July 31, 2013

System Summary

Geothermal System

Energy 1 has completed the design and installation of an eleven ton (11) ton (132,000 BTU/hr) closed-loop geothermal heating and cooling system. The system consists of 6 boreholes, each 321 feet deep, and includes three heat pumps: (2) water-to-water heat pumps to serve as the primary heating source via in-floor radiant heat and (1) water-to-air heat pump to serve as the primary cooling source and a secondary heat source. The bore field is located north-east of the house (reference as-built site plan for specific locations). The radiant and forced air systems are supplemented by two propane-fired boilers during peak heating demands.

This manual provides specific system specifications, equipment cut-sheets, as-built documentation, warranty information and important federal tax incentive information. Should any questions arise regarding your new system, please don't hesitate to contact Energy 1 via office phone or email.

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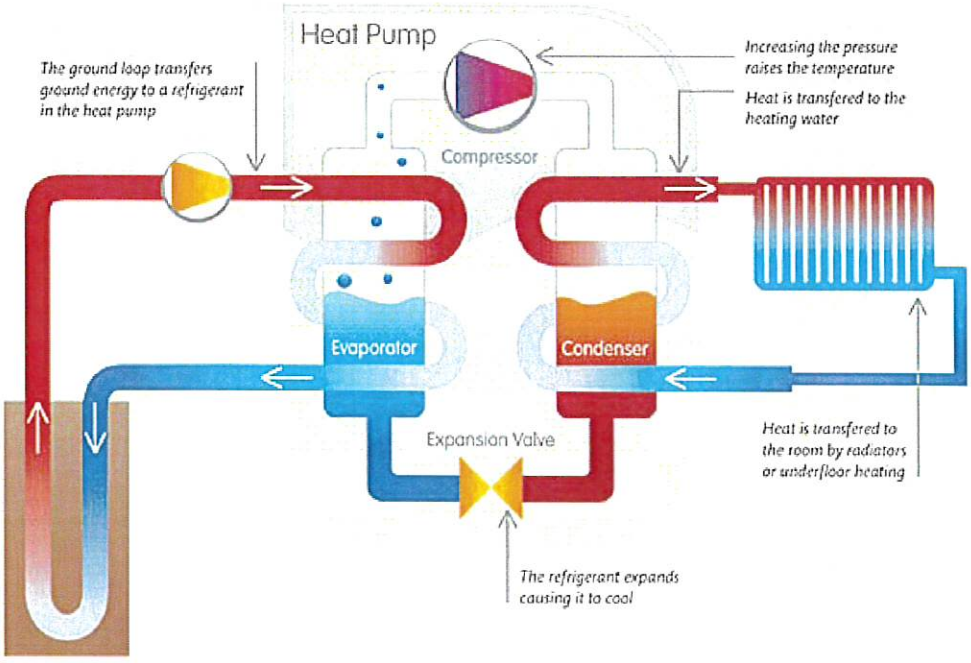
Geothermal Heating and Cooling – Technology Overview

Ground source heat pumps work in the same fundamental manner as all heat pumps (including refrigerators, air conditioners, freezers, etc.). They ***move heat*** from one area to another. The advantage that ground source heat pumps have over standard heat pumps and air conditioners is that they use the relatively ***stable and moderate temperature of the earth or groundwater*** to transfer heat to or from a building.

In northern climates such as ours ground source heat pumps ***move 3-4 times more energy than they consume*** in heating mode and ***5-6 times more energy than they consume*** in cooling mode. The energy they do consume is electricity to power pumps, compressors, and fans. As a comparison, combustion of natural gas in a furnace produces up to about 92% of the energy that it uses, and electric resistance heating produces the same amount of heat energy as it uses. Additionally, maintenance costs on geothermal systems are typically lower than those of a traditional heating or air conditioning system. This is because the outdoor heat exchanger does not experience wide temperature variations, airborne dust contamination, or accidental damage, which traditional evaporator coils are very prone to sustaining.

The diagram below depicts how a closed loop ground source heat pump operates while in heating mode. A cold heat transfer fluid is pumped through buried pipes allowing it to collect heat. It continues on to the heat pump where it is used to warm a refrigerant fluid. As the liquid warms it begins to boil and evaporate. The vapor is then compressed, which causes the temperature of the refrigerant to increase dramatically. This heated vapor then passes through another heat exchanger where it heats hot water for radiant heating or air for forced air distribution. This transfer of heat cools the vapor causing it to condense to a liquid form. Finally, the liquid passes through an expansion valve, which causes it to cool further so it can once again absorb heat from the earth. In cooling mode, the cycle is simply reversed.



Operation and Maintenance Guidelines

Maintenance Overview

The following guidelines are meant to serve as a general overview. For complete and detailed maintenance instructions on individual system components, please refer to the manufacturers' user information manuals.

Geothermal System

The anti-freeze used in the geothermal bore field piping should be checked annually. The propylene glycol concentration should be no less than 25%. Annual maintenance should be performed on the heat pump units to ensure all components are cleaned and working properly. Other system components that should be inspected annually include, but are not limited to: piping, manifolds, pumps, and sequence of operations.

Forced Air System

Annual maintenance should be performed on the heat pump unit to ensure all components are cleaned and functioning properly. The air filters on the water-to-air heat pump should be replaced a minimum of once per year. Ducting, controls, fans, and coils should also be inspected for proper function.

Backup Heating System

Periodically the boiler piping and venting should be visually inspected to ensure there are no leaks in the water piping or flue vent. During this visual inspection, check the hot water heaters and buffer tank for any leaks. Annual maintenance should be performed to ensure all components of the heating system are cleaned and working properly. Annual maintenance is also required under the warranty.

General System Specifications

Geothermal System

Bore Field
Number of Wells: 6
Well Depth: 321'
Approximate Pipe Distance Below Grade: 6'- 8'

Three (3) Ton Water to Water Heat Pump 1:
Manufacturer: ClimateMaster
Model: TMW036AGC00C0CS
S/N: Q15117977
Rated Heating Capacity: 25,400 Btu/hr
Heating COP: 3.6

Five (5) Ton Water to Water Heat Pump 2:
Manufacturer: ClimateMaster
Model: TMW060BGC00C0CS
S/N: Q15117989
Rated Heating Capacity: 44,400 Btu/hr
Heating COP: 3.6

Three (3) Ton Water to Air Heat Pump 1:
Manufacturer: ClimateMaster
Model: TEV038AGD05ALTS
S/N: R10410254
Rated Heating Capacity: 28,900 Btu/hr
Heating COP: 3.9

Buffer Tank:
Manufacturer: Boiler Buddy
Model: BBT-120
S/N: (21) 032212D1009597
Volume: 120 Gallons

Supplemental Heating, Domestic Hot Water, Make-up Air Systems, and Spa Heating

Boiler 1: Supplemental Heating and Domestic Hot Water
Manufacturer: Triangle Tube
Model: Prestige TriMax Solo 175
S/N: PT0016948

Rated Heating Capacity: 154,000 BTU/hr
Annual Fuel Utilization Efficiency: 95%

Boiler 2: Make-up Air Systems and Spa Heating
Manufacturer: Triangle Tube
Model: Prestige TriMax Solo 399
S/N: PT0011983
Rated Heating Capacity: 379,000 BTU/hr
Annual Fuel Utilization Efficiency: 95%

Domestic Hot Water Tank 1
Manufacturer: HTP
Model: SSC-119
S/N: (21) 120312D1061795
Volume: 119 Gallons

Domestic Hot Water Tank 2
Manufacturer: HTP
Model: SSC-119
S/N: (21) 120312D1061810
Volume: 119 Gallons