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USACE / NAVFAC / AFCEC / NASA **UFGS-33 63 13.19 (February 2016)**

Preparing Activity: USACE **Superseding UFGS-33 61 15 (July 2006)**

UNIFIED FACILITIES GUIDE SPECIFICATIONS

References are in agreement with UMRL dated October 2018
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DIVISION 33 - UTILITIES

SECTION 33 63 13.19

CONCRETE TRENCH HYDRONIC AND STEAM ENERGY DISTRIBUTION

02/16

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SECTION 33 63 13.19

CONCRETE TRENCH HYDRONIC AND STEAM ENERGY DISTRIBUTION
02/16

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NOTE: This guide specification covers the requirements for heat distribution systems of the concrete trench type for water systems from 66 to 232 degrees C 150 to 450 degrees F and steam systems up to 1.72 MPa 250 psig.

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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PART 1 GENERAL

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NOTE: For a complete system include Section 33 61 13.19 VALVES, PIPING, AND EQUIPMENT IN VALVE MANHOLES. The designer will comply with the procedure as outlined in the following paragraphs 1 through 5 in determining site conditions and trench system design. If specific site conditions are not suitable for a concrete trench system in accordance with following guidance, refer to Section 33 63 23 EXTERIOR ABOVEGROUND STEAM DISTRIBUTION or Section 33 61 13 PRE-ENGINEERED UNDERGROUND HEAT DISTRIBUTION SYSTEM.

SITE CLASSIFICATION AND CONCRETE TRENCH DESIGN

GUIDANCE

1. Classification of the Site: A detailed site classification survey will be conducted by a geotechnical engineer using the following guidelines:

a. The survey will be made after the general layout of the system has been determined and will cover the entire length of the proposed system. The geotechnical engineer must be a registered professional engineer with a minimum of 3 years of experience in the field of soil mechanics and foundation design.

b. The survey should be conducted during the time of the year when the groundwater table is historically at its highest point; if this is not possible, water table measurements will be corrected, on the basis of professional judgment, to indicate the highest seasonal water table when water table is at its highest point.

c. As a minimum, information on groundwater conditions, soil types, terrain, and precipitation rates and irrigation practices in the area of the system will be collected. This information will be obtained from available records at the installation.

d. Information on groundwater conditions and soil types will be obtained through borings, test pits, or other suitable exploratory means. Generally, in areas of prior construction, a boring or test pit will be made at least every 30 m 100 feet along the line of the proposed system. In open undisturbed natural areas, the spacing of borings may be increased. Each exploratory hole should extend to a level at least 1.5 m 5 feet below the bottom of the tunnel. If a significant difference in underground conditions is found at adjacent exploratory points, additional explorations will be made between those points in order to determine where the change occurs. Upon completion of the survey, each exploration point will be classified on the basis of the criteria presented in Table 1, ALLOWABLE SOIL CHARACTERISTICS and the soil classification system in ASTM D2487. If the criteria of Table 1 is not met, the site conditions are not suitable for the use of a concrete trench.

TABLE 1 ALLOWABLE SOIL CHARACTERISTICS FOR CONCRETE TRENCH APPLICATION (SEE NOTE 1.)			
Site Soil Conditions	**General Conditions of Ground Water During the Wettest Period of the Year**	**Surface Water Accumulation Rainfall/ Irrigation**	**Trench Construction**
A. Fine Grained Impervious or Semipervious and Coarse Grained Impervious	**Water table generally 300 mm 1 foot below lowest point of water entry (See Note 4) with not more than 25 percent of the proposed concrete trench system showing water within 300 mm 1 foot but no higher than lowest point of water entry**	**5 year - 7 day rainfall equal to or less than 250 mm 10 inches (See Note 2.)**	**Continuous wall and bottom**
B. Coarse Grained Semipervious	**Same as for A., above**	**5 year - 7 day rainfall equal to or less than 250 mm 10 inches (See Note 2.)**	**Continuous wall and bottom**
	Water table generally 600 mm 2 foot or more below lowest point of water entry with not more than 10 percent of the proposed concrete trench system showing water within 600 mm 2 feet but no closer than 300 mm 1 foot to lowest point of water entry	**5 year - 7 day rainfall equal to or less than 200 mm 8 inches (See Note 2.)**	**Continuous wall; opening may be provided in trench bottom to provide drainage**

TABLE 1 ALLOWABLE SOIL CHARACTERISTICS FOR CONCRETE TRENCH APPLICATION (SEE NOTE 1.)			
Site Soil Conditions	General Conditions of Ground Water During the Wettest Period of the Year	Surface Water Accumulation Rainfall/ Irrigation	Trench Construction
C. Swelling Soils	Same as for A., above (See Note 3.)	Same as for A., above	Same as for A., above plus design of joint spacing and joint details to accommodate movement
1. Concrete trench systems will not be used if any of the conditions defined by these criteria are exceeded.			
2. As shown in U.S. Weather Bureau (USWB) Tech. Paper 40 and confirmed with local data and local weather patterns.			
3. Swelling soils are defined as those which experience large volume changes with changes in moisture content.			
4. Lowest point of water entry is defined as the joint between trench wall and trench bottom.			

2. DESIGN: The design will be completed based on the following soil conditions:

a. Fine grained impervious soils. The highest groundwater level evident during the wettest period of the year should be a minimum of 300 mm 1 foot below the lowest point of water entry into the concrete trench system. The lowest point of entry is defined as the joint between the concrete trench wall and concrete trench bottom. The concrete trench bottom will be continuous with no openings. The above condition will allow the concrete trench to be constructed and will minimize potential infiltration of water into the trench. Open drainage ways, swales, or swampy/boggy areas will preclude use of a concrete trench system because of ground water level guidance in Table 1. The concrete trench system must be rerouted or regraded to bring the concrete trench out of the unsuitable conditions. The geotechnical engineer who performed the detailed site classification survey will provide regrading instructions and will select fill that will remain stable and will not be subject to future wash-outs.

b. Coarse grained semipervious/pervious soils. The groundwater level during the wettest period of the year should be at least 300 mm 1 foot below the lowest point of water entry into the concrete trench system. For a water table 300 to 600 mm 1 to 2 feet below the lowest point of water entry the criteria of paragraph 2.a., above apply.

c. Swelling Soils with high swell potential. The design of the concrete trench system in materials having high swell potential will be in accordance with paragraph 2.a., above. Soils having a liquid limit (LL) greater than 50 and a plasticity index (PI) greater than 25 will require testing (consolidation swell) to determine the swell characteristics. When the results of the swell test indicate high swell potential, special considerations such as over excavation (width and depth) and replacement with nonexpansive fill, under-trench drainage system, or other methods of minimizing differential heave will be provided. The design of special features such as described above will be in accordance with instructions provided by the geotechnical engineer who performed the detailed site classification survey. Design of joint spacing and joint details to accommodate movements will be provided when required.

3. SETTLEMENT OF TRENCHES: Generally, settlement of concrete trenches will not be a problem since the unit load of the trench system will be similar to the existing unit overburden load. Backfill adjacent to the concrete trench must be compacted to prevent settlement which would create ponding. Positive slopes away from the concrete trench are required. Special care of backfill and compaction will be required where the system crosses existing streets to preclude settlement and cracking of the roadway adjacent to the trench from repeated traffic loads.

4. LOAD-BEARING QUALITIES: The soil in which the system will be installed should be investigated by an experienced geotechnical engineer responsible for other soils engineering work, and the location and nature of potential soils problems should be identified. Depending on the nature of the problem, the designer may choose to reroute the line, use a combination of concrete trench or aboveground low-profile systems, or elect to over-excavate and replace with nonexpansive fill.

5. CONCRETE TRENCH DESIGN: The concrete trench design will consist of poured concrete sides and floor with removable tops. Portions of the floor may be omitted at locations specified under course grained soils with water table 600 mm 2 feet or more below lowest point of water entry.

The depth of the concrete trench will be sufficient to provide adequate protection to the piping system and the floor of the trench must be sloped to provide adequate internal drainage, but in all cases will not be less than 150 mm 6 inches from the bottom surface of the suspended pipe insulation to the floor of the trench. There will also be a minimum of 75 mm 3 inches between the surface of the

pipe insulation and the adjoining trench walls, and a minimum of 100 mm 4 inches between surfaces of adjacent pipe insulation.

For those instances where natural drainage cannot be provided (storm water drainage system at least 600 mm 2 feet below trench bottom at all times), a dual sump pump will be provided with failure annunciator. This signal will be tied-in to the EMCS system, if any.

The tops of the concrete trenches will serve as sidewalks, if practical, and will be removable by use of a forklift or backhoe. Earth must not cover the tops. Covers will be close tolerance fit with a maximum gap tolerance build up of 3 mm 1/8 inch from all causes.

The pipes will be supported within the trenches by pipe supports fastened to the walls. In no case will they be supported from either the floor of the trench or from the removable top. All noninsulated ferrous parts of the piping, piping support system, or equipment will be hot-dipped galvanized. The pipe hanger design must provide for adequate system expansion and contraction.

Use minimum of 25 mm 1 inch pipe size for piping in trench system with all joints welded. Smaller pipe sizes and screwed joints are allowable in valve manholes.

Provide the following information on the contract drawings for the concrete Trench System, as applicable: (1) dimension on all runs of pipe; (2) pipe support spacings; (3) pipe support spacing at changes in direction and changes in elevation (MSS SP-58 is not applicable); (4) elevations of the pipe along the systems path; (5) sizes of the pipe; (6) location of all valve manholes; (7) location and details of all expansion loops, Z-and L-bends; (8) location of pipe anchors; (9) how changes in pipe direction are made; (10) thickness of the insulation on the pipe; (11) concrete trench details; (12) final elevations of concrete trench; (13) profile of trench showing all existing utilities; (14) valve manhole dimensions; (15) valve manhole cover details, including manway access details; (16) how valve manholes are drained and vented; (17) sump pump piping details; (18) sump pump capacity; (19) locations of inspection ports; (20) include specific requirements for modification to existing and new electrical wiring, devices, or equipment (dedicated service for sump pump); (21) steam drip trap locations with access and capacities; (22) system pipe vent locations with access details; (23) steam main drip leg sizes; and (24) other pertinent information and details required to clearly show the intent of the Concrete Trench Heat Distribution

System. Also, indicate any obstructions in the path of the distribution system that the Contractor may have to work around.

Provide and edit for the project all other guide specifications as applicable to the trench design, and include and edit for the project the following Sections: 31 00 00 EARTHWORK; 32 12 13 BITUMINOUS TACK AND PRIME COATS; 33 63 23 EXTERIOR ABOVEGROUND STEAM DISTRIBUTION; 33 71 01 OVERHEAD TRANSMISSION AND DISTRIBUTION; 33 71 02 UNDERGROUND ELECTRICAL DISTRIBUTION; 03 15 00.00 10 CONCRETE ACCESSORIES ; 03 30 00.00 10 CAST-IN-PLACE CONCRETE; 05 05 23.16 STRUCTURAL WELDING; 05 50 13 MISCELLANEOUS METAL FABRICATIONS; 07 13 53 ELASTOMERIC SHEET WATERPROOFING; 09 90 00 PAINTS AND COATINGS; 40 05 13.96 WELDING PROCESS PIPING; 26 20 00 INTERIOR DISTRIBUTION SYSTEM; and others as applicable to the project.

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1.1 REFERENCES

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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.

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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.

ASME INTERNATIONAL (ASME)

ASME B1.20.1	(2013) Pipe Threads, General Purpose (Inch)
ASME B1.20.2M	(2006; R 2011) Pipe Threads, 60 Deg. General Purpose (Metric)
ASME B16.11	(2016) Forged Fittings, Socket-Welding and Threaded
ASME B16.3	(2016) Malleable Iron Threaded Fittings,

	Classes 150 and 300
ASME B16.34	(2017) Valves - Flanged, Threaded and Welding End
ASME B16.39	(2014) Standard for Malleable Iron Threaded Pipe Unions; Classes 150, 250, and 300
ASME B16.5	(2017) Pipe Flanges and Flanged Fittings NPS 1/2 Through NPS 24 Metric/Inch Standard
ASME B16.9	(2012) Standard for Factory-Made Wrought Steel Buttwelding Fittings
ASME B31.1	(2016; Errata 2016) Power Piping
ASME B40.100	(2013) Pressure Gauges and Gauge Attachments
ASME BPVC SEC VIII D1	(2017) BPVC Section VIII-Rules for Construction of Pressure Vessels Division 1

ASTM INTERNATIONAL (ASTM)

ASTM A106/A106M	(2018) Standard Specification for Seamless Carbon Steel Pipe for High-Temperature Service
ASTM A123/A123M	(2017) Standard Specification for Zinc (Hot-Dip Galvanized) Coatings on Iron and Steel Products
ASTM A234/A234M	(2018) Standard Specification for Piping Fittings of Wrought Carbon Steel and Alloy Steel for Moderate and High Temperature Service
ASTM A47/A47M	(1999; R 2014) Standard Specification for Ferritic Malleable Iron Castings
ASTM A53/A53M	(2018) Standard Specification for Pipe, Steel, Black and Hot-Dipped, Zinc-Coated, Welded and Seamless
ASTM A733	(2016) Standard Specification for Welded and Seamless Carbon Steel and Austenitic Stainless Steel Pipe Nipples
ASTM B209	(2014) Standard Specification for Aluminum and Aluminum-Alloy Sheet and Plate
ASTM B209M	(2014) Standard Specification for Aluminum and Aluminum-Alloy Sheet and Plate (Metric)
ASTM B650	(1995; R 2013) Standard Specification for Electrodeposited Engineering Chromium Coatings on Ferrous Substrates

ASTM C533	(2017) Standard Specification for Calcium Silicate Block and Pipe Thermal Insulation
ASTM C547	(2017) Standard Specification for Mineral Fiber Pipe Insulation
ASTM C552	(2017; E 2018) Standard Specification for Cellular Glass Thermal Insulation
ASTM C920	(2018) Standard Specification for Elastomeric Joint Sealants
ASTM D1056	(2014) Standard Specification for Flexible Cellular Materials - Sponge or Expanded Rubber
ASTM F1139	(1988; R 2015) Steam Traps and Drains

EXPANSION JOINT MANUFACTURERS ASSOCIATION (EJMA)

EJMA Stds	(10th Ed) EJMA Standards

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

MSS SP-25	(2013) Standard Marking System for Valves, Fittings, Flanges and Unions
MSS SP-45	(2003; R 2008) Bypass and Drain Connections
MSS SP-58	(2009) Pipe Hangers and Supports - Materials, Design and Manufacture, Selection, Application, and Installation
MSS SP-80	(2013) Bronze Gate, Globe, Angle and Check Valves

NATIONAL FIRE PROTECTION ASSOCIATION (NFPA)

NFPA 70	(2017; ERTA 1-2 2017; TIA 17-1; TIA 17-2; TIA 17-3; TIA 17-4; TIA 17-5; TIA 17-6; TIA 17-7; TIA 17-8; TIA 17-9; TIA 17-10; TIA 17-11; TIA 17-12; TIA 17-13; TIA 17-14; TIA 17-15; TIA 17-16; TIA 17-17) National Electrical Code

SOCIETY FOR PROTECTIVE COATINGS (SSPC)

SSPC SP 10/NACE No. 2	(2007) Near-White Blast Cleaning

1.2 SUBMITTALS

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NOTE: Review submittal description (SD) definitions in Section 01 33 00 SUBMITTAL PROCEDURES and edit the following list to reflect only the submittals required for the project.

The Guide Specification technical editors have

designated 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 submittals requiring Government approval on Army projects, a code of up to three characters within the submittal tags may be used following the "G" designation 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" following a submittal item indicates that the submittal is required for the Sustainability eNotebook to fulfill federally mandated sustainable requirements in accordance with Section 01 33 29 SUSTAINABILITY REPORTING. Locate the "S" submittal under the SD number that best describes the submittal item.

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

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Government approval is required for submittals with a "G" designation; submittals not having a "G" designation are for [Contractor Quality Control approval.] [information only. When used, a designation following the "G" designation identifies the office that will review the submittal for the Government.] Submittals with an "S" are for inclusion in the Sustainability eNotebook, in conformance to Section 01 33 29 SUSTAINABILITY REPORTING. Submit the following in accordance with Section 01 33 00 SUBMITTAL PROCEDURES:

SD-02 Shop Drawings

Heat Distribution System

SD-03 Product Data

Spare Parts

Support of the Equipment

SD-04 Samples

Insulation

SD-05 Design Data

Expansion Loop Insulation Method; G[, [_____]]

SD-06 Test Reports

Tests

SD-07 Certificates

Flange Gasket Kits

SD-10 Operation and Maintenance Data

Maintenance; G[, [_____]]

1.3 DELIVERY, STORAGE, AND HANDLING

Store all materials and equipment delivered and placed in storage with protection from the weather; excessive humidity and excessive temperature variation; and dirt, dust, or other contaminants.

1.4 EXTRA MATERIALS

Submit spare parts data for each different item of material and equipment specified, after approval of the related submittals and not later than the start of the field tests. Include in the data a complete list of parts and supplies and source of supply.

PART 2 PRODUCTS

2.1 GENERAL REQUIREMENTS

2.1.1 Standard Products

Provide materials and equipment which are the standard products of a manufacturer regularly engaged in the manufacture of such products and that essentially duplicate items that have been in satisfactory use for at least 2 years prior to bid opening.

Equipment items must be supported by service organizations. Submit a certified list of qualified permanent service organizations for support of the equipment which includes their addresses and qualifications. These service organizations must be reasonably convenient to the equipment installation and able to render satisfactory service to the equipment on a regular and emergency basis during the warranty period of the contract.

2.1.2 Nameplates

Ensure each major item of equipment such as sump pumps, motors, steam traps, and pressure reducing valves is provided with the manufacturer's name, address, type or style, model or serial number, and catalog number on a plate secured to the item of equipment.

2.1.3 Asbestos Prohibition

Asbestos and asbestos-containing products are not allowed.

2.1.4 Electrical Work

Provide motors, manual or automatic motor control equipment, and protective

or signal devices required for the operation specified under this section in accordance with NFPA 70 and Section 33 71 02 UNDERGROUND ELECTRICAL DISTRIBUTION.

2.2 PIPING AND FITTINGS

Unless otherwise specified, provide all pipe, fittings, valves, and piping accessories conforming to the requirements of ASME B31.1, and be the proper type, class, and grade for pressure and temperature of the heating medium.

2.2.1 Steel Pipe

Provide steel pipe 50 mm 2 inches in diameter and larger that are seamless or electric-resistance welded conforming to ASTM A53/A53M, Grade B, Type E or S; or to ASTM A106/A106M, Grade B. Provide steel pipe 40 mm 1-1/2 inches in diameter and smaller that are seamless conforming to ASTM A106/A106M, Grade B. Provide condensate piping, gauge piping, and piping 19 mm 0.75 inch in diameter and smaller that are extra strong. Provide all other pipe that are standard weight.

2.2.1.1 Nipples

Provide nipples conforming to ASTM A733 as required to match adjacent piping.

2.2.1.2 Steel Flanges

****

NOTE: Use not less than Class 150 for steam up to 862 kPa 125 psig, not less than Class 300 for steam 863 to 1724 kPa 126 to 250 psig, and for high temperature hot water.

****

Provide steel flanges conforming to ASME B16.5 Class [150] [and] [or] [300] and matching valves or flanged fittings on which used. Ensure flanges have the manufacturer's trademark affixed in accordance with MSS SP-25 so as to permanently identify the manufacturer.

2.2.1.3 Pipe Threads

Provide pipe threads conforming to ASME B1.20.2M ASME B1.20.1. Pipe threads may be used only on pipe 19 mm 0.75 inch or smaller.

2.2.2 Fittings

Provide fittings, valves, flanges and unions that have the manufacturer's trademark affixed in accordance with MSS SP-25 so as to permanently identify the manufacturer.

2.2.2.1 Welded Fittings

Provide welded fittings conforming to ASTM A234/A234M, buttwelded or socket welded, standard weight or extra strong, as required to match connecting piping. Provide buttwelded fittings conforming to ASME B16.9, and socket welded fittings conforming to ASME B16.11.

2.2.2.2 Malleable Iron Fittings

Provide fittings conforming to ASME B16.3, ASTM A47/A47M, class as required to match connecting piping.

2.2.2.3 Unions

Provide unions conforming to ASME B16.39 as required to match adjacent piping.

2.2.3 Insulating Flanges and Dielectric Waterways

****

NOTE: Where dissimilar metals are to be joined, or when connecting to cathodically protected systems, electrically insulating flanges or dielectric waterways will be provided.

For flanges, use not less than Class 150 for up to 862 kPa 125 psig steam, not less than Class 300 for 863 to 1724 kPa 126 to 250 psig steam, and for high temperature hot water. Gaskets must have the following characteristics: (1) Impermeability with respect to the fluid/gas contained by the system; (2) Chemical stability with respect to the fluid/gas contained by the system; (3) Sufficient deformability so as to flow into the imperfections on the seating surfaces and provide intimate contact between the gasket and these surfaces; (4) Thermal stability with respect to the fluid/gas contained by the system; (5) Sufficient resiliency so as to support an adequate portion of the applied load when joint movements are not completely eliminated by the system design; (6) Sufficient strength to resist crushing under the applied load and blow-out under the system pressure; (7) Contain no products that could contaminate the fluid/gas contained by the system; (8) Contain no products that could cause corrosion of the seating surfaces; (9) Able to maintain integrity during handling and installation; (10) Able to be readily removed at the time of replacement; (11) Must have a sufficiently high dielectric strength; (12) Gaskets containing metallic graphite or wire cannot be used for this application; and (13) Must not contain asbestos.

****

Submit certificate from the material supplier of the electrically insulating flange gasket kits stating that the supplied material meets specified requirements and that provides evidence that satisfactory operating requirements have been met, before the materials are delivered. Certificate must be signed by an official authorized to certify in behalf of material supplier or product manufacturer and must identify quantity and date or dates of shipment or delivery to which the certificates apply. Install insulating flanges or flange gasket kits at every pipe connection from the trench system to an underground system and at dissimilar metals. Provide a kit consisting of a flange gasket, bolt sleeves, and one insulating washer and one steel washer for both ends of each bolt. Ensure the gasket kits are capable of electrically isolating the pipe at the

pressure and temperature of the heating medium at the point of application. Material of the type being used must have been installed in an installation which has been satisfactorily operating for not less than 2 years. Ensure that these kits are provided and properly installed according to manufacturer published instructions as indicated. Provide dielectric waterways with temperature and pressure rating equal to or greater than that specified for the connecting piping used for joining dissimilar metals, 19 mm 0.75 inch and smaller threaded pipe. Ensure waterways have metal connections on both ends suited to match connecting piping. Provide dielectric waterways internally lined with an insulator specifically designed to prevent current flow between dissimilar metals. Ensure dielectric flanges meet the performance requirements described herein for dielectric waterways.

2.3 VALVES

****

NOTE: Select the appropriate valves for the operating temperatures and pressures of all systems in the project. Delete valve types not included in project.

Use not less than Class 150 for up to 862 kPa 125 psig steam, not less than Class 300 for 863 to 1724 kPa 126 to 250 psig steam, and for high temperature hot water. For isolation and shutoff, use gate valves only. Steam pressure reducing valves are not normally part of the system. If needed, designer should refer to Section 23 70 01.00 10 CENTRAL STEAM-GENERATING SYSTEM, COAL-FIRED.

****

Unless otherwise specified, provide valves that comply with the material, fabrication, and operating requirements of ASME B31.1. Provide valves suitable for the temperature and pressure requirements of the system on which used. Provide valves for [steam] [hot water] conforming to ASME B31.1 Class [150] [and] [or] [300], as suitable for the application. [Provide valves for condensate services conforming to ASME B31.1 Class 150.] Provide valves 150 mm 6 inches and larger with a 25 mm 1 inch minimum gate or globe [integral] bypass valve sized in conformance with MSS SP-45. Provide valves that have the manufacturer's trademark.

2.3.1 Steel Valves

Provide globe, gate, angle, and check valves conforming to the requirements of ASME B16.34 and ASME B31.1 for the temperature and pressure requirements of the system. Provide gate valves 65 mm 2-1/2 inches and smaller with a rising stem. Provide gate valves 80 mm 3 inches and larger with an outside screw and yoke.

2.3.2 Bronze Valves

2.3.2.1 Globe, Gate, and Angle Valves

Provide globe, gate, and angle valves conforming to requirements of MSS SP-80.

2.3.2.2 Check Valves

Provide check valves conforming to the requirements of MSS SP-80.

2.3.3 Packing

Provide valves with packing that does not contain asbestos. Provide valve stem packing that is die-formed, ring type specifically designated as suitable for the temperature and pressure of the service and compatible with the fluid in the system. Provide packing rings that are polytetrafluoroethylene with minimum 50 percent graphite filament top and bottom rings. Provide valves 40 mm 1-1/2 inches and smaller that have four or five packing rings. Provide valves 50 mm 2 inches and larger with at least six packing rings. Spiral or continuous packing will not be acceptable. Provide a metal insert having proper clearance around the valve stem at the bottom of the stuffing box and acting as a base for the packing material. Provide packing glands furnished with a liner of noncorrosive material and one piece construction with provisions for not less than two bolts for packing adjustment.

2.4 STEAM TRAPS

****
NOTE: The following paragraphs are applicable to steam systems only. Only these two types will be used. A schedule of steam trap selections will be shown on the drawings.

Trap capacity (kg per hour (pounds per hour during normal operation), pressure drop kPa psi, and pressure rating kPa psi of each trap will be included in this schedule. Show on drawings a vent valve or test valve connection downstream of traps for test of trap operation, a strainer ahead of trap, a check valve in outlet piping, and shut-off valves on both sides of trap for trap changeout. A means of bypassing the trap must be provided for system warm-up.
****

Provide class of trap bodies suitable for a working pressure of not less than 1.5 times the steam supply pressure, but not less than 1.38 MPa 200 psi, and traps capable of operation under a steam-supply pressure as indicated with trap capacities as shown when operating under the specified working conditions. Provide traps that fail open.

2.4.1 Bucket Traps

Provide inverted-bucket type bucket traps with automatic air discharge conforming to ASTM F1139.

2.4.2 Thermostatic Traps

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NOTE: Specify thermostatic traps where the trap location is subject to freezing. Style B traps are bimetallic element traps.
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Provide thermostatic type thermostatic traps with bimetallic element automatic air discharge conforming to ASTM F1139.

2.5 STRAINERS

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NOTE: Delete for high temperature water systems.
****

Provide basket or Y-type strainers with connections the same size as the pipe lines in which the connections are installed. Provide heavy and durable strainer bodies of cast steel with bottoms drilled and plugged suitable for service temperatures and pressures utilized with arrows clearly cast on the sides to indicate the direction of flow. Each strainer is equipped with an easily removable cover and sediment basket with the body or bottom opening equipped with nipple and gate valve for blowdown. Provide 0.6350 mm 0.025 inch thick stainless steel, Monel or sheet brass strainer basket with small perforations of sufficient number to provide a net free area at least 2.5 times the area of the entering pipe. Provide cast steel bodies and stainless or Monel baskets for high temperature hot water systems.

2.6 PRESSURE GAUGES

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NOTE: Delete if not required.
****

Provide pressure gauges conforming to ASME B40.100 with a minimum dial size of 110 mm 4-1/4 inches, a throttling type needle valve or a pulsation dampener, and shut-off valve.

2.7 THERMOMETERS

****
NOTE: Delete if not required.
****

Do not provide thermometers containing mercury.

2.7.1 Liquid in Glass

Provide liquid in glass type thermometer with well and separable corrosion-resistant steel socket. Provide thermometer on insulated pipe with an insulation stand-off provision. Provide thermometer with minimum scale length of 178 mm 7 inches.

2.7.2 Dial

Provide a dial type thermometer with a dial size of 90 mm 3.5 inches in diameter with stainless steel case, remote-type bulb or direct-type bulb as applicable, with an accuracy of plus or minus 1 degree C 2 degrees F and white face with black digits graduated in 1 degree C 2 degrees F increments.Provide thermometer wells of the separable socket type for each thermometer with direct-type bulb.

2.8 INSULATION AND JACKETING

2.8.1 Insulation for Piping in Concrete Trenches

Provide molded calcium silicate insulation for all piping, fittings, and valves conforming to ASTM C533, Type I, or molded mineral fiber insulation conforming to ASTM C547, Class 2, or cellular glass insulation conforming to ASTM C552. Provide factory or field applied insulation. Other than FOAMGLAS, do not use laminated construction in thicknesses less than 102 mm 4 inches. Provide insulation on piping in concrete trenches covered with aluminum or nonmetallic jacket.

2.8.2 Aluminum Jacket

Provide smooth sheet jacket, 0.4064 mm 0.016 inch nominal thickness; ASTM B209M ASTM B209, Type 3003, 3105, or 5005. Use aluminum jacket over calcium silicate insulation.

2.8.3 Nonmetallic Jacket

Provide nonmetallic jacket consisting of a 203 grams/square meter 6 ounces per square yard fiberglass fabric impregnated with chlorosulfanated polyethylene (Hypalon) and a 0.038 mm 1.5 mils polyvinyl fluoride film (Tedlar) bonded to it. Ensure overall thickness of the composite is 0.254 mm 0.010 inch and weigh approximately 356 grams/square meter 10.5 ounces per square yard. Jacket may be either field or factory applied to the insulation. Do not use the jacket with any calcium silicate insulation. Use nonmetallic jacket with molded mineral fiber insulation.

2.8.4 Bands

Provide bands for aluminum jackets that are 10 mm .38 inch wide and 0.8128 mm 32 gauge thickness made of aluminum or annealed stainless steel. Provide bands for insulation that are 13 mm 0.5 inch wide and 0.8128 mm 32 gauge thickness made of annealed stainless steel.

2.8.5 Insulation for Flanges, Unions, Valves, and Fittings

Provide flanges, unions, valves, and fittings insulated with premolded prefabricated, or field fabricated segments of removable and reusable insulation of the same material and thickness as the manhole pipe insulation with the same thermal characteristics and thickness as the adjoining piping.

2.9 CONCRETE WORK

****
NOTE: Specify concrete work in detail in Section 03 30 00.00 10 CAST-IN-PLACE CONCRETE. Specify precast concrete work in detail in SECTION 03 42 13.00 10 PLANT-PRECAST CONCRETE PRODUCTS FOR BELOW GRADE CONSTRUCTION. Use applicable requirements of, and edit the above guide specifications and include all specific requirements pertinent to local conditions.
****

2.9.1 Concrete

2.9.1.1 Cast-in-Place Concrete

Provide as specified in [Section 03 30 00.00 10 CAST-IN-PLACE CONCRETE][Section 03 30 00 CAST-IN-PLACE CONCRETE].

2.9.1.2 Precast Concrete Products

Provide as specified in [Section 03 42 13.00 10 PLANT-PRECAST CONCRETE PRODUCTS FOR BELOW GRADE CONSTRUCTION][Section 03 41 16.08 PRECAST CONCRETE SLABS (MAX. SPAN 8 FEET O.C.)].

2.9.2 Concrete Joint Sealants

Provide concrete joint sealants conforming to ASTM C920, Type M (multicomponent), Class 25, grade NS (nonsag) for vertical surfaces or grade P (pourable self-leveling).

2.9.3 Gasket Material

Provide gasket material used between concrete trench covers and trench wall tops that is 6 mm 0.25 inch thick neoprene pad with a minimum width of 50 mm 2 inches conforming to ASTM D1056.

2.9.4 Concrete Expansion Joints, Contraction Joints, and Waterstops

Provide concrete expansion joints, contraction joints, and waterstops as specified in Section 03 15 00.00 10 CONCRETE ACCESSORIES.

2.10 BITUMINOUS PAVING

****
NOTE: Delete if not required or if roads are constructed after tunnel crossings.
****

Provice bituminous course and tack coat used at street crossings as specified in Section 32 12 16 HOT-MIX ASPHALT (HMA) FOR ROADS and Section 32 12 13 BITUMINOUS TACK AND PRIME COATS.

2.11 MISCELLANEOUS METAL

****
NOTE: Include miscellaneous metals located in trenches or valve manholes in Section 05 50 13 MISCELLANEOUS METAL FABRICATIONS.
****

Provide miscellaneous metal not otherwise specified conforming to Section 05 50 13 MISCELLANEOUS METAL FABRICATIONS. Provide miscellaneous metal bolted together, shop welded, or assembled in the field, and pipe supports including structural cross support members and anchors that is hot-dip galvanized in accordance with Section 05 50 13 MISCELLANEOUS METAL FABRICATIONS.

2.12 INSPECTION PORTS AND ACCESS COVERS

Provide inspection ports and access covers in concrete tops that are standard cast iron frame and cover. Provide inspection ports that are 300 mm 12 inch nominal diameter and access covers shall be 600 mm 24 inch nominal diameter unless otherwise indicated.

****

NOTE: Expansion joints generally will not be used in the design of the piping layout. If no other method is available to handle the expansion problem in a specific location, the design layout using an expansion joint at a specific location must be justified by a design analysis and approved in the planning phase of the piping layout prior to including expansion joints in the specifications. If expansion joints or ball joints are required, the locations will be indicated on the drawings. Since expansion joints are high maintenance items, these must be located in a readily accessible location. The following requirements tailored as EXPANSION JOINTS must be included in this specification section.

****

2.13 BELLOWS TYPE JOINTS

Select bellows type or slip-type to satisfy specific design conditions. Provide joints that are flexible, guided expansion joints. Ensure the expansion element is stainless steel. Provide bellows type expansion joints that are in accordance with the applicable requirements of EJMA Stds and ASME B31.1 with internal liners.

2.14 EXPANSION JOINTS

Provide expansion joints for either single or double slip of connected pipes, as required or indicated, and for not less than the traverse indicated. Provide joints designed for hot water working pressure and are in accordance with applicable requirements of EJMA Stds and ASME B31.1. Provide joints designed for packing injection under full line pressure. Provide end connections flanged or beveled for welding as indicated. Provide joints with anchor base where required or indicated. Where adjoining pipe is carbon steel, the sliding slip must be seamless steel plated with a minimum of 0.0508 mm 2 mils of hard chrome in accordance with ASTM B650. Provide joint components fabricated from material equivalent to that of the pipeline. Ensure initial setting are made in accordance with the manufacturer's recommendations to compensate for ambient temperature at time of installation. Install pipe alignment guides as recommended by the joint manufacturer, but in any case not be more than 1.5 m 5 feet from expansion joint except for lines 100 mm 4 inches or smaller; guides must be installed not more than 600 mm 2 feet from the joint. Provide service outlets where indicated.

2.15 FLEXIBLE BALL JOINTS

Provide flexible ball joints constructed of alloys as appropriate for the service intended. Where so indicated, the ball joint must be designed for packing injection under full line pressure to contain leakage. Provide joint ends threaded to 50 mm 2 inches only, grooved, flanged or beveled for

welding as indicated or required, and be capable of absorbing a minimum of 15 degrees angular flex and 360 degrees rotation. Provide balls and sockets of equivalent material as the adjoining pipeline. Exterior spherical surface of carbon steel balls must be plated with 0.0508 mm 2 mils of hard chrome in accordance with ASTM B650. Provide ball type joints designed and constructed in accordance with ASME B31.1 and ASME BPVC SEC VIII D1, where applicable. Provide flanges conforming to ASME B16.5. Provide gaskets and compression seals compatible with the service intended.

PART 3 EXECUTION

3.1 EXAMINATION

After becoming familiar with all details of the work, verify all dimensions in the field, and advise the Contracting Officer of any discrepancy before performing the work.

3.2 SITEWORK

3.2.1 Excavation, Trenching, and Backfilling

Provide excavation, trenching, and backfilling of concrete trench systems, [and relocation of interferences and modifications to existing facilities] in accordance with Section 31 00 00 EARTHWORK.

3.2.2 Removal, Replacement, or Relocation of Interferences

Remove, replace, or relocate interferences indicated or found during construction. Removal, replacement, or relocation must be as shown, or as approved by the Contracting Officer. Examples of interferences include:

a. Storm and sanitary sewers and manholes.

b. Water lines, gas lines, fire hydrants, and lawn sprinkler systems.

c. Power and communication lines, conduits, poles, and guys.

d. Fences, sidewalks, and signs.

e. Grass, shrubs, trees, and rocks.

3.2.3 Modifications to Existing Facilities

Modifications to existing facilities must be made as indicated. Examples of modifications include:

a. Removal and replacement of street or parking area pavements.

b. Removal and replacement of curbs, gutters, and sidewalks.

c. Reconstruction of existing valve manholes.

d. New heat distribution piping entrances to buildings, valve manholes, or trenches.

3.2.4 Electric Work

Provide any wiring required for the operation of the equipment specified,

but not shown on the electrical drawings, in this section in accordance with Section 33 71 01 OVERHEAD TRANSMISSION AND DISTRIBUTION, and Section 33 71 02 UNDERGROUND ELECTRICAL DISTRIBUTION.

3.2.5 Painting

Clean the heat affected zone of field welded galvanized surfaces and other galvanized surfaces damaged during installation in compliance with SSPC SP 10/NACE No. 2 and painted in accordance with Section 09 90 00 PAINTS AND COATINGS.

3.3 PIPING

3.3.1 General Piping Requirements

****

NOTE: Expansion joints generally will not be used in the design of the piping layout. If no other method is available to handle the expansion problem in a specific location, the design layout using an expansion joint at a specific location must be justified by a design analysis and approved in the planning phase of the piping layout prior to including expansion joints in the specifications. If expansion joints or ball joints are required, the locations will be indicated on the drawings. Since expansion joints are high maintenance items, these must be located in a readily accessible location. EXPANSION JOINTS tailoring requirements must be included in this specification section.

****

Accurately cut pipe to measurements established at the site and worked into place without springing or forcing. Ensure pipe is clear of all openings and equipment. Excessive cutting or other weakening of structural members to facilitate piping installation will not be permitted. Remove burrs from ends of pipe by reaming. Ensure installation permits free expansion and contraction without damage to joints or hangers. Install piping in accordance with ASME B31.1. Weld joints for piping in concrete trenches [, except joints at traps, strainers, and at valves 19 mm 0.75 inch and smaller in steam, condensate, and drip lines, which may use unions or may be threaded]. Do not attach supports, anchors, or stays where either expansion or the weight of the pipe will cause damage to permanent construction. Provide noninsulated ferrous parts of the piping, piping support system, or equipment that are hot-dip galvanized after fabrication in conformance with ASTM A123/A123M.

a. Ensure expansion of piping provide for by changes in the direction of the run of pipe or by expansion loops as shown.

b. Changes in direction may be made by bending the pipe, provided that a hydraulic pipe bender is used. Pipe to be bent must be steel conforming to ASTM A53/A53M or ASTM A106/A106M type and grade for bending, and class required to match adjoining pipe. Bent pipe showing kinks, wrinkles, or malformations will not be acceptable.

c. Pitch all piping, unless otherwise indicated, with a grade of not less than 25 mm in 6 m 1 inch in 20 feet toward drain points with slope maintained throughout the system, including through each leg of each

expansion loop.

d. Properly cap or plug open ends of pipe lines and equipment during installation to keep dirt and other foreign matter out of the system.

3.3.2 Welded Joints

Weld joints between sections of pipe and between pipe and fittings in accordance to the requirements specified in paragraph WELDING. Branch connections may be made with either welding tees or forged branch outlet fittings. Branch outlet fittings where used, must be forged and must be no larger than two nominal pipe sizes smaller than the main run. Branch outlet fittings must be flared for improved flow where attached to the run, reinforced against external strains, and designed to withstand full pipe bursting strength.

3.3.3 Flanged and Threaded Joints

****
NOTE: Flanged joints will be permitted for dielectric isolation only.
****

3.3.3.1 Flanged Joints

Provide true faced joints with gaskets, square and tight. Provide electrically isolated flange joints at all connections to building underground systems and between dissimilar metals.

3.3.3.2 Threaded Joints

Provide joints with graphite or inert filler and oil, graphite compound, or polytetrafluoroethylene tape applied to the male threads only. Provide dielectric unions at connections of dissimilar metals in 19 mm 0.75 inch and smaller piping.

3.3.4 Reducing Fittings

3.3.4.1 Horizontal Water Heating Lines

In horizontal hot water heating lines, provide eccentric type reducing fittings to maintain the tops of adjoining pipes at the same level.

3.3.4.2 Horizontal Steam Lines

In horizontal steam lines, provide eccentric type reducing fittings to maintain the bottom of adjoining pipes at the same level.

3.3.5 Branch Connections

Ensure branches from mains branch off top of mains as indicated or as approved. Ensure connections allow unrestricted circulation, elimination of air pockets, and permit the complete drainage of the system.

3.3.6 Pipe Supports Exposed in Concrete Trenches

Securely support horizontal and vertical runs of pipe in concrete trenches . Provide adjustable pipe hangers having bolted hinged loops and turnbuckles or by other approved devices as shown on the drawings, and all conforming

to MSS SP-58 for suspended pipe. Chain or flat steel strap hangers or single point supports will not be acceptable. Provide all pipe supports including the structural cross support member in accordance with Section 05 50 13 MISCELLANEOUS METAL FABRICATIONS.

3.4 WELDING

Perform welding and radiographic examination of all steel carrier pipe welds in accordance with Section 40 05 13.96 WELDING PROCESS PIPING. Weld structural members in accordance with Section 05 05 23.16 STRUCTURAL WELDING.

3.5 RADIOGRAPHIC TESTING

Submit detail drawings for steam traps, valves, sump pumps, pressure gauges, thermometers and insulation, including a complete list of equipment and material, including manufacturer's descriptive and technical literature, performance charts and curves, catalog cuts, and installation instructions. Show on the drawings complete wiring and schematic diagrams, pipe stress calculations for any revised expansion loops, and any other details required to demonstrate that the system has been coordinated and will properly function as a unit. Show on the drawings proposed system layout, provisions for expansion, pipe anchors and guides, and layout and anchorage of equipment and appurtenances in valve manholes, and equipment relationship to other parts of the work including clearances for maintenance and operation.

a. Provide radiographic examination of all field welds in the steel carrier piping of the heat distribution system in accordance with ASME B31.1 performed as specified in Section 40 05 13.96 WELDING PROCESS PIPING. Provide an approved independent testing firm or firms regularly engaged in radiographic testing to perform a radiographic examination of all field welds in accordance with ASME B31.1.

b. Furnish a set of films showing each weld inspected, a reading report evaluating the quality of each weld, and a location plan showing the physical location where each weld is to be found in the completed project, prior to backfilling and hydrostatic testing. Provide a report that is reviewed and interpreted by a Certified Level III Radiographer employed by the testing firm with signature of reviewer/interpreter on the report readings for all radiographs.

c. The Contracting Officer reserves the right to review all inspection records, and if any welds inspected are found unacceptable they will be removed, rewelded, and radiographically examined at no cost to the Government.

3.6 INSULATION

Submit display sample sections for insulation of pipe, elbow, tee, valve, support point, and terminating points. After approval of material and prior to insulation of piping, prepare a display of insulated sections showing compliance with specifications, including fastening, sealing, jacketing, straps, waterproofing, supports, hangers, anchors, and saddles. Keep sample sections on display at the jobsite during the construction period until no longer needed. Install insulation so that it is not damaged by pipe expansion or contraction. Groove insulation installed over welds to assure a snug fit. Hold insulation in place with stainless steel straps. Install a minimum of 2 bands on each individual length of

insulation with maximum spacing not exceeding 450 mm 18 inch centers. Submit performance test reports in booklet form showing all field tests performed to adjust each component and all field tests performed to prove compliance with the specified performance criteria, upon completion and testing of the installed system. Indicate on each test report the final position of controls and valves.

3.6.1 Installation

Install material in accordance with published installation instructions of the manufacturer. Apply insulation materials only after piping tests are satisfied completed.

3.6.1.1 Preparation

Prior to application, thoroughly clean surfaces of moisture, grease, dirt, rust, and scale, and paint where required.

3.6.1.2 Thickness

****
NOTE: Delete inapplicable columns in Tables 1 and 2.
****

Provide the minimum thickness of insulation for [the heat distribution system] [and] [condensate return system] [each section of pipe] in accordance with Tables 1 and 2.

TABLE 1
Minimum Pipe Insulation Thickness (mm) (inches)

For steam up to 1.10 MPa to 1.72 MPa 16 psig to 250 psig and high temperature hot water supply and return piping up to 232 degrees C 450 degrees F

Nominal Pipe Diameter (mm) (inches)	Insulation Thermal Conductivity (k)		
	k less than 0.29	k from 0.29 to 0.40	k greater than 0.40
25 1.0	50 2.0	63 2.5	100 4.0
40 1.5	50 2.0	63 2.5	100 4.0
50 2.0	63 2.5	85 3.5	110 4.5
65 2.5	63 2.5	85 3.5	110 4.5
80 3.0	75 3.0	100 4.0	125 5.0
100 4.0	75 3.0	100 4.0	125 5.0
125 5.0	75 3.0	100 4.0	125 5.0
150 6.0	85 3.5	110 4.5	135 5.5
200 8.0	85 3.5	110 4.5	135 5.5

TABLE 1
Minimum Pipe Insulation Thickness (mm) (inches)

For steam up to 1.10 MPa to 1.72 MPa 16 psig to 250 psig and high temperature hot water supply and return piping up to 232 degrees C 450 degrees F

250 10.0	100 4.0	125 5.0	150 6.0
300 12.0	100 4.0	125 5.0	150 6.0
350 14.0	100 4.0	125 5.0	150 6.0
400 16.0	100 4.0	125 5.0	150 6.0
450 18.0	100 4.0	125 5.0	150 6.0

NOTE: Insulation thermal conductivity (k-value) is in units of watt per meter-degree K at 93 degrees C Btu-inches/hour-square-feet-degrees F at 200 degrees F mean temperature.

TABLE 2
Minimum Pipe Insulation Thickness (mm) (inches)

For Low Pressure Steam (less than 110 kPa (gage) 16 psig), Condensate Return and Low Temperature Hot Water (less than 121 degrees C 250 degrees F) supply and return piping.

Nominal Pipe Diameter (mm) (inches)	Insulation Thermal Conductivity (k)		
	k less than 0.29	k from 0.29 to 0.40	k greater than 0.40
25 1.0	35 1.5	50 2.0	75 3.0
40 1.5	35 1.5	50 2.0	75 3.0
50 2.0	35 1.5	50 2.0	75 3.0
65 2.5	35 1.5	50 2.0	75 3.0
80 3.0	50 2.0	63 2.5	85 3.5
100 4.0	50 2.0	63 2.5	85 3.5
125 5.0	50 2.0	63 2.5	85 3.5
150 6.0	63 2.5	75 3.0	110 4.5
200 8.0	63 2.5	75 3.0	110 4.5
250 10.0	75 3.0	100 4.0	125 5.0
300 12.0	75 3.0	100 4.0	125 5.0

TABLE 2 Minimum Pipe Insulation Thickness (mm) (inches)			
For Low Pressure Steam (less than 110 kPa (gage) 16 psig), Condensate Return and Low Temperature Hot Water (less than 121 degrees C 250 degrees F) supply and return piping.			
350 14.0	75 3.0	100 4.0	125 5.0
400 16.0	75 3.0	100 4.0	125 5.0
450 18.0	75 3.0	100 4.0	125 5.0
NOTE: Insulation thermal conductivity (k-value) is in units of watt per meter-degree K at 93 degrees C Btu-inches/hour-square-feet-degrees F at 200 degrees F mean temperature.			

3.6.2 Insulation on Pipes Passing Through Sleeves

Install insulation continuously through sleeves. Provide aluminum jackets over the insulation. When penetrating building walls, extend aluminum jackets not less than 50 mm 2 inches beyond the sleeve on each side of the wall and be secured with an aluminum band on each side of the wall. Where flashing is provided, secure the jacket with one band not more than 25 mm 1 inch from the end of the jacket.

3.6.3 Covering of Insulation in Concrete Trenches

Provide aluminum jackets for pipe insulation, flanges, valves, and fittings.

3.7 CONCRETE TRENCH SYSTEM

****
NOTE: Provide details on plan/profile drawings showing concrete trench size, profile of existing grade, grading and drainage problems along trench route, elevations of trench floor and piping, and thickness of trench concrete cover.
****

Provide and install a concrete cast-in-place trench system with a removable top as shown on the drawings.

3.7.1 Concrete

****
NOTE: Concrete work will be specified in detail in Section 03 30 00.00 10 CAST-IN-PLACE CONCRETE, edit the spec and include all specific requirements pertinent to local conditions and designers General Notes.
****

Provide materials and methods for mixing and placing of concrete as specified in [Section 03 30 00.00 10 CAST-IN-PLACE CONCRETE][Section 03 30 00 CAST-IN-PLACE CONCRETE].

3.7.2 Joint Sealants

Seal concrete joints as indicated. Provide type II sealant (non-sagging) for vertical joints. Provide type I sealant for trench top butt joints. For all other joints, seal with Type I or Type II sealant. Provice trench bottom sealant finish flush with floor.

3.7.3 Concrete Trench Tops

****
NOTE: Tops must be square and not out of plane, and must be cast to lay flat in all directions. Provide notes on drawings.
****

Provide precast or cast-in-place concrete trench tops. Provide concrete as specified in [Section 03 30 00.00 10 CAST-IN-PLACE CONCRETE][Section 03 30 00 CAST-IN-PLACE CONCRETE]. Ensure tops are flat and true and lay flat at all locations where contact on trench wall is to be made. Tolerances must be true planes within 4 mm in 3 m 0.012 inch in 8 feet as determined by 2.44 m 8 foot straight edge placed diagonally on top. Deviation from square or designated skew (difference in length of the two diagonal measurements) must be 3 mm in 2 m 0.012 inch in 6 feet or 6 mm 0.25 inch total, whichever is greater. Maximum permissible warpage of one corner out of the plane of the other three must be 5 mm per meter 0.06 inch per foot distance from the nearest adjacent corner. Do not install concrete trench tops with defects which affect the strength of the cover unit, or which are warped, honeycombed, contain visible air pockets, exposed aggregate, or other surface defects such as spalled, chipped, or broken edges, . Place neoprene gasket material on the top of concrete trench walls so as to provide a seal between the wall and the concrete trench covers. Surfaces of joints to be in contact with gasket material must be dry and free of oil, grease, dirt, loose concrete particles, or other foreign substances. Place gasket material in a continuous length along the wall as much as practical. Butt gasket ends tightly together at splices. Construct concrete trench tops in maximum lengths of 2.4 m 8 feet and minimum lengths of 1.2 m 4 feet and must be a minimum of 100 mm 4 inches thick, unless otherwise indicated. Provide each top section with means to accept a lifting device for removal of slab, as indicated on the drawings.

3.7.4 Concrete Trench Construction

****
NOTE: Provide details on the drawings of the concrete trenches and concrete walks. Provide details of the various trench sizes for the different sizes of heat distribution piping anticipated for this contract.

Where concrete trench tops are used in conjunction with sidewalks, provide sidewalk sections on the drawings between loop legs to maintain a continuous sidewalk.
****

Ensure inside edge and top of walls has smooth and even surfaces to accommodate trench tops.

3.7.5 Final Elevations

Slope the concrete trench floor continuously and drain toward valve manholes. Construct the concrete trench at the elevation shown on the drawings and grade the adjacent areas. Grade any cut or fill areas adjacent to the concrete trench back to the existing grade at a 1 to 10 slope, or as indicated. Take care to avoid forming pockets adjacent to the concrete trench; thereby, preventing surface drainage. Install the concrete trench floor and pipe parallel and maintain constant slope toward the drain points indicated.

3.7.6 Coordination with Existing Utilities

Before beginning work in a given area, all utility information must be field verified by surface markings made by the affected utility Owner's Representative. Notify the Contracting Officer in advance, and receive prior approval before excavating in any areas. The actual concrete trench routing may be offset or changed if approved by the Contracting Officer in order to reduce conflicts, interruptions, expedite the work, or for any other reason to the mutual benefit of the Contractor and the Government. Utility conflicts may be cast into the floor of the trench providing they do not interfere with concrete trench drainage and are approved by the Contracting Officer. [After the new heat distribution system is cut-in, the existing system can be [removed.] [abandoned in place if not in conflict with the new construction and not shown to be removed on the drawings.]]

3.7.7 Piping Support System

****

NOTE: Provide design details of pipe supports on drawings. Show sizes, shapes and means of how the system is to function. Supports may consist of welded plates, channels, structural tees, pipes or other support means.

****

Do not install pipes, pipe supports, or other related items on the floor of the concrete trench system. Pipe support members spanning traversely across the tunnel must allow a minimum of 100 mm 4 inches clearance between structural member and concrete trench floor. Additional minimum clearances required from the pipe insulation surface must be as follows: 200 mm 8 inches to concrete trench floor, 150 mm 6 inches to side walls, 150 mm 6 inches to trench cover, and 150 mm 6 inches between adjoining pipes.

3.7.8 Pipe Expansion

****

NOTE: Coordinate this paragraph with the specified requirements in paragraph General Piping Requirements.

****

Expansion must be accommodated by loops and bends as indicated on the drawings and specified. Pipe in the loops and bends must accommodate expansion while maintaining required insulation clearance from floors, walls, tops, and other pipes to avoid crushing or breaking of insulation. Expansion loops may be designed around obstacles such as utility manholes, structures, or trees to avoid construction conflicts. Maintain slopes of

pipe and trench bottoms Contractor must have the option to adjust the loop dimensions around obstacles based on final field measurements, if approved by the Contracting Officer. Submit pipe stress calculations for each revised expansion loop or bend based on the final actual measured lengths, or must submit dimensions to the Contracting Officer for verification of loop and bend sizes before proceeding with that segment of work. Ensure allowable pipe stresses are in accordance with ASME B31.1. Submit final expansion loop insulation method for approval to the Contracting Officer.

3.7.9 Concrete Trench Inspection Ports

****
NOTE: Show inspection ports on plan view and detail them on the drawings.

Provide inspection ports at appropriate locations to enable the user to observe elbows in expansion loops and bends, at high point pipe vents, approximately every 30 m (100 feet) of straight run, and at locations requiring frequent (monthly) observation.
****

3.7.10 Road/Drive Crossings

Install handicap ramp style curb cuts at all street and drive crossings as indicated.

3.7.11 Railroad Crossings

****
NOTE: Review railroad track removal/replacement with respective authority and coordinate all activities.
****

Restore tracks to their original condition as approved by the Contracting Officer after construction is complete.

3.8 TESTS

Conduct tests before, during, and after the installation of the system. Provide all instruments, equipment, facilities, and labor required to properly conduct the tests. Test pressure gauges for a specific test must be approved by the Contracting Officer and must have dials indicating not less than 1.5 times, nor more than 3 times the test pressure.

3.8.1 Cleaning of Piping

Prior to the hydrostatic and operating tests, flush the interior of the piping with clean water until the piping is free of all foreign materials. Flushing and cleaning out of system pipe, equipment, and components must not be considered completed until witnessed and accepted by the Contracting Officer. After flushing the system is completed, drain and fill the system with clean water. Provide temporary bypasses or temporary strainers around equipment and control valves to prevent clogging.

3.8.2 Field Tests

Conduct the following field tests when applicable to the system involved. If any failures occur, ensure adjustments or replacements as directed by the Contracting Officer and repeat the tests until satisfactory tests are completed.

3.8.2.1 Hydrostatic Tests of Service Piping

Hydrostaically test service piping before insulation is applied at field joints, and be proved tight at a pressure 1.5 times the working pressure of [_____] kPa psig or at 1.38 MPa 200 psig, whichever is greater. Hydrostatic test pressure must not exceed 3.45 MPa 500 psig. Hydrostatic test pressures must be held for a minimum of 4 hours. If the hydrostatic test pressure cannot be held, make necessary adjustments or replacements and repeat the tests until satisfactory results are achieved.

3.8.2.2 Equipment Tests

Operate all pumps, valves, traps, alarms, controls, and any other operable item of equipment to verify proper operation and compliance with the specifications. Record and submit pump voltage, current, and discharge readings for approval in accordance with SUBMITTALS paragraph (SD-06).

3.8.2.3 Insulating Flange Test

Test insulating flanges for electrical isolation in accordance with the insulating flange manufacturer's standard test. This test must be witnessed and approved by the Contracting Officer.

3.8.2.4 Operational Tests

After installation of the concrete trench system, or testable portion thereof, conduct operational tests. Do not place trench covers prior to completion of operational tests. Operational tests must consist of operating the system at the pressure and temperature expected for the system when in normal service, and must demonstrate satisfactory operating effectiveness. Ensure the test on each system, or portion thereof, last a minimum of 24 hours.

3.8.2.5 Trench Water Removal Tests

After the above tests are completed, and before concrete trench and valve manhole covers are placed, clean the concrete trenches, sumps, and valve manholes of dirt and debris. Test concrete trench system to ensure gravity drainage of water is maintained in trench bottom from high points to drained low points. Verify water does not pond between high and low points, and that drained low points are operational either by use of sump pumps or by gravity drainage to storm drains, as indicated. Test must not be considered completed until witnessed and accepted by the Contracting Officer. Place trench tops and sealed immediately after approval by the Contracting Officer.

3.9 MAINTENANCE

Provide [six] [_____] [hard] [optical disc] copies of operation and [six] [_____] copies of maintenance manuals for the equipment furnished. Provide one complete set prior to performance testing, and the remainder upon acceptance. Detail in the operation manuals the step-by-step procedures

required for system startup, operation, and shutdown and include the manufacturer's name, model number, parts list, and brief description of all equipment and their basic operating features. List in the maintenance manuals routine maintenance procedures, possible breakdowns and repairs, and troubleshooting guides and include piping and equipment layout and simplified wiring and control diagrams indicating location of electrical components with terminals designated for wiring, as installed. Operation and maintenance manuals must be approved prior to performance testing.

-- End of Section --