

SECTION 15080 - UNDERGROUND PIPE AND CONDUIT SYSTEM FOR CLASS A SOILS

PART 1 - GENERAL

1.1 DESCRIPTION OF WORK:

- A. This section specifies piping materials and installation methods common to this section of Division 15 and includes joining materials, piping specialties, and basic piping installation instructions for poorly drained soils subject to prolonged saturation.

1.2 REFERENCES:

- A. ANSI B31.1
- B. Federal Agency Guideline Specifications FCGS 15705.

1.3 SUBMITTALS:

- A. Refer to Division 1 and Basic Mechanical Requirements for administrative and procedural requirements for submittals.
- B. Product Data: Submit industry standards and manufacturer's technical product data, installation instructions, and dimensioned drawings for each type of pipe and pipe fitting. Submit piping schedule showing pipe or tube weight, fitting type, and joint type for each piping system.
- C. Welding Certifications: Submit reports as required for piping work.
- D. Brazing Certifications: Submit reports as required for piping work.

1.4 QUALITY ASSURANCE:

- A. System shall be factory tested and inspected in accordance with the manufacturer's requirements.

PART 2 - PRODUCTS

2.1 MANUFACTURERS:

- A. Piping Materials: Provide pipe and tube of type, pressure and temperature ratings, capacities, joint type, grade, size and weight (wall thickness or Class) indicated for each service. Where type, grade or class is not indicated, provide proper selection as determined by Installer for installation requirements, and comply with governing regulations and industry standards.
- B. Pipe/Tube Fittings: Provide factory-fabricated fittings of type, materials, grade, class and pressure rating indicated for each service and pipe size. Provide sizes and types matching pipe, tube, valve or equipment connection in each case. Where not otherwise indicated, comply with governing regulations and industry standards.
- C. Manufacturers: Subject to compliance with requirements, provide products by the manufacturers listed.
 - 1. Perma-Pipe/RicWil

2.2 DESCRIPTION:

- A. The pre-fabricated underground heat distribution system specified herein shall be chemically bonded urethane coated, air pressure testable, drainable and dryable, steel conduit type system for [15] [] psig steam and high temperature water service. The condensate return system shall either be identical to the steam system, or shall be a direct buried, reinforced thermosetting resin plastic pipe system conforming to NAVFAC Specification TS 15707, whichever is required by the contract specifications.

2.3 USAGE:

- A. The system specified herein shall be intended for use in Class A (underground water conditions) sites and in corrosive soil conditions as defined in FCGS Specification 15705. It is also qualified for use in Class B, C and D sites as specified in FCGS Specification 15705. Cathodic protection shall be provided.

2.4 MATERIALS:

- A. All components and materials shall conform to specifications, drawings, manufacturer's letters and tables hereinafter specified. Referenced Federal and Military Specifications and Industry Standards are specified by basic designation only.

2.5 PREFABRICATED COMPONENTS:

- A. Materials and coatings for prefabricated components shall be as specified in Paragraph 2.6 "Materials."
- B. Straight conduit sections shall be factory coated as specified hereinafter. Straight sections shall be fabricated in 40 foot nominal length with five pipe supports as indicated; shorter lengths shall be fabricated with supports not more than nine feet apart and with a pipe support not more than two feet from each end.
- C. Terminal sections shall be identical to straight sections except that they shall be prefabricated with leak plates and seals as follows, and shall be provided with a minimum one inch vent (open) and minimum one inch drain half coupling (threaded) fitted with a threaded forged steel plug.
 - 1. Leak plates shall be of 120 gauge steel plate conforming to ASTM A-36.
 - 2. End seals shall be of 1/4 inch steel plate conforming to ASTM A-36.
 - 3. Gland seals shall consist of a steel closure plate with stainless steel bolts and a steel gland welded thereto a temperature resistant teflon impregnated asbestos packing gland and a gland follower.
- D. Expansion loops shall be properly engineered and designed in accordance with the allowable stress limits indicated by ANSI B31.10 for the type of pipe used. Expansion loops shall consist of conduit composed of the same material and the same coating as the straight run conduit and sized to accommodate anticipated expansion. Decreaser conduit connections and thicknesses for two piece type and expansion type loops together with expansion type pipe supports shall be provided. End width shall be sized according to field/jobsite conditions.
- E. Pipe supports shall be of the type where calcium silicate pipe insulation thermally and electrically isolates the pipe from outer conduit. Direct contact with support and pipe will not be allowed.

- F. Elbows shall be of either the anchor or expansion type.
- G. Anchor sections shall be 1/4 inch steel plate conforming to ASTM A-36 steel.

2.6 MATERIALS:

- A. Casing for all components shall be either electric resistance welded or spiral welded steel pipe conforming to ASTM Specifications A-211, A-134 and A-135.
- B. Coating:
 - 1. Outside casing shall be factory coating with a chemically bonded urethane or fully impregnated fiberglass cloth with multiple pass epoxy resin (450-525 epoxide equivalent). Coating application shall be a minimum of 30 mill thickness and as specified in the Quality Control Section. Coating shall pass 100 percent holiday testing at 5000 volt spark level.
 - 2. Field joints shall be coated with chemically bonded polyurethane or shrink sleeves. Field joint application shall be as specified in the Quality Control Section.
 - 3. Factory fabricated fittings shall be factory coated on the outside with the coating specified above for outside casings. Factory fittings application shall be as specified in the Quality Control Section.
 - 4. End seals and other steel surfaces except anchor plates, shall be coated using chemically bonded polyurethane. Coating application shall be as specified in the Quality Control Section.
- C. Anchor plates and miscellaneous steel parts shall be ASTM A-36 steel unless otherwise specified hereinafter.

2.7 CATHODIC PROTECTION SYSTEMS:

- A. General
 - 1. Cathodic protection against galvanic corrosion shall be provided for the underground conduit system. The cathodic protection system shall be as shown on the contract drawings.
 - 2. Installation of cathodic protection system shall be in strict accordance with the recommendations of and under the direct supervision of the conduit manufacturer, including anodes, conductors, isolation, splices, electrical connections to conduit, and test stations.
- B. Scope of Work:
 - 1. Supply all manpower, tools, equipment and transportation to complete the cathodic protection installation.
 - 2. The installation shall include, but not be limited to, the following:
 - a. Installation of all magnesium anodes, and anode collector cable.
 - b. Supply an attachment of test cables to conduit and magnesium anodes.

- c. Supply and installation of test stations as shown.
- d. Testing of the system as outlined in the Nace Recommended Practice RP-01-69 (Latest Revision). All tests shall be made by a Nace accredited corrosion specialist or a representative under his direct supervision.
- e. The cathodic protection system shall be tested within six months of completion of backfilling, by a "corrosion Specialist" as certified by the National Association of Corrosion Engineers or his authorized representative.
- f. Cathodic protection test instrument shall be furnished by the Owner.

C. Magnesium Anodes:

COMPOSITION	PERCENT BY WEIGHT
Aluminum	5.300 - 6.700
Zinc	2.500 - 3.500
Manganese (Min.)	0.150
Iron (Max.)	0.003
Nickel (Max.)	0.002
Copper (Max.)	0.020
Silicon (Max.)	0.100
Other (Max.)	0.300
Magnesium	Remainder
Total Anode Weight	17 lbs

1. All anodes shall be cast with a perforated galvanized steel strap core. The anode lead wire shall be connected to the strap core with cadmium weld connection. The connection shall be mechanically secured before soldering with at least 1-1/2 turns of wire at the connection. The connection shall be insulated by filling the anodes recess with an electrical potting compound.
2. The anode shall be packaged in a permeable cloth bag containing a backfill of the following composition:

Ground Hydrated Gypsum	75%
Powdered Wyoming Bentonite	20%
Anhydrous Sodium Sulfate	5%
3. Backfill shall have a grain size so that 100 percent is capable of passing through 100 mesh screen. The mixture shall be firmly packaged around the magnesium anode within the cloth bag by means of adequate vibration so that the anode is completely surrounded with a minimum of 1/2 inch of backfill material.

- D. Conductors - Anode conductor or lead wire shall be #12 type TW solid copper wire, unless otherwise shown on drawings.

- E. Cartridge size and alloy type shall be #CA-15 cartridge and F-33 alloy. Wires connected to the piping system for test purposes shall be not less than #12 type TW. Anode wires shall be spliced to a common or gathering cable. The cable size shall be #8 type CP (HMWPE) stranded copper wire suitable for direct burial.
 - F. Electrical Isolation - Piping shall be electrically isolated from internal building piping at the point of connection inside the building. Dielectric flanges shall be installed on each pipe and the conduit shall be isolated from the building wall with a wall sleeve and neoprene link seal.
 - G. Underground Cable Splices - All underground splices shall be made using copper compression bolts. All splices shall be moisture-proof.
 - H. All electrical wire connections to the conduit shall be made using the thermit welding process.
 - I. Electrical Isolation - It shall be the responsibility of the contractor installing the underground conduit and related piping to prevent shorting of the system to building steel, reinforcing steel in building, foundations and other buried metallic structures.
 - J. Test Stations:
 - 1. Test Stations shall be provided where shown on contract drawing for the purpose of testing the performance of the cathodic protection system. Test leads terminating in test stations shall have a minimum of 18 inches of slack lead below grade. Test leads shall be housed in electrical conduit and shall terminate in waterproof junction boxes.
- 2.8 SPECIAL STRUCTURAL ELEMENTS:
- A. Special structural elements for unstable soils and super- imposed loads shall be designed as required for the application and submitted for approval.
- 2.9 CONCRETE:
- A. Concrete for anchor blocks and flotation pads shall be 3,000 pound minimum strength concrete conforming to ACI 2.11 1-74.
- 2.10 MANHOLES:
- A. Manholes shall be pre-cast concrete type.
 - B. Manhole dimensions shall be as indicated on drawings and in all cases shall provide sufficient room for maintenance.
 - C. Manhole ladders shall have non-slip surface and shall consist of uprights and steps or rungs, or of full U-shaped rungs firmly embedded in concrete sidewalls. Uprights shall be firmly anchored to the manhole walls. All parts shall be treated for corrosion protection.
 - D. Piping and equipment in manholes shall be installed so as to provide easy access without stepping on piping or equipment and to provide sufficient working room. Piping in manholes shall rest on suitable sidewall or floor supports equipped with cast iron rollers.

PART 3 EXECUTION

3.1 INSTALLATION SPECIFICATION:

- A. A fully qualified and certified factory representative shall be present during all crucial periods of the installation of the underground heat distribution system. Crucial periods of the installation shall be defined as periods which include one or more of the following types of work.
1. Inspection and unloading.
 2. Inspection of trench prior to laying of conduit.
 3. Inspection of concrete thrust blocks prior to cold springing.
 4. Cold springing.
 5. Hydrostatic test of all service lines.
 6. Field joint closure work.
 7. Air test of conduit.
 8. Repair of any coating patch work.
 9. Holiday test of conduit coating.
 10. Initial backfill up to 10 inches above the top of the conduit casing.
- B. The representative shall see that all damaged material is repaired or replaced as required by the contract documents, including the quality control requirements of this specification.
- C. Detailed Specifications:
1. Unloading - Materials shall be unloaded with a padded sling. Long conduit sections, manholes and expansion loops, etc. shall be unloaded with a spreaderbar type hoist having two or more slings.
 2. Storage - System sections shall be stored and blocked with 2 inches x 4 inches on 8 foot centers. System sections shall be stored with end seals in place. Each system section shall be checked to ensure that any end cover removed for inspection of inside of conduit line has been properly replaced.
 3. When insulation accidentally becomes wet at any time before or during installation, the air space in the system shall be force ventilated at a rate of not less than 2 CFM, and heat shall be applied through the internal piping. A cool mirror shall be placed at the exhaust point for a short time at appropriate intervals and shall be so positioned as to indicate maximum fogging due to moisture. The ventilation shall continue until the mirror exhibits no visible fogging.
 4. Inside shall be inspected for mud or other blockage of drainage. If blockage or mud is found, the component shall be flushed out with water before drying. If the blockage cannot be flushed so as to ensure proper drainage, the component shall be rejected and a new one provided.
 5. Trenching shall be to the depth indicated on the drawings. Trench widths in stable soil shall be as indicated on drawings. For unstable soil, high or low PH or other unusual soil conditions, trenching shall be as specified by the engineer. Trenches shall be kept dry and excavated soil shall be placed so as to prevent rain runoff from entering trench. Grading shall be checked to ensure correct pitch of lines. Trench bottoms for FRP pipe in stable soils shall be bedded with three inches of fine granular fill. For trench bottoms in unstable soil, the bedding shall be determined by the engineer.

6. Welding in trenches - System end covers and shipping tie rods shall remain in place until welding operations are ready to commence. Welding in trenches shall be minimized. System sections including loops and ells shall be first laid out, aligned and welded above the trench. Prior to welding a check shall be made to ensure pipe and expansion supports are aligned and true. The initial 15 psi conduit pressure test shall also be accomplished on as long a connected system above the trench as possible; then the completed and tested sections lowered and positioned in the trench.
7. Factory representatives shall ensure that welding is properly done and tested as follows:
 - a. Conduct test of the welding procedure used to determine its suitability to ensure welds will meet the required tests and conduct tests of the welders to ensure their competence to make quality welds under standard conditions. Radiographic examination of welds may be required to ensure quality welds.
 - b. Be thoroughly familiar with the requirements of ANSI B31.1 and American Welding Society Standard B3.0.
 - c. Be capable of performing all welding operations required for construction and installation of the heat distribution system.
8. Lowering Conduit Sections into Trench - Conduit sections whether or not welded and tested above ground shall be lowered with slings, etc. Remove end covers and remove shipping tie rods when necessary for installation. Place only the amount of conduit in trench that can be tested, field closed and coated in one day. If any ends or joints are uncovered at the end of the day or during rain, they shall be waterproofed, sealed and recovered to prevent moisture. If internal moisture is detected they shall be dried as specified in paragraph 4 of the preceding Installation Specifications.
9. Expansion Loops and L and Z Bends and Elbows shall be sloped to drain to the straight runs. Pipe supports, expansion loops, reducers, etc. shall be properly aligned and positioned for a true fit.
10. Cold Spring - All piping systems shall be cold spring 1/2 the total calculation expansion of the system. Angle clips shall then be welded on the ends of the adjusted pipes. Then a single threaded rod shall be placed through the holes in the clips and tightened until the pipes are aligned. The pipes shall then be welded as specified in ANSI B31.1.
11. Hydrostatic tests of service piping - All service piping shall be tested hydrostatically before insulation is applied at field joints, and shall be proved tight at a pressure 100 psig. Hydrostatic test pressure shall be tested before conduit field joints are insulated and closed. Prior to the hydrostatic, performance and operating tests, the interior of the heat-carrying piping shall be flushed with water until the piping is free of all foreign materials to the satisfactory of the Engineer.
12. Casing Field Joints:
 - a. Insulation - Insulation shall be banded on pipe with stainless steel bands maximum of 18 inches on center. At field joints insulation shall be grooved to fit over welded pipe.
 - b. Field joint shall be accomplished by cleaning to bare metal the conduit section to be joined, banding tightly the steel sleeve over the conduit, welding both sleeve collars and horizontal sleeve lap, then apply the chemically bonded polyurethane.

13. Final inspection and test before backfill - The completed system shall be visually inspected for blisters, loose coating, damage, etc.; spark tested and sections repaired or replaced in accordance with the Quality Control Section of this specifications.
14. Cathodic protection shall be installed before backfilling.
15. Final testing after backfilling shall be performed in accordance with the Quality Control section of this specification. Any repairs or replacements necessary will be at the contractor's or manufacturer's expense.

3.2 QUALITY CONTROL:

- A. Factory - All factory fabrication at either the jobsite plant or the home office plant shall be overseen, inspected, tested and accepted or rejected by the Factory Quality Control Section.
1. Welding shall be by qualified welders and shall be performed and inspected in accordance with ANSI B31.1.
 2. Conduit components shall be coated as follows:
 - a. 1.2.1 Outer casing
 - 1) Clean to bare metal by shot or sand blasting, mechanical wire brushing or mechanical sanding.
 - 2) Factory applied polyurethane coating.
 - b. All other components and steel parts shall be cleaned to bare metal as specified in Section C, Hardware Specifications.
 3. Inspection - All conduit, assemblies and other components shall be carefully inspected to insure that coating is solid and firmly bonded and that dimensions are correct. All insulation shall be inspected for thickness and correct banding, including banding spacing and snugness.
 4. Testing - All exterior steel casing parts shall be spark tested at a voltage of 1250 times the square root of the average coating thickness in mils plus/minus 5 percent with an approved calibrated spark tester.
 5. All casings including fittings and preassembled units shall be air pressure tested at 15 psig for a period of not less than two hours.
 6. All expansion loops and elbows and straight runs connecting thereto shall be checked for correct alignment of expansion guides and marked to assure assembly in correct position.
 7. Storage in stockpile shall be as follows: Store with shipping tie rods (conduit to pipe ends) and end covers firmly in place to prevent water entry, all as described in paragraph 3 of Installation Specifications.
 8. The Quality Control Section shall oversee removal from stockpile and proper loading and blocking, etc., for shipment.
- B. Field Inspection and Testing:

1. Visual Inspection - Each section of conduit, fittings and batch of material shall be visually examined and measured, where necessary, to determine shipping damage, thickness of coating, required air space, bond of coating to conduit and other evidence of conformance or non-conformance to the requirements of these specifications. Any conduit section, fitting or batch of material which does not conform to these requirements or which shows shipping damage beyond that permitted by the paragraph on holiday testing shall be rejected without further examination or test. End covers removed for inspection shall be carefully and securely replaced.
2. Holiday Detector Test - After visual examination and prior to installation in the trench, holiday detector tests shall be performed on the exterior of the first five sections and every tenth section thereafter of coated metallic conduit. If it is found that the factory applied waterproofing material is inadequate, the section shall be rejected and every section of the uninstalled material on the jobsite and all material delivered thereafter shall be holiday tested. The tests shall be accomplished with silicone rubber electric wirebrush, or a coil probe testing set with an operating bell, buzzer or other audible signal. The tester shall be a type so fixed that field adjustment cannot be made. Calibration by the manufacturer of the tester shall be performed at six-month intervals or at such times as crest voltage is questionable. The manufacturer of the test shall certify in writing the date of calibration and crest voltage setting. The battery shall be maintained at ample charge to produce the crest voltage during all tests. If voids detected by either visual examination or by holiday test of any section were obviously caused by improper banding, and are such that the areas of patches extending a minimum of two inches from the outer periphery of the voids will total less than 100 square inches, for sections 20 feet or less in length, or less than 200 square inches for sections approximately 40 feet in length, the sections may be repaired. The repair shall be effected by using material identical to that of the original coating or that being used for field joints shall be accomplished to the satisfaction of the Engineer. The repaired section shall be tested to prove that there are no holidays evident before installation. When more than the above specified area of any section of coated conduit fails to meet the first holiday test, that section shall be removed from the jobsite and replaced with new materials. After installation of conduit and prior to backfilling, the waterproofed exterior surfaces, including completed field joints of the conduit, shall again be tested for holidays. Any of the conduit, shall again be tested for holidays. Any holidays revealed shall be promptly repaired to a condition as good as the rest of the system, or the conduit section shall be replaced.
 - a. Coating repair procedure when repair permitted. Clean coating down to bare metal and apply by smoothly brushing chemically bonded polyurethane.
3. Examination of welds on pipe - All pipe welds shall be inspected in accordance with ANSI B31.1.
4. Air pressure test of sections in trench before backfill - All conduit casing shall be proved tight after installation, and before applying field joint waterproofing and before backfilling by the application of an internal air pressure of 15 psig, for a period of not less than one hour without any additional air being supplied. All joints shall be tested with an application of soap and water solution. All leaks located shall be repaired and retested until proven tight. Repairs to metallic casings shall be made by welding.
5. Holiday detector test before backfill. After assembly in trench and before backfill, the sections to be backfilled shall be holiday detector tested and repaired or replaced as necessary.

6. Hydrostatic test of system - After completion the entire system shall be flushed and hydrostatic tested. Any leaks shall be repaired and the entire test sequence repeated on the leaking section.
7. Final air pressure test after backfill manhole to manhole - After completion of the entire system or section between manholes the 15 lb. air pressure test shall be applied manhole to manhole for a period of not less than one hour.
8. Operational Tests - After completion of the system, or testable portions thereof, operational tests shall be conducted as in service to demonstrate satisfactory function and operation effectiveness. The tests on each system, or portion thereof, shall last not less than six hours.

END OF SECTION 15080