts.
   h. Inlet cascade baffle and convex heads.
   i. Cast-iron inlet strainer with self-cleaning bronze screen, dirt pocket, and cleanout plug on receiver inlet.
3. Pumps:
   a. Centrifugal, close coupled.
   b. Permanently aligned.
   c. Bronze fitted with enclosed bronze impellers.
   d. Replaceable bronze case rings.
   e. `Stainless-steel shafts.
   f. Mechanical seals rated at 250 deg F.
   g. Mounted on base below receiver.
   h. Rated to operate with a minimum of 2 feet (6 kPa) of NPSH.
4. Automatic Flow Control Valves for electric condensate return pumps:
   a. The flow cartridge must be non-clogging single orifice design shall include no metal-to-metal contact, no segmented ports, no rolling diaphragm, and incorporate a tapered profile flow nozzle and metering disk controlled by a pressure compensating spring.
   b. The flow cartridge shall be a single assembly, constructed with stainless steel moving parts and be accessible without removing the valve from the piping. Flow cartridges constructed with composite or rubber materials are not acceptable.
   c. The flow cartridge shall be factory flow tested and calibrated to maintain accuracy of ±5%; the accuracy shall be maintained over standard operating range of 2 - 45 PSID. Cartridges that prevent flow above the maximum operating range are not acceptable.
   d. The flow cartridge shall be clearly inscribed with the designed manufactured flow rate and must match pump design.

e. Valves 1 ½" and smaller shall be a forged brass Y-pattern body and valves 2" - 2½" shall be a cast brass y-pattern body with integrated ball valve, pressure/temperature test ports
f. Valves 2½" and larger shall be a wafer style cast iron body with pressure and temperature test plugs across the flow cartridge
g. Approved Manufacturers:
Nexus Valve, Inc. or Approved Equal

5. Control Panel:
a. Factory wired between pumps and float switches, for single external electrical connection.
b. Provide fused, control-power transformer.
c. NEMA 250, [Type 1] [Type 3] [Type 12] enclosure with hinged door and grounding lug, mounted on pump.
d. Motor controller for each pump.
e. Electrical pump alternator to operate pumps in lead-lag sequence and allow both pumps to operate on receiver high level.
f. Manual lead-lag control to override electrical pump alternator and manually select the lead pump.
g. Momentary-contact "TEST" push button on cover for each pump.
h. Numbered terminal strip.
i. Disconnect switch.
j. Approved Manufactures:
Spirax Sarco, Armstrong, Bell & Gossett

B. Mechanical - Pressure Powered (HPA) Condensate Recovery Unit

1. General
a. Provide packaged preassembled unit, mounted on steel frame, of size and capacity indicated.
b. Provide complete compressed air powered unit with receiver and accessories suitable for operation with 212 deg F steam condensate.
c. ASME Compliance: Fabricate and label steam condensate receivers to comply with ASME Boiler and Pressure Vessel Code: Section VIII, Division 1.
d. Configuration: Floor mounted package Construction
e. Receiver: Cast iron or Welded steel 1/4" minimum.
f. Mechanical Pump: Welded steel body.
g. Stainless steel float valve.
h. Stainless steel check valves on motive inlet, outlet and vent. Stainless steel wye-strainer and screen.
i. Stainless steel isolation valves on motive inlet, outlet and vent.

2. Manufacture: Spirax Sarco APT10 Vented Pump Package, Armstrong

2.6 PRESSURE REDUCING VALVES AND STATIONS

A. General

1. Regulators shall be single seated, flanged, ANSI 125 lb.; cast iron body, stainless steel diaphragm, Seco metal disc, stainless steel stem, and carbon steel main spring. Valves shall be normally closed type and designed for dead end service. Steam velocity through the valve shall be limited to 7,000 fpm.

B. Trip Stop PRV Station

1. Two stage PRV station where indicated and as scheduled on drawings. Each station shall consist of steam pressure reducing valves, strainers, relief valves, isolation gate valves, globe style bypass valves, pressure gauges etc. as detailed
2. Provide muffling orifice required to limit sound level to 85 dba, 3 feet from the valve.

C. Approved Manufacturers:

Armstrong, Leslie, Spirax-Sarco, Spence.

2.7 EXPANSION JOINTS - STEAM AND CONDENSATE (UP TO 60 PSIG)

A. General

1. Conform to the standards of ASME B31.1
2. Conform to the standards of the Expansion Joint Manufacturers Association and shall be pressure rated for 60 PSI for low pressure systems and for 175 PSI for high pressure systems.
3. Expansion joints sizes 2" and smaller: NPT screwed connection
4. Joints 2-1/2" and larger: Provide 150# raised forged steel flanges conforming to ANSI B16.5.
5. Traverse distances as indicated on drawings
6. Provide guides as per manufactures recommendations.

B. External Pressurized Bellows Joints

1. Expansion joints shall be externally pressurized, externally/internally guided type, with Vanstone flange on one end.
2. Shall have drain, drip and vent port with an NPT connections.
3. Entire joint suitable for 450 F. minimum operating temperature, and traverse as scheduled.
4. Provide an internal integral limit stop to limit travel to traverse plus one half-inch minimum over travel.
5. All bellows joints shall be pre-set at the factory and "held" with removable metal clips or strips tack welded across the flanges.
6. Housing shall be standard wall pipe; two-ply testable bellows shall be laminated 304 stainless steel.
7. Acceptable Manufacturers: Hyspan, US Bellows

C. Slip Joints

1. Internally and externally guided steel slip, chrome plated to reduce corrosion, ground to reduce friction.
2. Guides shall be non-ferrous, non-corroding, low friction, designed to prevent scoring or binding of the slip.
3. Flanged ends.
4. Limit stop to prevent slip disengagement if pipe anchor fails.

5. All slip type expansion joints to be pre-compressed 1", to compensate for pipe contraction.
6. Semi plastic, self-lubricating, injectable packing contained between sealing rings.
7. Injection devices to allow addition of packing under full line pressure.
8. Acceptable Manufacturers: Advanced Thermal Systems, Inc., Hyspan, Metroflex.

D. Ball Joints

1. Ball joints to incorporate packing cylinders to permit injection of packing under full line pressure.
2. Flexible ball joints shall be constructed of alloys as appropriate for the service intended. Where so indicated, the ball joint shall be designed for packing injection under full line pressure to contain leakage. Joint ends shall be threaded (to 50 mm 2 inches only), grooved, flanged or beveled for welding as indicated or required and shall be capable of absorbing a minimum of 15-degree angular flex and 360-degree rotation. Balls and sockets shall be of equivalent material as the adjoining pipeline. Exterior spherical surface of carbon steel balls shall be plated with 0.0508 mm 2 mils of hard chrome conforming to ASTM B650. Ball type joints shall be designed and constructed in accordance with ASME B31.1 and ASME BPVC SEC VIII D1, where applicable. Flanges where required shall conform to ASME B16.5. Gaskets and compression seals shall be compatible with the service intended.
3. Approved Manufacturers:
Advanced Thermal Systems, Inc., Hyspan.

2.8 SPECIALTIES:

A. Strainers – Trap Stations

1. Strainers shall be same size as piping, with screwed connections and cast steel bodies. Screen shall be made of 304SS with a maximum of 20 mesh openings. Screen free area shall be a minimum of twice the internal cross sectional area of the piping where installed. Pressure rating shall be that of piping system.
2. Provide a forged steel threaded gate valve on the strainer blow down port with plug.
3. Strainers shall place on their side so that condensate is not trapped in the strainer
4. Approved Manufacturers: Armstrong, Anvil International, Mueller, Spirax-Sarco or approved equal

B. Strainers – PRV Stations

1. Provide strainer approved for installation with the Pressure reducing valve. Strainers shall place on their side so that condensate is not trapped in the strainer

C. Inverted Bucket Trap

1. The trap shall be of the inverted bucket type, designed for use with a 360° universal connector. The entire trap body shall be fabricated from thin wall drawn stainless steel for enhanced freeze resistance. The trap shall be capable of continuous air venting at steam temperature. The trap shall employ a simple free-floating valve mechanism with no fixed pivots and no valve or bucket guides. The discharge valve shall be so attached to the valve lever that it is free to rotate for even wear distribution, and the valve and seat of the trap shall be lapped together as a matched set to insure tight shutoff. Traps shall be self-priming, with orifice size selected for the capacity required by the application, and suitable for system working pressures
2. Trap size and orifice size shall be equal to or as scheduled on the drawings:
   a. HPS - Armstrong Model 2010 Part# - C5324-1 w/ #38 orifice.
   b. LPS - Armstrong Model 2010 Part# - C5324-5 w/ 5/32” orifice.
3. Traps stations to incorporated upstream and downstream inline check valves to prevent loss of trap prime in varying conditions.
4. Provide inline stainless steel check valve, Armstrong CVI; Spirax Sarco AE 36A or equal.
5. Manufacturers: Armstrong Series 2000, Spirax-Sarco UIB30, Watson Mc Daniels USIB450

D. Condensate Flash Tank

1. Provide condensate flash tank of size and with openings as shown on drawings. Tank shall be ASME constructed and stamped for 125 PSIG.
2. Manufacturers: Cemline, Spirax-Sarco, Wessels, Watson Mc Daniels.

2.9 THERMOMETERS AND GAUGES:

A. Dial Thermometers

1. Thermometers shall be bimetal type, adjustable angle, 5-inch stainless steel hermetic sealed case, external adjustment, 1/2-inch NPT connection, and 6-inch steam length.
2. Thermometers for use on steam lines shall have a range 50 degrees F to 500 degrees F.
3. Thermometers shall be Ashcroft 50-EI-60-E-060; or equal by Trerice.
4. A 316 stainless steel Thermowell with 2-inch lagging extension shall be Ashcroft socket weld type; or equal by Trerice.

B. Pressure Gauge

1. Provide all pressure gauges with 4 ½” clear glass window, cast aluminum, stainless steel or polypropylene case, black on white face, stainless steel wetted parts, brass 1/2" MPT socket, 1% full scale accuracy complying with ASME/ANSI B40-1 Grade 1A. Provide coil siphon (pigtail) configuration installed on steam pipes.

2. Gauge pressure range shall be twice normal operating pressure.
3. Manufacture: Ashcroft, Trerice

2.10 UTILITIES STEAM AND CONDENSATE (LIQUID) METERS, SENSORS, TRANSDUCERS, COMPONENTS AND INSTALLATION REQUIREMENTS:

A. General Requirements - Controls Contractor:

B. Contractor to contact UM Utilities for assistance in meter selections and design requirements.

C. Provide conduit and wiring to power all 120 VAC control accessories such as flow meters, and data acquisition panels. Feed this power from A DEDICATED 120V, 20 AMP CIRCUIT. Power connection for each device shall be installed with a lockable local service disconnect. Electrical power requirements to be coordinated with electrical drawings.

1. For U-M Utility's energy metering, install U-M furnished data acquisition panel. Provide conduit and wiring from meters and transmitters to utility data acquisition panels. Provide communication wiring to utility data acquisition panels. Terminations inside panels by U-M.
2. Ethernet connection of Utility Meters to host computer. Connection to host computer via trunk connection to a communications closet, or local Ethernet data port, and as indicated on the drawings.
3. Flow meter transmitters/displays shall be mounted 4 to 6 Feet above finished floor. They shall be located at the DDC panel array or other acceptable location within the Maximum available cable length.
4. Utilities metering cabling shall not be spliced.
5. NOTE: ALL METER COMPONENTS, INCLUDING SENSORS, SHALL BE MOUNTED IN ACCESSIBLE LOCATIONS. ALL SERVICABLE POINTS SHALL HAVE ADEQUATE CLEARANCES FROM OBSTRUCTIONS AND SAFETY CONCERNS, ie. UNINSULATED STEAM LINES.

D. Wiring and Conduits:

1. Wire and cable shall be pulled from device to Utilities Data Acquisition Panel with 3'-0" spare coiled at the panel. All wire and cable shall be labeled and tagged 4 inches down from the point at which the wire enters the cabinet with the corresponding equipment name.
2. All wiring carrying voltages greater than 24 volts shall be run in conduit.
3. All wiring carrying voltages 24 volts nominal or less shall be run in conduit.
4. Conduits shall be sized on a maximum fill of 40% capacity.
5. Three separate conduit systems shall be provided:
    a) DO/DI and AO/AI wiring.
    b) 120 VAC CONTROL WIRING.
    c) Ethernet communication
6. Data transmission cabling and equipment grounding procedures shall meet the latest FCC guidelines for electromagnetic field generation.

7. All control wiring sizes and types shall meet the equipment manufacturer's recommendations.
8. All control wiring shall have insulation rated for 300 volts minimum, and be installed per NEC requirements.

E. Steam (Vapor) Flowmeters (Vortex-shedding type):

1. This application is for buildings that utilize steam for direct humidification and the service is ≤ 6" pipe size. This is a steam recharge revenue meter.
2. The meter system shall consist of a primary flow sensor and transmitter. The flow sensor body and wetted parts shall be stainless steel, and shall be flanged and suitable for the service rating. The meter shall be installed with all necessary grounding components and gaskets per manufacturer's instructions. The transmitter shall be provided with a remote mounting bracket and cable, integral LCD display, NEMA 4X housing, shall indicate flow rate and totalized flow, shall have an isolated 2-wire 4-20 mA linear output flow signal and a pulsed output signal for totalization. Both outputs to be powered from meter, not an external source. The transmitter shall be capable of being field calibrated and reprogrammed from the outside housing via magnetic probe or security protected integral keypad menu switching and Hart capable. The transmitter shall be capable of being field calibrated and reprogrammed from the outside housing via magnetic probe or security protected integral keypad menu switching. Unit electronics shall have noise immunity. Unit shall have the capability to maintain flow total in non-volatile memory. The primary flow sensor and transmitter shall be mounted in accessible locations. The flowmeter shall be provided with a 1-year warranty and application non-degradation performance guarantee. The flowmeter and transmitter as a unit shall have the following minimum characteristics:
   a. Temperature range shall be -40 to +750°F.
   b. Accuracy shall be 1.0% of rate and 0.1% of full scale.
   c. Repeatability shall be 0.15% of flow rate.
   d. Each meter shall be factory calibrated for the specified flow range prior to shipment and specific performance test data shall be furnished with the meter.
   e. Meter range shall accommodate the minimum and maximum expected flow for the steam pressure at the installed location.
   f. Meter shall be equipped with a temperature and pressure compensation feature.
3. Provide a phenolic tag for each transmitter to identify service and Meter ID number (i.e. Building Number, VOR-1, etc.).
4. Approved Manufacturers:
   a. Rosemount (8800 Series or Equivalent)
   b. Krohne (4200 Series or Equivalent)
   c. ABB (FSV430 or Equivalent)
5.

F. Steam (Vapor) Flow Meters (Differential-pressure type):

1. This application is for buildings that utilize steam for process loads or direct humidification where condensate is not returned and the service is > 6" pipe size. This is a steam recharge revenue meter.
2. The meter system shall consist of a differential pressure primary flow element, a differential pressure transmitter (or transmitters), and a flow monitor/computer. The flow sensor body and wetted parts shall be stainless steel, and shall be equipped with 150-lb. flanges. The transmitter(s) and flow computer shall be provided with a remote mounting bracket and cable, integral LCD display, and NEMA 4X housing. Flow computer shall indicate flow rate and totalized flow, shall have an isolated 2-wire 4-20 mA linear output flow signal and a pulsed output signal for totalization. Both outputs to be powered from meter, not an external source. Unit electronics shall have noise immunity. The transmitter shall be capable of being field calibrated and reprogrammed from the outside housing via magnetic probe or security protected integral keypad menu switching. Unit shall have the capability to maintain flow total in nonvolatile memory. The flow meter and transmitter as a unit shall have the following minimum characteristics:
   a. Temperature range shall be –40 to +750°F.
   b. Accuracy shall be 1.0% of rate or better and 0.1% of full scale with a 10:1 turndown.
   c. Repeatability shall be 0.15% of flow rate.
   d. Each meter shall be factory calibrated for the specified flow range prior to shipment and specific performance test data shall be furnished with the meter.
   e. Meter range shall accommodate the minimum and maximum expected flow for the steam pressure at the installed location.
   f. Meter shall be equipped with a temperature and pressure compensation feature.
   g. V-cone horizontal pilot lines shall be pitched back to steam lines and shall not trap condensate.
3. Provide a phenolic tag for each meter to identify service and meter ID number (i.e. Building Number, STM-1, etc.).
4. Approved Manufacturers: McCrometer (V-cone-style meter)

G. Liquid Flow Meters: (Vortex Type):

1. This optional meter application is for buildings requiring condensate recharge revenue metering.
2. The meter system shall consist of a primary flow sensor and transmitter.
3. The flow sensor shall be equipped with 150-lb. flanges.
4. The meter system shall be installed with all necessary grounding components to bond flanges together and gaskets per manufacturer's instructions.
5. The flow meter shall be manufactured by an ISO9001 certified company.
6. The meter shall be sized appropriately for the range of flow for the system.
7. **Meter size larger than 1.5" will need to be approved by utilities representative.**

8. The flowmeter shall have no moving parts and must be a vortex shedding type utilizing the Von Karman effect to measure volumetric flow.
9. The flowmeter design must be a cantilevered beam dual piezoelectric crystal configuration that is non-wetted all welded and fully isolated, and provides immunity to common mode noise and pipe vibration.
10. The flowmeter shall have no internal cavities that can clog causing the meter to lose functionality.
11. f. The flowmeter shall have a process temperature rating of 500F (260C), with option up to 750F (400C).
12. The flow sensor shall be hydrotested at 1.5 times the cold work pressure for 10 minutes.
13. The flow sensor shall have all wetted parts made of 316SS.
14. The flow sensor shall have options for fully integrated velocity, temperature, and pressure sensors for calculating volumetric flow, density, energy, and mass flow readings from a single point of installation in the pipe.
15. The optional multivariable sensors shall be embedded near the velocity measurement point and shall be fully enclosed within the flow meter.
16. The transmitter shall be capable of being provided with a remote mounting bracket, cable up to 100 feet, integral LCD display, NEMA 4X housing, shall indicate flow rate and totalized flow, shall have an isolated 2-wire 4-20 mA linear output flow rate signal, and shall have a pulsed output signal for totalization. Both outputs to be powered from meter, not an external source. The electronics calculated variables shall be available in the options of HART, Modbus RTU, Modbus TCP-IP, BACNet MS/TP or BACnet/IP without the need of an external gateway. The transmitter shall be capable of being field calibrated and reprogrammed from the outside housing via magnetic probe or security protected integral keypad menu switching and Hart capable. Unit electronics shall have noise immunity. The primary flow sensor and transmitter shall be mounted in accessible locations. Unit shall have the capability to maintain flow total in non-volatile memory.
17. The flowmeter and transmitter as a unit shall have the following minimum characteristics:
    a. Accuracy:
        1) Volumetric Flow: +/-0.7% of rate (liquids)
        2) Mass Flow: +/-1.0% of rate (liquids),
        3) Optional Temperature: +/-2.0 deg F
        4) Optional Pressure: +/- 0.3% of full scale
18. Provide a phenolic tag for each transmitter to identify service and meter ID number (i.e. Building Number, MAG-X, etc.)
19. Approved Manufacturers:
        1) Rosemount 8800 or equivalent
        2) Krohne 4200 or equivalent
        3) Azbil/Vortek M24 or equivalent

H. Steam/Liquid Differential Pressure Transducers:

1. This application is used when remote steam or water pressure measurement is required.

2. Each differential pressure transducer shall be selected and calibrated for operations between 0 and 200% of the normal differential pressure. The calibration point shall be rounded upward to the nearest 10 inches WC (for spans less than 200" WC) or to the nearest 5 psi for larger spans. Calibration date shall be included on an embossed tag attached to each transducer.
3. The accuracy, including linearity, hysteresis and repeatability, of the transducer for measuring differential pressure shall be better than 2% of the span stated above throughout a minimum of a 10:1 turndown. Turndown ratio shall be based on the actual differential span.
4. The transducer shall not be damaged by pressures of up to 500 psig on either side of the transducer and all wetted parts shall be inert in the presence of up to a 40% concentration of ethylene or polypropylene glycol in water.
5. Provide a drain valve for each side of the pressure chamber. Furnish and install mounting brackets appropriate for the installation location.
6. Span and zero shall be individually adjustable.
7. Shall be 2-wire and 4-20 mA output.
8. Approved manufacturers: Rosemount/Emerson; ABB; Siemens
9.

I. Steam/Liquid Differential Pressure Transducers (Flow Only):

1. This application is used when remote steam or water flow measurement is required.
2. Each differential pressure transducer shall be selected and calibrated for operations between 0 and 125% of the normal differential pressure and up to 150-psig line pressure. The calibration point shall be rounded upward to the nearest 10 inches WC (for spans less than 200" WC) or to the nearest 5 psi for larger spans. Calibration date shall be included on an embossed tag attached to each transmitter.
3. The accuracy, including linearity, hysteresis and repeatability, of the transducer for measuring differential pressure shall be better than 0.25% of the span stated above throughout a minimum of a 6:1 10:1 turndown. Turndown ratio shall be based on the actual flow span.
4. The transducer shall not be damaged by pressures of up to 500 psig on either side of the transducer.
5. Provide a drain valve for each side of the pressure chamber. Furnish and install mounting brackets appropriate for the installation location.
6. Span and zero shall be individually adjustable.
7. Shall be 2-wire and 4-20mA output.
8. Approved manufacturers:
    1) Rosemount/Fischer
    2) ABB
    3) Siemens

J. Components:

1. Three Valve Manifolds for Liquid Pressure Transducers:
    a. Provide a three-valve manifold for each transducer. Pressures of up to 500 psig shall not damage the manifold.

b. The manifold shall be designed for direct mounting on the transducer it serves and utilizes three needle valves to provide zeroing, blocking and normal service modes.
c. Approved Manufacturers:
1) D/A Manufacturing
2)

2. Indication Gauges for Steam/Liquid Pressure Transducers:
a. Each transducer shall come with an indicating gauge that reads in inches WC for pressure sensing. The gauge shall be analog differential pressure type piped in parallel to the transducer.
b. The analog pressure gauge shall be selected and calibrated for the same span as the transducer it serves.
c. The accuracy, including linearity, hysteresis and repeatability of the gauge for measuring differential pressure shall be better than 1% of the span stated above throughout its span. Calibration data shall be included on an embossed tag attached to each gauge.
d. The gauge shall not be damaged by pressures of up to 500 psig on either side of the gauge.
e. Scale shall be a minimum of 4.5" diameter. Furnish and install two bleed fittings for each gauge and mounting brackets appropriate for the installation location.
f. Gauges shall be field mounted. Provide a phenolic identification tag for each gauge and indicator.
g. Approved manufacturers:
1) Ashcroft
2) Trerice
3) Dwyer

PART 3 - EXECUTION

3.1 GENERAL PIPING INSTALLATION REQUIREMENTS:

A. Work shall be done in accordance with applicable ordinances and codes. Arrange for inspections.

B. Install pipe components and joining systems in accordance with the manufacturer's installation instructions.

C. Install trap stations at all low points in the steam system and install drains at all low points in the condensate system.

D. Branch connections from horizontal steam main shall be done in such a manner as to not trap condensate and/or permit proper drainage of condensate.

E. All branch connections shall have a three valve configuration to allow flexibility in directing flow in the future.

F. Provide fittings and specialties necessary to properly interconnect all items, whether or not shown in detail.

G. Piping shall remain protected and capped until just prior to connection. Immediately after assembly, restore all protection and cap unprotected ends to prevent odors, dust, moisture, and other debris from entering the piping system.

H. Use eccentric reducing fittings to increase or decrease pipe sizes. Bushings are not acceptable. Orient reducers to prevent trapping of condensate.

I. Bolts for the expansion joints are not to be tightened until a representative from Utilities verifies proper alignment.

J. Use a torque wrench to tighten flange bolts to the gasket manufacturer's recommended torque.

K. Locate groups of pipe parallel to each other, spaced to permit applying insulation and servicing of valves.

L. Install piping at least 3 inches clear of electrical conduit. Do not install pipe within the National Electrical Code (NEC) working space zone of electrical equipment/panels.

M. Pitch piping as follows, but not less than required by code:

1. Steam piping down in direction of flow at 1/16" per foot

3.2 FLUSHING AND CLEANING OF PIPING:

A. Flush the following piping systems:

B. Steam and Condensate(flush only)

C. Develop plan for flushing and cleaning piping. Submit plan for approval prior to completion of piping. Provide all temporary and permanent piping, equipment, materials necessary to complete flushing and cleaning.

D. Install steam traps after steam system has been flushed or install fine mesh construction strainers at inlet to traps and all other equipment. Install fine mesh construction element in permanent strainers. During flushing and cleaning, remove and clean strainers periodically. At completion of final flush, install clean permanent strainers, remove construction strainers.

E. Flushing for new piping: Flush all piping with cold water (or fire protection system where approved by owner) for a minimum of one hour, until water runs clear. Water supply shall be equivalent to piping to be flushed. Use (2) 2-1/2" fire hose connections for piping 3" and larger. Drain all low points.

F. Where removal of the post flush water from tunnel is not feasible, steam blow down of system is allowable, if pre-approved by owner. Coordinate all steam blow down activities with Utilities group.

3.3 PIPING SYSTEMS PRESSURE TESTING

A. General

1. Test new systems only, from point of connection to the existing systems. Perform initial tests and correct deficiencies prior to requesting acceptance test.
2. Perform acceptance pressure tests in the presence of the owner representative.

B. Acceptance Pressure Testing:

1. Perform acceptance pressure testing
2. In accordance with the following table:

Piping System	**Hydro Test Pressure**
High/Low Pressure Steam (HPS/LPS) (up to 60#)	125 psig
Low Pressure Condensate (LPC)	125 psig
Pumped Condensate (PC)	125 psig

3. Remake leaking gasket joints with new flange bolting. Where welded joints fail, submit proposed method of repair for approval by the Owner's representative and authorities having jurisdiction.
4. For each system tested, provide a certificate testifying that the system was satisfactorily tested and passed, using owner furnished forms.

3.4 WELDING GENERAL:

A. All welding shall be performed by registered welders qualified to perform welding operations in accordance with the National Certified Pipe Welding Bureau's procedures and standards, ASME Code Standards and the HPACCNA Standard Manual of Welding.

B. Submit a certified copy of "Record of Pipefitter Welder Performance Qualification Test" of any employees who will be doing welding on this project.

C. Mitered turns will not be allowed. Turns shall be made with factory-made ASME B16.9 long radius wrought steel butt welding fittings.

D. Except where prohibited by the Reference Standards, code, or ordinance, branch take-offs with manufactured formed nipples will be permitted provided nipple size is at least two pipe sizes smaller than the main size. Formed nipples shall be Bonney Forge "Weldolets", "Threadolets", "Sockolets". In all other cases, use factory-made ASME B16.9 wrought steel buttwelding tee fittings.

E. Shop welded pipe assemblies shall have all welds plainly stamped by the welding operator for inspection by the Engineer before installation.

F. SPECIAL WELDING REQUIREMENTS

1. Welding Procedure Specifications (WPS) and the related Welder Qualification Record (WQR) as described in ASME/B31.1/AWS codes shall be submitted for approval by owner prior to beginning work. Copies of these documents are to be included in the turnover documents at project completion.
2. Welding on piping and components may be done using automatic welding techniques, except where not practical as an application due to location (Weld procedure documents must be approved and verified per weld specifications).
3. The two welding surfaces shall be clean, and prepared to standards for weld process to be utilized and match accordingly.
4. Preparation of the weld end shall be performed by manual grinding, machining, torch cutting, or automatic beveling processes.

5. The machining faces, free from notches or other method shall leave the pipe or tube weld end with smooth irregularities.
6. The weld ends of the pipe or tube shall be clean and free of oils, dirt, or any other material that will adversely affect the specified weld processes.
7. No welding shall be done when the surfaces to be welded are wet.
8. The minimum base metal temperature shall not be less than 70 degrees F prior to welding. Preheating or post weld heating of weld joint shall be per weld process specified and in accordance with standard practices.
9. The welding equipment shall be set up by the contractor and approved by the owner.
10. At the start of each day and after any lengthy shut-down period, weld process equipment shall be checked and determined as to fitness for duty status.
11. All openings shall be kept sealed at all times with plastic caps or in sealed bags as warranted per conditions of work site.
12. Pipe, fitting ends and flange faces shall be protected from damage in handling, installation, and storage.
13. During handling and storage, other than work on tables, spools shall be on cribbing or racks in a protected and segregated area.
14. The welder shall ensure that all equipment associated with the welding process operates properly.

G. Welding Materials:

1. Welding electrodes to be used shall be of materials approved per weld process utilized. U of M reserves the right to remove any welding electrodes they feel have not been stored or handled properly.
2. The welding electrode shall be new and replaced if compromised. All electrodes shall be stored per standards for electrode (per manufacturer or code).
3. If any tool or component is suspected of having elements that may contaminate the weld process, the material shall be replaced and the tool shall be cleaned per an acceptable cleaning process.
4. Tools used for weld joint preparation, fabrication, and installation shall be of materials compatible with the approved weld process.

H. Identification:

1. All welds are to be labeled by number using an electro-engraver, metal stamp, indelible marker, or paint stick. The ID shall be in close proximity to the weld (outside the heat affected zone) and applied after the weld has cooled to ambient temperature.
2. The weld identification used shall be traceable to a weld track document, (provide within the turnover documents), that will show the weld procedure, welder identification, base material, and grade joined and that the weld was inspected on OD and ID. Log is to identify the type of inspection used and weld inspection status.
3. The contractor shall maintain within the turnover documents a weld map showing the location of all weld joints and noting which weld procedure was utilized for each joint.

4. The weld identification log shall be maintained by the contractor and contain cross reference information to fabrication drawings.

I. Weld Inspection:

J. Examine all welds by physical method. Include the cost of examining 5% of welds (but a minimum of 2 welds) to be selected at random by the Owner, by approved graphic method similar to gamma ray process.

K. The radiographic examination shall be by technicians of a reputable company regularly engaged in this type of work and skilled in the use of interpretation of results of this type of examination.

L. The process shall provide visual proof at the site and such proof on photographs with reports which shall become the property of the Owner and will be included in the final Contract Documents.

M. The report on the interpretation of the radiographic examination shall state whether or not the quality of the welding is suitable for the service for which the piping was designed.

N. Welds examined by the above process shall be identified by a number and service symbol and shall be stamped into pipe adjacent to weld at the time of examination

O. Failure to pass this test shall be cause for the rejection of the weld and authority to examine an additional weld. Rejected welds shall be repaired by an approved method and proven satisfactory by radiographic examination.

P. If a second weld proves unsatisfactory by the radiographic examination, all welds shall be X-Rayed. Any welds proved unacceptable shall be repaired and X-Rayed again at no additional expense to the Owner.

Q. The following weld defects are examples for which re-welding may be attempted. In accordance with ASME, AWS, or U of M specifications. Rewelding may be attempted one time only.

a. Incomplete penetration, (lack of penetration)
b. Incomplete Fusion, (lack of fusion)
c. Unconsumed tack welds that can be inspected.
d. Visible porosity
e. Visible slag inclusions

R. Note: All re-welds shall overlap or consume the original weld.

a. All welds with irreparable defects or welds that have had one repair attempt and still found to have defect, shall be considered a reject and removed including the heat-affected zone.

S. All welds shall meet Acceptance Criteria for weld processes approved per specifications.

T. Pipe sections adjacent to rejected welds may be reused after the weld and heat affected zone is cut off. The heat affected zone shall be considered to extend to the limit of the discoloration of the weld. Fittings shall not be reused. The contractor shall assume all costs to replace said welds.

U. All fabrication assembly dimensions shall be in accordance with the project approved drawings.

V. If a weld is cut out, the replacement weld shall have the same weld identification number plus an alphabetic suffix (a, b, c, etc.). A new weld checklist shall be completed for the replacement weld.

W. If an accepted weld must be cut out for any reason such as piping revision or rejection of associated welds, then the check list for the weld shall be marked void. The new shall be tested same as previous welds and fall under the same visual and NDE formats as described previously.

X. All “fit ups” for weld joints for piping and components shall be visually inspected and logged per ASME B31.1 standards and included in Turn Over Document.

Y. Owner may examine welds at structural supports and pipe attachment assemblies at their discretion.

Z. All welded joints shall be visually inspected by representative for overall system compliance. The contractor shall provide a log document for their record retention. This log shall be part of the Turn Over Documents.

AA. Testing:

BB. After completion of welds and prior to turnover, the piping system shall be tested per specifications of project.

CC. Contractor shall maintain a record of all pressure testing performed and include a testing report in the Turn Over Documents.

DD. Turnover Documents (Traveler):

EE. Material Test Reports

FF. Heat Number Summary

GG. Other MTRs

HH. Purchase Orders

II. Material Requisitions

JJ. Packing Slips

KK. Material Receiving Reports

LL. Material Examination Log

MM. Nonconformance Reports

NN. Weld Coupon Log

OO. Welding Procedure

PP. Welder Certification

QQ. Welding Machine ID

RR. 9.14 Quality Control Pre-Testing & Passivation Check List

SS. Component alignment and “fit up” documents

TT. Proof of non-magnetic properties of piping and/or fittings, or any component that may affect the weld process approved for the project.

UU. Test Reports

VV. Weld Log

WW. Fabrication Drawings showing each weld location and ID of welder

XX. Drawings

3.5 INSTALLATION OF PIPE HANGERS AND SUPPORTS:

A. Arrange pipe hangers and supports to permit proper pitch of piping, free to move with pipe expansion, installed at proper intervals. Hangers shall be located near or at changes in piping direction and concentrated loads. Valves, strainers, in line pumps and other heavy equipment shall be supported independent of the pipes. After systems have been installed and filled adjust hangers and supports to evenly distribute weight, and maintain proper pitch. Refer to drawings for pipe hanger and support details.

B. Horizontal Piping Hanger Spacing: Space hangers in compliance with schedule on drawings and applicable codes, or per MSS SP-89, which ever results in shortest spacing.

3.6 INSTALLATION OF STRAINERS:

A. Provide Y-strainers in steam and condensate piping preceding control valves, traps, pumps, pressure regulating valves and elsewhere as shown on drawings.

3.7 INSULATION INSTALLATION

A. All systems shall be tested and approved before being insulated.

B. The insulation shall be applied over clean, dry surface.

C. Insulate all valves, expansion joints, flanges, couplings and fittings. Valve, expansion joint, and flange insulation shall be provided with removable and re-installable jackets, regardless if missing on drawings. Removable blanks are required, even if not detailed in construction drawings.

D. Insulation jackets to maintain outer temperature at or below 120 Degrees F.

E. Full lengths of insulation shall be used except at end of straight sections and as required to accommodate fittings. Insulation shall be applied with the joints tightly fitted together. Cracks or voids shall be filled with insulation. Manufacturer's recommended installation procedures shall be strictly adhered to.

F. The edges and seams at all visible locations shall be finished in a neat and workmanlike manner.

3.8 HANGER AND SUPPORT APPLICATIONS

A. General Requirements:

B. The selection of pipe hangers and supports shall be based on the overall design concept of the piping system and any special requirements which may be called for in these Specifications or as indicated on the Drawings. The support systems shall provide for, and control, the free or intended movement of the piping including its movement in relation to that of the connected equipment. They shall prevent excess stress resulting from the transfer of weight being introduced into the pipe or connected equipment.

C. The selection of hangers and supports shall be made to provide the piping system with the degree of control that its operating characteristics require.

D. The selection of hangers or supports will take into consideration the combined weight of the supported systems, including system contents and test water.

E. Select and install hangers and supports to allow controlled thermal and seismic movement of piping system, to permit freedom of movement between pipe anchors, and facilitate action of expansion joints, expansion loops, expansion bends and similar units.

F. The spans in MSS SP-58 do not apply where concentrated weights, such as valves or heavy fittings, or where changes in direction of the piping occur between hangers.

G. Select all hangers and supports rated for the maximum potential loading with pipe full.

H. Select hangers for cold (less than 50 degrees F) piping service for installation over the insulation.

I. Comply with MSS SP-69 for pipe hanger selections and applications that are not specified in piping system Specification sections.

3.9 HANGER AND SUPPORT INSTALLATION

A. Pipe Hanger and Support Installation: Comply with MSS SP-58. Install hangers, supports, clamps, and attachments as required to properly support piping from building structure.

B. General:

C. Adjust all components as required for proper operation and required pipe slope.

D. Double nut all support rods at hangers.

E. Location and Routing:

   a. Install Piping as Indicated:
      1) On the Drawings.
      2) On the reviewed Shop Drawings.
   b. Secure Engineer's approval for all pipe routing changes.

F. Coordinate with other trades for placement of concrete attachments prior to concrete pouring.

G. Install all items in accordance with Manufacturer's instructions.

H. Support at Valves: Provide additional supports at all valves in piping 4-inch and larger.

I. Vertical Risers:

J. Support independently from adjacent hangers on horizontal piping.

K. Horizontal Runs:

L. General:

a. Provide adequate supports for the loads with a factor of safety of at least 5 (400 pounds minimum).
b. Support spacing not to exceed MSS SP-58, or the requirements for seismic restraint, whichever is more stringent.
c. Hanger rod diameter shall not be less than the requirements of MSS SP-58, or the requirements for seismic restraint, whichever is more stringent.

3.10 SLIDES, GUIDES, AND ROLLERS

A. All piping systems designed to accommodate thermal expansion movement shall be mounted on rollers or slides.

B. Provide at all expansion loops and joints:

C. As indicated on the Drawings.

D. As required to maintain alignment.

E. In accordance with Expansion Joint Manufacturer's Association recommendations

3.11 PIPE RESTRAINTS

A. Provide adequate pipe restraints for all expansion or contraction of piping due to temperature change:

B. Including, but not limited to, that indicated on the Drawings.

C. As instructed by Engineer.

D. At locations to prevent stresses from exceeding those permitted by ANSI B31 and to prevent transfer of loading and stresses to connected equipment.

3.12 INSULATION PROTECTION

A. Provide Protection Saddle:

B. Equal to insulation thickness.

C. At each hanger.

D. For all insulated piping systems where longitudinal expansion exceeds 1-inch per 100 feet.

3.13 PAINTING

A. Touchup: Cleaning and touchup of painting of field welds, bolted connections and abraded areas of shop paint on miscellaneous metal are specified in Division 09 - Finishes.

B. Galvanized Surfaces: Clean welds, bolted connections and abraded areas. Apply galvanizing repair paint to comply with ASTM A780.

3.14 CONSTRUCTION WASTE

A. Construction Waste Management: Refer to Division 01 requirements applicable to all trades.

3.15 VALVE INSTALLATION

A. General: Install valves such that operator is completely operable, and the valve position indicator is discernible from the floor.

B. Install warm-up valves, drains and piping configuration, as shown on plans, for all 8" or larger isolation valves.

C. When indicated on plans relocate position of the packing ports for access. (Not at 6 o'clock)

3.16 INSTALLATION OF EXPANSION JOINTS

A. The installations shall be in strict accordance with manufacturer's instructions.

B. For each expansion joint, record the initial position, final position and actual movement of the joint and include in Turnover Documents.

C. Expansion joint will be shipped at a preset ambient temperature. If the ambient temperature at the time of installation is colder or hotter, then adjust the travel of the expansion joint as required.

D. All bellows joints in steam and condensate system shall be pre-set at the factory and "held" with removable metal clips or strips tack welded across the flanges.

3.17 INSTALLATION OF STEAM AND CONDENSATE SYSTEM:

A. Drip and Trap Installation:

B. At end of steam mains, at the end of horizontal runs, prior to control valves (where condensate will collect behind control valve when closed), at low points (where steam pipe rises in direction of flow), at intervals of no less than 300 feet for continuous pipe, and where noted on the drawings, provide drip leg.

C. No steam traps shall directly discharge to a condensate return main.

D. All high pressure traps shall discharge to a flash recovery vessel.

E. Trap size to be selected from schedule on drawings.

F. Bypass and Drain Installation:

G. Provide bypass and drain connection for steam valves 8" and larger, Comply with MSS SP-45 bypass and drain connections.

H. Flash Tank Installation:

I. Install as detailed and per manufacturer's recommendation.

J. Thermometers and Gauges Installation

K. Install and orient wells and thermometers so thermometer can be read from the floor. Thermometer Wells: For piping 2" and below, install in piping tee where thermometers are indicated, in vertical position. For piping below 2 1/2" and above, "weldolets" may be used. Fill well with oil or graphite and secure cap.

L. Install pressure gauges with 1/2" isolation ball valve. Where needle valves are specified as a substitute for glycerin filled in Part 2, install the needle valve between the ball valve and the gauge. Locate gauges to be readable from the floor preferably at eye level. Mount gauges securely to prevent excessive vibration, adjust needle valve to dampen pulsations. Install syphon tubes for steam pressure gauges, connected after the isolation ball valve. Do not install pressure gauges on bottom of piping.

M. Adjust faces of meters and gauges to proper angle for best visibility.

N. Clean meters and gauges. Replace cracked and broken windows. Touch up scratches.

O. Install in the following locations and elsewhere as indicated:

   a. As shown on the project drawings.
   b. At inlet and outlet of each pressure-reducing valve.
   c. After every tunnel isolation valve that isolates more than 100 lineal feet of steam or condensate pipe.

P. Installation Of Test Plugs

Q. Test Plugs: Install in piping tee where indicated, located on pipe at most readable position. Secure cap.

R. Pressure Powered Condensate Pumps:

S. Do not install pumping traps on housekeeping pads (housekeeping pads reduce the filling head to the pump). Install the pump at the lowest possible point below the equipment that is being drained. University of Houston Master Construction Specifications Insert Project Name AE Project Number: Steam and Steam Condensate Specialties 23 22 30 – 13 Revision Date: 1/29/2016 2. Where specified, provide an inlet condensate receiver. The receiver shall be an ASME vessel as shown on the Drawings. Install and support the receiver above the pumping trap unit. Route all condensate to be drain to the top on the receiver. The receiver shall be vented to atmosphere and shall also be supplied with a drain connection and drain valve. 3. The pumping trap body shall be provided with a gauge glass assembly. 4. When motive gas pressure is greater than 20 psig over the required discharge head, provide a PRV assembly to regulate motive gas pressure. The PRV assembly shall include an inlet block valve, y-strainer, PRV and pressure gauge assembly. When motive gas is steam, install a drip trap assembly upstream of the PRV. When motive gas is air or nitrogen, provide a spring loaded check valve downstream of the PRV. 5. Route the exhaust vent pipe of the pumping trap, and the receiver vent (when receiver is installed), to an atmospheric vent line, or, it may be routed 8 to 10 feet up and piped back down a minimum of 6 inches. Install a drain valve and drain line off the pumping trap unit and route to the nearest floor drain.

3.18 QUALITY ASSURANCE/ QUALITY CONTROL (QA/QC)

A. Perform QA/QC activities in accordance with Related Sections.

END OF SECTION 336330