

SECTION 23 21 16 - UNDERGROUND HYDRONIC PIPING

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

- A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and Division 01 Specification Sections, apply to this Section.

1.2 SUMMARY

- A. Section Includes:
 - 1. Factory fabricated and pre-insulated Cased piping system and fittings.

1.3 PERFORMANCE REQUIREMENTS

- A. Hydronic piping components and installation shall be 150 PSI pressure class unless otherwise noted or required by project conditions.

1.4 SYSTEM DESCRIPTION

- A. Where more than one piping system material is specified, provide compatible system components and joints. Provide flanges, union, and couplings at locations requiring servicing.
- B. Provide unions, flanges, and couplings downstream of valves and at equipment or apparatus connections.
- C. Provide non-conducting dielectric connections whenever jointing dissimilar metals in open systems.
- D. Do not use direct welded or threaded connections to valves, equipment or other apparatus.

1.5 ACTION SUBMITTALS

- A. Product Data: For the following:
 - 1. Cased piping.
- B. Shop Drawings: Detail, at 1/4 scale, the piping layout, fabrication of pipe anchors, hangers, supports for multiple pipes, alignment guides, expansion joints and loops. Detail location of anchors, alignment guides, and expansion joints and loops. Show types, sizes, materials, and elevations of other utilities crossing hydronic piping.
 - 1. Grooved joint couplings and fittings shall be shown on drawings and product submittals, and be specifically identified with the applicable manufacturer style or series number.
 - 2. Calculate requirements for expansion compensation for underground piping.

3. Show expansion compensators, offsets, and loops with appropriate materials to allow piping movement in the required locations. Show anchors and guides that restrain piping movement with calculated loads, and show concrete thrust block dimensions.
4. Show pipe sizes, locations, and elevations. Show piping in trench, conduit, and cased pipe with details showing clearances between piping, and show insulation thickness.

1.6 INFORMATIONAL SUBMITTALS

- A. Qualification Data: For qualified Installer.
- B. Welding certificates.
- C. Material Test Reports: For cased piping.
- D. Source quality-control reports.
- E. Field quality-control reports.

1.7 QUALITY ASSURANCE

- A. All pipe and accessories shall be of United States domestic manufacture.
- B. Installer Qualifications:
 1. Installers of Pressure-Sealed Joints: Installers shall be certified by the pressure-seal joint manufacturer as having been trained and qualified to join piping with pressure-seal pipe couplings and fittings.
- C. Steel Support Welding: Qualify processes and operators according to AWS D1.1/D1.1M, "Structural Welding Code - Steel."
- D. Welding: Qualify processes and operators according to ASME Boiler and Pressure Vessel Code: Section IX.
 1. Comply with provisions in ASME B31 Series, "Code for Pressure Piping."
 2. Certify that each welder has passed AWS qualification tests for welding processes involved and that certification is current.
- E. ASME Compliance: Comply with ASME B31.9, "Building Services Piping," for materials, products, and installation. Safety valves and pressure vessels shall bear the appropriate ASME label. Fabricate and stamp air separators and expansion tanks to comply with ASME Boiler and Pressure Vessel Code: Section VIII, Division 1.
- F. Perform Work in accordance with ASME B31.5 code for installation of piping systems and ASME Section IX for welding materials and procedures.
- G. Maintain one copy of each document on site.

- H. All grooved joint piping products shall be supplied by a single domestic manufacturer. Grooving tools shall be supplied by the same manufacturer as the grooved components.
- I. Design piping systems under direct supervision of Professional Engineer experienced in design of this Work and licensed at Project location.

1.8 DELIVERY, STORAGE, AND HANDLING

- A. In accordance with Division 1 - General Requirements.
- B. Furnish temporary end caps and closures on piping and fittings. Maintain in place until installation.
- C. Protect piping from entry of foreign materials by temporary covers, completing sections of the work, and isolating parts of completed system Protect.
- D. Contractor shall adequately protect piping from damage after delivery to the project. Piping shall be completely covered and secured with heavy tarpaulins, drop cloths or other protective coverings as required to protect from inclement weather, moisture, chemicals, construction traffic, plaster, paint, mortar and/or dirt. Do not cover with plastic materials and trap condensate and cause corrosion. Protective covering is in addition to the manufacturer's original factory packaging. Original factory packaging shall not be deemed as acceptable protection of equipment.
- E. Do not deliver piping to the project site until progress of construction has reached the stage where piping is actually needed or until building is closed in enough to protect the equipment from weather. Equipment allowed to stand in the weather will be rejected, and the contractor is obligated to furnish new equipment of like kind at no additional cost to the Owner. Limit shipment of bulk and multi-use materials to quantities needed for immediate installation.

1.9 ENVIRONMENTAL REQUIREMENTS

- A. Do not install underground piping when bedding is wet or frozen.

1.10 WELDING

- A. Welding Procedures: Conform to latest recommendations of American Welding Society and Code for Pressure Piping, ANSI B31.1, and current edition. Welding and stress relieving procedures shall conform to Appendix, Section VI, and "Standard Qualifications for Welding Procedures, Welders and Welding Operators."
- B. Locations for Welding: Welding shall not be permitted within occupied area of the building. When the building or a portion of the building is in use as a permanent occupancy welding shall be permitted only in areas physically separated from occupied spaces by fire rated or non-combustible walls to deck or on completely gutted and unoccupied floors.
- C. Fire Protection and Smoke Venting: The Contractor shall provide all manpower and equipment required to protect the building structure and site occupants, other Contractors, etc., from hazards and to remove welding fumes from the building conform to the latest requirements of NFPA 51B.

PART 2 - PRODUCTS

2.1 CASED PIPING SYSTEM

- A. Description: Factory-fabricated piping with carrier pipe, insulation, and casing.
1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
 - a. Perma-Pipe, Inc.
 - b. Thermacor Process, L.P.
 - c. Insul-Pipe Systems
- B. Carrier Pipe: ASTM A53 Electric Resistance Weld (ERW), Type E, Grade B, Schedule 40 black steel with plain ends.
1. When practical, piping shall be provided in 40-foot double-random lengths. All carbon steel pipes shall have ends cut square and beveled for butt-welding. Straight sections of factory pre-insulated pipe shall have six (6) inches of exposed pipe at each end for field joint fabrication.
- C. Carrier Pipe Insulation:
1. Polyurethane Foam Pipe Insulation: Rigid, cellular, high-pressure injected between carrier pipe and jacket.
 - a. Comply with ASTM C 591; thermal conductivity (k-value) shall not exceed 0.16 Btu x in. /h x sq. ft. x deg F at 75 deg F after 180 days of aging.
- D. Casing: Extruded, black, high density polyethylene (HDPE), wall thickness not less than 125 mils for pipe sizes less than or equal to 12 inches, 150 mils for jacket sizes greater than 12 inches. No FRP, HDUP, or tape jacket allowed.
- E. Casing accessories include the following:
1. Joint Kit: Half-shell, pourable or split insulation, casing sleeve, and shrink-wrap sleeve.
 2. Expansion Blanket: Elastomeric foam, formed to fit over piping.
 3. End Seals: Shrink wrap the casing material to seal watertight around casing and carrier pipe.
- F. Moisture barrier and seals: Factory applied, sealed to the jacket and carrier pipe. End seals shall be certified as having passed a 20-foot head pressure test. End seals shall be high temperature mastic completely sealing the exposed end of the insulation.
- G. Straight joints shall be factory fabricated and pre-insulated, using polyurethane foamed poured in HDPE sleeve and sealed with a pressure sensitive polyethylene backed, 30 mils thick heat shrink wrap. All joint closures and insulation shall occur at straight sections of pipe. All insulation and jacketed materials shall be furnished and installed by pre-insulated pipe manufacturer. Field applied insulation piping shall not be acceptable.

- H. Fittings: Factory fabricated and pre-insulated with polyurethane foam to the thickness specified and jacketed with a one piece seamless molded HDPE fitting cover, a butt fusion welded, or an extrusion welded and mitered HDPE jacket. Carrier pipe fittings shall butt-welded, except sizes smaller than two (2) inches shall be socket-welded. Fittings shall be prefabricated / pre-engineered. Fittings include expansion loops, elbows, tees, reducers, and anchors. Elbows, loops, offset, or any other direction changes shall conform to the standards set by ANSI B3.1.1. Field applied insulated fittings shall not be acceptable.
- I. Expansion and Contraction: Compensation will be accomplished utilizing factory prefabricated and preinsulated expansion elbows, Z-bends, expansion loops and anchors specifically designed for the intended application. External expansion compensation utilizing flexible expansion pad (minimum one (1) inch thickness), extending on either side, both inside and outside the radius of the fittings are used with all fittings having expansion in excess of 1/2 inch.
- J. Manholes: Black steel with lifting eyes.
 - 1. Finish: Spray-applied urethane, minimum 30 mils thick.
 - 2. Access: 30-inch diameter waterproof cover with gasket, ladder, and two 6-inch vents, one high and one low, extending above grade with rain caps.
 - 3. Conduit Stub-Outs and Seals: Welded steel with drain and vent openings.
 - 4. Sump: 12 inches in diameter, 12 inches deep.
 - 5. Floatation Anchor: Oversized bottom keyed into concrete base.
- K. Source Quality Control: Factory test the carrier pipe to 150 percent of the operating pressure of system. Furnish test certificates.

PART 3 - EXECUTION

3.1 EARTHWORK

- A. See Division 31 "Earth Moving" for excavating, trenching, and backfilling.

3.2 PIPING APPLICATION

- A. Hot water heating piping, chilled water piping, condenser water piping, underground, shall be the following:
 - 1. Cased piping with polyurethane carrier-pipe insulation.
 - a. Piping Insulation Thickness: 1 inch.

3.3 PIPING INSTALLATION

- A. Drawing plans, schematics, and diagrams indicate general location and arrangement of piping systems. Indicate piping locations and arrangements if such were used to size pipe and

calculate friction loss, expansion, pump sizing, and other design considerations. Install piping as indicated unless deviations to layout are approved on Coordination Drawings.

- B. Remove standing water in the bottom of trench.
- C. Do not backfill piping trench until field quality-control testing has been completed and results approved.
- D. Install piping at uniform grade of 0.2 percent. Install drains, consisting of a tee fitting, NPS 3/4 ball valve, and short NPS 3/4 threaded nipple with cap, at low points and elsewhere as required for system drainage. Install manual air vents at high points.
- E. Install components with pressure rating equal to or greater than system operating pressure.
- F. Install piping free of sags and bends.
- G. Install fittings for changes in direction and branch connections.
- H. See Section 23 05 29 "Hangers and Supports for HVAC Piping and Equipment" for mechanical sleeve seals through exterior building walls.
- I. Secure anchors with concrete thrust blocks.

3.4 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. Brazed Joints: Construct joints according to AWS's "Brazing Handbook," Ch. 35, "Pipe and Tubing," using copper-phosphorus brazing filler metal complying with AWS A5.8/A5.8M.
- D. Threaded Joints: Thread pipe with tapered pipe threads according to ASME B1.20.1. 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.
 - 2. Damaged Threads: 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.
- E. Welded Joints: Construct joints according to AWS D10.12M/D10.12, using qualified processes and welding operators according to "Quality Assurance" Article.
- F. Flanged Joints: Select appropriate gasket material, size, type, and thickness for service application. Install gasket concentrically positioned. Use suitable lubricants on bolt threads.
- G. Cased Piping Joints: Assemble sections and finish joints with pourable or split insulation and exterior jacket sleeve, and apply shrink-wrap seals.

3.5 IDENTIFICATION

- A. Install continuous plastic underground warning tapes during back filling of trenches for underground hydronic piping. Locate tapes 6 to 8 inches below finished grade, directly over piping.

3.6 FIELD QUALITY CONTROL

- A. Manufacturer's Field Service: Engage a factory-authorized service representative to inspect, test, and adjust components, assemblies, and equipment installations, including connections.
- B. Perform tests and inspections.
 - 1. Manufacturer's Field Service: Engage a factory-authorized service representative to inspect components, assemblies, and equipment installations, including connections, and to assist in testing.
- C. Tests and Inspections:
 - 1. Prepare hydronic piping for testing according to ASME B31.9 and as follows:
 - a. Leave joints, including welds, uninsulated and exposed for examination during test.
 - b. Fill system with water. Where there is risk of freezing, air or a safe, compatible liquid may be used.
 - c. Use vents installed at high points to release trapped air while filling system.
 - 2. Test hydronic piping as follows:
 - a. Subject hydronic piping to hydrostatic test pressure that is not less than 1.5 times the design pressure.
 - b. After hydrostatic test pressure has been applied for a minimum of (1) one hour and not to exceed a maximum of four (4) hours to examine piping connections, fittings, and joints for leakage. Remake leaking joints using new materials or replacement of pipe section and repeat hydrostatic test until no leaks exist.
- D. Prepare test and inspection reports.

END OF SECTION