

**SECTION 23 21 14
GROUND-LOOP HEAT PUMP PIPING**

SPEC WRITER NOTES:

1. Use this section only for NCA projects.
2. Delete between // // if not applicable to project. Also delete any other item or paragraph not applicable in the section and renumber the paragraphs.
3. References to pressure in this section are gage pressure unless otherwise noted.
4. The spec writer shall review the Physical Security Design Manual for VA Facilities to determine and include any Life Safety requirements called out.
5. This section covers ground-source closed loop heat pump systems. If ground-source heat pump is included in this project the Section 23 81 49, GROUND-SOURCE HEAT PUMP shall be obtained from the VA Masters for open system components.

PART 1 - GENERAL

1.1 DESCRIPTION

- A. Ground-source water piping to connect HVAC equipment: This Section includes piping for //horizontal// //vertical//, direct-buried, ground-loop, and heat pump systems.
- B. A complete listing of common acronyms and abbreviations are included in Section 23 05 11, COMMON WORK RESULTS FOR HVAC.

1.2 RELATED WORK

SPEC WRITER NOTE: Retain one of two paragraphs below.

- A. //Section 01 00 01, GENERAL REQUIREMENTS (Major NCA Projects).//
- B. //Section 01 00 02, GENERAL REQUIREMENTS (Minor NCA Projects).//
- C. Section 01 33 23, SHOP DRAWINGS, PRODUCT DATA, AND SAMPLES.
- D. Section 01 42 19, REFERENCE STANDARDS.
- E. Section 01 81 13, SUSTAINABLE DESIGN REQUIREMENTS.
- F. //Section 01 91 00, GENERAL COMMISSIONING REQUIREMENTS//
- G. Section 23 05 11, COMMON WORK RESULTS FOR HVAC: General mechanical requirements and items which are common to more than one section of Division 23.
- H. Section 23 07 11, HVAC INSULATION: Piping insulation.

- I. //Section 23 08 00, COMMISSIONING OF HVAC SYSTEMS.//
- J. //Section 23 09 23, DIRECT-DIGITAL CONTROL SYSTEM FOR HVAC: Temperature and pressure sensors and valve operators.//
- K. Section 23 21 13, HYDRONIC PIPING: Water-source or ground-source heat pump.
- L. Section 23 21 23, HYDRONIC PUMPS: Pumps.
- M. Section 23 23 00, REFRIGERANT PIPING: Refrigerant piping and refrigerants.
- N. Section 23 25 00, HVAC WATER TREATMENT: Water treatment for open and closed systems.
- O. Section 23 81 46, WATER-SOURCE UNITARY HEAT PUMPS.
- P. Section 31 20 00, EARTH MOVING.

1.3 APPLICABLE PUBLICATIONS

SPEC WRITER NOTE: Make material requirements agree with requirements specified in the referenced Applicable Publications. Verify and update the publication list to that which applies to the project, unless the reference applies to all mechanical systems. Publications that apply to all mechanical systems may not be specifically referenced in the body of the specification, but, shall form a part of this specification.

- A. The publications listed below form a part of this specification to the extent referenced. The publications are referenced in the text by the basic designation only.
- B. American Society for Testing and Materials (ASTM):
 - D2239-2012a.....Standard Specification for Polyethylene (PE) Plastic Pipe (SIDR-PR) Based on Controlled Inside Diameter
 - D2657-2007 (R2015).....Standard Practice for Heat Fusion Joining of Polyolefin Pipe and Fittings
 - D2683-2014.....Standard Specification for Socket-Type Polyethylene Fittings for Outside Diameter-Controlled Polyethylene Pipe and Tubing
 - D2774-2012.....Standard Practice for Underground Installation of Thermoplastic Pressure Piping
 - D3261-2015.....Standard Specification for Butt Heat Fusion Polyethylene (PE) Plastic Fittings for Polyethylene (PE) Pipe and Tubing

F645-2015a.....Standard Guide for Selection, Design, and
 Installation of Thermoplastic Water-Pressure
 Piping Systems

1.4 SUBMITTALS

- A. Submittals, including number of required copies, shall be submitted in accordance with Section 01 33 23, SHOP DRAWINGS, PRODUCT DATA, AND SAMPLES.
- B. Information and material submitted under this section shall be marked "SUBMITTED UNDER SECTION 23 21 14, GROUND-LOOP HEAT PUMP PIPING", with applicable paragraph identification.
- C. Manufacturer's Literature and Data including: Full item description and optional features and accessories. Include dimensions, weights, materials, applications, standard compliance, model numbers, size, and capacity.
 - 1. Pipe and tubing, with specification, class or type, and schedule.
 - 2. Pipe fittings, including miscellaneous adapters and special fittings.
 - 3. Propylene glycol solution.
- D. Complete operating and maintenance manuals including wiring diagrams, technical data sheets, information for ordering replacement parts, and troubleshooting guide:
 - 1. Include complete list indicating all components of the systems.
 - 2. Include complete diagrams of the internal wiring for each item of equipment.
 - 3. Diagrams shall have their terminals identified to facilitate installation, operation and maintenance.
- E. //Completed System Readiness Checklist provided by the Commissioning Agent and completed by the contractor, signed by a qualified technician and dated on the date of completion, in accordance with the requirements of Section 23 08 00, COMMISSIONING OF HVAC SYSTEMS.//
- F. //Submit training plans and instructor qualifications in accordance with the requirements of Section 23 08 00, COMMISSIONING OF HVAC SYSTEMS.//

1.5 QUALITY ASSURANCE

- A. Section 23 05 11, COMMON WORK RESULTS FOR HVAC, which includes welding qualifications.

1.6 AS-BUILT DOCUMENTATION

SPEC WRITER NOTE: Coordinate O&M Manual requirements with Section 01 00 01, GENERAL REQUIREMENTS (Major NCA Projects) or Section 01 00 02, GENERAL REQUIREMENTS (Minor NCA Projects). O&M manuals shall be submitted for content review as part of the close-out documents.

- A. Submit manufacturer's literature and data updated to include submittal review comments and any equipment substitutions.
- B. Submit operation and maintenance data updated to include submittal review comments, substitutions and construction revisions shall be //in electronic version on CD or DVD// inserted into a three ring binder. All aspects of system operation and maintenance procedures, including applicable piping isometrics, wiring diagrams of all circuits, a written description of system design, control logic, and sequence of operation shall be included in the operation and maintenance manual. The operations and maintenance manual shall include troubleshooting techniques and procedures for emergency situations. Notes on all special systems or devices shall be included. A List of recommended spare parts (manufacturer, model number, and quantity) shall be furnished. Information explaining any special knowledge or tools the owner will be required to employ shall be inserted into the As-Built documentation.
- C. The installing contractor shall maintain as-built drawings of each completed phase for verification; and, shall provide the complete set at the time of final systems certification testing. As-built drawings are to be provided, and a copy of them in Auto-CAD version //____// provided on CD or DVD. Should the installing contractor engage the testing company to provide as-built or any portion thereof, it shall not be deemed a conflict of interest or breach of the 'third party testing company' requirement.
- D. Certification documentation shall be provided to COR 10 working days prior to submitting the request for final inspection. The documentation shall include all test results, the names of individuals performing work for the testing agency on this project, detailed procedures followed for all tests, and certification that all results of tests were within limits specified.

PART 2 - PRODUCTS**2.1 PIPE AND TUBING**

- A. Provide in accordance with Section 23 05 11, COMMON WORK RESULTS FOR HVAC.

2.2 PIPE AND FITTINGS

- A. Polyethylene (PE) Pipe: ASTM D2239, SDR Numbers 5.3, 7, 9, or 11.5; with PE compound number required to achieve // // psi working pressure.
- B. Molded PE Fittings: ASTM D2683 or ASTM D3261, PE resin, socket- or butt-fusion type, made to match PE pipe dimensions and class.
- C. U-Bend Assembly: Factory fabricated with embossed depth stamp every 900 mm (36 inches) from U-bend.

2.3 BOREHOLE BACKFILL

- A. Surface Seal: Cement with thermal conductivity greater than 0.7 W/sq. m x K (1.2 Btu/h sq. ft. x degree F).
- B. Backfill below Surface Seal with natural or manufactured sand.

2.4 ANTIFREEZE SOLUTION

- A. Propylene Glycol: Minimum 99 percent propylene glycol with corrosion inhibitors and environmental stabilizer additives to be mixed with water to protect the piping circuit and connected equipment from physical damage from freezing or corrosion.
- B. Quantity: Sufficient solution for initial system startup and for preventive maintenance for one year from date of Substantial Completion.
- C. Dilution Water: Chloride content shall be less than 25 ppm, sulfate less than 25 ppm, and hardness less than 100 ppm.

PART 3 - EXECUTION**3.1 GENERAL**

- A. If an installation is unsatisfactory to the COR, the Contractor shall correct the installation at no additional cost or time to the Government.
- B. Excavating, trenching, warning tape, and backfilling are specified in Section 31 20 00, EARTH MOVING.

3.2 HORIZONTAL PIPING INSTALLATION

- A. Separate trenches by 3 m (10 feet) minimum, unless otherwise indicated. Remove rocks in trenches that could contact pipe.
- B. Backfill to 600 mm (24 inches) above pipe with mud developed from excavated rock-free soil or with sand, pea gravel, or fly ash. Backfill

from slurry level to grade with excavated soil, compacting as specified for pipe burial in Section 31 20 00, EARTH MOVING.

- C. Install PE piping in trenches according to ASTM D2774 or ASTM F645.
 - 1. Clean PE pipe and fittings and make heat-fusion joints according to ASTM D2657. Minimize number of joints.
- D. Purge, flush, and pressure test piping before backfilling trenches.
- E. Install continuous detectable warning tape for underground piping. Locate tape a minimum of 600 mm (24 inches) below finished grade, directly over piping. Underground warning tapes are specified in Section 31 20 00, EARTH MOVING.

3.3 VERTICAL PIPING INSTALLATION

- A. Install PE piping in boreholes according to ASTM D2774 or ASTM F645.
 - 1. Clean PE pipe and fittings and make heat-fusion joints according to ASTM D2657. Minimize number of joints.
- B. Purge, flush, and pressure test piping before backfilling boreholes.
- C. After installation of loop pipe in borehole, fill piping loop with water or antifreeze solution, and pump backfill into borehole to discharge at base of borehole.
- D. Fill borehole with backfill to a point at least 1500 mm (60 inches) below grade and backfill remainder with surface seal material.
- E. Extend piping, and connect to water-source, ground-loop, and heat pump piping systems at outside face of building wall in locations and pipe sizes indicated.
 - 1. Terminate water-service piping at building wall until building water-source, ground-loop, and heat pump piping systems are installed. Terminate piping with caps. Make connections to building water-source, ground-loop, and heat pump piping systems when those systems are installed.
- F. Wall sleeves are specified in Section 23 05 11, COMMON WORK RESULTS FOR HVAC.

3.4 ANTIFREEZE SOLUTION FILL

- A. Fill system with required quantity of propylene glycol and water to provide minus 23 degrees C (minus 10 degrees F) freezing temperature.
- B. Test the dilute solution using gas chromatography to verify concentration of propylene glycol, and forward report to COR.

3.5 CONNECTIONS

- A. Drawings indicate general arrangement of piping, fittings, and specialties.

3.6 FIELD QUALITY CONTROL

- A. Piping Tests: Fill piping 24 hours before testing and apply test pressure to stabilize piping. Use potable water only.
- B. Hydrostatic Tests: Test at not less than 1-1/2 times the pipe working pressure rating allowing for static pressure of borehole depth.
 - 1. Increase pressure in 345 kPa (50 psi) increments and inspect each joint between increments. Hold at test pressure for 30 minutes. Slowly increase to next test pressure increment and hold for 30 minutes. After testing at maximum test pressure, reduce pressure to 207 kPa (30 psi), hold for 90 minutes, and measure pressure at 30-minute intervals. Repair leaks and retest until no leaks exist.
- C. Prepare reports of testing activity and submit to COR.

3.7 STARTUP AND TESTING

- A. Make tests as recommended by product manufacturer and listed standards and under actual or simulated operating conditions and prove full compliance with design and specified requirements. Tests of the various items of equipment shall be performed simultaneously with the system of which each item is an integral part.
- B. When any defects are detected, correct defects and repeat test at no additional cost or time to the Government.
- C. //The Commissioning Agent will observe startup and contractor testing of selected equipment. Coordinate the startup and contractor testing schedules with the COR and Commissioning Agent. Provide a minimum notice of 10 working days prior to startup and testing.//

3.8 //COMMISSIONING

- A. Provide commissioning documentation in accordance with the requirements of Section 23 08 00, COMMISSIONING OF HVAC SYSTEMS.
- B. Components provided under this section of the specification will be tested as part of a larger system.//

3.9 DEMONSTRATION AND TRAINING

- A. Provide services of manufacturer's technical representative for //four// // // hour//s// to instruct each VA personnel responsible in the operation and maintenance of units.
- B. //Submit training plans and instructor qualifications in accordance with the requirements of Section 23 08 00, COMMISSIONING OF HVAC SYSTEMS.//

- - - E N D - - -