Preparing Activity: NAVFAC Replacing without change
UFGS-02554 (August 2004)

UNIFIED FACILITIES GUIDE SPECIFICATIONS

References are in agreement with UMRL dated July 2023
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04/06

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USACE / NAVFAC / AFCEC / NASA	**UFGS-33 63 23 (April 2006)**

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UNIFIED FACILITIES GUIDE SPECIFICATIONS

References are in agreement with UMRL dated July 2023
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SECTION 33 63 23

EXTERIOR ABOVEGROUND STEAM DISTRIBUTION
04/06

****
NOTE: This guide specification covers the requirements for exterior aboveground steam and condensate piping systems and buried factory-prefabricated preinsulated steam and condensate piping under roads.

Adhere to UFC 1-300-02 Unified Facilities Guide Specifications (UFGS) Format Standard when editing this guide specification or preparing new project specification sections. Edit this guide specification for project specific requirements by adding, deleting, or revising text. For bracketed items, choose applicable item(s) or insert appropriate information.

Remove information and requirements not required in respective project, whether or not brackets are present.

Comments, suggestions and recommended changes for this guide specification are welcome and should be submitted as a Criteria Change Request (CCR).
****

****
NOTE: Piping systems include piping exposed to the weather exterior of buildings and supported on pedestals or poles; on piers, under piers, and in trenches on piers; in tunnels, in manholes, and related work. System design must conform to UFC 3-430-09, "Exterior Mechanical Utility Distribution."
****

****
NOTE: The following information shall be shown on the project drawings:

1. Only drawings (not specifications) shall indicate capacity, efficiency, dimensions, details,

plan view, sections, elevations, and location of equipment; and space required for equipment maintenance.

2. Configuration, slope, and sizes for each piping system

3. Locations, sizes, and type of each valve and each trap

4. Details of expansion joints and expansion loops for aboveground piping

5. Locations and installation details of poles supporting aboveground piping, including anchors and guy wires

6. Capacity, sizes, bypass valves, and piping for steam flow meters and pressure regulating valves

7. Scale ranges for pressure gages and thermometers

8. Whether piping is run aboveground on pedestals or poles, on piers, under piers, in trenches on piers, or in manholes

9. Details, sections, and elevations, of manholes, piping within manholes, piping aboveground, and piping under roads in approved factory-prefabricated insulated conduit systems (see note below).

10. Details of sacrificial anode type cathodic protection system for metal conduit

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NOTE: Design on project drawings the buried factory-prefabricated insulated piping in a conduit for which approval has been issued.

****

PART 1 GENERAL

1.1 REFERENCES

****

NOTE: This paragraph is used to list the publications cited in the text of the guide specification. The publications are referred to in the text by basic designation only and listed in this paragraph by organization, designation, date, and title.

Use the Reference Wizard's Check Reference feature when you add a Reference Identifier (RID) outside of the Section's Reference Article to automatically place the reference in the Reference Article. Also use the Reference Wizard's Check Reference feature to update the issue dates.

References not used in the text will automatically be deleted from this section of the project specification when you choose to reconcile references in the publish print process.
****

The publications listed below form a part of this specification to the extent referenced. The publications are referred to within the text by the basic designation only.

AMERICAN SOCIETY OF MECHANICAL ENGINEERS (ASME)

ASME B16.3	(2021) Malleable Iron Threaded Fittings, Classes 150 and 300
ASME B16.5	(2020) Pipe Flanges and Flanged Fittings NPS 1/2 Through NPS 24 Metric/Inch Standard
ASME B16.9	(2018) Factory-Made Wrought Buttwelding Fittings
ASME B16.11	(2022) Forged Fittings, Socket-Welding and Threaded
ASME B16.20	(2017) Metallic Gaskets for Pipe Flanges
ASME B16.21	(2021) Nonmetallic Flat Gaskets for Pipe Flanges
ASME B16.34	(2021) Valves - Flanged, Threaded and Welding End
ASME B16.39	(2020) Standard for Malleable Iron Threaded Pipe Unions; Classes 150, 250, and 300
ASME B31.1	(2022) Power Piping

ASTM INTERNATIONAL (ASTM)

ASTM A36/A36M	(2019) Standard Specification for Carbon Structural Steel
ASTM A53/A53M	(2022) Standard Specification for Pipe, Steel, Black and Hot-Dipped, Zinc-Coated, Welded and Seamless
ASTM A106/A106M	(2019a) Standard Specification for Seamless Carbon Steel Pipe for High-Temperature Service
ASTM A153/A153M	(2023) Standard Specification for Zinc Coating (Hot-Dip) on Iron and Steel Hardware
ASTM A193/A193M	(2023) Standard Specification for Alloy-Steel and Stainless Steel Bolting Materials for High-Temperature Service and

	Other Special Purpose Applications
ASTM A194/A194M	(2023) Standard Specification for Carbon Steel, Alloy Steel, and Stainless Steel Nuts for Bolts for High-Pressure or High-Temperature Service, or Both
ASTM A307	(2021) Standard Specification for Carbon Steel Bolts, Studs, and Threaded Rod 60 000 PSI Tensile Strength
ASTM A475	(2022) Standard Specification for Metallic-Coated Steel Wire Strand
ASTM D229	(2019) Standard Test Methods for Rigid Sheet and Plate Materials Used for Electrical Insulation

MANUFACTURERS STANDARDIZATION SOCIETY OF THE VALVE AND FITTINGS INDUSTRY (MSS)

MSS SP-58	(2018) Pipe Hangers and Supports - Materials, Design and Manufacture, Selection, Application, and Installation
MSS SP-69	(2003; Notice 2012) Pipe Hangers and Supports - Selection and Application (ANSI Approved American National Standard)
MSS SP-70	(2011) Gray Iron Gate Valves, Flanged and Threaded Ends
MSS SP-71	(2018) Gray Iron Swing Check Valves, Flanged and Threaded Ends
MSS SP-80	(2019) Bronze Gate, Globe, Angle and Check Valves
MSS SP-85	(2011) Gray Iron Globe & Angle Valves Flanged and Threaded Ends

1.2 SYSTEM DESCRIPTION

Provide [new and modify existing] exterior aboveground steam and condensate piping system complete and ready for operation. Provide piping to and including the main steam pressure regulating valves, bypass valves, safety-relief valves, and high pressure traps within each building. Design pressure and temperature ratings of system components shall be for working pressure of 1034 kPa-gage 150 psig steam at 186 degrees C 366 degrees F and 862 kPa-gage 125 psig condensate at 121 degrees C 250 degrees F. [Provide [new and modify existing] exterior buried factory-prefabricated preinsulated steam and condensate piping under roads as specified in paragraph entitled "Buried Piping Under Roads."]

1.3 SUBMITTALS

****

NOTE: Review Submittal Description (SD) definitions in Section 01 33 00 SUBMITTAL PROCEDURES and edit

the following list, and corresponding submittal items in the text, to reflect only the submittals required for the project. The Guide Specification technical editors have classified those items that require Government approval, due to their complexity or criticality, with a "G". Generally, other submittal items can be reviewed by the Contractor's Quality Control System. Only add a "G" to an item if the submittal is sufficiently important or complex in context of the project.

For Army projects, fill in the empty brackets following the "G" classification, with a code of up to three characters to indicate the approving authority. Codes for Army projects using the Resident Management System (RMS) are: "AE" for Architect-Engineer; "DO" for District Office (Engineering Division or other organization in the District Office); "AO" for Area Office; "RO" for Resident Office; and "PO" for Project Office. Codes following the "G" typically are not used for Navy, Air Force, and NASA projects.

The "S" classification indicates submittals required as proof of compliance for sustainability Guiding Principles Validation or Third Party Certification and as described in Section 01 33 00 SUBMITTAL PROCEDURES.

Choose the first bracketed item for Navy, Air Force, and NASA projects, or choose the second bracketed item for Army projects.
****

Government approval is required for submittals with a "G" or "S" classification. Submittals not having a "G" or "S" classification are [for Contractor Quality Control approval.][for information only. When used, a code following the "G" classification identifies the office that will review the submittal for the Government.] Submit the following in accordance with Section 01 33 00 SUBMITTAL PROCEDURES:

SD-03 Product Data

Piping

Valves

Strainers

Pipe hangers and supports

Traps

Gages

Steam flow meters

Expansion joints

Manhole drainers

SD-07 Certificates

Certification of welder's qualifications

SD-10 Operation and Maintenance Data

Manhole drainers, Data Package 2; G[, [_____]]

Steam flow meters, Data Package 2; G[, [_____]]

Submit in accordance with Section 01 78 23 OPERATION AND MAINTENANCE DATA.

1.4 QUALITY ASSURANCE

1.4.1 Certification of Welder's Qualifications

Submit prior to site welding. Certifications shall not be more than one year old.

PART 2 PRODUCTS

2.1 PIPING

Steam piping includes piping upstream of steam traps. Condensate piping includes piping downstream of steam traps.

2.1.1 Steam Pipe

a. ASTM A53/A53M, Type E (electric-resistance welded, Grade A or B) or Type S (seamless, Grade A or B); black steel. Provide Weight STD (Standard) for welding end connections. Provide Weight Class XS (Extra Strong) for threaded end connections.

b. ASTM A106/A106M, Grade A or B, black steel, Schedule No. 40 for pipe sizes through 250 mm 10 inches, and minimum pipe wall thickness of 9.50 mm 0.375 inch for pipe sizes 300 mm 12 inches and larger for welding end connections. Provide Schedule 80 for threaded end connections.

2.1.2 Condensate Pipe

a. ASTM A53/A53M, Type E (electric-resistance welded, Grade A or B) or Type S (seamless, Grade A or B); black steel, Weight Class XS (Extra Strong).

b. ASTM A106/A106M, Grade A or B, black steel, Schedule No. 80.

2.1.3 Buried Steel Piping to Cooling Well or Drain

Provide direct buried steel condensate pipe and fittings with exterior coal tar epoxy painting system.

2.2 FITTINGS

2.2.1 Threaded Fittings

ASME B16.11, or ASME B16.3, Class 150 for steam, Class 300 for condensate.

2.2.2 Socket Welding Fittings

ASME B16.11.

2.2.3 Buttwelding Fittings

ASME B16.9. Provide the same material and weight as the piping in which fittings are installed. Backing rings shall conform to ASME B31.1 and be compatible with materials being welded.

2.2.4 Eccentric Reducing Fittings

ASME B16.9. Provide the same material and weight as the piping in which fittings are installed. Provide for changes in horizontal steam piping sizes.

2.2.5 Flanges and Unions

2.2.5.1 Flanges

ASME B16.5, Class 150 or 300 as required.

2.2.5.2 Unions

ASME B16.39, Class 150 for steam, Class 250 for condensate.

2.2.6 Gaskets, Bolts, Nuts, and Washers

a. Gaskets: Provide spiral wound, non-asbestos gasket with centering ring per ASME B16.20. [ASME B16.21, composition ring 1.60 mm 0.0625 inch thick. Provide one piece factory cut ring gaskets for raised-face flanged joints, and full-face gaskets for flat-face flanged joints.]

b. Bolts: ASTM A193/A193M, Grade B7. Extend a minimum of two full threads beyond the nut with the bolts tightened to the required torque.

c. Nuts: ASTM A194/A194M, Grade 7, with Teflon coated threads.

d. Washers: Provide steel flat circular washers under bolt heads and nuts.

e. Electrically isolating (insulating) gaskets for flanges: Provide ASTM D229 electrical insulating material of 1000 ohms minimum resistance. Provide one piece factory cut insulating gaskets between flanges. Provide silicon-coated fiberglass insulating sleeves between the bolts and the holes in flanges; bolts may have reduced shanks of a diameter not less than the diameter at the root of threads. Provide 3.20 mm 0.125 inch thick high-strength insulating washers next to flanges and provide stainless steel flat circular washers over insulating washers and under bolt heads and nuts. Provide bolts 13 mm 0.5 inch longer than standard length to compensate for the thicker insulating gaskets and the washers under bolt heads and nuts in the

horizontal position or not greater than 45 degrees above the horizontal position.

2.3 VALVES

Provide with stems in the horizontal position or not greater than 45 degrees above the horizontal position. Valves shall have flanged end connections, except sizes smaller than 65 mm 2.5 inches may have union end connections, or threaded end connections with a union on one side of the valve.

2.3.1 Valves for Steam Service

Valves upstream of steam traps shall be steel body for minimum working pressure of ASME Class 150.

2.3.1.1 Gate Valves, Globe Valves, Angle Valves, and Check Valves

ASME B16.34, steel body, minimum of ASME Class 150. Provide swing check valves.

2.3.1.2 Steam Pressure Regulating Valves

Steel body, minimum of ASME Class 150, except as modified herein. Valve seats and disc shall be of replaceable heat-treated stainless steel. Valves shall be single seated, seat tight under dead end conditions, and move to the closed position in the event of pressure failure of the operating (controlling) medium. Provide strainer in inlet from external operating (controlling) medium. Valves shall be controlled by pilot valve with strainer at inlet from external pressure sensing piping. Valves shall be internally or externally steam traced for freeze protection. Valves shall be piston operated type or spring loaded diaphragm operated type with stainless steel springs.

2.3.1.3 Safety-Relief Valves

Minimum of ASME Class 150, with test lever. Valves shall have steel or copper alloy body. Valves shall have flanged inlet and outlet connections or threaded connections attached to threaded ASME Class 150 flanges. Valves shall be ASME rated for capacity indicated.

2.3.2 Valves for Condensate Service

Valves downstream of steam traps shall be for minimum working pressures of ASME Class 125.

2.3.2.1 Gate Valves

MSS SP-80, except sizes 65 mm 2.5 inches and larger shall conform to MSS SP-70.

2.3.2.2 Globe and Angle Valves

MSS SP-80, except sizes 65 mm 2.5 inches and larger shall conform to MSS SP-85.

2.3.2.3 Check Valves

MSS SP-80, except sizes 65 mm 2.5 inches and larger shall conform to

MSS SP-71. Provide swing check valves.

2.4 PIPING ACCESSORIES

2.4.1 Pipe Hangers and Supports

Provide MSS SP-58 and MSS SP-69, Type 43, of the adjustable type, except as specified or indicated otherwise. Tack-weld Type 39 pipe covering protection saddles to steel pipe for insulated piping. Provide steel support rods. The finish of rods, nuts, bolts, washers, hangers, and supports shall be hot-dip galvanized after fabrication. Rollers, bases, and saddles may be painted with two coats of aluminum or light gray paint rated for use on hot metal surfaces up to 232 degrees C 450 degrees F in lieu of hot-dip galvanized. Provide stainless steel axles for rollers. Miscellaneous metal shall conform to ASTM A36/A36M, hot-dip galvanized after fabrication.

2.4.2 Strainers

Construct of steel in accordance with ASME B16.5 for minimum of ASME Class 150. Provide stainless steel strainer element with perforations of 0.40 mm 0.016 inch for steam, 0.80 mm 0.031 inch for steam mixed with condensate, and 1.20 mm 0.047 inch for condensate (hot water). Provide blow-off outlet with pipe nipple, gate valve, and discharge pipe nipple.

2.4.3 Traps

Steel body, internals of stainless steel, minimum of ASME Class 150, and of the types indicated.

2.4.4 Gages

Provide single style pressure gage for steam with 115 mm 4.5 inch dial, brass or aluminum case, bronze tube, gage cock, pressure snubbers, and syphon. Provide scale range for the intended service.

2.4.5 Pipe Sleeves

Provide where piping passes entirely through walls and floors. Provide sleeves of sufficient length to pass through entire thickness of walls and floors. Provide 25 mm one inch minimum clearance between exterior of piping or pipe insulation, and interior of sleeve or core-drilled hole. Firmly pack space with mineral wool insulation. Seal space at both ends of sleeve or core-drilled hole with plastic waterproof cement which will dry to a firm but pliable mass, or provide mechanically adjustable segmented elastomeric seal. In fire walls and fire floors, seal both ends of sleeves or core-drilled holes with UL listed fill, void, or cavity material.

a. Sleeves in Masonry and Concrete Walls and Floors: Provide hot-dip galvanized steel, ductile-iron, or cast-iron sleeves. Core drilling of masonry and concrete may be provided in lieu of sleeves when cavities in the core-drilled hole are grouted smooth.

b. Sleeves in Other Than Masonry and Concrete Walls and Floors: Provide 26 gage galvanized steel sheet.

2.4.6 Escutcheon Plates

Provide split hinge type metal plates for piping entering walls and floors in exposed spaces. Provide polished stainless steel plates or chromium-plated copper alloy plates in finished spaces. Provide paint finish on metal plates in unfinished spaces.

2.4.7 Electronic Steam Flow Meter

Meter shall be for minimum working pressure of ASME Class 150. Meter shall include an orifice plate, pressure transmitter, indicator, and totalizer. Provide meter for measuring steam flow in kg per second pounds per hour. Meter shall be for installation and operation in horizontal position.

2.4.7.1 Orifice Plate

Provide differential producing type orifice plate with circular hole for insertion into the steam piping between two ASME B16.5 Class 300 welding neck orifice flanges. Orifice plate shall be Type 304 stainless steel. Furnish a dimensional report and flow versus differential curve with accuracy of plus or minus one percent over a 5 to 1 flow range. Orifice flanges shall have at least two radially-drilled and tapped holes for metering and two jack screws.

2.4.7.2 Pressure Transmitter

Provide solid state electronic type differential pressure transmitter. Transmitter shall utilize Type 316 stainless steel dual opposed rupture-proof bellows converted to produce a 4 to 20 mA dc output. Transmitter shall have a flow range of zero to 0.40 kg per second 3000 pounds per hour of steam flow with accuracy of plus or minus 2 percent of the full scale over a 5 to 1 flow range. House transmitter in a weatherproof enclosure designed for wall mounting. Bellows body shall be rated for not less than 6894 kPa (gage) 1000 psig. Power requirements are 120 volts ac. Provide transmitter complete with condensate reservoirs, steel three-valve manifold for isolation and nulling, and blowdown valves.

2.4.7.3 Indicator

Provide electric indicator to continuously indicate steam flow by means of a 4 to 20 mA dc electrical input signal. Indicator shall have pivot and jewel suspension and a mirrored scale with uniform graduations over a steam flow range of zero to 0.40 kg per second 3000 pounds per hour.

2.4.7.4 Totalizer

Provide totalizer that linearizes a 4 to 20 mA dc electrical input signal into a digital signal scaled in kg pounds of steam flow, displays totalized steam flow on a six-digit nonresettable counter, and transmits each totalizer count to the output.

2.4.7.5 Output

An isolated (500 volts minimum) ac or dc switch closure rated at 50 volts dc or 40 volts RMS ac, one ampere minimum capacity. Duration of closure shall be not less than 0.04 second or more than 0.06 second.

2.4.7.6 Adjustments

Upon completion of the work, furnish the services of a competent technician regularly employed by the manufacturer of the flow meter to make the necessary adjustments to place the steam flow meter in operation and to conduct performance tests which demonstrate that the flow measuring equipment is functioning. Install the steam flow meter in accordance with manufacturer's recommendations.

2.4.8 Steam Flow Meters

****
NOTE: Meters can have (a) six-dial counter, or (b) remote totalizer, or (c) pressure compensated six-dial counter, or (a) and (b). Meters cannot have (a) and (c), or (b) and (c).
****

Meter shall be for minimum working pressure of ASME Class 150 with steel pressure chambers or ASME Class 250 with cast-iron pressure chambers. Provide meter in horizontal pipe between two ASME B16.5 welding neck flanges. Provide rotary type meter for flow integration. Working parts shall be stainless steel. Steam flow shall cause rotation of a rotor assembly at a speed directly proportional to the rate of steam flow, as controlled by a damping liquid. The rotational speed of the rotor assembly shall be reduced by gearing in the damping liquid chamber. Final drive to the exterior counter shall be by driving magnets; stuffing box shall not be allowed. Counter shall be enclosed in a dust-tight cast-aluminum housing attached to, but easily removable from the meter. For steam pipe main sizes 100 mm 4 inches and smaller, provide meter directly in the steam piping. For steam pipe main sizes larger than 100 mm 4 inches, provide meter in shunt bypass piping with two ASME B16.5 Class 300 welding neck orifice flanges in the steam pipe main. In the shunt bypass piping, provide two flanged gate valves calibrated by the meter manufacturer. In the steam pipe main, provide 3.20 mm 0.125 inch thick stainless steel orifice plate sized to suit meter capacity between two ASME B16.5 Class 300 welding neck orifice flanges. [Provide six-dial counter with an electrical contactor to transmit signal to data terminal cabinet (DTC) for indicating steam flow in kg pounds.] [Provide remote totalizer for recording steam flow in kg pounds.] [Provide pressure compensated six-dial counter to automatically and continuously correct steam flow meter readings for steam pressure variations.]

2.4.9 Steam Meter-Strain Gage Target Flow Type

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NOTE: Refer to UFC 3-430-09, "Exterior Mechanical Utility Distribution" for selection of steam flow meter type.
****

a. Operation: The steam meter shall have four interconnected strain gages attached to the sensing tube, two in the forward side of flow, two on the reverse side of the flow, producing a four-active arm, bridge circuit. At zero flow, the bridge circuit is balanced and produces zero output. Forces from the fluid are transferred from the target to the sensing tube producing strain on the sensing tube. The bridge circuit becomes unbalanced producing an output to a microprocessor sending unit. A mass flow computer is connected to the sending unit

for visual display.

b. Valve Body: ANSI Class 150; Inline type body with flanged ends - 303/304 stainless steel.

c. Sensing Element: 316 Stainless Steel.

d. Seals: Teflon, Vitron, Buna-N, Grafoil.

e. Sending Unit: Microprocessor design with 24-bit speed and accuracy, 4-20 mA output, programmable cutoff, two programmable open collector output hi/lo set points, RS-232 communications, open collector 0-1000hz square wave output.

Accuracy: 0.02 percent of rate.
Repeatability: 0.01 percent of rate.
Power: 16-30vdc, 24vdc at 100mA maximum with current loop connected at 4.00maDC.
Temperature: 0-60 degrees C 32-140 degrees F
Enclosure: Explosion proof type watertight housing.

f. Mass Flow Computer: Wall mounted. The mass flow computer indicates mass rate, mass totalization, flow rate, temperature, pressure and density.

Flow: Square wave digital pulse with plus or minus 0.057 percent accuracy.

Temperature: 4-wire RTD: 100 ohm platinum to European alpha 3850 curve;

Current loop; 4-20 mA; Accuracy: plus or minus 0.1 percent at 25 degrees C 77 degrees F.

Pressure: Current Loop: 4-20mA; Accuracy: plus or minus 0.1 percent at 25 degrees C 77 degrees F.

Power: 120/240vac plus 10 percent to 15 percent. 50/60 Hz at .2amps.
Temperature: 0-55 degrees C 32-131 degrees F.

2.4.10 Guided Slip Tube Expansion Joints

Internally-externally guided type, injected semiplastic type packing, with service outlets. Joints shall be for minimum working pressure of ASME Class 150. Provide single or double slip tube type as indicated. Provide flanged or buttwelding end connections as indicated.

2.4.11 Flexible Ball Expansion Joints

Provide chromium plated steel balls capable of 360-degree rotation plus 15-degree angular flex movement. Provide pressure molded composition gaskets designed for continuous operation temperature of 274 degrees C 525 degrees F. Joints shall be for minimum working pressure of ASME Class 150. Provide flanged or buttwelding end connections as indicated.

2.4.12 Bellows Expansion Joints

Type 304 stainless steel corrugated bellows, reinforced with rings, internal sleeves, and external protective covers. Provide limit stops to limit total movement in both directions. Cold set the joints to

compensate for temperature at time of installation. Joints shall withstand 10,000 cycles over a 20 year period. Joints shall be for minimum working pressure of ASME Class 150. Provide single or double bellows expansion joint as indicated. Provide first pipe alignment guide no more than four pipe diameters from the expansion joint; provide second pipe alignment guide no more than 14 pipe diameters from the first guide. Provide flanged or buttwelding end connections as indicated.

2.5 POLES SUPPORTING ABOVEGROUND PIPING

2.5.1 Concrete Poles

Provide under this section as specified in Section 03 45 33 PRECAST[PRESTRESSED] STRUCTURAL CONCRETE. Accurately set the top fittings to grade by means of adjusting screws, and grout in place. Provide high-strength grout consisting of one part portland cement and two parts clean, sharp sand with minimal water to make a workable grout. Wet tops of poles before placing the grout. Prevent grout leaks around the bottom of the fittings which streak or disfigure the concrete. Discoloration or disfiguring of concrete will not be permitted.

2.5.2 Steel Pipe Poles

a. ASTM A53/A53M: Type E (electric-resistance welded, Grade A or B) or Type S (seamless, Grade A or B; hot-dip galvanized, Weight Class STD (Standard).

b. ASTM A106/A106M: Grade A or B, hot-dip galvanized, Schedule No. 40 for pipe sizes through 250 mm 10 inches, and minimum pipe wall thickness of 9.50 mm 0.375 inch for pipe sizes 300 mm 12 inches and larger.

2.5.3 Guy Wires, Fittings, and Hardware

****
NOTE: Use a minimum factor of safety of 3.0 . Use 9.5 mm 3/8 inch minimum wire strand thickness.
****

a. Guy Wires: ASTM A475, high strength grade, extra galvanized, stranded with seven wires in each strand. Wire shall be a minimum of 9.5 mm 3/8 inch diameter. Provide thimbles at each end of guy wire. Prestress guy wires until taut.

b. Anchor Rods and Anchors: Provide thimble-eye, 32 mm 1.25 inch diameter steel rod with 250 mm 10 inch diameter screw anchor, hot-dip galvanized.

c. Turnbuckles: Provide open turnbuckles, forged steel body, with jaw and jaw end pulls, 9.50 mm 0.375 inch size, hot-dip galvanized.

d. Clamps: Provide hot-dip galvanized forged high carbon steel clamps capable of developing full strength of guy wire, and fitted with galvanized heat-treated bolts. Provide two clamps at each connection of guy wire.

2.5.4 Miscellaneous Metal

ASTM A36/A36M, standard mill finished structural shapes, hot-dip

galvanized after fabrication.

2.5.5 Fastenings

Provide steel bolts and oversized nuts conforming to ASTM A307. Galvanize in accordance with ASTM A153/A153M. Provide nuts with an approved means for locking to ensure nuts remain tight under severe service, including vibrations. Drive bolts to a tight fit without injury to the threads. Bolts with injured threads will not be permitted. Drill holes 1.60 mm 1/16 inch larger than bolts; burning of holes will not be permitted. Tighten bolts to the required torque.

2.6 MANHOLE DRAINERS (EJECTORS)

Provide automatic type drainers to operate on 862 kPa (gage) 125 psig steam supply. The drainer shall operate when the water level rises sufficiently in the sump, the float shall rise and open the steam control valve to admit steam to the drainer, which in turn shall pump the water from the sump. When the water level is lowered by the pumping action, the float shall lower and close the steam valve to stop the pumping action until water again gathers in the sump. Provide each drainer with controls to accomplish the above sequence of operation. The automatic float-operated steam valve shall be designed to prevent dead centering under field conditions and to lengthen the life of the valve seat. The valve shall have a high grade, renewable composition disc and a stainless steel or hard, noncorrosive bronze renewable seat inserted in the valve body. The drainer shall be constructed of corrosion-resistant copper and bronze. Piping from manhole drainers shall be ASTM A53/A53M, Weight Class XS (Extra Strong), hot-dip galvanized steel pipe with ASME B16.11 or ASME B16.3, Class 300, hot-dip galvanized threaded fittings. Provide a steam pressure regulating valve assembly for manhole drainers for operation on steam system above 862 kPa (gage) 125 psig.

2.7 CONCRETE MANHOLES

Provide under this section as specified in Section 03 30 00 CAST-IN-PLACE CONCRETE, except as modified herein. Concrete shall be of 30 MPa 4000 psi minimum 28 day compressive strength, air entrained admixture (133 grams per cubic meter 3.6 ounces per cubic yard), with water-reducing admixture (814 grams per cubic meter 22 ounces per cubic yard), reinforced with deformed steel bars. Construct manhole sides by one monolithic pour. Cast-iron steps with nonslip surfaces, and spaced 300 to 400 mm 12 to 16 inches apart on centers shall be firmly embedded in concrete walls for access to bottom of manholes. Provide top of manhole as indicated. [Steel grating covers for manholes shall be welded parallel bearing bars, with right angle cross members, zinc coated after fabrication; size as indicated.]

2.8 BURIED PIPING UNDER ROADS

Provide [new and modify existing] buried factory-prefabricated preinsulated steam and condensate piping in accordance with Section 33 63 13 EXTERIOR UNDERGROUND STEAM DISTRIBUTION SYSTEM.

2.8.1 Carrier Piping

2.8.1.1 Steam Piping

Provide steel piping.

2.8.1.2 Condensate Piping

Provide steel piping.

2.8.2 Piping Insulation for Carrier Piping

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NOTE: The insulation thickness indicated is suitable for most geographical regions. However, if the project is located in a region where extreme annual temperatures occur, the design engineer should evaluate the insulation thickness based on an economical analysis, with the approval of the Mechanical Engineering Branch.
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Products containing asbestos will not be permitted.

2.8.2.1 Insulation for Steam Piping

Nominal Pipe Sizes (mm)	Calcium Silicate Insulation Cellular Glass Insulation (mm)	Mineral Fiber Insulation (mm)
less than 80	76.20	63.50
80 thru 100	88.90	76.20
125 thru 150	101.60	88.90
200 and larger	127.00	114.30

Nominal Pipe Sizes (inches)	Calcium Silicate Insulation Cellular Glass Insulation (inches)	Mineral Fiber Insulation (inches)
less than 3	3.0	2.5
3 thru 4	3.5	3.0
5 thru 6	4.0	3.5
8 and larger	5.0	4.5

2.8.2.2 Insulation for Steam Condensate Carrier Piping

Nominal Pipe Sizes (mm)	Calcium Silicate Insulation Cellular Glass Insulation (mm)	Mineral Fiber Insulation (mm)
less than 80	50.80	38.10
80 thru 100	63.50	50.80
125 and larger	76.20	63.50

Nominal Pipe Sizes (inches)	Calcium Silicate Insulation Cellular Glass Insulation (inches)	Mineral Fiber Insulation (inches)
less than 3	2.0	1.5
3 thru 4	2.5	2.0
5 and larger	3.0	2.5

2.8.3 Cathodic Protection

Provide sacrificial anode type cathodic protection system for metal conduits.

2.8.4 Buried Warning and Identification Tape

Provide detectable aluminum foil plastic backed tape or detectable magnetic plastic tape manufactured specifically for warning and identification of buried piping. Tape shall be detectable by an electronic detection instrument. Provide tape in rolls, 80 mm 3 inches minimum width, color coded for the utility involved, with warning and identification imprinted in bold black letters continuously and repeatedly over entire tape length. Warning and identification shall read CAUTION BURIED STEAM PIPING BELOW OR similar wording. Use permanent code and letter coloring unaffected by moisture and other substances contained in trench backfill material.

PART 3 EXECUTION

3.1 INSTALLATION

Installation of exterior steam distribution system including equipment, materials, installation, workmanship, fabrication, assembly, erection, examination, inspection, and testing shall be in accordance with ASME B31.1, except as modified herein. Install piping straight and true to bear evenly on supports and sand bedding material. Install valves with stems horizontal or above. Provide flanges or unions at valves, traps, strainers, connections to equipment, and as indicated.

3.1.1 Cleaning of Piping

Keep the interior and ends of new piping and existing piping affected by the Contractor's operations, cleaned of water and foreign matter during installation by using plugs or other approved methods. When work is not in progress, securely close open ends of pipe and fittings to prevent entry of water and foreign matter. Inspect piping before placing into position.

3.1.2 Demolition

Remove materials so as not to damage materials which are to remain. Replace existing work damaged by the Contractor's operations with new work of the same construction.

3.2 PIPING

Test, inspect, and approve piping before burying, covering, or concealing. Provide fittings for changes in direction of piping and for connections. Reducing branch connections in steel piping may be made with forged branch outlet reducing fittings for branches two or more pipe sizes smaller than mains. Branch outlet fittings shall be forged, flared for improved flow where attached to the run, reinforced against external strains, and designed to withstand full pipe bursting strength. Stab type connections will not be permitted. Jointing compound for pipe threads shall be Teflon pipe thread paste. Pipe nipples 150 mm 6 inches long and shorter shall be Schedule 80 steel pipe. Make changes in piping sizes through tapered reducing fittings; bushings will not be permitted. Condensate piping shall include drip, vent, relief, and gage connecting piping.

3.2.1 Fittings and End Connections

For sizes less than 25 mm one inch provide threaded fittings and end connections. For sizes 25 to 50 mm one to 2 inches provide threaded or socket-welding or buttwelding fittings and end connections; provide threaded connections for threaded valves, traps, strainers, and threaded connections to equipment. For sizes 65 mm 2.5 inches and larger provide buttwelding fittings and end connections; provide flanged connections for flanged valves, traps, strainers, and flanged connections to equipment.

3.2.2 Welding

ASME B31.1, metallic arc process, including qualification of welders.

3.2.3 Pipe Hangers and Supports

Provide additional hangers and supports for concentrated loads in piping between hangers and supports, such as for valves. Support steel piping as follows:

MAXIMUM SPACING (METER)									
Pipe Size (mm)	25 and under	40	50	80	100	150	200	250	300
Steel Piping	2.70	3.70	4.00	4.60	5.20	6.40	7.30	8.00	9.20
MAXIMUM SPACING (FEET)									
Pipe Size (inches)	one and under	1.5	2	3	4	6	8	10	12
Steel Piping	9	12	13	15	17	21	24	26	30

3.2.4 Buried Piping Under Roads

Installation including field joints, bedding, and initial backfill shall be in accordance with the Approved Brochure.

3.3 NAMEPLATES

Provide laminated plastic nameplates for equipment, gages, thermometers, and valves. Nameplates shall be melamine plastic, 3.20 mm 0.125 inch thick, black with white center core. Surface shall be matte finish. Corners shall be square. Accurately align lettering and engrave into the white core. Minimum size of nameplates shall be 25 by 65 mm one by 2.5 inches. Lettering shall be minimum of 6.40 mm 0.25 inch high normal block style. Key the nameplates to a chart and schedule for each system. Frame charts and schedules under glass, and locate where directed near each system. Furnish two copies of each chart and schedule.

3.4 FIELD QUALITY CONTROL

3.4.1 Inspections

Prior to initial operation, inspect piping system for compliance with drawings, specifications, and manufacturer's submittals.

3.4.2 Piping Tests

Before final acceptance of the work, test each system as in service to demonstrate compliance with contract requirements. Before insulation is applied, hydrostatically test each piping system at not less than 1551 kPa (gage) 225 psig in accordance with ASME B31.1, with no leakage or reduction in gage pressure for 2 hours. Flush and clean piping before placing in operation. Flush piping at a minimum velocity of 2.40 meters per second 8 fps. Correct defects in work provided by Contractor and repeat tests until work is in compliance with contract requirements. Furnish potable water, electricity, instruments, connecting devices, and personnel for the tests.

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NOTE: On projects that provide modifications to

existing piping systems, pneumatic pressure testing and hydraulic pressure testing of newly installed piping is much more difficult than the same testing on a complete new system. Therefore, by means of the following design techniques, provide for the Contractor a piping modification design that facilitates acceptance testing: piping design which includes flanges at appropriate locations for flanged blanks to be installed for testing; specifications which include requirements for how the modified piping shall be pressure tested; specifications which specify which pipe sections shall be pressure tested in the shop if absolutely necessary.

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3.4.3 Buried Piping Under Roads

Installation including field joints, bedding, and initial backfill shall be in accordance with the Section 33 63 13 EXTERIOR UNDERGROUND STEAM DISTRIBUTION SYSTEM. Bury tape with the printed side up at a depth of 300 mm 12 inches below the top surface of earth or the top surface of the subgrade under pavements.

3.4.3.1 Conduit Coating

Test conduit coating of buried piping under roads prior to backfill in accordance with the approved brochure.

3.4.3.2 Cathodic Protection

Test cathodic protection of buried piping under roads to prove continuity of electrical connections prior to backfill.

3.5 FIELD PAINTING

After completion of field inspections and tests, clean and paint metal surfaces exposed to the weather and in manholes, including valves, strainers, traps, flow meters, pipe flanges, bolts, nuts, washers, pipe hangers, supports, expansion joints, and miscellaneous metal. Do not paint piping prior to the application of field-applied insulation. Do not paint stainless steel or aluminum jackets. Apply paint to clean dry surfaces. Clean surfaces to remove dust, dirt, rust, oil, and grease. Provide surfaces with two coats of enamel paint applied to a total minimum dry film thickness of 0.05 mm 2 mils. Apply the second coat of paint after the preceding coat is thoroughly dry. Color of finish coat shall be aluminum or light gray. Paint shall be rated for use on hot metal surfaces up to 232 degrees C 450 degrees F and for use on surfaces exposed to the weather.

3.6 CONNECTIONS TO EXISTING SYSTEMS

Notify the Contracting Officer in writing at least 15 days prior to the date the connections are required. Obtain approval before interrupting

service. Provide materials required to make connections into existing systems and perform excavating, backfilling, compacting, and other incidental labor as required.

-- End of Section --