

Engineering Data and Installation Manual

XT MODELS PACKAGED WATER-TO-AIR MULTI-POSITIONAL HEAT Pumps

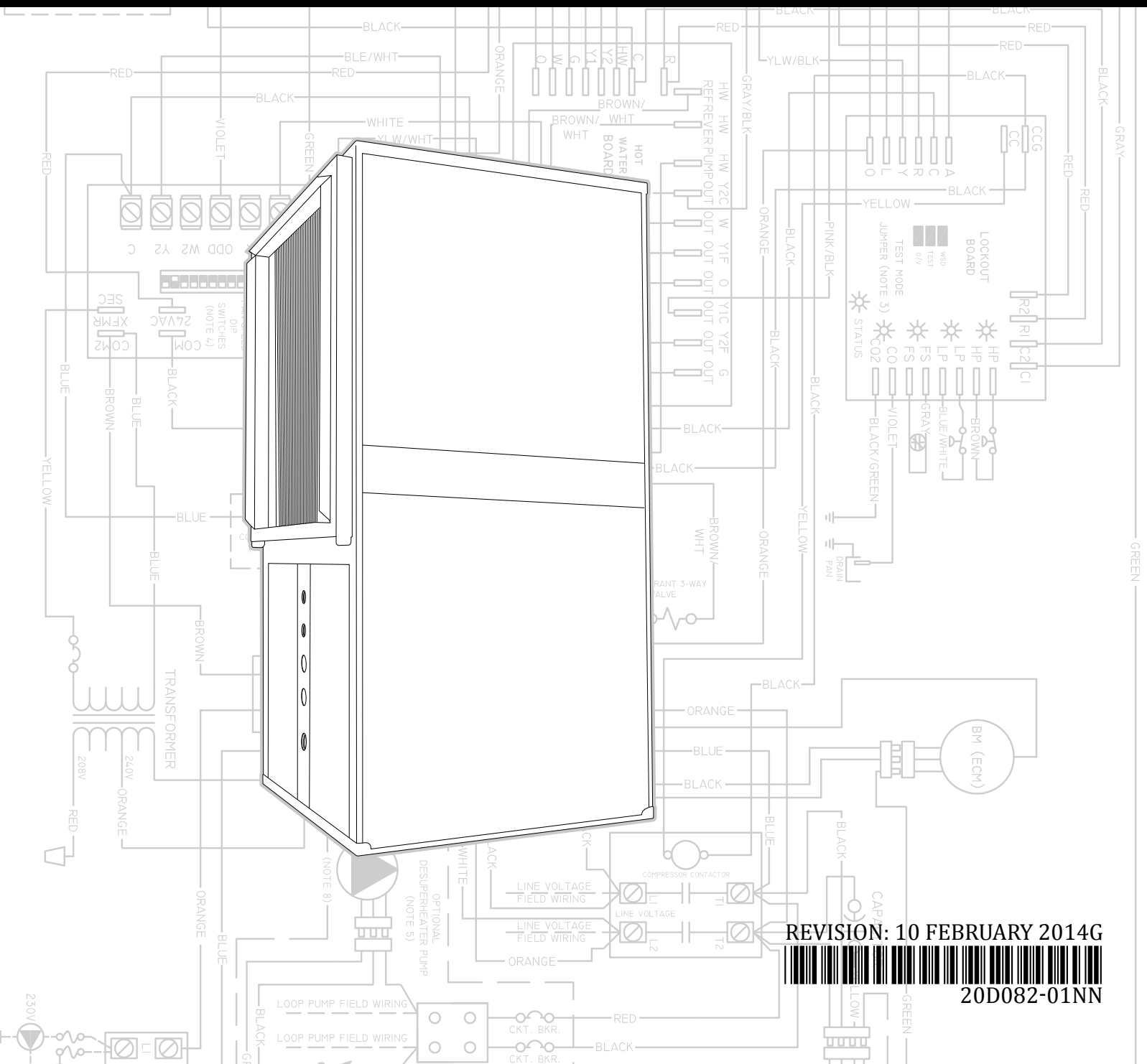


Table of Contents:

Section 1: Model Nomenclature

Model Nomenclature.....4

Section 2: Installation Introduction

Introduction, Inspection, Unit Protection, Pre-Installation, Components.....5 - 6

Section 3: Installation Considerations

Consumer Instructions, DIY Policy, Installation, Electrical, Thermostat, Loop Pumps, Desuperheater Package and Piping, UV Light Usage.....7

Section 4: Installation

Unit Placement, Pre-Installation Checklist.....8

Unit Dimensional Data.....9

Unit Physical Data.....10

Unit Conversion.....11

Ductwork Installation.....12 - 13

Section 5: Unit Piping Installation

Open Loop, Interior Piping, Water Quality.....14 - 18

Section 6: Antifreeze

Overview.....19

Antifreeze Charging.....20 - 21

Section 7: Desuperheater Installation

Installation.....22 - 24

Section 8: Controls

Controls & Wiring Diagrams.....25 - 33

Section 9: Accessories

Auxiliary Electric Heat.....34

AP SMA Pump Sharing Module.....35

Section 10: Equipment Start-Up Procedures

Equipment Start-Up Checklist.....37

Equipment Start-Up Form.....38

Section 11: Troubleshooting

Troubleshooting, Superheat/Subcooling Conditions, Troubleshooting Form.....39 - 47

Section 12: Engineering and AHRI Data

Unit Electrical Data.....48 - 49

Water Flow and Heating/Cooling Calculations, Corrections Factor.....50 - 51

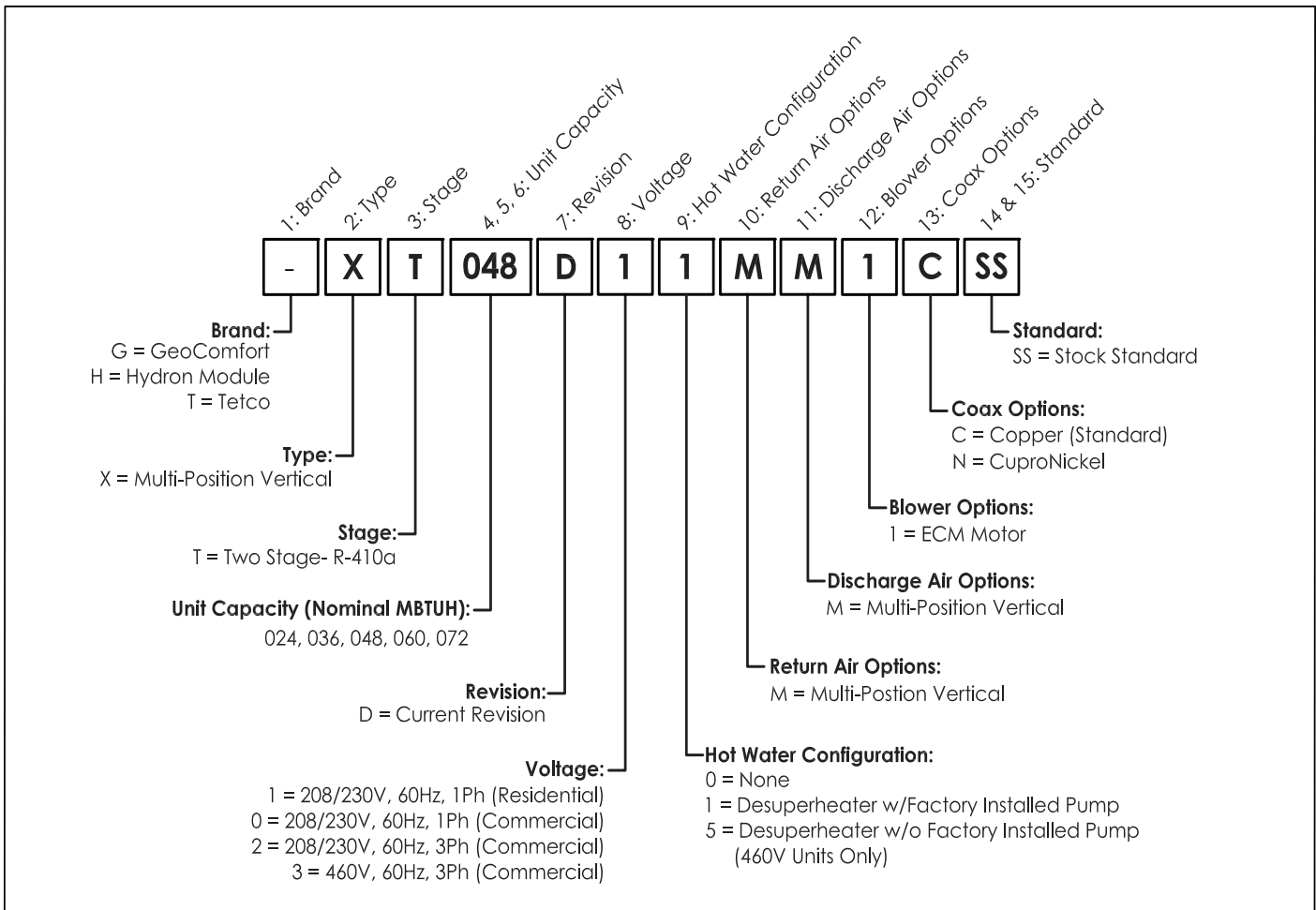
AHRI and Full Load Extended Data Tables.....52 - 63

Section 13: Warranty Forms

Warranty Registration and Claim Forms.....64 - 66

Revision Table.....67

Section 1: Model Nomenclature



Section 2: Installation Introduction

INTRODUCTION:

This geothermal heat pump provides heating and cooling as well as optional domestic water heating capability. 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 15 days. If not filed within 15 days the freight company can deny all claims.

Note: Notify Enertech Global's shipping department of all damages within 15 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.

⚠ CAUTION ⚠

DO NOT OPERATE THE GEOTHERMAL HEAT PUMP UNIT DURING BUILDING CONSTRUCTION PHASE.

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.

Pre-Installation:

Special care should be taken in locating the geothermal unit. Installation location chosen should include adequate service clearance around the unit. All vertical 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. Flex connectors should also be installed in between the ductwork and the unit. 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. Remove any packaging used to support or hold the blower during shipping.
3. 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.

Section 2: Installation Introduction

4. Verify that all refrigerant tubing is free of dents and kinks. Refrigerant tubing should not be touching other unit components.
5. Before unit start-up, read all manuals and become familiar with unit components and operation. Thoroughly check the unit before operating.

⚠ 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.

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.

Reversing Valve: Controls the cycle of the refrigerant system (heating or cooling). Energized in cooling mode.

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.

Flow Switch (Freeze Protection Device): Protects the water heat exchanger from freezing, by shutting down compressor if water flow decreases.

Electric Heater: Provides auxiliary heat during cold temperatures and provides electric backup if unit malfunctions.

Blower Motor (ECM): ECM (Electrically Communicated Motor) for variable fan speeds.

Compressor (Copeland Scroll): Pumps refrigerant through the heat exchangers and pressurizes the refrigerant, which increases the temperature of the refrigerant.

Components:

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

Section 3: Installation Considerations

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 vertical units should be placed on a vibration absorbing pad (air pad) slightly larger than the base of the unit. Downflow units should be placed on a non-combustible base. Flex connectors should also be installed in between the ductwork and the unit. 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.

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

Thermostat: 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.

Desuperheater Package: Water heating is standard on all residential units (units may be ordered without). It uses excess heat, during both heating and cooling cycles, to provide hot water for domestic needs. A desuperheater exchanger (coil) located between the compressor and the reversing valve, extracts superheated vapor to heat domestic water; while satisfying its heating and cooling needs. The water circulation pump comes pre-mounted in all residential units, but must be electrically connected to the master contactor. Leaving it unconnected ensures that the pump is not run without a water supply. The Desuperheater package can make up to 60% (depending on heat pump usage) of most domestic water needs, but a water heater is still recommended.

Desuperheater Piping: All copper tubes & fittings should be 5/8" O.D (1/2" nom) minimum with a maximum of 50ft separation. Piping should be insulated with 3/8" wall closed cell insulation.

Note: Copper is the only approved material for desuperheater piping.

UV Light Usage: The use of a UV light in the unit return air plenum should be such that the light does not have a direct line of sight to the air coil of the unit. UV lights could cause internal wiring, foam insulation, or other components to deteriorate. It would be better to place the UV light in the supply air plenum, or ductwork. This also helps keep the light cleaner. Additionally, if a humidifier is installed and in line of the sight of the UV light, consult the humidifier install manual for indication of whether the light will deteriorate any parts of the humidifier (like the pad).

Section 4: Unit Installation

UNIT PLACEMENT:

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

1. **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.
2. **Unit Air Pad.** All vertical geothermal heating and cooling equipment should be placed on either a formed plastic air pad, or a high density, closed cell polystyrene pad. Downflow units should be placed on a non-combustible base. This helps eliminate vibration noise that could be transmitted through the floor.
3. The installer has verified that all applicable wiring, ductwork, piping, and accessories are correct and on the job site.

PRE-INSTALLATION:

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.
- Open both the air handler section and compressor section and removed any packaging material or documentation included in the unit.
- Remove all packaging materials and brackets from the rear of the blower.
- Locate the Unit Start-Up form from this manual and have it available as the unit installation proceeds.
- Clean the air coil with soap and water solution to remove any oil or dirt.

⚠ WARNING ⚠

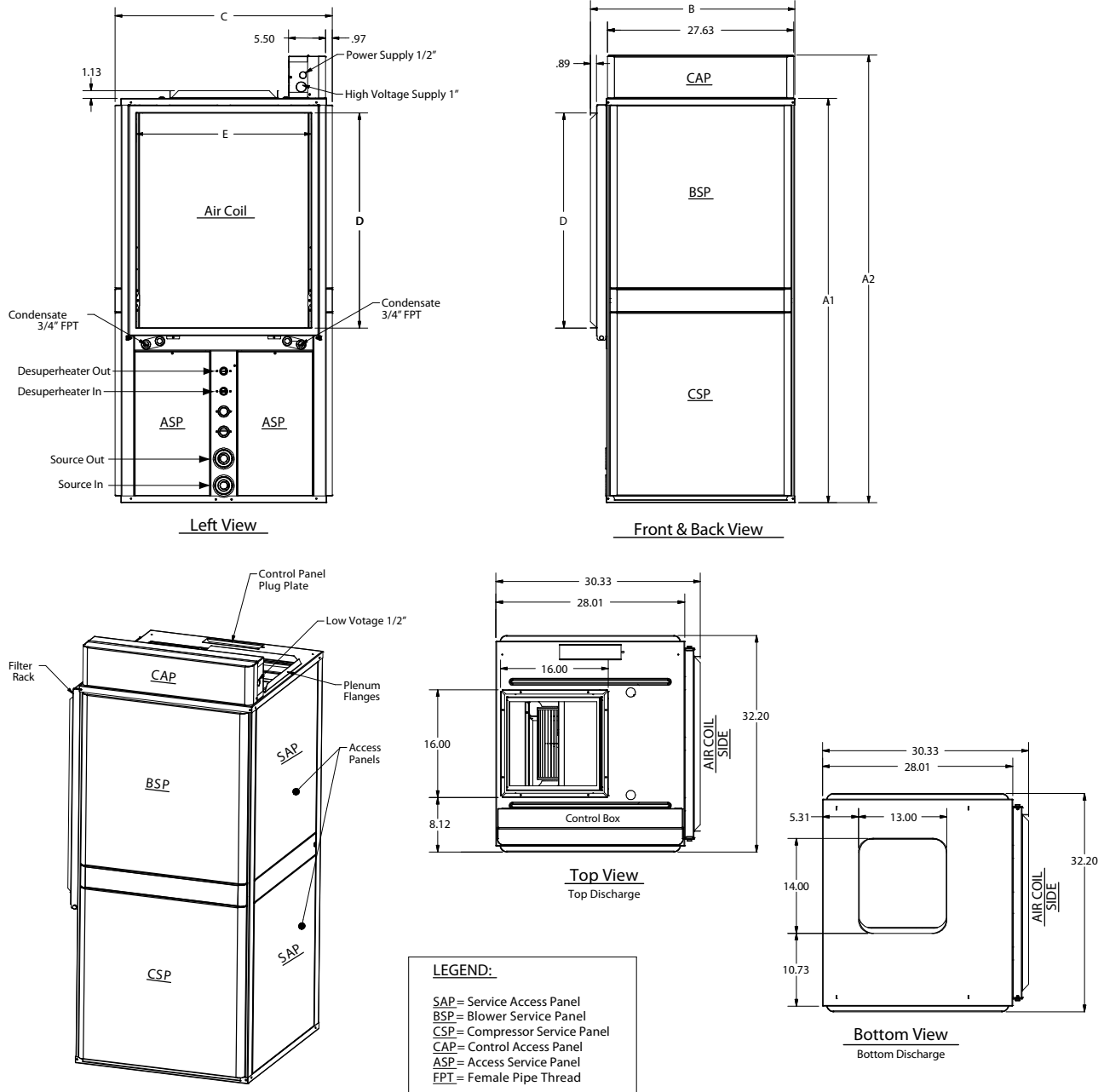
DOWNFLOW UNITS REQUIRE THAT THE FLOOR OPENING (BETWEEN THE UNIT AND THE SUPPLY DUCT PLENUM) BE SLEEVED THROUGH THE FLOOR WITH METAL DUCT. THIS IS ESPECIALLY IMPORTANT IF THE UNIT IS SITTING ON A PAD.

⚠ NOTICE ⚠

THE BLOWER SUPPORT BRACKET, LOCATED ON THE BACK OF THE BLOWER FOR SHIPPING PURPOSES, MUST BE REMOVED BEFORE OPERATION. FAILURE TO REMOVE THE BRACKET COULD RESULT IN POTENTIALLY NOISY OPERATION AND EQUIPMENT DAMAGE.

Section 4: Unit Installation

DIMENSIONAL DATA:



Model	Dimensional Data without Control Box			Dimensional Data with Control Box	Supply Air (Top Discharge)		Supply Air (Bottom Discharge)		Return Air	
	Height (A1)	Width (B)	Depth (C)		Height (A2)	Width	Depth	Width	Depth	Width (E)
024 - 048	56.1	30.3	32.2	62.5	16.0	16.0	13.0	14.0	26.0	28.0
060 - 072	60.1	30.3	32.2	66.5	16.0	16.0	13.0	14.0	26.0	32.0

Notes:

All Desuperheater connections are 3/4" FPT.

All measurements are in inches.

* For the source water loop, GeoComfort residential models use 1" double o-ring fittings. GeoComfort commercial models, Hydron Module & TETCO models use 1" FPT fittings.

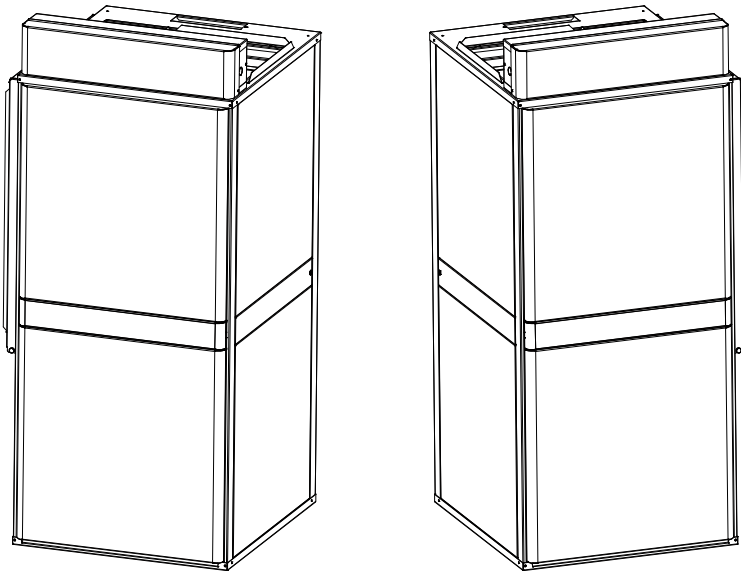
Section 4: Unit Installation

Unit Physical Data

Dual Capacity Vertical					
Model Number	024	036	048	060	072
Fan Wheel (in.)	10 x 11	10 x 11	10 x 11	10 x 11	10 x 11
Fan Motor ECM (HP)	.5	.5	.75	1	1
Refrigerant Charge (oz.)	48	68	63	84	86
Air Coil					
Face Area (Sq.Ft.)	5.55	5.55	5.55	6.17	6.17
Dimensions (in.)	31.8 x 25.1 x 1.0			35.9 x 24.7 x 1.26	
Number Of Rows	N/A - Micro-Channel Coil				
Filter 1" Thick	28 x 30 x 1			28 x 34 x 1	
Unit Weight (nominal) - lbs	395	400	450	455	460

Section 4: Unit Installation

Unit Conversion



UNIT CONVERSION:

Units are shipped in the left hand return air, upflow configuration. The control box is shipped inside the unit. The control box plugs into the electrical connection plate on the top of the unit and mounts with two screws to the top of the unit.

To convert the unit to right hand return air:

1. Remove the front panels and rear panels. The panel screws are located under the band that runs across the middle of the unit. *(GeoComfort & Hydron Module units only)*
2. Rotate the unit to the correct position.
3. Move the unit controls connection plate from its current position (on the top of the unit) to the opposite side of the top of the unit. Use the block off plate from that side to cover the other side.
4. Mount the control box on what is now the top front of the unit. Plugs are available now to facilitate this.
5. Replace the front and rear panels onto the unit.

The source, hot water generator, and condensate fittings are on the air coil side of the unit, under the air coil itself. These connections are easier to facilitate if done prior to the fitting of the return air drop.

NOTE: Do not pry on the "belly band" that runs across the front of the unit to hide the access panel screws. Slight pressure on the rounded portion of the "belly band" will release the catch. *(GeoComfort & Hydron Module units only)*

To convert the unit to downflow supply air:

1. Remove the screws holding the blower and heater housing and drop the assembly down.
2. Remove the block off plate from the area under the blower housing on the bottom blower section panel.
3. Place the block off plate over the opening where the blower housing was.
4. Install the downflow duct kit (instruction included with kit, which is ordered and shipped separately) in the compressor section of the unit.
5. Install the heater and blower housing assembly onto the downflow opening in the blower section securing it with the screws removed in step 1.

Figure 2: Blower Housing Connections



Section 4: Unit Installation

DUCT WORK:

All new ductwork shall be designed as outlined in Sheet Metal and Air Conditioning Contractors National Association (SMACNA) or Air Conditioning Contractors of America (ACCA) or American Society of Heating, Refrigerating and Air Conditioning Engineers (ASHRAE) handbooks.

All supply/return plenums should be isolated from the unit by a flexible connector (canvas) or equivalent to prevent transfer of vibration noise to the ductwork. The flex connector should be designed so as not to restrict airflow. Turning vanes should be used on any transition with airflow over 500 CFM. If the unit is installed in a unconditioned space, the metal ductwork should be insulated on the inside with fiberglass insulation or similar insulation to prevent heat loss/gain and to absorb air noise. If the unit is being installed with existing ductwork, the ductwork must be designed to handle the air volume required by the unit being installed. When running a cooling or heating load on a building, size ductwork accordingly to the building design load and heat pump CFM.

Industry Standard: When sizing ductwork use 400 CFM per Ton.

As a general rule, maximum recommended face velocity for a supply outlet used in a residential application is 750 FPM. Maximum recommended return grille velocity is 600 FPM. Systems with higher velocity, are likely to have noise problems.

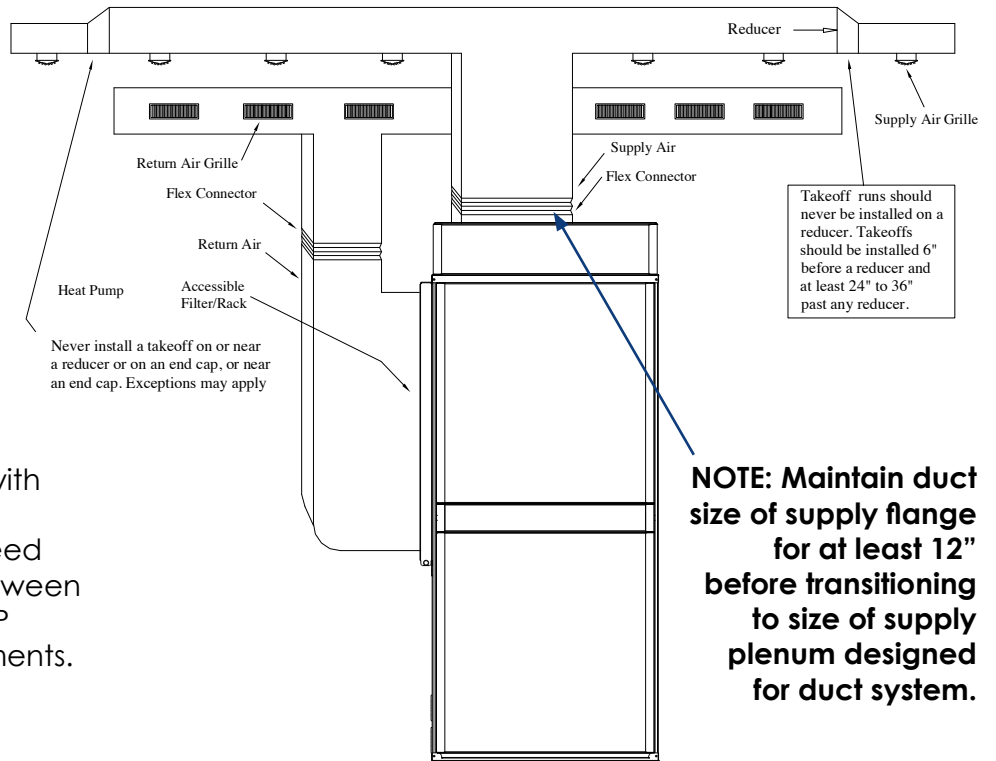
In buildings where ceilings are 8 feet or more, at least 50 percent of the return air should be taken back to the heat pump from the ceiling or high sidewall location and not more than 50 percent from the floor or low sidewall location.

Table 1: Maximum Air Velocities

Location	Supply	Return
Main Ducts	900 FPM	600 FPM
Branch Ducts	700 FPM	600 FPM
Grills, Registers, Diffusers	750 FPM	600 FPM

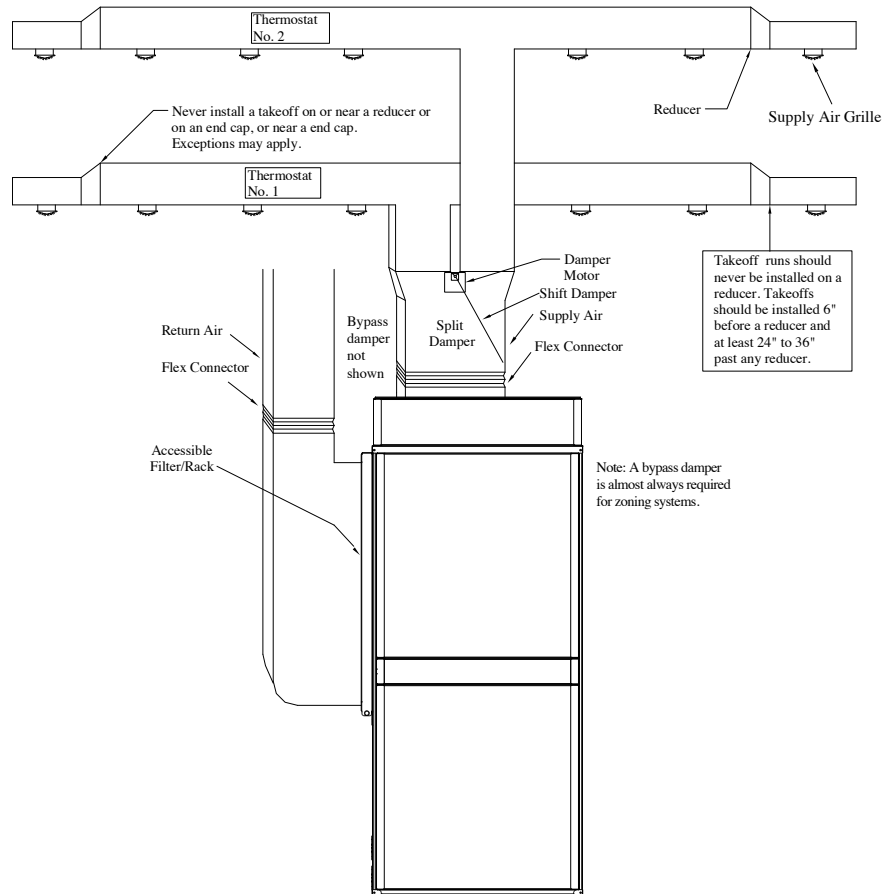
Section 4: Unit Installation

Figure 3: Standard Ductwork Connection Setup



The geothermal unit comes with an ECM Motor. For maximum performance, the blower speed should be set to maintain between 350 and 450 CFM/ton. Use DIP switch for ECM motor adjustments.

Figure 4: Ductwork with Split Damper Connection Setup



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. If the heat exchanger is under pressure, minerals will stay in suspension. 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.

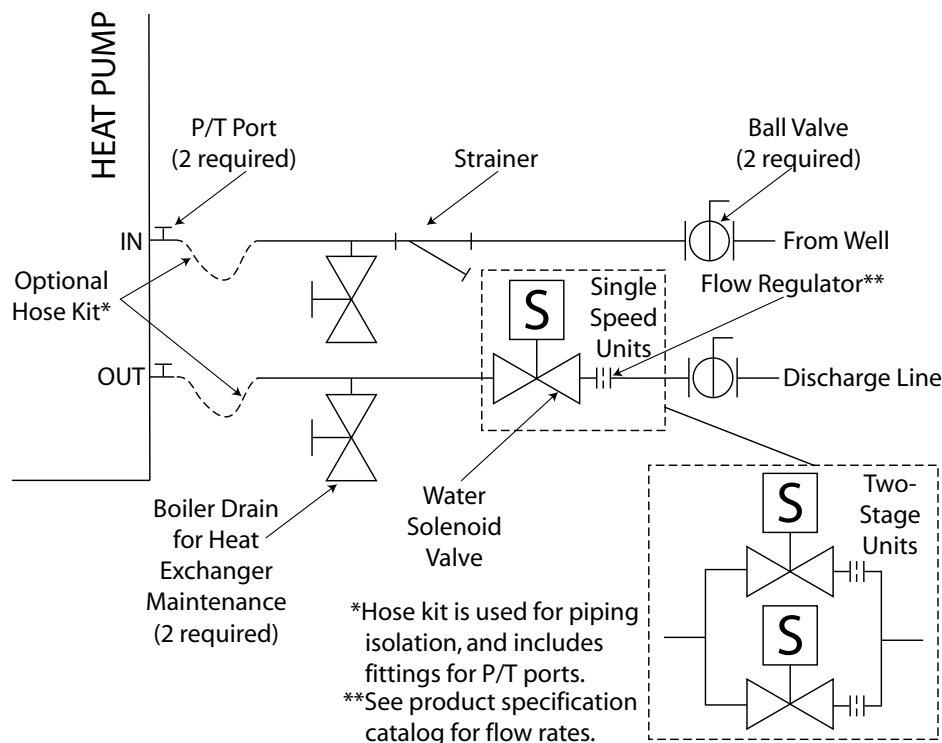
Other necessary components include a strainer, boiler drains for heat exchanger flushing, P/T ports and ball valves. Ball valves allow the water to be shut off for service, and also help when velocity noise is noticeable through the flow regulator. Spreading some of the pressure drop across the ball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

Since the heat pump can operate at lower waterflow on first stage, two stage units typically include two water solenoid valves to save water. The flow regulators should be sized so that when one valve is open the unit operates at first stage flow rate, and when both valves are open, the unit operates at full load flow rate. For example, a 4 ton unit needs approximately 4 GPM on first stage, and approximately 7 GPM at full load. The flow regulator after the first valve should be 4 GPM, and the flow regulator after the second valve should be 3 GPM. When both valves are open, the unit will operate at 7 GPM.

Figure 5: Open Loop Piping Example



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 Table 2 for guidelines.

Removing Debris During Purging

Most flow center or pump failures are a result of poor water quality or debris. Debris entering the loop during fusion and installation can cause noise and premature pump failure. EnerTech recommends a double flush filtering method during purging. When purging, use a 100 micron bag filter until air bubbles are removed. Remove the 100 micron bag, replace it with a 1 micron bag and restart the flushing.

Table 2: Water Quality

Potential Problem	Chemical(s) or Condition	Range for Copper Heat Exchangers	Range for Cupro-Nickel Heat Exchangers
Scaling	Calcium & Magnesium Carbonate	Less than 350 ppm	Less than 350 ppm
Corrosion	pH Range	7 - 9	5 - 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 Chloride / Sodium Chloride	Less than 125 ppm	Less than 125 ppm - Note 4
	Chlorine	Less than 0.5 ppm	Less than 0.5 ppm
Biological Growth	Hydrogen Sulfide	None Allowed	None Allowed
	Iron Bacteria	None Allowed	None Allowed
Erosion	Iron Oxide	Less than 1 ppm	Less than 1 ppm
	Suspended Solids	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. Copper and cupro-nickel heat exchangers are not recommended for pool applications for water outside the range of the table. Secondary heat exchangers are required for 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.

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.**

Table 3: Pipe Insulation

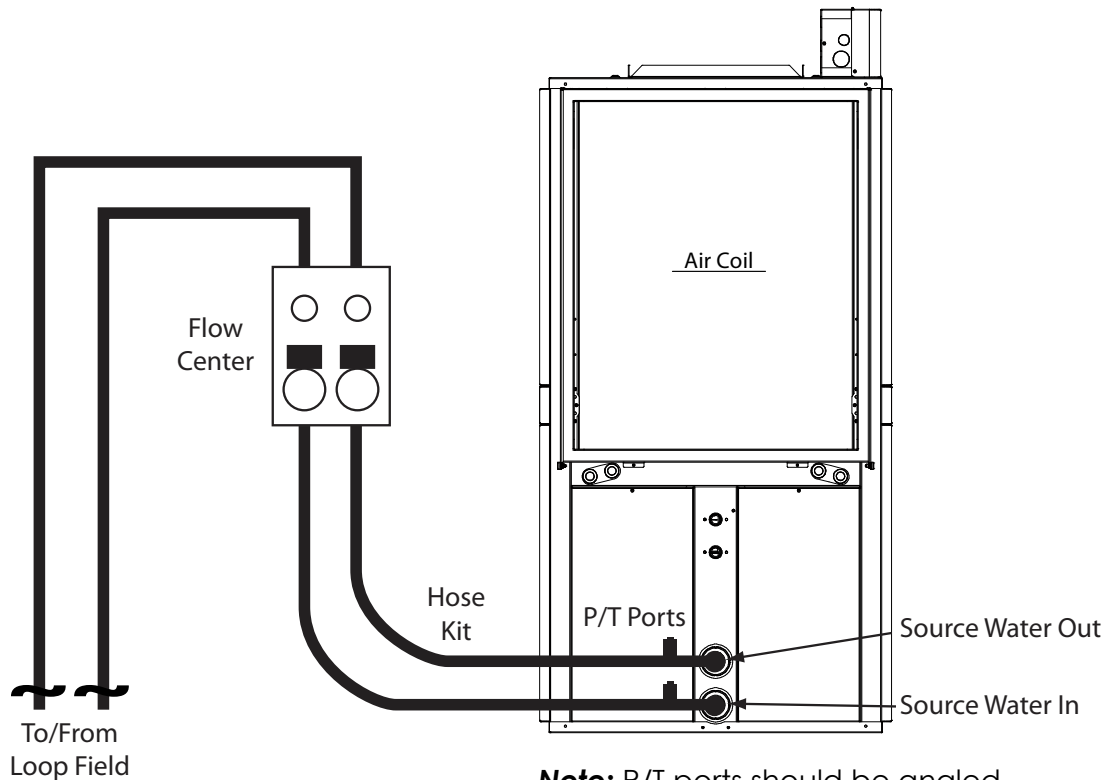
Piping Material	Insulation Description
1" IPS Hose	1-3/8" ID - 3/8" Wall
1" IPS PE	1-1/4" ID - 3/8" Wall
1-1/4" IPS PE	1-5/8" ID - 3/8" Wall
2" IPS PD	2-1/8" ID - 3/8" Wall

Typical Pressurized Flow Center Installation

The 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. See figure 6 for connection options. A typical installation will require the use of a hose kit. Matching hose kits come with double o-ring adapters to transition to 1" hose connection.

Note: Threaded flow centers all have 1" FPT connections. Matching hose kits come with the AGBA55 adapter needed to transition from 1" FPT to 1" hose.

Figure 6: Typical Single Unit Piping Connection (Pressurized Flow Center)



Note: P/T ports should be angled away from the unit for ease of gauge reading.

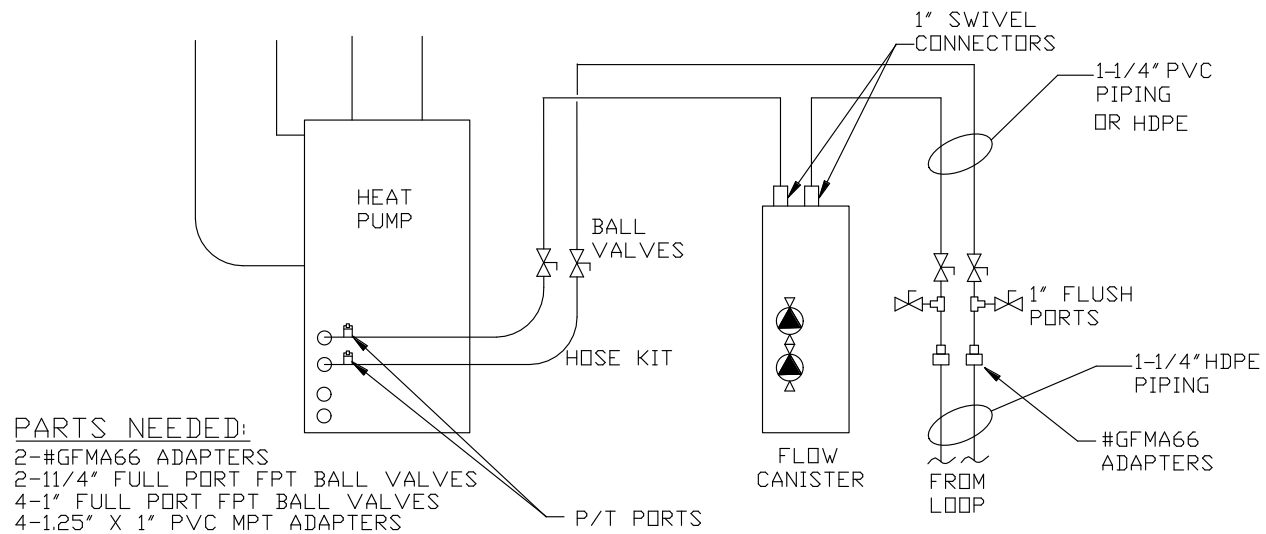
Section 5: Unit Piping Installation

Typical Non-Pressurized Flow Center Installation

Standing column 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.

Figure 7: Typical Single Unit Piping Connection (Non-Pressurized Flow Center)



Section 5: Unit Piping Installation

Condensation Drain Connection

Connect the EZ-Trap to the equipment condensate drain connection as shown in figures 9a through 9d. The condensate line must be trapped a minimum of 1.0" as shown on diagram. The condensate line should be pitched away from the unit a minimum of 1/4" per foot. The condensate line from the unit drain connection to the P-trap should be sloped downward. For more information on installing EZ-Trap, see installation sheet that comes with the EZ-Trap Kit. Always install the air vent after the trap.

Figure 9a: Condensation Drain Connection

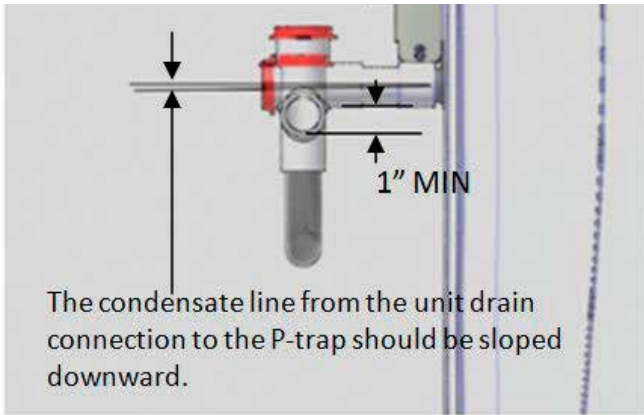
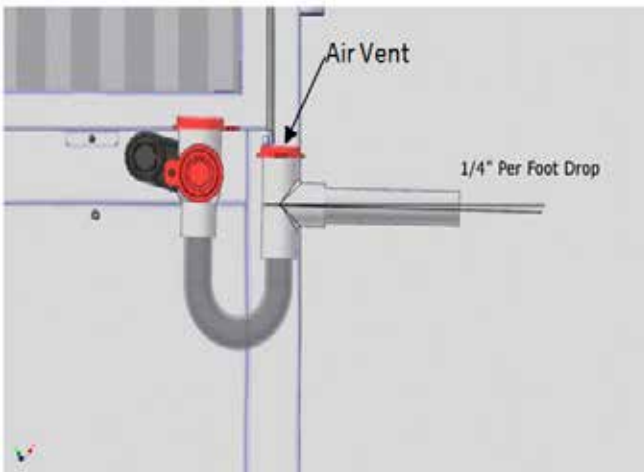


Figure 9b: Condensation Drain Drop



Note: Connect the drain through the trap to the condensation drain system in conformance to local plumbing codes.

Part Number	Description
ACDT1A	EZ-Trap 3/4" Kit
ACDT2A	EZ-Trap 1" Kit

Note: Make Sure the condensate overflow sensor is mounted to the side closest to the drain being used as shown in figures 9c and 9d below.

Figure 9c: Left Overflow Sensor Connection

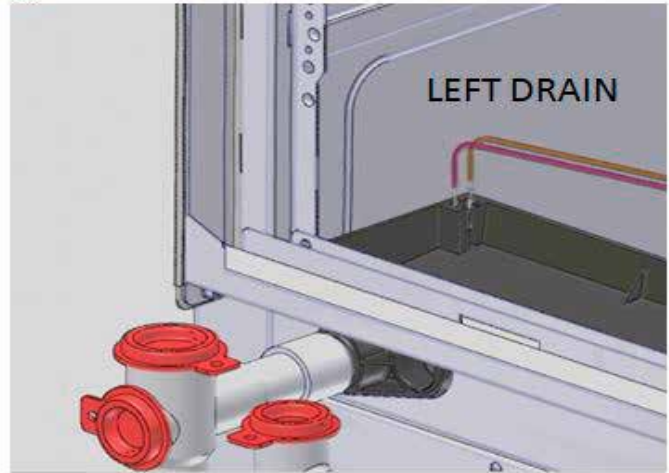
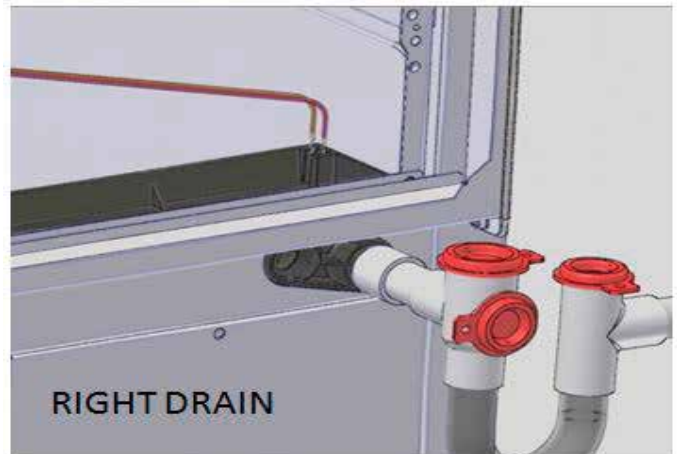


Figure 9d: Right Overflow Sensor Connection



Section 6: Antifreeze

Antifreeze Overview

In areas where minimum entering loop 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. The system needs antifreeze to protect the coaxial heat exchanger from freezing and rupturing. Freeze protection should be maintained to 15°F below the lowest expected entering source loop temperature. For example, if 30°F is the minimum expected entering source loop temperature, the leaving source loop 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 4 and 5 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, high viscosity when cold, and can introduce micro air bubbles when adding to the system. It has also been known to form a "slime-type" coating inside the pipe. Food grade glycol is recommended because some of the other types have certain inhibitors that react poorly with geothermal systems. A 25% brine solution is a minimum required by glycol manufacturers, so that bacteria does not start to form.

Ethylene Glycol: Considered toxic and is not recommended for use in earth loop applications.

GS4 (POTASSIUM ACETATE): Considered highly corrosive (especially if air is present in the system) and has a very low surface tension, which causes leaks through most mechanical fittings. This brine is not recommended for use in earth loop applications.

Section 6: Antifreeze

Notes:

1. Consult with your representative or distributor if you have any questions regarding antifreeze selection or use.
2. All antifreeze suppliers and manufacturers recommend the use of either de-ionized or distilled water with their products.

Antifreeze Charging

Calculate the total amount of pipe in the system and use Table 4 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 5) for the freeze protection required in your area. Then, double check calculations during installation with the proper hydrometer and specific gravity chart (Figure 9) to determine if the correct amount of antifreeze was added.

Table 4: Pipe Fluid Volume

Type	Size	Volume Per 100ft US Gallons
Copper	1" CTS	4.1
Copper	1.25" CTS	6.4
Copper	1.5" CTS	9.2
HDPE	.75 SDR11	3.0
HDPE	1" SDR11	4.7
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

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

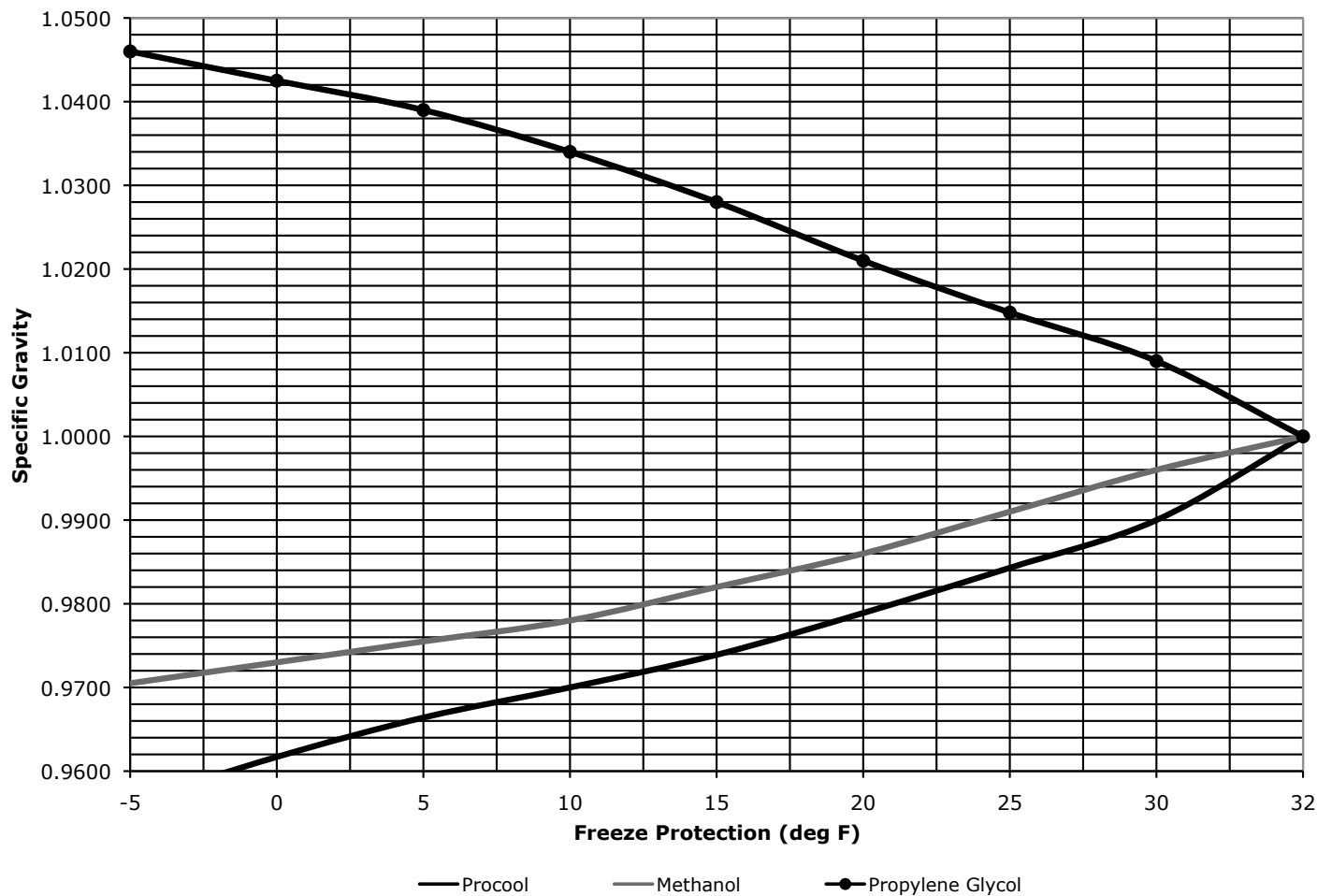
Table 5: Antifreeze Percentages by Volume

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)	25%	22%	17%	12%
Methanol	25%	21%	16%	10%
Propylene Glycol	38%	30%	22%	15%
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

NOTE: Most manufacturers of antifreeze solutions recommend the use of de-ionized water. Tap water may include chemicals that could react with the antifreeze solution.

Figure 9: Antifreeze Specific Gravity



Section 7: Desuperheater Installation

Desuperheater Installation

Units that ship with the desuperheater function also ship with a connection kit.

Note: Desuperheater capacity is based on 0.4 GPM Flow per nominal ton at 90°F entering hot water temperature.

Note: Units that are shipped with a desuperheater do not have the desuperheater pump wires connected to the electrical circuit, to prevent accidentally running the pump while dry. Pump has to be connected to the electric circuit (master contactor) when the lines from the water heater are installed & air is removed.

CONTENTS OF THE DESUPERHEATER FITTING KIT, P/N 11080008001:

- (1) p/n 23-23-0024-001, Installation Instructions
- (1) p/n 11-08-0004-001, 3/4"x 3/4"x 3/4" FPT Brass Tee
- (1) p/n 11-08-0003-001, 3/4" Boiler Drain Valve
- (1) p/n 11-08-0005-001, 3/4" MPT x 3-1/2" Brass Nipple
- (3) p/n 11-08-0006-001, 1/2" SWT x 3/4" MPT Copper Adaptor
- (1) p/n 11-08-0007-001, 3/4" x 3/4" x 1/2" SWT Copper Tee

⚠ WARNING ⚠

TO AVOID SERIOUS INJURY, IT IS RECOMMENDED THAT AN ANTI-SCALD MIXING VALVE IS INSTALLED ON THE HOT WATER SUPPLY LINE INTO THE HOME. EVEN THOUGH HOT WATER TANK TEMPERATURES COULD APPEAR TO BE SET AT LOWER LEVELS, HIGH TEMPERATURE WATER UP TO 130 DEGREES FROM THE DESUPERHEATER COULD RAISE TANK TEMPERATURES TO UNSAFE LEVELS.

Plumbing Installation

NOTE: All plumbing and piping connections must comply with local plumbing codes. Desuperheater circuits are NOT to be connected to gas water heaters!

TIP: Measure the distance above the floor or shelf that the water heater is setting on, to where the drain valve is located. This distance must be greater than one-half the width of the tee you're about to install, or you won't be able to thread the tee on to the water heater.

Note: Copper is the only approved material for piping the desuperheater.

1. Disconnect electricity to water heater.
2. Turn off water supply to water heater.
3. Drain water heater. Open pressure relief valve.
4. Remove drain valve and fitting from water heater.
5. Thread the 3/4" MPT x 3-1/2" nipple into the water heater drain port. Use Teflon tape, or pipe thread sealant on threads.
6. Thread the branch port of the 3/4" brass tee to the other end of the nipple.
7. Thread one of the copper adaptors into the end of the tee closest to the heat pump.
8. Thread the drain valve into the other end of the nipple. See Figure 10.
9. Above the water heater, cut the incoming cold water line. Remove a section of that line to enable the placement of the copper tee.
10. Insert the copper tee in the cold water line. See Figure 11.
11. Thread the remaining two 1/2" SWT x 3/4" MPT copper adaptors into the 3/4" FPT fittings on the heat pump, marked HOT WATER IN and

Section 7: Desuperheater Installation

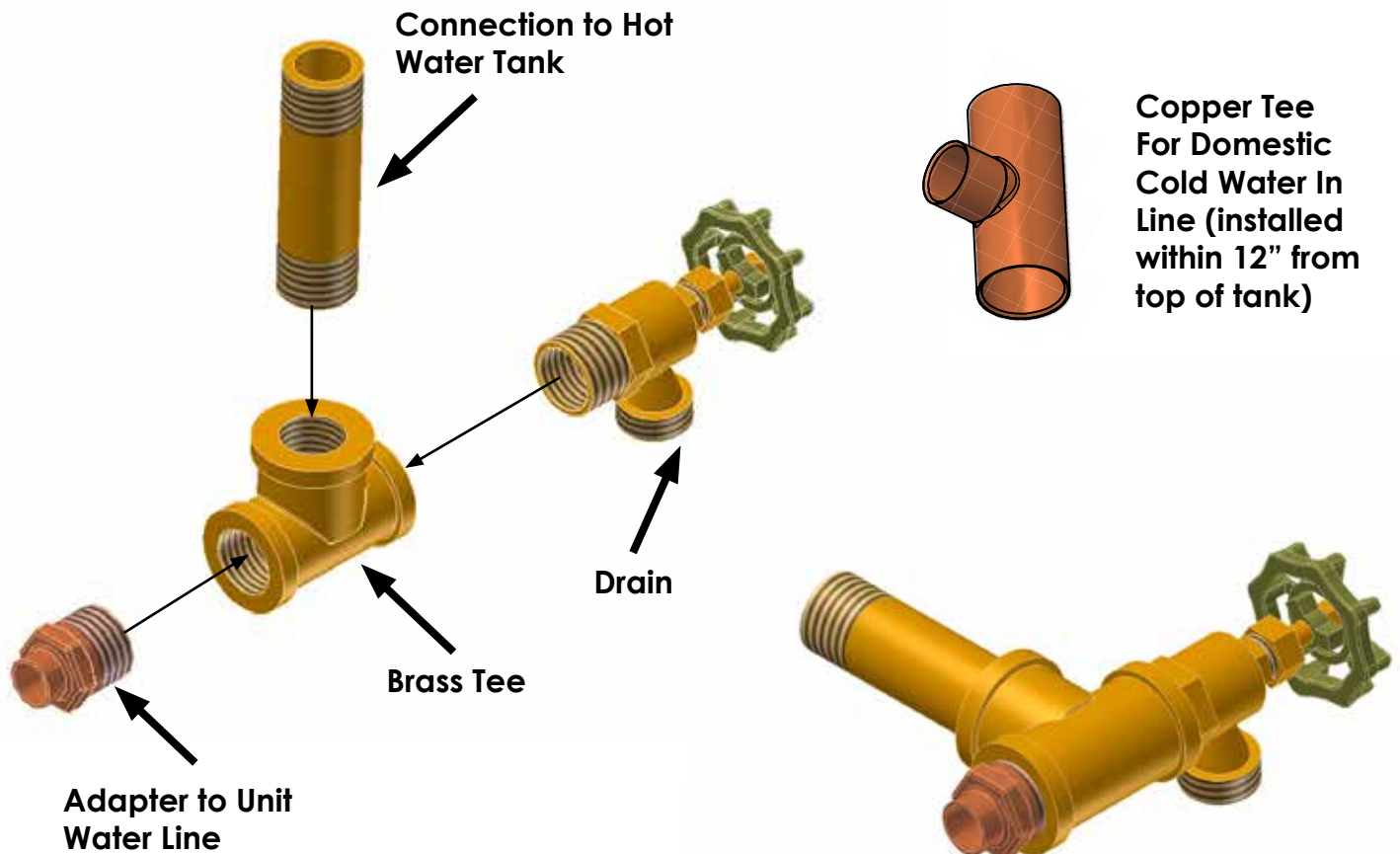
HOT WATER OUT.

12. Run interconnecting ½" copper pipe from the HOT WATER OUT on the heat pump, to the copper adaptor located on the tee at the bottom of the water heater (Step 7).
13. Run interconnecting ½" copper pipe from the HOT WATER IN on the heat pump, to the copper tee in the cold water line (Step 10).
14. Install an air vent fitting at the highest point of the line from step 13 (assuming it's the higher of the two lines from the heat pump to the water heater). See Figure 11.
15. Shut of the valve installed in the desuperheater line close to the tee in the cold water line. Open the air vent and all shut off valves installed in the "hot water out".
16. Turn the water supply to the water heater on. Fill water heater. Open highest hot water faucet to purge air from tank and piping.
17. Flush the interconnecting lines, and check for leaks. Make sure air vent is shutoff when water begins to drip steadily from the vent.
18. Loosen the screw on the end of the desuperheater pump to purge the air from the pump's rotor housing. A steady drip of water will indicate the air is removed. Tighten the screw and the pump can be connected to the contactor or terminal block.
19. Install 3/8" closed cell insulation on the lines connecting the heat pump to the water heater.
20. Reconnect electricity to water heater.

Figure 10: Water Heater Connection Kit Assembly for Bottom of Water Heater

NOTE:

Drawing shown vertically for detail. Fitting installs horizontally into hot water tank. Desuperheater circuits are **NOT** to be connected to gas water heaters!



Section 7: Desuperheater Installation

Figure 11: Typical Desuperheater Installation

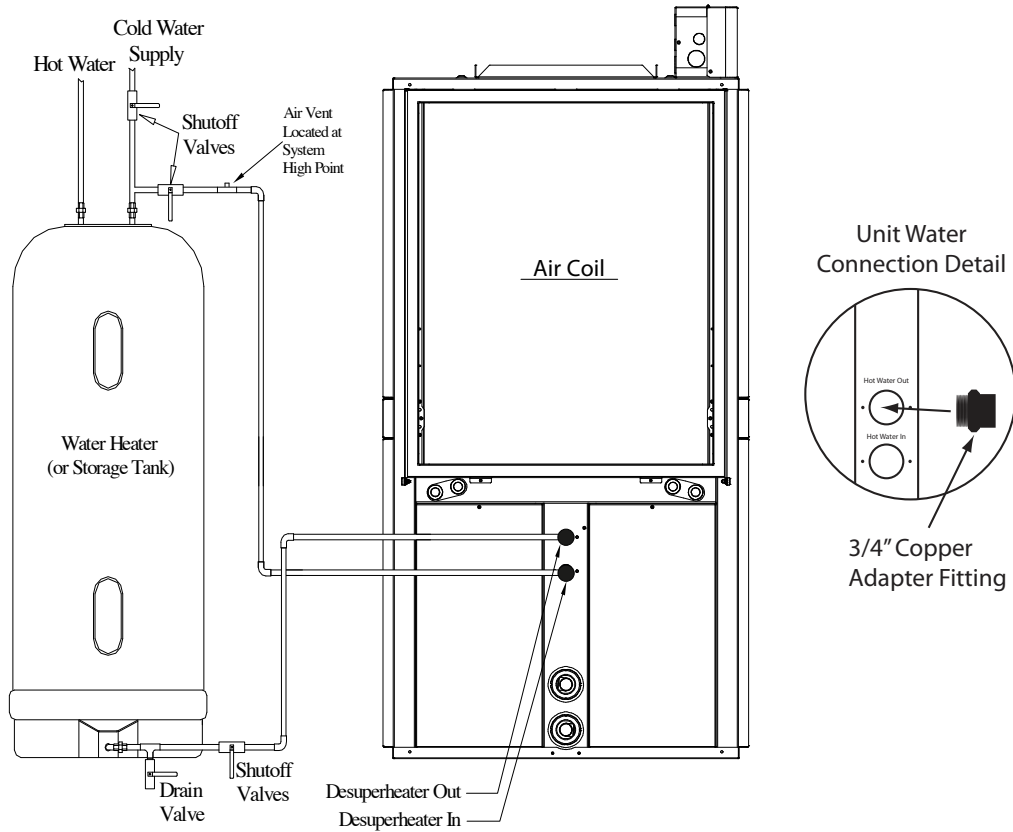
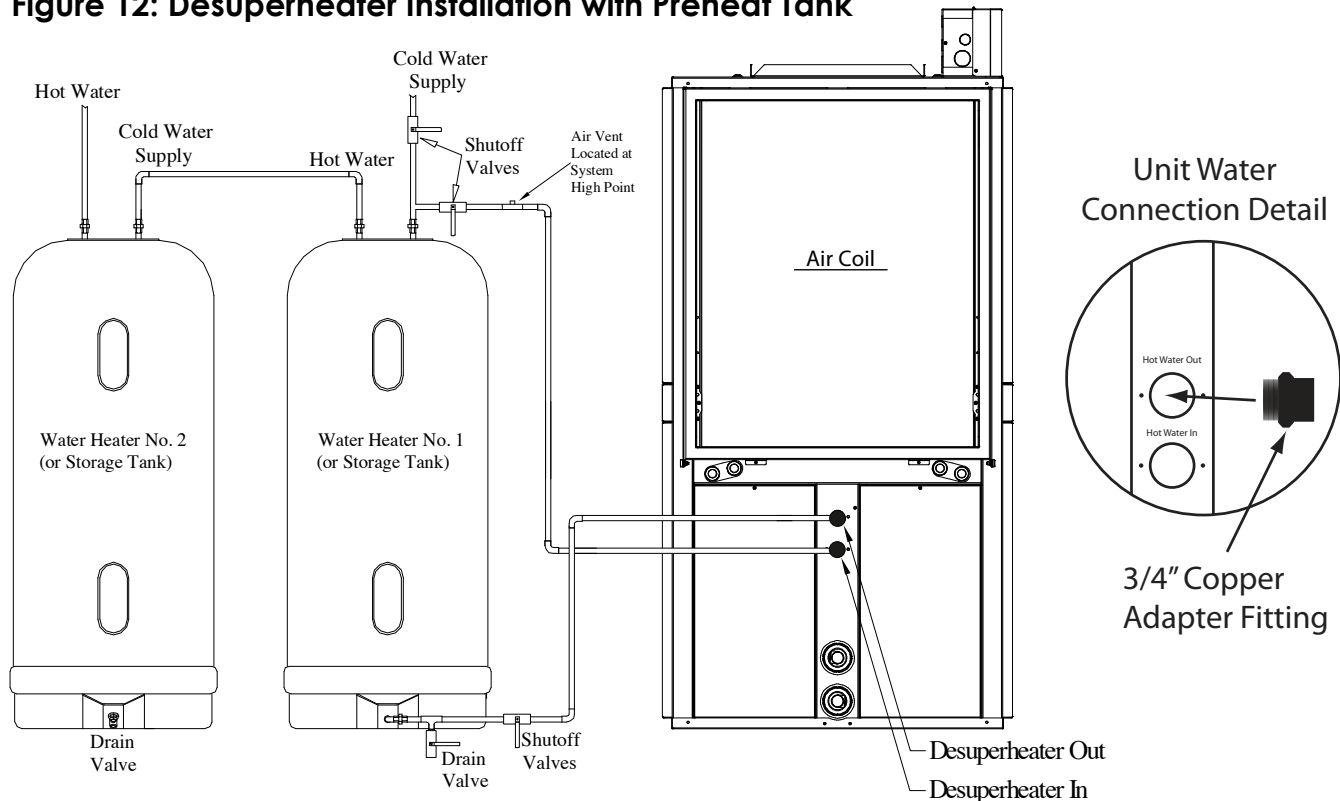


Figure 12: Desuperheater Installation with Preheat Tank



Desuperheater circuits are NOT to be connected to gas water heaters!

Section 8: Controls

MICROPROCESSOR FEATURES AND OPERATION

EnerTech Global geothermal heat pump controls provide a unique modular approach for controlling heat pump operation. The control system uses one, two, or three printed circuit boards, depending upon the features of a particular unit. This approach simplifies installation and troubleshooting, and eliminates features that are not applicable for some units.

A microprocessor-based printed circuit board controls the inputs to the unit as well as outputs for status mode, faults, and diagnostics. A status LED and an LED for each fault is provided for diagnostics. An ECM control module provides field selectable options for airflow and dehumidification mode, plus an LED to indicate CFM (100 CFM per flash).

Removable low voltage terminal strips provide all necessary terminals for field connections. Not only are the thermostat inputs included, but there are also two additional removable terminal strips for all of the accessory and electric heat wiring for ease of installation and troubleshooting.

Startup/Random Start

The unit will not operate until all the inputs and safety controls are checked for normal conditions. At first power-up, the compressor is energized after a five minute delay. In addition, a zero to sixty second random start delay is added at first power-up to avoid multiple units from being energized at the same time.

Short Cycle Protection

A built-in five minute anti-short cycle timer provides short cycle protection of the compressor.

Component Sequencing Delays

Components are sequenced and delayed for optimum space conditioning performance and to make any startup noise less noticeable.

Test Mode

The microprocessor control allows the technician to shorten most timing delays for faster diagnostics by changing the position of a jumper located on the lockout board.

Water Solenoid Valve Connections

Two accessory relay outputs at the terminal strip provide a field connection for two types of water solenoid valves, a standard 24VAC solenoid valve, or a 24VAC solenoid valve with an end switch. Additional field wiring is no longer required for operation of the end switch.

Humidifier/Dehumidification Connections

Connections for a humidistat are provided, which automatically engages the fan when the humidistat contact closes. In addition, a field connection is provided at the terminal strip for external control of the On Demand Dehumidification (ODD) feature for the variable speed ECM motor, which automatically lowers the fan speed when the space humidity is higher than set point. Either connection may be used with a thermostat that includes humidifier/dehumidification outputs. Not applicable for splits/water-to-water.

Airflow Monitor

An LED on the ECM control module flashes one time per 100 CFM when the unit's fan is operating to indicate airflow.

Resistance Heat Control

The electric heat control module contains the appropriate high-voltage control relays. Low voltage control signals from the compressor section energize the relays in the electric heat module to engage backup electric heat when necessary.

Electronic Condensate Overflow Protection

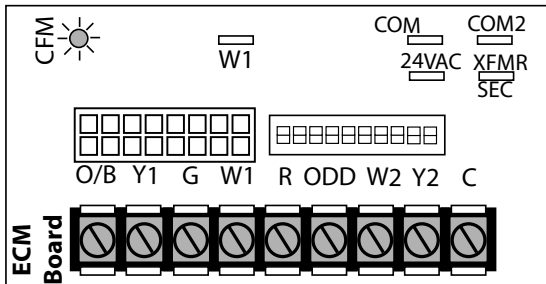
The control board utilizes an impedance sensing liquid sensor at the top of the drain pan. Since the drain pan is grounded, when water touches the sensor for 30 continuous seconds, the sensor sends a ground signal to the lockout board, indicating that a condensate overflow fault has occurred.

Loop Pump Circuit Breakers

The loop pump(s) and desuperheater pump are protected by control box mounted circuit breakers for easy wiring of pumps during installation. Circuit breakers eliminate the need to replace fuses.

Section 8: Controls

Figure 13: ECM Board Layout



Safety Controls

The control receives separate signals for high pressure, low pressure, low water flow, and condensate overflow faults. Upon a continuous 30-second measurement of the fault (immediate for high pressure), compressor operation is suspended (see Fault Retry below), and the appropriate LED flashes. Once the unit is locked out (see Fault Retry below), an output (terminal "L") is made available to a fault LED at the thermostat.

Low Pressure: If the low pressure switch is open for 30 continuous 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 90 seconds to avoid nuisance faults.

High Pressure: 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 from the time the switch opens and the board goes into fault retry mode. There is also no delay of switch monitoring at startup.

Flow Switch: If the flow switch is open for 30 continuous seconds, the compressor operation will be interrupted, and the control will go into fault retry mode. At startup, the flow switch is not monitored for 30 seconds to avoid nuisance faults.

Condensate Overflow: If water touches the condensate overflow sensor for 30 continuous seconds, the compressor operation will be interrupted, and the control will go into fault retry mode. There is no delay of switch monitoring at startup.

FAULT RETRY

All faults are retried twice before finally locking the unit out. The fault retry feature is designed to prevent nuisance service calls. There is an anti-short cycle period between fault retries. On the third fault, the board will go into lockout mode.

Over/Under Voltage Shutdown

The lockout board protects the compressor from operating when an over/under voltage condition exists. The control monitors secondary voltage (24VAC) to determine if an over/under voltage condition is occurring on the primary side of the transformer. For example, if the secondary voltage is 19 VAC, the primary voltage for a 240V unit would be approximately 190V, which is below the minimum voltage (197V) recommended by the compressor manufacturer. This feature is self-resetting. If the voltage comes back within range, normal operation is restored. Therefore, over/under voltage is not a lockout.

Under voltage (18 VAC) causes the compressor to disengage and restart when the voltage returns to 20 VAC. Over voltage (31 VAC) causes the compressor to disengage and restart when the voltage returns to 29 VAC. During an over or under voltage condition, all five fault LEDs will blink (HP + LP + FS + CO + Status). When voltage returns to normal operation, the four fault LED's will stop blinking, but the status LED will continue to flash. While the board LEDs are flashing, the thermostat fault light will be illuminated.

Intelligent Reset

If the thermostat is powered off and back on (soft reset), the board will reset, but the last fault will be stored in memory for ease of troubleshooting. If power is interrupted to the board, the fault memory will be cleared.

Lockout with Emergency Heat

While in lockout mode, if the thermostat is calling for backup heat, emergency heat mode will occur.

Section 8: Controls

Diagnostics

The lockout board includes five LEDs (status, high pressure, low pressure, low water flow, condensate overflow) for fast and simple control board diagnosis. Below is a table showing LED function.

Table 6: LED Identification

LED Color	Location ¹	Function	Normal Operation	Fault Retry ²	Lockout ²
Green	Top	High Pressure	OFF	Flashing ³	ON ³
Orange	2nd	Low Pressure	OFF	Flashing ³	ON ³
Red	3rd	Water Flow	OFF	Flashing ³	ON ³
Yellow	4th	Condensate Overflow	OFF	Flashing ³	ON ³
Green	Bottom	Status	Flashing ⁴	Flashing ⁵	Flashing ⁴

Notes:

1. Looking at the board when the LEDs are on the right hand side.
2. If all five lights are flashing, the fault is over/under voltage.
3. Only the light associated with the particular fault/lockout will be on or flashing.
For example, if a high pressure lockout has occurred, the top green light will be on. The orange, red, and yellow lights will be off.
4. Status lights will be off when in test mode.
5. Flashes alternately with the fault LED.

Hot Water Pump Control

Controls for high water temperature and low compressor discharge line temperature prevent the hot water (desuperheater) pump from operating when the leaving water temperature is above 130°F, or when the compressor discharge line is too cool to provide adequate water heating.

Lockout Board Jumper Selection

The lockout board includes three jumpers for field selection of various board features.

Water Solenoid Valve Delay (WSD): When the WSD jumper is installed, the “A” terminal is energized 10 seconds before the compressor is energized. When the jumper is removed, the “A” terminal is energized with the compressor. If using a water solenoid valve without an end switch, connect to terminal “A”. If using a water solenoid valve with an end switch, connect to terminals YT and YU (remove the jumper wire). Refer to wiring diagram. EnerTech recommends the use of a slow acting valve to reduce the chance of water hammer.

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. When service is complete, the jumper must be re-installed in order to make sure that the unit operates with normal sequencing delays. While the test jumper is removed, the status light (bottom green) will remain off.

Over/Under Voltage Disable (O/V): When the O/V 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 that would cause this fault must be thoroughly investigated before taking any action regarding the jumper

Section 8: Controls

removal. Likely causes of an over/under voltage condition include power company transformer selection, insufficient entrance wire sizing, defective breaker panel, incorrect transformer tap (unit control box), or other power-related issues.

SEQUENCE OF OPERATION:

Water-to-Air Units, Single Compressor, ECM Fan

Heating, 1st Stage (Y1,G) Two-Stage Units

The ECM fan is started immediately at 75% (of 1st stage operation) CFM level (based on DIP switch settings), first stage compressor and the loop/desuperheater pump(s) are energized 10 seconds after the "Y1" input is received, and the ECM fan adjusts to 100% (of 1st stage operation) CFM level 30 seconds after the "Y1" input.

Heating, 2nd Stage (Y1,Y2,G) Two-Stage Units

The ECM fan adjusts to 2nd stage CFM level (based on DIP switch settings), and the compressor full load solenoid valve is energized.

Heat, 3rd Stage (Y1,Y2,W,G) Two-Stage Units

The ECM fan remains at 100% of 2nd stage CFM level (based on DIP switch settings), and the electric backup heat is energized.

Emergency Heat (W,G)

The fan is started immediately at 2nd stage CFM level (based on DIP switch settings), and the electric backup heat is energized.

Cooling Operation

The reversing valve is energized for cooling operation. Terminal "O" from the thermostat is connected to the reversing valve solenoid.

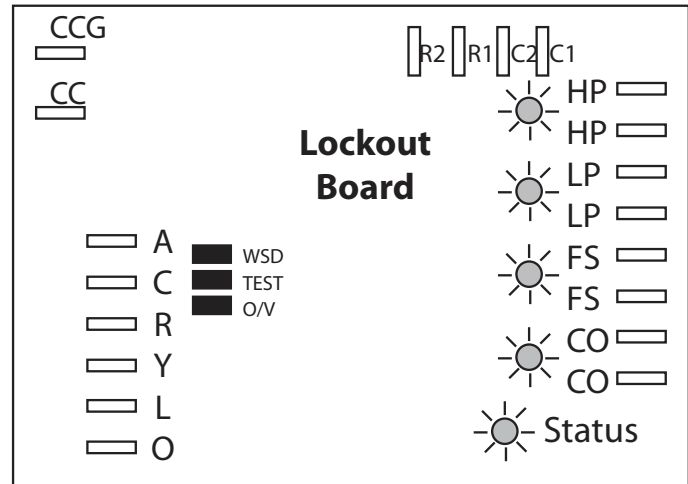
Cooling, 1st stage (Y1,O,G) Two-Stage Units

The ECM fan is started immediately at 75% (of 1st stage operation) CFM level (based on DIP switch settings), first stage compressor and the loop/desuperheater pump(s) are energized 10 seconds after the "Y1" input is received, and the ECM fan adjusts to 100% (of 1st stage operation) CFM level 30 seconds after the "Y1" input.

Cooling, 2nd Stage (Y1,Y2,O,G) Two-Stage Units

The ECM fan adjusts to 2nd stage CFM level (based on DIP switch settings), and the compressor full load solenoid valve is energized.

Figure 14: Lockout Board Layout



Cooling, Dehumidification Mode

The ECM control module includes two types of dehumidification modes, Forced Dehumidification mode, and On Demand Dehumidification (ODD). If the ECM control module is set to Forced Dehumidification mode, the ECM fan runs at normal CFM in all heating stages, but all cooling operation will be 85% of the current stage CFM level (based on DIP switch settings), which lowers the CFM through the evaporator coil, improving latent capacity. In ODD mode, a humidistat or a thermostat with a dehumidification output (output must be reverse logic -- i.e. it must operate like a humidistat) is connected to the ODD terminal. When the module receives a call for dehumidification, the fan runs at 85% of the current stage CFM in the cooling mode. Otherwise, the airflow is at the normal CFM level. The signal is ignored in the heating mode.

Fan Only

When the ECM control module receives a "G" call without a call for heating or cooling, the fan operates at a lower CFM level (based on DIP switch settings).

Section 8: Controls

Table 7: ECM Fan Performance - Two-Stage Compressor Units

ECM Fan Performance - Two-Stage Compressor Units

Model ¹	Program ²	Heating Modes		Cooling Modes		Dehumidification Mode ⁶		Only Fan	DIP Switch Settings ⁴							
		1st Stage	2nd Stage	1st Stage	2nd Stage	1st Stage	2nd Stage		S1	S2	S3	S4	S5	S6	S7	S8
024	A	800	1000	800	1000	680	850	550	ON	OFF	ON	OFF	ON	OFF	OFF	OFF
	B	750	950	750	950	640	810	515	ON	OFF	OFF	OFF	ON	OFF	OFF	OFF
	C	700	850	700	850	595	725	475	ON	OFF	OFF	ON	ON	OFF	OFF	OFF
	D	600	750	600	750	510	640	450	OFF	ON	OFF	OFF	OFF	ON	OFF	OFF
036	A	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
	B	1050	1350	1050	1350	895	1150	700	OFF	OFF	ON	OFF	OFF	OFF	OFF	OFF
	C	950	1200	950	1250	810	1065	635	OFF	OFF	OFF	OFF	OFF	OFF	OFF	OFF
	D	850	1100	850	1150	725	980	575	OFF	OFF	OFF	ON	OFF	OFF	OFF	OFF
048	A	1500	1800	1500	1900	1275	1615	945	ON	OFF	ON	OFF	ON	OFF	OFF	OFF
	B	1450	1700	1450	1750	1235	1490	890	OFF	ON	ON	OFF	OFF	ON	OFF	OFF
	C	1300	1500	1300	1600	1105	1360	680	OFF	ON	OFF	OFF	OFF	ON	OFF	OFF
	D	1150	1350	1150	1400			725	OFF	ON	OFF	ON	OFF	ON	OFF	OFF
060	A	1850	2200	1750	2100	1490	1785	980	OFF	OFF	ON	OFF	OFF	OFF	OFF	OFF
	B	1600	1850	1650	1950	1405	1660	870	ON	OFF	ON	OFF	ON	OFF	OFF	OFF
	C	1450	1700	1450	1750	1235	1490	800	ON	OFF	OFF	OFF	ON	OFF	OFF	OFF
	D	1300	1500	1300	1550			725	ON	OFF	OFF	ON	ON	OFF	OFF	OFF
072	A	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
	B	1850	2100	1750	2150	1490	1830	1075	OFF	OFF	ON	OFF	OFF	OFF	OFF	OFF
	C	1650	2000	1600	1900			975	OFF	OFF	OFF	OFF	OFF	OFF	OFF	OFF
	D	1500	1750	1450	1700			875	OFF	OFF	OFF	ON	OFF	OFF	OFF	OFF

Notes:

1. Program B (Bold type) is factory settings and rated CFM. CFM is controlled within 5% up to the max. ESP. Max. ESP includes allowance for wet coil and standard filter.
2. Power must be off to the unit for at least 3 seconds before the ECM motor will recognize a speed change.
3. Models 024 - 036 can maintain above CFM up to 0.5" ESP; Models 048 - 072 can maintain above CFM up to 0.75" ESP.

Dehumidification Mode Options

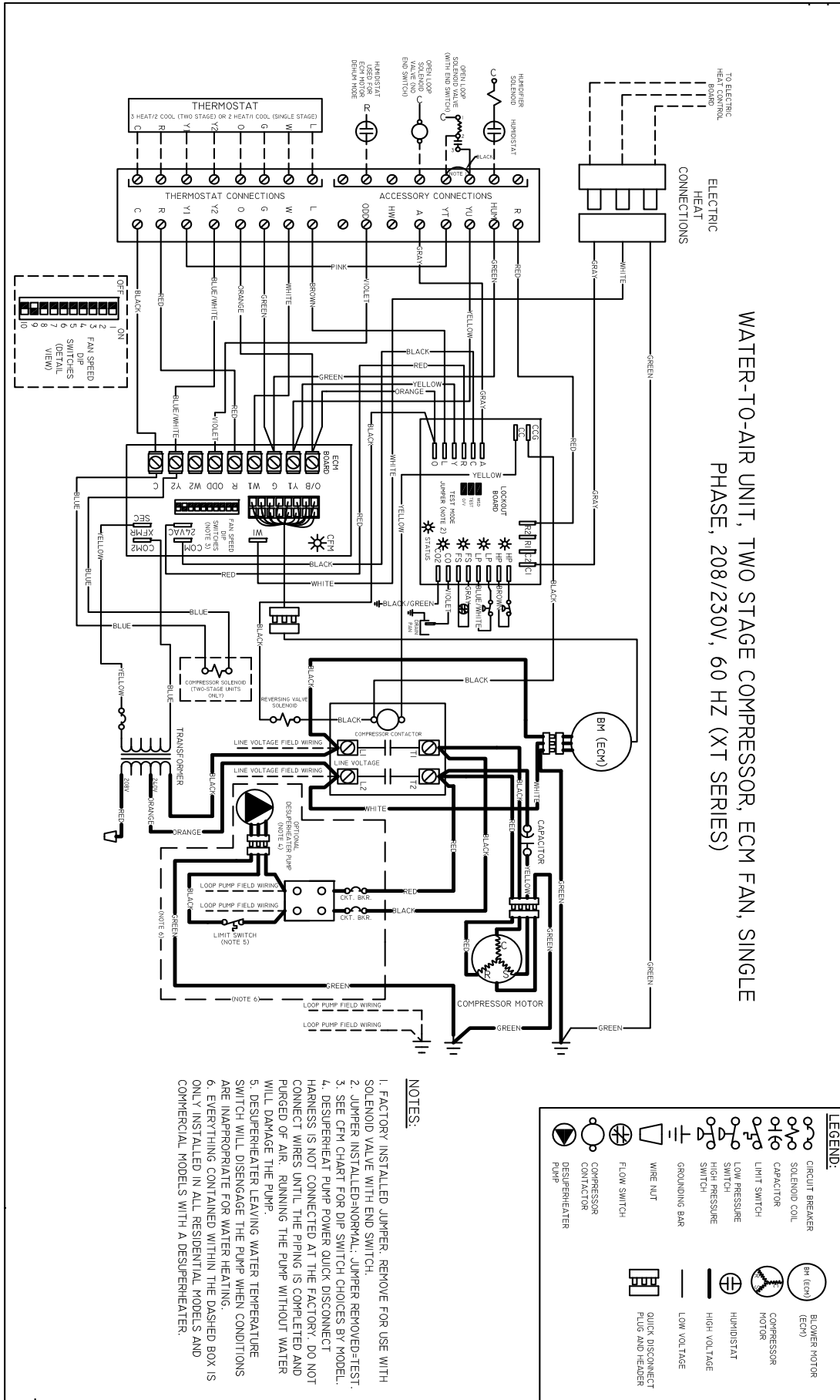
DIP Switch		Mode	Operation
S9	S10		
ON	OFF	Normal	Dehumidification mode disabled (normal Htg/Clg CFM) - factory setting
OFF	ON	ODD	On Demand dehumidification mode (humidistat input at terminal ODD) - Humidistat required
OFF	OFF	Constant Dehum	Constant dehumidification mode (always uses dehum CFM for cooling and normal CFM for heating) - No humidistat required
ON	ON	Not Used	Not an applicable selection

Notes:

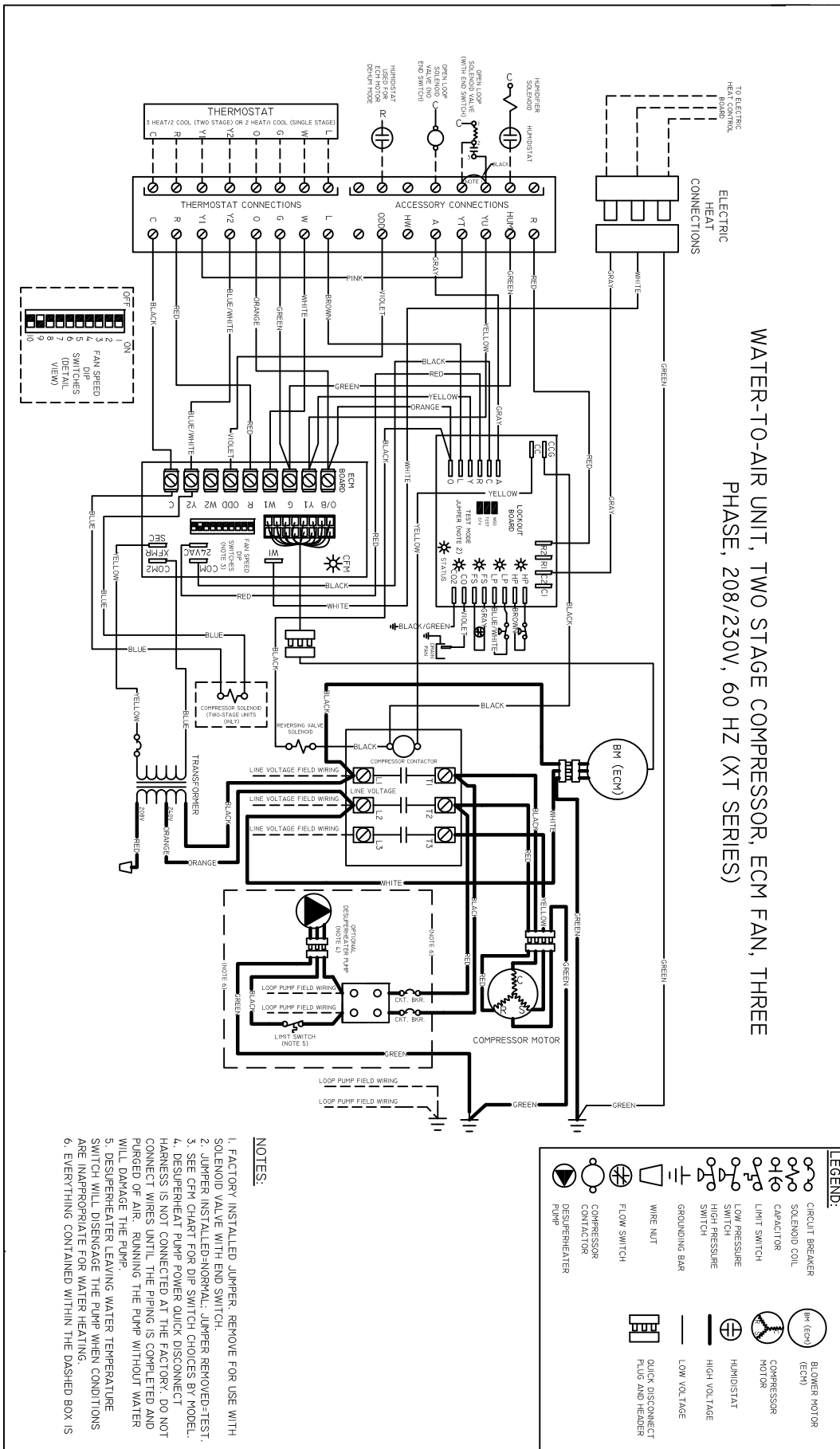
1. To enter dehumidification mode, ODD input should be 0 VAC; for normal cooling CFM, ODD input should be 24VAC.
2. Heating CFM is not affected by dehumidification mode. When in dehumidification mode, cooling CFM is 85% of normal cooling CFM.

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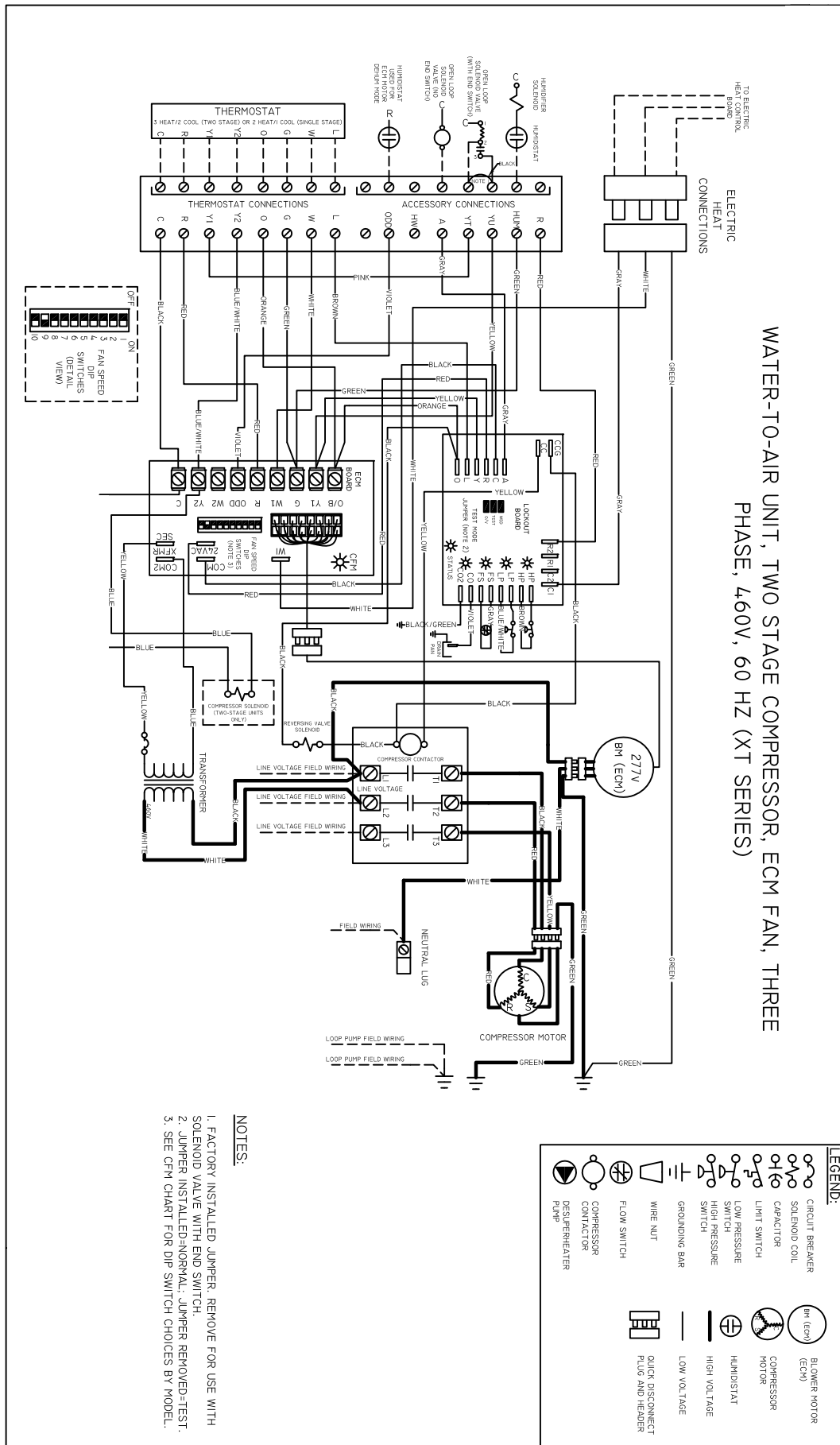
Section 8: Controls



Section 8: Controls



Section 8: Controls

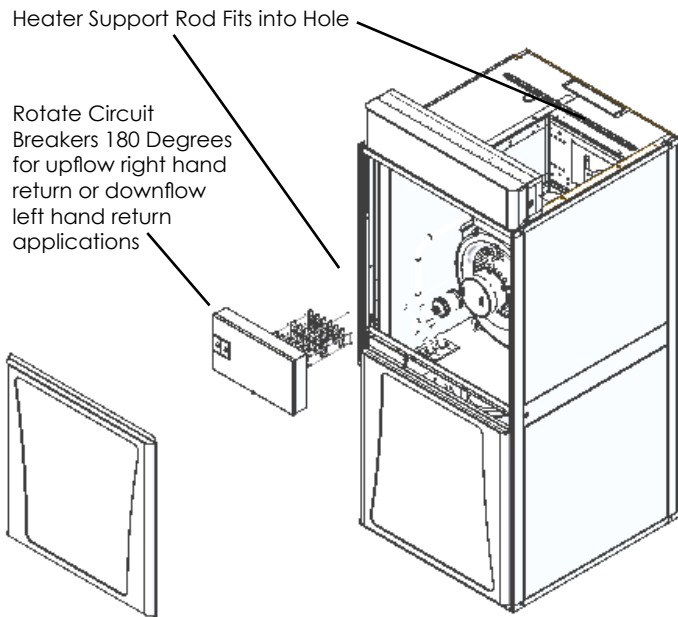


Section 9: Accessories

Table 9: Auxiliary Heater Electrical Data

TECHNICAL DATA (AHTR Electric Heaters only) Single Phase w/ Circuit Breaker												
Heater Model	Supply Voltage	Heat kW	Supply Circuit Number	Heater kW Per Circuit	FLA Total AMPS	MCA Min Circuit Ampacity	Maximum Over-Current Protective Device (AMPS.)	Recommended				
								Supply Wire 75°C. Copper			Ground Wire	
								# of Wires	Wire Size	Max Length (Ft)	# of wires	Min Size
AHTR101B OR AHTR101C	240	10	Single	5	41.7	52.1	60	2	6	101	1	10
	208	7.5	Single	3.75	36.1	45.1		2	6	115	1	10
AHTR151B OR AHTR151C	240	15	Mult. 1	5	20.8	26.0	30	2	10	118	1	10
	240		Mult. 2	10	41.7	52.1	60	2	6	101	1	10
	208	11.25	Mult. 1	3.75	18.0	22.5	30	2	10	118	1	10
	208		Mult. 2	7.5	36.1	45.1	60	2	6	101	1	10
AHTR201B OR AHTR201C	240	20	Mult. 1	10	41.6	52.0	60	2	6	101	1	10
	240		Mult. 2	10	41.6	52.0	60	2	6	101	1	10
	208	15	Mult. 1	7.5	48.1	60.0	60	2	6	101	1	10
	208		Mult. 2	7.5	48.1	60.0	60	2	6	101	1	10

Figure 15: Auxiliary Heater Placement



Representative drawing only, some models may vary in appearance.

Installing Electric Heater High Voltage Wires:

All wiring **MUST** be done in strict compliance with local, state, national or any other applicable codes.

Note: If Electric Auxiliary is used, never disconnect power to the heat unit as it may be required to properly heat the home. Major damage may result.

Please note, these heaters are for vertical units only. Please see the Field-Installed Electric Heat IOM, part number 27P009-01NN for detailed instructions on the installation and wiring of auxiliary electric heaters.

Section 9: Accessories

AP SMA PUMP SHARING MODULE

The pump sharing module, part number APS-MA, 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 Figure 16, below. Figure 17 includes a schematic of the board. The module must be mounted in a NEMA enclosure or inside the unit control box. Local code supersedes any recommendations in this document.

Figure 16: APSMA Module Layout

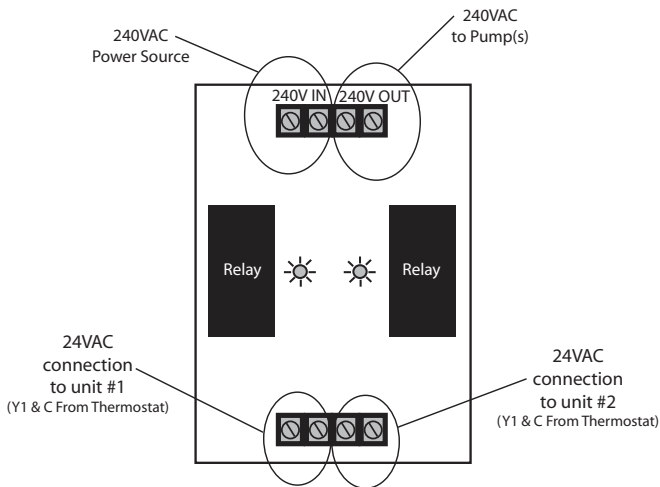
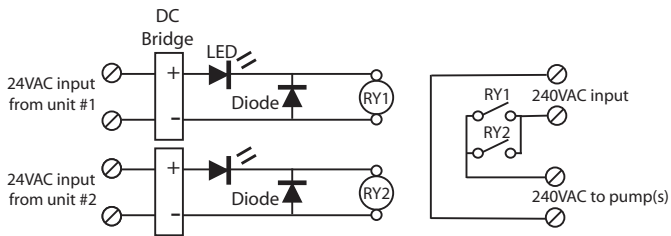


Figure 17: APSMA Module Wiring Schematic



Section 10: Equipment Start-Up Procedures

Equipment Start-Up Process

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.

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		°F		°F
Source Water Temperature Out		°F		°F
Source Water Temperature Difference		°F		°F
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		°F		°F
Load Water Temperature Out		°F		°F
Load Water Temperature Difference		°F		°F

Air Temperature Difference	Cooling	Heating
Supply Air Temperature	°F	°F
Return Air Temperature	°F	°F
Air Temp. Difference	°F	°F

*Confirm auxiliary heaters are de-energized for the above readings.

Auxiliary Heat Operation Only	Heating
Supply Air Temperature	°F
Return Air Temperature	°F
Air Temp. Difference	°F

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

Cut along this line

Installer/Technician: _____ Date: _____

Section 11: Troubleshooting

PERFORMANCE CHECK

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

Equipment should be in full load operation for a minimum of 10 minutes in either mode – **WITH THE HOT WATER GENERATOR TURNED OFF.**

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: $GPM \times \text{water temp diff} \times 485$
(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 11: Troubleshooting

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.

BLOWER RUNS BUT COMPRESSOR WILL NOT START (COMPRESSOR OVERLOAD, CAPACITOR BLOWN, HP FAULT)

Logic Board	Check if logic board is working properly. Check status light for fault. See board imprint for blink faults.
Flow Switch	Temporarily bypass flow switch until compressor starts. If compressor runs properly, check switch. If defective, replace. If switch is not defective, check for air in loop system. Make sure loop system is properly purged. Verify flow rate before changing switch.
Defective capacitor	Check capacitor. If defective, replace.
Frozen Compressor	See charts O and P for compressor diagnostic. If compressor still doesn't run, replace it.

BLOWER RUNS BUT COMPRESSOR SHORT CYCLES OR DOES NOT RUN

Wiring	Loose or broken wires. Tighten or replace wires. See A: Unit will not start in either cycle.
Blown Fuse	Check fuse size. Check unit nameplate for correct sizing. Replace fuse or reset circuit breaker. Check low voltage circuit breaker.
Flow Switch	Temporarily bypass flow switch for a couple seconds. If compressor runs properly, check switch. If defective, replace. If switch is not defective, check for air in loop system. Make sure loop system is properly purged. Verify flow rate before changing switch. .
Water Flow	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.
High or low pressure switches	If heat pump is out on high or low-pressure cutout (lockout), check for faulty switches by jumping the high and low-pressure switches individually. If defective replace. Check airflow, filters, water flow, loss of refrigerant and ambient temperature. WARNING: Only allow compressor to run for a couple of seconds with the high pressure switch jumpered
Defective logic board relay	Jump or bypass relay. If defective, replace.
Low refrigerant charge	Check for leaks and fix leaks.

NOISY BLOWER AND LOW AIR FLOW

Noisy Blower	Blower wheel contacting housing—Readjust. Foreign material inside housing—Clean housing. Loose duct work—Secure properly.
Low air flow	Check speed setting, check nameplate or data manual for proper speed, and correct speed setting. Check for dirty air filter—Clean or replace; obstruction in system—Visually check. Balancing dampers closed, registers closed, leaks in ductwork. Repair. Ductwork too small. Resize ductwork.

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).
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Section 11: Troubleshooting

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. Re-pressurize 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.

IN HEATING OR COOLING MODE, UNIT OUTPUT IS LOW

Water	Water flow & temperature insufficient.
Airflow	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.
Reversing valve	Defective reversing valve can create bypass of refrigerant to suction side of compressor. Switch reversing valve to heating and cooling mode rapidly. If problem is not resolved, replace valve. Wrap the valve with a wet cloth and direct the heat away from the valve. Excessive heat can damage the valve. Always use dry nitrogen when brazing. Replace filter/drier any time the circuit is opened.
Heat pump will not cool but will heat. Heat pump will not heat but will cool.	Reversing valve does not shift. Check reversing valve wiring. If wired wrong, correct wiring. If reversing valve is stuck, replace valve. Wrap the valve with a wet cloth and direct the heat away from the valve. Excessive heat can damage the valve. Always use dry nitrogen when brazing. Replace filter/drier any time the circuit is opened.
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.

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.

EXCESSIVE HEAD PRESSURE IN COOLING MODE

Inadequate water flow	Low water flow, increase flow.
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EXCESSIVE HEAD PRESSURE IN HEATING MODE

Low air flow	See E: Noisy blower and low air flow.
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AIR COIL FREEZES OVER IN COOLING MODE

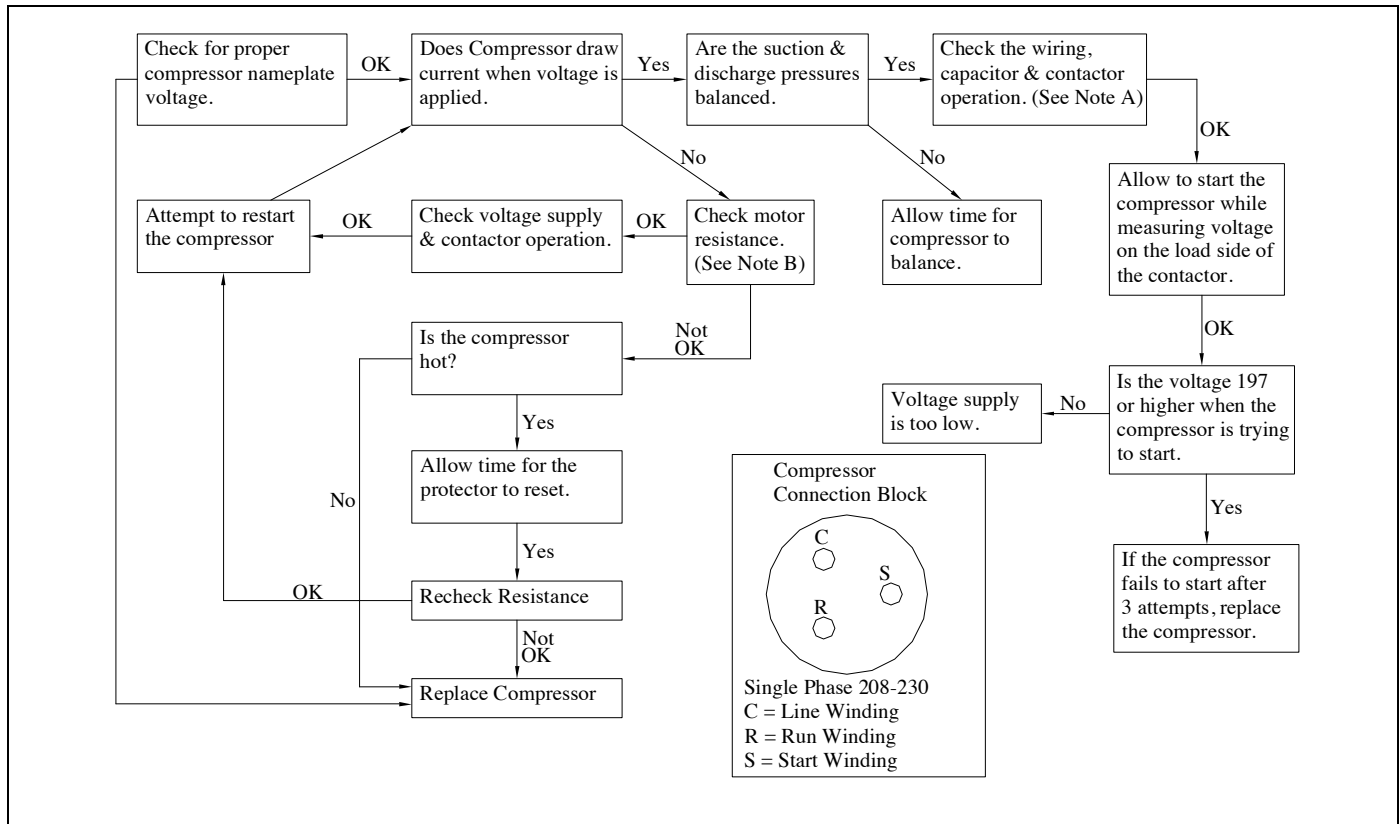
Air flow	See E: Noisy blower and low air flow.
Blower motor	Motor not running or running too slow. Motor tripping off on overload. Check for overheated blower motor and tripped overload. Replace motor if defective.
Panels	Panels not in place.
Low air flow	See E: Noisy blower and low air flow.

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 11: Troubleshooting

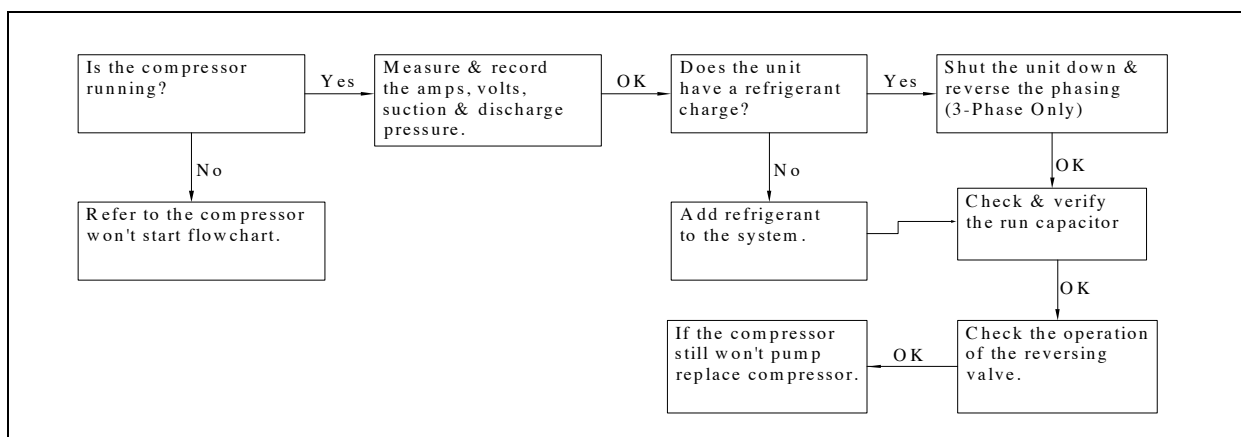
COMPRESSOR WON'T START



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.

COMPRESSOR WON'T PUMP CHART



Section 11: Troubleshooting

Table 15: 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

Section 11: Troubleshooting

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

Table 4: Typical R-410A Unit Superheat/Subcooling Values

Heating - Without Desuperheater							
EWT	GPM Per Ton	Discharge Pressure (PSIG)	Suction Pressure (PSIG)	Sub Cooling	Super Heat	Air Temperature Rise (°F-DB)	Water Temperature Drop (°F)
30	1.5	285-310	68-76	4-10	8-12	14-20	5-8
	3	290-315	70-80	4-10	8-12	16-22	3-6
50	1.5	315-345	100-110	6-12	9-14	22-28	7-10
	3	320-350	105-115	6-12	9-14	24-30	5-8
70	1.5	355-395	135-145	7-12	10-15	30-36	9-12
	3	360-390	140-150	7-12	10-15	32-38	7-10

Cooling - Without Desuperheater							
EWT	GPM Per Ton	Discharge Pressure (PSIG)	Suction Pressure (PSIG)	Sub Cooling	Super Heat	Air Temperature Drop (°F-DB)	Water Temperature Rise (°F)
50	1.5	220-235	120-130	10-16	12-20	20-26	19-23
	3	190-210	120-130	10-16	12-20	20-26	9-12
70	1.5	280-300	125-135	8-14	10-16	19-24	18-22
	3	250-270	125-135	8-14	10-16	19-24	9-12

Section 11: Troubleshooting

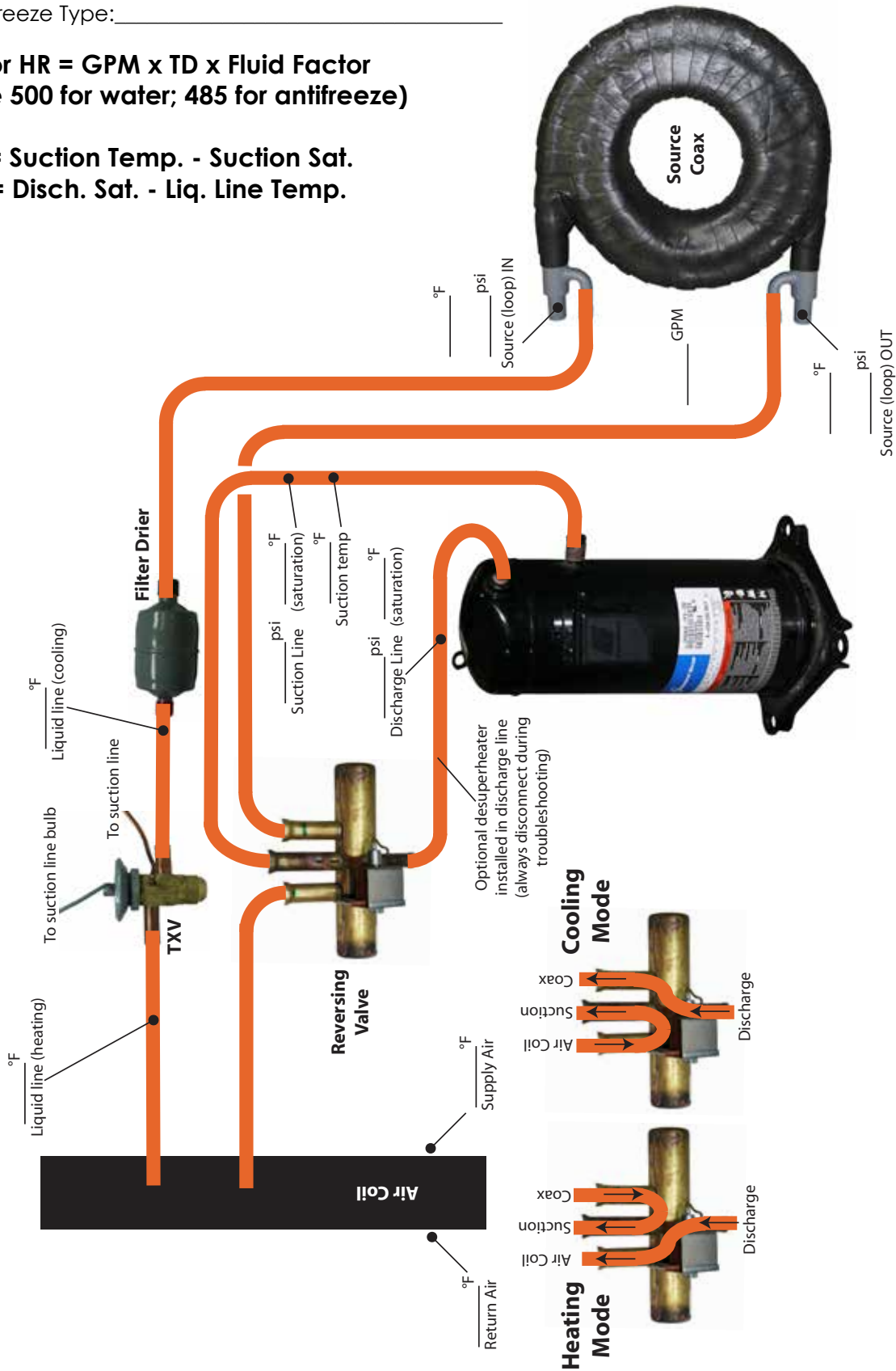
Customer/Job Name: _____ Date: _____

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.



Cut along this line

Section 11: Engineering Data

Unit Electrical Data

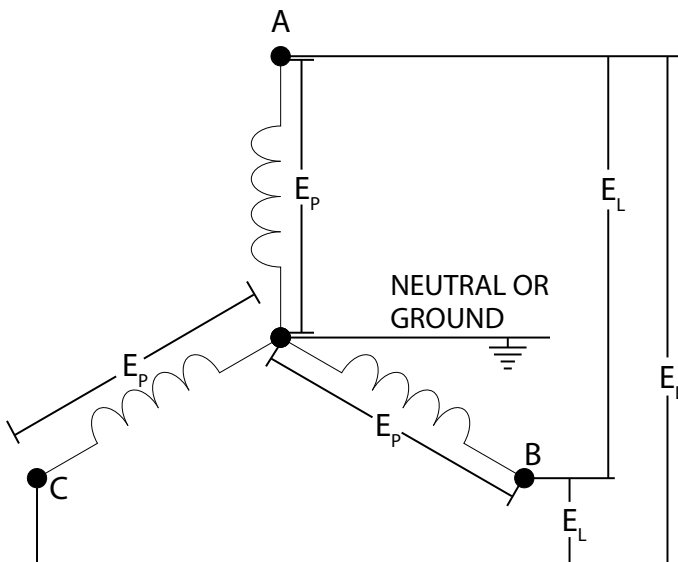
⚠ CAUTION ⚠

CHECK COMPRESSOR AMP DRAW TO VERIFY COMPRESSOR ROTATION ON THREE PHASE UNITS. COMPARE AGAINST UNIT ELECTRICAL TABLES. REVERSE ROTATION RESULTS IN HIGHER SOUND LEVELS, LOWER AMP DRAW, AND INCREASED COMPRESSOR WEAR. THE COMPRESSOR INTERNAL OVERLOAD WILL TRIP AFTER A SHORT PERIOD OF OPERATION.

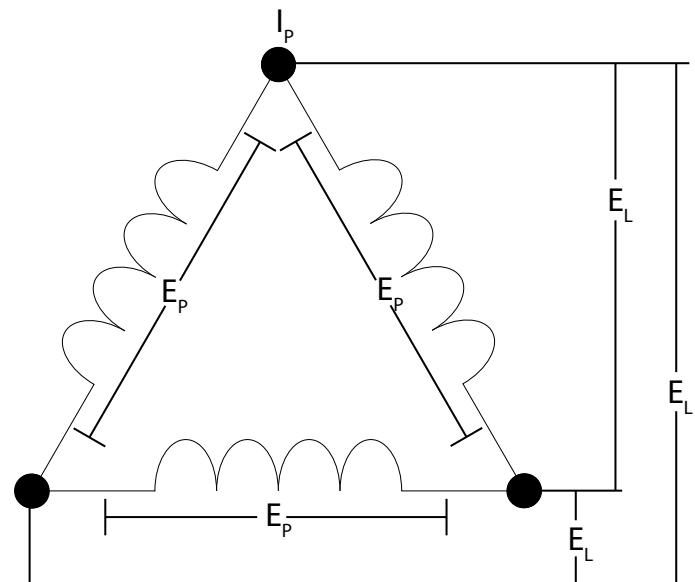
NOTE: Proper Power Supply Evaluation

When any compressor bearing unit is connected to a weak power supply, starting current will generate a significant “sag” in the voltage which reduces the starting torque of the compressor motor and increases 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 with an electrician and HVAC technician. The evaluation should include all 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.

Example 1: WYE (STAR) Electrical Circuit



Example 2: DELTA Electrical Circuit



⚠ CAUTION ⚠

ALL VOLTAGE CODE “3” 460V UNITS UTILIZE A 277V ECM MOTOR WHICH REQUIRES A NEUTRAL WIRE. THE MOTORS ARE WIRED BETWEEN THE NEUTRAL AND ONE HOT LEG OF THE CIRCUIT. SOURCE WIRING MUST BE WYE (STAR) CONFIGURATION. 3-PHASE DELTA CONNECTIONS WILL NOT PROVIDE THE CORRECT WIRING AND WILL CAUSE THE UNIT NOT TO OPERATE.

Section 11: Engineering Data

Unit Electrical Data

Model	Voltage Code	60Hz Power		Compressor		ECM Fan Motor FLA	HWG Pump FLA	Ext Loop Pump FLA*	Total Unit FLA	Min Circuit AMPS	Max Fuse HACR	Min AWG	Max Ft
		Volts	Phase	LRA	RLA								
024	1	208/230	1	58.3	11.7	3.9	0.5	4.0	20.1	23.0	35	12	49
	0	208/230	1	58.3	11.7	3.9	N/A	N/A	15.6	18.5	30	14	41
	2	208/230	3	55.4	6.5	3.9	N/A	N/A	10.4	12.0	15	14	62
	3	460	3	28.0	3.5	3.9	N/A	N/A	7.4	8.4	10	14	87
036	1	208/230	1	83.0	15.3	3.9	0.5	4.0	23.7	27.5	40	10	70
	0	208/230	1	83.0	15.3	3.9	N/A	N/A	19.2	23.0	35	12	52
	2	208/230	3	73.0	11.6	3.9	N/A	N/A	15.5	18.4	30	14	41
	3	460	3	38.0	5.7	3.9	N/A	N/A	9.6	11.0	15	14	67
048	1	208/230	1	104.0	21.2	5.2	0.5	5.5	32.4	37.7	50	8	79
	0	208/230	1	104.0	21.2	5.2	N/A	N/A	26.4	31.7	50	8	97
	2	208/230	3	83.1	14.0	5.2	N/A	N/A	19.2	22.7	35	12	52
	3	460	3	41.0	6.4	5.2	N/A	N/A	11.6	13.2	20	14	55
060	1	208/230	1	152.9	27.1	6.9	0.5	5.5	40.0	46.8	70	6	102
	0	208/230	1	152.9	27.1	6.9	N/A	N/A	34.0	40.8	60	6	120
	2	208/230	3	110.0	16.5	6.9	N/A	N/A	23.4	27.5	40	10	71
	3	460	3	52.0	7.2	6.9	N/A	N/A	14.1	15.9	20	14	45
072	1	208/230	1	179.2	29.7	6.9	0.5	5.5	42.6	50.0	80	6	95
	0	208/230	1	179.2	29.7	6.9	N/A	N/A	36.6	44.0	70	6	111
	2	208/230	3	136.0	17.6	6.9	N/A	N/A	24.5	28.9	45	10	68
	3	460	3	66.1	8.5	6.9	N/A	N/A	15.4	17.5	25	14	41

Notes:

1. All line and low voltage wiring must adhere to the National Electrical Code and local codes, whichever is the most stringent.
2. Wire length based on a one way measurement with a 2% voltage drop.
3. Wire size based on 60°C copper conductor and minimum circuit ampacity.
3. All fuses class RK-5.
4. Min/Max Voltage: 208/230/60/1 = 187-252, 208/230/60/3 = 187-252, 460/60/3 = 432-504
5. See Example Electrical Circuits for proper 460V power

* The external loop pump FLA is based on a maximum of three UP26-116F-230V pumps (1/2hp) for 048 - 072 and two pumps for 024 - 036.

Section 11: Engineering Data

Water Flow Calculations and Selection

Proper flow rate is crucial for reliable operation of geothermal heat pumps. The performance data shows three flow rates for each entering water temperature (EWT column). The general "rule of thumb" when selecting flow rates is the following:

Top flow rate: Open loop systems (1.5 to 2.0 gpm per ton)
Middle flow rate: Minimum closed loop system flow rate (2.25 to 2.50 gpm/ton)
Bottom flow rate: Nominal (optimum) closed loop system flow rate (3.0 gpm/ton)

Although the industry standard is adequate in most areas of North America, it is important to consider the application type before applying this "rule of thumb." Antifreeze is generally required for all closed loop (geothermal) applications. Extreme Southern U.S. locations are the only exception. Open loop (well water) systems cannot use antifreeze, and must have enough flow rate in order to avoid freezing conditions at the Leaving Source Water Temperature (LWT) connection.

Calculations must be made for all systems without antifreeze to determine if the top flow rate is adequate to prevent LWT at or near freezing conditions. The following steps should be taken in making this calculation:

Determine minimum EWT based upon your geographical area.
Go to the performance data table for the heat pump model selected and look up the the Heat of Extraction (HE) at the "rule of thumb" water flow rate (GPM) and at the design Entering Air Temperature (EAT).

Calculate the temperature difference (TD) based upon the HE and GPM of the model.

$$TD = HE / (GPM \times 500).$$

Calculate the LWT.

$$LWT = EWT - TD.$$

If the LWT is below 35-38°F, there is potential for freezing conditions if the flow rate or water temperature is less than ideal conditions, and the flow rate must be increased.

Example 1:

EWT = 50°F.

Model GXT048, high capacity. Flow rate = 6 GPM.

Air Flow = 1500 CFM. HE = 36,700 Btuh.

$$TD = 36,700 / (6 \times 500) = 12.2^\circ\text{F}$$

$$LWT = 50 - 12.2 = 37.8^\circ\text{F}$$

Since the water flow is leaving at approximately 38°F, the flow rate is acceptable.

Example 2:

EWT = 40°F.

Model GXT048, high capacity. Flow rate = 6 GPM.

Air Flow = 1500 CFM. HE = 36,700 Btuh.

$$TD = 36,700 / (6 \times 500) = 12.2^\circ\text{F}$$

$$LWT = 40 - 12.2 = 27.8^\circ\text{F}$$

Water flow rate must be increased to avoid freezing.

Performance Data Notes

1. Capacity data is based upon 15% (by volume) methanol antifreeze solution.
2. Desuperheater capacity is based upon 0.4 GPM Flow per nominal ton at 90°F entering hot water temperature.
3. Interpolation between above categories is permissible; extrapolation is not.
4. See Flow Rate Selection above for proper application.

Section 11: Engineering Data

Glossary of Terms

CFM = Airflow, Cubic Feet/Minute	HR = Total Heat Of Rejection, Btu/hr
COP = Coefficient of Performance = BTU Output / BTU Input	KW = Total Power Unit Input, Kilowatts
DH = Desuperheater Capacity, Btu/hr	LAT = Leaving Air Temperature, Fahrenheit
EAT = Entering Air Temperature, Fahrenheit (Dry Bulb/Wet Bulb)	LC = Latent Cooling Capacity, Btu/hr
EER = Energy Efficiency Ratio = BTU output/Watts input	SC = Sensible Cooling Capacity, Btu/hr
EWT = Entering Source Water Temperature, Fahrenheit	LWT = Leaving Source Water Temperature, Fahrenheit
ELT = Entering Load Water Temperature, Fahrenheit	LLT = Leaving Load Water Temperature, Fahrenheit
GPM = Water Flow, Gallons Per Minute	TC = Total Cooling Capacity, Btu/hr
HC = Total Heating Capacity, Btu/hr	WPD = Water Pressure Drop, PSI & Feet of Water
HE = Total Heat Of Extraction, Btu/hr	

Heating & Cooling Calculations

Heating	Cooling
$LAT = EAT + \frac{HC}{CFM \times 1.08}$	$LAT (DB) = EAT (DB) - \frac{SC}{CFM \times 1.08}$
$LWT = EWT - \frac{HE}{GPM \times 500}$	$LWT = EWT + \frac{HR}{GPM \times 500}$
$LC = TC - SC$	

Performance Data Correction Factors

Heating Correction Factors - Full Load

EAT °F	HC	HE	kW
50	1.0450	1.1136	0.8208
55	1.0347	1.0892	0.8567
60	1.0260	1.0640	0.9019
65	1.0089	1.0270	0.9497
70	1.0000	1.0000	1.0000
75	0.9924	0.9741	1.0527
80	0.9870	0.9653	1.0522

Heating Correction Factors - Part Load

EAT °F	HC	HE	kW
50	1.0480	1.1240	0.7839
55	1.0355	1.0943	0.8305
60	1.0246	1.0650	0.8837
65	1.0126	1.0330	0.9411
70	1.0000	1.0000	1.0000
75	0.9866	0.9661	1.0579
80	0.9613	0.9325	1.0513

Cooling Correction Factors

EAT (WB) °F	TC	HR	kW
55	0.8215	0.8293	0.8635
60	0.8955	0.9001	0.9205
65	0.9701	0.9715	0.9774
67	1.0000	1.0000	1.0000
70	1.0446	1.0425	1.0335
75	1.1179	1.1124	1.0878

Sensible Cooling Correction Factors

EAT (WB) °F	EAT (DB) °F				
	70	75	80	85	90
55	1.201	1.289			
60	0.943	1.067	1.192		
63	0.852	0.995	1.138		
65	0.797	0.952	1.106	1.261	
67	0.624	0.812	1.000	1.188	1.343
70		0.697	0.820	0.944	1.067
75			0.637	0.817	0.983

Section 11: Engineering Data

AHRI Performance Data

Ground Loop Heat Pump

MODEL	CAPACITY	HEATING		COOLING	
		Btu/hr	COP	Btu/hr	EER
XT024	Full Load	19,800	4.3	27,200	20.3
	Part Load	16,600	4.8	21,400	29.1
XT036	Full Load	29,200	4.2	38,900	18.3
	Part Load	23,200	4.6	29,900	27.0
XT048	Full Load	38,200	3.9	49,000	17.1
	Part Load	29,700	4.3	37,400	24.1
XT060	Full Load	47,700	3.7	63,000	17.8
	Part Load	38,600	4.3	49,000	24.9
XT072	Full Load	55,900	3.6	71,100	17.1
	Part Load	46,700	4.1	57,500	23.0



Note:

Rated in accordance with ISO Standard 13256-1 which includes Pump Penalties.
 Heating capacities based on 68.0°F DB, 59.0°F WB entering air temperature.
 Cooling capacities based on 80.6°F DB, 66.2°F WB entering air temperature.
 Entering water temperatures Full Load: 32°F heating / 77°F cooling.
 Entering water temperatures Part Load: 41°F heating / 68°F cooling.

Ground Water Heat Pump

MODEL	CAPACITY	HEATING		COOLING	
		Btu/hr	COP	Btu/hr	EER
XT024	Full Load	24,600	5.3	29,600	26.9
	Part Load	18,200	5.5	22,400	34.0
XT036	Full Load	35,700	4.9	40,900	23.4
	Part Load	24,800	5.3	30,400	32.8
XT048	Full Load	47,700	4.5	53,600	22.5
	Part Load	34,000	4.9	39,800	29.6
XT060	Full Load	60,000	4.5	67,700	22.4
	Part Load	43,300	4.8	50,800	29.8
XT072	Full Load	70,300	4.3	75,600	21.1
	Part Load	52,800	4.6	59,200	26.9

Note:

Rated in accordance with ISO Standard 13256-1 which includes Pump Penalties.
 Heating capacities based on 68.0°F DB, 59.0°F WB entering air temperature.
 Cooling capacities based on 80.6°F DB, 66.2°F WB entering air temperature.
 Entering water temperatures: 50°F heating / 59°F cooling.

Section 11: Engineering Data

Model 024 Full Load Heating Performance Data: 2.0 Ton,

EWT °F	Flow GPM	WPD		LWT °F	Heating									
		PSI	FT		Aiflow	LAT	HC	HE	kW	COP	Discharge	Suction	Subcooling	Superheat
					CFM	°F	MBtuh	MBtuh		W/W	PSIG	PSIG	°F	°F
25	6.0	4.6	10.5	20.3	850	90.4	18.7	13.6	1.49	3.68	288.9	76.1	20.5	8.6
				20.3	950	88.3	18.8	13.7	1.49	3.70	287.1	76.2	20.4	8.6
30	3.0	1.6	3.6	20.9	850	89.8	18.2	13.3	1.45	3.68	282.2	74.0	19.5	10.1
				20.8	950	87.8	18.3	13.4	1.45	3.70	280.4	74.1	19.3	10.0
	4.5	2.9	6.6	23.5	850	90.8	19.1	14.1	1.48	3.78	287.6	78.3	19.4	9.8
				23.5	950	88.7	19.2	14.2	1.48	3.80	285.8	78.4	19.2	9.7
	6.0	4.5	10.3	24.9	850	91.5	19.7	14.7	1.48	3.90	289.9	80.6	19.3	9.7
				24.9	950	89.3	19.8	14.8	1.48	3.92	288.1	80.7	19.1	9.7
40	3.0	1.5	3.4	29.1	850	92.9	21.0	15.9	1.50	4.10	295.0	87.1	19.0	9.7
				29.0	950	90.6	21.1	16.0	1.49	4.15	293.2	87.2	18.9	9.6
	4.5	2.7	6.2	32.3	850	94.1	22.1	16.9	1.53	4.23	300.7	92.2	18.9	9.9
				32.2	950	91.6	22.2	17.0	1.52	4.28	298.8	92.3	18.7	9.8
	6.0	4.2	9.7	34.0	850	94.7	22.7	17.5	1.53	4.35	303.1	94.9	18.7	10.0
				34.0	950	92.2	22.8	17.6	1.52	4.40	301.3	95.0	18.5	10.0
50	3.0	1.4	3.2	37.3	850	95.9	23.8	18.5	1.55	4.50	308.6	101.0	18.3	9.8
				37.2	950	93.3	23.9	18.6	1.54	4.55	306.7	101.1	18.2	9.8
	4.5	2.5	5.8	41.0	850	97.3	25.1	19.7	1.58	4.66	314.5	106.9	18.1	10.6
				40.9	950	94.6	25.2	19.8	1.57	4.70	312.6	107.0	18.0	10.5
	6.0	3.9	9.1	43.0	850	98.0	25.7	20.3	1.58	4.77	317.1	110.0	17.9	11.0
				43.0	950	95.2	25.9	20.5	1.57	4.83	315.1	110.1	17.8	10.9
60	3.0	1.3	3.0	45.6	850	98.6	26.3	20.9	1.59	4.85	319.6	114.7	16.8	10.6
				45.6	950	95.7	26.4	21.0	1.58	4.90	317.6	114.7	16.8	10.6
	4.5	2.4	5.5	49.8	850	100.2	27.7	22.2	1.62	5.01	325.7	121.4	16.6	11.8
				49.7	950	97.2	27.9	22.4	1.61	5.08	323.7	121.4	16.5	11.8
	6.0	3.7	8.6	52.1	850	101.0	28.5	23.0	1.62	5.16	328.3	124.9	16.4	12.6
				52.1	950	97.9	28.6	23.1	1.61	5.21	326.3	125.0	16.2	12.6
70	3.0	1.3	2.9	54.0	850	101.5	28.9	23.3	1.64	5.16	332.3	130.3	15.2	11.3
				53.8	950	98.4	29.1	23.5	1.64	5.20	330.3	130.4	15.1	11.2
	4.5	2.3	5.3	58.6	850	103.2	30.5	24.8	1.68	5.32	338.7	137.9	14.8	12.9
				58.6	950	99.8	30.6	24.9	1.67	5.37	336.6	137.9	14.7	12.9
	6.0	3.6	8.3	61.2	850	104.1	31.3	25.6	1.68	5.46	341.4	141.9	14.5	13.9
				61.1	950	100.7	31.5	25.8	1.67	5.53	339.3	142.0	14.4	13.9
80	3.0	1.2	2.8	62.1	850	104.9	32.0	26.1	1.74	5.39	350.7	149.5	13.8	11.3
				62.0	950	101.3	32.1	26.2	1.73	5.44	348.5	149.5	13.8	11.3
	4.5	2.2	5.1	67.3	850	106.7	33.7	27.7	1.77	5.58	357.4	158.1	13.3	13.6
				67.3	950	102.9	33.8	27.8	1.77	5.60	355.2	158.2	13.2	13.5
	6.0	3.4	7.9	70.2	850	107.7	34.6	28.6	1.77	5.73	360.3	162.8	12.9	14.7
				70.1	950	103.9	34.8	28.8	1.77	5.76	358.1	162.8	12.8	14.7
90	3.0	1.1	2.7	70.2	850	108.2	35.1	28.8	1.85	5.56	369.8	169.4	12.1	11.8
				70.1	950	104.3	35.2	28.9	1.84	5.61	367.5	169.5	12.0	11.8
	4.5	2.1	4.8	76.0	850	110.2	36.9	30.5	1.88	5.75	376.9	179.2	11.4	14.4
				75.9	950	106.2	37.1	30.7	1.87	5.81	374.6	179.3	11.4	14.3
	6.0	3.3	7.5	79.2	850	111.3	37.9	31.5	1.88	5.91	379.9	184.5	11.0	15.8
				79.1	950	107.1	38.1	31.7	1.87	5.97	377.6	184.6	11.0	15.8

Heating data based on 70 °F EAT. See Correction Factors at end of section for different conditions

LWT is based on 15% (by volume) methanol antifreeze solution only or 485 multiplier

Performance data accurate within ± 10%

Discharge pressure is ± 20 PSI; Suction pressure is ± 10 PSI

SubCooling is ± 5 °F; Superheat is ± 6 °F

Section 11: Engineering Data

Model 024 Full Load Cooling Performance Data: 2.0 Ton,

EWT °F	Flow GPM	WPD		LWT °F	Cooling										
		PSI	FT		Aiflow	TC	SC	S/T	HR	EER	Discharge	Suction	Subcooling	Superheat	
					CFM	MBtuh	MBtuh		MBtuh	kW	Btuh/W	PSIG	PSIG	°F	°F
50	3.0	1.7	3.9	73.2	850	29.7	19.0	0.64	33.8	1.21	24.5	219.5	142.8	17.1	20.1
				73.8	950	30.5	20.4	0.67	34.7	1.23	24.8	220.9	145.0	16.8	19.4
	4.5	2.7	6.2	65.5	850	30.0	19.1	0.64	33.9	1.14	26.3	200.3	141.9	13.1	21.1
				65.9	950	30.8	20.5	0.67	34.8	1.16	26.6	201.6	144.1	12.8	20.4
	6.0	3.9	8.9	61.6	850	30.1	19.3	0.64	33.9	1.11	27.1	192.3	141.4	11.3	21.5
				62.0	950	30.9	20.7	0.67	34.8	1.13	27.3	193.5	143.6	11.0	20.8
60	3.0	1.6	3.7	82.9	850	28.7	18.8	0.66	33.3	1.35	21.3	256.7	145.7	17.6	16.8
				83.4	950	29.4	20.2	0.69	34.1	1.38	21.3	258.3	148.0	17.1	16.1
	4.5	2.5	5.9	75.3	850	29.0	18.9	0.65	33.3	1.27	22.8	234.2	144.8	13.3	17.7
				75.7	950	29.8	20.3	0.68	34.2	1.30	22.9	235.7	147.1	12.8	17.0
	6.0	3.7	8.5	71.4	850	29.1	19.1	0.66	33.3	1.24	23.5	224.8	144.3	11.4	18.1
				71.8	950	29.9	20.5	0.69	34.2	1.26	23.7	226.3	146.6	11.1	17.4
70	3.0	1.5	3.5	92.5	850	27.7	18.6	0.67	32.8	1.50	18.5	295.9	148.6	17.7	13.6
				93.1	950	28.4	20.0	0.70	33.6	1.53	18.6	297.8	150.9	17.2	12.9
	4.5	2.4	5.6	85.0	850	28.0	18.7	0.67	32.8	1.41	19.9	270.0	147.6	13.4	14.7
				85.4	950	28.7	20.1	0.70	33.6	1.44	19.9	271.8	149.9	13.0	14.0
	6.0	3.5	8.0	81.3	850	28.1	18.9	0.67	32.8	1.37	20.5	259.2	147.1	11.5	15.1
				81.5	950	28.8	20.3	0.70	33.6	1.40	20.6	260.9	149.5	11.0	14.3
80	3.0	1.5	3.4	101.9	850	26.3	18.0	0.68	31.9	1.64	16.0	338.5	150.8	17.8	12.3
				102.4	950	26.9	19.3	0.72	32.6	1.67	16.1	340.7	153.1	17.2	11.6
	4.5	2.4	5.4	94.6	850	26.5	18.0	0.68	31.8	1.55	17.1	308.9	149.8	13.8	13.2
				94.9	950	27.2	19.4	0.71	32.6	1.58	17.2	310.9	152.1	13.2	12.5
	6.0	3.4	7.8	90.9	850	26.6	18.2	0.68	31.7	1.50	17.7	296.5	149.3	12.0	13.6
				91.2	950	27.3	19.6	0.72	32.5	1.53	17.8	298.5	151.6	11.4	12.9
90	3.0	1.4	3.3	111.2	850	24.7	17.2	0.70	30.8	1.80	13.7	386.3	152.7	17.7	11.9
				111.7	950	25.3	18.5	0.73	31.6	1.84	13.8	388.8	155.1	17.0	11.2
	4.5	2.3	5.4	104.1	850	25.0	17.3	0.69	30.8	1.70	14.7	352.5	151.7	14.3	12.9
				104.4	950	25.6	18.6	0.73	31.5	1.73	14.8	354.8	154.0	13.5	12.2
	6.0	3.4	7.7	100.5	850	25.0	17.5	0.70	30.6	1.65	15.2	338.4	151.2	12.6	13.2
				100.8	950	25.7	18.8	0.73	31.5	1.69	15.2	340.6	153.5	11.9	12.5
100	3.0	1.4	3.2	120.7	850	23.2	16.6	0.72	30.1	2.01	11.5	439.8	154.8	17.4	11.7
				121.2	950	23.8	17.8	0.75	30.8	2.05	11.6	442.6	157.2	16.6	11.0
	4.5	2.3	5.2	113.7	850	23.5	16.7	0.71	29.9	1.89	12.4	401.3	153.8	14.3	12.7
				114.1	950	24.1	17.9	0.74	30.7	1.93	12.5	403.9	156.2	13.3	12.0
	6.0	3.3	7.5	110.3	850	23.6	16.8	0.71	29.9	1.84	12.8	385.2	153.3	12.8	13.1
				110.5	950	24.2	18.1	0.75	30.6	1.88	12.9	387.8	155.7	12.0	12.4
110	3.0	1.4	3.2	130.1	850	21.7	15.9	0.73	29.3	2.22	9.8	495.3	156.8	17.6	12.0
				130.6	950	22.3	17.1	0.77	30.0	2.27	9.8	498.5	159.3	16.7	11.3
	4.5	2.2	5.1	123.4	850	22.0	16.0	0.73	29.2	2.10	10.5	452.0	155.8	13.7	13.0
				123.7	950	22.5	17.2	0.76	29.8	2.14	10.5	454.9	158.2	12.8	12.2
	6.0	3.2	7.3	120.0	850	22.0	16.2	0.74	29.0	2.04	10.8	433.9	155.3	12.2	13.4
				120.2	950	22.6	17.4	0.77	29.7	2.08	10.9	436.7	157.7	11.3	12.6

Cooling data based on 80/67 °F EAT. See Correction Factors at end of section for different conditions

LWT is based on 15% (by volume) methanol antifreeze solution only or 485 multiplier

Performance data accurate within ± 10%

Discharge pressure is ± 20 PSI; Suction pressure is ± 10 PSI

SubCooling is ± 5 °F; Superheat is ± 6 °F

Section 11: Engineering Data

Model 036 Full Load Heating Performance Data: 3.0 Ton,

EWT °F	Flow GPM	WPD		LWT °F	Heating									
		PSI	FT		Aiflow	LAT	HC	HE	kW	COP	Discharge	Suction	Subcooling	Superheat
					CFM	°F	MBtuh	MBtuh		W/W	PSIG	PSIG	°F	°F
25	9.0	4.1	9.4	20.6	1200	90.7	26.8	19.2	2.24	3.51	295.3	66.3	23.1	8.3
				20.5	1350	88.6	27.1	19.5	2.24	3.55	295.3	66.1	23.1	8.4
30	4.5	1.4	3.2	20.3	1200	92.4	29.0	21.2	2.29	3.71	304.6	68.8	28.2	7.9
				20.1	1350	90.1	29.3	21.5	2.29	3.75	304.6	68.7	28.2	8.0
	7.0	2.8	6.6	23.3	1200	93.5	30.5	22.6	2.31	3.87	308.2	74.9	25.7	6.7
				23.3	1350	91.1	30.8	22.9	2.31	3.91	308.2	74.8	25.7	6.7
	9.0	4.0	9.1	24.8	1200	93.5	30.5	22.7	2.30	3.89	307.4	77.4	23.5	5.6
				24.8	1350	91.1	30.7	22.9	2.30	3.91	307.4	77.3	23.5	5.7
40	4.5	1.3	2.9	28.7	1200	95.2	32.6	24.6	2.34	4.08	314.9	83.7	25.0	6.3
				28.6	1350	92.6	32.9	24.9	2.34	4.12	314.9	83.5	25.0	6.4
	7.0	2.6	6.0	32.3	1200	96.5	34.3	26.2	2.36	4.26	318.7	91.1	22.2	5.7
				32.2	1350	93.7	34.6	26.5	2.36	4.30	318.7	90.9	22.2	5.8
	9.0	3.6	8.3	34.0	1200	96.5	34.3	26.3	2.34	4.30	317.8	94.2	19.8	4.7
				33.9	1350	93.7	34.5	26.5	2.34	4.32	317.8	94.0	19.8	4.8
50	4.5	1.2	2.7	37.1	1200	98.1	36.4	28.2	2.40	4.44	326.5	99.0	22.2	5.7
				36.9	1350	95.2	36.7	28.5	2.40	4.48	326.5	98.8	22.2	5.8
	7.0	2.4	5.5	41.2	1200	99.5	38.2	29.9	2.42	4.63	330.4	107.9	19.1	5.7
				41.1	1350	96.4	38.5	30.2	2.42	4.66	330.4	107.6	19.1	5.8
	9.0	3.3	7.6	43.1	1200	99.5	38.2	30.0	2.40	4.66	329.5	111.5	16.5	4.9
				43.1	1350	96.4	38.5	30.3	2.40	4.70	329.5	111.2	16.5	5.0
60	4.5	1.1	2.5	44.9	1200	102.0	41.5	33.0	2.50	4.86	345.7	117.2	21.3	5.1
				44.7	1350	98.7	41.9	33.4	2.50	4.91	345.7	116.9	21.3	5.2
	7.0	2.2	5.0	49.7	1200	103.6	43.6	35.0	2.52	5.07	349.9	127.6	18.0	5.8
				49.6	1350	100.2	44.0	35.4	2.52	5.12	349.9	127.3	18.0	6.0
	9.0	3.0	7.0	52.0	1200	103.6	43.6	35.0	2.51	5.09	348.9	131.8	15.2	5.2
				51.9	1350	100.1	43.9	35.3	2.51	5.13	348.9	131.5	15.2	5.3
70	4.5	1.0	2.3	52.6	1200	106.2	46.9	37.9	2.64	5.21	368.3	136.4	21.1	5.2
				52.5	1350	102.4	47.3	38.3	2.64	5.25	368.3	136.1	21.1	5.3
	7.0	2.0	4.7	58.1	1200	108.1	49.4	40.3	2.66	5.44	372.6	148.6	17.5	6.6
				58.0	1350	104.2	49.8	40.7	2.66	5.49	372.6	148.2	17.5	6.8
	9.0	2.8	6.5	60.8	1200	108.0	49.3	40.3	2.65	5.45	371.6	153.5	14.7	6.0
				60.7	1350	104.1	49.7	40.7	2.65	5.50	371.6	153.2	14.7	6.1
80	4.5	0.9	2.1	60.8	1200	109.7	51.4	41.9	2.78	5.42	388.7	154.9	20.0	6.2
				60.6	1350	105.5	51.8	42.3	2.78	5.46	388.7	154.6	20.0	6.3
	7.0	1.9	4.4	66.9	1200	111.7	54.0	44.4	2.80	5.65	393.3	168.7	16.2	8.2
				66.8	1350	107.4	54.5	44.9	2.80	5.70	393.3	168.3	16.2	8.4
	9.0	2.6	6.1	69.8	1200	111.6	53.9	44.4	2.78	5.68	392.2	174.3	13.2	7.6
				69.7	1350	107.3	54.4	44.9	2.78	5.73	392.2	173.9	13.2	7.8
90	4.5	0.9	2.0	69.0	1200	113.1	55.9	45.9	2.92	5.61	410.5	173.9	19.1	7.5
				68.7	1350	108.7	56.4	46.4	2.92	5.66	410.5	173.5	19.1	7.6
	7.0	1.8	4.1	75.6	1200	115.4	58.8	48.8	2.94	5.86	415.3	189.4	15.1	10.1
				75.5	1350	110.7	59.3	49.3	2.94	5.91	415.3	188.9	15.1	10.2
	9.0	2.4	5.6	78.8	1200	115.3	58.7	48.7	2.93	5.87	414.2	195.7	12.0	9.5
				78.7	1350	110.6	59.2	49.2	2.93	5.92	414.2	195.2	12.0	9.7

Heating data based on 70 °F EAT. See Correction Factors at end of section for different conditions

LWT is based on 15% (by volume) methanol antifreeze solution only or 485 multiplier

Performance data accurate within ± 10%

Discharge pressure is ± 20 PSI; Suction pressure is ± 10 PSI

SubCooling is ± 5 °F; Superheat is ± 6 °F

Section 11: Engineering Data

Model 036 Full Load Cooling Performance Data: 3.0 Ton,

EWT °F	Flow GPM	WPD		LWT °F	Cooling										
		PSI	FT		Aiflow	TC	SC	S/T	HR	EER	Discharge	Suction	Subcooling °F	Superheat °F	
					CFM	MBtuh	MBtuh		MBtuh		kW	Btuh/W			PSIG
50	4.5	1.1	2.6	72.5	1250	42.4	28.5	0.67	49.1	1.95	21.7	243.9	135.5	27.1	12.2
				72.9	1350	43.1	29.8	0.69	49.9	2.00	21.6	244.7	137.2	27.4	12.9
	7.0	2.1	4.8	64.5	1250	42.9	28.8	0.67	49.1	1.83	23.4	222.7	134.8	22.1	13.0
				64.7	1350	43.5	30.1	0.69	49.9	1.88	23.1	223.4	136.6	22.3	13.6
	9.0	3.1	7.0	61.2	1250	43.0	28.9	0.67	49.1	1.79	24.0	215.0	134.6	20.3	13.1
				61.4	1350	43.7	30.2	0.69	49.9	1.83	23.9	215.7	136.4	20.5	13.8
60	4.5	1.0	2.4	82.0	1250	40.8	27.9	0.68	48.1	2.13	19.2	281.0	137.5	27.0	10.1
				82.4	1350	41.5	29.1	0.70	48.9	2.18	19.0	281.9	139.3	27.3	10.6
	7.0	2.0	4.5	74.2	1250	41.3	28.2	0.68	48.1	1.99	20.8	256.6	136.9	21.8	10.8
				74.4	1350	41.9	29.4	0.70	48.9	2.04	20.5	257.3	138.7	22.0	11.3
	9.0	2.9	6.6	71.0	1250	41.4	28.2	0.68	48.1	1.95	21.2	247.7	136.7	19.9	11.0
				71.2	1350	42.0	29.5	0.70	48.8	2.00	21.0	248.5	138.5	20.1	11.5
70	4.5	1.0	2.3	91.5	1250	39.1	27.2	0.70	47.0	2.32	16.9	320.5	139.6	26.5	8.1
				91.9	1350	39.7	28.4	0.72	47.8	2.38	16.7	321.5	141.4	26.8	8.6
	7.0	1.8	4.2	83.8	1250	39.6	27.5	0.69	47.0	2.17	18.2	292.6	139.0	21.4	8.8
				84.1	1350	40.2	28.7	0.71	47.8	2.23	18.0	293.5	140.8	21.6	9.4
	9.0	2.7	6.2	80.7	1250	39.7	27.5	0.69	46.9	2.12	18.7	282.6	138.7	19.4	9.0
				80.9	1350	40.3	28.8	0.71	47.7	2.18	18.5	283.4	140.5	19.6	9.6
80	4.5	0.9	2.2	101.1	1250	37.3	26.3	0.71	46.0	2.54	14.7	364.8	141.3	25.9	7.2
				101.4	1350	37.9	27.5	0.73	46.8	2.61	14.5	365.9	143.1	26.1	7.7
	7.0	1.7	4.0	93.5	1250	37.7	26.6	0.71	45.8	2.38	15.8	333.0	140.6	21.2	7.9
				93.7	1350	38.3	27.7	0.72	46.6	2.44	15.7	334.0	142.5	21.4	8.4
	9.0	2.6	5.9	90.5	1250	37.8	26.7	0.71	45.7	2.32	16.3	321.6	140.4	19.3	8.0
				90.7	1350	38.4	27.8	0.72	46.5	2.38	16.1	322.5	142.2	19.5	8.5
90	4.5	0.9	2.1	110.6	1250	35.3	25.3	0.72	44.9	2.81	12.6	415.1	142.9	25.1	6.9
				110.9	1350	35.8	26.4	0.74	45.6	2.88	12.4	416.4	144.8	25.3	7.4
	7.0	1.7	3.8	103.2	1250	35.7	25.5	0.71	44.7	2.63	13.6	378.9	142.3	20.7	7.6
				103.4	1350	36.2	26.7	0.74	45.4	2.70	13.4	380.1	144.1	20.8	8.2
	9.0	2.4	5.7	100.2	1250	35.8	25.6	0.72	44.6	2.57	13.9	365.9	142.0	18.9	7.8
				100.4	1350	36.3	26.7	0.74	45.3	2.63	13.8	367.0	143.8	19.1	8.4
100	4.5	0.8	1.9	120.1	1250	33.1	24.2	0.73	43.8	3.14	10.5	471.0	145.0	24.3	7.1
				120.4	1350	33.6	25.3	0.75	44.6	3.22	10.4	472.4	146.9	24.5	7.6
	7.0	1.6	3.6	112.8	1250	33.4	24.5	0.73	43.4	2.94	11.4	430.0	144.3	19.6	7.9
				113.0	1350	33.9	25.5	0.75	44.2	3.02	11.2	431.3	146.2	19.8	8.4
	9.0	2.3	5.3	109.9	1250	33.5	24.5	0.73	43.3	2.87	11.7	415.2	144.1	17.9	7.9
				110.1	1350	34.0	25.6	0.75	44.0	2.94	11.6	416.5	145.9	18.1	8.5
110	4.5	0.8	1.8	129.6	1250	30.8	23.1	0.75	42.7	3.49	8.8	529.3	147.1	24.5	7.6
				129.9	1350	31.2	24.1	0.77	43.4	3.58	8.7	531.0	149.0	24.8	8.1
	7.0	1.5	3.3	122.5	1250	31.1	23.3	0.75	42.3	3.27	9.5	483.2	146.4	18.6	8.3
				122.7	1350	31.6	24.3	0.77	43.0	3.35	9.4	484.7	148.3	18.9	8.9
	9.0	2.1	4.9	119.6	1250	31.2	23.4	0.75	42.1	3.19	9.8	466.6	146.1	16.7	8.4
				119.8	1350	31.7	24.4	0.77	42.9	3.27	9.7	468.1	148.0	16.9	9.1

Cooling data based on 80/67 °F EAT. See Correction Factors at end of section for different conditions

LWT is based on 15% (by volume) methanol antifreeze solution only or 485 multiplier

Performance data accurate within ± 10%

Discharge pressure is ± 20 PSI; Suction pressure is ± 10 PSI

SubCooling is ± 5 °F; Superheat is ± 6 °F

Section 11: Engineering Data

Model 048 Full Load Heating Performance Data: 4.0 Ton,

EWT °F	Flow GPM	WPD		LWT °F	Heating									
		PSI	FT		Aiflow	LAT	HC	HE	kW	COP	Discharge	Suction	Subcooling	Superheat
					CFM	°F	MBtuh	MBtuh		W/W	PSIG	PSIG	°F	°F
25	12.0	5.7	13.1	20.4	1500	92.8	37.0	26.6	3.06	3.54	295.2	66.6	13.4	7.7
				20.2	1700	90.8	38.1	27.7	3.05	3.66	294.2	66.5	13.2	7.7
30	6.0	1.8	4.2	21.1	1500	92.3	36.2	25.8	3.04	3.49	292.7	67.9	17.2	7.9
				20.7	1700	90.3	37.3	27.0	3.03	3.61	291.8	67.8	17.0	8.0
	9.0	3.5	8.2	23.8	1500	93.2	37.6	27.1	3.07	3.59	297.8	72.4	15.9	7.4
				23.5	1700	91.1	38.8	28.3	3.07	3.70	296.9	72.2	15.7	7.4
	12.0	5.5	12.7	25.2	1500	93.7	38.4	27.9	3.09	3.64	300.1	74.8	12.7	7.0
				25.0	1700	91.6	39.6	29.1	3.08	3.77	299.2	74.7	12.5	7.0
40	6.0	1.7	4.0	29.6	1500	95.3	41.0	30.3	3.15	3.81	309.2	82.2	15.0	7.1
				29.1	1700	93.0	42.3	31.6	3.15	3.94	308.2	82.1	14.8	7.2
	9.0	3.4	7.8	32.7	1500	96.3	42.6	31.7	3.19	3.91	314.5	87.6	13.3	7.3
				32.4	1700	93.9	43.9	33.0	3.18	4.05	313.5	87.4	13.1	7.4
	12.0	5.3	12.2	34.4	1500	96.9	43.5	32.6	3.20	3.98	317.0	90.6	9.9	7.2
				34.2	1700	94.5	44.9	34.0	3.20	4.11	316.0	90.4	9.7	7.3
50	6.0	1.7	3.8	38.1	1500	98.3	45.9	34.7	3.27	4.11	325.6	96.7	12.8	7.4
				37.6	1700	95.8	47.3	36.2	3.26	4.25	324.6	96.5	12.6	7.4
	9.0	3.2	7.5	41.7	1500	99.4	47.6	36.3	3.31	4.21	331.2	103.0	11.0	8.5
				41.3	1700	96.7	49.1	37.8	3.30	4.36	330.2	102.8	10.8	8.5
	12.0	5.1	11.7	43.6	1500	100.0	48.6	37.3	3.32	4.29	333.8	106.5	7.2	8.6
				43.3	1700	97.3	50.1	38.8	3.32	4.42	332.8	106.4	7.0	8.7
60	6.0	1.6	3.6	46.8	1500	100.7	49.8	38.3	3.38	4.32	339.5	111.8	11.7	8.2
				46.3	1700	98.0	51.4	39.9	3.37	4.47	338.5	111.7	11.6	8.2
	9.0	3.0	7.0	50.8	1500	102.0	51.8	40.1	3.42	4.44	345.4	119.1	9.8	10.0
				50.4	1700	99.1	53.4	41.8	3.41	4.59	344.4	118.9	9.6	10.0
	12.0	4.7	11.0	52.9	1500	102.6	52.8	41.1	3.43	4.51	348.1	123.2	5.9	10.6
				52.6	1700	99.7	54.5	42.8	3.43	4.66	347.0	123.0	5.7	10.6
70	6.0	1.4	3.3	55.6	1500	103.2	53.8	41.9	3.50	4.50	353.5	127.5	11.7	9.4
				55.0	1700	100.2	55.5	43.6	3.49	4.66	352.4	127.3	11.4	9.4
	9.0	2.8	6.5	60.0	1500	104.5	55.9	43.8	3.54	4.63	359.6	135.8	9.5	11.9
				59.6	1700	101.4	57.6	45.6	3.53	4.78	358.5	135.6	9.4	11.9
	12.0	4.4	10.2	62.3	1500	105.2	57.0	44.9	3.55	4.71	362.4	140.5	5.5	12.8
				62.0	1700	102.0	58.8	46.7	3.55	4.85	361.3	140.3	5.4	12.7
80	6.0	1.3	3.1	64.2	1500	106.2	58.6	46.1	3.65	4.71	369.9	143.4	11.7	11.0
				63.5	1700	102.9	60.4	48.0	3.64	4.86	368.8	143.2	11.5	11.0
	9.0	2.6	6.0	69.0	1500	107.5	60.8	48.2	3.69	4.83	376.3	152.8	9.4	14.1
				68.5	1700	104.2	62.7	50.1	3.68	4.99	375.2	152.5	9.3	14.1
	12.0	4.1	9.4	71.5	1500	108.3	62.1	49.4	3.71	4.91	379.3	158.0	5.3	15.3
				71.2	1700	104.9	64.0	51.4	3.70	5.07	378.1	157.8	5.1	15.3
90	6.0	1.2	2.8	72.7	1500	109.1	63.3	50.3	3.80	4.88	386.3	159.5	11.9	12.8
				72.0	1700	105.6	65.3	52.4	3.79	5.05	385.1	159.2	11.8	12.9
	9.0	2.4	5.5	77.9	1500	110.6	65.8	52.7	3.85	5.01	393.1	169.9	9.7	16.6
				77.5	1700	106.9	67.8	54.7	3.84	5.17	391.8	169.6	9.5	16.6
	12.0	3.7	8.5	80.7	1500	111.4	67.1	53.9	3.87	5.08	396.1	175.8	5.3	18.0
				80.4	1700	107.7	69.2	56.0	3.86	5.25	394.9	175.5	5.1	18.0

Heating data based on 70 °F EAT. See Correction Factors at end of section for different conditions

LWT is based on 15% (by volume) methanol antifreeze solution only or 485 multiplier

Performance data accurate within ± 10%

Discharge pressure is ± 20 PSI; Suction pressure is ± 10 PSI

SubCooling is ± 5 °F; Superheat is ± 6 °F

Section 11: Engineering Data

Model 048 Full Load Cooling Performance Data: 4.0 Ton,

EWT °F	Flow GPM	WPD		LWT °F	Cooling										
		PSI	FT		Aiffow	TC	SC	S/T	HR		EER	Discharge	Suction	Subcooling	Superheat
					CFM	MBtuh	MBtuh		MBtuh	kW	Btuh/W	PSIG	PSIG	°F	°F
50	6.0	1.7	4.0	71.8	1600	54.4	37.0	0.68	63.3	2.60	20.9	236.5	132.2	19.1	12.2
				72.0	1750	54.7	38.2	0.70	63.9	2.71	20.2	237.2	134.5	19.0	12.4
	9.0	3.4	7.8	64.6	1600	55.5	37.3	0.67	63.9	2.46	22.6	219.7	131.5	16.0	12.8
				64.8	1750	55.8	38.5	0.69	64.6	2.57	21.7	220.4	133.7	16.0	13.1
	12.0	4.7	10.7	61.0	1600	55.9	37.6	0.67	64.1	2.41	23.2	211.7	130.7	14.8	13.7
				61.1	1750	56.2	38.8	0.69	64.8	2.52	22.3	212.4	132.9	14.7	14.0
60	6.0	1.7	3.9	81.3	1600	52.2	36.2	0.69	61.9	2.83	18.4	272.8	134.4	17.6	11.1
				81.5	1750	52.5	37.3	0.71	62.6	2.95	17.8	273.7	136.6	17.5	11.4
	9.0	3.3	7.5	74.3	1600	53.3	36.5	0.68	62.4	2.68	19.9	253.4	133.6	14.6	11.7
				74.5	1750	53.6	37.6	0.70	63.2	2.80	19.1	254.3	135.9	14.5	12.0
	12.0	4.5	10.4	70.8	1600	53.6	36.7	0.68	62.6	2.63	20.4	244.2	132.9	13.3	12.6
				70.9	1750	53.9	37.9	0.70	63.2	2.74	19.7	245.0	135.1	13.2	12.9
70	6.0	1.6	3.7	90.8	1600	49.9	35.3	0.71	60.4	3.09	16.1	311.1	136.5	15.9	10.1
				91.0	1750	50.2	36.4	0.73	61.2	3.22	15.6	312.1	138.8	15.8	10.4
	9.0	3.1	7.2	84.0	1600	51.0	35.6	0.70	61.0	2.92	17.5	289.1	135.7	13.2	10.8
				84.1	1750	51.3	36.7	0.72	61.7	3.05	16.8	290.0	138.0	13.0	11.1
	12.0	4.3	10.0	80.5	1600	51.3	35.9	0.70	61.1	2.86	17.9	278.5	135.0	12.0	11.7
				80.6	1750	51.6	37.0	0.72	61.8	2.99	17.3	279.4	137.2	11.7	12.0
80	6.0	1.5	3.4	100.3	1600	47.6	34.1	0.72	59.1	3.37	14.1	353.1	138.9	15.0	9.3
				100.5	1750	47.8	35.1	0.73	59.8	3.52	13.6	354.3	141.2	14.7	9.6
	9.0	2.9	6.7	93.6	1600	48.5	34.4	0.71	59.4	3.19	15.2	328.1	138.1	12.5	10.0
				93.8	1750	48.8	35.4	0.73	60.2	3.33	14.7	329.2	140.4	12.4	10.3
	12.0	4.0	9.2	90.2	1600	48.9	34.6	0.71	59.5	3.12	15.7	316.1	137.3	11.6	10.9
				90.4	1750	49.2	35.7	0.73	60.3	3.26	15.1	317.2	139.6	11.3	11.2
90	6.0	1.4	3.1	109.8	1600	45.0	32.8	0.73	57.7	3.71	12.1	400.2	141.2	14.2	8.9
				110.1	1750	45.3	33.8	0.75	58.5	3.87	11.7	401.5	143.6	13.8	9.1
	9.0	2.6	6.1	103.3	1600	46.0	33.1	0.72	58.0	3.51	13.1	371.8	140.4	12.2	9.6
				103.4	1750	46.2	34.1	0.74	58.7	3.67	12.6	373.1	142.7	12.0	9.9
	12.0	3.7	8.4	100.0	1600	46.3	33.3	0.72	58.0	3.44	13.5	358.3	139.6	11.5	10.5
				100.1	1750	46.5	34.3	0.74	58.7	3.59	13.0	359.5	141.9	11.2	10.7
100	6.0	1.3	3.0	119.4	1600	42.3	31.7	0.75	56.4	4.12	10.3	452.2	143.1	13.3	9.1
				119.7	1750	42.6	32.7	0.77	57.3	4.30	9.9	453.7	145.5	13.0	9.3
	9.0	2.5	5.8	112.9	1600	43.2	32.0	0.74	56.5	3.90	11.1	420.1	142.3	11.5	9.8
				113.2	1750	43.5	33.0	0.76	57.4	4.08	10.7	421.5	144.7	11.1	10.0
	12.0	3.5	8.0	109.7	1600	43.5	32.2	0.74	56.5	3.82	11.4	404.8	141.5	11.0	10.6
				109.8	1750	43.7	33.2	0.76	57.3	3.99	11.0	406.1	143.9	10.6	10.9
110	6.0	1.2	2.8	129.0	1600	39.6	30.7	0.78	55.2	4.56	8.7	506.2	145.0	13.3	9.4
				129.2	1750	39.8	31.6	0.79	56.0	4.76	8.4	507.9	147.4	12.9	9.7
	9.0	2.4	5.5	122.6	1600	40.4	31.0	0.77	55.1	4.32	9.4	470.3	144.1	10.8	10.1
				122.8	1750	40.6	31.9	0.79	56.0	4.51	9.0	471.8	146.6	10.4	10.4
	12.0	3.3	7.6	119.5	1600	40.6	31.2	0.77	55.0	4.23	9.6	453.2	143.3	10.2	11.0
				119.6	1750	40.9	32.1	0.78	56.0	4.42	9.3	454.6	145.7	9.7	11.3

Cooling data based on 80/67 °F EAT. See Correction Factors at end of section for different conditions

LWT is based on 15% (by volume) methanol antifreeze solution only or 485 multiplier

Performance data accurate within ± 10%

Discharge pressure is ± 20 PSI; Suction pressure is ± 10 PSI

SubCooling is ± 5 °F; Superheat is ± 6 °F

Section 11: Engineering Data

Model 060 Full Load Heating Performance Data: 5.0 Ton,

EWT °F	Flow GPM	WPD		LWT °F	Heating									
		PSI	FT		Aiflow	LAT	HC	HE	kW	COP	Discharge	Suction	Subcooling	Superheat
					CFM	°F	MBtuh	MBtuh		W/W	PSIG	PSIG	°F	°F
25	15.0	10.5	24.3	20.8	1700	93.6	43.4	30.2	3.88	3.28	301.7	65.7	26.9	3.3
				20.7	1850	92.4	44.7	31.4	3.90	3.36	301.3	65.6	26.8	3.3
30	7.5	3.6	8.2	21.6	1700	93.9	43.8	30.6	3.87	3.32	305.8	66.6	29.8	4.8
				21.3	1850	92.6	45.1	31.8	3.90	3.39	305.4	66.6	29.7	4.7
	11.5	6.7	15.4	24.1	1700	95.4	46.6	33.1	3.95	3.46	313.6	71.3	28.2	3.6
				23.8	1850	94.0	48.0	34.5	3.97	3.54	313.2	71.2	28.1	3.6
	15.0	10.1	23.3	25.3	1700	95.9	47.5	34.0	3.96	3.52	315.4	73.5	26.3	3.0
				25.1	1850	94.5	48.9	35.3	3.99	3.59	315.0	73.5	26.2	3.0
40	7.5	3.3	7.6	29.9	1700	97.4	50.3	36.7	4.00	3.69	321.9	81.1	27.4	3.7
				29.6	1850	95.9	51.8	38.0	4.03	3.77	321.5	81.1	27.3	3.7
	11.5	6.2	14.3	32.9	1700	99.1	53.5	39.6	4.08	3.84	330.1	86.8	25.3	3.3
				32.6	1850	97.6	55.1	41.1	4.11	3.93	329.7	86.7	25.3	3.2
	15.0	9.4	21.7	34.4	1700	99.7	54.5	40.5	4.10	3.90	332.0	89.6	23.4	3.0
				34.2	1850	98.1	56.2	42.1	4.12	4.00	331.6	89.5	23.3	3.0
50	7.5	3.1	7.1	38.3	1700	100.9	56.8	42.6	4.15	4.01	338.6	96.3	24.9	3.6
				37.8	1850	99.3	58.5	44.3	4.17	4.11	338.2	96.3	24.9	3.5
	11.5	5.8	13.3	41.8	1700	102.9	60.4	46.0	4.23	4.18	347.2	103.0	22.6	3.9
				41.4	1850	101.2	62.3	47.8	4.25	4.30	346.7	103.0	22.5	3.9
	15.0	8.7	20.1	43.5	1700	103.6	61.6	47.1	4.24	4.26	349.2	106.3	20.4	3.9
				43.3	1850	101.7	63.4	48.8	4.27	4.35	348.7	106.3	20.3	3.9
60	7.5	2.8	6.6	46.6	1700	104.7	63.7	48.9	4.33	4.31	360.2	112.8	23.2	4.2
				46.1	1850	102.8	65.6	50.7	4.36	4.41	359.8	112.7	23.2	4.2
	11.5	5.3	12.3	50.5	1700	106.9	67.8	52.8	4.41	4.51	369.4	120.7	20.6	5.3
				50.2	1850	105.0	69.9	54.8	4.44	4.61	368.9	120.6	20.5	5.2
	15.0	8.1	18.7	52.6	1700	107.6	69.1	54.0	4.43	4.57	371.5	124.5	18.2	5.7
				52.3	1850	105.6	71.2	56.0	4.46	4.68	371.0	124.4	18.1	5.7
70	7.5	2.7	6.2	54.8	1700	108.5	70.7	55.2	4.54	4.56	383.2	131.0	21.9	5.2
				54.3	1850	106.4	72.8	57.2	4.57	4.67	382.7	130.9	21.8	5.3
	11.5	5.0	11.6	59.4	1700	111.0	75.2	59.4	4.63	4.76	392.9	140.1	18.9	7.1
				59.0	1850	108.8	77.5	61.6	4.66	4.87	392.4	140.0	18.8	7.0
	15.0	7.6	17.5	61.7	1700	111.7	76.6	60.7	4.65	4.83	395.2	144.6	16.3	7.8
				61.4	1850	109.5	78.9	62.9	4.68	4.94	394.7	144.5	16.2	7.8
80	7.5	2.6	5.9	63.2	1700	112.1	77.3	61.0	4.77	4.75	403.5	150.8	20.4	6.4
				62.6	1850	109.8	79.6	63.2	4.80	4.86	403.0	150.7	20.3	6.4
	11.5	4.8	11.1	68.2	1700	114.8	82.2	65.6	4.87	4.95	413.8	161.3	17.2	8.9
				67.8	1850	112.4	84.7	68.0	4.89	5.08	413.2	161.2	17.1	8.8
	15.0	7.3	16.7	70.8	1700	115.6	83.7	67.0	4.88	5.03	416.1	166.4	14.3	10.0
				70.4	1850	113.2	86.3	69.5	4.91	5.15	415.6	166.3	14.2	9.9
90	7.5	2.4	5.6	71.6	1700	115.7	83.9	66.8	5.01	4.91	424.3	171.3	19.0	8.0
				71.0	1850	113.2	86.4	69.2	5.04	5.02	423.8	171.2	18.9	7.9
	11.5	4.6	10.6	77.1	1700	118.6	89.2	71.8	5.11	5.12	435.1	183.2	15.6	11.1
				76.7	1850	116.0	91.9	74.4	5.14	5.24	434.5	183.1	15.5	11.0
	15.0	7.0	16.0	79.9	1700	119.5	90.9	73.4	5.13	5.19	437.6	189.1	12.6	12.4
				79.5	1850	116.9	93.7	76.1	5.16	5.32	437.0	188.9	12.5	12.4

Heating data based on 70 °F EAT. See Correction Factors at end of section for different conditions

LWT is based on 15% (by volume) methanol antifreeze solution only or 485 multiplier

Performance data accurate within ± 10%

Discharge pressure is ± 20 PSI; Suction pressure is ± 10 PSI

SubCooling is ± 5 °F; Superheat is ± 6 °F

Section 11: Engineering Data

Model 060 Full Load Cooling Performance Data: 5.0 Ton,

EWT °F	Flow GPM	WPD		LWT °F	Cooling										
		PSI	FT		Aiflow	TC	SC	S/T	HR		EER	Discharge	Suction	Subcooling	Superheat
					CFM	MBtuh	MBtuh		MBtuh	kW	Btuh/W	PSIG	PSIG	°F	°F
50	7.5	2.6	6.0	71.7	1750	67.7	43.1	0.64	78.8	3.25	20.8	238.3	124.2	27.8	13.8
				72.1	1950	68.8	45.6	0.66	80.4	3.40	20.2	239.1	129.5	28.0	13.5
	11.5	5.3	12.2	64.1	1750	68.0	43.3	0.64	78.5	3.07	22.1	218.8	123.5	23.1	14.3
				64.4	1950	69.2	45.8	0.66	80.1	3.20	21.6	219.6	128.9	23.2	13.9
	15.0	8.2	19.0	60.7	1750	68.0	43.4	0.64	78.2	2.99	22.7	210.7	123.5	20.9	14.5
				61.0	1950	69.2	45.9	0.66	79.9	3.13	22.1	211.4	128.8	21.1	14.2
60	7.5	2.4	5.6	81.6	1750	66.4	42.5	0.64	78.4	3.51	18.9	274.0	126.5	28.0	10.5
				82.0	1950	67.5	44.9	0.67	80.0	3.67	18.4	274.9	132.0	28.2	10.0
	11.5	4.9	11.4	74.0	1750	66.7	42.7	0.64	78.0	3.31	20.2	251.6	125.8	23.0	10.9
				74.3	1950	67.9	45.1	0.66	79.7	3.46	19.6	252.4	131.3	23.2	10.5
	15.0	7.7	17.7	70.7	1750	66.7	42.8	0.64	77.7	3.23	20.7	242.2	125.8	20.7	11.1
				70.9	1950	67.9	45.3	0.67	79.4	3.38	20.1	243.0	131.2	20.9	10.7
70	7.5	2.3	5.2	91.4	1750	64.8	41.8	0.65	77.8	3.80	17.1	311.8	128.8	27.8	7.6
				91.9	1950	66.0	44.2	0.67	79.5	3.97	16.6	312.8	134.4	27.9	7.0
	11.5	4.6	10.6	83.9	1750	65.1	42.0	0.65	77.3	3.58	18.2	286.3	128.1	22.8	8.0
				84.2	1950	66.3	44.4	0.67	79.1	3.74	17.7	287.3	133.7	22.9	7.5
	15.0	7.2	16.5	80.6	1750	65.2	42.1	0.65	77.1	3.49	18.7	275.7	128.1	20.4	8.2
				80.8	1950	66.3	44.5	0.67	78.8	3.65	18.2	276.6	133.6	20.6	7.7
80	7.5	2.2	5.0	101.0	1750	62.3	40.8	0.65	76.4	4.13	15.1	354.6	131.2	27.3	7.1
				101.5	1950	63.4	43.1	0.68	78.1	4.31	14.7	355.8	136.9	27.4	6.6
	11.5	4.4	10.1	93.6	1750	62.6	41.0	0.65	75.9	3.89	16.1	325.6	130.5	22.6	7.6
				93.9	1950	63.7	43.3	0.68	77.6	4.07	15.7	326.7	136.2	22.7	7.1
	15.0	6.8	15.7	90.4	1750	62.6	41.1	0.66	75.6	3.80	16.5	313.5	130.5	20.3	7.8
				90.6	1950	63.7	43.4	0.68	77.2	3.97	16.0	314.6	136.1	20.4	7.3
90	7.5	2.1	4.8	110.5	1750	59.1	39.5	0.67	74.6	4.53	13.0	402.7	133.7	26.4	7.8
				111.0	1950	60.1	41.8	0.70	76.3	4.74	12.7	404.1	139.4	26.6	7.4
	11.5	4.2	9.7	103.3	1750	59.4	39.7	0.67	74.0	4.27	13.9	369.8	132.9	22.1	8.3
				103.6	1950	60.4	42.0	0.70	75.6	4.46	13.5	371.1	138.7	22.2	7.8
	15.0	6.5	15.1	100.1	1750	59.4	39.8	0.67	73.6	4.17	14.2	356.1	132.9	19.9	8.5
				100.4	1950	60.5	42.1	0.70	75.4	4.36	13.9	357.3	138.6	20.1	8.1
100	7.5	2.0	4.6	120.0	1750	55.8	38.1	0.68	72.9	5.01	11.1	454.9	136.1	25.4	7.8
				120.5	1950	56.8	40.3	0.71	74.7	5.24	10.8	456.5	141.9	25.5	7.3
	11.5	4.0	9.3	112.9	1750	56.1	38.3	0.68	72.2	4.72	11.9	417.8	135.3	21.0	8.3
				113.3	1950	57.1	40.5	0.71	74.0	4.94	11.6	419.2	141.2	21.1	7.8
	15.0	6.3	14.5	109.9	1750	56.1	38.4	0.68	71.8	4.61	12.2	402.2	135.3	18.9	8.5
				110.1	1950	57.1	40.6	0.71	73.5	4.82	11.8	403.6	141.1	19.1	8.0
110	7.5	1.9	4.5	129.5	1750	52.3	36.5	0.70	71.1	5.52	9.5	509.3	138.5	25.0	8.2
				130.0	1950	53.2	38.6	0.73	72.9	5.76	9.2	511.0	144.4	25.2	7.8
	11.5	3.9	9.0	122.6	1750	52.5	36.7	0.70	70.2	5.20	10.1	467.7	137.7	19.6	8.7
				122.9	1950	53.5	38.8	0.73	72.1	5.44	9.8	469.2	143.7	19.8	8.3
	15.0	6.1	14.1	119.6	1750	52.6	36.8	0.70	69.9	5.08	10.4	450.3	137.7	17.4	8.9
				119.8	1950	53.5	38.9	0.73	71.6	5.31	10.1	451.8	143.6	17.6	8.5

Cooling data based on 80/67 °F EAT. See Correction Factors at end of section for different conditions

LWT is based on 15% (by volume) methanol antifreeze solution only or 485 multiplier

Performance data accurate within ± 10%

Discharge pressure is ± 20 PSI; Suction pressure is ± 10 PSI

SubCooling is ± 5 °F; Superheat is ± 6 °F

Section 11: Engineering Data

Model 072 Full Load Heating Performance Data: 6.0 Ton,

EWT °F	Flow GPM	WPD		LWT °F	Heating									
		PSI	FT		Aiflow	LAT	HC	HE	kW	COP	Discharge	Suction	Subcooling	Superheat
					CFM	°F	MBtuh	MBtuh		W/W	PSIG	PSIG	°F	°F
25	18.0	10.3	23.7	20.9	2000	94.4	52.6	36.2	4.80	3.21	301.6	66.5	23.7	4.2
				20.7	2100	93.6	53.6	37.3	4.79	3.28	298.6	66.1	23.0	4.5
30	9.0	3.3	7.6	21.2	2000	95.6	55.2	38.4	4.91	3.29	310.9	70.1	28.3	2.6
				21.0	2100	94.8	56.2	39.5	4.90	3.36	307.8	69.7	27.7	2.9
	13.5	6.6	15.2	23.9	2000	96.4	57.0	40.2	4.93	3.39	315.7	75.1	25.8	1.5
				23.7	2100	95.6	58.1	41.3	4.92	3.46	312.5	74.7	25.1	1.8
	18.0	10.0	23.1	25.3	2000	96.9	58.0	41.1	4.96	3.43	318.1	77.2	24.5	1.3
				25.2	2100	96.1	59.1	42.2	4.94	3.51	315.0	76.8	23.9	1.5
40	9.0	3.1	7.1	29.7	2000	98.8	62.3	45.1	5.05	3.62	326.1	84.8	24.5	1.9
				29.4	2100	98.0	63.4	46.2	5.04	3.69	322.9	84.3	23.9	2.1
	13.5	6.1	14.2	32.8	2000	99.8	64.4	47.1	5.07	3.72	331.1	90.9	21.6	1.6
				32.6	2100	98.9	65.6	48.3	5.06	3.80	327.8	90.4	21.0	1.7
	18.0	9.3	21.6	34.5	2000	100.4	65.6	48.2	5.10	3.77	333.7	93.4	20.1	1.7
				34.3	2100	99.4	66.7	49.4	5.08	3.85	330.4	92.9	19.5	1.9
50	9.0	2.9	6.6	38.2	2000	102.2	69.5	51.7	5.21	3.91	342.7	99.9	21.1	2.1
				37.8	2100	101.2	70.8	53.1	5.20	3.99	339.2	99.4	20.5	2.4
	13.5	5.7	13.2	41.8	2000	103.3	71.9	54.0	5.24	4.02	347.9	107.1	17.8	2.7
				41.5	2100	102.3	73.2	55.4	5.22	4.11	344.4	106.5	17.2	2.9
	18.0	8.7	20.1	43.7	2000	103.9	73.2	55.3	5.26	4.08	350.6	110.0	16.2	3.2
				43.5	2100	102.8	74.5	56.6	5.25	4.16	347.1	109.5	15.6	3.4
60	9.0	2.7	6.3	46.4	2000	106.2	78.2	59.5	5.48	4.18	368.4	117.5	20.6	2.0
				46.0	2100	105.1	79.6	61.0	5.46	4.27	364.7	117.0	20.0	2.1
	13.5	5.4	12.5	50.5	2000	107.4	80.8	62.0	5.50	4.31	374.0	126.0	17.0	3.2
				50.3	2100	106.3	82.3	63.6	5.49	4.39	370.2	125.4	16.4	3.4
	18.0	8.3	19.1	52.7	2000	108.1	82.3	63.4	5.53	4.36	376.9	129.5	15.2	4.1
				52.6	2100	106.9	83.7	64.9	5.51	4.45	373.2	128.8	14.7	4.4
70	9.0	2.6	6.0	54.6	2000	110.3	87.1	67.3	5.79	4.41	397.5	136.3	21.1	2.4
				54.2	2100	109.1	88.6	68.9	5.78	4.49	393.6	135.6	20.6	2.7
	13.5	5.2	12.0	59.3	2000	111.7	90.0	70.1	5.82	4.53	403.6	146.1	17.3	4.4
				59.0	2100	110.4	91.6	71.8	5.80	4.63	399.6	145.3	16.7	4.7
	18.0	7.9	18.3	61.8	2000	112.4	91.6	71.7	5.84	4.60	406.7	150.1	15.4	5.7
				61.6	2100	111.1	93.3	73.4	5.83	4.69	402.7	149.3	14.8	5.9
80	9.0	2.5	5.8	63.0	2000	114.0	95.0	74.2	6.09	4.57	423.4	154.1	20.9	4.5
				62.6	2100	112.6	96.7	76.0	6.08	4.66	419.2	153.4	20.3	4.8
	13.5	5.0	11.5	68.2	2000	115.5	98.3	77.4	6.12	4.71	429.9	165.2	16.9	7.3
				67.9	2100	114.1	100.0	79.2	6.10	4.80	425.6	164.4	16.3	7.6
	18.0	7.6	17.6	71.0	2000	116.3	100.0	79.0	6.15	4.77	433.2	169.8	14.9	9.0
				70.7	2100	114.9	101.8	80.9	6.13	4.87	428.9	168.9	14.3	9.2
90	9.0	2.4	5.6	71.4	2000	117.7	103.1	81.2	6.41	4.71	450.7	172.4	21.2	7.0
				70.9	2100	116.3	105.0	83.2	6.40	4.81	446.2	171.6	20.6	7.3
	13.5	4.8	11.2	77.1	2000	119.4	106.6	84.6	6.44	4.85	457.6	184.8	17.0	10.5
				76.8	2100	117.9	108.6	86.7	6.43	4.95	453.0	183.9	16.4	10.8
	18.0	7.4	17.0	80.1	2000	120.2	108.5	86.4	6.47	4.91	461.2	189.9	15.0	12.5
				79.9	2100	118.7	110.5	88.5	6.46	5.01	456.6	189.0	14.3	12.8

Heating data based on 70 °F EAT. See Correction Factors at end of section for different conditions

LWT is based on 15% (by volume) methanol antifreeze solution only or 485 multiplier

Performance data accurate within ± 10%

Discharge pressure is ± 20 PSI; Suction pressure is ± 10 PSI

SubCooling is ± 5 °F; Superheat is ± 6 °F

Section 11: Engineering Data

Model 072 Full Load Cooling Performance Data: 6.0 Ton,

EWT °F	Flow GPM	WPD		LWT °F	Cooling										
		PSI	FT		Aiflow	TC	SC	S/T	HR	kW	EER	Discharge PSIG	Suction PSIG	Subcooling °F	Superheat °F
					CFM	MBtuh	MBtuh		MBtuh		Btuh/W				
50	9.0	3.0	6.9	71.0	1900	78.3	47.1	0.60	91.5	3.87	20.2	234.0	124.6	25.0	4.9
				71.1	2150	78.3	48.2	0.62	92.3	4.11	19.1	235.7	127.8	25.3	6.6
	13.5	5.8	13.4	63.9	1900	78.9	47.5	0.60	91.3	3.64	21.7	215.0	124.4	20.4	5.2
				64.1	2150	78.9	48.7	0.62	92.1	3.87	20.4	216.6	127.6	20.7	6.9
	18.0	8.6	19.8	60.5	1900	79.3	48.4	0.61	91.5	3.57	22.2	208.9	124.3	18.9	6.9
				60.6	2150	79.3	49.6	0.63	92.3	3.80	20.9	210.4	127.5	19.2	8.7
60	9.0	2.9	6.6	80.8	1900	76.3	46.3	0.61	90.6	4.18	18.3	269.9	127.8	26.1	4.2
				80.9	2150	76.3	47.5	0.62	91.4	4.44	17.2	271.8	131.1	26.4	5.8
	13.5	5.6	12.9	73.8	1900	76.9	46.7	0.61	90.3	3.94	19.5	248.0	127.6	21.2	4.4
				73.9	2150	76.9	47.9	0.62	91.2	4.18	18.4	249.7	130.9	21.6	6.2
	18.0	8.3	19.2	70.4	1900	77.3	47.6	0.62	90.5	3.86	20.0	240.9	127.4	19.6	6.2
				70.5	2150	77.3	48.8	0.63	91.3	4.10	18.9	242.6	130.8	19.9	8.0
70	9.0	2.8	6.4	90.5	1900	74.1	45.4	0.61	89.5	4.52	16.4	307.7	130.8	26.7	3.5
				90.7	2150	74.1	46.5	0.63	90.5	4.81	15.4	309.9	134.2	27.0	5.2
	13.5	5.4	12.5	83.6	1900	74.6	45.8	0.61	89.1	4.26	17.5	282.7	130.6	21.9	3.9
				83.8	2150	74.6	47.0	0.63	90.1	4.53	16.5	284.7	134.0	22.2	5.6
	18.0	8.1	18.6	80.2	1900	75.0	46.7	0.62	89.3	4.18	17.9	274.7	130.5	20.1	5.5
				80.3	2150	75.0	47.9	0.64	90.1	4.44	16.9	276.6	133.9	20.5	7.3
80	9.0	2.7	6.2	100.2	1900	71.2	44.4	0.62	88.0	4.92	14.5	349.0	133.7	27.0	2.9
				100.4	2150	71.2	45.5	0.64	89.0	5.23	13.6	351.4	137.2	27.2	4.6
	13.5	5.2	12.1	93.4	1900	71.8	44.8	0.62	87.6	4.63	15.5	320.6	133.5	22.3	3.3
				93.5	2150	71.8	45.9	0.64	88.6	4.93	14.6	322.9	136.9	22.6	5.0
	18.0	7.8	17.9	90.0	1900	72.1	45.6	0.63	87.6	4.55	15.8	311.5	133.4	20.6	5.0
				90.1	2150	72.1	46.8	0.65	88.6	4.83	14.9	313.7	136.8	20.9	6.8
90	9.0	2.6	6.0	109.7	1900	67.7	42.9	0.63	86.1	5.40	12.5	395.2	136.3	26.8	2.5
				110.0	2150	67.7	44.0	0.65	87.3	5.75	11.8	398.0	139.8	26.9	4.2
	13.5	5.1	11.7	103.1	1900	68.2	43.4	0.64	85.6	5.09	13.4	363.1	136.0	22.4	2.8
				103.2	2150	68.2	44.4	0.65	86.7	5.41	12.6	365.7	139.6	22.7	4.6
	18.0	7.5	17.3	99.8	1900	68.5	44.2	0.65	85.5	4.99	13.7	352.8	135.9	20.9	4.7
				99.9	2150	68.5	45.3	0.66	86.6	5.31	12.9	355.3	139.5	21.2	6.4
100	9.0	2.5	5.9	119.2	1900	63.6	41.0	0.64	84.0	5.97	10.7	446.5	138.4	26.3	2.4
				119.5	2150	63.6	42.0	0.66	85.3	6.35	10.0	449.7	142.0	26.5	4.2
	13.5	4.9	11.4	112.7	1900	64.1	41.4	0.65	83.3	5.62	11.4	410.2	138.2	22.1	2.8
				112.9	2150	64.1	42.4	0.66	84.5	5.98	10.7	413.1	141.8	22.2	4.6
	18.0	7.3	16.9	109.5	1900	64.4	42.2	0.66	83.2	5.52	11.7	398.5	138.1	20.6	4.5
				109.7	2150	64.4	43.3	0.67	84.4	5.87	11.0	401.3	141.7	20.9	6.5
110	9.0	2.5	5.7	128.7	1900	59.3	38.9	0.66	81.8	6.58	9.0	499.7	140.4	26.3	2.5
				129.1	2150	59.3	39.9	0.67	83.2	6.99	8.5	503.3	144.1	26.6	4.2
	13.5	4.8	11.2	122.3	1900	59.7	39.3	0.66	80.8	6.19	9.6	459.2	140.2	21.4	2.9
				122.6	2150	59.7	40.3	0.68	82.2	6.58	9.1	462.4	143.9	21.6	4.6
	18.0	7.2	16.6	119.2	1900	60.0	40.1	0.67	80.7	6.07	9.9	446.1	140.1	19.8	4.7
				119.4	2150	60.0	41.1	0.69	82.0	6.46	9.3	449.2	143.7	20.0	6.6

Cooling data based on 80/67 °F EAT. See Correction Factors at end of section for different conditions

LWT is based on 15% (by volume) methanol antifreeze solution only or 485 multiplier

Performance data accurate within ± 10%

Discharge pressure is ± 20 PSI; Suction pressure is ± 10 PSI

SubCooling is ± 5 °F; Superheat is ± 6 °F



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 # _____

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

FAILURE DATE _____

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.)

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.



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

Revision Table:

Date	By	Page	Note
10 Feb 2014	GT	52	Corrected AHRI Data Ratings
06 Jan 2014	GT	All	Added Revised Full Load Extended Data, Nomenclature, WSD instructions, On line warranty registration form.
01 NOV 2013	GT	All	Added All Voltage Wiring Diagrams, Added Cover and Back page, Modified Extended Data, Added Superheat/Subcooling Conditions and Values, Corrected WSD instructions.
23 May 2013	GT	5, 45	Updated AHRI Data Tables, CFM Chart
01 Jan 2013	GT	All	Updated 048 Dimensions
05 Dec 2012	GT	5	Update AHRI Perf Charts
16 OCT 2012	GT	34	Update Unit Piping Install
07 Aug 2012	DS	All	Updated 060 - 072 to Revision D
22 May 2012	DS	All	Added Voltage Code "3"
20 Jan 2012	DS	All	Added Voltage Code "2"
20 Dec 2011	DS	13	Updated Perf Data
11 Nov 2011	DS	All	Added Voltage Code "0"
03 Oct 2011	DS	All	Updated 060 - 072 to Revision B
03 Oct 2011	DS	All	Updated 024 - 048 to Revision C
22 Aug 2011	DS	All	First published



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