GEOTHERMAL COMFORT

Indoor Comfort for Families

According to the U.S. Environmental Protection Agency (EPA) geothermal systems are, "the most energy-efficient, environmentally clean, and cost-effective space conditioning systems available today." Extremely high levels of efficiency are possible because a geothermal heat pump only uses electricity to move heat, not produce it. A geothermal unit typically supplies 4 kilowatts of heat for every kilowatt of electricity used. Three of these kilowatts of heat come directly from the earth itself, and are clean, free and renewable. Geothermal heat pumps also take advantage of the mild ground temperature for extremely high efficiency cooling. Most systems also include a hot water generator, which diverts a portion of the supplied heat to the domestic water heater. This provides a substantial portion of a family's hot water needs at a very low cost. Overall, geothermal technology offers the highest cooling and heating efficiencies of any system available today.

Geothermal systems transfer heat from your home to the earth in the cooling mode, or from the earth to your home in the heating mode. Water is used as the heat transfer medium through a closed-loop piping system buried in the ground. By using this stable thermal source, geothermal heat pumps provide energy efficient comfort year round with a factory-tested and sealed packaged unit, without the need for a noisy outdoor fan, or a flue.

Tranquility 27® Vertical Geothermal Heat Pump with EarthPure® Zero Ozone Depletion Refrigerant

The environmental advantages of geothermal systems have caught the eye of governmental agencies such as the Environmental Protection Agency (EPA) and the Department of Energy (DOE). Because geothermal technology is lowest in CO2 emissions, it provides a solution to global warming by primarily using the natural energy of the earth. EarthPure® (HFC-410A) zero ozone depletion refrigerant is available for ClimateMaster Geothermal Heat Pumps for an even friendlier system.

There are two types of geothermal systems commonly installed in North America, closed-loop geothermal, and open-loop (well water systems) geothermal. Both types of systems work well and achieve very similar operating costs. An open-loop system is less expensive to install, but over time could require more maintenance. A closed-loop system is more expensive up front, but requires almost no maintenance.

Closed-loop systems use a network of buried high-density polyethylene (plastic) pipe, circulating a water/antifreeze solution from the ground to the heat pump. These systems are sealed and pressured, and thus recirculate the fluid, eliminating any water usage. Polyethylene pipe is always utilized to ensure long life and system reliability. Milk jugs are made from polyethylene. Polyethylene is a very tough plastic, especially when considering the wall thickness of a milk jug (pipe wall thickness is many times greater), but it is also extremely flexible, which allows the pipe to avoid damage even as the ground shifts. All connections are heat fused, which is a welding process, whereby the pipe and fitting are heated up to the melting point, around 500°F [260°C]. The two pieces are joined together while the plastic is still in its molten state. Once cooled, the joint is stronger than the pipe itself. Therefore, leak potential of the in-ground piping is nearly nonexistent. Properly installed, loop piping will last more than 50 years.

Closed-loop systems may be installed in a variety of configurations, depending upon the size of the yard and local excavation costs. A horizontal loop is typically installed with a trencher or backhoe. Trenches are normally four to six feet deep [1.2 - 1.8 meters]. One of the advantages of a horizontal loop system is being able to lay the trenches according to the shape of the land. As a rule of thumb, 125 - 300 feet of trench is required per ton of heat pump capacity [11 - 27 meters per kW of capacity], depending on geographic location. Anywhere from 1 to 6 pipes per trench may be used, depending upon the optimal design for the yard. More pipe per trench shortens the total amount of trench required.

For smaller yards, the loops can be installed vertically using a drill rig, much like a water well installation. Holes are bored to about 150 - 300 feet per ton of heat pump capacity [13 - 27 meters per kW of capacity]. U-shaped loops of pipe are inserted in the holes. The holes are then backfilled with a sealing solution (grouting material). Vertical and horizontal loops perform very similarly, and therefore are selected based upon the individual preference and yard layout.

Pond or lake loops are another type of closed-loop system, which is very cost effective, since excavation is limited to the trenching between the home and the pond/lake. Pond loops are still closed-loop systems. Polyethylene pipe is sunk at the bottom of the pond, and fluid is circulated through the pipe to exchange heat between the geothermal heat pump and the body of water. Using pond water directly is never recommended. A minimum of 8 - 10 feet [2.5 - 3 meters] in depth at its lowest level during the year is needed for a pond to be considered. Generally, a minimum of 1/2 acre [0.2 hectare] pond is required to provide adequate surface area for heat transfer.

The antifreeze solution in closed-loop system will keep it from freezing down to about 15°F [-9°C]. In the U.S. and Canada, three types of antifreeze solution are acceptable: propylene glycol, methyl alcohol, and ethyl alcohol. Some states/provinces may require one type over another. The term "Open-loop" is commonly used to describe a geothermal

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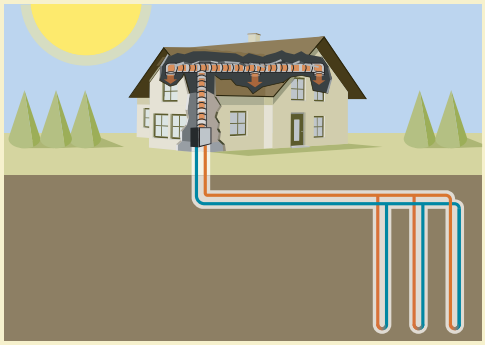
heat pump system that uses groundwater from a conventional well as a heat source in winter and a heat sink in summer. The groundwater is pumped through the heat pump where heat is extracted (in winter) or rejected (in summer), then the water is disposed of in an appropriate manner. Since groundwater is at a relatively constant temperature year-round, it is an excellent heat source/heat sink.

There are a number of ways to dispose of water after it has passed through the heat pump in an open-loop application. The open discharge method is the easiest and least expensive. Open discharge simply involves releasing the water into a stream, river, lake, pond, ditch, or drainage tile. Obviously, one of these alternatives must be readily available and must possess the capacity to accept the amount of water used by the heat pump before open discharge is feasible. A second means of water discharge is the return well. A return well is a second well bore that returns the water to the ground aquifer. A return well must have enough capacity to dispose of the water passed through the heat pump. A new return well should be installed by a qualified well driller. Likewise, a professional should test the capacity of an existing well before it is used as a return.

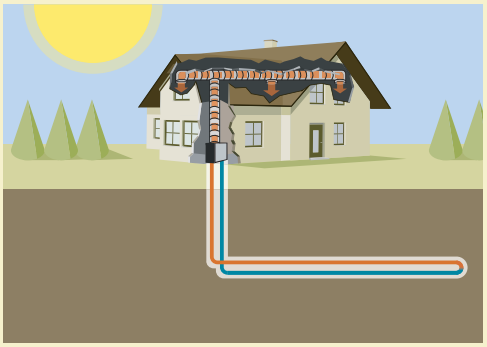
No matter which type of geothermal system is installed, homeowners benefit from the most comfortable system available, while saving money on operating costs and helping the environment. Today's geothermal systems are unmatched in comfort. State-of-the-art two-stage compressors, variable speed fans and microprocessor controls adjust the heating and cooling capacity based upon the current weather conditions. No matter what the temperature is outside, geothermal systems are always taking advantage of the mild ground temperature year round.

Vertical (Drilled) Closed Loop



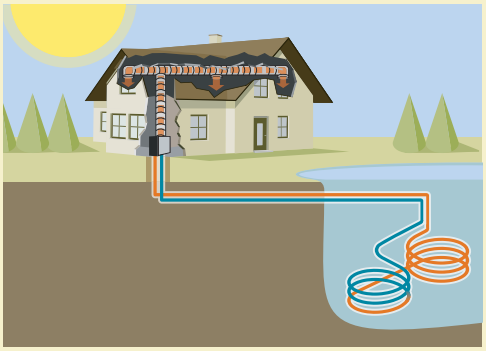
Vertical Loops are used extensively where land area is limited or soil conditions prohibit digging horizontal loops. A pair of pipes with a special U-Bend assembly at the bottom are inserted into a bore hole that averages between 150 to 300 feet deep per ton [13 to 27 meters per kW] of equipment. These holes are then backfilled with a special grout solution to ensure good contact with the earth.

Horizontal (Trenched or Bored) Loop



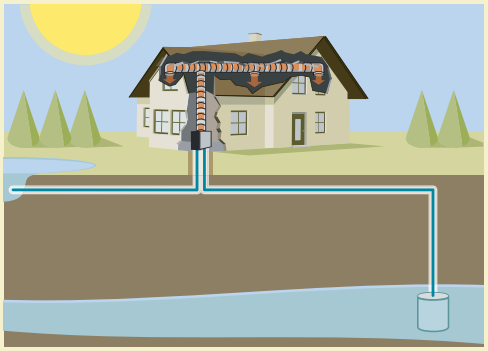
Horizontal Loops are installed in areas where the soil conditions allow for economical excavation. Taking up more land area than any other loop type, they are used where space permits. Trenches are normally about 4 to 6 feet [1.2 to 1.8 meters] deep with multiple pipes placed in the trench at different depths. Normally, several hundred feet [over 100 meters] of trench is required, but where space permits these loops are considered desirable.

Pond/Lake Loop



Pond Loops are usually very economical to install. If a pond or lake at least eight feet [2.5 meters] deep is available, pond loops can utilize the water (rather than soil) to transfer heat to and from the pond. A coiled pipe is placed in the water, which should cover about 1/2 acre [0.2 hectare]. An average home would require about 900 feet [27 meters] of pipe. Reduced installation costs and high performance are characteristic of this type of loop.

Open Loop



Open-loop installations actually pump water from an underground aquifer through the geothermal unit and then discharge that water to a drainage ditch or pond. The geothermal unit processes the heat energy from the water just like a closed-loop installation. Discharging water to a "return" well is sometimes effective, but sending water to a pond or lake is considered more reliable.