

Installation & Operations Manual

WT Models - Water-to-Water Heat Pumps

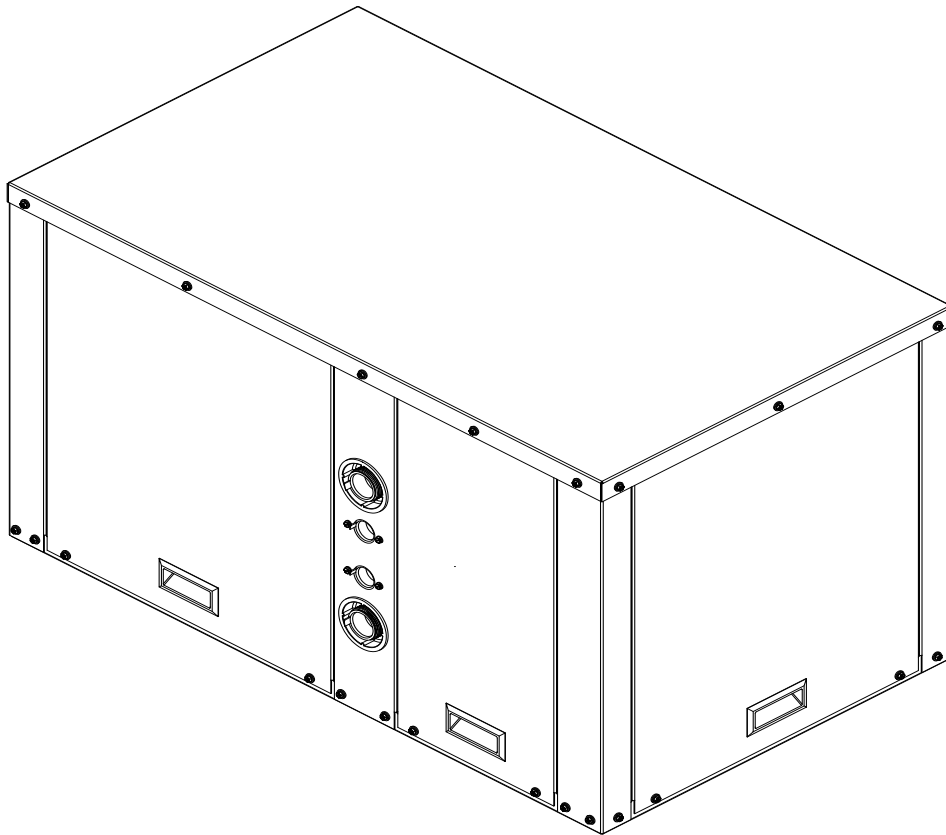


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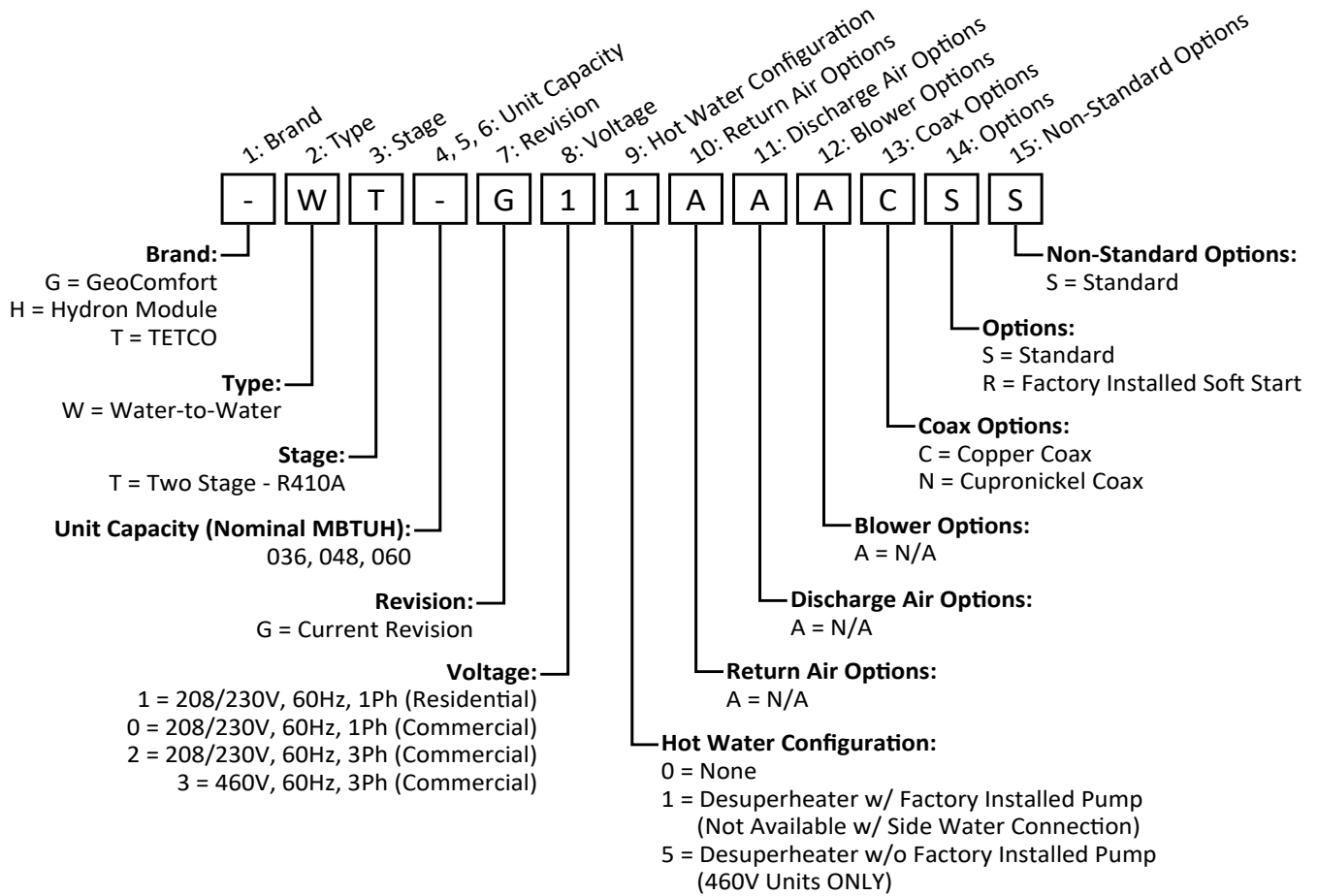
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Section 1: WT Water-To-Water Unit Model Nomenclature

Unit Model Nomenclature



Section 2: Installation Introduction

Introduction

This geothermal heat pump provides heated water and chilled water 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 5 days. If not filed within 5 days the freight company can deny all claims.

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

Unit Protection

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

Storage

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

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

Pre-Installation

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

Pre-Installation Steps

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

Section 2: Installation Introduction

CAUTION

ALL GEOTHERMAL EQUIPMENT IS DESIGNED FOR INDOOR INSTALLATION ONLY. DO NOT INSTALL OR STORE UNIT IN A CORROSIVE ENVIRONMENT OR IN A LOCATION WHERE TEMPERATURE AND HUMIDITY ARE SUBJECT TO EXTREMES.

EQUIPMENT IS NOT CERTIFIED FOR OUTDOOR APPLICATIONS. SUCH INSTALLATION WILL VOID ALL WARRANTIES.

WARNING

FAILURE TO FOLLOW THIS CAUTION MAY RESULT IN PERSONAL INJURY. USE CARE AND WEAR APPROPRIATE PROTECTIVE CLOTHING, SAFETY GLASSES AND PROTECTIVE GLOVES WHEN SERVICING UNIT AND HANDLING PARTS.

CAUTION

BEFORE DRILLING OR DRIVING ANY SCREWS INTO CABINET, CHECK TO BE SURE THE SCREW WILL NOT HIT ANY INTERNAL PARTS OR REFRIGERANT LINES.

Components

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

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

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

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

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

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.

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

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

Consumer Instructions

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

Enertech Global D-I-Y Policy

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

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

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

Equipment Installation

Special care should be taken in locating the unit. All units should be placed on a formed plastic air pad, or a high density, closed cell polystyrene pad slightly larger than the base of the unit. All units should be located in an indoor area 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.

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.

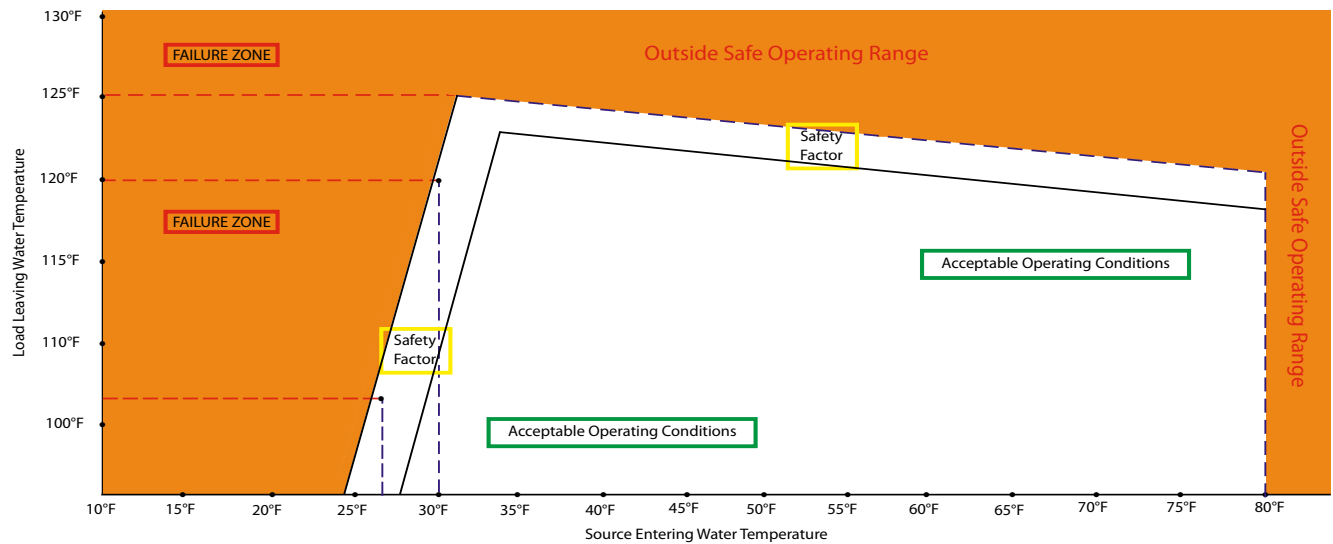
Note: Copper is the only approved material for piping the desuperheater.

Loop Pumping Modules

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

Section 3: Installation and Operation Considerations

SCROLL COMPRESSOR OPERATING CONDITIONS (WATER TO WATER) HEATING MODE OPERATION



Buffer Tanks

Virtually all water-to-water heat pumps used for hydronic applications require a buffer tank to prevent equipment short cycling, and to allow lower flow rates through the water-to-water unit than through the hydronic delivery system. Exceptions include single zone systems with sufficient flow rate to meet the minimum heat pump requirements in full load (e.g. large barn with a number of circuits), and variable speed heat pumps in some cases. The following are considerations for buffer tank sizing:

- The size of the buffer tank should be determined based upon the predominant use of the water-to-water equipment (heating or cooling).
- The size of the buffer tank is based upon the lowest operating stage of the equipment. For example, a water-to-water heat pump with a two-stage compressor or two compressors may be sized for first stage capacity, reducing the size of the tank (two-stage aquastat required).
- Pressurized buffer tanks are sized differently than non-pressurized tanks (see guidelines listed below).

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

For predominately cooling applications, pressurized buffer tanks should be sized at one (1) U.S. gallon per 1,000 Btuh of cooling capacity (10 U.S. gallons per ton may also be used) at the minimum EST and the maximum ELT, the point at which the water-to-water unit has the highest cooling capacity, usually 50-70°F EST and 50-60°F ELT.

Select the size of the tank based upon the larger of the calculations (heating or cooling).

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

Unit Placement

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

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 geothermal heating and cooling equipment should be placed on either a formed plastic air pad, or a high density, closed cell polystyrene pad. This helps eliminate vibration noise that could be transmitted through the floor.
3. If units are being placed on racking, the unit must be placed on a solid foundation covering the full base of the unit. Also, utilize a foam pad between the unit and the rack.
4. The installer must verify that all applicable wiring, piping, and accessories are correct and on the job site.

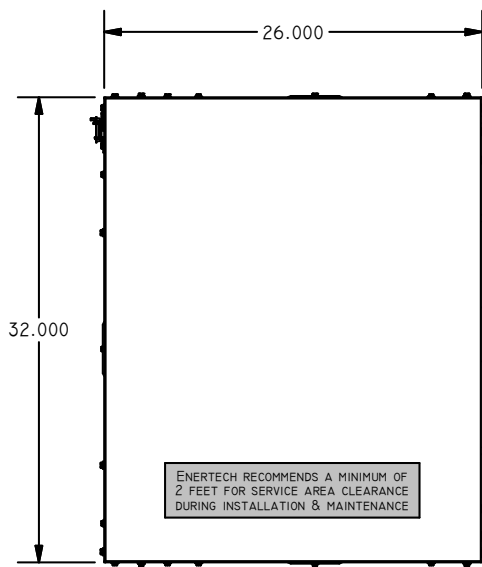
Pre-Installation

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

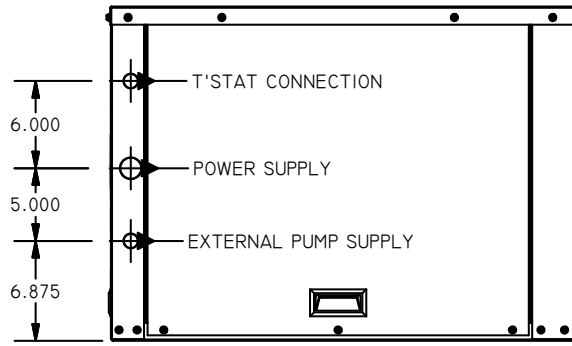
- Fully inspect the unit after unpacking.
- Locate the Unit Start-Up form from this manual and have it available as the unit installation proceeds.

Section 4: Unit Dimensional Data

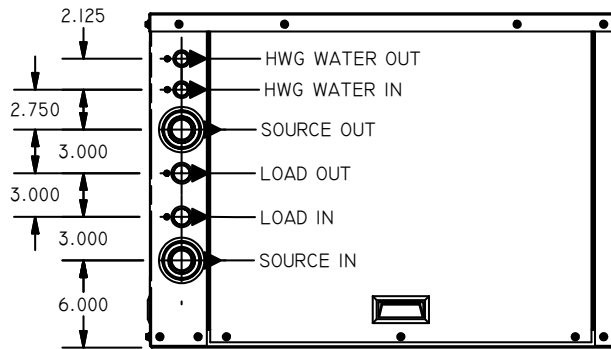
Unit Dimensional Data - 036



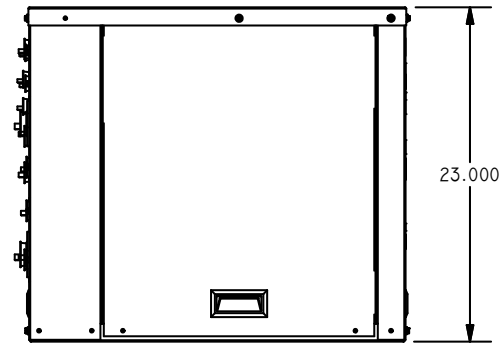
TOP VIEW



RIGHT SIDE VIEW



LEFT SIDE VIEW



FRONT VIEW

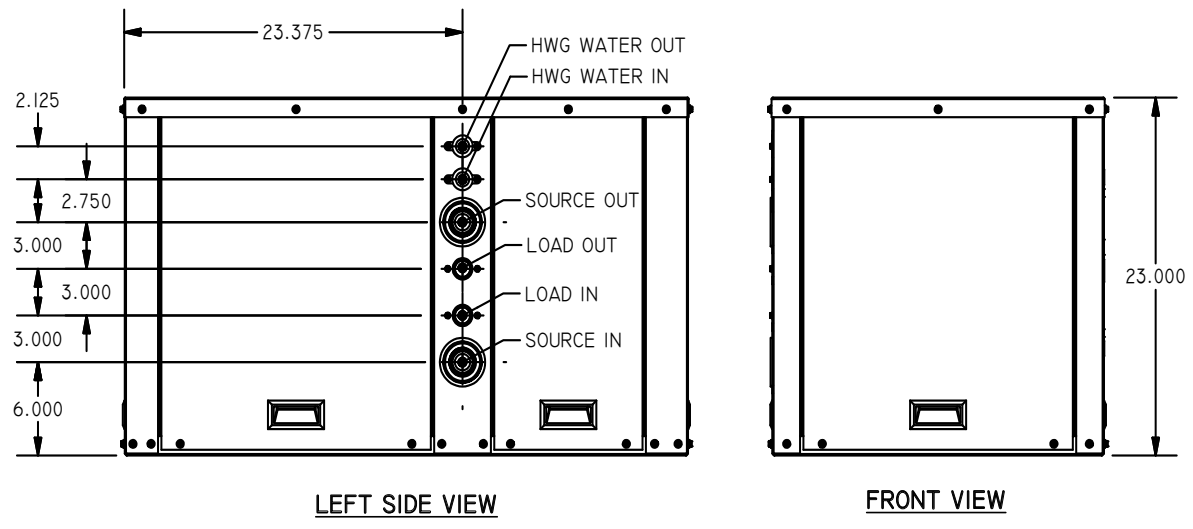
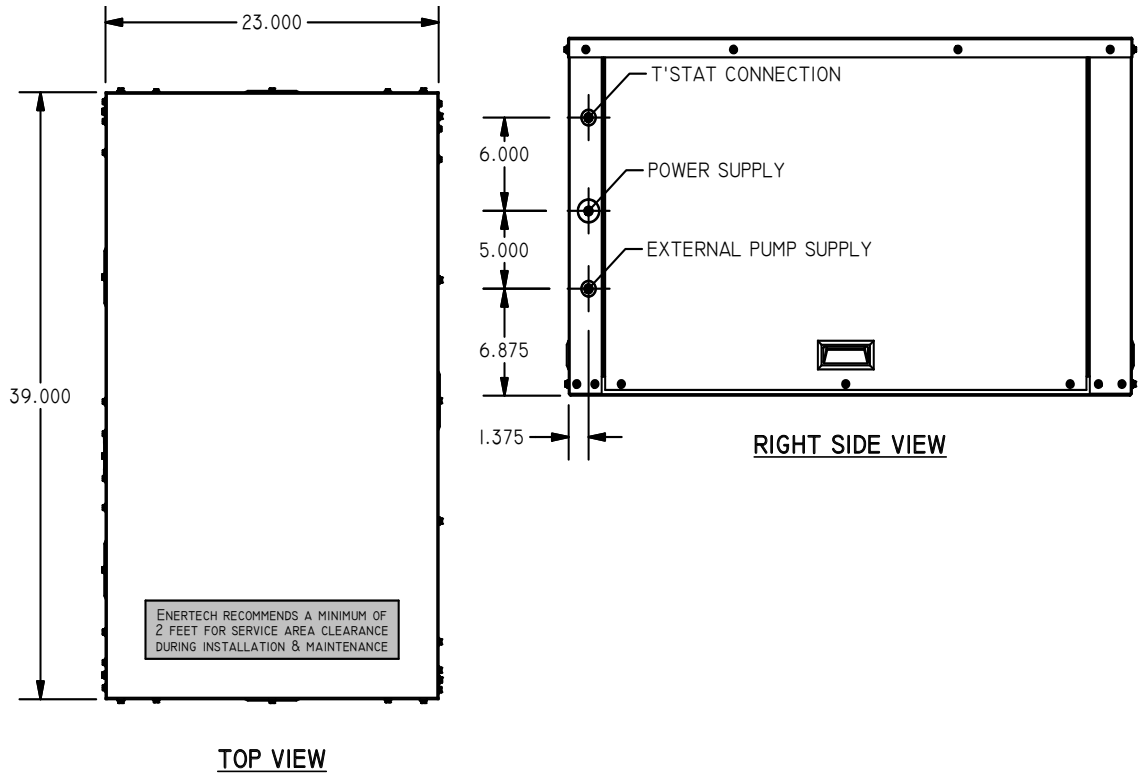
Single Compressor Unit										
MODEL	SOURCE Water: D/O*		SOURCE Water: FPT		LOAD Water: FPT		HWG Water: FPT		Factory Charge	Unit Weight
	IN	OUT	IN	OUT	IN	OUT	IN	OUT		
036	1-1/4"	1-1/4"	1"	1"	1"	1"	3/4"	3/4"	69 oz	334 Lbs
	RESIDENTIAL		COMMERCIAL							

Notes:

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

*D/O = Double O-ring connections (requires double O-ring hose kit or adapters)

Section 4: Unit Dimensional Data
Unit Dimensional Data - 048 and 060



Single Compressor Unit										
MODEL	SOURCE Water: D/O*		SOURCE Water: FPT		LOAD Water: FPT		HWG Water: FPT		Factory Charge	Unit Weight
	IN	OUT	IN	OUT	IN	OUT	IN	OUT		
048	1-1/4"	1-1/4"	1"	1"	1"	1"	3/4"	3/4"	118 oz	430 Lbs
060									119 oz	430 Lbs
RESIDENTIAL			COMMERCIAL							

Notes:
 - Electrical connections are 1" DIA for high voltage, & 1/2" DIA for low voltage.
 *D/O = Double O-ring connections (requires double O-ring hose kit or adapters)

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 hardened 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.

See Water Quality Table below for guidelines.

Water Quality Table				
Potential Problem	Chemical(s) or Condition	Range for Copper Heat Exchangers	Cupro-Nickel Heat Exchanger Ranges	Stainless Steel Heat Exchanger Ranges
Scaling	Calcium & Magnesium Carbonate	Less than 350 ppm	Less than 350 ppm	Less than 0.1 ppm
Corrosion	pH Range	7 - 9	5 - 9	7 - 9
	Total Dissolved Solids	Less than 1000 ppm	Less than 1500 ppm	No rigid setpoint
	Ammonia, Ammonium Hydroxide	Less than 0.5 ppm	Less than 0.5 ppm	No Limit
	Ammonium Chloride, Ammonium Nitrate	Less than 0.5 ppm	Less than 0.5 ppm	Less than 2-20 ppm
	Calcium/Sodium Chloride (Note 5)	Less than 125 ppm	Less than 125 ppm	None Allowed
	Chlorine (Note 1)	Less than 0.5 ppm	Less than 0.5 ppm	Less than 1 ppm (Note 1)
	Hydrogen Sulfide	None Allowed	None Allowed	Less than 0.05 ppm
Biological Growth	Iron Bacteria	None Allowed	None Allowed	None Allowed
	Iron Oxide	Less than 1 ppm	Less than 1 ppm	Less than 0.2 ppm
Erosion	Suspended Solids (Note 6)	Less than 10 ppm	Less than 10 ppm	16-20 mesh strainer recommended
	Water Velocity	Less than 8 ft/s	Less than 12 ft/s	Less than 5.5 m/s in the port

Notes:

1. Chlorine can not be used with 304 Stainless Steel.
2. Hardness in ppm is equivalent to hardness in mg/l.
3. Grains/gallon = ppm divided by 17.1.
4. Unit internal heat exchangers are not recommended for pool applications or water outside the range of the table
5. Secondary heat exchangers are required for pool or other applications not meeting the requirements shown above.
6. Saltwater applications (approx. 25,000 ppm) require secondary heat exchangers due to copper piping between the heat exchanger
7. Filter for maximum of 600 micron size.

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.

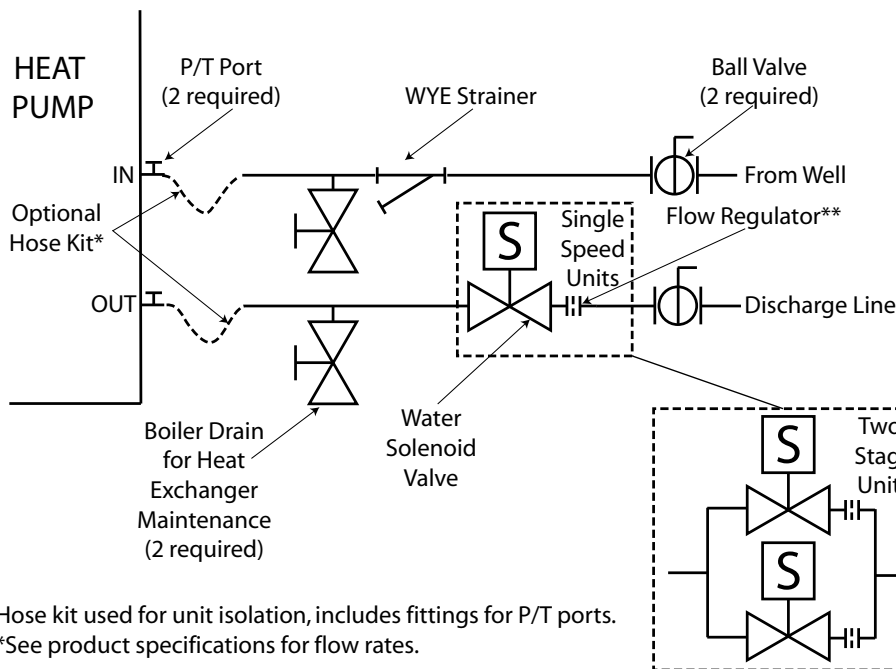
Always double check flow rate at the P/T ports to make sure the ball valve adjustments have not lowered water flow too much, and essentially taken the flow regulator out of the equation. It's a good idea to remove the ball valve once the system is completed to avoid nuisance service calls.

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 water flow 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 1: Open Loop Piping Example

TYPICAL OPEN LOOP PLUMBING AND VALVE INSTALLATION EXAMPLE



Note: All GWT, HWT, & TWT units are two-stage units.

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

*Hose kit used for unit isolation, includes fittings for P/T ports.

**See product specifications for flow rates.

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 "Pipe Insulation" table below for insulation sizes with different pipe sizes. All pipe insulation should be a closed cell and have a minimum wall thickness of 3/8". All piping insulation should be glued and sealed to prevent condensation and dripping. Interior piping may consist of the following materials: HDPE, copper, brass, or rubber hose (hose kit only). PVC is not allowed on pressurized systems.

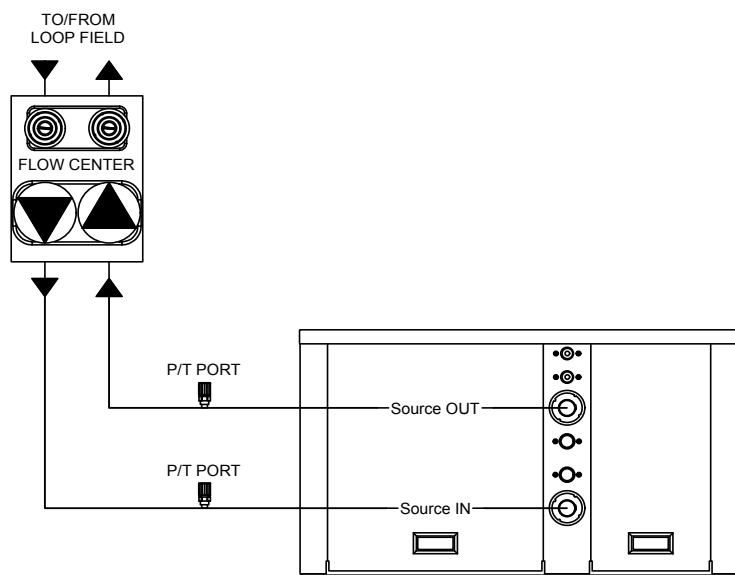
Pipe Insulation Table	
Piping Material	Insulation Description
1" IPS Hose	1-3/8" ID - 3/8" Wall
1" IPS PE	1-1/4" ID - 3/8" Wall
1-1/4" IPS PE	1-5/8" ID - 3/8" Wall
2" IPS PD	2-1/8" ID - 3/8" Wall

Typical Pressurized Flow Center Installation

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 example "Typical Single Unit Piping Connection (Pressurized Flow Center)", 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.

Typical Single Unit Piping Connection (Pressurized Flow Center)



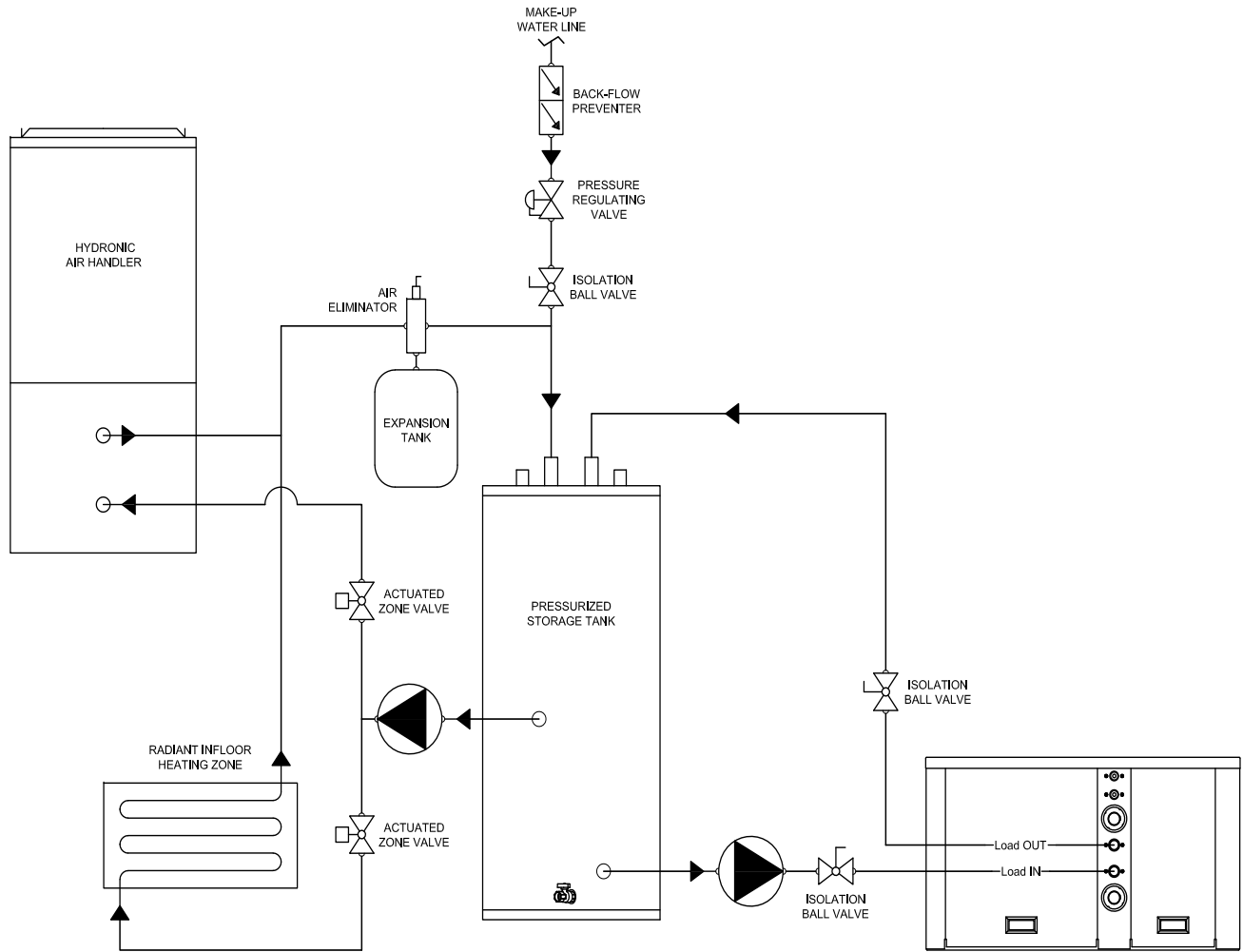
Section 5: Unit Piping Installation

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.

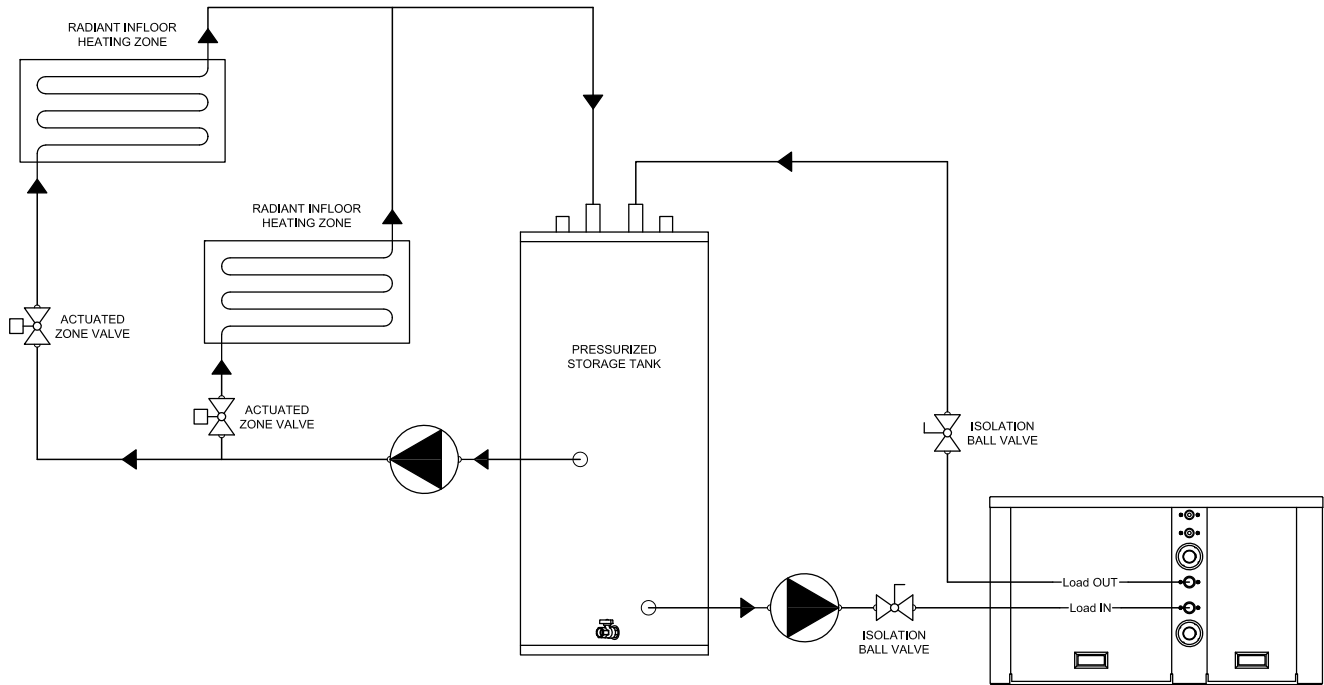
The non-pressurized flow center needs to be isolated from the flush cart during flushing because the flow center is not designed to handle pressure. Since this is a non-pressurized system, the interior piping can incorporate all the above mentioned pipe material options (see interior piping), including 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. See example "Typical Single Compressor Unit Piping Connection" below for example.

Typical Single Compressor Unit Piping Connection



Section 5: Unit Piping Installation

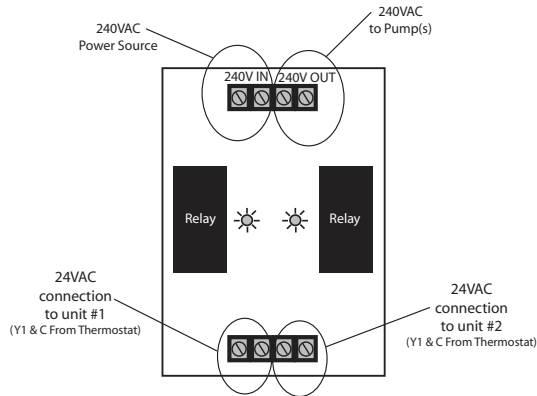
Typical Storage Tank Piping For Radiant Floor Heating



APSMA Pump Sharing Module

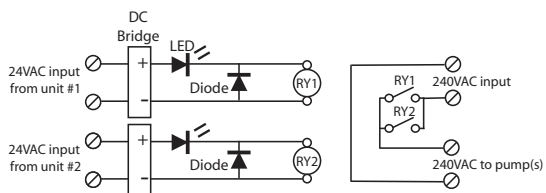
The pump sharing module, part number APSMA, is designed to allow two units to share one flow center. With the APSMA module, either unit can energize the pump(s). Connect the units and flow center as shown in “APSMA Module Layout” below.

APSMA Module Layout



The module must be mounted in a NEMA enclosure or inside the unit control box. Local code supersedes any recommendations in this document. See “APSMA Module Wiring Schematic” below.

APSMA Module Wiring Schematic



Section 6: Desuperheater Installation

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 double wall desuperheater exchanger (coil) located between the compressor and the reversing valve, extracts superheated vapor to heat domestic water; still 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 disconnected ensures that the pump will not run without a water supply.

The illustration below shows the parameters which are safe for compressor operation. Based on the leaving load water of 120°F, the loop would have to maintain 35°F to operate within the acceptable operating conditions for the compressor. Once your loop temperatures drop below 35°F, the acceptable leaving load temperature drops below 120°F. If you are designing loops for 30°F, the recommended leaving load temperature is 110°F. Because the water-to-water machines have become so popular for providing heated water for a multitude of uses, we've provided the above chart for reference.

The obvious correlation is that the warmer the Source Entering Water Temperature, the hotter the Load Leaving Water Temperature can be, to a point. R410A can only handle up to about 125°F Load Leaving Water Temperature before putting the compressor at risk.

Actual usage, and choices of heat distribution devices need to follow the acceptable operating conditions presented in the chart. If a question arises, please consult the Technical Services Department.

Desuperheater Installation

Units that ship with the desuperheater function must be connected to the water heater/storage tank with the optionally offered Desuperheater Connection Kit or (as supplied by others) shown on the following sections of this manual.

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:

- (1) p/n 20D052-01NN, Installation Instructions
- (1) p/n 33P211-01BN, 3/4" x 3/4" x 3/4" FPT Brass Tee
- (1) p/n 33P210-01NN, 3/4" Boiler Drain Valve
- (1) p/n 11080005001, 3/4" MPT x 3-1/2" Brass Nipple
- (3) p/n 11080006001, 1/2" SWT x 3/4" MPT Copper Adaptor
- (1) p/n 11080007001, 3/4" x 3/4" x 1/2" SWT Copper Tee

Plumbing Installation

All plumbing and piping connections must comply with local plumbing codes.

TIP: Measure the distance above the floor or shelf that the water heater is sitting 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.

⚠ 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 FROM THE DESUPERHEATERS COULD RAISE TANK TEMPERATURES TO UNSAFE LEVELS.

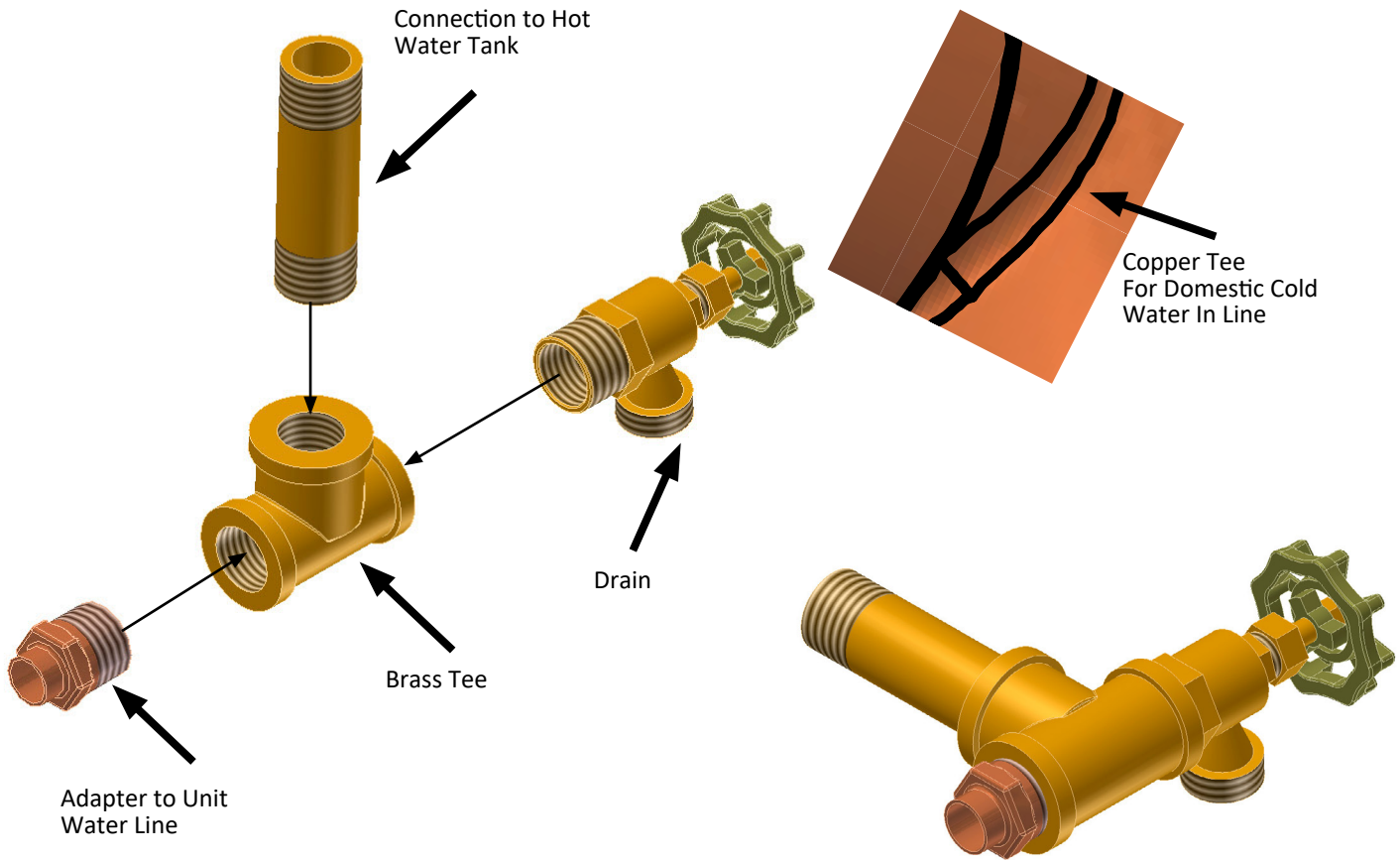
Tip: Measure the distance above the floor or shelf that the water heater is setting on, to where the drain valve is located. This distance must be greater than one-half the width of the tee you're about to install, or you won't be able to thread the tee on to the water heater.

1. Remove drain valve and fitting from water heater.
2. Thread the 3/4" MPT x 3-1/2" nipple into the water heater drain port. Use Teflon tape, or pipe dope on threads.
3. Thread the center port of the 3/4" brass tee to the other end of the nipple.
4. Thread one of the copper adaptors into the end of the tee closest to the heat pump.
5. Thread the drain valve into the other end of the nipple.
6. Above the water heater, cut the incoming cold water line. Remove a section of that line to enable the placement of the copper tee.
7. Insert the copper tee in the cold water line.
8. Thread the remaining two 1/2" SWT x 3/4" MPT copper adaptors into the 3/4" FPT fittings on the heat pump, marked HWG IN and HWG OUT.
9. Run interconnecting 1/2" 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.
10. Run interconnecting 1/2" copper pipe from the HOT WATER IN on the heat pump, to the copper tee in the cold water line.
11. 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).
12. Shut off 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 hot".
13. Turn the water supply to the water heater on. Fill water heater. Open highest hot water faucet to purge air from tank and piping.
14. Flush the interconnecting lines, and check for leaks. Make sure air vent is shutoff when water begins to drip steadily from the vent.
15. 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.
16. Install 3/8" closed cell insulation on the lines connecting the heat pump to the water heater.
17. Reconnect electricity to water heater.

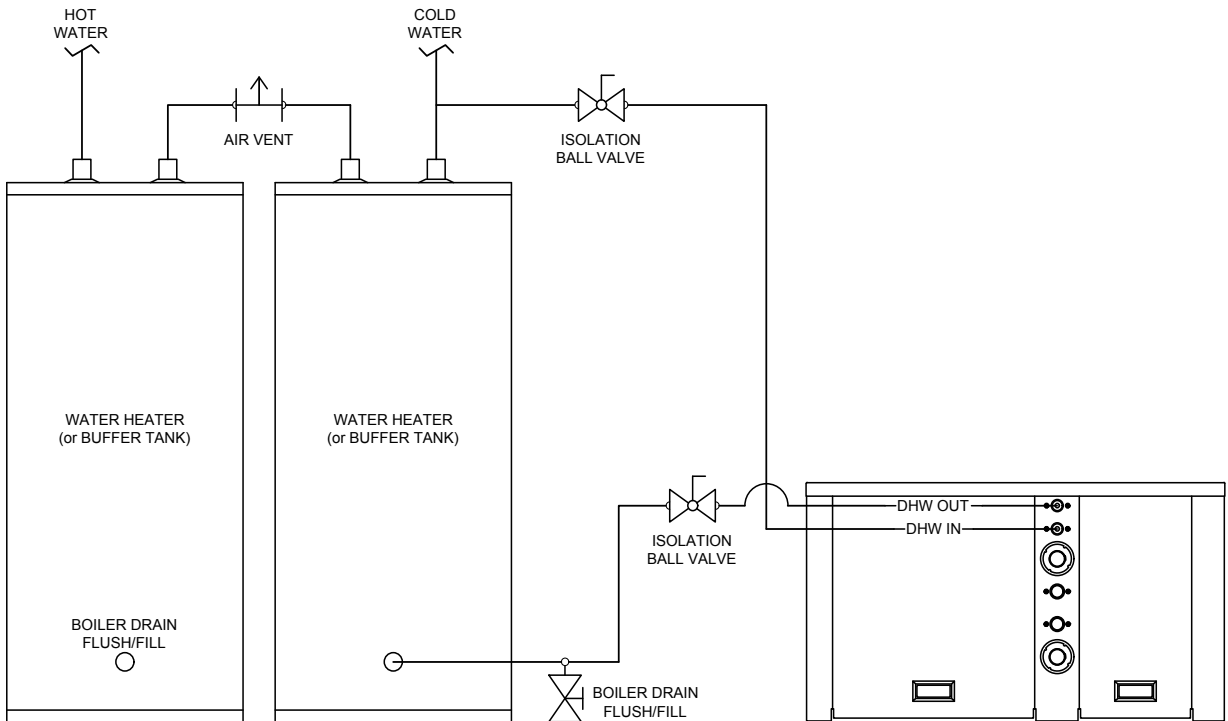
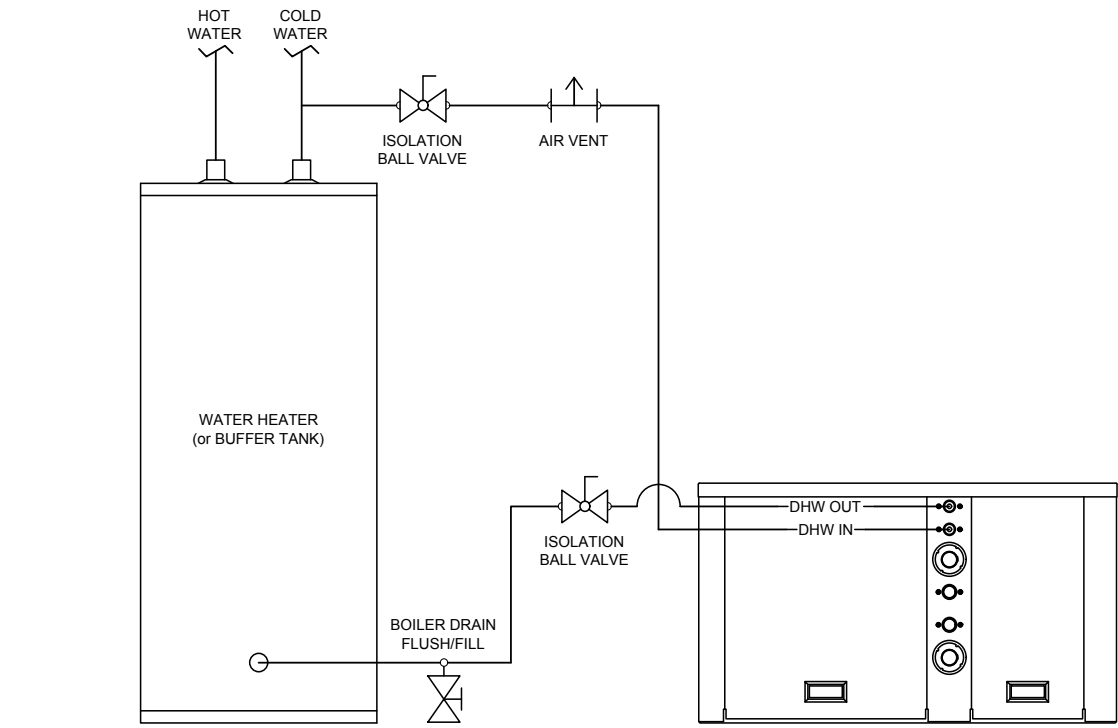
Section 6: Desuperheater Installation

Water Heater Connection Kit Assembly for Bottom of Water Heater

Note: Drawing shown vertically for detail. Fitting installs horizontally into hot water tank.



Section 6: Desuperheater Installation
Figure 8: Typical Desuperheater Installation Diagrams



Section 7: 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 heat exchanger from freezing and rupturing. Freeze protection should be maintained to 15°F below the lowest expected entering loop temperature. For example, if 30°F is the minimum expected entering loop temperature, the leaving 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 Pipe Fluid Volume and Antifreeze Percentages by Volume Tables on the next page for volumes and percentages. The freeze protection should be checked during installation using the proper hydrometer to measure the specific gravity and freeze protection level of the solution.

Antifreeze Characteristics

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

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

Cost: Prices vary widely.

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

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

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

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

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

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

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

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

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

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

Antifreeze Charging

Calculate the total amount of pipe in the system and use the **Pipe Fluid Volume Table** 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 (**See Antifreeze Percentages by Volume**) for the freeze protection required in your area. Then, double check calculations during installation with the proper hydrometer and specific gravity chart (**See Antifreeze Specific Gravity Table**) to determine if the correct amount of antifreeze was added.



CAUTION



GROUND LOOPS MUST BE ANTIFREEZE PROTECTED.
INSUFFICIENT AMOUNTS OF ANTIFREEZE MAY CAUSE
SEVERE DAMAGE AND MAY VOID WARRANTY.



WARNING



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 7: Antifreeze

Figure 9: Antifreeze Specific Gravity

Pipe Fluid Volume Table		
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

Unit coaxial heat exchanger = 1 Gallon

Flush Cart = 8-10 Gallons

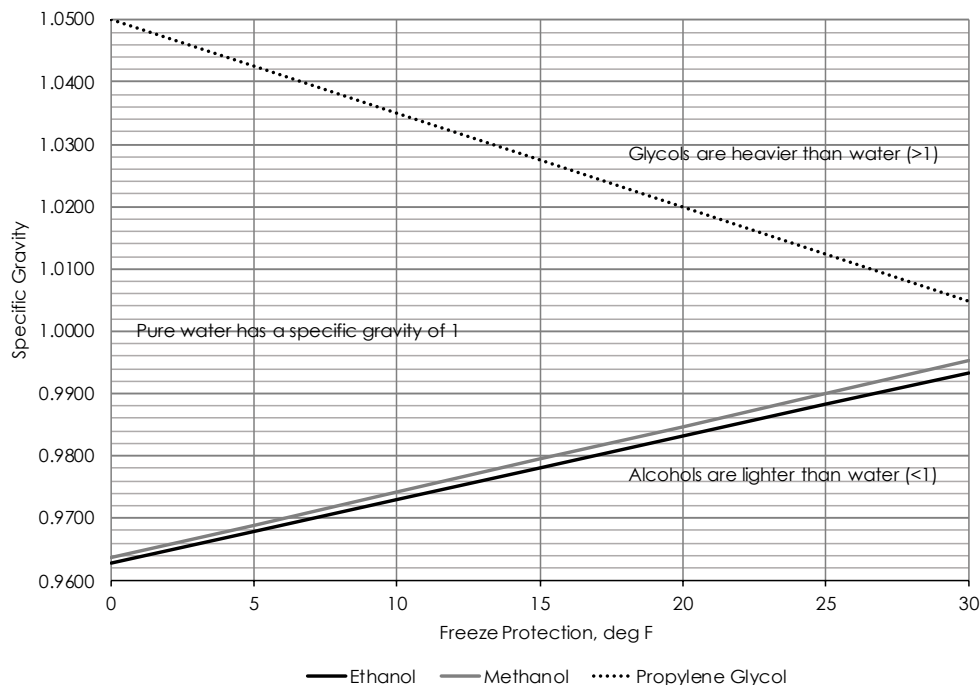
10' of 1" Rubber Hose = 0.4 Gallons

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)
Propylene Glycol	30%	25%	20%*	13%*
Methanol	21%	17%	13%	5%
Ethanol	26%	23%	18%	13%

Note: Antifreeze solutions are shown in pure form - not premixed

*Concentrations below 25-30% (consult manufacturer) typically require additional inhibitors.

Figure 8: Antifreeze Specific Gravity

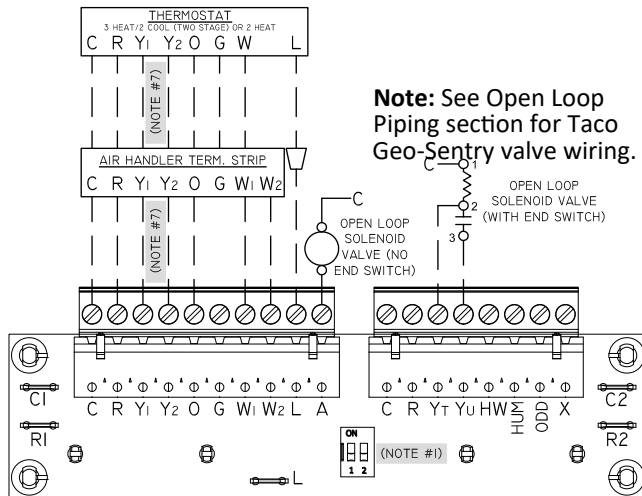


NOTES:

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

Section 8: Controls

Thermostat Wiring



The Enertech thermostat board is designed to eliminate jumpers and spade connectors and is equipped with two DIP switches for flexibility of applications. Verify that the switches are set correctly prior to starting the unit with the following options:

DIP #1 - Single Speed or Two Stage
ON = Single Stage
OFF = Two Stage

Note: Setting this DIP switch ON connects Y1 to Y2 and provides full stage airflow for single speed systems.

DIP #2 - Water Valve End Switch (terminals YT & YU)
ON = No end switch (YT is jumpered to YU)
OFF = Water valve has end switch (see wiring diagram)

Features

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

Microprocessor Features and Operations

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 LED(s) for each fault are provided for diagnostics.

A removable low voltage terminal strip provides the necessary terminals for thermostat connections. Some models offer an additional removable terminal strip for accessory wiring connections.

Startup/Random Start

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

Short Cycle Protection (ASC)

A built-in five minute anti-short cycle (ASC) 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. There is a short delay between the blower motor and the compressor start up.

Test Mode

The microprocessor control allows the technician to shorten timing delays for faster diagnostics by removing the TEST jumper located on the lockout board. It should be reinstalled for normal operation after testing. The status LED will not be illuminated during the TEST mode.

Resistance Heat Control

The resistance heat control module contains the appropriate high-voltage control relays. Low voltage control signals from the lockout board energize the relays in the resistance heat module to engage backup resistance heat when necessary. The lockout board offers a pass through W1 (1st Stage) and a relay output for W2 (2nd Stage). See staging in sequence of operation section.

Loop Pump Circuit Breakers

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

Safety Controls

The lockout board receives separate signals for high pressure, low pressure, low load heat exchanger freeze, source heat exchanger freeze, condensate overflow, and hot gas temperature limit faults. Upon a continuous 30-second measurement of all faults, except the high pressure fault, the compressor operation is suspended. The high pressure fault is immediate. The combination of LED(s) indicate each fault. Once the unit is locked out (see fault retry below), an output of 24VAC is energized on the "L" terminal for remote indication of a fault at the thermostat.

Flow Switch - FS (If equipped - brazed plate only).

A flow switch ensures the source water maintains the minimum required flow rate. This ensures that pumps are working and water connections remain intact. The flow switch will also trip when the source water begins to freeze, providing additional protection. A Flow Switch is utilized on units with a BPHE source coil. A Flow Switch is not included on units utilizing a COAX source coil.

Electronic Condensate Overflow Protection (CO) (If equipped - Packaged Units Only)

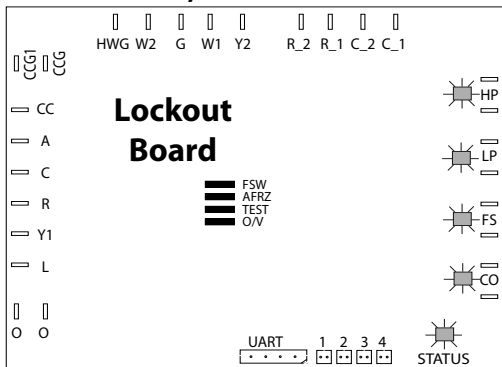
The control board utilizes an impedance sensing liquid sensor at the top of the drain pan. When water touches the sensor, CO fault occurs. If the fault is present for 30 continuous seconds, the lockout board indicates a condensate overflow fault has occurred.

Section 8: Controls

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

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

Lockout Board Layout



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

Load Heat Exchanger Freeze-T1 (If equipped - units with coaxial heat exchangers): When in cooling mode, if the heat exchanger temperature is lower than 30°F for 30 continuous seconds, the compressor operation will be interrupted, and the control will go into fault retry mode. This sensor is located on the refrigerant line in between the heat exchanger and TXV (refrigerant inlet of heat exchanger in cooling mode).

Source Heat Exchanger Freeze -T4 (If equipped - units with coaxial heat exchangers): When in heating mode, if the heat exchanger is lower than setpoint for 30 continuous seconds, the compressor operation will be interrupted, and the control will go into fault retry mode. The setpoint is 12°F for closed loop (A-FRZ jumper removed) and 30°F (A-FRZ jumper installed) for open loop. At startup, the flow sensor is not monitored for 30 seconds to avoid nuisance faults. This sensor is located on the refrigerant line in between the source heat exchanger and TXV (refrigerant inlet of heat exchanger in heating mode).

Hot Gas Line Temperature limit (T2>220°F): When T2 is >220°F for 30 continuous seconds, the compressor operation will be interrupted. The control will go into fault retry mode.

Temperature Sensor Operating Range	
Sensor's Name	Range(°F)
T1	10 – 220
T2	20 – 257
T3	20 – 220
T4	10 – 220

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

Over/Under Voltage Protection

The lockout board protects the compressor from operating when an over/under voltage condition exists. The control monitors secondary voltage (24VAC) to determine an over/under voltage condition is occurring on the primary side of the transformer. For example, if the secondary voltage is 18VAC, the primary voltage for a 240V unit would be approximately 180V which is below the minimum voltage (197V) recommended by the compressor manufacturer. Under voltage (<18VAC) causes the compressor to disengage and restart when the voltage returns to >20VAC. Over voltage (>31VAC) causes the compressor to disengage and restart when the voltage returns to <29VAC.

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

Fault Retry

All faults (except O/U Voltage) 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 (ASC) period (5 min.) between fault retries. On the third fault within 30 minutes, the board will go into lockout mode and the "Call For Service" indicator on the thermostat will illuminate.

Intelligent Lockout Reset

If the thermostat is powered off for one minute then back on (soft reset), the board will reset and the last fault will be stored in memory for ease of troubleshooting. If 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 auxiliary heat (W1), emergency heat mode will energize. W2 is energized two minutes after W1 is energized.

Hot Water Generator (HWG) Pump Control (If equipped with Desuperheater)

Controls check for HWG temperature (T3) and hot gas (compressor discharge) line (HGT) temperature (T2). The hot water generator pump is de-energized when the leaving water temperature (T3) is above 130°F or when the compressor discharge line (T2) is cooler than leaving water temperature (T3). Also when the hot gas line temperature (T2) is higher than 220°F, the HWG pump will be de-energized. All of the issues above will break the circuit of the HWG pump (via the HWG signal from the lockout board) and will not lockout the compressor except when T2>220°F. Units without a HWG also do not have sensors T2 and T3. The control ignores T2 and T3 and disables Faults 15 and 16, Sensor BAD.

Section 8: Controls

LED Identification

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

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

NOTES:

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

Section 8: Controls

Diagnostics

The lockout board includes five LEDs (Green-HP, Orange-LP, Red-FS, Yellow-CO, Green-Status) for fast and simple control board diagnosis. Refer to the LED Identification table for LED function.

Lockout Board Jumper Selection

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

Load/Source Temperature Sensing (FS)

When the FS jumper is installed (T1 and T4 monitored, FS terminals ignored), the board operates in the load and source heat exchanger temperature sensing mode. When the FS jumper is removed, the board monitors the flow switch to ensure adequate flow through the heat exchanger. **Factory set, NOT field selectable.**

Anti-Freeze (A-FRZ)

When the jumper is installed, the board operates in open loop mode. The setpoint for the source heat exchanger freeze sensor is 30°F. When the A-FRZ jumper is removed, the board operates in the closed loop mode. The setpoint for the source heat exchanger freeze sensor is 12°F.

Test Mode (TEST)

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

Over/Under Voltage Disable (O/U)

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

Likely causes of an over/under voltage condition include power company transformer selection, insufficient entrance wire sizing, defective breaker panel, incorrect 24VAC transformer tap (unit control box), or other power-related issues.

Sequence of Operation

The description below is based on Water-to-Water Units, Two Stage Compressor. Timings assume the ASC timer is expired. If the ASC timer is not expired the accessory, compressor, and loop pump operation do not start until the ASC timer is expired.

Heating 1st Stage

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

Heating 2nd Stage, (Y1, Y2)

After the Y2 call is received, the second stage of the compressor is energized.

Cooling Operation

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

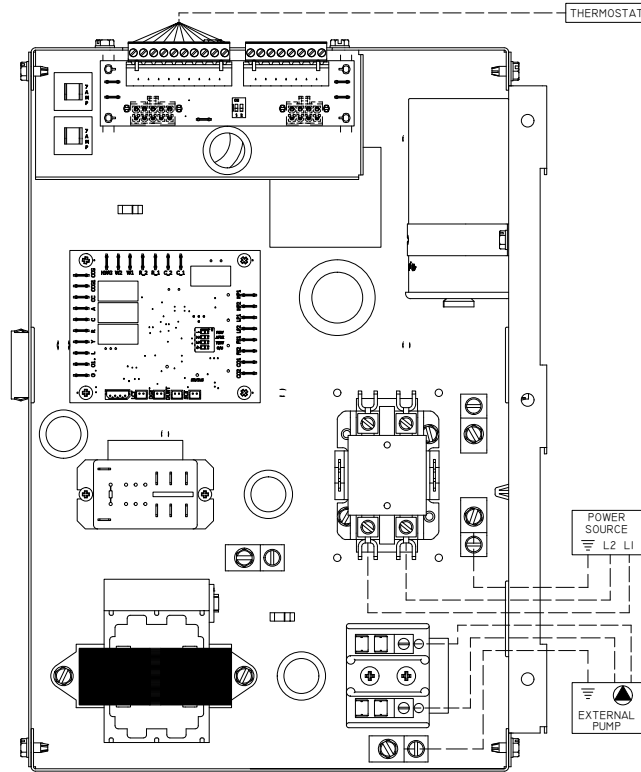
Cooling 1st stage (Y1, O)

The Accessory (A) terminal output is energized after the random start timer (10s-20s) expires then the first stage compressor and the loop pump(s) are energized 10 seconds after A.

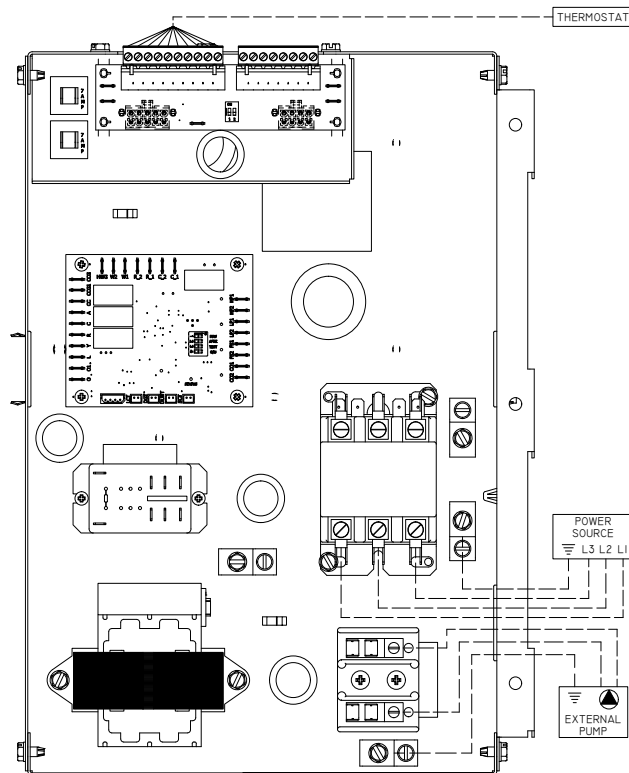
Cooling 2nd Stage (Y1, Y2, O)

After the Y2 call is received, the second compressor is energized.

High and Low Voltage - Single Phase Control Box Connections

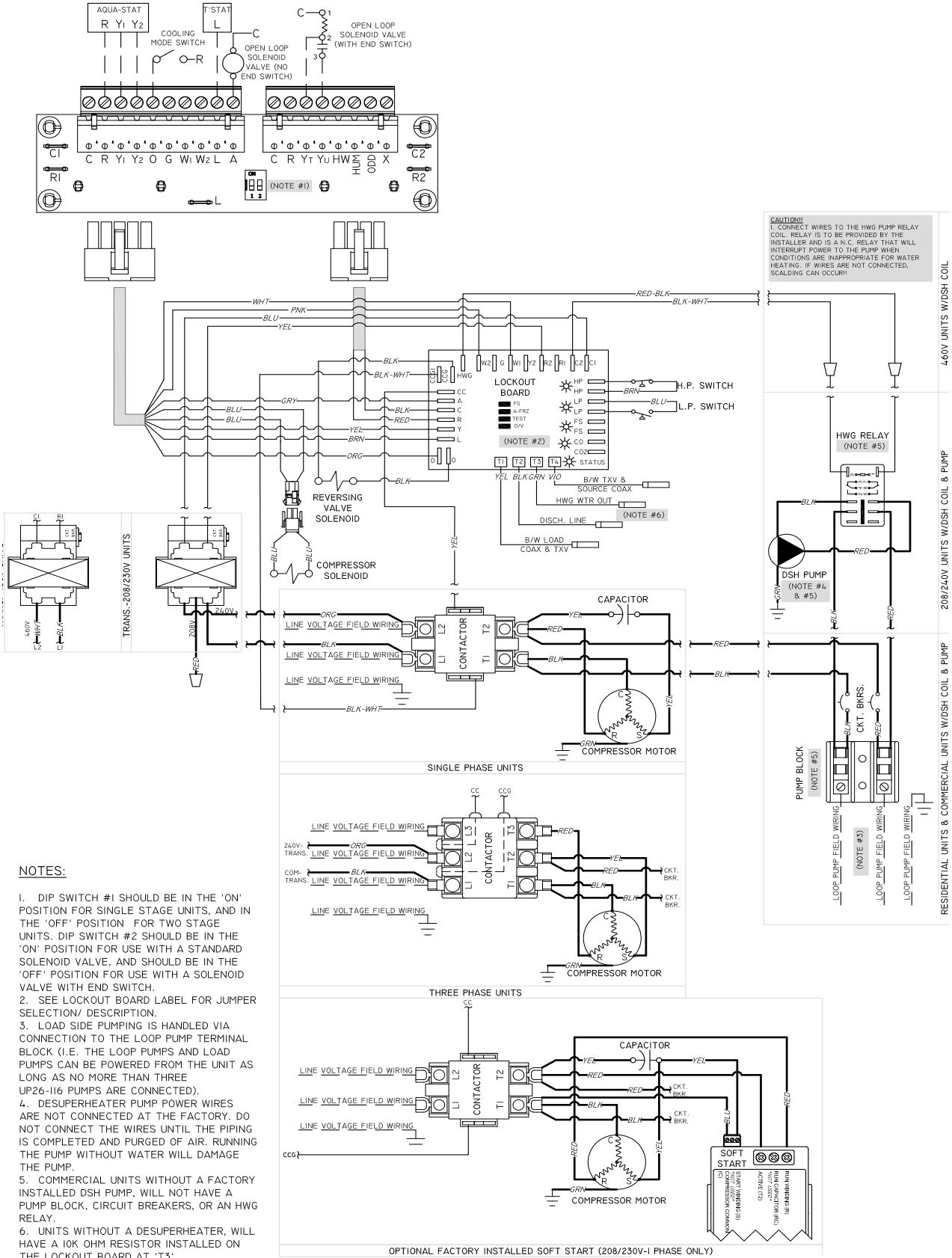


High and Low Voltage - Three Phase Control Box Connections

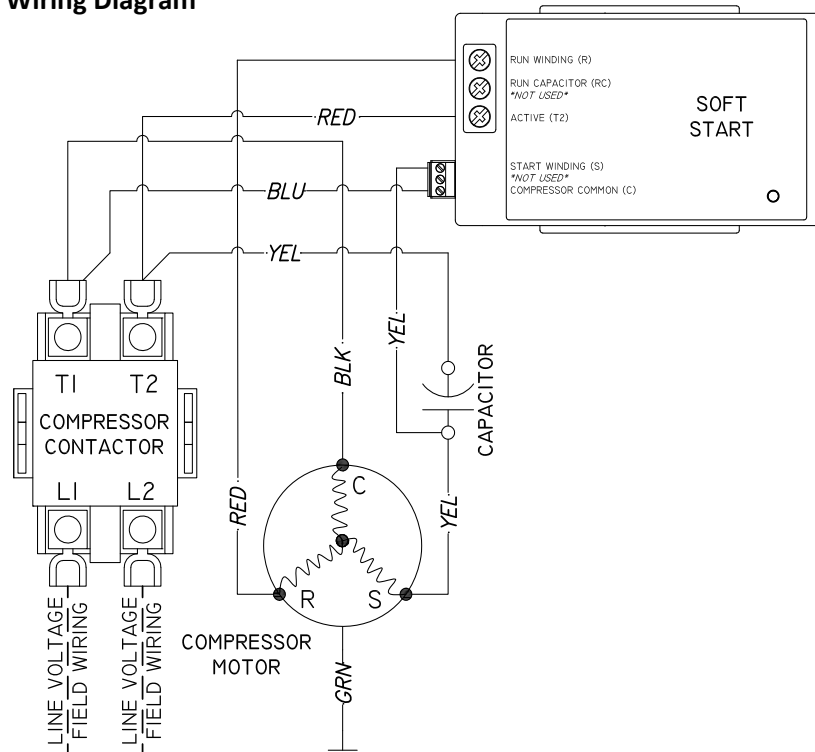


Section 8: Controls

Water-to-Water Unit, Two-Stage, Wiring Diagram



Section 9: Soft Start Controls and Compressor Defender Hyper Engineering (SureStart) Soft Start Wiring Diagram



Introduction

The SureStart Series soft-starter was the first of its kind invented by Hyper Engineering over a decade ago in Wollongong, Australia. It was invented for use in the residential heating, ventilation, and air-conditioning (HVAC) industry.

Hyper Engineering (SureStart)

SureStart Series is specifically targeted to reduce light flicker caused by the startup of fixed speed permanent split-capacitor motors (PSC). These motors are often of the scroll compressor types which are commonly used in air-conditioning and heat pump applications. The SureStart includes the following features:

- 60-70% reduction in direct on-line (DOL) or in-rush current.
- Sophisticated under voltage protection
- Motor reversal protection.
- Self-adjusting up to nominal 7 hp for optimal start performance.
- 50/60 Hz compatible.
- ETL, CE, EMC, and RoHs compliant.
- Tolerant to "dirty power" conditions.
- Versions available for retrofit installations or OEM production use.
- Fault LED
- Internal Current Limiting

Background

In air conditioning and heat pump applications, energy is moved through the system by a compressor which is an electrically driven pump that compresses refrigerant as it pumps to a heat exchanger. Compressors are the heart of air conditioning equipment so it is important to protect them against failure. Inside of every compressor is an electric motor that draws a significant electrical current at startup. This startup current is often referred to as the instantaneous current, in-rush current, locked-rotor amps (LRA), or direct-on-line (DOL) current. In-rush current is generally between 5-8 times higher than the current consumed by the compressor during normal operation.

As the name suggests, in-rush current is very brief lasting for a fraction of a second until the motor begins operating at normal speed. This time period may appear trivial; however, it is the cause of many issues for owners, power companies, and equipment manufacturers.

Below is a list of common problems created by high in-rush current.

- Flickering of lights
- Nuisance trips on safety protection equipment
- Disrupts sensitive electronics such as computers
- Increased stress on the motor which reduces the reliability of the air conditioning equipment.
- Higher installation cost due to insufficient transformer sizing
- Increased noise and vibration at compressor startup

Section 9: Soft Start Controls and Compressor Defender

Most contractors install hard start kits to eliminate these problems. Unfortunately, hard start kits don't provide a complete solution to the problem. Hard start kits do not reduce the startup current but only the startup time which may give a perceived improvement in light flicker, but still stress the compressor during every start. Mechanical shock is also increased to the compressor by use of a hard start device. Installing a SureStart corrects these problems by significantly reducing the start current, optimizing the start time to the compressor size, power supply and loading while providing vital protection to the compressor, and promoting improved reliability at startup.

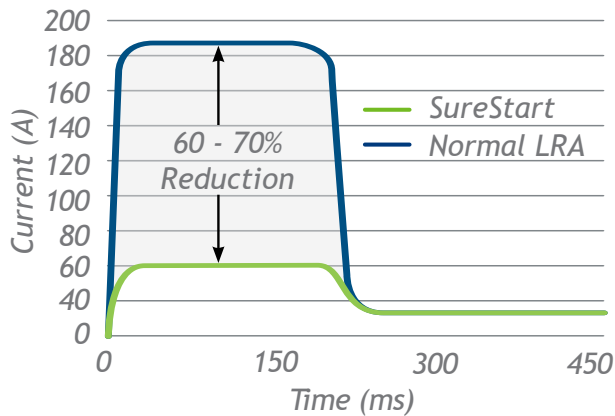
In-Rush Current

Motor in-rush occurs due to low resistance in motor windings essentially acting like a short circuit. This temporary short circuit causes an immediate spike in current and simultaneous drop in supply voltage. Voltage drops for air conditioning compressors are often 15% or more which is 3-4 times greater than what most electrical power distributors prefer. The more frequently the compressor starts, the more noticeable the problem becomes. For most homes in the US, air conditioners usually start at a rate of 6-10 starts per hour.

SureStart In-Rush Reduction

HVAC Tons	Compressor RLA	Before In-Rush	After SureStart	% Reduction
1.5	9	48	15	69
2.0	14	73	22	70
2.5	17	79	24	69
3.0	20	109	33	70
4.0	26	134	40	71
5.0	30	158	47	71
7.0	32	185	56	54

Normal 5.0 Ton LRA vs. SureStart



SureStart Operation

When the system control calls for compressor operation, the compressor contactor will energize. If the supply voltage to the SureStart is less than "Minimum Startup Voltage", a 50 second delay is initiated. At the end of the delay, another attempt to start the compressor will begin unless the supply voltage remains unchanged. SureStart uses an optimized starting process that learns the starting characteristics of the compressor to further refine the starting cycle on each recurring start.

If the compressor fails to start, the module will terminate the start attempt after 1 second and initiate a 3 minute lockout before attempting a restart. If the supply voltage falls below "Shutdown on Low voltage" limit for 2 seconds or below 130 volts for 0.1 seconds while the compressor is running the module will stop the compressor and initiate a 3 minute lockout. A restart will be attempted after 3 minutes if the supply voltage is equal to "Minimum Startup Voltage" or higher. This is done to protect the compressor against a sudden drop in supply voltage.

SureStart is able to detect an interruption in power, when the interruption is 0.1 seconds or longer. When a power interrupt is detected, SureStart will shut down the compressor for 3 minutes. SureStart is also able to determine if the compressor is running backwards. If this condition is detected, SureStart will stop the compressor for 3 minutes before a restart is attempted. A power interrupt that is shorter duration than 0.1 seconds may result in a compressor running backwards, which the SureStart can detect and stop compressor operation.

If the run capacitor is faulty or has failed, SureStart will shutdown the compressor for 3 minutes before attempting a restart.

Led Flash Codes

A Red LED indicator will flash under the following conditions.

Note: LED fault indicator is turned off in normal running mode.)

- Rapid Flash (10/sec) : Low Voltage
- Triple Flash Every Three Seconds (3 / 3 secs): Lockout on Three Failed Starts
- Slow Flash (1 / 3 secs): Lockout on Over Current
- Slow Steady Flash (1/sec): Cycle Delay / Fault Mode

Flash Code (Rapid Flash (10/sec) : Low Voltage)

- Displayed for "Low supply voltage" before or after a softstart.
- If Low voltage is detected before a start, a re-start is attempted after 50 seconds.
- If Low voltage is detected after a start, a re-start is attempted after 3 minutes.

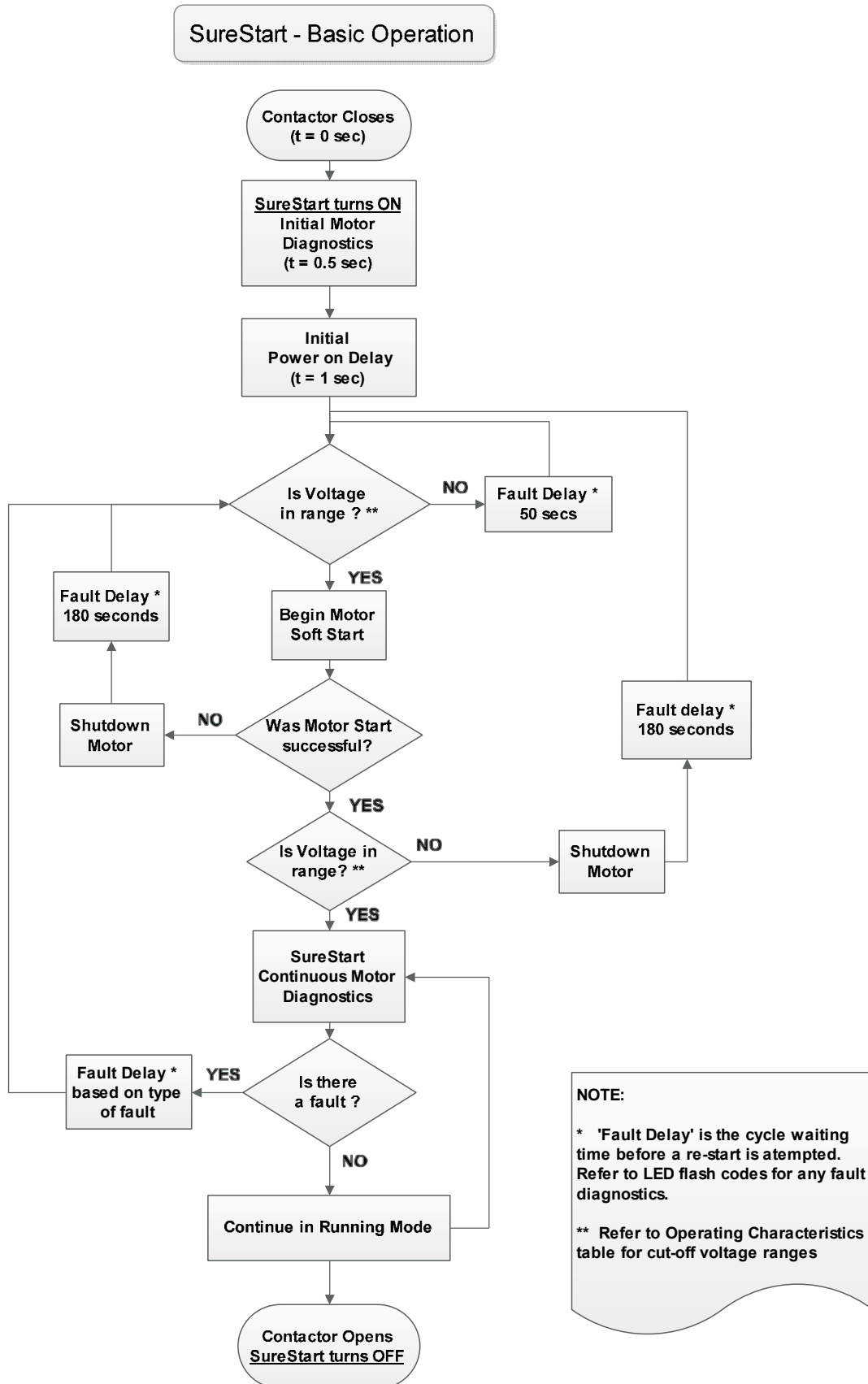
Flash Code (Triple Flash every three seconds (3/3 secs): Lockout on Three Failed Starts)

- Displayed after failure to start on "Three consecutive start attempts".
- Re-start is attempted after 50 minutes.
- Standard lockout period is revised to 3 minutes after a successful start.

In circumstances where the compressor may have seized or is unable to startup due to failure of other components in the HVAC system, the software will check for three consecutive failed starts. On the third sequential failed start, the program goes into Lockout for 50 mins. On failing to get a good start even after 50 mins, it will re-attempt start again after duration of 50 mins. Once a good start is eventually achieved, it will reset the hardstart counter and will require 3 failed starts again to force it back into Lockout mode. Lockout can be cleared anytime through a power reset of the SureStart device.

Section 9: Soft Start Controls and Compressor Defender

SureStart Basic Operation Chart

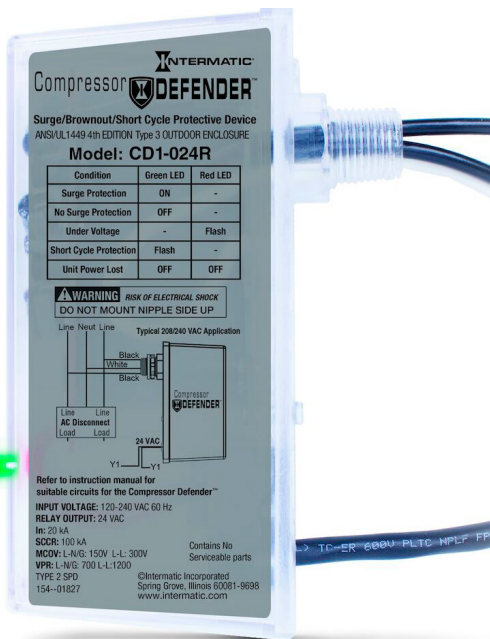


Section 9: Soft Start Controls and Compressor Defender Compressor Defender

To ensure electrical components of units with a factory or field installed soft start (factory or field installed) will not be subjected to poor power quality issues, a field-installed surge protection device is required. In the event a Soft Start fails and a surge protection device has not been installed, the application will be considered an improper installation, and therefore the Soft Start will be excluded from the limited warranty. See unit warranty certificate for further details.

Enertech Global recommended surge protector.

The Compressor Defender™ from Intermatic protects compressors and electrical components inside the unit. It is designed to protect from under/over voltage conditions, surge events and system short cycling caused from AC power interruptions. The Compressor Defender self-resets and includes a 3-minute time delay built into its design. It also features LED diagnostic indicators for operational analysis. It can be mounted on the heat pump or nearby. Intermatic includes a limited three-year product warranty and a \$7,500.00 connected equipment warranty for its Compressor Defender. This is administered through Intermatic Inc. and not through Enertech Global. Details are included with the packaging.



The Compressor Defender™ from Intermatic or comparable surge protection device is required to be purchased through Enertech. When using a 3rd party surge protection device, it is the responsibility of the customer to ensure that this device is of comparable protection to the Compressor Defender™. Additional documentation may be required to show proof that protection device was installed if not purchased through Enertech on the equipment invoice.

Section 10: Equipment Start-Up

Equipment Start-Up Checklist

⚠ CAUTION ⚠
DO NOT START-UP THE UNIT UNTIL THE NEW
STRUCTURE IS READY TO BE OCCUPIED

⚠ CAUTION ⚠
CHECK THE FOLLOWING BEFORE POWER IS APPLIED TO
THE EQUIPMENT

Electrical:

- High voltage wiring and breakers are properly sized and installed.
- Auxiliary electric heaters are wired and installed correctly.
- Circulator pumps are wired properly and connected to the proper terminal block.
- Low voltage wiring is correct and completely installed.
- Source voltage is correct and matches dataplate.
- HWG pump is not wired or is switched off until all piping is correct and air is purged from the system.
- Lockout board jumpers are properly selected for installation, i.e., A-FRZ jumper removed for closed loop.

Plumbing:

- Piping is completed, properly sized and purged of all air and debris, loop, HWG and load side.
- Pumps are properly sized and purged of all air.
- Correct amount of antifreeze has been added.
- All valves are open including flow center.
- Condensate is trapped and properly piped to drain.

Mechanical:

- Filter is installed and clean.
- Packaging and shipping brackets are removed from the blower assembly.
- Blower turns freely.
- Canvas connections installed on supply plenum & return drop.
- Replace all service panels and screws.

Equipment Start-Up:

1. Energize geothermal unit with high voltage.
2. Make sure secondary/low voltage is between 20V and 29V. Check the transformer's primary connections at the main contactor for the correct voltage (Orange & Black = 230V; Red & Black = 208V). Correct any possible voltage drops in the main voltage.
3. 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).
4. 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. 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-toair). 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.
10. Connect HWG wires or turn switch (if equipped) to on position.

Section 10: Equipment Start-Up

Equipment Start-Up Form

Customer Name: _____

Customer Address: _____

Model #: _____ Serial #: _____

Dealer Name: _____

Distributor Name: _____ Start-up Date: _____

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

Source Water Temp. Difference	Cooling		Heating	
Source Water Temperature In		°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	

Installer/Technician: _____ Date: _____

Section 10: Equipment Start-Up

WT036 - Heat of Extraction (HE) Table

Model	Mode	Source Flow		Heat of Extraction (MBtuh) at Various Entering Load Temperatures (°F)														
				70	80	90	100	110	70	80	90	100	110	70	80	90	100	110
WT036	Full Load Heating	EST (°F)	Source GPM	Load Flow GPM 4.5					Load Flow GPM 7					Load Flow GPM 12				
				4.5	23.0	22.2	21.1	19.9	18.7	23.2	22.4	21.3	20.1	18.9	22.6	21.5	20.2	19.1
		25	7	24.5	23.7	22.5	21.2	20.0	24.7	23.9	22.7	21.4	20.2	ONR	24.1	22.9	21.6	20.4
			12	26.3	25.3	24.1	22.7	21.4	26.5	25.6	24.4	23.0	21.6	25.8	24.6	23.2	21.8	
			4.5	25.0	24.1	23.0	21.6	20.4	25.2	24.3	23.2	21.9	20.6	25.4	24.5	23.4	22.0	20.8
		30	7	26.7	25.7	24.5	23.1	21.8	26.9	26.0	24.7	23.3	22.0	27.1	26.2	24.9	23.5	22.1
			12	28.6	27.6	26.3	24.8	23.3	28.9	27.8	26.5	25.0	23.5	29.1	28.1	26.7	25.2	23.7
			4.5	35.5	34.3	32.6	30.8	29.0	35.9	34.6	33.0	31.1	29.3	36.2	34.9	33.2	31.3	29.5
		50	7	37.9	36.6	34.8	32.8	30.9	38.3	36.9	35.2	33.2	31.2	38.6	37.2	35.5	33.4	31.5
			12	40.6	39.2	37.3	35.2	33.1	41.0	39.6	37.7	35.5	33.5	41.4	39.9	38.0	35.8	33.7
			4.5	46.9	45.3	43.1	40.7	38.3	47.4	45.7	43.5	41.0	38.7	47.8	46.1	43.9	41.4	39.0
		70	7	50.1	48.3	46.0	43.4	40.9	50.6	48.8	46.5	43.8	41.3	51.0	49.2	46.9	44.2	41.6
			12	53.7	51.8	49.3	46.5	43.8	54.2	52.3	49.8	46.9	44.2	54.6	52.7	50.2	47.3	44.6
			EST (°F)	Source GPM	Load Flow GPM 3					Load Flow GPM 5					Load Flow GPM 6			
		25	3	14.3	13.7	13.0	12.1	11.1	14.6	13.9	13.2	12.3	11.3	ONR	14.1	13.3	12.5	11.4
			5	15.2	14.5	13.8	12.9	11.8	15.5	14.8	14.0	13.1	12.0	14.9	14.2	13.2	12.1	
			6	15.7	15.0	14.2	13.3	12.1	16.0	15.3	14.5	13.5	12.4	15.4	14.6	13.6	12.5	
		30	3	16.4	15.6	14.8	13.8	12.7	16.7	15.9	15.1	14.1	12.9	16.9	16.1	15.2	14.2	13.0
5	17.4		16.6	15.7	14.7	13.4	17.7	16.9	16.0	15.0	13.7	17.9	17.1	16.2	15.1	13.8		
6	18.0		17.1	16.2	15.2	13.9	18.3	17.4	16.5	15.4	14.1	18.5	17.6	16.7	15.6	14.3		
50	3	25.5	24.3	23.1	21.5	19.7	26.0	24.8	23.5	21.9	20.0	26.2	25.0	23.7	22.1	20.3		
	5	27.1	25.8	24.5	22.9	20.9	27.6	26.3	24.9	23.3	21.3	27.9	26.6	25.2	23.5	21.5		
	6	28.0	26.7	25.3	23.6	21.6	28.5	27.1	25.7	24.0	22.0	28.8	27.4	26.0	24.3	22.2		
70	3	34.3	32.7	31.0	29.0	26.5	34.9	33.3	31.6	29.5	27.0	35.3	33.6	31.9	29.8	27.2		
	5	36.4	34.8	33.0	30.8	28.1	37.1	35.4	33.5	31.3	28.6	37.5	35.7	33.9	31.6	28.9		
	6	37.6	35.9	34.0	31.7	29.0	38.3	36.5	34.6	32.3	29.5	38.7	36.9	35.0	32.6	29.8		

1. It is recommended to avoid extended operation in the shaded areas. ONR=Operation Not Recommended.
2. Capacity data is based on 15% (by mass) methanol antifreeze solution (multiplier: 485) on the source side and pure water (multiplier: 500) on the load side.
3. Performance data accurate within ±15%.
4. Unit performance test is run without hot water generation.
5. Performance data is based upon the lower voltage of dual voltage rated units.
6. Interpolation of unit performance data is permissible; extrapolation is not.
7. Due to variations in installation, actual unit performance may vary from the tabulated data.

WT036 - Heat of Rejection (HR) Table

Model	Mode	Source Flow		Heat of Rejection (MBtuh) at Various Entering Load Temperatures (°F)														
				45	55	65	75	85	45	55	65	75	85	45	55	65	75	85
WT036	Full Load Cooling	EST (°F)	Source GPM	Load Flow GPM 4.5					Load Flow GPM 7					Load Flow GPM 12				
				4.5	42.3	47.8	53.5	57.2	59.7	44.5	50.3	56.2	60.1	62.8	ONR	54.3	60.7	64.9
		40	7	41.8	47.3	52.9	56.5	59.1	44.0	49.8	55.6	59.5	62.1	ONR	53.7	60.0	64.2	67.1
			12	41.7	47.2	52.7	56.3	58.9	43.8	49.6	55.4	59.3	61.9	53.5	59.8	64.0	66.8	
			4.5	42.2	47.8	53.4	57.1	59.6	44.4	50.3	56.2	60.1	62.7	47.9	54.2	60.6	64.8	67.7
		50	7	41.7	47.2	52.8	56.4	59.0	43.9	49.7	55.5	59.4	62.0	47.4	53.6	59.9	64.1	67.0
			12	41.6	47.1	52.6	56.3	58.8	43.8	49.5	55.4	59.2	61.8	47.2	53.5	59.7	63.9	66.7
			4.5	41.3	46.7	52.2	55.9	58.3	43.5	49.2	55.0	58.8	61.4	46.9	53.1	59.3	63.4	66.3
		70	7	40.8	46.2	51.7	55.2	57.7	43.0	48.6	54.4	58.1	60.7	46.4	52.5	58.7	62.7	65.5
			12	40.7	46.1	51.5	55.1	57.5	42.8	48.5	54.2	57.9	60.5	46.2	52.3	58.5	62.5	65.3
			4.5	40.6	45.9	51.3	54.9	57.3	42.7	48.3	54.0	57.7	60.3	46.1	52.1	58.3	62.3	65.1
		90	7	40.1	45.4	50.7	54.3	56.7	42.2	47.8	53.4	57.1	59.6	45.6	51.6	57.6	61.6	64.4
			12	40.0	45.3	50.6	54.1	56.5	42.1	47.6	53.2	56.9	59.4	45.4	51.4	57.4	61.4	64.2
			EST (°F)	Source GPM	Load Flow GPM 3					Load Flow GPM 5					Load Flow GPM 6			
		40	3	30.1	34.0	38.8	43.3	46.5	31.8	36.0	41.0	45.8	49.1	ONR	37.0	42.2	47.1	50.6
			5	30.1	34.0	38.7	43.3	46.5	31.8	36.0	40.9	45.7	49.1	ONR	37.0	42.1	47.1	50.6
			6	30.1	34.0	38.7	43.3	46.5	31.8	35.9	40.9	45.7	49.1	ONR	37.0	42.1	47.1	50.5
		50	3	30.0	34.0	38.7	43.2	46.4	31.7	35.9	40.9	45.7	49.0	32.7	37.0	42.1	47.0	50.5
5	30.0		34.0	38.7	43.2	46.4	31.7	35.9	40.9	45.7	49.0	32.6	36.9	42.1	47.0	50.5		
6	30.0		33.9	38.6	43.2	46.4	31.7	35.9	40.8	45.6	49.0	32.6	36.9	42.0	47.0	50.4		
70	3	29.5	33.4	38.0	42.5	45.6	31.2	35.3	40.2	44.9	48.2	32.1	36.3	41.3	46.2	49.6		
	5	29.5	33.4	38.0	42.4	45.6	31.2	35.3	40.1	44.9	48.2	32.1	36.3	41.3	46.2	49.6		
	6	29.5	33.4	38.0	42.4	45.6	31.2	35.3	40.1	44.9	48.2	32.1	36.3	41.3	46.2	49.6		
90	3	28.7	32.5	37.0	41.4	44.4	30.4	34.4	39.1	43.7	47.0	31.3	35.4	40.3	45.0	48.3		
	5	28.7	32.5	37.0	41.4	44.4	30.4	34.4	39.1	43.7	46.9	31.3	35.4	40.3	45.0	48.3		
	6	28.7	32.5	37.0	41.3	44.4	30.4	34.4	39.1	43.7	46.9	31.2	35.4	40.2	45.0	48.3		

1. It is recommended to avoid extended operation in the shaded areas. ONR=Operation Not Recommended.
2. Capacity data is based on 15% (by mass) methanol antifreeze solution (multiplier: 485) on the source side and pure water (multiplier: 500) on the load side.
3. Performance data accurate within ±15%.
4. Unit performance test is run without hot water generation.
5. Performance data is based upon the lower voltage of dual voltage rated units.
6. Interpolation of unit performance data is permissible; extrapolation is not.
7. Due to variations in installation, actual unit performance may vary from the tabulated data.

Section 10: Equipment Start-Up

WT036 - WPD Table - Load

Model	Load GPM	Load Water Pressure Drop at Various Entering Load Temperatures (°F)									
		60		70		80		90		110	
		PSI	FT HD	PSI	FT HD	PSI	FT HD	PSI	FT HD	PSI	FT HD
WT036 Part Load Heating	3	0.1	0.2	0.1	0.2	0.1	0.2	0.1	0.2	0.1	0.2
	5	0.6	1.3	0.6	1.3	0.6	1.3	0.6	1.3	0.5	1.2
	6	0.8	1.9	0.8	1.9	0.8	1.8	0.8	1.9	0.8	1.8
	7	1.1	2.4	1.1	2.4	1.0	2.4	1.1	2.5	1.0	2.3
WT036 Full Load Heating	4.5	0.4	0.8	0.4	0.9	0.4	0.9	0.4	0.9	0.4	0.8
	7	1.1	2.5	1.1	2.5	1.1	2.5	1.1	2.5	1.1	2.5
	9	1.7	4.0	1.7	4.0	1.7	4.0	1.7	4.0	1.7	3.9
	12	2.9	6.7	2.9	6.7	2.9	6.8	2.9	6.8	2.9	6.6
Model	Load GPM	Load Water Pressure Drop at Various Entering Load Temperatures (°F)									
		45		55		65		75		85	
		PSI	FT HD	PSI	FT HD	PSI	FT HD	PSI	FT HD	PSI	FT HD
WT036 Part Load Cooling	3	0.1	0.3	0.2	0.4	0.2	0.4	0.2	0.6	0.4	0.8
	5	0.8	1.8	0.9	2.0	1.1	2.5	1.4	3.2	2.0	4.7
	6	1.1	2.5	1.2	2.9	1.5	3.5	1.9	4.5	2.9	6.6
	7	1.4	3.3	1.6	3.8	2.0	4.6	2.5	5.9	3.8	8.7
WT036 Full Load Cooling	4.5	0.3	0.7	0.4	0.8	0.4	0.9	0.5	1.1	0.7	1.6
	7	1.4	3.1	1.5	3.5	1.7	4.0	2.1	4.8	2.9	6.6
	9	2.2	5.1	2.5	5.7	2.9	6.6	3.4	7.9	4.7	10.9
	12	3.8	8.7	4.1	9.5	4.8	11.1	5.8	13.3	8.0	18.4

1. Load WPD data are based on pure water WPD at 50 °F EST in heating mode and 90 °F EST in cooling mode.
2. Pressure drop data accurate within ±25%.
3. Interpolation of unit pressure drop data is permissible; extrapolation is not.

WT036 - WPD Table - Source

Model	Source GPM	Source Brine Pressure Drop at Various Entering Source Temperatures °F									
		30		40		50		70		90	
		PSI	FT HD	PSI	FT HD	PSI	FT HD	PSI	FT HD	PSI	FT HD
WT036 Part Load Heating	3	0.9	2.0	0.8	1.9	0.8	1.8	0.7	1.6	0.6	1.5
	5	1.6	3.7	1.5	3.5	1.4	3.3	1.3	2.9	1.2	2.7
	6	2.0	4.6	1.9	4.3	1.8	4.1	1.6	3.6	1.4	3.3
	7	2.4	5.5	2.2	5.1	2.1	4.9	1.9	4.3	1.7	4.0
WT036 Full Load Heating	4.5	1.4	3.1	1.3	3.0	1.2	2.8	1.1	2.5	1.0	2.3
	7	2.5	5.7	2.3	5.3	2.2	5.0	2.0	4.5	1.8	4.2
	9	3.4	7.9	3.2	7.4	3.0	7.0	2.7	6.3	2.5	5.9
	12	5.3	12.2	5.0	11.4	4.7	10.8	4.2	9.7	3.9	9.0
WT036 Part Load Cooling	3	1.2	2.7	1.1	2.6	1.1	2.4	0.9	2.2	0.9	2.0
	5	1.7	3.9	1.6	3.8	1.5	3.5	1.4	3.2	1.3	3.0
	6	1.9	4.5	1.9	4.3	1.8	4.1	1.6	3.6	1.5	3.4
	7	2.2	5.2	2.2	5.0	2.0	4.7	1.8	4.2	1.7	3.9
WT036 Full Load Cooling	4.5	1.4	3.2	1.3	3.0	1.3	2.9	1.1	2.6	1.1	2.4
	7	2.3	5.3	2.2	5.1	2.1	4.9	1.9	4.3	1.8	4.1
	9	3.1	7.2	3.0	7.0	2.9	6.7	2.6	6.0	2.4	5.6
	12	4.9	11.3	4.7	10.9	4.5	10.5	4.0	9.3	3.8	8.7

1. Source WPD data are based on 15% (by mass) methanol solution while the unit is operating.
2. Pressure drop data accurate within ±25%.
3. Interpolation of unit pressure drop data is permissible; extrapolation is not.

Section 10: Equipment Start-Up

WT048 - Heat of Extraction (HE) Table

Model	Mode	Source Flow		Heat of Extraction (MBtuh) at Various Entering Load Temperatures (°F)														
				70	80	90	100	110	70	80	90	100	110	70	80	90	100	110
WT048	Full Load Heating	EST (°F)	Source GPM	Load Flow GPM 6					Load Flow GPM 9					Load Flow GPM 12				
				6	31.3	30.7	29.5	28.0	26.5	31.3	30.7	29.5	28.0	26.5	31.3	30.6	29.5	28.0
		25	9	32.6	32.0	30.7	29.2	27.6	32.6	32.0	30.7	29.2	27.6	ONR	31.9	30.7	29.2	27.6
			12	33.9	33.3	32.0	30.4	28.7	33.9	33.2	32.0	30.4	28.7	ONR	33.2	31.9	30.3	28.7
			6	34.1	33.5	32.2	30.5	28.9	34.1	33.5	32.2	30.5	28.9	34.1	33.4	32.1	30.5	28.9
		30	9	35.6	34.9	33.5	31.8	30.1	35.6	34.9	33.5	31.8	30.1	35.5	34.8	33.5	31.8	30.1
			12	37.0	36.3	34.9	33.1	31.3	37.0	36.3	34.9	33.1	31.3	37.0	36.2	34.8	33.1	31.3
			6	47.9	46.9	45.1	42.9	40.5	47.9	46.9	45.1	42.9	40.5	47.8	46.9	45.1	42.8	40.5
		50	9	49.9	48.9	47.0	44.7	42.2	49.9	48.9	47.0	44.7	42.2	49.9	48.9	47.0	44.6	42.2
			12	51.9	50.9	48.9	46.5	43.9	51.9	50.9	48.9	46.4	43.9	51.9	50.8	48.9	46.4	43.9
			6	64.6	63.3	60.8	57.8	54.6	64.6	63.3	60.8	57.8	54.6	64.5	63.2	60.8	57.7	54.6
		70	9	67.3	66.0	63.4	60.2	56.9	67.3	66.0	63.4	60.2	56.9	67.2	65.9	63.4	60.2	56.9
			12	70.0	68.6	65.9	62.6	59.2	70.0	68.6	65.9	62.6	59.2	69.9	68.5	65.9	62.6	59.2
			6	51.8	50.2	47.7	44.6	41.1	51.8	50.2	47.7	44.6	41.1	51.4	49.8	47.3	44.2	40.7

1. It is recommended to avoid extended operation in the shaded areas. ONR=Operation Not Recommended.
2. Capacity data is based on 15% (by mass) methanol antifreeze solution (multiplier: 485) on the source side and pure water (multiplier: 500) on the load side.
3. Performance data accurate within ±15%.
4. Unit performance test is run without hot water generation.
5. Performance data is based upon the lower voltage of dual voltage rated units.
6. Interpolation of unit performance data is permissible; extrapolation is not.
7. Due to variations in installation, actual unit performance may vary from the tabulated data.

WT048 - Heat of Rejection (HR) Table

Model	Mode	Source Flow		Heat of Rejection (MBtuh) at Various Entering Load Temperatures (°F)																
				45	55	65	75	85	45	55	65	75	85	45	55	65	75	85		
WT048	Full Load Cooling	EST (°F)	Source GPM	Load Flow GPM 6					Load Flow GPM 9					Load Flow GPM 12						
				6	55.0	62.7	71.2	79.3	81.7	57.7	65.8	74.7	83.2	85.7	ONR	68.8	78.1	86.9	89.6	
		40	9	55.0	62.7	71.2	79.3	81.7	57.7	65.8	74.7	83.2	85.7	ONR	68.8	78.1	86.9	89.6		
			12	55.0	62.7	71.2	79.3	81.7	57.7	65.8	74.7	83.2	85.7	ONR	68.8	78.1	86.9	89.6		
			6	54.7	62.4	70.8	78.8	81.3	57.4	65.5	74.3	82.7	85.3	60.0	68.5	77.7	86.5	89.2		
		50	9	54.7	62.4	70.8	78.8	81.3	57.4	65.5	74.3	82.7	85.3	60.0	68.5	77.7	86.5	89.2		
			12	54.7	62.4	70.9	78.9	81.3	57.4	65.5	74.3	82.7	85.3	60.0	68.5	77.7	86.5	89.2		
			6	53.3	60.7	68.9	76.7	79.1	55.9	63.7	72.3	80.5	83.0	58.4	66.6	75.6	84.2	86.8		
		70	9	53.3	60.7	68.9	76.7	79.1	55.9	63.7	72.3	80.5	83.0	58.4	66.6	75.6	84.2	86.8		
			12	53.3	60.7	68.9	76.7	79.1	55.9	63.7	72.3	80.5	83.0	58.4	66.6	75.6	84.2	86.8		
			6	50.9	58.0	65.8	73.3	75.5	53.4	60.9	69.1	76.9	79.3	55.8	63.6	72.2	80.4	82.9		
		90	9	50.9	58.0	65.8	73.3	75.5	53.4	60.9	69.1	76.9	79.3	55.8	63.6	72.2	80.4	82.9		
			12	50.9	58.0	65.8	73.3	75.5	53.4	60.9	69.1	76.9	79.3	55.8	63.6	72.2	80.4	82.9		
			6	40.2	46.2	52.8	59.5	65.8	41.0	47.1	53.8	60.6	67.1	ONR	49.0	55.9	63.0	69.7		
		WT048	Part Load Cooling	EST (°F)	Source GPM	Load Flow GPM 5					Load Flow GPM 6					Load Flow GPM 8				
						5	40.2	46.2	52.8	59.5	65.8	41.0	47.1	53.8	60.6	67.1	ONR	49.0	55.9	63.0
				40	6	40.2	46.2	52.8	59.5	65.8	41.0	47.1	53.8	60.6	67.1	ONR	49.0	56.0	63.1	69.8
					8	40.3	46.2	52.8	59.5	65.8	41.1	47.1	53.8	60.7	67.1	ONR	49.0	56.0	63.1	69.8
5	40.0				46.0	52.5	59.2	65.5	40.8	46.9	53.5	60.3	66.8	42.5	48.7	55.7	62.7	69.4		
50	6			40.1	46.0	52.5	59.2	65.5	40.8	46.9	53.6	60.4	66.8	42.5	48.7	55.7	62.8	69.4		
	8			40.1	46.0	52.5	59.2	65.5	40.9	46.9	53.6	60.4	66.8	42.5	48.8	55.7	62.8	69.5		
	5			38.7	44.4	50.8	57.2	63.3	39.5	45.3	51.8	58.4	64.6	41.1	47.1	53.8	60.7	67.1		
70	6			38.7	44.4	50.8	57.2	63.3	39.5	45.3	51.8	58.4	64.6	41.1	47.1	53.9	60.7	67.1		
	8			38.7	44.5	50.8	57.3	63.4	39.5	45.3	51.8	58.4	64.6	41.1	47.2	53.9	60.7	67.2		
	5			36.9	42.3	48.4	54.5	60.3	37.6	43.2	49.3	55.6	61.5	39.1	44.9	51.3	57.8	64.0		
90	6			36.9	42.3	48.4	54.5	60.3	37.6	43.2	49.3	55.6	61.5	39.1	44.9	51.3	57.8	64.0		
	8	36.9	42.4	48.4	54.6	60.4	37.6	43.2	49.4	55.6	61.5	39.1	44.9	51.3	57.8	64.0				
	6	36.9	42.4	48.4	54.6	60.4	37.6	43.2	49.4	55.6	61.5	39.1	44.9	51.3	57.8	64.0				

1. It is recommended to avoid extended operation in the shaded areas. ONR=Operation Not Recommended.
2. Capacity data is based on 15% (by mass) methanol antifreeze solution (multiplier: 485) on the source side and pure water (multiplier: 500) on the load side.
3. Performance data accurate within ±15%.
4. Unit performance test is run without hot water generation.
5. Performance data is based upon the lower voltage of dual voltage rated units.
6. Interpolation of unit performance data is permissible; extrapolation is not.
7. Due to variations in installation, actual unit performance may vary from the tabulated data.

Section 10: Equipment Start-Up

WT048 - WPD Table - Source

Source Brine Pressure Drop at Various Entering Source Temperatures °F											
Model	Source	30		40		50		70		90	
	GPM	PSI	FT HD	PSI	FT HD	PSI	FT HD	PSI	FT HD	PSI	FT HD
WT048 Part Load Heating	5	0.3	0.6	0.3	0.6	0.2	0.6	0.2	0.5	0.2	0.4
	6	0.8	1.7	0.7	1.6	0.7	1.5	0.5	1.3	0.5	1.2
	8	1.7	3.9	1.6	3.6	1.5	3.4	1.2	2.8	1.1	2.6
	10	2.7	6.1	2.5	5.8	2.3	5.4	1.9	4.5	1.8	4.1
WT048 Full Load Heating	6	0.6	1.3	0.5	1.2	0.5	1.1	0.4	1.0	0.4	0.9
	9	2.1	4.9	2.0	4.6	1.9	4.4	1.7	3.8	1.5	3.5
	12	3.7	8.6	3.5	8.1	3.3	7.7	2.9	6.7	2.7	6.1
	15	5.6	13.0	5.3	12.3	5.0	11.6	4.4	10.1	4.0	9.3
WT048 Part Load Cooling	5	0.3	0.6	0.2	0.6	0.2	0.5	0.2	0.5	0.2	0.4
	6	0.7	1.6	0.6	1.5	0.6	1.4	0.5	1.2	0.5	1.1
	8	1.6	3.6	1.4	3.3	1.3	3.0	1.2	2.7	1.1	2.5
	10	2.6	5.9	2.3	5.4	2.1	5.0	1.9	4.5	1.8	4.0
WT048 Full Load Cooling	6	0.6	1.4	0.6	1.3	0.5	1.2	0.5	1.1	0.4	0.9
	9	2.2	5.0	2.0	4.7	1.9	4.4	1.7	3.8	1.5	3.4
	12	3.8	8.7	3.5	8.1	3.3	7.7	2.9	6.7	2.5	5.9
	15	5.8	13.5	5.4	12.6	5.1	11.9	4.5	10.3	3.9	9.1

1. Source WPD data are based on 15% (by mass) methanol solution while the unit is operating.
2. Pressure drop data accurate within ±25%.
3. Interpolation of unit pressure drop data is permissible; extrapolation is not.

WT048 - WPD Table - Load

Load Water Pressure Drop at Various Entering Load Temperatures (°F)											
Model	Load	60		70		80		90		110	
	GPM	PSI	FT HD	PSI	FT HD	PSI	FT HD	PSI	FT HD	PSI	FT HD
WT048 Part Load Heating	5	1.3	3.0	1.2	2.7	1.1	2.6	1.1	2.6	1.0	2.4
	6	1.6	3.7	1.5	3.4	1.4	3.2	1.4	3.2	1.3	2.9
	8	2.2	5.0	2.0	4.6	1.9	4.4	1.9	4.4	1.7	4.0
	10	2.8	6.6	2.6	6.1	2.5	5.8	2.5	5.8	2.3	5.3
WT048 Full Load Heating	6	1.5	3.4	1.4	3.3	1.4	3.2	1.4	3.2	1.3	3.0
	9	2.4	5.5	2.3	5.4	2.3	5.3	2.3	5.3	2.1	4.9
	12	3.3	7.7	3.2	7.5	3.2	7.4	3.2	7.4	3.0	6.9
	15	4.6	10.5	4.4	10.2	4.4	10.0	4.4	10.0	4.1	9.4
Load Water Pressure Drop at Various Entering Load Temperatures (°F)											
Model	Load	45		55		65		75		85	
	GPM	PSI	FT HD	PSI	FT HD	PSI	FT HD	PSI	FT HD	PSI	FT HD
WT048 Part Load Cooling	5	1.2	2.8	1.2	2.8	1.2	2.8	1.1	2.6	0.9	2.0
	6	1.5	3.4	1.5	3.4	1.4	3.3	1.3	3.1	1.1	2.5
	8	1.9	4.4	1.9	4.4	1.9	4.3	1.7	4.0	1.4	3.2
	10	2.6	5.9	2.6	5.9	2.5	5.8	2.3	5.4	1.9	4.3
WT048 Full Load Cooling	6	1.1	2.6	1.1	2.6	1.1	2.6	1.1	2.4	0.9	2.1
	9	2.3	5.2	2.3	5.2	2.2	5.2	2.1	4.9	1.9	4.3
	12	3.4	7.8	3.4	7.8	3.4	7.8	3.2	7.4	2.8	6.4
	15	4.6	10.7	4.6	10.7	4.6	10.6	4.4	10.1	3.8	8.8

1. Load WPD data are based on pure water WPD at 50 °F EST in heating mode and 90 °F EST in cooling mode.
2. Pressure drop data accurate within ±25%.
3. Interpolation of unit pressure drop data is permissible; extrapolation is not.

Section 10: Equipment Start-Up

WT060 - Heat of Extraction (HE) Table

Model	Mode	Source Flow		Heat of Extraction (MBtuh) at Various Entering Load Temperatures (°F)														
				70	80	90	100	110	70	80	90	100	110	70	80	90	100	110
WT060	Full Load Heating	EST (°F)	Source GPM	Load Flow GPM 7.5					Load Flow GPM 12					Load Flow GPM 15				
				7.5	34.0	33.9	32.5	30.2	28.5	34.0	33.9	32.5	30.2	28.5	34.0	33.9	32.5	30.2
		25	12	36.0	35.9	34.4	31.9	30.2	36.0	36.0	34.5	32.0	30.2	ONR	36.0	34.5	32.0	30.2
			15	37.1	37.1	35.5	33.0	31.1	37.2	37.1	35.6	33.1	31.2		37.2	35.6	33.1	31.2
			7.5	37.7	37.6	36.1	33.5	31.6	37.8	37.7	36.1	33.6	31.7	37.8	37.7	36.2	33.6	31.7
		30	12	40.0	39.9	38.2	35.5	33.5	40.0	40.0	38.3	35.6	33.6	40.1	40.0	38.3	35.6	33.6
			15	41.3	41.2	39.5	36.7	34.6	41.4	41.3	39.5	36.7	34.7	41.4	41.3	39.6	36.8	34.7
			7.5	52.8	52.7	50.5	46.9	44.3	52.9	52.8	50.6	47.0	44.4	53.0	52.8	50.6	47.0	44.4
		50	12	56.0	55.8	53.5	49.7	46.9	56.1	55.9	53.6	49.8	47.0	56.1	56.0	53.6	49.8	47.0
			15	57.8	57.6	55.2	51.3	48.4	57.9	57.8	55.4	51.4	48.5	57.9	57.8	55.4	51.5	48.6
			7.5	70.5	70.3	67.4	62.6	59.1	70.6	70.4	67.5	62.7	59.2	70.7	70.5	67.6	62.8	59.2
		70	12	74.7	74.5	71.4	66.3	62.6	74.8	74.6	71.5	66.4	62.7	74.9	74.7	71.6	66.5	62.7
			15	77.1	76.9	73.7	68.5	64.6	77.3	77.1	73.9	68.6	64.8	77.3	77.1	73.9	68.7	64.8

1. It is recommended to avoid extended operation in the shaded areas. ONR=Operation Not Recommended.
2. Capacity data is based on 15% (by mass) methanol antifreeze solution (multiplier: 485) on the source side and pure water (multiplier: 500) on the load side.
3. Performance data accurate within ±15%.
4. Unit performance test is run without hot water generation.
5. Performance data is based upon the lower voltage of dual voltage rated units.
6. Interpolation of unit performance data is permissible; extrapolation is not.
7. Due to variations in installation, actual unit performance may vary from the tabulated data.

WT060 - Heat of Rejection (HR) Table

Model	Mode	Source Flow		Heat of Rejection (MBtuh) at Various Entering Load Temperatures (°F)														
				45	55	65	75	85	45	55	65	75	85	45	55	65	75	85
WT060	Full Load Cooling	EST (°F)	Source GPM	Load Flow GPM 7.5					Load Flow GPM 12					Load Flow GPM 15				
				7.5	61.8	71.0	81.6	91.9	96.9	65.4	75.1	86.2	97.1	102.4	ONR	77.6	89.1	100.3
		40	12	60.8	69.9	80.2	90.3	95.3	64.3	73.9	84.8	95.5	100.7		76.3	87.6	98.6	104.0
			15	60.0	68.9	79.2	89.1	94.0	63.4	72.9	83.7	94.2	99.4		75.3	86.4	97.3	102.6
			7.5	61.5	70.7	81.2	91.4	96.4	65.1	74.7	85.8	96.6	101.9	67.2	77.2	88.6	99.8	105.2
		50	12	60.5	69.5	79.9	89.9	94.8	64.0	73.5	84.4	95.0	100.2	66.1	75.9	87.2	98.2	103.5
			15	59.7	68.6	78.8	88.7	93.6	63.1	72.5	83.3	93.8	98.9	65.2	74.9	86.0	96.9	102.1
			7.5	60.0	68.9	79.2	89.1	94.0	63.4	72.9	83.7	94.2	99.4	65.5	75.3	86.4	97.3	102.6
		70	12	59.0	67.8	77.9	87.7	92.5	62.4	71.7	82.3	92.7	97.7	64.4	74.0	85.0	95.7	101.0
			15	58.2	66.9	76.8	86.5	91.2	61.6	70.7	81.2	91.5	96.4	63.6	73.1	83.9	94.5	99.6
			7.5	58.3	66.9	76.9	86.5	91.3	61.6	70.8	81.2	91.5	96.5	63.6	73.1	83.9	94.5	99.6
		90	12	57.3	65.8	75.6	85.1	89.8	60.6	69.6	79.9	90.0	94.9	62.6	71.9	82.5	92.9	98.0
			15	56.5	65.0	74.6	84.0	88.6	59.8	68.7	78.9	88.8	93.6	61.7	70.9	81.4	91.7	96.7

1. It is recommended to avoid extended operation in the shaded areas. ONR=Operation Not Recommended.
2. Capacity data is based on 15% (by mass) methanol antifreeze solution (multiplier: 485) on the source side and pure water (multiplier: 500) on the load side.
3. Performance data accurate within ±15%.
4. Unit performance test is run without hot water generation.
5. Performance data is based upon the lower voltage of dual voltage rated units.
6. Interpolation of unit performance data is permissible; extrapolation is not.
7. Due to variations in installation, actual unit performance may vary from the tabulated data.

Section 10: Equipment Start-Up

WT060 - WPD Table - Source

Model	Source GPM	Source Brine Pressure Drop at Various Entering Source Temperatures °F									
		30		40		50		70		90	
		PSI	FT HD	PSI	FT HD	PSI	FT HD	PSI	FT HD	PSI	FT HD
WT060 Part Load Heating	5	1.1	2.5	1.0	2.3	0.9	2.1	0.8	1.8	0.7	1.6
	8	2.3	5.2	2.1	4.8	1.9	4.4	1.7	3.8	1.4	3.3
	10	3.0	6.9	2.8	6.4	2.6	5.9	2.2	5.1	1.9	4.4
	12	3.9	9.0	3.6	8.3	3.3	7.6	2.9	6.6	2.5	5.7
WT060 Full Load Heating	7.5	1.7	4.0	1.6	3.8	1.5	3.5	1.4	3.3	1.3	2.9
	12	3.7	8.5	3.5	8.0	3.2	7.3	3.0	6.9	2.7	6.1
	15	5.1	11.8	4.8	11.1	4.4	10.1	4.2	9.6	3.7	8.5
	17	6.2	14.2	5.8	13.5	5.3	12.3	5.0	11.6	4.4	10.2
WT060 Part Load Cooling	5	1.7	3.9	1.6	3.8	1.5	3.5	1.4	3.2	1.3	3.0
	8	2.7	6.1	2.6	5.9	2.4	5.6	2.2	5.0	2.0	4.7
	10	3.8	8.7	3.6	8.4	3.4	7.9	3.0	7.0	2.9	6.6
	12	5.0	11.5	4.8	11.1	4.5	10.4	4.0	9.3	3.8	8.7
WT060 Full Load Cooling	7.5	1.5	3.5	1.4	3.3	1.3	3.0	1.2	2.7	1.1	2.4
	12	3.3	7.5	3.0	7.0	2.8	6.5	2.5	5.8	2.3	5.2
	15	4.6	10.6	4.3	9.8	4.0	9.2	3.5	8.1	3.2	7.3
	17	5.6	12.9	5.2	12.1	4.9	11.2	4.3	10.0	3.9	9.0

1. Source WPD data are based on 15% (by mass) methanol solution while the unit is operating.
2. Pressure drop data accurate within ±25%.
3. Interpolation of unit pressure drop data is permissible; extrapolation is not.

WT060 - WPD Table - Load

Model	Load GPM	Load Water Pressure Drop at Various Entering Load Temperatures (°F)									
		60		70		80		90		110	
		PSI	FT HD	PSI	FT HD	PSI	FT HD	PSI	FT HD	PSI	FT HD
WT060 Part Load Heating	5	0.9	2.1	0.8	1.8	0.7	1.7	0.7	1.7	0.6	1.4
	8	1.9	4.4	1.7	3.8	1.5	3.5	1.5	3.5	1.3	3.0
	10	2.5	5.9	2.2	5.2	2.1	4.8	2.1	4.8	1.8	4.0
	12	3.2	7.4	2.8	6.5	2.6	6.0	2.6	6.0	2.2	5.1
WT060 Full Load Heating	7.5	1.9	4.3	1.7	3.8	1.5	3.4	1.4	3.3	1.4	3.2
	12	3.0	6.9	2.6	6.1	2.4	5.5	2.3	5.2	2.2	5.1
	15	4.0	9.2	3.5	8.2	3.2	7.4	3.0	7.0	3.0	6.9
	17	4.9	11.4	4.4	10.1	3.9	9.1	3.8	8.7	3.7	8.5
Model	Load GPM	Load Water Pressure Drop at Various Entering Load Temperatures (°F)									
		45		55		65		75		85	
		PSI	FT HD	PSI	FT HD	PSI	FT HD	PSI	FT HD	PSI	FT HD
WT060 Part Load Cooling	5	0.8	1.8	0.9	2.0	1.1	2.5	1.4	3.2	2.0	4.7
	8	1.8	4.2	2.1	4.8	2.6	5.9	3.2	7.5	4.8	11.1
	10	2.7	6.3	3.2	7.3	3.9	8.9	4.9	11.3	7.2	16.7
	12	3.7	8.6	4.3	9.9	5.3	12.2	6.7	15.4	9.9	22.7
WT060 Full Load Cooling	7.5	1.5	3.5	1.4	3.3	1.4	3.2	1.4	3.2	1.4	3.1
	12	2.9	6.6	2.7	6.3	2.7	6.2	2.6	6.1	2.6	5.9
	15	3.8	8.7	3.6	8.4	3.5	8.2	3.5	8.1	3.4	7.9
	17	4.6	10.7	4.4	10.2	4.3	10.0	4.3	9.8	4.2	9.6

1. Load WPD data are based on pure water WPD at 50 °F EST in heating mode and 90 °F EST in cooling mode.
2. Pressure drop data accurate within ±25%.
3. Interpolation of unit pressure drop data is permissible; extrapolation is not.

Section 11: Troubleshooting

WT036 - Operating Parameter Tables - Heating

WT036 Full Load Heating-No Desuperheater Operation								
EST	Source Flow	ELT @ 3 Load GPM/Ton	Discharge	Suction	Subcooling	Superheat	Source Brine Temp Drop	Load Water Temp Rise
°F	GPM/Ton	°F	PSIG	PSIG	°F	°F	°F	°F
30	3	70	227 - 313	63 - 84	14 - 19	10 - 14	5 - 9	7 - 11
		80	262 - 353	65 - 86	11 - 16	9 - 13	5 - 9	7 - 11
		90	301 - 395	67 - 88	10 - 15	9 - 13	5 - 9	7 - 11
		100	344 - 443	69 - 90	9 - 14	9 - 13	5 - 9	7 - 11
		110	393 - 497	70 - 91	9 - 14	8 - 12	4 - 8	7 - 11
40	3	70	231 - 318	77 - 98	14 - 19	11 - 15	7 - 11	9 - 13
		80	267 - 358	79 - 101	11 - 16	10 - 14	6 - 10	9 - 13
		90	306 - 401	82 - 103	10 - 15	10 - 14	6 - 10	8 - 12
		100	350 - 450	84 - 105	9 - 14	9 - 13	6 - 10	8 - 12
		110	400 - 505	86 - 107	8 - 13	9 - 13	5 - 9	8 - 12
50	3	70	234 - 322	92 - 113	13 - 18	11 - 15	8 - 12	10 - 14
		80	271 - 363	95 - 116	10 - 15	10 - 14	8 - 12	10 - 14
		90	311 - 406	98 - 119	9 - 14	10 - 14	7 - 11	10 - 14
		100	355 - 456	100 - 122	8 - 13	10 - 14	7 - 11	10 - 14
		110	406 - 512	102 - 124	8 - 13	9 - 13	7 - 11	9 - 13
70	3	70	243 - 332	125 - 147	11 - 16	12 - 16	11 - 15	13 - 17
		80	281 - 374	129 - 150	9 - 14	11 - 15	11 - 15	13 - 17
		90	322 - 418	132 - 154	7 - 12	11 - 15	10 - 14	12 - 16
		100	368 - 469	135 - 157	7 - 12	10 - 14	10 - 14	12 - 16
		110	420 - 527	138 - 160	6 - 11	10 - 14	9 - 13	12 - 16

WT036 Part Load Heating-No Desuperheater Operation								
EST	Source Flow	ELT @ 3 Load GPM/Ton	Discharge	Suction	Subcooling	Superheat	Source Brine Temp Drop	Load Water Temp Rise
°F	GPM/Ton	°F	PSIG	PSIG	°F	°F	°F	°F
30	3	70	216 - 297	68 - 88	12 - 17	11 - 15	4 - 8	6 - 10
		80	251 - 335	70 - 91	9 - 14	10 - 14	4 - 8	6 - 10
		90	288 - 376	72 - 92	8 - 13	9 - 13	4 - 8	6 - 10
		100	330 - 421	73 - 94	7 - 12	9 - 13	3 - 7	6 - 10
		110	377 - 472	75 - 96	7 - 12	9 - 13	3 - 7	6 - 10
40	3	70	220 - 302	83 - 104	12 - 17	10 - 14	6 - 10	7 - 11
		80	256 - 341	86 - 106	9 - 14	9 - 13	5 - 9	7 - 11
		90	294 - 382	88 - 108	7 - 12	8 - 12	5 - 9	7 - 11
		100	336 - 428	89 - 110	7 - 12	8 - 12	5 - 9	7 - 11
		110	384 - 480	92 - 113	7 - 12	8 - 12	4 - 8	7 - 11
50	3	70	225 - 307	99 - 120	10 - 15	9 - 13	7 - 11	9 - 13
		80	262 - 347	102 - 124	8 - 13	8 - 12	7 - 11	9 - 13
		90	300 - 389	105 - 126	6 - 11	8 - 12	6 - 10	8 - 12
		100	343 - 436	107 - 128	6 - 11	8 - 12	6 - 10	8 - 12
		110	392 - 488	110 - 131	6 - 11	8 - 12	5 - 9	8 - 12
70	3	70	234 - 317	135 - 156	6 - 11	10 - 14	10 - 14	11 - 15
		80	272 - 358	139 - 160	4 - 9	9 - 13	10 - 14	11 - 15
		90	312 - 402	142 - 164	4 - 9	9 - 13	9 - 13	11 - 15
		100	357 - 450	145 - 167	3 - 8	8 - 12	8 - 12	11 - 15
		110	407 - 505	148 - 170	3 - 8	8 - 12	8 - 12	10 - 14

Section 11: Troubleshooting

WT036 - Operating Parameter Tables - Cooling

WT036 Full Load Cooling-No Desuperheater Operation								
EST	Source Flow	ELT @ 3 Load GPM/Ton	Discharge	Suction	Subcooling	Superheat	Source Brine Temp Rise	Load Water Temp Drop
°F	GPM/Ton	°F	PSIG	PSIG	°F	°F	°F	°F
50	3	45	164 - 221	77 - 88	14 - 19	15 - 19	9 - 13	8 - 12
		55	169 - 225	91 - 101	14 - 19	15 - 19	11 - 15	9 - 13
		65	171 - 228	103 - 112	15 - 20	17 - 21	12 - 16	11 - 15
		75	172 - 229	112 - 120	15 - 20	23 - 27	13 - 17	12 - 16
		85	171 - 228	117 - 124	15 - 20	31 - 35	14 - 18	12 - 16
70	3	45	230 - 286	81 - 92	13 - 18	13 - 17	9 - 13	7 - 11
		55	236 - 292	96 - 105	14 - 19	14 - 18	11 - 15	9 - 13
		65	240 - 295	109 - 117	14 - 19	16 - 20	12 - 16	10 - 14
		75	241 - 296	118 - 125	14 - 19	21 - 25	13 - 17	11 - 15
90	3	45	313 - 367	85 - 95	13 - 18	13 - 17	9 - 13	7 - 11
		55	321 - 376	100 - 109	14 - 19	14 - 18	10 - 14	8 - 12
		65	326 - 380	114 - 122	14 - 19	15 - 19	12 - 16	9 - 13
		75	327 - 381	123 - 130	15 - 20	20 - 24	12 - 16	10 - 14
110	3	45	326 - 380	129 - 135	15 - 20	28 - 32	13 - 17	10 - 14
		45	407 - 460	88 - 98	13 - 18	14 - 18	9 - 13	6 - 10
		55	418 - 471	104 - 112	13 - 18	14 - 18	10 - 14	7 - 11
		65	423 - 476	118 - 125	14 - 19	16 - 20	11 - 15	8 - 12
110	3	75	425 - 478	128 - 134	14 - 19	21 - 25	12 - 16	9 - 13
		85	424 - 477	134 - 139	15 - 20	29 - 33	13 - 17	9 - 13

WT036 Part Load Cooling-No Desuperheater Operation								
EST	Source Flow	ELT @ 3 Load GPM/Ton	Discharge	Suction	Subcooling	Superheat	Source Brine Temp Rise	Load Water Temp Drop
°F	GPM/Ton	°F	PSIG	PSIG	°F	°F	°F	°F
50	3	45	155 - 212	84 - 94	11 - 16	12 - 16	8 - 12	7 - 11
		55	160 - 217	99 - 107	12 - 16	13 - 17	9 - 13	8 - 12
		65	162 - 219	115 - 121	11 - 16	13 - 17	11 - 15	10 - 14
		75	164 - 221	131 - 135	11 - 16	15 - 19	12 - 16	11 - 15
		85	164 - 220	141 - 145	11 - 16	20 - 24	13 - 17	12 - 16
70	3	45	220 - 276	89 - 98	10 - 15	11 - 15	8 - 12	6 - 10
		55	227 - 282	105 - 112	11 - 16	11 - 15	9 - 13	8 - 12
		65	230 - 286	122 - 127	10 - 15	12 - 16	11 - 15	9 - 13
		75	232 - 288	139 - 142	10 - 15	13 - 17	12 - 16	10 - 14
90	3	45	232 - 288	150 - 152	10 - 15	18 - 22	13 - 17	11 - 15
		45	296 - 351	93 - 102	10 - 15	11 - 15	8 - 12	6 - 10
		55	304 - 359	109 - 116	10 - 15	11 - 15	9 - 13	7 - 11
		65	309 - 364	127 - 132	10 - 15	12 - 16	10 - 14	8 - 12
110	3	75	312 - 366	144 - 147	10 - 14	14 - 18	12 - 16	9 - 13
		85	311 - 366	156 - 158	10 - 15	18 - 22	13 - 17	10 - 14
		45	388 - 441	97 - 106	9 - 14	11 - 15	7 - 11	5 - 9
		55	398 - 451	115 - 121	10 - 15	12 - 16	8 - 12	6 - 10
110	3	65	404 - 457	133 - 137	10 - 14	12 - 16	10 - 14	7 - 11
		75	408 - 461	151 - 153	9 - 14	14 - 18	11 - 15	8 - 12
		85	407 - 460	163 - 164	9 - 14	19 - 23	12 - 16	8 - 12

Section 11: Troubleshooting

WT048 - Operating Parameter Tables - Heating

WT048 Full Load Heating-No Desuperheater Operation								
EST	Source Flow	ELT @ 3 Load GPM/Ton	Discharge	Suction	Subcooling	Superheat	Source Brine Temp Drop	Load Water Temp Rise
°F	GPM/Ton	°F	PSIG	PSIG	°F	°F	°F	°F
30	3	70	212 - 283	60 - 81	10 - 15	12 - 16	5 - 9	7 - 11
		80	249 - 322	63 - 84	9 - 14	10 - 14	5 - 9	7 - 11
		90	287 - 362	65 - 86	8 - 13	10 - 14	5 - 9	7 - 11
		100	328 - 405	67 - 88	7 - 12	10 - 14	5 - 9	7 - 11
		110	378 - 458	69 - 90	7 - 12	10 - 14	4 - 8	7 - 11
40	3	70	216 - 288	73 - 95	12 - 17	12 - 16	7 - 11	8 - 12
		80	253 - 327	76 - 98	11 - 16	10 - 14	6 - 10	8 - 12
		90	293 - 368	79 - 100	9 - 14	10 - 14	6 - 10	8 - 12
		100	334 - 412	81 - 102	9 - 14	10 - 14	6 - 10	8 - 12
		110	386 - 465	84 - 105	8 - 13	10 - 14	5 - 9	8 - 12
50	3	70	220 - 292	88 - 109	12 - 17	11 - 15	8 - 12	9 - 13
		80	258 - 332	91 - 113	11 - 16	10 - 14	8 - 12	9 - 13
		90	298 - 374	95 - 116	10 - 15	10 - 14	7 - 11	9 - 13
		100	341 - 419	97 - 119	9 - 14	10 - 14	7 - 11	9 - 13
		110	393 - 473	100 - 122	9 - 14	9 - 13	7 - 11	9 - 13
70	3	70	232 - 304	124 - 146	12 - 17	10 - 14	11 - 15	12 - 16
		80	271 - 346	129 - 151	11 - 16	9 - 13	11 - 15	12 - 16
		90	313 - 390	133 - 155	10 - 15	9 - 13	10 - 14	12 - 16
		100	357 - 436	136 - 158	9 - 14	9 - 13	10 - 14	12 - 16
		110	412 - 493	140 - 162	9 - 14	8 - 12	9 - 13	11 - 15

WT048 Part Load Heating-No Desuperheater Operation								
EST	Source Flow	ELT @ 3 Load GPM/Ton	Discharge	Suction	Subcooling	Superheat	Source Brine Temp Drop	Load Water Temp Rise
°F	GPM/Ton	°F	PSIG	PSIG	°F	°F	°F	°F
30	3	70	202 - 272	63 - 84	7 - 12	9 - 13	4 - 8	6 - 10
		80	239 - 311	66 - 87	6 - 11	8 - 12	4 - 8	6 - 10
		90	277 - 351	68 - 89	5 - 10	8 - 12	4 - 8	6 - 10
		100	318 - 394	71 - 92	5 - 10	7 - 11	4 - 8	6 - 10
		110	364 - 443	73 - 94	4 - 9	6 - 10	3 - 7	6 - 10
40	3	70	207 - 278	78 - 99	9 - 14	10 - 14	6 - 10	7 - 11
		80	245 - 318	81 - 102	8 - 13	9 - 13	6 - 10	7 - 11
		90	284 - 358	84 - 105	7 - 12	8 - 12	5 - 9	7 - 11
		100	325 - 402	86 - 108	6 - 11	8 - 12	5 - 9	7 - 11
		110	373 - 452	89 - 111	5 - 10	6 - 10	5 - 9	7 - 11
50	3	70	212 - 283	94 - 116	10 - 15	10 - 14	8 - 12	9 - 13
		80	251 - 324	97 - 119	9 - 14	9 - 13	7 - 11	9 - 13
		90	290 - 365	101 - 123	8 - 13	9 - 13	7 - 11	9 - 13
		100	333 - 410	104 - 126	7 - 12	8 - 12	6 - 10	8 - 12
		110	382 - 461	108 - 130	6 - 11	6 - 10	6 - 10	8 - 12
70	3	70	222 - 293	128 - 151	12 - 17	10 - 14	11 - 15	11 - 15
		80	262 - 336	133 - 156	10 - 15	9 - 13	11 - 15	11 - 15
		90	303 - 379	138 - 160	9 - 14	8 - 12	10 - 14	11 - 15
		100	348 - 426	142 - 165	8 - 13	8 - 12	9 - 13	11 - 15
		110	399 - 479	147 - 169	7 - 12	6 - 10	8 - 12	11 - 15

Section 11: Troubleshooting

WT048 - Operating Parameter Tables - Cooling

WT048 Full Load Cooling-No Desuperheater Operation								
EST	Source Flow	ELT @ 3 Load GPM/Ton	Discharge	Suction	Subcooling	Superheat	Source Brine Temp Rise	Load Water Temp Drop
°F	GPM/Ton	°F	PSIG	PSIG	°F	°F	°F	°F
50	3	45	157 - 214	77 - 87	12 - 17	14 - 18	9 - 13	7 - 11
		55	162 - 219	92 - 100	13 - 18	14 - 18	11 - 15	9 - 13
		65	168 - 225	108 - 114	14 - 19	15 - 19	12 - 16	10 - 14
		75	172 - 229	124 - 128	15 - 20	16 - 20	14 - 18	12 - 16
		85	174 - 231	128 - 132	15 - 20	24 - 28	14 - 18	12 - 16
70	3	45	221 - 277	81 - 90	11 - 16	13 - 17	9 - 13	7 - 11
		55	228 - 284	97 - 104	12 - 17	12 - 16	10 - 14	8 - 12
		65	236 - 292	114 - 119	13 - 18	13 - 17	12 - 16	10 - 14
		75	241 - 297	130 - 133	14 - 19	15 - 19	13 - 17	11 - 15
		85	243 - 299	135 - 138	15 - 20	21 - 25	14 - 18	12 - 16
90	3	45	299 - 354	83 - 92	11 - 16	14 - 18	9 - 13	6 - 10
		55	307 - 362	100 - 107	12 - 17	13 - 17	10 - 14	7 - 11
		65	318 - 372	117 - 122	13 - 18	14 - 18	11 - 15	9 - 13
		75	325 - 380	133 - 136	13 - 18	16 - 20	13 - 17	10 - 14
		85	328 - 382	138 - 140	14 - 19	23 - 27	13 - 17	10 - 14
110	3	45	392 - 446	86 - 95	10 - 15	14 - 18	8 - 12	5 - 9
		55	403 - 457	103 - 109	11 - 16	14 - 18	9 - 13	6 - 10
		65	417 - 470	121 - 125	12 - 17	15 - 19	11 - 15	7 - 11
		75	426 - 479	137 - 140	12 - 17	16 - 20	12 - 16	9 - 13
		85	429 - 482	143 - 144	13 - 18	24 - 28	13 - 17	9 - 13

WT048 Part Load Cooling-No Desuperheater Operation								
EST	Source Flow	ELT @ 3 Load GPM/Ton	Discharge	Suction	Subcooling	Superheat	Source Brine Temp Rise	Load Water Temp Drop
°F	GPM/Ton	°F	PSIG	PSIG	°F	°F	°F	°F
50	3	45	151 - 207	82 - 94	10 - 14	12 - 16	9 - 13	7 - 11
		55	155 - 211	98 - 108	11 - 15	12 - 16	10 - 14	9 - 13
		65	159 - 215	115 - 124	11 - 15	11 - 15	12 - 16	10 - 14
		75	165 - 221	134 - 141	12 - 16	12 - 16	14 - 18	12 - 16
		85	169 - 225	151 - 156	13 - 16	14 - 18	15 - 19	14 - 18
70	3	45	214 - 269	87 - 98	9 - 13	11 - 15	9 - 13	7 - 11
		55	220 - 275	103 - 113	10 - 14	11 - 15	10 - 14	8 - 12
		65	226 - 280	121 - 129	11 - 14	11 - 15	12 - 16	10 - 14
		75	233 - 288	140 - 147	11 - 15	11 - 15	13 - 17	11 - 15
		85	240 - 294	158 - 163	12 - 16	13 - 17	15 - 19	13 - 17
90	3	45	288 - 341	91 - 102	8 - 12	11 - 15	8 - 12	6 - 10
		55	295 - 348	108 - 117	9 - 13	11 - 15	9 - 13	7 - 11
		65	303 - 356	127 - 135	9 - 13	11 - 15	11 - 15	8 - 12
		75	313 - 366	147 - 153	10 - 14	11 - 15	13 - 17	10 - 14
		85	321 - 373	166 - 170	11 - 14	13 - 17	14 - 18	11 - 15
110	3	45	378 - 429	95 - 106	7 - 11	11 - 15	8 - 12	5 - 9
		55	387 - 439	113 - 122	8 - 12	11 - 15	9 - 13	6 - 10
		65	397 - 448	132 - 140	8 - 12	11 - 15	10 - 14	7 - 11
		75	410 - 460	153 - 159	9 - 13	11 - 15	12 - 16	8 - 12
		85	420 - 471	172 - 176	9 - 13	13 - 17	13 - 17	9 - 13

Section 11: Troubleshooting

WT060 - Operating Parameter Tables - Heating

EST	Source Flow	Full Load Heating-No Desuperheater Operation						
		ELT @ 1.5-3 Load GPM/Ton	Discharge	Suction	Subcooling	Superheat	Source Brine Temp Drop	Load Water Temp Rise
°F	GPM/Ton	°F	PSIG	PSIG	°F	°F	°F	°F
30	3	50	158-217	52-72	8-23	17-26	4-8	4-16
		70	222-288	60-80	5-21	14-23	4-8	4-17
		80	257-326	62-83	4-19	13-22	4-8	4-17
		90	295-368	64-84	3-19	12-22	4-8	4-17
		100	337-415	65-86	3-19	12-21	3-7	4-16
50	3	50	165-224	76-98	10-25	13-23	6-10	6-20
		70	231-298	87-110	7-23	11-21	6-10	6-21
		80	267-338	91-114	6-22	10-20	6-10	6-21
		90	307-381	93-116	5-21	10-19	6-10	6-21
		100	350-429	95-117	5-21	9-19	5-9	6-21
70	3	50	171-232	103-124	11-27	12-23	8-12	8-24
		70	240-308	118-139	9-24	10-21	8-12	8-26
		80	278-349	123-144	8-23	10-20	8-12	8-26
		90	318-394	126-147	7-23	9-20	8-12	8-26
		100	363-444	128-149	7-23	9-20	7-12	8-25
90	3	50	176-237	128-149	13-28	16-27	10-14	9-28
		70	246-315	146-167	10-26	15-25	11-15	10-30
		80	285-357	151-173	9-25	14-25	11-15	10-30
		90	327-404	155-176	9-24	14-25	10-14	10-30
		100	373-454	157-179	8-24	14-25	10-14	10-29

EST	Source Flow	Part Load Heating-No Desuperheater Operation						
		ELT @ 1.5-3 Load GPM/Ton	Discharge	Suction	Subcooling	Superheat	Source Brine Temp Drop	Load Water Temp Rise
°F	GPM/Ton	°F	PSIG	PSIG	°F	°F	°F	°F
30	3	50	156-213	55-76	9-22	14-25	4-8	4-17
		70	216-279	61-82	6-19	12-23	4-8	4-17
		80	251-318	64-84	5-19	12-22	4-8	4-17
		90	290-360	66-87	4-18	11-21	3-8	4-17
		100	332-406	68-89	4-18	10-21	3-7	4-17
50	3	50	163-221	81-102	9-24	11-21	7-11	6-22
		70	226-290	90-111	6-22	9-19	7-11	7-22
		80	262-330	94-115	5-21	8-18	7-11	7-23
		90	302-373	97-118	4-21	7-18	6-10	7-23
		100	346-421	100-121	4-21	7-17	5-10	6-22
70	3	50	170-229	110-131	11-26	9-19	9-14	8-27
		70	235-300	122-143	8-23	7-18	10-14	9-28
		80	273-341	126-148	7-23	7-17	9-14	9-28
		90	314-387	131-152	6-22	6-17	9-13	9-28
		100	359-436	134-156	6-22	6-17	8-13	9-27
90	3	50	177-236	141-163	12-27	10-20	12-16	11-32
		70	244-309	156-177	9-25	8-19	13-17	11-34
		80	283-352	162-184	8-24	8-18	12-17	11-34
		90	326-400	167-189	7-24	8-18	12-16	11-34
		100	373-451	172-194	7-23	8-18	11-15	11-33

Section 11: Troubleshooting

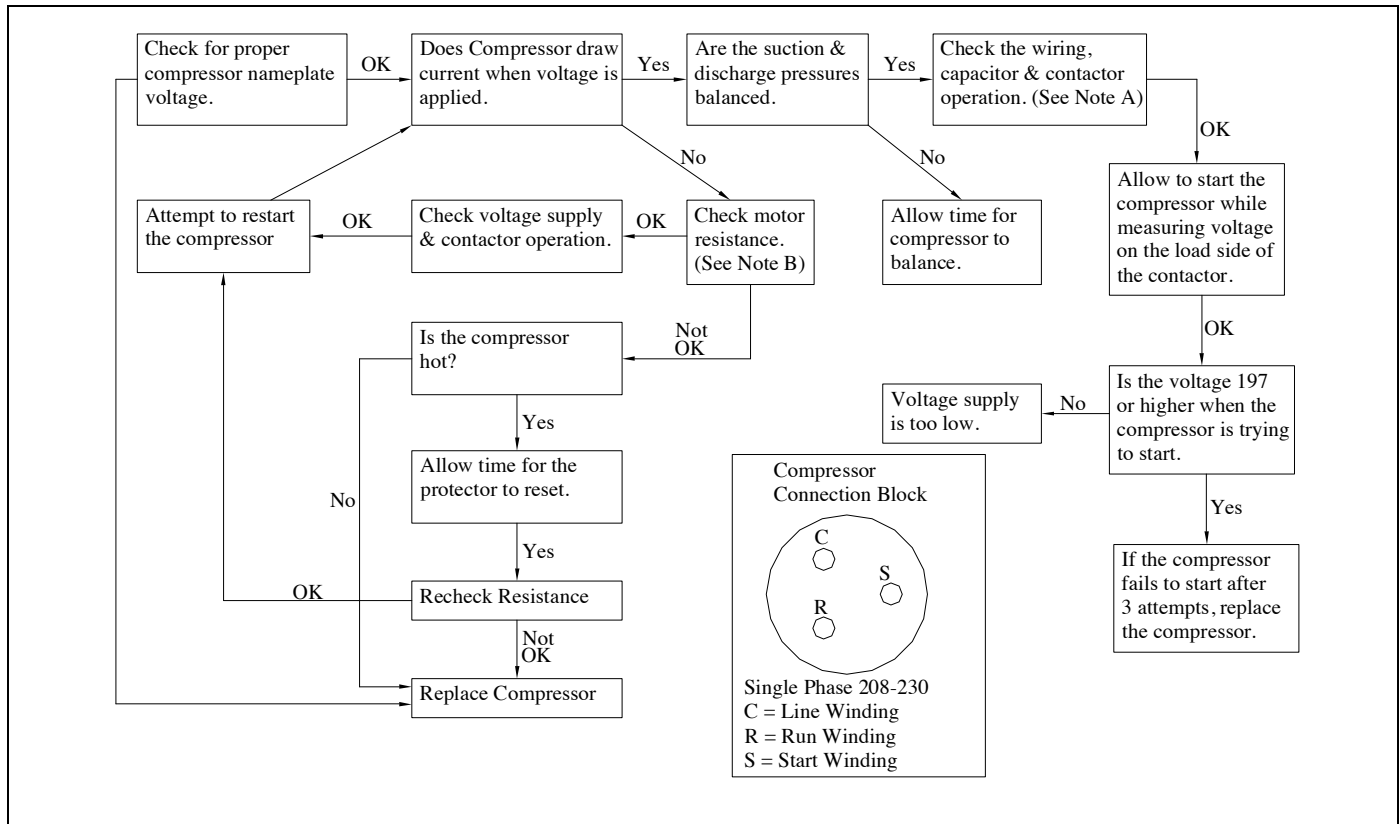
WT060 - Operating Parameter Tables - Cooling

EST	Source Flow	Full Load Cooling-No Desuperheater Operation						
		ELT @ 1.5-3 Load GPM/Ton	Discharge	Suction	Subcooling	Superheat	Source Brine Temp Rise	Load Water Temp Drop
°F	GPM/Ton	°F	PSIG	PSIG	°F	°F	°F	°F
50	3	45	161-205	65-96	7-18	12-25	6-11	5-15
		50	163-207	71-103	7-18	12-25	7-12	5-17
		60	167-211	87-120	8-19	11-23	8-13	7-20
		70	171-215	102-138	8-19	11-23	10-15	8-22
		90	176-220	116-154	9-21	22-34	11-17	9-25
70	3	45	225-271	69-100	7-18	11-24	6-11	4-15
		50	228-273	75-107	7-18	11-24	7-12	5-16
		60	233-278	91-125	7-19	10-22	8-13	6-19
		70	238-284	108-144	8-19	10-22	9-15	7-21
		90	246-292	122-161	9-20	22-33	11-16	9-24
90	3	45	303-350	72-102	6-18	11-24	6-11	4-13
		50	306-353	78-109	6-18	11-23	7-11	4-15
		60	313-360	95-128	7-18	10-22	8-13	6-17
		70	320-367	112-147	7-18	11-22	9-14	7-19
		90	330-377	127-164	8-19	22-35	10-16	8-22
110	3	45	393-442	74-104	5-17	12-24	6-10	3-12
		50	397-446	81-112	5-17	12-24	6-11	4-13
		60	406-455	98-131	5-17	11-23	7-12	5-15
		70	415-464	115-151	6-17	12-23	8-13	5-17
		90	428-477	131-168	6-18	24-37	10-15	7-19

EST	Source Flow	Part Load Cooling-No Desuperheater Operation						
		ELT @ 1.5-3 Load GPM/Ton	Discharge	Suction	Subcooling	Superheat	Source Brine Temp Rise	Load Water Temp Drop
°F	GPM/Ton	°F	PSIG	PSIG	°F	°F	°F	°F
50	3	45	160-204	69-100	6-17	12-24	7-12	5-17
		50	161-206	77-109	7-17	11-23	8-13	6-18
		60	165-209	92-127	7-17	10-21	8-13	6-18
		70	168-213	107-144	8-18	10-21	8-13	6-18
		90	177-222	137-178	8-19	13-24	8-13	6-18
70	3	45	224-270	73-105	5-16	11-23	7-12	5-16
		50	226-272	81-114	5-17	10-22	8-13	5-17
		60	230-276	97-133	6-17	9-20	9-14	7-20
		70	235-282	113-151	6-17	10-20	11-16	8-23
		90	247-294	144-186	6-18	13-24	13-19	11-28
90	3	45	301-348	76-109	4-16	11-23	7-12	4-14
		50	303-351	85-119	4-16	10-21	7-12	5-16
		60	309-357	102-138	5-16	9-20	7-12	5-16
		70	316-364	118-157	5-16	10-20	7-12	5-16
		90	331-380	151-194	5-16	13-24	7-12	5-16
110	3	45	390-440	79-112	3-14	12-23	7-11	3-12
		50	394-444	88-122	3-15	11-22	7-12	4-14
		60	401-452	105-142	3-15	11-21	7-12	4-14
		70	410-460	122-161	3-15	12-22	7-12	4-14
		90	430-481	155-199	3-14	15-27	7-12	4-14

Section 11: Troubleshooting

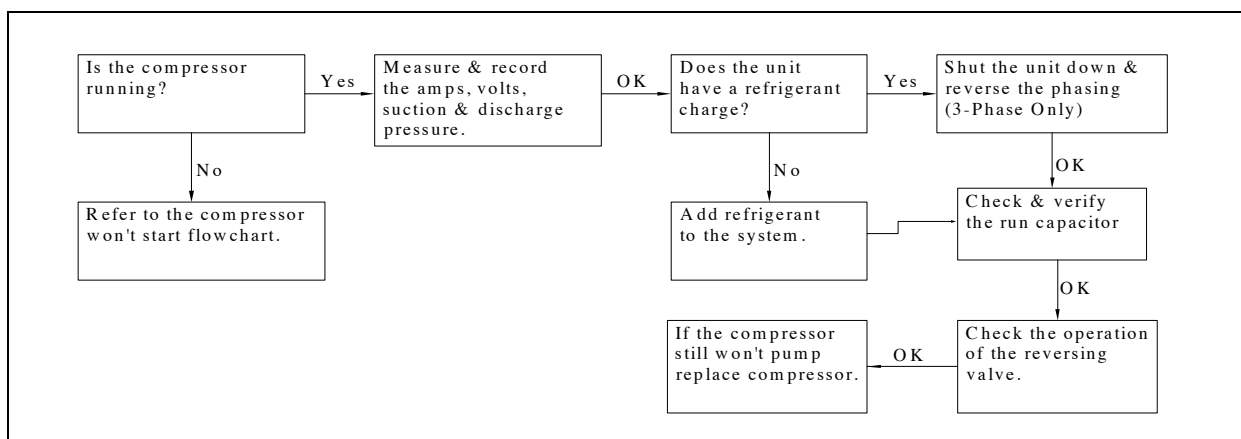
J: Compressor Won't Start



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.

K: Compressor Won't Pump Chart



Section 11: Troubleshooting

Table 4: Refrigeration Troubleshooting

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

Superheat/Subcooling Conditions

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

Section 11: Troubleshooting

Troubleshooting Tips

A: UNIT WILL NOT START IN EITHER CYCLE	
Thermostat	Set thermostat on heating and highest temperature setting. Unit should run. Set thermostat on cooling and lowest temperature setting. Unit should run. Set fan to On position. Fan should run. If unit does not run in any position, disconnect wires at heat pump terminal block and jump R, G, Y. Unit should run in heating. If unit runs, replace thermostat with correct thermostat only.
Loose or Broken Wires	Tighten or replace wires.
Blown Fuse/	Check fuse size, replace fuse or reset circuit breaker. Check low voltage circuit breaker.
Tripped Circuit Breakers	Check fuse size, replace fuse or reset 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.
B: BLOWER RUNS BUT COMPRESSOR WILL NOT START (COMPRESSOR OVERLOAD, BAD CAPACITOR, HP FAULT)	
Logic Board	Check if status light is on and logic board is working properly. Check fault lights. See LED Identification chart in Controls Section
Defective Sensors	Check status/fault lights. Sensor is out of normal range for resistance values, open, or shorted. Compare sensor resistance values with the charted resistance in Controls Section
Defective Capacitor	Check capacitor. If defective, replace.
Failed Compressor	See charts M and N for compressor diagnostic. If compressor still doesn't run, replace it.
Low Pressure Switch	Low refrigerant charge. Check for pressure. Check for leaks.
C: 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.	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. .
Defective Sensors	Check status/fault lights. Sensor is out of normal range for resistance values, open, or shorted. Compare sensor resistance values with the charted resistance in Controls Section
Water Flow (Source Heat Exchanger Freeze Fault)	Check status/fault lights. To check water flow remove the FS jumper (see Controls Section for location) and jumper the two FS terminals (located between blue and violet wires on the right side of the board) together to complete the flow switch circuit. Determine if the required water pressure drop is present. If required pressure drop is present, check the resistance of T4 source sensor (15°F=41.39kΩ; 30°F=28.61kΩ) and temperature of the refrigerant line between the source heat exchanger and TXV.
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, refrigerant pressures, and ambient temperature. WARNING: Only allow compressor to run for a couple of seconds with the high pressure switch jumped.
Defective Logic Board Relay	Jump R to Y directly on lockout board. Check for 24V at Y. If no operation and no faults occur, replace lockout board.
Hot Gas Temperature>220°F	Check status/fault lights. Check hot gas/discharge line temperature with a thermocouple type thermometer. WARNING: Let the unit remain off for several minutes and touch the thermocouple to the discharge line to check if it is cooled enough to strap/tape a thermocouple to it. Check the discharge line temperature during the next operation cycle to compare the temperature to the lockout temperature of 220°F. Check water/air flow. If water/air flow is present, check the refrigerant pressures.
Condensate Overflow (CO)	Check status/fault lights. Check sensors for contact with water, debris, or a loose sensor touching metal. Clean sensors if contacting debris. Flush drain lines if the drain pan is full. If no debris is present and drain pan is empty, remove violet wire from CO terminal on lockout board (lower right). If CO lockout occurs with violet wire removed replace the lockout board.
Over/Under Voltage	Make sure secondary/low voltage is between 20V and 29V. Check the transformer's primary connections for the correct voltage (Orange & Black = 230V; Red & Black = 208V). Correct any possible voltage drops in the main voltage.
Load Heat Exchanger Frozen	Check status/fault lights. Check for reduced air flow due to dirty filter, obstructions, or poor blower performance. Check T1 sensor for the proper resistance (30°F = 28.61kΩ).
D: 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).

Section 11: Troubleshooting

Troubleshooting Tips

E: 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.
F: 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.
G: 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.
H: 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.
I: EXCESSIVE HEAD PRESSURE IN COOLING MODE	
Inadequate water flow	Low water flow, increase flow.
J: EXCESSIVE HEAD PRESSURE IN HEATING MODE	
Low air flow	See E: Noisy blower and low air flow.
K: 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.
L: 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

Troubleshooting Forms

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.
 C = Disch. Sat. - Liq. Line Temp.

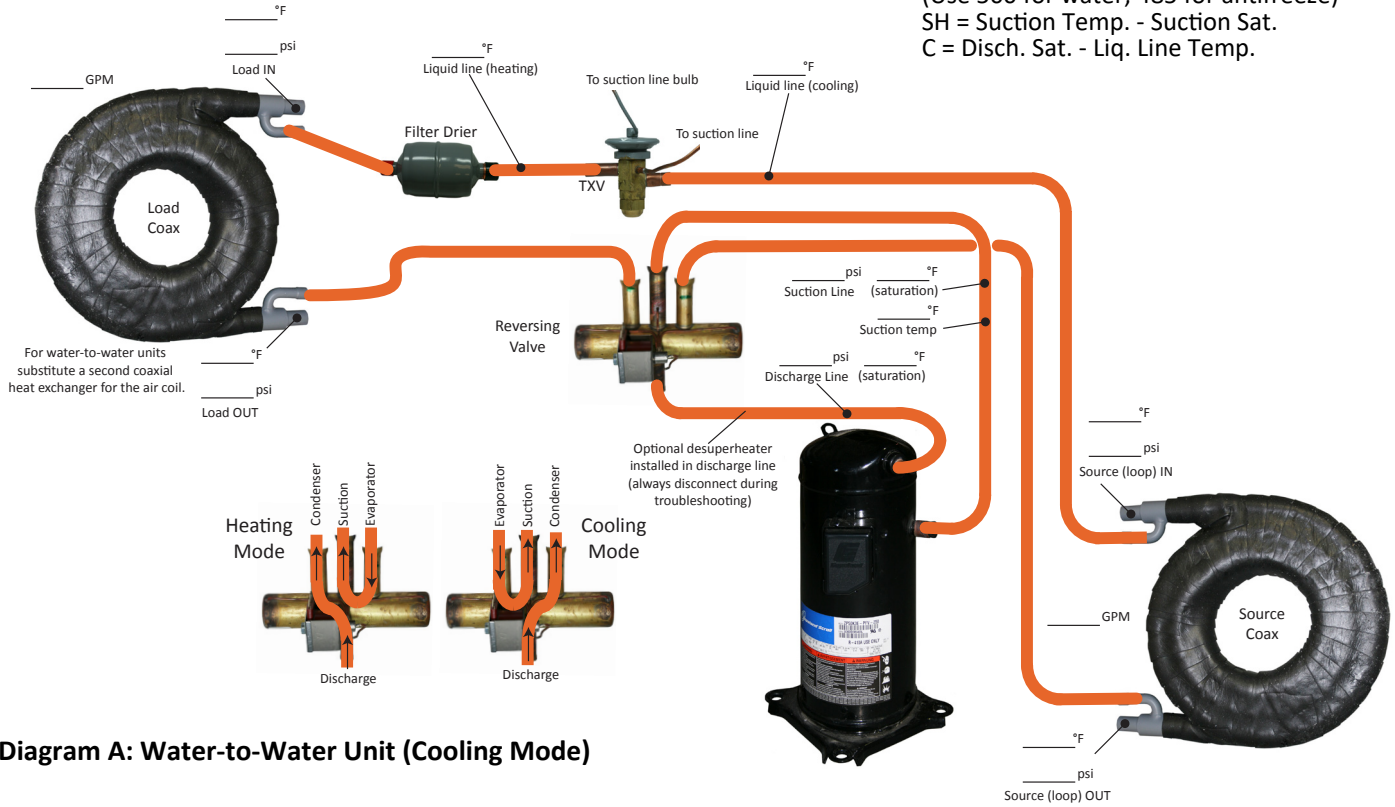


Diagram A: Water-to-Water Unit (Cooling Mode)

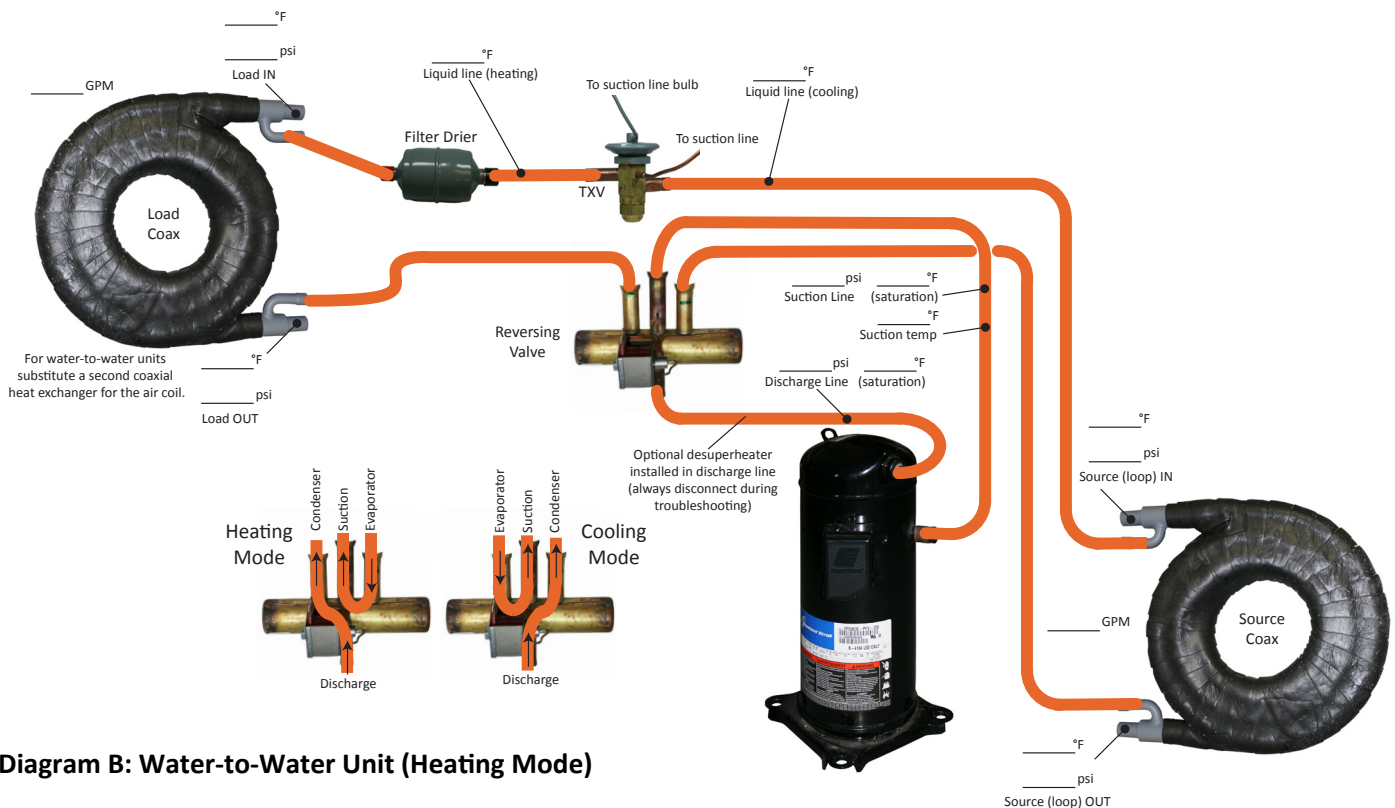


Diagram B: Water-to-Water Unit (Heating Mode)

Section 12: Unit Electrical

Unit Electrical Data

Model	Voltage Code/ HWG Option	60 Hz Power		Compressor		HWG Pump FLA	Ext. Loop Pump FLA	Total Unit FLA	Min Circuit AMPS	Max Brkr HACR
		Volts	Phase	LRA	RLA					
WT036	00	208/230	1	104.0	21.2	0.0	0.0	21.2	26.5	45
	01	208/230	1	104.0	21.2	0.5	0.0	21.7	27.0	45
	10	208/230	1	104.0	21.2	0.0	4.0	25.2	30.5	50
	11	208/230	1	104.0	21.2	0.5	4.0	25.7	31.0	50
	20	208/230	3	83.1	14.0	0.0	0.0	14.0	17.5	30
	21	208/230	3	83.1	14.0	0.5	0.0	14.5	18.0	30
	30/35	460	3	41.0	6.4	0.0	0.0	6.4	8.0	15
WT048	00	208/230	1	152.9	27.1	0.0	0.0	27.1	33.9	60
	01	208/230	1	152.9	27.1	0.5	0.0	27.6	34.4	60
	10	208/230	1	152.9	27.1	0.0	5.5	32.6	39.4	60
	11	208/230	1	152.9	27.1	0.5	5.5	33.1	39.9	60
	20	208/230	3	110.0	16.5	0.0	0.0	16.5	20.6	35
	21	208/230	3	110.0	16.5	0.5	0.0	17.0	21.1	35
	30/35	460	3	52.0	7.2	0.0	0.0	7.2	9.0	15
WT060	00	208/230	1	179.2	29.7	0.0	0.0	29.7	37.1	60
	01	208/230	1	179.2	29.7	0.5	0.0	30.2	37.6	60
	10	208/230	1	179.2	29.7	0.0	5.5	35.2	42.6	70
	11	208/230	1	179.2	29.7	0.5	5.5	35.7	43.1	70
	20	208/230	3	136.0	17.6	0.0	0.0	17.6	22.0	40
	21	208/230	3	136.0	17.6	0.5	0.0	18.1	22.5	40
	30/35	460	3	66.1	8.5	0.0	0.0	8.5	10.6	15

Notes:

1. All line and low voltage wiring must adhere to the National Electrical Code and local codes, whichever is the most stringent.
 2. In determining the correct supply wire size and maximum length, reference NFPA 70, Section 310. If the calculation is close to the maximum allowable ampacity of a particular wire size, use the next size up. This will ensure that no adverse effects occur, such as light dimming and/or shortened compressor life.
 3. Min/Max Voltage: 208/230/60 = 187-252, 460/60 = 432-504
- *The external loop pump FLA is based on a maximum of three UP26-116F-230V pumps (1/2hp) for 048-060 and two pumps for 036.

Proper Power Supply Evaluation:

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

⚠ 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.

Section 13: Warranty Registration Form

Warranty Registration Form



WARRANTY REGISTRATION

NOW REGISTER ONLINE AT WARRANTY-REGISTRATION.ENERTECHGEO.COM

WARRANTY REGISTRATIONS SHOULD BE SUBMITTED WITHIN 60 DAYS OF INSTALLATION

Model Number _____ Serial Number _____ Install Date _____

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

Purchaser/User Name _____ Phone _____

Address _____ City _____ State/Prov _____

Postal Code _____ Email _____

Installer Company Name _____

City _____ State/Prov _____ Email _____

Application

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

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

Use (check all that apply)

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

Other _____

Loop Type

Horizontal Loop Vertical Loop Pond Loop Open Loop

Demographics

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

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

Home Location Rural Urban Suburban

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

Customer Satisfaction

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

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

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

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

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

EMAIL THIS FORM TO:
WARRANTY@ENERTECHGEO.COM

FAX THIS FORM TO:
 ENERTECH GLOBAL LLC
 618.664.4597

REGISTER ONLINE AT: warranty-registration.enertechgeo.com

Rev 30 DEC 2013B

Section 14: Revision Table

Revision Table

Date	Description of Revision	Page
04MAR2022	IOM updated	All
15FEB2021	Minor layout changes made	Various
06OCT2020	Layout changes	Various
17SEP2020	WT Rev. E IOM created	ALL



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