



## SECTION 23 21 13.13

### UNDERGROUND HYDRONIC PIPING

#### PART 1 GENERAL

##### 1.1 SECTION INCLUDES

- A. Crosslinked polyethylene, Engel method (PEX-a) pipe and fittings for the following applications:
  - 1. Hot-water heating piping, aboveground.
  - 2. Hot-water heating piping installed belowground and within slabs.
  - 3. Chilled-water piping, aboveground.
  - 4. Chilled-water piping installed belowground and within slabs.
  - 5. Condenser-water piping.
  - 6. Makeup-water piping, aboveground.
  - 7. Makeup-water piping installed belowground and within slabs.

##### 1.2 RELATED SECTIONS

- A. Section 23 05 29 — Hangers and Supports for HVAC Piping and Equipment
- B. Section 23 07 19 — HVAC Piping Insulation
- C. Section 23 21 16 — Hydronic Piping Specialties

##### 1.3 REFERENCES

- A. ASTM International (ASTM):
  - 1. ASTM D2657 Standard Practice for Heat Fusion Joining of Polyolefin Pipe and Fittings.
  - 2. ASTM D2765 Test Methods for Determination of Gel Content and Swell Ratio of Crosslinked Ethylene Plastics.
  - 3. ASTM D6394 Specification for Sulfone Plastics (SP).
  - 4. ASTM E84 Standard Test Method for Surface Burning Characteristics of Building Materials.
  - 5. ASTM E119 Standard Test Methods for Fire Tests of Building Construction and Materials.
  - 6. ASTM E814 Standard Test Method for Fire Tests of Through-Penetration Fire Stops.
  - 7. ASTM F876 Standard Specification for Crosslinked Polyethylene (PEX) Tubing.
  - 8. ASTM F877 Standard Specification for Crosslinked Polyethylene (PEX) Plastic Hot- and Cold-Water Distribution Systems.
  - 9. ASTM F1960 Standard Specification for Cold Expansion Fittings with PEX Reinforcing Rings for Use with Crosslinked Polyethylene (PEX) Tubing.
  - 10. ASTM F2389 Standard Specification for Pressure-rated Polypropylene (PP) Piping Systems.
- B. American National Standards Institute (ANSI)/National Sanitation Foundation (NSF):
  - 1. NSF/ANSI Standard 359 Valves for Crosslinked Polyethylene (PEX) Water Distribution Tubing Systems.

- C. American National Standards Institute (ANSI)/Underwriters Laboratories, Inc. (UL)
  - 1. UL/ANSI 263 Standard for Safety for Fire Tests of Building Construction and Materials.
  - 2. UL/ANSI 2846 Standard for Fire Test of Plastic Water Distribution Plumbing Pipe for Visible Flame and Smoke Characteristics.
- D. American Society of Mechanical Engineers (ASME)
  - 1. ASME B16.5 Pipe Flanges and Flanged Fittings: NPS 1/2 through NPS 24 Metric/Inch Standard.
  - 2. ASME B16.51 Copper and Copper Alloy Press-Connect Pressure Fittings.
- E. Canadian Standards Association (CSA)
  - 1. CAN/CSA B137.5 Crosslinked Polyethylene (PEX) Tubing Systems for Pressure Applications.
  - 2. CSA B242-05 Groove-and Shoulder-Type Mechanical Pipe Couplings.
- F. German Institute for Standardization (DIN)
  - 1. DIN 4726 Warm Water Surface Heating Systems and Radiator Connecting Systems – Plastics Piping Systems and Multilayer Piping Systems.
- G. International Code Council (ICC)
  - 1. International Mechanical Code (IMC)
- H. International Association of Plumbing and Mechanical Officials (IAPMO)
  - 1. Uniform Mechanical Code (UMC)
- I. International Organization for Standardization (ISO)
  - 1. ISO 15874 Plastics Piping Systems for Hot and Cold Water Installations – Polypropylene (PP).
- J. Plastics Pipe Institute (PPI)
  - 1. PPI Technical Report TR-4.
- K. Underwriters Laboratories (UL)
  - 1. UL 2846 Standard for Fire Tests of Plastic Water Distribution Plumbing Pipe for Visible Flame and Smoke Characteristics.
- L. Uponor Inc.
  - 1. Uponor Ecoflex® Pre-insulated Piping Systems Design and Installation Manual, current edition.
  - 2. Uponor PEX Piping Systems Installation Guide, current edition.
  - 3. Uponor PEX Piping Systems Design and Installation Manual (PDIM), current edition.

#### 1.4 SUBMITTALS

- A. Submit under provisions of Section 01 30 00 – Administrative Requirements.

- B. Product data: Submit manufacturer's product submittal data and installation instructions.
- C. Shop drawings: Provide installation drawings indicating: piping layout, size dimension by installation segment, vault locations, support fixtures and schedules with all details required for installation of the system.
- D. Samples: Submit selection and verification samples of piping.
- E. Quality assurance/control submittals
  - 1. Test reports: Upon request, submit test reports from recognized testing laboratories.
  - 2. Submit the following documentation.
    - a. Manufacturer's certificate stating that products comply with specified requirements.
    - b. Manufacturer's flow schedule for the distribution system.
    - c. Documentation that the installer is trained to install the manufacturer's products.
- F. Closeout submittals: Submit the following documents.
  - 1. Warranty documents specified herein.
  - 2. Operation and maintenance data.
  - 3. Manufacturer's field reports specified herein.
  - 4. Final as-built piping layout drawing.

#### 1.5 QUALITY ASSURANCE

- A. Installer qualifications: Use an installer with demonstrated experience on projects of similar size and complexity and who has been trained by Uponor or an Uponor-approved manufacturer's representative.
  - 1. Regulatory requirements and approvals: Ensure the piping distribution system complies with all applicable codes and regulations.
  - 2. Certifications: Provide letters of certification indicating: Installer uses skilled workers holding a trade qualification license or equivalent, or apprentices under the supervision of a licensed tradesperson.
  - 3. Pre-installation meetings:
    - a. Verify project requirements, excavation conditions, system performance requirements, manufacturer's installation instructions and warranty requirements.
    - b. Review project construction timeline to ensure compliance or discuss modifications as required.
    - c. Interface with other trade representatives to verify areas of responsibility.
    - d. Establish the frequency and construction phase the project engineer intends for site visits and inspections by the piping manufacturer's representative.
- B. Installer qualifications for PEX: Installer shall have successfully completed the Uponor Piping Systems Training Course and is able to provide proof/verification of the training. Course shall be conducted by the manufacturer or a manufacturer's representative.

## 1.6 DELIVERY, STORAGE AND HANDLING

- A. General: Comply with Division 1 Product Requirement Section.
- B. Comply with manufacturer's ordering instructions and lead-time requirements to avoid construction delays.
- C. Delivery: Deliver materials in manufacturer's original, unopened, undamaged containers with identification labels intact.
- D. Storage and protection: Store materials protected from exposure to harmful environmental conditions and at temperature and humidity conditions recommended by the manufacturer.
  - 1. Store PEX piping in cartons or under cover to avoid dirt or foreign material from entering the piping.
  - 2. Do not expose white or blue PEX piping to direct sunlight for more than one month. Do not expose red PEX piping to direct sunlight for more than six months.
  - 3. Store piping on a flat surface to prevent unwanted deformation.

## 1.7 WARRANTY

- A. Project warranty: Refer to Conditions of the Contract for project warranty provisions.
- B. Manufacturer's warranty:
  - 1. PEX-a manufacturer system warranty shall cover piping and fittings from defect for a duration of 25 years from the date of installation. Piping system warranty shall apply to systems constructed of pipe and fitting products sourced from the same manufacturer.

## PART 2 PRODUCTS

### 2.1 MANUFACTURERS

- A. Acceptable manufacturer: Uponor, located at: 5925 148th St. W.; Apple Valley, MN, 55124; toll-free: 800-321-4739; tel: 952-891-2000; email: [NASpecifications@uponor.com](mailto:NASpecifications@uponor.com); web: [uponor.com](http://uponor.com).
- B. Substitutions: Not permitted.
- C. Requests for substitutions will be considered in accordance with provisions of Section 01 60 00 — Product Requirements.

### 2.2 PIPE

- A. Performance requirements:
  - 1. PEX-a piping and fittings shall meet the following pressure and temperature ratings per ASTM F876:
    - a. 200 degrees F (93 degrees C) at 80 psi (551 kPa).
    - b. 180 degrees F (82 degrees C) at 100 psi (689 kPa).
    - c. 73.4 degrees F (23 degrees C) at 160 psi (1,102 kPa).
  - 2. Minimum bend radius (cold bending): Six times the outside diameter.
- B. PEX-a (Engel-method crosslinked polyethylene) piping, ASTM 876 and F877 (CAN/CSA-B137.5)
  - 1. Single (one service pipe)
    - a. 3/4 inch (19mm)
    - b. 1 inch (25mm)

- c. 1-1/4 inch (32mm)
  - d. 1-1/2 inch (38mm)
  - e. 2 inch (51mm)
  - f. 3 inch (76mm)
  - g. 4 inch (102mm)
- 2. Twin (two service pipes)
    - a. 1 inch (25mm)
    - b. 1-1/4 inch (32mm)
    - c. 1-1/2 inch (38mm)
    - d. 2 inch (51mm)
    - e. 2-1/2 inch (64mm)
- C. EVOH oxygen-diffusion barrier that meets DIN 4726, SDR 9.
- D. Insulation:
- 1. The insulation shall be multi-layered expanded crosslinked water-resistant polyethylene closed-cell foam.
  - 2. All seams of the insulation shall be sealed.
  - 3. Insulation shall not be bonded to the service tubing.
  - 4. Thermal conductivity of 0.28 BTU · in./ft.2 · h · °F (0.037 W/m<sup>2</sup>)
- E. Jacketing:
- 1. Corrugated seamless high-density polyethylene (HDPE).
  - 2. The HDPE jacket completely encompasses and protects the insulation from moisture and damage.
  - 3. Outer jacket shall be extruded directly over the insulation and shall be flexible.
  - 4. The outer jacket shall contain 2 percent carbon black, finely divided and thoroughly dispersed to provide protection from UV degradation.
  - 5. Jacket shall not be bonded to the insulation.
  - 6. Minimum bend radius:
    - a. Single:
      - 1) 3/4 inch (19mm) pre-insulated tubing with 2.7-inch (69mm) jacket has a bend radius of 8 inches (203mm).
      - 2) 1 inch (25mm) pre-insulated tubing with 5.5-inch (140mm) jacket has a bend radius of 10 inches (254mm).
      - 3) 1-1/4 inch (32mm) pre-insulated tubing with 5.5-inch (140mm) jacket has a bend radius of 12 inches (305mm).
      - 4) 1-1/2 inch (38mm) pre-insulated tubing with 6.9-inch (175mm) jacket has a bend radius of 14 inches (356mm).
      - 5) 2 inch (51mm) pre-insulated tubing with 6.9-inch (175mm) jacket has a bend radius of 18 inches (457mm).
      - 6) 2-1/2 inch (64mm) pre-insulated tubing with 6.9-inch (175mm) jacket has a bend radius of 30 inches (762mm).
      - 7) 3 inch (76mm) pre-insulated tubing with 7.9-inch (200mm) jacket has a bend radius of 32 inches (813mm).
      - 8) 4 inch (102mm) pre-insulated tubing with 7.9-inch (200mm) jacket has a bend radius of 48 inches (1219mm).

- b. Twin:
  - 1) 1 inch (25mm) pre-insulated twin tubing with 6.9-inch (175mm) jacket has a bend radius of 20 inches (254mm).
  - 2) 1-1/4 inch (32mm) pre-insulated twin tubing with 6.9-inch (175mm) jacket has a bend radius of 28 inches (711mm).
  - 3) 1-1/2 inch (38mm) pre-insulated twin tubing with 6.9-inch (175mm) jacket has a bend radius of 32 inches (812mm).
  - 4) 2 inch (51mm) pre-insulated twin tubing with 7.9-inch (200mm) jacket has a bend radius of 40 inches (1016mm).
  - 5) 2-1/2 inch (64mm) pre-insulated twin tubing with 7.9-inch (200mm) jacket has a bend radius of 48 inches (1219mm).

### 2.3 FITTINGS

- A. Fittings for PEX-a piping: Elbows, adapters, couplings, plugs, tees and multiport tees (1/2 inch through 3 inch nominal pipe size):
  - 1. ASTM F1960 cold-expansion fittings in brass or engineered polymer (EP) manufactured by the pipe manufacturer, utilizing cold-expansion PEX-a reinforcing rings made of same material as the pipe.
  - 2. Fittings shall be third-party certified to NSF 14 and ASTM F1960 and shall comply with ASTM F876 and ASTM F877.

### 2.4 TRANSITION FITTINGS

- A. PEX-to-metal transition fittings:
  - 1. Manufacturers: Provide transition fittings from the same manufacturer as the piping.
  - 2. PEX-a to threaded transition: One-piece brass fitting with one male or female threaded end and one ASTM F1960 cold-expansion end, with PEX-a reinforcing cold-expansion ring.
  - 3. PEX-a to copper sweat transition: One-piece brass fitting with one sweat adapter end and one ASTM F1960 cold-expansion end, with PEX-a reinforcing cold-expansion ring.
  - 4. PEX-a to copper press transition: One-piece lead-free (LF) brass fitting with one ASME B16.51 copper press end and one ASTM F1960 cold-expansion end, with PEX-a reinforcing cold-expansion ring.
  - 5. PEX-a to flange transition: Two-piece fitting with one steel flange conforming to ASME B16.5 and one lead-free (LF) brass adapter conforming to ASTM F1960.
  - 6. PEX-a to groove transition: One-piece lead-free (LF) brass fitting with one CSA B242-05 groove end in either iron pipe size (IPS) or copper tube size (CTS) and one ASTM F1960 cold-expansion end, with PEX-a reinforcing cold-expansion ring.
- B. Uponor WIPEX™
  - 1. Compression fittings for 4 inch PEX-a service tubing:
    - a. For system compatibility, use fittings offered by the tubing manufacturer.
    - b. The fitting assembly must comply with performance requirements of ASTM F877.

- c. Fittings will consist of a compression fitting with a coupling sleeve, a fitting body insert with o-ring(s) and a bolt and nut.
  - d. All buried fittings will be installed, insulated, and sealed in accordance with the piping manufacturer's instructions.
  - e. Male NPT thread for each compression fitting
- C. PEX-to-CPVC transition fittings:
- 1. PEX-a to CPVC transition: Thermoplastic fitting with one ASTM D1784 spigot or socket end and one ASTM F1960 cold-expansion end, with PEX-a reinforcing cold-expansion ring.

## 2.5 VALVES

- A. PEX-to-PEX, brass ball valves (1/2 inch through 2 inch nominal pipe size)
- 1. Manufacturers: Provide ball valve(s) from the same manufacturer as the piping system.
  - 2. Full-port ball valve: Two-piece, ASTM F1960 cold-expansion ends, with PEX-a reinforcing cold-expansion ring.
  - 3. In compliance with: 250 CWP, NSF/ANSI 359, ASTM F1960, ASTM F877 (CAN/CSA B137.5).

## PART 3 EXECUTION

### 3.1 EXAMINATION

- A. Site verification of conditions: Verify that site conditions are acceptable for installation of the hydronic piping. Do not proceed with installation until unacceptable conditions are corrected.

### 3.2 INSTALATION

- A. Install hydronic piping according to approved shop drawings or coordination drawings.
- B. Use the fewest possible joints and install per manufacturer's recommendations.
- C. Comply with manufacturer's product data, including product technical bulletins, installation instructions and design drawings, including the following:
- 1. Install PEX piping system in compliance with the Uponor PEX Piping Systems Design and Installation Manual (PDIM), current edition, the Uponor PEX Piping Systems Installation Guide, current edition, and the Uponor Ecoflex® Pre-insulated Piping Systems Design and Installation Manual, current edition.
  - 2. Remove standing water in the bottom of trench.
  - 3. Do not backfill piping trench until field quality-control testing has been completed and results approved.
  - 4. Use accessories associated with the installation of the piping system as recommended by or available from the manufacturer.
  - 5. White or blue PEX shall not be installed outdoors where it is exposed to direct sunlight light for more than one month. Red PEX shall not be installed outdoors where it is exposed to direct sunlight for more than six months.
  - 6. Install support strapping as required by manufacturer to provide a code compliant installation.
  - 7. Install PEX piping free of kinks.

8. All penetrations through exterior walls shall be sealed watertight.
9. The piping system will be installed with the fewest number of underground joints as possible.
10. The piping system does not require expansion loops, expansion joints or compensators of any type.
11. An EPDM rubber end cap shall be applied at all terminations of the piping system, including all fitting locations, to form a watertight seal.
12. Insulation Kits shall be installed on all buried fittings to insulate and seal the piping system.
13. PEX piping penetrations through slabs shall be protected by PEX stand-up brackets or PVC bend supports to prevent damage to piping.
14. Insulation shall not be exposed to groundwater

D. Backfill:

1. The piping system will be backfilled with clean sand material.
  - a. Minimum vertical distance from the bottom of the tubing to the trench floor is 4 inches (100 mm).
  - b. Minimum lateral distance from the side of the tubing to the trench wall is 6 inches (150 mm).
  - c. Install a minimum of 12 inches (300 mm) of clean fill over the top of the piping.
2. The balance of the trench can be backfilled with native soil void of stone greater than 2 inches (50m) in diameter.

3.3 Application piping schedule:

- A. Belowground/under-slab; mechanical piping 4 inch and smaller used for hydronic heating, cooling and condenser water applications.
  1. Single service, jacketed pre-insulated PEX-a pipe 1/2 inch through 3 inches
  2. Engineered polymer ASTM F1960 cold expansion fittings.
  3. 4 inch pipe shall use WIPEX compression fittings for PEX-a service tubing
- B. Belowground/under-slab; mechanical piping 1 inch through 2-1/2 inches used for hydronic heating, cooling and condenser water applications.
- C. Twin service, Jacketed, pre-insulated PEX-a pipe 1 inch through 2-1/2 inches.
  1. Engineered polymer ASTM F1960 cold expansion fittings.
- D. Pipe joint construction:
  1. PEX-a connections:
    - a. Install per manufacturer's recommendations.
    - b. Use manufacturer-recommended cold-expansion tool for ASTM F1960 connections.

3.4 ANCHORS

- A. Use of anchors is determined by engineer, if required in system.



### 3.5 FIELD QUALITY

- A. Pressure testing PEX pipe and fittings: Pressure test PEX-a piping systems in accordance with local code and manufacturer's requirements.

### 3.6 CLEANING

- A. Remove temporary coverings and protection of adjacent work areas.
- B. Repair or replace damaged installed products.
- C. Clean the installed products in accordance with manufacturer's instructions prior to owner's acceptance.
- D. Remove construction debris from project site and legally dispose of debris.
- E. Flush the system with fresh potable water to remove any potential debris from installation.
- F. If disinfection is required, follow the manufacturer's guidelines for the specific application.

### 3.7 PROTECTION

- A. Protect installed work from damage caused by subsequent construction activity on the site.

END OF SECTION