

CONSTRUCTION STANDARD SPECIFICATION

SECTION 02551

UNDERGROUND HYDRONIC DISTRIBUTION SYSTEMS

PART 1 - GENERAL

1.01	SCOPE OF WORK.....	2
1.02	REFERENCES	3
1.03	QUALITY ASSURANCE.....	3
1.04	SUBMITTALS	4
1.05	PROJECT CONDITIONS	4

PART 2 - PRODUCTS

2.01	PIPING.....	5
2.02	ACCESSORIES.....	5
2.03	INSULATION	5
2.04	PROTECTIVE JACKET	6
2.05	VALVES.....	6

PART 3 - EXECUTION

3.01	EARTHWORK AND TRAFFIC CONTROL.....	7
3.02	PIPING INSTALLATION.....	7
3.03	VALVES.....	8
3.04	VALVE BOXES.....	8
3.05	VALVE STEM EXTENSIONS.....	8
3.06	TEST	8
3.07	JACKET JOINTS	9
3.08	CLEANING AND FLUSHING.....	9
3.09	IDENTIFICATION.....	10
3.010	SURFACE RESTORATION.....	10

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SECTION 02551

UNDERGROUND HYDRONIC DISTRIBUTION SYSTEMS

PART 1 - GENERAL

1.01 SCOPE OF WORK

- A. Furnish and install all materials and labor required to execute the installation of the complete direct buried chilled water and heating water piping and insulation necessary for a complete and waterproof installation to include the following:
 - 1. Traffic Control
 - 2. Excavation, trenching, and shoring.
 - 3. Chilled and heating water piping installation.
 - 4. Foam polyurethane insulation.
 - 5. Backfilling and Surface Restoration.
 - 6. Testing, Flushing, Cleaning and Inspections.

- B. General: All underground chilled water and heating water lines shall be the XTRU-THERM as manufactured by PERMA-PIPE or FERRO-THERM as manufactured by THERMOCOR or approved equivalent. All straight section, fittings, anchors and other accessories shall be factory fabricated to job dimensions and designed to minimize the number of field welds. Each system layout shall be computer analyzed by the piping system manufacture to determine stress on the carrier pipe and anticipated thermal movement of the service pipe. The system design shall be in strict conformance with ANSI B31.1, latest edition. Factory trained field technical assistance shall be provided for critical periods of installation; unloading, field joint instruction and testing.

- C. Related Sections: Refer to the following sections for related work:
 - 1. Section 01001S, Traffic Control Management
 - 2. Section 01300, Descriptive Submittals

02551-2

UNDERGROUND HYDRONIC DISTRIBUTION SYSTEMS

3. 01701S, As-Built Drawing Process
4. Section 02200, Earthwork
5. Section 15050, Basic Mechanical Materials and Methods
6. Section 15189, Chemical Treatment for Hydronic Systems

1.02 REFERENCES

A. American National Standards Institute (ANSI)

B31.1 Power Piping

B. American Society of Mechanical Engineers (ASME)

Boiler and Pressure Vessel Code, Section IX

ASME B16.5 Pipe Flanges and Flanged Fittings

ASME B16.9 Factory-made Wrought Steel Butt Welding Fitting

ASME B16.11 Forged Fittings, Socket-Welding and Threaded

C. American Society of Testing and Materials (ASTM)

ASTM A53 Pipe, Steel, Black and Hot-Dipped, Zinc-Coated Welded and Seamless

ASTM A193 Alloy-Steel and Stainless Steel Bolting Materials for High Temperature Service

ASTM A194 Carbon and Alloy Steel Nuts for Bolts for High Pressure and High Temperature Service

ASTM C591 Unfaced Preformed Rigid Cellular Polyisocyanurate Thermal Insulation

D. American Water Works Association (AWWA)

C500 Metal-Seated Gate Valves for Water Supply Service

C600 Installation of Ductile-Iron Water Mains and Their Appurtenances

1.03 QUALITY ASSURANCE

- A. Manufacture of prefabricated pipe, insulation, and jacket shall have 10 years or more experience in design and fabrication of specified product.
- B. Welding: Qualify processes and welder performance according to ASME Boiler and Pressure Vessel Code: Section IX. Certify that each field welder has satisfactorily passed ASME qualification test for welding processes involved and, has undergone recertification.

- C. Examination of welds shall be per ANSI B31.1, Power Piping and Section 15050 Basic Mechanical Materials and Methods.

1.04 SUBMITTALS

- A. Shop Drawings: Shop drawing shall be prepared based on actual field measurements taken by the contractor. Drawings shall be signed and sealed by a qualified professional engineer.
 - 1. Show anchors and guides that restrain piping movement with calculated loads, and show concrete thrust block dimensions.
 - 2. Scaled plan drawings shall show pipe sizes, locations, and elevations. Show piping in trench, conduit and cased pipe with details showing clearances between piping, and show insulation thickness.
 - 3. As-Built Drawings: Upon completion of the work, the Contractor shall revise all drawings to agree with the construction materials, capacities, locations, and routing as actual accomplished. The notation "AS-Built" shall be entered in the revision block, dated and initialed.
- B. Provide manufactures literature for all pipe, valves, fittings and accessories.
- C. Submit complete data on materials, insulation, thermal expansion, and protective jacket.
- D. Submit complete data on polyurethane properties to include density, compressive strength in PSI, tensile strength in PSI, closed cell percentage, moisture permeation rate in perm-inch, aged thermal conductivity, dimensional stability, flame spread, and smoke density.
- E. Submit complete data on installation procedures for connections, joints etc. relative to scope of work.
- F. Manufacture Certificates: Signed by manufactures certifying that piping complies with requirements.
- G. Welding certificates.
- H. Field quality-control test reports.

1.05 PROJECT CONDITIONS

- A. Existing Utilities: Do not interrupt utilities serving facilities occupied by SNL or others unless permitted under the following conditions and then only after arranging to provide temporary utility services according to requirements indicated:

1. Notify SNL SDR no fewer than five days in advance of proposed utility interruptions.
2. Do not proceed with utility interruptions without SDR's written permission.

PART 2 - PRODUCTS

2.01 PIPING

- A. Provide a piping system with a maximum allowable working pressure (MAOP) of at least 150 psig.
- B. Service Pipe:
 1. Internal piping shall be standard weight carbon steel, ASTM, A-53 Grade B, ERW (Type E) or seamless (Type S). All joints shall be butt-welded for 2-1/2 inch and greater, and socket or butt-welded for 2 inch and below. Where possible, straight sections shall be supplied in 40-foot random lengths. Factory insulated pipe shall have steel carrier exposed at each end for field joint fabrication.
- C. Fittings:
 1. Forged Steel Socket Weld Fittings: ASME B16.11, Class 2000 and 3000.
 2. Wrought Steel Butt Welded Fittings: ASME B16.9, equal in thickness to meet pipe pressure ratings. All elbows shall be long radius where space conditions allow.
 3. Cast and Forged Steel Flanges: ASME B16.5, Class 150, Material Group 1.1, welding neck, raised face (or faced to match adjoining valves) and including bolts, nuts and gaskets.
 4. Gaskets: Material shall be of compressed sheet suitable for the operating conditions. Group 1a or 1b as listed in ASTM B16.5
 5. Bolts and Nuts: Bolts shall conform to ASTM A193M Rev. B, Grade B7. Nuts shall conform to ASTM A194/A194M Rev. A, Grade 2H.

2.02 ACCESSORIES

- A. End seals, gland seals, and anchors shall be designed and factory fabricated to prevent the ingress of moisture into the system.

2.03 INSULATION

- A. Insulation shall be polyurethane foam either spray applied or high pressure injected with one shot into the annular space between carrier pipe and jacket. Insulation shall be rigid, 90% closed cell polyurethane with a 2.0 to 3.0 pounds per cubic foot density and coefficient of thermal conductivity (K-Factor) of 0.14 and shall conform to ASTM C-591. Insulations shall have a compressive strength of 35 psig minimum at 5% deformation and maximum moisture absorption of 0.054 percent by volume per ASTM D 2842. Maximum operating temperature shall exceed 250 deg. F.
- B. To ensure no voids are present, all insulation shall be inspected by one of the following three methods: visually checked prior to application of the protective jacket; infrared inspection of the entire length; or x-ray inspection of the entire length. The insulation shall be applied to the minimum thickness specified below. The insulation thickness shall not be less than indicated in these specifications.

<u>Pipe Size (in.)</u>	<u>Insulation Thickness (in.)</u>
1 – 8	1
10 – 12	1.5
14 – 36	2

2.04 PROTECTIVE JACKET

- A. The straight sections of the insulated piping system shall be extruded, black, high density polyethylene (HDPE). Thermoplastic casing material, e.g., PVC or PE, shall not be allowed.
- B. The minimum thickness for HDPE jacket shall be as follows: 125 mils (0.125 in.) for jacket sizes less than or equal to 12 inch, 150 mils (0.150 in.) for jacket sizes larger than 12 inch to 24 inch, and 175 mils (0.175 in.) for jacket sizes greater than 24 inch.
- C. For submitted design, all fittings of the insulated piping system shall be factory prefabricated and pre-insulated jacketed with a one piece seamless molded HDPE fitting cover with polyurethane foam to the thickness specified. For site modifications fittings can be field insulated with liquid urethane foam insulation, jacketed with PCV fitting cover and then wrapped with polyethylene backed, pressure sensitive rubberized bitumen adhesive tape, 30 mils (0.03 in.), or per the manufacturer recommendations.

2.05 VALVES

- A. Gate valves shall have 200 psi minimum working pressure, sizes 3 inch through 12 inch, double disk, parallel seat, iron body, bronze mounted, non-rising stem, “O”-ring stem seals, conforming to AWWA C500. Valves shall open counterclockwise. The operating nut shall be standard 2 inch square with an arrow cast in the metal

indicating the direction of opening. End connections shall be flanged joints, Class 125, unless otherwise indicated.

- B. Valves installed in pits and vaults shall be hand wheel-operated with flanged end connections conforming to ASME B16.1, Class 125. Gate valves shall be M&H Valve Co. (McWane Inc.), Muller or approved equal.
- C. Valve boxes shall have a ray cast-iron ring and cover as designated on the standard drawing conforming to ASTM A48, Class 25C. The words (“CSW” or “CWR”) or (“HWS” or “HWR”) shall be cast onto the top of the cover in raised letters.

PART 3 - EXECUTION

3.01 EARTHWORK AND TRAFFIC CONTROL

- A. Refer to Division 2 Section “Earthwork” for excavating, trenching, and backfilling.
- B. Refer to Division 1 Section 01001S “Traffic Control Management” for requirements.

3.02 PIPING INSTALLATION

- A. General Locations and Arrangements: Drawings indicate general location and arrangement of piping. Indicated location and arrangements 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 by SNL.
- B. Remove any standing water in the bottom of trench.
- C. Do not insulate piping or backfill piping trench until field quality-control testing has been completed and results approved.
- D. Install components with pressure rating equal to or greater than system operating pressure.
- E. Install piping free of sags and bends.
- F. Install fittings for changes in direction and branch connections. All elbows shall be long-radius elbows where space permits. Tees shall be used for branch connections. Fittings formed from welded pipe sections will not be permitted.
- G. Refer to details for sleeves and mechanical sleeve seals through exterior building walls.
- H. Secure anchors with concrete thrust blocks.

- I. Connect to hydronic piping where it passes through the building wall or floor or where noted on plans. Hydronic piping inside the building is specified in SNL Standard specification 15051 "Piping Systems".
- J. Welded Joints: Joints between sections of pipe and between pipe and fittings may be welded using either gas or electric welding equipment. All piping surfaces shall be thoroughly cleaned before welding. Each joint, except socket-weld joints, shall be beveled before being welded. All welding shall conform to the requirements of Sandia Construction Standards Section 15050, Basic Mechanical Materials and Methods. Any welding work being done requires:
 - 1. A hot work permit from SNL Fire Protection.
 - 2. A dedicated fire watch during the work process until thirty (30) minutes after completion.
 - 3. A minimum 2-A rated fire extinguisher located near the welding site.
 - 4. Any other special requirements listed on the permit.

3.03 VALVES

- A. Valves shall be installed at the locations indicated and as detailed on the contract drawings, and in accordance with AWWA C600. No change in the vertical or horizontal alignment of the pipe shall be allowed at connections to the valve. Valves shall be installed in accordance with the manufacture's recommendations.

3.04 VALVE BOXES

- A. Install valve boxes over all gate and butterfly valves as detailed on the contract drawings, and in accordance with AWWA C600. Boxes shall be installed plumb and true, and shall be centered on the valve operating nut. The weight of the valve box shall not bear upon the control valve or pipeline.

3.05 VALVE STEM EXTENSIONS

- A. Where the valve operating nut is at a depth greater than 2 feet below the valve box cover, an extension stem shall be installed in the box with the required size square wrench nut. Extension stems shall be equipped with a minimum of one stem guide or stem guides at intervals not exceeding 10 feet, and shall be affixed to the interior of the valve box.

3.06 TEST

- A. Source Quality Control: Factory test the conduit to 15 psig for a minimum of 2 minutes with no change in pressure. Factory test the carrier pipe to 150 percent of the operating pressure of the system. Furnish test certificates.
- B. Prepare hydronic piping for testing according to ASME B31.1 and as follows:
 - 1. Leave joints, including welds, uninsulated and exposed for examination during test.
 - 2. Isolate equipment. Do not subject equipment to test pressure.
 - 3. Install relief valve set at pressure no more than on-third higher than test pressure.
 - 4. Fill system with water. Where there is risk of freezing, air or a safe, compatible liquid may be used.
 - 5. Use vents installed at high points to release trapped air while filling system.
- C. All piping shall be proven tight at a hydrostatic pressure of 150% of the system design operating pressure. The system shall show no loss in pressure or indication of leakage at any joint or connection for a period of one hour. All tests shall be conducted in the presence of the SNL Inspector. Any system failing to meet the specified test requirements shall be corrected and retested until the test requirements are met and the system accepted by the SNL Inspector with no change in contract price.
- D. Welding Inspection: Welding inspection shall conform with Section 15050 Basic Mechanical Materials and Methods.

3.07 JACKET JOINTS

- A. Do not install any jacket joints until the carrier pipe joints have been inspected and tested. Assemble sections and finish joints with pourable or split insulation, exterior jacket sleeve, and apply shrink-wrap seals as required by manufacture's written installation instruction.

3.08 CLEANING AND FLUSHING

- A. Refer to Division 15 Section "Chemical Treatment for Hydronic Systems" for cleaning and flushing requirements.
- B. The Contractor shall flush all new installations in accordance with an approved flushing plan submitted by the contractor. If no fire hydrants or other convenient outlets for flushing are available, the Contractor shall install flush points at no additional cost to SNL. Flushing shall be of sufficient magnitude to flush foreign

materials out of the lines, valves and hydrants. All valves shall be fully opened and closed under water pressure to ensure proper operations during flushing and to dislodge foreign material. All valves on fire protection lines (except curb box valves) shall be sealed with a plastic seal in the normal position (opened or closed) at the conclusion of testing.

- C. During flushing operations, all valves or connections to existing systems shall be closed and backflow preventors or other approved equipment installed at the source to prevent contamination of existing systems. Contractor shall protect existing site improvements during flushing operation. The flushing velocity shall be a minimum of 2.5 fps for non-fire protection lines.
- D. Omit the Division 15 requirements to drain the water used for hydrostatic testing.

3.09 IDENTIFICATION

- A. Refer to Division 2 Section "Earthwork" for warning tape requirements.

3.010 SURFACE RESTORATION

- A. Upon completion of backfill, grade surfaces shall be restored to match existing. Refer to the Drawings for other requirements.

END OF SECTION