PART 1 – GENERAL

WORK INCLUDED

A. Extent of heat distribution system in direct buried system required by this section is indicated on drawings and schedules and by requirements of this section. Work shall include all piping and pipe insulation to provide a complete system for hot water heating and chilled water cooling piping as indicated.

B. Types of shallow trench system work specified in this section include the following:

2. Valves
3. Pre-Insulated Hot Water Supply and Return Piping (Direct Buried System).

1.2 QUALITY ASSURANCE

A. Manufacturer's Qualifications: Firms regularly engaged in manufacture of piping products of types, materials, and sizes required, whose products have been in satisfactory use in similar service for not less than 5 years.

B. Installer's Qualifications: Firm with at least 3 years of successful installation experience on projects with piping work similar to that required for project.

C. Codes and Standards

1. ASME Compliance: Fabricate and install piping in accordance with ASME B31.9 "Building Services Piping".
2. PPI TR-4 – Recommended Hydrostatic Strengths and Design Stresses for Thermoplastic Pipe and Fittings Compounds.
3. ASTM F 714 – Polyethylene (PE) Plastic Pipe (SDR-PR) Based on Outside Diameter.
4. ASTM D 3035 - Polyethylene (PE) Plastic Pipe (DR-PR) Based on Controlled Outside Diameter.
1.3 SUBMITTALS

A. Product Data: Submit manufacturer's technical product data and installation instructions for piping materials and products listed below:

1. Pipe Insulation
2. Valves
3. Direct buried distribution system with installation instructions

B. Fabrication and Erection Drawings: Submit layout of piping system in shallow trench, and also provide layout of direct buried distribution system.

C. Record Drawings: At project closeout, submit record drawings of installed piping and piping products, in accordance with requirements of Section 15000.
PART 2 - PRODUCTS

2.1 ACCEPTABLE MANUFACTURERS

A. Subject to compliance with requirements, provide hydronic piping system products from one of the following:

1. Pre-insulated Steel Pipe & Fittings:
   a. Thermacor Process Inc.
   b. Perma-Pipe

2. Polyethylene Pipe & Fittings:
   a. Plexco Performance Pipe Division of Chevron Chemical Company

3. Mechanical Sleeve Seals:
   a. Thunderline Corp.

2.2 MATERIALS AND PRODUCTS

A. General: Provide piping materials and factory-fabricated piping products of sizes, types, pressure ratings, temperature ratings, and capacities as indicated. Where not indicated, provide proper selection as determined by Installer to comply with installation requirements. Provide materials and products complying with ASME B31.9 Code for Building Services Piping where applicable, base pressure rating on piping systems maximum design pressures. Provide sizes and types matching piping and equipment connections; provide fittings of materials which match pipe materials used in hydronic piping systems.

2.3 PIPE AND FITTINGS IN VAULTS AND WITHIN BUILDINGS

A. General: Provide pipe, tube, and fittings complying with Division-15 Basic Mechanical Materials and Methods section "Pipes and Pipe Fittings", in accordance with the following listing:

B. All pipe fittings and valves shall be with welded joints.

1. Pipe 2 inches in diameter and larger shall be black steel plain end beveled and shall be standard weight to conform with ASTM A 53, Grade B, Type E (electric resistance welded) or S (seamless), or to ASTM A 106 Grade B.
2.4 PRE-INSULATED PIPE AND FITTINGS (HEATING HOT WATER)

A. General: Provide pre-insulated piping system consisting of carrier pipe, prefabricated fittings, foam insulation, jacket, joint closures, bolstering material, anchors, and foundation link seals.

B. Carrier Pipe: Black steel plain end beveled and shall be standard weight to conform with ASTM A 53, Grade B, Type E (electric resistance welded) or S (seamless), or to ASTM A 106 Grade B. When practical, piping shall be provided in 4-foot double-random lengths. Straight sections of factory pre-insulated pipe shall have 6” of exposed pipe at each end for field joint fabrication. All pipe fittings shall be with welded joints.

C. Foam Insulation: 87 percent closed cell polyisocyanurate foam insulation, 2.4 Lb/CF density with a compressive strength of 30 PSI, thermal conductivity of .14-.24 at 70-366 degrees F, minimum 2.9 inches thick.

D. Jacket: High density polyethylene (HDPE) conforming to ASTM D-1248 with a minimum wall thickness of 125 mils.

E. Joint Closure: High density polyethylene, 125 mills minimum thickness, fusion welded to pre-insulated pipe jacket and pressure testable to 5 PSI.

F. Expansion Compensation: Expansion compensation will be accomplished utilizing factory prefabricated and pre-insulated expansion elbows, expansion loops, Z-bends and L-bends, and anchors. External expansion compensation utilizing flexible expansion bolsters, extending on either side, both inside and outside the radius of the fittings shall be used.

G. Anchors: Steel plate welded to carrier pipe and encapsulated in piping system jacket.

H. Mechanical Sleeve Seals: Modular mechanical type, consisting of interlocking synthetic rubber links shaped to continuously fill annular space between pipe jacket and sleeve, connected with bolts and pressure plates which cause rubber sealing elements to expand when tightened, providing watertight seal and electrical insulation.

2.5 POLYETHYLENE PIPE AND FITTINGS (CHILLED WATER)

A. Materials: Materials used for the manufacture of polyethylene pipe and fittings shall be PE3408 high density polyethylene meeting cell classification 345444C or 345444E per ASTM D 3350 and shall be listed in the name of the pipe and fitting Manufacturer in Plastics Pipe Institute (PPI) TR-4 with a standard grade HDB rating of 1600 PSI at 73 degrees F. The manufacturer shall certify that the materials used to manufacture pipe and fittings meet these requirements.

B. Pressure Rating: Piping to be installed under this project shall be DR 11.0 and designed for a pressure rating of 160 PSI at 73 degrees F.
C. Polyethylene Pipe: Polyethylene pipe shall be manufactured in accordance with ASTM F 714 or ASTM D 3035 and shall be so marked. Each production lot of pipe shall be tested for melt index, density, percent carbon, dimensions and either quick burst or ring tensile strength. All polyethylene pipe and fittings for this project shall be supplied by a single manufacturer.

D. Service Identification Stripes: Permanent identification of piping service shall be provided by co-extruding four equally spaced color stripes into the pipe outside surface. The striping material shall be the same material as the pipe material except for color. The following colors shall be used to identify piping service:

1. Yellow Stripe – Gaseous fuels.
2. Blue Stripe – Potable water.
5. Purple Stripe – Re-use water.

E. Polyethylene Fittings and Custom Fabrications: Polyethylene fittings and custom fabrications shall be molded or fabricated by the pipe manufacturer. Butt fusion outlets shall be made to the same outside diameter, wall thickness, and tolerances as the mating pipe. All fittings and custom fabrications shall be fully rated for the same internal pressure as the mating pipe. Pressure de-rated fabricated fittings are prohibited.

F. Molded Fittings: Molded fittings shall be manufactured in accordance with ASTM D 3261 and shall be so marked. Each production lot of molded fittings shall be subjected to the tests required under ASTM D 3261.

G. X-Ray Inspection: The manufacturer shall submit samples from each molded fittings production lot to x-ray inspection for voids, and shall certify that voids were not found.

H. Fabricated Fittings: Fabricated fittings shall be made by heat fusion joining specially machined shapes cut from pipe, polyethylene sheet stock, or molded fittings. Fabricated fittings shall be rated for internal pressure service equivalent to the full service pressure rating of the mating pipe. Directional fittings 16” IPS and larger such as elbows, tees, crosses, etc., shall have a plain end inlet for butt fusion and flanged directional outlets. Part drawings shall be submitted for the approval of the Project Engineer.

I. Polyethylene Flange Adapters: Flange adapters shall be made with sufficient through-bore length to be clamped in a butt fusion joining machine without the use of a stub-end holder. The sealing surface of the flange adapter shall be machined with a series of small v-shaped groves to provide gasketless sealing, or to restrain the gasket against blow-out.

J. Back-Up Rings and Flange Bolts: Flange adapters shall be fitted with lap joint flanges pressure rated equal to or greater than the mating pipe. The lap joint flange bore shall be chamfered or radiused to provide clearance to the flange adapter radius. Flange bolts and nuts shall be Grade 2 or higher.
2.6 BASIC SUPPORTS AND ANCHORS

A. Provide supports and anchors as detailed on drawings and complying with Division-15 Basic Mechanical Materials and Methods section "Supports and Anchors".

2.7 BASIC VALVES

A. General: Provide valves complying with Division-15 Basic Mechanical Materials and Methods section "Valves", in accordance with the following listing and with welded fittings:

B. Sectional Valves:
   1. 2" and Smaller: Ball valves.
   2. 2-1/2" and Larger: Butterfly valves.

C. Drain Valves:
   1. 2" and Smaller: Ball valves.
PART 3 - EXECUTION

3.1 EXAMINATION

A. General: Examine areas and conditions under which trench and piping systems materials and products are to be installed. Do not proceed with work until unsatisfactory conditions have been corrected in manner acceptable to Installer.

3.2 PIPING INSTALLATION

A. General: All pipe shall be accurately cut to measurements established at the construction site and shall be worked into place without springing or forcing, properly clearing all openings and equipment. Excessive cutting or other weakening of structural members to facilitate piping installation shall not be permitted. Pipe ends shall have burrs removed by reaming and pipe shall be installed to permit free expansion and contraction without damage to joints or hangers.

B. Expansion of piping shall be provided for by changes in the direction of the run of pipe, or by expansion loops as indicated. Piping shall be cold sprung one-half the calculated maximum operational expansion during field assembly.

C. Changes in direction may be made by bending of pipe provided that a hydraulic pipe bender is used. Pipe to be bent shall be steel conforming to ASTM A53, Grade A, class as required to match adjoining pipe. Bent pipe showing kinks, wrinkles, or malformations will not be acceptable.

D. All piping, unless otherwise indicated, shall be pitched toward drain points.

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

F. Welded Joints: Joints between sections of pipe and between pipe and fittings shall be welded. Branch connections may be made with either welding tees or forged branch outlet fittings, either being acceptable without size limitations. Branch outlet fittings where used shall be forged, flared for improved flow where attached to the run, reinforced against external strains, and designed to withstand full pipe bursting strength.

G. Branch Connections: Branches from mains shall branch off top of mains as indicated or as approved. Connections shall insure unrestricted circulation, elimination of air pockets, and shall permit the complete drainage of the system. Changes in horizontal piping sizes shall be made through eccentric reducing fittings. Branches shall be 45 degrees wye connections in the direction of the fluid flow.
3.3 PREINSULATED PIPE INSTALLATION

A. General: Pre-insulated piping systems shall be pre-engineered by the factory and shall be provided with all straight pipe and fittings factory pre-insulated and prefabricated to job dimensions.

B. Foundation and Bedding: Pipe shall be laid on a stable foundation consisting of 6” thick bedding of compacted Class I material. Excess groundwater shall be removed from the trench before bedding the pipe.

C. Excavation: Trench excavations shall conform to the plans and drawings and in accordance with applicable codes. Excess groundwater shall be removed by the Contractor. Where necessary, trench walls shall be shored or reinforced and all necessary precautions shall be taken to ensure a safe working environment.

D. Foundation and Bedding: Pipe shall be laid on a stable foundation consisting of 6” thick bedding of compacted Class I material. Excess groundwater shall be removed from the trench before bedding the pipe.

E. Pipe Handling: When lifting with slings, use only wide fabric choker slings capable of safely carrying the load. Wire rope or chains shall not be used.

F. Welding: Piping and fittings shall be laid out, aligned and welded in accordance with ASME B31.1

G. Pressure Testing: Piping system shall be hydrostatically tested to one and one-half the normal system operating pressure for not less than two hours. Normal system operating pressure shall be 150 PSI.

H. Joint Closure Installation: Upon completion of the hydrostatic pressure testing, the joints shall be foamed in with polyisocyanurate insulation, formed to match the adjacent insulation thickness. Joint closures securing insulation in place shall be fused to the pipe jacket material and then tested to a pressure of 5 PSI before backfilling.

I. Backfilling: Pipe embedment backfill shall be Class I or II material placed and compacted to at least 90 percent Standard Proctor Density in 6” lifts to at least 6” above the pipe crown. Final backfill shall be placed and compacted to finished grade in 6” lifts. Native soils without debris, stones, boulders, clumps, frozen clods or the like larger than 8” in their largest dimension may be used.
3.4 POLYETHYLENE PIPE INSTALLATION

A. Heat Fusion Joining: Joints between plain end pipes and fittings shall be made by butt fusion, and joints between the main and saddle branch fittings shall be saddle fusion using only procedures that are recommended by the pipe and fitting manufacturer. External and internal beads shall not be removed. The contractor shall ensure that persons making heat fusion joints have received training in the manufacturer’s recommended procedure. The contractor shall maintain records of trained personnel, and shall certify that training was received not more than 12 months before commencing construction.

B. Flanged Connections: Polyethylene pipe and fittings may be joined together or to other materials by means of flanged connections (flange adapters and back-up rings). Flanged connections shall be fully pressure rated and fully thrust restrained such that when installed in accordance with manufacturer’s recommendations, a longitudinal load applied to the flanged connection will cause the pipe to yield. External joint restraints shall not be used. Flanged connections shall be installed in accordance with the manufacturer’s recommended procedures. Flange faces shall be centered and aligned to each other before assembling and tightening bolts. In no case shall the flange bolts be used to draw the flanges into alignment. Bolt threads shall be lubricated, and flat washers shall be fitted under the flange nuts. Bolts shall be evenly tightened according to the tightening pattern and torque step recommendations of the manufacturer. At least one hour after initial assembly, flange connections shall be retightened following the tightening pattern and torque step recommendations of the manufacturer. The final tightening torque shall be 100 ft-lbs or less as recommended by the manufacturer.

C. Excavation: Trench excavations shall conform to the plans and drawings and in accordance with applicable codes. Excess groundwater shall be removed by the Contractor. Where necessary, trench walls shall be shored or reinforced and all necessary precautions shall be taken to ensure a safe working environment.

D. Foundation and Bedding: Pipe shall be laid on a stable foundation consisting of 6” thick bedding of compacted Class I material. Excess groundwater shall be removed from the trench before bedding the pipe.

E. Pipe Handling: When lifting with slings, use only wide fabric choker slings capable of safely carrying the load. Wire rope or chains shall not be used.

F. Backfilling: Pipe embedment backfill shall be Class I or II material placed and compacted to at least 90 percent Standard Proctor Density in 6” lifts to at least 6” above the pipe crown. Final backfill shall be placed and compacted to finished grade in 6” lifts. Native soils without debris, stones, boulders, clumps, frozen clods or the like larger than 8” in their largest dimension may be used.
G. Butt Fusion Testing: Each day that butt fusions are to be made, the first butt fusion joint of the day shall be a trial fusion. The trial fusion shall be allowed to cool completely then fusion test straps shall be cut out. The test strap shall be 12” minimum or 30 times the wall thickness in length with the fusion in the center and 1” minimum or 1.5 times the wall thickness in width. Bend the test strap until the ends of the strap touch. If the fusion fails at the joint, a new trial fusion shall be made, cooled completely and tested. Butt fusion of pipe to be installed shall not commence until a trial fusion has passed the bent strap test.

H. Pressure Testing: Pressure testing shall be conducted in accordance with the manufacturers recommendations. Pressure testing shall be by hydrostatic method, pneumatic pressure testing will not be allowed.

3.5 INSTALLATION OF VALVES

A. Install valves in accordance with Division-15 Basic Mechanical Materials and Methods section "Valves".

B. Sectional Valves: Install on each branch as indicated.

C. Drain Valves: Install on each low point in piping system item located to completely drain piping for service or repair.

3.6 FIELD QUALITY CONTROL

A. Piping Tests: Test hydronic piping in accordance with testing requirements of Division-15 Basic Mechanical Materials and Methods section "Pipes and Pipe Fittings".

3.7 ADJUSTING AND CLEANING

A. Cleaning, flushing and Inspecting: Clean, flush and inspect piping systems in accordance with requirements of Division-15 Basic Mechanical Materials and Methods section "Pipes and Pipe Fittings".

B. Chemical Treatment: Refill piping systems, adding caustic soda to maintain pH of 8.0 to 8.5 and sodium sulfate in amount of 1/3 caustic soda or to maintain residual of 30- to 4- ppm in system. Add trisodium phosphate to make hardness of 0-ppm and residual of approximately 30-ppm in system. Repeat measurements daily with system under full circulation and apply chemicals to adjust levels until no change is apparent.