COLMAC WATERHEAT

Installation, Operation, and Maintenance

940126-0001 Rev L

Heat Pump Water Heaters

Contents

1. INTRODUCTION

1.1. Heat Pump Concept

1.1.1. Colmac air and water source heat pumps offer the commercial hot water user a highly energy efficient means of generating potable hot water. The Colmac heat pump water heater uses the same operating principle as an air-conditioner or domestic refrigerator. The heat pump gathers heat from a suitable fluid, and through the refrigeration cycle, deposits the heat into water at a useable temperature. This principle of moving heat with a heat pump, rather than generating it by burning fossil fuel (i.e. natural gas), or electric resistance, makes water heating with heat pumps the best choice for conserving fossil fuels. Depending on the temperature of the heat source supplied to the heat pump, water can be heated using one third to one fifth of the energy required by electric resistance, or gas.

1.1.2. Since the Colmac heat pump uses the same principle as an air-conditioner, it produces cool air or water as it makes hot water. This "free" cooling benefit can be put to use to supplement the existing air-conditioning system, or to provide "spot cooling" to hot work areas.

1.1.3. The maximum leaving water temperature that can be produced by any heat pump water heater is determined by the maximum allowable pressure of the refrigerant. The Colmac heat pump uses environmentally friendly R-134a refrigerant which operates at lower pressures than R22. This allows the heat pump to produce maximum leaving water temperatures up to 160°F (71°C).

1.1.4. Remember that average tank temperature sensed by the aquastat bulb will be somewhat lower than the water temperature leaving the heat pump. This means the practical maximum aquastat set point will be between 140° and 150°F (60° and 65°C).

2. GENERAL

2.1. Air Source Heat Pump (HPA) Applications

2.1.1. Colmac Air Source Heat Pump (HPA) heat pumps can be successfully applied wherever there is a need for large amounts of hot water and there is a source of warm air available. The Colmac HPA is best suited for supplying hot water in commercial facilities where demands for hot water and space cooling are concurrent, or where there is a demand for hot water and ambient air temperatures do not fall below 50°F (10°C).

2.1.2. There are two basic types of applications for Colmac HPA heat pumps:

- Water Heating Only. In these applications, hot water is made energy efficiently while the air-conditioning benefit is not used because of building configuration and other reasons. These systems are the simplest to design and control; however, since the air-conditioning effect is not used it cannot be taken as added savings in the economic payback analysis. Examples of this type of building would be Apartments, Condominiums, Hotels, Hospitals, or Dormitories located in warm climates.

- Water Heating with Air-Conditioning (A/C) Benefit. Here the cool air produced by the Colmac HPA is used to cool an occupied space while energy efficient hot water is being made. When the A/C benefit is used it becomes important to know and/or calculate both the hot water and air-conditioning loads and the profiles of both loads throughout the day. There are two possible cases when using the A/C benefit:

The Hot Water Load exceeds the A/C Load. In this case, size the HPA for the A/C load and deposit the hot water in a preheat tank to feed the main water heating system. Use a room thermostat in series with the preheat tank aquastat to control the HPA to prevent "overcooling" of the space where the HPA is located.

The A/C Load exceeds the Hot Water Load. Here, again, there are two strategies for sizing the HPA. The designer can 1.) Size the HPA to match the Hot Water Load and "assist" the A/C system by ducting the cool air for "spot cooling", or 2.) Size the HPA to match the A/C load and incorporate a "Remote Heat Rejection" option.

Examples of applications requiring concurrent space cooling and water heating are: Restaurants, Nursing Homes, Laundries, Hospitals, Kitchens, Food Processing Plants, Photographic Processing Plants, etc.

2.1.3. Limitations

The Colmac HPA heat pump capacity is affected by the temperature of the entering air. As entering air temperature falls, so does heat pump capacity and efficiency. The minimum allowable entering air temperature is 50°F (10°C). For conditions outside of these parameters, consult the factory.

2.2. Water Source Heat Pump (HPW) Applications

2.2.1. Colmac Water Source Heat Pumps (HPW) use waste heat in the form of any filtered, non-corrosive, pressurized stream of liquid at temperatures as low as 50°F (10°C).

2.2.2. Building hydronic loop water, return chilled water, condenser or cooling tower water, geothermal loops or wells, and industrial process water are a few of the possible heat sources that can be utilized by the HPW heat pump.

2.2.3. Limitations

The Colmac HPW heat pump capacity is affected by the temperature of the source water. As source water temperature falls, so does heat pump capacity and efficiency. The minimum allowable source water temperature is 50-55°F (10°- 13°C). For conditions outside of these parameters, consult the factory.

3. WATER QUALITY

3.1. Colmac Heat Pump Water Heaters use stainless steel, copper brazed, plate heat exchangers (condensers) to transfer heat from the condensing R-134a refrigerant to water. Standard heat pump units are supplied with copper water piping and condensers which may be affected by poor quality water. Following are guidelines for determining the acceptability of standard copper construction in terms of water quality.

3.2. One very general method of describing water quality is Total Dissolved Solids, TDS, in Parts Per Million, ppm. In broad terms:

100 ppm or less TDS = good quality drinking water
500 ppm TDS = marginally drinkable water

1200 ppm TDS = considered "brackish" water

3.3. Standard HPA/HPW units with copper condensers should operate acceptably with water having up to 500 ppm TDS provided there are no sulfides (i.e. Hydrogen Sulfide) present.

3.4. If sulfides are present and/or TDS is 500 ppm or higher, then Nickel brazed condensers must be used. The Colmac factory must be consulted regarding pricing for these special units.

3.5. Cleaning of the condensers should not be necessary under most conditions (even with marginal quality water) for the following reasons:

3.5.1. Turbulence of the water flowing through the condenser tubing will keep solids in suspension.

3.5.2. Surface temperatures in the condenser are normally below the level at which calcification will occur.

3.5.3. This has been confirmed by field experience in Hawaii and elsewhere.

3.6. If condensers must be cleaned, an organic acid (vinegar) solution flushing procedure can be performed (see Section 8.24 on De-liming).

3.7. If there are further concerns and questions about specific cases of poor quality water, then the following information should be obtained and relayed to Colmac:

- What is the pH?
- What is the Calcium level?
- What is the Alkalinity?
- Are Chlorides present? If so, in what amounts?
- Are Sulfides present? If so, in what amounts?

These values should be within the limits of the following:

WATER QUALITY GUIDE FOR COPPER BRAZED PLATE HEAT EXCHANGERS

Table 1 - Influence of Chloride on Corrosion Resistance at Varying Temperatures

CHLORIDE	**MAXIMUM TEMPERATURE**			
CONTENT	60°C	80°C	120°C	130°C
= 10 ppm	SS 304	SS 304	SS 304	SS 316
= 25 ppm	SS 304	SS 304	SS 316	SS 316
= 50 ppm	SS 304	SS 316	SS 316	Ti / 254 SMO
= 80 ppm	SS 316	SS 316	SS 316	Ti / 254 SMO
= 150 ppm	SS 316	SS 316	Ti / 254 SMO	Ti / 254 SMO
= 300 ppm	SS 316	Ti / 254 SMO	Ti / 254 SMO	Ti / 254 SMO
> 300 ppm	Ti / 254 SMO	Ti / 254 SMO	Ti / 254 SMO	Ti / 254 SMO

Table 2 - Influence of Water Composition on Corrosion Resistance

+	Good resistance under normal conditions
0	Corrosion problems may occur especially when more factors are valued 0
-	Use is not recommended

			Plate Material			Brazing Material		
WATER CONTENT	TIME LIMITS Analyze before	CONCENTRATION (mg/l or ppm)	AISI 304	AISI 316	254 SMO	COPPER	NICKEL	Stainless
Alkalinity (HCO3-)	Within 24 h	< 70	+	+	+	0	+	+
		70-300	+	+	+	+	+	+
		> 300	+	+	+	0/+	+	+
Sulphate[1] (SO42-)	No limit	< 70	+	+	+	+	+	+
		70-300	+	+	+	0/-	+	+
		> 300	+	+	+	-	+	+
HCO3- / SO42-	No limit	> 1.0	+	+	+	+	+	+
		< 1.0	+	+	+	0/-	+	+
Electrical conductivity	No limit	< 10 µS/cm	+	+	+	0	+	+
		10-500 µS/cm	+	+	+	+	+	+
		> 500 µS/cm	+	+	+	0	+	+
pH [2]	Within 24 h	< 6.0	0	0	0	0	+	+
		6.0-7.5	+	+	+	0	+	+
		7.5-9.0	+	+	+	+	+	+
		>9.0	+	+	+	0	+	+
Ammonium (NH4+)	Within 24 h	< 2	+	+	+	+	+	+
		2-20	+	+	+	0	+	+
		>20	+	+	+	-	+	+
Chlorides (Cl-) Please also see 100-200 table below	No limit	<100	+	+	+	+	+	+
		100-200	0	+	+	+	+	+
		200-300	-	+	+	+	+	+
		>300	-	-	+	0/+	+	+
Free chlorine (Cl2)	Within 5 h	< 1	+	+	+	+	+	+
		1-5	-	-	0	0	+	+
		> 5	-	-	-	0/-	+	+
Hydrogen sulfide (H2S)	No limit	< 0.05		+	+	+	+	+
		>0.05		+	+	0/-	+	+
Free (aggressive) carbon dioxide (CO2)	No limit	< 5	+	+	+	+	+	+
		5-20	+	+	+	0	+	+
		> 20	+	+	+	-	+	+
Total hardness (°dH)	No limit	4.0-8.5	+	+	+	+	+	+
Nitrate[1] (NO3-)	No limit	< 100	+	+	+	+	+	+
		> 100	+	+	+	0	+	+
Iron[3] (Fe)	No limit	< 0.2	+	+	+	+	+	+
		> 0.2	+	+	+	0	+	+
Aluminium (Al)	No limit	< 0.2	+	+	+	+	+	+
		> 0.2	+	+	+	0	+	+
Manganese[3] (Mn)	No limit	< 0.1	+	+	+	+	+	+
		> 0.1	+	+	+	0	+	+

3.8. Colmac water source heat pump water heaters (HPW) use stainless steel, copper brazed, plate heat exchangers (evaporators) to transfer heat from the source water to the evaporating R-134a refrigerant. Mechanical filtration is an important consideration on the source water side of the water source heat pump. ***If the potable or source water contains particles larger than 0.04 inches (1 mm), Colmac recommends a strainer with a size of 16-20 mesh (number of openings per inch) is installed before the source water evaporator***. Failure to meet this requirement will result in fouling of the heat exchanger channels causing poor performance, increased pressure drop, and risk of freezing. See Colmac document 940126-0003 for more information on strainer use in potable and source water piping.

CAUTION

4. EQUIPMENT SIZING

4.1. Proper selection and sizing of Colmac heat pumps is determined by several factors including:

- Size and orientation of the storage tank.
- Supply water temperature.
- Delivered water (tank) temperature.
- Total daily volume of hot water.
- Usage pattern (load profile).
- Tank and line losses.
- Inlet air temperature and humidity (air source heat pumps).
- Source water temperature (water source heat pumps).

4.2. Consult Colmac Sales staff for assistance in correctly sizing air and water source heat pumps and storage tanks for a given application.

5. STORAGE TANK SIZING

5.1. The storage tank performs three important functions:

5.1.1. Allows the system to meet periods of high peak hot water demand.

5.1.2. Provides the water temperature stratification required by the HPA/HPW for efficient operation.

5.1.3. Properly sized storage volume with correct aquastat differential setting prevents short cycling.

5.2. HPAPro Software

5.2.1. Colmac provides at no charge to its representatives and distributors a complete engineering software package for proper selection of air and water source heat pump water heaters. HPAPro software allows the user to accurately size heat pumps and matching storage tanks. The program also performs energy savings calculations and contains detailed engineering specifications for all heat pump models.

6. INSTALLATION

6.1. Inspection

6.1.1. Upon receipt of equipment, inspect for shortages and damage. Any shortage or damage found should be noted on delivery receipt; this action notifies the carrier a claim is intended to be filed. If any shortage or damage is discovered after unpacking the unit, call the delivering carrier for a concealed damage or shortage inspection. The inspector will need related paperwork, delivery receipt, and any information indicating their liability for the damage.

6.1.2. Also check the electrical characteristics on nameplate of unit to be certain unit is compatible with the power supply.

6.1.3. Remove all **red** shipping brackets and bracing applied to unit. Any red shipping brackets, wood bracing or blue or pink packaging foam need to be removed prior to machine start up. See Figure 1 below.

Figure 1 - Example of Red Shipping Bracket

6.2. Mounting

6.2.1. Rigging: Units are crated and shipped in an upright position. After uncrating, use of nylon slings is recommended for lifting the unit.

6.2.2. Compressor: The hermetic compressor in the heat pump is mounted on four rubber mounts for vibration isolation. No adjustments to the four (4) bolts in the compressor mounting feet are necessary. Remove any shipping shims if present. In the case of scroll compressors (by Copeland), vibration isolation is by springs which require adjustment at the time of installation.

6.2.3. Mounting: Anchor the machine in compliance to local machine mounting codes and seismic restrictions. Failure to restrain the machine may lead to movement due to vibration, which may result in machine damage. Machines must be oriented and handled in the vertical upright position.

6.2.4. Curb Mount: When mounting the heat pump on a curb or on structural beams, isolate the unit from the building with cork type pads or vibration isolation springs. Optional Spring Isolation Kits are available for all air and water source heat pumps.

6.2.5. Machine frame: Machines are not designed to support any additional loads, other than the machine structure. If units are to be suspended or stacked, a separate frame work should be considered.

6.2.6. Location: Position the heat pump so the unit can be easily serviced through access panels. Minimum distance from the unit to any wall is 24 inches (610 mm) for this reason. On air source heat pumps, the air inlet (evaporator coil) and outlet (fan discharge) must be unrestricted. Units with horizontal discharge fan arrangement should be mounted with a minimum of 4 feet (1219 mm) from the fan outlet to closest wall. Units with vertical air discharge can be located no closer than the 24 inches (610 mm) minimum mentioned above. ***Reference the installation drawing associated to the model to be installed for specific clearances***. Consideration of surrounding equipment should be accounted for in the event of water leaks.

6.3. Electrical

6.3.1. Supply: Supply wiring is single point in the unit control panel. Fused disconnect, if required, is supplied by others. Refer to the wiring diagram attached to the unit. Supply wire sizing and routing shall be considered and supplied by others, consistent with the load requirements and components of the equipment supplied by Colmac.

6.3.2. Control: Control wiring is single point in the unit control panel. The basic heat pump control circuit will require a normally open contact closure from the aquastat for the heat pump run signal. Heat pumps which utilize the remote heat rejection option will require additional control wiring from the room thermostat. Refer to the wiring diagram attached to the unit.

6.3.3. Wire Size: Incoming line conductors must be sized according to national and local codes for the voltage, and amperage shown on the unit nameplate. Heat pump control leads (aquastat and room thermostat) must be a minimum of 14 AWG. Use only copper conductors for all field wiring.

6.3.4. Source Water Circulating Pump: Source water circulating pump is to be appropriately sized for the source water system and is to be provided by others. A contact set will be provided in the water source heat pump (HPW) control circuit for starting and stopping the source water pump. Pump power circuitry hardware, circuit protection and contactors by others.

6.3.5. Consistent power quality electrical supplies shall be provided for all operating conditions. Considerations of the equipment requiring operation in poor power quality environments may result in additional cost to the equipment in supplemental parts and labor, and shall be assumed by the equipment owner. Warranty conditions shall be invalidated in poor power quality conditions.

6.3.6. The quality of electrical power may be described as a set of values of parameters, such as:

6.3.6..1. Continuity of service
6.3.6..2. Variation in voltage magnitude
6.3.6..3. Transient voltages and currents
6.3.6..4. Harmonic content in the waveforms for AC power

6.3.7. Examples of possible variations:

Variations in the peak or RMS, when the RMS voltage exceeds the nominal voltage by 10 to 80% for 0.5 cycles to 1 minute, the event is called a "swell."

Sag: the RMS voltage is below the nominal voltage by 10 to 90% for 0.5 cycles to 1 minute.

Random or repetitive variations in the RMS voltage between 90 and 110% of nominal can produce a phenomenon known as "flicker."

Abrupt, very brief increases in voltage called "spikes," "impulses," or "surges," generally caused by large inductive loads being turned off, or by severely by lightning impacting voltage supplies.

"Under voltage" occurs when the nominal voltage drops below 90% for more than 1 minute.

"Overvoltage" occurs when the nominal voltage rises above 110% for more than 1 minute.

Variations in the source frequency.

Variations in the wave shape – usually described as harmonics.

Each of these power quality problems has a different cause. Some problems are a result of the shared infrastructure.

Electrical supply quality should be provided within standard NFPA 79 as listed below:

- (NFPA 79 : 4.3.2.1) Voltage. The electrical equipment shall be designed to operate correctly where the steady-state supply voltage is from 90% to 110% of the nominal voltage.
- (NFPA 79 : 4.3.2.5) Voltage Impulses. The electrical equipment shall be designed to operate correctly where the supply voltage impulses do not exceed 1.5 milliseconds in

duration with a rise/ fall time between 500 nanoseconds and 500 microseconds. A peak supply voltage impulse shall not exceed more than 200% of the rated supply voltage (RMS value).

- (NFPA 79 : 4.3.2.6) Voltage Interruption. The electrical equipment shall be designed to operate correctly where the supply voltage is interrupted at zero voltage for not more than 3 milliseconds at any random time in the supply cycle. The time interval between successive voltage interruptions shall be more than 1 second.
- (NFPA 79 : 4.3.2.7) Voltage Dips. The electrical equipment shall be designed to operate correctly where the supply voltage dips do not exceed 20% of the peak voltage of the supply for more than one cycle. The time interval between successive dips shall be more than 1 second.

6.3.8. Electrical supply design reviews by certified professionals are recommended for local conditions in consideration of the operation of the heat pump and its components.

6.4. Water Piping

6.4.1. General: For proper heat pump operation it is important to plumb the water piping and storage tanks as indicated in the appropriate piping diagrams. **Refer to Colmac Engineering Bulletin 940126-0003**.

6.4.2. All piping diagrams show non-vented pressurized systems. Vented non-pressurized systems are not recommended.

6.4.3. System piping should be plumbed and storage tanks installed in accordance with all local and national codes that apply.

6.4.4. A Pressure Temperate (P-T) type relief valve is required on all non-vented pressurized tank, as shown in the piping diagrams.

6.4.5. Insulation: It is highly recommended all hot water piping and storage tanks be insulated for energy efficiency.

Outdoor applications: Fiberglass with aluminum sheathing is preferred for piping and tanks (also sprayed foam for tanks).

Indoor applications: Fiberglass with paper sheathing is preferred for piping and tanks (also sprayed foam for tanks). Closed cell foam is acceptable for piping and tanks where permitted.

6.4.6. Pipe Sizing: System piping shall be sized for the minimum allowable water flow rate required for the heat pump.

6.4.7. Existing Water Storage Tanks: The use of existing resistance heat water tanks is permitted when the tank volume is suitable for the job application.

CAUTION

6.4.8. The use of existing gas water heaters and boiler as storage tanks is not recommended due to high standby losses.

CAUTION

6.4.9. Using the existing water tanks without proper cleaning can result in fouling of the internal water piping and may cause damage to the system water pump. The use of existing water storage tanks is permitted only if measures are taken to remove all accumulated scale deposits in the tank.

6.4.10. Strainers should be added to all water inlet lines to filter out sediment and particulates before they reach the Heat Pump (strainer on potable water inlet of HPA and strainers on both potable water inlet and source water inlet on HPW).

6.5. Booster Pump

6.5.1. In piping systems where the heat pump is located far away from the storage tanks (greater than the maximum allowable external water pressure drop), it will be necessary to install a booster pump to maintain the minimum required flow rate. See the pump manufacturers design data for the required flow rate and pressure.

6.6. Net Positive Suction Head (NPSH)

6.6.1. This term is defined as the water pressure required at the inlet of the pump to cause water to flow (and prevent cavitation). NPSH can be calculated as follows:

6.6.2. NPSH = Barometric Pressure + Static Pressure on Pump Suction - Friction losses in Suction Piping - Vapor Pressure of Water

6.6.3. Normally with non-vented, pressurized hot water systems, NPSH is high enough to prevent cavitation. Vented, non-pressurized systems are not recommended unless special care is taken to prevent cavitation of the water circulating pump. Cavitation can lead to pump failure not covered by warranty.

6.7. Condensate Drain

6.7.1. During normal operation of air source heat pumps, the air drawn into the heat pump is dehumidified producing condensate on the surface of the evaporator coil. This condensate is collected in the coil drain pan and must be piped away to a suitable drain system. There is a drain connection provided on all air source heat pumps for draining the condensate from the unit. This connection is located on the underside of the heat pump base. Pipe the condensate drain with a "P" trap to prevent drain system air from being drawn back into the unit.

6.8. Aquastat

6.8.1. General: Heat pump water heaters are controlled by a remote aquastat, which senses storage tank temperature and turns the heat pump on and off to maintain a preset temperature. Typical aquastat installations include the aquastat control unit, a sensing bulb, and a bulb well. The aquastat control will be installed and wired by the job contractor.

6.8.2. Sensing Bulb: The use of a sensing bulb well with thermal mastic is highly recommended for installing the aquastat sensing bulb. This will result in greater accuracy and much faster response times than surface mounted sensing bulbs. The location of the sensing bulb on the tank will depend on tank orientation and piping arrangement. Refer to the piping diagrams.

6.8.3. Wiring: The aquastat will provide the heat pump run signal through a set of normally open contacts on the aquastats output relay. As hot water is used the storage tank temperature will fall. When the water temperature reaches the aquastat set point (minus differential) the normally open contacts will close to start the heat pump. Refer to the appropriate wiring diagram included with the heat pump.

CAUTION

6.8.4. **Normally open contacts on aquastat must be non - powered**. Damage will result to the heat pump control circuits if voltage is applied to the control terminals.

6.8.5. Aquastat Settings: The aquastat has two adjustments, Set point and Differential, which must be set properly by the installer for the water heating system to operate correctly.

6.8.6. The Set point is the temperature at which the aquastat contacts open and stop the heat pump.

6.8.7. The Differential is the temperature difference between the Set point and the temperature at which the aquastat contacts close and the heat pump starts.

6.8.8. For example, an aquastat with 140°F (60°C) Set point and 10°F (5.6°C) Differential settings would start the heat pump when tank temperature falls to 140° - 10° = 130°F (54.4°C), and stop the heat pump when tank temperature is brought up to 140°F (60°C).

6.8.9. **It is critical to set the Differential large enough so that the heat pump runs for at least 10 minutes once it starts.** This allows oil to circulate properly, compressor windings to cool, Expansion Valve to modulate, etc. The minimum Differential setting to produce 10 minutes of running time is a function of heat pump heating capacity and storage tank volume.

6.8.10. On larger systems where multiple heat pumps are piped in parallel to a common storage tank, an aquastat having more than one stage can be used to sequentially add or shed units to adjust total system heating capacity to the load. For multistage systems, use the following rules for setting aquastat set point and differential for each stage:

Rule 1: Make set point for all stages the same. For example, if desired tank temperature is 140°F (60°C) and the system has 3 stages, then make the aquastat set point 140°F (60°C) for stages 1, 2, and 3.

Rule 2: Give each stage equal heating capacity. For example, in a system having 4 x HPA/HPW, either a 2 stage aquastat with 2 x HPA/HPW on each stage or a 4 stage aquastat with 1 x HPA/HPW on each stage could be used.

6.8.11. Colmac HPAPro Software calculates minimum aquastat differential for any combination of heat pump capacity and tank volume.

7. OPERATION

ELECTRICAL

DO NOT turn the machine on or push any of the controls until you have read and understood the Operating Instructions.

Be familiar with all safety release switches.

Operators and supervisors should check all switches and safety features **EACH DAY** to assure they are operating properly.

Disconnect power **WHENEVER** any maintenance work is to be performed on the machine. Electricity must always be disconnected when changing blower belts. Use of the **"Lockout-Tagout"** method is suggested (Figure 2).

Figure 2 - Locked and Tagged Interlock

Only qualified electricians should open control box doors. Operators and supervisory personnel should never open the control box.

Electric power to the machine should be turned off before the electrician is allowed to open the control box door.

If, for the purpose of locating electrical trouble, it is necessary to have the electricity on to the control box, the electrician should use **EXTREME CAUTION!**

If the electrician or engineer must work on the machine with the electricity on, another person should guard against accidental operation of the controls by others that could result in damage to equipment or personal injury.

Damaged or worn-out electrical parts should be promptly replaced with replacements of same rating as originals.

7.1. e-TCV (Electronic Temperature Control Valve)

7.1.1. General: Colmac heat pump models are supplied with an electronic temperature control valve (e-TCV) as a standard feature. This valve is designed to control the flow of water being circulated through the heat pump in response to refrigerant condensing pressure. By slowing the flow of circulating water during periods when the inlet water temperature to the heat pump is low (during system startup when the system storage tank is full of cold water; for example), this control enables the heat pump to maintain a constant, high outlet water temperature. This means during startup or during periods of high usage the user will still be getting hot water without having to wait for the entire water storage system to heat up.

7.1.2. The e-TCV control is actuated by refrigerant discharge pressure. The control is mounted in the heat pump at the factory and tested prior to shipment. Installation, operation, and maintenance of these controls are described below.

7.1.3. The e-TCV Proportional Pressure Control is mounted in the control panel on the heat pump and is accessed by removing the electrical access panel on the unit. This control allows the installer to adjust the maximum heat pump condensing pressure and so adjusting the maximum leaving water temperature. Lowering the setpoint pressure will lower the leaving water temperature. Raising the setpoint pressure will raise the leaving water temperature.

7.1.4. **NOTE**: It is important to measure the leaving water temperature during operation after the Set Point Potentiometer has been adjusted to confirm desired outlet water temperature. Maximum outlet water temperature will be limited by safety switches designed to protect the compressor.

7.1.5. During operation the Proportional Pressure Control will indicate the control valve actuator position by the LED's on the control. One (1) lighted LED indicates a closed valve position/low flow while all LED's lighted indicate open valve position/high flow. During periods of low inlet water temperatures, the control should show closed valve position. As the tank temperature rises and inlet water temperature to the heat pump increases, the control should show valve position progressively opening eventually to full flow.

7.1.6. Note that the e-TCV control system is factory set such that the valve position can never be fully closed (no flow) while energized.

Prior to Startup

7.1.7. System Piping: Check the water system valve line-up to ensure the heat pump is not isolated from the system and there is make-up water available.

7.1.8. Venting: Ensure the water side of the system has been vented at the system high point and the heat pump water piping is free from air. **Failure to do so can lead to pump failure, and poor performance due to trapped air in the heat exchangers.** In the un-energized state, the e-TCV valve is in the closed position (see Figure 3).

Figure 3 – e-TCV in Closed Position

Prior to energizing the machine, manually cycle the e-TCV valve to the open position while purging the system of air. To do this, press the black trapezoidal button on the side of the valve (see Figure 4), and manually move the lever (Figure 5) to the open position (see Figure 6). Purge the system of air.

Figure 4 - Button For Manual Cycling

Figure 5 - Manually Moving the Lever

Figure 6 - e-TCV in Open Position

> ***WARNING:* *Do not run the circulator pump dry! Failure of the circulator may result. Before starting the circulator, be sure to fill the system completely with water and fully purge ALL air from the lines.***

Return the valve back to the closed position prior to energizing the machine (as shown in Figure 3).

7.1.9. When the circulating pumps are activated with a call for heat during normal operation, the e-TCV valve opens to 35%. This valve opening value may be inadequate to completely purge cartridge type circulator pumps of air. See preceding procedure for air purge process valve settings.

7.1.10. Electrical: Before energizing the heat pump, ensure all electrical connections are tight and the electrical cabinet is in order.

7.1.11. Check incoming voltage at the heat pump disconnect to ensure the proper voltage is available and all phases are present.

7.1.12. Have a Digital Multi Meter available and ready to measure total amperage.

7.1.13. Gauges: A standard set of refrigeration gauges should be installed on the suction and discharge lines to monitor the refrigeration side of the unit during startup.

7.1.14. Three Phase Reverse Rotation: On heat pumps with three phase compressors it is very important to check the compressor for proper rotation. This should be the first item checked during startup.

7.1.15. When the compressor is rotating in the correct direction, on startup the discharge pressure will begin to rise and the suction pressure fall as indicated by the installed service gauges.

7.1.16. Use the Phase Sequence Indicator to correctly identify L1, L2, & L3 power supply wires. The yellow light on the Phase Sequence Indicator will be illuminated when power supply wires are properly identified. When connected to the heat pump terminal block as labeled, the heat pump should run with correct rotation (see wiring diagram).If on startup the suction pressure begins to rise with a corresponding decrease in discharge pressure or if there is an objectionable noise emanating from the compressor, then the compressor is reverse rotating.

7.1.17. If the compressor is reverse rotating, de-energize the heat pump and reverse any (2) of the incoming power supply wires.

7.1.18. When the heat pump is reenergized, proper gauge readings should now be present.

7.1.19. Single phase compressors are not affected by phase reversal.

7.2. Startup

7.2.1. Energize the heat pump power source. The Power On light will illuminate.

7.2.2. If the temperature of the water in the storage tanks is less than the aquastat set point the HW Demand light will illuminate and the time delay relay will begin to time out.

7.2.3. On HPW units the circulation pumps will activate, and the source water pump contacts will close. After the time delay relay times out, the main contractor will close to energize the compressor.

7.2.4. On HPA units, after the time delay relay times out the main contactor will close to energize the compressor, blower, and water pump.

7.2.5. Check for proper rotation on three phase models at this time.

7.2.6. Check the line current with the amp probe, this value should be below the rated full load current stated on the heat pump wiring diagram and the heat pump serial tag.

7.2.7. Monitor the temperature difference between inlet and outlet water. This value should be between 7°F (3°C) and 10°F (7°C) if the heat pump is operating correctly.

7.2.8. On air source units (HPA), monitor the temperature difference between the inlet and out air. The leaving air temperature should be lower than the entering air temperature.

7.2.9. On water source units (HPW), monitor the temperature difference between the incoming and outgoing source water. The leaving water temperature should be lower than the entering water temperature.

7.2.10. Monitor the liquid refrigerant sight glass. It will probably indicate the presence of bubbles. These should clear within the first 30 minutes of operation. Refer to the troubleshooting section of this manual if this condition persists.

7.2.11. The above listed conditions indicate a successful startup. Any deviations from these normal startup conditions should be checked out in the troubleshooting section.

7.2.12. Continue to run the heat pump until it reaches steady state operating conditions before filling out the startup portion of the Warranty Registration Card.

7.2.13. Warranty Registration Card: It is very important to fill out the Warranty Registration Card completely (including startup information) and send it in to the factory. This will allow the factory to document the successful startup.

7.2.14. **NOTE**: The Warranty Registration Card ***must be returned within (10) days*** of installation to validate warranty coverage. A copy of the Warranty Registration Card is included at the end of this manual.

CAUTION

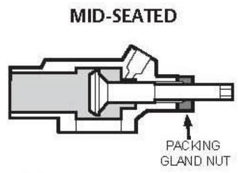
7.2.15. The scroll compressors that are delivered* with threaded Rotalock shut off valves. ***It is strongly recommended to periodically re-torque all fixing connections to the original setting after the system has been put into operation. Initial re-torqueing shall take place 7 days after initial startup.**** Proper tooling should be utilized to ensure Service Valve (King Valve) joints are not damaged. Tooling can be purchased though Colmac to meet machine torque specifications.

Table 3 - Rotalock Torque Values

Torque Values*		
Rotalock Size	**ft-lb**	**N.m**
3/4" - 16 UN	30 - 37	40 - 50
1-1/4" - 12 UN	74 - 81	100 - 110
1-3/4" - 12 UN	125 - 133	170 - 180
2-1/4" - 12UN	140 - 148	190 - 200
Flange w/ M16 bolts	75 - 83	102 - 113
Sight Glass	18 - 19	25 - 25.5
Mounting Bolts 5/16" M9	20 max	27 max

* Information in section 7.2.16 from Emerson Application Engineering Bulletin AE-1361 R1 and Copeland Scroll Compressors Replacement Guideline C05.2.4/1007/E. Rotalocks on units larger than 4 tons.

Figure 7 – Rotalock cross section.



**

When opening and closing the Service Valve (King Valve) the packing gland nut must be loosened ¼ - 1 turn before opening the valve. Turning the valve stem without doing so may damage the packing gland nut. Make sure to tighten it to the correct torque rating, utilizing the correct tooling. Do not use an adjustable Wrench*   22-25ft lbs
Note: ** Emerson form 2002DS-122

7.3. Normal Operation

7.3.1. General: Once the heat pump is operating at steady state condition and the water temperature is up to a higher value 130-140°F (52-60°C) the unit can be checked for normal operation.

7.3.2. The suction and discharge pressures should be similar to the values shown on the provided test report example sheet included at the end of this manual.

7.3.3. Using caution, the amperages of the compressor, blower motor, and water pump(s) can be checked and compared to the full load current indicated on the wiring diagrams included with the heat pump.

7.4. TXV Operation

7.4.1. General: The Thermostatic Expansion Valve (TXV) found in Colmac heat pump water heaters acts to control the amount of refrigerant entering the evaporator coil. The TXV responds to changing load conditions and keeps the heat pump running at optimum efficiency.

7.4.2. Another function performed by this valve is to prevent liquid refrigerant from returning to the compressor and causing damage.

7.4.3. Superheat: The TXV is controlled by Suction Superheat which is defined as the temperature difference between Suction Gas Temperature (measured directly) and Saturated Suction Temperature (found on P-T table using measured Suction Pressure).

7.4.4. It is very important to insure the HPA/HPW heat pump is operating with the proper amount of Suction Superheat.

To Calculate Suction Superheat:Read Suction Pressure using standard refrigeration service gauges. Find R-134a Saturated Suction Temperature (SST) from

- Table 4 or Table 5 below.
- Measure Suction Gas Temperature (SGT) directly using a surface temperature probe at the TXV bulb.
- Calculate: Suction Superheat = SGT - SST

Table 4 - R-134a Pressure-Temperature, IP units

Suction Pressure psig	SST °F	Suction Pressure psig	SST °F	Suction Pressure psig	SST °F
0	-15	24	28	48	53
2	-9	26	30	50	54
4	-9	28	33	55	58
6	0	30	35	60	62
8	4	32	37	65	66
10	7	34	39	70	69
12	11	36	41	75	73
14	14	38	43	80	76
16	17	40	45	85	79
18	20	42	47	90	82
20	22	44	49	95	85
22	25	46	51	100	88

Table 5 - R-134a Pressure-Temperature, SI units

Suction Pressure kPa(abs)	SST °C	Suction Pressure kPa(abs)	SST °C	Suction Pressure kPa(abs)	SST °C
100	-26	220	-8	340	4
110	-24	230	-6	350	5
120	-22	240	-5	375	7
130	-20	250	-4	400	9
140	-19	260	-3	425	11
150	-17	270	-2	450	12
160	-16	280	-1	475	14
170	-14	290	0	500	16
180	-13	300	1	525	17
190	-11	310	2	550	19
200	-10	320	2	575	20
210	-9	330	3	600	22

7.4.5. **NOTE**: Suction Superheat should be between 10°F and 15°F (5.6°C and 8.5°C) during normal operating conditions.

7.4.6. When the heat pump is equipped with a field adjustable TXV, Suction Superheat can be changed if necessary using the following procedure:

- Using two (2) wrenches, remove the TXV service cap (opposite the diaphragm end of the valve).

- To increase Suction Superheat, turn the adjusting stem CLOCKWISE.
- To decrease Suction Superheat, turn the adjusting stem COUNTER-CLOCKWISE.
- When adjusting the TXV, make no more than one turn of the stem at a time and observe the change in superheat closely to prevent over-shooting the desired setting.
- As much as 30 minutes may be required for the new balance to take place after an adjustment is made.
- After completing the adjustment, replace and tighten the service cap.

7.4.7. **NOTE**: The TXV used on Colmac heat pumps uses an M.O.P. (Maximum Operating Charge) to prevent excessive suction pressures during periods of very high entering air temperature. Superheat adjustments can only be made when the Suction Pressure reads 60 psig or less.

7.5. Time Delay Relay

7.5.1. General: **All Colmac heat pumps incorporate a time delay relay in the heat pump electrical control circuit.** The time delay relay reduces the possibility of compressor short cycling. Compressor short cycling is when the compressor attempts to start too often in a short period of time. The result of this frequent starting would be to overheat the compressor motor windings because of insufficient runtime.

7.6. Enunciator Lights

7.6.1. There are several enunciator lights (number varies by model) which indicate the following:

- Power On - Illuminates when power is applied to the heat pump.
- HW Demand - Illuminates when the water temperature has fallen below the aquastat set point.
- AC Demand - On units with remote heat rejection, this light illuminates when the room temperature has fallen below the room thermostat set point.
- High Press Fail - Illuminates when the high pressure cutout switch receives a high pressure signal.
- Low Press Fail - Illuminates when the low pressure cutout switch receives a low pressure signal.
- Phase Failure – Illuminates when any one of the following conditions exist:
    - Low Voltage
    - High Voltage
    - Phase Imbalance
    - Loss of Phase

- Phase Reversal

- Oil Press Fail – Illuminates when there is insufficient oil pressure for safe compressor operation.

- Low Flow (source water) – Illuminates when there is insufficient source water flow (only for water source units).

- Low Temp (source water) – Illuminates when the source water temperature falls below 37°F (2.7°C) to prevent freezing of the source water components and piping (only for water source units).

7.7. Status Lights

7.7.1. Depending on model there are three status lights on the exterior of the heat pump (some skinned units with lift off panels).

- The red light indicates an alert or error.

- The amber light indicates a call for heat.

- The green light indicates the unit is running and producing hot water.

7.8. Safety Switches

7.8.1. The refrigerant system has (2) safety cutout switches which will prevent the heat pump from running in the following cases:

Low Pressure Cutout - Stops the heat pump when refrigerant suction pressure decreases to 5 psig. The switches normally open contacts close to energize a latching relay. This relay energizes the Low Press Fail light and de-energizes the main contactor.

High Pressure Cutout - Stops the heat pump when refrigerant discharge pressure increases to 400 psig. The switches normally open contacts close to energize a latching relay. This relay energizes the High Press Fail light and de-energizes the main contactor.

7.8.2. Resetting the unit: The above conditions generally indicate the heat pump needs attention from a qualified service technician.

7.8.3. The above conditions will lock out the heat pump electrically until the main power has been de-energized and reenergized.

8. MAINTENANCE

ELECTRICAL

DO NOT turn the machine on or push any of the controls until you have read and understood the Operating Instructions.

Be familiar with all safety release switches.

Operators and supervisors should check all switches and safety features **EACH DAY** to assure they are operating properly.

Disconnect power **WHENEVER** any maintenance work is to be performed on the machine. Electricity must always be disconnected when removing lint screen or changing blower belts. Use of the **"Lockout- Tagout** method is suggested (Figure 2).

Figure 8 – Locked and Tagged Interlock

Only qualified electricians should open control box doors. Operators and supervisory personnel should never open the control box.

Electric power to the machine should be turned off before the electrician is allowed to open the control box door.

If, for the purpose of locating electrical trouble, it is necessary to have the electricity on to the control box, the electrician should use **EXTREME CAUTION!**

If the electrician or engineer must work on the machine with the electricity and/or air on, another person should guard against accidental operation of the controls by others that could result in damage to equipment or personal injury.

Damaged or worn-out electrical parts should be promptly replaced with replacements of same rating as originals.

8.1. Air Filter (Air Source Units)

8.1.1. To ensure proper operation the heat pump air filters should be cleaned on a regular basis. Dirty filters that restrict air flow across the evaporator coil will reduce water heating capacity and may adversely affect heat pump components.

8.1.2. The standard air filter can be cleaned with a mild soap and water. Care should be taken to avoid damaging the filter with a high pressure water stream. The larger optional filter requires replacement when fouled.

8.1.3. Air Filters are recommended on all air source heat pumps.

8.2. Evaporator Coil (Air Source Units)

8.2.1. Drain pan: The drain pan and drain tube should be cleaned and checked regularly to prevent fouling.

8.2.2. P-trap: The P-trap should also be checked regularly. If a Colmac P-trap was used, it can be cleaned via a removable plug.

8.2.3. Evaporator fins should be maintained in straightened condition and free of contaminates that could contribute to moisture retention and premature failure. A regular schedule for vacuuming the exterior coil surface should be implemented. This is especially important if air filters are not employed.

8.3. Blower Belts and Bearings (Air Source Units)

8.3.1. Lubrication of the pillow block bearings and drive belt inspection should take place at regular intervals on all HPA units larger than 4 tons equipped with centrifugal fans. Refer to Table 6 for lubrication intervals.

Table 6 - Lubrication Intervals

Bearing Operating Temperature	Environmental Condition		
°F	**Clean**	**Dirty**	**Washdown or Extremely Dirty**
Up to 122	12 months	6 months	3 months
Up to 156	6 months	2 months	1 month
Up to 212	3 months	2 weeks	1 week
Up to 248	6 weeks	1 week	3 days
Up to 302	2 weeks	3 days	daily

CAUTION

8.3.2. Compatibility: **Do not mix greases!** When two incompatible greases are mixed, the mixture will either harden and will not release any of the oil, or soften and releases all of the oil. In either case, the bearing is not effectively lubricated. **Colmac Industries uses and recommends: Lubrication Engineers 1250 ALMASOL High Temperature Lubricant.**

8.3.3. The bearing seals should be maintained to ensure long life. Pushing excessive lubrication into bearing can cause seal (B in Figure 9) displacement, damaging ball lubricity capacity. The lubrication tubes on the bearings are pre-charged and require very little pressure to advance lube. Excessive lube pressure to the lubrication line will displace the tube from bearing fitting due to hydraulic pressure, and damage the access port. Take caution not to damage lubrication tubing (see Figure 10 and Figure 11).

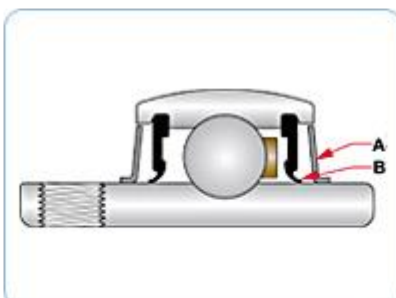


Figure 9 - Standard Single Lip Seal

Figure 10 - Excessive Lubrication Damage

Figure 11 - Excessive Lubrication Damage

8.3.4. Mounting Instructions (Accu-Loc)

1. Inspect the Shaft
    a. Measure the shaft to ensure it is within the recommended tolerances per Table 7.

Table 7 - Recommended Shaft Tolerances

Inch Size Shafting	Metric Size Shafting
Shaft Diameter up to 1-15/16" Nominal to -0.0005"	Shaft Diameter up to 45 mm Nominal to - 0.013 mm
Shaft Diameters 2" to 4-7/16" Nominal to - 0.0010"	Shaft Diameters 50 mm to 140 mm Nominal to - 0.025 mm

    b. Check for any nicks or burrs that might percent the bearing from sliding on the shaft easily.
    c. Clean the mounting surface, and then apply a film of light weight oil.
2. Place the bearing on the shaft
    a. Do not hammer the bearing onto the shaft
3. Bolt the housing to the mounting surface
    a. Use plain washer under the mounting bolt heads to span the slot width.
    b. The bearing and shaft must be aligned to within 2 degrees.
    c. Rotate the shaft to ensure it rotates smoothly and freely.
4. Fasten the unit to the shaft
    a. Place the locking collar on the tangs of the inner bearing ring with the chamfered corner (see Figure 127) on the bore of the collar towards the bearing. The collar is stamped with the word “FRONT” on one side. This side should be facing away from the bearing and should be readable to the installer.

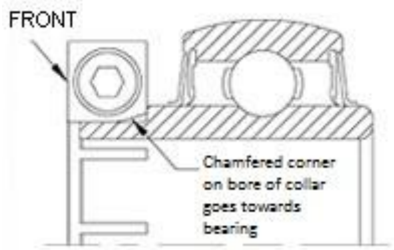


Figure 127 - Collar Placement

b. Tighten the capscrew to the recommended tightening torque per Table 8 using a variable torque wrench.

Table 8 - Recommended Tightening Torque of Accu-Loc Collar Capscrews

Applicable Bearing #	Recommended Tightening Torque (in-lb)	
	Black Oxide Finish	Kanigen Corrosion Resistant
UE204-206	70	30
UE207-208	90	45

8.4. Source Water Strainer (Water Source Units)

8.4.1. Y-strainers are to be flushed periodically to remove any particulate that may accumulate. Frequencies of flushes are dependent on water quality.

Electrical Connections

8.4.2. When performing periodic maintenance and while the heat pump is de-energized all electrical connections should be checked to ensure they are tight. Loose electrical connections can cause high resistance connections that will lead to failure of the terminal.

8.5. Safety

WARNING

8.5.1. De-energize all electrical power sources before attempting to service any heat pump.

WARNING

8.5.2. Before brazing on any piping system, ensure the system is depressurized and vented to atmosphere.

8.6. Refrigerant

8.6.1. The refrigerant used in the HPA/HPW heat pumps is R-134a. This refrigerant is an HFC and therefore has no Ozone Depletion Potential.

8.6.2. Only qualified refrigeration technicians should perform maintenance on any refrigeration system and they must comply with any local or national codes that apply.

8.7. Refrigerant Oil

8.7.1. Colmac heat pumps use R-134a refrigerant and POE (polyolester) oil. This oil is very hygroscopic (will absorb moisture from air) and therefore care should be taken to minimize the time the system is open to the atmosphere during repairs. Make sure all the needed components and supplies are available prior to starting any repair procedure.

CAUTION

8.7.2. Do not mix refrigeration oils. Use only the oil that is named on the compressor label. Refer to compressor manufacturer specifications for type and volumes of required oil.

8.7.3. POE* = Copeland® Ultra 22 CC, Copeland® Ultra 32 CC, Copeland® Ultra 32-3MAF ,Mobil EAL™ Arctic 22 CC or Uniqema RL32-3MAF

*Emerson Form No. 93-111R17

8.8. Refrigerant Gauge Ports

8.8.1. Standard access valve ports (with valve cores) are provided on the suction and discharge lines. The ports will accommodate standard refrigeration gauges and can also be used for evacuation and charging. Replace port caps after access.

8.9. Access Panels

8.9.1. During normal operation all panels should be in place and secured with fasteners to prevent unauthorized access.

8.10. Troubleshooting

8.10.1. Use Table 9 to diagnose heat pump problems.

Table 9 - Colmac HPA/HPW Troubleshooting Chart

PROBLEM	OBSERVATION	POSSIBLE CAUSE(S)	REMEDY
#1 Unit not running, no hot water.	High pressure light on.	Aquastat setting too high.	Reduce aquastat temperature setting.
		Faulty high pressure switch.	Replace high pressure switch.
		Loss of water supply to the HPA/HPW.	Check water flow to the HPA/HPW.
		Pump has stopped operating.	Check pump wiring. Replace pump if necessary.
		Aquastat has failed (closed).	Replace aquastat.
	Low pressure light on.	Faulty low pressure switch.	Replace low pressure switch.
		Fan motor is not operating properly.	Check fan motor wiring. Replace motor if necessary.
		Loss of refrigerant.	Check refrigerant piping for leaks. Add refrigerant until sight glass is clear.
		Flow through evaporator restricted or blocked.	Remove any material which may be blocking evaporator coil. Clean coil if necessary with a warm soapy water solution. Back flush brazed plate version evaporators.
		Air filter is blocked with dirt.	Remove and clean air filter with a warm, soapy water solution.
		Filter dryer restricted or blocked.	Replace filter dryer.
		TXV has failed in closed position.	Clean and/or replace TXV internals if necessary. Check power element and replace if necessary
	No lights on.	Main fuses failed.	Replace fuses.

PROBLEM	OBSERVATIONS	POSSIBLE CAUSE(S)	REMEDY
#2 Unit runs but no hot water (or reduced capacity).	Suction pressure reads low with clear sight glass.	Flow through evaporator restricted or blocked.	Remove any material which may be blocking evaporator coil. Clean coil if necessary with a warm soapy water solution. Back flush brazed plate version evaporators.
		Air filter is blocked with dirt.	Remove and clean air filter with a warm soapy water solution.
		Fan motor is not operating properly.	Check fan motor wiring. Replace motor if necessary.
	Suction pressure reads low and sight glass shows bubbles.	Low refrigerant charge.	Check refrigerant piping for leaks. Add refrigerant until sight glass is clear.
		Filter dryer restricted or blocked	Replace filter dryer
	Discharge pressure reads high	Air trapped in the water tube of the condenser.	Bleed all air from the water system.
		Water pump beginning to fail (insufficient water flow).	Check operation of pump and replace if necessary.
		Air or other non-condensable in the refrigerant system.	Remove refrigerant from the HPA/HPW. Evacuate and recharge with R-134a.
		Unit is overcharged with refrigerant.	Remove refrigerant until normal operating condensing pressures are observed.
		Condenser surface fouled.	Flush water piping and condenser with acetic acid solution.
	Compressor runs but suction and discharge pressures are equal.	Compressor failure.	Replace compressor.
	Fan and pump run but compressor not running.	Compressor internal overload (tripped).	Allow compressor to cool and restart.
	Compressor runs noisy and suction pressure reads higher than discharge pressure.	Three phase compressor is running backwards.	Switch any two (2) supply voltage wires to the HPA/HPW.

8.11. Leak Repair/Brazing

8.11.1. Care should be taken to use good refrigeration service techniques when repairing the heat pump.

8.11.2. Always follow all of the component manufacturers' instructions when installing or servicing individual components.

8.11.3. When repairing water system leaks it will be necessary to isolate the heat pump from the water system and drain the heat pump piping before brazing.

8.11.4. When replacing any refrigeration system component it is recommended the filter drier be replaced also.

8.11.5. On all copper to copper joints 15% silver solder should be used.

8.11.6. On all copper to steel or copper to copper plated steel joints 56% silver solder with paste flux should be used, insulate behind braze to reduce heat transfer to other components. Overheating of Condenser plates, Service Valves (King Valves), TXV Valves, will cause failure. Wet ragging techniques should be considered.*

*Emerson form 2002DS-122

8.11.7. The following general procedures can be used for replacing refrigeration system components.

8.12. Removal of existing refrigerant charge

8.12.1. Ensure the proper replacement parts are on hand before starting any repair procedure.

8.12.2. If heat pump has a refrigerant charge present then that charge needs to be recovered according to local and national laws using appropriate recovery and recycling equipment.

8.12.3. Typically this refrigerant is recovered to a refrigerant bottle. If the refrigerant is suspected to be contaminated it must be recycled (cleaned) at an appropriate facility for future use. If the refrigerant is not contaminated and good recovery techniques are used, it can be placed back into the original equipment after repairs are complete.

8.13. Removal of defective components

8.13.1. The refrigeration system piping should remain vented while brazing to prevent a buildup of pressure.

8.13.2. Use a nitrogen gas purge when brazing if possible to prevent the formation of internal scale in the system piping.

8.13.3. When brazing at high temperatures it is necessary to protect the components that are not being removed from the high heat to prevent damage. This can be done by using wet rags to wrap the heat sensitive components. You can also utilize small pieces of sheet metal to act as barriers between the torch flame and any other item that needs to be protected (insulation, cabinet sheet metal, or wiring). Usually it is not necessary to protect the defective component from the heat.

8.13.4. After the brazing preparation is complete identify the joints/connections where the component/piping will be separated.Apply heat at the first joint and at the same time grasp the component or pipe with a pair of pliers or similar tool so that the component can be pulled free from the pipe when the solder melting temperature has been reached.

8.13.5. After the first connection has been separated then proceed to the second joint and repeat the above step.

8.13.6. When the TXV is being removed the ¼ inch equalizing tube must also be de-brazed from the TXV.

8.13.7. Care should be taken not to let foreign materials or water enter any of the open piping or component ends.

CAUTION

8.13.8. ***If pipes are required to be cut, use a pipe cutter to sever pipe. Saws produce shavings that can travel through the system under pressure and foul otherwise functional components.***

8.14. Installation of new components

8.14.1. Check the new component/assembly for proper fit up by holding it up to the free pipe ends.

8.14.2. Use wet rags to completely wrap the new component. This will prevent damage due to overheating. Do not allow any water from the wet rag to enter any of the replacement components/assemblies.

8.14.3. Braze in the new component using proper brazing techniques. It may be necessary to heat a previously soldered connection so the new component will slide onto it.

8.14.4. Apply heat to the first connection and then apply the silver solder to the entire pipe circumference so a leak free braze joint is formed.

8.14.5. Repeat the above step for the second connection.

8.14.6. Repeat the above step for the TXV equalizing tube if the TXV is being replaced.

8.14.7. After brazing is complete, allow the piping and components to return to ambient temperature (this can be hastened by applying wet rags).

8.15. Leak Test

8.15.1. After the system has returned to ambient temperature proceed with leak testing.

8.15.2. Attach a set of standard refrigeration gauges to the suction and discharge access valves.

8.15.3. Pressurize the system with 400 psig of pure nitrogen gas via the “common” gauge port (gauge valves open).

8.15.4. Isolate the Nitrogen supply and note the pressure reading.

8.15.5. Allow the system to remain in this condition while performing a leak check with a soapy water solution.

8.15.6. Apply the soapy water solution to all connections that were previously worked on as well as the hose/gauge connections. Bubbles will form in the soapy water solution wherever a leak is located.

8.15.7. If leaks are found then the nitrogen must be bled off and the gauges removed for additional brazing. Be sure to check any solder connections that may have been loosened during the initial brazing operation.

8.15.8. If no leaks are found utilizing the soapy water solution then allow the system to remained charged with nitrogen for a minimum total of (3) hours (preferably overnight). At the end of this time period, check the pressure reading of the gauges. They should be unchanged from the previous readings (except for changes due to a change in ambient temperature).

8.16. Evacuation

8.16.1. Prepare an evacuation pump for evacuation of the system by ensuring there is fresh refrigeration oil in it and the connections are in good working order. There should also be a vacuum gauge in line with the system. This gauge should be able to be isolated from the evacuation pump to determine the system vacuum level.

8.16.2. Connect the evacuation pump to the “common” gauge connection and energize.

8.16.3. Allow the evacuation pump to run for several hours.

8.16.4. Check the vacuum gauge reading. If the reading is less than 500 microns, isolate the evacuation pump from the system. Allow the reading to stabilize. If the vacuum maintains a reading below 500 microns for 10 minutes, close the gauges isolation valves. Shutdown the evacuation pump, then proceed to charging.

8.16.5. If the reading goes above 500 microns, continue to pump down. If the vacuum reading cannot be maintained below 500 microns after pumping down overnight then the system will need to be checked for leaks again.

8.16.6. If replacing refrigeration on a unit that has been run, use best practices to ensure refrigeration is evacuated from the oil.

8.17. Refrigerant charging

8.17.1. Ensure the gauge isolation valves are closed.

8.17.2. Locate a bottle of R-134a refrigerant with enough refrigerant to completely charge the system (charge quantity is indicated on the unit nameplate).

8.17.3. Attach one end of a refrigerant charging hose to the refrigerant bottle.

8.17.4. Attach the other end to the “common” gauge port of the charging gauge set (do not tighten this connection at this time).

8.17.5. Crack open the bottle isolation valve to allow a small quantity of refrigerant vapor to purge the line. This vapor should be escaping from the “common” gauge port connection. After a few seconds of purging, tighten the hose connection on the “common” gauge port.

8.17.6. The refrigerant charge should be added to the unit through the suction gauge and port connection.

8.17.7. If the heat pump is being charged for the first time, break the vacuum (see Section 8.17) with refrigerant vapor. Energize the unit. Add refrigerant vapor while the unit is running until bubbles in the sight glass disappear.

8.17.8. Return the system to the normal operating condition and then proceed with system startup as discussed previously.

8.18. Testing

8.18.1. Whenever major service work is performed on the heat pump it is necessary to test the unit for proper performance.

8.19. **Refrigerant Pressure Switch Replacement**

8.19.1. If the suction and discharge pressure safety switch fails in any of the following ways, the switch must be replaced.

- Contacts fail to operate at the set point.
- The contacts do not reset at the correct value.
- The switch body fails mechanically resulting in a leak.

8.20. Switch Replacement

8.20.1. **NOTE**: Observe all local and national codes when servicing refrigeration equipment.

8.20.2. De-energize heat pump power supply and allow the unit to cool to ambient temperature.

8.20.3. Remove the wiring harness (¼ inch (6 mm)) wire disconnects) from the switch terminals.

8.20.4. Using (2) wrenches, loosen the switch body on the Schrader valve. Spin the switch off of the Schrader valve. The valve core will close to keep the refrigerant in the line.

8.20.5. Check to ensure the correct replacement switch is being used.

8.20.6. Spin on the new switch by hand until the connection is sealed then tighten using (2) wrenches.

8.20.7. Replace the wires on the switch terminals.

8.20.8. Energize the heat pump and resume normal operation.

8.21. Pump Replacement

8.21.1. De-energize heat pump power supply and allow the unit to cool to ambient temperature. Close the heat pump isolation valves and disconnect the piping at the pipe unions. Allow the water lines to drain.

8.21.2. Remove the water pump access panel.

8.21.3. Disconnect the supply wires in the water pump connection box and remove the supply wiring harness.

8.21.4. If the pump motor has burned out or if the motor canister flange is not sealing to the bronze pump body, the entire motor assembly will need replaced.

8.21.5. If the impeller is damaged, only the pump cartridge needs replaced.

8.21.6. Remove the affected component and replace it with the new repair part. Ensure the correct replacement part is being used.

8.21.7. Install the wiring harness into the connection box and connect the supply wires to the appropriate motor leads.

8.21.8. Reconnect the pipe unions and open the isolation valves. **Vent water system piping to remove all air.**

8.21.9. Check the water pump for leaks and then replace the access panel.

8.21.10. Re-energize heat pump and resume normal operation.

8.22. **Fan Motor Replacement**

8.22.1. If the blower fan motor has failed, use the following replacement procedure.

8.22.2. Ensure the correct replacement part is on hand before starting this procedure.

8.22.3. De-energize the heat pump power supply and remove the unit top. On ceiling suspended units, the heat pump must be lowered to floor level to gain access for this repair.

8.22.4. Disconnect the supply wiring from the motor.

8.22.5. Remove the motor/belly band assembly from the unit.

8.22.6. For motors that are mounted using a wire type belly band, measure and note the belly ban position on the original motor then loosen the belly band fasteners. Place the belly band on the replacement motor on adjust to match the original position then tighten securely.

8.22.7. Install the new motor/belly band assembly on the blower housing making sure the blower wheel is properly aligned. Test blower wheel for proper alignment and adjust as necessary.

8.22.8. Re-connect the supply leads to the motor leads.

8.22.9. Re-energize heat pump and resume normal operation.

8.23. De-liming

8.23.1. General: Liming is the fouling of the heat exchanger surface with calcium deposits.

8.23.2. Under normal circumstances the low surface temperatures in the heat pump condenser together with high water velocity and turbulence suppress the formation of scale and fouling.

8.23.3. A severely scaled condenser will cause the heat pump to run with excessively high Head Pressure while at the same time exhibiting a very large difference between condensing temperature and leaving water temperature.

8.24. De-liming Procedure:

CAUTION

8.24.1. Never perform de-liming with the heat pump attached to the hot water system. This will introduce the cleaning solution and all dissolved scale into the water lines.

CAUTION

8.24.2. Only qualified service technicians should perform the following procedure.

WARNING

8.24.3. Avoid breathing the fumes! Do not get solution in eyes! Use adequate ventilation!

8.24.4. De-energize the heat pump and then disconnect the power supply.

8.24.5. Close water valves that isolate the heat pump from the hot water system. Disconnect the heat pump from the system water piping at the pipe unions near the water inlet and outlet.

8.24.6. Move the heat pump unit to an area that is well ventilated, has a floor drain, and a source of water.

8.24.7. Pour approximately 3 gallons (11.3 liters) of household (white) vinegar in a plastic or metal bucket. Elevate the bucket to a position higher than the heat pump inlet and then place both heat pump pipes (hot water inlet and outlet) in the bucket.

8.24.8. **NOTE**: The heat pump will require flexible hoses or special piping for this step. A throttling valve should be added to the outlet hose or pipe to control the amount of vinegar flowing through the heat pump.

8.24.9. Disconnect the HPA/HPW fan and compressor wires from their respective contactors so that only the water pump inside the heat pump will run, circulating the vinegar in and out of the bucket.

8.24.10. Apply power to the pump and throttle the outlet valve to allow vinegar to circulate at a rate of approximately 2 gallons per minute (7.0 l/m).

8.24.11. Household vinegar is a mild acid. It is in a diluted form as sold in the store so it is limited in descaling capabilities. If the solution in the bucket is discoloring or scale particles are observed, it is cleaning satisfactorily. Continue de-liming action for 1/2 hour or until foaming stops then turn off the heat pump.

8.24.12. Areas with particularly hard water may require with a stronger chemical. Food grade cleaners bearing USDA acceptance seals are available through your local water softener dealer or refrigeration supply house.

8.24.13. The procedure for using the stronger cleaner is the same as given above; however, the cleaner container will provide additional information and instructions on the particular product's characteristics and usage. These instructions must also be followed.

8.24.14. When De-liming process is completed, the heat pump should be flushed with clean water to remove residual scale and cleaning solution.

8.25. **Flushing Procedure**

8.25.1. Thoroughly rinse out the bucket and refill with clean water. Place the heat pump hoses/pipes back into the bucket and run for 10 minutes. At end of 10 minutes, shut the heat pump off.

8.25.2. After rinsing the bucket out, place the bucket under a fresh water tap and let the water run into bucket at about the pumping rate of the heat pump.

8.25.3. Place the heat pump inlet hose/pipe in the bucket. Position the outlet hose/pipe to discharge into a drain.

8.25.4. Apply power to the pump and allow fresh water to circulate through the heat pump for five (5) minutes or until discharged water is clear. Shut off the heat pump.

8.25.5. Reconnect the heat pump to the water tank and purge air from the piping.

8.25.6. Reconnect wiring to fan and compressor.

8.25.7. Reconnect power to the heat pump and resume normal operation.

Colmac HPA/HPW Owner Warranty Registration Card
Important Product Warranty Information

Owner must complete and return to Colmac Industries Inc. within 10 days of start up for validation.

Owner's Name:____

Address:____City:___________________________

State/Province: _______________________PostalCode:_______________Country:____________

Unit Model #: _________________________Unit Serial #: _________________________________

Installer Name:____

Address:____ City: _______________________

State/Province: _____________________Postal Code: ___________Country: ________________

Yes No
___ ___ Was there any visible shipping damage?
___ ___ This unit was started only after completion of construction.
___ ___ The installer has checked this unit for proper installation and operation.
___ ___ The owner has accepted a maintenance or service agreement from the installer or service agent.
___ ___ The dealer/installer included one year service in his proposal.
___ ___ The unit was purchased with an extended compressor warranty.
___ ___ Was the unit started by Colmac or a Colmac approved Technician?

HPA/HPW Performance Test Data (Installer to complete)

___ ___ Does the Service Correspond to the unit name plate?
Volts______ Hz______ Phase______.

___ ___ Is the unit mounted level?
___ ___ Is the condensate line trapped?
___ ___ Fill Drain pan, does it drain freely with the machine running?
___ ___ Are all electrical connections tight?

1. Line Voltage _______L1-L2______L2-L3______L1-L3
2. Total Amps _______L1______ L2_______L3
3. Inlet Air Dry Bulb Temp. ________C° ________F°
4. Inlet Air Wet Bulb Temp. ________C° _______ F°
5. Inlet Air Relative Humidity, % ________%
6. Leaving Air Dry Bulb Temp. ________C° ________F°
7. Source Water Temp. ________C° _________F°

8. Leaving Source water Temp. _______C° ________F°
9. Potable Inlet Water Temp. ________C° ________F°
10. Potable Outlet Water Temp. ________C° ________F°
11. Tank Aquastat Model ___________________________
12. Tank Aquastat Set point Temp. ________C° ________F°
13. Tank Aquastat Differential ________C° ________F°
14. Head Pressure __________kPa __________psig
15. Suction Pressure __________kPa __________psig
16. Suction Gas Temp. ________C° ________F°
17. Discharge Gas Temp. ________C° ________F°
18. Liquid Line Temp. ________C° ________F°
19. Electrical Heater Voltage _______L1-L2______L2-L3______L1-L3
20. Amp draw across each phase at each heating element
    _______L1-L2______L2-L3______L1-L3

Owner's Signature: _______________________________________Date: _______________________

Owner's Printed Name: _______________________________________

Installer's Signature: ______________________________________Date: _______________________

Installers Printed Name: _______________________________________

While the following information is not required to validate the warranty of your Colmac HPA/HPW heat pump, we would appreciate you taking a few minutes to furnish us with additional data to help us provide our customers with the best products and service that we can. Thank you.

THIS IS A ___New Installation ___Retrofit ___Replacement
If replacement, what type of system was replaced? (brand, type, etc.)?____
____

Why did you replace your existing water heating system with a Colmac HPA/HPW unit?
___ Old system needed to be replaced
___ Desirable energy savings
___ Needed hot water with cool air benefit
___ Other:____

Why did you purchase a Colmac HPA/HPW heat pump?
___ Advice from Dealer
___ Advice from friend
___ Personal Knowledge
___ Energy Savings
___ Other:____

Where did you first see or hear about HPA/HPW heat pumps?
___ Magazine
___ Trade Show
___ Dealer Display
___ Friend
___ Utility Company
___ Direct Mail

Did you have any installation problems?
___ Yes ____
___ No ___ Don't Know

Is your HPA/HPW heat pump operating satisfactorily?
___ Yes
___ No ____
____
Other Comments:

401 N. Lincoln • P.O. Box 72
Colville, WA 99114 USA
Tel: (509) 684-4505 • Fax: (509) 684-4500
Toll Free: (800) 926-5622
sales@colmacind.com | www.colmacwaterheat.com

LIMITED WARRANTY

WARRANTY

Colmac warrants that the product manufactured by it will be of the kind and quality described in its specifications, and will be free of defects in workmanship and material. Should any failure to conform to this warranty appear within a period of one year from the date of original installation or eighteen months from date of shipment to the purchaser, whichever comes first, Colmac shall, upon prompt written notification thereof correct such non-conformity at its option, by repair or replacement F.O.B. factory, of the defective part or parts.

In no event shall Colmac be responsible for providing working access to the defect, the removal, disassembly, replacement or reinstallation of any product, materials or structures to the extent necessary to permit Colmac to perform its warranty obligations, or transportation costs to and from the Colmac factory. The conditions of any tests shall be mutually agreed upon and Colmac shall be notified of and may be present at all tests that may be made.

GENERAL WARRANTY

To validate a claim, Colmac reserves the right to require that defective parts be returned to the factory, transportation charges prepaid.

Filters, fan belts, refrigerants, pads, covers, oil or other consumables are not included. This warranty does not apply to products or parts damaged by accidents, abuse, improper installation, lack of proper maintenance, unauthorized alterations, misapplications, improper applications, fire, flood, or acts of God. Furnishing of parts as described above shall constitute fulfillment of all Colmac obligations with respect to the warranty and replacement parts will be warranted only for the unexpired portion of the original warranty.

Products supplied by Colmac, but manufactured by others, are warranted only to the extent of the manufacturer's warranty.

THE WARRANTIES SET FORTH IN THIS PROVISION ARE EXCLUSIVE AND IN LIEU OF ALL OTHER WARRANTIES WHETHER STATUTORY, EXPRESS OR IMPLIED (INCLUDING ALL WARRANTIES OF MERCHANTABILITY AND FITNESS FOR PARTICULAR PURPOSE AND ALL WARRANTIES ARISING FROM COURSE OF DEALING OR USAGE OF TRADE), EXCEPT OF TITLE AND AGAINST PATENT INFRINGEMENT.

The remedies provided above are the purchaser's sole remedies for any failure of Colmac to comply with its obligations. Correction of any non-conformity in the manner and for the period of time provided above shall constitute complete fulfillment of all the liabilities of Colmac whether the claims of the purchaser are based in contract, in tort (including negligence) or otherwise with respect to or arising out of the product furnished hereunder.

LIMITATION OF LIABILITY

Colmac, its contractors and suppliers shall not be liable in contract, in tort (including negligence and strict liability) or otherwise for damage or loss of other property or equipment, loss of profits or revenue, loss of use of equipment or power system, cost of capital, cost of purchased or replaced power or temporary equipment (including additional expenses incurred in using existing facilities), claims of customers of the purchaser or for any special, indirect, incidental, or consequential damages whatsoever.

The remedies of the purchaser set forth herein are exclusive and the liability of Colmac with respect to any contract, or anything done in connection therewith such as the performance of breach thereof, or from the manufacture, sale, delivery, resale, or use of any equipment covered by or furnished under the contract, whether in contract, in tort (including negligence and strict liability) or otherwise, shall not exceed the price of the equipment or part on which such liability is based.

What do I do if something goes wrong with my Colmac Water Heating Heat Pump?

Call Colmac Service
1-800-926-5622

A Colmac service technician will help you by offering troubleshooting advice to determine specifically what may be wrong.
Often times Colmac can remedy the problem over the phone.

Remember, Colmac technical support over the phone is free!!

Can I get on-site help at location?

I would like a Colmac Technician

YES!
Colmac factory rep "COLMISSION" is an on site visit to help solve problems and train operators/staff.

Call for pricing and to set up a schedule for your on site visit!

1-800-926-5622

I have a local contractor.

YES!
If your WHHP is less than one (1) year old, please have your contractor contact Colmac for a "Field Repair Authorization".

Remember…
Only pre-authorized field repair procedures and costs are eligible for reimbursement.

What if I need parts to fix my problem?

If the problem may be caused by "workmanship" or a "defect in material" AND your machine is less than one (1) year old…
Or if you purchased an extended compressor warranty.

Your parts may be covered under warranty!

Colmac's service department will issue you a quote, and you need to send a purchase order for the parts in question.

Colmac will issue RMA (Return Material Authorization) information to you.

Parts are shipped based on your requested shipping method. Overnight shipping is usually available, but remember, you will need to pay the shipping costs... (even on warranty parts)

You return the problem parts back to Colmac; remember to include the same RMA information Colmac issued you earlier!

Colmac will inspect the returned parts and determine the root cause of the failure.

If the failure is deemed to be a defect in "workmanship" or "material"…
Colmac will credit your account the amount of the purchase order you issued earlier!

If the failure is deemed NOT to be a defect in "workmanship" or "material"…
Colmac will not issue a credit for the parts not qualifying for warranty replacement.

If your machine is older than one (1) year, or the parts in question are "consumable/ wear" parts...

Are belts, air filters, covered under warranty?

Sorry, but consumable/wear parts like these are not covered under warranty.

Your parts may be purchased and are usually shipped the same day to you.

For more information on Colmac products call us at 1-800-926-5622 or visit us online at:

[WWW.COLMACWATERHEAT.COM](http://www.colmacwaterheat.com)