ENERTECH
ENERGY + TECHNOLOGY

Installation & Operations Manual

WS MODELS WATER-TO-WATER HEAT PUMPS

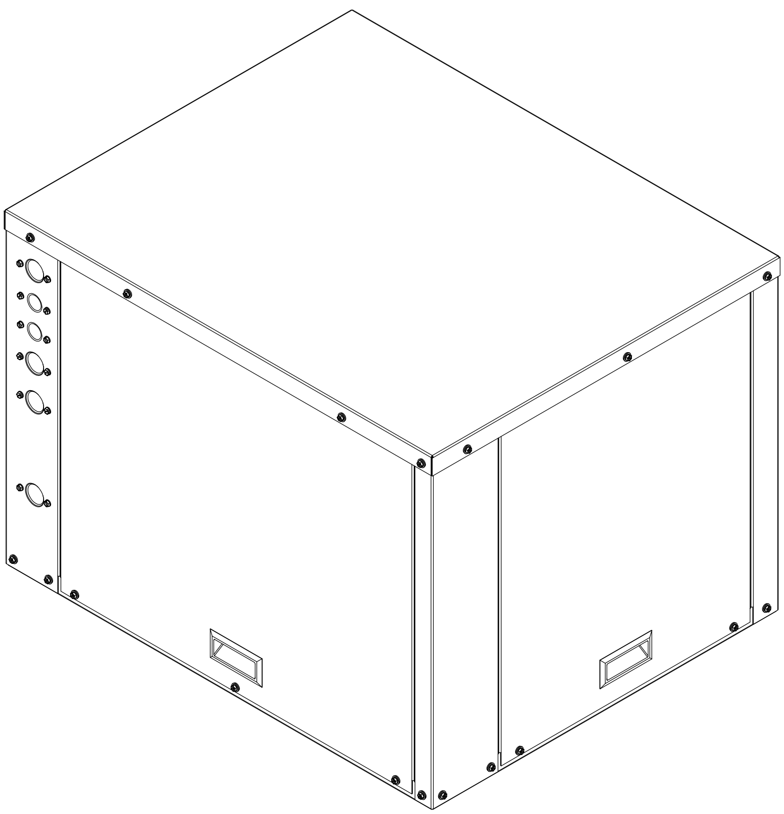

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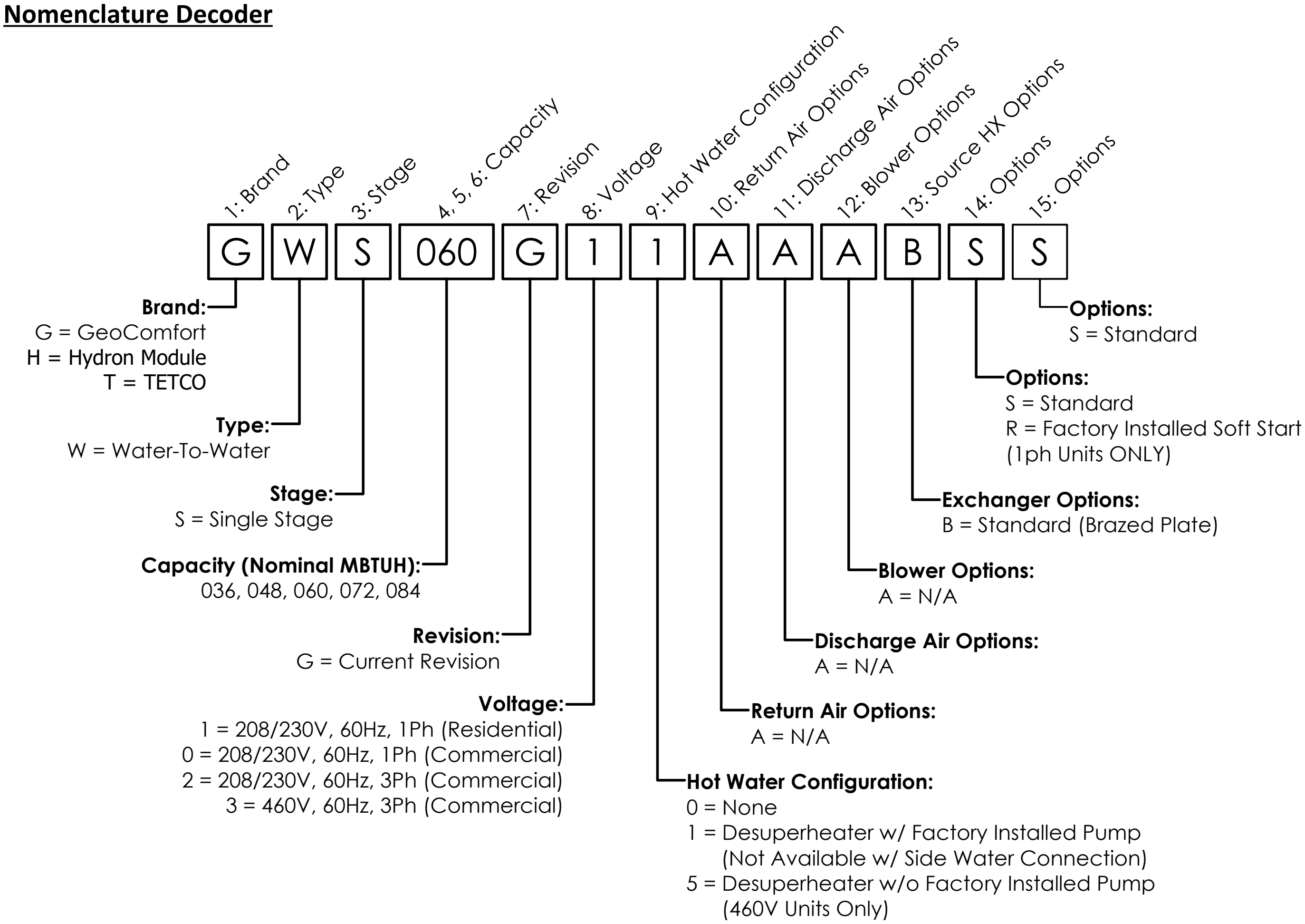
Table of Contents

Section 9: Troubleshooting

Section 10: Warranty Form and Revision Table

Section 1: Model Nomenclature

Nomenclature Decoder



Introduction

Engineering and quality control is built into every geothermal unit. Good performance depends on proper application and correct installation.

This geothermal heat pump provides heated water and chilled water as well as optional domestic water heating capability.

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. Ensure 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.

Un-packaging

Enertech units are mounted to wooden pallets for easy handling during shipment and installation. Units are protected during shipment with durable cardboard corner posts, top and air coil panels. Shrink wrap is applied covering the entire unit and attachment to the pallet.

Upon receipt of the unit, carefully remove the shrink wrap. Using a box cutter, slit the shrink wrap on the cardboard top and corner posts. Use caution to not damage the finished surface of the unit. Keep all cardboard or other packaging material for safe storage and transport to the job site prior to installation.

Remove the front service panel to locate technical documents; manuals, bulletins or instructions and accessory items; HWG piping kits, and strainers.

⚠ NOTICE ⚠

ENERTECH REQUIRES THAT A STRAINER BE INSTALLED ON THE INLET OF SOURCE AND LOAD SIDE BRAZED-PLATE HEAT EXCHANGERS

⚠ CAUTION ⚠

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

⚠ WARNING ⚠

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

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.

Removal and Disposal

All Geothermal units removed from service should have all components, oils, antifreeze and refrigerants properly disposed of according to local and national environmental recycling codes, regulations, standards and rules.

Pre-Installation Steps

Before you fully install the geothermal equipment, it is recommended you do the following:

1. Fully inspect the unit after unpacking
2. Compare the electrical data on the unit nameplate with packing slip and ordering information to verify that the correct unit has been shipped.
3. Inspect all electrical connections and wires. Connections must be clean and tight at the terminals, and wires should not touch any sharp edges or copper pipe.
4. Verify that all refrigerant tubing is free of dents and kinks. Refrigerant tubing should not be touching other unit components.
5. Before unit start-up, read all manuals and become familiar with unit components and operation. Thoroughly check the unit before operating.
6. Locate the Unit Start-Up Form from this manual and have it available as the unit installation proceeds.

Equipment Installation

All units should be located in an indoor area were the ambient temperature will remain above 55°F and should be located in a way that piping and ductwork or other permanently installed fixtures do not have to be removed for servicing and filter replacement.

⚠ CAUTION ⚠

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.

⚠ CAUTION ⚠

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

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

- Service Access. Is there enough space for service access? A general rule of thumb is at least 2 feet in the front and 2 feet on at least one side.
- Unit Air Pad. All geothermal heating and cooling equipment should be placed on a high-density rubber pad, 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.
- Unit Racking: If units are being placed on racking, the unit must be placed on a solid foundation covering the full base of the unit. Also, utilize a foam pad between the unit and the rack.
- The installer must verify that all applicable wiring, piping, and accessories are correct and on the job site.

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

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

Loop Pumping Modules
Must be wired to the heat pump's electric control box. A pump module connection block (connected to the master contactor) and circuit breaker is provided to connect the Pump Module wiring.

Desuperheater
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.

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.

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

Electronic Expansion Valve (EXV): A step valve able to open and close in microsteps based on the signals from the EXV control board. The EXV and EXV control board are only utilized in the WS072 & WS084 models.

Electronic Expansion Valve (EXV) Control Board: A superheat controller providing control for the EXV based on the pressure transducer and thermistor inputs.

Buffer Tanks

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

- The size of the buffer tank should be determined based upon the predominant use of the water-to-water equipment (heating or cooling).
- 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.

Heating Mode Operation Guidelines

Enertech recommends the aquastat setting not be set above 110°F for the storage tank temperature. Excessive vibration and part failure can occur at higher than recommended temperature settings. The higher operating temperatures cause substantial efficiency and capacity reductions.

The performance is negatively affected as the unit operates at the higher water temperatures and it benefits the unit and the homeowner to operate at or below the recommended water temperature of 110°F.

With the lower efficiency created by higher water temperatures, the output capacity of the unit is decreased along with the efficiency. When operating at the higher entering water temperature the heat of extraction is significantly reduced, as well. In order to maintain the needed capacity, more of the heat is coming from the compressor working harder to compress the refrigerant.

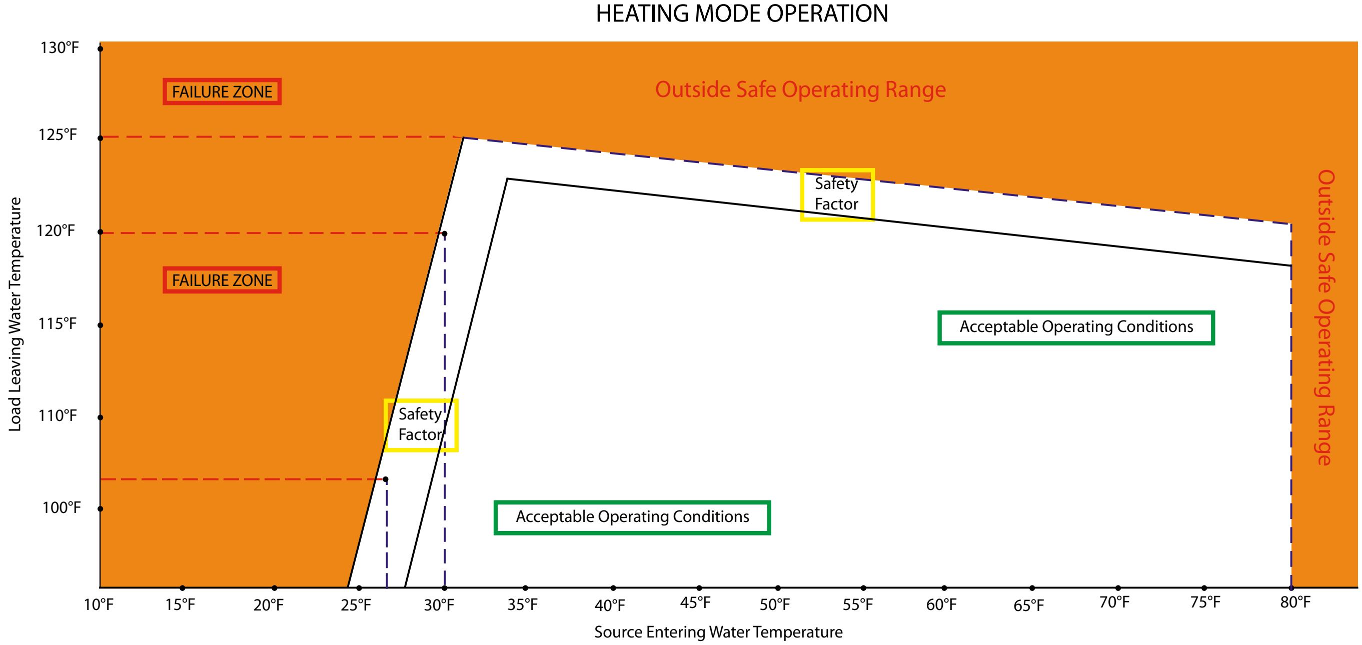
The illustration below shows the parameters which are safe for compressor operation. Based on the leaving load water of 120°F, the loop would have to maintain 35°F to operate within the acceptable operating conditions for the compressor. Once your loop temperatures drop below 35°F, the acceptable leaving load temperature drops below 120°F. If you are designing loops for 30°F, the recommended leaving load temperature is 110°F.

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 below 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.

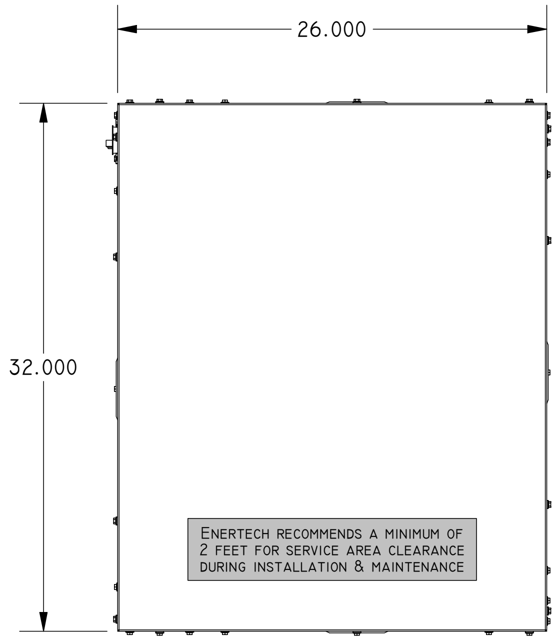
Actual usage, and choices of heat distribution devices need to follow the acceptable operating conditions presented in the chart. If a question arises, please consult the Technical Services Department.

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

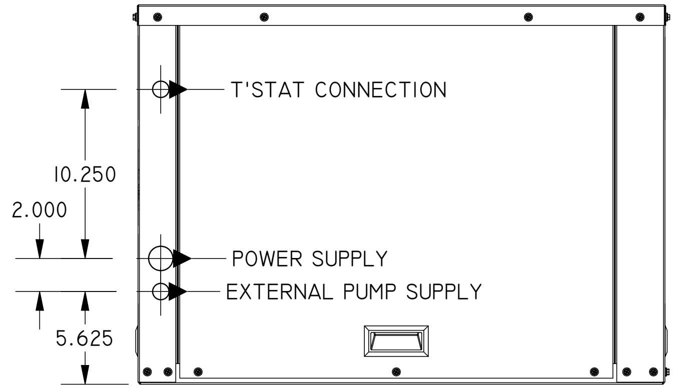


Section 3: Unit Data

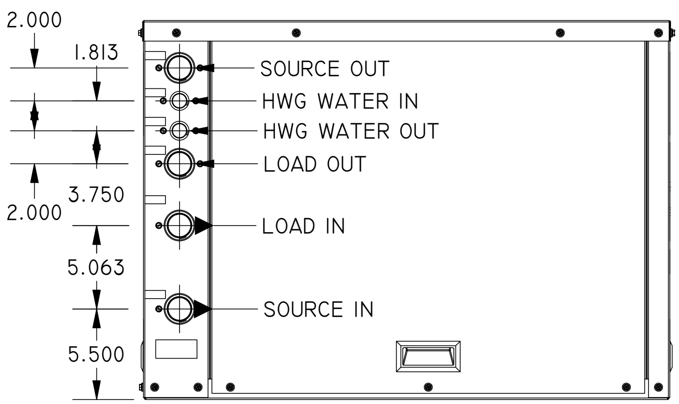
Unit Dimensional Data



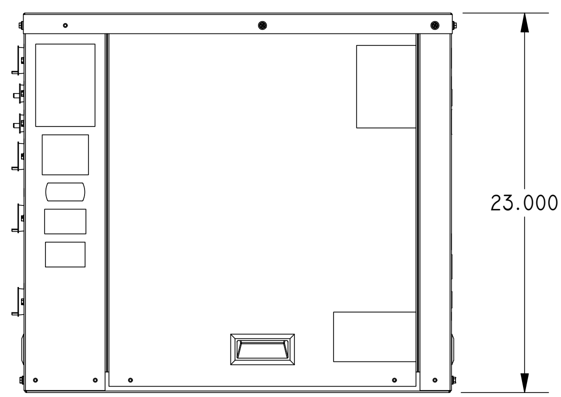
TOP VIEW



RIGHT SIDE VIEW



LEFT SIDE VIEW



FRONT VIEW

Single Compressor Unit								
MODEL	**SOURCE Water: FPT**		**LOAD Water: FPT**		**HWG Water: FPT**		Factory Charge	Unit Weight
	IN	OUT	IN	OUT	IN	OUT		
036							55 oz	259 Lbs
048							65 oz	277 Lbs
060	1-1/4”	1-1/4”	1-1/4”	1-1/4”	3/4”	3/4”	59 oz	277 Lbs
072							99 oz	327 Lbs
084							105 oz	348 Lbs

Notes:
- Electrical connections are 1” DIA for high voltage, & 1/2” DIA for low voltage.

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					
WS036	00	208/230	1	109.0	16.7	0.0	0.0	16.7	20.9	35
	01	208/230	1	109.0	16.7	0.5	0.0	17.2	21.4	35
	10	208/230	1	109.0	16.7	0.0	4.0	20.7	24.9	40
	11	208/230	1	109.0	16.7	0.5	4.0	21.2	25.4	40
	20	208/230	3	84.0	11.2	0.0	0.0	11.2	14.0	25
	21	208/230	3	84.0	11.2	0.5	0.0	11.7	14.5	25
	30/35	460	3	44.0	5.6	0.0	0.0	5.6	7.0	15
WS048	00	208/230	1	144.2	24.4	0.0	0.0	24.4	30.5	50
	01	208/230	1	144.2	24.4	0.5	0.0	24.9	31.0	50
	10	208/230	1	144.2	24.4	0.0	5.5	29.9	36.0	60
	11	208/230	1	144.2	24.4	0.5	5.5	30.4	36.5	60
	20	208/230	3	110.0	16.0	0.0	0.0	16.0	20.0	35
	21	208/230	3	110.0	16.0	0.5	0.0	16.5	20.5	35
	30/35	460	3	52.0	7.8	0.0	0.0	7.8	9.8	15
WS060	00	208/230	1	178.0	30.8	0.0	0.0	30.8	38.5	60
	01	208/230	1	178.0	30.8	0.5	0.0	31.3	39.0	70
	10	208/230	1	178.0	30.8	0.0	5.5	36.3	44.0	70
	11	208/230	1	178.0	30.8	0.5	5.5	36.8	44.5	70
	20	208/230	3	136.0	19.6	0.0	0.0	19.6	24.5	40
	21	208/230	3	136.0	19.6	0.5	0.0	20.1	25.0	45
	30/35	460	3	66.1	8.2	0.0	0.0	8.2	10.3	15
WS072	00	208/230	1	148.0	32.1	0.0	0.0	32.1	40.1	70
	01	208/230	1	148.0	32.1	0.5	0.0	32.6	40.6	70
	10	208/230	1	148.0	32.1	0.0	5.5	37.6	45.6	70
	11	208/230	1	148.0	32.1	0.5	5.5	38.1	46.1	70
	20	208/230	3	164.0	23.2	0.0	0.0	23.2	29.0	50
	21	208/230	3	164.0	23.2	0.5	0.0	23.2	29.5	50
	30/35	460	3	75.0	11.2	0.0	0.0	11.2	14.0	25
WS084	00	208/230	1	185.0	32.1	0.0	0.0	32.1	40.1	70
	01	208/230	1	185.0	32.1	0.5	0.0	32.6	40.6	70
	10	208/230	1	185.0	32.1	0.0	5.5	37.6	45.6	70
	11	208/230	1	185.0	32.1	0.5	5.5	38.1	46.1	70
	20	208/230	3	164.0	25.0	0.0	0.0	25.0	31.3	50
	21	208/230	3	164.0	25.0	0.5	0.0	25.5	31.8	50
	30/35	460	3	100.0	12.2	0.0	0.0	12.2	15.3	25

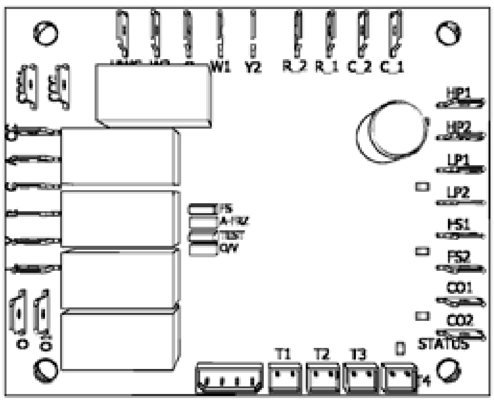
Notes:
1. All line and low voltage wiring must adhere to the National Electrical Code and local codes, whichever is the most stringent.
2. In determining the correct supply wire size and maximum length, reference NFPA 70, Section 310. If the calculation is close to the maximum allowable ampacity of a 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 = 432-502
4. See Wiring Diagrams for proper 460V power.
*The external loop pump FLA is based on a maximum of three UP26-116F-230V pumps (1/2hp) for 048-084 and two pumps for 036.

Proper Power Supply Evaluation

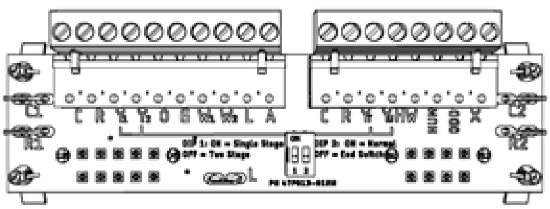
When any compressor bearing unit is connected to a weak power supply, starting current will generate a significant “sag” in the voltage which reduces the starting torque of the compressor motor and increases the start time. This will influence the rest of the electrical system in the building by lowering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

Section 4: Controls

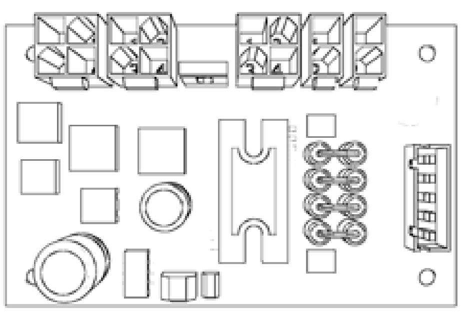
Lockout Board Layout



Thermostat Board Layout



EXV Control Board



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

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.

An electronic expansion valve (EXV) control board controls the evaporator superheat by stepping open or closed the EXV based on the inputs from the suction pressure transducer and thermistor. The EXV and EXV control board are only utilized in the WS072 & WS084 models.

Startup/Random Start

The unit will not operate until all the inputs and safety controls are checked for normal conditions. A 10-20 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**), an output of 24VAC is energized on the "L" terminal for remote indication of a fault at the thermostat.

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 a Y1 call and will lock out instead.)

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

Section 4: Controls

Flow Switch - FS (If equipped - brazed plate only)
A flow switch ensures the source water maintains the minimum required flow rate. This ensures 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 Ffow switch is not included on units utilizing a COAX source coil.

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 an HWG also do not have sensors T2 and T3. The control ignores T2 and T3 and disables Faults 15 and 16, Sensor BAD.

Electronic Expansion Valve (EXV) Control Board
Input signals are received from both the pressure transducer and the temperature thermistor located on the common suction line (between reversing valve and compressor). Based on the inputs the controller will adjust the EXV in microsteps to maintain the lowest stable superheat. A minimum of ten minutes of run time should be allowed before checking supperheat of the system as the control will adjust in time intervals to stabilize the superheat.

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.

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- 12˚F SETTING FOR T4
TEST	OPERATES IN NORMAL MODE WITH STANDARD DELAYS	OPERATES IN TEST MODE WITH DELAYS SPED UP
O/ V	FEATURE IS ACTIVE	FEATURE IS INACTIVE

NOTES:

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

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.

Thermostat Board DIP Switch Selection
Verify that the switches are set correctly prior to starting the unit with the following options:

DIP #1 - Single Stage or Two Stage

- ON = Single Stage
- OFF = Two Stage (factory default)

Note: Setting this DIP switch ON connects Y1 to Y2 and provides full load capacity for single speed systems, or for two-stage systems that are used in single-stage mode (e.g. with a single stage buffer tank controller).

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)

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 (Y1) WS and WT models
The Accessory (A) terminal output is energized after the random start timer (10s-20s) expires. Next, after another 10s delay, the first stage compressor and the loop pump(s) are energized.

Heating 2nd Stage, (Y1, Y2) WT models only
After the Y2 call is received, the second stage solenoid or second compressor is energized.

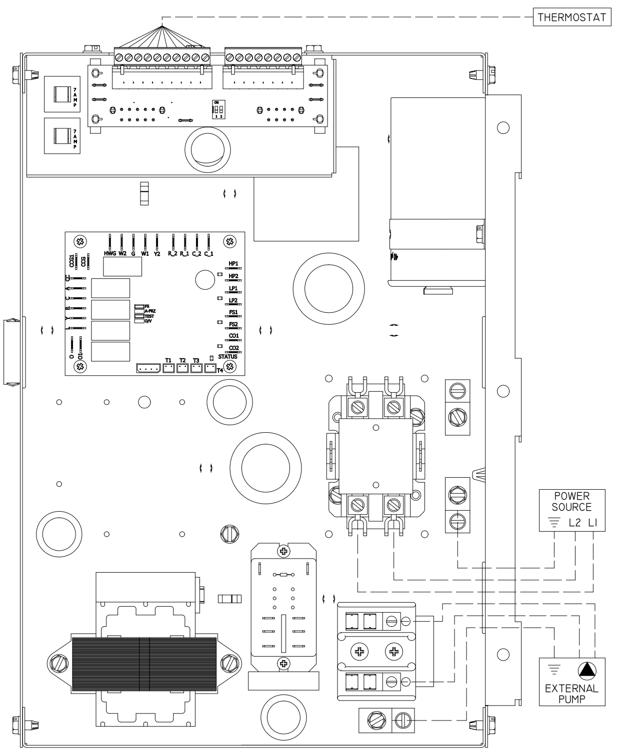
Cooling Operation
The reversing valve is energized for cooling operation. Terminal “O” from the thermostat is connected to the reversing valve solenoid.

Cooling 1st stage (Y1, 0) WS and WT models
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) WT models only
After the Y2 call is received, the second stage solenoid or second compressor is energized.

Electrical Connections

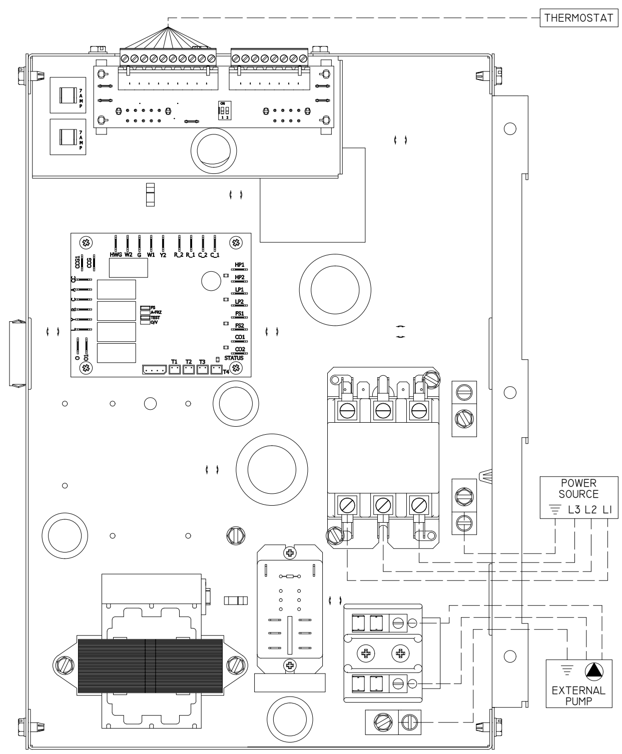
WS036-060 SINGLE PHASE:



WS072-084 SINGLE PHASE CONNECTIONS

NOTES:
- Route and trim wires to leave enough slack for opening, closing, and removal of control box.
* All drawings are for reference only, models and revisions may change components and/or locations.

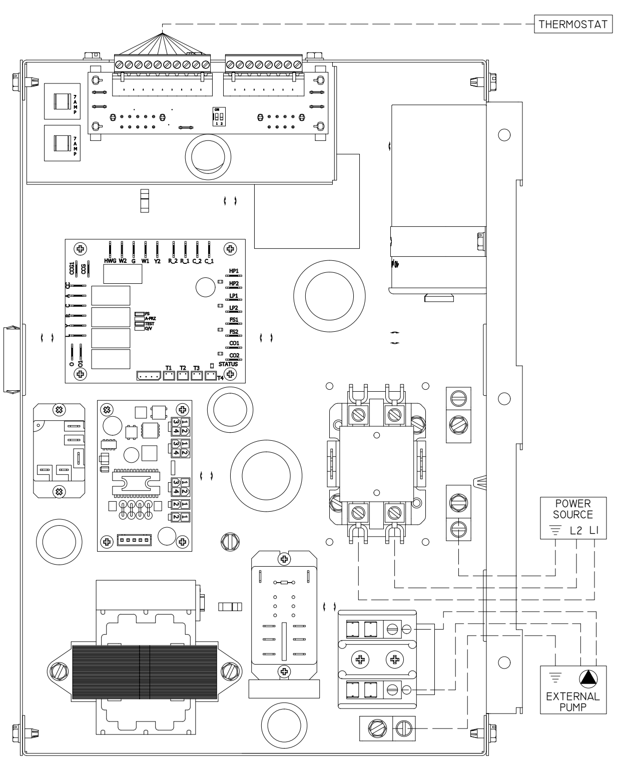
WS036-060 THREE PHASE:



WS072-084 THREE PHASE CONNECTIONS

NOTES:
- Route and trim wires to leave enough slack for opening, closing, and removal of control box.
* All drawings are for reference only, models and revisions may change components and/or locations.

WS072-084 SINGLE PHASE:



WS072-084 SINGLE PHASE CONNECTIONS

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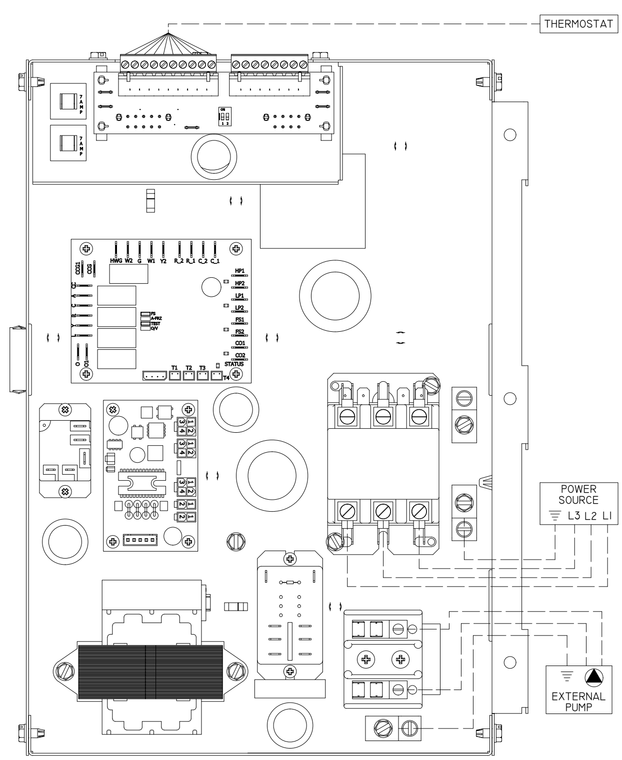


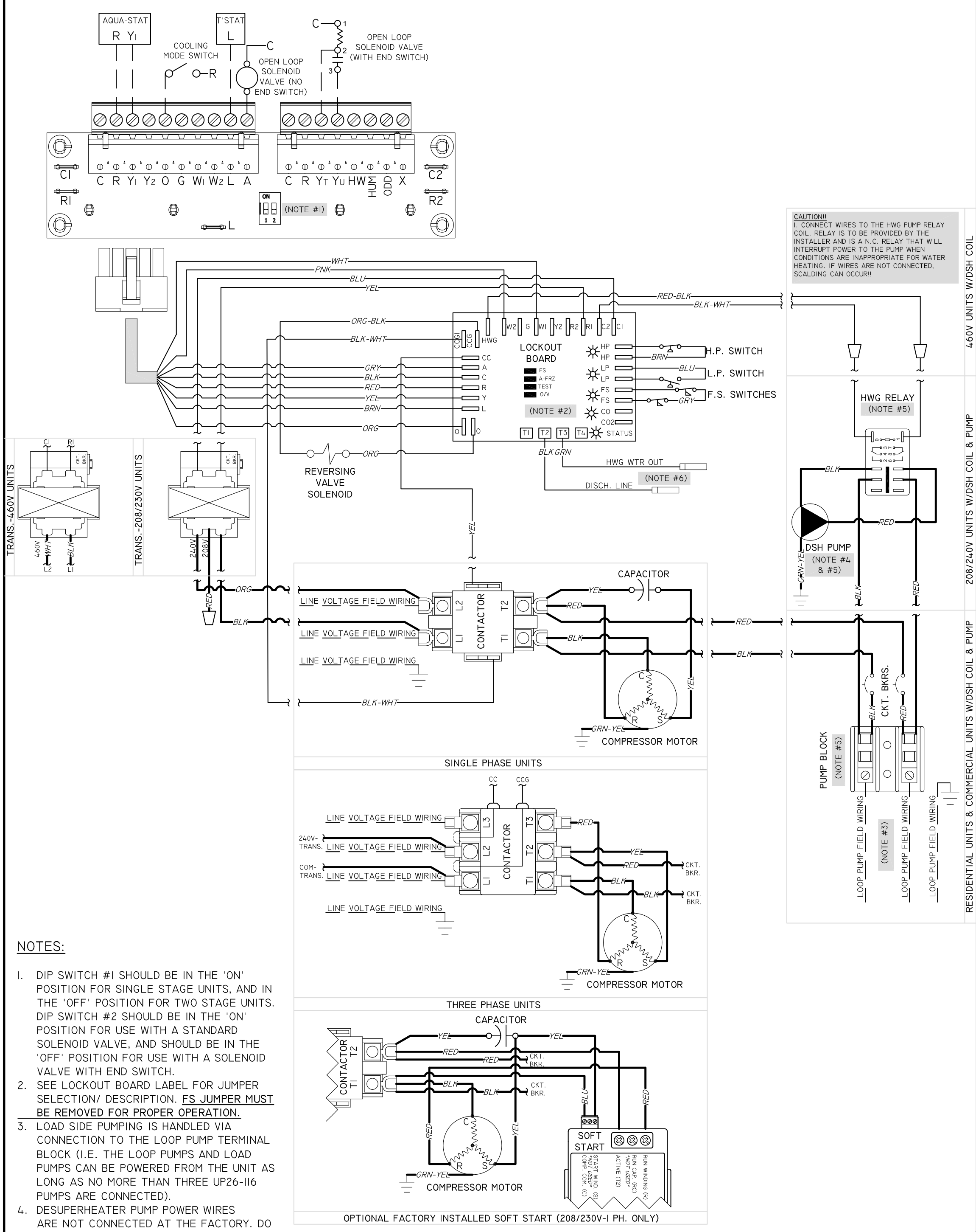
WS072-084 THREE PHASE CONNECTIONS

NOTES:
- Route and trim wires to leave enough slack for opening, closing, and removal of control box.
* All drawings are for reference only, models and revisions may change components and/or locations.

Wiring Diagram - WS036-060

REVISION HISTORY				
REV	DESCRIPTION	DATE	ECN	APPD
B	MODIFIED COLORS	11/10/2021	21-318-N01	KW
C	MODIFIED NOTES	5/3/2023	23-086-N03	KW

WATER-TO-WATER UNIT, SINGLE STAGE, RESIDENTIAL & COMMERCIAL *WS SERIES



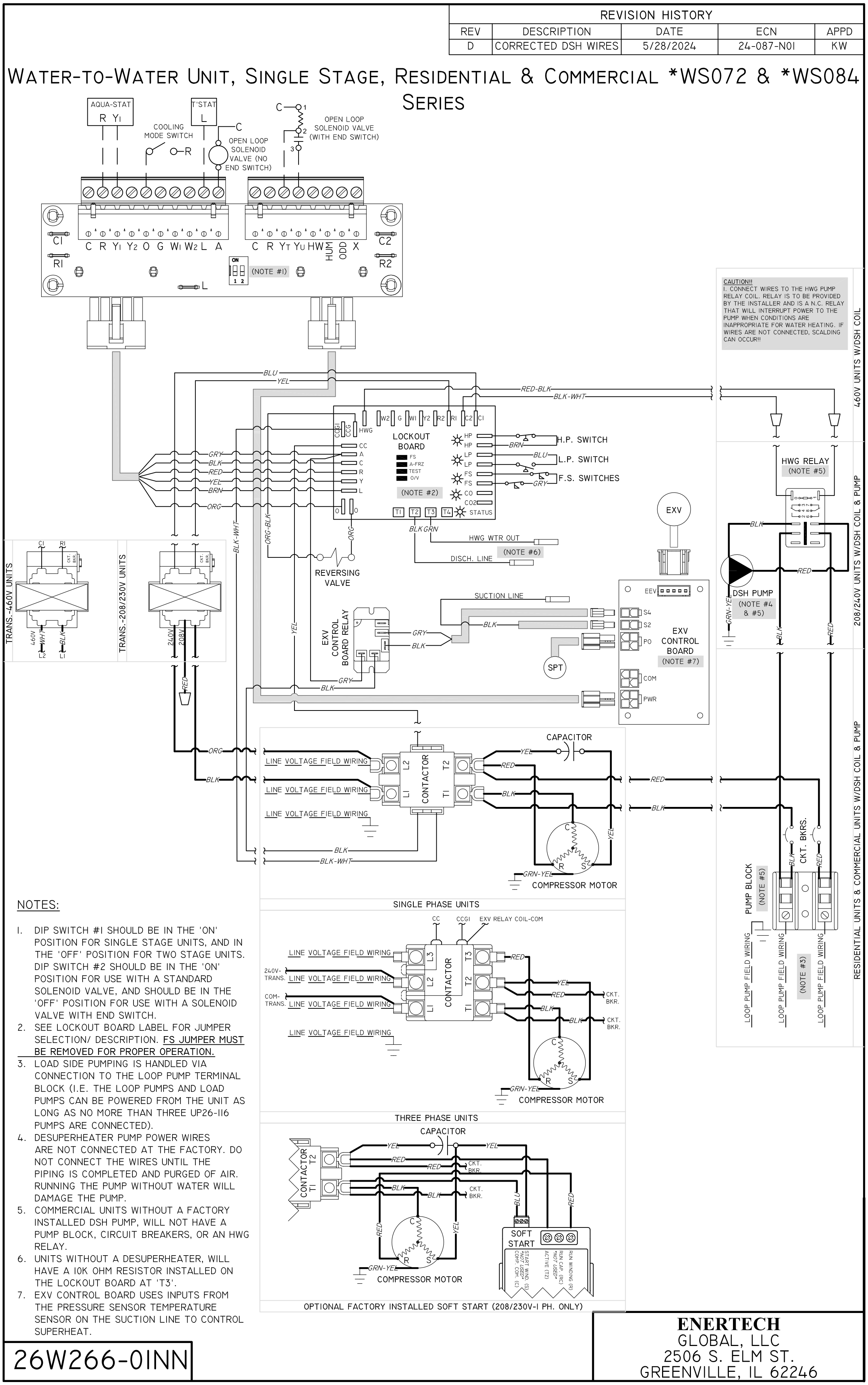
NOTES:

1. DIP SWITCH #1 SHOULD BE IN THE 'ON' POSITION FOR SINGLE STAGE UNITS, AND IN THE 'OFF' POSITION FOR TWO STAGE UNITS. DIP SWITCH #2 SHOULD BE IN THE 'ON' POSITION FOR USE WITH A STANDARD SOLENOID VALVE, AND SHOULD BE IN THE 'OFF' POSITION FOR USE WITH A SOLENOID VALVE WITH END SWITCH.
2. SEE LOCKOUT BOARD LABEL FOR JUMPER SELECTION/ DESCRIPTION. FS JUMPER MUST BE REMOVED FOR PROPER OPERATION.
3. LOAD SIDE PUMPING IS HANDLED VIA CONNECTION TO THE LOOP PUMP TERMINAL BLOCK (I.E. THE LOOP PUMPS AND LOAD PUMPS CAN BE POWERED FROM THE UNIT AS LONG AS NO MORE THAN THREE UP26-116 PUMPS ARE CONNECTED).
4. DESUPERHEATER PUMP POWER WIRES ARE NOT CONNECTED AT THE FACTORY. DO NOT CONNECT THE WIRES UNTIL THE PIPING IS COMPLETED AND PURGED OF AIR. RUNNING THE PUMP WITHOUT WATER WILL DAMAGE THE PUMP.
5. COMMERCIAL UNITS WITHOUT A FACTORY INSTALLED DSH PUMP, WILL NOT HAVE A PUMP BLOCK, CIRCUIT BREAKERS, OR AN HWG RELAY.
6. UNITS WITHOUT A DESUPERHEATER, WILL HAVE A 10K OHM RESISTOR INSTALLED ON THE LOCKOUT BOARD AT 'T3'.

26W192-01NN

ENERTECH
GLOBAL, LLC
2506 S. ELM ST.
GREENVILLE, IL 62246

Wiring Diagram - WS072-084



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6. UNITS WITHOUT A DESUPERHEATER, WILL HAVE A 10K OHM RESISTOR INSTALLED ON THE LOCKOUT BOARD AT 'T3'.
7. EXV CONTROL BOARD USES INPUTS FROM THE PRESSURE SENSOR TEMPERATURE SENSOR ON THE SUCTION LINE TO CONTROL SUPERHEAT.

Soft Start Controls

Hyper Engineering 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

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

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.

⚠ NOTICE ⚠

SureStart uses an optimized starting process that learns the starting characteristics of the compressor to further refine the starting cycle on each recurring start. It will usually optimize itself within the first (6-8) starts. For this reason, the first few starts should be ignored.

Section 4: Controls

FLASH CODE	DEFINITION	RE-START TIME
RAPID (10/sec)	LOW VOLTAGE	3 MIN.
TRIPLE (3/3 sec)	LOCKOUT: THREE FAILED STARTS	50 MIN.
SLOW (1/3 sec)	LOCKOUT: OVERCURRENT	10 MIN.
STEADY (1/sec)	CYCLE DELAY / FAULTS	3 MIN.
NOTE: LED REMAINS OFF IN NORMAL RUN MODE		

Led Flash Codes

A Red LED indicator will flash under the following conditions.

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 sec): 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.

Flash Code (Slow Flash (1/3 sec): Lockout on Over current)

- Displayed for "Overcurrent" in running mode of the compressor motor.
- Overcurrent limit is "25A for 08-16A version" and "50A for 16-40A rated version".
- Also displayed, if internal Klixon of the compressor trips out on overheat.
- Re-start is attempted after 10 minutes.

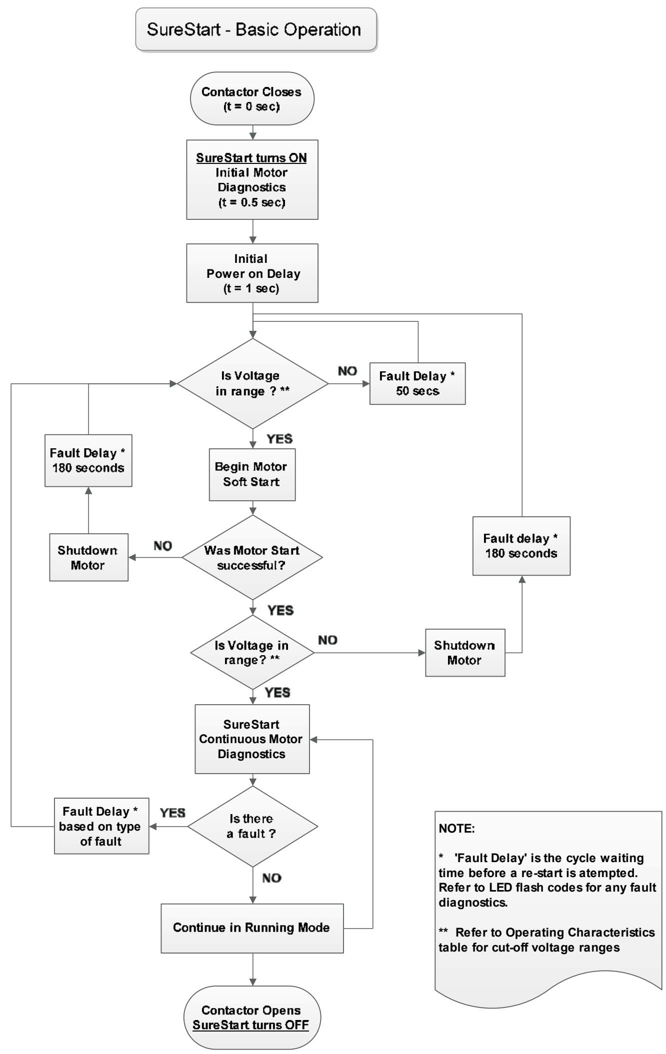
To limit the current in compressors from extending abnormally beyond its stated capacities, SureStart is also equipped with Overcurrent limit protection. For models rated from 16-40A, SureStart is designed to trip out in overload conditions exceeding 50A. In smaller models, it is designed to cutoff power to the compressor if the current drawn exceeds 25A. On overcurrent lockout, SureStart attempts a re-start automatically after 10 minutes.

Both failed start lockout and overcurrent limit protection have been designed to prevent the compressor from drawing abnormal currents in conditions not feasible for the compressor operation.

Flash Code (Slow Steady Flash (1/sec): Cycle Delay / Fault Mode)

- Displayed for "Cycle delay" between two consecutive softstarts or other faults mentioned below.
- Re-start is attempted after a default period of 3 minutes.
- Other possible reasons for this Fault mode indicator can be due to:
  - incorrect wiring during installation
  - a failed soft start attempt
  - intermittent power loss (duration longer than 100ms)
  - frequency out of range

SureStart Basic Operation Chart:



Water Quality Table

Potential	Problem Chemical(s) or Condition	Range for Copper Heat Exchangers	Range for Cupro-Nickel Heat Exchangers	Range for Stainless Steel BPHE
Scaling	Calcium & Magnesium	Less than 350 ppm	Less than 350 ppm	Less than 0.1 ppm
	pH Range	7 - 9	5 - 9	7 - 9
Corrosion	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	Less than 0.5 ppm	Less than 0.5 ppm	Less than 2-20 ppm
	Calcium Chloride / Sodium	Less than 125 ppm	Less than 125 ppm	Not Allowed
	Chlorine	Less than 0.5 ppm	Less than 0.5 ppm	Not Allowed
	Hydrogen Sulfide	None Allowed	None Allowed	Less than 0.05 ppm
Biological	Iron Bacteria	None Allowed	None Allowed	Not Allowed
	Iron Oxide	Less than 1 ppm	Less than 1 ppm	Less than 0.2 ppm
Erosion	Suspended Solids	Less than 10 ppm	Less than 10 ppm	16-20 mesh strainer recommended
	Water Velocity	Less than 8ft/s	Less than 12 ft/s	Less than 5.5 m/s in the port

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

Water Quality

The quality of the water used in geothermal systems is very important. Water quality is not only important for the source side of the system, but even more so for the load side of the system. Due to use of dissimilar metals throughout the system (i.e. stainless braze plates, cast iron pump volutes, etc.) certain minerals or chemicals may build up and become detrimental to system operation and longevity. Filling the system with good quality water that meets the specifications outlined in the table above.

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.

Note: Once the system has been flushed and filled, Enertech recommends the use of Fernox F1 (Enertech P/N: F-57880) water treatment products in order to keep the system clean and running smooth for years to come.

In an open loop system the water quality is of no less importance. Due to the inherent variation of the supply water, it should be tested prior to making the decision to use an open loop system. Scaling of the heat exchanger and corrosion of the internal parts are two of the potential problems. The Department of Natural Resources or your local municipality can direct you to the proper testing agency. Please see Table 2 for guidelines.

Note: Failure to adhere to the water quality guidelines may result in loss of warranty.

Interior Piping

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

Table: Pipe Insulation

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

Flow Center

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 connections. Various fittings are available for the double o-ring flow centers for different connections. See figure 6 for connection options. A typical installation will require the use of a hose kit. Matching hose kits come with double o-ring adapters to transition to 1” hose connection.

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

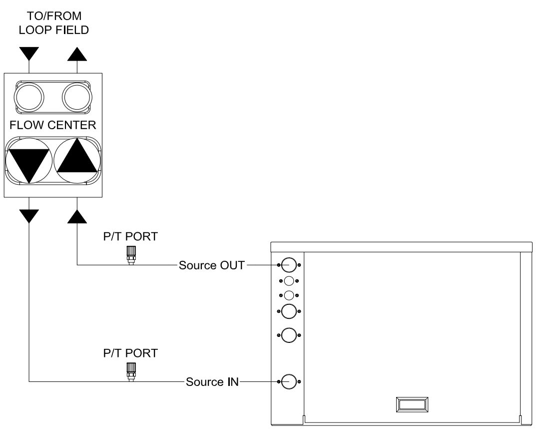
Section 5: Unit Piping

Flushing & Charging a Pressurized Flow Center

Once piping is completed between the unit, flow center, and the earth loop, final purging and charging of the system is needed. A flush cart (at least a minimum of 1.5 hp pump motor or larger) is needed to achieve adequate flow velocity (2 fps in all piping) in the loop to purge air and debris from the loop piping (unless the header manifold is located inside and has isolation valves). All air and debris must be removed from the system before operation or pump failure could result. The flush ports located on the flow center are access to the piping system for the flush cart. See below for connection details.

The 3-way valves on the flow center include direction indicators on the valves which determine the flow path (see figure 8). A 3/8" socket drive is required to operate the 3-way valves. The valves will turn in either direction, 360 degrees. Make sure during this process that the valves are in the same position so that air does not become trapped in the system.

Typical Single Unit Piping Connection (Pressurized Flow Center)



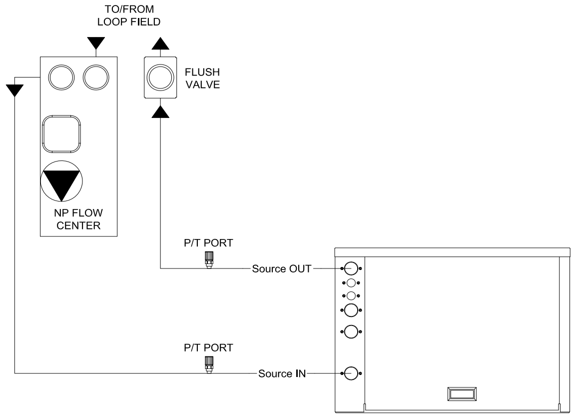
Typical Non-Pressurized Flow Center Installation

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.

Flushing the Interior Piping (Non-Pressurized)

Do not use the flush cart to purge the interior piping and flow center in a non-pressurized system. Once the loop has been flushed the ball valves may be opened above the flush ports. Take a garden hose from the flush port connected to the water out to the loop pipe, and run the other end of the hose into the top of the canister. Fill the canister with water and turn the pumps on. Continue to fill the canister until the water level stays above the dip tube. Once filling is complete, remove the hose and close the flush port. Turn the system on. Any air that may still be in the system will burp itself out of the top of the canister. Leave the top open for the first 1/2 hour of run time to ensure that all of the air is bled out. Tighten the cap on the flow center to complete the flushing and filling procedure (hand tighten only -- do not use a wrench).

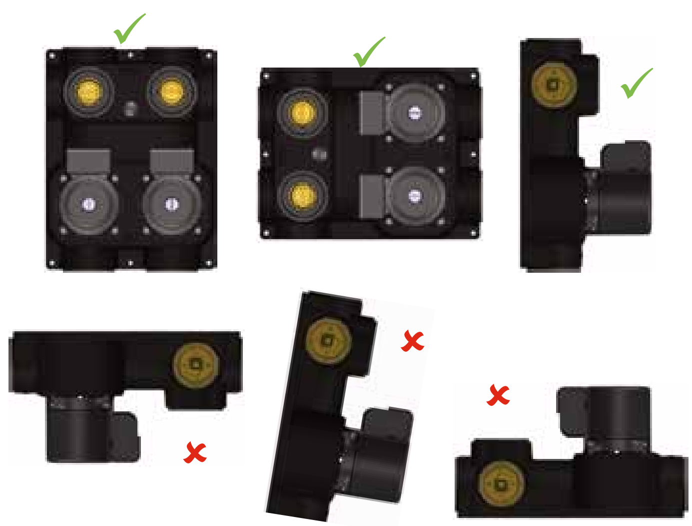
Typical Single Unit Piping Connection (Non-Pressurized Flow Center)

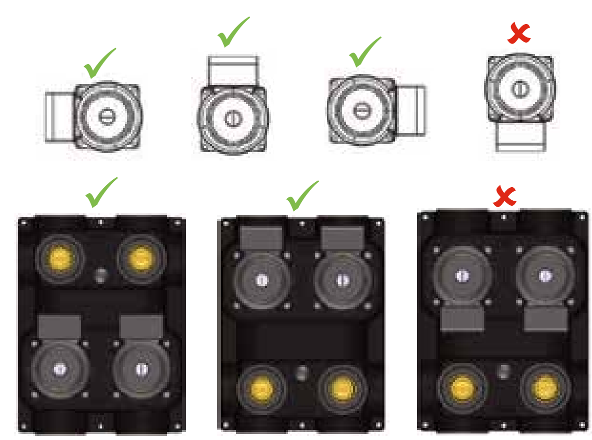


Pressurized Flow Center and Pump Mounting

The flow center can be mounted with the flow paths either vertical or horizontal (see Acceptable mounting positions for Flo-Link and GPM series flow centers). However, the flow center cannot be mounted on its back, upside down, or at an angle, as premature pump failure will occur when the pump shaft is not in the horizontal position.

Equally important to pump longevity is terminal box orientation (See Acceptable terminal box locations for UPS26-99, UP26-99, and UP26-116 pumps) for proper control box orientation. The pump terminal box must be located in a position to avoid condensation running into the control box, and also to take advantage of the "weep holes" designed to drain any condensation that may have formed. "Weep holes" are located on three sides of the pump.



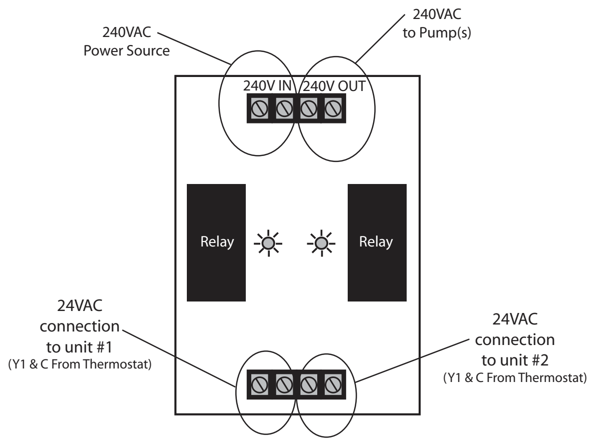


Section 5: Unit Piping

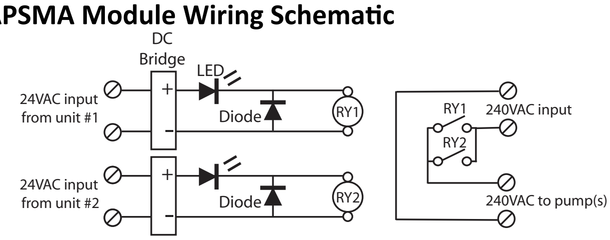
APSMA Pump Sharing Module

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. The APSMA Module Wiring Schematic provides a layout of the board. The module must be mounted in a NEMA enclosure or inside the unit control box. Local code supersedes any recommendations in this document.

APSMA Module Layout



APSMA Module Wiring Schematic



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.

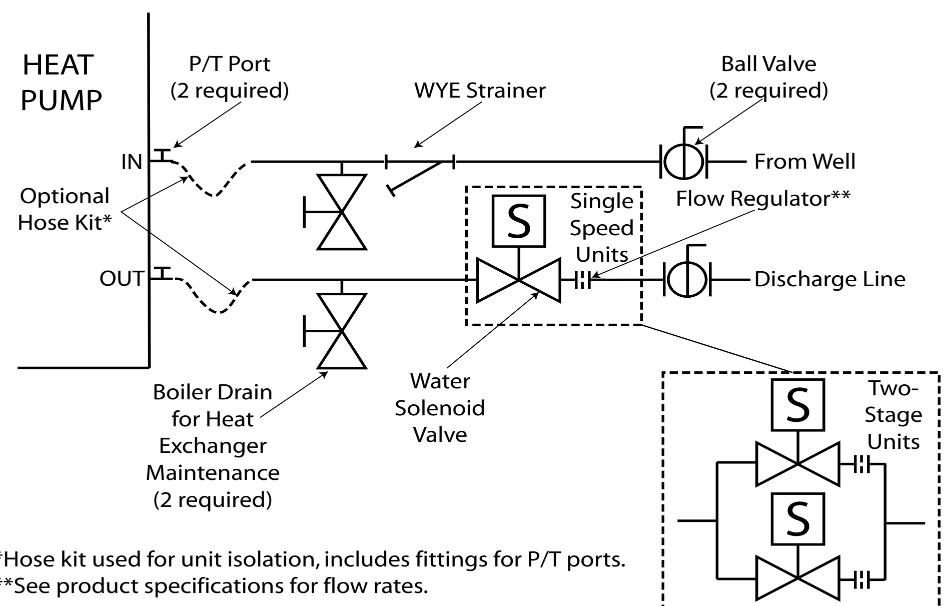
A flow regulator should be placed after the water solenoid valve. Always check the product specification catalog for proper flow rate. A calculation must be made to determine the flow rate, so that the leaving water temperature does not have the possibility of freezing.

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 help when velocity noise is noticeable through the flow regulator. Spreading some of the pressure drop across the ball valves will lessen the velocity noise. Always double check flow rate at the P/T ports to make sure the ball valve adjustments have not lowered water flow too much; and essentially taken the flow regulator out of the equation. It's a good idea to remove the ball valve handles once the system is completed to avoid nuisance service calls.

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

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

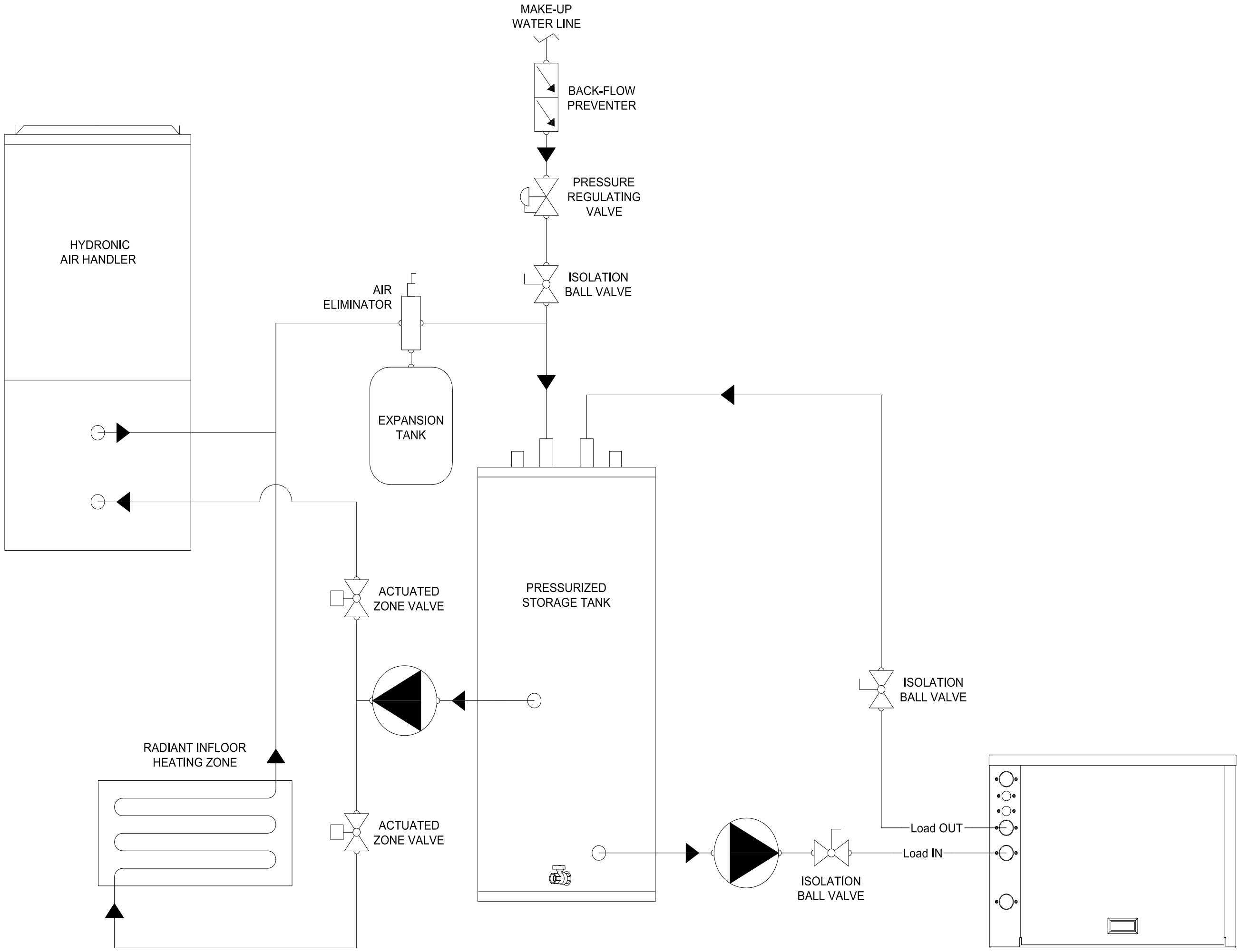
Open Loop Piping Example



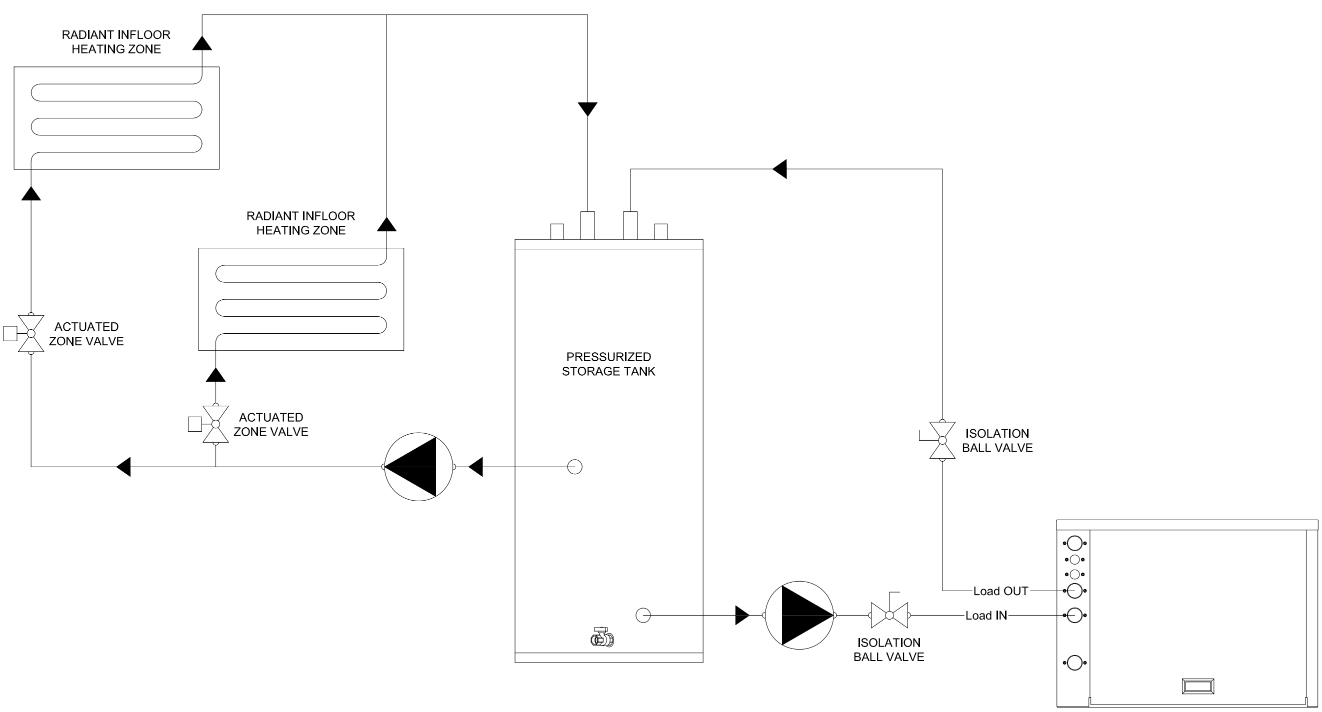
*Hose kit used for unit isolation, includes fittings for P/T ports.
**See product specifications for flow rates.

Section 5: Unit Piping

Typical Single Compressor Unit Piping Connection



Typical Storage Tank Piping For Radiant Floor Heating



Section 5: Unit Piping

Flush Cart Design

The Enertech Manufacturing flush cart has been designed to effectively and efficiently flush the earth loop and to facilitate injecting and mixing of the antifreeze. The single most important element in flow center reliability is the ability to remove all the air and debris from the loop and to provide the proper working pressure.

Removing Debris During Flushing

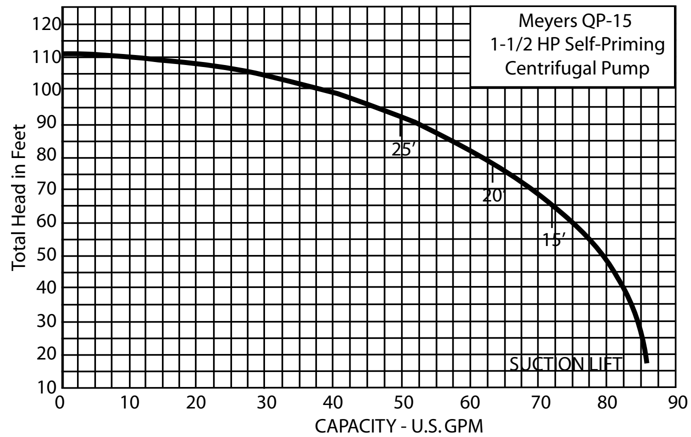
Most flow center or pump failures are a result of poor water quality or debris. Debris entering the loop during fusion and installation can cause noise and premature pump failure. Enertech recommends a double flush filtering method during purging. When purging, use a 100 micron bag filter until air bubbles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

Features of the Flush Cart:

- Cylinder: HDPE, SDR15.5, 10” dia. (10 Gallons)
- Pump: Myers High Head QP15, 1.5hp, 115V
- Hose connections: Cam Lock quick connects - 1-1/2” hoses
- Hand Truck: 600lb rating with pneumatic tires
- Wiring: Liquid Tight metal on/off switch
- Tubing: SDR11 HDPE
- Connections: 2 - 3/4” connections for antifreeze and discharge
- Drain: one on the pump and the tank

Enertech Flush Cart:

Flush Cart Pump Curve:

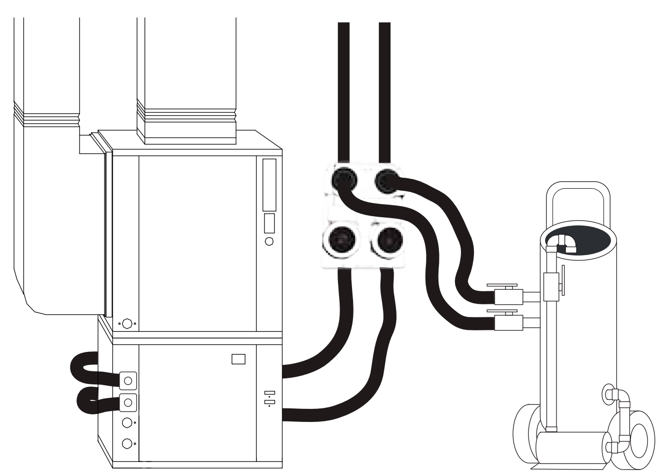


Flushing Process

Step 1: Flushing the Earth Loop

1. Connect flush cart hoses to flow center flush ports using proper adapters #AGAFP.
2. Connect water supply to hose connection on return line of flush cart.
3. Turn both 3-way valves on flow center to flush ports and loop position.
4. Turn on water supply (make sure water is of proper quality).
5. As the reservoir fills up, turn the pump on and off, sucking the water level down. Do not allow the water level to drop below intake fitting to the pump.
6. Once the water level remains above the water outlet in the reservoir leave the pump running continuously.
7. Once the water level stays above the “T” in the reservoir, turn off the water supply (this also allows observation of air bubbles).
8. Run the pump for a minimum of 2 hours for proper flushing and purging (depending on system size it may take longer).
9. “Dead head” the pump every so often and watch the water level in the reservoir. Once all the air is removed there should not be more than a 1” to 2” drop in water level in the reservoir. If there is more than a 2” drop, air is still trapped in the system. This is the only way to tell if air is still trapped in the system.
10. To dead head the pump, shut off the return side ball valve on the flush cart. This will provide a surge in pressure to the system piping, helping to get the air bubbles moving. Do not reverse flow during flushing.

Flush Cart Connections



Section 5: Unit Piping

Water Quality: Even on a closed loop system water quality is an issue. The system needs to be filled with clean water. If the water on site has high iron content, high hardness, or the PH is out of balance, premature pump failure may result. Depending upon water quality, it may need to be brought in from off site.

Step 2: Flushing the Unit

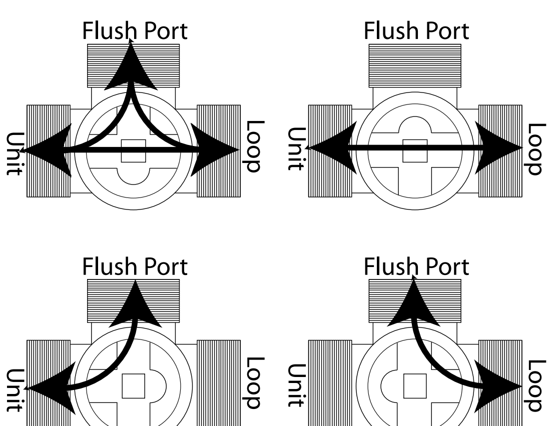
1. Turn off the pump on the flush cart.
2. Turn both 3-way valves to the unit and flush port position.
3. Turn the pump back on. It may be necessary to turn the water supply back on to keep the water level in the reservoir above the return tee.
4. This should only take 5 to 10 minutes to purge the unit.
5. Once this is done, the entire system is now full of water, and the flush cart pump may be turned off.

Step 3: Adding Antifreeze by Displacement

If the antifreeze was not added when the loop was being filled, it will be necessary to follow the next few steps.

1. Turn both 3-way “Ts” back to the original position for flushing the loop only.
2. Close the return side ball valve on the flush cart.
3. Connect hose to the return side discharge line and run it to a drain. Open the ball valve on discharge line on flush cart.
4. Turn pump on until water level is sucked down just above the water outlet in the reservoir, and turn pump off. Be sure not to suck air back into the system.
5. Fill the reservoir back up with the antifreeze.
6. Repeat steps 5 and 6 until all the antifreeze is in the system and reservoir.
7. Turn the discharge line ball valve off at the flush cart. Turn the return line ball valve back to the on position.
8. It may be necessary to add some water into the reservoir to keep the water level above the return tee so that the solution does not foam.
9. The system must be run for 3 to 4 hours to mix the antifreeze and water in the reservoir. The fluid will not mix inside the loop.
10. Check the antifreeze level every so often to insure that the proper amount was added to the system (see antifreeze charging section).

Flow Center 3-Way Valves:



Step 4: Final Pressurization of System

Once all of the air and debris has been removed, and the antifreeze has been added and mixed, the system is ready for final pressurization.

1. Turn one of the 3-way valves so that it is open to all 3 ports, the unit, loop, and flush port. Turn the other valve so it is only open to the loop and flush port (pressure is also applied to the hose kit in this arrangement).
2. Turn the flush cart pump on and allow the system to start circulating.
3. With the pump running, turn the return line ball valve to the off position on the flush cart, “dead heading” the pump.
4. There should be a maximum of 1 to 2 inches of drop in the water level in the reservoir. This only takes about 3-5 seconds.
5. Next, turn the supply line ball valve to the off position on the flush cart (isolates the flow center from the flush cart).
6. Now that the system is isolated from the reservoir the pump can be turned off. Do not open the main flush cart ball valves yet.
7. Connect the water supply back to the discharge line hose connection, and open the ball valve. Turn on the water supply and leave it on for 20 to 30 minutes. This will stretch the pipe properly to insure that the system will not have a “flat” loop during cooling operation.
8. Once the loop is pressured (recommended pressure on initial start up is 50 to 70 psi), turn the water supply off. Turn off the discharge line ball valve, and disconnect the water supply. Maximum pressure should never exceed 100 psi under any circumstance!
9. Turn the 3-way valves on the flow center back to the normal operation mode, which closes the flush port connections.
10. Open the ball valves on the flush cart to relieve pressure on the hoses. Disconnect the hoses from the flow center.

Note: Pressurized flow centers and Grundfos UP series pumps need a minimum of 3psi on the suction side of the pump to operate. Maximum operating pressure is 100 psi.

Loop static pressure will fluctuate with the seasons. Pressures will be higher in the winter months than during the summer months. In the cooling mode, the heat pump is rejecting heat, which relaxes the pipe. This fluctuation is normal and needs to be considered when charging and pressuring the system initially. Typical operating pressures of an earth loop are 15 to 50 psi.

Note: Burping pump(s): On flow center initial start up, the pumps must be bled of air. Start the system and remove the bleed screw from the back side of the pump(s). This allows any trapped air to bleed out. It also floods the pump shaft, and keeps the pump(s) cool. Failure to do this could result in premature pump failure.

Section 6: Desuperheater Package

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 vented 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.

Desuperheater Installation

Units that ship with the desuperheater function also ship with a connection kit. Installation of the kit and examples of connection to the potable water system is described in the following steps and drawings.

Notes:

- ALL Enertech Global products meet the requirements of NSF-372 (Lead Free).
- Desuperheater capacity is based on 0.4 GPM Flow per nominal ton at 90°F entering hot water temperature.
- 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.

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 DESUPERHEATER COULD RAISE TANK TEMPERATURES TO UNSAFE LEVELS.

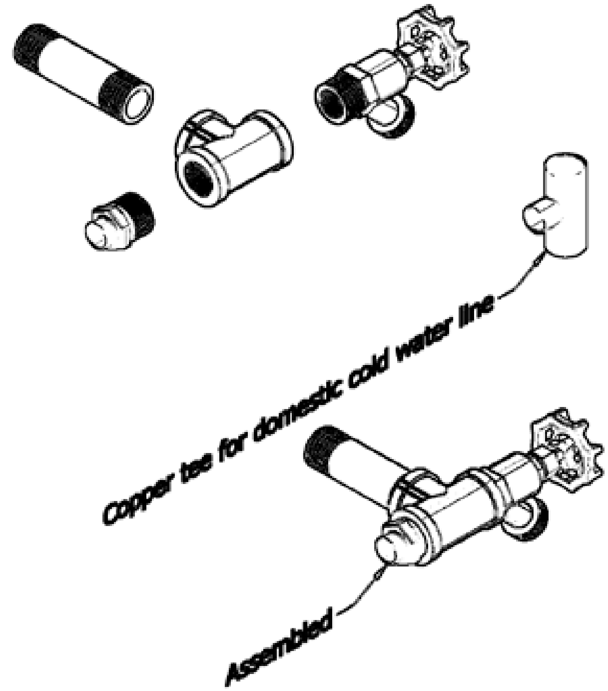
Plumbing Installation

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

1. Disconnect electricity to water heater.
2. Turn off water supply to water heater.
3. Drain water heater. Open pressure relief valve.
4. Remove drain valve and fitting from water heater.
5. Thread the ¾" MPT x 3-1/2" nipple into the water heater drain port. Use Teflon tape, or pipe dope on threads.
6. Thread the center port of the ¾" brass tee to the other end of the nipple.
7. Thread one of the copper adaptors into the end of the tee closest to the heat pump.
8. Thread the drain valve into the other end of the nipple.
9. Above the water heater, cut the incoming cold water line. Remove a section of that line to enable the placement of the copper tee.
10. Insert the copper tee in the cold water line.
11. Thread the remaining two ½"SWT x ¾"MPT copper adaptors into the ¾" FPT fittings on the heat pump marked HWG IN and HWG OUT.
12. Run interconnecting ½" copper pipe from the HOT WATER OUT on the heat pump, to the copper adaptor located on the tee at the bottom of the water heater.
13. Run interconnecting ½" copper pipe from the HOT WATER IN on the heat pump, to the copper tee in the cold water line.
14. Install an air vent fitting at the highest point of the line from step 13 (assuming it's the higher of the two lines from the heat pump to the water heater).
15. 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 out".
16. Turn the water supply to the water heater on. Fill water heater. Open highest hot water faucet to purge air from tank and piping.
17. Flush the interconnecting lines, and check for leaks. Make sure air vent is shut off when water begins to drip steadily from the vent.
18. Loosen the screw on the end of the despuerheater pump to purge the air from the pump's rotor housing. A steady drip of water will indicate the air is removed. Tighten the screw and the pump can be connected to the contactor or terminal block.
19. Install 3/8" closed cell insulation on the lines connecting the heat pump to the water heater.
20. Reconnect electricity to water heater.

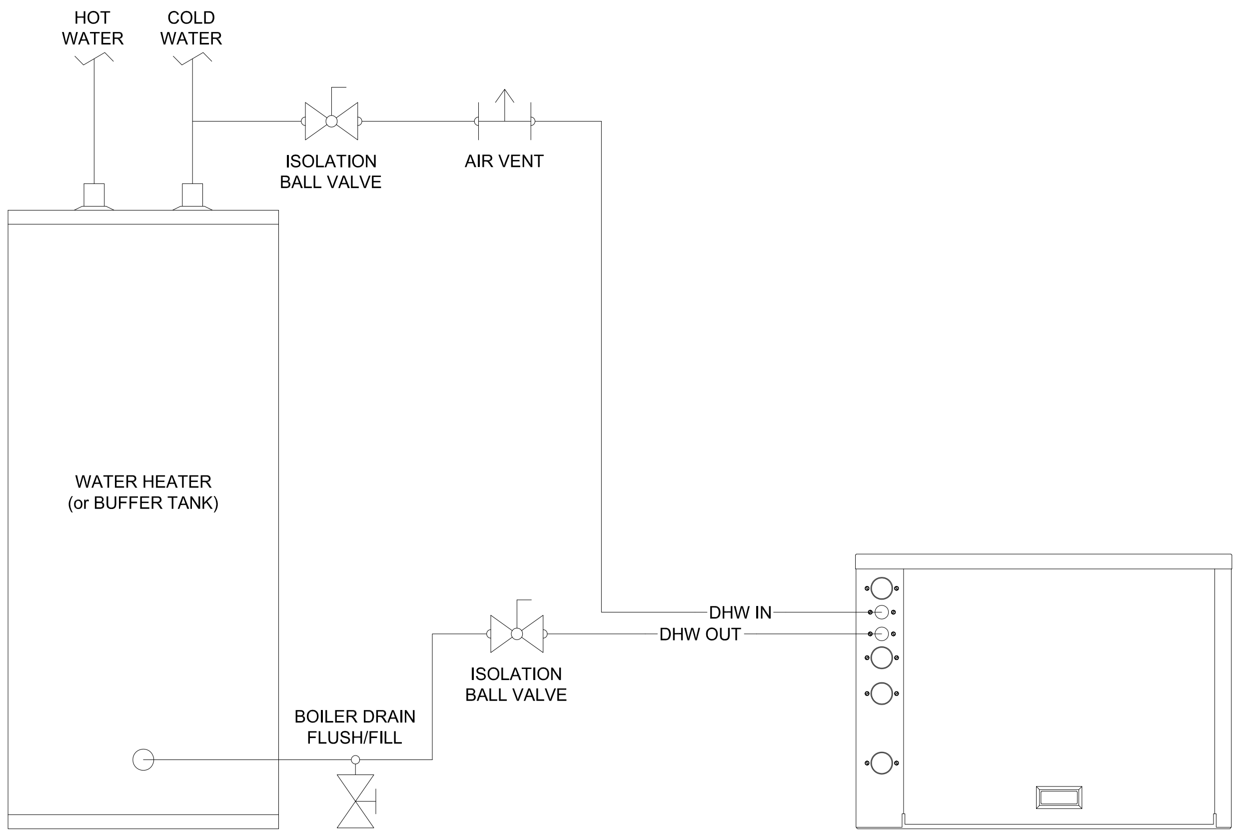
Contents of the Desuperheater Fitting Kit

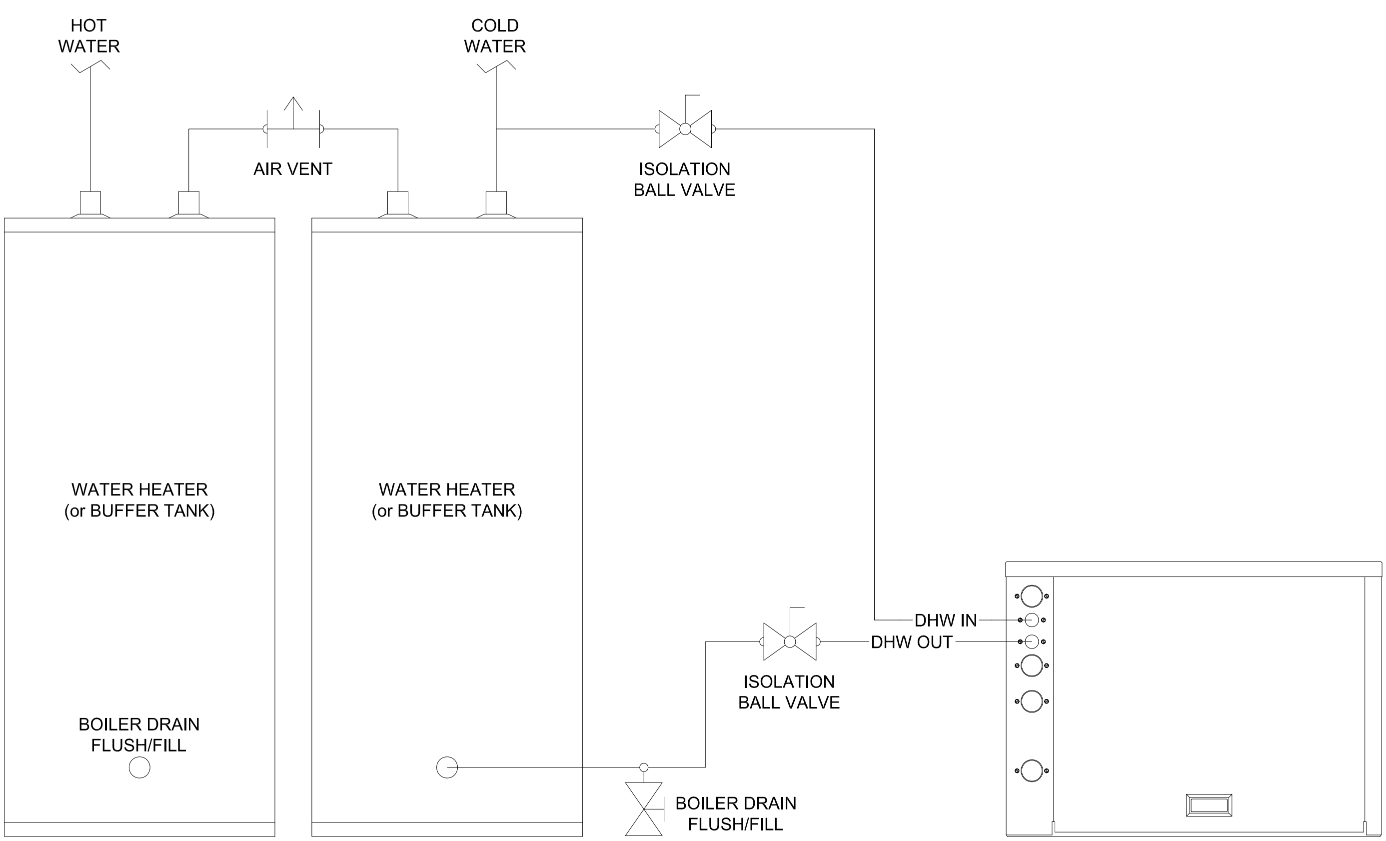
- (1) p/n 20D052-01NN, Installation Instructions
- (1) p/n 33P211-01BN, 3/4"x 3/4"x 3/4" FPT Brass Tee
- (1) p/n 33P210-01NN, ¾" Boiler Drain Valve
- (1) p/n 11080005001, ¾" MPT x 3-1/2" Brass Nipple
- (3) p/n 11080006001, ½" SWT x ¾" MPT Copper Adaptor
- (1) p/n 11080007001, ¾" x ¾" x ½" SWT Copper Tee



Section 6: Desuperheater Package

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 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?

⚠ CAUTION ⚠

GROUND LOOPS AND/OR HYDRONIC LOOPS MUST BE ANTIFREEZE PROTECTED. HYDRONIC LOOP ANTIFREEZE MUST BE NON-FLAMMABLE. 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. DO NOT SMOKE WHEN HANDLING FLAMMABLE SOLUTIONS AND USED ONLY IN A WELL VENTILATED AREA. FAILURE TO OBSERVE SAFETY PRECAUTIONS MAY RESULT IN FIRE, INJURY, OR DEATH. NEVER WORK WITH 100% ALCOHOL SOLUTIONS.

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, 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 is also 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 following **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.

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

Notes:
Unit coaxial heat exchanger = 1 Gallon
Flush Cart = 8-10 Gallons
10' of 1" Rubber Hose = 0.4 Gallons

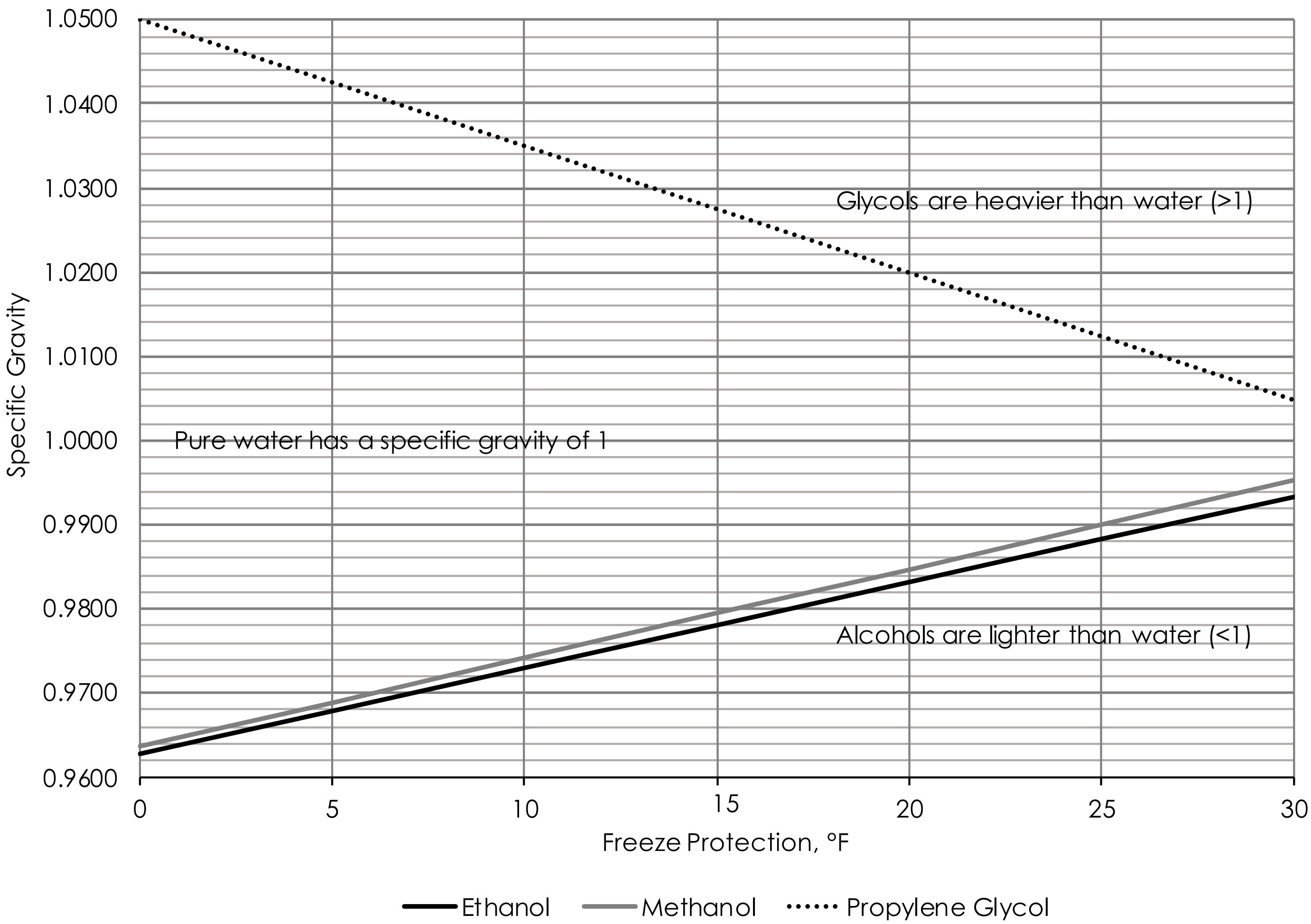
Section 7: Antifreeze

Antifreeze Percentages by Volume Table

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%
Heat Transfer Fluid (HTF)	Mix according to manufacturer's directions on container label			

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

Antifreeze Specific Gravity Table



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.

⚠ MISES EN GARDE ⚠
NE PAS DÉMARRER L'APPAREIL AVANT QUE LA NOUVELLE STRUCTURE SOIT PRÊTE À ÊTRE OCCUPÉE

⚠ MISES EN GARDE ⚠
VÉRIFIER LES POINTS SUIVANTS AVANT DE METTRE L'ÉQUIPEMENT SOUS TENSION

Equipment Start-Up Checklist

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 8: 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	COOLING		HEATING	
Source IN Water Pressure		PSI		PSI
Source OUT Water Pressure		PSI		PSI
Source Water Pressure DROP		PSI		PSI
Flow Rate		GPM		GPM
*Check pressure drop chart for GPM				

ELECTRICAL DATA	COOLING		HEATING	
Line Voltage		V		
Total Unit AMPS		A		A
Compressor AMPS		A		A
Wire Size		GA		
Circuit Breaker Size		A		

Source Water	COOLING		HEATING	
Source IN Water Temp.		°F		°F
Source OUT Water Temp.		°F		°F
Source Water Temp. Diff.		°F		°F

HE/HR	COOLING		HEATING	
Heat of Rejection		BTU/HR		
Heat of Extraction				BTU/HR

Notes: HE/HR = GPM x Water Temp. Diff. x 500 (Water – Open Loop)
HE/HR = GPM x Water Temp. Diff. x 485 (Water/Antifreeze – Closed Loop)

Load Water	COOLING		HEATING	
Load IN Water Temp.		°F		°F
Load OUT Water Temp.		°F		°F
Load Water Temp. Diff.		°F		°F

Air Coil	COOLING		HEATING	
Supply Air Temp.		°F		°F
Return Air Temp.		°F		°F
Air Temp. Diff.		°F		°F

*Confirm auxiliary heat is de-energized for the above readings.

Auxiliary Heat Operation	HEATING	
Supply Air Temp.		°F
Return Air Temp.		°F
Air Temp. Diff.		°F

Auxiliary Heat Elec. Data	HEATING	
Line Voltage		V
Total AMPS (Full KW – All Stages)		A
Wire Size		GA
Breaker Size		A

CFM = (Watts x 3.413) ÷ (Air Temp. Diff. x 1.08)
Watts = Volts x Auxiliary Heat AMPS

Installer / Technician: ____________________________________ Date: ______________

Water Flow Calculations and Selection

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

Top flow rate: Open loop systems (1.5 to 2.0 gpm per ton)

Middle flow rate: Minimum closed loop system flow rate (2.25 to 2.50 gpm/ton)

Bottom flow rate: Nominal (optimum) closed loop system flow rate (3.0 gpm/ton)

Performance Check

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

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

1. **Determine flow rate in gallons per minute.**
   - Check entering water temperature
   - Check entering water pressure
   - Check leaving water pressure

2. **After information is recorded.**
   - Find corresponding entering water temperature column in the WPD Table
   - Find pressure differential in PSI column
   - Then read the GPM column to determine flow in GPM

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

Note: A 10% variance from table is allowed. Always use the same pressure gauge & temperature measuring device. Water flow must be in range of table. If system has too much water flow, performance problems should be expected.

HE / HR Tables - WS036

Model	Mode	EST (°F)	Source GPM	Heat of Extraction (MBtuh) at Various Entering Load Temperatures (°F)														
		Source Flow		50	80	100	110	120	50	80	100	110	120	50	80	100	110	120
				Load Flow GPM 5					Load Flow GPM 7					Load Flow GPM 9				
WS036	Full Load Heating	25	5	19.4	18.7	18.2	15.9	14.9	19.5	18.8	18.3	16.0	15.0	ONR	18.9	18.3	16.0	15.0
			7	20.9	20.1	19.6	17.1	16.0	21.0	20.3	19.7	17.2	16.1	ONR	20.3	19.8	17.3	16.2
			9	21.7	21.0	20.4	17.8	16.7	21.9	21.1	20.5	17.9	16.8	ONR	21.2	20.6	18.0	16.8
		30	5	21.1	20.4	19.8	17.3	16.2	21.3	20.5	19.9	17.4	16.3	21.3	20.6	20.0	17.5	16.4
			7	22.8	22.0	21.4	18.7	17.5	22.9	22.1	21.5	18.8	17.6	23.0	22.2	21.6	18.8	17.7
			9	23.7	22.9	22.2	19.4	18.2	23.8	23.0	22.3	19.5	18.3	23.9	23.1	22.4	19.6	18.4
		50	5	30.4	29.4	28.5	24.9	23.4	30.6	29.5	28.7	25.1	23.5	30.7	29.6	28.8	25.2	23.6
			7	32.8	31.6	30.7	26.9	25.2	33.0	31.8	30.9	27.0	25.3	33.1	31.9	31.0	27.1	25.4
			9	34.1	32.9	32.0	28.0	26.2	34.3	33.1	32.2	28.1	26.4	34.5	33.2	32.3	28.2	26.5
		70	5	40.3	38.8	37.8	33.0	30.9	40.5	39.0	38.0	33.2	31.1	40.7	39.2	38.1	33.3	31.2
			7	43.4	41.8	40.7	35.5	33.3	43.6	42.1	40.9	35.7	33.5	43.8	42.2	41.1	35.9	33.6
			9	45.1	43.5	42.3	37.0	34.7	45.4	43.8	42.6	37.2	34.9	45.6	43.9	42.7	37.3	35.0

Model	Mode	EST (°F)	Source GPM	Heat of Rejection (MBtuh) at Various Entering Load Temperatures (°F)														
		Source Flow		40	50	60	75	90	40	50	60	75	90	40	50	60	75	90
				Load Flow GPM 5					Load Flow GPM 7					Load Flow GPM 9				
WS036	Full Load Cooling	40	5	33.5	38.6	44.5	51.2	52.9	35.8	41.3	47.6	54.7	56.6	ONR	42.6	49.1	56.5	58.4
			7	33.3	38.4	44.2	50.8	52.5	35.6	41.0	47.2	54.3	56.2	ONR	42.3	48.8	56.1	58.0
			9	32.9	37.9	43.7	50.3	52.0	35.2	40.6	46.7	53.7	55.6	ONR	41.9	48.2	55.5	57.4
		50	5	33.6	38.7	44.6	51.3	53.0	35.9	41.4	47.7	54.8	56.7	37.1	42.7	49.2	56.6	58.5
			7	33.4	38.4	44.3	50.9	52.6	35.7	41.1	47.3	54.4	56.3	36.8	42.4	48.9	56.2	58.1
			9	33.0	38.0	43.8	50.4	52.1	35.3	40.6	46.8	53.8	55.7	36.4	42.0	48.3	55.6	57.5
		70	5	33.0	38.0	43.8	50.4	52.1	35.3	40.6	46.8	53.9	55.7	36.4	42.0	48.3	55.6	57.5
			7	32.8	37.7	43.5	50.0	51.7	35.0	40.3	46.5	53.5	55.3	36.2	41.7	48.0	55.2	57.1
			9	32.4	37.3	43.0	49.5	51.1	34.6	39.9	46.0	52.9	54.7	35.8	41.2	47.5	54.6	56.4
		90	5	32.0	36.8	42.4	48.8	50.5	34.2	39.4	45.4	52.2	53.9	35.3	40.7	46.8	53.9	55.7
			7	31.7	36.6	42.1	48.5	50.1	33.9	39.1	45.0	51.8	53.6	35.0	40.4	46.5	53.5	55.3
			9	31.4	36.2	41.7	47.9	49.6	33.6	38.7	44.5	51.2	53.0	34.7	39.9	46.0	52.9	54.7

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
3. Performance data accurate within ±15%.
4. Unit performance test is run without hot water generation.
5. Capacity data does not include the source-side pump power and it does not reflect pump power correction for AHRI/ISO conditions.
6. Performance data is based upon the lower voltage of dual voltage rated units.
7. Interpolation of unit performance data is permissible; extrapolation is not.
8. Performance data is a result of lab testing and is not related to warranty.
9. Due to variations in installation, actual unit performance may vary from the tabulated data.

WPD Tables - WS036

Model	Source GPM	Source Brine Pressure Drop at Various Entering Source Temperatures (°F) 30 PSI	30 FT HD	40 PSI	40 FT HD	50 PSI	50 FT HD	70 PSI	70 FT HD	90 PSI	90 FT HD
WS036 Full Load Heating	5	1.3	3.0	1.3	3.1	1.4	3.2	1.4	3.1	1.3	3.0
	7	1.6	3.8	1.7	3.9	1.8	4.1	1.7	4.0	1.6	3.8
	9	2.1	4.8	2.2	5.0	2.3	5.2	2.2	5.1	2.1	4.8
	11	2.6	6.0	2.7	6.2	2.8	6.5	2.8	6.4	2.6	6.0
WS036 Full Load Cooling	5	1.4	3.1	1.4	3.1	1.3	3.1	1.3	2.9	1.3	2.9
	7	1.7	4.0	1.7	4.0	1.7	3.9	1.6	3.7	1.6	3.7
	9	2.2	5.0	2.2	5.0	2.1	4.9	2.0	4.7	2.0	4.7
	11	2.7	6.3	2.7	6.2	2.7	6.1	2.5	5.8	2.5	5.8

Model	Load GPM	Load Water Pressure Drop at Various Entering Load Temperatures (°F) 60 PSI	60 FT HD	80 PSI	80 FT HD	100 PSI	100 FT HD	110 PSI	110 FT HD	110 PSI	110 FT HD
WS036 Full Load Heating	5	0.9	2.1	0.8	1.9	1.0	2.3	0.6	1.5	0.6	1.5
	7	1.5	3.4	1.3	3.1	1.6	3.8	1.0	2.4	1.0	2.4
	9	1.6	3.7	1.5	3.4	1.8	4.1	1.1	2.6	1.1	2.6
	11	1.9	4.5	1.8	4.1	2.2	5.0	1.4	3.2	1.4	3.2

Model	Load GPM	Load Water Pressure Drop at Various Enterting Load Temperatures (°F) 40 PSI	40 FT HD	50 PSI	50 FT HD	60 PSI	60 FT HD	75 PSI	75 FT HD	90 PSI	90 FT HD
WS036 Full Load Cooling	5	0.9	2.1	0.9	2.1	0.9	2.1	0.8	1.9	0.7	1.7
	7	1.5	3.4	1.5	3.4	1.5	3.4	1.3	3.0	1.2	2.7
	9	2.0	4.6	2.0	4.6	2.0	4.6	1.8	4.1	1.6	3.7
	11	2.5	5.8	2.5	5.8	2.5	5.8	2.3	5.3	2.0	4.7

1. Source WPD data are based on 15% (by mass) methanol solution while the unit is operating.
2. Load WPD data are based on pure water WPD at 50 °F EST in heating mode and 90 °F EST in cooling mode.
3. Pressure drop data accurate within ±25%.
4. Unit test is run without hot water generation.
5. Interpolation of unit pressure drop data is permissible; extrapolation is not.
6. Pressure drop data is a result of lab testing and is not related to warranty.
7. Due to variations in installation, actual unit performance may vary from the tabulated data.

HE / HR Tables - WS048

Model	Mode	Source Flow		Heat of Extraction (MBtuh) at Various Entering Load Temperatures (°F)														
				50	80	100	110	120	50	80	100	110	120	50	80	100	110	120
		EST (°F)	Source GPM	Load Flow GPM 6					Load Flow GPM 9					Load Flow GPM 12				
WS048	Full Load Heating	25	6	29.9	28.9	26.8	25.0	22.8	29.8	28.9	26.8	25.0	22.8		28.7	26.6	24.8	22.7
			9	32.0	31.0	28.7	26.8	24.5	32.0	31.0	28.7	26.7	24.4	ONR	30.7	28.5	26.6	24.3
			12	33.1	32.1	29.7	27.7	25.3	33.1	32.0	29.7	27.7	25.3		31.8	29.5	27.5	25.1
		30	6	32.2	31.2	28.9	27.0	24.6	32.2	31.2	28.9	26.9	24.6	32.0	31.0	28.7	26.7	24.4
			9	34.5	33.5	31.0	28.9	26.4	34.5	33.4	31.0	28.9	26.4	34.2	33.2	30.7	28.6	26.2
			12	35.7	34.6	32.1	29.9	27.3	35.7	34.6	32.0	29.9	27.3	35.4	34.3	31.8	29.6	27.1
		50	6	45.5	44.0	40.8	38.0	34.8	45.4	44.0	40.8	38.0	34.7	45.1	43.7	40.5	37.7	34.5
			9	48.7	47.2	43.7	40.7	37.2	48.6	47.1	43.7	40.7	37.2	48.3	46.8	43.4	40.4	36.9
			12	50.4	48.8	45.2	42.1	38.5	50.3	48.8	45.2	42.1	38.5	50.0	48.4	44.9	41.8	38.2
		70	6	61.6	59.7	55.3	51.5	47.1	61.5	59.6	55.2	51.5	47.0	61.1	59.2	54.8	51.1	46.7
			9	66.0	63.9	59.2	55.2	50.5	65.9	63.9	59.2	55.1	50.4	65.5	63.4	58.7	54.7	50.0
			12	68.3	66.1	61.3	57.1	52.2	68.2	66.1	61.2	57.0	52.1	67.7	65.6	60.8	56.6	51.8

Model	Mode	Source Flow		Heat of Rejection (MBtuh) at Various Entering Load Temperatures (°F)														
				40	50	60	75	90	40	50	60	75	90	40	50	60	75	90
		EST (°F)	Source GPM	Load Flow GPM 6					Load Flow GPM 9					Load Flow GPM 12				
WS048	Full Load Cooling	40	6	52.1	58.9	68.4	81.9	88.7	53.0	59.9	69.5	83.2	90.1		61.8	71.7	85.8	93.0
			9	51.7	58.5	67.8	81.2	88.0	52.6	59.4	69.0	82.6	89.4	ONR	61.3	71.1	85.2	92.2
			12	51.3	58.0	67.3	80.6	87.3	52.2	59.0	68.4	82.0	88.8		60.8	70.6	84.5	91.5
		50	6	52.2	59.0	68.5	82.0	88.8	53.1	60.0	69.6	83.4	90.3	54.8	61.9	71.8	86.0	93.1
			9	51.8	58.6	67.9	81.4	88.1	52.7	59.5	69.1	82.7	89.6	54.3	61.4	71.3	85.3	92.4
			12	51.4	58.1	67.4	80.7	87.4	52.3	59.1	68.6	82.1	88.9	53.9	60.9	70.7	84.7	91.7
		70	6	50.6	57.2	66.4	79.5	86.1	51.5	58.2	67.5	80.9	87.6	53.1	60.0	69.6	83.4	90.3
			9	50.2	56.8	65.9	78.9	85.5	51.1	57.7	67.0	80.2	86.9	52.7	59.6	69.1	82.7	89.6
			12	49.9	56.4	65.4	78.3	84.8	50.7	57.3	66.5	79.6	86.2	52.3	59.1	68.6	82.1	88.9
		90	6	49.8	56.3	65.4	78.3	84.8	50.7	57.3	66.5	79.6	86.2	52.3	59.1	68.5	82.1	88.9
			9	49.4	55.9	64.8	77.6	84.1	50.3	56.8	65.9	78.9	85.5	51.8	58.6	68.0	81.4	88.2
			12	49.1	55.5	64.4	77.1	83.5	49.9	56.4	65.4	78.3	84.9	51.5	58.2	67.5	80.8	87.5

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
3. Performance data accurate within ±15%.
4. Unit performance test is run without hot water generation.
5. Capacity data does not include the source-side pump power and it does not reflect pump power correction for AHRI/ISO conditions.
6. Performance data is based upon the lower voltage of dual voltage rated units.
7. Interpolation of unit performance data is permissible; extrapolation is not.
8. Performance data is a result of lab testing and is not related to warranty.
9. Due to variations in installation, actual unit performance may vary from the tabulated data.

WPD Tables - WS048

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
WS048 Full Load Heating	6	1.0	2.3	1.0	2.3	1.0	2.2	0.9	2.1	0.9	2.0
	9	1.5	3.5	1.5	3.4	1.4	3.3	1.4	3.2	1.3	3.0
	12	2.3	5.2	2.2	5.0	2.1	4.9	2.0	4.7	1.9	4.4
	15	3.2	7.3	3.1	7.0	3.0	6.8	2.8	6.5	2.7	6.2
WS048 Full Load Cooling	6	1.0	2.4	1.0	2.3	1.0	2.3	0.9	2.1	0.9	2.0
	9	1.5	3.5	1.5	3.4	1.4	3.3	1.4	3.1	1.3	3.0
	12	2.2	5.1	2.2	5.0	2.1	4.9	2.0	4.6	1.9	4.4
	15	3.1	7.1	3.0	7.0	3.0	6.8	2.8	6.4	2.7	6.1

Model	Load GPM	Load Water Pressure Drop at Various Entering Load Temperatures (°F) 60		80		100		110		120	
		PSI	FT HD	PSI	FT HD	PSI	FT HD	PSI	FT HD	PSI	FT HD
WS048 Full Load Heating	6	0.4	0.9	0.3	0.8	0.2	0.5	0.3	0.6	0.3	0.6
	9	1.4	3.2	1.3	2.9	0.8	1.9	1.0	2.4	1.0	2.4
	12	2.1	4.9	1.9	4.4	1.3	2.9	1.6	3.7	1.6	3.7
	15	3.3	7.7	3.0	6.9	2.0	4.6	2.5	5.8	2.5	5.8
Model	Load GPM	Load Water Pressure Drop at Various Enterting Load Temperatures (°F) 40		50		60		75		90	
		PSI	FT HD	PSI	FT HD	PSI	FT HD	PSI	FT HD	PSI	FT HD
WS048 Full Load Cooling	6	0.8	1.9	0.8	1.8	1.0	2.3	1.4	3.2	1.9	4.3
	9	0.8	1.9	0.8	1.9	1.0	2.4	1.4	3.2	1.9	4.4
	12	1.4	3.2	1.3	3.1	1.7	4.0	2.3	5.4	3.2	7.4
	15	2.2	5.2	2.2	5.1	2.8	6.5	3.8	8.8	5.2	12.1

1. Source WPD data are based on 15% (by mass) methanol solution while the unit is operating.
2. Load WPD data are based on pure water WPD at 50 °F EST in heating mode and 90 °F EST in cooling mode.
3. Pressure drop data accurate within ±25%.
4. Unit test is run without hot water generation.
5. Interpolation of unit pressure drop data is permissible; extrapolation is not.
6. Pressure drop data is a result of lab testing and is not related to warranty.
7. Due to variations in installation, actual unit performance may vary from the tabulated data.

HE / HR Tables - WS060

Model	Mode	Source Flow		Heat of Extraction (MBtuh) at Various Entering Load Temperatures (°F)														
				60	80	100	110	120	60	80	100	110	120	60	80	100	110	120
		EST (°F)	Source GPM	Load Flow GPM 7					Load Flow GPM 11					Load Flow GPM 15				
WS060	Full Load Heating	25	7	30.8	30.3	28.6	25.1	23.1	31.1	30.5	28.8	25.3	23.3		31.4	29.6	26.0	23.9
			11	34.6	33.9	32.0	28.1	25.9	34.9	34.2	32.3	28.4	26.1	ONR	35.2	33.2	29.2	26.8
			15	35.8	35.2	33.2	29.1	26.8	36.2	35.5	33.5	29.4	27.1		36.5	34.4	30.2	27.8
		30	7	34.4	33.7	31.8	28.0	25.7	34.7	34.0	32.1	28.2	26.0	35.6	35.0	33.0	29.0	26.7
			11	38.5	37.8	35.7	31.3	28.8	38.9	38.2	36.0	31.6	29.1	39.9	39.2	37.0	32.5	29.9
			15	39.9	39.2	37.0	32.5	29.9	40.3	39.6	37.3	32.8	30.2	41.4	40.6	38.4	33.7	31.0
		50	7	48.0	47.2	44.5	39.1	36.0	48.5	47.6	44.9	39.5	36.3	49.8	48.9	46.2	40.5	37.3
			11	53.9	52.9	49.9	43.8	40.3	54.4	53.4	50.4	44.2	40.7	55.8	54.8	51.7	45.4	41.8
			15	55.8	54.8	51.7	45.4	41.8	56.3	55.3	52.2	45.8	42.2	57.9	56.8	53.6	47.1	43.3
		70	7	61.3	60.2	56.8	49.9	45.9	61.9	60.7	57.3	50.3	46.3	63.6	62.4	58.9	51.7	47.6
			11	68.7	67.5	63.7	55.9	51.4	69.4	68.1	64.3	56.4	51.9	71.3	69.9	66.0	58.0	53.3
			15	71.2	69.9	66.0	58.0	53.3	71.9	70.6	66.6	58.5	53.8	73.9	72.5	68.4	60.1	55.3

Model	Mode	Source Flow		Heat of Rejection (MBtuh) at Various Entering Load Temperatures (°F)														
				40	50	60	75	90	40	50	60	75	90	40	50	60	75	90
		EST (°F)	Source GPM	Load Flow GPM 7					Load Flow GPM 11					Load Flow GPM 15				
WS060	Full Load Cooling	40	7	60.1	68.4	77.8	92.8	100.0	64.3	73.2	83.3	99.3	107.0		76.3	86.7	103.5	111.5
			11	59.8	68.1	77.4	92.4	99.5	64.0	72.9	82.9	98.9	106.5	ONR	75.9	86.3	103.0	111.0
			15	59.5	67.7	77.0	91.9	99.0	63.7	72.5	82.4	98.3	105.9		75.5	85.9	102.4	110.3
		50	7	59.9	68.1	77.5	92.4	99.6	64.1	72.9	82.9	98.9	106.5	66.7	75.9	86.3	103.0	111.0
			11	59.6	67.8	77.1	92.0	99.1	63.8	72.5	82.5	98.4	106.0	66.4	75.6	85.9	102.5	110.5
			15	59.3	67.4	76.7	91.5	98.6	63.4	72.1	82.0	97.9	105.5	66.1	75.1	85.5	102.0	109.9
		70	7	57.4	65.3	74.3	88.7	95.5	61.5	69.9	79.5	94.9	102.2	64.0	72.8	82.8	98.8	106.5
			11	57.2	65.0	74.0	88.2	95.1	61.2	69.6	79.1	94.4	101.7	63.7	72.5	82.5	98.4	106.0
			15	56.9	64.7	73.6	87.8	94.6	60.8	69.2	78.7	93.9	101.2	63.4	72.1	82.0	97.8	105.4
		90	7	55.2	62.8	71.4	85.2	91.8	59.1	67.2	76.4	91.2	98.2	61.5	70.0	79.6	95.0	102.4
			11	55.0	62.5	71.1	84.8	91.4	58.8	66.9	76.1	90.8	97.8	61.3	69.7	79.3	94.6	101.9
			15	54.7	62.2	70.7	84.4	90.9	58.5	66.5	75.7	90.3	97.3	60.9	69.3	78.8	94.0	101.3

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
3. Performance data accurate within ±15%.
4. Unit performance test is run without hot water generation.
5. Capacity data does not include the source-side pump power and it does not reflect pump power correction for AHRI/ISO conditions.
6. Performance data is based upon the lower voltage of dual voltage rated units.
7. Interpolation of unit performance data is permissible; extrapolation is not.
8. Performance data is a result of lab testing and is not related to warranty.
9. Due to variations in installation, actual unit performance may vary from the tabulated data.

WPD Tables - WS060

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
WS060 Full Load Heating	7	1.1	2.6	1.1	2.6	1.1	2.5	1.0	2.4	1.0	2.3
	11	2.2	5.0	2.1	4.9	2.1	4.7	2.0	4.5	1.9	4.3
	15	3.4	7.9	3.4	7.7	3.3	7.6	3.1	7.2	3.0	6.9
	18	4.6	10.7	4.5	10.4	4.4	10.2	4.2	9.7	4.0	9.3
WS060 Full Load Cooling	7	1.1	2.5	1.1	2.5	1.1	2.4	1.0	2.3	1.0	2.3
	11	2.0	4.6	2.0	4.5	1.9	4.5	1.8	4.2	1.8	4.2
	15	3.1	7.2	3.1	7.1	3.0	7.0	2.9	6.7	2.9	6.7
	18	4.3	9.8	4.2	9.7	4.2	9.6	3.9	9.1	3.9	9.1

Model	Load GPM	Load Water Pressure Drop at Various Entering Load Temperatures (°F)									
		60		80		100		110		125	
		PSI	FT HD	PSI	FT HD	PSI	FT HD	PSI	FT HD	PSI	FT HD
WS060 Full Load Heating	7	1.4	3.3	1.3	3.0	1.3	3.1	1.1	2.5	1.1	2.4
	11	2.1	4.8	1.9	4.4	1.9	4.5	1.6	3.6	1.5	3.5
	15	3.0	7.0	2.7	6.3	2.8	6.5	2.3	5.3	2.2	5.1
	18	3.9	9.1	3.6	8.3	3.6	8.4	3.0	6.8	2.9	6.7
Model	Load GPM	Load Water Pressure Drop at Various Enterting Load Temperatures (°F)									
		40		50		60		75		90	
		PSI	FT HD	PSI	FT HD	PSI	FT HD	PSI	FT HD	PSI	FT HD
WS060 Full Load Cooling	7	1.1	2.5	1.1	2.5	1.0	2.4	1.0	2.2	1.0	2.2
	11	1.9	4.5	1.9	4.5	1.8	4.2	1.7	3.9	1.7	3.9
	15	3.0	6.9	3.0	6.9	2.8	6.4	2.6	6.0	2.6	6.0
	18	3.9	9.1	3.9	9.1	3.7	8.5	3.4	7.8	3.4	7.8

1. Source WPD data are based on 15% (by mass) methanol solution while the unit is operating.
2. Load WPD data are based on pure water WPD at 50 °F EST in heating mode and 90 °F EST in cooling mode.
3. Pressure drop data accurate within ±25%.
4. Unit test is run without hot water generation.
5. Interpolation of unit pressure drop data is permissible; extrapolation is not.
6. Pressure drop data is a result of lab testing and is not related to warranty.
7. Due to variations in installation, actual unit performance may vary from the tabulated data.

HE / HR Tables - WS072

Model	Mode			Heat of Extraction (MBtuh) at Various Entering Load Temperatures (°F)														
		Source Flow		60	80	100	110	120	60	80	100	110	120	60	80	100	110	120
		EST (°F)	Source GPM	Load Flow GPM 9					Load Flow GPM 13					Load Flow GPM 18				
WS072	Full Load Heating	25	9	37.4	36.9	32.4	29.9	26.6	38.1	37.6	33.0	30.4	27.1		37.9	33.3	30.7	27.4
			13	40.9	40.3	35.4	32.6	29.1	41.6	41.1	36.0	33.2	29.6	ONR	41.5	36.4	33.6	29.9
			18	43.2	42.6	37.4	34.5	30.8	44.0	43.4	38.0	35.1	31.3		43.8	38.4	35.4	31.6
		30	9	41.9	41.3	36.2	33.4	29.8	42.6	42.1	36.9	34.0	30.4	43.0	42.5	37.3	34.4	30.7
			13	45.8	45.2	39.6	36.5	32.6	46.6	46.0	40.3	37.2	33.2	47.0	46.4	40.7	37.6	33.5
			18	48.3	47.7	41.8	38.6	34.4	49.2	48.6	42.6	39.3	35.1	49.7	49.0	43.0	39.7	35.4
		50	9	61.6	60.8	53.3	49.2	43.9	62.7	61.9	54.3	50.1	44.7	63.3	62.5	54.8	50.6	45.1
			13	67.3	66.5	58.3	53.8	48.0	68.5	67.7	59.3	54.8	48.8	69.2	68.3	59.9	55.3	49.3
			18	71.1	70.2	61.6	56.8	50.7	72.4	71.5	62.7	57.8	51.6	73.1	72.1	63.3	58.4	52.1
		90	9	101.3	99.9	87.7	80.9	72.1	103.1	101.7	89.2	82.3	73.4	104.1	102.7	90.1	83.1	74.1
			13	110.6	109.2	95.8	88.4	78.8	112.7	111.2	97.5	90.0	80.3	113.7	112.3	98.5	90.9	81.0
			18	116.9	115.4	101.2	93.4	83.3	119.0	117.4	103.0	95.0	84.8	120.1	118.6	104.0	96.0	85.6

Model	Mode			Heat of Rejection (MBtuh) at Various Entering Load Temperatures (°F)														
		Source Flow		40	50	60	75	90	40	50	60	75	90	40	50	60	75	90
		EST (°F)	Source GPM	Load Flow GPM 9					Load Flow GPM 13					Load Flow GPM 18				
WS072	Full Load Cooling	40	9	67.2	78.0	90.1	102.1	107.2	72.7	84.4	97.6	110.6	116.1		88.8	102.6	116.3	122.2
			13	66.6	77.4	89.4	101.3	106.4	72.2	83.8	96.8	109.7	115.2	ONR	88.2	101.8	115.4	121.2
			18	66.9	77.7	89.7	101.7	106.8	72.5	84.1	97.2	110.2	115.7		88.5	102.3	115.9	121.7
		50	9	69.6	80.8	93.4	105.8	111.1	75.4	87.5	101.1	114.6	120.4	79.3	92.1	106.4	120.6	126.6
			13	69.1	80.2	92.6	105.0	110.3	74.8	86.8	100.3	113.7	119.4	78.7	91.4	105.6	119.7	125.6
			18	69.3	80.5	93.0	105.4	110.7	75.1	87.2	100.7	114.2	119.9	79.0	91.7	106.0	120.1	126.1
		70	9	66.0	76.6	88.5	100.3	105.3	71.5	83.0	95.9	108.6	114.1	75.2	87.3	100.8	114.3	120.0
			13	65.5	76.0	87.8	99.5	104.5	70.9	82.3	95.1	107.8	113.2	74.6	86.6	100.1	113.4	119.1
			18	65.7	76.3	88.2	99.9	104.9	71.2	82.6	95.5	108.2	113.6	74.9	87.0	100.5	113.9	119.6
		90	9	63.2	73.4	84.8	96.2	101.0	68.5	79.5	91.9	104.1	109.3	72.1	83.7	96.7	109.6	115.0
			13	62.8	72.9	84.2	95.4	100.2	68.0	78.9	91.2	103.3	108.5	71.5	83.0	95.9	108.7	114.1
			18	63.0	73.1	84.5	95.8	100.6	68.2	79.2	91.5	103.8	108.9	71.8	83.3	96.3	109.2	114.6

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
3. Performance data accurate within ±15%.
4. Unit performance test is run without hot water generation.
5. Capacity data does not include the source-side pump power and it does not reflect pump power correction for AHRI/ISO conditions.
6. Performance data is based upon the lower voltage of dual voltage rated units.
7. Interpolation of unit performance data is permissible; extrapolation is not.
8. Performance data is a result of lab testing and is not related to warranty.
9. Due to variations in installation, actual unit performance may vary from the tabulated data.

WPD Tables - WS072

Model	Source GPM	40 PSI	40 FT HD	50 PSI	50 FT HD	70 PSI	70 FT HD	90 PSI	90 FT HD	110 PSI	110 FT HD
		Source Brine Pressure Drop at Various Entering Source Temperatures (°F)									
WS072 Full Load Heating	**9**	1.0	2.3	1.0	2.3	1.1	2.5	1.1	2.5	1.0	2.4
	13	1.8	4.2	1.8	4.1	1.9	4.5	1.9	4.4	1.8	4.2
	18	3.0	7.0	3.0	6.9	3.2	7.5	3.2	7.3	3.1	7.1
	20	3.7	8.5	3.6	8.3	3.9	9.0	3.8	8.9	3.7	8.5
WS072 Full Load Cooling	**9**	1.7	3.8	1.6	3.8	1.6	3.6	1.4	3.2	1.3	3.1
	13	2.3	5.4	2.3	5.3	2.2	5.1	1.9	4.4	1.9	4.3
	18	3.5	8.0	3.4	7.9	3.3	7.6	2.9	6.6	2.8	6.5
	20	4.1	9.5	4.1	9.3	3.9	8.9	3.4	7.8	3.3	7.6

Model	Load GPM	60 PSI	60 FT HD	80 PSI	80 FT HD	100 PSI	100 FT HD	110 PSI	110 FT HD	120 PSI	120 FT HD
		Load Water Pressure Drop at Various Entering Load Temperatures (°F)									
WS072 Full Load Heating	**9**	1.4	3.3	1.3	3.0	1.2	2.8	1.2	2.8	1.1	2.6
	13	2.0	4.7	1.8	4.2	1.7	4.0	1.7	4.0	1.6	3.7
	18	3.3	7.6	3.0	6.9	2.8	6.4	2.8	6.4	2.6	6.0
	20	3.9	8.9	3.5	8.1	3.3	7.5	3.3	7.5	3.0	7.0
		Load Water Pressure Drop at Various Enterting Load Temperatures (°F)									
Model	**Load GPM**	**40**		**50**		**60**		**75**		**90**	
		PSI	**FT HD**	**PSI**	**FT HD**	**PSI**	**FT HD**	**PSI**	**FT HD**	**PSI**	**FT HD**
WS072 Full Load Cooling	**9**	1.1	2.6	1.2	2.7	1.1	2.6	1.0	2.4	1.0	2.4
	13	1.8	4.1	1.9	4.4	1.8	4.1	1.6	3.8	1.6	3.8
	18	2.8	6.4	3.0	6.9	2.8	6.4	2.6	6.0	2.6	6.0
	20	3.1	7.1	3.3	7.6	3.1	7.1	2.9	6.6	2.9	6.6

1. Source WPD data are based on 15% (by mass) methanol solution while the unit is operating.
2. Load WPD data are based on pure water WPD at 50 °F EST in heating mode and 90 °F EST in cooling mode.
3. Pressure drop data accurate within ±25%.
4. Unit test is run without hot water generation.
5. Interpolation of unit pressure drop data is permissible; extrapolation is not.
6. Pressure drop data is a result of lab testing and is not related to warranty.
7. Due to variations in installation, actual unit performance may vary from the tabulated data.

HE / HR Tables - WS084

Model	Mode			Heat of Extraction (MBtuh) at Various Entering Load Temperatures (°F)														
		Source Flow		60	80	100	110	120	60	80	100	110	120	60	80	100	110	120
		EST (°F)	Source GPM	Load Flow GPM 10					Load Flow GPM 16					Load Flow GPM 21				
WS084	Full Load Heating	25	10	44.2	44.7	40.8	37.7	34.3	44.9	45.4	41.5	38.3	34.9		45.8	41.8	38.6	35.2
			16	48.3	48.8	44.6	41.2	37.5	49.1	49.6	45.3	41.8	38.1	ONR	50.0	45.7	42.2	38.4
			21	50.4	50.9	46.5	43.0	39.1	51.2	51.7	47.2	43.6	39.7		52.1	47.6	44.0	40.1
		30	10	47.8	48.3	44.1	40.8	37.1	48.6	49.1	44.8	41.4	37.7	49.0	49.5	45.2	41.8	38.0
			16	52.2	52.7	48.2	44.5	40.5	53.0	53.6	48.9	45.2	41.2	53.5	54.0	49.4	45.6	41.5
			21	54.5	55.0	50.3	46.4	42.3	55.3	55.9	51.1	47.2	43.0	55.8	56.4	51.5	47.6	43.3
		50	10	69.1	69.8	63.8	58.9	53.6	70.2	70.9	64.8	59.9	54.5	70.8	71.5	65.3	60.4	55.0
			16	75.5	76.2	69.6	64.3	58.6	76.7	77.4	70.7	65.4	59.5	77.3	78.1	71.3	65.9	60.0
			21	78.7	79.5	72.7	67.1	61.1	80.0	80.8	73.8	68.2	62.1	80.7	81.5	74.4	68.8	62.6
		90	10	100.1	101.1	92.4	85.4	77.7	101.7	102.7	93.9	86.7	79.0	102.6	103.6	94.7	87.4	79.6
			16	109.3	110.5	100.9	93.2	84.9	111.1	112.2	102.5	94.7	86.2	112.0	113.2	103.4	95.5	87.0
			21	114.1	115.2	105.3	97.3	88.6	115.9	117.1	107.0	98.8	90.0	116.9	118.1	107.9	99.6	90.7

Model	Mode			Heat of Rejection (MBtuh) at Various Entering Load Temperatures (°F)														
		Source Flow		40	50	60	75	90	40	50	60	75	90	40	50	60	75	90
		EST (°F)	Source GPM	Load Flow GPM 10					Load Flow GPM 16					Load Flow GPM 21				
WS084	Full Load Cooling	40	10	69.3	81.9	90.0	95.7	99.2	76.1	90.0	98.8	105.1	109.0		94.7	104.0	110.6	114.7
			16	68.5	81.0	88.9	94.6	98.1	75.2	88.9	97.7	103.8	107.7	ONR	93.6	102.8	109.3	113.4
			21	68.8	81.3	89.3	94.9	98.4	75.5	89.3	98.0	104.2	108.1		93.9	103.2	109.7	113.8
		50	10	73.4	86.7	95.2	101.3	105.0	80.6	95.2	104.6	111.2	115.4	84.8	100.2	110.1	117.0	121.4
			16	72.5	85.7	94.1	100.1	103.8	79.6	94.1	103.4	109.9	114.0	83.8	99.1	108.8	115.7	120.0
			21	72.8	86.0	94.5	100.5	104.2	79.9	94.5	103.8	110.3	114.4	84.1	99.4	109.2	116.1	120.4
		70	10	74.4	88.0	96.6	102.7	106.6	81.7	96.6	106.1	112.8	117.0	86.0	101.7	111.7	118.7	123.2
			16	73.5	86.9	95.5	101.5	105.3	80.8	95.5	104.9	111.5	115.7	85.0	100.5	110.4	117.4	121.7
			21	73.8	87.3	95.8	101.9	105.7	81.1	95.8	105.3	111.9	116.1	85.3	100.9	110.8	117.8	122.2
		90	10	70.6	83.4	91.6	97.4	101.1	77.5	91.6	100.6	107.0	111.0	81.6	96.4	105.9	112.6	116.8
			16	69.8	82.5	90.6	96.3	99.9	76.6	90.6	99.5	105.8	109.7	80.6	95.3	104.7	111.3	115.5
			21	70.0	82.8	90.9	96.7	100.3	76.9	90.9	99.8	106.2	110.1	80.9	95.7	105.1	111.7	115.9

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
3. Performance data accurate within ±15%.
4. Unit performance test is run without hot water generation.
5. Capacity data does not include the source-side pump power and it does not reflect pump power correction for AHRI/ISO conditions.
6. Performance data is based upon the lower voltage of dual voltage rated units.
7. Interpolation of unit performance data is permissible; extrapolation is not.
8. Performance data is a result of lab testing and is not related to warranty.
9. Due to variations in installation, actual unit performance may vary from the tabulated data.

WPD Tables - WS084

Model	Source GPM	Source Brine Pressure Drop at Various Entering Source Temperatures (°F) 40 PSI	40 FT HD	50 PSI	50 FT HD	70 PSI	70 FT HD	90 PSI	90 FT HD	110 PSI	110 FT HD
WS084 Full Load Heating	10	0.9	2.1	0.9	2.1	0.9	2.1	0.9	2.0	0.9	2.0
	16	3.5	8.1	3.5	8.2	3.5	8.1	3.5	8.0	3.4	7.9
	21	5.3	12.3	5.4	12.3	5.3	12.2	5.2	12.1	5.2	11.9
	24	6.7	15.5	6.8	15.6	6.7	15.5	6.6	15.3	6.5	15.1
WS084 Full Load Cooling	10	1.6	3.7	1.6	3.7	1.6	3.7	1.6	3.7	1.6	3.6
	16	3.5	8.0	3.5	8.0	3.4	7.9	3.4	7.9	3.4	7.7
	21	5.3	12.3	5.3	12.3	5.2	12.1	5.2	12.1	5.1	11.9
	24	6.7	15.4	6.7	15.4	6.6	15.2	6.6	15.2	6.5	14.9

Model	Load GPM	Load Water Pressure Drop at Various Entering Load Temperatures (°F) 50 PSI	50 FT HD	80 PSI	80 FT HD	100 PSI	100 FT HD	110 PSI	110 FT HD	115 PSI	115 FT HD
WS084 Full Load Heating	10	1.7	3.9	1.7	3.9	1.7	3.9	1.6	3.7	1.7	3.9
	16	3.5	8.1	3.5	8.1	3.5	8.1	3.4	7.8	3.5	8.0
	21	5.8	13.3	5.8	13.3	5.8	13.3	5.6	12.9	5.8	13.3
	24	7.3	16.8	7.3	16.8	7.3	16.8	7.0	16.2	7.3	16.8

Model	Load GPM	Load Water Pressure Drop at Various Enterting Load Temperatures (°F) 40 PSI	40 FT HD	50 PSI	50 FT HD	60 PSI	60 FT HD	75 PSI	75 FT HD	90 PSI	90 FT HD
WS084 Full Load Cooling	10	1.9	4.5	1.9	4.5	1.9	4.5	1.9	4.3	1.9	4.3
	16	3.3	7.6	3.3	7.6	3.3	7.6	3.2	7.3	3.2	7.3
	21	5.6	12.9	5.6	12.9	5.6	12.9	5.4	12.4	5.4	12.4
	24	7.1	16.3	7.1	16.3	7.1	16.3	6.8	15.8	6.8	15.8

1. Source WPD data are based on 15% (by mass) methanol solution while the unit is operating.
2. Load WPD data are based on pure water WPD at 50 °F EST in heating mode and 90 °F EST in cooling mode.
3. Pressure drop data accurate within ±25%.
4. Unit test is run without hot water generation.
5. Interpolation of unit pressure drop data is permissible; extrapolation is not.
6. Pressure drop data is a result of lab testing and is not related to warranty.
7. Due to variations in installation, actual unit performance may vary from the tabulated data.

Operating Parameter Tables - WS036

WS036 : 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
25	3	60	206 - 287	55 - 75	11 - 16	10 - 14	4 - 8	6 - 10
		80	240 - 324	56 - 77	10 - 15	10 - 14	4 - 8	6 - 10
		100	322 - 413	61 - 82	7 - 12	7 - 11	4 - 8	5 - 9
		110	374 - 469	61 - 81	9 - 14	7 - 11	3 - 7	5 - 9
		120	426 - 526	63 - 84	8 - 13	7 - 11	3 - 7	5 - 9
30	3	60	210 - 291	61 - 81	12 - 17	10 - 14	4 - 8	6 - 10
		80	245 - 329	63 - 83	12 - 17	9 - 13	4 - 8	6 - 10
		100	327 - 419	68 - 89	8 - 13	7 - 11	4 - 8	6 - 10
		110	380 - 476	68 - 88	10 - 15	7 - 11	3 - 7	6 - 10
		120	433 - 533	70 - 91	9 - 14	7 - 11	3 - 7	6 - 10
50	3	60	217 - 299	93 - 114	11 - 16	9 - 13	7 - 11	8 - 12
		80	253 - 337	95 - 116	11 - 16	8 - 12	7 - 11	8 - 12
		100	338 - 430	103 - 124	7 - 12	6 - 10	6 - 10	8 - 12
		110	392 - 489	102 - 123	9 - 14	6 - 10	5 - 9	8 - 12
		120	446 - 548	106 - 127	8 - 13	6 - 10	5 - 9	8 - 12
70	3	60	225 - 308	131 - 152	7 - 12	9 - 13	9 - 13	11 - 15
		80	262 - 348	134 - 155	6 - 11	9 - 13	9 - 13	11 - 15
		100	350 - 444	145 - 166	4 - 9	6 - 10	9 - 13	10 - 14
		110	407 - 505	144 - 165	6 - 11	7 - 11	8 - 12	10 - 14
		120	462 - 565	150 - 171	5 - 10	6 - 10	7 - 11	10 - 14

WS036 : 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
40	3	40	118 - 176	68 - 77	11 - 16	13 - 17	7 - 11	6 - 10
		50	121 - 179	83 - 90	11 - 16	14 - 18	9 - 13	7 - 11
		60	125 - 183	99 - 103	13 - 18	14 - 18	10 - 14	9 - 13
		75	130 - 188	118 - 119	16 - 21	18 - 22	12 - 16	11 - 15
		90	132 - 189	123 - 124	16 - 21	30 - 34	12 - 16	11 - 15
50	3	40	144 - 202	71 - 79	11 - 16	11 - 15	7 - 11	6 - 10
		50	148 - 205	86 - 92	11 - 16	12 - 16	9 - 13	7 - 11
		60	153 - 210	102 - 106	13 - 18	12 - 16	10 - 14	9 - 13
		75	159 - 216	122 - 123	16 - 21	15 - 19	12 - 16	10 - 14
		90	161 - 218	127 - 127	16 - 21	27 - 31	12 - 16	11 - 15
70	3	40	209 - 265	76 - 83	10 - 15	11 - 15	7 - 11	6 - 10
		50	214 - 270	92 - 97	10 - 15	12 - 16	8 - 12	7 - 11
		60	220 - 277	109 - 112	12 - 17	12 - 16	10 - 14	8 - 12
		75	229 - 285	130 - 129	14 - 19	15 - 19	12 - 16	10 - 14
		90	231 - 287	135 - 134	15 - 20	26 - 30	12 - 16	10 - 14
90	3	40	290 - 345	79 - 86	10 - 15	12 - 16	7 - 11	5 - 9
		50	297 - 352	95 - 100	11 - 16	12 - 16	8 - 12	6 - 10
		60	306 - 361	113 - 115	13 - 18	12 - 16	10 - 14	7 - 11
		75	317 - 372	135 - 134	15 - 20	16 - 20	11 - 15	9 - 13
		90	320 - 375	141 - 139	16 - 21	27 - 31	12 - 16	9 - 13

Operating Parameter Tables - WS048

WS048 : 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
25	3	60	214 - 297	57 - 79	8 - 13	8 - 12	5 - 9	6 - 10
		80	243 - 328	59 - 80	8 - 13	7 - 11	4 - 8	6 - 10
		100	332 - 426	63 - 84	8 - 13	7 - 11	4 - 8	6 - 10
		110	376 - 473	64 - 86	7 - 12	5 - 9	4 - 8	6 - 10
		120	428 - 530	66 - 87	6 - 11	6 - 10	3 - 7	6 - 10
30	3	60	217 - 299	63 - 84	9 - 14	8 - 12	5 - 9	7 - 11
		80	246 - 331	64 - 86	9 - 14	8 - 12	5 - 9	7 - 11
		100	336 - 430	69 - 91	9 - 14	8 - 12	4 - 8	7 - 11
		110	380 - 477	71 - 92	8 - 13	6 - 10	4 - 8	7 - 11
		120	433 - 535	72 - 94	7 - 12	6 - 10	4 - 8	6 - 10
50	3	60	228 - 311	91 - 113	12 - 17	9 - 13	8 - 12	9 - 13
		80	258 - 345	93 - 115	12 - 17	9 - 13	7 - 11	9 - 13
		100	353 - 448	99 - 122	12 - 17	9 - 13	7 - 11	9 - 13
		110	398 - 497	102 - 124	10 - 15	7 - 11	6 - 10	9 - 13
		120	453 - 558	104 - 126	10 - 15	7 - 11	6 - 10	9 - 13
70	3	60	239 - 324	126 - 149	15 - 20	9 - 13	11 - 15	12 - 16
		80	271 - 359	129 - 152	15 - 20	8 - 12	10 - 14	12 - 16
		100	370 - 466	138 - 161	15 - 20	9 - 13	9 - 13	12 - 16
		110	417 - 518	141 - 164	13 - 18	6 - 10	9 - 13	12 - 16
		120	475 - 581	144 - 167	12 - 17	7 - 11	8 - 12	11 - 15

WS048 : 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
40	3	40	123 - 182	68 - 84	27 - 32	13 - 17	8 - 12	7 - 11
		50	127 - 186	81 - 96	25 - 30	14 - 18	9 - 13	8 - 12
		60	132 - 191	97 - 111	22 - 27	14 - 18	11 - 15	10 - 14
		75	139 - 197	121 - 134	18 - 23	15 - 19	14 - 18	12 - 16
		90	144 - 203	133 - 146	17 - 22	24 - 28	15 - 19	13 - 17
50	3	40	153 - 211	72 - 87	35 - 40	11 - 15	8 - 12	7 - 11
		50	158 - 216	85 - 100	33 - 38	12 - 16	9 - 13	8 - 12
		60	163 - 221	101 - 115	29 - 34	12 - 16	11 - 15	9 - 13
		75	171 - 229	126 - 139	24 - 29	13 - 17	14 - 18	12 - 16
		90	178 - 236	139 - 151	22 - 27	21 - 25	15 - 19	13 - 17
70	3	40	221 - 279	74 - 90	53 - 58	12 - 16	8 - 12	6 - 10
		50	228 - 285	88 - 103	50 - 55	12 - 16	9 - 13	7 - 11
		60	236 - 293	105 - 119	44 - 49	12 - 16	11 - 15	9 - 13
		75	247 - 304	131 - 144	36 - 41	13 - 17	13 - 17	11 - 15
		90	256 - 313	144 - 156	34 - 39	21 - 25	14 - 18	12 - 16
90	3	40	306 - 363	78 - 94	70 - 75	12 - 16	8 - 12	5 - 9
		50	315 - 371	93 - 107	66 - 71	12 - 16	9 - 13	7 - 11
		60	325 - 382	110 - 124	58 - 63	12 - 16	11 - 15	8 - 12
		75	340 - 396	138 - 150	48 - 53	13 - 17	13 - 17	10 - 14
		90	352 - 408	151 - 162	44 - 49	21 - 25	14 - 18	11 - 15

Operating Parameter Tables - WS060

WS060 : 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
25	3	60	222 - 302	55 - 74	10 - 15	7 - 11	4 - 8	6 - 10
		80	243 - 324	57 - 76	7 - 12	6 - 10	4 - 8	6 - 10
		100	326 - 414	59 - 78	5 - 10	7 - 11	4 - 8	6 - 10
		110	374 - 467	61 - 80	6 - 11	5 - 9	3 - 7	6 - 10
		125	449 - 547	63 - 82	5 - 10	6 - 10	3 - 7	5 - 9
30	3	60	223 - 303	61 - 81	10 - 15	8 - 12	5 - 9	6 - 10
		80	244 - 326	64 - 83	7 - 12	7 - 11	5 - 9	6 - 10
		100	327 - 416	66 - 85	5 - 10	7 - 11	4 - 8	6 - 10
		110	376 - 469	68 - 87	6 - 11	6 - 10	4 - 8	6 - 10
		125	451 - 549	70 - 89	5 - 10	7 - 11	3 - 7	6 - 10
50	3	60	233 - 314	92 - 110	8 - 13	9 - 13	7 - 11	9 - 13
		80	255 - 337	95 - 114	5 - 10	8 - 12	7 - 11	9 - 13
		100	341 - 431	98 - 116	4 - 9	8 - 12	6 - 10	8 - 12
		110	392 - 486	100 - 119	5 - 10	7 - 11	5 - 9	8 - 12
		125	470 - 569	104 - 123	4 - 9	8 - 12	5 - 9	8 - 12
70	3	60	242 - 323	123 - 142	3 - 8	12 - 16	9 - 13	11 - 15
		80	264 - 348	127 - 146	2 - 7	11 - 15	9 - 13	11 - 15
		100	354 - 444	131 - 149	1 - 6	11 - 15	8 - 12	10 - 14
		110	406 - 501	135 - 153	2 - 7	9 - 13	7 - 11	10 - 14
		125	486 - 587	139 - 158	1 - 6	11 - 15	6 - 10	10 - 14

WS060 : 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
40	3	40	119 - 176	68 - 78	9 - 14	12 - 16	8 - 12	7 - 11
		50	123 - 180	83 - 91	10 - 15	13 - 17	9 - 13	8 - 12
		60	127 - 184	99 - 105	10 - 15	13 - 17	11 - 15	9 - 13
		75	132 - 188	124 - 127	10 - 15	13 - 17	13 - 17	12 - 16
		90	135 - 191	134 - 135	13 - 18	23 - 27	14 - 18	13 - 17
50	3	40	146 - 202	71 - 80	9 - 14	11 - 15	8 - 12	7 - 11
		50	151 - 207	86 - 94	10 - 15	11 - 15	9 - 13	8 - 12
		60	155 - 211	102 - 108	10 - 15	12 - 16	11 - 15	9 - 13
		75	161 - 217	128 - 130	9 - 14	12 - 16	13 - 17	12 - 16
		90	164 - 220	138 - 139	12 - 17	21 - 25	14 - 18	13 - 17
70	3	40	212 - 267	74 - 83	9 - 14	11 - 15	8 - 12	6 - 10
		50	219 - 274	89 - 97	10 - 15	12 - 16	9 - 13	7 - 11
		60	226 - 280	106 - 111	10 - 15	12 - 16	10 - 14	9 - 13
		75	233 - 288	133 - 135	9 - 14	12 - 16	12 - 16	11 - 15
		90	237 - 292	143 - 144	12 - 17	21 - 25	14 - 18	12 - 16
90	3	40	291 - 344	76 - 85	9 - 14	11 - 15	7 - 11	5 - 9
		50	300 - 353	92 - 99	10 - 15	12 - 16	9 - 13	6 - 10
		60	309 - 362	110 - 114	10 - 15	12 - 16	10 - 14	8 - 12
		75	318 - 371	137 - 138	10 - 15	12 - 16	12 - 16	10 - 14
		90	324 - 377	148 - 147	13 - 18	22 - 26	13 - 17	11 - 15

Operating Parameter Tables - WS072

WS072 : 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
25	3	60	192 - 270	59 - 79	5 - 10	5 - 9	4 - 8	6 - 10
		80	236 - 318	62 - 82	5 - 10	4 - 8	4 - 8	6 - 10
		100	317 - 406	61 - 82	5 - 10	5 - 9	3 - 7	5 - 9
		110	367 - 459	65 - 86	4 - 9	4 - 8	3 - 7	5 - 9
		120	415 - 512	66 - 87	4 - 9	4 - 8	3 - 7	5 - 9
30	3	60	193 - 272	65 - 86	6 - 11	5 - 9	5 - 9	7 - 11
		80	238 - 320	69 - 89	5 - 10	4 - 8	5 - 9	6 - 10
		100	320 - 408	68 - 88	6 - 11	5 - 9	4 - 8	6 - 10
		110	369 - 462	73 - 93	5 - 10	4 - 8	4 - 8	6 - 10
		120	418 - 515	74 - 94	5 - 10	4 - 8	3 - 7	6 - 10
50	3	60	202 - 282	97 - 117	7 - 12	6 - 10	7 - 11	9 - 13
		80	249 - 332	102 - 123	6 - 11	5 - 9	7 - 11	9 - 13
		100	334 - 424	101 - 121	7 - 12	5 - 9	6 - 10	8 - 12
		110	386 - 480	107 - 128	6 - 11	5 - 9	6 - 10	8 - 12
		120	437 - 535	109 - 129	5 - 10	5 - 9	5 - 9	8 - 12
70	3	60	213 - 293	134 - 154	7 - 12	7 - 11	10 - 14	12 - 16
		80	261 - 345	141 - 162	7 - 12	6 - 10	10 - 14	12 - 16
		100	350 - 441	139 - 160	7 - 12	7 - 11	9 - 13	11 - 15
		110	404 - 500	148 - 168	6 - 11	6 - 10	8 - 12	11 - 15
		120	457 - 557	150 - 170	6 - 11	6 - 10	7 - 11	10 - 14

WS072 : 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
30	3	40	88 - 146	61 - 70	11 - 16	23 - 27	7 - 11	6 - 10
		50	92 - 149	75 - 82	11 - 16	19 - 23	9 - 13	7 - 11
		60	95 - 152	91 - 95	12 - 17	19 - 23	10 - 14	9 - 13
		75	99 - 156	105 - 108	16 - 21	40 - 44	12 - 16	11 - 15
		90	101 - 159	111 - 113	19 - 24	71 - 75	12 - 16	11 - 15
50	3	40	139 - 196	75 - 82	7 - 12	7 - 11	8 - 12	6 - 10
		50	144 - 200	93 - 97	8 - 13	5 - 9	10 - 14	8 - 12
		60	149 - 205	112 - 114	8 - 13	6 - 10	11 - 15	10 - 14
		75	154 - 210	130 - 128	11 - 16	12 - 16	13 - 17	11 - 15
		90	158 - 214	137 - 134	13 - 18	23 - 27	14 - 18	12 - 16
70	3	40	202 - 257	76 - 83	7 - 12	7 - 11	8 - 12	6 - 10
		50	209 - 264	94 - 98	8 - 13	5 - 9	9 - 13	7 - 11
		60	215 - 270	114 - 115	8 - 13	6 - 10	11 - 15	9 - 13
		75	223 - 277	131 - 130	11 - 16	12 - 16	12 - 16	10 - 14
		90	227 - 282	139 - 136	13 - 18	23 - 27	13 - 17	11 - 15
90	3	40	281 - 335	80 - 86	8 - 13	7 - 11	7 - 11	5 - 9
		50	291 - 344	98 - 101	8 - 13	5 - 9	9 - 13	6 - 10
		60	299 - 352	118 - 119	9 - 14	5 - 9	10 - 14	8 - 12
		75	310 - 363	137 - 134	12 - 17	12 - 16	12 - 16	9 - 13
		90	316 - 368	144 - 141	14 - 19	22 - 26	12 - 16	10 - 14

Operating Parameter Tables - WS084

WS084 : 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
25	3	50	144 - 219	47 - 67	7 - 12	16 - 20	4 - 8	5 - 9
		80	237 - 322	58 - 79	6 - 11	5 - 9	4 - 8	6 - 10
		100	322 - 413	61 - 82	6 - 11	5 - 9	4 - 8	6 - 10
		110	371 - 467	61 - 82	6 - 11	5 - 9	3 - 7	5 - 9
		115	396 - 494	62 - 82	6 - 11	5 - 9	3 - 7	5 - 9
30	3	50	145 - 221	52 - 73	8 - 13	16 - 20	4 - 8	6 - 10
		80	240 - 324	65 - 86	7 - 12	5 - 9	5 - 9	6 - 10
		100	325 - 417	68 - 89	7 - 12	5 - 9	4 - 8	6 - 10
		110	374 - 471	69 - 89	7 - 12	5 - 9	4 - 8	6 - 10
		115	399 - 498	69 - 90	6 - 11	5 - 9	3 - 7	6 - 10
50	3	50	151 - 227	80 - 100	9 - 14	15 - 19	7 - 11	8 - 12
		80	248 - 333	98 - 119	8 - 13	5 - 9	7 - 11	9 - 13
		100	336 - 429	102 - 123	8 - 13	5 - 9	6 - 10	8 - 12
		110	387 - 485	103 - 124	8 - 13	5 - 9	6 - 10	8 - 12
		115	413 - 513	103 - 125	8 - 13	5 - 9	5 - 9	8 - 12
70	3	50	159 - 236	108 - 129	13 - 18	21 - 25	9 - 13	10 - 14
		80	261 - 347	132 - 154	12 - 17	7 - 11	9 - 13	11 - 15
		100	353 - 447	137 - 159	11 - 16	7 - 11	9 - 13	11 - 15
		110	407 - 506	138 - 160	11 - 16	7 - 11	8 - 12	10 - 14
		115	433 - 535	139 - 161	11 - 16	8 - 12	7 - 11	10 - 14

WS084 : 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
30	3	40	89 - 147	54 - 65	9 - 14	25 - 29	6 - 10	5 - 9
		50	92 - 150	69 - 78	10 - 15	20 - 24	8 - 12	6 - 10
		60	95 - 153	78 - 86	13 - 18	32 - 36	8 - 12	7 - 11
		75	98 - 156	84 - 90	14 - 19	71 - 75	9 - 13	8 - 12
		90	100 - 158	88 - 94	15 - 20	112 - 116	9 - 13	8 - 12
50	3	40	143 - 200	71 - 80	10 - 15	12 - 16	7 - 11	6 - 10
		50	146 - 203	89 - 95	10 - 15	10 - 14	9 - 13	8 - 12
		60	151 - 208	101 - 105	13 - 18	16 - 20	10 - 14	9 - 13
		75	155 - 212	108 - 111	14 - 19	36 - 40	10 - 14	9 - 13
		90	158 - 214	113 - 116	15 - 20	57 - 61	11 - 15	10 - 14
70	3	40	210 - 266	78 - 86	9 - 14	6 - 10	7 - 11	6 - 10
		50	215 - 271	98 - 103	10 - 15	5 - 9	9 - 13	7 - 11
		60	221 - 277	111 - 114	12 - 17	8 - 12	10 - 14	8 - 12
		75	227 - 282	118 - 120	14 - 19	19 - 23	11 - 15	9 - 13
		90	231 - 286	125 - 126	15 - 20	30 - 34	11 - 15	10 - 14
90	3	40	289 - 343	81 - 88	9 - 14	7 - 11	7 - 11	5 - 9
		50	296 - 350	101 - 105	10 - 15	5 - 9	8 - 12	7 - 11
		60	304 - 358	115 - 117	12 - 17	9 - 13	9 - 13	8 - 12
		75	312 - 365	122 - 123	14 - 19	20 - 24	10 - 14	8 - 12
		90	317 - 370	129 - 129	14 - 19	32 - 36	10 - 14	9 - 13

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.

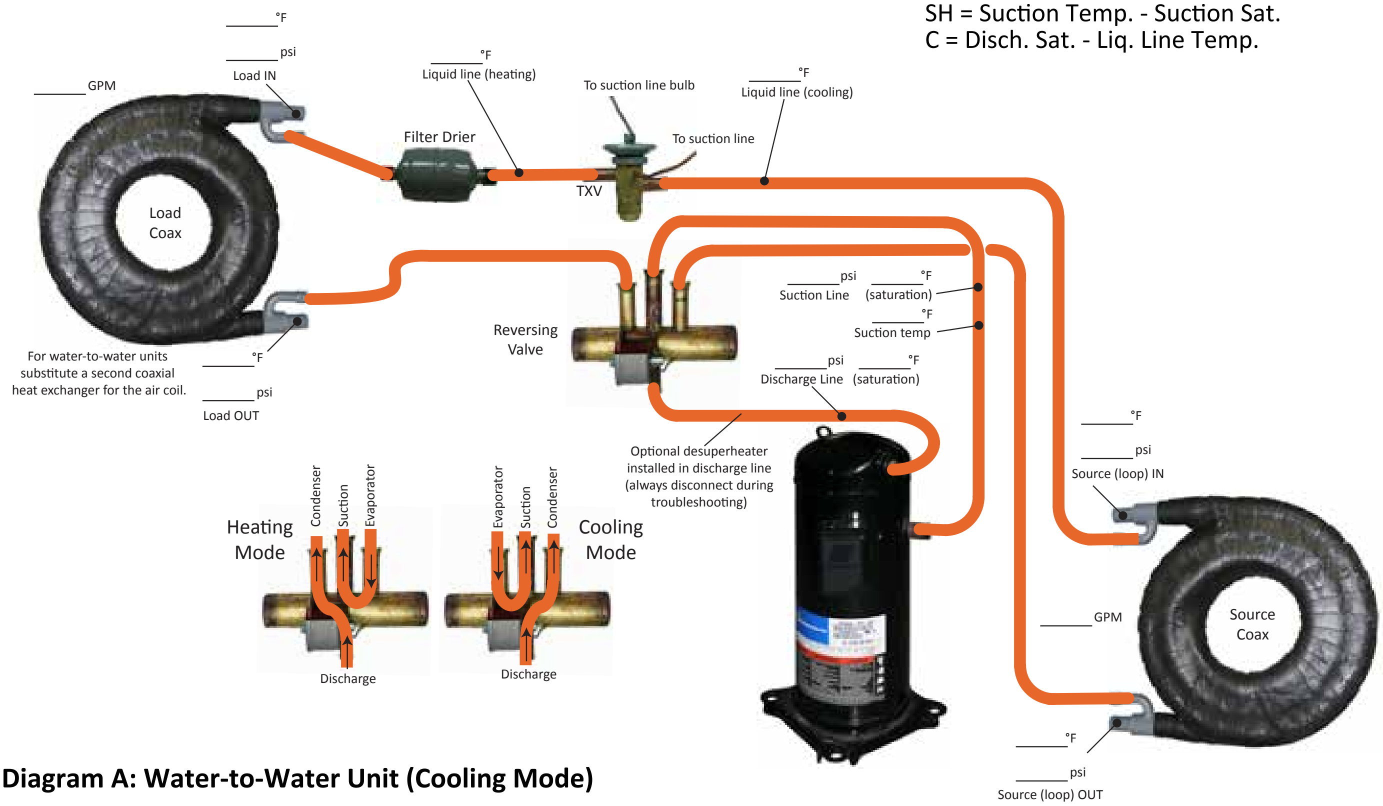


Diagram A: Water-to-Water Unit (Cooling Mode)

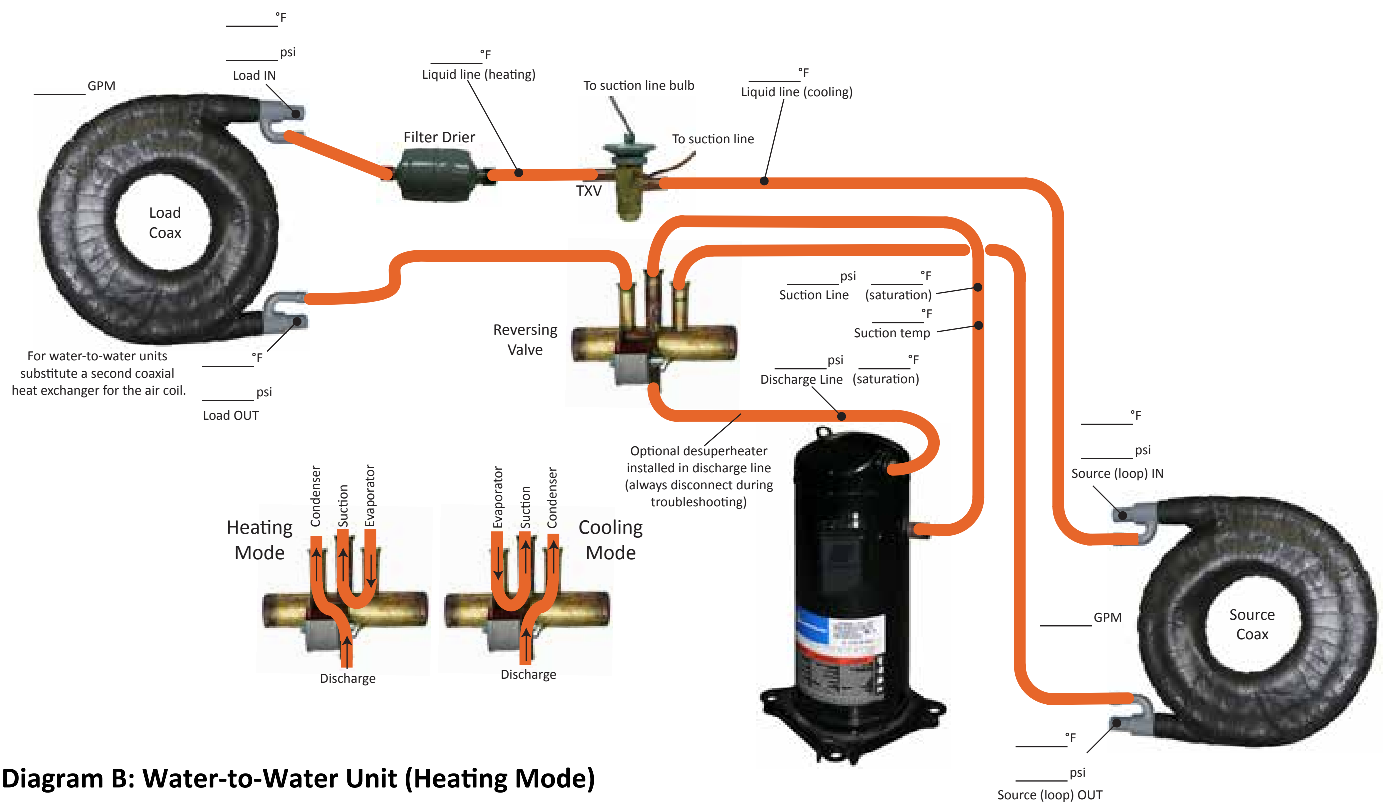


Diagram B: Water-to-Water Unit (Heating Mode)

Section 9: Troubleshooting

QR Codes for Installation or Troubleshooting Tip Videos

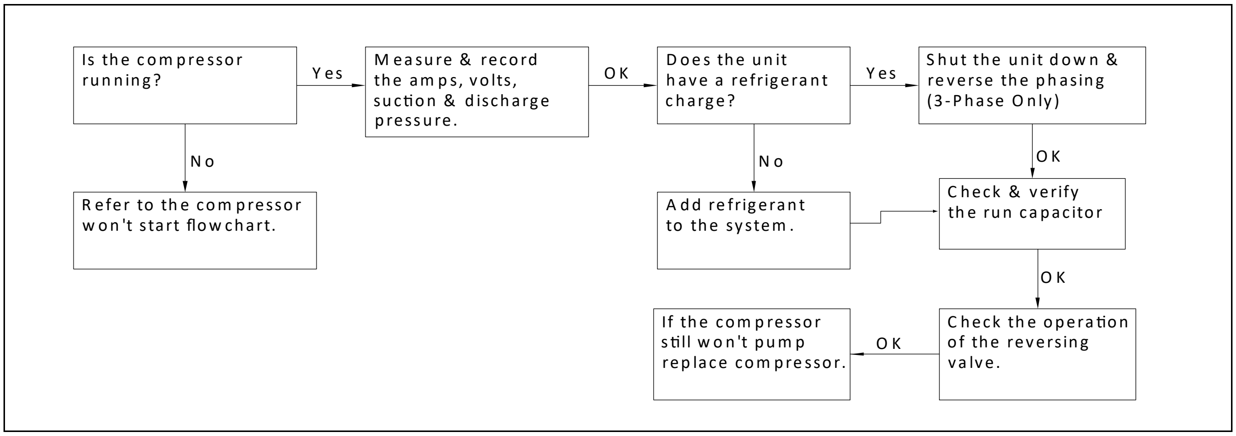
- ECM Temporary Replacement
- ECM Motor Troubleshooting
- Troubleshooting a TXV
- Compressor Troubleshooting
- Variable Speed Flow Centers
- Return Conversion for and XT or CT
- Heat Of Extraction and Rejection
- Measuring Subcooling/Superheat
- Nitrogen Purge While Brazing
- Leak Testing an Air Coil
- Loop Flushing
- Repairing a Microchannel Air Coil
- Testing a Coaxial Heat Exchanger
- Troubleshooting a TXV

Section 9: Troubleshooting

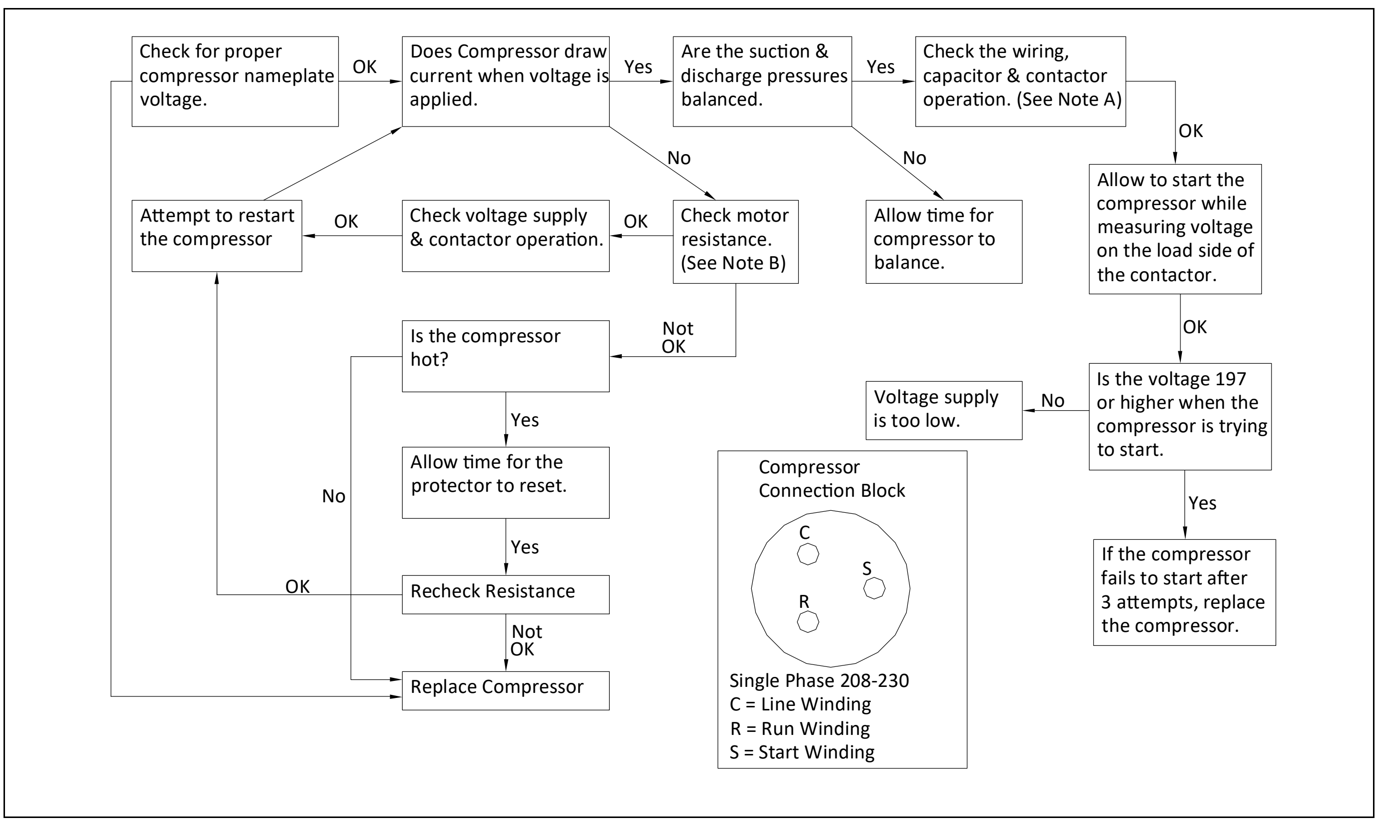
Compressor Troubleshooting

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

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



Compressor Won't Start:



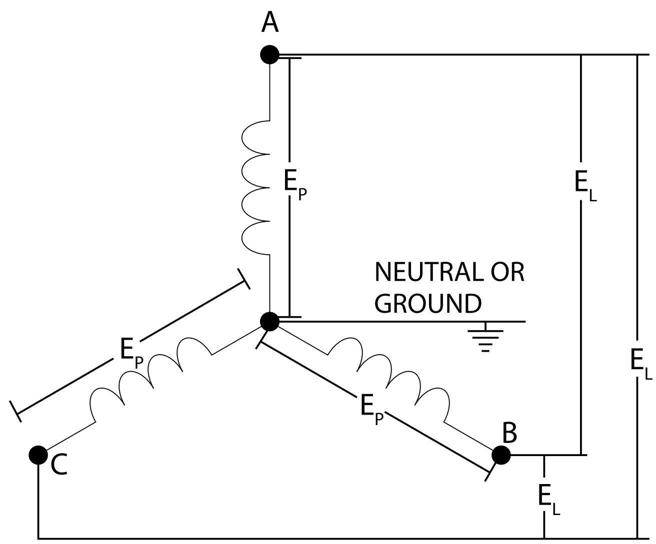
⚠ CAUTION ⚠

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.

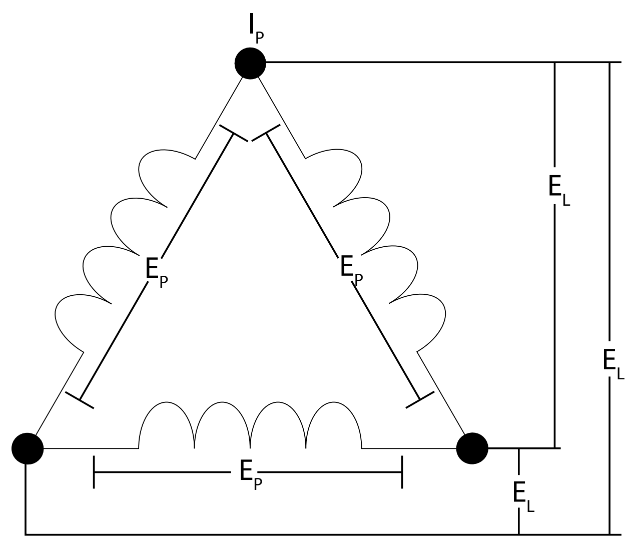
Proper Power Supply Evaluation

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

Example 1: WYE (STAR) Electrical Circuit



Example 2: DELTA Electrical Circuit



⚠ CAUTION ⚠

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

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

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).

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. Repressurize if necessary. May require re-flushing if there is air in the loop.
Solenoid valve	Make sure solenoid valve is connected. Check solenoid. If defective, replace.
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.

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Warranty Claim(s)
For warranty claims, the Installer/Dealer can visit: **http://warranty-claim.enertechgeo.com**

Warranty Registration Form

WARRANTY REGISTRATION

NOW REGISTER ONLINE AT SUPPORT.ENERTECHUSA.COM/WARRANTY-REGISTRATION

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@ENERTECHUSA.COM

FAX THIS FORM TO:
ENERTECH GLOBAL LLC
618.664.4597

REGISTER ONLINE AT: support.enertechusa.com/warranty-registration

QMS-CSF-007
Rev 7.05.2023

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Revision Table

Date	Description of Revision	Page
07JUNE2024	Updated Unit Dimensional Data & Added EXV Verbiage	6, 8, 10-11
28MAY2024	Updated Wiring Diagram	16
08SEPT2023	WS Unit Revision G IOM created.	ALL

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