



**Closed-Pipe, Closed Loop Ground-Coupled Heat Pump Applications  
Technical Bulletin 2007-11**

<b>GENERAL</b>	<b>NOTES</b>
<p>Retrofit of an existing heating, cooling, and domestic hot water system can run the gamut from a minor to a major impact on the home or building.</p> <p>This technical bulletin will identify some of the major components of the home and space conditioning system and what actions the installer may require to make a successful and efficient heating, ventilation, and air conditioning (HVAC) geothermal heat pump installation.</p> <p><b>CAUTION</b> Flaws in the existing retrofit building have been there a long time, and often the owner has learned to live with them. Poor insulation, pierced vapor barriers, under/uninsulated ducts in cold spaces, uninsulated pipes, unvented attics, and the like must be part of your inventory. Many times you can and should rectify these flaws. But in all cases, bring the flaw to the owner's attention. Building flaws that remain after the retrofit can become identified with you. As a minimum, identify – where possible, rectify.</p> <p><b>REQUIREMENTS</b></p> <p>First things first; a full analysis of the heating and cooling requirements must be completed. This analysis is most often performed by the “Manual J” method. This manual, published by the Air Conditioning Contractors of America (ACCA), specifies the industry standards to determine the size of the heating and cooling system for the home. Many state building codes now require a Manual-J requirements analysis.</p> <p>Our tech bulletin #1 and “Home inventory” form (#148) should be completed before an accurate analysis can be completed.</p> <p>If an accurate and recent copy of this Manual J analysis is completed and available in writing, the analysis need not be recomputed, but must be attached for our review.</p> <p>There are two major ways a home loses (winter) or gains (summer) heat.</p> <ol style="list-style-type: none"><li>1. Conductive – the migration of the heat through the walls, windows, and insulation.</li><li>2. Infiltration – the amount of fresh air brought into the home through leakage. The leakage can be around windows, wall plugs, doors, pipe entries, etc.</li></ol> <p>We would strongly urge a critical look at the home's insulation and infiltration before you decide on the size of a new energy efficient geothermal heat pump. We regard the re-insulation and resealing of a home to be the most cost effective method of energy conservation. As in any activity, over-insulation or over-sealing may not be cost effective.</p>	



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In general, increasing wall insulation to R=19 and ceilings to R=38 can be cost effective and be required by most state building codes. Decreasing the infiltration leakage down to a 0.40 Air Change per Hour (ACH) can also be cost effective and lasting. Many homes with an advertised lower infiltration ACH eventually result in leakages that re-approaches 0.50 after a two year period due to the house inevitably moving and warping.

Keep in mind an older fireplace or old oil/gas furnace without outdoor air ducts requires its combustion air from the leaks in the home, creating an increased heat loss or gain. The geothermal heat pump has no need for combustion air and that loss is not found in the "heat pump house."

Many electric utilities offer a critical analysis at a minimum or no cost of the infiltration or insulation of a home. Various computer and manual methods exist to evaluate the effectiveness of these energy-conserving procedures. Take advantage of them!

Keep in mind that the analysis a utility's consultant performs may be tied to the accurate evaluation of their conservation measures and are not designed for HVAC equipment selection – only trust Manual-J to select equipment sizing.

### COMPONENTS

Your HVAC "Retrofit Check List" provides us with an accurate reference for your geothermal assets and lets us evaluate the impact on your home of the change to an efficient geothermal heat pump.

Building Assets Evaluated are  
Supply Water (Geothermal Water)  
Domestic Water  
Electrical Service  
Air Ducts

All too often, many of these assets are buried beneath walls and ceilings. Your judgment becomes important.

### SUPPLY WATER (GEO/EARTH SIDE)

The typical residential well in New England has required a minimum of 3pgm and in more recent years, 5gpm. This usually results in a well pump that is ½ horsepower and pipes that are 1" polyethylene.

Try to get the name of the driller if there is an existing well on site.

Most states require the driller to file a "well log" with the state or local officials. The log will list depth, amount of water in the well (static level), and the capacity of the well.

The two key sources of information are the original drillers log and the nameplate information on the owner's well pump controller.



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### **DOMESTIC WATER**

What are the present domestic water requirements and how will a new geothermal heat pump impact that system?

If a homeowner is used to a 40-60psig shower water pressure, you can be you'll get a call if the water pressure drops below that level when a well water heat pump starts up. For a well water system, make sure there is a minimal change in the domestic water system's performance. Size the pumps and pipes accordingly.

A geothermal heat pump with copper-nickel heat exchanger will not have corrosion or scaling problems. However, high concentrations of hydrogen sulfide (rotten eggs) is the one chemical that can cause a corrosion problem, even for stainless steel. Contact us immediately if the water smells bad. Concentrations have to be very high to be a problem.

The domestic hot water tank will also have the benefit of the geothermal heat pump's desuperheater. Check the condition of the heater tank and the size of the existing pipes. Also, how far way is the domestic tank from the geothermal heat pump; typically a 50 foot maximum.

### **ELECTRICITY**

If the house has electric heat or an air-to-air heat pump in place, the electric service will probably be more than adequate. An old oil or other fossil burning system may not have a large enough service for the geothermal heat pump.

Check availability of service breakers for the heat pump and so note on the form.

Of particular importance is an adequate "electrical earth" for the heat pump. The National Electric Code (NEC) requires any electrically driven device with water to carry a fourth wire earth bond. This is very important – check it!

Some states now require the steel well casing to be the electrical earth bond for the building. We definitely support that requirement.

### **CONTROLS**

The old thermostat is the only visible part of the old system in the home and it is a "friend of the family," but is most likely not adequate for the new heat pump system. Check the size of the new thermostat to insure it covers wall paper/pain void or specify an attractive hardwood or metal bexel. Try to keep the controls on the same level of complexity – or insure the home owner is familiar with the new control functions.

Thermostat wire should be 18 AWG for longer run (Over 75 feet). In all cases, 18 AWG is desirable. Make note of the wire size and number of wires on the inventory form.



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We do not recommend timer/set back thermostats for a heat pump.

If the retrofit involves a fan coil unit, note the fan coils may require a line voltage control. If the line voltage wires cannot be pulled, request the manufacturer supply a 24-volt relay interface.

Fan coil controls with 3 speed fan switches can provide the owner with substantially more control than they had with their old system. Insure this feature is understood; however, these controls may be hard to understand or the larger wall switches may not fit aesthetically into the décor.

### SUPPLY DUCTS

If the supply ducts are sized for fossil temperatures of 180°F+, they will not be large enough for the geothermal's gentle 95-100°F temperatures for air conditioning's heavy, dense air.

A fossil burner at one end of the cellar with a long extended plenum could be replaced by a geothermal heat pump in the middle of that duct. In this manner, the geothermal heat pump can at least take advantage of the larger ducts in one direction and only ½ of the ducts would require augmentation.

Supply ducts properly sized for air conditioning will be adequate for the cooling load and may or may not be adequate for the heating load.

Duct sizing is often difficult to determine until the new heat pump is installed, as trunk line and branches may be buried in walls.

Measuring cfm and/or statics can provide some information. But old dirty blower fans, older motors, and unknown/lost blower performance data always leaves some doubts as to the fit of the new system. Be prepared to augment supply ducts and/or registers as required.

In the case of ductwork buried in the floor or wall and/or of doubtful duct quality, it is often wise to consider a water-to-water heat pump with fan coils. Unlike an air-ducted heat pump, the fan coils can tolerate greatly reduced airflows and temperature variations.

Undersized ducts, or otherwise reduced air flows, can greatly decrease the reliability and performance of any heat pump, air-to-air or water-to-air.

Supply ducts should be sized to 0.10" WC External Static Pressure and returns to 0.05" WC. Note the new international standards are in "pascal" 0.10" WC in 25 pascals.

### LAYOUT

On the back of the Retrofit Form, please make a sketch of the facility and point out important features that would or can affect the heat losses and gains. Also not



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potential sites for wells or closed loop fields.

### **IMPORTANT**

The name of a single individual with decision-making capability is most important for a retrofit. The form will be RETURNED to you if that person and their phone number are not included. At best, a retrofit involves many persons, disciplines, and motivations.

That single decision maker may be the general contractor, homeowner, architect, or others. All parties must be kept informed, but a single decision maker increases the probability of a good installation.