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Preparing Activity: NAVFAC Superseding
UFGS-33 63 16 (April 2006)

**UNIFIED FACILITIES GUIDE SPECIFICATIONS**

**References are in agreement with UMRL dated July 2023**
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| **Preparing Activity: NAVFAC** | **Superseding** |
| | **UFGS-33 63 16 (April 2006)** |

**UNIFIED FACILITIES GUIDE SPECIFICATIONS**

**References are in agreement with UMRL dated July 2023**
**********

SECTION 33 63 16

EXTERIOR SHALLOW TRENCH STEAM DISTRIBUTION
**07/06**

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**NOTE: This guide specification covers the requirements for exterior shallow trench heat distribution systems including concrete trench, manholes, piping, pipe anchors, pipe supports, interface with each manhole, and the watershed to aboveground piping.**

**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).**
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**********
**NOTE: System design must conform to UFC 3-430-09, "Exterior Mechanical Utility Distribution."**
**********

**********
**NOTE: Following information shall be shown on 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 concrete trench and for each piping system.**

**3. Location, sizes, and type of each valve and each trap.**

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

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

**6. Scale ranges for pressure gages and thermometers.**

**7. Whether piping is run in shallow concrete trenches, aboveground on pedestals or poles, on piers, under piers, in trenches on piers, or in manholes.**

**8. Details, sections, and elevations of shallow concrete trenches and manholes, piping within trenches and manholes, and piping aboveground.**

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# 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 B16.34 | (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 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 A615/A615M | (2022) Standard Specification for Deformed and Plain Carbon-Steel Bars for Concrete Reinforcement |
| ASTM C920 | (2018) Standard Specification for Elastomeric Joint Sealants |
| 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 [steam and condensate] [hot water] piping system of shallow concrete trench type, complete and ready for operation. [Provide piping to and including 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] [hot water at 232 degrees C 450 degrees F].

## 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-02 Shop Drawings

Piping system; G[, [_____]]

Pipe hangers and supports; G[, [_____]]

Manholes; G[, [_____]]

Shallow concrete trench; G[, [_____]]

SD-03 Product Data

Pipe

Valves; G[, [_____]]

Strainers; G[, [_____]]

Pipe hangers and supports

Traps

Gages

Steam flow meters; G[, [_____]]

Expansion joints; G[, [_____]]

Manhole drainers; G[, [_____]]

Sealant

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. Certification shall not be more than one year old.

# PART 2 PRODUCTS

## 2.1 PIPE

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

### 2.1.1 [Steam] [Hot Water] 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 Class 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 No. 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] [300 for hot water].

### 2.2.2 Socket-Welding Fittings

ASME B16.11.

### 2.2.3 Buttwelding Fittings

ASME B16.9. Provide same material and weight as 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 same material and weight as piping in which fittings are installed.

2.2.5 Flanges and Unions

a. Flanges: ASME B16.5, Class [150 or Class 300 as required] [300 for hot water].

b. Unions: ASME B16.39, Class [150 for steam, Class 250 for condensate] [300 for hot water].

2.2.6 Gaskets, Bolts, Nuts, and Washers

a. Gaskets: Provide gaskets suitable for the intended service. Provide spiral wound, non-asbestos gasket with centering ring per ASME B16.20.

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 bolts and holes in flanges; bolts may have reduced shanks of a diameter not less than diameter at 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 thicker insulating gaskets and washers under bolt heads and nuts.

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 valve.

2.3.1 Valves for [Steam] [Hot Water] Service

Valves [upstream of steam traps] shall be steel body for minimum working pressure of ASME Class [150] [300 for hot water].

a. Gate Valves, Globe Valves, Angle Valves, and Check Valves: ASME B16.34, steel body, minimum of ASME Class [150] [300 for hot water]. Provide swing check valves.

b. 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.

c. Safety-Relief Valve: Minimum of ASME Class [150] [300 for hot water], with test lever. Valves shall have steel [or copper alloy] body with flanged inlet and outlet connections or threaded connections attached to threaded ASME Class [150] [300 for hot water] 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.

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

b. Globe and Angle Valves: MSS SP-80, except sizes 65 mm 2.5 inches and larger shall conform to MSS SP-85.

c. 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 46, of the adjustable type, except as specified or indicated otherwise. Tack-welded Type 39 pipe covering protection saddles to steel pipe for insulated piping. Provide steel support rods. 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. Axles for rollers shall be stainless steel. 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] [300 for hot water]. 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)] [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 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 completely 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 finish on copper alloy plates in finished spaces. Provide paint finish on metal plates in unfinished spaces.

2.4.7 Electronic Steam Flow Meters

Meter shall be for minimum working pressure of ASME Class [150] [300]. 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.

a. Orifice Plate: Provide differential producing type orifice plate with circular hole for insertion into 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 tapered holes for metering and two jack screws.

b. 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 0 to 0.40 kg per second 3000 pounds per hour of steam flow with accuracy of plus or minus 2 percent of 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.

c. 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 0 to 0.40 kg per second 3000 pounds per hour.

d. Totalizer: Provide totalizer that linearizes a 4 to 20 mA dc electrical input signal into 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.

e. Output: An isolated, 500 volt 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.

2.4.8 Steam Flow Meters

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

Meter shall be for minimum working pressure of ASME Class [150] [300] 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 or brass. Steam flow shall cause rotation of a rotor assembly at a speed directly proportional to rate of steam flow, as controlled by a damping liquid. Rotational speed of rotor assembly shall be reduced by gearing in damping liquid chamber. Final drive to exterior counter shall be by driving magnets; stuffing box shall not be allowed. Counter shall be enclosed in dust-tight cast-aluminum housing attached to, but easily removable from, meter. For steam pipe main sizes 100 mm 4 inches and smaller, provide meter directly in 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 steam pipe main. In shunt bypass piping, provide two flanged gate valves calibrated by meter manufacturer. In 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 electrical contactor to transmit signal to data terminal cabinet (DTC) for indicating steam flow in kg pounds.] [Provide pressure compensated six-dial counter to automatically and continuously correct steam flow meter readings for steam pressure variations.] [Provide remote totalizer for recording steam flow in kg pounds.]

2.4.9 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] [300]. Provide single or double slip tube type as indicated. Provide flanged or buttwelding end connections as indicated.

### 2.4.10 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 for continuous operation temperature of 274 degrees C 525 degrees F. Joints shall be designed for minimum working pressure of ASME Class [150] [300]. Provide flanged or buttwelding end connections as indicated.

### 2.4.11 Bellows Expansion Joints

Type 304 stainless steel corrugated bellows, reinforced with rings, internal sleeves, and external protective covers or externally pressurized joints. Provide limit stops to limit total movement in both directions. Cold set 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] [300]. Provide single or double bellows expansion joint as indicated. Provide first pipe alignment guide no more than four pipe diameters from expansion joints; 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 MANHOLE DRAINERS (EJECTORS)

Provide automatic type drainers to operate on 862 kPa (gage) 125 psig steam supply. Drainer shall operate when water level rises sufficiently in the sump and shall pump water from the sump. When water level is lowered by pumping action, pumping action shall stop until water again gathers in sump. Provide each drainer with controls to accomplish above sequence of operation. Drainer shall be constructed of stainless steel or 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 steam pressure regulating valve assembly for manhole drainers for operation on steam system above 862 kPa (gage) 125 psig.

## 2.6 CONCRETE MANHOLES

Provide under this section as specified in Section 03 42 13.00 10 PLANT-PRECAST CONCRETE PRODUCTS FOR BELOW GRADE CONSTRUCTION, 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 non-slip surfaces and spaces 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.

## 2.7 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 1 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 to

identify its function. Frame charts and schedules under glass, and locate where directed near each system. Furnish two copies of each chart and schedule.

## 2.8 SHALLOW CONCRETE TRENCH

a. Cast-in-Place Concrete: Provide concrete as specified in Section 03 30 00 CAST-IN-PLACE CONCRETE, except as modified herein. Concrete shall be 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 ASTM A615/A615M deformed steel bars.

b. Precast Concrete: Provide as specified in Section 03 42 13.00 10 PLANT-PRECAST CONCRETE PRODUCTS FOR BELOW GRADE CONSTRUCTION, except as modified herein. Concrete shall be 30 MPa 4000 psi minimum 28 day compressive strength, air-entrained.

c. Gasket Material: Provide neoprene pad, not less than 50 mm 2 inch wide by 6.40 mm 0.25 inch thick, between concrete trench covers and concrete trench wall tops.

d. Backing Rods: Provide compressible, nonshrinkable, nonreactive with joint sealant and nonabsorptive type such as upholstery cord, cotton, jute, or plastic rod, all free of oils or bitumens.

e. Separating Tape: Provide polyethylene or polyester tape, 0.08 mm 3 mil minimum thickness or masking tape, rubber tape, or other barrier sheet, nonreactive, nonabsorptive, adhesive-back tape, 3.20 mm 0.12 inch wider than normal width of the joint.

f. Dowel Bars: Provide ASTM A615/A615M including supplementary requirements (S1), Grade 40 or 60 for plain billet-steel concrete reinforcement bars. Coat sliding portion of each bar with lacquer resisting primer. Remove burrs and projections from the bars. Fit the outer end of the sliding portion of each dowel with a tight-fitting metal sleeve which conforms to manufacturer's recommendation for the dowel bars.

g. Exterior Sealant: ASTM C920, Type S or Type M, Class 25. Provide Grade NS, Use NT, sealant for joints in vertical surfaces. Provide Grade P, Use T, sealant for joints in horizontal surfaces.

# PART 3 EXECUTION

## 3.1 INSTALLATION

Installation of exterior heat distribution system including equipment, materials, 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 centerline of pipe. Provide flanges or unions at valves, traps, strainers, connections to equipment, and as indicated.

a. 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.

b. 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 pipe, 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.

a. Fittings and End Connections: For sizes less than 25 mm 1 inch provide threaded fittings and end connections. For sizes 25 to 50 mm 1 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.

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

c. 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 |

| MAXIMUM SPACING (FEET) | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|
| Steel Piping | 9 | 12 | 13 | 15 | 17 | 21 | 24 | 26 | 30 |

## 3.3 FIELD QUALITY CONTROL

### 3.3.1 Inspections

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

### 3.3.2 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] [3447] kPa (gage) [225] [500] 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 compliance with contract requirements. Furnish potable water, electricity, instruments, connecting devices, and personnel for tests.

## 3.4 FIELD PAINTING

After completion of field inspections and tests, clean and paint metal surfaces exposed to weather and in manholes, including valves, strainers, traps, flow meters, pipe flanges, bolts, nuts, washers, pipe hangers, support, expansion joints, manhole drainers, 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 weather.

## 3.5 CONNECTIONS TO EXISTING SYSTEMS

Notify Contracting Officer in writing at least 15 days prior to 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 --