



# SYSTEM SELECTION & INSTALLATION REQUIREMENTS



NATURAL RENEWABLE ENERGY.

# Selecting and sizing a Geothermal Heat Pump system for home or office

Determine the method of connection to the earth

1. Water Well
2. Waterbased Ground Loops
3. Waterless Direct Expansion

Determine the method of heat distribution to the home.

1. Air Duct System
2. Infloor Heating
3. BOTH

## Water Wells

Pumping water from a drilled water well is a common method of coupling the Geothermal Heat Pump (GHP) to the earth for extraction of thermal energy. If a well already exists, this is the least expensive method of providing a source of energy for the heat pump. The well should have the following characteristics:

1. DRILLED well of 5" diameter or larger so that a submersible pump can be accommodated.
2. Well casing properly sealed or grouted into rock.
3. Water flow preferably entering at a depth of 75 ft. or more to insure reliability during dry weather.
4. Temperature of water at least 40°F.
5. Well must be able to supply requirements of BOTH the heat pump and residence usage at the same time with maximum drawdown from static level of 30 ft.

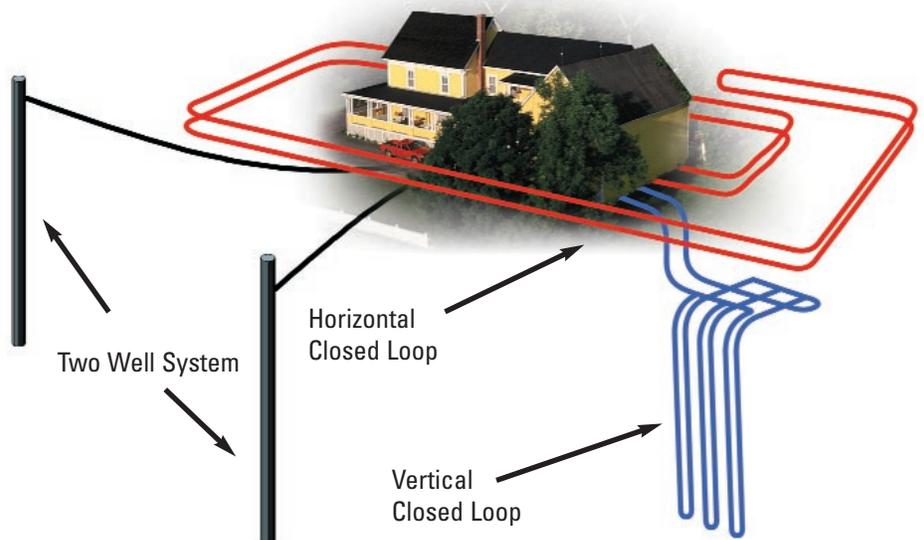
Water flow requirements for Nordic series "O" "R" "W" and "TF" are shown in the table below.

Water flows are based on an entering water temp. of 45°F.

## Water Pump System

1. A submersible pump is generally required to produce the volume of water required and for longevity.
2. If the pump is also supplying the household requirements it must be able to pump the required water flow listed above at a minimum of 30 psig. at the dynamic pumping depth of the well.
3. Always select a pump by referencing the pump manufacturers chart.
4. Use a minimum of a 30 gal. equivalent air bladder tank to prevent short cycling of the well pump.

## The Earth Connection



## Open Loop Water Flow & Sizing Chart

Model	HP lgpm	Home lgpm	Total lgpm	CFM Available	Floor Grills	Will heat Sq. Ft.	Output Btu
Nordic 45	8	3	11	1600	16	1800	43,000
Nordic 55	10	3	13	1800	20	2700	51,000
Nordic 65	12	3	15	2000	24	3500	58,000

Table (1) . Assumes groundwater temperature of 45°F . Higher EWT or flows will yield greater performance.

# Water Based Ground Loops

## Horizontal

A plastic pipe horizontal ground loop is a collector system which is buried in the ground at a depth of approximately 6 ft. A successful configuration will have the following characteristics:

1. Pipe is type 3408 (SDR 11 160 psig.) high density polyethylene.
2. 500 ft. of pipe is required for each ton of capacity in a horizontal configuration.
3. A typical configuration consist of a two pipe per trench system wherein a 250 ft. x 4 ft. wide trench is dug and a 500 ft. roll of 3/4" plastic pipe is rolled out as a "U" tube with 4 ft. of horizontal pipe separation.
4. Multiple parallel loop systems must employ a reverse return (first pipe out is last one back) header technique to insure even flow through all loops.
5. Horizontal loop systems may also be constructed as a single continuous length of 1 1/2" plastic pipe of the length shown in Table 2.
6. Installers have generally gravitated to the multiple loop parallel system since the 3/4" pipe is easier to handle, less expensive and produces a lower pressure drop in the system allowing for the use of a smaller circulator pump.
7. A geothermal loop system does not allow the use of mechanical joints of any kind outside the building. All underground joints are made by fusing the plastic pipe with socket or butt fusion techniques.

## Vertical

A vertical ground loop system is similar to the horizontal loop except that the tubing loops are installed vertically in 4-6" boreholes.

Special "U" bends are available to allow the insertion of (2) plastic pipes down each borehole. See chart below for depth and spacing information. Vertical loops are an effective solution in locations where available land is at a premium.

## Additional Loop Equipment Required

In addition to the plastic pipe itself, the geothermal loop system also requires one or two (depending on the system size) small circulator pumps to move the loop fluid from the ground to the heat pump. The loop fluid consists of water and a freeze depressant such as methanol to allow the fluid temperature to drop below 32°F during winter operation. Your local loop installer or government environmental branch can advise you of an acceptable antifreeze suitable for GHP use.

## Waterless -Direct Expansion Systems

DX systems are a third style of heat pump system which extract heat from the ground via buried copper tubing containing refrigerant. The DX loop system can normally be installed in a horizontal area about 40% smaller than a conventional plastic ground loop. Normal loop length is only 350 ft. per ton. Vertical systems can be installed in a 3" vertical bore and require 100 ft. of copper "U" tube per ton. The DX system does not require loop pumps or loop fluid since the refrigerant absorbs heat directly from the ground. DX systems are very efficient and often are the system of choice where land area is at a minimum. As with the open and closed loop systems DX systems are available with water or air output.

## Plastic Pipe Ground Loop Minimum Requirements

Model	Horiz. Loop Req'd. Linear (Ft.)	Horiz. 250 ft. Trenches Req'd.	Horiz. Loop Min. Area (10 Ft. spacing) Sq. Ft.	Minimum separation between loops (Ft.)	Vert. Loop Req'd. (Ft.) ("U" tube)	Vertical Borehole Req'd. (Ft.)	Minimum separation between boreholes (Ft.)
Nordic 45	1500	3	10,500	10	900	450	15
Nordic 55	2000	4	14,000	10	1200	600	15
Nordic 65	2500	5	17,500	10	1500	750	15

Table (2) Assumes ground temperature of 45°F. Warmer earth temperature may allow shorter loop lengths.

## Desuperheater coils

Most heat pump manufacturers offer an additional heat exchanger either as part of the GHP or as an option. The desuperheater coil and pump are plumbed to your hot water tank and operate to provide domestic hot water whenever the heat pump operates. "O" series units provide hot water only in the heating mode.

## Sizing a GHP

Conducting a heating / cooling load analysis of your home is the only way to properly insure that the correct size (output capacity) of heat pump is installed in your home. A quick rule of thumb however is to refer to the chart on page (2) for general sizing. The 45, 55 and 65 designations of NORDIC® equipment indicate the nominal BTU output of the machines:

- *Nordic 45 = 3 ton / 43,000 Btu.  
heats / cools up to 1800 ft².*
- *Nordic 55 = 4 ton / 54,000 Btu.  
heats / cools up to 2700 ft².*
- *Nordic 65 = 5 ton / 65,000 Btu.  
heats / cools up to 3500 ft².*

The square footage chart in Table 1 refers to area above the basement with sufficient heat remaining to heat an insulated basement as well.

## Performance Comparisons

The performance or COP of all the GHP systems as determined in the US by ARI 325 & 330 standards or in CANADA the CSA 446 M-94 will normally be in the range of 3 to 3.3 and is largely dependent on the Entering Source Water Temperature (ESWT) and the Entering "Sink" Water to the Heat Pump.

Dealer

## Other Factors to Consider

Although the COP of a heat pump is a factor in selecting the GHP other factors such as proven durability, quietness, long life compressor, freeze resistant water coil, and easy accessibility to replacement components are equally important in selecting the manufacturer of your Geothermal Heat Pump.

## Pricing a Geothermal Heat Pump

Estimating the price a GHP system can be made relatively simple by breaking the entire system into it's component parts. Make sure your dealer has sized the heat pump for 100% heating capability using a commercial software program or other acceptable technique. Check with your dealer to make sure you understand exactly what he is quoting on.

## An Open Loop well

**Water based system has the following subsystems:**

1. *Water well (can use the same one for drinking water).*
2. *Submersible well pump system.*
3. *Heat Pump.*
4. *Heat Pump Installation.*
5. *Electrical Wiring.*
6. *Back-up electric plenum heater.*
7. *Duct system (or) infloor heating system.*
8. *Return well or disposal field.*

## Closed loop system water based

Items (3) through (7) above are similar for both open and closed loops. In place of the well(s) and pump you will need the following:

1. *Horizontal or vertical ground loop system.*
2. *Loop pump circulator kit.*
3. *Antifreeze solution.*



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