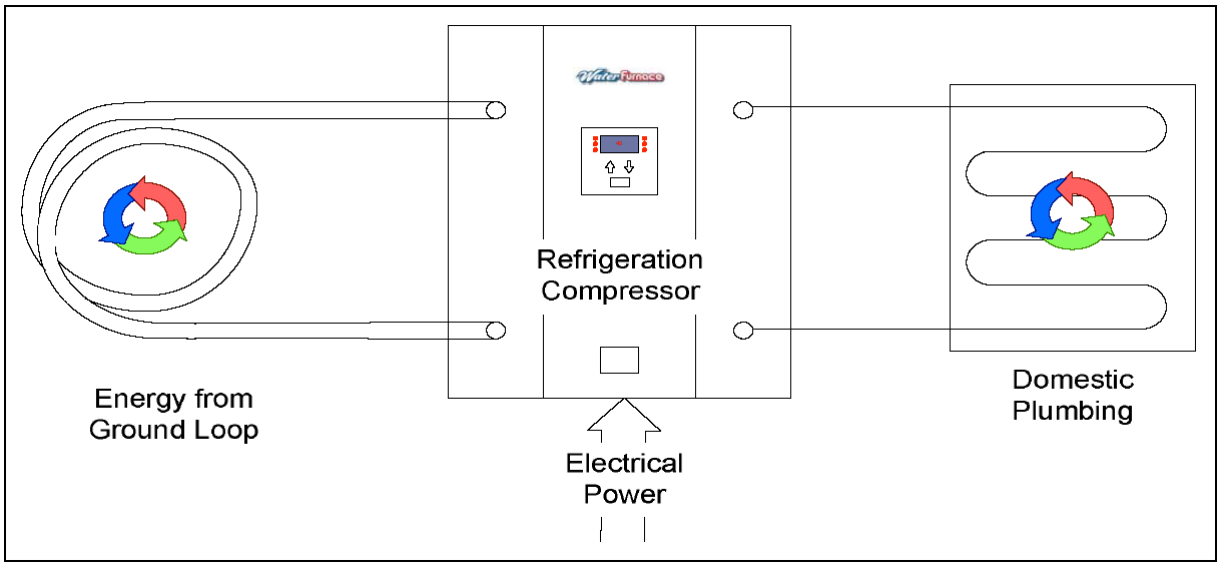
geothermal international

Ground Source Heat Pump System

User Guide



ground source heating, cooling + hot water

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Contents

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1 Definitions

This document refers to the following terms:

Source Side: The Ground Loop components of the Geothermal System, including pipe, flow pumps, valves etc.

Load Side: The components of the building system, often including radiators, under floor heating, domestic hot water, flow pumps and pipe.

2 What has been installed?

The commissioning pack completed at the time of your installation should describe what your system consists of.

The commissioning pack will contain: a description of the Source side (Heating) installation; a description of the Load Side installation; a commissioning sheet for each heat pump installed confirming the performance of each heat pump.

Insert this information with this user guide.

Please note that whilst the performance of individual heat pumps can be ascertained, the performance of the total system – including how heat is dissipated throughout your building - is beyond the scope of the service provided by Geothermal International.

2.1 System Set Points

Heating systems have a flow of heated water to radiators or UFH and a return of slightly cooler water. The heating system is usually controlled by monitoring the temperature of either the flow or return water. The control temperature is known as a set-point.

The set-points established when your system was commissioned should be used as the basis for the operation of your system.

The temperature shown on the front of the heat pump is the Return Temperature into the heat pump from either your heating system or hot water storage tank.

The Flow Temperature out of the heat pump will be approximately 5 to 10 degrees higher than this indicated temperature.

Please note, Temperatures above 60 degrees (55 degrees displayed temperature) MUST be avoided, otherwise serious damage to the heat pump can occur.

3 What to expect during the normal operation of your Heat Pump.

3.1 General (Heating Mode)

The heat pump operates by extracting heat from the ground via the source coils. (Please note that straight lengths of pipe may be referred to as coils) These coils may be located in bore holes, trenches, a pond; or they could be replaced altogether by a direct water source. The heat is transferred to your building using the refrigeration cycle within the heat pump.

A typical system supplying both domestic hot water and heating will consist of:

a. The Heat Pump
b. The Hot water storage tank fitted with a thermostat.
c. The heating system consisting of radiators /underfloor pipework
d. Room thermostats.
e. Motorised valves for controlling the flow of water to either the hot water tank or heating system.

Usually, Geothermal International will have installed the heat pump and everything on the ground side (or Source side). In most cases, your heating and hot water system (the Load side) will have been installed by a Heating Engineer or Plumber.

You may wish to record here the contact details of the Heating Engineer who has installed the Load side of the system:

On a single heating loop, the heat pump may control itself. Otherwise the heat pump will be controlled by the heating system in your building. This will have its own series of temperature sensors (or Thermostats) and timers. This control system is independent to the heat pump itself. It is one of the most important elements in determining the total efficiency of your system.

If the heat pump is controlling itself, it will monitor the return water temperature and operate accordingly to maintain its set-point temperature. The heat pump will display the return water temperature from your heating system.

If the heat pump is controlled externally, during normal operation it will receive a signal from your control system requesting the Heat Pump to run. The heatpump will operate as previously described.

The system starts in the following order:

a. Load side circulating pump
b. Source side circulating pump(s)
c. Heat Pump

There may be a delay in starting of up to 10 minutes whilst the heat pump software conducts various checks prior to starting.

Upon starting, the Heat Pump will heat incrementally. Depending on the flow rate, the water leaving the heat pump should be 5 to 10 degrees hotter than the water returning to it. This heated water then flows into your heating circuit, where some of this heat is dissipated. It is likely, therefore, to take some time for the system to increase the temperature to the appropriate point.

For a system that is supplying both hot water and heating, hot water should be given priority by your controller when the storage tank thermostat is sensing that the water in the tank is below the required temperature. This operation is governed by motorised valves located on either the flow or return pipework from the heating and hot water systems.

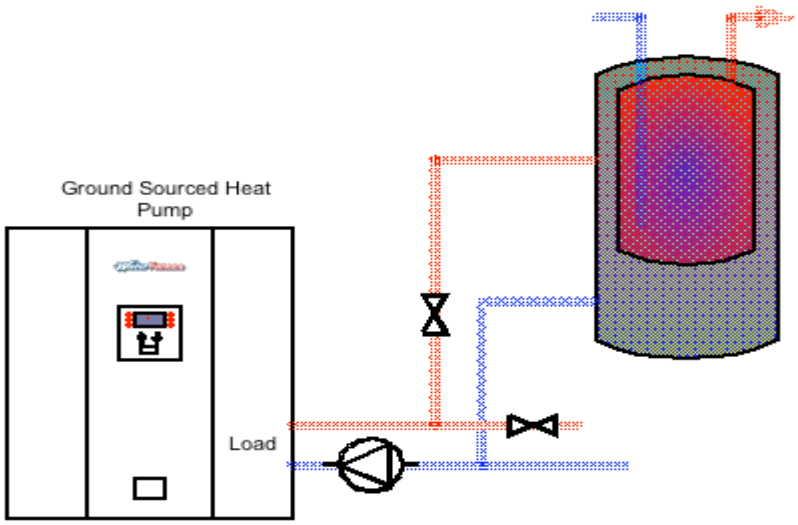
Usually this will also be governed by a time clock, so your hot water tank will be raised up to the temperature set by the thermostat only at certain times of the day (often twice a day). If the hot water tank is at the correct temperature, the system can return attention to the central heating load.

When the Heat Pump has its attention on the central heating load and there is a subsequent demand from the hot water tank, the motorised valves will open and close accordingly and the Heat Pump will start to provide heat to the hot water tank again.

3.2 Heat Pump Supplying the Hot Water Storage Tank

From a starting temperature of 10°C the hot water tank will be heated to 50°C-55°C within approximately 1 hour depending on:

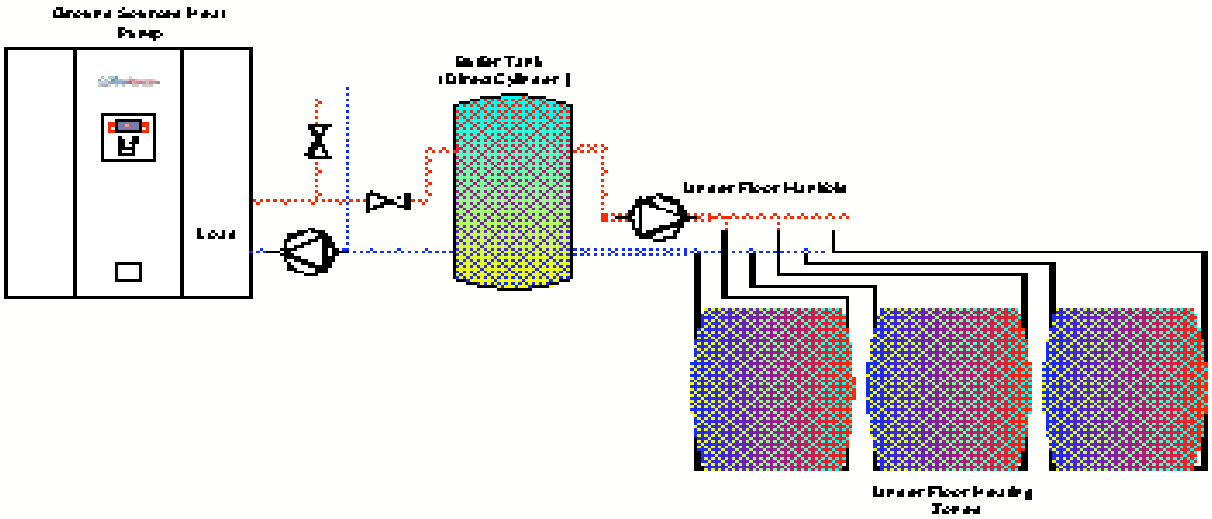
a. The design of your system
b. Hot water usage during the period of recovery
c. The size of the hot water tank



During recovery of the hot water tank the heat pump will be extracting heat from the ground/source loops and transferring this, via the refrigeration cycle within the Heat Pump, to the hot water storage tank.

During this operation the Heat Pump may reach its maximum return temperature before the hot water storage tank thermostat has reached its set point temperature. This means that it may take two or three cycles of the heat pump before the temperature within the storage tank is satisfied. Throughout this period the Heat pump will not be supplying heat to the central heating system if your control system is configured to prioritise hot water. This can be optimised by careful tuning; setting the hot water tank thermostat at the lowest setting that gives enough hot water.

3.3 Heat Pump Supplying the Heating System



When the Heat Pump is supplying the heating system the Heat Pump will be extracting heat from the ground source loops and transferring it, via the refrigeration cycle within the Heat Pump, to the heat exchangers within the property, i.e. the Radiators, Underfloor heating pipes, Fan-Coils, Trench Heaters etc…

The controls of heating systems are wide and varied and are beyond the scope of this document. As a generalisation most systems will consist of a timer with room thermostats and/or thermostatic control valves on the radiators or underfloor manifolds. These controls should be understood and explained to you by your heating system installer.

Providing the timer is requesting heating and the room thermostats are also calling for heat the Heat Pump will go through its start up cycle and then provide heat to the heating circuit.

There are very few situations when a mixing valve will be required in an underfloor system heated by a heat pump. Mixing valves are used in traditional heating systems to reduce the flow temperature in under floor heating. Ground Source Heat Pumps provide the correct flow temperature for under floor heating and so mixing valves are not required.

4 How to get the best from your system?

Geothermal can only advise on the overall operation of the system. How the system is controlled on a day to day basis depends largely on the lifestyle of the customer. As with any heating system, if left to run continuously then fuel bills may be much higher than expected.

The most important factor in the efficiency of the system is usually the level of insulation and amount of vented losses in the property. Careful management of building openings, i.e. doors and windows, will always be beneficial to the heat retention of the property.

It is essential to remember that the Heat Pump will only do either the domestic hot water or the heating system at any specific moment, it will not be efficient or effective if it is configured to supply both at the same time. A heat pump supplying an underfloor system is perfectly capable of switching over to provide normal domestic hot water quantities and switching back to the underfloor system, without a noticeable difference in the space heating temperature.

Low temperature for longer will be more efficient. A large surface area radiator, a forced convection – low flow temperature radiator, or an underfloor system should be ran at the lowest flow temperature possible to maintain the space temperature. For example, a radiator at 60 degrees for 3 hours is approximately the same amount of energy as the same radiator at 40 degrees for four hours. However, a heat pump will generate 60 degree heat for approximately 50% more cost than 40 degree heat.

Thus, turning the heating down as you go out and turning it up high on your return to the property is NOT the most effective way to run an optimised, cost effective heating system based around the heat pump.

Typically an underfloor system will have a thermal “lag”, such that it will take some time for the building space to respond once the heating set-point is altered.

One suggested method for optimising the performance of the heating system (depending on the heating system design):

1. Choose a low set point on both building space thermostats and heat pump return temperature set points and run this for a long time (say 24 hours).
2. Increase set point a couple of degrees at a time, allowing a long period of time after each alteration.
3. Alter the heat pump set point so that it is running between 60% to 80% of the time to maintain the building space temperature.
4. Repeat 2. and 3. until the building space is at the right comfort level.

DO NOT adjust the set point on the Heat Pump itself unless you are sure you know what you are doing. Make sure you know whether the actual flow temperature is governed by the heat pump itself or an external temperature sensor. If you do wish to adjust the set point within the heat pump, Page 20 of the EKW Installation Manual explains how to do this. PROCEED WITH CAUTION.

For long periods of un-occupancy, a lower temperature set-back point is usually the best way to maintain temperature. In modern buildings this is often a better strategy than letting the building totally cool down. Of course, this will depend on the design of the building and the length of un-occupancy.

A house and its heating infrastructure form a very complex system, and the occupant is best placed to understand and optimise the energy provision and energy usage. Rest assured that at the very least, a well managed heat pump should always provide cheaper heat than a similarly managed oil, gas or electrical system.

A heat pump is useful, because it takes less energy to move heat-energy from one space to another rather than to convert chemical-energy or electrical-energy into heat-energy.

5 New Buildings.

The moisture content of new buildings changes the heating demand and energy consumption profile for the first few months of occupancy.
You could expect considerably more consumption than “normal circumstances” for anything up to a year from the commissioning of a new building.

6 What to do if your system malfunctions.

Should your system malfunction then please follow the guidelines.

If the WaterFurnace Heat Pump has an error, it will display a fault code.

Please see the table below for an explanation of the unit fault codes.

Should you require to contact Geothermal International, please call 02476 673131 during normal office hours.

Fault Code	Code Description	Action
DC	The Freeze Protection thermistor is closed (shorted)	Attempt to reset the unit by isolating power for 3 minutes. If the fault re-occurs contact Geothermal International for advice.
DO	The Freeze Protection thermistor is closed	Attempt to reset the unit by isolating power for 3 minutes. If the fault re-occurs contact Geothermal International for advice.
FP	Freeze Protection thermistor has detected a condition within the heat pump indicating that the source loop water is reaching its freezing point	Attempt to reset the unit by isolating power for 3 minutes. If the fault re-occurs contact Geothermal International for advice.
HC	The water set point thermistor is closed (shorted)	Attempt to reset the unit by isolating power for 3 minutes. If the fault re-occurs contact Geothermal International for advice.
PO	The water set point thermistor is open	Attempt to reset the unit by isolating power for 3 minutes. If the fault re-occurs contact Geothermal International for advice.
HP	The compressor within the heat pump has reached its maximum operating pressure. Usually due to Low Flow on the Load Side. Check Load Side Pressure, Heating System Air-locks and Load Side Flow Pump.	Usually caused by loss of flow on the heating or hot water systems due to a loss of pressure. Check your system pressure, if it is low (< 0.1Bar) you may have a leak in the system. Check your heating flow pump is operating correctly. Contact your heating system installer.

Fault Code	Code Description	Action
LP	The compressor within the heat pump has reached its minimum operating pressure	Attempt to reset the unit by isolating power for 3 minutes. If the fault re-occurs contact Geothermal International for advice.

NOTE: If a fault is present the Heat Pump will run three times after powering up before displaying the fault code.

If the unit is not displaying a fault code and is displaying a temperature check the following:

a. Is the timer actually requesting for the heat pump to run, i.e. if you have the time clock set to 'Auto/Timed' is it in a period when heating is required?

b. Is the timer set to 'Off', if so select 'On' or 'Auto/Timed'?

c. If the timer is in a state that heating is required are your room thermostats set correctly?

Otherwise, the Compressor's built in over-heat protection may have been reached. This may take a few hours to cool down. Ensure that the system is NOT calling for temperatures exceeding 60 degrees C and that adequate flow is present. If this persists contact Geothermal International for assistance.

If the display on the unit is totally blank – as if the unit is off, then check the following:

a. Is there power to the unit?

b. Your control system may be configured such that power is automatically isolated to the unit when there is no demand for heating. Check there is a demand for heating.

7 Frequently Asked Questions

7.1 My hot water is hot but the heating system is cold and the Heat Pump is off what should I do?

If your hot water is hot then the Heat Pump is functioning correctly. The likely problem is that your thermostat on the hot water tank is set too high. The Heat Pump will only provide hot water at approximately 55^{o}C to 60^{o}C and if your tank thermostat is set above this then the system will never change over to heating.

Adjust the thermostat slightly to decrease the set point, and you should hear the thermostat 'click'. Your control system will now realise that the hot water in the storage tank is at the correct temperature and providing your timer, if fitted, is set to heating on then the Heat Pump will now supply hot water to the heating system.

7.2 The Heat Pump is displaying HP, what should I do?

HP is an abbreviation for High Pressure. This is a protection device fitted in the Heat Pump to protect the compressor.

The likely cause is a flow problem on the load side (heating or hot water circuits) of the system. This can be caused by a leak in the system, an air-lock in your radiators/ underfloor or a flow pump failure. Your system should have been fitted with an expansion vessel, pressure gauge and filling loop by your heating system installer. Check the pressure gauge; it should be reading approximately 1 bar (15psi). If the pressure is low then re-pressurise the system using the filling loop. The initial cause of the pressure loss should be investigated as there may be a leak in the system.

Bleeding the system should resolve any air-locks.

If the pressure is correct and there are no air-locks then it may be a problem with the recirculation pump.

7.3 All my pumps seem to be running but the heat pump does not appear to be running, what should I do?

There is likely to be a problem with either the control board within the heat pump or the soft start. Switch off the Heat Pump for 3 minutes this will reset the system. After this time, switch the system back on again and if the fault re-occurs switch the unit off and call Geothermal International for advice.

NOTE: If the fault is still present the Heat Pump will run three times before displaying the fault code.

7.4 My unit is displaying FP, what should I do?

FP is an abbreviation for Freeze Protection. This is a protection device fitted to the unit to protect the evaporating coils and the ground loops.

There are numerous causes for this fault. Initially switch off the unit for 3 minutes to reset the system. After the 3 minutes switch the unit on. If the fault re-occurs call Geothermal International for advice

NOTE: If the fault is still present the Heat Pump will run three times before displaying the fault code.

7.5 Some of my heating zones/radiators are nice and warm whilst others never seem to get warm, what should I do?

This is unlikely to be a fault with the Heat Pump if some of the areas in the house are getting warm and the Heat Pump is reaching its operating temperatures. Contact your heating system installer for advice.

7.6 How do I get hotter hot-water?

Be Careful. Your system should be set up and optimised, altering set-points will disturb the original configuration. Make sure you understand your system before making any adjustments.

Firstly, be clear whether you require Hotter Water, or More Water at the temperature that is already being achieved?

If you want hotter water, check the mixing valve that may be restricting the flow of hot water from the tank. Your hot water is likely to be controlled by a thermostat on either the hot water tank or the return from the heat exchanger in it. This can be adjusted, but it must NEVER exceed a temperature that will allow a return back to the Heat Pump above 55 degrees C.

If you already get water at an adequate temperature, just not enough of it, you may need to change the times hot water is re-heated. You can understand the recovery time of your system by emptying your hot water tank, refilling it, and timing how long it takes before the heat pump brings it up to temperature.

If your system was not designed specifically for your needs, there may be periods when your hot water demand exceeds the design of your hot water system. If this is the case, it should be possible for you to have an immersion heater back-up, which isolates the tank from the heat pump and heats the water more directly, solely for these periods.

7.7 Is my heat pump too small?

Your heat pump will have been carefully selected to match the heating load either provided by you, the Customer, your plumber, heating Engineer or Architect, or calculated from information provided by you. A heat pump must be “right sized”. If it is too big, then it will run and stop, run and stop in short bursts (know as short cycling). This is very inefficient and will lead to long term damage. This is never an issue with traditional heating systems, since fossil fuel burners are usually oversized to enable excess hot heat to always be available.

It is unlikely that your heat pump is too small unless you have a problem with your insulation, or if you are trying to dry out a new building (Do Not Do This), or are heating a new building from cold. It might take some days to overcome the thermal inertia in the heating system.

Other common errors which may lead you to question the amount of energy out of your heat pump are:

(i) an over or under sized load side flow pump
(ii) an incorrectly specified hot water tank
(iii) poorly designed or poorly installed underfloor heating
(iv) the inclusion of a mixing valve in your system.

Many heating engineers will be used to tuning a system with 80 degree hot water available. They will have to understand that the heat pump will produce hot water up to 60 degrees, BUT will be much more efficient at lower temperatures.

It is very rare, and very unlikely that you have been supplied with an incorrectly sized heat pump.

7.8 Is my heat pump costing too much?

The cost of running the heat pump is a factor of two things:

i) How often is it used
ii) What flow conditions are present when it is used

The specification / installation manual will detail the Coefficient of Performance of the Heat Pump at different flow conditions. This determines how many kilowatts heat output you get for kilowatts of electricity input. The cost to run the Heat Pump is determined by the cost per kilowatt hour and the amount of kilowatts drawn per hour.

As a rule, the lower the flow temperature the higher the COP, and the cheaper to run.