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USACE / NAVFAC / AFCESA / NASA **UFGS-02547 (April 2005)**

Preparing Activity: USACE **MasterFormat™ 2004 - 33 61 15**
Superseding
UFGS-02553 (August 2004)

UNIFIED FACILITIES GUIDE SPECIFICATIONS

References are in agreement with UMRL dated 23 June 2005

Latest change indicated by CHG tags
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DIVISION 02 - SITE CONSTRUCTION

SECTION 02547

HEAT DISTRIBUTION SYSTEMS IN CONCRETE TRENCHES

04/05

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SECTION 02547

HEAT DISTRIBUTION SYSTEMS IN CONCRETE TRENCHES
04/05

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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).

Comments and suggestions on this guide specification are welcome and should be directed to the technical proponent of the specification. A listing of technical proponents, including their organization designation and telephone number, is on the Internet.

Recommended changes to a UFGS should be submitted as a Criteria Change Request (CCR).

Use of electronic communication is encouraged.

Brackets are used in the text to indicate designer choices or locations where text must be supplied by the designer.
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PART 1 GENERAL

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NOTE: For a complete system include Section 02560 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 02554 EXTERIOR ABOVEGROUND STEAM DISTRIBUTION or Section 02546 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 judgement, 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 D 2487. 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 feet) or more below lowest point of water entry with not more than 10 percent of the length 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
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

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
			movement

Notes:

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 the 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 shall 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-69 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: 02300 EARTHWORK; 02741 BITUMINOUS CONCRETE PAVEMENT; 02748 BITUMINOUS TACK AND PRIME COATS; 02554 EXTERIOR ABOVEGROUND HEAT DISTRIBUTION; 16370A ELECTRICAL DISTRIBUTION SYSTEM, AERIAL; 16375A ELECTRICAL DISTRIBUTION SYSTEM, UNDERGROUND; 03150A EXPANSION JOINTS, CONTRACTION JOINTS, AND WATERSTOPS; 03300A CAST-IN-PLACE STRUCTURAL CONCRETE; 05090A WELDING, STRUCTURAL; 05500A MISCELLANEOUS METAL; 07131 ELASTOMERIC SHEET WATERPROOFING; 09900 PAINTS AND COATINGS; 05093 WELDING PRESSURE PIPING; 16402 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 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	(1983; R 2001) Pipe Threads, General Purpose, Inch
ASME B16.11	(2002) Forged Fittings, Socket-Welding and Threaded
ASME B16.3	(1998) Malleable Iron Threaded Fittings
ASME B16.34	(1996) Valves Flanged, Threaded, and Welding End

ASME B16.39	(1998) Malleable Iron Threaded Pipe Unions
ASME B16.5	(2003) Pipe Flanges and Flanged Fittings
ASME B16.9	(2003) Factory-Made Wrought Steel Buttwelding Fittings
ASME B31.1	(2004) Power Piping
ASME B40.100	(2000) Pressure Gauges and Gauge Attachments

ASTM INTERNATIONAL (ASTM)

ASTM A 106/A 106M	(2004b) Seamless Carbon Steel Pipe for High-Temperature Service
ASTM A 123/A 123M	(2002) Zinc (Hot-Dip Galvanized) Coatings on Iron and Steel Products
ASTM A 234/A 234M	(2004) Piping Fittings of Wrought Carbon Steel and Alloy Steel for Moderate and High Temperature Service
ASTM A 47/A 47M	(1999) Ferritic Malleable Iron Castings
ASTM A 53/A 53M	(2004a) Pipe, Steel, Black and Hot-Dipped, Zinc-Coated, Welded and Seamless
ASTM A 733	(2003) Welded and Seamless Carbon Steel and Austenitic Stainless Steel Pipe Nipples
ASTM B 209	(2004) Aluminum and Aluminum-Alloy Sheet and Plate
ASTM B 209M	(2004) Aluminum and Aluminum-Alloy Sheet and Plate (Metric)
ASTM C 533	(2004) Calcium Silicate Block and Pipe Thermal Insulation
ASTM C 547	(2003) Mineral Fiber Pipe Insulation
ASTM C 552	(2003) Cellular Glass Thermal Insulation
ASTM C 920	(2005) Elastomeric Joint Sealants
ASTM D 1056	(2000) Flexible Cellular Materials - Sponge or Expanded Rubber
ASTM F 1139	(1988; R 2004) Steam Traps and Drains

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

MSS SP-25	(1998) Standard Marking System for Valves, Fittings, Flanges and Unions
MSS SP-45	(2003) Bypass and Drain Connections

MSS SP-58	(2002) Pipe Hangers and Supports - Materials, Design and Manufacture
MSS SP-69	(2002) Pipe Hangers and Supports - Selection and Application
MSS SP-80	(2003) Bronze Gate, Globe, Angle and Check Valves

NATIONAL FIRE PROTECTION ASSOCIATION (NFPA)

NFPA 70	(2005) National Electrical Code

THE SOCIETY FOR PROTECTIVE COATINGS (SSPC)

SSPC SP 10	(2000) Near-White Blast Cleaning

1.2 SUBMITTALS

****
NOTE: Review submittal description (SD) definitions in Section 01330 SUBMITTAL PROCEDURES and edit the following list to reflect only the submittals required for the project. Submittals should be kept to the minimum required for adequate quality control.

A "G" following a submittal item indicates that the submittal requires Government approval. Some submittals are already marked with a "G". Only delete an existing "G" if the submittal item is not complex and can be reviewed through the Contractor's Quality Control system. Only add a "G" 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.

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.] The following shall be submitted in accordance with Section

01330 SUBMITTAL PROCEDURES:

SD-02 Shop Drawings

Heat Distribution System

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. Drawings shall contain 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. Drawings shall show 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.

SD-03 Product Data

Spare Parts

Spare parts data, as specified.

SD-04 Samples

Insulation

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, a display shall be prepared of insulated sections showing compliance with specifications, including showing fastening, sealing, jacketing, straps, waterproofing, supports, hangers, anchors, and saddles. Display sample sections shall remain on display at the jobsite during the construction period until no longer needed.

SD-06 Test Reports

Tests

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. Each test report shall indicate the final position of controls and valves.

SD-07 Certificates

Flange Gasket Kits

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 shall be signed by an official authorized to certify in behalf of material supplier or

product manufacturer and shall identify quantity and date or dates of shipment or delivery to which the certificates apply.

1.3 DELIVERY AND STORAGE

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

1.4 FIELD MEASUREMENTS

The Contractor shall become familiar with all details of the work, verify all dimensions in the field, and shall advise the Contracting Officer of any discrepancy before performing the work.

1.5 OPERATION AND MAINTENANCE MANUALS

[Six] [_____] copies of operation and [six] [_____] copies of maintenance manuals for the equipment furnished shall be provided. One complete set prior to performance testing, and the remainder upon acceptance. Operation manuals shall detail the step-by-step procedures required for system startup, operation, and shutdown. Operation manuals shall include the manufacturer's name, model number, parts list, and brief description of all equipment and their basic operating features. Maintenance manuals shall list routine maintenance procedures, possible breakdowns and repairs, and troubleshooting guides. Maintenance manuals shall 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 shall be approved prior to performance testing.

1.6 SPARE PARTS

The Contractor shall 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. The data shall include a complete list of parts and supplies and source of supply.

PART 2 PRODUCTS

2.1 GENERAL REQUIREMENTS

2.1.1 Standard Products

Materials and equipment shall be the standard products of a manufacturer regularly engaged in the manufacture of such products and shall essentially duplicate items that have been in satisfactory use for at least 2 years prior to bid opening. Equipment shall be supported by a service organization that is, in the opinion of the Contracting Officer, reasonably convenient to the site.

2.1.2 Nameplates

Each major item of equipment such as sump pumps, motors, steam traps, and pressure reducing valves shall have 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 shall not be used.

2.1.4 Electrical Work

Motors, manual or automatic motor control equipment, and protective or signal devices required for the operation specified shall be provided under this section in accordance with NFPA 70 and Section 16375A ELECTRICAL DISTRIBUTION SYSTEM, UNDERGROUND.

2.2 PIPING AND FITTINGS

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

2.2.1 Steel Pipe

Steel pipe 50 mm 2 inches in diameter and larger shall be seamless or electric-resistance welded conforming to ASTM A 53/A 53M, Grade B, Type E or S; or to ASTM A 106/A 106M, Grade B. Steel pipe 40 mm 1-1/2 inches in diameter and smaller shall be seamless conforming to ASTM A 106/A 106M, Grade B. Condensate piping, gauge piping, and piping 19 mm 3/4 inch in diameter and smaller shall be extra strong. All other pipe shall be standard weight.

2.2.1.1 Nipples

Nipples shall conform to ASTM A 733, standard weight or extra-heavy weight, 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.
****

Steel flanges shall conform to ASME B16.5 Class [150] [and] [or] [300] and shall match valves or flanged fittings on which used. Flanges shall 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

Pipe threads shall conform to ASME B1.20.1. Pipe threads may be used only on pipe 19 mm 3/4 inch or smaller.

2.2.2 Fittings

Fittings shall 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

Welded fittings shall conform to ASTM A 234/A 234M, buttwelded or socket welded, standard weight or extra strong, as required to match connecting piping. Buttwelded fittings shall conform to ASME B16.9, and socket welded fittings shall conform to ASME B16.11.

2.2.2.2 Malleable Iron Fittings

Fittings shall conform to ASME B16.3, ASTM A 47/A 47M, class as required to match connecting piping.

2.2.2.3 Unions

Unions shall conform to ASME B16.39, standard weight or extra heavy, 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.

****

Insulating flanges or flange gasket kits shall be installed at every pipe connection from the trench system to an underground system and at dissimilar metals. The kit shall consist of a flange gasket, bolt sleeves, and one insulating washer and one steel washer for both ends of each bolt. The gasket kits shall be 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. The Contractor shall ensure that these kits are provided and properly installed according to manufacturer published instructions as indicated. Dielectric waterways shall have temperature and pressure rating equal to or greater than that specified for the connecting piping and shall be used for joining dissimilar metals, 19 mm 3/4 inch and smaller threaded pipe. Waterways shall have metal connections on both ends suited to match connecting piping. Dielectric waterways shall be insternally lined with an insulator specifically designed to prevent current flow between dissimilar metals. Dielectric flanges shall 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, and 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 15559A CENTRAL STEAM-GENERATING SYSTEM, COAL-FIRED.

****

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

2.3.1 Steel Valves

Globe, gate, angle, and check valves shall conform to the requirements of ASME B16.34 and ASME B31.1 for the temperature and pressure requirements of the system. Gate valves 65 mm 2-1/2 inches and smaller shall be rising stem. Gate valves 80 mm 3 inches and larger shall be outside screw and yoke.

2.3.2 Bronze Valves

2.3.2.1 Globe, Gate, and Angle Valves

Globe, gate, and angle valves shall conform to requirements of MSS SP-80.

2.3.2.2 Check Valves

Check valves shall conform to the requirements of MSS SP-80.

2.3.3 Packing

Packing used with valves shall not contain asbestos. Valve stem packing shall be die-formed, ring type specifically designated as suitable for the temperature and pressure of the service and compatible with the fluid in the system. Packing rings shall be polytetrafluoroethylene with minimum 50 percent graphite filament top and bottom rings. Valves 40 mm 1-1/2 inches and smaller shall have four or five packing rings and valves 50 mm 2 inches and larger shall have at least six packing rings. Spiral or continuous packing will not be acceptable. A metal insert shall be provided having proper clearance around the valve stem at the bottom of the stuffing box and acting as a base for the packing material. Packing glands shall be furnished with a liner of noncorrosive material and shall be of 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 shall be provided for system warm-up.

****

Class of trap bodies shall be 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 shall be capable of operation under a steam-supply pressure as indicated. Traps shall have capacities as shown when operating under the specified working conditions. Traps shall fail open.

2.4.1 Bucket Traps

Traps shall be inverted-bucket type with automatic air discharge conforming to ASTM F 1139.

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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Traps shall be thermostatic type with bimetallic element automatic air discharge conforming to ASTM F 1139.

2.5 STRAINERS

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NOTE: Delete for high temperature water systems.
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Strainers shall be basket or Y-type with connections the same size as the pipe lines in which the connections are installed. Strainer shall be suitable for the temperature and pressure requirements of the system. The strainer bodies shall be of cast steel with bottoms drilled and plugged. The bodies shall have arrows clearly cast on the sides to indicate the direction of flow. Each strainer shall be equipped with an easily removable cover and sediment basket. The body or bottom opening shall be equipped with nipple and gate valve for blowdown. The basket shall be of not less than 0.6350 mm 0.025 inch thick stainless steel, or monel with small perforations of sufficient number to provide a net free area through the basket of at least 2.5 times that of the entering pipe. The flow shall be into the basket and out through the perforations.

2.6 PRESSURE GAUGES

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

Gauges shall conform to ASME B40.100 and shall be provided with throttling type needle valve or a pulsation dampener and shut-off valve. Minimum dial size shall be 110 mm 4-1/4 inches.

2.7 THERMOMETERS

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NOTE: Delete if not required.
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Mercury shall not be used in thermometers.

2.7.1 Liquid in Glass

Thermometer shall be liquid in glass type with well and separable corrosion-resistant steel socket. Thermometer on insulated pipe shall have insulation stand-off provision. Minimum scale length shall be 178 mm 7 inches.

2.7.2 Dial

Dial type thermometer shall be 90 mm 3-1/2 inches in diameter chromium plated case, remote-type bulb or direct-type bulb as required, plus or minus 1 degree C 2 degrees F accuracy, white face with black digits graduated in 1 degree C 2 degrees F increments.

2.8 INSULATION AND JACKETING

The Contractor shall comply with EPA requirements in accordance with Section 01670 RECYCLED / RECOVERED MATERIALS.

2.8.1 Insulation for Piping in Concrete Trenches

Insulation for all piping, fittings, and valves shall be molded calcium

silicate conforming to ASTM C 533, Type I, asbestos free, or molded mineral fiber insulation conforming to ASTM C 547, Class 2, asbestos free, or cellular glass insulation conforming to ASTM C 552. Insulation shall be factory or field applied. Other than FOAMGLAS, laminated construction shall not be used in thicknesses less than 102 mm 4 inches. Insulation on piping in concrete trenches shall be covered with aluminum or nonmetallic jacket.

2.8.2 Aluminum Jacket

Jacket shall be smooth sheet, 0.4064 mm 0.016 inch nominal thickness; ASTM B 209M ASTM B 209, Type 3003, 3105, or 5005. Aluminum jacket shall be used over calcium silicate insulation.

2.8.3 Nonmetallic Jacket

Nonmetallic jacket shall consist 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. Overall thickness of the composite shall be 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. This jacket shall not be used with any calcium silicate insulation. Nonmetallic jacket shall be used with molded mineral fiber insulation.

2.8.4 Bands

Bands for aluminum jacket shall be 10 mm 3/8 inch wide and 0.8128 mm 32 gauge thickness made of aluminum or annealed stainless steel. Bands for insulation shall be 13 mm 1/2 inch wide and 0.8128 mm 32 gauge thickness made of annealed stainless steel.

2.8.5 Insulation for Flanges, Unions, Valves, and Fittings

Flanges, unions, valves, and fittings shall be insulated with premolded prefabricated, or field fabricated segments of insulation. Insulation shall be removable and reusable and shall have essentially the same thermal characteristics and thickness as the adjoining piping.

2.9 CONCRETE WORK

****

NOTE: Specify concrete work in detail in Section 03300A CAST-IN-PLACE STRUCTURAL CONCRETE, edit the spec and include all specific requirements pertinent to local conditions.

****

2.9.1 Concrete

Concrete shall be as specified in Section 03300A CAST-IN-PLACE STRUCTURAL CONCRETE.

2.9.2 Concrete Joint Sealants

Concrete joint sealants shall conform to ASTM C 920, Type M (multicomponent), Class 25, grade NS (nonsag) for vertical surfaces or grade P (pourable selfleveling).

2.9.3 Gasket Material

Gasket material used between concrete trench covers and trench wall tops shall be 6 mm 1/4 inch thick neoprene pad with a minimum width of 50 mm 2 inches conforming to ASTM D 1056.

2.9.4 Concrete Expansion Joints, Contraction Joints, and Waterstops

Concrete expansion joints, contraction joints, and waterstops shall be as specified in Section 03150A EXPANSION JOINTS, CONTRACTION JOINTS, AND WATERSTOPS.

2.10 BITUMINOUS PAVING

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

Bituminous course and tack coat used at street crossings shall be as specified in Section 02703 HOT-MIX ASPHALT (HMA) FOR ROADS and Section 02748 BITUMINOUS TACK AND PRIME COATS.

2.11 MISCELLANEOUS METAL

****
NOTE: Include miscellaneous metals located in trenches or valve manholes in Section 05500A MISCELLANEOUS METAL.
****

Miscellaneous metal not otherwise specified shall conform to Section 05500 METAL: MISCELLANEOUS AND FABRICATIONS. Miscellaneous metal bolted together, shop welded, or assembled in the field, and pipe supports including structural cross support members and anchors shall be hot-dip galvanized in accordance with Section 05500 METAL: MISCELLANEOUS AND FABRICATIONS.

2.12 INSPECTION PORTS AND ACCESS COVERS

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

PART 3 EXECUTION

3.1 SITEWORK

3.1.1 Excavation, Trenching, and Backfilling

Excavation, trenching, and backfilling of concrete trench systems, [and relocation of interferences and modifications to existing facilities] shall be as shown and in accordance with Section 02300 EARTHWORK.

3.1.2 Removal, Replacement, or Relocation of Interferences

Interferences indicated or found during construction shall be removed, replaced, or relocated. Removal, replacement, or relocation shall 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.

3.1.3 Modifications to Existing Facilities

Modifications to existing facilities shall be made as shown. 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.

3.1.4 Electric Work

Any wiring required for the operation of the equipment specified, but not shown on the electrical drawings, shall be provided under this section in accordance with Section 16370A ELECTRICAL DISTRIBUTION SYSTEM, AERIAL, and Section 16375A ELECTRICAL DISTRIBUTION SYSTEM, UNDERGROUND.

3.1.5 Painting

The heat affected zone of field welded galvanized surfaces and other galvanized surfaces damaged during installation shall be cleaned in compliance with SSPC SP 10 and painted in accordance with Section 09900 PAINTS AND COATINGS.

3.2 PIPING

3.2.1 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. The following requirements must be added to the specification as paragraphs 2.14 through 2.16. If these requirements are included in the specifications, the publications referenced in them must also be included in paragraph REFERENCES.

2.14 Bellows Type Joints: Select bellows type or slip-type to satisfy specific design conditions. Joints shall be flexible, guided expansion joints. The expansion element shall be of stainless steel. Bellows type expansion joints shall be in accordance with the applicable requirements of EJMA-01 and ASME B31.1 with internal liners.

2.15 Expansion Joints: Expansion joints shall provide for either single or double slip of connected pipes, as required or indicated, and for not less than the traverse indicated. The joints shall be designed for hot water working pressure and shall be in accordance with applicable requirements of EJMA-01 and ASME B31.1. Joints shall be designed for packing injection under full line pressure. End connections shall be flanged or beveled for welding as indicated. Joints shall be provided with anchor base where required or indicated. Where adjoining pipe is carbon steel, the sliding slip shall be seamless steel plated with a minimum of 0.0508 mm (2 mils) of hard chrome in accordance with ASTM B 650. Joint components shall be fabricated from material equivalent to that of the pipeline. Initial setting shall be made in accordance with the manufacturer's recommendations to compensate for ambient temperature at time of installation. Pipe alignment guides shall be installed as recommended by the joint manufacturer, but in any case shall not be more than 1.5 m (5 feet) from expansion joint except for lines 100 mm (4 inches) or smaller; guides shall be installed not more than 600 mm (2 feet) from the joint. Service outlets shall be provided where indicated.

2.16. Flexible Ball Joints: Flexible ball joints shall be constructed of alloys as appropriate for the service intended. Where so indicated, the ball joint shall be designed for packing injection under full line pressure to contain leakage. Joint ends shall be threaded to 50 mm (2 inches) only, grooved, flanged or beveled for welding as indicated or required, and shall be capable of absorbing a minimum of 15 degrees angular flex and 360 degrees rotation. Balls and sockets shall be of equivalent material as the adjoining pipeline. Exterior spherical surface of carbon steel balls shall be plated with 0.0508 mm (2 mils) of hard chrome in accordance with ASTM B 650. Ball type joints shall

be designed and constructed in accordance with ASME B31.1 and ASME BPVC SEC VIII D1, where applicable. Flanges where required shall conform to ASME B16.5. Gaskets and compression seals shall be compatible with the service intended.

****

Pipe shall be accurately cut to measurements established at the site and shall be worked into place without springing or forcing. Pipe shall clear all openings and equipment. Excessive cutting or other weakening of structural members to facilitate piping installation will not be permitted. Burrs shall be removed from ends of pipe by reaming. Installation shall permit free expansion and contraction without damage to joints or hangers. Piping shall be installed in accordance with ASME B31.1. Joints for piping in concrete trenches shall be welded [, except joints at traps, strainers, and at valves 19 mm 3/4 inch and smaller in steam, condensate, and drip lines, which may use unions or may be threaded]. Supports, anchors, or stays shall not be attached where either expansion or the weight of the pipe will cause damage to permanent construction. Noninsulated ferrous parts of the piping, piping support system, or equipment shall be hot-dip galvanized after fabrication in conformance with ASTM A 123/A 123M.

a. Expansion of piping shall be provided 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 shall be steel conforming to ASTM A 53/A 53M or ASTM A 106/A 106M type and grade for bending, and class required to match adjoining pipe. Bent pipe showing kinks, wrinkles, or malformations will not be acceptable.

c. All piping, unless otherwise indicated, shall be pitched with a grade of not less than 25 mm in 6 m 1 inch in 20 feet toward drain points. The slope shall be maintained throughout the system, including through each leg of each expansion loop.

d. Open ends of pipe lines and equipment shall be properly capped or plugged during installation to keep dirt and other foreign matter out of the system.

3.2.2 Welded Joints

Joints between sections of pipe and between pipe and fittings shall be welded. The welding shall conform 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, shall be forged and shall be no larger than two nominal pipe sizes smaller than the main run. Branch outlet fittings shall be flared for improved flow where attached to the run, reinforced against external strains, and designed to withstand full pipe bursting strength.

3.2.3 Flanged and Threaded Joints

****

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

****

3.2.3.1 Flanged Joints

Joints shall be faced true, provided with gaskets, and made perfectly square and tight. Electrically isolated flange joints shall be provided at all connections to building underground systems and between dissimilar metals.

3.2.3.2 Threaded Joints

Joints shall have graphite or inert filler and oil, graphite compound, or polytetrafluoroethylene tape applied to the male threads only. Dielectric unions shall be used at connections of dissimilar metals in 19 mm 3/4 inch and smaller piping.

3.2.4 Reducing Fittings

Eccentric reducers in horizontal runs shall be installed with the straight side down. Changes in horizontal piping sizes shall be made through eccentric reducing fittings.

3.2.5 Branch Connections

Branches from mains shall branch off top of mains as indicated or as approved. Connections shall insure unrestricted circulation, elimination of air pockets, and shall permit the complete drainage of the system.

3.2.6 Pipe Supports Exposed in Concrete Trenches

Horizontal and vertical runs of pipe in concrete trenches shall be securely supported. Suspended pipe shall be held by 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 and MSS SP-69. Chain or flat steel strap hangers or single point supports will not be acceptable. Spacing between pipe supports shall be as indicated. All pipe supports including the structural cross support member shall be hot-dip galvanized in accordance with Section 05500 METAL: MISCELLANEOUS AND FABRICATIONS.

3.3 WELDING

Welding and radiographic examination of all steel carrier pipe welds shall be as specified in Section 05093 WELDING PRESSURE PIPING. Structural members shall be welded in accordance with Section 05090A WELDING, STRUCTURAL.

3.4 RADIOGRAPHIC TESTING

Radiographic examination of all field welds in the steel carrier piping of the heat distribution system shall be in accordance with ASME B31.1 performed as specified in Section 05093 WELDING PRESSURE PIPING. An approved independent testing firm or firms regularly engaged in radiographic testing shall perform a radiographic examination of all field welds in the steel carrier piping of the heat distribution system in accordance with ASME B31.1. The Contractor shall 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. All radiographs shall be reviewed and interpreted by a Certified Level III Radiographer employed by the testing firm whose signature shall appear on the reading report. 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.

3.5 INSULATION

The insulation shall be installed in such a manner that it will not be damaged by pipe expansion or contraction. Insulation installed over welds shall be grooved to assure a snug fit. Insulation shall be held in place with stainless steel straps. A minimum of 2 bands shall be installed on each individual length of insulation and maximum spacing shall not exceed 450 mm 18 inch centers.

3.5.1 Installation

Material shall be installed in accordance with published installation instructions of the manufacturer. Insulation materials shall not be applied until piping tests are completed.

3.5.1.1 Preparation

Prior to application, surfaces shall be thoroughly cleaned of moisture, grease, dirt, rust, and scale. Insulation manufacturer's published installation instructions shall be followed.

3.5.1.2 Thickness

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

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

TABLE 1

Minimum Pipe Insulation Thickness (millimeters)

For steam piping 1.10 MPa to 1.72 MPa and high temperature hot water supply and return piping up to 232 degrees C.

Nominal Pipe Diameter (mm)	Insulation Thermal Conductivity (k)		
	k less than 0.29	k from 0.29 to 4.0	k greater than 0.40
25	50	63	100
40	50	63	100
50	63	85	110
65	63	85	110
80	75	100	125
100	75	100	125
125	75	100	125
150	85	110	135
200	85	110	135
250	100	125	150

TABLE 1

Minimum Pipe Insulation Thickness (millimeters)

For steam piping 1.10 MPa to 1.72 MPa and high temperature hot water supply and return piping up to 232 degrees C.

Nominal Pipe Diameter (mm)	Insulation Thermal Conductivity (k)		
	k less than 0.29	k from 0.29 to 4.0	k greater than 0.40
300	100	125	150
350	100	125	150
400	100	125	150
450	100	125	150

NOTE: Insulation thermal conductivity (k-value) is in units of watt per meter-degree K at 93 degrees C mean temperature.

TABLE 1

Minimum Pipe Insulation Thickness (inches)

For steam piping 16 psig to 250 psig and high temperature hot water supply and return piping up to 450 degrees F

Nominal Pipe Diameter (in.)	Insulation Thermal Conductivity (k)		
	k less than 0.29	k from 0.29 to 4.0	k greater than 0.40
1.0	2.0	2.5	4.0
1.5	2.0	2.5	4.0
2.0	2.5	3.5	4.5
2.5	2.5	3.5	4.5
3.0	3.0	4.0	5.0
4.0	3.0	4.0	5.0
5.0	3.0	4.0	5.0
6.0	3.5	4.5	5.5
8.0	3.5	4.5	5.5
10.0	4.0	5.0	6.0
12.0	4.0	5.0	6.0
14.0	4.0	5.0	6.0
16.0	4.0	5.0	6.0
18.0	4.0	5.0	6.0

NOTE: Insulation thermal conductivity (k-value) is in units of Btu-inches/hour-square feet-degrees F at 200 degrees F mean temperature.

TABLE 2

Minimum Pipe Insulation Thickness (millimeters)

(For low pressure (less than 1.10 MPa) steam, condensate return, and low temperature (less than 121 degrees C) hot water supply and return piping.)

Nominal Pipe Diameter (mm)	Insulation Thermal Conductivity (k)		
	k less than 0.29	k from 0.29 to 4.0	k greater than 0.40
25	35	50	75
40	35	50	75
50	35	50	75
65	35	50	75
80	50	63	85
100	50	63	85
125	50	63	85
150	63	75	110
200	63	75	110
250	75	100	125
300	75	100	125
350	75	100	125
400	75	100	125
450	75	100	125

NOTE: Insulation thermal conductivity (k-value) is in units of watt per meter - degree L at 93 degrees C mean temperature.

TABLE 2

Minimum Pipe Insulation Thickness (inches)

(For low pressure (less than 16 psig) steam, condensate return, and low temperature (less than 250 degrees F) hot water supply and return piping.)

Nominal Pipe Diameter (in.)	Insulation Thermal Conductivity (k)		
	k less than 0.29	k from 0.29 to 4.0	k greater than 0.40
1.0	1.5	2.0	3.0
1.5	1.5	2.0	3.0
2.0	1.5	2.0	3.0
2.5	1.5	2.0	3.0
3.0	2.0	2.5	3.5
4.0	2.0	2.5	3.5
5.0	2.0	2.5	3.5
6.0	2.5	3.0	4.5
8.0	2.5	3.0	4.5
10.0	3.0	4.0	5.0

TABLE 2

Minimum Pipe Insulation Thickness (inches)

(For low pressure (less than 16 psig) steam, condensate return, and low temperature (less than 250 degrees F) hot water supply and return piping.)

Nominal Pipe Diameter (in.)	Insulation Thermal Conductivity (k) k less than 0.29	k from 0.29 to 4.0	k greater than 0.40
12.0	3.0	4.0	5.0
14.0	3.0	4.0	5.0
16.0	3.0	4.0	5.0
18.0	3.0	4.0	5.0

NOTE: Insulation thermal conductivity (k-value) is in units of Btu-inches/hour-square feet-degrees F at 200 degrees F mean temperature.

3.5.2 Insulation on Pipes Passing Through Sleeves

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

3.5.3 Covering of Insulation in Concrete Trenches

The insulation for pipe, flanges, valves, and fittings shall be covered with aluminum jackets.

3.6 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.
****

A concrete cast-in-place trench system shall be provided and installed with a removable top as shown on the drawings.

3.6.1 Concrete

****
NOTE: Concrete work will be specified in detail in Section 03300A CAST-IN-PLACE STRUCTURAL CONCRETE, edit the spec and include all specific requirements pertinent to local conditions and designers General Notes.

****

Materials and methods for mixing and placing of concrete shall be as specified in Section 03300A CAST-IN-PLACE STRUCTURAL CONCRETE.

3.6.2 Joint Sealants

Concrete joints shall be sealed as indicated. Type II sealant (nonsagging) shall be used for vertical joints. Type I sealant shall be used for trench top butt joints. All other joints shall be sealed with Type I or Type II sealant. Sealant in trench bottom shall finish flush with floor.

3.6.3 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.

****

Concrete trench tops shall be precast or cast-in-place. Concrete shall be as specified in Section 03300A CAST-IN-PLACE STRUCTURAL CONCRETE. The tops shall be flat and true and shall lay flat at all locations where contact on trench wall is to be made. Tolerances shall be true planes within 4 mm in 3 m 1/8 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) shall be 3 mm in 2 m 1/8 inch in 6 feet or 6 mm 1/4 inch total, whichever is greater. Maximum permissible warpage of one corner out of the plane of the other three shall be 5 mm per meter 1/16 inch per foot distance from the nearest adjacent corner. 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, shall not be installed. Neoprene gasket material shall be placed 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 shall be dry and free of oil, grease, dirt, loose concrete particles, or other foreign substances. Gasket material shall be placed in a continuous length along the wall as much as practical. Gasket ends shall be butted tightly together at splices. Concrete trench tops shall be constructed in maximum lengths of 2.4 m 8 feet and minimum lengths of 1.2 m 4 feet and shall be a minimum of 100 mm 4 inches thick, unless otherwise indicated. Each top section shall be provided with means to accept a lifting device for removal of slab, as indicated on the drawings.

3.6.4 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.

****

The concrete trench shall be of the sizes indicated on drawings. Inside edge and top of walls shall have smooth even surfaces to accommodate trench tops.

3.6.5 Final Elevations

The concrete trench floor shall slope continuously and drain toward valve manholes. The Contractor shall construct the concrete trench at the elevation shown on the drawings and shall grade the adjacent areas. Any cut or fill areas adjacent to the concrete trench shall be graded back to the existing grade at a 1 to 10 slope, or as indicated. Care shall be taken to avoid forming pockets adjacent to the concrete trench; thereby, preventing surface drainage. The concrete trench floor and pipe shall be parallel and shall maintain constant slope toward the drain points indicated.

3.6.6 Coordination with Existing Utilities

Before beginning work in a given area, all utility information shall be field verified by surface markings made by the affected utility Owner's Representative. Contractor shall 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.]]

3.6.7 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.

****

Piping shall have supports as indicated. No pipes, pipe supports, or other related items shall be permitted on the floor of the concrete trench system. Pipe support members spanning traversely across the tunnel shall 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 shall 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.

3.6.8 Pipe Expansion

****

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

****

Expansion shall be accommodated by loops and bends as indicated on the drawings and specified. Pipe in the loops and bends shall 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. Slopes of pipe and trench bottoms shall be maintained. Contractor shall have the option to adjust the loop dimensions around obstacles based on final field measurements, if approved by the Contracting Officer. Contractor shall submit pipe stress calculations for each revised expansion loop or bend based on the final actual measured lengths, or shall submit dimensions to the Contracting Officer for verification of loop and bend sizes before proceeding with that segment of work. Allowable pipe stresses shall be in accordance with ASME B31.1. Final expansion loop insulation method shall be submitted for approval to the Contracting Officer.

3.6.9 Pipe Anchors

Pipe anchors shall be as indicated on the drawings.

3.6.10 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.

****

Inspection ports shall be provided as indicated.

3.6.11 Road/Drive Crossings

Road/drive crossings shall be as indicated. Handicap ramp style curb cuts shall be installed at all street and drive crossings as indicated.

3.6.12 Railroad Crossings

****

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

****

Railroad crossings shall be as indicated. The tracks shall be restored to their original condition as approved by the Contracting Officer after construction is complete.

3.7 TESTS

Tests shall be conducted before, during, and after the installation of the system. All instruments, equipment, facilities, and labor required to properly conduct the tests shall be provided by the Contractor. Test

pressure gauges for a specific test shall be approved by the Contracting Officer and shall have dials indicating not less than 1-1/2 times, nor more than 3 times the test pressure.

3.7.1 Cleaning of Piping

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

3.7.2 Field Tests

The following field tests shall be conducted when applicable to the system involved. If any failures occur, the Contractor shall make such adjustments or replacements as the Contracting Officer may direct, and the tests shall be repeated until satisfactory tests are completed.

3.7.2.1 Hydrostatic Tests of Service Piping

Service piping shall be tested hydrostatically before insulation is applied at field joints, and shall 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 shall not exceed 3.45 MPa 500 psig. Hydrostatic test pressures shall be held for a minimum of 4 hours. If the hydrostatic test pressure cannot be held, the Contractor shall make such adjustments or replacements and the tests repeated until satisfactory results are achieved.

3.7.2.2 Equipment Tests

All pumps, valves, traps, alarms, controls, and any other operable item of equipment shall be operated to verify proper operation and compliance with the specifications. Pump voltage, current, and discharge readings shall be recorded and submitted for approval in accordance with SUBMITTALS paragraph (SD-06).

3.7.2.3 Insulating Flange Test

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

3.7.2.4 Operational Tests

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

3.7.2.5 Trench Water Removal Tests

After the above tests are completed, and before concrete trench and valve manhole covers are placed, the concrete trenches, sumps, and valve manholes shall be cleaned of dirt and debris. Concrete trench system shall be tested to ensure gravity drainage of water is maintained in trench bottom from high points to drained low points. Contractor shall 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 shall not be considered completed until witnessed and accepted by the Contracting Officer. Trench tops shall be placed and sealed immediately after approval by the Contracting Officer.

-- End of Section --