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Installation, Operation & Maintenance: GWSR, GWTR, & W-Series Water-to-Water Units and Hydronic Air Handlers / "A" Coils

Rev.: 22 April 2011D
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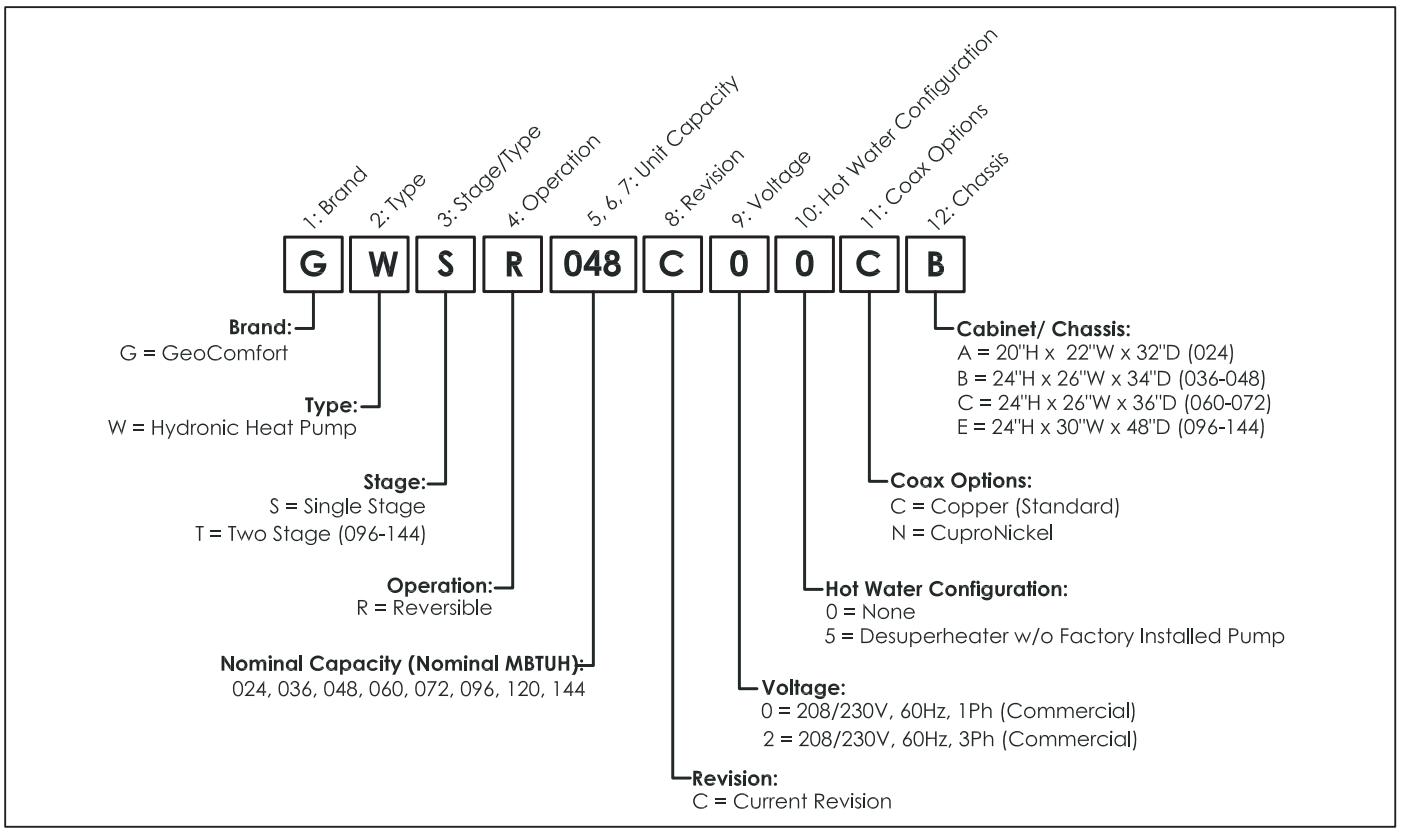
Guide Revision Table:

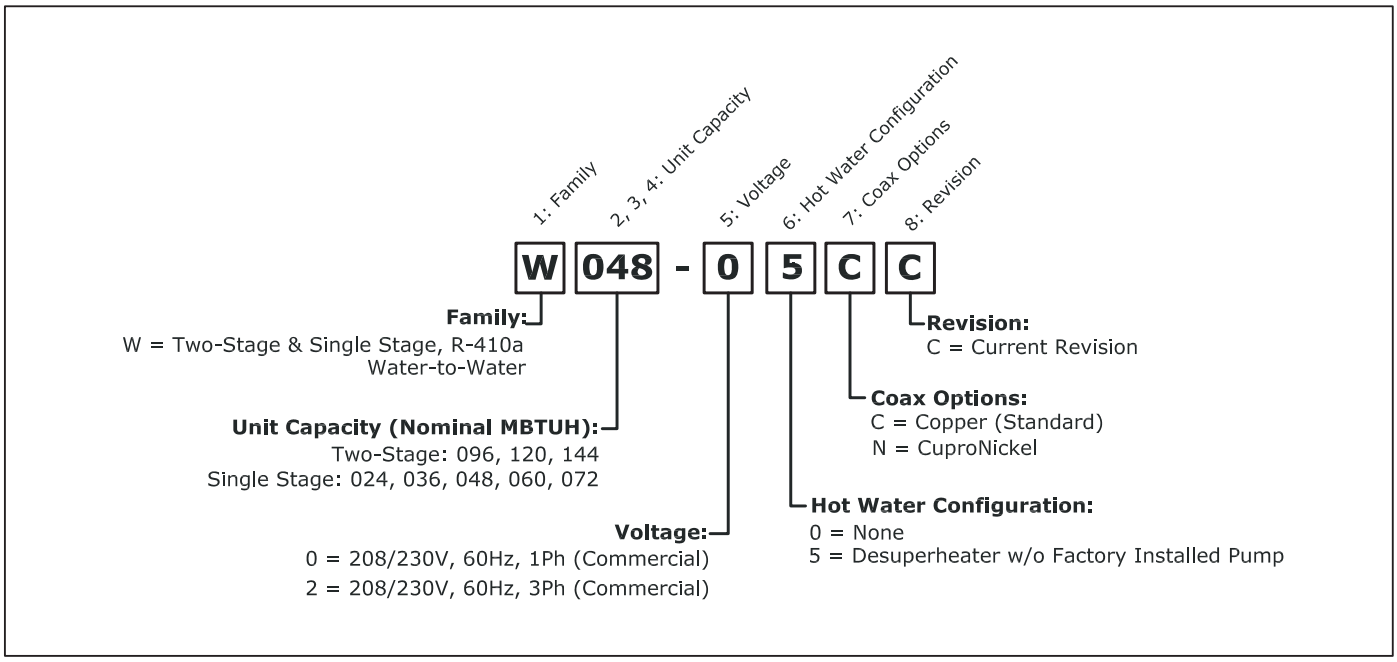
Date	By	Page	Note
22 Apr 2011	DS	31-32	Updated Wiring Diagram
22 Apr 2011	DS	10-11	Added Connection Sizes
22 Apr 2011	DS	2-4	Updated Decoders
22 Apr 2011	DS	All	Removed TW Units
22 July 2010	DS	All	Removed Legacy Controls
22 July 2010	DS	13-14	Discontinued 575V & 460V Units
27 May 2010	AV	32-33 36-37	Updated Wiring Diagram Updated Wiring Diagram
23 Feb 2010	AV	13-15	Updated Electrical Data
31 Dec 2009	DS	All	Split Out Owner's Manual
3 Sept 2009	DS	12 - 13	Updated electrical data
20 Aug 2009	DS	2-3	Updated decoders
20 Aug 2009	DS	12-13	Added Comm'l voltages
27 July 2009	DS	All	Added TETCO products
17 July 2009	DS	11-12	Updated electrical data
09 Jun 2009	JH	Various	Added hydronic air handler and "A" coil
19 May 2009	DS	All	Updated for Rev B
09 Mar 2009	DS	8 & 9	Updated electrical data
19 Feb 2009	DS	All	First published

Section 1a: GeoComfort® Series Model Nomenclature (Pre-2010 Models)



Rev.: 20 Jan. 2011E

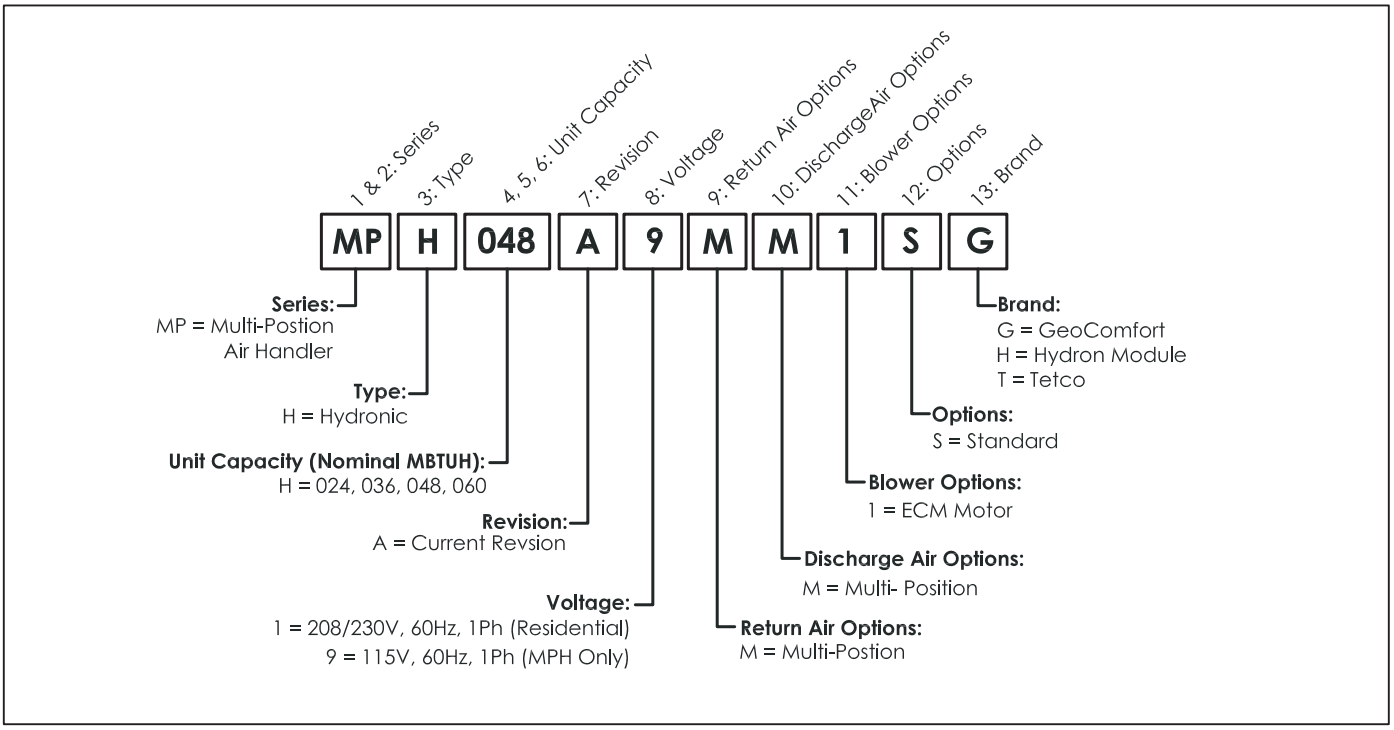
Section 1c: Hydron Module® Series Model Nomenclature (Pre-2010 Models)



Rev.: 20 Jan. 2011E

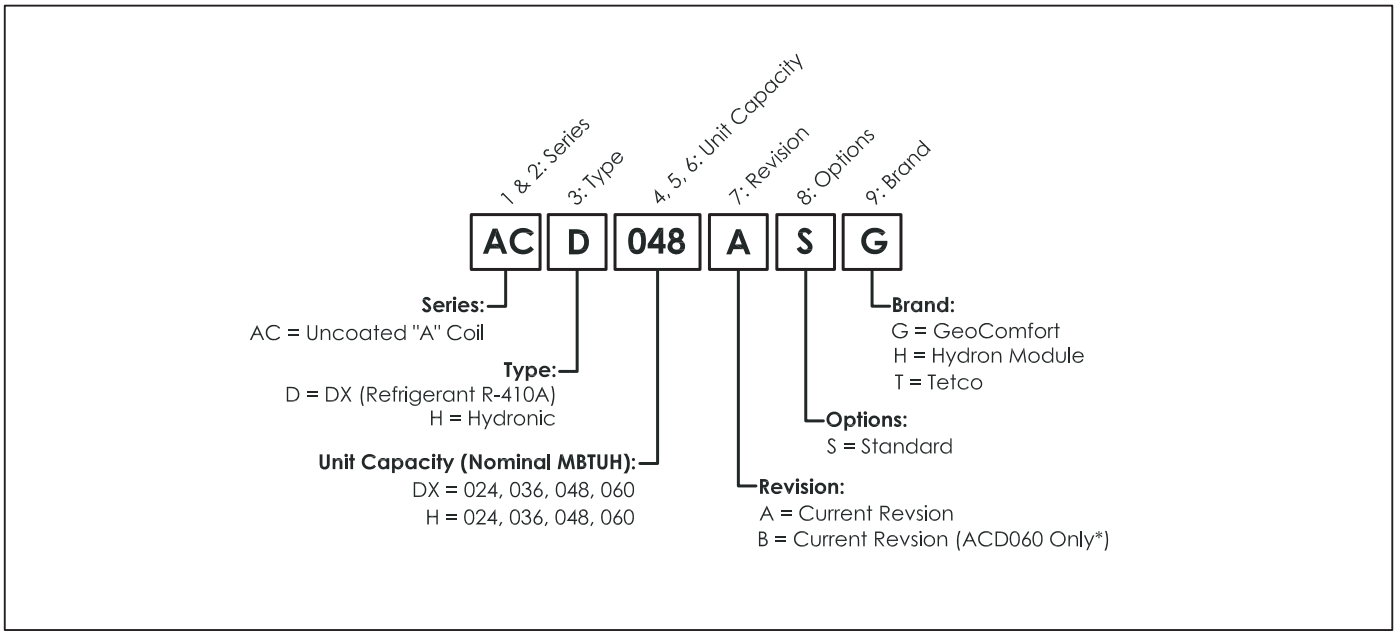
Section 1f: Air Handler/"A" Coil Model Nomenclature

Air Handlers



Rev.: 5 Nov. 2010E

"A" Coils



Rev.: 19 April 2011E

Section 2: Introduction

INTRODUCTION

This geothermal heat pump provides heated water and chilled water as well as optional domestic water heating capability. Engineering and quality control is built into every geothermal unit. Good performance depends on proper application and correct installation.

Notices, Cautions, Warnings, & Dangers:

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

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

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

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

Inspection

Upon receipt of any geothermal equipment, carefully check the shipment against the packing slip and the freight company bill of lading. Verify that all units and packages have been received. Inspect the packaging of each package and each unit for damages. Insure that the carrier makes proper notation of all damages or shortage on all bill of lading papers. Concealed damage should be reported to the freight company within 15 days. If not filed within 15 days the freight company can deny all claims.

Note: Notify Enertech Manufacturing, LLC shipping department of all damages within 15 days. It is the responsibility of the purchaser to file all necessary claims with the freight company.

Unit Protection

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

⚠ CAUTION ⚠

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

Storage

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

Pre-Installation

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

Pre-Installation Steps:

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

4. Before unit start-up, read all manuals and become familiar with unit components and operation. Thoroughly check the unit before operating.

⚠ CAUTION ⚠

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

⚠ WARNING ⚠

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

⚠ CAUTION ⚠

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

Components

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

Section 3: Installation Considerations

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

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

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

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

Equipment Installation: Special care should be taken in locating the unit. All units should be placed on a vibration absorbing pad (air pad) slightly larger than the base of the unit. All units should be located in an indoor area were the ambient temperature will remain above 55°F and should be located in a way that piping and ductwork or other permanently installed fixtures do not have to be removed for servicing and filter replacement.

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

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

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

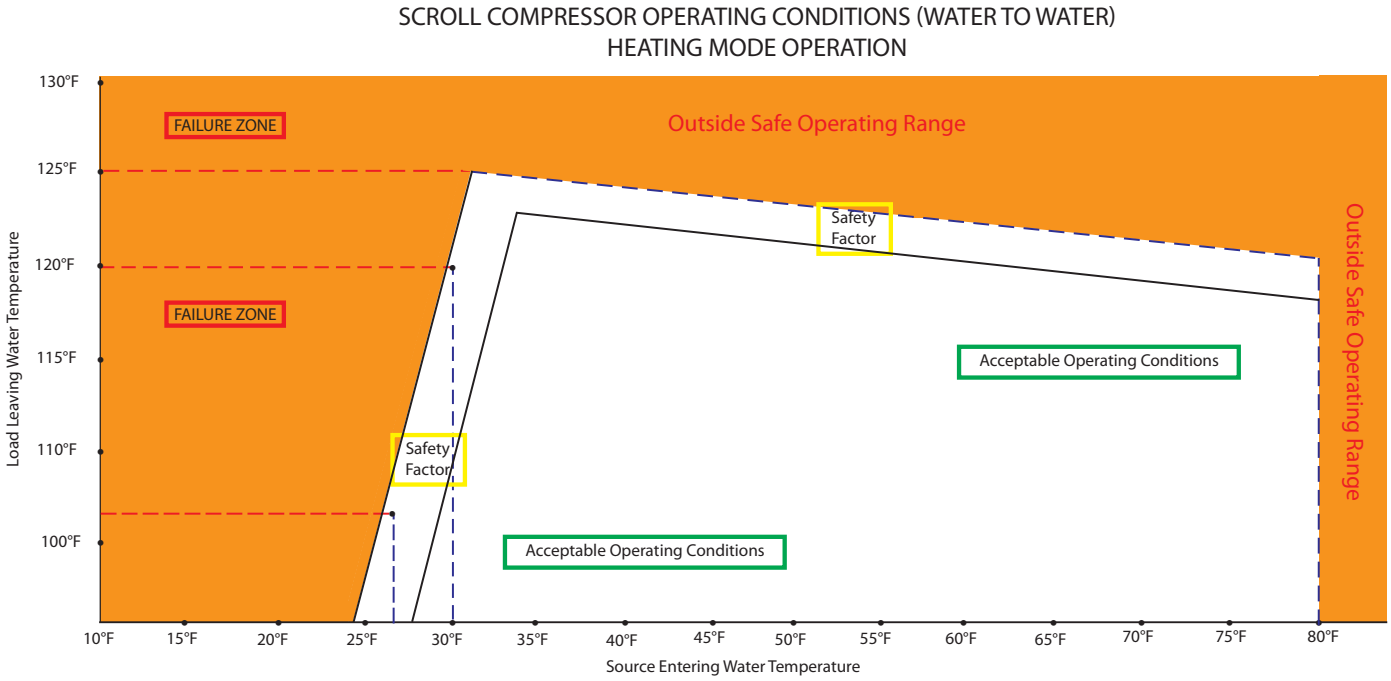
Desuperheater Package: Water heating is standard on all residential units (units may be ordered without). It uses excess heat during both heating and cooling cycles, to provide hot water for domestic needs. A desuperheater exchanger (coil) located between the compressor and the reversing valve, extracts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

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

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

Section 3: Installation Considerations

Guidelines For Heating Mode Operation For Water-To-Water Units Using Scroll Compressors

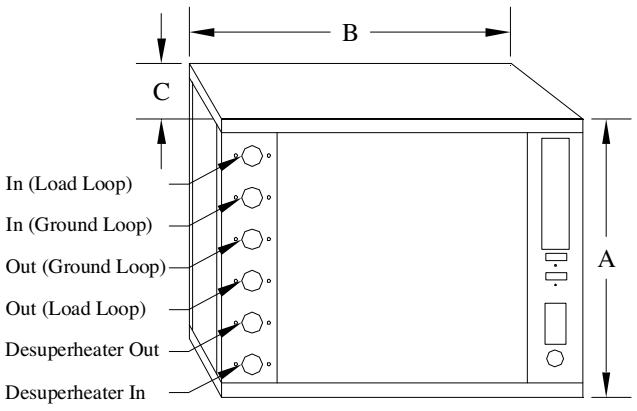


Because the water-to-water machines have become so popular for providing heated water for a multitude of uses, we've provide the above chart for reference.

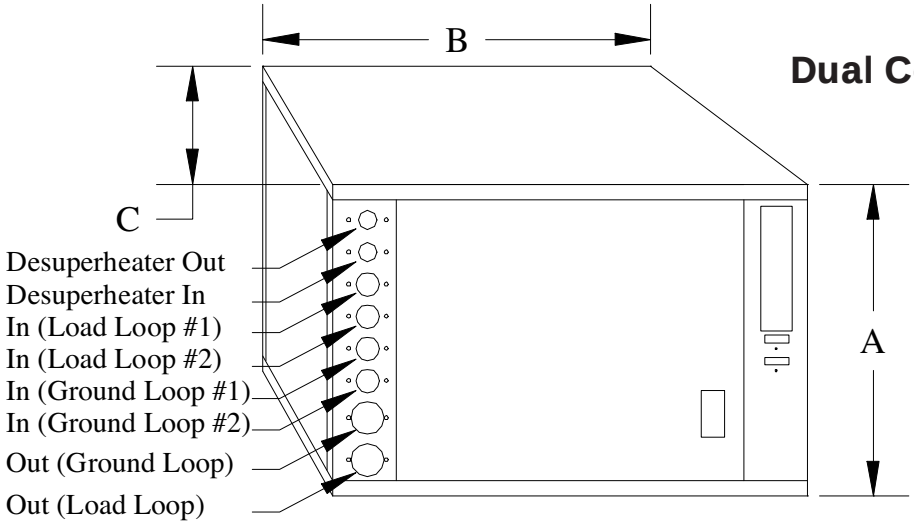
The obvious correlation is that the warmer the Source Entering Water Temperature, the hotter the Load Leaving Water Temperature can be, to a point. R410A can only handle up to about 125°F Load Leaving Water Temperature before putting the compressor at risk.

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

Section 4a: Water-to-Water Equipment Physical Data



Single Compressor



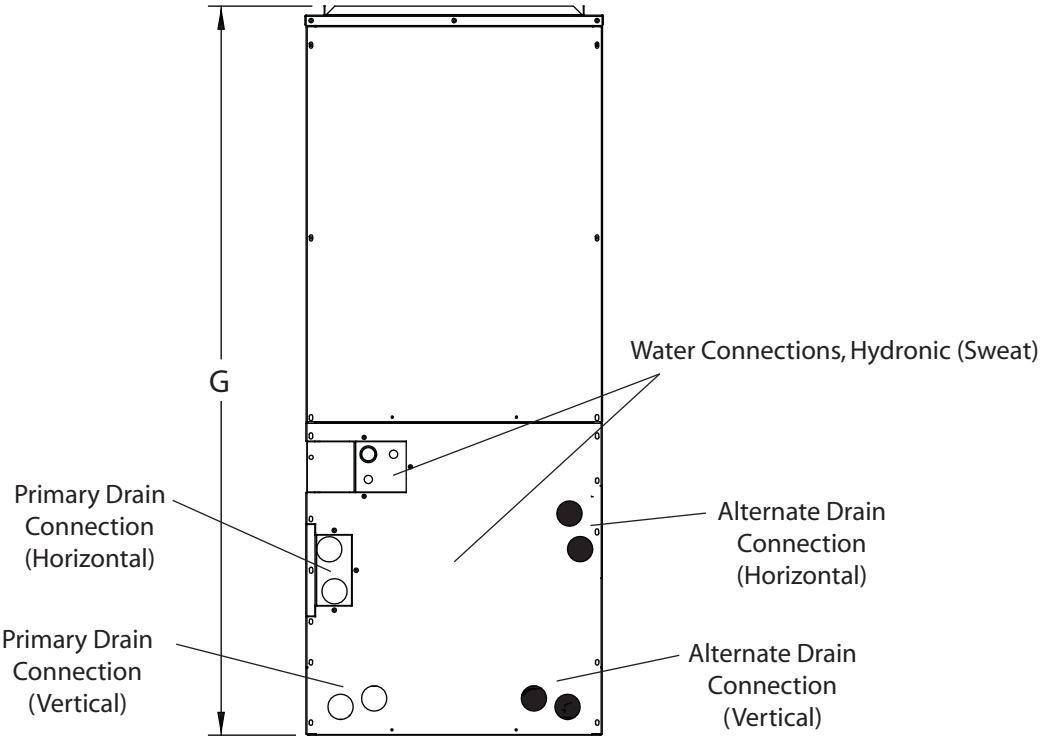
Dual Compressor

Single Compressor Units								
Model	Dimensional Data			Source Loop**		Load Loop		Weight
	A	B	C	IN	OUT	IN	OUT	
024	20	22	32	0.75”	0.75”	0.75”	0.75”	200
036	24	26	34	1”	1”	1”	1”	280
048	24	26	34	1”	1”	1”	1”	300
060	24	26	36	1”	1”	1”	1”	350
072	24	26	36	1”	1”	1”	1”	350
Dual Compressor Units								
Model	Dimensional Data			Ground Loop		Load Loop		Weight
	A	B	C	IN*	OUT	IN*	OUT	
096	24	30	48	1”	1.25”	1”	1.25”	550
120	24	30	48	1”	1.5”	1”	1.5”	670
144	24	30	48	1”	1.5”	1”	1.5”	670

* There are two “IN” connections, but only one “Out” connection
•• GeoComfort Series Only - 1” double o-ring fittings

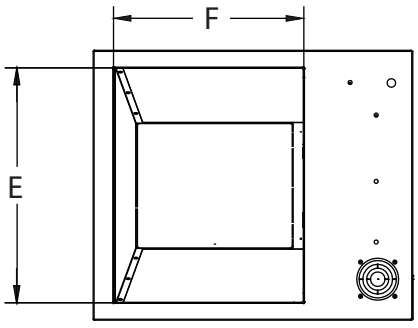
Section 4b: MPH Series Air Handler Physical Data

FRONT VIEW

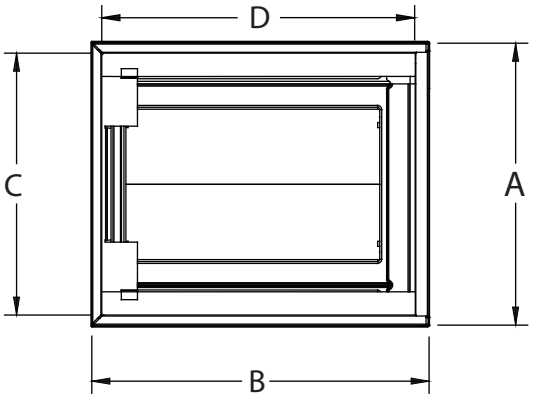


Model	Size (tons)	All Dimensions in Inches							Water Connection Size (Sweat, "L" Copper)
		A	B	C	D	E	F	G	
024	2	17 5/8	21	16 1/3	20 1/4	15 1/2	12 1/2	43	0.875" O.D. 0.045" Wall
036	3	21 1/8	21	19 3/4	20 1/4	19	12 1/2	48 1/4	
048-060	4 - 5	25	22	23 3/8	20 1/2	22 1/4	14 1/4	58 3/4	

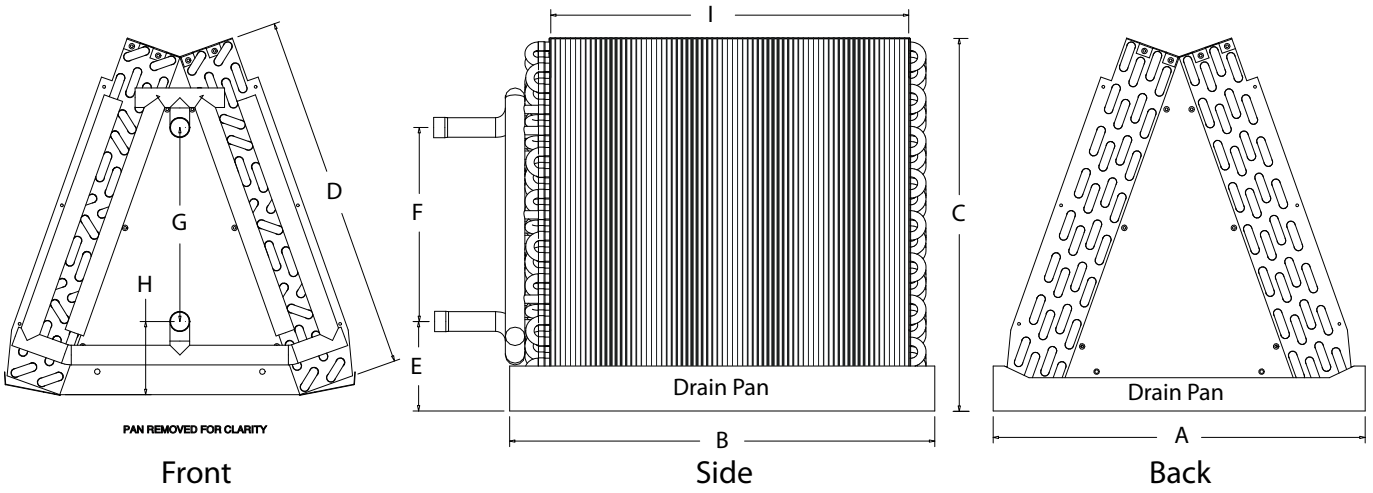
TOP VIEW



BOTTOM VIEW



Section 4c: AC Series "A" Coil Physical Data



Model	Size (Tons)	All Dimensions In Inches									Weight (lbs)	Water Connection Size (Sweat, "L" Copper)
		B	A	I	D	E	F	G	H	C		
024	2	19.00	16.63	16.00	16.00	4.00	8.67	8.67	3.27	18.5	38	0.875" O.D. 0.045" Wall
036	3	19.00	19.63	16.00	20.00	6.76	6.77	6.77	6.04	21.0	46	
048	4	20.50	23.92	17.50	28.58	9.38	9.38	9.38	8.66	28.0	48	
060	5	20.50	23.92	17.50	28.58	9.38	9.38	9.38	8.66	28.0	67	

NOTES:
1. The AC series coils are designed as high efficiency "A" coils to be installed on new and existing indoor furnaces. These coils may be used in upflow and downflow applications.
2. Coils are ETL and CSA approved.
3. Primary and secondary drain connections are available on the LH or RH side of the drain pan, and are 3/4" FPT. Center line of drains located from pan corner, 1 1/2" for primary and 3 1/2" for secondary.
4. Drain pan is injection molded high temperature UL approved plastic.

⚠ WARNING ⚠

IF USING A DUAL FUEL APPLICATION, "A" COIL MUST BE INSTALLED ON THE OUTLET OF THE FURNACE. INSTALLATION ON THE RETURN COULD CAUSE FURNACE HEAT EXCHANGER FAILURE, AND MAY VOID FURNACE WARRANTY.

Section 5a: Single Compressor Unit Electrical Data

Model	Voltage Code	60Hz Power		Compressor		HWG Pump FLA	Ext Loop Pump FLA*	Total Unit FLA	Min Circuit AMPS	Max Fuse HACR	Min AWG	Max Ft
		Volts	Phase	LRA	RLA							
024	0	208/230	1	64.0	12.8	N/A	N/A	12.8	16.0	25	N/A	N/A
	1	208/230	1	64.0	12.8	0.5	4.0	17.3	20.5	30	12	57
	2	208/230	3	63.0	8.3	N/A	N/A	8.3	10.4	15	N/A	N/A
036	0	208/230	1	112.0	17.9	N/A	N/A	17.9	22.4	40	N/A	N/A
	1	208/230	1	112.0	17.9	0.5	4.0	22.4	26.9	40	10	74
	2	208/230	3	88.0	13.5	N/A	N/A	13.5	16.9	30	N/A	N/A
048	0	208/230	1	134.0	26.4	N/A	N/A	26.4	33.0	50	N/A	N/A
	1	208/230	1	134.0	26.4	0.5	5.5	32.4	39.0	60	8	79
	2	208/230	3	123.0	17.6	N/A	N/A	17.6	22.0	35	N/A	N/A
060	0	208/230	1	158.0	30.1	N/A	N/A	30.1	37.6	60	N/A	N/A
	1	208/230	1	158.0	30.1	0.5	5.5	36.1	43.6	70	6	113
	2	208/230	3	155.0	20.5	N/A	N/A	20.5	25.6	45	N/A	N/A
072	0	208/230	1	148.0	32.1	N/A	N/A	32.1	40.1	70	N/A	N/A
	1	208/230	1	148.0	32.1	0.5	5.5	38.1	46.1	70	6	107
	2	208/230	3	149.0	22.4	N/A	N/A	22.4	28.0	50	N/A	N/A

Notes:
1. All line and low voltage wiring must adhere to the National Electrical Code and Local Codes, whichever is the most stringent.
2. Wire length based on a one way measurement with a 2% voltage drop.
3. Wire size based on 60°C copper conductor and minimum circuit ampacity.
3. All fuses class RK-5
4. Min/Max Voltage: 208/230/60/1 = 197/243, 208/230/60/3 = 197/243
* The external loop pump FLA is based on a maximum of three UP26-116F-230V pumps (1/2hp) for 048 - 072 and two pumps for 024 - 036

Section 5b: Dual Compressor Unit Electrical Data

Model	Voltage Code	60Hz Power		Compressor		HWG Pump FLA	Ext Loop Pump FLA*	Total Unit FLA	Min Circuit AMPS	Max Fuse HACR	Min AWG	Max Ft
		Volts	Phase	LRA	RLA							
096	0	208/230	1	134.0 Each	26.4 Each	N/A	N/A	52.8	59.4	80	N/A	N/A
	1	208/230	1	134.0 Each	26.4 Each	N/A	N/A	52.8	59.4	80	4	122
	2	208/230	3	123.0 Each	17.6 Each	N/A	N/A	35.2	39.6	50	N/A	N/A
120	0	208/230	1	158.0 Each	30.1 Each	N/A	N/A	60.2	67.7	90	N/A	N/A
	1	208/230	1	158.0 Each	30.1 Each	N/A	N/A	60.2	67.7	90	4	107
	2	208/230	3	155.0 Each	20.5 Each	N/A	N/A	41.0	46.1	60	N/A	N/A
144	0	208/230	1	148.0 Each	32.1 Each	N/A	N/A	64.2	72.2	100	N/A	N/A
	1	208/230	1	148.0 Each	32.1 Each	N/A	N/A	64.2	72.2	100	3	129
	2	208/230	3	149.0 Each	22.4 Each	N/A	N/A	44.8	50.4	70	N/A	N/A

Notes:
1. All line and low voltage wiring must adhere to the National Electrical Code and Local Codes, whichever is the most stringent.
2. Wire length based on a one way measurement with a 2% voltage drop.
3. Wire size based on 60°C copper conductor and minimum circuit ampacity.
3. All fuses class RK-5
4. Min/Max Voltage: 208/230/60/1 = 197/243, 208/230/60/3 = 197/243
* The external loop pump FLA is based on a maximum of three UP26-116F-230V pumps (1/2hp)

Section 5e: Hydronic Air Handler Unit Electrical Data

Model	60 HZ Power Single Phase Volts	Motor Amps / HP	Electric Heater Data							Minimum Circuit Ampacity					Maximum Overcurrent Protection				
			# of Circuits	kW	Amps 115V	Amps 208V	Amps 208V	Amps 240V	Amps 240V	MCA 115V	MCA 208V	MCA 208V	MCA 240V	MCA 240V	MOCP 115V	MOCP 208V	MOCP 208V	MOCP 240V	MOCP 240V
					Cr 1	Cr 1	Cr 2	Cr 1	Cr 2	Cr 1	Cr 1	Cr 2	Cr 1	Cr 2	Cr 1	Cr 1	Cr 2	Cr 1	Cr 2
024	208/240	2.8 / 0.33	0	0	-	-	-	-	-	-	3.5	-	3.5	-	-	10.0	-	10.0	-
	208/240	2.8 / 0.33	1	5	-	18.0	-	20.8	-	-	25.3	-	28.8	-	-	35.0	-	35.0	-
	208/240	2.8 / 0.33	1	10	-	36.1	-	41.7	-	-	47.9	-	54.9	-	-	60.0	-	60.0	-
	115	5.0 / 0.33	0	0	5.0	-	-	-	-	6.3	-	-	-	-	10.0	-	-	-	-
036	208/240	4.3 / 0.50	0	0	-	-	-	-	-	-	5.4	-	5.4	-	-	10.0	-	10.0	-
	208/240	4.3 / 0.50	1	5	-	18.0	-	20.8	-	-	26.8	-	30.3	-	-	35.0	-	40.0	-
	208/240	4.3 / 0.50	1	10	-	36.1	-	41.7	-	-	49.4	-	56.4	-	-	60.0	-	60.0	-
	208/240	4.3 / 0.50	2	15		18.0	36.1	20.8	41.7		26.8	49.4	30.3	56.4		35.0	60.0	40.0	60.0
	115	7.7 / 0.50	0	0	7.7	-	-	-	-	9.6	-	-	-	-	15.0	-	-	-	-
048-060	208/240	6.8 / 0.75	0	0	-	-	-	-	-	-	8.5	-	8.5	-	-	15.0	-	15.0	-
	208/240	6.8 / 0.75	1	5	-	18.0	-	20.8	-	-	29.3	-	32.8	-	-	35.0	-	40.0	-
	208/240	6.8 / 0.75	1	10	-	36.1	-	41.7	-	-	51.9	-	58.9	-	-	60.0	-	70.0	-
	208/240	6.8 / 0.75	2	15	-	18.0	36.1	20.8	41.7	-	29.3	51.9	32.8	58.9	-	35.0	60.0	40.0	70.0
	208/240	6.8 / 0.75	2	20	-	36.1	36.1	41.7	41.7	-	51.9	51.9	58.9	58.9	-	60.0	60.0	70.0	70.0
	115	12.8 / 1.0	0	0	12.8	-	-	-	-	16.0	-	-	-	-	20.0	-	-	-	-

Notes:
1. Always refer to unit nameplate data prior to installation
2. Maximum overcurrent device, overcurrent protection installed on breaker are sized per MCA

Section 6: Unit Placement

UNIT PLACEMENT

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

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

PRE-INSTALLATION

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

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

Section 7: Unit Piping Installation

Open Loop Piping

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

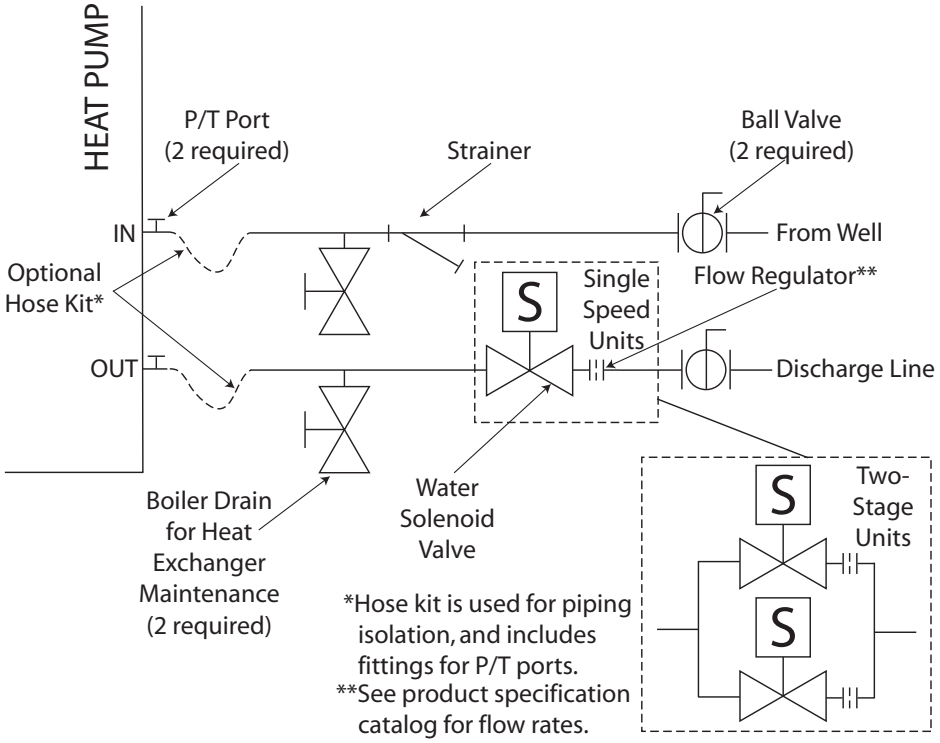
A flow regulator should be placed after the water solenoid valve. Always check the product specification catalog for proper flow rate. A calculation must be made to determine the flow rate, so that the leaving water temperature does not have the possibility of freezing.

Other necessary components include a strainer, boiler drains for heat exchanger flushing, P/T ports and ball valves. Ball valves allow the water to be shut off for service, and also help when velocity noise is noticeable through the flow regulator. Spreading some of the pressure drop across the ball valves will lessen the velocity noise. Always double check flow rate at the P/T ports to make sure the ball valve adjustments have not lowered water flow too much, and essentially taken the flow regulator out of the equation. It's a good idea to remove the ball valve handles once the system is completed to avoid nuisance service calls.

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

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

Figure 1: Open Loop Piping Example



Section 7: Unit Piping Installation

Water Quality

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

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

In an open loop system the water quality is of no less importance. Due to the inherent variation of the supply water, it should be tested prior to making the decision to use an open loop system. Scaling of the heat exchanger and corrosion of the internal parts are two of the potential problems. The Department of Natural Resources or your local municipality can direct you to the proper testing agency. Please see Table 1 for guidelines.

Table 1: Water Quality

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

Notes:
1. Harness in ppm is equivalent to hardness in mg/l
2. Grains/gallon = ppm divided by 17.1
3. Copper and cupro-nickel heat exchangers are not recommended for pool applications for water outside the range of the table. Secondary heat exchangers are required for applications not meeting the requirements shown above.
4. Saltwater applications (approx. 25,000 ppm) require secondary heat exchangers due to copper piping between the heat exchanger and the unit fittings.

Section 7: Unit Piping Installation

Interior Piping

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

Table 2: Pipe Insulation

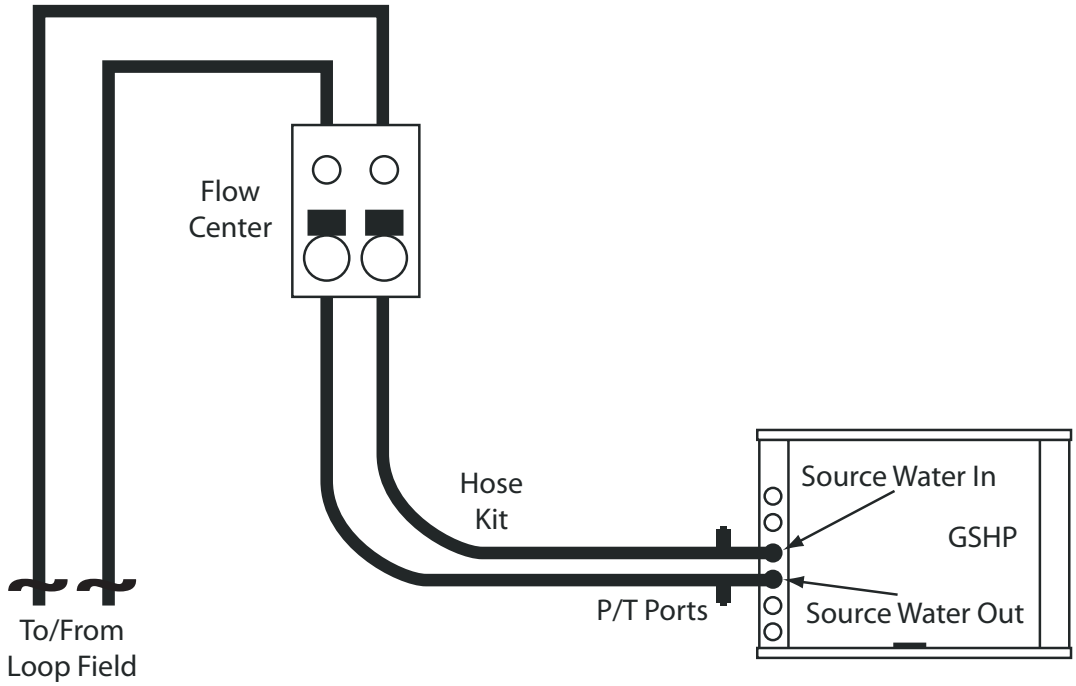
Piping Material	Insulation Description
1" IPS Hose	1-3/8" ID - 3/8" Wall
1" IPS PE	1-1/4" ID - 3/8" Wall
1-1/4" IPS PE	1-5/8" ID - 3/8" Wall
2" IPS PD	2-1/8" ID - 3/8" Wall

Typical Pressurized Flow Center Installation

The flow centers are insulated and contain all flushing and circulation connections for residential and light commercial earth loops that require a flow rate of no more than 20 gpm. 1-1/4" fusion x 1" double o-ring fittings (AGA6PES) are furnished with the AGFC_A flow centers for HDPE loop connections. Various fittings are available for the AGFC_A flow centers for different connections. A typical installation will require the use of a hose kit. Hose kits AGHK_A come with the AGA5INS adapter to transition from the AGFC_A double o-ring connection to 1" hose connection.

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

Figure 2: Typical Single Unit Piping Connection (Pressurized Flow Center)



Section 7: Unit Piping Installation

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

Figure 3: Typical Single Compressor Unit Piping Connection (Non-Pressurized Flow Center)

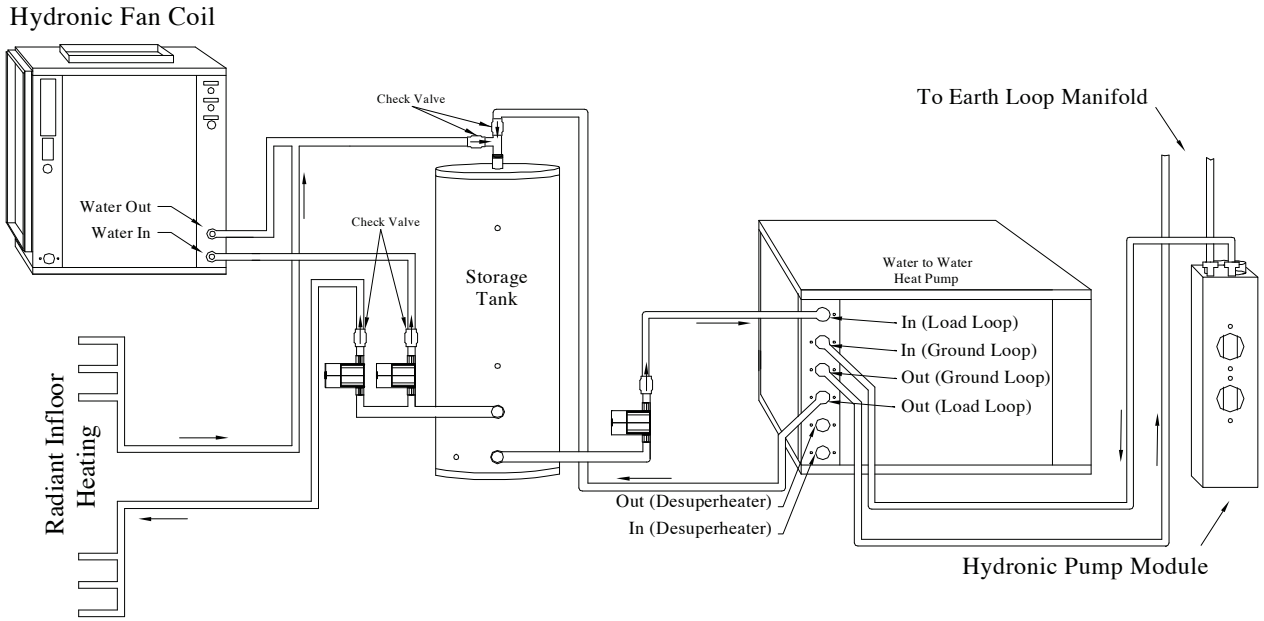


Figure 4: Typical Dual Compressor Unit Piping Connection (Non-Pressurized Flow Center)

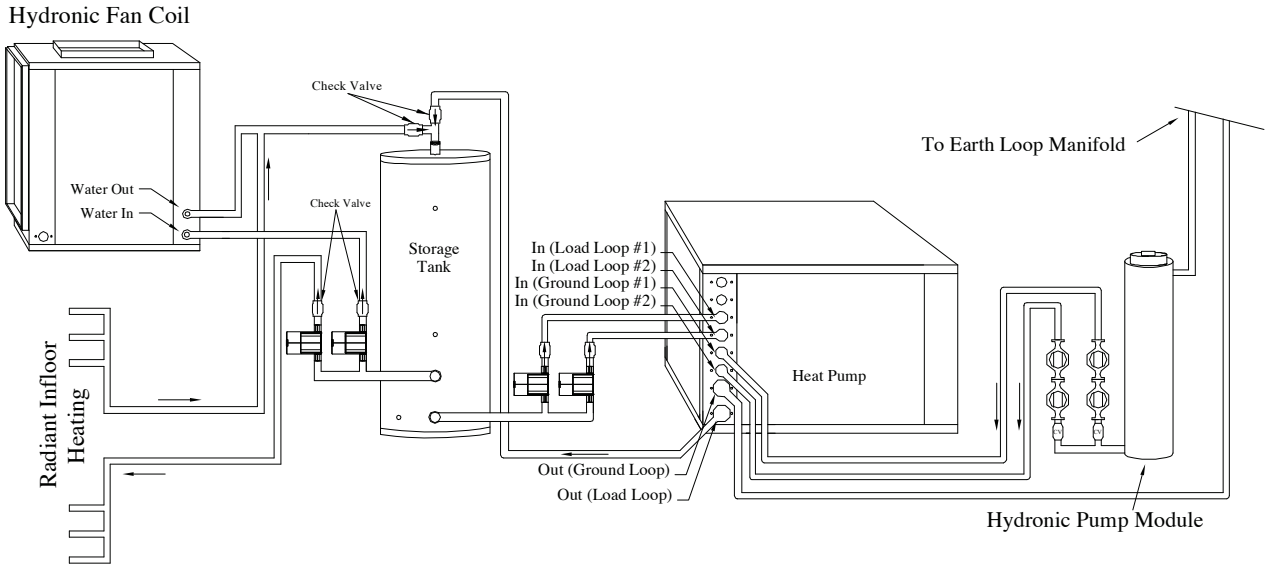


Figure 5: Typical Storage Tank Piping For Radiant Floor Heating

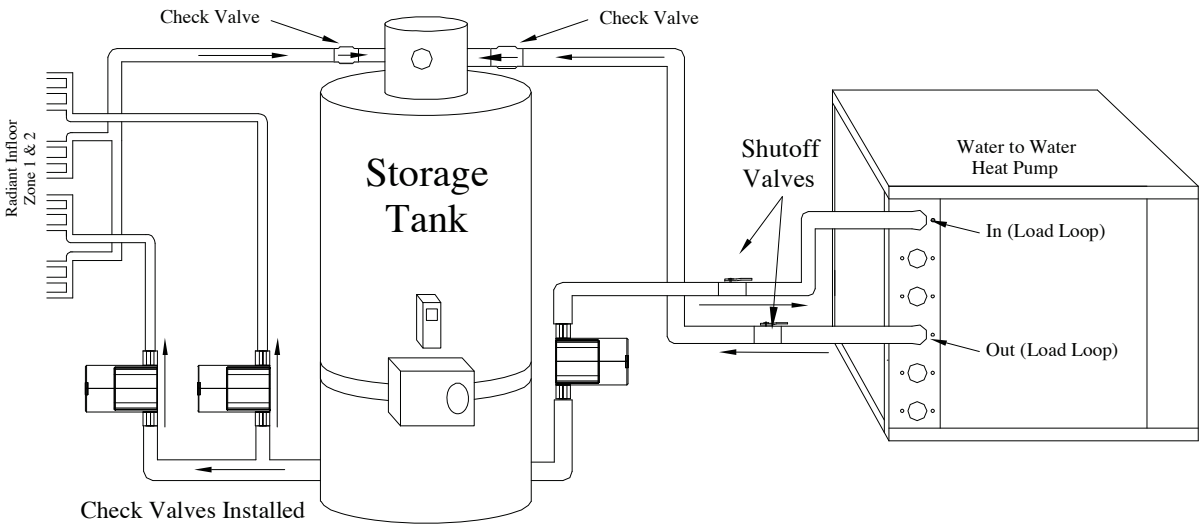


Table 3a: Air Handler / "A" Coil Capacities

Hot Water Heating Capacity -- 68°F EAT (DB)						
Model	CFM	EWT °F	GPM	WPD Ft Hd	Htg Cap Btuh	LAT °F
MPH024	789	100	3.0	1.9	13,526	83.9
		105		1.9	17,677	88.7
		110		1.9	21,829	93.6
		115		1.8	25,980	98.5
		120		1.8	30,131	103.4
MPH036	1058	100	4.5	1.9	17,808	83.6
		105		1.9	23,527	88.6
		110		1.9	29,246	93.6
		115		1.8	34,965	98.6
		120		1.8	40,684	103.6
MPH048	1564	100	6.0	2.5	25,339	83.0
		105		2.4	33,373	87.8
		110		2.4	41,407	92.5
		115		2.4	49,441	97.3
		120		2.3	57,474	102.0
MPH060	1952	100	7.5	4.0	34,801	84.5
		105		3.9	44,796	89.2
		110		3.9	54,791	94.0
		115		3.8	64,785	98.7
		120		3.7	74,779	103.5

Chilled Water Cooling Capacity -- 80/67°F EAT (DB/WB)						
Model	CFM	EWT °F	GPM	WPD Ft Hd	TC Btuh	SC Btuh
MPH024	789	45	3.0	2.5	30,776	21,517
MPH036	1058	45	4.5	2.5	41,100	28,654
MPH048	1564	45	6.0	3.2	52,901	38,568
MPH060	1952	45	7.5	5.1	64,516	47,117

Table 3b: Air Handler / "A" Coil Corrections

Airflow Correction Factors				
Model	CFM	Heating Capacity	Tot Cooling Capacity	Sensible Capacity
MPH024	880	1.047	1.046	1.074
	789	1.000	1.000	1.000
	690	0.949	0.950	0.920
	584	0.895	0.897	0.833
MPH036	1058	1.000	1.000	1.000
	1023	0.987	0.987	0.979
	831	0.913	0.915	0.862
	657	0.846	0.850	0.757
MPH048	1952	1.101	1.098	1.159
	1761	1.051	1.050	1.081
	1564	1.000	1.000	1.000
	1385	0.954	0.955	0.927
MPH060	1952	1.000	1.000	1.000
	1761	0.960	0.961	0.937
	1564	0.919	0.921	0.873
	1385	0.882	0.885	0.814

Table 3c: Air Handler / "A" Coil Corrections

Entering Air Correction Factors										
Heating		Cooling								
				Sensible Capacity						
EAT °F (DB)	Heating Capacity	EAT °F (WB)	Total Capacity	EAT °F (DB)						
				60	65	70	75	80	85	
50	1.038	50	0.743	0.911	**	**	**	**	**	
55	1.028	55	0.820	0.771	0.882	1.019	**	**	**	
60	1.018	60	0.896		0.670	0.854	1.047	**	**	
65	1.007	65	0.971			0.649	0.866	1.081	**	
68	1.000	67	1.000			0.556	0.780	1.000	1.216	
70	0.995	70	1.044				0.638	0.865	1.085	
75	0.984	75	1.116					0.601	0.832	

**At this condition, Total Capacity = Sensible Capacity.

Gray shaded area includes conditions not typical for cooling operation.

Section 8: Antifreeze

Antifreeze Overview

In areas where minimum entering loop temperatures drop below 40°F, or where piping will be routed through areas subject to freezing, antifreeze is required. Alcohols and glycols are commonly used as antifreeze. However, local and state/provincial codes supersede any instructions in this document. The system needs antifreeze to protect the coaxial heat exchanger from freezing and rupturing. Freeze protection should be maintained to 15°F below the lowest expected entering 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 Tables 3 and 4 for volumes and percentages. The freeze protection should be checked during installation using the proper hydrometer to measure the specific gravity and freeze protection level of the solution.

Antifreeze Characteristics

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

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

Cost: Prices vary widely.

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

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

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

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

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

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

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

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

Propylene Glycol: Non-toxic, non-corrosive, mid to high price, poor heat transfer, high viscosity when cold, and can introduce micro air bubbles when adding to the system. It has also been known to form a "slime-type" coating inside the pipe. Food grade glycol is recommended because some of the other types have certain inhibitors that react poorly with geothermal systems. A 25% brine solution is a minimum required by glycol manufacturers, so that bacteria does not start to form.

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

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

Section 8: Antifreeze

Notes:

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

Antifreeze Charging

Calculate the total amount of pipe in the system and use Table 4a to calculate the amount of volume for each specific section of the system. Add the entire volume together, and multiply that volume by the proper antifreeze percentage needed (Table 4b) for the freeze protection required in your area. Then, double check calculations during installation with the proper hydrometer and specific gravity chart (Figure 6) to determine if the correct amount of antifreeze was added.

⚠ CAUTION ⚠

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

Table 4a: Pipe Fluid Volume

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

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

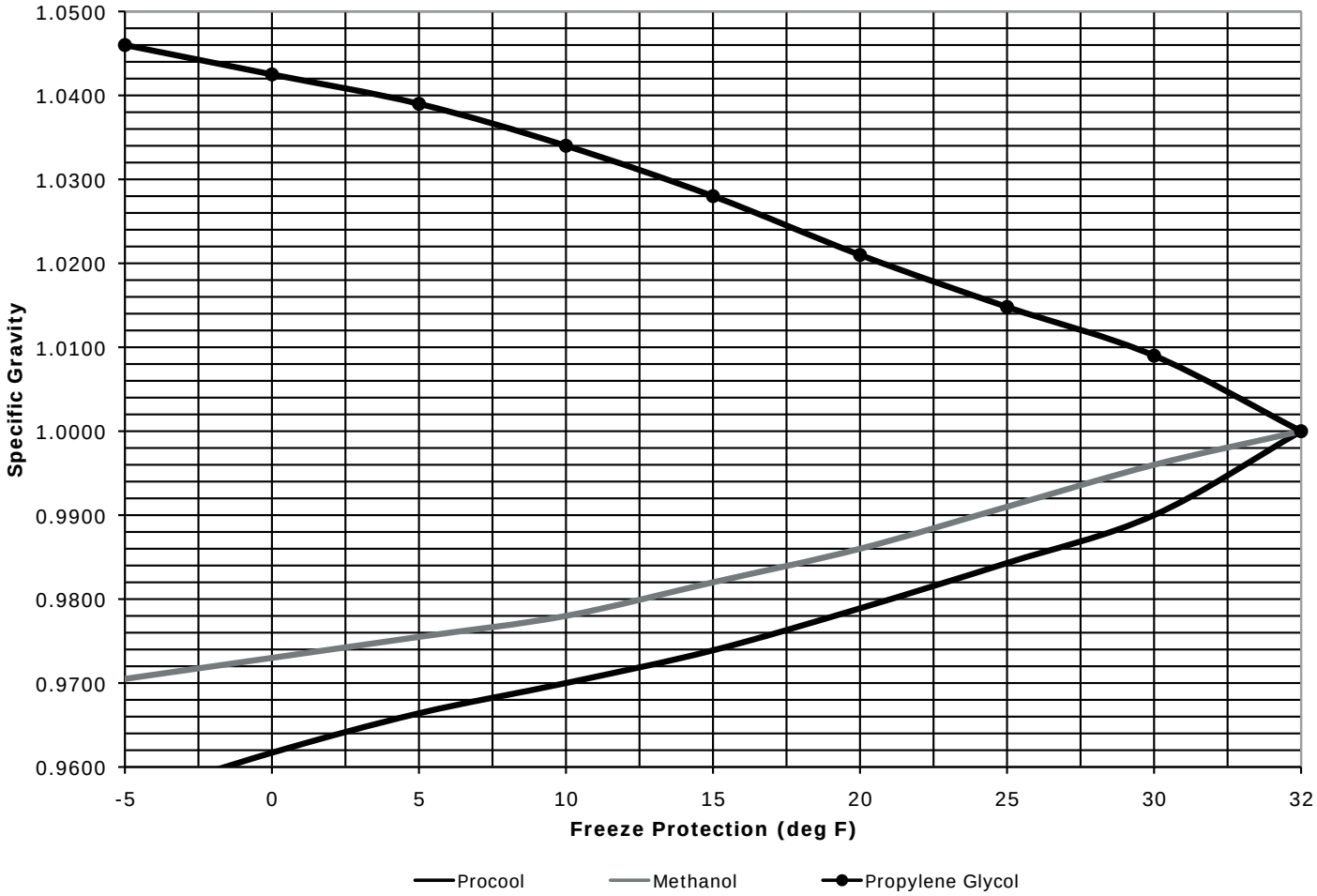
Table 4b: Antifreeze Percentages by Volume

Type of Antifreeze	Minimum Temperature for Freeze Protection			
	10°F (-12.2°C)	15°F (-9.4°C)	20°F (-6.7°C)	25°F (-3.9°C)
ProCool (Ethanol)	25%	22%	17%	12%
Methanol	25%	21%	16%	10%
Propylene Glycol	38%	30%	22%	15%

All antifreeze solutions are shown in pure form - not premixed

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

Figure 6: Antifreeze Specific Gravity



Section 9: Desuperheater Installation

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

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

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

CONTENTS OF THE DESUPERHEATER FITTING KIT:

- (1) p/n 23-23-0024-001, Installation Instructions
- (1) p/n 11-08-0004-001, 3/4"x 3/4"x 3/4" FPT Brass Tee
- (1) p/n 11-08-0003-001, ¾" Boiler Drain Valve
- (1) p/n 11-08-0005-001, ¾" MPT x 3-1/2" Brass Nipple
- (3) p/n 11-08-0006-001, ½" SWT x ¾" MPT Copper Adaptor
- (1) p/n 11-08-0007-001, ¾" x ¾" x ½" SWT Copper Tee

Plumbing Installation:

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

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

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

1. Disconnect electricity to water heater.
2. Turn off water supply to water heater.
3. Drain water heater. Open pressure relief valve.
4. Remove drain valve and fitting from water heater.
5. Thread the 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. See Figure 7.
9. Above the water heater, cut the incoming cold water line. Remove a section of that line to enable the placement of the copper tee.
10. Insert the copper tee in the cold water line. See Figure 8.
11. Thread the remaining two ½"SWT x ¾"MPT copper adaptors into the ¾" FPT fittings on the heat pump, marked HOT WATER IN and HOT WATER OUT.
12. Run interconnecting ½" copper pipe from the HOT WATER OUT on the heat pump, to the copper adaptor located on the tee at the bottom of the water heater (Step 7).
13. Run interconnecting ½" copper pipe from the HOT WATER IN on the heat pump, to the copper tee in the cold water line (Step 10).
14. Install an air vent fitting at the highest point of the line from step 13 (assuming it's the higher of the two lines from the heat pump to the water heater). See Figure 8.
15. Turn the water supply to the water heater on. Fill water heater.

Section 9: Desuperheater Installation

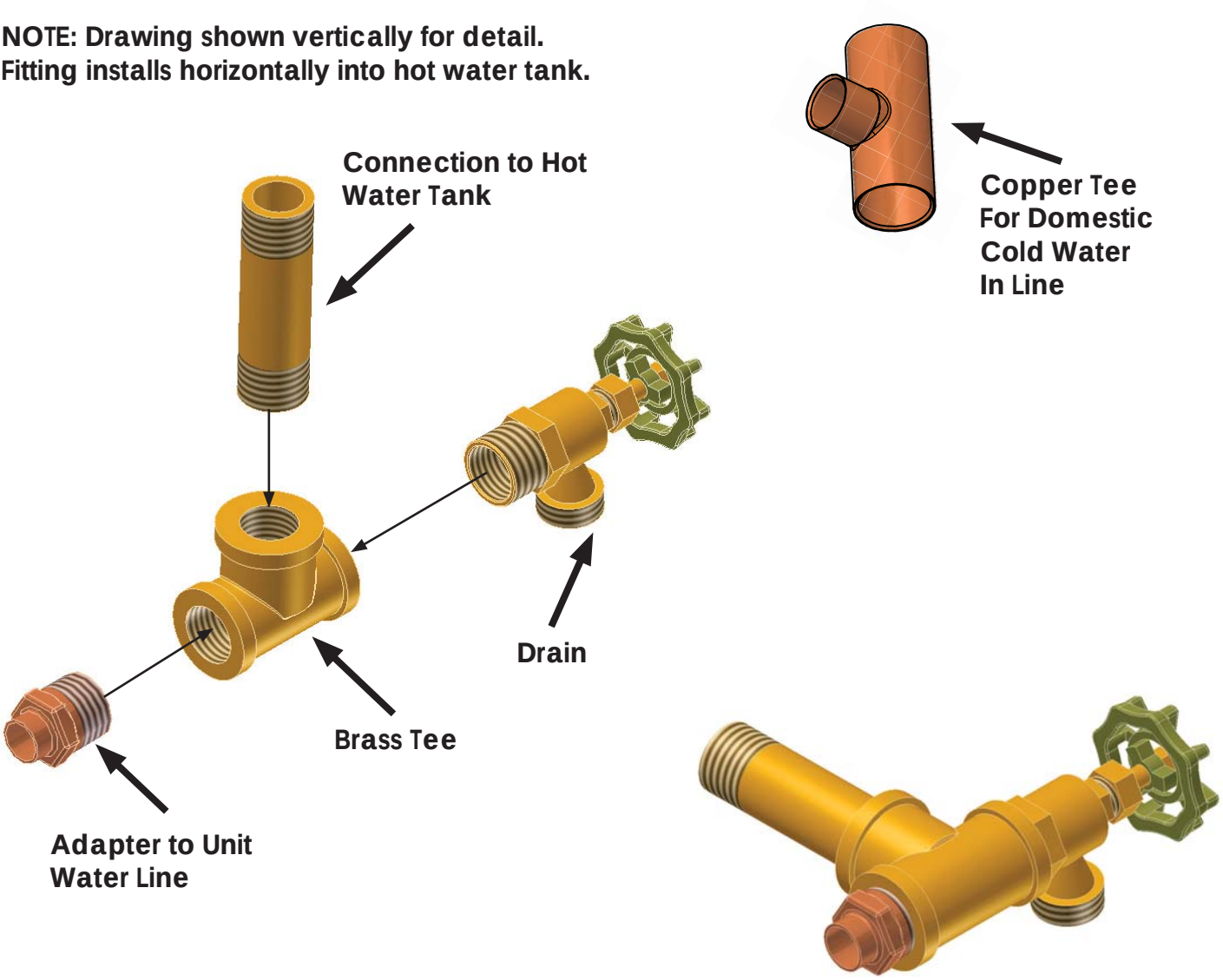
16. Flush the interconnecting lines, and check for leaks.

17. Install 3/8" closed cell insulation on the lines connecting the heat pump to the water heater.

18. Reconnect electricity to water heater.

Figure 7: Water Heater Connection Kit Assembly for Bottom of Water Heater

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



Section 9: Desuperheater Installation

Figure 8: Typical Desuperheater Installation

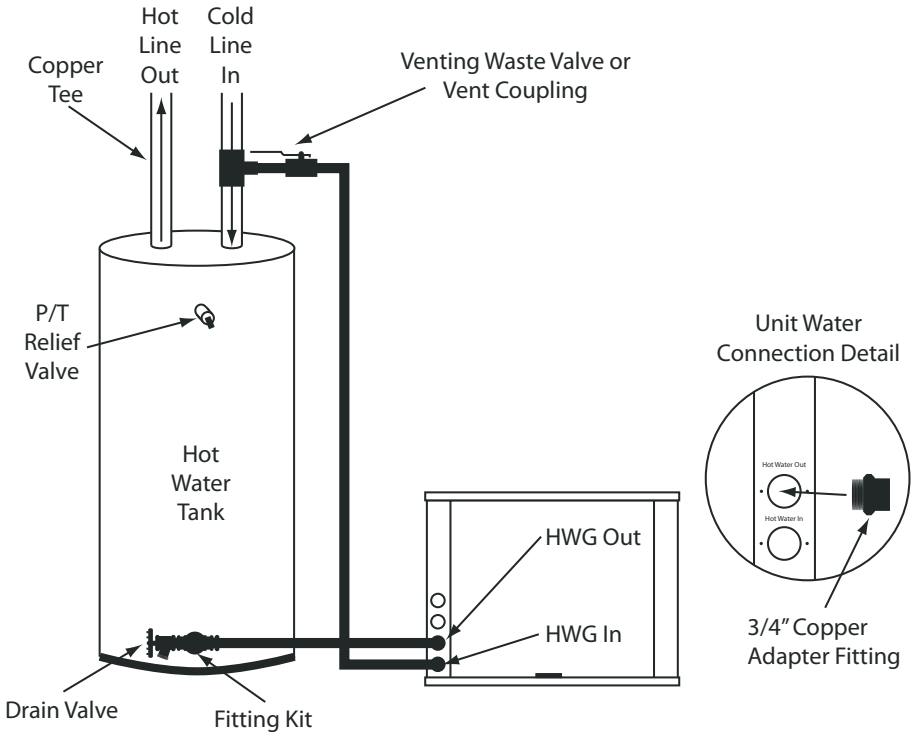
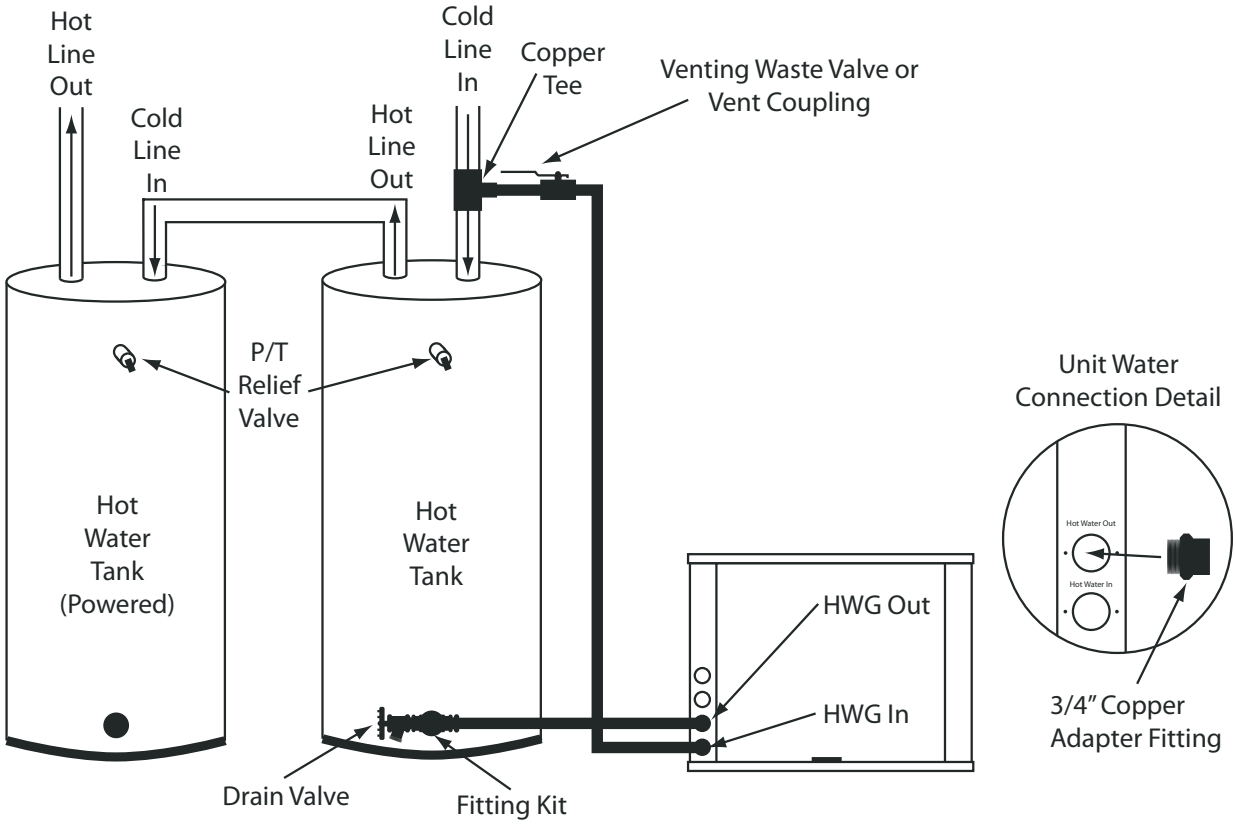


Figure 9: Desuperheater Installation in Preheat Tank



Section 9: Desuperheater Installation

Figure 10: Typical Desuperheater Installation using Marathon Hot Water Tanks

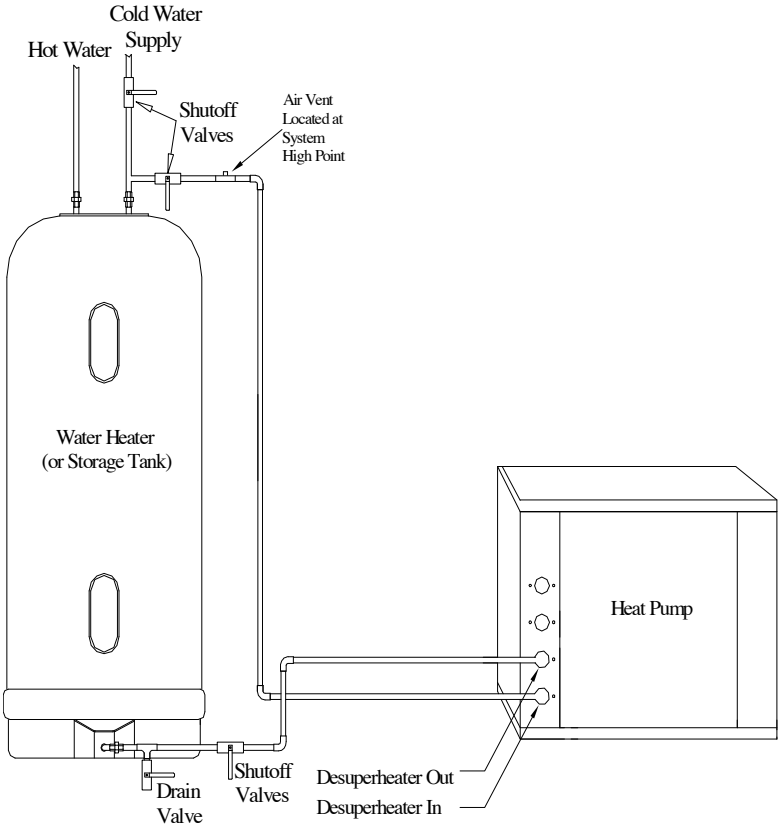
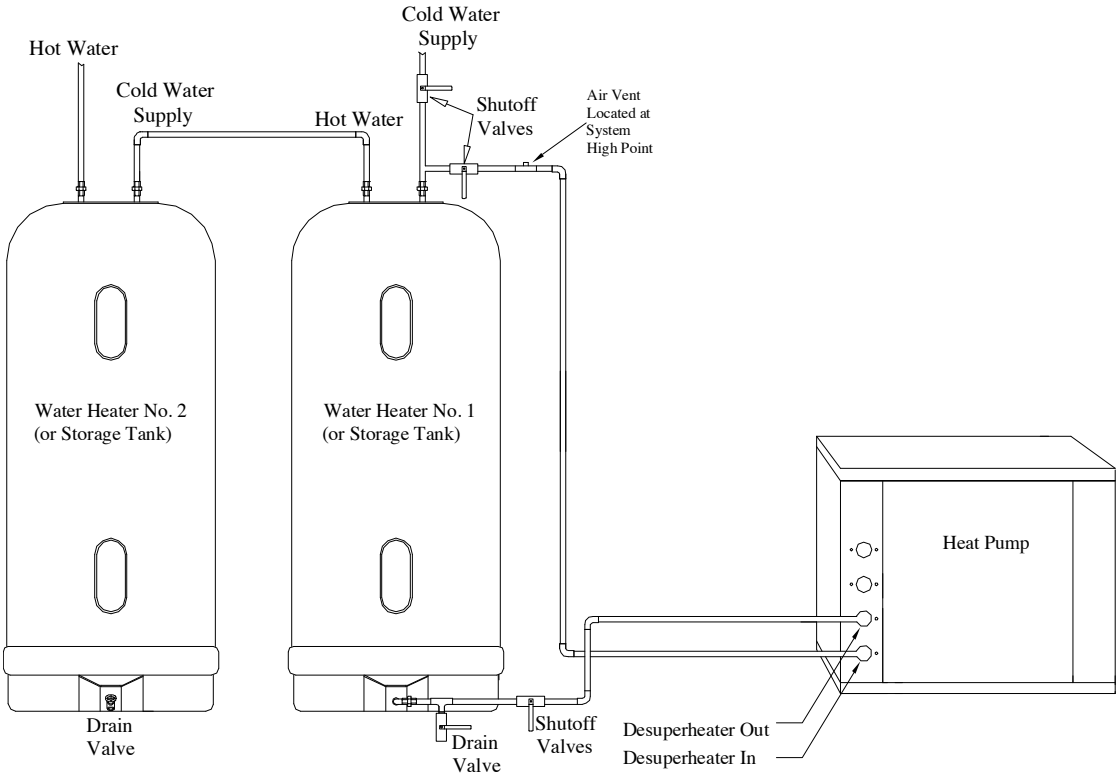


Figure 11: Desuperheater Installation in Preheat Tank using Marathon Hot Water Tanks



MICROPROCESSOR FEATURES AND OPERATION

Enertech Manufacturing 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 also eliminates features that are not applicable for some units.

A microprocessor-based printed circuit board controls the inputs to the unit as well as outputs for status mode, faults, and diagnostics. A status LED and an LED for each fault is provided for diagnostics.

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

Startup/Random Start

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

Short Cycle Protection

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

Component Sequencing Delays

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

Test Mode

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

Water Solenoid Valve Connections

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

Loop Pump Circuit Breakers (Single Compressor Units)

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

Safety Controls

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

Low Pressure: If the low pressure switch is open for 30 continuous seconds, the compressor operation will be interrupted, and the control will go into fault retry mode. At startup, the low pressure switch is not monitored for 90 seconds to avoid nuisance faults.

High Pressure: If the high pressure switch opens, the compressor operation will be interrupted, and the control will go into fault retry mode. There is no delay from the time the switch opens and the board goes into fault retry mode. There is also no delay of switch monitoring at startup.

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

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

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

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

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

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

Table 6a: LED Identification

LED Color	Location[1]	Function	Normal Operation	Fault Retry[2]	Lockout[2]
Green	Top	High Pressure	OFF	Flashing[3]	ON[3]
Orange	2nd	Low Pressure	OFF	Flashing[3]	ON[3]
Red	3rd	Water Flow	OFF	Flashing[3]	ON[3]
Yellow	Not applicable on water-to-water units				
Green	Bottom	Status	Flashing[4]	Flashing[5]	Flashing[4]

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

Hot Water Pump Control

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

Lockout Board Jumper Selection

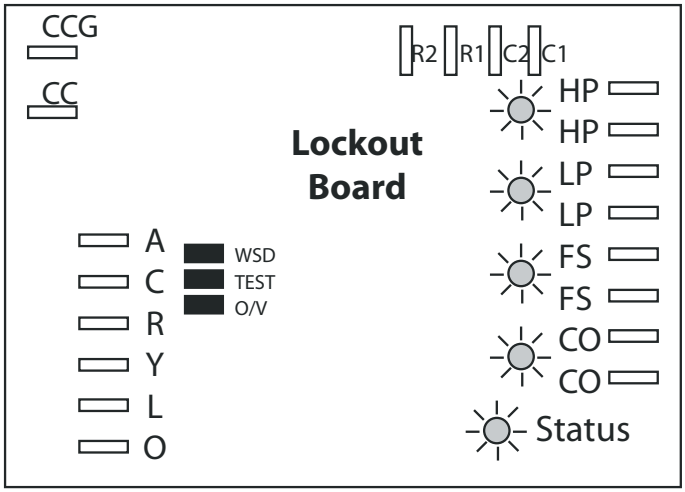
The lockout board includes three jumpers for field selection of various board features.

Water Solenoid Valve Delay (WSD): When the WSD jumper is installed, the "A" terminal is energized when the compressor is energized. When the jumper is removed, the "A" terminal is energized 10 seconds after the compressor. If using the Taco water solenoid valve (or a valve with an end switch), the unit terminal strip includes a means for connecting a valve of this type. The WSD jumper should be installed. If using a fast opening valve that does not have an end switch, the jumper should be removed.

Test Mode (TEST): When the TEST jumper is installed, the board operates in the normal mode. When the jumper is removed, the board operates in test mode, which speeds up all delays for easier troubleshooting. When service is complete, the jumper must be re-installed in order to make sure that the unit operates with normal sequencing delays.

Over/Under Voltage Disable (O/V): When the O/V jumper is installed, the over/under voltage feature is active. When the jumper is removed, the over/under voltage feature is disabled. On rare occasions, variations in voltage will be outside the range of the over/under voltage feature, which may require removal of the jumper. However, removal of the jumper could cause the unit to run under adverse conditions, and therefore should not be removed without contacting technical services. An over/under voltage condition could cause premature component failure or damage to the unit controls. Any condition that would cause this fault must be thoroughly investigated before taking any action regarding the jumper removal. Likely causes of an over/under voltage condition include power company transformer selection, insufficient entrance wire sizing, defective breaker panel, incorrect transformer tap (unit control box), or other power-related issues.

Figure 15a: Lockout Board Layout



SEQUENCE OF OPERATION:
Water-to-Water Units, Single Compressor

Heating (Y1)
Water-to-Water Units, Single Compressor

Heating first stage (Y1)
The compressor (first stage) and loop/ desuperheater pump(s) are energized 10 seconds after the "Y1" input is received.

Heating second stage (Y1, Y2)
The compressor solenoid is energized immediately upon receiving a "Y2" input, switching the compressor to full load.

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

Cooling first stage (Y1, O)
The compressor (first stage) and loop/ desuperheater pump(s) are energized 10 seconds after the "Y1" input is received.

Cooling second stage (Y1, Y2, O)
The compressor solenoid is energized immediately upon receiving a "Y2" input, switching the compressor to full load.

SEQUENCE OF OPERATION:
Water-to-Water Units, Dual Compressors

Heating first stage (Y1)
Both compressors are energized in first stage 10 seconds after the "Y1" input is received.

Heating second stage (Y1, Y2)
Both compressor solenoids are energized immediately upon receiving a "Y2" input, switching the compressors to full load.

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

Cooling first stage (Y1, O)
Both compressors are energized in first stage 10 seconds after the "Y1" input is received.

Cooling second stage (Y1, Y2, O)
Both compressor solenoids are energized immediately upon receiving a "Y2" input, switching the compressors to full load.

HYDRONIC AIR HANDLER:
ECM fan/hydronic chilled water/hot water coil

Thermostat Wiring / Fan Speed Notes
For two-stage thermostats, use both Y1 and Y2. For single stage thermostats, jumper Y1 and Y2, and use the "CFM Y2" column in table 6b for determining jumper location. The ECM control board in the air handler is the thermostat connection point. Wire nut the thermostat wiring to the "pigtails" connected to the 1/4" spades on the ECM board.

For dehumidification in cooling, cut the resistor at the "DEHUMIDIFY" LED. Use either the HUM terminal (reverse logic -- designed to be used with a humidistat) to lower the fan speed when dehumidification is needed, or if the HUM terminal is not connected (and the resistor is cut), the air handler will operate at a lower fan speed in cooling and normal fan speed in heating.

Figure 15b: ECM Board (Air Handler Board)

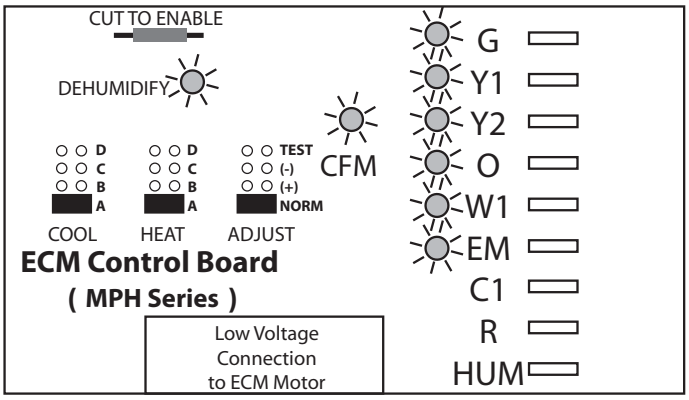
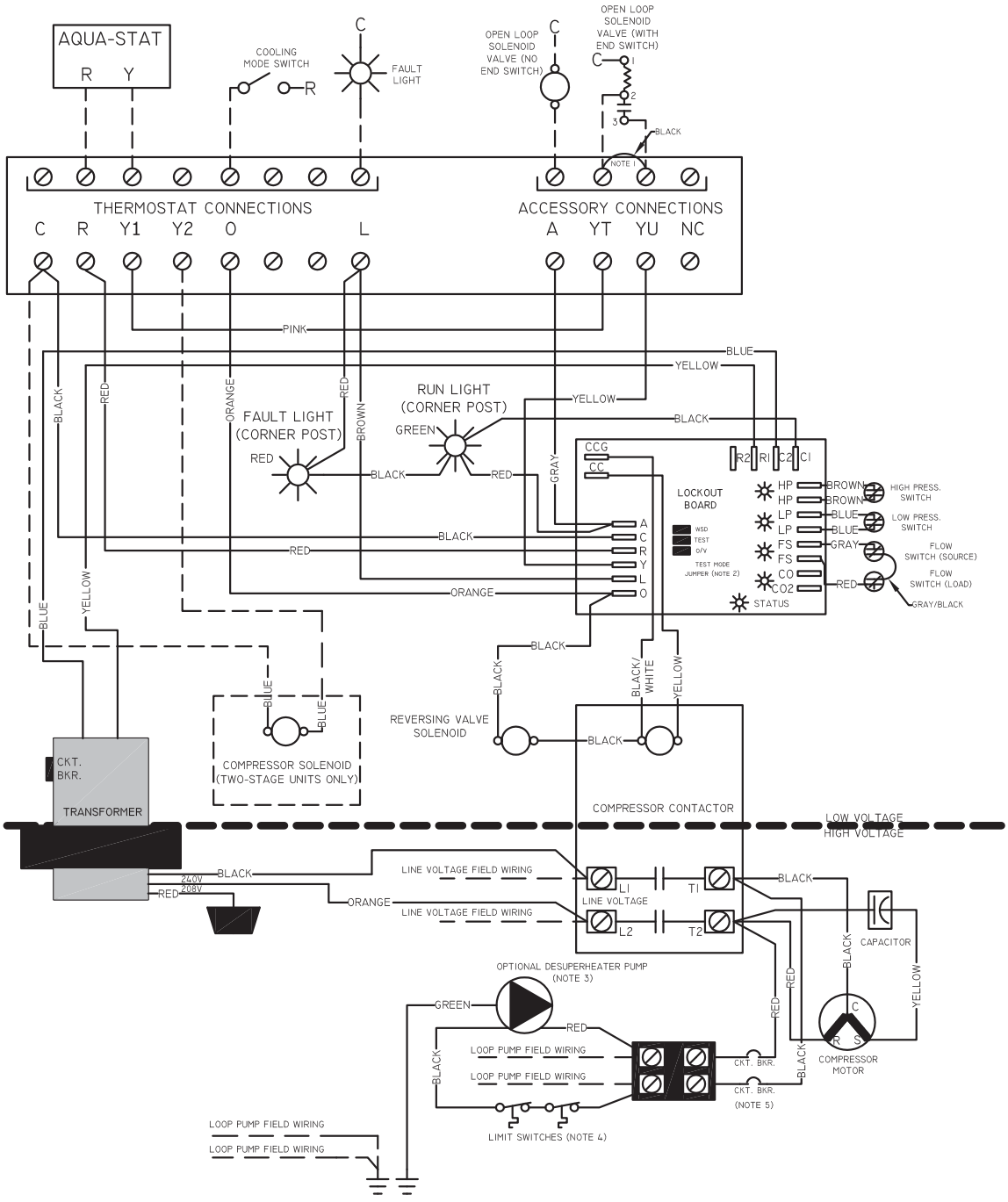


Table 6b: MPH Air Handler Fan Speeds

Enertech Model	Cool/ Heat Jumpers	High Spd Cfm Y2	Low Spd Cfm Y1	Fan G
MPH024	A	880	490	440
	B	789	440	395
	C	690	390	345
	D	584	330	300
MPH036	A	1058	730	530
	B	1023	710	510
	C	831	575	415
	D	657	455	330
MPH048	A	1952	1235	975
	B	1761	1115	880
	C	1564	990	780
	D	1385	875	695
MPH060	A	1952	1235	975
	B	1761	1115	880
	C	1564	990	780
	D	1385	875	695

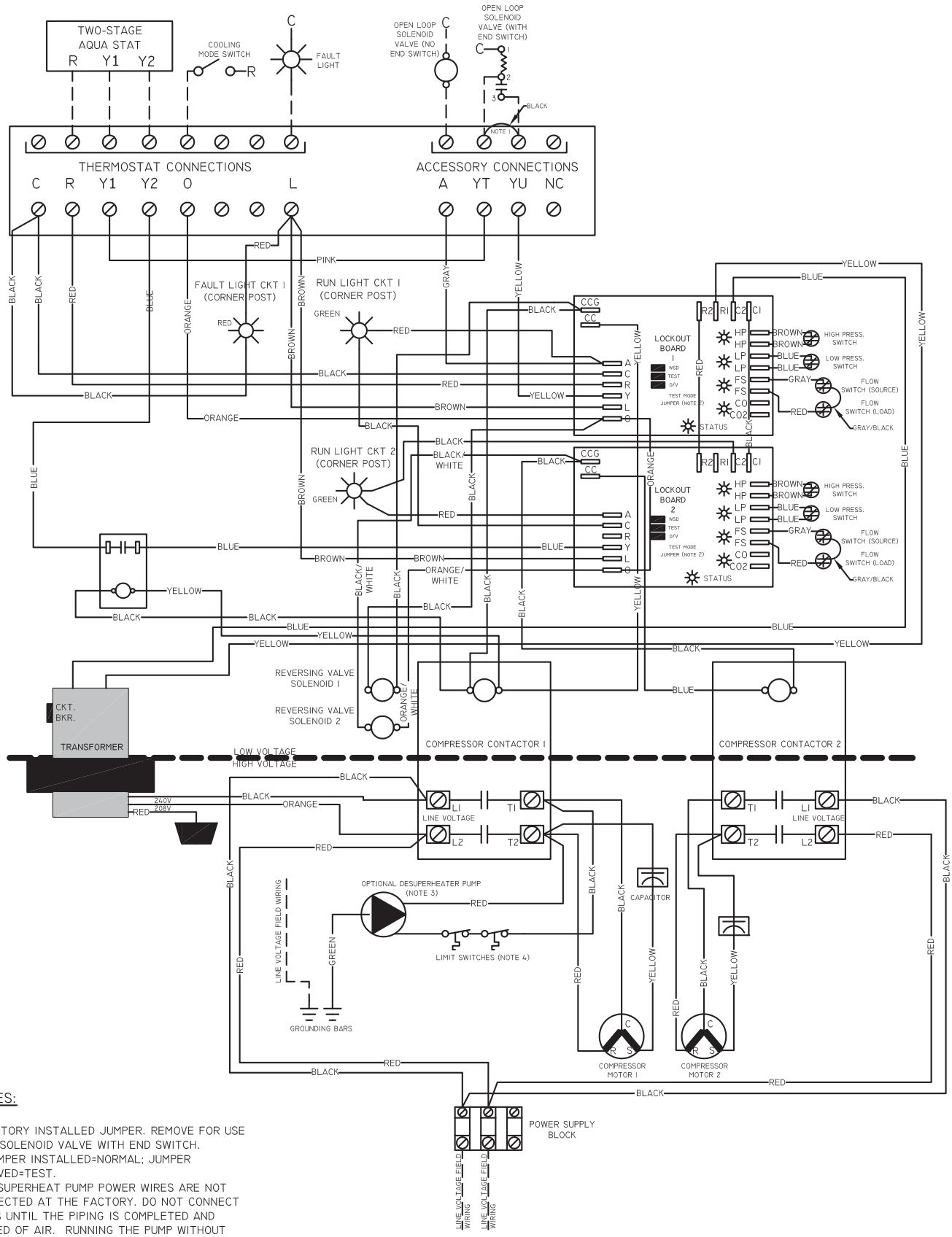
NOTES:
1. The COOL and HEAT jumpers should both be set at the same position.
2. The ADJUST jumper provides for a +/- 15% adjustment.

WATER-TO-WATER UNIT, TWO STAGE OR SINGLE SPEED COMPRESSOR, SINGLE PHASE, 60HZ



NOTES:

1. FACTORY INSTALLED JUMPER. REMOVE FOR USE WITH SOLENOID VALVE WITH END SWITCH.
2. JUMPER INSTALLED=NORMAL; JUMPER REMOVED=TEST.
3. DESUPERHEAT PUMP POWER WIRES ARE NOT CONNECTED AT THE FACTORY. DO NOT CONNECT WIRES UNTIL THE PIPING IS COMPLETED AND PURGED OF AIR. RUNNING THE PUMP WITHOUT WATER WILL DAMAGE THE PUMP.
4. DESUPERHEATER LEAVING WATER TEMPERATURE SWITCH OR HOT GAS LINE TEMPERATURE SWITCH WILL DISENGAGE THE PUMP WHEN CONDITIONS ARE INAPPROPRIATE FOR WATER HEATING.
5. CIRCUIT BREAKERS ARE INSTALLED ON RESIDENTIAL MODELS ONLY.



NOTES:

1. FACTORY INSTALLED JUMPER. REMOVE FOR USE WITH SOLENOID VALVE WITH END SWITCH.
2. JUMPER INSTALLED=NORMAL; JUMPER REMOVED=TEST.
3. DESUPERHEAT PUMP POWER WIRES ARE NOT CONNECTED AT THE FACTORY. DO NOT CONNECT WIRES UNTIL THE PIPING IS COMPLETED AND PURGED OF AIR. RUNNING THE PUMP WITHOUT WATER WILL DAMAGE THE PUMP.
4. DESUPERHEATER LEAVING WATER TEMPERATURE SWITCH OR HOT GAS LINE TEMPERATURE SWITCH WILL DISENGAGE THE PUMP WHEN CONDITIONS ARE INAPPROPRIATE FOR WATER HEATING.

Section 11: Accessories

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 Figure 13, below. Figure 14 includes a schematic of the board. The module must be mounted in a NEMA enclosure or inside the unit control box. Local code supersedes any recommendations in this document.

Figure 13: APSMA Module Layout

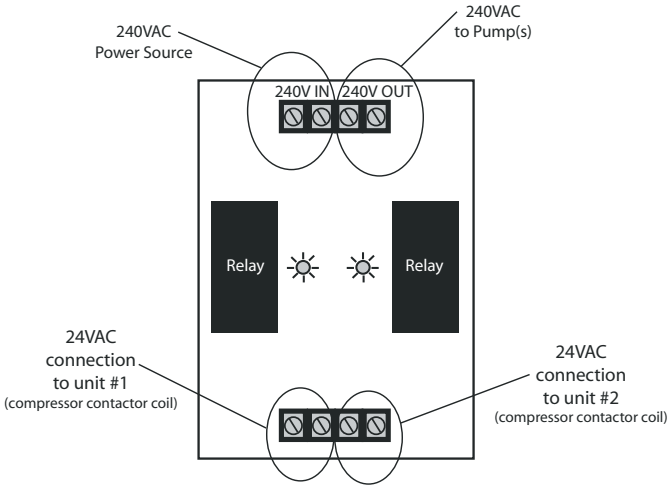


Figure 14: APSMA Module Wiring Schematic

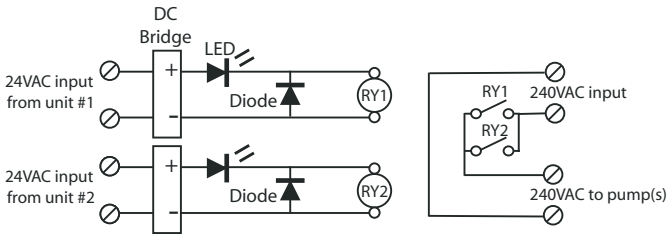


Table 5: Two-Stage Unit Heat of Extraction/Rejection Data (Full Load)

Two-Stage (Dual Systems) Water-to-Water Units (95°F ELT Heating; 45°F ELT Cooling)							
Heat of Extraction/Rejection-Full Load Operation* (Mbtuh) -- DSP Disconnected							
EWT	Flow Rate	096		120		144	
°F	GPM/Ton	HE	HR	HE	HR	HE	HR
30	1.5	57.8		64.7		79.4	
	2.25	60.2		67.3		82.7	
	3	61.7		68.9		84.7	
50	1.5	80.8	113.0	90.3	126.3	110.9	155.1
	2.25	84.9	113.2	94.8	126.5	116.5	155.4
	3	87.0	113.9	97.3	127.3	119.4	156.4
70	1.5	102.1	109.8	114.1	122.8	140.1	150.8
	2.25	107.6	110.4	120.2	123.4	147.6	151.5
	3	110.9	111.0	124.0	124.0	152.2	152.3
90	1.5	120.2	105.8	134.4	118.2	165.0	145.1
	2.25	127.7	106.3	142.7	118.8	175.2	145.9
	3	132.2	106.5	147.7	119.0	181.4	146.2
110	1.5		100.7		112.6		138.3
	2.25		100.9		112.8		138.5
	3		100.9		112.8		138.5

* Full load/high heating or cooling (both compressors operating)

Table 6: Two-Stage Unit Heat of Extraction/Rejection Data (Part Load)

Two-Stage (Dual Systems) Water-to-Water Units (95°F ELT Heating; 45°F ELT Cooling)							
Heat of Extraction/Rejection-Part Load Operation** (Mbtuh) -- DSP Disconnected							
EWT	Flow Rate	096		120		144	
°F	GPM/Ton	HE	HR	HE	HR	HE	HR
30	1.5	28.9		32.3		39.7	
	2.25	30.1		33.7		41.3	
	3	30.8		34.5		42.3	
50	1.5	40.4	56.5	45.2	63.1	55.4	77.5
	2.25	42.4	56.6	47.4	63.3	58.2	77.7
	3	43.5	57.0	48.6	63.7	59.7	78.2
70	1.5	51.0	54.9	57.0	61.4	70.1	75.4
	2.25	53.8	55.2	60.1	61.7	73.8	75.8
	3	55.5	55.5	62.0	62.0	76.1	76.2
90	1.5	60.1	52.9	67.2	59.1	82.5	72.6
	2.25	63.8	53.2	71.3	59.4	87.6	73.0
	3	66.1	53.2	73.9	59.5	90.7	73.1
110	1.5		50.4		56.3		69.1
	2.25		50.5		56.4		69.3
	3		50.5		56.4		69.3

** Part load/low heating or cooling (one compressor operating)

Table 7: Two-Stage Unit Heat Exchanger Pressure Drop (Full Load)

Two-Stage (Dual Systems) Water-to-Water Units						
Heat Exchanger Pressure Drop						
Full Load Operation*		Pressure Drop at Entering Water Temp. Listed Below				
Model	Flow Rate GPM	30°F PSI	50°F PSI	70°F PSI	90°F PSI	110°F PSI
096	14.5	2.2	2.0	2.0	1.9	1.8
	20.2	4.0	3.7	3.6	3.3	3.3
	26.0	6.5	6.0	5.8	5.3	5.3
120	15.6	2.3	2.1	2.1	2.0	1.9
	21.8	4.3	4.0	3.8	3.5	3.5
	28.0	6.8	6.4	6.1	5.6	5.5
144	17.8	2.3	2.2	2.2	2.0	2.0
	24.9	4.4	4.1	3.9	3.6	3.6
	32.0	7.0	6.6	6.2	5.8	5.7

* Full load/high heating or cooling (both compressors operating)

Table 8: Two-Stage Unit Heat Exchanger Pressure Drop (Part Load)

Two-Stage (Dual Systems) Water-to-Water Units						
Heat Exchanger Pressure Drop						
Part Load Operation**		Pressure Drop at Entering Water Temp. Listed Below				
Model	Flow Rate GPM	30°F PSI	50°F PSI	70°F PSI	90°F PSI	110°F PSI
096	7.2	2.1	2.0	2.0	1.8	1.8
	10.1	3.9	3.6	3.5	3.2	3.2
	13.0	6.3	5.9	5.6	5.2	5.1
120	8.3	2.2	2.0	2.0	1.9	1.8
	11.7	4.0	3.7	3.6	3.3	3.3
	15.0	6.5	6.0	5.8	5.3	5.3
144	10.0	2.2	2.0	2.0	1.9	1.8
	14.0	4.0	3.7	3.6	3.3	3.3
	18.0	6.5	6.0	5.8	5.3	5.3

** Part load/low heating or cooling (one compressor operating)

Section 12: Troubleshooting (Pre-2010 Units)

Table 9: Single Stage Unit Heat of Extraction/Rejection Data

Single-Stage Water-to-Water Units (95°F ELT Heating; 45°F ELT Cooling)											
Heat of Extraction/Rejection-Full Load Operation (Mbtuh) -- DSP Disconnected											
EWT	Flow Rate GPM/Ton	024		036		048		060		072	
°F		HE	HR	HE	HR	HE	HR	HE	HR	HE	HR
30	1.5	13.6		20.4		28.9		32.3		39.7	
	2.25	14.2		21.3		30.1		33.7		41.3	
	3	14.5		21.8		30.8		34.5		42.3	
50	1.5	19.0	26.6	28.5	39.9	40.4	56.5	45.2	63.1	55.4	77.5
	2.25	20.0	26.6	30.0	39.9	42.4	56.6	47.4	63.3	58.2	77.7
	3	20.5	26.8	30.7	40.2	43.5	57.0	48.6	63.7	59.7	78.2
70	1.5	24.0	25.8	36.0	38.8	51.0	54.9	57.0	61.4	70.1	75.4
	2.25	25.3	26.0	38.0	39.0	53.8	55.2	60.1	61.7	73.8	75.8
	3	26.1	26.1	39.1	39.2	55.5	55.5	62.0	62.0	76.1	76.2
90	1.5	28.3	24.9	42.4	37.3	60.1	52.9	67.2	59.1	82.5	72.6
	2.25	30.0	25.0	45.1	37.5	63.8	53.2	71.3	59.4	87.6	73.0
	3	31.1	25.1	46.7	37.6	66.1	53.2	73.9	59.5	90.7	73.1
110	1.5		23.7		35.6		50.4		56.3		69.1
	2.25		23.7		35.6		50.5		56.4		69.3
	3		23.7		35.6		50.5		56.4		69.3

Table 10: Single Stage Unit Heat Exchanger Pressure Drop

Single-Stage Water-to-Water Units						
Heat Exchanger Pressure Drop						
Model	Flow Rate GPM	Pressure Drop at Entering Water Temp Listed Below				
		30°F PSI	50°F PSI	70°F PSI	90°F PSI	110°F PSI
024	3.3	1.4	1.3	1.3	1.2	1.1
	4.7	2.5	2.3	2.3	2.1	2.1
	6.0	4.1	3.8	3.6	3.4	3.3
036	5.0	1.8	1.7	1.7	1.6	1.5
	7.0	3.4	3.1	3.0	2.8	2.8
	9.0	5.4	5.0	4.8	4.5	4.4
048	7.2	2.2	2.0	2.0	1.9	1.8
	10.1	4.0	3.7	3.6	3.3	3.3
	13.0	6.5	6.0	5.8	5.3	5.3
060	8.3	2.2	2.0	2.0	1.9	1.8
	11.7	4.0	3.7	3.6	3.3	3.3
	15.0	6.5	6.0	5.8	5.4	5.3
072	10.0	2.3	2.2	2.0	2.0	2.0
	14.0	4.4	4.1	3.9	3.6	3.6
	18.0	7.0	6.6	6.2	5.8	5.7

Table 19: Unit Operating Pressures (R-410a)

Heating - Without Desuperheater						
EWT (°F)	GPM Per Ton	Discharge Pressure (PSIG)	Suction Pressure (PSIG)	Sub Cooling (°F)	Super Heat (°F)	Water Temperature Drop (°F)
30	1.5	285-310	68-76	4-10	8-12	5-8
	3	290-315	70-80	4-10	8-12	3-6
50	1.5	315-345	100-110	6-12	9-14	7-10
	3	320-350	105-115	6-12	9-14	5-8
70	1.5	355-395	135-145	7-12	10-15	9-12
	3	360-390	140-150	7-12	10-15	7-10
Cooling - Without Desuperheater						
EWT (°F)	GPM Per Ton	Discharge Pressure (PSIG)	Suction Pressure (PSIG)	Sub Cooling (°F)	Super Heat (°F)	Water Temperature Rise (°F)
50	1.5	220-235	120-130	10-16	12-20	19-23
	3	190-210	120-130	10-16	12-20	9-12
70	1.5	280-300	125-135	8-14	10-16	18-22
	3	250-270	125-135	8-14	10-16	9-12
90	1.5	360-380	130-145	8-14	10-14	17-21
	3	330-350	130-140	8-14	10-14	8-11

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

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

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

Once this information is recorded, find corresponding entering water temperature column in Specification Manual for unit. Find pressure differential in PSI column in Spec Manual. Then read the GPM column in Spec Manual to determine flow in GPM.

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

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

Section 12: Troubleshooting

A: UNIT WILL NOT START IN EITHER CYCLE

Thermostat	Set thermostat on heating and highest temperature setting. Unit should run. Set thermostat on cooling and lowest temperature setting. Unit should run. Set fan to On position. Fan should run. If unit does not run in any position, disconnect wires at heat pump terminal block and jump R, G, Y. Unit should run in heating. If unit runs, replace thermostat with correct thermostat only.
Loose or broken wires	Tighten or replace wires.
Blown Fuse/ Tripped Circuit Breakers	Check fuse size, replace fuse or reset circuit breaker. Check low voltage circuit breaker.
Low Voltage Circuit	Check 24 volt transformer. If burned out or less than 24 volt, replace. Before replacing, verify tap setting and correct if necessary.
Water Flow	If water flow is low (less than 1 GPM), unit will not start. Make sure Pump Module or solenoid valve is connected (see wiring diagram). Water has to flow through the heat exchanger in the right direction (see labels at water fitting connections) before the compressor can start. If water flow is at normal flow, use an ohmmeter to check if you get continuity at the flow switch. If no switch is open and flow is a normal flow, remove switch and check for stuck particles or bad switch.

B: UNIT RUNNING NORMAL, BUT SPACE TEMPERATURE IS UNSTABLE

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

C: NO WATER FLOW

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

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

Water	Water flow & temperature insufficient.
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.

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

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.

F: WATER HEAT EXCHANGER FREEZES IN HEATING MODE

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

G: EXCESSIVE HEAD PRESSURE IN COOLING MODE

Inadequate water flow	Low water flow, increase flow.

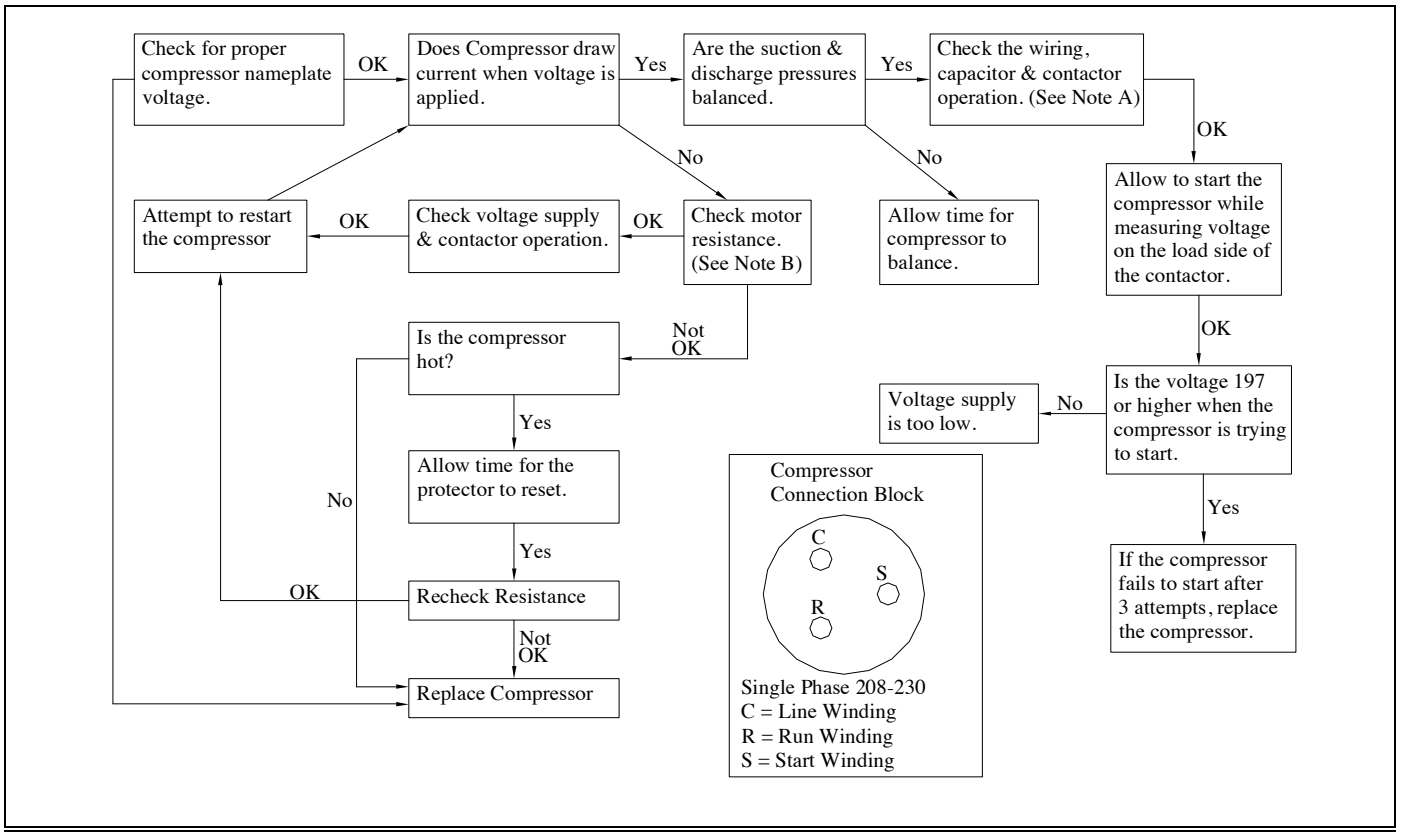
H: EXCESSIVE HEAD PRESSURE IN HEATING MODE

Low air flow	See E: Noisy blower and low air flow.

I: 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.

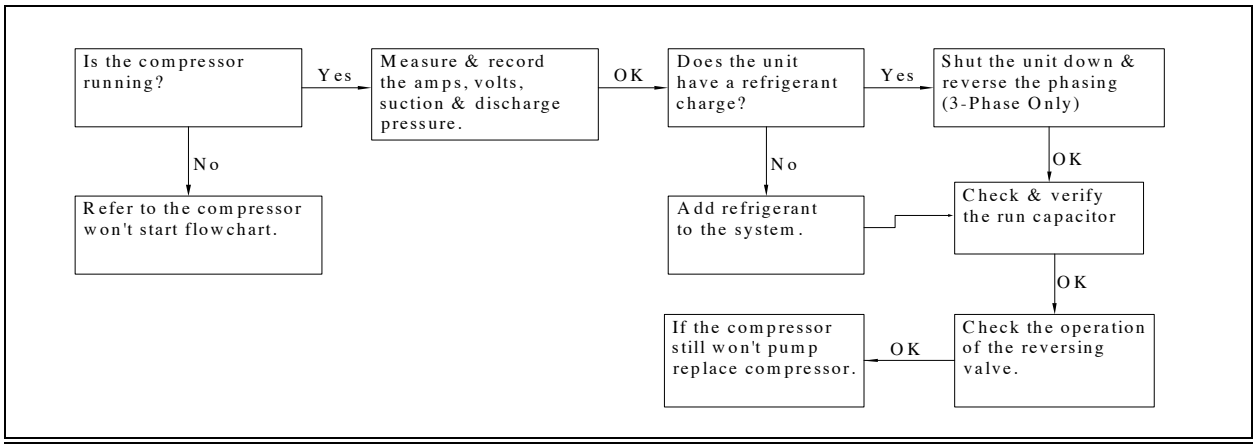
J: COMPRESSOR WON'T START



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

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

K: COMPRESSOR WON'T PUMP CHART



Section 12: Troubleshooting

Table 20: Refrigeration Troubleshooting

System Faults		Air Flow	Water Flow	Under Charge	Over Charge	Super Heat	Subcooling
Head Pressure Too High	Heat	P - Too Low			P		
	Cool		P - Too Low		P		
Head Pressure Too Low	Heat		P - Too Low	P		High	Low
	Cool	P - Too Low	S - Too High	P		High	Low
Suction Pressure Too High	Heat	P - Too Low					High
	Cool				P		High
Suction Pressure Too Low	Heat		P - Too Low	P		High	Low
	Cool	P - Too Low		P		High	Low
Liquid Refrigerant Flood Back	Heat				P		High
	Cool				P		High
Air Coil Frosting	Heat						
	Cool	P - Too Low		P		High	Low
Compressor Runs Inadequate. Or No Cooling/Heating	Heat	S - Too High	P - Too Low	P		High	Low
	Cool	S - Too High	P - Too Low	P		High	Low

P - Primary causes (most common problems) S - Secondary causes (problems that occur, but are not common)

Section 13: Forms - Troubleshooting

Customer/Job Name:_____ Date:_____

Model #:_____ Serial #:_____

Antifreeze Type:_____

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

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

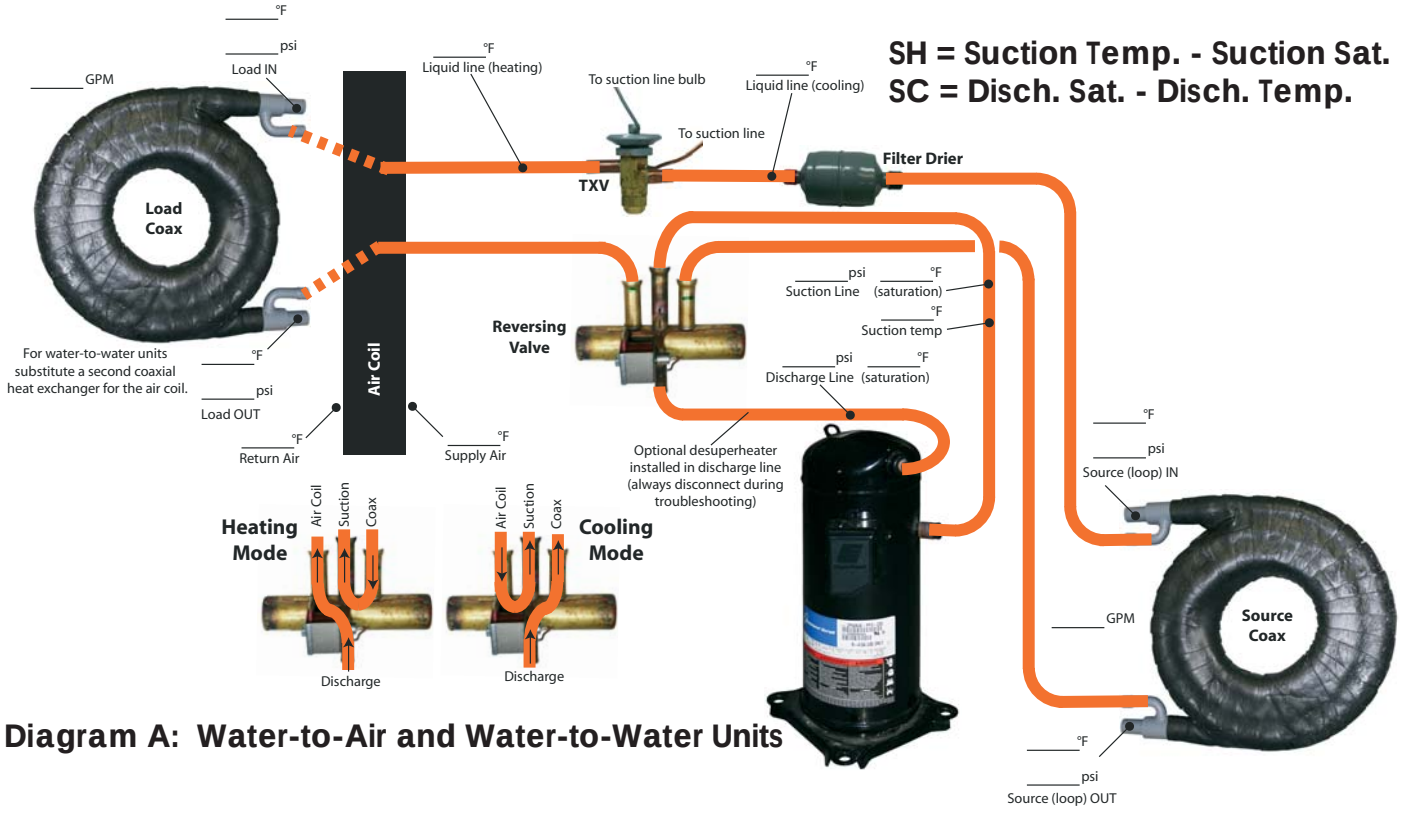


Diagram A: Water-to-Air and Water-to-Water Units

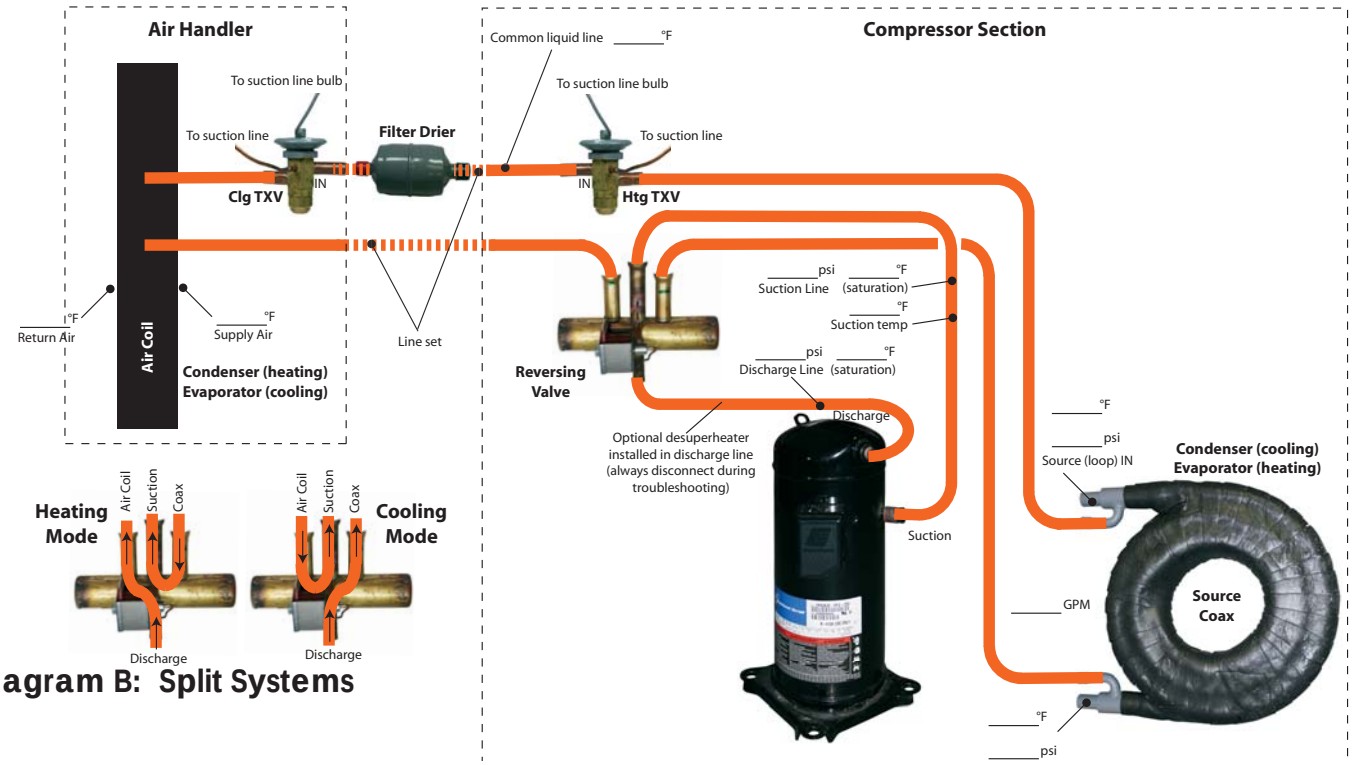


Diagram B: Split Systems

EQUIPMENT START-UP FORM

Customer/Job Name:_____ Date:_____

Model #:_____ Serial #:_____

Dealer Name:_____

Check the following before power is applied to the equipment

Note: Start-Up should not occur until the structure is ready to be occupied

ELECTRICAL:

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

PLUMBING:

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

DUCTWORK:

- ☐ Filter is installed and clean
- ☐ Packaging is removed from the blower assembly
- ☐ Blower turns freely

Cut along this line

Equipment Start-Up

Note: Steps should be followed in order
Note: Equipment operation will vary with thermostat brand and model. Refer to thermostat instructions

1. Energize equipment with high voltage.
2. Be sure all pumps and valves are open.
3. Set thermostat settings to correspond with application, and set thermostat to "Heat". Place set point above room temperature. Compressor will start after thermostat time delay expires.
4. Check water flow via one or a combination of these 3 methods:
A: ΔT (temp difference):
1. Source (5°-10° F) _____
B: Flowmeter:
1. 3 gpm (gallons per minute) per nominal ton of equipment. (Open Loop 1.5 to 2 GPM).
C: Pressure Drop:
1. Refer to Table 7, 8, & 10.
5. Check ΔT of return and discharge air.
1. (18°-30°F) _____
6. If system is two stage or dual capacity, increase set point and verify that second stage engages (increasing air flow). ΔT will remain the same.
7. If system has auxiliary heat, increase set point and verify that auxiliary heat engages ΔT will increase.
8. Switch thermostat to off, Compressor will shutoff.
9. Place thermostat in "Cooling" and decrease set point below room temperature. Compressor will start after thermostat time delay expires.
10. Check water flow via and one or combination of these 3 methods:
A. ΔT(temp difference).
1. Source (6°-12° F) _____.
B. Flowmeter.
1. 3 GPM (gallons per minute) per nominal ton of equipment. (Open Loop 1.5 to 2 GPM).
C. Pressure Drop.
1. Refer to Table 13.
11. Check ΔT of return and discharge air.
1. 16°-25° F
12. If system is two stage or dual capacity, increase set point and verify that second stage engages (increasing air flow). ΔT will remain the same.
13. If, at anytime, there is excessive noise or vibration, the problem should be fixed and testing resumed.

Note: If a problem occurs during start-up, please do the following:
1. Refer to the troubleshooting sections contained within the unit Installation, Operation, and Maintenance Manual
2. Contact Technical Support at your distributor.

Installer/Technician:_____ Date:_____

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