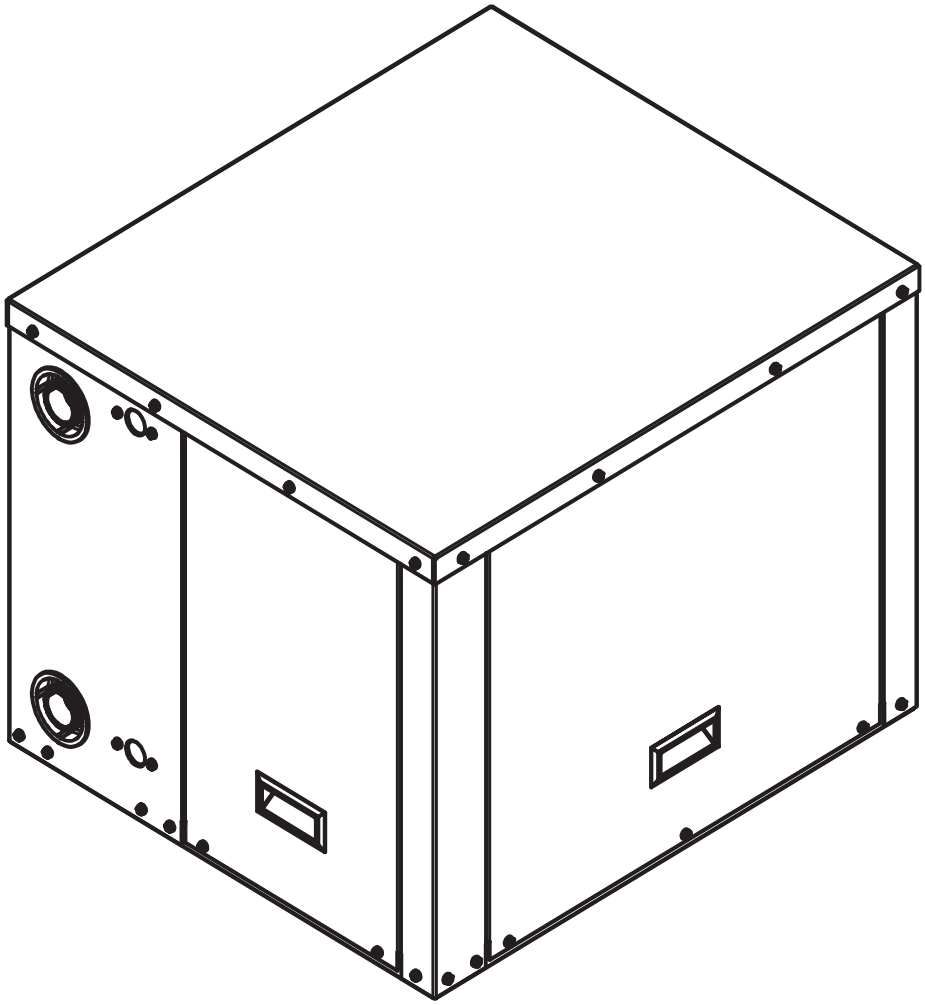
ENERTECH
ENERGY + TECHNOLOGY

Installation and Operations Manual

HP Models Water-to-Water Heat Pumps



Revision B

20D811-01NN

Table of Contents

Section 8: Wiring Diagram

Section 9: Equipment Start-Up

Section 10: Troubleshooting: WPD Table

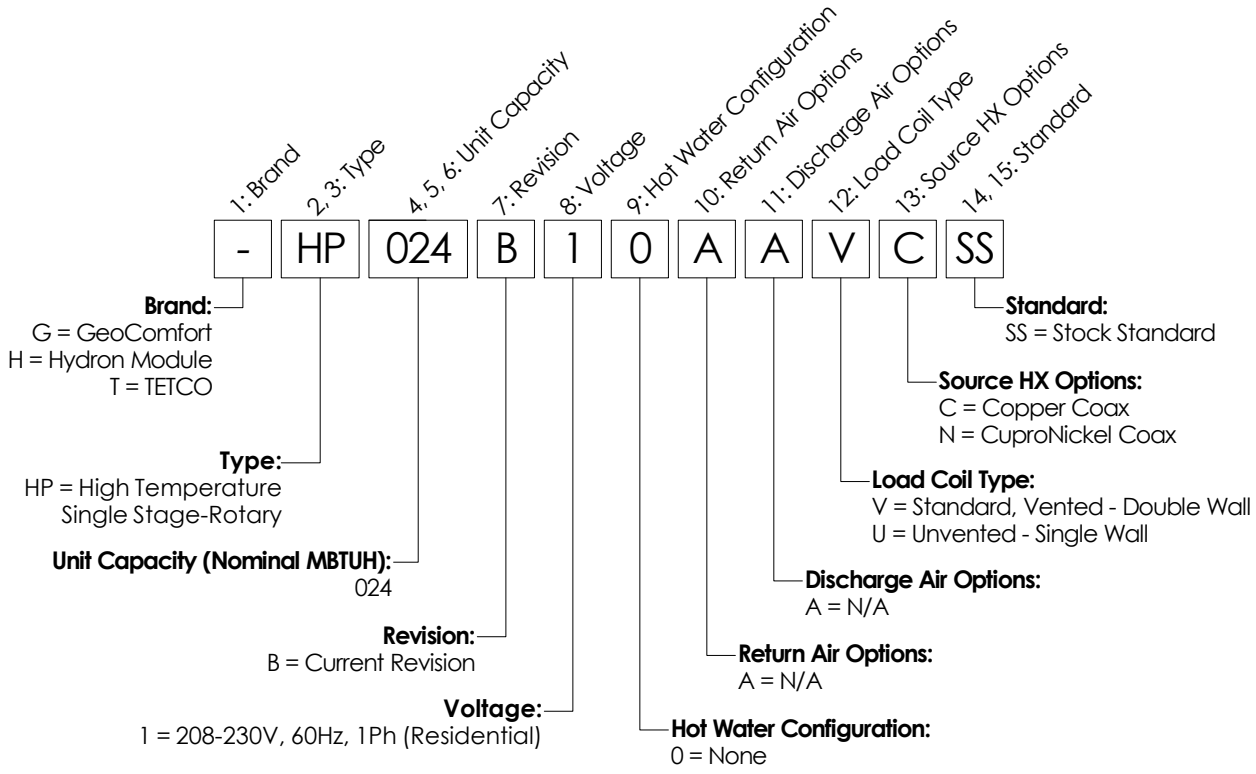
Section 11: Unit Electrical Data

Section 12: Unit Electrical Data-Electrical Connections

Section 13: Warranty Forms and Revision Table

Section 1: HP Unit Nomenclature

HP Model Unit Nomenclature



Section 2: Installation Introduction

Introduction

This geothermal heat pump provides heated water. Engineering and quality control is built into every geothermal unit. Good performance depends on proper application and correct installation.

Notices, Cautions, Warnings, & Dangers:

"NOTICE" Notification of installation, operation or maintenance information which is important, but which is NOT hazard-related.

"CAUTION" Indicates a potentially hazardous situation or an unsafe practice which, if not avoided, COULD result in minor or moderate injury or product or property damage.

"WARNING" Indicates potentially hazardous situation which, if not avoided, COULD result in death or serious injury.

"DANGER" Indicates an immediate hazardous situation which, if not avoided, WILL result in death or serious injury.

Inspection

Upon receipt of any geothermal equipment, carefully check the shipment against the packing slip and the freight company bill of lading. Verify that all units and packages have been received. Inspect the packaging of each package and each unit for damages. Insure that the carrier makes proper notation of all damages or shortage on all bill of lading papers. Concealed damage should be reported to the freight company within 5 days. If not filed within 5 days the freight company can deny all claims.

Note: Notify Enertech Global, LLC shipping department of all damages within 5 days. It is the responsibility of the purchaser to file all necessary claims with the freight company.

Unit Protection

Protect units from damage and contamination due to plastering (spraying), painting and all other foreign materials that may be used at the job site. Keep all units covered on the job site with either the original packaging or equivalent protective covering. Cap or recap unit connections and all piping until unit is installed. Precautions must be taken to avoid physical damage and contamination which may prevent proper start-up and may result in costly equipment repair.

Storage

All geothermal units should be stored inside in the original packaging in a clean, dry location. Units should be stored in an upright position at all times. Units should not be stacked unless specially noted on the packaging.

⚠ CAUTION ⚠

Do not operate the Geothermal Heat Pump Unit during construction phase.

Pre-Installation

Special care should be taken in locating the geothermal unit. Installation location chosen should include adequate service clearance around the unit. All units should be placed on a formed plastic air pad, or a high density, closed cell polystyrene pad slightly larger than the base of the unit. If units are being placed on racking, the unit must be placed on a solid foundation. All units should be located in an indoor area where the ambient temperature will remain above 55°F and should be located in a way that piping and ductwork or other permanently installed fixtures do not have to be removed for servicing and filter replacement.

Pre-Installation Steps:

1. Compare the electrical data on the unit nameplate with packing slip and ordering information to verify that the correct unit has been shipped.
2. Inspect all electrical connections and wires. Connections must be clean and tight at the terminals, and wires should not touch any sharp edges or copper pipe.
3. Verify that all refrigerant tubing is free of dents and kinks. Refrigerant tubing should not be touching other unit components.
4. Before unit start-up, read all manuals and become familiar with unit components and operation. Thoroughly check the unit before operating.

Section 2: Installation Introduction

⚠ CAUTION ⚠

All GEOTHERMAL equipment is designed for indoor installation only. DO NOT install or store unit in a corrosive environment or in a location where temperature and humidity are subject to extremes. Equipment is not certified for outdoor applications. Such installation will void all warranties.

⚠ WARNING ⚠

Failure to follow this caution may result in personal injury. Use care and wear appropriate PROTECTIVE clothing, safety glasses and protective gloves when servicing unit and handling parts.

⚠ CAUTION ⚠

Before drilling or driving any screws into cabinet, check to be sure the screw will not hit any internal parts or refrigerant lines.

Components

Master Contactor: Energizes Compressor and optional Hydronic Pump and/or Desuperheater pump package.

Logic Board: Logic Board operates the compressor and protects unit by locking out when safety switches are engaged. It also provides fault indicator(s).

Terminal Strip: Provides connection to the thermostat or other accessories to the low voltage circuit.

Transformer: Converts incoming (source) voltage to 24V AC.

Low Voltage Breaker: Attached directly to transformer, protects the transformer and low voltage circuit.

High Pressure Switch: Protects the refrigerant system from high refrigerant pressure, by locking unit out if pressure exceeds setting.

Low Pressure Switch: Protects the refrigerant system from low suction pressure, if suction pressure falls below setting.

Shipping Bolts: This unit is equipped with the new COMPRESSOR ISOLATION feature. Do not loosen or remove the bolts.

Consumer Instructions

Dealer should instruct the consumer in proper operation, maintenance, filter replacements, thermostat and indicator lights. Also provide the consumer with the manufacturer's Owner's Manual for the equipment being installed.

Enertech Global D-I-Y Policy: Enertech Global's geothermal heat pumps and system installations may include electrical, refrigerant and/or water connections. Federal, state and local codes and regulations apply to various aspects of the installation. Improperly installed equipment can lead to equipment failure and health/safety concerns. For these reasons, only qualified technicians should install a Enertech Global built geothermal system.

Because of the importance of proper installation, Enertech Global does not sell equipment direct to homeowners. Internet websites and HVAC outlets may allow for purchases directly by homeowners and do-it-yourselfers, but Enertech Global offers no warranty on equipment that is purchased via the internet or installed by persons without proper training.

Enertech Global has set forth this policy to ensure installations of Enertech Global geothermal systems are done safely and properly. The use of well-trained, qualified technicians helps ensure that your system provides many years of comfort and savings.

Equipment Installation

Special care should be taken in locating the unit. All units should be placed on a formed plastic air pad, or a high density, closed cell polystyrene pad slightly larger than the base of the unit. All units should be located in an indoor area were the ambient temperature will remain above 55°F and should be located in a way that piping and ductwork or other permanently installed fixtures do not have to be removed for servicing and filter replacement.

Electrical

All wiring, line and low voltage, should comply with the manufacturer's recommendations, The National Electrical Code, and all local codes and ordinances.

Thermostats should be installed approximately 54 inches off the floor on an inside wall in the return air pattern and where they are not in direct sunlight at anytime.

Loop Pumping Modules must be wired to the heat pump's electric control box. A special entrance knockout is provided below the thermostat entrance knockout. A pump module connection block, connected to the master contactor, and circuit breaker is provided to connect the Pump Module wiring.

Section 3: Installation Considerations

Guidelines for Heating Mode Operation

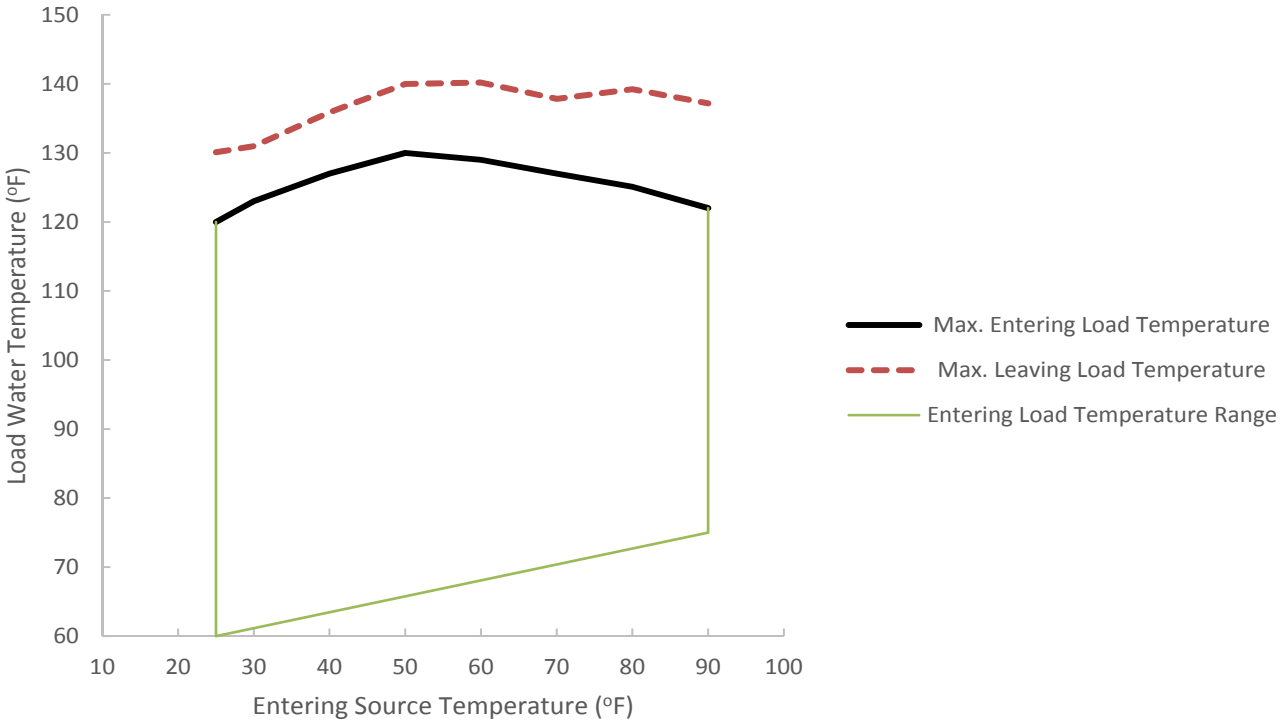
Enertech requires that the controls maintain the temperatures within the operating temperature shown in the following graph. Excessive vibration and premature compressor failure can occur at higher than allowed temperature settings.

The graph below shows the parameters that are safe for compressor operation.

Two common extreme conditions to be aware of are as follows:

1. Extremely low entering source temperature in combination with very high entering load water temperature may lead to a high discharge gas temperature. The maximum allowable discharge gas temperature for the HP024 compressor is 220 ˚F.
2. High entering source temperature in combination with very high entering load water temperature may lead to a high discharge pressure that will trigger high pressure cut out and potentially shortened compressor life. A high limit is recommended for vented heat exchangers (domestic water generation).

Section 5 (Unit Piping Installation) provides piping diagrams and control wiring for both vented (DHW generation) and unvented (radiant heating) applications. A key to smooth and safe operation is to stay within compressor operating envelope. The graph translates refrigerant temperatures to water temperatures for easier implementation.



Notes:

1. Water temperatures must not exceed the acceptable operating conditions.
2. Operating ranges obtained with 6 GPM on both the source and load side.

Section 3: Installation Considerations

Buffer Tanks

Virtually all water-to-water heat pumps used for hydronic applications require a buffer tank to prevent equipment short cycling, and to allow lower flow rates through the water-to-water unit than through the hydronic delivery system. The following are considerations for buffer tank sizing.

- The size of the buffer tank should be determined based upon the predominant use of the water-to-water equipment (heating or cooling).
- Pressurized buffer tanks are sized differently than non-pressurized tanks (see guidelines listed below).

Pressurized buffer tanks for predominately heating applications should be sized at one (1) U.S. gallon per 1,000 Btuh of heating capacity (10 gallons per ton may also be used) at the maximum entering source water temperature (EST) and the minimum entering load water temperature (ELT), the point at which the water-to-water unit has the highest heating capacity, usually 50-70°F EST and 80-90°F ELT.
Select the size of the tank based upon the larger of the calculations (heating or cooling).

Non-pressurized buffer tanks must also be sized based upon predominate use (heating) and based upon the lowest capacity stage. Requirements for storage are less according to the manufacturer of the HSS series non-pressurized buffer tank. Using the same conditions for maximum heating and cooling capacity mentioned above, non-pressurized buffer tanks require 6 U.S. gallons per ton.

Unit Placement

When installing a geothermal heating and cooling unit, there are several items the installer should consider before placing the equipment.

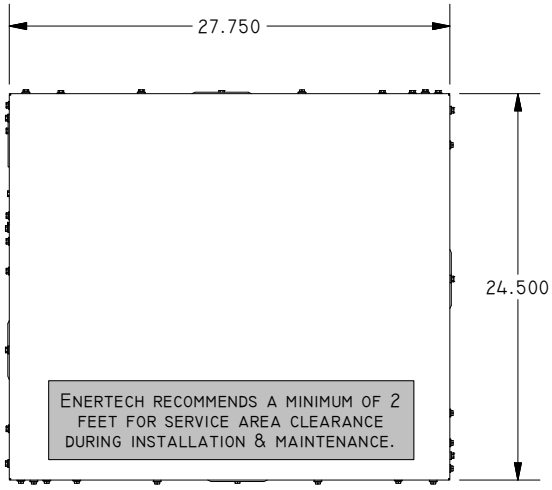
- Service Access: Is there enough space for service access? A general rule of thumb is at least 2 feet in the front and 2 feet on at least one side.
- Unit Air Pad: All geothermal heating and cooling equipment should be placed on either a formed plastic air pad, or a high density, closed cell polystyrene pad. This helps eliminate vibration noise that could be transmitted through the floor.
- If units are being placed on racking, the unit must be placed on a solid foundation covering the full base of the unit. Also, utilize a foam pad between the unit and the rack.
- The installer must verify that all applicable wiring, piping, and accessories are correct and on the job site.

Before you fully install the geothermal equipment, it is recommended you go through this quick checklist before placing the equipment.

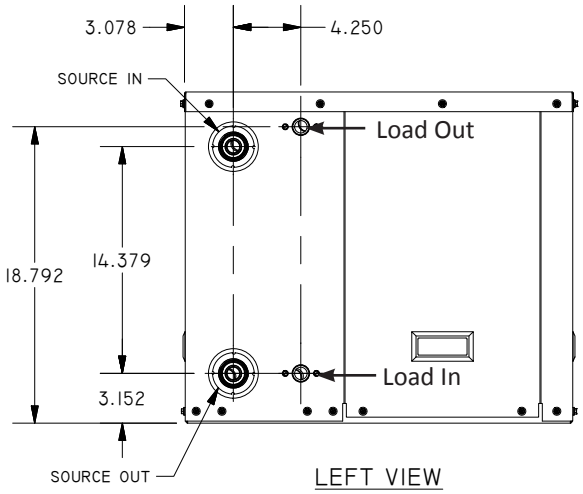
- Fully inspect the unit after unpacking.
- Locate the Unit Start-Up form from this manual and have it available as the unit installation proceeds.

Section 4: Unit Dimensional Data

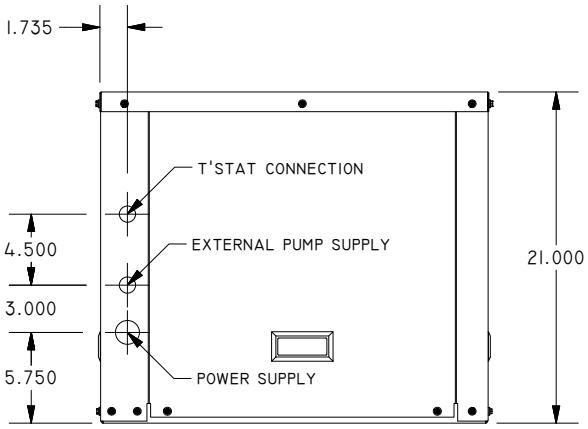
Unit Dimensional Data and Connections



TOP VIEW



LEFT VIEW



RIGHT VIEW

HP024						
MODEL	SOURCE Water: D/O		LOAD Water: FPT		Factory Charge	Unit Weight
	IN	OUT	IN	OUT		
Vented	1-1/4"	1-1/4"	3/4"	3/4"	63 oz	248 lbs
Unvented	1-1/4"	1-1/4"	1"	1"	52 oz	253 lbs

Notes:

- Electrical connections are 1" DIA for high voltage, & 1/2" DIA for low voltage.

Section 5: Unit Piping Installation

Open Loop Piping

Placement of the components for an open loop system are important when considering water quality and long term maintenance. The water solenoid valve should always be placed on the outlet of the heat pump, which will keep the heat exchanger under pressure when the unit is not operating. Water solenoid valves are also designed to close against the pressure, not with the pressure. Otherwise, they tend to be noisy when closing.

A flow regulator should be placed after the water solenoid valve. Always check the product specification catalog for proper flow rate. A calculation must be made to determine the flow rate, so that the leaving water temperature does not have the possibility of freezing.

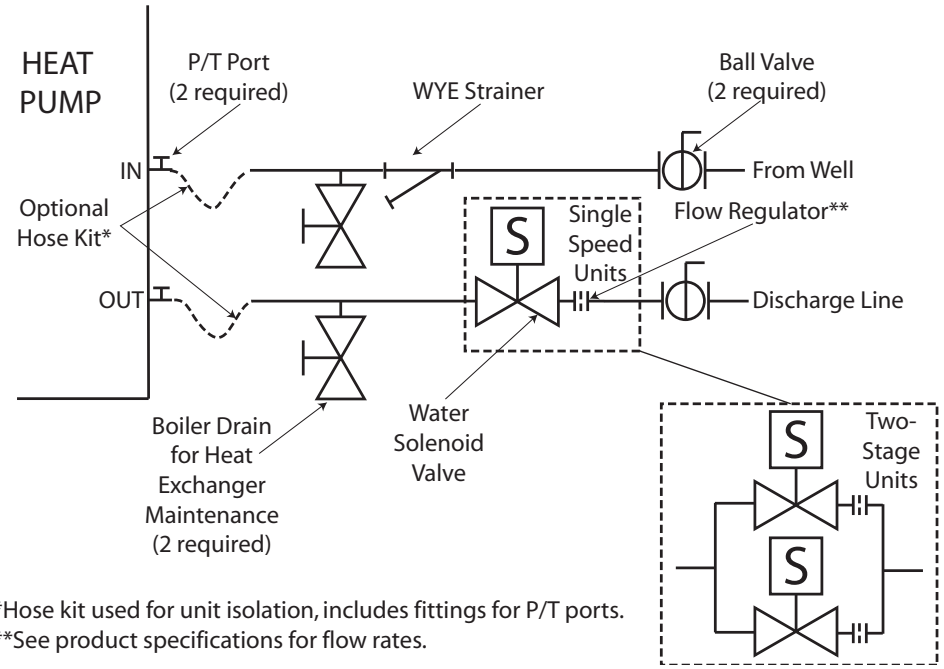
Other necessary components include a strainer, boiler drains for heat exchanger flushing, P/T ports and ball valves. Ball valves allow the water to be shut off for service, and also help when velocity noise is noticeable through the flow regulator. Spreading some of the pressure drop across the ball valves will lessen the velocity noise.

Always double check flow rate at the P/T ports to make sure the ball valve adjustments have not lowered water flow too much, and essentially taken the flow regulator out of the equation. It's a good idea to remove the ball valve handles once the system is completed to avoid nuisance service calls.

Hose kits are optional, but make for an easier installation, since the P/T ports and connections are included. The hose also helps to isolate the heat pump from the piping system.

Open Loop Piping Example

TYPICAL OPEN LOOP PLUMBING
AND VALVE INSTALLATION EXAMPLE



*Hose kit used for unit isolation, includes fittings for P/T ports.
**See product specifications for flow rates.

Note: HP units are single-stage units.

Not recommended for 3 ton and smaller. Use single solenoid and flow regulator.

Section 5: Unit Piping Installation

Water Quality

The quality of the water used in geothermal systems is very important. In closed loop systems the dilution water (water mixed with antifreeze) must be of high quality to ensure adequate corrosion protection. Water of poor quality contains ions that make the fluid "hard" and corrosive. Calcium and magnesium hardness ions build up as scale on the walls of the system and reduce heat transfer. These ions may also react with the corrosion inhibitors in glycol based heat transfer fluids, causing them to precipitate out of solution and rendering the inhibitors ineffective in protecting against corrosion. In addition, high concentrations of corrosive ions, such as chloride and sulfate, will eat through any protective layer that the corrosion inhibitors form on the walls of the system.

Ideally, de-ionized water should be used for dilution with antifreeze solutions since de-ionizing removes both corrosive and hardness ions. Distilled water and zeolite softened water are also acceptable. Softened water, although free of hardness ions, may actually have increased concentrations of corrosive ions and, therefore, its quality must be monitored. It is recommended that dilution water contain less than 100 PPM calcium carbonate or less than 25 PPM calcium plus magnesium ions; and less than 25 PPM chloride or sulfate ions.

In an open loop system the water quality is of no less importance. Due to the inherent variation of the supply water, it should be tested prior to making the decision to use an open loop system. Scaling of the heat exchanger and corrosion of the internal parts are two of the potential problems. The Department of Natural Resources or your local municipality can direct you to the proper testing agency. Please see Water Quality Table below for guidelines.

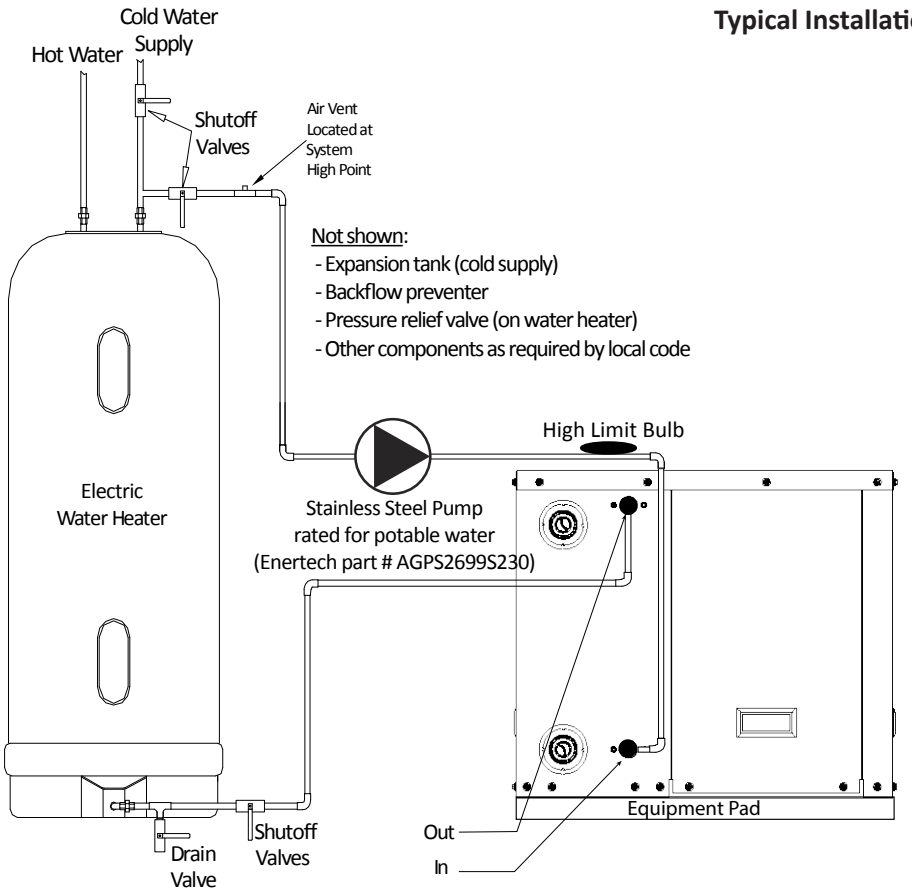
Water Quality Table

Potential Problem	Chemical(s) or Condition	Range for Copper Heat Exchangers	Cupro-Nickel Heat Exchanger Ranges
Scaling	Calcium & Magnesium Carbonate	Less than 350 ppm	Less than 350 ppm
Corrosion	pH Range	7 - 9	7 - 9
	Total Dissolved Solids	Less than 1000 ppm	Less than 1500 ppm
	Ammonia, Ammonium Hydroxide	Less than 0.5 ppm	Less than 0.5 ppm
	Ammonium Chloride, Ammonium Nitrate	Less than 0.5 ppm	Less than 0.5 ppm
	Calcium/Sodium Chloride See Note 4	Less than 125 ppm	Less than 125 ppm
	Chlorine	Less than 0.5 ppm	Less than 0.5 ppm
	Hydrogen Sulfide	None Allowed	None Allowed
Biological Growth	Iron Bacteria	None Allowed	None Allowed
	Iron Oxide	Less than 1 ppm	Less than 1 ppm
Erosion	Suspended Solids - Note 5	Less than 10 ppm	Less than 10 ppm
	Water Velocity	Less than 8 ft/s	Less than 12 ft/s

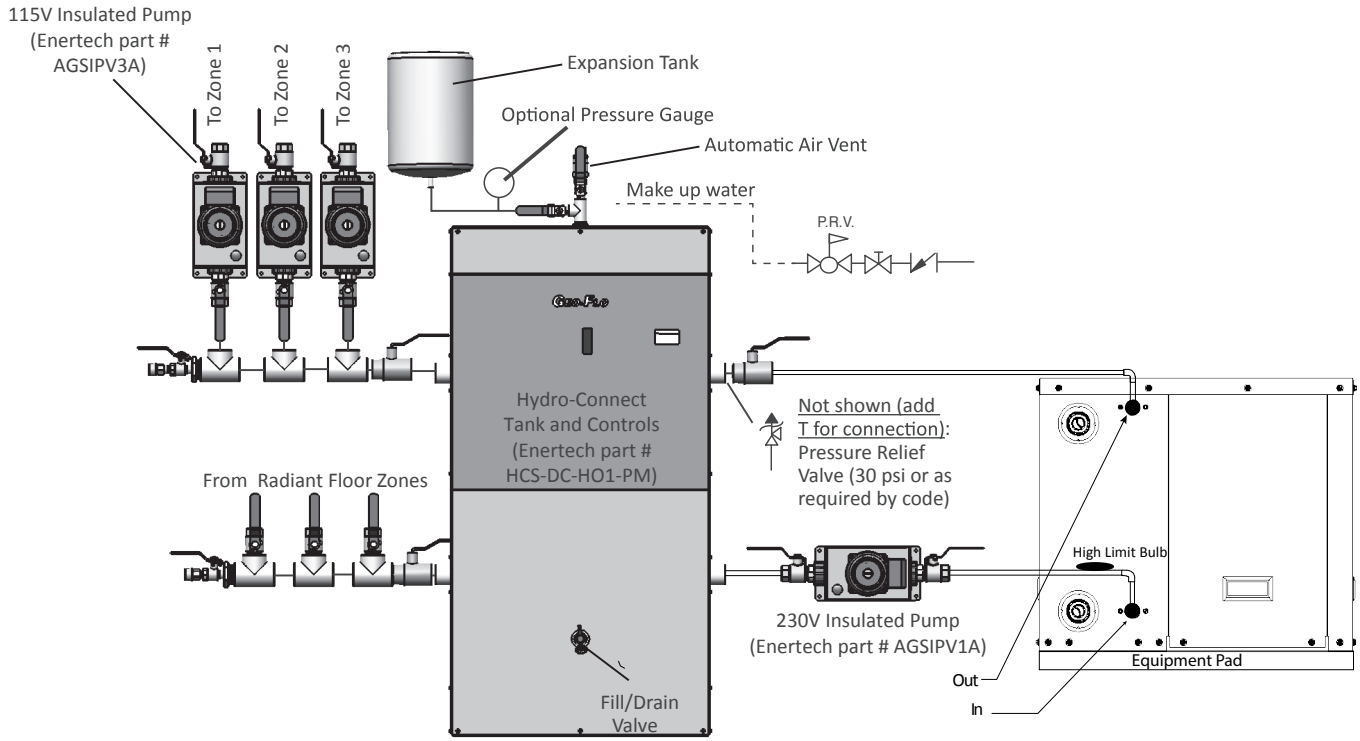
Notes:

1. Hardness in ppm is equivalent to hardness in mg/l.
2. Grains/gallon = ppm divided by 17.1.
3. Unit internal heat exchangers are not recommended for pool applications or water outside the range of the table. Secondary heat exchangers are required for pool or other applications not meeting the requirements shown above.
4. Saltwater applications (approx. 25,000 ppm) require secondary heat exchangers due to copper piping between the heat exchanger and the unit fittings.
5. Filter for maximum of 600 micron size.

Typical Installation with Vented Coaxial Heat Exchanger



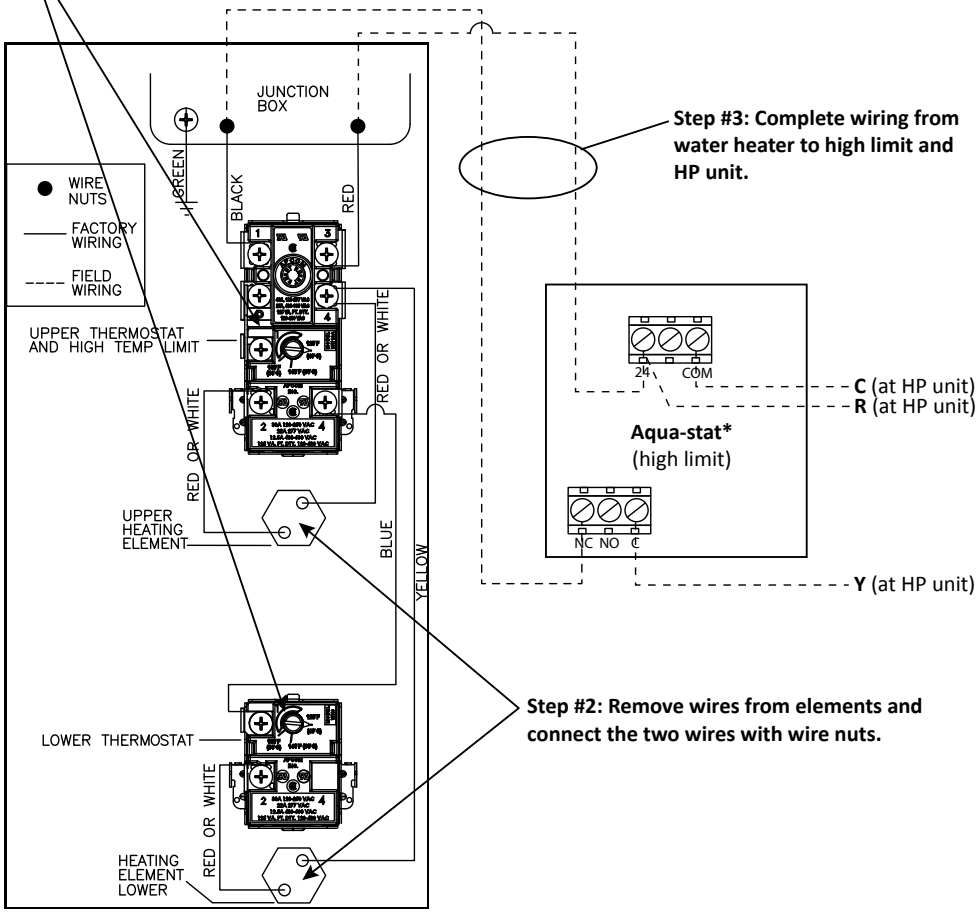
Typical Installation with Unvented Coaxial Heat Exchanger (Radiant Heating)



Section 5: Unit Piping Installation

DHW Tank Wiring

Step #1: Adjust water heater thermostats to maximum temperature of 120°F to 125°F (see compressor operating map on page 7).

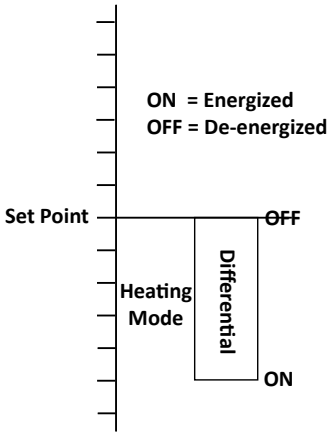


Step #3: Complete wiring from water heater to high limit and HP unit.

Step #2: Remove wires from elements and connect the two wires with wire nuts.

Electric Water Heater Wiring
(thermostat for HP heating call)

Step #4: Set aqua-stat (high limit) to a maximum temperature of 130°F (see compressor operating map on page 7) with a differential of 5°F.

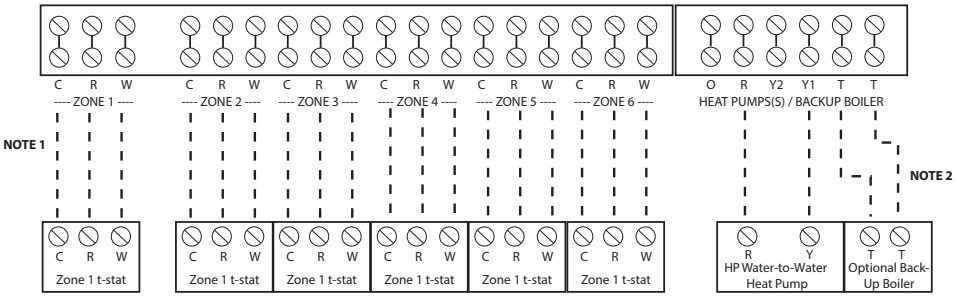


*Use aqua-stat with metal sensor. Some aqua-stats use plastic sensors, which may not react quickly.

Section 5: Unit Piping Installation

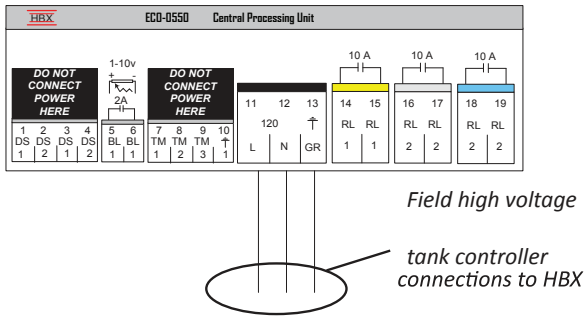
Radiant Floor Zone Panel WIring (Enertech Part # HCS-DC-H01-PM --part # includes buffer tank)

Hydro-Connect Low Voltage Wiring:

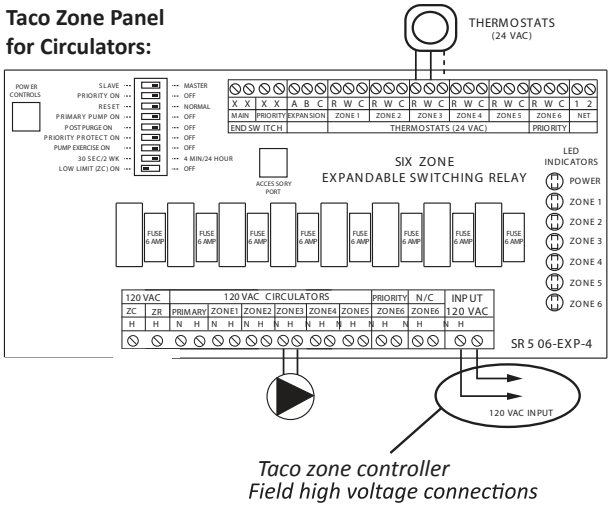


NOTES:
1. Common (C) terminal optional.
2. Backup boiler connections may also be used for a second heat pump

HBX Tank Controller:



Taco Zone Panel for Circulators:



Section 5: Unit Piping Installation

Interior Piping

All interior piping must be sized for proper flow rates and pressure loss. Insulation should be used on all inside piping when minimum loop temperatures are expected to be less than 50°F. Use the table below for insulation sizes with different pipe sizes. All pipe insulation should be a closed cell and have a minimum wall thickness of 3/8". All piping insulation should be glued and sealed to prevent condensation and dripping. Interior piping may consist of the following materials: HDPE, copper, brass, or rubber hose (hose kit only). PVC is not allowed on pressurized systems.

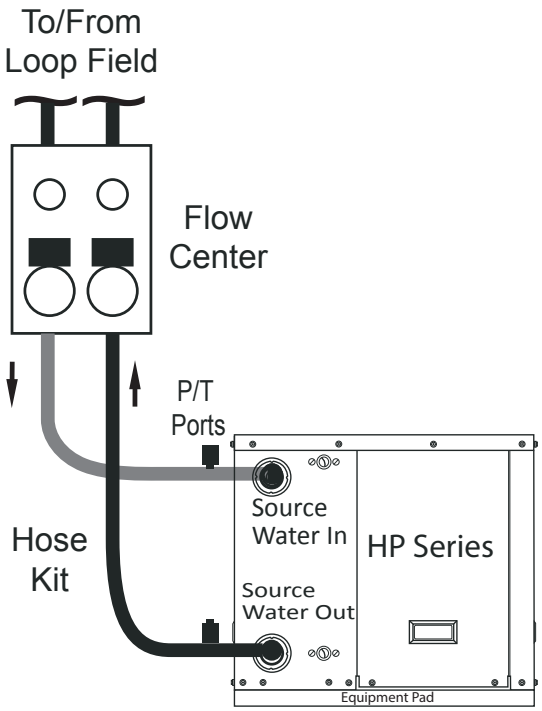
Pipe Insulation Table

Piping Material	Insulation Description
1" IPS Hose	1-3/8" ID - 3/8" Wall
1" IPS PE	1-1/4" ID - 3/8" Wall
1-1/4" IPS PE	1-5/8" ID - 3/8" Wall
2" IPS PD	2-1/8" ID - 3/8" Wall

Typical Pressurized Flow Center Installation

Flow centers are insulated and contain all flushing and circulation connections for residential and light commercial earth loops that require a flow rate of no more than 20 gpm. 1-1/4" fusion x 1" double O-ring fittings (AGA6PES) are furnished with the double O-ring flow centers for HDPE loop constructions. Various fittings are available for the double O-ring flow centers for different connections. Matching hose kits come with double O-ring adapters to transition to 1" hose connection.

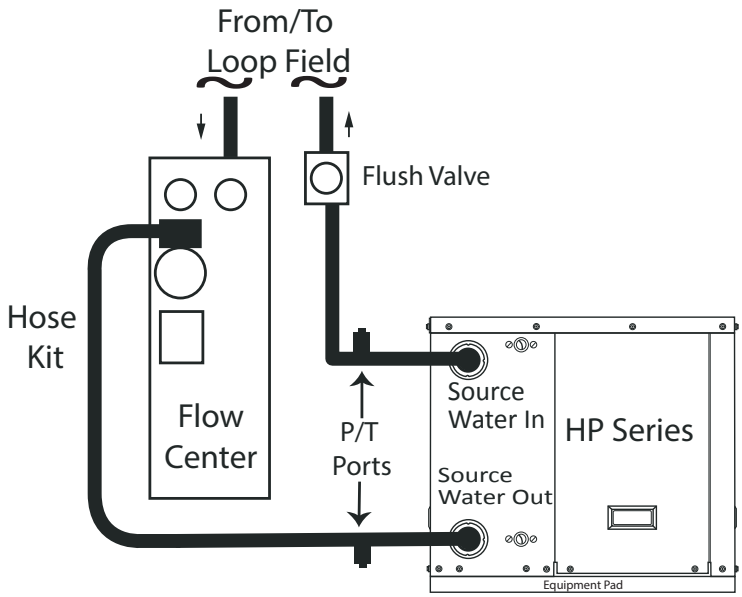
Typical Single Unit Piping Connection (Pressurized Flow Center)



Section 5: Unit Piping Installation

Typical Non-Pressurized Flow Center Installation

Non-pressurized flow centers are designed to operate with no static pressure on the earth loop. The design is such that the column of water in the flow center is enough pressure to prime the pumps for proper system operation and pump reliability. The flow center does have a cap/seal, so it is still a closed system, where the fluid will not evaporate. If the earth loop header is external, the loop system will still need to be flushed with a purge cart. The non-pressurized flow center needs to be isolated from the flush cart during flushing because the flow center is not designed to handle pressure. Since this is a non-pressurized system, the interior piping can incorporate all the above-mentioned pipe material options (see interior piping), including PVC. The flow center can be mounted to the wall with the included bracket or mounted on the floor as long as it is properly supported.

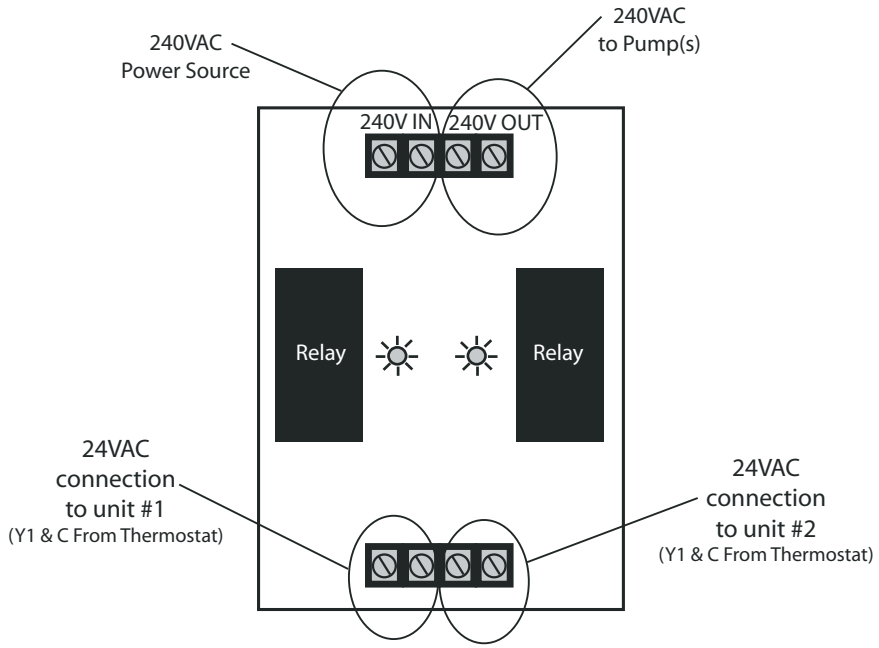


Section 5: Unit Piping Installation

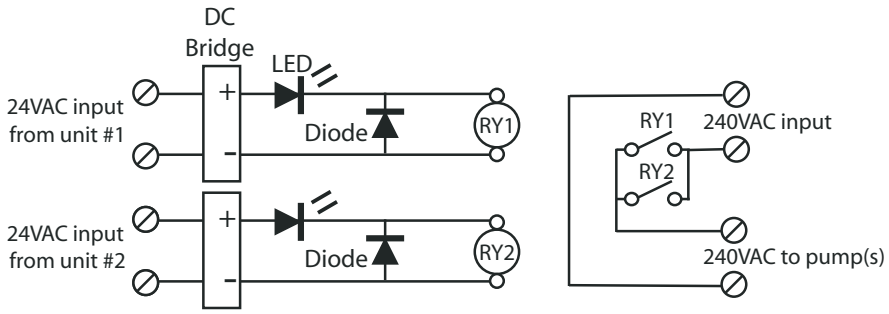
APSMA PUMP SHARING MODULE

The pump sharing module, part number APSMA, is designed to allow two units to share one flow center. With the APSMA module, either unit can energize the pump(s). Connect the units and flow center as shown in the drawing, below. A schematic of the board is also shown. The module must be mounted in a NEMA enclosure or inside the unit control box. Local code supersedes any recommendations in this document.

APSMA Module Layout



APSMA Module Wiring Schematic



Section 6: Antifreeze

Antifreeze Overview

In areas where minimum entering source temperatures drop below 40°F, or where piping will be routed through areas subject to freezing, antifreeze is required. Alcohols and glycols are commonly used as antifreeze. However, local and state/provincial codes supersede any instructions in this document. In addition, the system needs antifreeze to protect the braze plate heat exchanger from freezing and rupturing. Freeze protection should be maintained to 15°F below the lowest expected entering loop temperature. For example, if 30°F is the minimum expected entering loop temperature, the leaving source temperature could be 22 to 25°F. Freeze protection should be set at 15°F (30-15 = 15°F). To determine antifreeze requirements, calculate how much volume the system holds. Then, calculate how much antifreeze will be needed by determining the percentage of antifreeze required for proper freeze protection. **See Tables 3a and 3b for volumes and percentages.** The freeze protection should be checked during installation using the proper hydrometer to measure the specific gravity and freeze protection level of the solution.

Antifreeze Characteristics

Selection of the antifreeze solution for closed loop systems require the consideration of many important factors, which have long-term implications on the performance and life of the equipment. Each area of concern leads to a different "best choice" of antifreeze. **There is no "perfect" antifreeze.** Some of the factors to consider are as follows (Brine = antifreeze solution including water):

Safety: The toxicity and flammability of the brine (especially in a pure form).

Cost: Prices vary widely.

Thermal Performance: The heat transfer and viscosity effect of the brine.

Corrosiveness: The brine must be compatible with the system materials.

Stability: Will the brine require periodic change out or maintenance?

Convenience: Is the antifreeze available and easy to transport and install?

Codes: Will the brine meet local and state/provincial codes?

The following are some general observations about the types of brines presently being used:

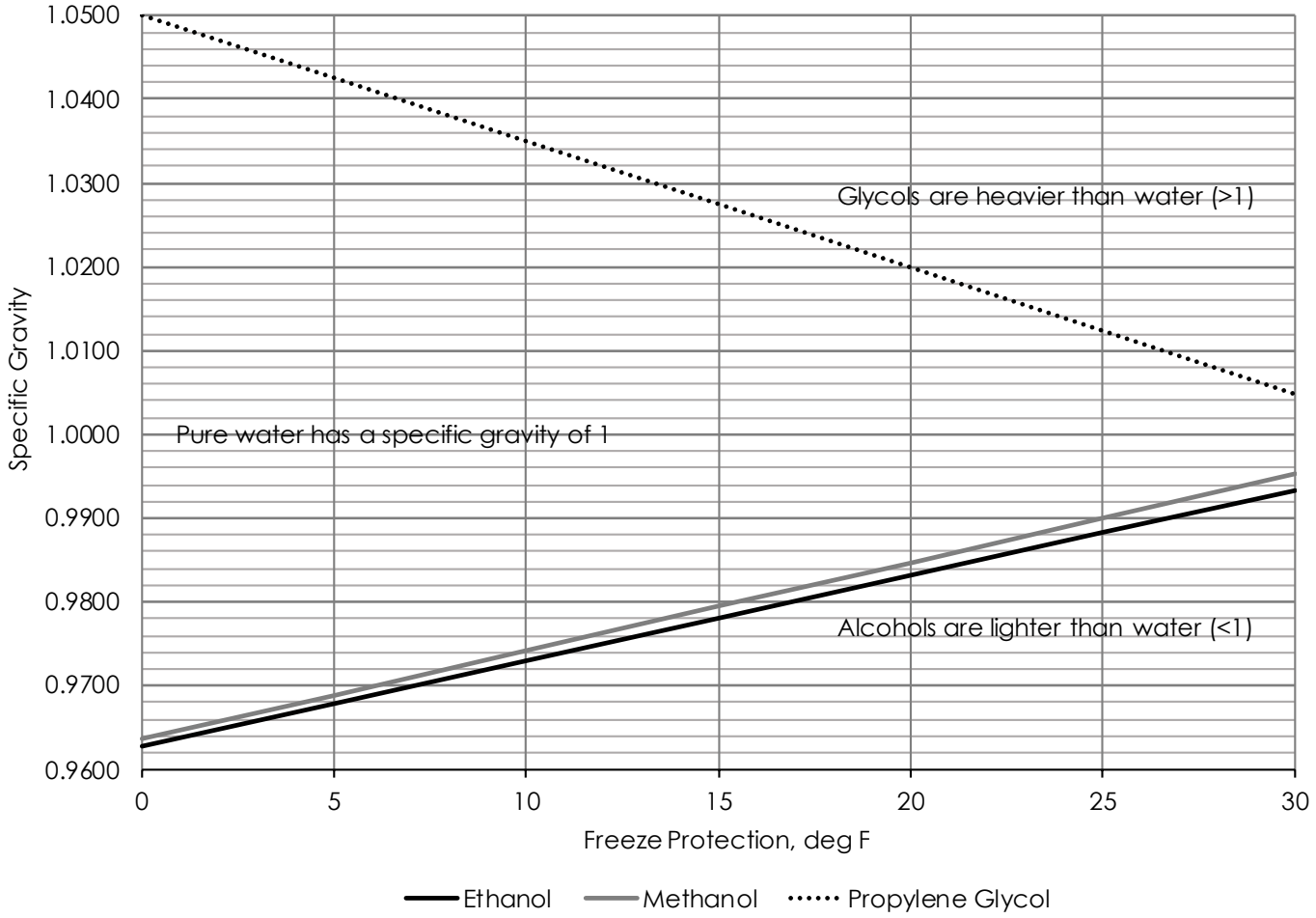
Methanol: Wood grain alcohol that is considered toxic in pure form. It has good heat transfer, low viscosity, is non-corrosive, and is mid to low price. The biggest down side is that it is flammable in concentrations greater than 25%.

Ethanol: Grain alcohol, which by the ATF (Alcohol, Tobacco, Firearms) department of the U.S. government, is required to be denatured and rendered unfit to drink. It has good heat transfer, mid to high price, is non-corrosive, non-toxic even in its pure form, and has medium viscosity. It also is flammable with concentrations greater than 25%. Note that the brand of ethanol is very important. Make sure it has been formulated for the geothermal industry. Some of the denaturants are not compatible with HDPE pipe (for example, solutions denatured with gasoline).

Propylene Glycol: Non-toxic, non-corrosive, mid to high price, poor heat transfer in high concentrations, and potential for high viscosity when cold (in high concentrations). It has also been known to form a "slime-type" coating inside the pipe when inhibitors are not used. Do not use food grade glycol, since it does not include inhibitors. A 25% to 30% brine solution is a minimum concentration for required inhibitors, depending upon brand of glycol. If using a lower concentration (e.g. 20% provides 19°F freeze protection), additional inhibitors must be added. Note that some states/provinces have toxicity requirements that must be verified based upon the chemical composition of the inhibitors.

Section 6: Antifreeze

Specific Gravity Chart



Notes:

1. Consult with your representative or distributor if you have any questions regarding antifreeze selection or use.
2. Some antifreeze suppliers and manufacturers recommend the use of either de-ionized or distilled water with their products. Some brands are designed to work with tap water. Consult the antifreeze manufacturer's technical data.

⚠ CAUTION ⚠

Use extreme care when opening, pouring, and mixing flammable antifreeze solutions. Remote flames or electrical sparks can ignite undiluted antifreezes and vapors. Use only in a well ventilated area. Do not smoke when handling flammable solutions. Failure to observe safety precautions may result in fire, injury, or death. Never work with 100% alcohol solutions.

Section 6: Antifreeze

Antifreeze Charging

Calculate the total amount of pipe in the system and use **(Table #3a)** to calculate the amount of volume for each specific section of the system. Add the entire volume together, and multiply that volume by the proper antifreeze percentage needed **(Table #3b)** for the freeze protection required in your area. Then, double check calculations during installation with the proper hydrometer and specific gravity chart (Figure 7) to determine if the correct amount of antifreeze was added.

Table #3a: Pipe Fluid Volume

Type	Size	Volume Per 100ft US Gallons	Type	Size	Volume Per 100ft US Gallons
Copper	1” CTS	4.1	HDPE	.75” SDR11	3.0
Copper	1.25” CTS	6.4	HDPE	1” SDR11	4.7
Copper	1.5” CTS	9.2	HDPE	1.25” SDR11	7.5
			HDPE	1.5” SDR11	9.8
			HDPE	2” SDR11	15.4

Additional component volumes:
Unit coaxial heat exchanger = 1 Gallon
Flush Cart = 8-10 Gallons
10’ of 1” Rubber Hose = 0.4 Gallons

Table #3b: Antifreeze Percentages by Volume

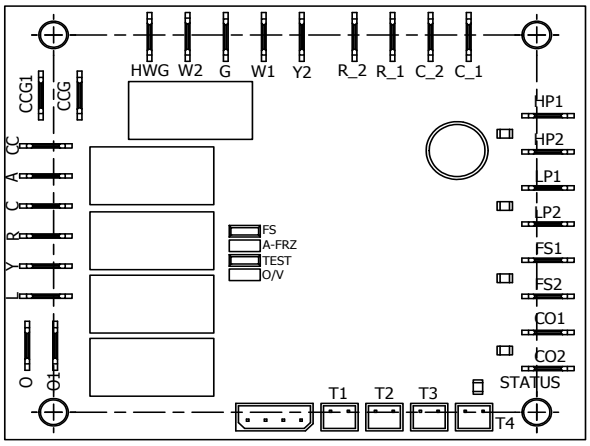
Type of Antifreeze	Minimum Temperature for Freeze Protection			
	10°F (-12.2°C)	15°F (-9.4°C)	20°F (-6.7°C)	25°F (-3.9°C)
ProCool (Ethanol)	26%	23%	18%	13%
Methanol	21%	17%	13%	5%
Propylene Glycol*	30%	25%	20%	13%
Heat Transfer Fluid (HTF)	Mix according to manufacturer’s directions on container label			

Antifreeze solutions are shown in pure form - not premixed
HTF is a premixed Methanol solution
*Concentrations below 25-30% (consult manufacturer) typically require additional inhibitors.

Section 7: Controls

Features

Enertech Global geothermal heat pump controls leverage a modular approach for controlling heat pump operation. The control system uses a combination of printed circuit boards, depending upon the features equipped in a particular unit. This approach simplifies installation and troubleshooting, and eliminates features that are not applicable for some units.



The Lockout Board controls the inputs to the unit as well as outputs for current mode, faults, and diagnostics. A status LED and different combinations of four LEDs for each fault are provided for diagnostics. The Lockout Board terminal “L” puts out the number of corresponding 24VAC pulses to indicate the Lockout condition on the Thermostat (if equipped and wired).

Startup/Random Start

The unit will not operate until all the inputs and safety controls are checked for normal conditions. A ten to twenty second random start delay is added at power up and whenever a Y1 call is received. This avoids multiple units from being energized at the same time after events such as power loss or brown outs.

Short Cycle Protection

A built-in 8 minute anti-short cycle (ASC) timer provides short cycle protection ensuring that the compressor isn’t damaged due to rapid cycling.

Component Sequencing Delays

Components are sequenced and delayed for reduction in surge current, and to reduce startup noise of the system. The accessory terminal on the Lockout Board engages 10 seconds prior to the compressor. This provides increased time for items such as external pumps to provide adequate water flow prior to the system starting.

Test Mode

The Lockout Board allows the technician to shorten timing delays for faster diagnostics by placing the DIP switch ‘TEST’ switch in the ON position (See ‘Settings’ section). It should be moved back to OFF for normal operation after testing. The status LED will not be illuminated during the TEST mode.

Water Solenoid Valve Connections

If equipped, the accessory terminal strip provides a field connection for a valve with an end switch, which is recommended (see wiring diagram). An accessory relay terminal, “A”, can be used for solenoid valves without an end switch. This terminal is energized 10 seconds before the compressor contactor. A valve without an end switch could cause a water hammer effect and is not recommended.

Safety

The lockout board receives feedback signals for high pressure, low pressure, load heat exchanger temperature, and source heat exchanger temperature. Upon a continuous 10-second measurement of all faults (except the high pressure) the compressor operation is suspended. The high pressure fault is tripped instantly. The different combination of LED(s) indicate each temporary fault. Once the unit is locked out (see fault retry below), the Lockout Board outputs a number of 24VAC pulses equal to the numbered fault code.

Low Pressure-LP

If the low pressure switch is open continuously for 30 seconds, the compressor operation will be interrupted, and the control will go into fault retry mode. At startup, the low pressure switch is not monitored for 30 seconds to avoid nuisance faults. (If the low pressure switch is open before startup then the unit will not start upon receiving an Y1 call and will lock out instead.)

High Pressure (HP)

If the high pressure switch opens, the compressor operation will be interrupted, and the control will go into fault retry mode. There is no delay between the time the switch opens and the board entering into fault retry mode. There is also no delay of switch monitoring at startup. (If the high pressure switch is open before startup then the unit will not start upon receiving an Y1 call and will lock out instead.)

Section 7: Controls

Load Heat Exchanger Freeze (T1)

When in cooling mode, if the heat exchanger temperature is lower than 30°F for 10 continuous seconds, the compressor operation will be interrupted, and the control will go into fault retry mode. This sensor is located on the refrigerant line in between the heat exchanger and TXV (refrigerant inlet of heat exchanger in cooling mode).

Source Heat Exchanger Freeze (T4)

When in heating mode, if the heat exchanger is lower than the setpoint for 10 continuous seconds, the compressor operation will be interrupted, and the control will go into fault retry mode. The setpoint is 12°F for closed loop (DIP switch AFRZ = ON) and 30°F for open loop (DIP switch AFRZ = OFF). At startup, the flow sensor is not monitored for 30 seconds to avoid nuisance faults. This sensor is located on the refrigerant line in between the source heat exchanger and TXV (refrigerant inlet of heat exchanger in heating mode).

Domestic Water Safety

Only Vented Units equipped to heat domestic hot water require a separate electrical safety circuit. Units with domestic water creation include an additional contactor which is energized through a thermal switch. This switch is attached to the load outlet and ensures water temperature does not exceed 150°F. Should temperatures reach this point, the switch will open and the secondary contactor will open, disabling the compressor.

Thermistor Sensors

The following table indicates the normal operating range of the temperature sensing thermistors. Readings outside this range are indicative of a bad sensor. The Lockout Board will display the associated fault.

Temperature Sensor Operating Range	
Sensor Name	**Range**
T1	10-200
T2	20-257
T3	20-220
T4	10-220

Over/Under Voltage Protection

The lockout board protects the compressor from operating when an over/under voltage condition exists. The control monitors secondary voltage from the transformer (24VAC) to determine an over/under voltage condition is occurring on the primary side of the transformer. Under voltage (<18VAC) causes the compressor to disengage and restart when the voltage returns to >20VAC. Over voltage (>31VAC) causes the compressor to disengage and restart when the voltage returns to <29VAC.

When an O/U Voltage condition occurs, the board will initiate a fault, shut down the compressor, and start the 8 minute ASC period. All four fault LEDs will flash and the thermostat "Call For Service" indicator will be flashing 11 pulses.
This feature is self- resetting and never retries or locks out. If voltage returns to normal range, normal operation will resume if/when the ASC period is over. When normal operation is restored the four fault LED's will stop flashing and the "Call For Service" indicator will turn off.

When diagnosing a possible bad sensor, the following table may be used to verify a valid temperature reading.

Temp. (°F)	Resistance (KΩ)	TEMP. (°F)	Resistance (KΩ)
10	46.95	130	3.60
15	41.39	200	1.16
20	36.50	220	0.87
30	28.61	250	0.59
77	10.00	257	0.54

Fault Retry

All faults (except O/U Voltage and Bad Thermistor Sensors) are retried twice before finally locking the unit out (three faults total).

The fault retry feature is designed to prevent nuisance service calls. There is an anti-short cycle (ASC) period of 8 minutes between fault retries. On the third fault of the same sensor, within 30 minutes, the board will go into lockout mode and the "Call For Service" indicator on the thermostat will flash the number of pulses that correspond to the fault as shown in Fault Indication Table.

Intelligent Lockout Reset

If the thermostat is powered off (Y1 removed) for one minute then back on (soft reset), the board will reset and the last fault will be stored in memory for ease of troubleshooting. If main power is interrupted to the board, the fault memory will be cleared (hard reset).

Control Board Switch Settings and Diagnostics

For fast and simple control board diagnosis, the lockout board includes five LEDs: Green, Orange, Red, Yellow, and a Green status indicator.

The Lockout Board LED Identification Table is located on the following page.

Section 7: Controls

Lockout Board LED Identification Table

LOCKOUT BOARD LED IDENTIFICATION & L TERMINAL STATUS						
CONDITION	GREEN HP	ORANGE LP	RED FS	YELLOW CO	STATUS GREEN	L TERMINAL[1]
NORMAL MODE					FLASH	
TEST MODE[2]						
HP FAULT	FLASH				FLASH	
HP LOCKOUT	ON				FLASH	ON
LP FAULT		FLASH			FLASH	
LP LOCKOUT		ON			FLASH	ON
SOURCE COIL FRZ/ WF FAULT (T4/FS)[3]			FLASH		FLASH	
SOURCE COIL FRZ/ WF LOCKOUT (T4/FS)[3]			ON		FLASH	ON
LOAD/ AIR COIL FRZ FAULT (T1)[4,5]		FLASH	FLASH		FLASH	
LOAD/ AIR COIL FRZ LOCKOUT (T1)[4,5]		ON	ON		FLASH	ON
CO FAULT[5]				FLASH	FLASH	
CO LOCKOUT[5]				ON	FLASH	ON
O/ U VOLTAGE	FLASH	FLASH	FLASH	FLASH	FLASH	ON
T1 FAULTY[5,6]	FLASH			ON	FLASH	FLASH
T2 FAULTY[5,6]		FLASH		ON	FLASH	FLASH
T3 FAULTY[5,6]			FLASH	ON	FLASH	FLASH
T4 FAULTY[5,6]		ON		FLASH	FLASH	FLASH
T1 & T4 SWAPPED[7]	ON			ON		FLASH
HOT GAS LINE FAULT > 220˚F (T2)[8]	FLASH		FLASH	ON	FLASH	
HOT GAS LINE LOCKOUT > 220˚F (T2)[8]	ON		ON	ON	FLASH	ON

LOCKOUT BOARD JUMPERS		
JUMPER	INSTALLED	REMOVED
FS	T1 & T4 MONITORED FOR FLOW- 'FS' TERMINALS IGNORED	FS' TERMINALS USED FOR FLOW SWITCH- T1 & T4 IGNORED
A-FRZ	OPEN LOOP MODE- 30˚F SETTING FOR T4	CLOSED LOOP MODE- 15˚F SETTING FOR T4
TEST	OPERATES IN NORMAL MODE WITH STANDARD DELAYS	OPERATES IN TEST MODE WITH DELAYS SPED UP
O/ V	FEATURE IS ACTIVE	FEATURE IS INACTIVE

NOTES:

1. THE 'L' TERMINAL CONTROLS A FAULT LED AT THE THERMOSTAT OR DRIVES AN AUXILIARY FAULT RELAY.
2. WHEN THE TEST JUMPER IS PULLED, GREEN STATUS LED WILL BE OFF.
3. DEPENDING UPON MODEL, THE SOURCE COIL FRZ/ WATER FLOW FAULT OR LOCKOUT CAN BE AN INTERNAL OR EXTERNAL FLOW SWITCH (FS), OR A SENSOR (T4) LOCATED BETWEEEN THE TXV AND SOURCE COIL.
4. THE LOAD/ AIR COIL FREEZE PROTECTION SENSOR IS LOCATED BETWEEN THE TXV AND LOAD/ AIR COIL.
5. NOT ALL MODELS HAVE THIS FEATURE.
6. THIS FAULT INDICATES A BAD SENSOR (OPEN, SHORTED, OR DISCONNECTED).
7. THIS CAN ONLY BE CHECKED WHILE IN TEST MODE.
8. HOT GAS LINE IS TOO HOT.

Section 7: Controls

Lockout Board Jumper Selection
The lockout board includes four jumpers for field selection of various board features.

Load/Source HX Temperature Sensing (FS)
When the FS jumper is installed (T1 and T4 monitored, FS terminals ignored), the board operates in the load and source heat exchanger temperature sensing mode, which is the factory setting.

Anti-Freeze (A-FRZ)
When the jumper is installed, the board operates in open loop mode. The setpoint for the source heat exchanger freeze sensor is 30°F. When the A-FRZ jumper is removed, the board operates in the closed loop mode. The setpoint for the source heat exchanger freeze sensor is 15°F.

Test Mode (TEST)
When the TEST jumper is installed, the board operates in the normal mode. When the jumper is removed, the board operates in test mode, which speeds up all delays for easier troubleshooting. While in the test mode the T1 & T4 sensors will be checked for the proper location based on temperature. Sensors are swapped if T1>T4 in cooling or T1<T4 in heating. This fault will only show up in the test mode. When service is complete, the jumper must be re-installed in order to make sure the unit operates with normal sequencing delays. While the test jumper is removed, the status light (bottom green) will remain off. If the test jumper is not re-installed the control will revert to normal mode after one (1) hour, green status light blinking.

Over/Under Voltage Disable (O/U)
When the O/U jumper is installed, the over/under voltage feature is active. When the jumper is removed, the over/under voltage feature is disabled. On rare occasions, variations in voltage will be outside the range of the over/under voltage feature, which may require removal of the jumper. However, removal of the jumper could cause the unit to run under adverse conditions, and therefore should not be removed without contacting technical services. An over/under voltage condition could cause premature component failure or damage to the unit controls. Any condition causing this fault must be thoroughly investigated before taking any action regarding the jumper removal.

Sequence of Operation
This description is based on the HP Water-to-Water Units, Single-Stage Compressor, heating only.

Timings assume the ASC timer (8 min) is expired. If the ASC timer is not expired the accessory, compressor, and loop pump operation do not start until the ASC timer is expired.

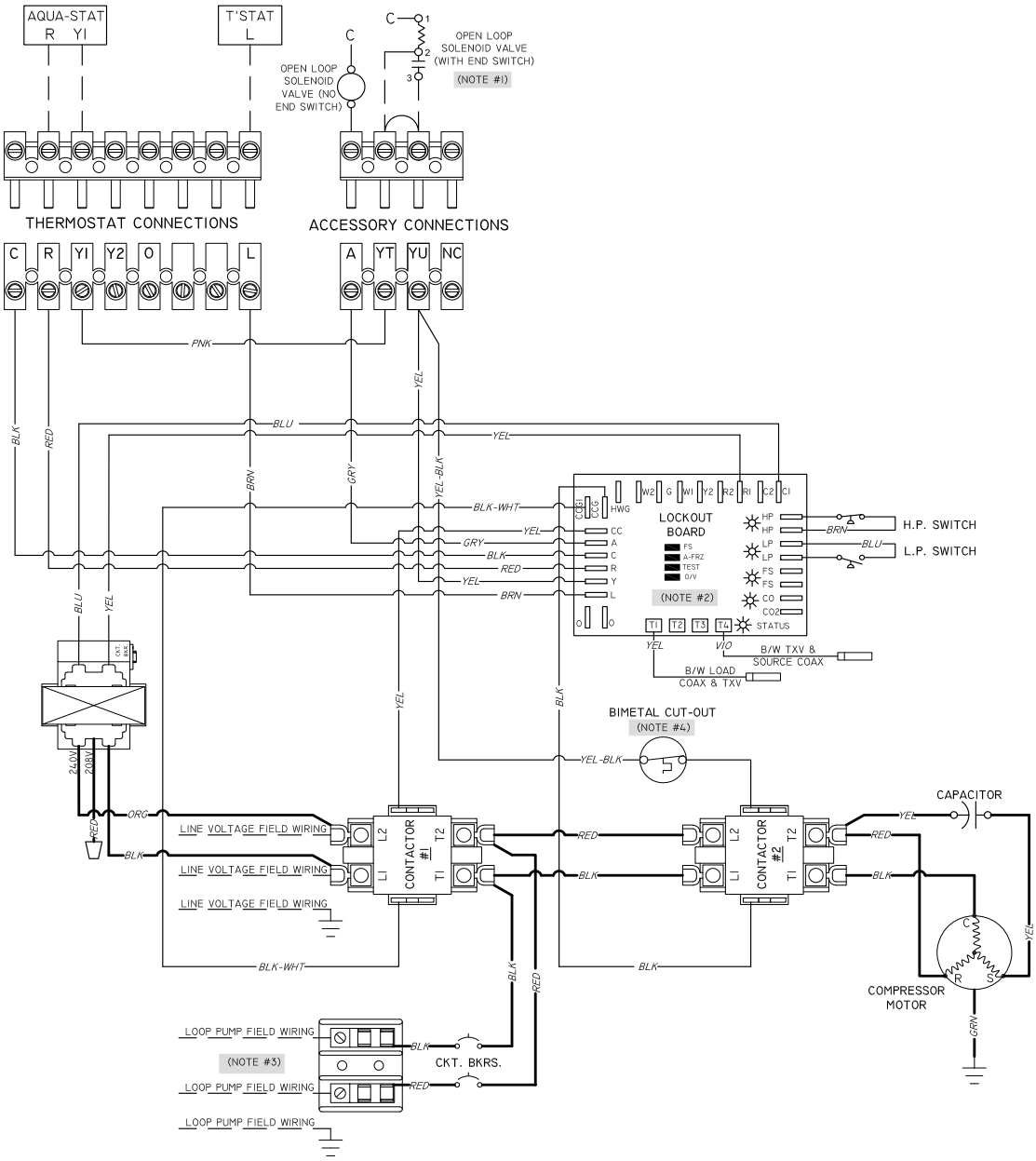
The Accessory (A) terminal output is energized after the random start timer (10s-20s) expires. After another 10 second delay, the compressor and the loop pump(s) are energized.

This unit utilizes two contactors and a bi-metal normally closed temperature switch located on the leaving water line to comply with UL/CSA requirements for units providing domestic hot water. Operation is as follows:

1. When the aqua-stat calls for heating, the Y terminal at the lockout board is energized. If the unit is not in fault mode and the ASC timer has expired, the lockout board will send 24 VAC to the pump contactor coil (labeled "contactor #1" on the wiring diagram), which will energize the pumps and provide line voltage to the compressor contactor (labeled "contactor #2" on the wiring diagram).
2. At the same time the Y terminal is energized at the lockout board, the compressor contactor coil is energized. If the pump contactor is energized AND the bi-metal switch is closed, the compressor will be energized. The pumps and the compressor are normally energized at the same time. Even though contactor #2 may be energized before contactor #1, it cannot get power until contactor #1 is energized.
3. The bi-metal switch is part of the safety circuit and opens at 150 deg. F (normally closed -- opens on temperature rise). Once the switch opens, it closes again when the water line cools to 135 deg. F. The pumps will continue to run, even if the bi-metal cut-off is open, as long as there is still a call from the aqua-stat.

Section 8: Wiring Diagram

Single Stage, Single Phase, 208/230V, 60hz, Residential



NOTES:

1. FACTORY INSTALLED JUMPER (BLACK) BETWEEN 'YT' AND 'YU' TERMINALS. REMOVE FOR USE WITH SOLENOID VALVE WITH END SWITCH.
2. SEE LOCKOUT BOARD LABEL FOR JUMPER SELECTION/ DESCRIPTION.
3. LOAD SIDE PUMPING IS HANDLED VIA CONNECTION TO THE LOOP PUMP TERMINAL BLOCK (I.E. THE LOOP PUMP AND LOAD PUMPS CAN BE POWERED FROM THE UNIT AS LONG AS NO MORE THAN THREE UP26-116 PUMPS ARE CONNECTED).
4. BIMETAL CUT-OUT IS A NORMALLY CLOSED SPST SWITCH THAT WILL OPEN ON TEMPERATURE RISE.

Section 9: Equipment Start-Up

Equipment Start-Up Form

Customer Name:_____

Customer Address:_____

Model #:_____ Serial #:_____

Dealer Name:_____

Distributor Name:_____ Start-up Date:_____

Loop Type: Open Closed (Circle One)									
Flow Rate	**Cooling**		**Heating**		**Unit Electrical Data**	**Cooling**		**Heating**	
Source Water Pressure In		PSI		PSI	Line Voltage		V		
Source Water Pressure Out		PSI		PSI	Total Unit Amps		A		A
Source Water Pressure Drop		PSI		PSI	Compressor Amps		A		A
Flow Rate		GPM		GPM	Wire Size		GA		
*Check pressure drop chart for GPM					Circuit Breaker Size		A		

Source Water Temp. Difference	**Cooling**		**Heating**	
Source Water Temperature In		ºF		ºF
Source Water Temperature Out		ºF		ºF
Source Water Temperature Difference		ºF		ºF
Heat of Rejection/Extraction	**Cooling**		**Heating**	
Heat of Rejection		BTU/HR		
Heat Of Extraction				BTU/HR

Heat of Extraction/Rejection = GPM X Water Temp. Difference X 500 (Water - Open Loop)
Heat of Extraction/Rejection = GPM X Water Temp. Difference X 485 (Water & Antifreeze - Closed Loop)

Load Water Temp. Difference	**Cooling**		**Heating**	
Load Water Temperature In		ºF		ºF
Load Water Temperature Out		ºF		ºF
Load Water Temperature Difference		ºF		ºF
Air Temperature Difference	**Cooling**		**Heating**	
Supply Air Temperature		ºF		ºF
Return Air Temperature		ºF		ºF
Air Temp. Difference		ºF		ºF
*Confirm auxiliary heaters are de-energized for the above readings.				
Auxiliary Heat Operation Only			**Heating**	
Supply Air Temperature				ºF
Return Air Temperature				ºF
Air Temp. Difference				ºF
Auxiliary Heat Electrical Data			**Heating**	
Line Voltage				V
Total Amperage (Full kW - All Stages)				A
Wire Size				GA
Breaker Size				A
CFM = (Watts X 3.413) ÷ (Air Temp. Difference X 1.08)				
Watts = Volts X Auxiliary Heater Amps				

Installer/Technician:_____ Date:_____

Check the following before power is applied to the equipment

Caution: Do not start-up the unit until the new structure is ready to be occupied

Electrical:

- ☐ Geothermal unit high voltage wiring is installed correctly
- ☐ Geothermal unit high voltage wiring and breaker are the correct size
- ☐ Auxiliary electric heaters are wired and installed correctly
- ☐ Circulating pumps are wired and fused (if necessary) correctly
- ☐ Desuperheater pump is NOT wired, unless piping is complete and all air is purged
- ☐ Low voltage wiring is correct and completely installed

Plumbing:

- ☐ Pipe and pump sizes are correct
- ☐ Air is purged from all lines
- ☐ Antifreeze is installed
- ☐ All valves are open, including those on the flow center
- ☐ Condensate is trapped and piped to the drain

Ductwork:

- ☐ Filter is installed and clean
- ☐ Packaging is removed from the blower assembly
- ☐ Blower turns freely
- ☐ Canvas connections installed on supply plenum & return drop

Equipment Start-Up

1. Energize geothermal unit with high voltage.
2. Set the thermostat to “Heat” or “Cool.” Adjust set point to energize the unit. System will energize after delays expire (typically a five minute delay).
3. Check water flow with a flow meter (non-pressurized) or pressure drop conversion (pressurized). Pressure drop tables must be used to convert the pressure drop to GPM. The pressure drop can be obtained by checking water pressure in and water pressure out at the P/T ports.
4. Check the geothermal unit’s electrical readings listed in the Unit Electrical Data table.
5. Check the source water temperature in and out at the P/T ports (use insertion probe). Allow 10 minutes of operation before recording temperature drop.
6. Calculate the heat of extraction or heat of rejection.
7. Check the temperature difference of the load coax (water-to-water) or air coil (water-to-air). P/T ports are recommended for use on the load side, but the line temperatures can be used to check the temperature difference.
8. Change the mode of the thermostat and adjust the set point to energize the unit. Check the data in opposite mode as the previous tests. Amp draws as well as temperature differences and flow rate should be recorded.
9. Check auxiliary heat operation by adjusting the thermostat set point 5°F above the room temperature in “Heat” mode or set thermostat to “Emergency." Record voltage, amperage, and air temperature difference.

Section 9: Equipment Start-Up: HE Table

HE Table

Model	Source Flow		Load Flow 3 GPM					Load Flow 4.5 GPM					Load Flow 6 GPM				
	EST	GPM	Heat of Extraction (MBtuh)					Heat of Extraction (MBtuh)					Heat of Extraction (MBtuh)				
	°F		50 °F	80 °F	100 °F	120 °F	130 °F	50 °F	80 °F	100 °F	120 °F	130 °F	50 °F	80 °F	100 °F	120 °F	130 °F
HP024 Vented Version	30	3.0	22.4	18.5	15.6			22.6	18.8	15.9			22.9	19.1	16.3	13.1	
		4.5	23.4	19.4	16.4			23.6	19.7	16.7			23.9	20.0	17.1	13.8	
		6.0	24.4	20.2	17.2			24.6	20.5	17.5			24.9	20.9	17.9	14.6	
	50	3.0	29.8	25.1	21.7	17.8		30.0	25.5	22.1	18.3		30.3	25.8	22.5	18.7	
		4.5	31.1	26.3	22.8	18.8		31.3	26.6	23.2	19.2		31.6	27.0	23.6	19.7	17.5
		6.0	32.3	27.4	23.8	19.7		32.6	27.8	24.2	20.2		32.9	28.2	24.7	20.7	18.5
	70	3.0	38.7	33.3	29.3	24.8		38.9	33.6	29.7	25.3		39.3	34.0	30.2	25.8	23.3
		4.5	40.3	34.7	30.7	26.0		40.6	35.1	31.1	26.5		40.9	35.5	31.6	27.1	24.5
		6.0	41.9	36.2	32.0	27.3		42.2	36.6	32.5	27.8		42.6	37.0	32.9	28.3	25.7
	90	3.0	47.9	41.8	37.3	32.2		48.2	42.2	37.8	32.7		48.6	42.6	38.3	33.3	
		4.5	49.9	43.6	39.0	33.8		50.2	44.0	39.5	34.3		50.6	44.5	40.0	34.8	
		6.0	51.9	45.4	40.7	35.3		52.2	45.8	41.1	35.8		52.6	46.3	41.7	36.4	
HP024 Unvented Version	30	3.0	20.6	17.1	14.5			21.0	17.6	15.0	11.8		21.3	17.9	15.4	12.2	
		4.5	22.0	18.4	15.7			22.4	18.9	16.2	12.9		22.7	19.3	16.6	13.4	
		6.0	23.0	19.4	16.6			23.4	19.8	17.1	13.7		23.8	20.2	17.5	14.2	
	50	3.0	28.0	23.9	20.9	17.0		28.4	24.5	21.4	17.6	15.3	28.8	24.9	21.9	18.1	15.8
		4.5	29.8	25.6	22.5	18.4		30.3	26.2	23.1	19.1	16.6	30.7	26.6	23.5	19.6	17.2
		6.0	31.2	26.9	23.6	19.5		31.7	27.5	24.2	20.2	17.7	32.1	27.9	24.7	20.7	18.2
	70	3.0	36.0	31.4	27.9	23.5		36.6	32.0	28.6	24.2		37.0	32.5	29.1	24.8	22.1
		4.5	38.4	33.6	30.0	25.3		39.0	34.2	30.6	26.0		39.4	34.8	31.2	26.7	23.8
		6.0	40.1	35.2	31.5	26.7		40.7	35.8	32.1	27.4		41.2	36.4	32.7	28.0	25.1
	90	3.0	43.7	38.6	34.7			44.3	39.3	35.4	30.5		44.8	39.8	36.0	31.2	28.1
		4.5	46.5	41.2	37.2	32.0		47.1	41.9	37.9	32.8		47.6	42.5	38.5	33.4	30.3
		6.0	48.6	43.1	39.0	33.6		49.2	43.8	39.7	34.4		49.7	44.4	40.3	35.1	

1. Operation is not recommended in areas with black shading. Operation is permissible for short periods of time in gray shaded areas.
2. Capacity data is based on 15% (by volume) methanol antifreeze solution (multiplier: 485) on the source side and pure water (multiplier: 500) on the load side.
3. Any condition outside this performance table is not allowed to ensure safe and continuous operation.
4. Performance data accurate within ±15%.
5. Performance data is based upon the lower voltage of dual voltage rated units.
6. Interpolation of unit performance data is permissible; extrapolation is not.
7. Due to variations in installation, actual unit performance may vary from the tabulated data.

Section 10: Troubleshooting: WPD Table

WPD Table

Model	EST	Source Flow		Load Flow 3 GPM					Load Flow 4.5 GPM					Load Flow 6 GPM					Load Flow 8 GPM				
				Load Water Pressure Drop (PSI)					Load Water Pressure Drop (PSI)					Load Water Pressure Drop (PSI)					Load Water Pressure Drop (PSI)				
	°F	GPM	PSI	50 °F	80 °F	100 °F	120 °F	130 °F	50 °F	80 °F	100 °F	120 °F	130 °F	50 °F	80 °F	100 °F	120 °F	130 °F	50 °F	80 °F	100 °F	120 °F	130 °F
HP024 Vented Version	25	6.0	2.3	2.0	1.9	1.8	1.8	1.8	2.6	2.5	2.4	2.3	2.3	3.4	3.2	3.1	3.0	2.9	4.7	4.4	4.2	4.1	4.0
		8.0	3.8	2.0	1.9	1.8	1.8	1.8	2.6	2.5	2.4	2.3	2.3	3.4	3.2	3.1	3.0	2.9	4.7	4.4	4.2	4.1	4.0
	30	3.0	1.1	2.0	1.9	1.8	1.8	1.7	2.6	2.4	2.4	2.3	2.3	3.4	3.2	3.0	3.0	2.9	4.6	4.3	4.2	4.1	4.0
		4.5	1.5	2.0	1.9	1.8	1.8	1.7	2.6	2.4	2.4	2.3	2.3	3.4	3.2	3.0	3.0	2.9	4.6	4.3	4.2	4.1	4.0
		6.0	2.2	2.0	1.9	1.8	1.8	1.7	2.6	2.4	2.4	2.3	2.3	3.4	3.2	3.0	3.0	2.9	4.6	4.3	4.2	4.1	4.0
		8.0	3.6	2.0	1.9	1.8	1.8	1.7	2.6	2.4	2.4	2.3	2.3	3.4	3.2	3.0	3.0	2.9	4.6	4.3	4.2	4.1	4.0
	50	3.0	0.8	1.9	1.8	1.7	1.7	1.7	2.5	2.3	2.2	2.2	2.1	3.2	3.0	2.9	2.8	2.8	4.4	4.1	3.9	3.8	3.8
		4.5	1.2	1.9	1.8	1.7	1.7	1.7	2.5	2.3	2.2	2.2	2.1	3.2	3.0	2.9	2.8	2.8	4.4	4.1	3.9	3.8	3.8
		6.0	1.8	1.9	1.8	1.7	1.7	1.7	2.5	2.3	2.2	2.2	2.1	3.2	3.0	2.9	2.8	2.8	4.4	4.1	3.9	3.8	3.8
		8.0	2.8	1.9	1.8	1.7	1.7	1.7	2.5	2.3	2.2	2.2	2.1	3.2	3.0	2.9	2.8	2.8	4.4	4.1	3.9	3.8	3.8
	70	3.0	0.7	1.9	1.8	1.7	1.7	1.6	2.5	2.3	2.2	2.1	2.1	3.2	3.0	2.8	2.8	2.7	4.3	4.0	3.9	3.8	3.8
		4.5	1.0	1.9	1.8	1.7	1.7	1.6	2.5	2.3	2.2	2.1	2.1	3.2	3.0	2.8	2.8	2.7	4.3	4.0	3.9	3.8	3.8
		6.0	1.5	1.9	1.8	1.7	1.7	1.6	2.5	2.3	2.2	2.1	2.1	3.2	3.0	2.8	2.8	2.7	4.3	4.0	3.9	3.8	3.8
		8.0	2.4	1.9	1.8	1.7	1.7	1.6	2.5	2.3	2.2	2.1	2.1	3.2	3.0	2.8	2.8	2.7	4.3	4.0	3.9	3.8	3.8
	90	3.0	0.7	1.9	1.8	1.7	1.7	1.6	2.5	2.3	2.2	2.1	2.1	3.2	3.0	2.8	2.8	2.7	4.3	4.0	3.9	3.8	3.8
		4.5	1.0	1.9	1.8	1.7	1.7	1.6	2.5	2.3	2.2	2.1	2.1	3.2	3.0	2.8	2.8	2.7	4.3	4.0	3.9	3.8	3.8
		6.0	1.4	1.9	1.8	1.7	1.7	1.6	2.5	2.3	2.2	2.1	2.1	3.2	3.0	2.8	2.8	2.7	4.3	4.0	3.9	3.8	3.8
		8.0	2.3	1.9	1.8	1.7	1.7	1.6	2.5	2.3	2.2	2.1	2.1	3.2	3.0	2.8	2.8	2.7	4.3	4.0	3.9	3.8	3.8
HP024 Unvented Version	25	6.0	2.3	1.5	1.5	1.4	1.4	1.3	1.9	1.9	1.8	1.7	1.7	2.4	2.3	2.2	2.1	2.1	3.0	2.9	2.8	2.7	2.7
		8.0	3.8	1.5	1.5	1.4	1.4	1.3	1.9	1.9	1.8	1.7	1.7	2.4	2.3	2.2	2.1	2.1	3.0	2.9	2.8	2.7	2.7
	30	3.0	1.1	1.5	1.5	1.4	1.4	1.3	1.9	1.9	1.8	1.7	1.7	2.4	2.3	2.2	2.1	2.1	3.0	2.9	2.8	2.7	2.7
		4.5	1.5	1.5	1.5	1.4	1.4	1.3	1.9	1.9	1.8	1.7	1.7	2.4	2.3	2.2	2.1	2.1	3.0	2.9	2.8	2.7	2.7
		6.0	2.2	1.5	1.5	1.4	1.4	1.3	1.9	1.9	1.8	1.7	1.7	2.4	2.3	2.2	2.1	2.1	3.0	2.9	2.8	2.7	2.7
		8.0	3.6	1.5	1.5	1.4	1.4	1.3	1.9	1.9	1.8	1.7	1.7	2.4	2.3	2.2	2.1	2.1	3.0	2.9	2.8	2.7	2.7
	50	3.0	0.8	1.5	1.4	1.4	1.3	1.3	1.9	1.8	1.8	1.7	1.7	2.4	2.3	2.2	2.1	2.1	3.0	2.9	2.8	2.7	2.6
		4.5	1.2	1.5	1.4	1.4	1.3	1.3	1.9	1.8	1.8	1.7	1.7	2.4	2.3	2.2	2.1	2.1	3.0	2.9	2.8	2.7	2.6
		6.0	1.8	1.5	1.4	1.4	1.3	1.3	1.9	1.8	1.8	1.7	1.7	2.4	2.3	2.2	2.1	2.1	3.0	2.9	2.8	2.7	2.6
		8.0	2.8	1.5	1.4	1.4	1.3	1.3	1.9	1.8	1.8	1.7	1.7	2.4	2.3	2.2	2.1	2.1	3.0	2.9	2.8	2.7	2.6
	70	3.0	0.7	1.5	1.4	1.4	1.3	1.3	1.9	1.8	1.8	1.7	1.7	2.3	2.2	2.2	2.1	2.0	2.9	2.8	2.8	2.6	2.6
		4.5	1.0	1.5	1.4	1.4	1.3	1.3	1.9	1.8	1.8	1.7	1.7	2.3	2.2	2.2	2.1	2.0	2.9	2.8	2.8	2.6	2.6
		6.0	1.5	1.5	1.4	1.4	1.3	1.3	1.9	1.8	1.8	1.7	1.7	2.3	2.2	2.2	2.1	2.0	2.9	2.8	2.8	2.6	2.6
		8.0	2.4	1.5	1.4	1.4	1.3	1.3	1.9	1.8	1.8	1.7	1.7	2.3	2.2	2.2	2.1	2.0	2.9	2.8	2.8	2.6	2.6
	90	3.0	0.7	1.5	1.4	1.4	1.3	1.3	1.9	1.8	1.7	1.7	1.6	2.3	2.2	2.2	2.1	2.0	2.9	2.8	2.7	2.6	2.6
		4.5	1.0	1.5	1.4	1.4	1.3	1.3	1.9	1.8	1.7	1.7	1.6	2.3	2.2	2.2	2.1	2.0	2.9	2.8	2.7	2.6	2.6
		6.0	1.4	1.5	1.4	1.4	1.3	1.3	1.9	1.8	1.7	1.7	1.6	2.3	2.2	2.2	2.1	2.0	2.9	2.8	2.7	2.6	2.6
		8.0	2.3	1.5	1.4	1.4	1.3	1.3	1.9	1.8	1.7	1.7	1.6	2.3	2.2	2.2	2.1	2.0	2.9	2.8	2.7	2.6	2.6

1. Pressure drop data is based on 15% (by volume) methanol antifreeze solution on the source side and pure water on the load side.
2. Pressure drop data accurate within ±25%.
3. Interpolation of unit pressure drop data is permissible; extrapolation is not.
4. Due to variations in installation, actual unit performance may vary from the tabulated data.

Performance Check:
Heat of Extraction(HE)/Rejection(HR)
Record information on the Unit Start-up Form

Equipment should be in operation for a minimum of 10 minutes in heating mode

1. Determine flow rate in gallons per minute
   a. Check entering water temperature
   b. Check entering water pressure
   c. Check leaving water pressure

Once this information is recorded, find corresponding entering water temperature column in Specification Manual for unit.

Find pressure differential in PSI column in Spec Manual. Then read the GPM column in Spec Manual to determine flow in GPM.

2. Check leaving water temperature of unit.
FORMULA: GPM x water temp diff. x 485 (antifreeze) or 500 (fresh water) = HE or HR in BTU/HR

A 10% variance from Spec Manual is allowed. Always use the same pressure gauge & temperature measuring device.

Water flow must be in range of Specification Manual. If system has too much water flow, performance problems should be expected.

Section 10: Troubleshooting

A: UNIT WILL NOT START IN EITHER CYCLE

Thermostat	Set thermostat on heating and highest temperature setting. Unit should run. Set thermostat on cooling and lowest temperature setting. Unit should run. Set fan to On position. Fan should run. If unit does not run in any position, disconnect wires at heat pump terminal block and jump R, G, Y. Unit should run in heating. If unit runs, replace thermostat with correct thermostat only.
Loose or broken wires	Tighten or replace wires.
Blown Fuse/ Tripped Circuit Breakers	Check fuse size, replace fuse or reset circuit breaker. Check low voltage circuit breaker.
Low Voltage Circuit	Check 24 volt transformer. If burned out or less than 24 volt, replace. Before replacing, verify tap setting and correct if necessary.
Water Flow (runs for 30 sec)	If water flow is low (less than 3.5 GPM), unit will not start. Make sure Pump Module or solenoid valve is connected (see wiring diagram). Water has to flow through the heat exchanger in the right direction (see labels at water fitting connections) before the compressor can start. If water flow is at normal flow, use an ohmmeter to check if you get continuity at the flow switch. If no switch is open and flow is a normal flow, remove switch and check for stuck particles or bad switch.

B: UNIT RUNNING NORMAL, BUT SPACE TEMPERATURE IS UNSTABLE

Thermostat	Thermostat is getting a draft of cold or warm air. Make sure that the wall or hole used to run thermostat wire from the ceiling or basement is sealed, so no draft can come to the thermostat. Faulty Thermostat (Replace).

C: NO WATER FLOW

Pump Module	Make sure Pump Module is connected to the control box relay (check all electrical connections). For non-pressurized systems, check water level in Pump Module. If full of water, check pump. Close valve on the pump flanges and loosen pump. Take off pump and see if there is an obstruction in the pump. If pump is defective, replace. For pressurized systems, check loop pressure. Repressurize if necessary. May require re-flushing if there is air in the loop.
Solenoid valve	Make sure solenoid valve is connected. Check solenoid. If defective, replace.

D: IN HEATING OR COOLING MODE, UNIT OUTPUT IS LOW

Water	Water flow & temperature insufficient.
Load Side Flow	Check speed setting, check nameplate or data manual for proper speed, and correct speed setting. Check for dirty air filter—Clean or replace. Restricted or leaky ductwork. Repair.
Refrigerant charge	Refrigerant charge low, causing inefficient operation. Make adjustments only after airflow and water flow are checked.

E: IN HEATING OR COOLING MODE, UNIT OUTPUT IS LOW

Water heat exchanger	Check for high-pressure drop, or low temperature drop across the coil. It could be scaled. If scaled, clean with condenser coil cleaner.
System undersized	Recalculate conditioning load.

F: WATER HEAT EXCHANGER FREEZES IN HEATING MODE

Water flow	Low water flow. Increase flow. See F. No water flow.
Flow Switch	Check switch. If defective, replace.

G: EXCESSIVE HEAD PRESSURE IN HEATING MODE

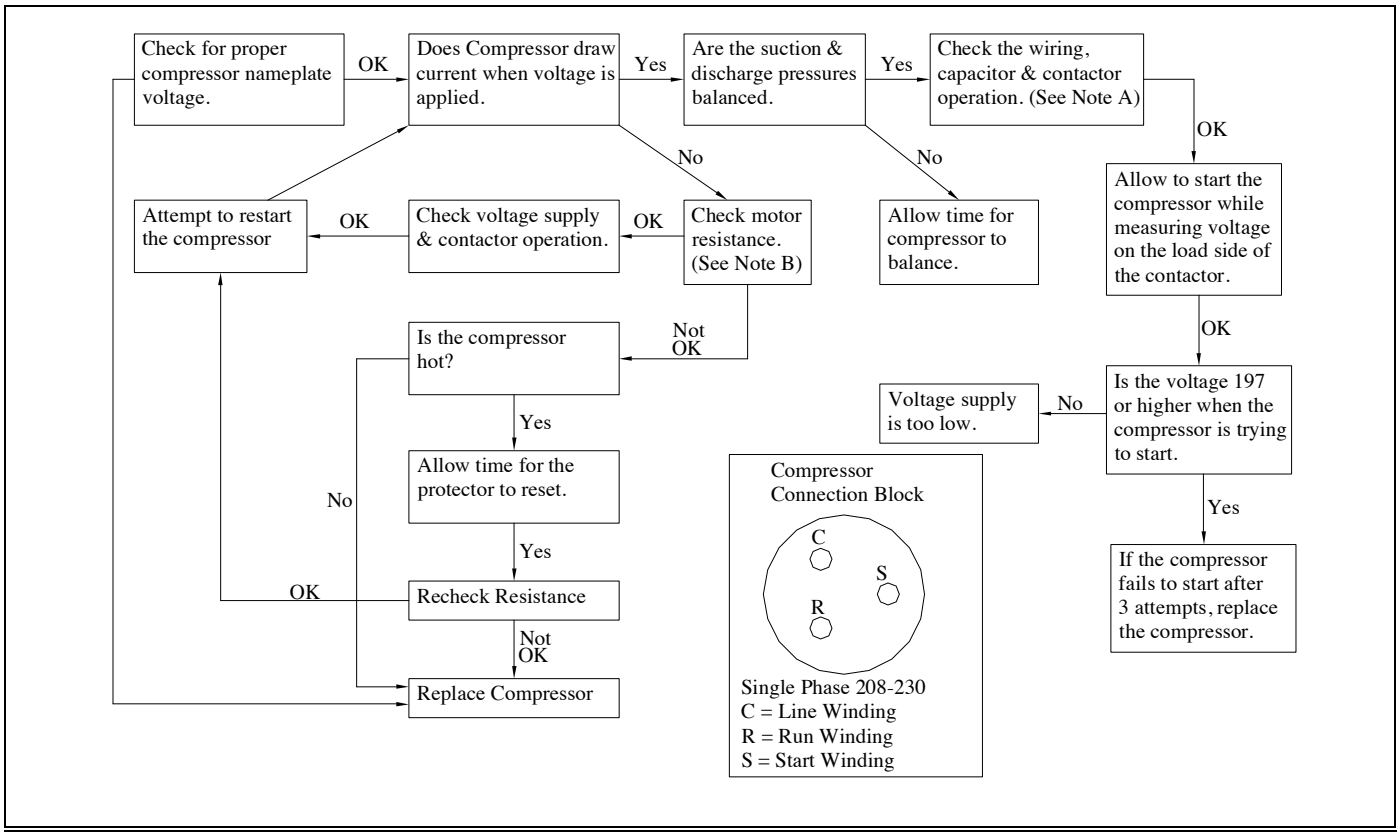
Load Side Flow	See E: Noisy blower and low air flow.

H: WATER DRIPPING FROM UNIT

Unit not level	Level unit.
Condensation drain line plugged	Unplug condensation line.
Water sucking off the air coil in cooling mode	Too much airflow. Duct work not completely installed. If duct work is not completely installed, finish duct work. Check static pressure and compare with air flow chart in spec manual under specific models section. If ductwork is completely installed it may be necessary to reduce CFM.
Water sucking out of the drain pan	Install an EZ-Trap or P-Trap on the drain outlet so blower cannot suck air back through the drain outlet.

Section 10: Troubleshooting

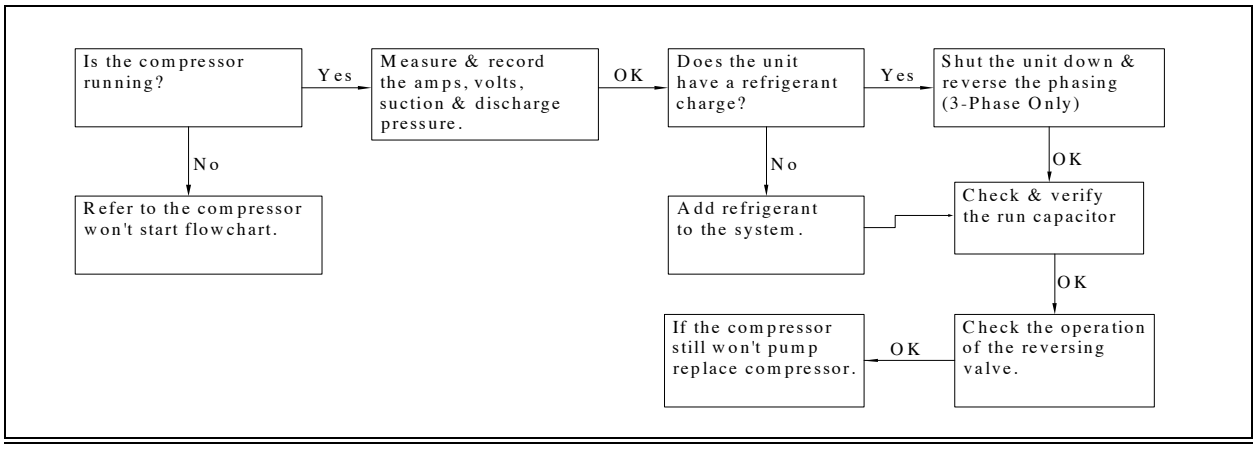
I: COMPRESSOR WON'T START



A: Check all terminals, wires & connections for loose or burned wires and connections. Check contactor and 24 Volt coil. Check capacitor connections & check capacitor with capacitor tester.

B: If ohm meter reads 0 (short) resistance from C to S, S to R, R to C or from anyone of one of these terminals to ground (shorted to ground), compressor is bad.

J: COMPRESSOR WON'T PUMP CHART



Section 10: Troubleshooting

Refrigeration Troubleshooting

System Faults	Mode	Discharge Pressure	Suction Pressure	Superheat	Subcooling	Air TD	Water TD	Compressor Amps
Under Charge	Heat	Low	Low	High	Low	Low	Low	Low
	Cool	Low	Low	High	Low	Low	Low	Low
Over Charge	Heat	High	High/Normal	Normal	High	High	Normal	High
	Cool	High	High/Normal	Normal	High	Normal	High	High
Low Air Flow	Heat	High	High/Normal	Normal	High/Normal	High	Low	High
	Cool	Low	Low/Normal	Low	Normal	High	Low	High/Normal
Low Source Water Flow	Heat	Low	Low/Normal	Low	Normal	High	Low	High/Normal
	Cool	High	High/Normal	Normal	High/Normal	High	Low	High
Low Load Water Flow	Heat	High	High/Normal	Normal	High/Normal	High	Low	High
	Cool	Low	Low/Normal	Low	Normal	High	Low	High/Normal
Restricted TXV	Heat	High	Low	High	High	Low	Low	Low
	Cool	High	Low	High	High	Low	Low	Low
TXV Stuck Open	Heat	Low	High/Normal	Low	Low	Low	Low	High
	Cool	Low	High/Normal	Low	Low	Low	Low	High
Inadequate Compression	Heat	Low	High	High/Normal	Low/Normal	Low	Low	Low
	Cool	Low	High	High/Normal	Low/Normal	Low	Low	Low

Superheat/Subcooling Conditions

Superheat	Subcooling	Condition
Normal	Normal	Normal operation
Normal	High	Overcharged
High	Low	Undercharged
High	High	Restriction or TXV is stuck almost closed
Low	Low	TXV is stuck open

Section 10: Troubleshooting

HP Operating Parameter Table

EST	Source Flow	Full Load Heating-No Desuperheater Operation						
		ELT @ 1.5-3.0 GPM/Ton	Discharge	Suction	Subcooling	Superheat	Source Water Temp Drop	Load Water Temp Rise
°F	GPM/Ton	°F	PSIG	PSIG	°F	°F	°F	°F DB
30	1.5	50	180-252	53-68	11-26	12-24	13-17	6-20
		80	282-354	56-70	10-22	11-22	11-14	6-19
		100	363-438	58-72	10-19	10-21	9-12	6-18
		120	424-535	60-75	9-20	9-20	7-11	5-17
		130	513-590	61-76	8-20	9-20	5-9	5-16
	2.25	50	182-254	58-73	11-26	11-23	9-12	7-21
		80	285-357	61-75	11-21	9-21	7-10	6-20
		100	367-441	63-77	10-20	8-20	6-9	6-19
		120	428-540	65-80	8-20	8-20	5-8	6-18
		130	518-595	66-81	7-20	8-19	4-6	5-17
	3.0	50	183-256	61-76	11-26	11-23	7-10	7-22
		80	287-360	64-79	11-21	9-20	6-8	7-20
		100	370-445	67-81	10-20	8-19	5-7	6-19
		120	432-544	69-84	8-20	7-19	4-7	6-19
		130	522-600	70-85	7-21	8-19	3-5	5-17
50	1.5	50	187-263	79-96	10-26	10-22	18-22	9-25
		80	293-370	84-100	9-21	8-19	15-19	8-24
		100	377-457	87-102	8-18	7-18	13-16	8-22
		120	444-559	90-105	7-17	7-18	11-15	7-22
		130	533-616	91-107	5-17	7-18	9-12	7-20
	2.25	50	189-265	86-103	11-26	10-21	13-15	10-26
		80	296-373	91-106	9-20	7-19	11-13	9-24
		100	381-461	95-109	8-18	6-18	9-12	9-23
		120	448-564	97-113	6-17	6-18	7-11	8-23
		130	537-621	98-114	5-17	7-18	6-9	7-21
	3.0	50	191-267	91-108	11-26	9-22	10-12	10-27
		80	298-376	96-112	10-20	7-19	8-11	10-25
		100	384-465	100-115	9-18	6-18	7-10	9-24
		120	452-569	103-119	6-18	6-18	6-9	8-23
		130	542-627	104-121	5-18	7-18	5-7	8-22
70	1.5	50	194-275	108-128	10-26	12-22	24-28	12-31
		80	303-386	114-132	8-20	9-19	21-24	11-29
		100	391-478	119-136	6-16	8-19	18-22	10-28
		120	465-585	122-140	5-15	8-19	15-20	10-27
		130	552-644	124-143	3-15	9-19	13-17	9-25
	2.25	50	196-277	117-136	10-26	12-23	17-20	13-32
		80	306-390	124-141	8-20	9-20	14-17	12-30
		100	395-482	129-145	7-16	8-20	13-15	11-29
		120	469-590	132-150	4-15	8-20	11-14	10-28
		130	557-650	134-152	3-15	10-20	9-12	10-26
	3.0	50	198-279	124-144	11-26	12-24	13-16	13-34
		80	309-393	131-149	8-20	10-21	11-14	12-31
		100	398-486	136-153	7-16	9-21	10-12	12-30
		120	473-595	140-158	4-15	9-21	8-12	11-29
		130	561-655	141-161	2-15	10-21	7-10	10-27
90	1.5	50	202-286	132-156	13-29	22-32	29-34	15-38
		80	315-403	139-162	11-23	18-29	26-30	14-35
		100	406-498	145-166	10-20	18-28	23-27	13-33
		120	486-609	149-171	8-19	19-29	19-26	12-32
		130	573-672	151-174	7-19	19-31	17-22	11-30
	2.25	50	204-289	143-167	13-29	24-34	20-24	15-39
		80	318-406	151-173	12-23	20-30	18-21	14-36
		100	410-502	156-178	10-20	20-31	16-19	14-35
		120	490-615	161-183	8-19	20-31	14-18	13-33
		130	578-677	163-186	6-19	21-32	12-16	12-31
	3.0	50	205-291	150-176	14-29	25-36	16-19	16-40
		80	321-409	159-182	12-23	22-32	14-17	15-38
		100	413-506	165-188	11-20	21-32	12-15	14-36
		120	494-620	170-194	8-19	22-33	11-14	13-35
		130	583-683	172-197	6-19	23-34	9-12	12-32

Section 10: Troubleshooting

Customer/Job Name:_____ Date:_____

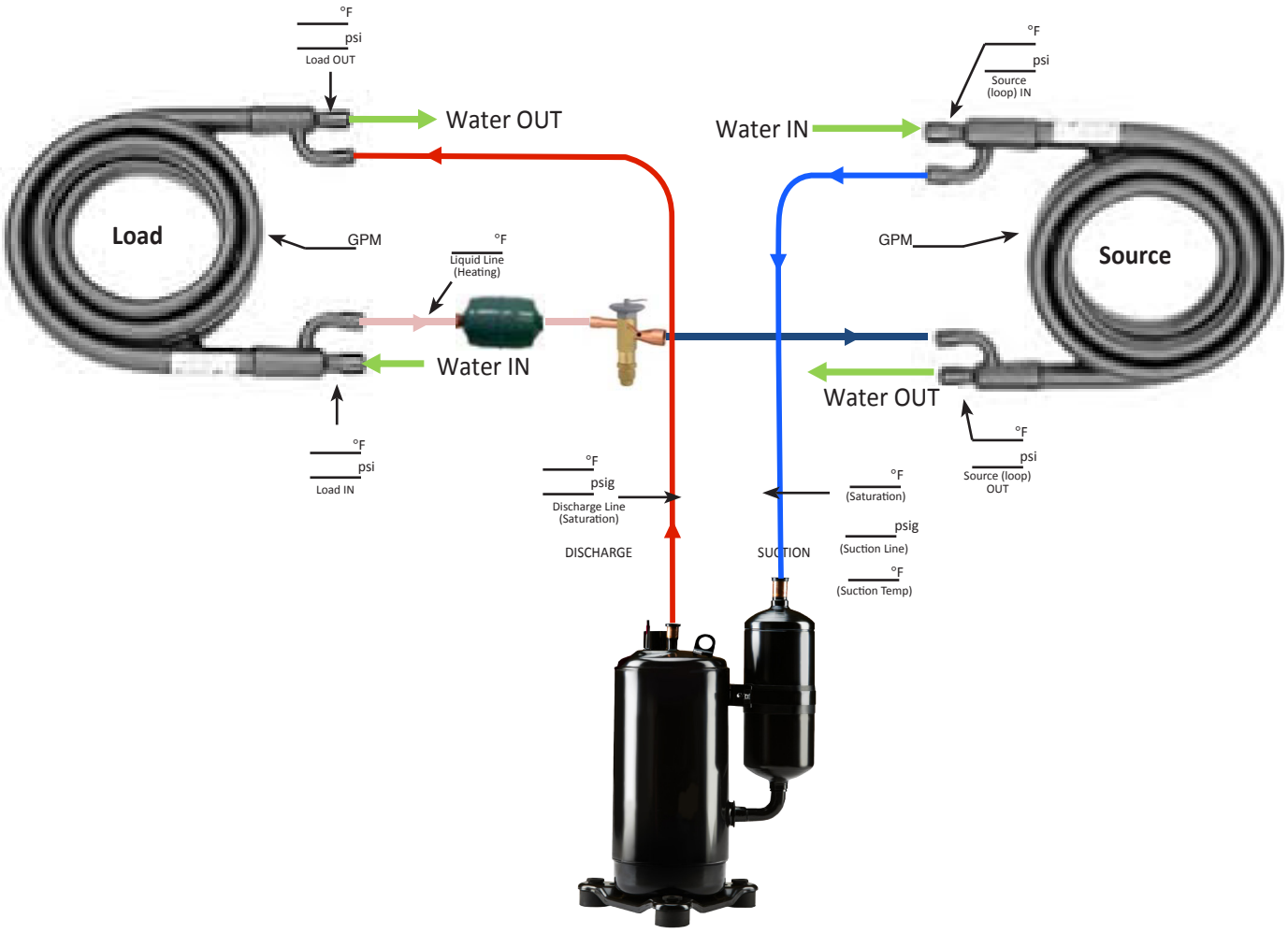
Model #:_____ Serial #:_____

Antifreeze Type:_____

HE or HR = GPM x TD x Fluid Factor
(Use 500 for water; 485 for antifreeze)

SH = Suction Temp. - Suction Sat.
SC = Disch. Sat. - Liq. Line Temp.

Water-to-Water Unit (Heating Mode)



Section 11: Unit Electrical Data

Unit Electrical Data

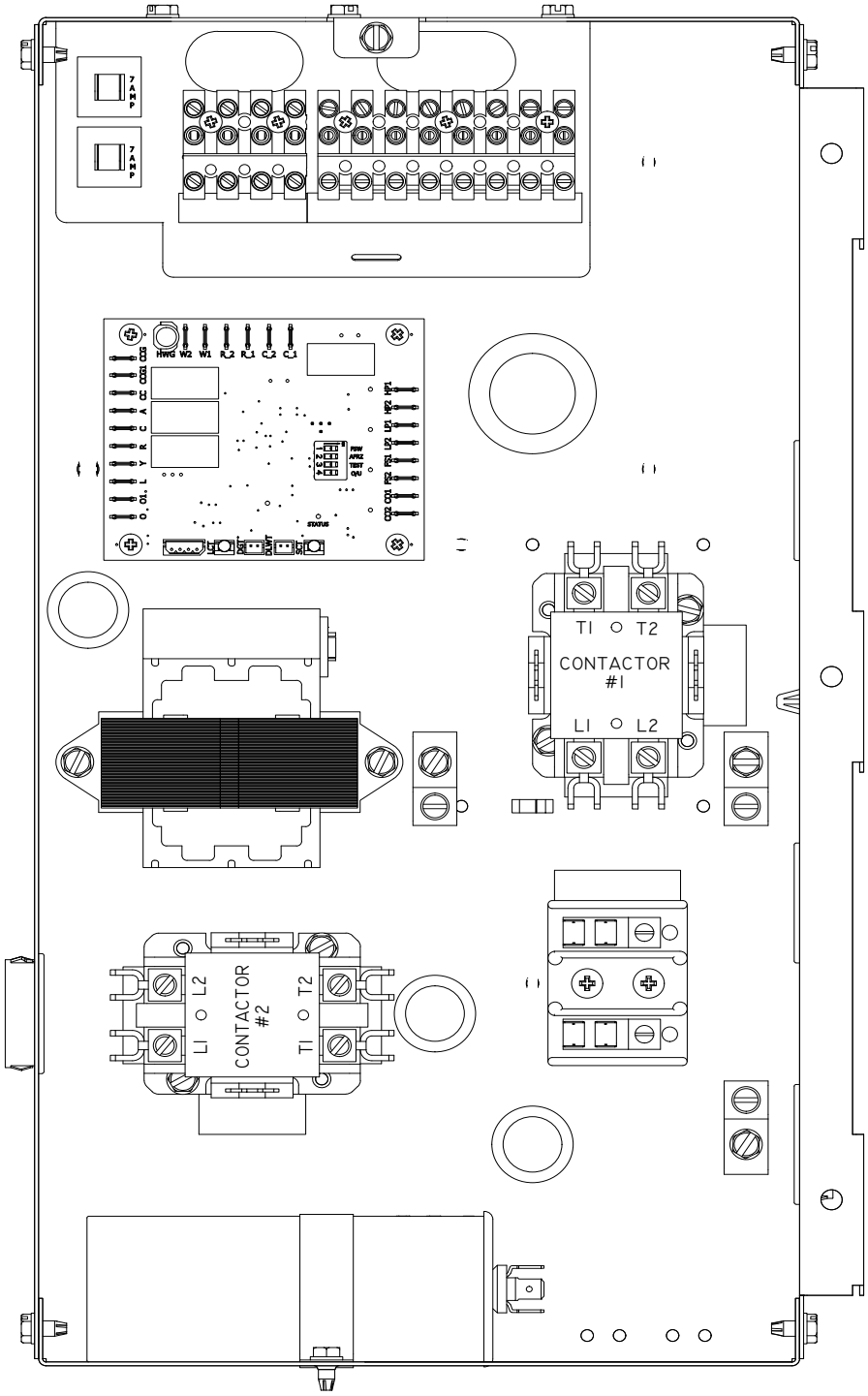
Model	Voltage Code/ HWG Option	60 Hz Power		Compressor		Fan Motor FLA	HWG Pump FLA	Ext. Loop Pump FLA	Total Unit FLA	Min Circuit AMPS	Max Brkr HACR
		Volts	Phase	LRA	RLA						
HP024	10	208/230	1	70.0	13.5	0.0	0.0	4.0	17.5	20.9	30

Notes:
1. All line and low voltage wiring must adhere to the National Electrical Code and local codes, whichever is the most stringent.
2. In determining the correct supply wire size and maximum length, reference NFPA 70, Section 310. If the calculation is close to the maximum allowable ampacity of a particular wire size, use the next size up. This will ensure that no adverse effects occur, such as light dimming and/or shortened compressor life.
3. Min/Max Voltage: 208/230/60 = 187-252
*The external loop pump FLA is based on a maximum of two UP26-116F-230V pumps.

Proper Power Supply Evaluation: When any compressor bearing unit is connected to a weak power supply, starting current will generate a significant “sag” in the voltage reducing the starting torque of the compressor motor increasing the start time. This will influence the rest of the electrical system in the building by lowering the voltage to the lights. This momentary low voltage causes “light dimming”. The total electrical system should be evaluated by an electrician and HVAC technician. The evaluation should include connections, sizes of wires, and size of the distribution panel between the unit and the utility’s connection. The transformer connection and sizing should be evaluated by the electric utility provider.

Section 12: Unit Electrical Data-Electrical Connections

Unit Electrical Data and Connections



Warranty Order & Claim Form

ENERTECH
ENERGY + TECHNOLOGY

WARRANTY ORDER & CLAIM

PHONE: 618.664.9010 **FAX:** 618.664.4597 **EMAIL:** WARRANTY@ENERTECHGEO.COM

ALL WARRANTY REGISTRATIONS SHOULD BE SUBMITTED WITHIN 10 DAYS OF INSTALLATION

COMPANY NAME _____ (Form submitter) DATE _____

PHONE _____ FAX _____ EMAIL _____

ORDERED BY _____ JOB NAME/PO # _____

UNIT *Model* # _____ *Serial* # _____

FAILURE DATE _____

SHIP TO _____ HOMEOWNER _____
(If different than company) _____ ADDRESS _____

_____ _____

Required if claim is for defective flow center

FLOW CENTER MODEL # _____ FLOW CENTER SERIAL # _____

FAILURE CODES, DESCRIPTION AND LABOR REIMBURSEMENT MUST BE FOUND IN WARRANTY MANUAL

FAILURE CODE	DESCRIPTION	PART NUMBER
_____	_____	_____
_____	_____	_____
_____	_____	_____

LABOR REIMBURSEMENT REQUESTED ☐ *NO* ☐ *YES*

DO YOU NEED PARTS ORDERED? ☐ *NO* ☐ *YES* _____ _____

(If no, and replacement was purchased from another vendor, attach copy of bill if reimbursement is needed[3].)

OTHER NOTES _____

_____

FOR ENERTECH COMPANIES USE ONLY

SRO# _____ CREDIT MEMO# _____

1) See warranty coverage summary sheet for labor allowances, conditions and exclusions, etc. **2)** Warranty start date is ship date from Enertech facility unless proof of startup is presented. **3)** Outsourced warranty replacement parts will be reimbursed in the form of credit for the part only. Credit will be no more than the standard equivalent part cost through Enertech. **4)** Factory pre-approval is required for anything outside the scope of this document. **5)** Fuses, hose kits and items not mentioned on Warranty Coverage Summary are not covered under this program.

Section 13: Warranty

Warranty Registration Form

ENERTECH
ENERGY + TECHNOLOGY

WARRANTY REGISTRATION

NOW REGISTER ONLINE AT WARRANTY-REGISTRATION.ENERTECHGEO.COM

WARRANTY REGISTRATIONS SHOULD BE SUBMITTED WITHIN 60 DAYS OF INSTALLATION

Model Number _____ Serial Number _____ Install Date _____

This unit is performing ☐ Satisfactorily ☐ Not Satisfactorily (please explain) _____

_____

Purchaser/User Name _____ Phone _____

Address _____ City _____ State/Prov _____

Postal Code _____ Email _____

Installer Company Name _____

City _____ State/Prov _____ Email _____

Application

☐ Residential New Construction ☐ Residential Geo Replacement ☐ Residential Replacement of Electric, Gas or Other

☐ Multi-Family (Condo/Townhome/Multiplex) ☐ Commercial ☐ Other _____

Use (check all that apply)

☐ Space Conditioning ☐ Domestic Water Heating ☐ Radiant Heat ☐ Swimming Pool ☐ Snow/Ice Melt

☐ Other _____

Loop Type

☐ Horizontal Loop ☐ Vertical Loop ☐ Pond Loop ☐ Open Loop

Demographics

Household Income ☐ Under $30,000 ☐ $30,000–$45,000 ☐ $45,000–$60,000 ☐ $60,000–$75,000 ☐ $75,000–$100,000 ☐ Over $100,000

Home Size ☐ Up to 1500 sq. ft. ☐ 1501 to 2500 sq. ft. ☐ 2501 to 4000 sq. ft. ☐ Over 4000 sq. ft.

Home Location ☐ Rural ☐ Urban ☐ Suburban

Value of Home ☐ Less than $100,000 ☐ $100,000–$250,000 ☐ $250,000–$500,000 ☐ $500,000–$1 mil ☐ Over $1 mil

Customer Satisfaction

How would you rate your overall satisfaction with your new geothermal system?

○ 1 (Very Dissatisfied) ○ 2 ○ 3 ○ 4 ○ 5 ○ 6 ○ 7 ○ 8 ○ 9 ○ 10 (Very Satisfied)

How would you rate your overall satisfaction with your installing geothermal contractor?

○ 1 (Very Dissatisfied) ○ 2 ○ 3 ○ 4 ○ 5 ○ 6 ○ 7 ○ 8 ○ 9 ○ 10 (Very Satisfied)

MAIL THIS FORM TO:
ENERTECH GLOBAL LLC
2506 SOUTH ELM STREET
GREENVILLE, IL 62246

EMAIL THIS FORM TO:
WARRANTY@ENERTECHGEO.COM

FAX THIS FORM TO:
ENERTECH GLOBAL LLC
618.664.4597

REGISTER ONLINE AT: warranty-registration.enertechgeo.com

Rev 30 DEC 2013B

Revision Table

Date	Note	Page
28JAN2020	"High Limit Bulb" added to Typical Installation with Vented Coaxial Heat Exchanger Diagram	12
	"High Limit Bulb" added to Typical Installation with Unvented Heat Exchanger (Radiant) Diagram	
	Operation Steps added to Sequence of Operation	24
27JAN2020	Wiring Diagram updated (minor layout changes)	25
20DEC2019	Unit Electrical Data Table	35
25OCT2019	Wiring Diagram updated	25
22OCT2019	Verbiage and layout changes made	Various
	Lockout Board LED Identification Table updated	23
	Lockout Board diagram updated	21
19SEP2019	DHW Tank Wiring Diagram updated	13
	Buffer Tank Connection Diagram updated	12
22AUG2019	Document part number revised from 20811-20NN to 20D811-01NN	ALL
16AUG2019	Minor layout changes made	Various
15AUG2019	Radiant Floor Wiring Diagram diagram added	13
	Typical Installation with Preheat Tank updated	13
	DHW Tank Wiring Diagram added	12
	Typical Installation with Vented COAX diagram updated	12
30JUL2019	Layout changes made	Various
09JUL2019	HP Rev B Nomenclature added	4
27JUN2019	HP Rev B Unit Connections Diagram added	34
	HP Rev B Unit Electrical Data added	33
	Water-To-Water Heating Mode Diagram added	32
	HP Rev B Wiring Diagram added	23
	Rev B Nomenclature added	4
	HP Rev B IOM created	ALL

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