STATEMENT Q

Plastics Pipe Institute
Position Statement on Polyethylene Materials
For Closed-Loop Ground-Coupled
Refrigeration and Heating Applications

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Closed-Loop Ground-Coupled (also referred to as “Geothermal”) refrigeration and heating applications use polyethylene pipe and fittings that are buried in the ground or submerged in water. This network of pipe and fittings, a ground-coupled heat exchanger, is connected to a mechanical fluid-source refrigeration unit. The ground-coupled heat exchanger is the thermal source during heating cycles and the thermal sink during cooling cycles.

A basic system includes:

1. Mechanical Components – Water-Source Refrigeration Unit, Pumps and Valves

2. Ground-Coupled Heat Exchanger Piping System – Polyethylene Pipe and Fittings
    a. Buried in a Horizontal Plane
    b. Buried in a Vertical Configuration
    c. Submerged in a Surface Body of Water

3. Heat Transfer Fluid – Water, Water/Antifreeze Solution, or Brine solution

1. MECHANICAL COMPONENTS:

Mechanical components and installation practices should be designed for closed-loop ground-coupled refrigeration and heating applications. For details regarding equipment, components and installation, contact the American Society of Heating, Refrigeration and Air-Conditioning Engineers, Inc. (ASHRAE), 1791 Tullie Circle, N.E., Atlanta, GA 30329, (404) 636-8400.

2. GROUND-COUPLED HEAT EXCHANGER PIPING SYSTEM:

The ground-coupled heat exchanger piping system should be designed to handle the capacity of the building or the mechanical unit load for the specific geographical location. The PPI PE Handbook contains information on PE pipe used in HVAC applications. For additional information regarding design, contact either ASHRAE or IGSHPA (International Ground Source Heat Pump Association, 347 Cordell South, Oklahoma State University, Stillwater, OK 74078, (405) 744-5175).

The piping material is critical to the overall success of the closed-loop ground-coupled system. This system experiences changes in pressure up to 60 psig due to thermal expansion and contraction of the heat transfer fluid over a temperature range of 25ºF to 115ºF. This cycle of change, in both pressure and temperature, occurs to some degree every time the system is operated. The typical average static pressure at ground level is 40 psig; however, substantially greater pressures can occur at the bottom of vertical piping loops and when connected to a high rise building.

A. Horizontal Piping Systems:

The piping system is typically buried at depths of 4 to 6 feet.

B. Vertical Piping Systems:

Polyethylene pipes are paired, connected together with return-bend (U-bend) assemblies, lowered into non-cased wells, and then backfilled. Typical wells range from 50 to 500 feet deep, and may in some cases extend into or through water aquifers that are sources for residential or municipal potable water systems.

C. Surface Water Piping Systems:

The piping system is submerged in a water reservoir (lake, pond or tank) that is capable of handling the thermal rejection or extraction load of the application. The piping system must be weighted to hold it on or near the bottom of the reservoir. This body of water may, in some cases, be the water source for a potable water system.

Industry standards require all below grade connections to be heat fusion or approved mechanical fittings. The operator should be knowledgeable of and

proficient in the joining procedures recommended by the pipe and fittings manufacturer.

The Technical Committee of the Plastics Pipe Institute recommends that all polyethylene piping components used for a ground-coupled heat exchanger should be manufactured from a material:

1. That has a 1600-psi Hydrostatic Design Basis at 73º F per ASTM D-2837.

2. Is listed by the Plastics Pipe Institute Hydrostatic Stress Board in PPI TR-4, “PPI Listing of Hydrostatic Design Basis (HDB), Strength Design Basis (SDB), Pressure Design Basis (PDB) and Minimum Required Strength (MRS) Ratings for Thermoplastic Piping Materials or Pipe” with a minimum Hydrostatic Design Stress for water of 800 psi at 73° F.

3. Is a high-density polyethylene extrusion compound per ASTM D-3350 with a minimum cell classification of 345464 and an ultraviolet stabilizer code of C or E.

4. That meets the requirements of NSF 14 or NSF 61 if the water reservoir into which the piping system is submerged is a water source for a potable water system.

3. HEAT TRANSFER FLUID:

The type of fluid can vary depending on system design, local regulations, cost, availability and contractor preference. For a detailed list of recommended fluids contact IGSHPA or ASHRAE. Some fluids may have characteristics that can be harmful to both the environment and humans if not properly handled and contained. Contact the heat transfer fluid manufacturer for a materials safety data sheet and for specific information about environmental safety and hazards.