INSTALLATION INSTRUCTIONS

HS Series
Geothermal Heat Pump
Sizes 024, 036, 048, 060

NOTE: Read the entire instruction manual before starting the installation.

TABLE OF CONTENTS

Information in these installation instructions pertains only to HS series units.

SAFETY CONSIDERATIONS

Improper installation, adjustment, alteration, service, maintenance, or use can cause explosion, fire, electrical shock, or other conditions which may cause death, personal injury, or property damage. Consult a qualified installer, service agency, or your distributor or branch for information or assistance. The qualified installer or agency must use factory-authorized kits or accessories when modifying this product. Refer to the individual instructions packaged with the kits or accessories when installing.

Follow all safety codes. Wear safety glasses, protective clothing, and work gloves. Use quenching cloth for brazing operations. Have fire extinguisher available. Read these instructions thoroughly and follow all warnings or cautions included in literature and attached to the unit. Consult local building codes and current editions of the National Electrical Code (NEC) NFPA 70. In Canada, refer to current editions of the Canadian electrical code CSA 22.1.

Recognize safety information. This is the safety-alert symbol ⚠ When you see this symbol on the unit and in instructions or manuals, be alert to the potential for personal injury. Understand these signal words; DANGER, WARNING, and CAUTION. These words are used with the safety-alert symbol. DANGER identifies the most serious hazards which **will** result in severe personal injury or death. WARNING signifies hazards which **could** result in personal injury or death. CAUTION is used to identify unsafe practices which **would** result in minor personal injury or product and property damage. NOTE is used to highlight suggestions which **will** result in enhanced installation, reliability, or operation.

⚠ WARNING

ELECTRICAL SHOCK HAZARD

Failure to follow this warning could result in personal injury or death.

Before installing, modifying, or servicing system, main electrical disconnect switch must be in the OFF position. There may be more than 1 disconnect switch. Lock out and tag switch with a suitable warning label.

⚠ WARNING

UNIT OPERATION AND SAFETY HAZARD

Failure to follow this warning could result in personal injury or equipment damage.

Puron® refrigerant systems operate at higher pressures than standard R-22 systems. Do not use R-22 service equipment or components on Puron® refrigerant equipment.

⚠ WARNING

EXPLOSION HAZARD

Failure to follow this warning could result in death, serious personal injury, and/or property damage.

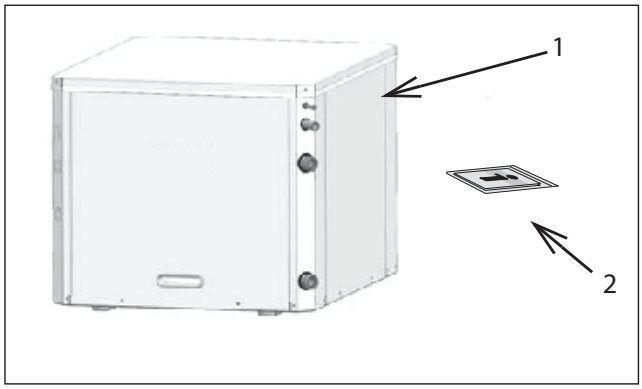
Never use air or gases containing oxygen for leak testing or operating refrigerant compressors. Pressurized mixtures of air or gases containing oxygen can lead to an explosion.

⚠ CAUTION

CUT HAZARD

Failure to follow this caution may result in personal injury.

Sheet metal parts may have sharp edges or burrs. Use care and wear appropriate protective clothing and gloves when handling parts.



1. HS Series Water-To Air Split System
2. Packet containing: Installation, Owner's Manual, Warranty Certificate and badges

A14176

Fig. 1 - Standard Package

INSTALLATION RECOMMENDATIONS

The Water-to-Air Heat Pumps are designed to operate with entering fluid temperature between 20°F to 90°F in the heating mode and between 30°F to 120°F in the cooling mode.

NOTE: 50°F minimum Entering Water Temperature (EWT) is recommended for well water applications with sufficient water flow to prevent freezing. Antifreeze solution is required for all closed loop applications. Geothermal applications should have sufficient antifreeze solution to protect against extreme conditions and equipment failure. Frozen water coils are not covered under warranty. Other equivalent methods of temperature control are acceptable.

Check Equipment and Job Site

Moving and Storage

If the equipment is not needed for immediate installation upon its arrival at the job site, it should be left in its shipping carton and stored in a clean, dry area. Units must only be stored or moved in the normal upright position as indicated by the "UP" arrows on each carton at all times.

⚠ CAUTION

EQUIPMENT DAMAGE HAZARD

Failure to follow this caution may result in equipment damage.

If unit stacking is required for storage, stack units as follows:
Do not stack units larger than 6 tons!
Vertical units: less than 6 tons, no more than two high.
Horizontals units: less than 6 tons, no more than three high.

Inspect Equipment

Be certain to inspect all cartons or crates on each unit as received at the job site before signing the freight bill. Verify that all items have been received and that there are no visible damages; note any shortages or damages on all copies of the freight bill. In the event of damage or shortage, remember that the purchaser is responsible for filing the necessary claims with the carrier. Concealed damages not discovered until after removing the units from the packaging must be reported to the carrier within 24 hours of receipt.

Location / Clearance

To maximize system performance, efficiency and reliability, and to minimize installation costs, it is always best to keep the refrigerant lines as short as possible. Every effort should be made to locate the air handler and the condensing section as close as possible to each other.

Serviceability should be a consideration and units should be placed so that installer and service technicians can access the service side of the unit with ease. The electrical box side of unit should maintain a clearance of 24" (609.6mm) minimum.

Condensing Section Location

Locate the condensing section in an area that provides sufficient room to make water and electrical connections and allows easy removal of the access panels in order for service personnel to perform maintenance or repair.

The condensing section is designed primarily for Indoor use. However, if installed in outside location where it could be subjected to freezing conditions the following conditions should be implemented:

- Freeze protection should be employed.
  - Freeze stat
  - Pump timer/starter
  - or similar device
- Water lines entering and leaving the unit should be properly insulated prior to ground contact.

The HS unit should be mounted level on a vibration absorbing pad slightly larger than the base to minimize vibration transmission to the building structure. It is not necessary to anchor the unit to the floor. (see Fig. 2).

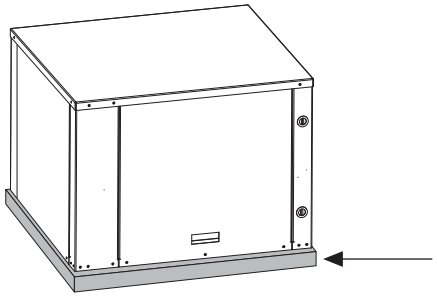


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Fig. 2 - Vibration Pad Location

The vast majority of geothermal units are installed indoors and the condenser pads on the market are typically not designed for indoor equipment. Table 1 lists recommended pads (sold separately) designed for indoor packaged equipment. ACMP pads are made of 3/4" thick high density SBR recycled rubber, which provides a high degree of vibration and sound absorption for compressor bearing units installed indoors. These pads may be trimmed as needed.

Table 1 – Recommended Mounting Pads

Unit Size	Mounting Pad	Pad Dimensions
HS024	ACMP2436	24" x 36"
HS036	ACMP2436	24" x 36"
HS048	ACMP2436	24" x 36"
HS060	ACMP2836	28" x 36"

Fan Coil or Furnace Location

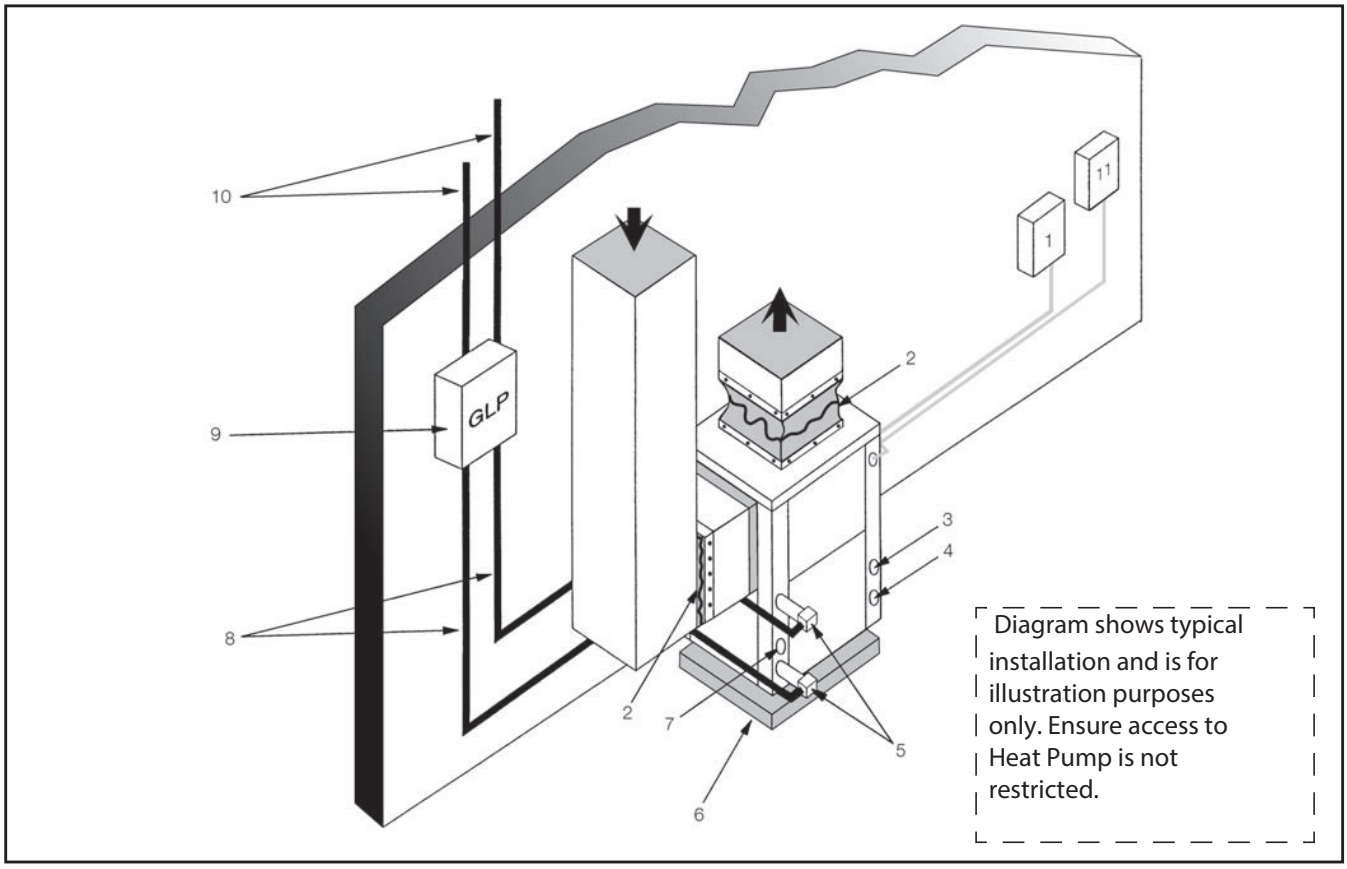
Refer to the Fan Coil or Furnace Installation Manual for complete Details on indoor locations and clearances.

APPLICATION CONSIDERATIONS

Geothermal Systems

Closed loop and pond applications require specialized design knowledge. No attempt at these installations should be made unless the dealer has received specialized training.

Anti-freeze solutions are utilized when low evaporating conditions are expected to occur. Refer to the Flow Center installation manuals for more specific instructions. (See Fig. 3)



Note: Package unit shown. HS unit is connected to furnace or fan coil (see page 8).

(1) Line Voltage Disconnect (unit)
(2) Flex Duct Connection
(3) Low Voltage Control Connection
(4) Line Voltage Connection
(5) P/T Ports
(6) Vibration Pad
(7) Condensate Drain Connection
(8) Ground Loop Connection Kit
(9) Ground Loop Pumping Package
(10) Polyethylene with Insulation
(11) Line Voltage Disconnect (electric heater)

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Fig. 3 - Example Geothermal System Setup

Open Loop Well Water Systems

IMPORTANT: Table 2 must be consulted for water quality requirements when using open loop systems. A water sample must be obtained and tested, with the results compared to the table. Scaling potential should be assessed using the pH/Calcium hardness method. If the pH is <7.5 and the calcium hardness is l<100 ppm, the potential for scaling is low. For numbers out of the range listed, a monitoring plan must be implemented due to probable scaling.

Other potential issues such as iron fouling, corrosion, erosion and clogging must be considered. Careful attention to water conditions must be exercised when considering a well water application.

Failure to perform water testing and/or applying a geothermal heat pump to a water supply that does not fall within the accepted quality parameters will be considered a mis-application of the unit and resulting heat exchanger failures will not be covered under warranty. Where a geothermal system will be used with adverse water conditions, a suitable plate-frame heat exchanger MUST be used to isolate the well water from the geothermal unit.

Proper testing is required to assure the well water quality is suitable for use with water source equipment.

In conditions anticipating moderate scale formation or in brackish water, a cupronickel heat exchanger is recommended. Copper is adequate for ground water that is not high in mineral content.

In well water applications, water pressure must always be maintained in the heat exchanger. This can be accomplished with either a control valve or a bladder type expansion tank.

When using a single water well to supply both domestic water and the heat pump, care must be taken to insure that the well can provide sufficient flow for both.

In well water applications, a slow closing solenoid valve must be used to prevent water hammer (hammering or stuttering sound in the pipeline). Solenoid valves should be connected across Y1 and C1 on the interface board for all. Make sure that the VA draw of the valve does not exceed the contact rating of the thermostat. (See Fig. 4)

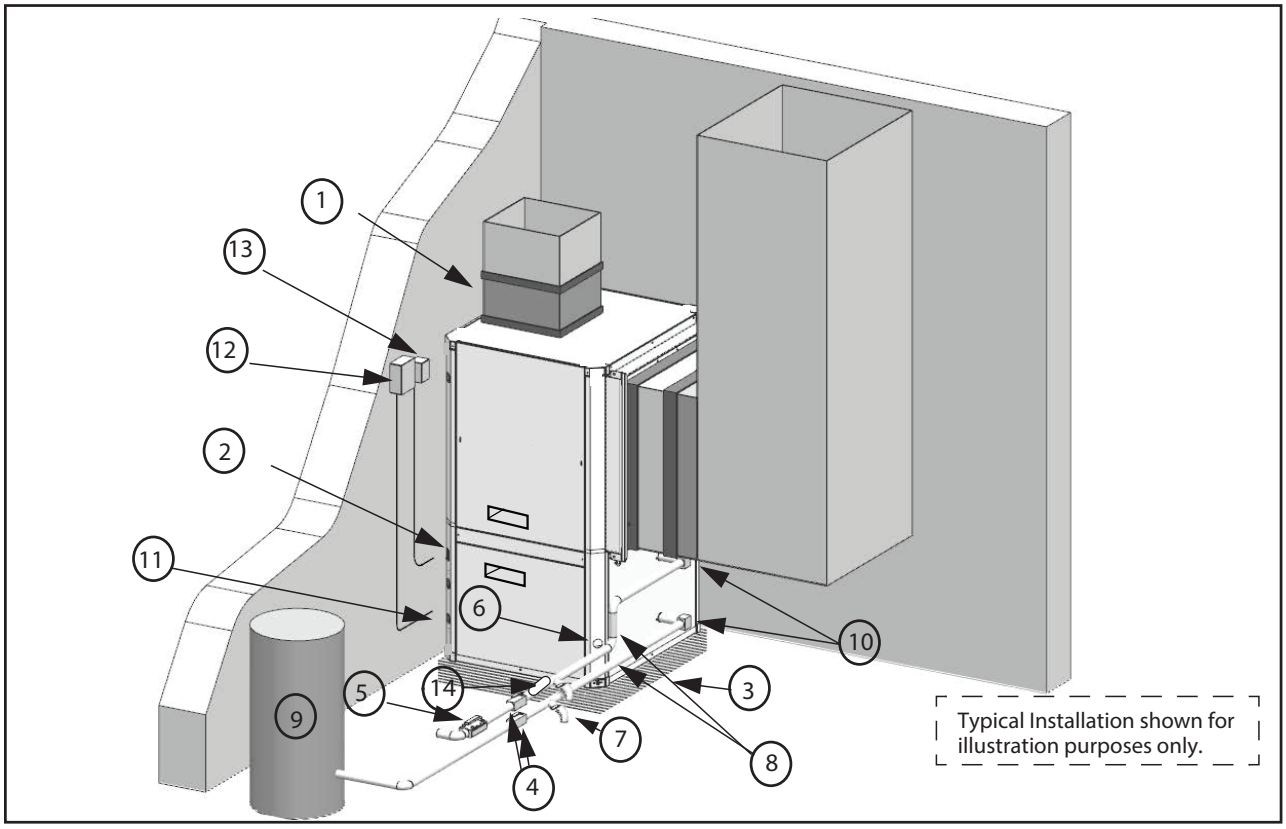
The water solenoid valve should be installed in the leaving water line. A flow regulator valve should be located after the solenoid to set the flow rate. The suggested flow rate is 1.5 GPM per ton if the Entering Water Temperature (EWT) is 50°F or above. If below 50°F EWT use 2 GPM per ton. Example, a 4 ton unit with 50°F EWT would require a 6 GPM flow regulator. This would be part # FR6 (Flow Regulator) and the 6 is the GPM. If example was with 48°F EWT part. Refer to the *Open Loop Accessories* section in the Geothermal System Components Catalog for more part numbers.

⚠ CAUTION

UNIT OPERATION HAZARD

Failure to follow this caution may result in equipment damage or improper operation.

Discharge air configuration change is not possible on Heat Pumps equipped with Electric Heat Option.



Note: Package unit shown. HS unit is connected to furnace or fan coil (see page 8).

(1) Flex Duct Connection
(2) Low Voltage Control Connection
(3) Vibration Pad
(4) Ball Valves
(5) Solenoid Valve Slow Closing
(6) Condensate Drain Connection
(7) Drain Valves
(8) Hose Kits (optional)
(9) Pressure Tank (optional)
(10) P/T Ports (optional)
(11) Line Voltage Connection
(12) Electric Heater Line Voltage Disconnect
(13) Unit Line Voltage Disconnect
(14) Flow Regulator

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Fig. 4 - Example Well Water System Setup

Table 2 – Water Quality Requirements for Open-Loop Geothermal Heat Pump System

Water Quality Parameter	HX Material	Closed Recirculating	Open Loop and Recirculating Well		
Scaling Potential - Primary Measurement Above the given limits, scaling is likely to occur. Scaling indexes should be calculated using the limits below:					
pH/Calcium Hardness Method	All	--	pH <7.5 and Ca Hardness <100ppm		
Index Limits for Probable Scaling Situations - (Operation outside these limits is not recommended) Scaling indexes should be calculated at 150°F for direct use and HWG applications, and at 90°F for indirect HX use. A monitoring plan should be implemented.					
Ryznar Stability Index	All	--	6.0 - 7.5 If > 7.5 minimize steel pipe use		
Langelier Saturation Index	All	--	-0.5 to +0.5 If <-0.5 minimize steel pipe use. Based upon 150°F HWG and Direct well, 84°F Indirect Well HX		
Iron Fouling					
Iron Fe^{2} (Ferrous) (Bacterial Iron Potential)	All	--	<0.2 ppm (Ferrous) If Fe^{2*} (ferrous) >0.2 ppm with pH 6-8, O2<5 ppm check for iron bacteria		
Iron Fouling	All	--	<0.5 ppm of Oxygen Above this level deposition will occur		
Corrosion Prevention					
pH	All	6 - 8.5 Monitor/treat as needed	6 - 8.5 Minimize steel pipe below 7 and no open tanks with pH <8		
Hydrogen Sulfide (H_2S)	All	--	At H S>0.2 ppm, avoid use of copper and copper nickel piping or HXs. Rotten egg smell appears at 0.5 ppm level. Copper alloy (bronze or brass) cast components are OK to <0.5 ppm		
Ammonia ion as hydroxide, chloride, nitrate and sulfate compounds	All	--	<0.5 ppm		
Maximum Chloride Levels			**Maximum Allowable at Maximum Water Temperature**		
			50°F	**75°F**	**100°F**
	Copper	--	<20 ppm	NR	NR
	cupronickel	--	<150 ppm	NR	NR
	304 SS	--	<400 ppm	<250 ppm	<150 ppm
	316 SS	--	<1000 ppm	<550 ppm	<375 ppm
	Titanium	--	>1000 ppm	>550 ppm	>375 ppm
Erosion and Clogging					
Particulate Size and Erosion	All	<10 ppm of particles and a maximum velocity of 1.8 m/s. Filtered for maximum 841 micron [0.84 mm 20 mesh] size	<10 ppm (<1 ppm "sandfree" for reinjection) of particles and a maximum velocity of 1.8 m/s. Filtered for maximum 841 micron [0.84 mm. 20 mesh] size. Any particulate that is not removed can potentially clog components		

NOTES:

- Closed recirculating system is identified by a closed pressurized piping system.
- Recirculating open wells should observe the open recirculating design considerations.
- NR - application not recommended
- "—" No design Maximum

WATER PIPING

Supply and return piping must be as large as the unit connections on the heat pump (larger on long runs).

⚠ CAUTION

UNIT OPERATION HAZARD

Failure to follow this caution may result in improper equipment operation.

Never use flexible hoses of a smaller inside diameter than that of the fluid connections on the unit.

HS units are supplied with either a copper or optional cupronickel condenser. Copper is adequate for ground water that is not high in mineral content.

NOTE: Proper testing is recommended to assure the well water quality is suitable for use with water source equipment. When in doubt, use cupronickel. See Application Considerations notes on page 4.

In conditions anticipating moderate scale formation or in brackish water, a cupronickel heat exchanger is recommended.

Both the supply and discharge water lines will sweat if subjected to low water temperature. These lines should be insulated to prevent damage from condensation. All manual flow valves used in the system must be ball valves. Globe and gate valves must not be used due to high pressure drop and poor throttling characteristics.

⚠ CAUTION

EQUIPMENT DAMAGE AND/OR UNIT OPERATION HAZARD

Failure to follow this caution may result in equipment damage and/or improper operation.

Never exceed the recommended water flow rates as serious damage or erosion of the water-to-refrigerant heat exchanger could occur.

Always check carefully for water leaks and repair appropriately. Units are equipped with female pipe thread fittings.

NOTE: Teflon tape sealer should be used when connecting water piping connections to the units to insure against leaks and possible heat exchanger fouling.

NOTE: The unit is shipped with water connection O-rings. A 10 pack of O-rings (part #4026) can be ordered through FAST® Parts.

IMPORTANT: Do not over-tighten connections.

Flexible hoses should be used between the unit and the rigid system to avoid possible vibration. Ball valves should be installed in the supply and return lines for unit isolation and unit water flow balancing (on open-loop systems).

MATCHED SYSTEM

The HS geothermal splits have been tested and rated with ICP air handlers (fan coils) and evaporator coils (for use with furnaces).

Use air handler or cased coil from the list below and follow the Installation Instructions for those components.

Geothermal and Air Handler or Cased Coil Match-Up		
Geothermal Split	**Air Handler**	**Cased Coil**
HS024	FVM4X36	EAM4X24
HS036	FVM4X36	EAM4X36
HS048	FVM4X48	EAM4X48
HS060	FVM4X60	EAM4X60

REFRIGERANT LINES

⚠ WARNING

PERSONAL INJURY / ENVIRONMENTAL HAZARD

Failure to follow this warning could result in personal injury or death.

Relieve pressure and recover all refrigerant before system repair or final unit disposal.

Use all service ports and open all flow–control devices, including solenoid valves.

⚠ CAUTION

ENVIRONMENTAL HAZARD

Failure to follow this caution may result in environmental damage.

Federal regulations require that you do not vent refrigerant to the atmosphere. Recover during system repair or final unit disposal.

The installation of the copper refrigerant tubing must be done with care to obtain reliable, trouble free operation. This installation should only be performed by qualified refrigeration service and installation personnel.

Refrigerant lines generally can and should be routed and supported so as to prevent the transmission of vibrations into the building structure. Experience and good design practice dictate 75 feet as the maximum practical length for interconnecting refrigerant lines in split system heat pumps without special considerations. Beyond 75 feet, system losses become substantial and the total refrigerant charge required can compromise the reliability and design life of the equipment.

Refrigerant lines should be sized in accordance with those listed in Table 3. Copper tubing should be clean and free of moisture and dirt or debris. The suction and liquid lines MUST be insulated with at least 3/8" wall, closed-cell foam rubber insulation or equivalent.

Table 3 – Valve Sizing Chart

Valve Sizing Chart			
Unit Size	**Line Type**	**Valve Conn. Size**	**Allen Wrench Size**
HS024, 036	Suction	3/4	5/16
HS048, 060	Suction	7/8	5/16
All Valves	Liquid	3/8	5/16

Note: Liquid Line is recommended to be installed.

Some points to consider are:

- Pressure drop (friction losses) in refrigerant suction lines reduces system capacity and increases power consumption by as much as 2% or more, depending on the line length, number of bends, etc. Pressure drop in liquid lines affects system performance to a lesser degree, provided that a solid column of liquid (no flash gas) is being delivered to the refrigerant metering device, and that the liquid pressure at the refrigerant metering device is sufficient to produce the required refrigerant flow.
- Oil is continually being circulated with the refrigerant so, oil return to the compressor is always a consideration in line sizing. Suction lines on split system heat pumps are also hot gas lines in the heating mode, but are treated as suction lines for sizing purposes. If the recommended suction lines sizes are used, there should be no problem with oil return.
- Vertical lines should be kept to a minimum. Vertical liquid lines will have a vertical liquid lift in either heating or cooling, and the weight of the liquid head is added to the friction loss to arrive at the total line pressure drop.
- Wherever possible, the air handler should be installed at a higher elevation than the condensing section to aid with oil return to the

compressor.

Linear vs Equivalent Line Length

Linear Line Length - is the actual measured length of the line including bends. This is used to calculate the additional refrigerant charge that must be added to the system.

Equivalent Line Length - is the combination of the actual length of all the straight runs and the equivalent length of all bends valves and fittings in a particular line. The equivalent length of a bend, valve or fitting is equal to the length of a straight tube of the same diameter having the same pressure drop as the particular valve or fitting. The ASHRAE Fundamentals Handbook provides tables for determining the equivalent length of various bends, valves and fittings.

Connecting Refrigerant Lines

- Use only ACR grade copper tubing and keep ends sealed until joints are made.
- For best performance, select routing of refrigerant lines for minimum distance and fewest number of bends.
- Size lines in accordance with unit wiring diagram.
- Cut crimped ends off the air handler suction and liquid lines. Connect and braze lines to the air handler.

NOTE: The air handler is factory supplied with a holding charge of dry nitrogen.

- Connect and braze lines to service valves on the condensing section.

⚠ CAUTION

UNIT DAMAGE HAZARD

Failure to follow this caution may result in equipment damage or improper operation.

- Use a brazing shield
- Wrap service valves with wet cloth or heat sink material.
- Direct flame away from the valve body.
- Valve body temperature must remain below 250°F to protect the internal rubber "O" rings and seals.

Pressurize the refrigerant lineset and air handler to 150 lbs with dry nitrogen through the ports provided on the self service valves. Check lineset and unit connections for leaks. Once system integrity is verified, evacuate lineset and air handler with a good vacuum pump to 500 microns and hold for half hour.

IMPORTANT: **Pumpdown must never be used with heat pumps.**

Table 4 – Liquid Line Charge per Linear Ft.

Liquid Line Charge per Linear Ft.	
Liquid Line Size O.D.	**R410A oz per ft.**
1/4	.25
5/16	.44
3/8	.60
1/2	1.15
5/8	1.95

Table 5 – Refrigerant Charge, Line Sizing & Capacity Multipliers

Refrigerant Charge, Line Sizing and Capacity Multiplier Chart												
Model	**Factory R410A Charge (oz)***	**Refrigerant Line O.D. Size (Based on Equivalent Line Length)**										**Suction Line Riser Max.**
		25 Ft.		**35 Ft.**		**45 Ft.**		**50 Ft.**		**75 Ft.**		
		LIQ.	**SUC**	**LIQ.**	**SUC**	**LIQ.**	**SUC**	**LIQ.**	**SUC**	**LIQ.**	**SUC**	
HS024	**80**	3/8	3/4	3/8	3/4	3/8	3/4	3/8	3/4	3/8	7/8	3/4
HS030	**86**	3/8	3/4	3/8	3/4	3/8	3/4	3/8	7/8	3/8	7/8	3/4
HS048	**93**	3/8	7/8	3/8	7/8	3/8	7/8	3/8	7/8	3/8	7/8	7/8
HS060	**115**	3/8	1–1/8	3/8	1–1/8	3/8	1–1/8	3/8	1–1/8	3/8	1–1/8	7/8
CAPACITY MULTIPLIER		1.00		.995		.990		.990		.980		

Example 1:	**Example 2:**
Model HS036 with 45 ft. of equivalent length of 3//8" O.D. Liquid Line. Total system charge = Factory charge + (45 ft – 25 ft) X .60 oz/ft. Total system charge = 86 oz + (20 ft x .60 oz/ft) = 98 oz. Additional 12 oz of R410A refrigerant required.	Model HS060 with 10 ft. of equivalent length of 3/8" O.D. Liquid Line. Total system charge = Factory charge + (10 ft – 25 ft) X .60 oz/ft. Total system charge =115 oz – (15 ft x .60 oz/ft) = 106 oz. Reduce charge 9 oz of R410A refrigerant required.

Table 6 – Charge Adjustments When Paired with Air Handlers

Charge Adjustments for HS condensing section when paired with air handlers (oz)								
Unit	**EAM4X24**	**FVM4X36**	**EAM4X36**	**FVM4X36**	**EAM4X48**	**FVM4X48**	**EAM4X60**	**FVM4X60**
HS024	**–11**	**–7**	**–**	**–**	**–**	**–**	**–**	
HS036	**–**	**–**	**0**	**0**	**–**	**–**	**–**	
HS048	**–**	**–**	**–**	**–**	**5**	**5**	**–**	
HS060	**–**	**–**	**–**	**–**	**–**	**–**	**–13**	**0**

Example: Model HS048 condensing section paired with FVM4X48 air handler with 45ft of equivalent length of 3/8" O.D liquid Line.
Total system charge = factory charge + (charge adjustments for air handler)+ (45ft – 25 ft) x .60 oz/ft.
Total system charge = 88 oz + (5 oz) + (20ft x .60 oz/ft) = 105 oz.
Additional 17 oz of R410A refrigerant required.

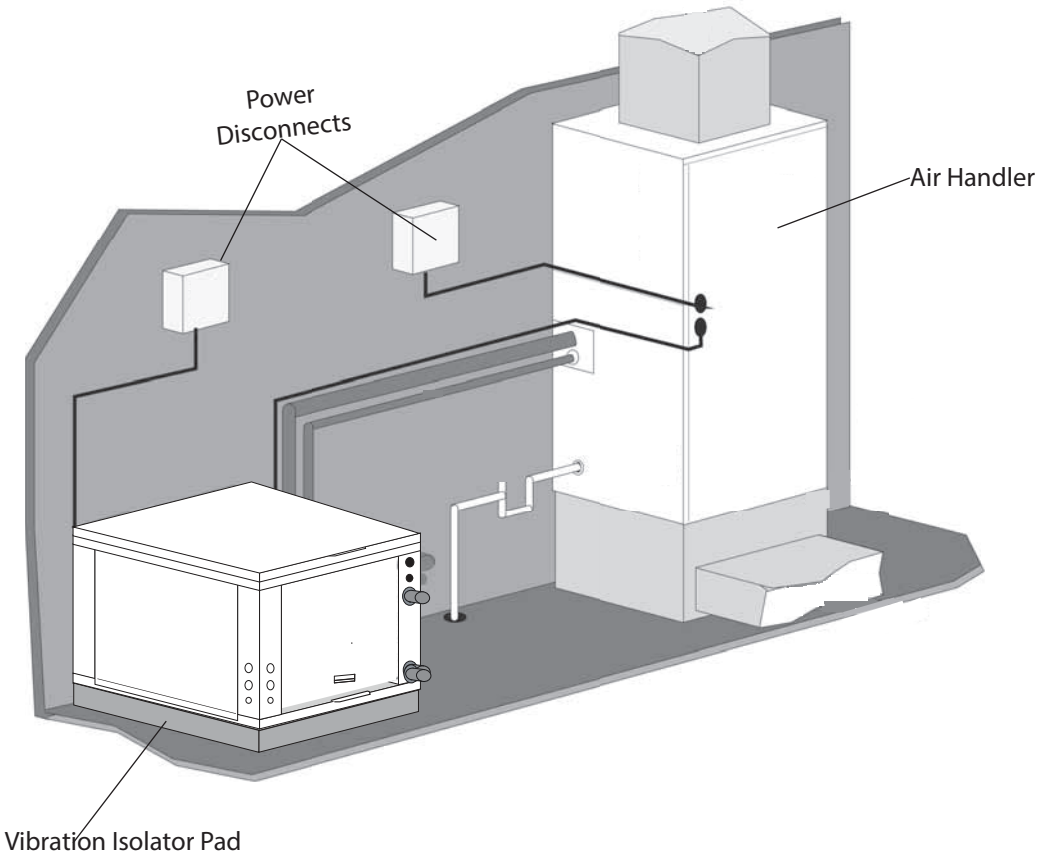


Fig. 5 - Typical Split with Air Handler Installation

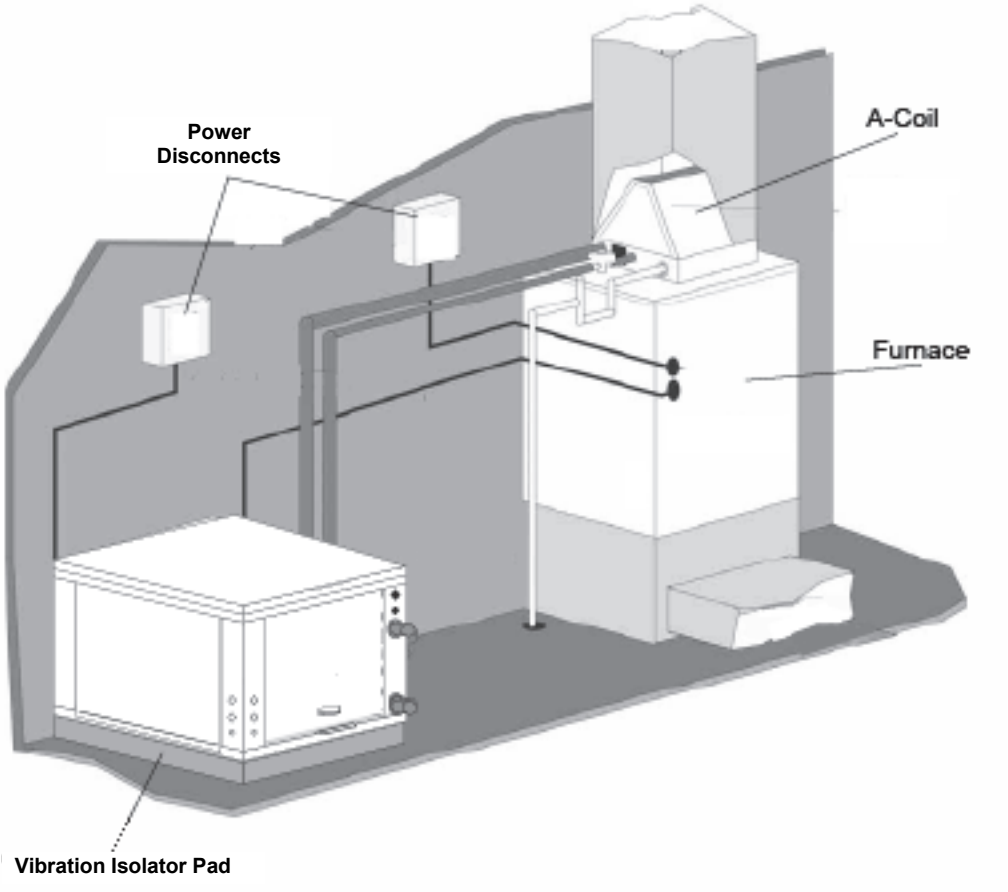


Fig. 6 - Typical Split with A-coil & Furnace Installation

ELECTRICAL

Refer to electrical component box layout. See Fig. 7.

⚠ CAUTION

UNIT OPERATION HAZARD

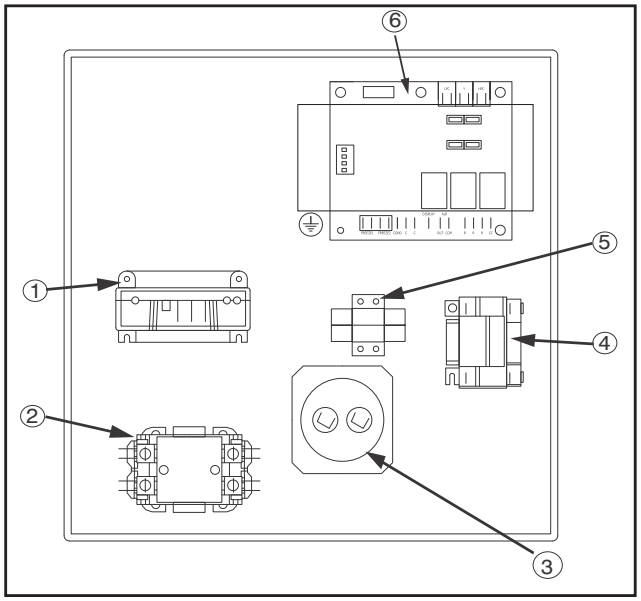
Failure to follow this caution may result in equipment damage and/or improper operation.

- Field wiring must comply with local and national electrical codes.
- Power to the unit must be within the operating voltage range indicated on the unit nameplate or on the performance data sheet.
- Operation of unit on improper line voltage or with excessive phase imbalance will be hazardous to the unit, constitutes abuse, and may void the warranty.

Properly sized fuses or HACR circuit breakers must be installed for branch circuit protection. See unit nameplate for maximum fuse or breaker size.

The unit is provided with a concentric knock-out for attaching common trade sizes of conduit, route power supply wiring through this opening.

Always connect the ground lead to the grounding lug provided in the control box and power leads to the line side of compressor contactor as indicated on the wiring diagrams.



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(1) Comfort Alert Module
(2) Compressor Contactor
(3) Capacitor
(4) Auxiliary Relay (DP/DT)
(5) 24VAC Terminal Block
(6) Unit Protection Module (UPM)

Fig. 7 - Electrical Component Box Layout

ELECTRONIC THERMOSTAT INSTALL

Thermostat wire must be 8-conductor, 18-AWG wire. Strip the wires back 1/4-inch (longer strip lengths may cause shorts) and insert the thermostat wires into the connector as shown in Fig. NO TAG. Tighten the screws to ensure secure connections. The thermostat has the same type connectors, requiring the same wiring.

Refer to the thermostat Installation Instructions for detailed installation and operation information.

NOTE: When using a 2-cool, 3-heat thermostat, both the W1 & W2 on the Heat Pump and W2 & EM on the thermostat must be connected together via a jumper.

NOTE: HS units are equipped with detachable thermostat connectors. These connectors are located in different locations based on the blower motor that is installed in the unit.

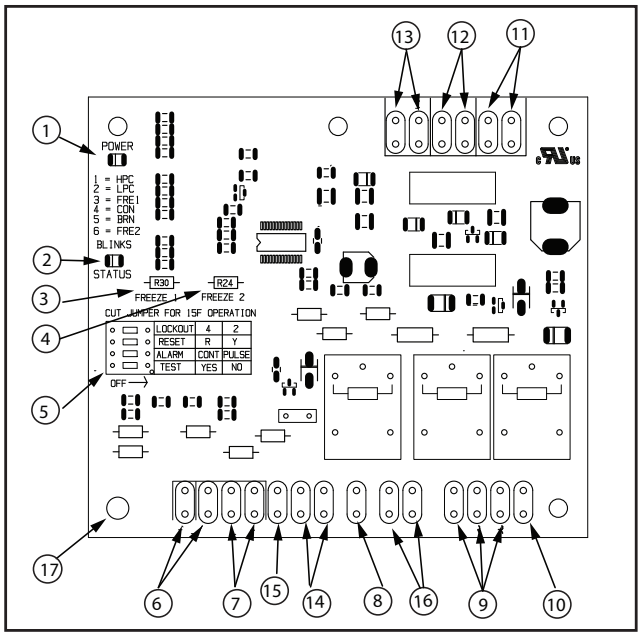
Connection point logic is as follows:

Table 7 – Low Voltage Connection Points

Low Voltage Connection Points				
Function	**From Thermostat**	**To Air Handler**	**From Air Handler**	**To Condensing Section**
24 HVAC Common	C	C	C	C
24 VAC Hot	R	R	R	R
Fan Operation	G	G		
Reversing Valve (3)	O	O	O	O
1st Stage Compressor Operation	Y1	Y1	Y1	Y1
2nd Stage Compressor Operation	Y2	Y2	Y2	Y2
Alarm Output (From UPM) (2)	L	Splice		ALR
Auxilliary Electric Heat (4)	W/W1/W2	W1		
Emergency Heat (4)	E	EM/W2		

1. If service LED is utilized connect 'ALR' terminal on the UPM board to 'L' on the thermostat sub base. The wiring may be spliced in the air handling unit. The ALR output is always dry contact between the OUT and COM Terminals. See Thermostat connections section of this manual for additional information.
2. 'O' – reversing valve is energized in the cooling mode. Fail safe is to heating.
3. Utilized when electric strip heater package present.

Safety Devices and UPM Board



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(1) Board Power Indicator
(2) UPM Status LED Indicator
(3) Water Coil Freeze Protection Temperature Selection [R30]
(4) Air Coil Freeze Protection Temperature Selection
(5) UPM Board Settings
(6) Water Coil Freeze Connection
(7) Air Coil Freeze Connection*
(8) LCD Unit Display Connection
(9) 24VAC Power Input
(10) Compressor Contact Output
(11) High Pressure Switch Connection
(12) Call for Compressor Y1
(13) Low Pressure Switch Connection
(14) 24VAC Power Common
(15) Condensate Overflow Sensor
(16) Dry Contact
(17) UPM Ground Standoff

*Air Coil Freeze Connection is not utilized in HS units. The factory installs a jumper across the Freeze2 connections on the UPM board. If jumper is not present, a Flash 6 code will occur.

Fig. 8 - UPM Board

NOTES:

1. If the unit is being connected to a thermostat with a malfunction light, this connection is made at the unit malfunction output or relay. Refer to Fig. 8.
2. If the thermostat is provided with a malfunction light powered off of the common (C) side of the transformer, a jumper between “R” and “COM” terminal of “ALR” contacts must be made.
3. If the thermostat is provided with a malfunction light powered off of the hot (R) side of the transformer, then the thermostat malfunction light connection should be connected directly to the (ALR) contact on the unit’s UPM board.

Each unit is factory provided with a Unit Protection Module (UPM) that controls the compressor operation and monitors the safety controls that protect the unit.

Safety controls include the following:

- High pressure switch located in the refrigerant discharge line and wired across the HPC terminals on the UPM.
- Low pressure switch located in the unit refrigerant suction line and wired across terminals LPC1 and LPC2 on the UPM.

NOTE: UPM Board Dry Contacts are normally open (NO)

- Water side freeze protection sensor, mounted close to condensing water coil, monitors refrigerant temperature between condensing water coil and thermal expansion valve. If temperature drops below or remains at freeze limit trip for 30 seconds, the controller will shut down the compressor and enter into a soft lockout condition.
- The default freeze limit trip is 26°F, however this can be changed to 15°F by cutting the R30 or Freeze1 resistor located on top of DIP switch SW1 (Refer to Fig. 8, item (3) for resistor location), Refer to Fig. 9 for sensor location.

UPM Board Factory Default Settings	
TEMP	30°F
LOCKOUT	2
RESET	Y
ALARM	PULSE
TEST	NO

UPM DIP SWITCH DEFAULT POSITION			
	lockout	4	2
	reset	R	Y
	alarm	Cont	pulse
	test	yes	no

The UPM Board includes the following features:

- **LOW PRESSURE SWITCH**: The low pressure switch safety is designed to shut down the compressor in th event of loss of charge. Cut in 60 +/- 15 psig and cut out 40 +/- psig.
- **HIGH PRESSURE SWITCH**: The high pressure switch safety is designed to shut down the compressor if it exceeds limits. Cut in 420 +/- 15 psig and cut out 600 +/- psig.

  Pressure Switch Protection: The split geothermal unit is equipped with high- and low-pressure switches. If the control senses the opening of a high- or low-pressure switch, it will respond as follows:

  1. De-energize the compressor contactor.
  2. Display the appropriate fault code (see Table NO TAG).
  3. After a 15 minute delay, if there is a call for cooling or heating and LPS or HPS is reset, the compressor contactor is energized.
  4. If the open switch closes anytime after the 15 minute delay, then resume operation with a call for cooling or heating.
  5. If LPS or HPS trips 2-4 consecutive cycles per the dip switch lockout setting or UI setting (Communicating only), the unit operation is locked out for 4 hours.
  6. In the event of a high-pressure switch trip or high-pressure lockout, check the refrigerant charge, and the coax coil (in cooling) for water issues, or indoor airflow in heating.
  7. In the event of a low-pressure switch trip or low-pressure lockout, check the refrigerant charge and indoor airflow (cooling) and coax coil water pressure and flow in heating.
- **LOW PRESSURE BYPASS TIMER**: If the compressor is running and the low pressure switch opens, the controller will keep the compressor ON for 120 seconds. After 2 minutes, if the low pressure switch remains open, the board will shut down the compressor and enter a soft lockout. The compressor will not be energized until the low pressure switch closes and the anti-short cycle time delay expires. If the low pressure switch opens 2-4 times in 1 hour, the unit will enter a 4 hour lockout period.
- **ANTI-SHORT CYCLE TIMER**: 5 minute delay on break timer to prevent compressor short cycling.

- **RANDOM START**: Each controller has a unique random start delay ranging from 270 to 300 seconds on initial power up to reduce the chance of multiple unit simultaneously starting at the same time after power up or after a power interruption, thus avoiding creating large electrical spike.
- **UPM DIP SWITCH SETTINGS:** The UPM has 3 features controlled on the dip switch.
  1. Freeze Protection Limit for the Freeze one water coil.
  2. Lockout Settings (Soft Lockouts)
  3. Brownout (High voltage protection)

DIP SWITCH		DIP Switch Position	
		ON	OFF (Default)
SW1	Freeze Protection Limit	15°F	26° F
SW2	Number of Trips to Lockout (HPS / LPS)	4	2
SW3	Brownout	Brownout Protection is Disabled	Brownout Protection is Active

- **FREEZE SENSOR**: The default setting for the freeze limit trip is 26°F (sensor number 1); however this can be changed to 15°F by cutting the R30 resistor located on top of the DIP switch SW1. The UPM board will constantly monitor the refrigerant temperature with the sensor mounted close to the condensing water coil between the thermal expansion valve and water coil. If temperature drops below or remains at the freeze limit trip for 30 seconds, the controller will shut the compressor down and enter into a soft lockout condition. Both the status LED and the Alarm contact will be active.
  The LED will flash the code associated with this alarm condition three (3) times. If this alarm occurs 2 times (or 4 if Dip switch is set to 4) within an hour, the UPM board will enter into a hard lockout condition. It will constantly monitor the refrigerant temperature with the sensor mounted close to the evaporator between the thermal expansion valve and evaporator coil as shown in Fig. 9.
  If temperature drops below or remains at the freeze limit trip for 30 seconds, the controller will shut the compressor down and enter into a soft lockout condition. Both the status LED and the alarm contact will be active. The LED will flash the code associated with this alarm condition six (6) times. If this alarm occurs 2 times (or 4 if Dip switch is set to 4) within an hour, the controller will enter into a hard lockout condition.

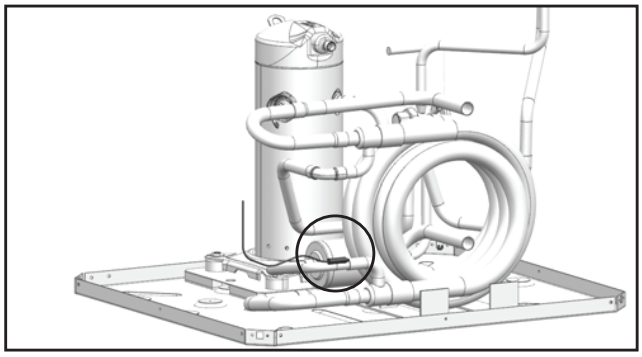

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Fig. 9 - Freeze Protection Sensor Location

⚠ CAUTION

UNIT DAMAGE AND/OR OPERATION HAZARD

Failure to follow this caution may result in unit damage and/or improper equipment operation.

Freeze sensor will not guard against the loss of water. A flow switch is recommended to prevent the unit from running if water flow is lost or reduced.

⚠ CAUTION

UNIT DAMAGE AND/OR OPERATION HAZARD

Failure to follow this caution may result in unit damage and/or improper equipment operation.

If unit is employing a fresh water system (no anti-freeze protection), it is extremely important to have the Freeze1 R30 resistor set to 26°F in order to shut down the unit at the appropriate leaving water temperature and protect your heat pump from freezing if a freeze sensor is included.

- **INTELLIGENT RESET**: If a fault condition is initiated, the 5 minute delay on break time period is initiated and the unit will restart after these delays expire. During this period the fault LED will indicate the cause of the fault. If the fault condition still exists or occurs 2 or 4 times (depending on 2 or 4 setting for Lockout dip switch) before 60 minutes, the unit will go into a hard lockout and requires a manual lockout reset.
  A single condensate overflow fault will cause the unit to go into a hard lockout immediately, and will require a manual lockout reset.
- **LOCKOUT RESET**: A hard lockout can be reset by turning the unit thermostat off and then back on when the "RESET" dip switch is set to "Y" or by shutting off unit power at the circuit breaker when the "RESET" dip switch is set to "R".

NOTES: The blower motor will remain active during a lockout condition.

- **BROWNOUT / SURGE / POWER INTERRUPTION PROTECTION**: The brownout protection in the UPM board will shut down the compressor if the incoming power falls below 18 VAC. The compressor will remain OFF until the voltage is above 18 VAC and ANTI-SHORT CYCLE TIMER (300 seconds) times out. The unit will not go into a hard lockout.
  Defeat the Brownout - The high voltage brownout feature can be defeated in the event of nuisance trips due to severe noisy power conditions. The UPM dip switch has brownout ON as default, to defeat the brown out protection, the selection can be changed to OFF. All efforts should be exhausted to correct any electrical deficiencies before defeating this safety feature to eliminate possible equipment damage.
- **COMPRESSOR VOLTAGE SENSING**: If there is no 230V at the compressor contactor(s) when the indoor unit is powered and cooling or heating demand exists, the appropriate fault code is displayed. Verify the disconnect is closed and 230V wiring is connected to the unit.
- **MALFUNCTION OUTPUT**: Alarm output is Normally Open (NO) dry contact. If pulse is selected the alarm output will be pulsed. The fault output will depend on the dip switch setting for "ALARM". If it is set to "CONST", a constant signal will be produced to indicate a fault has occurred and the unit requires inspection to determine the type of fault. If it is set to "PULSE", a pulse signal is produced and a fault code is detected by a remote device indicating the fault. See L.E.D Fault Indication below for blink code explanation. The remote device must have a malfunction detection capability when the UPM board is set to "PULSE".

NOTE: If 24 VAC output is needed, R must be wired to ALR-COM terminal; 24 VAC will be available o the ALR-OUT terminal when the unit is in the alarm condition.

- **DISPLAY OUTPUT**: The Display output is a pulse output connected to the Unit Diagnostic Display (UDD) and it pulses 24VAC when the unit is in an lockout alarm condition.
- **TEST DIP SWITCH**: A test dip switch is provided to reduce all time delays settings to 10 seconds during troubleshooting or verification of unit operation.

⚠ CAUTION

UNIT DAMAGE AND/OR OPERATION HAZARD

Failure to follow this caution may result in unit damage and/or improper equipment operation.

Operation of unit in test mode can lead to accelerated wear and premature failure of components. The ”TEST” switch must be set back to ”NO” after troubleshooting/ servicing.

Pump Relay

The factory installed pump relay can be used to energize a supply pump or solenoid valve when there is a call for compressor operation. This relay can be used to switch either high or low voltage power.

FACTORY INSTALLED FEATURES

A number of factory installed options are available on the HS Series of Heat Pumps. The following details the purpose, function and components of each option.

Heat Recovery Package (HRP) (optional)

The heat recovery package is a factory installed option on HS series heat pumps. The HRP can be used to heat potable water during unit operation using waste heat from the compressor discharge gas. In some cases the HRP can provide most or all of the hot water requirements for a typical home.

The HRP consists of three major components:

1. Double wall, vented refrigerant to water heat exchanger
2. Circulating pump
3. Control circuit

The heat exchanger is rated for use with potable water and is acceptable for use as a domestic water heating device in most building codes.

The pump circulates water between the domestic hot water tank and HRP heat exchanger in the Heat Pump. The control circuit ensures that the HRP only operates when there is available heat from the compressor and when the water is within a safe temperature range of below 140°F. When the heat pump compressor operates, the HRP will monitor the temperature of the discharge gas from the compressor. Once discharge gas is hot enough to provide useful heat to the domestic water tank, the circulating pump will be enabled, drawing water from the tank, through the HRP heat exchanger and then depositing the heated water back into the tank.

If the water temperature reaches 140°F, the circulating pump is disabled to prevent over heating of the domestic water. The HRP is provided with an on/off switch in case the end user desires that the HRP be inactivated (typically during the winter months when space heating is most important).

The circulating pump is enabled when compressor discharge temperature reaches 120°F (48.9°C).

The circulating pump is disabled if an overload condition exists (over 1.35 amps).

⚠ CAUTION

UNIT DAMAGE AND/OR OPERATION HAZARD

Failure to follow this caution may result in unit damage and/or improper equipment operation.

If heat recovery unit is installed in an area where freezing may occur, the unit must be drained during winter months to prevent heat exchanger damage. Heat exchanger ruptures that occur due to freezing will void the heat recovery package warranty along with the heat pump warranty.

Water Tank Preparation

1. Turn off electrical or fuel supply to the water heater.
2. Attach garden hose to water tank drain connection and run other end of hose out doors or to an open drain.
3. Close cold water inlet valve to water heater tank.
4. Drain tank by opening drain valve on the bottom of the tank, then open pressure relief valve or hot water faucet.
5. Once drained the tank should be flushed with cold water until the water leaving the drain hose is clear and free of sediment.
6. Close all valves and remove the drain hose.
7. Install HR water piping.

HR Water Piping

All hot water piping MUST be a minimum of 3/8” O.D. copper tube to a maximum distance of 15 feet. For distances beyond 15 feet, but not exceeding 60 feet, use 1/2” copper tube. Separately insulate all exposed surface of both connecting water lines with 3/8” wall closed cell insulation. Install isolation valves on supply and return to the heat recovery. (See Fig. 10)

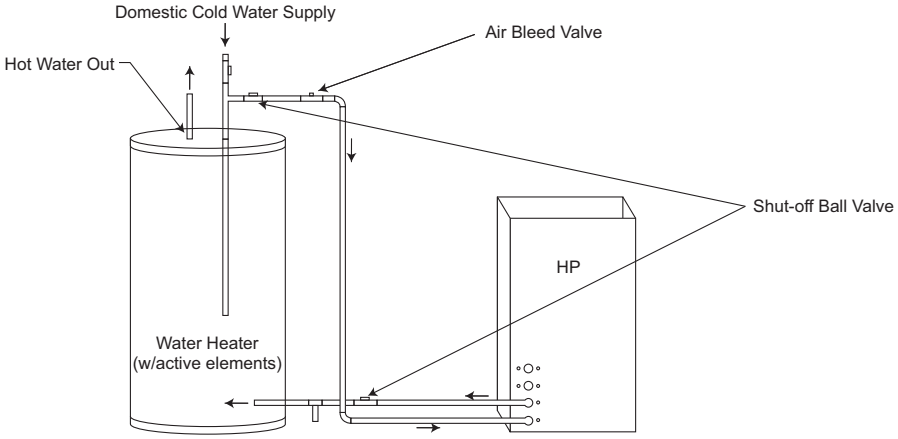
Water Tank Refill

1. Open the cold water supply to the tank.
2. Open a hot water faucet to vent air from the system until water flows from the faucet, then close.
3. Depress the hot water tank pressure relief valve handle to ensure there is no air remaining in the tank.
4. Carefully inspect all plumbing for water leaks. Correct as required.
5. Purge all air from HRP by depressing the Schrader valve on the HR unit. Allow all air to bleed out until water appears at the valve.
6. Before restoring the power or fuel supply to the water heater, adjust the temperature setting on the tank thermostat(s) to ensure maximum utilization of heat available from the refrigeration system and to conserve the most energy.
   On tanks with thermostats and both upper and lower elements, the lower element should be turned down to 100°F, while the upper element should be adjusted to 120°F. Depending upon the specific needs of the customer, you may need to adjust the upper element differently.
   On tanks with a single thermostat, lower the thermostat setting to 120°F or the “LOW” position. After thermostat adjustments are completed, replace access cover and restore electrical or fuel supply to water heater.

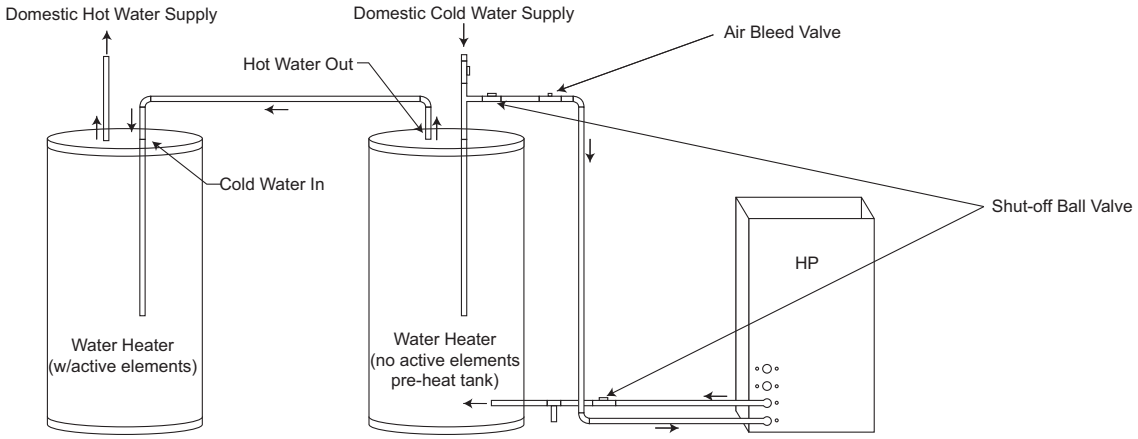
IMPORTANT: Copper should be used for piping from HRP to domestic water tank(s). Use 5/8” (16mm) O.D. copper or larger. Refer to local codes for hot water piping. Insulate the water lines between the GHP and the water heater with a minimum of 3/8” (10mm) closed cell insulation.

Refer to page 20 for HRP start-up information.

One Tank System



Two Tank System (preferred)



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Package unit shown. HS split unit arrangement similar with different water locations on unit.

Fig. 10 - HRP Water Piping

SYSTEM CHECKOUT

After completing the installation, and before energizing the unit, the following system checks should be made:

1. Verify that the supply voltage to the heat pump is in accordance with the nameplate ratings.
2. Make sure that all electrical connections are tight and secure.
3. Check the electrical fusing and wiring for the correct size.

⚠ WARNING

ELECTRICAL SHOCK HAZARD

Failure to follow this warning could result in personal injury or death.

Ensure cabinet and electrical box are properly grounded

4. Verify that the low voltage wiring between the thermostat and the unit is correct.
5. Verify that the water piping is complete and correct.
6. Check that the water flow is correct, and adjust if necessary.
7. Check the blower for free rotation, and that it is secured to the shaft.
8. Verify that vibration isolation has been provided.
9. Unit is serviceable. Be certain that all access panels are secured in place.

Considerations:

- Always check incoming line voltage power supply and secondary control voltage for adequacy. Transformer primaries are dual tapped for 208 and 230 volts. Connect the appropriate tap to ensure a minimum of 18 volts secondary control voltage. 24 volts is ideal for best operation.
- Long length thermostat and control wiring leads may create voltage drop. Increase wire gauge or up-sized transformers may be required to insure minimum secondary voltage supply.
- The following guidelines are recommended for wiring between a thermostat and the unit: 18 GA up to 60 foot, 16 GA up to 100 ft and 14 GA up to 140 ft.
- Do not apply additional controlled devices to the control circuit power supply without consulting the factory. Doing so may void equipment warranties.
- Check with all code authorities on requirements involving condensate disposal/overflow protection criteria.

UNIT START-UP

NOTE: A unit Start-Up checklist is included in the unit packet. Complete the Checklist and place it in the customer file at your dealership.

1. Set the thermostat to the highest setting.
2. Set the thermostat system switch to “COOL”, and the fan switch to the “AUTO” position. The reversing valve solenoid should energize. The compressor and fan should not run.
3. Reduce the thermostat setting approximately 5 degrees below room temperature.
4. Verify the heat pump is operating in the cooling mode.
5. Turn the thermostat system switch to the “OFF” position. The unit should stop running and the reversing valve should de-energize.
6. Leave the unit off for approximately five (5) minutes to allow for system equalization.
7. Turn the thermostat to the lowest setting.
8. Set the thermostat switch to “HEAT”.
9. Increase the thermostat setting approximately five (5) degrees above room temperature.
10. Verify the heat pump is operating in the heating mode.
11. Set the thermostat to maintain desired space temperature.
12. Check for vibrations, leaks, etc.

SEQUENCE OF OPERATION

Cooling Mode

Energizing the “O” terminal energizes the unit reversing valve thus placing the unit into cooling mode. The fan motor starts when the “G” terminal is energized.

NOTE: The fan motor will take 30 seconds to ramp up to operating speed and will run at fan only rated air flow as long as there is no call for compressor or heater operation.

When the thermostat calls for first stage cooling (Y1) the loop pump or solenoid valve, if present, is energized and the first stage of compressor capacity starts. The fan ramps up to first stage cooling air flow in 30 seconds.

NOTE: Some options will have a built in delay, and hence, compressor operation is not immediate. See *Factory Installed Options* section for more detail.

When the thermostat calls for second stage cooling (Y2), the second stage (or full compressor capacity) is initiated. The fan ramps up to full cooling air flow.
Once the thermostat is satisfied, the compressor shuts down and the fan ramps down to either FAN ONLY mode or OFF over a span of 30 seconds.

NOTE: A fault condition initiating a lockout will de-energize the compressor irrespective of which stage is engaged.

Heating Mode

The first two stages of heating (Y1 & Y2) operate in the same manner as cooling, but with the reversing valve de-energized. On a call for auxiliary heat (W1), the fan ramps up to auxiliary heat air flow immediately and the electric heater package is energized along with the compressor.

As the thermostat is satisfied, the heaters will shut off as soon as W1 is de-energized, and the compressors will remain on until the thermostat stages are satisfied.

NOTE: If the unit compressor locks out for any reason at this time, the electric heaters will continue to function normally.

Once the thermostat is satisfied, the compressor shuts down and the fan ramps down to either FAN ONLY mode or OFF over a span of 30 seconds.

If thermostat has two different output points one for Auxiliary heat and a different one for Emergency heat the two outputs must be terminated on W1 units equipped with one stage of Electric heat. (See Fig. 11)

NOTE: When using a 2-cool, 3-heat thermostat, both the W1 & W2 on the Heat Pump and W2 & EM on the thermostat must be connected together via a jumper.

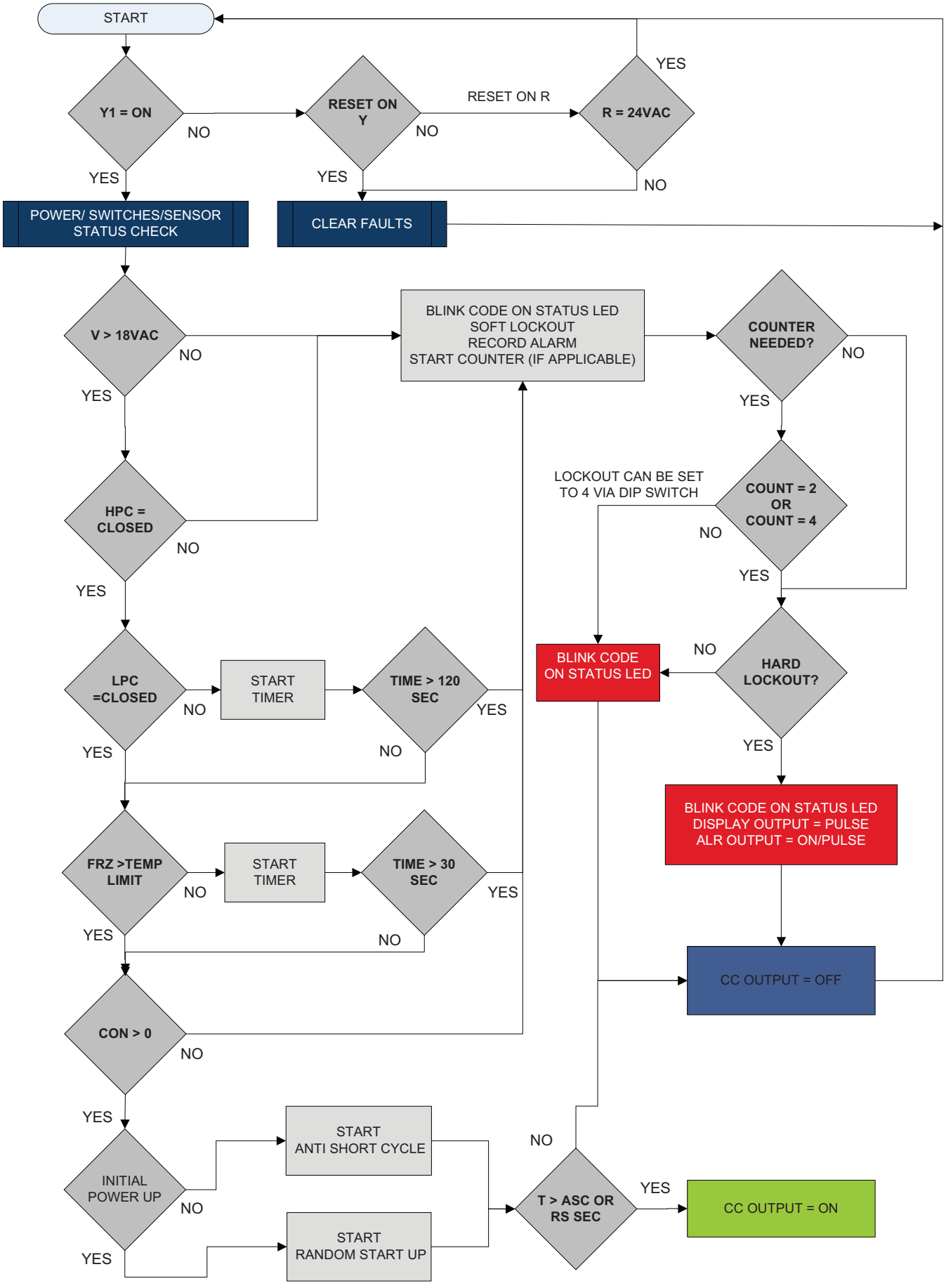

Fig. 11 - UPM Sequence of Operation (SOO) Flow Chart

Operating Temperatures and Pressures

			COOLING				HEATING			
Model	Entering Water Temp. °F	Water Flow	Suction Pressure PSIG	Discharge Pressure PSIG	Water Temp Rise °F	Air Temp Drop °F	Suction Pressure PSIG	Discharge Pressure PSIG	Water Temp Drop	Air Temp Rise °F
HS024 Part Load	30°	4					75-91	264-322	5-6	15-17
		8					79-96	270-331	3-4	16-18
	40°	4					88-107	277-339	6-7	17-20
		8	115-140	175-214	8-9	19-23	92-112	284-348	4-5	18-21
	50°	4	129-157	218-267	14-17	18-20	98-122	291-356	7-8	20-23
		8	124-151	204-250	8-9	19-22	110-130	298-364	5-6	21-24
	60°	4	134-163	249-305	13-16	17-20	112-136	304-372	8-10	22-26
		8	128-156	233-287	8-9	18-21	117-143	312-381	6-7	23-28
	70°	4	138-168	281-341	13-16	17-19	124-152	318-389	9-11	24-29
		8	133-161	263-323	7-9	18-21	131-159	325-398	6-8	26-31
	80°	4	143-174	317-388	13-16	16-19	136-166	331-405	11-13	27-32
		8	137-167	297-366	7-9	17-20	143-174	339-415	7-9	28-33
	90°	4	147-179	357-437	13-16	16-18	149-181	345-422	12-14	29-35
		8	141-172	335-411	7-9	17-20	156-190	352-432	8-10	31-37
	100°	4	151-185	402-492	13-15	15-18				
		8	146-177	378-459	7-9	16-19				
HS024 Full Load	30°	4					76-92	242-297	3-4	13-14
		8					80-97	249-304	2-3	13-15
	40°	4	125-151	180-221	14-18	19-22	89-108	255-312	4-5	15-17
		8	120-146	169-207	8-10	20-23	93-113	261-320	3-3	16-18
	50°	4	134-163	211-258	14-18	18-21	106-118	267-327	5-6	17-19
		8	129-157	198-242	8-10	19-23	110-126	274-335	3-4	18-21
	60°	4	139-169	241-295	14-17	18-21	113-138	280-342	6-7	19-22
		8	134-163	227-278	8-10	19-22	119-145	287-351	4-5	20-23
	70°	4	144-175	272-333	14-17	17-20	126-155	292-358	7-8	21-24
		8	138-168	255-313	8-10	18-21	133-162	300-367	5-6	22-26
	80°	4	148-181	307-375	14-17	17-19	138-168	305-373	8-9	23-27
		8	143-174	288-353	8-10	18-21	145-177	312-382	5-6	24-29
	90°	4	153-186	346-423	14-17	16-19	151-184	317-388	8-10	25-29
		8	147-179	325-398	8-9	17-20	158-193	325-398	6-7	26-31
	100°	4	158-191	389-477	13-16	16-18				
		8	152-185	366-448	8-9	17-20				

This chart shows approximate temperatures and pressures for a unit in good repair. The values shown are meant as a guide only and should not be used to estimate system charge. This chart assumes rated air flow and 80° d.b./67° w.b. entering air temperature in cooling, 70° d.b. entering air temperature in heating. Heating data at entering fluid temperatures below 50° assumes the use of antifreeze. As a result of continuing research and development, specifications are subject to change without notice.

Operating Temperatures and Pressures

			COOLING				HEATING			
Model	Entering Water Temp. °F	Water Flow	Suction Pressure PSIG	Discharge Pressure PSIG	Water Temp Rise °F	Air Temp Drop °F	Suction Pressure PSIG	Discharge Pressure PSIG	Water Temp Drop	Air Temp Rise °F
HS036 Part Load	30°	4.5					73-89	266-325	5-6	15-18
		9.0					77-94	272-333	3-4	16-19
	40°	4.5	117-143	189-231	14-17	18-22	86-105	279-341	6-7	17-21
		9.0	112-137	178-217	8-9	19-24	90-110	286-350	4-5	18-22
	50°	4.5	126-154	221-270	14-17	18-21	105-125	293-358	7-8	20-24
		9.0	121-148	207-253	8-9	19-23	109-130	300-366	5-6	21-25
	60°	4.5	131-160	252-308	13-16	17-21	110-134	306-374	8-10	22-27
		9.0	125-153	237-290	8-9	18-22	115-141	314-383	6-7	23-29
	70°	4.5	135-165	284-347	13-16	17-20	122-150	320-391	9-11	24-30
		9.0	130-158	266-326	7-9	18-22	129-157	327-400	6-8	26-32
	80°	4.5	140-171	320-391	13-16	16-20	134-164	333-407	11-13	27-33
		9.0	134-164	300-367	7-9	17-21	141-172	341-417	7-9	28-35
	90°	4.5	144-176	360-440	13-16	16-19	147-179	347-424	12-14	29-36
		9.0	138-169	338-414	7-9	17-21	154-188	355-434	8-10	31-38
	100°	4.5	149-182	405-495	13-15	15-19				
		9.0	143-174	381-465	7-9	16-20				
HS036 Full Load	30°	4.5					74-90	244-299	3-4	13-15
		9.0					78-95	251-306	2-3	13-16
	40°	4.5	122-149	183-224	14-18	19-23	87-106	257-314	4-5	15-18
		9.0	117-143	172-210	8-10	20-24	91-111	263-322	3-3	16-19
	50°	4.5	131-160	214-261	14-18	18-22	95-105	269-329	5-6	17-20
		9.0	126-154	201-245	8-10	19-24	100-125	276-337	3-4	18-22
	60°	4.5	136-166	244-298	14-17	18-22	111-136	282-344	6-7	19-23
		9.0	131-160	230-281	8-10	19-23	117-143	289-353	4-5	20-24
	70°	4.5	141-172	275-336	14-17	17-21	124-152	294-360	7-8	21-25
		9.0	135-165	258-316	8-10	18-22	131-160	302-369	5-6	22-27
	80°	4.5	145-178	310-378	14-17	17-20	136-166	307-375	8-9	23-28
		9.0	140-171	291-356	8-10	18-22	143-175	314-384	5-6	24-30
	90°	4.5	150-183	349-426	14-17	16-20	149-182	319-390	8-10	25-30
		9.0	144-176	328-401	8-9	17-21	156-191	327-400	6-7	26-32
	100°	4.5	155-189	392-480	13-16	16-19				
		9.0	149-182	369-451	8-9	17-21				

This chart shows approximate temperatures and pressures for a unit in good repair. The values shown are meant as a guide only and should not be used to estimate system charge. This chart assumes rated air flow and 80° d.b./67° w.b. entering air temperature in cooling, 70° d.b. entering air temperature in heating. Heating data at entering fluid temperatures below 50° assumes the use of antifreeze. As a result of continuing research and development, specifications are subject to change without notice.

Operating Temperatures and Pressures

			COOLING				HEATING			
Model	Entering Water Temp. °F	Water Flow	Suction Pressure PSIG	Discharge Pressure PSIG	Water Temp Rise °F	Air Temp Drop °F	Suction Pressure PSIG	Discharge Pressure PSIG	Water Temp Drop	Air Temp Rise °F
HS048 Part Load	30°	6.0					64-78	248-303	5-6	15-18
		12.0					67-82	254-311	3-4	16-19
	40°	6.0	109-134	183-224	18-22	19-23	75-91	261-319	6-8	17-21
		12.0	105-128	172-210	10-12	20-25	79-96	267-327	4-5	18-23
	50°	6.0	118-144	214-261	18-22	19-23	78-90	273-334	8-10	20-24
		12.0	113-138	201-245	10-12	20-24	82-95	280-342	5-7	21-26
	60°	6.0	122-149	244-298	17-21	18-22	96-117	286-349	9-11	22-27
		12.0	117-143	230-281	10-12	19-24	101-123	293-358	6-8	24-29
	70°	6.0	126-154	275-336	17-21	18-22	107-131	299-365	11-13	25-30
		12.0	121-148	258-316	10-12	19-23	113-138	306-374	7-9	26-32
	80°	6.0	130-159	310-378	17-21	17-21	117-143	311-380	12-15	27-33
		12.0	132-153	291-356	10-12	18-22	123-151	319-390	8-10	29-35
	90°	6.0	134-164	349-426	17-20	17-20	128-157	324-396	13-16	29-36
		12.0	129-158	328-401	9-12	18-22	135-165	332-406	9-11	31-38
	100°	6.0	139-170	392-480	16-20	16-20				
		12.0	133-163	369-451	9-11	17-21				
HS048 Full Load	30°	6.0					71-87	277-339	6-7	15-19
		12.0					75-92	284-347	4-5	16-20
	40°	6.0	118-144	194-237	21-25	19-23	84-102	291-356	7-9	18-22
		12.0	113-138	182-223	12-14	20-24	88-108	299-365	5-6	19-23
	50°	6.0	127-155	226-276	21-25	18-22	92-110	305-373	9-11	20-25
		12.0	122-149	213-260	12-14	19-24	98-120	313-383	6-7	21-26
	60°	6.0	131-160	259-316	21-25	18-22	108-132	320-391	10-13	23-28
		12.0	126-154	243-297	12-14	19-23	113-138	328-400	7-9	24-29
	70°	6.0	136-166	291-355	20-25	17-21	120-147	334-408	12-15	25-31
		12.0	130-159	273-334	12-14	18-22	126-154	342-418	8-10	27-32
	80°	6.0	140-171	328-401	20-24	17-20	131-161	348-425	14-17	27-34
		12.0	135-165	308-377	11-14	18-22	138-169	356-436	9-11	29-36
	90°	6.0	145-177	369-451	20-24	16-20	144-176	362-442	15-18	30-37
		12.0	139-170	347-424	11-14	17-21	151-185	371-453	10-12	32-39
	100°	6.0	149-183	415-508	19-24	16-19				
		12.0	143-175	391-477	11-14	17-21				

This chart shows approximate temperatures and pressures for a unit in good repair. The values shown are meant as a guide only and should not be used to estimate system charge. This chart assumes rated air flow and 80° d.b./67° w.b. entering air temperature in cooling, 70° d.b. entering air temperature in heating. Heating data at entering fluid temperatures below 50° assumes the use of antifreeze. As a result of continuing research and development, specifications are subject to change without notice.

Operating Temperatures and Pressures

			COOLING				HEATING			
Model	Entering Water Temp. °F	Water Flow	Suction Pressure PSIG	Discharge Pressure PSIG	Water Temp Rise °F	Air Temp Drop °F	Suction Pressure PSIG	Discharge Pressure PSIG	Water Temp Drop	Air Temp Rise °F
HS060 Part Load	30°	7.0					68-84	256-313	5-7	19-23
		14.0					73-89	261-319	4-5	20-25
	40°	7.0	113-138	172-210	18-22	19-23	81-99	277-339	7-8	22-26
		14.0	110-134	161-196	12-14	20-24	86-105	283-346	5-6	23-28
	50°	7.0	116-142	206-252	17-21	19-23	93-114	299-365	8-9	24-29
		14.0	112-137	193-236	12-14	19-24	99-121	305-373	6-7	25-31
	60°	7.0	118-145	241-294	17-21	18-23	106-129	321-392	9-11	26-32
		14.0	115-140	225-275	11-14	19-23	113-138	327-400	7-8	28-34
	70°	7.0	121-148	275-336	17-21	18-22	118-145	342-418	10-12	29-35
		14.0	117-143	257-314	11-14	19-23	126-154	349-427	8-9	30-37
	80°	7.0	123-151	309-378	16-20	18-22	131-160	364-444	11-14	31-38
		14.0	120-146	289-353	11-13	19-23	139-170	371-454	8-10	33-40
	90°	7.0	126-154	344-420	16-20	18-22	143-175	385-471	12-15	33-41
		14.0	122-149	321-392	11-13	18-22	152-186	393-480	9-11	35-43
	100°	7.0	128-157	378-462	16-19	17-21				
		14.0	125-152	353-432	11-13	18-22				
HS060 Full Load	30°	7.0					68-84	256-313	5-7	19-23
		14.0					73-89	261-319	4-5	20-25
	40°	7.0	117-143	182-222	15-19	21-26	81-99	277-339	7-8	22-26
		14.0	114-139	170-208	11-14	22-27	86-105	283-346	5-6	23-28
	50°	7.0	120-147	215-263	15-18	20-25	93-114	299-365	8-9	24-29
		14.0	117-143	201-246	11-14	21-26	99-121	305-373	6-7	25-31
	60°	7.0	123-150	248-304	14-17	20-24	106-129	321-392	9-11	26-32
		14.0	119-146	232-284	11-13	21-25	113-138	327-400	7-8	28-34
	70°	7.0	126-154	282-344	14-17	19-24	118-145	342-418	10-12	29-35
		14.0	122-149	263-322	10-13	20-25	126-154	349-427	8-9	30-37
	80°	7.0	129-157	315-385	13-16	19-23	131-160	364-444	11-14	31-38
		14.0	125-153	294-360	10-12	19-24	139-170	371-454	8-10	33-40
	90°	7.0	132-161	348-426	13-16	18-22	143-175	385-471	12-15	33-41
		14.0	128-156	326-398	10-12	19-23	152-186	393-480	9-11	35-43
	100°	7.0	134-164	382-466	12-15	17-21				
		14.0	131-160	357-436	9-11	18-22				

This chart shows approximate temperatures and pressures for a unit in good repair. The values shown are meant as a guide only and should not be used to estimate system charge. This chart assumes rated air flow and 80° d.b./67° w.b. entering air temperature in cooling, 70° d.b. entering air temperature in heating. Heating data at entering fluid temperatures below 50° assumes the use of antifreeze. As a result of continuing research and development, specifications are subject to change without notice.

Water Side Pressure Drop in PSIG		
Series	**GPM**	**Water PD @ 77° EWT with Water**
HS024	3	0.7
	4	1.2
	5	1.7
	6	2.4
	7	3.2
	8	4.0
HS036	6	1.1
	8	1.8
	10	2.7
	12	3.7
	14	4.9
	16	6.2
HS048	6	1.1
	8	1.8
	10	2.7
	12	3.7
	14	4.9
	16	6.2
HS060	7.5	1.1
	10	1.9
	12.5	2.8
	15	3.9
	17.5	5.2
	20	6.6

HRP Initial Start-Up

⚠ CAUTION

UNIT DAMAGE AND/OR OPERATION HAZARD

Failure to follow this caution may result in unit damage and/or improper equipment operation.

Make sure all valves in heat recovery water piping system are open. NEVER OPERATE HR PUMP DRY.

1. Turn on the heat pump. The HR pump should not run if the compressor is not running.
2. Turn HR switch to the "ON" position. The pump will operate if entering water temperature to HR is below 120°F.
3. The temperature difference between the water entering and leaving the heat recovery should be 5°F to 15°F.
4. Allow the unit to operate for 20 to 30 minutes to ensure it is functioning properly. The pump should shut off when the water temperature entering the heat recovery reaches 120°F.

TROUBLESHOOTING

IMPORTANT: The following Troubleshooting tables are designed to help identify possible causes and solutions for problems. There could be more than one cause/solution to a problem that can be applied. Check each cause and adopt "process of elimination" and/or verification of each before making a conclusion.

Unit Troubleshooting		
Problem	Possible Cause	Checks and Correction
ENTIRE UNIT DOES NOT RUN	Power Supply Off	Apply power, close disconnect
	Blown Fuse	Replace fuse or reset circuit breaker. Check for correct fuses
	Voltage Supply Low	If voltage is below minimum voltage specified on unit data plate, contact local power company.
	Thermostat	Set the fan to "ON", the fan should run. Set thermostat to "COOL" and lowest temperature setting, the unit should run in the cooling mode (reversing valve energized). Set unit to "HEAT" and the highest temperature setting, the unit should run in the heating mode. If neither the blower or compressor run in all three cases, the thermostat could be miswired or faulty. To ensure miswired or faulty thermostat verify 24 volts is available on the condensing section low voltage terminal strip between "R" and "C", "Y" and "C", and "O" and "C". If the blower does not operate, verify 24 volts between terminals "G" and "C" in the air handler. Replace the thermostat if defective.
UNIT OFF ON HIGH PRESSURE CONTROL	Discharge pressure too high	In "COOLING" mode: Lack of or inadequate water flow. Entering water temperature is too warm. Scaled or plugged condenser. In "HEATING" mode: Lack of or inadequate air flow. Blower inoperative, clogged filter or restrictions in duct work
	Refrigerant charge	The unit is overcharged with refrigerant. Reclaim refrigerant, evacuate and recharge with factor recommended charge.
	High pressure	Check for defective or improperly calibrated high pressure switch.
UNIT OFF ON LOW PRESSURE CONTROL	Suction pressure too low	In "COOLING" mode: Lack of or in adequate air flow. Entering air temperature is too cold. Blower inoperative, clogged filter or restrictions in duct work. In "HEATING" mode: Lack of or inadequate water flow. Entering water temperature is too cold. Scaled or plugged condenser.
	Refrigerant charge	The unit is low on refrigerant. Check for refrigerant leak, repair, evacuate and recharge with factory recommended charge.
	Low pressure switch	Check for defective or improperly calibrated low pressure switch.
UNIT SHORT CYCLES	Unit oversized	Recalculate heating and or cooling loads.
	Thermostat	Thermostat installed near a supply air grill; relocate thermostat. Readjust heat anticipator.
	Wiring and controls	Check for defective or improperly calibrated low pressure switch.

Unit Troubleshooting		
Problem	Possible Cause	Checks and Correction
INSUFFICIENT COOLING OR HEATING	Unit undersized	Recalculate heating and or cooling loads. If excessive, possibly adding insulation and shading will rectify the problem
	Loss of conditioned air by leakage	Check for leaks in duct work or introduction of ambient air through doors or windows
	Airflow	Lack of adequate air flow or improper distribution of air. Replace dirty filter
	Refrigerant charge	Low on refrigerant charge causing inefficient operation
	Compressor	Check for defective compressor. If discharge is too low and suction pressure is too high, compressor is not pumping properly. Replace compressor.
	Reversing Valve	Defective reversing valve creating bypass of refrigerant from discharge of suction side of compressor. Replace reversing valve
	Operating pressures	Compare unit operation pressures to the pressure/temperature chart for the unit.
	TXV	Check TXV for possible restriction or defect. Replace if necessary.
	Moisture, noncondensables	The refrigerant system may be contaminated with moisture or noncondensables. Reclaim refrigerant, replace filter dryer, evacuate the refrigerant system, and recharge with factory recommended charge.

UPM Board LED Indications		
Indication Color	**Blinks**	**Description**
GREEN	Solid	18-30 VAC Power is present
RED	1	High pressure lockout
RED	2	Low pressure lockout
RED	3	Freeze sensor lockout
RED	4	Condensate overflow
RED	5	Brownout
RED	6	Evaporator Freeze condition

Compressor Ohms		
Model	Start Winding	Run Winding
HS024	1.64	1.3
HS036	1.52	0.88
HS048	1.86	0.52
HS060	1.63	0.39
Tolerance +/- 7%. All resistance values must be measured with compressor at room temperature.		

HRP Troubleshooting

The HR pump will be enabled when compressor discharge temperature is 120°F (48.9°C)or above.
The circulating pump will be disabled if water temperature reaches 140°F (60°C) or amperage exceeds 0.4 amps.

HRP Troubleshooting		
Problem	Possible Cause	Checks and Corrections
NO FLOW LOW FLOW	No Power	Check power supply
	On/Off Switch Position	Set switch to “ON” position
	Compressor Contactor	Engage heat pump contactor
	Broken or loose wires	Repair or tighten wires
	Air Lock	Purge air from piping system
	Stuck pump shaft/impeller	Remove pump cartridge and clean
	Defective pump	Replace pump
	Kinked or under sized water piping	Repair kink and check for proper line size
HIGH WATER TEMPERATURE	Water temp limit closed	Stuck limit switch Sensor not attached securely to line
LOW HEAT OUTPUT	Scaled or fouled heat exchanger	Clean heat exchanger

MAINTENANCE

1. Filter changes or cleanings are required at regular intervals. The time period between filter changes will depend upon type of environment the equipment is used in.
   In a single family home, that is not under construction, changing or cleaning the filter every 60 days is sufficient. In other applications such as motels, where daily vacuuming produces a large amount of lint, filter changes may need to be as frequent as biweekly.

⚠ CAUTION

UNIT DAMAGE AND/OR OPERATION HAZARD

Failure to follow this caution may result in unit damage and/or improper equipment operation.

Equipment should never be used during construction due to likelihood of wall board dust accumulation in the air coil of the equipment which permanently affects the performance and may shorten the life of the equipment.

2. An annual “checkup” is recommended by a licensed refrigeration mechanic. Recording the performance measurements of volts, amps, and water temperature differences (both heating and cooling) is recommended. This data should be compared to the information on the unit’s data plate and the data taken at the original startup of the equipment.
3. Lubrication of the blower motor is not required, however may be performed on some motors to extend motor life. Use SAE-20 non-detergent electric motor oil.
4. The condensate drain should be checked annually by cleaning and flushing to insure proper drainage.
5. Periodic lockouts are commonly caused by air or water flow problems. The lockout (shutdown) of the unit is a normal protective measure in the design of the equipment. If continual lockouts occur, call a mechanic immediately and have them check for the following:
   - Water flow problems
   - Water temperature problems
   - Air flow problems
   - Air temperature problems.

   Use of the pressure and temperature charts for the unit may be required to properly determine the cause.

8-733-941-788

Replaces: 228 01 1300 00