

SECTION 33 63 00
STEAM ENERGY DISTRIBUTION

PART 1 - GENERAL

1.1 DESCRIPTION

- A. This section specifies materials and procedures for construction of underground steam distribution and condensate return piping system, outside the buildings. System shall be: walk through concrete tunnels, concrete shallow trenches, pre-engineered, direct-buried, drainable-dryable-testable (DDT).
- B. A complete listing of common acronyms and abbreviations are included in Section 23 05 10, COMMON WORK RESULTS FOR BOILER PLANT AND STEAM GENERATION.
- C. Definitions:
 - 1. System: The complete underground steam and condensate distribution system including all components such as carrier piping, pipe supports, insulation, protective enclosures, anchors, corrosion protection, stress analysis, and accessories.
 - 2. Pre-Engineered Direct-Buried System: A factory-fabricated system.
 - 3. Drainable-Dryable-Testable (DDT) Pre-Engineered Direct-Buried System: A factory-fabricated system.
 - 4. Concrete Shallow Trench: A system with removable concrete cover in sections located at grade.
 - 5. Walk-through Concrete Tunnels: A system located below grade with sufficient space for carrier pipes, other services, and space to walk upright along the entire length of the system.
 - 6. Carrier Pipe: Pipe carrying the steam or condensate.

1.2 RELATED WORK (ADDENDUM 3, 01-17-2025)

- A. Section 01 00 00, GENERAL REQUIREMENTS.
- B. Section 01 33 23, SHOP DRAWINGS, PRODUCT DATA AND SAMPLES.
- C. Section 01 74 19, CONSTRUCTION WASTE MANAGEMENT.
- D. Section 01 91 00, GENERAL COMMISSIONING REQUIREMENTS.
- E. SECTION 02 82 11, TRADITIONAL ASBESTOS ABATEMENT.
- F. Section 03 30 00, CAST-IN-PLACE CONCRETE: Concrete Work, Reinforcing, Placement and Finishing.
- G. Section 05 50 00, METAL FABRICATIONS: Steel for trench and tunnel pipe supports.

- H. Section 09 91 00, PAINTING, Painting exposed steel and other surfaces.
- I. Section 23 05 10, COMMON WORK RESULTS FOR BOILER PLANT AND STEAM GENERATION.
- J. Section 25 10 10, ADVANCED UTILITY METERING SYSTEM: Metering.
- K. Section 31 20 11, EARTHWORK: Short Form.ca

1.3 APPLICABLE PUBLICATIONS

- A. The publications listed below form a part of this specification to the extent referenced. The publications are referred in the text by the basic designation only. Where conflicts occur these specifications and the VHA standard will govern.
- B. American Association of State Highway and Transportation Officials (AASHTO):
 - M300-03-UL-2007.....Standard Specification for Inorganic Zinc-Rich Primer
 - M273-11-UL-2011.....Standard Specification for Precast Reinforced Concrete Box Sections for Culverts, Storm Drains, and Sewers with Less Than 2 Feet of Cover Subjected to Highway Loadings
- C. American Society of Heating, Refrigerating and Air-Conditioning Engineers (ASHRAE):
 - 90.1-2021.....Energy Efficient Design of New Buildings Except Low-Rise Residential Buildings
- D. American Society of Mechanical Engineers (ASME):
 - B1.20.1-2013.....Pipe Threads, General Purpose (Inch)
 - B16.5-2020.....Pipe Flanges and Flanged Fittings: NPS 1/2 through NPS 24 Metric/Inch Standard
 - B16.9-2018.....Factory-Made Wrought Buttwelding Fittings
 - B16.11-2021.....Forged Fittings, Socket-Welding and Threaded
 - B16.21-2021.....Nonmetallic Flat Gaskets for Pipe Flanges
 - B18.2.1-2021.....Square, Hex, Heavy Hex, and Askew Head Bolts and Hex, Heavy Hex, Hex Flange, Lobed Head, and Lag Screws (Inch Series)
 - B31.1-2022.....Power Piping
 - B31.9-2022.....Building Services Piping
 - B40.100-2022.....Pressure Gauges and Gauge Attachments
 - ASME Boiler and Pressure Vessel Code -

BPVC Section VIII-1-2021	Rules for Construction of Pressure Vessels, Division 1
BPVC Section IX-2021	Welding, Brazing, and Fusing Qualifications
E. American Society for Testing and Materials (ASTM):	
A36/A36M-2022	Standard Specification for Carbon Structural Steel
A53/A53M-2022	Standard Specification for Pipe, Steel, Black and Hot-Dipped, Zinc-Coated, Welded and Seamless
A105/A105M-2021	Standard Specification for Carbon Steel Forgings for Piping Applications
A106/A106M-2021	Standard Specification for Seamless Carbon Steel Pipe for High-Temperature Service
A126-2019 (R2019)	Standard Specification for Gray Iron Castings for Valves, Flanges, and Pipe Fittings
A139/A139M-2022	Standard Specification for Electric-Fusion (Arc)-Welded Steel Pipe (NPS 4 and Over)
A193/A193M-2022	Standard Specification for Alloy-Steel and Stainless-Steel Bolting for High Temperature or High-Pressure Service and Other Special Purpose Applications
A194/A194M-2022a	Standard Specification for Carbon Steel, Alloy Steel, and Stainless-Steel Nuts for Bolts for High Pressure or High Temperature Service, or Both
A234/A234M-2022	Standard Specification for Piping Fittings of Wrought Carbon Steel and Alloy Steel for Moderate and High Temperature Service
A240/A240M-2022b	Standard Specification for Chromium and Chromium-Nickel Stainless Steel Plate, Sheet, and Strip for Pressure Vessels and for General Applications
A733-2022	Standard Specification for Welded and Seamless Carbon Steel and Austenitic Stainless-Steel Pipe Nipples
B61-2021	Standard Specification for Steam or Valve Bronze Castings

- C177-2019.....Standard Test Method for Steady-State Heat Flux Measurements and Thermal Transmission Properties by Means of the Guarded-Hot-Plate Apparatus
- C411-2019.....Standard Test Method for Hot-Surface Performance of High-Temperature Thermal Insulation
- C552-2022.....Cellular Glass Thermal Insulation
- C655-2019a.....Standard Specification for Reinforced Concrete D-Load Culvert, Storm Drain, and Sewer Pipe
- C920-2018.....Standard Specification for Elastomeric Joint Sealants
- C1728-2022.....Standard Specification for Flexible Aerogel Insulation
- E84-2019b.....Standard Test Method for Surface Burning Characteristics of Building Materials
- F. American Welding Society (AWS):
- B2.1/B2.1M-2014.....Specification for Welding Procedure and Performance Qualification
- D10.12M/D10.12-2000.....Guide for Welding Mild Steel Pipe
- Z49.1-2012.....Safety in Welding and Cutting and Allied Processes
- G. Federal Specifications (Fed. Spec.):
- A-A-60005-2015.....Frames, Covers, Gratings, Steps, Sump and Catch Basin, Manhole
- L-S-125-1987.....Screening, Insect, Nonmetallic
- H. Manufacturer's Standardization Society (MSS):
- MSS SP-58-2018.....Pipe Hangers and Supports - Materials, Design, Manufacture, Selection, Application and Installation
- I. Military Specifications (Mil. Spec.):
- MIL-S-901-1989.....Shock Tests H.I. (High Impact) Shipboard Machinery, Equipment and Systems, Requirements for
- J. NACE International (NACE):
- SP0169-2013.....Control of External Corrosion on Underground or Submerged Metallic Piping Systems

K. National Fire Protection Association (NFPA):
 255-2006.....Standard Method of Test of Surface Burning
 Characteristics of Building Materials

L. Society for Protective Coatings (SSPC):
 SP-2-2004.....Hand Tool Cleaning

1.4 SUBMITTALS (ADDENDUM 3, 01-17-2025)

- A. Submittals, including number of required copies, shall be submitted in accordance with Section 01 33 23, SHOP DRAWINGS, PRODUCT DATA, and SAMPLES.
- B. Information and material submitted under this section shall be marked "SUBMITTED UNDER SECTION 33 63 00, STEAM ENERGY DISTRIBUTION", with applicable paragraph identification.
- C. Contractor shall make all necessary field measurements and investigations to assure that the equipment and assemblies will meet contract requirements and will fit the space available.
- D. If equipment is submitted which differs in arrangement from that shown, provide drawings that show the rearrangement of all associated systems. Approval will be given only if all features of the equipment and associated systems, including accessibility, are equivalent to that required by the contract.
- E. Prior to submitting shop drawings for approval, contractor shall certify in writing that manufacturers of all major items of equipment have each reviewed drawings and specifications, and have jointly coordinated and properly integrated their equipment and controls to provide a complete and efficient installation.
- F. Installing Contractor shall provide lists of previous installations for selected items of equipment. Contact persons who will serve as references, with telephone numbers and e-mail addresses shall be submitted with the references. COMMON WORK RESULTS FOR PLUMBING", with applicable paragraph identification.
- G. Manufacturers' Literature and Data including: Full item description and optional features and accessories of the complete system including, but not limited to, dimensions, weights, materials, applications, standard compliance, model numbers, size and capacity. Submit as one package for pipes, fittings and appurtenances, including jointing materials, insulation, hangars, expansion and power set fasteners, and other miscellaneous items.

- H. Submittals and shop drawings for interdependent items, containing applicable descriptive information, shall be furnished together and complete in a group. Coordinate and properly integrate materials and equipment in each group to provide a completely compatible and efficient installation. Final review and approvals will be made only by groups.
- I. Coordination/Shop Drawings:
1. Submit complete consolidated and coordinated shop drawings for all new systems, and for existing systems that are in the same areas.
 2. The coordination/shop drawings shall include plan views, elevations and sections of all systems and shall be on a scale of not less than 1:32 (3/8 inch equal to one foot). Clearly identify and dimension the proposed locations of the principal items of equipment. The drawings shall clearly show the proposed locations and adequate clearance for all equipment, controls, piping, pumps, valves and other items. All equipment requiring service shall be provided with an access door sized for the complete removal of device, component, or servicing of the equipment. Access for service and access for removal of components may be separate as necessary. Provide detailed coordination/shop drawings and loading calculations for all piping systems. The drawings should include all lockout/tagout points for all energy/hazard sources for each piece of equipment. Coordinate lockout/tagout procedures and practices with local VA requirements.
 3. Do not install equipment foundations, equipment or piping until coordination/shop drawings have been approved.
- J. Complete operating and maintenance manuals including wiring diagrams, technical data sheets, information for ordering replacement parts, and troubleshooting guide:
1. Include complete list indicating all components of the systems.
 2. Include complete diagrams of the internal wiring for each item of equipment.
 3. Diagrams shall have their terminals identified to facilitate installation, operation and maintenance.

1.5 QUALITY ASSURANCE

- A. Products Criteria:
1. Standard Products: Material and equipment shall be the standard products of a manufacturer regularly engaged in the manufacture, supply and servicing of the specified products for at least 5 years.

- However, digital electronics devices, software and systems such as controls and instruments, shall be the current generation of technology and basic design that has a proven satisfactory service record of at least 5 years.
2. All items furnished shall be free from defects that would adversely affect the performance, maintainability and appearance of individual components and overall assembly.
 3. The products and execution of work specified in Division 33 shall conform to the referenced codes and standards as required by the specifications. Local codes and amendments shall be enforced, along with requirements of local utility companies. The most stringent requirements of these specifications, local codes, or utility company requirements shall always apply. Any conflicts shall be brought to the attention of the COR.
 4. When two or more units of the same type or class of materials or equipment are required, these units shall be products of one manufacturer.
 5. Assembled Units: Manufacturers of equipment assemblies, which use components made by others, assume complete responsibility for the final assembled product.
 6. A nameplate bearing manufacturer's name or trademark, including model number, shall be securely affixed in a conspicuous place on equipment. In addition, the model number shall be cast integrally with equipment, stamped, or otherwise permanently marked on each item of equipment.
 7. Asbestos products or equipment or materials containing asbestos shall not be used.
- B. Contractor shall restore damaged items to as-new operating condition or replace damaged items as directed by the COR, at no additional cost or time to the Government.
- C. Welding Qualifications: Before any welding is performed, contractor shall submit a certificate certifying that welders comply with the following requirements:
1. Qualify welding processes and operators for piping according to ASME BPVC Section IX, AWS Z49.1 and AWS B2.1/B2.1M.
 2. Comply with provisions in ASME B31.1.
 3. Certify that each welder and welding operator has passed AWS qualification tests for welding processes involved and that

certification is current and recent. Submit documentation to the COR.

4. All welds shall be stamped according to the provisions of the American Welding Society.

D. ASME Compliance: Comply with ASME B31.1 for materials, products, and installation. Safety valves and pressure vessels shall bear appropriate ASME labels.

1.6 DELIVERY, STORAGE AND HANDLING

A. Equipment and material placed on the job site shall remain in the custody of the Contractor until phased acceptance, whether or not the Government has reimbursed the Contractor for the equipment and material. The Contractor is solely responsible for the protection of equipment and material against damage or theft.

B. Protect piping systems against the entry of water, mud or other foreign substances by installing watertight covers on open ends at all times. Both inside and outside shall be cleaned before painting or placing equipment in operation. Protect direct-buried system coatings from ultraviolet light (sunlight). Existing equipment worked on by the Contractor or in the Contractor's working area shall be considered to be in the custody and responsibility of the Contractor and shall be protected as required for new work.

C. Damaged equipment shall be replaced with an identical unit as determined and directed by the COR. All insulated piping systems exposed to water must be replaced prior to installation at no additional cost or time to the Government.

1.7 AS-BUILT DOCUMENTATION

A. Submit manufacturer's literature and data updated to include submittal review comments and any equipment substitutions.

B. Submit operation and maintenance data updated to include submittal review comments, VA approved substitutions and construction revisions shall be in electronic version on CD or DVD inserted into a three-ring binder. All aspects of system operation and maintenance procedures, including applicable piping isometrics, wiring diagrams of all circuits, a written description of system design, control logic, and sequence of operation shall be included in the operation and maintenance manual. The operations and maintenance manual shall include troubleshooting techniques and procedures for emergency situations.

Notes on all special systems or devices shall be included. A list of recommended spare parts (manufacturer, model number, and quantity) shall be furnished. Information explaining any special knowledge or tools the owner will be required to employ shall be inserted into the As-Built documentation.

- C. The installing contractor shall maintain as-built drawings of each completed phase for verification; and, shall provide the complete set at the time of final systems certification testing. Should the installing contractor engage the testing company to provide as-built or any portion thereof, it shall not be deemed a conflict of interest or breach of the 'third party testing company' requirement. Provide record drawings as follows:
 - 1. As-built drawings are to be provided, with a copy of them in three-dimensional Building Information Modeling (BIM) software version provided on CD or DVD.
- D. The as-built drawings shall indicate the location and type of all lockout/tagout points for all energy sources for all equipment and pumps to include breaker location and numbers, valve tag numbers, etc. Coordinate lockout/tagout procedures and practices with local VA requirements.
- E. Certification documentation shall be provided to COR 21 working days prior to submitting the request for final inspection. The documentation shall include all test results, the names of individuals performing work for the testing agency on this project, detailed procedures followed for all tests, and provide documentation/certification that all results of tests were within limits specified. Test results shall contain written sequence of test procedure with written test results annotated at each step along with the expected outcome or setpoint. The results shall include all readings, including but not limited to data on device (make, model and performance characteristics), normal pressures, switch ranges, trip points, amp readings, and calibration data to include equipment serial numbers or individual identifications, etc.

1.8 COORDINATION

- A. Coordinate exterior steam lines and associated systems and connections to building services up to the actual extent of building wall.

1.9 UTILITY LOCATION SERVICES

- A. Prior to any demolition or excavation, provide for utility location services to mark on the ground with fluorescent paint the location of existing underground utilities, and their identification. The term “utility(ies)” includes both public utilities and VA-owned utilities, for all underground services.

PART 2 – PRODUCTS

2.1 PRE-ENGINEERED, FACTORY-FABRICATED, DIRECT-BUIRED, DRAINABLE-DRYABLE-TESTABLE (DDT) SYSTEMS (ADDENDUM 3, 01-17-2025)

- A. Complete factory-fabricated steam and condensate piping system with carrier pipes, carrier pipe insulation with jackets and banding, air space, 6 mm (1/4 inch) thick steel casing, fusion-bonded epoxy casing coatings, cathodic protection, accessories. Do not locate condensate pipes in casings that contain steam pipes.
- B. All components of system shall be suitable for carrier pipe pressures and temperatures as follows:
 - 1. Steam System: 1035 kPa (150 psig); 185 degrees C (366 degrees F).
 - 2. Condensate System: 345 kPa (50 psig); 154 degrees C (310 degrees F).
- C. Steam Carrier Pipes and Condensate Carrier Pipes: No piping joints are allowed in factory-fabricated straight sections of pre-engineered direct-buried systems.
- D. Carrier Pipe Insulation:
 - 1. Conform to minimum thickness and type of insulation listed in Tables 1 and 2 below as required for service temperature in carrier pipe as listed below.
 - 2. Section A: Steam temperature is 154 degrees C (366 degrees F), steam pressure is 1035 kPa (150 psig). Pumped condensate temperature is 93 degrees C (200 degrees F). Drip return temperature is 100 degrees C (212 degrees F).
 - 3. Allowable Carrier Pipe Insulation Type and Minimum Insulation Thickness:

TABLE 1 Minimum Pipe Insulation Thickness mm (inches) For Steam 110 to 2800 kPa (16 to 406 psig) gauge		
Nominal Pipe Diameter mm (inches)	Pre-Formed Mineral Wool	Calcium Silicate
25 (1)	65 (2-1/2)	100 (4)

40 (1-1/2)	65 (2-1/2)	100 (4)
50 (2)	90 (3-1/2)	115 (4-1/2)
65 (2-1/2)	90 (3-1/2)	115 (4-1/2)
75 (3)	100 (4)	125 (5)
100 (4)	100 (4)	125 (5)
125 (5)	100 (4)	125 (5)
150 (6)	115 (4-1/2)	140 (5-1/2)
200 (8)	115 (4-1/2)	140 (5-1/2)
250 (10)	125 (5)	150 (6)
300 (12)	125 (5)	150 (6)
355 (14)	125 (5)	150 (6)
406 (16)	125 (5)	150 (6)
457 (18)	125 (5)	150 (6)

Notes:

1. Submittals shall include manufacturer's certification that all insulation have passed the 96-hour boiling water test.
2. Pipes smaller than 25 mm (1 inch) shall have same insulation thickness as required for 25 mm (1 inch) pipe.

TABLE 2 Minimum Pipe Insulation Thickness mm (inches) For Steam Less than 110 kPa (16 psig) gauge, Condensate Return		
Nominal Pipe Diameter mm (inches)	Pre-Formed Mineral Wool	Calcium Silicate
25 (1)	50 (2)	75 (3)
40 (1-1/2)	50 (2)	75 (3)
50 (2)	50 (2)	75 (3)
65 (2-1/2)	50 (2)	75 (3)
75 (3)	65 (2-1/2)	90 (3-1/2)
100 (4)	65 (2-1/2)	90 (3-1/2)
125 (5)	65 (2-1/2)	90 (3-1/2)
150 (6)	75 (3)	115 (4-1/2)
200 (8)	75 (3)	115 (4-1/2)
250 (10)	100 (4)	125 (5)
300 (12)	100 (4)	125 (5)
355 (14)	100 (4)	125 (5)

406 (16)	100 (4)	125 (5)
457 (18)	100 (4)	125 (5)

Notes:

1. Submittals shall include manufacturer's certification that all insulation have passed the 96-hour boiling water test which indicates that satisfactory performance in underground service can be expected.
 2. Pipes smaller than 25 mm (1 inch) shall have the same insulation thickness as required for 25 mm (1 inch) pipe.
- E. Insulation Banding and Jacket: 304 stainless steel bands and clips, at least 13 mm (1/2 inches) wide, maximum spacing 457 mm (18 inches). A minimum of two bands is required for each 1200 mm (4 foot) section of insulation.
- F. Vinyl-coated Fiberglass Scrim Jacket: Fed. Spec. L-S-125, Type II, Class 2, with 18 x 16 mesh (number of filaments per inch) and made of 0.335 mm (0.013 inch) diameter vinyl-coated fibrous glass yarn. Install bands over the jacket to secure the insulation to the carrier pipe.
- G. Casing: ASTM A139/A139M, smooth-wall steel, electric resistance welded. Plastic casings are prohibited. Use eccentric connectors as necessary between casing sections to provide continuous gravity drainage in bottom of casing between manholes and between manholes and buildings.

Casing Diameter mm (inches)	Minimum Thickness mm (inches)
150 - 1170 (6 - 46)	6.35 (0.250)

- H. Casing End Seal Plates with Vents and Drains: ASTM A36/A36M, steel, minimum thickness 10 mm (3/8 inch) for casings up through 300 mm (12 inches) diameter and 13 mm (1/2 inch) for casings over 300 mm (12 inches) diameter. Provide 25 mm (1 inch) drain at the bottom and vent at the top. Construct with threaded steel half couplings. Install threaded brass plugs in drains.
- I. Vent Riser Pipes: ASTM A53/A53M, Schedule 40, galvanized, extending through top of manhole and terminate 300 mm (12 inches) above grade with 180-degree bend. Provide stainless steel insect screen at pipe opening.
- J. Gland seals are prohibited because of the possibility of water entering the system through the gland seal from a flooded manhole.

- K. Provide continuous 25 mm (1 inch) minimum air space between carrier pipe insulation and casing.
- L. Casing coating shall be dual layers of fusion-bonded epoxy, inner green-colored layer minimum thickness 0.5 mm (0.020 inch), outer black-colored layer minimum thickness 0.25 mm (0.010 inch). Rated by coating manufacturer for continuous service for at least 25 years at minimum temperature of 110 degrees C (230 degrees F) and having a coefficient of expansion similar to that of steel. Coating shall be applied in accordance to recommendations of coating manufacturer including surface preparation. Factory-inspect for holidays and make repairs as necessary.
- M. Coating of end plates and casing sections extending in manholes shall be zinc-rich coating that conforms to AASHTO M300-03-UL, Type IA except that volatile organic compounds shall not exceed 0.34 kg per liter (2.8 pounds per gallon). The zinc rich coating shall be applied in accordance with the recommendations of the coating manufacturer including surface preparation. No additional top coat shall be applied.
- N. Carrier pipe guides and supports shall be maximum spacing 3000 mm (10 feet) on centers, no greater than 1500 mm (5 feet) from pipe ends, minimum of three guides per elbow section. Designed to permit thermal expansion without damage, provide proper pipe guiding and support, and to allow horizontal movement in two directions as necessary at expansion loops and bends. Design of guides and supports must permit continuous drainage of water in bottom of casing. Pipe insulation shall extend through the pipe guides and supports and be protected by steel sleeves. Design of guides and supports shall be such that no metal-to-metal contact exists between the casing and the carrier pipe. Insulation or non-metallic material used to ensure no metal to metal contact shall be designed to not be compressed by the weight of the carrier pipe when full of water.
- O. Anchor plates shall be ASTM A36/A36M steel, welded to carrier pipe and casing, 15 mm (1/2 inch) minimum thickness, passages for air flow and water drainage through the annular air space in the system. Coated with same coating material as the casing. Locate 900 to 1500 mm (3 to 5 feet) from piping entrance to manhole or building wall. Walls of manholes and buildings cannot be utilized as anchor points.
- P. Field connection of casing sections shall be steel section conforming to casing specification, welded to casing sections, coated on all

surfaces with system manufacturer's coating field repair compound, and covered with a 1.3 mm (0.05 inch) minimum thickness polyethylene shrink sleeve designed for a service temperature exceeding 80 degrees C (176 degrees F).

- Q. Manhole and building wall penetrations shall provide steel leak plates welded to wall sleeves or to casings. Where a wall sleeve is utilized, allow sufficient annular space between the sleeve and the casing and install a watertight seal, rated for 121 degrees C (250 degrees F) minimum. Manhole and building walls cannot be used as anchor points.
- R. Provide sacrificial anode type cathodic protection system with dielectric isolation devices and test stations for all systems. Design system for 25 years of service, assume two percent bare metal. System shall comply with NACE SP0169.
- S. Provide embossed brass or stainless-steel tag hung by a brass or stainless-steel chain at each end of each casing or insulated piping in the manholes and buildings. The tag shall identify system manufacturer's name, date of installation, government contract, and manufacturer's project number.
- T. All branch piping connections must be located in manholes.
- U. Ensure the DDT manufacturer is responsible for the complete design of the DDT system, including, but not limited to, the product to be supplied, fabrication, installation, supervision, and testing of the system within the design parameters established by the contract documents, and in compliance with the detailed design. The complete design of the system shall be sealed by a Professional Engineer in the employ of the DDT manufacturer.
- V. Furnish thermal expansion calculations for the steam and condensate piping using the design characteristics indicated in this section and installation temperature no higher than the ambient temperature at the site: 21 degrees C (70 degrees F).
- W. DDT manufacturer shall submit a complete description of the design and assembly of the system, materials of construction and field installation instructions. Include sufficient system details to show that the specified minimum insulation thickness has been met. A detailed design layout of the system (plan and elevation views) showing size, type, elevations and location of each component to be used in the system, the design and location of anchors, pipe guides, pipe supports,

expansion loops, Z-bends, L-bends, end seals, leak plates, joint locations, pipe and insulation thickness and sizes, types, and movements, connection to manhole and building wall penetrations, and including, if applicable, details of transition point to aboveground or other type systems. Detailed design layout drawings shall be stamped by a registered Professional Engineer.

- X. Expansion Loops and Bends: Pipe-stress and system-expansion calculations for each expansion compensation elbow using a finite element computer generated 3-dimensional analysis (FEA). Demonstrate with calculations that pipe stresses from temperature changes are within the allowable requirements in ASME B31.1 and that the anchors and the guides will withstand the resultant forces. Detailed design layout drawings shall include all analysis node points. As a minimum, computer analysis results shall include node stresses, forces, moments and displacements. Calculations shall be stamped by a registered Professional Engineer in the employ of the DDT manufacturer.
- Y. Drainage as shown on drawings. Provide a sump pit in each manhole where indicated on drawings.

2.2 STEAM PIPING

- A. Pipe: ASTM A53/A53M, steel, seamless, Grade B, ASTM A106/A106M, Grade B, electric resistance welded, Schedule 40, Schedule 80. Grade F, furnace butt-welded pipe is prohibited. Use Schedule 80 pipe and fittings for threaded joints.
- B. Joints:
 - 1. In trenches: Butt-weld joints. Socket weld is required for pipe sizes 50 mm (2 inches) and less.
 - 2. In tunnels, manholes, and open areas: Butt weld pipe sizes 65 mm (2-1/2 inches) and greater; thread or socket weld pipe sized 50 mm (2 inches) and less. Use Schedule 80 pipe and fittings for threaded joints.
- C. Fittings:
 - 1. Butt welded joints: ASTM A234/A234M or ASME B16.9, steel, Grade B, same schedule as adjoining pipe. All elbows shall be long radius unless otherwise indicated. Tees shall be full size or reducing as required, having interior surfaces smoothly contoured.
 - 2. Threaded joints: ASME B16.11, forged steel fittings, Class 2000. Use Schedule 80 pipe only.

3. Socket welded joints: ASME B16.11, forged steel, 13,800 kPa (2000 psig) class.
- D. Flanges and Bolts: ASME B16.5, weld neck, forged steel, ASTM A105/A105M, pressure class 1035 kPa (150 psig). Bolts shall be high strength ASTM A193/A193M, Class 2, Grade B7. Nuts shall be ASTM A194/A194M.
- E. Unions: Pipe 50 mm (2 inches) and less shall be threaded, steel, 2050 kPa (297 psig) class.

2.3 STEAM CONDENSATE PIPING

- A. Pipe: ASTM A53/A53M, seamless, Grade B, ASTM A106/A106M, Grade B, ASTM A53/A53M electric resistance welded, Grade B, Schedule 80. Grade F, furnace butt-welded pipe is prohibited. Use Schedule 80 pipe and fittings for threaded joints.
- B. Joints:
 1. In trenches: Butt weld joints. Socket weld is required for pipe sizes 50 mm (2 inches) and less.
 2. In tunnels, manholes, and open areas: Butt weld pipe sizes 65 mm (2-1/2 inches) and greater. For system pressures of 103 kPa (15 psi) or less, thread or socket weld pipe sizes 50 mm (2 inches) and less. For system pressures of 103 kPa (15 psi) and no greater than 700 kPa (100 psig), socket weld pipe sizes 25 mm (1 inch) and greater, and thread pipe sizes less than 25 mm (1 inch). For higher system pressure, socket weld pipe sizes of 50 mm (2 inches) or less.
- C. Fittings:
 1. Welded joints: ASTM A234/A234M, steel, Grade B, or ASME B16.9, same schedule as adjoining pipe.
 2. Threaded joints: ASME B16.11, forged steel fittings, Class 2000. Use Schedule 80 pipe and fittings only.
 3. Socket welded joints: ASME B16.11, forged steel, 13,800 kPa (2000 psig) class.
- D. Unions (Except in Trenches): Pipe 50 mm (2 inches) and less, 2050 kPa (297 psig) steel.
- E. Flanges: Weld neck ASME B16.5 or ASTM A105/A105M, forged steel, 1035 kPa (150 psig).

2.4 VALVES

A. Gate Valves:

1. Type 101:
 - a. Type applies to steam valves with sizes 65 mm (2-1/2 inches) and greater.
 - b. Steel body, rated 1035 kPa (150 psig) at 260 degrees C (500 degrees F), 11-1/2 to 13 percent chromium stainless steel flexible wedge and hard faced (stellite) or nickel copper alloy seats, 1035 kPa (150 psig) flanged ends, OS&Y, rising stem, bolted bonnet.
 - c. Factory installed globe valved bypass on all steam valves greater than 75 mm (3 inches).
 - d. Drill and tap bosses for connection of drains where shown.
2. Type 102 is not used.
3. Type 103:
 - a. Type applies to condensate valves with sizes 65 mm (2-1/2 inches) and greater.
 - b. Forged steel body, Class B, rated for 850 kPa (123 psig) saturated steam, 1380 kPa (200 psig) WOG, bronze or bronze face wedge and seats, 850 kPa (123 psig) ASME flanged ends, OS&Y, rising stem, bolted bonnet, renewable seat rings.
4. Type 104:
 - a. Type applies to condensate valves with sizes 50 mm (2 inches) and less.
 - b. Forged steel body, rated for 1380 kPa (200 psig) saturated steam, 2758 kPa (400 psig) WOG, bronze wedges and Monel or stainless-steel seats, threaded ends, rising stem, union bonnet.
5. Type 105 is not used.
6. Type 106:
 - a. Type applies to steam valves with sizes 50 mm (2 inches) and less.
 - b. Forged steel body, rated for 2070 kPa (300 psig) at 216 degrees C (420 degrees F) minimum Class 4138 kPa (600 psig) or Class 5515 kPa (800 psig), hardened stainless steel or satellite wedge and seats, threaded ends, OS&Y, rising stem, bolted bonnet.

B. Globe Valves (ASTM A126):

1. Type 201:

- a. Type applies to steam valves with sizes 65 mm (2-1/2 inches) and greater.
- b. Carbon steel body, rated 1035 kPa (150 psig) at 260 degrees C (500 degrees F), 11-1/2 to 13 percent chromium stainless steel or stellite disc and seat, 1035 kPa (150 psig) ASME flanged ends, OS&Y, rising stem, bolted bonnet, renewable seat rings. Drill and tap bosses for connection of drains.

2. Type 202 is not used.

3. Type 203:

- a. Type applies to condensate valves with sizes 65 mm (2-1/2 inches) and greater.
- b. Steel body, rated for 850 kPa (123 psig) saturated steam, 1380 kPa (200 psig) WOG, bronze or bronze-faced disc (Teflon or composition facing permitted) and seat, 850 kPa (123 psig) ASME flanged ends, OS&Y, rising stem, bolted bonnet, renewable seat rings.

4. Type 204:

- a. Type applies to steam valves and condensate valves with sizes 50 mm (2 inches) and less.
- b. ASTM B61, Forged steel body, rated for 1380 kPa (200 psig) saturated steam, 2758 kPa (400 psig) WOG, hardened stainless steel disc and seat, threaded ends, rising stem, union bonnet, renewable seat rings.

C. Check Valves (ASTM A126):

1. Type 401:

- a. Type applies to steam valves with sizes 65 mm (2-1/2 inches) and greater.
- b. Steel body, swing-type, rated for 1035 kPa (150 psig) at 260 degrees C (500 degrees F), stainless steel or stainless steel - faced disc and seat, 1035 kPa (150 psig) ASME flanged ends, bolted cover, renewable disc.

2. Type 402 is not used.

3. Type 403:

- a. Type applies to condensate valves with sizes 65 mm (2-1/2 inches) and greater.

- b. Forged Steel body, Class B, swing-type, rated for 850 kPa (123 psig) saturated steam, 1380 kPa (200 psig) WOG, bronze or bronze-faced disc and seat, 850 kPa (123 psig) ASME flanged ends, bolted cover, renewable disc and seat.
4. Type 404:
- a. Type applies to steam valves and condensate valves with sizes 50 mm (2 inches) and less.
 - b. Forged Steel body, swing-type, rated for 1380 kPa (200 psig) saturated steam, 2758 kPa (400 psig) WOG, bronze disc, threaded ends, regrinding disc.
- D. Ball Valves (ASTM A126):
- 1. Type 501 is not used.
 - 2. Type 502:
 - a. Type applies to steam valves and condensate valves with sizes 50 mm (2 inches) and less.
 - b. Forged steel body, rated for 1035 kPa (150 psig) at 185 degrees C (365 degrees F), 1725 kPa (250 psig) at 121 degrees C (250 degrees F); reinforced TFE seat, stem seal and thrust washer; end entry, threaded ends, one-fourth turn to open.
 - 3. Type 503 is not used.
 - 4. Type 504:
 - a. Type applies to steam valves and condensate valves with sizes 65 mm (2-1/2 inches) and greater.
 - b. Carbon steel or ductile iron body, saturated steam service, rated for 1035 kPa (150 psig), stainless steel ball and stem, Polyfil seat, live-loaded stem seal, 1035 kPa (150 psig) ASME flanged ends.

2.5 STEAM TRAPS

- A. Apply at steam line drip points.
- B. Fixed orifice or Venturi type traps are prohibited.
- C. Construct inverted bucket type with thermostatic vent in bucket, except closed-float-thermostatic on discharge side of pressure reducing stations. Each type furnished by a single manufacturer. Select the traps for pressures and capacities as shown or required.
- D. Traps: Steel bodies. Construction shall permit ease of removal and servicing working parts without disturbing connecting piping. Include

stainless steel floats, hardened chrome steel valves, stainless steel mechanisms and bi-metallic air vent on inverted bucket traps.

- E. Provide electronic trap performance monitoring devices that are compatible with the existing monitoring system. Trap malfunctions shall be automatically transmitted to and properly interpreted by the existing monitoring system. Provide all necessary power sources, transmitting and retransmitting devices and batteries to achieve a properly operating system.
- F. All traps shall include ports for future installation of monitoring devices. To facilitate future removal of plugs, remove plugs, install Teflon tape on the threads, and reinstall the plugs.
- G. Label each trap at the factory with an identification number keyed to the contract drawings. Label shall be a metal tag permanently attached to the trap.

2.6 STRAINERS, Y TYPE

- A. Provide as shown on steam and condensate piping systems.
- B. Include open end removable cylindrical screen and threaded blow off connection.
- C. For steam service up to 1035 kPa (150 psig) and at drip traps, strainer shall be rated for minimum 1035 kPa (150 psig) saturated steam; rated for 1035 kPa (150 psig), flanged ends, steel, for pipe sizes greater than 50 mm (2 inches). Use forged steel, rated for 1725 kPa (250 psig) saturated steam, threaded ends, for pipe sizes 50 mm (2 inches) and less.
- D. For condensate service, strainer shall be rated for 850 kPa (123 psig) saturated steam, 1200 kPa (175 psig) WOG. Provide steel, flanged ends, for pipe sizes greater than 50 mm (2 inches). Provide forged steel, threaded ends, for pipe sizes 50 mm (2 inches) and less.
- E. Strainer screen shall be stainless steel, with a free area not less than 2-1/2 times flow area of pipe. Diameter of openings shall be 1.3 mm (0.05 inch) or less on steam service and 1.5 mm (0.06 inch) or less on water service.
- F. Include gate type valve and quick couple hose connection on all blowoff connections.

2.7 PRESSURE GAUGES

- A. Provide gauges immediately downstream of each steam line isolation valve, before and after each steam pressure reducing station and where shown on the drawings.
- B. Gauges: ASME B40.100.
 - 1. Solid armored front between measuring element and dial, blowout back, bottom connection, phenol turret type.
 - 2. Non-corrosive, 115 mm (4-1/2 inches) diameter face with black markings on white background.
 - 3. Bourdon tube measuring element designed for service. Provide bellows for pressure ranges less than 103 kPa (15 psig).
 - 4. Stainless steel, rotary movement.
 - 5. Micrometer adjustable, black color pointer.
 - 6. Plastic window.
 - 7. Provide liquid filled gauges at outlet of all pumps.
 - 8. Factory calibrated and certified.
- C. Accuracy: Grade 2A, 1/2 percent, on all gauges; except Grade A, one percent permitted on diaphragm actuated gauges, liquid filled gauges, and compound gauges.
- D. Include:
 - 1. Red set hands on gauges located at automatic pressure regulator valve outlets.
 - 2. Needle valve or gauge cock rated for the service.
 - 3. Syphon on all steam gauges.
 - 4. Overload stop on all pressure gauges.
- E. Pressure gauge ranges shall be selected such that the normal operating pressure for each gauge is displayed near the midpoint of each gauge's range. Gauges with ranges selected such that the normal pressure is displayed at less than 30 percent or more than 70 percent of the gauge's range are prohibited. The units of pressure shall be psig.

2.8 THERMOMETERS, PIPE OR TANK MOUNTED

- A. Thermometer locations are shown on the drawings.
- B. Thermometers:
 - 1. Industrial type, separable well and socket.
 - 2. Red reading mercury combination Celsius/Fahrenheit scale, 225 mm (9 inches) long.
 - 3. Stainless steel corrosion resistant case with safety glass front.

4. Adjustable angle for ease of viewing.
5. Wells sized to suit pipe diameter without restricting flow, or provide oversized pipe at well location. Snug sliding fit between socket and well. Well should be 316 stainless steel.
6. Accuracy shall be one percent of scale range.
7. 0 to 149 degrees C (32 to 300 degrees F).
8. Factory calibrated and certified.

2.9 PIPE HANGERS AND SUPPORTS

- A. Requirements: MSS SP-58 and ASME B31.1.
- B. Applies to all piping not in factory-fabricated direct-buried system. All systems shall be completely supported. Arrange supports so that all loads due to weight, thermal expansion, seismic shock (if applicable), and pressure are transferred from the support system to the structure. The design and location of supports shall at all times prevent excessive forces, moments, and stresses from being imposed on the equipment, structure, supported system, and supports. Heated systems generally require resilient or roller/slide supports.
- C. Manufacturer Certification: Factory built products of a manufacturer whose principle business is pipe supports for 10 years. All components must have published load ratings. For concrete trenches, non-factory built products that comply with details may be utilized.
- D. Components:
 1. Roller supports: MSS SP-58, Type 41, 43, 46. Provide vertical adjustment for Type 41 with threaded studs and nuts adjacent to the roller.
 2. Variable spring support assembly: MSS SP-58, Type 51 variable spring, Type 3 pipe clamp, Type 1 clevis, Type 53 variable spring trapeze. Locate Type 51 variable spring within 300 mm (1 foot) above pipe attachment. Attach rod to top of variable spring with Type 14 clevis.
- E. Spring Cushion Support Assembly: MSS SP-58.
 1. Double rod assembly: Type 41 and 49.
 2. Single rod assembly: Type 48 spring cushion, Type 3 pipe clamp, Type 1 clevis. Locate spring cushion within 300 mm (1 foot) above pipe attachment.
- F. Clevis Supports: MSS SP-58, Type 1.
- G. Wall Brackets: MSS SP-58, Type 31, 32, 33.

- H. Pipe Stands: MSS SP-58, Type 38.
- I. Riser Clamp: MSS SP-58, Type 42.
- J. Alignment Guides: Welded steel as shown to restrain movement perpendicular to the long axis of the piping. If not welded, provide steel spider clamped to pipe, enclosed within steel sleeve that is bolted or welded to structural support. Must provide lateral force equal to minimum of 15 percent of anchor loading.
- K. Trapeze Supports: MSS SP-58, may be used where pipes are close together and parallel, structural steel channels or angles. Bolt roller supports to steel to support piping subject to horizontal thermal expansion. Attach other piping with "U" bolts.
- L. Pipe Covering Protection Saddles: MSS SP-58, Type 39. Provide at all support points on insulated pipe except where Type 3 pipe clamps are provided.
- M. Sliding Supports: MSS SP-58, Type 35. Welded steel attachments to pipe and structure with Teflon or graphite sliding surfaces bonded to the attachments. Provide steel guides, except at expansion bends, to prevent lateral movement of the pipe.
- N. Pipe Racks and Miscellaneous Supports: ASTM A36/A36M, structural steel shapes. Manufactured strut systems are acceptable if they have the required load carrying ability.
- O. Supports, including all structural steel, in trenches and manholes: Hot-dip galvanized.

2.10 BURIED UTILITY WARNING TAPE

- A. Tape: 0.1 mm (0.004 inch) thick, 150 mm (6 inches) wide, yellow polyethylene with a ferrous metallic core, acid and alkali-resistant and shall have a minimum strength of 12,000 kPa (1740 psig) lengthwise and 10,300 kPa (1500 psig) crosswise with an elongation factor of 350 percent. Provide bold black letters on the tape identifying the type of system. Tape color and lettering shall be unaffected by moisture and other substances contained in the backfill material.

PART 3 - EXECUTION

3.1 GENERAL

- A. If an installation is unsatisfactory to the COR, the Contractor shall correct the installation at no additional cost or time to the Government.
- B. Connect new work to existing work in a neat and workmanlike manner. Where an existing structure must be cut or existing utilities

interfere, such obstruction shall be bypassed, removed, replaced or relocated, patched and repaired. Piping connections shall be made only in manholes, tunnels or buildings.

- C. Coordinate the location of all items of equipment and work of all trades. Maintain operability and maintainability of the equipment and systems. The contractor at his cost shall perform any relocation of equipment or systems to comply with the requirement of operability and maintainability.
- D. Unless otherwise shown in the contract documents, steam lines shall be graded downward not less than 50 mm in 12 meters (2 inches in 40 feet) in direction of the flow. Provide eccentric reducing fittings on steam mains and branches, (except on vertical piping). Install said fittings to maintain continuity of grade in bottom of pipeline. Provide risers with drip pockets and steam traps on steam lines where space restrictions prevent continuous grading. All steam traps must be located in manholes or tunnels.

3.2 DEMOLITION

- A. Perform work in accordance with requirements for phasing and the Drawings. Phasing shown on drawings is an outline from which the contractor will use to provide more details in executing the work in each phase.
- B. If asbestos containing materials are suspected to be present in the demolished items not identified in the drawings to be part of the asbestos abatement, the contractor shall secure the area, remove their personnel and refer the matter to COR immediately for resolution. Refer to Section 02 82 11, TRADITIONAL ASBESTOS ABATEMENT.
- C. Completely remove all pipe, valves, fittings, insulation, and all hangers including the connection to the structure and any fastenings.
- D. Seal all openings in manhole or building walls after removal of piping.
- E. All material and equipment removed shall become the property of the Contractor and shall be removed from Government property and shall not be stored in operating areas unless designated as being turned over to the owner.
- F. All flame cutting shall be performed with facility burn permit in place and adequate fire protection facilities available as required by safety codes and COR.

3.3 PIPING INSTALLATION

- A. Drawings indicate general location and arrangement of piping systems. For field installed insulation, install piping insulation as specified herein and/or as recommended by the manufacturer.
- B. Remove all standing water in the bottom of trench.
- C. Pipe Bedding: Minimum 150 mm (6 inch) layer of sand. Provide compaction and leveling of virgin soil prior to installing bedding.
- D. Clearance: Minimum 150 mm (6 inches) clearance between the external insulation/casing of pipes 300 mm (12 inches) or smaller, and if no valves and fittings are present along the pipes. Otherwise provide the required service clearances between valves/fittings on adjacent pipes to allow future replacement. Obtain minimum service clearances from valve/fitting manufacturer.
- E. Testing: Do not insulate piping or backfill piping trench until field quality-control and cleaning, followed by testing has been completed and results approved by COR.
- F. Grade:
 - 1. Install condensate piping at uniform grade of 0.4 percent downward in direction of flow.
 - 2. Install steam piping at uniform grade of 0.2 percent downward in direction of flow or as indicated on the Drawings.
- G. Drain Valves and Air Vents: For carrier piping, install at low points and air vents at high points.
- H. Install components with pressure rating equal to or greater than system design pressure.
- I. Install piping free of sags and bends.
- J. Install fittings for changes in direction and branch connections.
- K. On direct-buried pipes, secure anchors with concrete thrust blocks.

3.4 DRAIN VALVES AND VENT VALVES

- A. Provide 40 mm (1-1/2 inch) minimum pipe size drain valves on condensate return carrier pipes at all low points in manholes. Provide 25 mm (1 inch) minimum manual air vent valves in manholes at all high points in condensate return carrier piping.
- B. Do not install any valves at the outer casing piping vents.

3.5 PIPE SUPPORT INSTALLATION (IN TRENCHES, TUNNELS, MANHOLES)

- A. Coordinate support locations prior to erection of piping. Hanger parts must be marked at the factory with a numbering system keyed to hanger

layout drawings. Layout drawings must be available at the site during construction.

B. Upper Attachments to Structure:

1. New reinforced concrete construction shall have concrete inserts.
2. For existing reinforced concrete construction, upper attachment shall be welded or clamped to steel clip angles or other construction methods/detail shown on the drawings that are expansion bolted to the concrete. Expansion bolting shall be located so that bolts are shear loaded.
3. For steel deck and structural framing, upper attachments shall be welded or clamped to structural steel members.

C. In existing concrete construction, expansion fasteners may be used for hanger loads up to one third the manufacturer's rated strength of the expansion fastener. Power set fasteners may be used for loads up to one fourth of rated load. When greater hanger loads are encountered, additional fasteners may be used and interconnected with steel members combining to support the hanger.

D. Special Supports:

1. Secure horizontal pipes where necessary to prevent vibration or excess sway.
2. Where hangers cannot be adequately secured as specified, make special provisions for hanging and supporting pipe to be submitted to COR for A/E review.
3. Do not attach pipe supports, hangers, clamps or anchors to equipment unless specified for that equipment or unless the COR gives written permission.

E. Locate spring hanger units within 300 mm (1 foot) of the pipe attachment, except in locations where spring assemblies interfere with pipe insulation.

F. Minimum Clearances in Tunnels and Trenches:

1. Floor to bottom of pipe support beam: 150 mm (6 inches).
2. Floor to bottom of pipe insulation jacket: 150 mm (6 inches).
3. Wall to side of pipe insulation jacket: 150 mm (6 inches.)
4. Ceiling to top of pipe insulation jacket: 150 mm (6 inches).
5. Greater clearances shall be provided to meet maintenance, repair/replacement, and service requirements of valves, fittings and equipment as recommended by their manufacturers.

3.6 PAINTING EXPOSED STEEL SURFACES IN MANHOLES, TUNNELS AND CONCRETE SHALLOW TRENCHES

- A. For manholes and walk-through tunnels, provide surface cleaning and preparation in accordance with SSPC SP-2 and apply prime coat of rust resistant metal primer.
- B. For concrete shallow trenches, provide surface cleaning and preparation in accordance with SSPC SP-2 and apply primer and finish coat of zinc-rich paint.

3.7 DIRECT-BURIED SYSTEM INSTALLATION

- A. The Contractor shall deliver, store, install and test the system as per manufacturer's recommendations. All work shall be in strict accordance with the requirements specified by the manufacturer. Printed instructions must be available on site prior to delivery of system components. Any changes required to the design and layout of the system due to site conditions must be approved in writing by the manufacturer and submitted for review by the COR. All branch piping connections, valves and drip traps must be located within manholes.
- B. Excavation, Trenching, and Backfilling: Perform all excavation, trenching, and backfilling as required by the system manufacturer's design. Beach sand or any sand with large amounts of chlorides is prohibited. Install per manufacturers recommendations and as shown on contract drawings based on soil conditions. Foundation for system must be firm and stable. Foundation and backfill must be free from rocks. Concrete anchor and thrust blocks must be installed in undisturbed earth. Backfilling must not commence until elevations have been surveyed and accepted and system has been satisfactorily pressure tested and cleaned, including hydrostatic testing of carrier pipes and air testing of casings.
- C. Maintain constant slope of carrier pipes as shown or specified. Prior to backfilling over the top of the casing, but after removal of temporary supports, Contractor shall measure and record elevations of top of casing in the trench. Elevations shall be taken at every field joint, 1/3 points along each pipe section, and at tops of elbows. These measurements shall be checked against contract drawings and shall confirm that the casing system has been installed to the elevations shown on the contract drawings unless approved by the COR. Slope shall be uniform within 0.1 percent. Measurements shall be recorded by the Contractor, accompanied with photo documentation of each piping with

the elevation instrument reading visible, included in the direct-buried system manufacturer representative's daily report, and given to the COR prior to covering the top of the casing with backfill.

- D. Provide cathodic protection for all steel casing systems and all buried exposed metal. Provide dielectric pipe flanges and unions and isolation devices at all points necessary. Provide test stations at grade on each section of the piping system. Isolation flanges and unions shall be rated for the carrier pipe service temperature and pressure.
- E. Completely remove all dirt, scale, oil, coatings, and other foreign matter from inside the piping by use of a pipe swab, pipe "pig", brush, scrapers, or chemical cleaning before connecting pipe sections, valves, or fittings.
- F. Sections of system that have been fully or partially submerged in water must be replaced. Moisture content of insulation during installation shall not exceed five percent by weight.
- G. At each casing termination (end plate) in buildings and manholes, plug the casing drain openings with brass plugs and extend 25 mm (1 inch) pipe size galvanized vent pipes (ASTM A53/A53M) from the casing vents through the tops of the manholes or 300 mm (1 foot) above the casing in buildings. Terminate the outside vents in 180-degree bends.
- H. Provide reports to the COR that include:
 - 1. Daily Written Report: Prepared daily and signed by the Contractor. Submit the original report to the COR two days after it is prepared. Provide one set of field pictures of work daily. Format shall be in digital PDF files and hardcopy printout. Digital files can be submitted through email, FTP, USB stick or CD.
 - 2. Report Contents: State whether or not the condition and quality of the materials used and the delivery, storage, installation and testing of the system are in accordance with the manufacturer's recommendations, changes to drawings and specifications, any corrective action that was taken of the system, identify any conditions that could result in an unsatisfactory installation.
 - 3. Report Certification: Daily reports are to be reviewed, signed and sealed by the Professional Engineer responsible for the system installation.
 - 4. Report Submittals and Stop Order: Daily reports shall be submitted with the payment requests. All work must stop if daily reports are

not furnished and requests for payments shall be denied if the daily reports are not furnished.

5. Certification of Compliance: Upon completion of the work and 30 days prior to final acceptance, deliver to COR a notarized Certificate of Compliance signed by principal officers of Contractor, stating that the installation is satisfactory and in accordance with plans, specifications, and manufacturer's instructions.
6. The Contractor shall retain copies of all the daily reports and the Certificate of Compliance for 5 years after final acceptance of the system by the Government.

3.8 JOINT CONSTRUCTION

- A. Ream ends of pipes and tubes and remove burrs. Bevel plain ends of steel pipe.
- B. Remove scale, slag, dirt, and debris from inside and outside of pipe and fittings before assembly.
- C. Threaded joints: ASME B1.20.1, tapered pipe threads. Cut threads full and clean using sharp dies. Ream threaded pipe ends to remove burrs and restore full ID. Join pipe fittings and valves as follows:
 1. Apply appropriate tape or thread compound to external pipe threads unless dry seal threading is specified. Joints made with oil and graphite pipe joint compound shall have compound applied to male threads only.
 2. Do not use pipe or pipe fittings with threads that are corroded or damaged. Do not use pipe sections that have cracked or open welds.
 3. Pipe threads shall be cut to give proper engagement in threaded fittings. Clean pipe and fittings before installation and ream pipe after cutting threads. Threaded pipe shall have clean-cut threads; dull or damaged pipe dies shall not be used.
- D. Construct Welded Joints: AWS D10.12M/D10.12, using qualified processes and welding operators according to paragraph, QUALITY ASSURANCE. Branch connections shall be made with either welding tees or welding outlet fittings. Welding outlet fittings shall be forged, integrally reinforced to provide 100 percent pipe strength, beveled for full penetration welding and funneled at inlet for full fluid flow.
- E. Flanged Joints: Select gasket material, size, type, and thickness for service application. Install gasket concentrically positioned. Use suitable lubricants on bolt threads. Gaskets and bolting shall be applied in accordance with the recommendations of the gasket

manufacturer and bolting standards of ASME B31.1. Strains shall be evenly applied without overstress of bolts. Gaskets shall cover entire area of mating faces of flanges.

- F. Location, Spacing and Cold Set of Ball Joints: Conform to layout drawings approved by manufacturer of ball joints. Representative of manufacturer shall visit site and verify that installation is proper. Locate to allow access to all packing injection devices, when provided.
- G. Expansion Joints (Bellows and Slip Type):
 - 1. Type, quantity and spacing of anchors and guides as recommended by manufacturer of expansion joint and as shown. A Professional Engineer shall verify in writing that anchors and guides are properly designed for forces and moments that will be imposed.
 - 2. Cold setting of joint travel at installation as recommended by the manufacturer for the ambient temperature during the installation.
 - 3. Prepare for service by cleaning all sliding surfaces, add packing as necessary. Remove all apparatus provided to restrain joint during shipping or installation.
 - 4. Expansion joints must be located in readily accessible manhole or in walk-through tunnel. Locate joints to permit access without removing piping or other devices. Allow clear space to permit replacement of joints and to permit access to devices for inspection of all surfaces and for adding packing.
- H. Piping joints shall be assembled in sections.
- I. All pipe intersections and changes in direction shall be made with factory-built-reinforced fittings. Field-fabricated fittings and miters are prohibited.

3.9 INSTALLATION - PRESSURE GAUGES

- A. Locate at inlet and outlet of each pressure reducing station, on each pump discharge and suction, and after main stop valves (gate valves) on steam distribution lines. Orient gauges so that dials are upright and visible from nearest walkway and from the main steam stop valves. Provide gauge cock. Provide siphon on steam service. Provide liquid filled gauges on pump discharge and suction.

3.10 INSTALLATION - THERMOMETERS

- A. Orient thermometers so that scales are upright and visible from nearest walkway. Locate wells in flow stream.

3.11 INSTALLATION - VALVES

- A. Do not locate valve stems below the horizontal centerline of the pipe.

- B. Locate valves to permit access for operation, maintenance, and replacement.
- C. Provide 20 mm (3/4 inch) globe-valved warm-up bypasses at all steam gate valves 75 mm (3 inch) pipe size and greater.
- D. Provide 20 mm (3/4 inch) gate or ball-valved drains at each side of steam gate valves where condensate could collect, due to the slope of the pipeline, when the main valve is shut.

3.12 THERMAL INSULATION

- A. Steam, condensate and drip return piping, other than in pre-engineered direct-buried systems, shall be insulated as follows:
 - 1. Piping in concrete trenches and manholes: Insulated with calcium silicate, cellular glass pipe insulation, or aluminum jacket.
 - 2. Exposed piping in walk through tunnels: Insulated with mineral wool, calcium silicate, fiberglass, or cellular glass pipe insulation, aluminum jacket. Condensate return piping may be insulated with mineral wool, calcium silicate, fiberglass, or cellular glass pipe insulation, aluminum jacket.
 - 3. Piping in manholes: Insulated with calcium silicate or cellular glass pipe insulation, aluminum jacket.
 - 4. Minimum insulation thickness: Insulation thicknesses given in Table 1 and 2 are minimum nominal thickness.
- B. Parts not to be insulated are:
 - 1. Threaded valves
 - 2. Steam traps
 - 3. Check valves
 - 4. Unions
 - 5. Threaded strainers
 - 6. Strainer basket removal cover and bolting
 - 7. Dielectric flanges and unions
 - 8. Expansion joints
 - 9. Flexible connectors
 - 10. Ball joints except piping between joints
- C. Installation of Insulation:
 - 1. Pressure Tests: Complete all pressure tests and cleaning before installing.
 - 2. Insulation Material: New, clean, dry and stored in a clean dry environment; jacketing materials to be clean and unmarred; store

- adhesives in original containers. Materials shall not have exceeded the predicted shelf life as set by manufacturer.
3. Identify all materials incorporated in the job on manufacturer's container by name, type and description.
 4. Apply materials on clean, dry surfaces from which all dirt, loose scale, construction debris has been removed by wire brushing.
 5. The installation shall be neat, thermally and structurally tight without sag, neatly finished at all hanger or other penetrations and shall provide a smooth finished surface primed as required to receive specified painting.
 6. Do not use scrap insulation. Repair any work damaged by welding, burning, compressing due to concentrated construction loads.
 7. Apply pipe covering protection saddles, MSS SP-58, Type 39, at all hanger points. Fill space between saddle and piping with high density insulation, thoroughly packed. Terminate jacket clear of saddle bearing area.
 8. Insulation and jacket shall terminate hard and tight at all anchor points.
 9. Insulation termination at piping facilities not to be insulated shall stop short, and be finished with 45-degree chamfered section of insulating and finishing cement, and covered with jacket.
 10. Flanged fittings and valves shall be insulated with sections of pipe insulation cut, fitted and arranged neatly, and firmly wired in place. Insulating cement shall fill all cracks, voids and outer surface for covering with glass cloth. Insulation of valve bonnet shall terminate on valve side of bonnet flange to permit valve repair.
 11. On calcium silicate, and cellular glass insulated piping systems, fittings shall be insulated with field or factory-shaped sections of insulation, finished with specified insulating and finishing cements and covered with specified jacket.
 12. On mineral wool insulated piping systems fittings over 50 mm (2 inches) shall be insulated with specified molded pipe fitting insulation or compressed blanket, finished with specified insulating and finishing cements and covered with jacket. On sizes 50 mm (2 inches) and less apply insulating and finishing cements and cover with specified jacket.

13. Apply glass cloth jacket using an approved adhesive. Glass cloth shall be smooth, tight and neatly finished at all edges; prime cloth to receive paint.

3.13 WELDING

- A. The Contractor is entirely responsible for the quality of the welding and shall:
 1. Conduct tests of the welding procedures used on the project, verify the suitability of the procedures used, verify that the welds made will meet the required tests, and also verify that the welding operators have the ability to make sound welds under standard conditions.
 2. Perform all welding operations required for construction and installation of the distribution system.
- B. Welder Qualifications: All welders shall be qualified as per ASME B31.1, AWS B2.1/B2.1M, and AWS Z49.1.
- C. Field Bevels and Shop Bevels: Done by mechanical means or by flame cutting. Where beveling is done by flame cutting, surfaces shall be thoroughly cleaned of scale and oxidation just prior to welding. Conform to specified standards.
- D. Provide approved welding method for field joints on all carrier pipes greater than 50 mm (2 inches) to assure proper alignment, complete weld penetration, and prevention of weld spatter reaching the interior of the pipe. Make field joints 50 mm (2 inches) and smaller with welding sockets.
- E. Piping shall not be split, bent, flattened, or otherwise damaged either before, during, or after installation. Where the pipe temperature falls to 0 degrees C (32 degrees F) or lower, the pipe shall be heated to approximately 38 degrees C (100 degrees F) for a distance of 300 mm (1 foot) on each side of the weld before welding, and the weld shall be finished before the pipe cools to 0 degrees C (32 degrees F).
- F. Replace and reinspect defective welds. Repairing defective welds by adding weld material over the defect or by peening are prohibited. Welders responsible for defective welds must be requalified.
- G. Electrodes shall be stored in a dry heated area, and be kept free of moisture and dampness during fabrication operations. Discard electrodes that have lost part of their coating.
- H. An approved independent testing firm regularly engaged in radiographic testing shall perform radiographic examination of field welds in the

steam and condensate piping of the systems, in manholes and in walk-through tunnels, in accordance with ASME B31.1. Perform radiographic examination of 50 percent of the first 10 welds made and 10 percent of all additional welds made. The COR reserves the right to identify individual welds for which the radiographic examination must be performed. All welds will be visually inspected by the COR. The VA reserves the right to require testing on additional welds up to 100 percent if more than 25 percent of the examined welds fail the inspection. Furnish a set of films or pictures showing each weld inspected, a 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 installing casing field joints, trench covers, backfilling and hydrostatic testing. All radiographs shall be reviewed and interpreted by an ASNT Certified Level III radiographer, employed by the testing firm, who shall sign the reading report. The COR or their representative shall review all inspection records, and if any welds inspected are found unacceptable they shall be removed, rewelded, and radiographically reexamined at no cost to the Government.

3.14 CLEANING OF PIPING

- A. Clean pipe and fittings inside and outside before and after assembly. Remove all dirt, scale, and other foreign matter from inside the piping by use of a pipe swab, pipe "pig", brush, scrapers or chemical cleaners before connecting pipe sections, valves, equipment or fittings. For carbon steel piping, use detergent to remove any oil and caustic solution to remove the mill scale.
- B. Cleaning of piping shall be witnessed by the COR, their representative, or the Commissioning Agent.

3.15 IDENTIFICATION FOR UTILITY LOCATING

- A. Install continuous plastic underground warning tapes during back filling of trenches for underground steam and condensate distribution piping. Locate tapes 300 mm (12 inches) below finished grade, directly over piping.

3.16 IDENTIFICATION TAGS

- A. Valves: Provide laminated brass tags, with engraved lettering not less than 5 mm (3/16 inch) high, on all isolating valves on steam and condensate return system, identifying building or area served. Attach to the valves with corrosion-resistant chains.

- B. Pipes: Label service of all pipes in manholes and walk-through tunnels every 7.6 m (25 feet) and at every change in direction. Label shall include flow direction arrows.

3.17 FIELD QUALITY CONTROL

- A. Demonstrate leak-tightness of all piping systems by performing hydrostatic tests at 1-1/2 times the design pressure and operational tests. All labor, material and test instruments must be furnished by the Contractor. All instruments must be approved by the COR.
- B. Pressure test direct-buried systems in conformance with requirements stated in this specification and in printed instructions for the system supplied. Tests must include carrier piping and casing.
- C. Holiday testing of direct-buried system steel casings: Test entire surface of casings for faults in coating after installation in trench prior to backfilling. Use test method and voltage recommended by coating manufacturer. Repair any holidays found and retest. System shall not be backfilled until all holidays are eliminated.
- D. Before conducting steam system operating test, remove steam trap elements or use bypass connections around traps; then flush lines with water until discharge shows no foreign matter to the satisfaction of COR.
- E. Steam and condensate piping shall be tested hydrostatically before insulation is applied at field joints and shall be proved tight at a pressure 1-1/2 times the design pressure for a period not less than 2 hours with no pressure decay.
 - 1. Test piping located in concrete trenches prior to installing trench covers. Test direct-buried systems prior to backfilling.
 - 2. Remove or isolate any elements of the system such as expansion joints and spring hangers which are not designed for the test pressure.
 - 3. Prior to acceptance of installation, Contractor shall subject system to operating tests as may be required by COR to demonstrate satisfactory functional and operating efficiency. These operating tests shall cover a period of not less than 8 hours for each portion of system tested. Conduct tests at times as the COR may direct.
 - 4. Provide calibrated instruments, equipment, facilities and labor, at no additional cost or time to the Government. Test gauge shall read in increments not exceeding 1 kPa (0.15 psig).
 - 5. Repeat tests when failures occur.

6. After completion of satisfactory test, replace all elements that have been removed prior to testing.
- F. Pneumatic Testing of DDT System Casings:
1. Perform test on all sections of the system before field-coating the field joints and before back-filling.
 2. Test shall be with compressed air at 103 kPa (15 psig) maximum for 2 hours with pressure source disconnected and with decay in pressure not to exceed 5 percent. Corrections to the readings are permissible to compensate for significant ambient temperature changes during the test period.
 3. Pressure shall be measured with a gauge with reading increments of 1 kPa (0.15 psig).
 4. Each casing field joint shall be tested for leaks by means of soap solution or equivalent.
- G. NACE-accredited corrosion specialist shall test cathodic protection systems and demonstrate proper operation and protection in accordance with the recommendations and criteria in NACE SP0169.
- H. Deficiencies discovered shall be corrected at the Contractor's expense, to satisfaction of COR. Major deficiencies or failure to correct deficiencies, to the satisfaction of the COR, may be considered cause for rejecting the entire installation.
- I. Contractor will engage a qualified testing agency to perform tests and inspections.
- J. Engage a factory-authorized service representative to inspect, test, and adjust components, assemblies, and equipment installations for the system.
- K. Engage a factory-authorized service representative to inspect components, assemblies, and equipment installations, including connections, and to assist in testing.
- L. Tests and Inspections:
1. Steam and condensate piping for testing: ASME B31.1 and ASME B31.9 and as follows:
 - a. Leave joints, including welds, uninsulated and exposed for examination during test.
 - b. Isolate equipment. Do not subject equipment to test pressure.

- c. Install relief valve set at pressure no more than one-third higher than test pressure and replace safety valves of the appropriate pressure. Reset pressure setpoint of all relief valves to the appropriate pressures and replace safety valves after all tests have been completed. Contractor to provide written report of the reset with date and time stamp for each relief valve and replacement of the safety valves.
 - d. Fill system with normal temperature water between 4 degrees C (40 degrees F) and 32 degrees C (90 degrees F). Ensure the water filled pipe system is protected against freezing during the test such as providing heat tracing along the pipe.
 - e. Use vents installed at high points to release trapped air while filling system. Use drip legs installed at low points for complete removal of liquid.
2. Test steam and condensate piping as follows:
- a. Subject steam and condensate piping to hydrostatic test pressure that is not less than 1-1/2 times the design pressure.
 - b. After hydrostatic test pressure has been applied for 10 minutes, examine joints for leakage. Remake leaking joints using new materials and repeat hydrostatic test until no leaks exist.
3. Test outer casing as follows: Seal vents and drains and subject casing to 103 kPa (15 psig) of air for 4 hours with no loss of pressure. Repair leaks and retest as required.
- M. Prepare and submit test and inspection reports to the COR within 5 working days of test completion and prior to covering the pipe.
- N. All tests shall be witnessed by the COR, their representative, or the Commissioning Agent and be documented by each section tested, date tested, and list of personnel present.

3.18 STARTUP AND TESTING

- A. Perform tests as recommended by product manufacturer and listed standards and under actual or simulated operating conditions and prove full compliance with design and specified requirements. Tests of the various items of equipment shall be performed simultaneously with the system of which each item is an integral part.
- B. When any defects are detected, correct defects and repeat test at no additional cost or time to the Government.
- C. The Commissioning Agent will observe startup and contractor testing of selected equipment. Coordinate the startup and contractor testing

schedules with COR and Commissioning Agent. Provide a minimum notice of 10 working days prior to startup and testing.

3.19 COMMISSIONING (ADDENDUM 3, 01-17-2025)

A. Components provided under this section of the specification will be tested as part of a larger system.

3.20 DEMONSTRATION AND TRAINING (ADDENDUM 3, 01-17-2025)

A. Provide services of manufacturer’s technical representative for 4 hours to instruct each VA personnel responsible in operation and maintenance of the system.

3.21 APPENDIX I - ALLOWABLE SITE CHARACTERISTICS FOR CONCRETE SHALLOW TRENCH APPLICATION (ADDENDUM 3, 01-17-2025)

ALLOWABLE SITE CHARACTERISTICS FOR CONCRETE SHALLOW TRENCH APPLICATION (SEE NOTE 1)			
SITE CONDITION	GENERAL CONDITIONS OF GROUND WATER DURING THE WETTEST PERIOD OF THE YEAR	SURFACE WATER ACCUMULATION RAINFALL/ IRRIGATION	TRENCH CONSTRUCTION
A. Fine grained impervious or semi pervious and coarse grained impervious	Water table generally 300 mm (1 foot) below lowest point of water entry (See Note 5) with not more than 25% of the length of the proposed concrete trench system showing water within 300 mm (1 foot) of the lowest point of water entry.	5 years - 7 day rainfall equal to or less than 250 mm (10 inches). (See Note 2)	Continuous wall and bottom.
B. Coarse grained semi pervious and pervious (See Note 2)	Same as for A. above.	5 years - 7 day rainfall equal to or less than 250 mm (10 inches).	Same as for A. above
	Water table generally 600 mm (2 feet) or more below point of water entry with not more than 10% of the length of trench system showing water within 600 mm (2 feet) but not closer than 300 mm (1 foot) to lowest point of water entry.	5 years - 7 day rainfall equal to or less than 200 mm (8 inches). (See Note 2)	Continuous wall; openings may be provided in trench bottom to provide drainage.
C. Swelling soils (See	Same as for A. above.	Same as for A.	Same as for A. above plus design

Note 3)		above.	of joint spacing and joint details to accommodate movement.
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NOTES:

1. Shallow concrete trench system shall not be used if any conditions defined by these criteria are exceeded.
2. As shown in U. S. Weather Bureau (USWB) Technical Paper 40 and confirmed with local data and local weather patterns
3. Swelling soils are materials with high swell potential when subjected to an increase in moisture content.
4. Lowest point of water entry is defined as the joint between trench wall and trench bottom.

3.22 APPENDIX II - CLASSIFICATIONS FOR DIRECT-BURIED SYSTEMS

A. Groundwater Conditions:

CLASSIFICATIONS FOR DIRECT-BURIED SYSTEMS	
Site Classification	General Conditions for Such Classifications
A - Severe	1. The water table is expected to be frequently above the bottom of the system and surface water is expected to accumulate and remain for long periods in the soil surrounding the system, or
	2. The water table is expected to be occasionally above the bottom of the system and surface water is expected to accumulate and remain for long periods in the soil surrounding the system.
B - Bad	1. The water table is expected to be occasionally above the bottom of the system and surface water is expected to accumulate and remain for short periods (or not at all) in the soil surrounding the system, or
	2. The water table is expected never to be above the bottom of the system but surface water is expected to accumulate and remain for long periods in the soil surrounding the system.
C - Moderate	The water table is expected never to be above the bottom of the system but surface water is expected to accumulate and remain for short periods in the soil surrounding the system.
D - Mild	The water table is expected never to be above the bottom of the system and surface water is not expected to accumulate or remain in the soil surrounding the system.

- B. System Temperature Classifications: High 127 to 232 degrees C (261 to 450 degrees F); Medium 94 to 126 degrees C (201 to 260 degrees F); Low 93 degrees C (200 degrees F) or lower.
- C. Type of Underground System Allowed: Drainable-Dryable-Testable (DDT) shall be allowed for Site Classifications A, B, C, D.
- D. Soil Conditions:
1. Soil Corrosiveness Classification:
 - a. The soil at the site should be classified as corrosive or noncorrosive on the basis of the following criteria:
 - b. Corrosive: The soil resistivity is less than 30,000 ohm-cm or stray direct currents can be detected underground.
 - c. Noncorrosive: The soil resistivity is 30,000 ohm-cm or greater and no stray direct currents can be detected underground.
 - d. The classification should be made by an experienced corrosion engineer based on a field survey of the site carried out in accordance with recognized guidelines for conducting such surveys.
 2. Soil pH: If there is any reason to suspect that the soil pH will be less than 5.0 anywhere along the proposed path of the system, pH measurements should be made at pipeline depth at close intervals along the proposed route, and all locations at which the pH is less than 5.0 should be indicated in the contract documents. An experienced soils engineer, preferably the same engineer responsible for other soil engineering work, should determine soil pH.

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