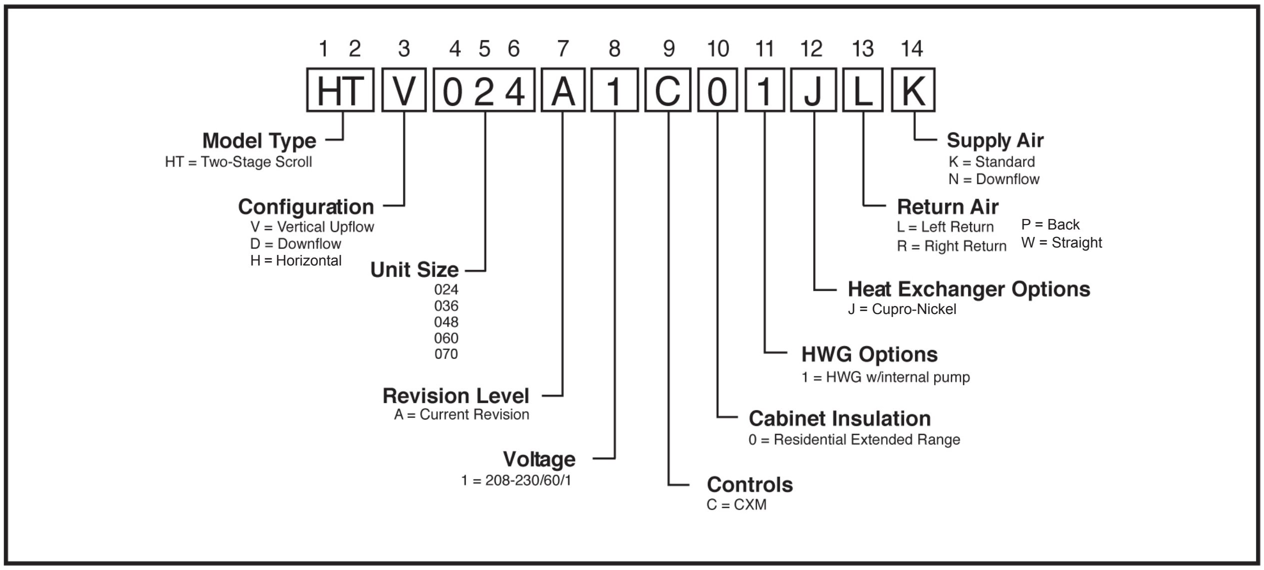
HEAT CONTROLLER, INC.

INSTALLATION, OPERATION & MAINTENANCE

HTV/HTD/HTH Series Two-Stage Geothermal Heat Pumps 2 to 6 Tons

Model Breakdown

Model Nomenclature – Two Stage Geothermal Heat Pump



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SAFETY

Warnings, cautions and notices appear throughout this manual. Read these items carefully before attempting any installation, service or troubleshooting of the equipment.

DANGER: Indicates an immediate hazardous situation, which if not avoided will result in death or serious injury. **DANGER** labels on unit access panels must be observed.

WARNING: Indicates a potentially hazardous situation, which if not avoided could result in death or serious injury.

⚠WARNING!⚠

WARNING! To avoid the release of refrigerant into the atmosphere, the refrigerant circuit of this unit must be serviced only by technicians who meet local, state and federal proficiency requirements.

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!⚠

WARNING! All refrigerant discharged from this unit must be recovered WITHOUT EXCEPTION. Technicians must follow industry accepted guidelines and all local, state, and federal statutes for the recovery and disposal of refrigerants. If a compressor is removed from this unit, refrigerant circuit oil will remain in the compressor. To avoid leakage of compressor oil, refrigerant lines of the compressor must be sealed after it is removed.

⚠CAUTION!⚠

CAUTION! To avoid equipment damage, DO NOT use these units as a source of heating or cooling during the construction process. The mechanical components and filters will quickly become clogged with construction dirt and debris, which may cause system damage.

General Information

INSPECTION

Upon receipt of the equipment, carefully check the shipment against the bill of lading. Make sure all units have been received.Inspect the packaging of each unit, and inspect each unit for damage. Insure that the carrier makes proper notation of any shortages or damage on all copies of the freight bill and completes a common carrier inspection report. Concealed damage not discovered during unloading must be reported to the carrier within 15 days of receipt of shipment. If not filed within 15 days, the freight company can deny the claim without recourse.Note:It is the responsibility of the purchaser to file all necessary claims with the carrier. Notify your equipment supplier of all damage within 15 days of shipment.

STORAGE

Equipment should be stored in its original packaging in a clean, dry area. Store units in an upright position at all times. Stack units a maximum of 3 units high.

UNIT PROTECTION

Cover units on the job site with either the original packaging or an equivalent protective covering. Cap the open ends of pipes stored on the job site. In areas where painting, plastering, and/or spraying has not been completed, all due precautions must be taken to avoid physical damage to the units and contamination by foreign material. Physical damage and contamination may prevent proper start-up and may result in costly equipment clean-up. Examine all pipes, fittings, and valves before installing any of the system components. Remove any dirt or debris found in or on these components.

PRE-INSTALLATION

This Installation, Operation, and Maintenance manual is provided with each unit. Units are typically installed in a mechanical room. The installation site chosen should include adequate service clearance around the unit. Before unit start-up, read all manuals and become familiar with the unit and its operation. Thoroughly check the system before operation.

Prepare units for installation as follows:

1. Compare the electrical data on the unit nameplate with ordering and shipping information to verify that the correct unit has been shipped.
2. Keep the cabinet covered with the original packaging until installation is complete and all plastering, painting, etc. is finished.
3. Verify refrigerant tubing is free of kinks or dents and that it does not touch other unit components.
4. Inspect all electrical connections. Connections must be clean and tight at the terminals.
5. Remove any blower support packaging.
6. Loosen compressor bolts on units equipped with compressor spring vibration isolation until the compressor rides freely on the springs. Remove shipping restraints.

⚠ WARNING! ⚠

WARNING! Polyolester Oil, commonly known as POE oil, is a synthetic oil used in many refrigeration systems including those with R-410A refrigerant. POE oil, if it ever comes in contact with PVC or CPVC piping, may cause failure of the PVC/CPVC. PVC/CPVC piping should never be used as supply or return water piping with water source heat pump products containing R-410A as system failures and property damage may result.

General Information

⚠ CAUTION! ⚠

CAUTION! DO NOT store or install units in corrosive environments or in locations subject to temperature or humidity extremes (e.g., attics, rooftops, etc.). Corrosive conditions and high temperature or humidity can significantly reduce performance, reliability, and service life. Always move and store units in an upright position. Tilting units on their sides may cause equipment damage.

⚠ CAUTION! ⚠

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, safety glasses and gloves when handling parts and servicing heat pumps.

NOTICE! Failure to remove shipping brackets from spring-mounted compressors will cause excessive noise, and could cause component failure due to added vibration.

UNIT PHYSICAL DATA

TWO STAGE HTV/HTD/HTH SERIES (60Hz Only)

Model	24	36	48	60	70
Compressor (1 Each)	Two-Stage Scroll				
Factory Charge R410A (oz)	58	78	81	144	156
ECM Fan Motor & Blower					
Fan Motor (hp)	1/2	1/2	1	1	1
Blower Wheel Size (dia x w) - (in)	9 x 7	11 x 10	11 x 10	11 x 10	11 x 10
Water Connection Size					
Swivel (in)	1	1	1	1	1
HWG Connection Size					
Swivel (in)	1	1	1	1	1
Coax Volume					
Volume (US Gallons)	0.76	0.92	1.24	1.56	1.56
Vertical Upflow/Downflow					
Air Coil Dimensions (h x w) - (in)	28 x 20	28 x 25	32 x 25	36 x 25	36 x 25
Standard Filter - 2” Pleated HERV11, Quantity - in x in	1-24 x 28	1-28 x 30	1-30 x 32	1-30 x 36	1-30 x 36
Weight - Operating, (lbs)	266	327	416	443	443
Weight -Packaged, (lbs)	276	337	426	453	453
Horizontal					
Air Coil Dimensions (H x W), in	18 x 31	20 x 35	20 x 40	20 x 45	20 x 45
Standard Filter - 2” Pleated MERV11, Quantity - in x in	2 - 18 x 18	1 - 12 x 20 1 - 20 x 25	1 - 18 x 20 1 - 20 x 24	2 - 20 x 24	2 - 20 x 24
Weight - Operating, lbs	266	327	416	443	443
Weight - Packaged, lbs	276	337	426	453	453

All units have TXV devices, 1/2” and 3/4” electrical knockouts.

Duct System Installation

DUCT SYSTEM INSTALLATION

Proper duct sizing and design is critical to the performance of the unit. The duct system should be designed to allow adequate airflow through the unit during operation. Air flow through the unit MUST be at or above the minimum stated airflow for the unit to avoid equipment damage. Duct systems should be designed for quiet operation. Refer to Figure 2 for vertical duct system details. A flexible connector is recommended for both discharge and return air duct connections on metal duct systems to eliminate the transfer of vibration to the duct system. To maximize sound attenuation of the unit blower, the supply and return plenums should include internal fiberglass duct liner or be constructed from ductboard for the first few feet. Application of the unit to uninsulated ductwork in an unconditioned space is not recommended as the unit's performance will be adversely affected.

At least one 90° elbow should be included in the supply duct to reduce air noise. If air noise or excessive air flow is a problem, the blower speed can be changed. For airflow charts, consult Engineering Design Guide for the specific unit.

If the unit is connected to existing ductwork, a previous check should have been made to insure that the ductwork has the capacity to handle the airflow required for the unit. If ducting is too small, as in the replacement of a heating only system, larger ductwork should be installed. All existing ductwork should be checked for leaks and repaired as necessary.

INSTALLATION

VERTICAL UNIT LOCATION

Units are not designed for outdoor installation. Locate the unit in an INDOOR area that allows enough space for service personnel to perform typical maintenance or repairs without removing unit from the mechanical room/closet. Vertical units are typically installed in a mechanical room or closet. Never install units in areas subject to freezing or where humidity levels could cause cabinet condensation (such as unconditioned spaces subject to 100% outside air). Consideration should be given to access for easy removal of the filter and access panels. Provide sufficient room to make water, electrical, and duct connection(s).

If the unit is located in a confined space, such as a closet, provisions must be made for return air to freely enter the space by means of a louvered door, etc. Any access panel screws that would be difficult to remove after the unit is installed should be removed prior to setting the unit. Refer to Figures 1 and 2 for typical installation illustrations. Refer to Engineering Design Guide for dimensional data.

1. Install the unit on a piece of rubber, neoprene or other mounting pad material for sound isolation. The pad should be at least 3/8” to 1/2” in thickness. Extend the pad beyond all four edges of the unit.

2. Provide adequate clearance for filter replacement and drain pan cleaning. Do not block filter access with piping, conduit or other materials. Refer to or Engineering Design Guide for dimensional data.
3. Provide access for fan and fan motor maintenance and for servicing the compressor and coils without removing the unit.
4. Provide an unobstructed path to the unit within the closet or mechanical room. Space should be sufficient to allow removal of the unit, if necessary.
5. In limited side access installations, pre-removal of the control box side mounting screws will allow control box removal for future servicing.
6. Provide access to water valves and fittings and screwdriver access to the unit side panels, discharge collar and all electrical connections.

Figure 1: Unit Mounting

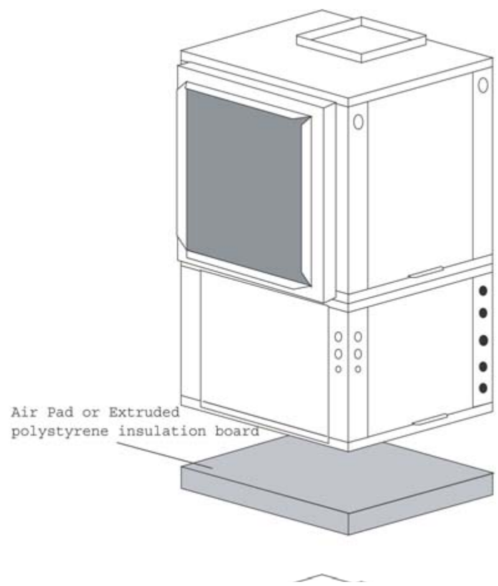
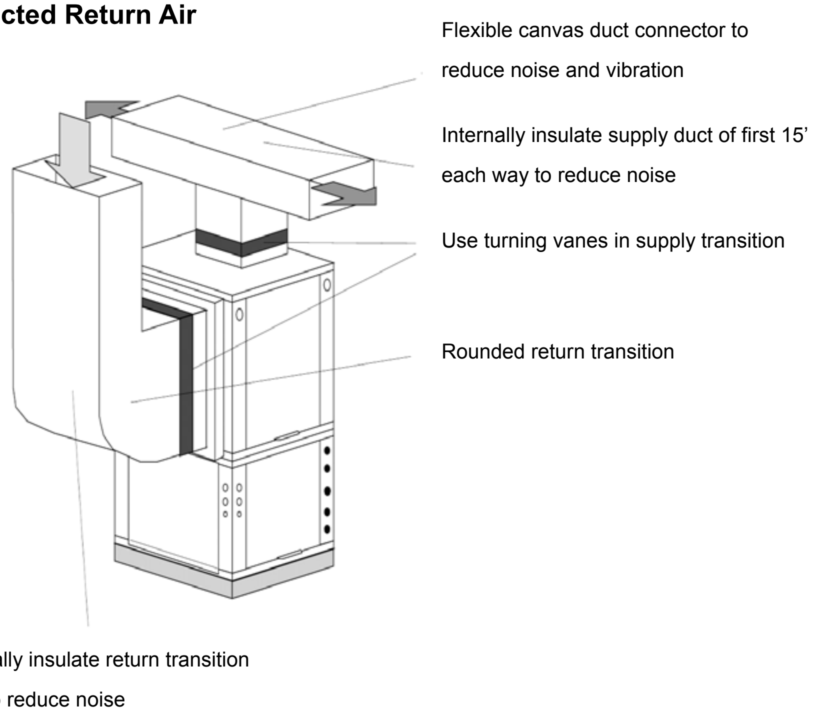


Figure 2: Typical Unit Installation Using Ducted Return Air

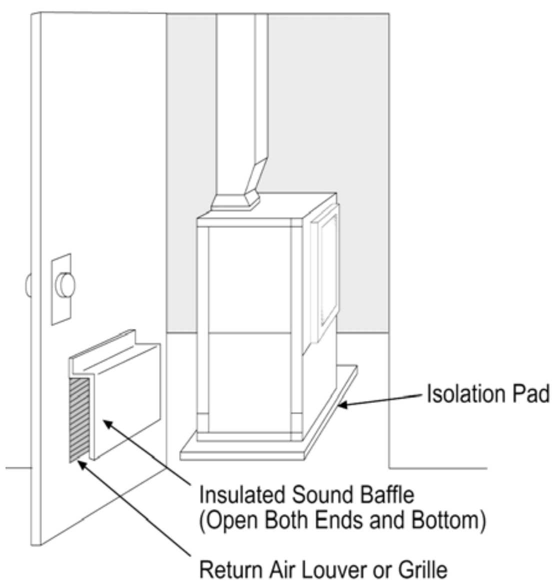


SOUND ATTENUATION

Sound attenuation is achieved by enclosing the unit within a small mechanical room or a closet. Additional measures for sound control include the following:

1. Mount the unit so that the return air inlet is 90° to the return air grille. Refer to Figure 3. Install a sound baffle as illustrated to reduce line-of sight sound transmitted through return air grilles.
2. Mount the unit on a rubber or neoprene isolation pad to minimize vibration transmission to the building structure.

Figure 3: Vertical Sound Attenuation



NOTICE! Units with clear plastic drain lines should have regular maintenance (as required) to avoid buildup of debris, especially in new construction.

CONDENSATE PIPING

These units utilize a condensate hose inside the cabinet as a trapping loop; therefore an external trap is not necessary. Figure 4A shows typical condensate connections. Figure 4B illustrates the internal trap for a typical vertical heat pump. Each unit must be installed with its own individual vent (where necessary) and a means to flush or blow out the condensate drain line. Do not install units with a common trap and/or vent.

Figure 4A: Condensate Drain Air

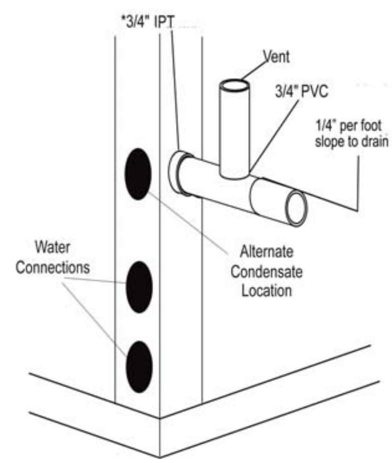
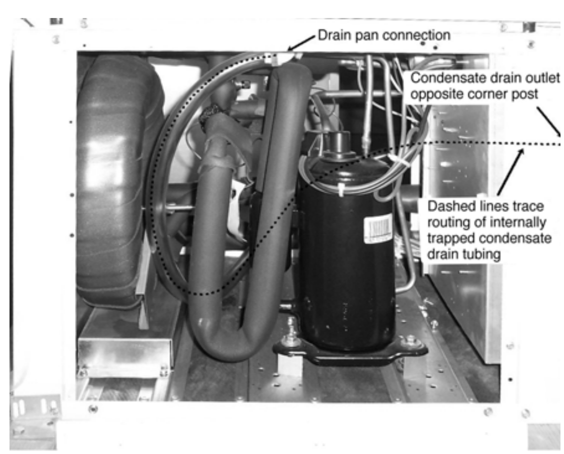


Figure 4B: Internal Condensate Trap



Horizontal Unit Location

Units are not designed for outdoor installation. Locate the unit in an INDOOR area that allows enough space for service personnel to perform typical maintenance or repairs without removing unit from the ceiling. Horizontal units are typically installed above a false ceiling or in a ceiling plenum. Never install units in areas subject to freezing or where humidity levels could cause cabinet condensation (such as unconditioned spaces subject to 100% outside air). Consideration should be given to access for easy removal of the filter and access panels. Provide sufficient room to make water, electrical, and duct connection(s).

If the unit is located in a confined space, such as a closet, provisions must be made for return air to freely enter the space by means of a louvered door, etc. Any access panel screws that would be difficult to remove after the unit is installed should be removed prior to setting the unit. Refer to Figure 3 for an illustration of a typical installation. Refer to unit specifications catalog for dimensional data.

Conform to the following guidelines when selecting unit location:

1. Provide a hinged access door in concealed-spline or plaster ceilings. Provide removable ceiling tiles in T-bar or lay-in ceilings. Refer to horizontal unit dimensions for specific series and model in unit specifications catalog. Size the access opening to accommodate the service technician during the removal or replacement of the compressor and the removal or installation of the unit itself.
2. Provide access to hanger brackets, water valves and fittings. Provide screwdriver clearance to access panels, discharge collars and all electrical connections.
3. DO NOT obstruct the space beneath the unit with piping, electrical cables and other items that prohibit future removal of components or the unit itself.
4. Use a manual portable jack/lift to lift and support the weight of the unit during installation and servicing.

The installation of water source heat pump units and all associated components, parts and accessories which make up the installation shall be in accordance with the regulations of ALL authorities having jurisdiction and MUST conform to all applicable codes. It is the responsibility of the installing contractor to determine and comply with ALL applicable codes and regulations.

Mounting Horizontal Units

Horizontal units have hanger kits pre-installed from the factory as shown in Figure 1. Figure 3 shows a typical horizontal unit installation.

Horizontal heat pumps are typically suspended above a ceiling or within a soffit using field supplied, threaded rods sized to support the weight of the unit.

Use four (4) field supplied threaded rods and factory provided vibration isolators to suspend the unit. Hang the unit clear of the floor slab above and support the unit by the mounting bracket assemblies only. DO NOT attach the unit flush with the floor slab above.

Pitch the unit toward the drain as shown in Figure 2 to improve the condensate drainage. On small units (less than 2.5 tons/8.8kW) ensure that unit pitch does not cause condensate leaks inside the cabinet.

Figure 1: Hanger Bracket

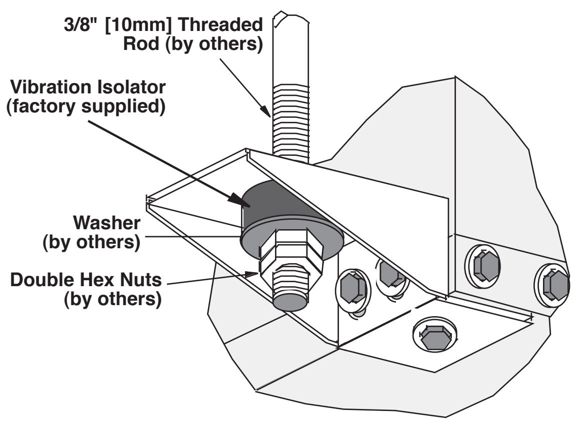


Figure 2: Horizontal Unit Pitch

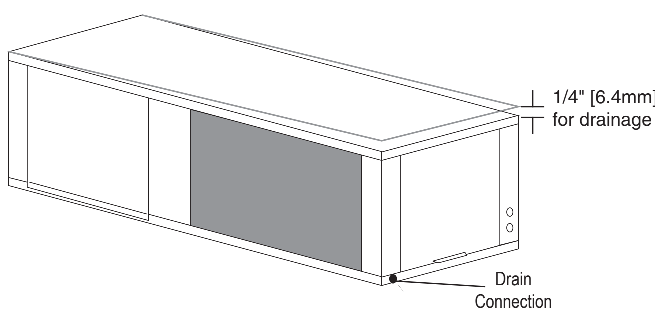
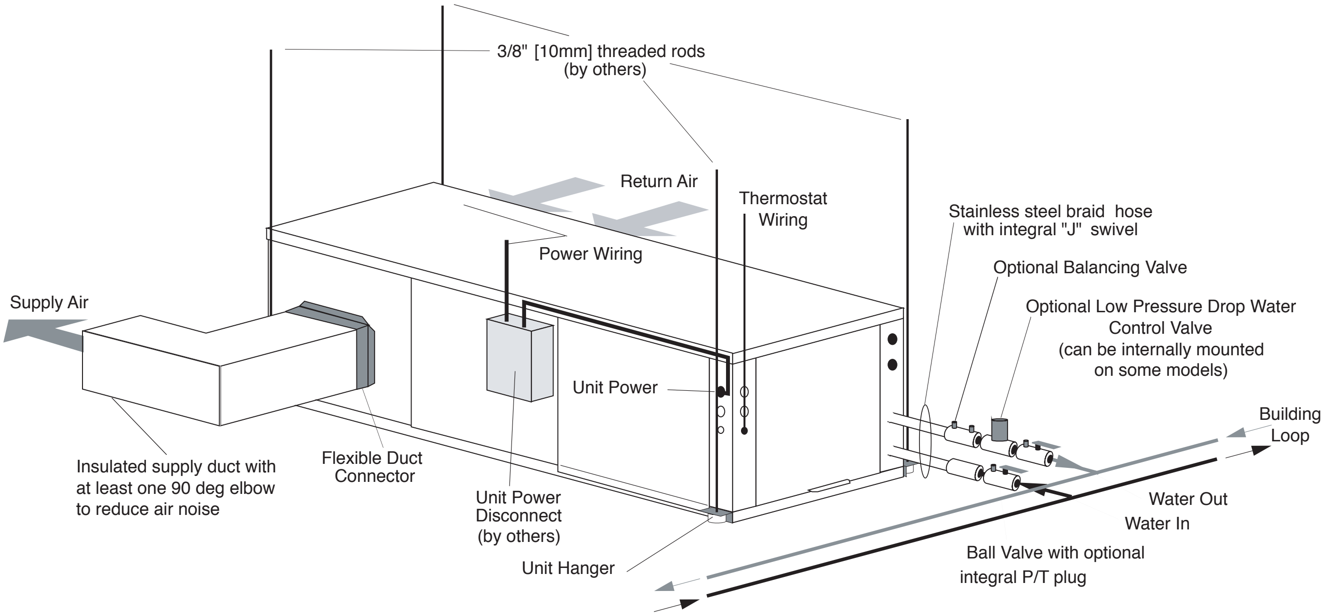


Figure 3: Typical Horizontal Unit Installation



Air Coil

To obtain maximum performance, the air coil should be cleaned before start-up. A 10% solution of dishwasher detergent and water is recommended for both sides of the coil. A thorough water rinse should follow. **UV based anti-bacterial systems may damage e-coated air coils.**

NOTICE! Failure to remove shipping brackets from spring-mounted compressors will cause excessive noise, and could cause component failure due to added vibration.

Overview

Horizontal units can be field converted between side (straight) and back (end) discharge using the instructions below.

Note: It is not possible to field convert return air between left or right return models due to the necessity of refrigeration copper piping changes.

Preparation

It is best to field convert the unit on the ground before hanging. If the unit is already hung it should be taken down for the field conversion.

Side to Back Discharge Conversion

1. Place unit in well lit area. Remove the screws as shown in Figure 4 to free top panel and discharge panel.
2. Lift out the access panel and set aside. Lift and rotate the discharge panel to the other position as shown, being careful with the blower wiring.
3. Check blower wire routing and connections for tension or contact with sheet metal edges. Reroute if necessary.
4. Check refrigerant tubing for contact with other components.
5. Reinstall top panel and screws noting that the location for some screws will have changed.
6. Manually spin the fan wheel to insure that the wheel is not rubbing or obstructed.
7. Replace access panels.

Back to Side Discharge Conversion

If the discharge is changed from back to side, use above instruction noting that illustrations will be reversed.

Left vs. Right Return

It is not possible to field convert return air between left or right return models due to the necessity of refrigeration copper piping changes. However, the conversion process of side to back or back to side discharge for either right or left return configuration is the same. In some cases, it may be possible to rotate the entire unit 180 degrees if the return air connection needs to be on the opposite side. Note that rotating the unit will move the piping to the other end of the unit.

Figure 4: Left Return Side to Back

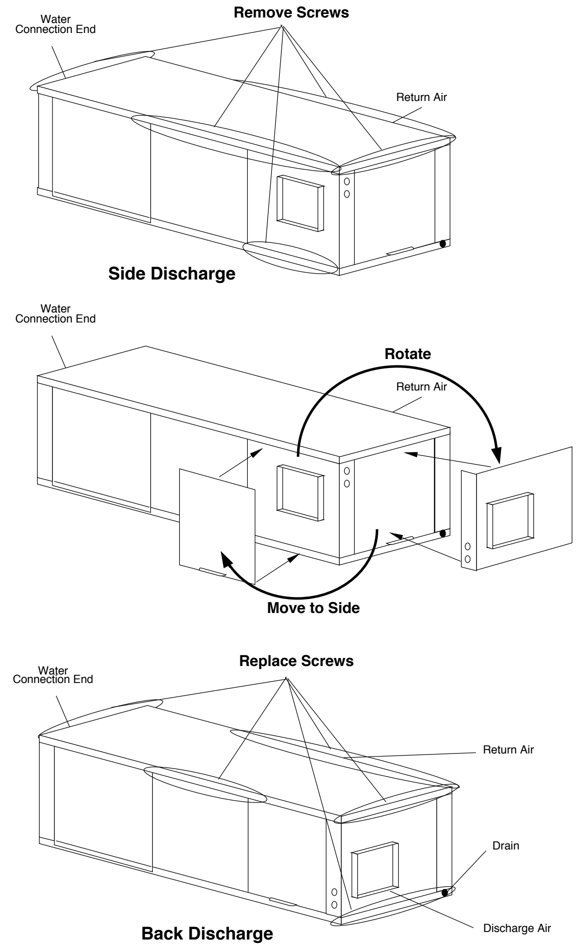
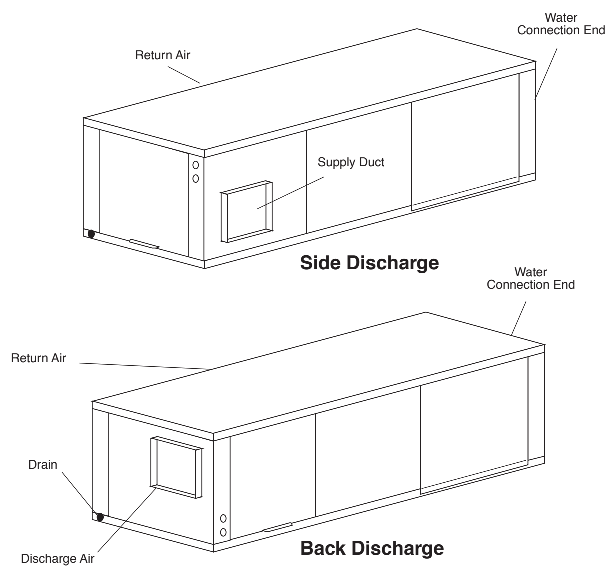


Figure 5: Right Return Side to Back



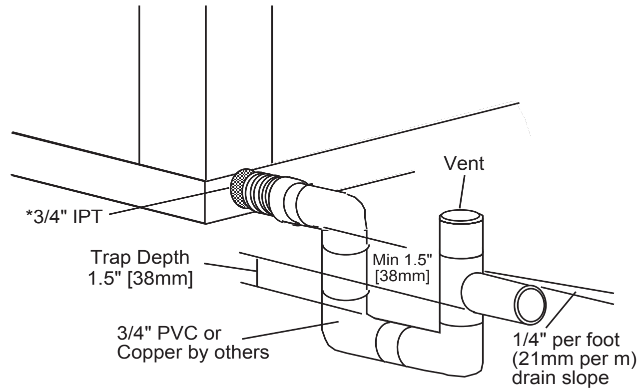
Condensate Piping – Horizontal Units
Pitch the unit toward the drain as shown in Figure 2 to improve the condensate drainage. On small units (less than 2.5 tons/8.8 kW), insure that unit pitch does not cause condensate leaks inside the cabinet.

Install condensate trap at each unit with the top of the trap positioned below the unit condensate drain connection as shown in Figure 6. Design the depth of the trap (water-seal) based upon the amount of ESP capability of the blower (where 2 inches [51mm] of ESP capability requires 2 inches [51mm] of trap depth). As a general rule, 1-1/2 inch [38mm] trap depth is the minimum.

Each unit must be installed with its own individual trap and connection to the condensate line (main) or riser. Provide a means to flush or blow out the condensate line. DO NOT install units with a common trap and/or vent.

Always vent the condensate line when dirt or air can collect in the line or a long horizontal drain line is required. Also vent when large units are working against higher external static pressure than other units connected to the same condensate main since this may cause poor drainage for all units on the line. **WHEN A VENT IS INSTALLED IN THE DRAIN LINE, IT MUST BE LOCATED AFTER THE TRAP IN THE DIRECTION OF THE CONDENSATE FLOW.**

Figure 6: Horizontal Condensate Connection



* Some units include a painted drain connection. Using a threaded pipe or similar device to clear any excess paint accumulated inside this fitting may ease final drain line installation.

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⚠ CAUTION! ⚠

CAUTION! Ensure condensate line is pitched toward drain 1/4" per foot [21mm per m] of run.

DUCT SYSTEM INSTALLATION

Duct System Installation
The duct system should be sized to handle the design airflow quietly. Refer to Figure 3 for horizontal duct system details or figure 8 for vertical duct system details. A flexible connector is recommended for both discharge and return air duct connections on metal duct systems to eliminate the transfer of vibration to the duct system. To maximize sound attenuation of the unit blower, the supply and return plenums should include internal fiberglass duct liner or be constructed from ductboard for the first few feet. Application of the unit to uninsulated ductwork in an unconditioned space is not recommended, as the unit's performance will be adversely affected.

At least one 90° elbow should be included in the supply duct to reduce air noise. If air noise or excessive air flow is a problem, the blower speed can be changed. For airflow charts, consult specifications catalog for the series and model of the specific unit.

If the unit is connected to existing ductwork, a previous check should have been made to insure that the ductwork has the capacity to handle the airflow required for the unit. If ducting is too small, as in the replacement of a heating only system, larger ductwork should be installed. All existing ductwork should be checked for leaks and repaired as necessary.

Piping Installation

INSTALLATION OF SUPPLY AND RETURN PIPING

Follow these piping guidelines

1. Install a drain valve at the base of each supply and return riser to facilitate system flushing.
2. Install shut-off / balancing valves and unions at each unit to permit unit removal for servicing.
3. Place strainers at the inlet of each system circulating pump.
4. Select the proper hose length to allow slack between connection points. Hoses may vary in length by +2% to -4% under pressure.
5. Refer to Table 1. Do not exceed the minimum bend radius for the hose selected. Exceeding the minimum bend radius may cause the hose to collapse, which reduces water flow rate. Install an angle adapter to avoid sharp bends in the hose when the radius falls below the required minimum.

Insulation is not required on loop water piping except where the piping runs through unheated areas, outside the building or when the loop water temperature is below the minimum expected dew point of the pipe ambient conditions. Insulation is required if loop water temperature drops below the dew point (insulation is required for ground loop applications in most climates).

Pipe joint compound is not necessary when Teflon® thread tape is pre-applied to hose assemblies or when flared-end connections are used. If pipe joint compound is preferred, use compound only in small amounts on the external pipe threads of the fitting adapters. Prevent sealant from reaching the flared surfaces of the joint.

Note: When anti-freeze is used in the loop, insure that it is compatible with the Teflon tape or pipe joint compound that is applied.

Maximum allowable torque for brass fittings is 30 ft-lbs. If a torque wrench is not available, tighten finger-tight plus one quarter turn. Tighten steel fittings as necessary.

Optional pressure-rated hose assemblies designed specifically for use with Heat Controller units are available. Similar hoses can be obtained from alternate suppliers. Supply and return connections are fitted with swivel-joint fittings. To prevent kinking during installation, make all connections before final attachment to the unit.

Install hose assemblies properly and check regularly to avoid system failure and reduced service life.

⚠ CAUTION! ⚠

CAUTION! Corrosive system water requires corrosion resistant fittings and hoses, and may require water treatment.

Table 1: Metal Hose Minimum Bend Radii

Hose Diameter	Minimum Bend Radii
1/2”	2-1/2”
3/4”	4”
1”	5-1/2”
1-1/4”	6-3/4”

⚠ CAUTION! ⚠

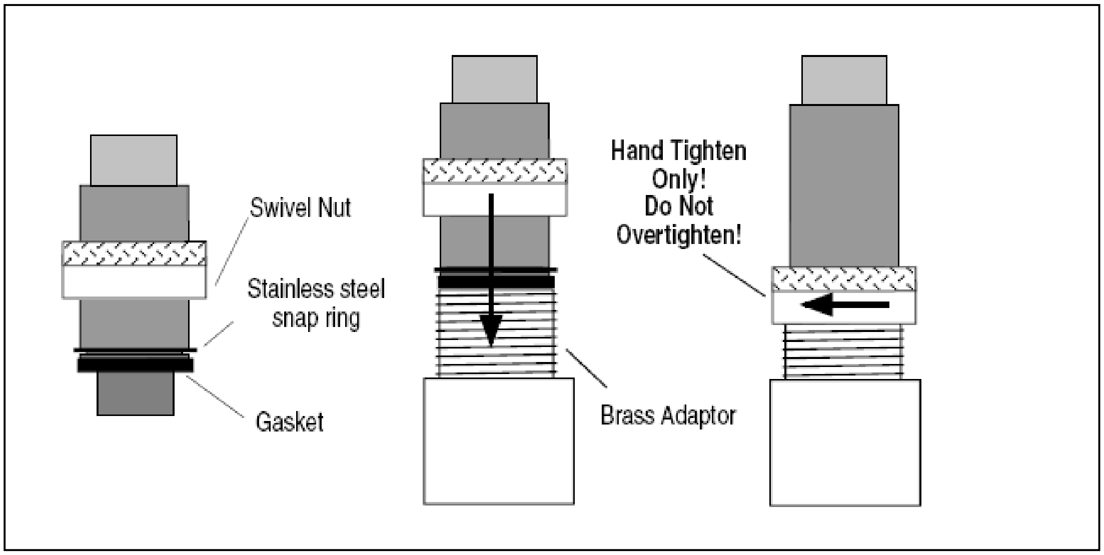
CAUTION! Do not bend or kink supply lines or hoses.

NOTICE! Do not allow hoses to rest against structural building components. Compressor vibration may be transmitted through the hoses to t he structure, causing unnecessary noise.

⚠ CAUTION! ⚠

CAUTION! Piping must comply with all applicable codes.

Figure 5: Water Connections



WATER CONNECTIONS

Models utilize swivel piping fittings for water connections that are rated for 450 psi operating pressure. The connections have a rubber gasket seal similar to a garden hose gasket, which when mated to the flush end of most 1” threaded male pipe fittings provides a leak-free seal without the need for thread sealing tape or joint compound. Insure that the rubber seal is in the swivel connector prior to attempting any connection (rubber seals are shipped attached to the swivel connector). DO NOT OVER TIGHTEN OR LEAKS MAY OCCUR.

The female locking ring is threaded onto the pipe threads which holds the male pipe end against the rubber gasket, and seals the joint. HAND TIGHTEN ONLY! DO NOT OVER TIGHTEN!

Ground-Loop Heat Pump Applications

⚠ CAUTION! ⚠

CAUTION! The following instructions represent industry accepted installation practices for closed loop earth coupled heat pump systems. Instructions are provided to assist the contractor in installing trouble free ground loops. These instructions are recommendations only. State/provincial and local codes MUST be followed and installation MUST conform to ALL applicable codes. It is the responsibility of the installing contractor to determine and comply with ALL applicable codes and regulations.

⚠ CAUTION! ⚠

CAUTION! Ground loop applications require extended range equipment with refrigerant/water circuit insulation.

PRE-INSTALLATION

Prior to installation, locate and mark all existing underground utilities, piping, etc. Install loops for new construction before sidewalks, patios, driveways, and other construction has begun. During construction, accurately mark all ground loop piping on the plot plan as an aid in avoiding potential future damage to the installation.

PIPING INSTALLATION

The typical closed loop ground source system is shown in Figure 6. All earth loop piping materials should be limited to polyethylene fusion only for in-ground sections of the loop. Galvanized or steel fittings should not be used at any time due to their tendency to corrode.

All plastic to metal threaded fittings should be avoided due to their potential to leak in earth coupled applications. A flanged fitting should be substituted. P/T plugs should be used so that flow can be measured using the pressure drop of the unit heat exchanger.

Earth loop temperatures can range between 25 and 110°F. Flow rates between 2.25 and 3 gpm per ton of cooling capacity is recommended in these applications.

Test individual horizontal loop circuits before backfilling. Test vertical U-bends and pond loop assemblies prior to installation. Pressures of at least 100 psi should be used when testing. Do not exceed the pipe pressure rating. Test entire system when all loops are assembled.

FLUSHING THE EARTH LOOP

Once piping is completed between the unit, Flow Controller and the ground loop (Figure 6a), the loop is ready for final purging and charging. A flush cart with at least a 1.5 hp pump is required to achieve enough fluid velocity in the loop piping system to purge air and dirt particles. An antifreeze solution is used in most areas to prevent freezing. All air and debris must be removed from the earth loop piping before operation. Flush the loop with a high volume of water at a minimum velocity of 2 fps in all piping. The steps below must be followed for proper flushing.

1. Fill loop with water from a garden hose through the flush cart before using the flush cart pump to insure an even fill.
2. Once full, the flushing process can begin. Do not allow the water level in the flush cart tank to drop below the pump inlet line to avoid air being pumped back out to the earth loop.

3. Try to maintain a fluid level in the tank above the return tee so that air cannot be continuously mixed back into the fluid. Surges of 50 psi can be used to help purge air pockets by simply shutting off the return valve going into the flush cart reservoir. This “dead heads” the pump to 50 psi to purge, dead head the pump until maximum pumping pressure is reached. Open the return valve and a pressure surge will be sent through the loop to help purge air pockets from the piping system.
4. Notice the drop in fluid level in the flush cart tank when the return valve is shut off. If air is adequately purged from the system, the level will drop only 1-2 inches in a 10” diameter PVC flush tank (about a half gallon), since liquids are incompressible. If the level drops more than this, flushing should continue since air is still being compressed in the loop fluid. Perform the “dead head” procedure a number or times.

Note: This fluid level drop is your only indication of air in the loop.

Antifreeze may be added before, during or after the flushing procedure. However, depending upon which time is chosen, antifreeze could be wasted when emptying the flush cart tank. See antifreeze section for more details.

Loop static pressure will fluctuate with the seasons. Pressures will be higher in the winter months than during the cooling season. This fluctuation is normal and should be considered when charging the system initially.

Run the unit in either heating or cooling for a number of minutes to condition the loop to a homogenous temperature. This is a good time for tool cleanup, piping insulation, etc. Then, perform final flush and pressurize the loop to a static pressure of 50-75 psi (winter) or 35-40 psi (summer). After pressurization, be sure to loosen the plug at the end of the Grundfos loop pump motor(s) to allow trapped air to be discharged and to insure the motor housing has been flooded. This is not required for Taco circulators. Insure that the Flow Controller provides adequate flow through the unit by checking pressure drop across the heat exchanger and compare to the pressure drop tables at the back of the manual.

ANTIFREEZE

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. Check with local authorities for the antifreeze best suited to your area. 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 would be 25 to 22°F and freeze protection should be at 15°F. Calculation is as follows:

$$30°F - 15°F = 15°F$$

All alcohols should be premixed and pumped from a reservoir outside of the building when possible or introduced under the water level to prevent fumes. Calculate the total volume of fluid in the piping system. Then use the percentage by volume shown in Table 2 and 2a for the amount of antifreeze needed. Antifreeze concentration should be checked from a well mixed sample using a hydrometer to measure specific gravity.

LOW WATER TEMPERATURE CUTOUT SETTING

CXM Control

When antifreeze is selected, the FP1 jumper (JW3) should be clipped to select the low temperature (antifreeze 13°F) set point and avoid nuisance faults (see "Low Water Temperature Cutout Selection" in this manual).

Table 2: Antifreeze Percentages by Volume

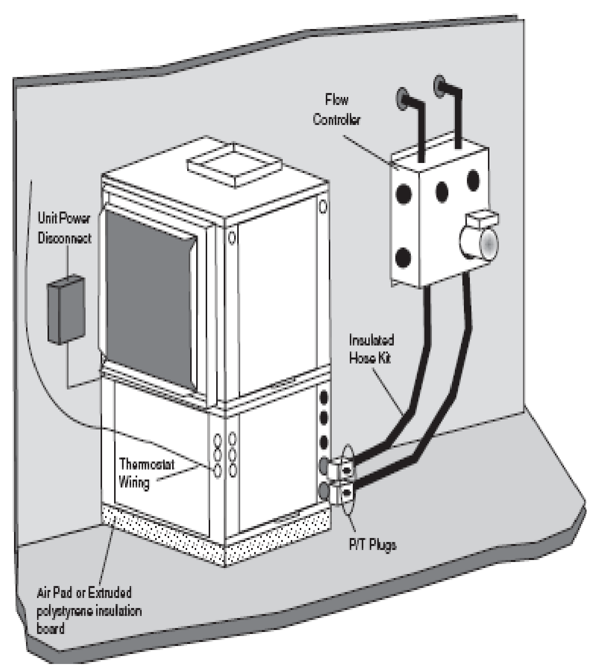
Type	Minimum Temperature for Low Temperature Protection			
	10°F	15°F	20°F	25°F
Methanol	25%	21%	16%	10%
100% USP Food Grade Propylene Glycol	38%	25%	22%	15%
Ethanol*	29%	25%	20%	14%

* Must not be denatured with any petroleum based product

Table 2a: Approximate Fluid Volume (gal.) per 100' of Pipe

Fluid Volume (gal. 100' Pipe)		
Pipe	Size	Volume (gal)
Copper	1"	4.1
	1.25"	6.4
	2.5"	9.2
Rubber Hose	1"	3.9
Polyethylene	¾" IPS SDR11	2.8
	1" IPS SDR11	4.5
	1.25" IPS SDR11	8.0
	1.5" IPS SDR11	10.9
	2" IPS SDR11	18.0
	1.25" IPS SCH40	8.3
	1.5" IPS SCH40	10.9
	2" IPS SCH40	17.0
Unit Heat Exchanger	Typical	1.0

Figure 6a: Typical Ground Loop Application



OPEN LOOP-GROUND WATER SYSTEMS

Typical open loop piping is shown in Figure 7. Shut off valves should be included for ease of servicing. Boiler drains or other valves should be "tee'd" into the lines to allow acid flushing of the heat exchanger. Shut off valves should be positioned to allow flow through the coax via the boiler drains without allowing flow into the piping system. P/T plugs should be used so that pressure drop and temperature can be measured. Supply and return water piping should be limited to copper, HPDE, or other acceptable high temperature material. Note that PVC or CPVC material is not recommended as they are not compatible with the polyolester oil used in R-410A products.

Water should be plentiful and of good quality. Consult Table 3 for water quality guidelines. The unit has a cupro-nickel water heat exchanger. Consult Table 3 for recommendations. In ground water situations where scaling could be heavy or where biological growth such as iron bacteria will be present, an open loop system is not recommended. Heat exchanger coils may over time lose heat exchange capabilities due to build up of mineral deposits. Heat exchangers must only be serviced by a qualified technician, as acid and special pumping equipment is required. Desuperheater coils can likewise become scaled and possibly plugged. In areas with extremely hard water, the owner should be informed that the heat exchanger may require occasional acid flushing. Additional maintenance may be required.

WATER QUALITY STANDARDS

Table 3 should be consulted for waterquality requirements. Scaling potential should be assessed using the pH/Calcium hardness method. If the pH ‹7.5 and the calcium hardness is less than 100 ppm, scaling potential is low. If this method yields numbers out of range of those listed, the Ryznar Stability and Langelier Saturation indecies should be calculated. Use the appropriate scaling surface temperature for the application, 150°F for direct use (well water/open loop) and HWG; 90°F for indirect use. A monitoring plan should be implemented in these probable scaling situations. Other water quality issues such as iron fouling, corrosion prevention and erosion and clogging should be referenced in Table 3.

EXPANSION TANK AND PUMP

Use a closed, bladder-type expansion tank to minimize mineral formation due to air exposure. The expansion tank should be sized to provide at least one minute continuous run time of the pump using its drawdown capacity rating to prevent pump short cycling. Discharge water from the unit is not contaminated in any manner and can be disposed of in various ways, depending on local building codes (e.g. recharge well, storm sewer, drain field, adjacent stream or pond, etc.). Most local codes forbid the use of sanitary sewer for disposal. Consult your local building and zoning department to assure compliance in your area.

WATER CONTROL VALVE

Note the placement of the water control valve in Figure 7. Always maintain water pressure in the heat exchanger by placing the water control valve(s) on the discharge line to prevent mineral precipitation during the off-cycle. Pilot operated slow closing valves are recommended to reduce water hammer.

If water hammer persists, a mini-expansion tank can be mounted on the piping to help absorb the excess hammer shock. Insure that the total 'VA' draw of the valve can be supplied by the unit transformer. For instance, a slow closing valve can draw up to 35VA. This can overload smaller 40 or 50 VA transformers depending on the other controls in the circuit. A typical pilot operated solenoid valve draws approximately 15VA. Note the special wiring diagrams for slow closing valves (Figures 12 and 13).

FLOW REGULATION

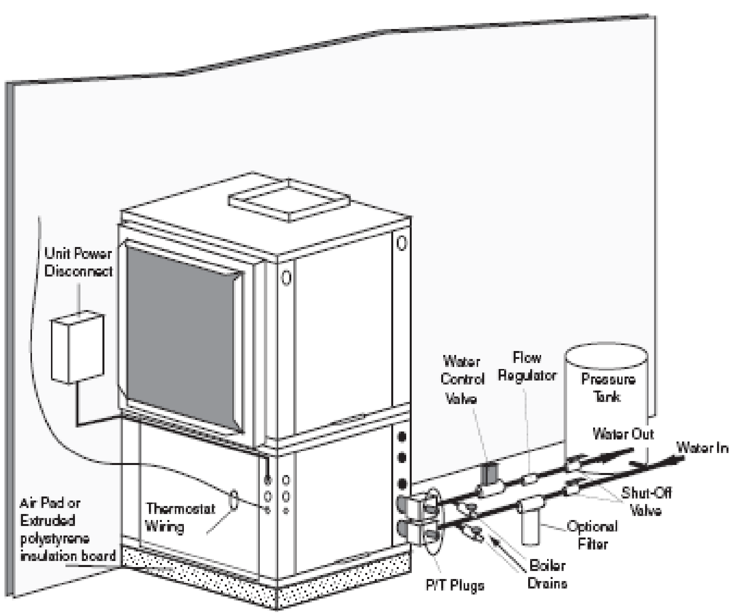
Flow regulation can be accomplished by two methods. One method of flow regulation involves simply adjusting the ball valve or water control valve on the discharge line. Measure the pressure drop through the unit heat exchanger, and determine flow rate from Table 8. Since the pressure is constantly varying, two pressure gauges may be needed. Adjust the valve until the desired flow of 1.5 to 2 gpm per ton is achieved. A second method of flow control requires a flow control device mounted on the outlet of the water control valve. The device is typically a brass fitting with an orifice of rubber or plastic material that is designed to allow a specified flow rate. On occasion, flow control devices may produce velocity noise that can be reduced by applying some back pressure from the ball valve located on the discharge line. Slightly closing the valve will spread the pressure drop over both devices, lessening the velocity noise.

NOTE: When EWT is below 50°F, 2 gpm per ton is required.

WATER COIL LOW TEMPERATURE LIMIT SETTING

For all open loop systems the 30°F FP1 setting (factory setting-water) should be used to avoid freeze damage to the unit. See "Low Water Temperature Cutout Selection" in this manual for details on the low limit setting.

Figure 6b: Typical Open Loop / Well Application



Hot Water Generator

The HWG (Hot Water Generator) or desuperheater option provides considerable operating cost savings by utilizing excess heat energy from the heat pump to help satisfy domestic hot water requirements. The HWG is active throughout the year, providing virtually free hot water when the heat pump operates in the cooling mode or hot water at the COP of the heat pump during operation in the heating mode. Actual HWG water heating capacities are provided in the appropriate heat pump performance data.

Heat pumps equipped with the HWG option include a built-in water to refrigerant heat exchanger that eliminates the need to tie into the heat pump refrigerant circuit in the field. The control circuit and pump are also built in for residential equipment. Figure 14 shows a typical example of HWG water piping connections on a unit with built-in circulating pump. This piping layout reduces scaling potential.

The temperature set point of the HWG is field selectable to 125°F or 150°F . The 150°F set point allows more heat storage from the HWG. For example, consider the amount of heat that can be generated by the HWG when using the 125°F set point, versus the amount of heat that can be generated by the HWG when using the 150°F set point.

In a typical 50 gallon two-element electric water heater the lower element should be turned down to 100°F, or the lowest setting, to get the most from the HWG. The tank will eventually stratify so that the lower 80% of the tank, or 40 gallons, becomes 100°F (controlled by the lower element). The upper 20% of the tank, or 10 gallons, will be maintained at 125°F (controlled by the upper element).

Using a 125°F set point, the HWG can heat the lower 40 gallons of water from 100°F to 125°F, providing up to 8,330 btu's of heat. Using the 150°F set point, the HWG can heat the same 40 gallons of water from 100°F to 150°F and the remaining 10 gallons of water from 125°F to 150°F, providing a total of up to 18,743 btu's of heat, or more than twice as much heat as when using the 125°F set point.

This example ignored standby losses of the tank. When those losses are considered the additional savings are even greater.

⚠ WARNING! ⚠

WARNING! A 150°F SETPOINT MAY LEAD TO SCALDING OR BURNS. THE 150°F SET POINT MUST ONLY BE USED ON SYSTEMS THAT EMPLOY AN APPROVED ANTI-SCALD VALVE.

Electric water heaters are recommended. If a gas, propane, or oil water heater is used, a second preheat tank must be installed (Figure 15). If the electric water heater has only a single center element, the dual tank system is recommended to insure a usable entering water temperature for the HWG.

Typically a single tank of at least 52 gallons (235 liters) is used to limit installation costs and space. However, a dual tank, as shown in Figure 15, is the most efficient system, providing the maximum storage and temperate source water to the HWG.

It is always advisable to use water softening equipment on domestic water systems to reduce the scaling potential and lengthen equipment life. In extreme water conditions, it may be necessary to avoid the use of the HWG option since the potential cost of frequent maintenance may offset or exceed any savings. Consult Table 3 for scaling potential tests.

Figure 14: Typical HWG Installation

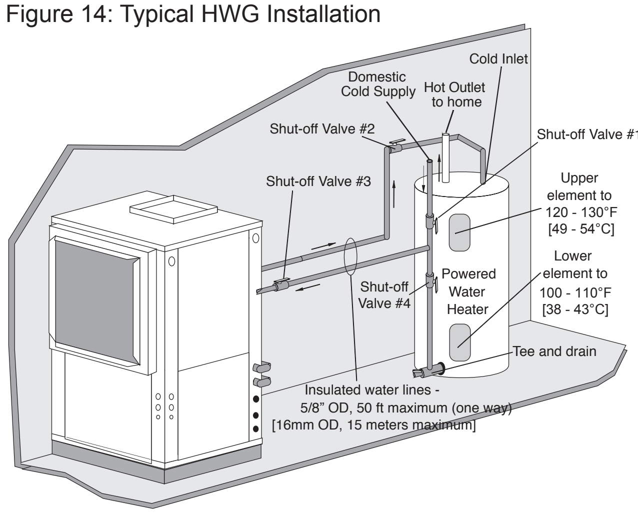
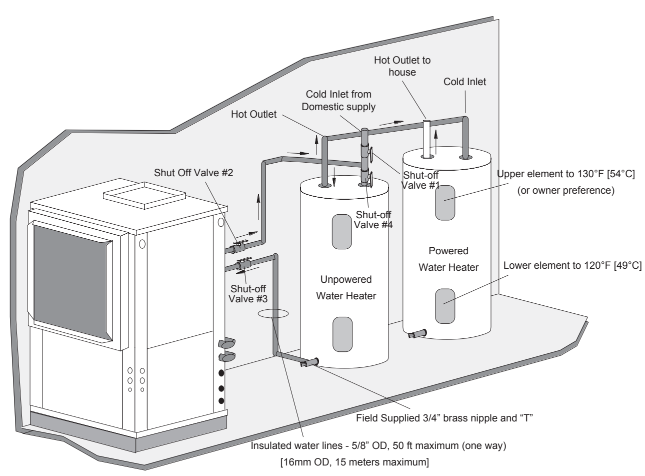


Figure 15: HWG Double Tank Installation



Installation

The HWG is controlled by two sensors and a microprocessor control. One sensor is located on the compressor discharge line to sense the discharge refrigerant temperature. The other sensor is located on the HWG heat exchanger's "Water In" line to sense the potable water temperature.

⚠ WARNING! ⚠
WARNING! UNDER NO CIRCUMSTANCES SHOULD THE SENSORS BE DISCONNECTED OR REMOVED AS FULL LOAD CONDITIONS CAN DRIVE HOT WATER TANK TEMPERATURES FAR ABOVE SAFE TEMPERATURE LEVELS IF SENSORS HAVE BEEN DISCONNECTED OR REMOVED.

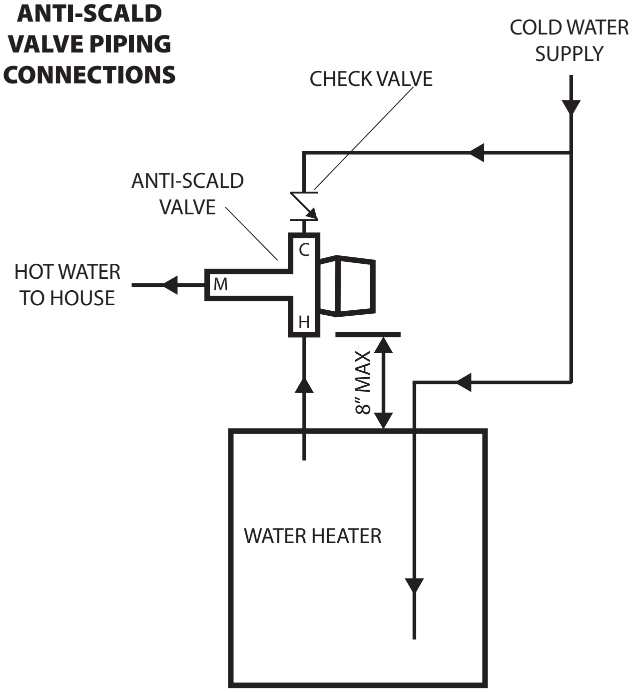
The microprocessor control monitors the refrigerant and water temperatures to determine when to operate the HWG. The HWG will operate any time the refrigerant temperature is sufficiently above the water temperature. Once the HWG has satisfied the water heating demand during a heat pump run cycle, the controller will cycle the pump at regular Intervals to determine if an additional HWG cycle can be utilized. The microprocessor control Includes 3 DIP switches, SW10 (HWG PUMP TEST), SW11 (HWG TEMP), and SW12 (HWG STATUS).

SW10 HWG PUMP TEST. When this switch is in the "ON" position, the HWG pump is forced to operate even if there is no call for the HWG. This mode may be beneficial to assist in purging the system of air during Initial start up. When SW10 is in the "OFF" position, the HWG will operate normally. This switch is shipped from the factory in the "OFF" (normal) position. NOTE; If left in the "On" position for 5 minutes, the pump control will revert to normal operation.

SW11 HWG TEMP. The control setpoint of the HWG can be set to either of two temperatures, 125°F or 150°F. When SW11 is in the "ON" position the HWG setpoint is 150°F. When SW11 is in the "OFF" position the HWG setpoint is 125°F. This switch Is shipped from the factory in the "OFF" (125°F) position.

⚠ WARNING! ⚠
WARNING! USING A 150°F SETPOINT ON THE HWG WILL RESULT IN WATER TEMPERATURES SUFFICIENT TO CAUSE SEVERE PHYSICAL INJURY IN THE FORM OF SCALDING OR BURNS, EVEN WHEN THE HOT WATER TANK TEMPERATURE SETTING IS VISIBLY SET BELOW 150°F. THE 150°F HWG SETPOINT MUST ONLY BE USED ON SYSTEMS THAT EMPLOY AN APPROVED ANTI-SCALD VALVE (CLIMATEMASTER PART NUMBER AVAS4) AT THE HOT WATER STORAGE TANK WITH SUCH VALVE PROPERLY SET TO CONTROL WATER TEMPERATURES DISTRIBUTED TO ALL HOT WATER OUTLETS AT A TEMPERATURE LEVEL THAT PREVENTS SCALDING OR BURNS!

ANTI-SCALD VALVE PIPING CONNECTIONS



SW12 HWG STATUS. This switch controls operation of the HWG. When SW12 is in the "ON" position the HWG is disabled and will not operate. When SW12 is in the "OFF" position the HWG is in the enabled mode and will operate normally. This switch is shipped from the factory in the "ON" (disabled) position. CAUTION: DO NOT PLACE THIS SWITCH IN THE ENABLED POSITION UNITL THE HWG PIPING IS CONNECTED, FILLED WITH WATER, AND PURGED OR PUMP DAMAGE WILL OCCUR.

When the control is powered and the HWG pump output is not active, the status LED (AN1) will be "On". When the HWG pump output is active for water temperature sampling or HWG operation, the status LED will slowly flash (On 1 second, Off 1 second).

If the control has detected a fault, the status LED will flash a numeric fault code as follows:

Hot Water Sensor Fault	1 flash
Compressor Discharge sensor fault	2 flashes
High Water Temperature (>160ºF)	3 flashes
Control Logic Error	4 flashes

Fault code flashes have a duration of 0.4 seconds with a 3 second pause between fault codes. For example, a "Compressor Discharge sensor fault" will be four flashes 0.4 seconds long, then a 3 second pause, then four flashes again, etc.

Warning! The HWG pump Is fully wired from the factory. Use extreme caution when working around the microprocessor control as it contains line voltage connections that presents a shock hazard that can cause severe injury or death!

The heat pump, water piping, pump, and hot water tank should be located where the ambient temperature does not fall below 50°F [10°C]. Keep water piping lengths at a minimum. DO NOT use a one way length greater than 50 ft. (one way) [15 m]. See Table 7 for recommended piping sizes and maximum lengths.

All installations must be in accordance with local codes. The installer is responsible for knowing the local requirements, and for performing the installation accordingly. DO NOT connect the pump wiring until "Initial Start-Up" section, below. Powering the pump before all installation steps are completed may damage the pump.

Water Tank Preparation

1. Turn off power or fuel supply to the hot water tank.
2. Connect a hose to the drain valve on the water tank.
3. Shut off the cold water supply to the water tank.
4. Open the drain valve and open the pressure relief valve or a hot water faucet to drain tank.
5. When using an existing tank, it should be flushed with cold water after it is drained until the water leaving the drain hose is clear and free of sediment.
6. Close all valves and remove the drain hose.
7. Install HWG water piping.

HWG Water Piping

1. Using at least 5/8" [16mm] O.D. copper, route and install the water piping, valves and air vent as shown in Figures 14 or 15. Install an approved anti-scald valve if the 150°F HWG setpoint is or will be selected. An appropriate method must be employed to purge air from the HWG piping. This may be accomplished by flushing water through the HWG (as In Figures 14 and 15) or by Installing an air vent at the high point of the HWG piping system.
2. Insulate all HWG water piping with no less than 3/8" [10mm] wall closed cell insulation.
3. Open both shut off valves and make sure the tank drain valve is closed.

Water Tank Refill

1. Close valve #4. Ensure that the HWG valves (valves #2 and #3) are open. Open the cold water supply (valve #1) to fill the tank through the HWG piping. This will purge air from the HWG piping.
2. Open a hot water faucet to vent air from the system until water flows from faucet; turn off faucet. Open valve #4.
3. Depress the hot water tank pressure relief valve handle to ensure that there is no air remaining in the tank.
4. Inspect all work for leaks.
5. Before restoring power or fuel supply to the water heater, adjust the temperature setting on the tank thermostat(s) to insure maximum utilization of the heat available from the refrigeration system and conserve the most energy. On tanks with both upper and lower elements and thermostats, the lower element should be turned down to 100°F [38°C] or the lowest setting; the upper element should be adjusted to 120-130°F [49-54°C]. Depending upon the specific needs of the customer, you may want to adjust the upper element differently. On tanks with a single thermostat, a preheat tank should be used (Fig 15).
6. Replace access cover(s) and restore power or fuel supply.

Initial Start-Up

1. Make sure all valves in the HWG water circuit are fully open.
2. Turn on the heat pump and allow it to run for 10-15 minutes.
3. Set SW12 to the "OFF" position (enabled) to engage the HWG.
4. The HWG pump should not run if the compressor is not running.
5. The temperature difference between the water entering and leaving the HWG coil should be approximately 5-10°F [3-6°C].
6. Allow the unit to operate for 20 to 30 minutes to insure that it is functioning properly.

Table 7: HWG Water Piping Sizes and Length

Unit Nominal Tonnage	Nominal HWG Flow (gpm)	1/2" Copper (max length*)	3/4" Copper (max length*)
1.5	0.6	50	-
2.0	0.8	50	-
2.5	1.0	50	-
3.0	1.2	50	-
3.5	1.4	50	-
4.0	1.6	45	50
5.0	2.0	25	50
6.0	2.4	10	50

*Maximum length is equivalent length to one way of L copper.

Water Quality Standards

Table 3: Water Quality Standards

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 limit					
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 operation 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 Direct well, 85°F Indirect Well		
Iron Fouling					
Iron Fe (Ferrous) (Bacterial Iron Potential)	All	-	<0.2 ppm (Ferrous) If Fe (ferrous) >0.2 ppm with pH 6 - 8, ppm check for		
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 <		
Hydrogen Sulfide (H_2S)	All	-	<0.5 ppm At H_2S>0.2 ppm, avoid use of copper and copper nickel Rotten egg smell appears at 0.5 ppm level Copper alloy (bronze or brass) cast components are okay		
Ammonia ion as Hydroxide, Chloride, Nitrate and Sulfate Compounds	All	-	<0.5 ppm		
			Maximum Allowable at maximum water temperature		
			50°F	75°F	100°F
Maximum Chloride Levels	Copper	-	<20 ppm	NR	NR
	Cupro Nickel	-	<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 & Erosion	All	<10 ppm of particles and a maximum velocity of 6 fps filtered for maximum 800 micron (800mm, 20 mesh) size			

Notes:

- Closed Recirculating system is identified by a closed pressurized piping system.
- Recirculating open wells should observe the open recirculating design

Notes:

- NR - Application not recommended
- "-" No design maximum

Electrical - Line Voltage

⚠ WARNING! ⚠

WARNING! To avoid possible injury or death due to electrical shock, open the power supply disconnect switch and secure it in an open position during installation.

⚠ CAUTION! ⚠

CAUTION! Use only copper conductors for field installed electrical wiring. Unit terminals are not designed to accept other types of conductors.

ELECTRICAL - LINE VOLTAGE

All field installed wiring, including electrical ground, must comply with the National Electrical Code as well as all applicable local codes. Refer to the unit electrical data for fuse sizes. Consult wiring diagram for field connections that must be made by the installing (or electrical) contractor. All final electrical connections must be made with a length of flexible conduit to minimize vibration and sound transmission to the building.

GENERAL LINE VOLTAGE WIRING

Be sure the available power is the same voltage and phase shown on the unit serial plate. Line and low voltage wiring must be done in accordance with local codes or the National Electric Code, whichever is applicable.

Table 4: Electrical Data (Standard Units) HTV/HTD/HTH

Model	Voltage Code	Voltage	Min/Max Voltage	Compressor			Fan Motor FLA	Total Unit FLA	MCA	Max/Fuse
				QTY	RLA	LRA				
024	1	208/230-60/1	197/254	1	10.3	52.0	3.9	18.6	21.2	30
036	1	208/230-60/1	197/254	1	16.7	82.0	3.9	25.0	29.2	45
048	1	208/230-60/1	197/254	1	21.2	96.0	6.9	32.5	37.8	50
060	1	208/230-60/1	197/254	1	25.6	118.0	6.9	36.9	43.3	60
070	1	208/230-60/1	197/254	1	27.2	150.0	6.9	38.5	45.3	70

Rated Voltage of 208-230/60/1
HACR circuit breaker in USA only
Wire length based on one way measurement with 2% voltage drop

Min/Max Voltage of 197/254
All fuses Class RK-5
Wire size based on 60°C copper conductor and Minimum Circuit Ampacity.

Electrical - Power Wiring

⚠ WARNING! ⚠

WARNING! Disconnect electrical power source to prevent injury or death from electrical shock.

⚠ CAUTION! ⚠

CAUTION! Use only copper conductors for field installed electrical wiring. Unit terminals are not designed to accept other types of conductors.

ELECTRICAL - LINE VOLTAGE

All field installed wiring, including electrical ground, must comply with the National Electrical Code as well as all applicable local codes. Refer to the unit electrical data for fuse sizes. Consult wiring diagram for field connections that must be made by the installing (or electrical) contractor. All final electrical connections must be made with a length of flexible conduit to minimize vibration and sound transmission to the building.

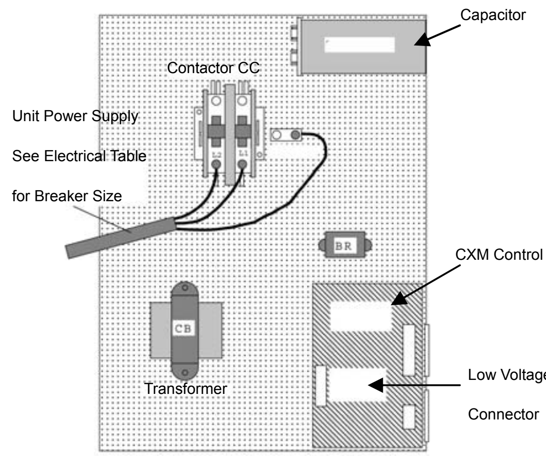
GENERAL LINE VOLTAGE WIRING

Be sure the available power is the same voltage and phase shown on the unit serial plate. Line and low voltage wiring must be done in accordance with local codes or the National Electric Code, whichever is applicable.

POWER CONNECTION

Line voltage connection is made by connecting the incoming line voltage wires to the "L" side of the contactor as shown in Figure 9. Consult Table 4 for correct fuse size.

Figure 9: HTV/HTD/HTH Single Phase Line Voltage Field Wiring



BLOWER SPEED SELECTION

ECM Motor speeds are set via low voltage controls (see "ECM Blower Control").

Consult Engineering Design Guide for specific unit airflow tables.

Electrical - Power & Low Voltage Wiring

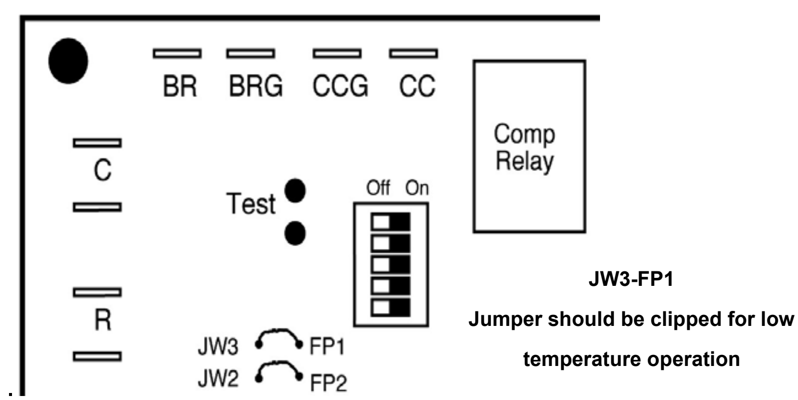
ELECTRICAL - LOW VOLTAGE WIRING

THERMOSTAT CONNECTIONS
Units include factory wiring from the CXM board to the ECM interface board. Thermostat wiring should be connected to the ECM interface board.

LOW WATER TEMPERATURE CUTOUT SELECTION
The CXM control allows the field selection of low water (or water-antifreeze solution) temperature limit by clipping jumper JW3, which changes the sensing temperature associated with thermistor FP1. Note that the FP1 thermistor is located on the refrigerant line between the coaxial heat exchanger and expansion device. Therefore, FP1 is sensing refrigerant temperature, not water temperature, which is a better indication of how water flow rate/temperature is affecting the refrigeration circuit.

The factory setting for FP1 is for systems using water (30°F refrigerant temperature). In low water temperature (extended range) applications with antifreeze (most ground loops), jumper JW3 should be clipped as shown in Figure 10 to change the setting to 10°F refrigerant temperature, a more suitable temperature when using an antifreeze solution. All Heat Controller units operating with entering water temperatures below 59°F include the water/refrigerant circuit insulation package to prevent internal condensation.

Figure 10: FP1 Limit Setting



CXM PCB

Electrical - Low Voltage Wiring

ACCESSORY CONNECTIONS

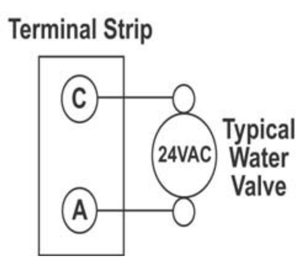
A terminal paralleling the compressor contactor coil has been provided on the CXM control. Terminal "A" is designed to control accessory devices, such as water valves. Note: This terminal should be used only with 24 Volt signals and not line voltage. Terminal "A" is energized with the compressor contactor. See Figure 11 or the specific unit wiring diagram for details.

Low Voltage VA Ratings

COMPONENT	VA
Typical Blower Relay	6-7
Typical Reversing Valve Solenoid	4-6
30A Compressor Contactor	6-9
SubTotal	16-22
+CXM Board (5-9 VA)*	21-31
Remaining VA for Accessories	19-29

* Standard transformer is 75VA.

Figure 11: Accessory Wiring



WATER SOLENOID VALVES

An external solenoid valve(s) should be used on ground water installations to shut off flow to the unit when the compressor is not operating. A slow closing valve may be required to help reduce water hammer. Figure 11 shows typical wiring for a 24VAC external solenoid valve. Figures 12 and 13 illustrate typical slow closing water control valve wiring for Taco 500 Series and Taco ESP Series valves. Slow closing valves take approximately 60 seconds to open (very little water will flow before 45 seconds). Once fully open, an end switch allows the compressor to be energized. Only relay or triac based electronic thermostats should be used with slow closing valves. When wired as shown, the slow closing valve will operate properly with the following notations:

1. The valve will remain open during a unit lockout.
2. The valve will draw approximately 25-35 VA through the "Y" signal of the thermostat.

Note: This valve can overheat the anticipator of an electromechanical thermostat. Therefore, only relay or triac based thermostats should be used.

TWO-STAGE UNITS

Two-stage units should be designed with two parallel valves for ground water applications to limit water use during first stage operation. For example, at 1.5 gpm/ton, a HTV048 unit requires 6 gpm for full load (2nd stage) operation, but only 4 gpm during 1st stage operation. Since the unit will operate on first stage 80-90% of the time, significant water savings can be realized by using two parallel solenoid valves with two flow regulators. In the example above, stage one solenoid would be installed with a 4 gpm flow regulator on the outlet, while stage two would utilize a 2 gpm flow regulator. When stage one is operating, the second solenoid valve will be closed. When stage two is operating, both valves will be open, allowing full load flow rate.

Figure 14 illustrates piping for two-stage solenoid valves. Review Figures 11 - 13 for wiring of stage one valve. Stage two valve should be wired between terminal “Y2” (ECM board) and terminal “C”. **NOTE:** When EWT is below 50°F, 2 gpm per ton is required.

Figure 12: AVM Valve Wiring

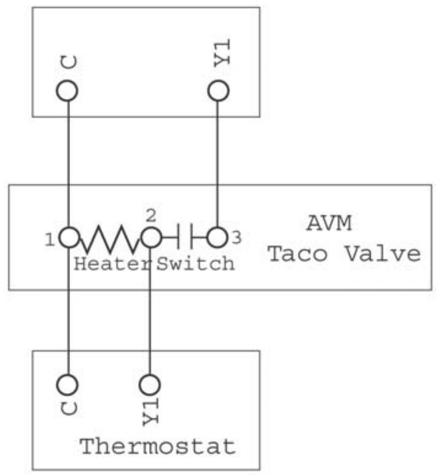


Figure 13: Taco SBV Valve Wiring

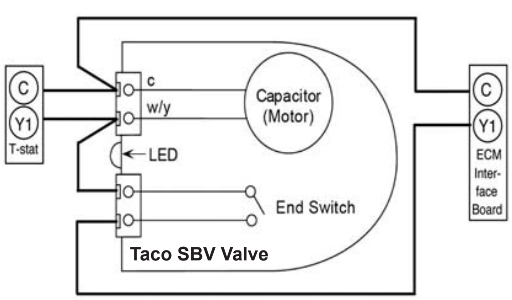
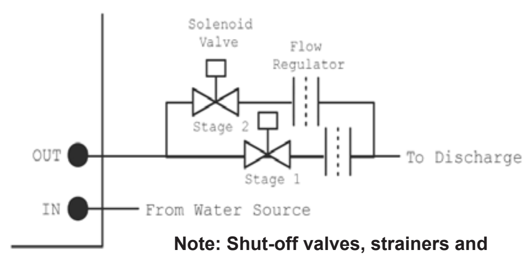


Figure 14: Two-Stage Piping



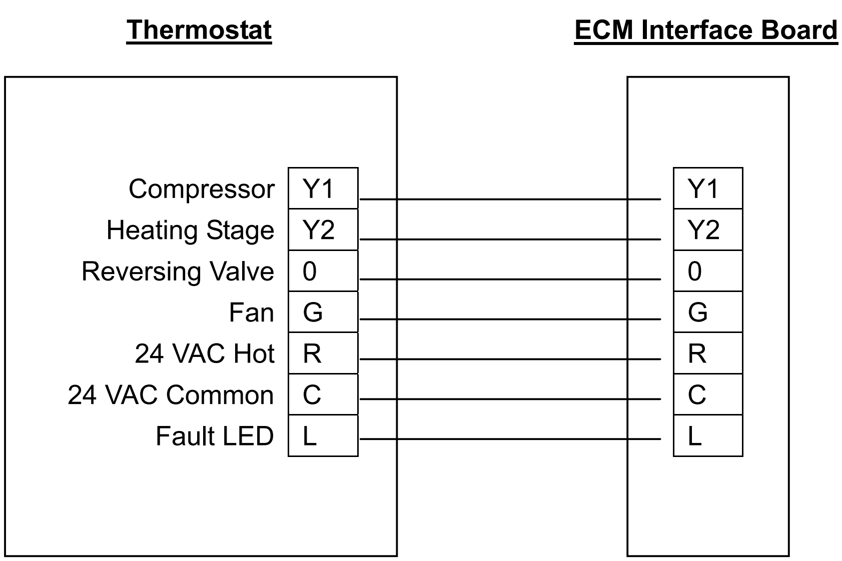
Electrical - Thermostat Wiring

THERMOSTAT INSTALLATION

The thermostat should be located on an interior wall in a larger room, away from supply duct drafts. DO NOT locate the thermostat in areas subject to sunlight, drafts or on external walls. The wire access hole behind the thermostat may in certain cases need to be sealed to prevent erroneous temperature measurement. Position the thermostat back plate against the wall so that it appears level and so the thermostat wires protrude through the middle of the back plate Mark the position of the back plate mounting holes and drill holes with a 3/16" bit. Install supplied anchors and secure plate to the wall. Thermostat wire must be 18 AWG wire. Wire the appropriate thermostat as shown in Figure 15 to the low voltage terminal strip on the ECM control board. Practically any heat pump thermostat will work with Heat Controller units, provided it has the correct number of heating and cooling stages.

Figure 15: Unit with ECM Fan
(A Two-Stage Thermostat is Required)

Connection to ECM Control



ECM Blower Control

The ECM fan is controlled by an interface board that converts thermostat inputs and field selectable CFM settings to signals used by the ECM motor controller. Fan speeds are selected via a nine position DIP switch. To take full advantage of the ECM motor features, a multi-stage thermostat should be used (2-stage heat/2-stage cool or 3-stage heat/2-stage cool).

Note: Power must be off to the unit for at least three seconds before the ECM motor will recognize a speed change. The motor will recognize a change in the CFM adjust or dehumidification mode settings while the unit is powered.

There are four different airflow settings from lowest airflow rate (speed tap 1) to the highest airflow rate (speed tape 4). The charts below indicate settings for the ECM interface board, followed by detailed information for each setting.

Cooling Settings: The cooling setting determines the cooling (normal) CFM for the ECM motor. Cooling (normal) setting is used when the unit is not in dehumidification mode. Tap 1 is the lowest CFM setting, while tap 4 is the highest CFM setting. To avoid air coil freeze-up, tap 1 may not be used if the dehumidification mode is selected. Consult Engineering Design Guide for the specific unit model to correlate speed tap setting to airflow in CFM.

Heating Settings: The heating setting determines the heating CFM. Tap 1 is the lowest CFM setting, while tap 4 is the highest CFM setting. Consult Engineering Design Guide for the specific unit model to correlate speed tap setting to airflow in CFM.

Auxiliary/Emergency Heat Settings: The auxiliary/emergency heat setting determines the CFM when the unit is in auxiliary heat or emergency heat mode. This setting is used for units with internal electric heat. When auxiliary electric heat is energized (i.e. compressor and electric heat), the greater of the auxiliary/emergency or heating setting will be used. A “G” (fan) signal must be present from the thermostat for electric heat to operate. Consult the Engineering Design Guide for the specific unit model to correlate speed tap setting to airflow in CFM.

CFM Adjust Settings: The CFM adjust setting allows four selections. The NORM setting is the factory default position. The + or - settings adjust the airflow by +/- 15%. The +/- settings are used to “fine tune” airflow adjustments. The TEST setting runs the ECM motor at 80% torque, which causes the motor to operate like a standard PSC motor, and disables the CFM counter.

Dehumidification Mode Settings: The dehumidification mode setting provides field selection of humidity control. When operating in the normal mode, the cooling airflow settings are determined by the cooling tap setting above. When dehumidification is enabled there is a reduction in airflow in cooling to increase the moisture removal of the heat pump. Consult Engineering Design Guide for the specific unit model to correlate speed tap to airflow in CFM. The dehumidification mode can be enabled in two ways.

1. **Constant Dehumidification Mode**: When the dehumidification mode is selected (via DIP switch setting), the ECM motor will operate with a multiplier applied to the cooling CFM settings (approx. 20-25% lower airflow).

Any time the unit is running in the cooling mode, it will operate at the lower airflow to improve latent capacity. The "DEHUM" LED will be illuminated at all times. Heating airflow is not affected. **NOTE**: Do not select dehumidification mode if cooling setting is tap 1.

2. **Automatic (Humidistat-Controlled)** Dehumidification Mode: When the dehumidification mode is selected (via DIP switch setting) AND a humidistat is connected to terminal DH, the cooling airflow will only be reduced when the humidistat senses that additional dehumidification is required. The DH terminal is reverse logic. Therefore, a humidistat (not dehumidistat) is required. The "DEHUM" LED will be illuminated only when the humidistat is calling for dehumidification mode. Heating airflow is not affected. **NOTE**: Do not select dehumidification mode if cooling setting is tap 1.

Figure 16: ECM Interface Layout

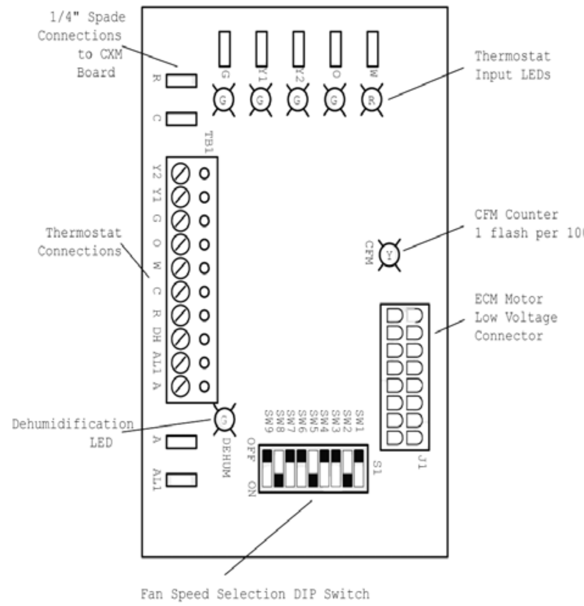


Table 5: ECM Board Tap Settings

Cooling Settings

Tap Setting	DIP Switch	
	SW1	SW2
1	ON	ON
2	ON	OFF
3	OFF	ON
4	OFF	OFF

Heating Settings

Tap Setting	DIP Switch	
	SW3	SW4
1	ON	ON
2	ON	OFF
3	OFF	ON
4	OFF	OFF

Aux / Emergency Heat Settings

Tap Setting	DIP Switch	
	SW5	SW6
1	ON	ON
2	ON	OFF
3	OFF	ON
4	OFF	OFF

CFM Adjust Settings

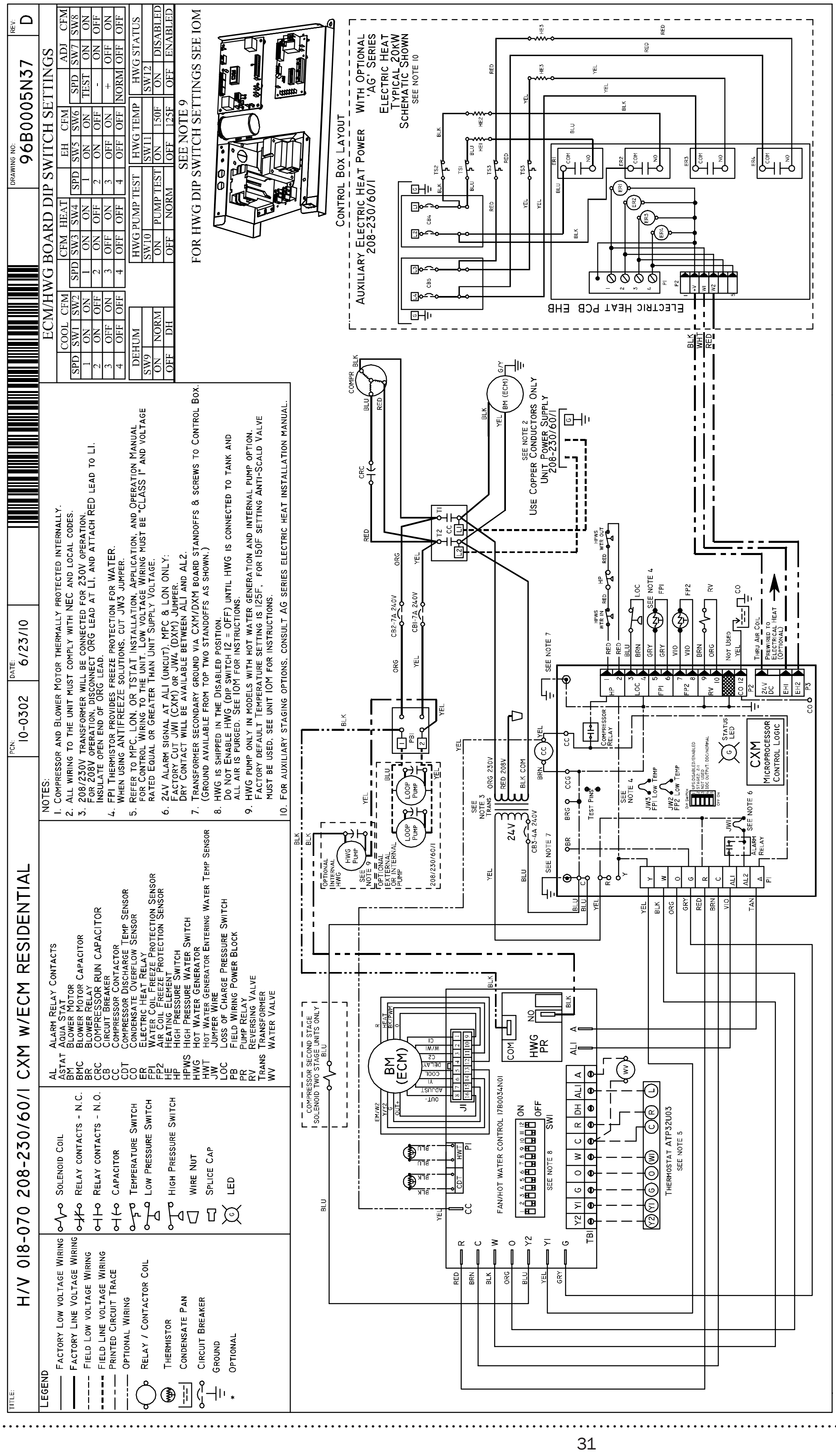
Tap Setting	DIP Switch	
	SW7	SW8
Test	ON	ON
-	ON	OFF
+	OFF	ON
Norm	OFF	OFF

Dehum Mode Settings

Tap Setting	DIP Switch
	SW9
Norm	ON
Dehumid	OFF

Typical Wiring Diagram

HTV/HTD/HTH Units with CXM Board and ECM Fan Motor (single phase)



CXM Controls

CXM CONTROL
For detailed control information, see CXM Application, Operation and Maintenance Manual.

FIELD SELECTABLE INPUTS
Test Mode: Test mode allows the service technician to check the operation of the control in a timely manner. By momentarily shorting the test terminals, the CXM control enters a 20 minute test mode period in which all time delays are sped up 15 times. Upon entering rest mode, the status LED will flash a code representing the last fault. For diagnostic ease at the thermostat, the alarm relay will also cycle during test mode. The alarm relay will cycle on and off similar to the status LED to indicate a code representing the last fault, at the thermostat. Test mode can be exited by shorting the test terminals for 3 seconds.
Retry Mode: If the control is attempting a retry of a fault, the status LED will slow flash (slow flash = one flash every 2 seconds) to indicate the control is in the process of retrying.

FIELD CONFIGURATION OPTIONS
Note: In the following field configuration options, jumper wires should be clipped ONLY when power is removed from the CXM control.

Water Coil Low Temperature Limit Setting: Jumper 3 (JW3-FP1 Low Temp) provides field selection of temperature limit setting for FP1 of 30°F or 10°F (refrigerant temperature).
Not Clipped = 30°F, Clipped = 10°F

Air Coil Low Temperature Limit Setting:
Jumper 2 (JW2-FP2 Low Temp) provides field selection of temperature limit setting for FP2 of 30°F or 10°F (refrigerant temperature). Note: This jumper should only be clipped under extenuating circumstances, as recommended by the factory.
Not Clipped = 30°F, Clipped = 10°F

Alarm Relay Setting: Jumper 1 (JW1-AL2 Dry) provides field selection of the alarm relay terminal AL2 to be jumpered to 24VAC or to be a dry contact (no connection).
Not Clipped = AL2 connected to R., Clipped = AL2 dry contact (no connection).

DIP SWITCHES
Note: In the following field configuration options, DIP switches should only be changed when power is removed from the CXM control.
DIP Switch 1: Unit Performance Sentinel Disable - provides field selection to disable the UPS feature.
On = Enabled. Off = Disabled.

DIP Switch 2: Stage 2 Selection - provides selection of whether compressor has an “on” delay. If set to stage 2, the compressor will have a 3 second delay before energizing. Also, if set for stage 2, the alarm relay will **NOT** cycle during test mode.
On = Stage 1. Off = Stage 2.

DIP Switch 3: Not Used.

DIP Switch 4: DDC Output at EH2 - provides selection for DDC operation. If set to "DDC Output at EH2," the EH2 terminal will continuously output the last fault code of the controller. If set to "EH2 normal," EH2 will operate as standard electric heat output.
On = EH2 Normal. Off = DDC Output at EH2
Note: Some CXM controls only have a 2 position DIP switch package. If this is the case, this option can be selected by clipping the jumper which is in position 4 of SW1.
Jumper not clipped = EH2 Normal, Jumper clipped = DDC Output at EH2.

DIP Switch 5: Factory Setting - Normal position is "On". Do not change selection unless instructed to do so by the factory.

⚠ CAUTION! ⚠

CAUTION! Do not restart units without inspection and remedy of faulting condition. Equipment damage may occur.

Table 6: CXM and Alarm Relay Operations

Description of Operation	LED	Alarm Relay
Normal Mode	ON	Open
Normal Mode with UPS Warning	ON	Cycle (closed 5 sec., open 25 sec.)
CXM is Non-Functional	OFF	Open
Fault Retry	Slow Flash	Open
Lockout	Fast Flash	Closed
Over/Under Voltage Shutdown	Slow Flash	Open (closed after 15 minutes)
Test Mode - No Fault in Memory	Flashing Code 1	Cycling Code 1
Test Mode - HP Fault in Memory	Flashing Code 2	Cycling Code 2
Test Mode - LP Fault in Memory	Flashing Code 3	Cycling Code 3
Test Mode - FP1 Fault in Memory	Flashing Code 4	Cycling Code 4
Test Mode - FP2 Fault in Memory	Flashing Code 4	Cycling Code 5
Test Mode - CO Fault in Memory	Flashing Code 6	Cycling Code 6
Test Mode - Over/Under Shutdown in Memory	Flashing Code 7	Cycling Code 7
Test Mode - UPS in Memory	Flashing Code 8	Cycling Code 8
Test Mode - Swapped Thermistors	Flashing Code 9	Cycling Code 9

- Slow Flash = 1 flash every 2 seconds
- Fast Flash = 2 flashes every 1 second
- Flash Code 2 = 2 quick flashes, 10 second pause, 2 quick flashes, 10 second pause, etc.
- On Pulse 1/3 second; Off Pulse 1/3 second

Safety Features - CXM Controls

Safety Features:

The safety features below are provided to protect the compressor, heat exchangers, wiring and other components from damage caused by operation outside of design conditions.

Anti-Short cycle Protection: The control features a 5 minute anti-short cycle protection for the compressor. **Note**: The 5 minute anti-short cycle also occurs at power up.

Random Start: The control features a random start upon power up of 5-80 seconds.

Fault Retry: In Fault Retry Mode, the Status LED begins slowly flashing to signal that the control is trying to recover from a fault input. The control will stage off the outputs and then “try again” to satisfy the thermostat input call. Once the thermostat input call is satisfied, the control will continue on as if no fault occurred. If 3 consecutive faults occur without satisfying the thermostat input call, the control will go into “lockout” mode. The last fault causing the lockout will be stored in memory and can be viewed at the “fault” LED by going into test mode. **Note**: FP1/FP2 faults are factory set at only one try.

Lockout: In Lockout Mode, the Status LED will begin fast flashing. The compressor relay is turned off immediately. Lockout Mode can be “soft” reset by turning off the thermostat (or satisfying the call). A “soft” reset keeps the fault in memory but resets the control. A “hard” reset (disconnecting power to the control) resets the control and erases fault memory.

Lockout with Emergency Heat: While in lockout mode, if W becomes active (CXM), Emergency Heat Mode will occur.

High Pressure Switch: When the high pressure switch opens due to high refrigerant pressures, the compressor relay is de-energized immediately since the high pressure switch is in series with the compressor contactor coil. The high pressure fault recognition is immediate (does not delay for 30 continuous seconds before de-energizing the compressor).

High pressure lockout code = 2

Example: 2 quick flashes, 10 sec pause, 2 quick flashes, 10 sec. pause, etc.

Low Pressure Switch: The low pressure switch must be open and remain open for 30 continuous seconds during “on” cycle to be recognized as a low pressure fault. If the low pressure switch is open for 30 seconds prior to compressor power up it will be considered a low pressure (loss of charge) fault. The low pressure switch input is bypassed for the initial 60 seconds of a compressor run cycle.

Low pressure lockout code = 3

Water Coil Low Temperature (FP1): The FP1 thermistor temperature must be below the selected low temperature limit setting for 30 continuous seconds during a compressor run cycle to be recognized as a FP1 fault. The FP1 input is bypassed for the initial 60 seconds of a compressor run cycle. FP1 is set at the factory for one try. Therefore, the control will go into lockout mode once the FP1 fault has occurred.

FP1 lockout code = 4

Air Coil Low Temperature (FP2): The FP2 thermistor temperature must be below the selected low temperature limit setting for 30 continuous seconds during a compressor run cycle to be recognized as a FP2 fault. The FP2 input is bypassed for the initial 60 seconds of a compressor run cycle. FP2 is set at the factory for one try. Therefore, the control will go into lockout mode once the FP2 fault has occurred.

FP2 lockout code = 5

Condensate Overflow: The condensate overflow sensor must sense overflow level for 30 continuous seconds to be recognized as a CO fault. Condensate overflow will be monitored at all times.

CO lockout code = 6

Over/Under Voltage Shutdown:: An over/under voltage condition exists when the control voltage is outside the range of 19VAC to 30VAC. Over/under voltage shut down is a self-resetting safety. If the voltage comes back within range for at least 0.5 seconds, normal operation is restored. This is not considered a fault or lockout. If the CXM is in over/under voltage shutdown for 15 minutes, the alarm relay will close.

Over/under voltage shut down code = 7

Unit Performance Sentinel-UPS: The UPS feature indicates when the heat pump is operating inefficiently. A UPS condition exists when:

b) In heating mode with compressor energized, FP2 is greater than 125°F for 30 continuous seconds, or:

b) In cooling mode with compressor energized, FP1 is greater than 125°F for 30 continuous seconds, or:

c) In cooling mode with compressor energized, FP2 is less than 40°F for 30 continuous seconds.

If a UPS condition occurs, the control will immediately go to UPS warning. The Status LED will remain on as if the control is in normal mode. Outputs of the control excluding LED and alarm relay, will NOT be affected by UPS. The UPS condition cannot occur during a compressor off cycle. During UPS warning, the alarm relay will cycle on and off. The cycle rate will be “on” for 5 seconds, “off” for 25 seconds, “on” for 5 seconds, “off” for 25 seconds, etc.

UPS warning code = 8

Swapped FP1/FP2 thermistors: During test mode, the control monitors to see if the FP1 and FP2 thermistors are in the appropriate places. If the control is in test mode, the control will lockout with code 9 after 30 seconds if:

a) The compressor is on in the cooling mode and the FP1 sensor is colder than the FP2 sensor,, or:

b) The compressor is on in the heating mode and the FP2 sensor is colder than the FP1 sensor.

Swapped FP1/FP2 thermistor code = 9

DIAGNOSTIC FEATURES

The LED on the CXM board advises the technician of the current status of the CXM control. The LED can display either the current CXM mode or the last fault in memory if in test mode. If there is no fault in memory, the LED will flash Code 1 (when in test mode).

CXM CONTROLS

CXM CONTROL START-UP OPERATION

The control will not operate until all inputs and safety controls are checked for normal conditions. The compressor will have a 5 minute anti-short cycle delay at power-up. The first time after power-up that there is a call for compressor, the compressor will follow a 5 to 80 second random start delay. After the random start delay and anti-short cycle delay, the compressor relay will be energized. On all subsequent compressor calls, the random start delay is omitted.

Unit Commissioning And Operating Conditions

Operating Limits

Environment – Units are designed for indoor installation only. Never install units in areas subject to freezing or where humidity levels could cause cabinet condensation (such as unconditioned spaces subject to 100% outside air).
Power Supply – A voltage variation of +/– 10% of nameplate utilization voltage is acceptable.

Determination of operating limits is dependent primarily upon three factors: 1) return air temperature. 2) water temperature, and 3) ambient temperature. When any one of these factors is at minimum or maximum levels, the other two factors should be at normal levels to insure proper unit operation. Extreme variations in temperature and humidity and/ or corrosive water or air will adversely affect unit performance, reliability, and service life. Consult Table 8a for operating limits.

Table 8a: Building Operating Limits

Operating Limits	HTV/HTD/HTH	
	Cooling	Heating
Air Limits		
Min. ambient air, DB	45ºF [7ºC]	39ºF [4ºC]
Rated ambient air, DB	80.6ºF [27ºC]	68ºF [20ºC]
Max. ambient air, DB	110ºF [43ºC]	85ºF [29ºC]
Min. entering air, DB/WB	60/45ºF [16/7ºC]	40ºF [4.4ºC]
Rated entering air, DB/WB	80.6/66.2ºF [27/19ºC]	68ºF [20ºC]
Max. entering air, DB/WB	100/75ºF [38/24ºC]	80ºF [27ºC]
Water Limits		
Min. entering water	30ºF [-1ºC]	20ºF [-6.7ºC]
Normal entering water	50-110ºF [10-43ºC]	30-70ºF [-1 to 21ºC]
Max. entering water	120ºF [49ºC]	90ºF [32ºC]
Normal Water Flow	1.5 to 3.0 gpm / ton [1.6 to 3.2 l/m per kW]	

Commissioning Conditions

Consult Table 8b for the particular model. Starting conditions vary depending upon model and are based upon the following notes:

Notes:

1. Conditions in Table 8b are not normal or continuous operating conditions. Minimum/maximum limits are start-up conditions to bring the building space up to occupancy temperatures. Units are not designed to operate under these conditions on a regular basis.
2. Voltage utilization range complies with AHRI Standard 110.

Table 8b: Building Commissioning Limits

Commissioning Limits	HTV/HTD/HTH	
	Cooling	Heating
Air Limits		
Min. ambient air, DB	45ºF [7ºC]	39ºF [4ºC]
Rated ambient air, DB	80.6ºF [27ºC]	68ºF [20ºC]
Max. ambient air, DB	110ºF [43ºC]	85ºF [29ºC]
Min. entering air, DB/WB	*50ºF [10ºC]	40ºF [4.5ºC]
Rated entering air, DB/WB	80.6/66.2ºF [27/19ºC]	68ºF [20ºC]
Max. entering air, DB/WB	110/83ºF [43/28ºC]	80ºF [27ºC]
Water Limits		
Min. entering water	30ºF [-1ºC]	20ºF [-6.7ºC]
Normal entering water	50-110ºF [10-43ºC]	30-70ºF [-1 to 21ºC]
Max. entering water	120ºF [49ºC]	90ºF [32ºC]
Normal Water Flow	1.5 to 3.0 gpm / ton [1.6 to 3.2 l/m per kW]	

Unit Starting And Operating Conditions

DO NOT use “Stop Leak” or similar chemical agent in this system. Addition of chemicals of this type to the loop water will foul the heat exchanger and inhibit unit operation.

⚠ CAUTION! ⚠

CAUTION! To avoid possible damage to a plastic (PVC) piping system, do not allow temperatures to exceed 113°F.

UNIT AND SYSTEM CHECKOUT

Unit and System Checkout:
BEFORE POWERING SYSTEM, please check the following:

UNIT CHECKOUT

☒ *Balancing/shutoff valves*: Insure that all isolation valves are open and water control valves are wired.

☒ *Line voltage and wiring*: Verify that voltage is within an acceptable range for the unit and wiring and fuses/breakers are properly sized. Verify that low voltage wiring is complete.

☒ *Unit control transformer*: Insure that transformer has the properly selected voltage tap.

☒ *Entering water and air*: Insure that entering water and air temperatures are within operating limits of Table 7.

☒ *Low water temperature cutout*: Verify that low water temperature cut-out on the CXM control is properly set.

☒ *Unit fan*: Manually rotate fan to verify free rotation and insure that blower wheel is secured to the motor shaft. Be sure to remove any shipping supports if needed.

DO NOT oil motors. Check unit fan speed selection and compare to design requirements.

☒ *Condensate line*: Verify that condensate line is open and properly pitched toward drain.

☒ *Water flow balancing*: Record inlet and outlet water temperatures for each heat pump upon startup. This check can eliminate nuisance trip outs and high velocity water flow that could erode heat exchangers.

☒ *Unit air coil and filters*: Insure that filter is clean and accessible. Clean air coil of all manufacturing oils.

☒ *Unit controls*: Verify that CXM field selection options are properly set.

SYSTEM CHECKOUT

☒ *System water temperature*: Check water temperature for proper range and also verify heating and cooling set points for proper operation.

☒ *System pH*: Check and adjust water pH if necessary to maintain a level between 6 and 8.5. Proper pH promotes longevity of hoses and fittings (see Table 3).

☒ *System flushing*: Verify that all hoses are connected end to end when flushing to insure that debris bypasses the unit heat exchanger, water valves and other components. Water used in the system must be potable quality initially and clean of dirt, piping slag, and strong chemical cleaning agents. Verify that all air is purged from the system. Air in the system can cause poor operation or system corrosion.

⚠ CAUTION! ⚠

CAUTION! Verify that ALL water control valves are open and allow water flow prior to engaging the compressor. Freezing of the coax or water lines can permanently damage the heat pump.

⚠ CAUTION! ⚠

CAUTION! To avoid equipment damage, DO NOT leave system filled in a building without heat during the winter unless antifreeze is added to the water loop. Heat exchangers never fully drain by themselves and will freeze unless winterized with antifreeze.

NOTICE! Failure to remove shipping brackets from spring-mounted compressors will cause excessive noise, and could cause component failure due to added vibration.

UNIT START-UP PROCEDURE

Unit Start-Up Procedure

1. Turn the thermostat fan position to "ON". Blower should start.
2. Balance air flow at registers.
3. Adjust all valves to their full open positions. Turn on the line power heat pump
4. Room temperature should be within the minimum-maximum ranges of Table 9. During start-up checks, loop water temperature entering the heat Pump should be between 60°F and 95°F.
5. Two factors determine the operating limits of Heat Controller heat pumps, (a) return air temperature, and (b) water temperature. When any one of these factors is at a minimum or maximum level, the other factor must be at normal level to insure proper unit operation.
   a. Adjust the unit thermostat to the warmest setting. Place the thermostat mode switch in the "COOL" position. Slowly reduce thermostat setting until the compressor activates.
   b. Check for cool air delivery at the unit grille within a few minutes after the unit has begun to operate. **Note:** Units have a five minute time delay in the control circuit that can be eliminated on the control board as shown below in Figure 17 on Page 37. See controls description for details.
   c. Verify that the compressor is on and that the water flow rate is correct by measuring pressure drop through the heat exchanger using the P/T plugs and comparing to Table 8.
   d. Check the elevation and cleanliness of the condensate lines. Dripping may be a sign of a blocked line. Check that the condensate trap is filled to provide a water seal.
   e. Refer to Table 7. Check the temperature of both entering and leaving water. If temperature is within range, proceed with the test. If temperature is outside of the operating range, check refrigerant pressures and compare to Table 9. Verify correct water flow by comparing unit pressure drop across the heat exchanger versus the data in Table 8.

Unit Start-Up Procedure

Heat of rejection (HR) can be calculated and compared to submittal data capacity pages. The formula for HR for systems with water is as follows: HR = TD x GPM x 500, where TD is the temperature difference between the entering and leaving water, and GPM is the flow rate in U.S. GPM, determined by comparing the pressure drop across the heat exchanger to Table 8.

f. Check air temperature drop across the air coil when compressor is operating. Air temperature drop should be between 15°F and 25°F.

g. Turn thermostat to “OFF” position. A hissing noise indicates proper functioning of the reversing valve.

6. Allow five (5) minutes between tests for pressure to equalize before beginning heating test

a. Adjust the thermostat to the lowest setting. Place the thermostat mode switch in the “HEAT” position.

b. Slowly raise the thermostat to a higher temperature until the compressor activates.

c. Check for warm air delivery within a few minutes after the unit has begun to operate.

d. Refer to Table 7. Check the temperature of both entering and leaving water. If temperature is within range, proceed with the test. If temperature is outside of the operating range, check refrigerant pressures and compare to Table 9. Verify correct water flow by comparing unit pressure drop across the heat exchanger versus the data in Table 8. Heat of extraction (HE) can be calculated and compared to submittal data capacity pages. The formula for HE for systems with water is as follows: HE = TD x GPM x 500, where TD is the temperature difference between the entering and leaving water, and GPM is the flow rate in U.S. GPM, determined by comparing the pressure drop across the heat exchanger to Table 8.

e. Check air temperature rise across the air coil when compressor is operating. Air temperature rise should be between 20°F and 30°F.

f. Check for vibration, noise, and water leaks.

7. If unit fails to operate, perform troubleshooting analysis (see troubleshooting section). If the check described fails to reveal the problem and the unit still does not operate, contact a trained service technician to insure proper diagnosis and repair of the equipment.

8. When testing is complete, set system to maintain desired comfort level.

9. BE CERTAIN TO FILL OUT AND FORWARD WARRANTY REGISTRATION CARD TO HEAT CONTROLLER.

Note: If performance during any mode appears abnormal, refer to the CXM section or troubleshooting section of this manual. To obtain maximum performance, the air coil should be cleaned before start-up. A 10% solution of dishwasher detergent and water is recommended.

Unit Start-Up Procedure

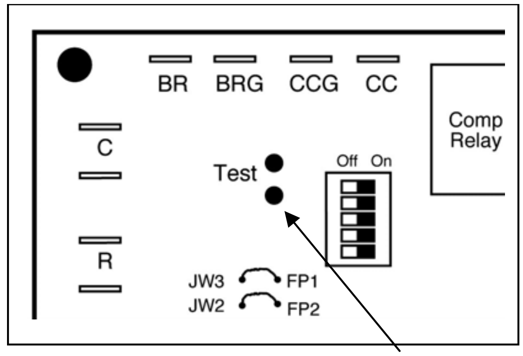
⚠ WARNING! ⚠

WARNING! When the disconnect switch is closed, high voltage is present in some areas of the electrical panel. Exercise extreme caution when working with energized equipment.

⚠ CAUTION! ⚠

CAUTION! Verify that all water control valves are open and allow water flow prior to engaging the compressor. Freezing of the coax or water lines can permanently damage the heat pump.

Figure 17: Test Mode Pins



Short test pins together to enter Test Mode and speed-up timing and delays for 20 minutes

Unit Operating Conditions

Table 8: HTV/HTD/HTH Water Pressure Drop

Model	GPM	Pressure Drop, psi			
		30°F	50°F	70°F	90°F
024	4.0	1.5	1.3	1.1	1.0
	6.0	3.1	2.6	2.3	2.1
	7.0	4.1	3.4	3.0	2.7
	8.0	5.1	4.3	3.8	3.4
036	4.0	1.2	1.0	0.8	0.6
	6.0	2.6	2.5	2.3	2.1
	8.0	4.5	4.2	4.0	3.7
	9.0	5.7	5.2	4.8	4.4
048	5.5	1.1	0.9	0.8	0.7
	8.3	2.2	2.1	2.0	1.8
	11.0	3.9	3.6	3.2	3.1
	12.0	4.5	4.2	3.8	3.5
060	7.0	0.5	0.3	0.2	0.1
	10.5	1.9	1.8	1.7	1.6
	14.0	3.9	3.5	3.2	2.9
	15.0	4.8	4.3	3.9	3.5
070	7.5	1.7	1.5	1.3	1.3
	11.3	3.9	3.4	3.0	2.8
	15.0	6.9	6.0	5.4	5.0
	17.0	8.9	7.7	6.9	6.5

NOTE: Table 9 includes the following notes:

- Airflow is at nominal (rated) conditions;
- Entering air is based upon 70°F DB in heating and 80/67° in cooling;
- Subcooling is based upon head pressure at compressor service port;
- HTV/HTD/HTH units have TXV expansion device;
- Cooling air and water values can vary greatly with changes in humidity level.

Table 9: HTV/HTD/HTH Typical Unit Operating Pressures and Temperatures (60 Hz)

024		Full Load Cooling - without HWG active						Full Load Heating - without HWG active					
Entering Water Temp °F	Water Flow GPM/ton	Suction Pressure PSIG	Discharge Pressure PSIG	Superheat	Subcooling	Water Temp Rise °F	Air Temp Drop °F DB	Suction Pressure PSIG	Discharge Pressure PSIG	Superheat	Subcooling	Water Temp Drop °F	Air Temp Rise °F DB
30	1.5	118-128	159-179	25-30	9-14	16.7-18.7	19-25	72-83	273-293	6-11	3-8	5.9-7.9	16-22
	2.25	118-128	146-166	25-30	7-12	12.3-14.3	20-26	75-85	275-295	6-11	3-8	4.2-6.2	17-23
	3	118-128	132-152	25-30	7-12	7.9-9.9	20-26	78-88	277-297	6-11	3-8	2.7-4.7	18-24
50	1.5	128-138	186-206	18-23	8-13	16.3-18.3	19-25	102-112	302-322	8-12	6-11	8.9-10.9	22-28
	2.25	128-138	172-192	18-23	6-11	12.1-14.1	20-26	106-116	303-323	8-12	6-11	6.7-8.7	23-29
	3	128-138	158-178	18-23	6-11	7.8-9.8	20-26	110-120	305-325	8-12	6-11	4.5-6.5	23-29
70	1.5	136-146	281-301	7-12	7-12	15.7-17.7	19-25	128-138	330-350	10-15	8-13	11.3-13.3	27-34
	2.25	136-146	267-287	7-12	5-10	11.6-13.6	19-25	134-144	332-352	10-15	8-13	8.5-10.5	28-35
	3	136-146	253-273	7-12	4-9	7.6-9.6	19-25	141-151	334-354	10-15	8-13	5.8-7.8	28-35
90	1.5	139-149	368-388	6-11	7-12	14.9-16.9	18-24	162-172	367-387	14-19	10-15	14.4-16.4	33-41
	2.25	139-149	354-374	6-11	5-10	11-13	18-24	166-176	372-392	15-20	10-15	10.8-12.8	34-42
	3	139-149	340-360	6-11	5-10	7.2-9.2	18-24	171-181	377-397	17-22	10-15	7.1-9.1	34-42
110	1.5	143-153	465-485	6-11	7-12	13.9-15.9	17-23						
	2.25	143-153	450-470	6-11	5-10	10.2-12.2	17-23						
	3	143-153	433-453	6-11	5-10	6.5-8.5	17-23						

036		Full Load Cooling - without HWG active						Full Load Heating - without HWG active					
Entering Water Temp °F	Water Flow GPM/ton	Suction Pressure PSIG	Discharge Pressure PSIG	Superheat	Subcooling	Water Temp Rise °F	Air Temp Drop °F DB	Suction Pressure PSIG	Discharge Pressure PSIG	Superheat	Subcooling	Water Temp Drop °F	Air Temp Rise °F DB
30	1.5	120-130	156-176	25-30	9-14	22.1-24.1	18-24	69-79	293-313	7-12	14-19	8.9-10.9	17-23
	2.25	119-129	148-168	25-30	8-13	16.8-18.8	19-25	73-83	297-317	7-12	14-19	6.7-8.7	18-24
	3	119-129	138-158	25-30	8-13	10.5-12.5	19-25	76-86	300-320	7-12	14-19	4.5-6.5	19-25
50	1.5	129-139	225-245	15-20	10-15	21.9-23.9	18-24	96-106	322-342	10-15	17-22	12.2-14.2	23-29
	2.25	128-138	211-231	15-20	9-14	16.1-18.1	19-25	100-110	326-346	10-15	17-22	9.3-11.3	24-30
	3	128-138	197-217	15-20	9-14	10.3-12.3	19-25	105-115	331-351	10-15	17-22	6.4-8.4	24-30
70	1.5	136-146	302-322	9-14	13-18	21.5-23.5	18-24	123-133	352-372	11-16	19-24	15-17	28-35
	2.25	135-145	283-303	9-14	12-17	15.8-17.8	19-25	129-139	358-378	11-16	19-24	11.6-13.6	29-36
	3	135-145	265-285	9-14	12-17	10-12	19-25	135-145	364-384	11-16	19-24	8.2-10.2	30-37
90	1.5	140-150	390-410	7-12	13-18	20.5-22.5	17-23	157-167	390-410	13-18	18-23	21-23	36-44
	2.25	140-150	369-389	8-13	8-13	14.9-16.9	17-23	169-179	399-419	13-18	16.5-21.5	15.5-17.5	37-45
	3	140-150	349-369	8-13	8-13	9.3-11.3	17-23	181-191	408-428	14-19	15-20	10.5-12.5	39-47
110	1.5	145-155	488-508	7-12	13-18	19-21	17-23						
	2.25	145-155	467-487	8-13	8-13	14-16	17-23						
	3	145-155	447-467	8-13	8-13	9-11	17-23						

048		Full Load Cooling - without HWG active						Full Load Heating - without HWG active					
Entering Water Temp °F	Water Flow GPM/ton	Suction Pressure PSIG	Discharge Pressure PSIG	Superheat	Subcooling	Water Temp Rise °F	Air Temp Drop °F DB	Suction Pressure PSIG	Discharge Pressure PSIG	Superheat	Subcooling	Water Temp Drop °F	Air Temp Rise °F DB
30	1.5	112-122	187-207	22-27	14-19	20.7-22.7	18-24	66-76	286-306	7-12	8-13	8-10	18-24
	2.25	111-121	167-187	22-27	12-17	15.5-17.5	18-24	69-79	289-309	7-12	9-14	6-8	19-25
	3	111-121	147-167	23-28	11-16	10.2-12.2	18-24	72-82	292-312	7-12	9-14	4-6	19-25
50	1.5	125-135	242-262	13-18	10-15	20.9-22.9	19-25	93-103	314-334	8-13	10-15	11.5-13.5	23-29
	2.25	123-133	224-244	13-18	9-14	15.6-17.6	19-25	98-108	320-340	8-13	10-15	8.7-10.7	24-30
	3	122-132	205-225	14-19	7-12	10.2-12.2	19-25	103-113	326-346	8-13	10-15	5.9-7.9	25-31
70	1.5	133-143	310-330	8-13	8-13	20.5-22.5	19-25	123-133	344-364	9-14	9-14	15-17	28-35
	2.25	132-142	290-310	8-13	7-12	15.2-17.2	19-25	130-140	354-374	9-14	9-14	11.5-13.5	29-36
	3	131-141	270-290	9-14	5-10	9.9-11.9	19-25	137-147	361-381	9-14	9-14	7.9-9.9	30-37
90	1.5	138-148	396-416	7-12	7-12	19.2-21.2	18-24	165-175	390-410	13-18	8-13	19.6-21.6	37-45
	2.25	137-147	374-394	7-12	6-11	14.3-16.3	18-24	175-185	401-421	15-20	8-13	15-17	38-46
	3	136-146	352-372	7-12	4-9	9.3-11.3	18-24	185-195	413-433	17-22	8-13	10.3-12.3	39-47
110	1.5	144-154	497-517	7-12	5-10	18-20	17-23						
	2.25	143-153	472-492	7-12	4-9	13.3-15.3	17-23						
	3	142-152	447-467	7-12	3-8	8.5-10.5	17-23						

Table 9: HTV/HTD/HTH Typical Unit Operating Pressures and Temperatures (60 Hz) - *continued*

060		Full Load Cooling - without HWG active						Full Load Heating - without HWG active					
Entering Water Temp °F	Water Flow GPM/ton	Suction Pressure PSIG	Discharge Pressure PSIG	Superheat	Subcooling	Water Temp Rise °F	Air Temp Drop °F DB	Suction Pressure PSIG	Discharge Pressure PSIG	Superheat	Subcooling	Water Temp Drop °F	Air Temp Rise °F DB
30	1.5	117-127	170-190	27-32	15-20	18.2-20.2	17-23	66-76	282-302	10-16	9-14	8-10	19-25
	2.25	116-126	143-163	28-33	13-18	12.6-14.6	17-23	69-79	285-305	10-16	9-14	6-8	19-25
	3	115-125	135-155	29-34	12-17	7-9	17-23	72-82	289-309	10-16	10-15	4-6	20-26
50	1.5	128-138	238-258	16-21	14-19	20.5-22.5	21-27	90-100	310-330	11-17	12-17	11.3-13.3	24-30
	2.25	126-136	222-242	21-26	13-18	14.9-16.9	21-27	95-105	313-333	11-17	12-17	8.5-10.5	25-31
	3	125-135	205-225	26-31	12-17	9.2-11.2	21-27	99-109	316-336	11-17	12-17	5.7-7.7	26-32
70	1.5	135-145	315-335	10-15	14-19	21-23	22-28	115-125	337-357	12-18	14-19	14-16	28-35
	2.25	134-144	296-316	12-17	13-18	15.5-17.5	22-28	120-130	341-361	12-18	14-19	10.6-12.6	29-36
	3	133-143	276-296	15-20	11-16	10-12	22-28	126-136	345-365	12-18	15-20	7.3-9.3	30-37
90	1.5	139-149	408-428	10-15	15-20	20.1-22.1	21-27	157-167	390-410	15-20	14-19	18.2-20.2	37-45
	2.25	138-148	386-406	10-15	13-18	14.8-16.8	21-27	161-171	394-414	15-20	14-19	13.9-15.9	38-46
	3	138-148	364-384	10-15	11-16	9.5-11.5	21-27	166-176	398-418	15-20	15-20	9.6-11.6	39-47
110	1.5	144-154	515-535	8-13	14-19	19-21	20-26						
	2.25	143-153	493-513	8-13	13-18	14-16	20-26						
	3	142-152	469-489	8-13	12-17	9-11	20-26						

070		Full Load Cooling - without HWG active						Full Load Heating - without HWG active					
Entering Water Temp °F	Water Flow GPM/ton	Suction Pressure PSIG	Discharge Pressure PSIG	Superheat	Subcool-ing	Water Temp Rise °F	Air Temp Drop °F DB	Suction Pressure PSIG	Discharge Pressure PSIG	Superheat	Subcool-ing	Water Temp Drop °F	Air Temp Rise °F DB
30	1.5	119-129	155-175	25-30	17-22	18-20	21-27	61-71	292-312	11-16	13-18	7.2-9.2	19-25
	2.25	117-127	150-170	25-30	17-22	13.2-15.2	21-27	65-75	296-316	11-16	14-19	5.4-7.4	20-26
	3	115-125	144-164	28-32	17-22	8.4-9.4	22-28	68-78	300-320	10-15	15-20	3.5-5.5	21-27
50	1.5	131-141	210-230	10-15	12-17	18.5-20.5	22-28	89-99	327-347	10-15	19-24	10.9-12.9	26-32
	2.25	130-140	205-225	11-16	12-17	14-16	23-29	98-108	337-357	10-15	14-19	8.3-10.3	28-34
	3	129-139	200-220	13-18	12-17	9.5-11.5	24-30	106-116	348-368	10-15	9-14	5.7-7.7	30-36
70	1.5	135-145	300-320	10-15	15-20	17.6-19.6	23-29	119-129	365-385	10-15	21-26	14.7-16.7	33-39
	2.25	131-141	295-315	11-16	14-19	13.8-15.8	23-29	132-142	380-400	10-15	16-21	11.3-13.3	36-42
	3	128-138	290-310	13-18	14-19	10-12	23-29	144-154	395-415	10-15	11-16	7.9-9.9	38-44
90	1.5	139-149	390-410	10-15	16-21	16.7-18.7	22-28	162-172	418-438	10-15	19-24	19.4-21.4	43-49
	2.25	137-147	370-390	10-15	14-19	12.6-14.6	22-28	172-182	430-450	10-15	19-24	14.7-16.7	45-51
	3	135-145	350-370	10-15	13-18	8.5-10.5	22-28	182-192	444-464	11-16	19-24	10.1-12.1	47-53
110	1.5	145-155	490-510	10-15	16-21	15.9-17.9	20-27						
	2.25	145-155	470-490	10-15	14-19	11.7-13.7	20-27						
	3	144-154	452-472	9-14	13-18	7.4-9	20-27						

Table 10: Water Temperature Change through Heat Exchanger

Water Flow gpm	Rise, Cooling °F	Drop, Heating °F
For Closed Loop: Ground Source or Closed Loop systems at 3 gpm per ton	9 - 12	4 - 8
For Open Loop: Ground Water Systems at 1.5 gpm per ton	20 - 26	10 - 17

Preventive Maintenance

Water Coil Maintenance
(Direct ground water applications only)
If the system is installed in an area with a known high mineral content (125 P.P.M. or greater) in the water, it is best to establish a periodic maintenance schedule with the owner so the coil can be checked regularly. Consult the well water applications section of this manual for a more detailed water coil material selection. Should periodic coil cleaning be necessary, use standard coil cleaning procedures, which are compatible with the heat exchanger material and copper water lines. Generally, the more water flowing through the unit, the less chance for scaling. Therefore, 1.5 gpm per ton is recommended as a minimum flow. Minimum flow rate for entering water temperatures below 50°F is 2.0 gpm per ton.

Water Coil Maintenance
(Water loop applications)
Generally, water coil maintenance is not needed for closed loop systems. However, if the piping is known to have high dirt or debris content, it is best to establish a periodic maintenance schedule with the owner so the water coil can be checked regularly. Dirty installations are typically the result of deterioration of iron or galvanized piping or components in the system.

Water Flow
Generally, the more water flowing through the unit, the less chance for scaling. However, flow rates over 3 gpm per ton can produce water (or debris) velocities that can erode the heat exchanger wall and ultimately produce leaks.

Hot Water Generator Coils
See water coil maintenance for ground water units. If the potable water is hard or not chemically softened, the high temperatures of the desuperheater will tend to scale even quicker than the water coil and may need more frequent inspections. In areas with extremely hard water, a HWG is not recommended.

Filters
Filters must be clean to obtain maximum performance. Filters should be inspected every month under normal operating conditions and be replaced when necessary. Units should never be operated without a filter.

Washable, high efficiency, electrostatic filters, when dirty, can exhibit a very high pressure drop for the fan motor and reduce air flow, resulting in poor performance. It is especially important to provide consistent washing of these filters (in the opposite direction of the normal air flow) once per month using a high pressure wash similar to those found at self-serve car washes.

Condensate Drain
In areas where airborne bacteria may produce a “slimy” substance in the drain pan, it may be necessary to treat the drain pan chemically with an algaecide approximately every three months to minimize the problem.

The condensate pan may also need to be cleaned periodically to insure indoor air quality. The condensate drain can pick up lint and dirt, especially with dirty filters. Inspect the drain twice a year to avoid the possibility of plugging and eventual overflow.

Compressor

Conduct annual amperage checks to insure that amp draw is no more than 10% greater than indicated on the serial plate data.

Fan Motors

All units have lubricated fan motors. Fan motors should never be lubricated unless obvious, dry operation is suspected. Periodic maintenance oiling is not recommended, as it will result in dirt accumulating in the excess oil and cause eventual motor failure. Conduct annual dry operation check and amperage check to insure amp draw is no more than 10% greater than indicated on serial plate data.

Air Coil

The air coil must be cleaned to obtain maximum performance. Check once a year under normal operating conditions and, if dirty, brush or vacuum clean. Care must be taken not to damage the aluminum fins while cleaning.

CAUTION: Fin edges are sharp.

Cabinet

Do not allow water to stay in contact with the cabinet for long periods of time to prevent corrosion of the cabinet sheet metal. Generally, vertical cabinets are set up from the floor a few inches to prevent water from entering the cabinet. The cabinet can be cleaned using a mild detergent.

Refrigerant System

To main tain sealed circuit integrity, do not install service gauges unless unit operation appears abnormal. Reference the operating charts for pressures and temperatures. Verify that air and water flow rates are at proper levels before servicing the refrigerant circuit.

Functional Troubleshooting

Fault	Htg	Clg	Possible Cause	Solution
Main Power Problems	X	X	Green Status Led Off	Check line voltage circuit breaker and cisconnect
				Check for line voltage between L1 and L2 on
				Check for 24 VAC between R and C on CXM
				Check primary/secondary voltage on transformer
HP Fault - Code 2 High Pressure		X	Reduced Or No Water Flow In Cooling	Check pump operation or valve operation/setting
				Check water flow adjust to proper flow rate
		X	Water Temperature Out Of Range In Cooling	Bring water temp within design parameters
	X		Reduced Or No Air Flow In Heating	Check for dirty air filter and clean or replace
				Check fan motor operation and airflow restriction
				Dirty Air coil - construction dust etc.
				Too high of external static. Check static valve
	X		Air Temperature Out Of Range In Heating	Bring return air temp within design parameters
	X	X	Overcharged With Refrigerant	Check superheat/subcooling vs. typical operation table
	X	X	Bad Hp Switch	Check switch continuity and operation. Replace
LP/LOC Fault- Code 3 Low Pressure/Loss of Charge	X	X	Insufficient Charge	Check for refrigerant leaks
	X		Compressor Pump Down At Start-Up	Check charge and start-up water flow
FP1 Fault - Code 4 Water Coil - Low Temperature Limit	X		Reduced Or No Water Flow In Heating	Check pump operation or water valve operation
				Plugged strainer or filter. Clean or replace
				Check water flow adjust to proper flow rate
	X		Inadequate Anti-Freeze Level	Check antifreeze density with hydrometer
	X		Improper Temperature Limit Setting (30°F Vs. 10°F)	Clip JW3 jumper for antifreeze (10°F)
	X		Water Temperature Out of Range	Bring water temp within design parameters
	X	X	Bad Thermistor	Check temp and impedance correlation per chart
FP2 - Code 5 Air Coil Low Temperature Limit		X	Reduced Or No Air Flow In Cooling	Check for dirty air filter and clean or replace
				Check fan motor operation and airflow restriction
				Too high of external static. Check static valve
		X	Air Temperature Out Of Range	Too much cold vent air? Bring entering air to design parameters
		X	Improper Temperature Limit Setting (30°F Vs. 10°F)	Normal airside applications will require 30°F
	X	X	Bad Thermistor	Check temp and impedance correlation per chart

Functional Troubleshooting

Fault	Htg	Clg	Possible Cause	Solution
Condensate Fault - Code 6	X	X	Blocked Drain	Check for blockage and clean drain
	X	X	Improper Trap	Check trap dimensions and location
		X	Poor Drainage	Check for piping slope away from unit
				Poor venting. Check vent location
		X	Moisture on Sensor	Check for moisture shorting to air coil
Over/Under Voltage - Code 7 (Auto Resetting)	X	X	Under Voltage	Check power supply and 24VAC voltage before operation
				Check power supply wire size
				Check compressor starting. Need hard start kit
				Check 24 VAC and unit transformer tap for correct supply voltage
	X	X		Check power supply voltage and 24 VAC before operation
				Check 24 VAC and unit transformer tap for correct supply voltage
Unit Performance Sentinel - Code 8	X		Heating Mode FP2>125°F	Check for poor air flow or overcharged unit
		X	Cooling Mode FP1>125°F or FP2<40°F	Check for poor water flow, or air flow
No Fault Code Shown	X	X	No Compressor Operation	See “only fan operates”
	X	X	Compressor Overload	Check and replace if necessary
	X	X	Control Board	Reset power and check operation
Unit Short Cycles	X	X	Dirty Air Filter	Check and clean air filter
	X	X	Unit in “Test Mode”	Reset power or wait 20 minutes for auto exit
	X	X	Unit Selection	Unit may be oversized for space. Check sizing load of space
	X	X	Compressor Overload	Check and replace if necessary
Only Fan Runs	X	X	Thermostat Position	Insure thermostat set for heating or cooling
	X	X	Unit Locked Out	Check for lockout codes. Reset power
	X	X	Compressor Overload	Check compressor overload. Replace if necessary
	X	X	Thermostat Wiring	Check thermostat wiring at heat pump. Jumper for compressor operation in test mode
Only Compressor Runs	X	X	Thermostat Wiring	Check G wiring at heat pump. Jumper G and R operation
	X	X	Fan Motor Relay	Jumper G and R for fan operation. Check for across BR contacts
				Check fan power enable relay operation (if possible)
	X	X	Fan Motor	Check for line voltage at motor. Check capacity
	X	X	Thermostat Wiring	Check thermostat wiring at heat pump. Jumper compressor operation in test mode.

Functional Troubleshooting

Fault	Htg	Clg	Possible Cause	Solution
Unit Does Not Operate in Cooling		X	Reversing Valve	Set for cooling demand and check 24 VAC on RV CXM board
				If RV is stuck, run high pressure up by reducing and while operating engage and disengage RV to push valve
		X	Thermostat Set-up	Check for ‘O’ RV set-up not ‘B’
		X	Thermostat Wiring	Check O wiring at heat pump. Jumper O and R ‘Click’
		X	Thermostat Wiring	Put thermostat in cooling mode. Check for 24 (check between C and O); check for 24 VAC on W between W and C). There should be voltage on W. If voltage is present on W, thermostat or wired incorrectly

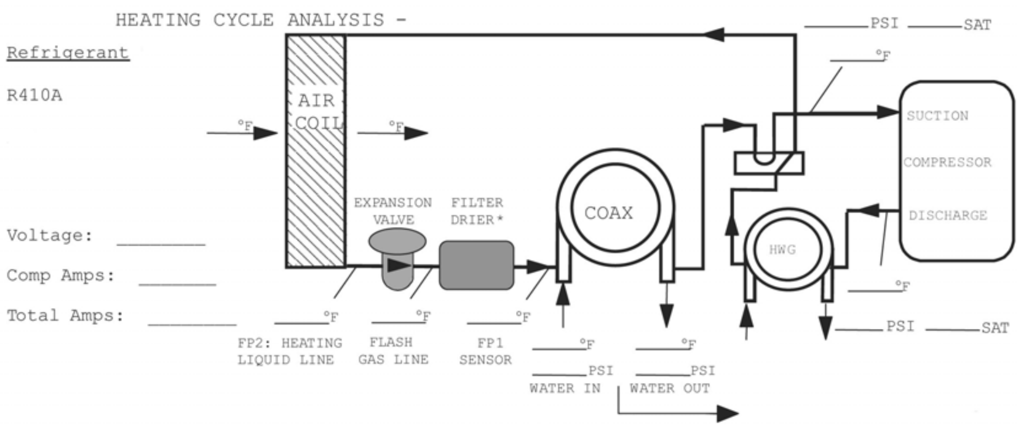
Performance Troubleshooting

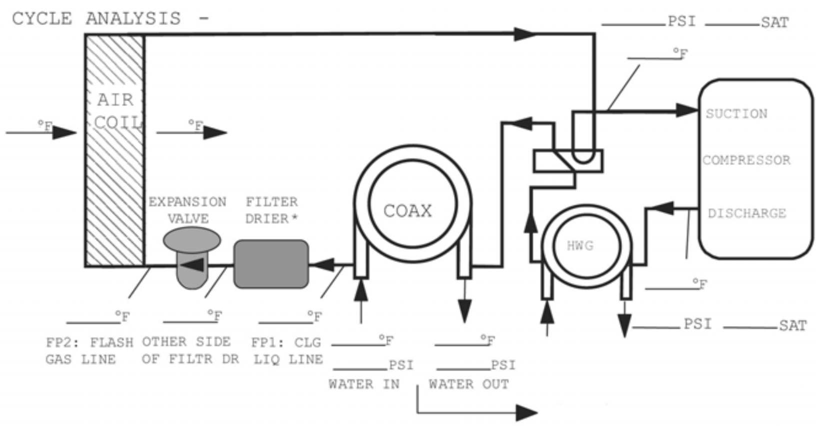
Performance Troubleshooting	Htg	Clg	Possible Cause	Solution
Insufficient Capacity/ Not Cooling or Heating Properly	X	X	Dirty Filter	Replace or clean
	X		Reduced or No Air Flow in Heating	Check for dirty air filter and clean or replace
				Check fan motor operation and airflow restriction
				Too high of external static. Check static valve
		X	Reduced or No Air Flow in Cooling	Check for dirty air filter and clean or replace
				Check fan motor operation and airflow restriction
				Too high of external static. Check static valve
	X	X	Leaky Duct Work	Check supply and return air temperatures at two distant duct registers if significantly different , restrictions are present
	X	X	Low Refrigerant Charge	Check superheat and subcooling per chart
	X	X	Restricted metering device	Check superheat and subcooling per chart
		X	Defective Reversing Valve	Perform RV touch test
	X	X	Thermostat Improperly Located	Check location and for air drafts behind stat
	X	X	Unit Undersized	Recheck loads & sizing check sensible clg load vs. heat pump capacity
	X	X	Scaling in Water Heat Exchanger	Perform scaling check and clean if necessary
	X	X	Inlet Water Too Hot or Cold	Check load, loop sizing, loop backfill, ground

Performance Troubleshooting

Performance Troubleshooting	Htg	Clg	Possible Cause	Solution
High Head Pressure	X		Reduced or No Air Flow in Heating	Check for dirty air filter and clean or replace
				Check fan motor operation and airflow restriction
				Too high of external static. Check static valve
		X	Reduced or No Water Flow in Cooling	Check pump operation or valve operation/setting
				Check water flow adjust to proper flow rate
		X	Inlet Water too Hot	Check load, loop sizing, loop backfill ground
	X		Air Temperature Out of Range in Heating	Bring return air temp within design parameters
		X	Scaling in water heat exchanger	Perform scaling check and clean if necessary
	X	X	Unit Overcharged	Check superheat and subcooling. Reweight in charge
	X	X	Non-condensables in System	Vacuum system and reweigh in charge
	X	X	Restricted Metering Device	Check superheat and subcooling per chart
Low Suction Pressure	X		Reduced Water Flow in Heating	Check pump operation or water valve operation
				Plugged strainer or filter. Clean or replace
				Check water flow adjust to proper flow rate
	X		Water Temperature Out of Range	Bring water temp within design parameters
		X	Reduced Air Flow in Cooling	Check for dirty air filter and clean or replace
				Check fan motor operation and airflow restrictions
				Too high of external static. Check static valve
		X	Air Temperature Out of Range	Too much cold vent air? Bring entering air temp to design parameters
	X	X	Insufficient Charge	Check for refrigerant leaks
Low Discharge Air Temperature in Heating	X		Too High of Air Flow	Check fan motor speed selection and airflow
	X		Poor Performance	See 'Insufficient Capacity'
High Humidity		X	Too High of Air Flow	Check fan motor speed selection and airflow
		X	Unit Oversized	Recheck loads & sizing check sensible clg load pump capacity

Troubleshooting Form





Heat of Extraction (Absorption) or Heat of Rejection =

Flow rate gpm 500* x °F (water temp. difference)

= BTUH (heat absorbed or rejected)

Superheat = Suction temp - Suction saturation temp = _____________°F Superheat

Subcooling = Discharge Saturation Temp - Liquid Line Temp. = ____________°F Subcooling

* Use 500 for Water, 485 for antifreeze solution

Note: Never connect refrigerant gauges during startup procedures. Conduct water-side analysis using P/T ports to determine water flow and temperature difference. If water-side analysis shows poor performance, refrigerant troubleshooting may be required. Connect refrigerant gauges as a last resort.

Design, material, performance data and components
subject to change without notice.

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