COLMAC WATERHEAT

Installation, Operation and Maintenance

940140-0001 Rev. B

Heat Pump Water Heaters

Content Overview

6/8/2021

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1 Installation

WARNING **DO NOT STAND ON THE HEAT PUMP!** SEVERE INJURY TO PERSONNEL AND/OR DAMAGE TO THE HEAT PUMP MAY RESULT.

1.1 Inspection

Inspect equipment for damage and shortages upon receipt from carrier. Any shortage or damage found should be noted on the 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.

NOTICE **Verify compatibility of the electrical characteristics on the nameplate to the power supply.**

1.2 Mounting

Units are crated and shipped in an upright position. After uncrating, use of nylon slings or a forklift for lifting the unit is recommended. Anchor the machine in compliance with 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.

When mounting the heat pump on a curb or on structural beams, isolate the unit from the building with cork or rubber type pads or vibration isolation springs. Optional spring isolation kits are available for all air and water source heat pumps.

NOTICE **Position the heat pump so the unit can be easily serviced through access panels.** Reference the installation drawing for the model for specific clearances. Surrounding equipment should be considered for possible damage in the event of a water leak.

1.3 Electrical

WARNING **RISK OF ELECTRIC SHOCK. CAN CAUSE INJURY OR DEATH: DISCONNECT ALL REMOTE ELECTRIC POWER SUPPLIES BEFORE SERVICING.**

Be familiar with all safety release switches and emergency stops.

Operators should check all switches and safety features annually for proper operation. Safety features should also be checked after mechanical or electrical maintenance of those systems.

Disconnect power when any maintenance work is to be performed on the machine. Use of the “Lockout-Tagout” method is suggested (Figure 1).

Figure 1: Locked and Tagged Interlock

NOTICE **Only qualified electricians should open control box doors.** Electric power to the machine should be turned off before the electrician opens the control box door.

If it is necessary to have the electricity on to the control box to troubleshoot electrical issues, the electrician should use extreme caution. Another person should guard against accidental operation of controls by others that could result in personal injury or damage to the equipment.

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

Supply wiring is connected at a 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.

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 field wiring.

1.4 Power Quality

The main electrical supply shall be consistent for all operating conditions. Operating the equipment with poor power quality supply may result in a need for supplemental protections requiring additional parts and labor, which shall be assumed by the equipment owner. Warranty conditions are considered invalidated in poor power quality conditions. These include:

- Non-continuous service
- Variation in voltage magnitude
- Transient voltages and currents
- Harmonic content in the waveforms for AC power

Examples include:

- **Swell**: Variates in the peak or RMS; when RMS voltage exceeds the nominal voltage by 10 to 80% for 0.5 cycles to 1 minute.

- **Sag**: RMS voltage is below the nominal voltage by 10 to 90% for 0.5 cycles to 1 minute.
- **Flicker**: Random or repetitive variations in the RMS voltage between 90 and 110% of nominal.
- **Spikes, impulses or surges**: Caused by large inductive loads being turned off, or by lightning impacting voltage supplies.
- **Under Voltage**: Nominal voltage drops below 90% for more than 1 minute.
- **Over Voltage**: Nominal voltage rises above 110% for more than 1 minute.
- **Harmonics**: Variations in the wave shape.
- Variation in source frequency.

Electrical supply quality should be within NFPA 79 requirements 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 1 cycle. The time interval between successive dips shall be more than 1 second.

NOTICE **Local electrical conditions which might require adjustment to the Heat Pump, or its components are recommended to be evaluated by certified professionals.**

Control wiring is connected at a single point in the unit control panel. The remote or external heat pump control circuit will require a normally open contact closure from the aquastat for the heat pump run signal. For heat pumps which utilize a remote thermostat, refer to the wiring diagram attached to the unit.

1.5 Water Quality

Colmac Heat Pump Water heaters use stainless steel copper brazed-plate heat exchangers to transfer heat from the condensing refrigerant to water. Standard units are also supplied with flexible stainless-steel water piping. These components may be affected by poor water quality. The following are guidelines for determining acceptability of water quality and may prevent damage to the physical equipment.

NOTICE Requirements for potable water quality must also comply with any local or national codes.

Water quality can be generally quantified by 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

Standard Cx-Series units with copper brazed condensers should operate acceptably with water having up to 500 ppm TDS, provided there are no sulfides (i.e. Hydrogen Sulfide) present.

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

Cleaning of the condensers should not be necessary under most conditions (even with marginal quality water) as turbulence of the water flowing through the condenser tubing will keep solids in suspension. If condensers must be cleaned, an organic acid (vinegar) solution flushing procedure can be performed as in the Appendix: 7.1 Deliming Procedure.

If there are further concerns and questions about specific cases of poor-quality water, 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 table:

WATER CONTENT	TIME LIMITS Analyze before	CONCENTRATION (mg/l or ppm)	AISI 304	AISI 316	COPPER
Alkalinity (HCO3-)	Within 24 h	< 70	+	+	**0**
		> 300	+	+	**0/+**
Sulphate (SO42-)	No limit	70 - 300	+	+	**0/-**
		> 300	+	+	**-**
HCO3- / SO42-	No limit	> 1.0	+	+	**0/-**
Electrical conductivity	No limit	< 10 µS/cm	+	+	**0**
		> 500 µS/cm	+	+	**0**

WATER CONTENT	TIME LIMITS Analyze before	CONCENTRATION (mg/l or ppm)	AISI 304	AISI 316	COPPER
pH	Within 24 h	< 6.0	0	0	0
		6.0 - 7.5	+	+	0
		> 9.0	+	+	0
Ammonium (NH4+)	Within 24 h	2 - 20	+	+	0
		> 20	+	+	-
Chlorides (Cl-)	No limit	50 - 200	0	+	+
		200 - 300	-	+	+
		> 300	-	-	0/+
Free chlorine (CL2)	Within 5 h	1 - 5	-	-	0
		> 5	-	-	0/-
Hydrogen sulfide (H2S)	No limit	> 0.05		+	0/-
Free (aggressive) carbon dioxide (CO2)	No limit	5 - 20	+	+	0
		> 20	+	+	-
Nitrate (NO3-)	No limit	> 100	+	+	0
Iron (Fe)	No limit	> 0.2	+	+	0
Aluminum (Al)	No limit	> 0.2	+	+	0
Manganese (Mn)	No limit	> 0.1	+	+	0

Table 1: Influence of Water Composition on Corrosion Resistance

Key

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

1.6 Water Piping

⚠CAUTION ONLY DOUBLE WALL HEAT EXCHANGERS ARE SUITABLE FOR POTABLE WATER CONNECTIONS.

System pipe sizing shall be sized for the water flow rate required for the heat pump across all operational ranges. The required flow rate may change substantially across the operational range of the heat pump.

Strainers should be added to all water inlet lines to filter out sediment and particulates before they reach the heat pump. This includes a strainer on the potable water inlet of the CxA/CxV, and strainers on both the potable water inlet and the source water inlet on the CxW).

⚠CAUTION A strainer with a size of 16 – 20 mesh (number of openings per inch) is recommended if the water contains particles larger than 0.04 inches (1 mm). 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.

1.7 Net Positive Suction Head (NPSH)

NPSH is defined as water pressure required at the inlet of the pump to cause water to flow and prevent cavitation. The standard potable pump on CxA and CxW units requires a minimum of 1.3 PSI inlet pressure.

Normally non-vented pressurized hot water systems have a NPSH 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.

1.8 Minimum Air Source Clearances

NOTICE **The minimum required distance between the fan and any obstruction should be at least 1.5 times the diameter of the fan**; refer to submittal drawing for specific distances. Failure to allow for the minimum distance may result in significant performance reductions. Note: some fan options may have different distance requirements.

NOTICE **The recommended minimum distance between the heat pump coil face and any obstruction is 36".** Refer to submittal drawing for specific required distances. Failure to allow for the minimum required distance may result in significant performance reductions.

1.9 Condensate Drain

During normal operation of air source heat pumps dehumidified air produces condensate on the surface of the evaporator coil. This is collected in the coil drain pan and must be piped away to a suitable drain system through the provided drain connection. It is recommended that the condensate drain have a "P" trap to prevent drain system air from being drawn back into the unit.

1.10 Aquastat

Heat pump water heaters may be controlled by a remote aquastat, which senses storage tank temperatures and turns the heat pump on and off to maintain a preset tank 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.

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.

The aquastat will provide the heat pump run signal through a set of normally open contacts on the aquastat's 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 **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.

The aquastat has two adjustments, Setpoint and Differential, which must be set properly by the installer for the water heating system to operate correctly. The Set point is the temperature at which the aquastat contacts open and stop the heat pump. The Differential is the temperature difference between the Set point and the temperature at which the aquastat contacts close and the heat pump starts.

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 stops the heat pump when tank temperature is brought up to 140°F (60°C).

⚠CAUTION **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.

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, make the 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.

For more information on staging and lead-lag control for larger systems, refer to the PLC manual.

2 Prior to startup

NOTICE **Remove all RED shipping brackets and bracing applied to the unit.** Any red shipping brackets, wood bracing, or blue or pink packaging foam need to be removed prior to machine startup.

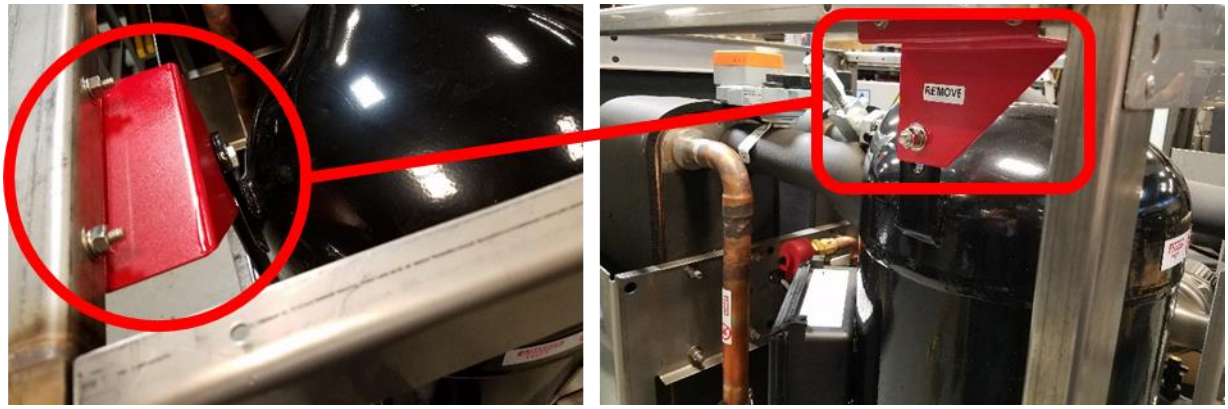

Figure 2: Shipping bracket to be removed before operation.

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.

Ensure the water side of the system has been vented at the system high point and the heat pump 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 electronic temperature control valve (e-TCV) valve is in the closed position.

For heat pumps with hot gas defrost only, ensure that the ball valve in the hot gas defrost line is in the open position. Refer to 5.9 in the maintenance section for further details.

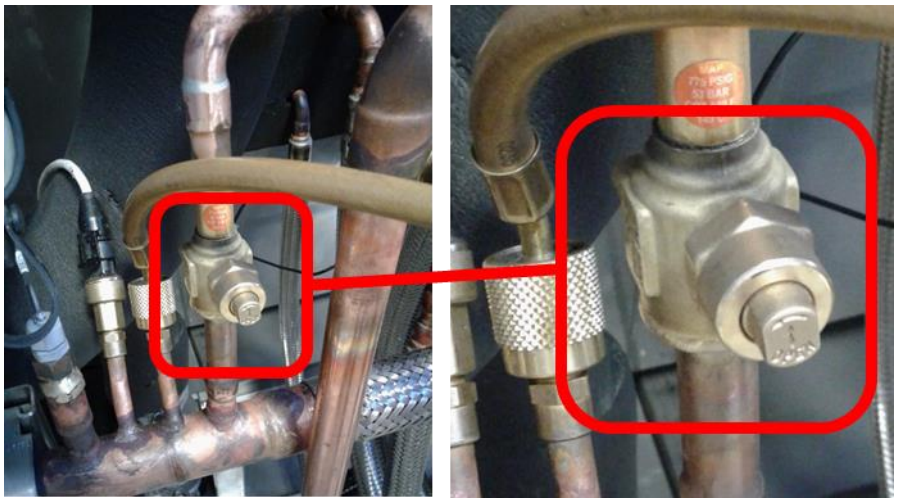

Figure 3: Ball valve set in the open position.

STOP! Before energizing the supply to the heat pump ensure all electrical connections are tight and the electrical cabinet is in order.

Have a Digital Multi Meter available and ready to measure AC voltage.

NOTICE Before turning on the disconnect, check incoming voltage at the building side of the heat pump disconnect to ensure the proper voltage is available, all phases are present, and the equipment is grounded according to local codes and requirements.

STOP! The voltage provided to the heat pump should match the nameplate! Failure to do so may result in significant damage to, or premature failure of the heat pump components.

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.

When the circulating pumps are activated with a call for heat during normal operation, the e-TCV valve partially opens. This valve opening position may be inadequate to completely purge circulator pumps of air. Refer to section 7.3 Vent the Piping System for a detailed procedure.

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.

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.

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

⚠ CAUTION 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.

If the compressor is reverse rotating, de-energize the heat pump and reverse any 2 of the incoming power supply wires to the main disconnect. When the heat pump is reenergized, proper gauge readings should now be present.

3 Startup

STOP! DO NOT turn the machine on or use any of the controls until you have read and understood all the Operating Instructions.

Energize the heat pump power source. Check the incoming voltage against the required supply for the machine.

Turn on the breakers for the crankcase (CC) heater. Allow the CC heater to run for at least two hours prior to running the compressor.

Turn on the control power switch on the front of the box. The PLC display will illuminate.

If the temperature of the water in the storage tanks is less than the aquastat setpoint, a time delay will start.

On CxW units, just prior to the delay time expiring, the source water pump contacts will close and the circulation pump will activate.

On CxA units, just prior to the delay time expiring, the fan and circulation pump will activate.

When the delay time has expired, the main contactor will close to energize the compressor.

Check for proper rotation on three phase models.

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

Monitor the temperature of the outlet water. This value should be 7°F (3°C) to 15°F (8°C) greater than the inlet temperature for “multi-pass” units. For “single-pass” units the outlet temperature should approach the setpoint temperature within a few minutes.

Monitor the difference between the inlet and outlet source (air or water). The leaving source temperature should be lower than the entering source temperature.

Monitor the liquid refrigerant sight glass. There should be no presence of bubbles, or they should clear within the first 30 minutes of operation. Refer to Section 6 Troubleshooting of this manual if this condition persists.

The above conditions indicate a successful startup.

Continue to run the heat pump unit it reaches a steady state operating condition before filling out the startup portion of the Warranty card.

NOTICE **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 the manual.

The scroll compressors are delivered with threaded Rotalock "King Valve" service shut off valves. Proper tooling should be utilized to ensure King Valve joints are not damaged. Tooling can be purchased through Colmac to meet machine torque specifications.

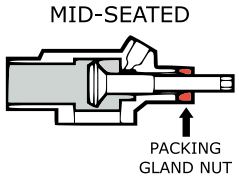

Figure 4: Rotalock cross-section

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.

4 Operation

STOP! **DO NOT turn the machine on or use any of the controls until you have read and understood all the Operating Instructions.**

4.1 Principles of Operation

During normal operation of the heat pump there are several timers that must be expired before a heat pump can run. These values are default by the factory to prevent damage to the heat pump system and components. While these values can be changed, it is recommended that changes are made only after contacting Colmac. The following are the timers:

1. Alarm time lockout (default: 600 seconds or 10 minutes)
2. Minimum off time (default: 300 seconds or 5 minutes)
3. Start delay (default: 5 seconds)

The Alarm time lockout will not begin counting down unless ALL alarms are inactive and is only applicable if the unit goes into an alarm state. The minimum off time and alarm time lockout are both able to countdown simultaneously. If able, these timers will begin to countdown as soon as the unit is no longer running.

Once an aquastat signal is sent to the heat pump(s) and the necessary timers have expired, the start delay will take place; this is between 5 seconds and 60 seconds, based on the number of units

operating together, the purpose of this delay is to prevent multiple units from starting simultaneously and causing a peak of demand power.

When the start delay is 3 seconds (default) from starting the compressor, the pump(s) and fan (air source) will turn on; allowing for their respective alarm conditions to be passed before running the compressor.

4.2 Electronic Temperature Control Valve (e-TCV)

Colmac heat pumps are supplied with an e-TCV. This valve is designed to control the flow of water being circulated through the heat pump in response to refrigerant condensing pressure. 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. The control of the e-TCV is operated by the PLC and tested prior to shipment.

For single-pass configured heat pumps, as inlet water to the heat pump increases, the controls will position the valve in a progressively more open state, eventually opening to full port flow.

NOTICE The e-TCV control system is factory set such that the valve position can never be fully closed (no-flow) while the heat pump is operating.

4.3 PLC display

Colmac heat pumps are supplied with a display for point of use control and configuration. Refer to Colmac heat pump PLC manual for more information on control and configuration of units.

5 Maintenance

STOP! DO NOT turn the machine on or use any of the controls until you have read and understood all the Operating Instructions.

WARNING DE-ENERGIZE ALL ELECTRICAL POWER SOURCES BEFORE ATTEMPTING TO SERVICE. REFER TO SECTION 1.3 ELECTRICAL BEFORE PROCEEDING.

WARNING DO NOT STAND ON THE HEAT PUMP! SEVERE INJURY TO PERSONNEL AND/OR DAMAGE TO THE HEAT PUMP MAY RESULT.

A typical maintenance schedule should include, where applicable, the following considerations:

- De-liming should be performed as needed; this is typically dependent on water quality.
- Air filters should be inspected and cleaned as needed, we typically recommend doing this every 2 months.
- Evaporator coils should be maintained free of contaminates and cleaned as needed, we recommend at least 4 times a year.
- Drain pan, drain tube, and p-trap should be checked as needed, we recommend this to be done at least once every 6 months.

5.1 Air Filter (Air Source Only)

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

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.

Air filters are recommended on all air source heat pumps.

5.2 Evaporator Coil (Air Source Only)

The drain pan, drain tube, and P-trap should be checked regularly to prevent fouling; it is recommended that these components are checked at least once every 6 months. Evaporator fins should be maintained in straitened conditions and free of contaminates that could contribute to moisture retention and premature failure. A regular scheduled cleaning of the exterior of the coil surface should be implemented. This is especially important if air filters are not employed.

5.3 Electrical Connections

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. Loose ground conditions can cause erroneous sensor data and false starts.

5.4 Refrigerant

The refrigerant in the CxA/CxW heat pumps is R-134a. The CxV heat pumps use R-410A refrigerant. Both refrigerants are HFCs and therefore have no Ozone Depletion Potential (ODP).

Only qualified refrigeration technicians should perform maintenance on any refrigeration systems; they must also comply with any local or national codes requirements.

5.5 Refrigerant Oil

All Colmac heat pumps contain refrigerant oil. This oil readily absorbs moisture from air and 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.

NOTICE **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.

5.6 Refrigeration Gauge Ports

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.

5.7 Access Panels

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

5.8 De-liming

The procedure for de-liming is included in this document, refer to Appendix: 7.1 Deliming Procedure.

5.9 Ball Valve

For heat pumps with hot gas defrost only, there is a hot gas defrost line which sends hot gas to the evaporator coil during defrost cycles. A ball valve is installed in the hot gas defrost line to isolate the hot gas solenoid. If for any reason the valve is to be opened or closed, the packing nut must be held in place; a loose packing can cause refrigerant to leak through the valve.

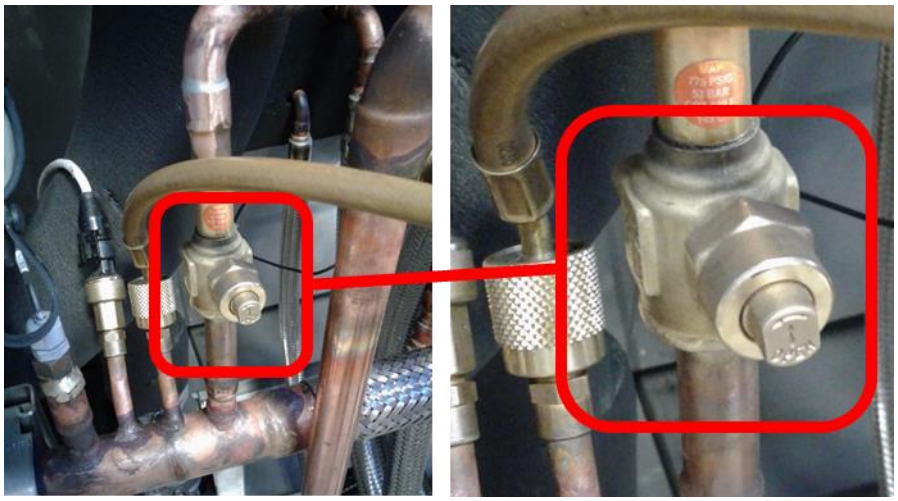

Figure 5: Ball valve set in the open position.

6 Troubleshooting

Problem	Observation	Possible Cause(s)	Remedy
Unit is not running, and the tank has no hot water	High discharge pressure	Aquastat setting is too high	Reduce aquastat temperature settings
		Loss of water supply to the unit	Check water flow to the CxA/CxW
		Pump has stopped operating	Check pump wiring. Replace pump if necessary
		Aquastat has failed (closed)	Replace aquastat
		Faulty high-pressure switch	Replace high pressure switch
	Low suction pressure, or Low suction temperature, or Low leaving source temperature	Flow through the evaporator is restricted or blocked	Remove any material which may be blocking the evaporator coil (Air Source)
			Clean coil if necessary with warm soapy water solution (Air Source)
			Backflush brazed plate evaporators (Water Source)
		Fan filter is blocked with debris or dirt (Air Source)	Remove and clean with warm, soapy water solution
		Source pump is not operating properly (Water Source)	Verify source flow is free of closed valves and clogged strainers
			Verify communication from dry contacts to source pump
			Check for source pump scheduling, external or secondary control
		Fan motor is not operating properly (Air Source)	Check fan motor wiring. Replace fan if necessary
		Faulty low-pressure switch	Replace low pressure switch
		Filter dryer restricted or blocked	Replace filter dryer
		EEV has failed in closed position	Clean and/or replace EEV internals if necessary Check power element and replace if necessary

Problem	Observation	Possible Cause(s)	Remedy
Unit is not running, and no hot water	Low Refrigerant Pressure	Loss of refrigerant	Check for refrigerant leaks in piping. Repair as necessary
			Add refrigerant until sight glass is clear
	Compressor overload, or Phase-Voltage Failure	Low voltage, or Missing phase, or Reverse phase	Check contactor
			Check fuses/breakers
			Check incoming line power
	Potable pump protection	Pump has stopped operating	Check pump wiring. Replace pump if necessary.
	Compressor Module	Module low voltage	Verify correct module p/n
			Check VA rating of transformer
			Check for blown fuse in transformer secondary
		Missing phase	Check incoming line power
			Check fuses/breakers
			Check contactor
		Scroll high temperature	Check system charge & superheat
			Check system operating conditions
			Check for abnormally low suction pressure
		Motor high temperature	Check supply voltage
			Check system charge & superheat
			Check contactor
		Reverse phase lockout	Check incoming phase sequence
			Check contactor
			Check module phase wires A-B-C
		Missing phase lockout	Check incoming power
			Check fuses/breakers
			Check contactor

Problem	Observation	Possible Cause(s)	Remedy
Unit runs, no hot water, or Unit runs, reduced capacity	Suction pressure reads low with a clear sight glass	Flow through the evaporator is restricted or blocked	Remove any material which may be blocking the evaporator coil (Air Source)
			Clean coil if necessary with warm soapy water solution (Air Source)
			Backflush brazed plate evaporators (Water Source)
		Fan filter is blocked with debris or dirt (Air Source)	Remove and clean with warm, soapy water solution
		Source pump is not operating properly (Water Source)	Verify source flow is free of closed valves and clogged strainers
			Verify communication from dry contacts to source pump
			Check for source pump scheduling, external or secondary control
		Fan motor is not operating properly (Air Source)	Check fan motor wiring Replace fan if necessary
	Discharge pressure reads high	High incoming potable water temperature	
		Air trapped in the water tube of the condenser	Bleed all air from the water system
		Insufficient water flow	Check operation of pump and replace if necessary; check for obstructions or closed valves
		Air or other non-condensable in the refrigerant system	Evacuate and recharge refrigerant
		Unit is overcharged with refrigerant	Remove refrigerant until normal operating pressures are observed
		Condenser surface fouled	Flush water piping and condenser with acetic acid solution
Unit runs, no hot water, or Unit runs, reduced capacity	Suction and discharge pressures are equal	Thermal snap safety disk	Takes up to 2 hours to reset, if this persists, potential compressor failure.

Problem	Observation	Possible Cause(s)	Remedy
	Suction pressure reads low and sight glass shows bubbles	Loss of refrigerant	Check for refrigerant leaks in piping. Repair as necessary
			Add refrigerant until sight glass is clear
		Filter dryer restricted or blocked	Replace filter dryer
	Fan and pump run but compressor does not	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 backward.	Switch any two (2) supply voltage wires to the unit

7 Appendix

7.1 Deliming Procedure

CAUTION **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 waterlines.

CAUTION **Only Qualified service technicians should perform the following procedure.**

STOP! **Refer to the appropriate safety data sheets (MSDS or SDS) before proceeding.**

1. De-energize the heat pump and disconnect the power supply.
2. Close water valves that isolate heat pump from the hot water system.
3. Disconnect the heat pump from the system water piping at the pipe unions near the water inlet and outlet.
4. 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 place both heat pump pipes (hot water inlet and outlet) into the bucket.
5. This will require flexible hoses or special piping for this step.
6. A throttling valve should be added to the outlet hose or pipe to control the amount of vinegar flowing into the heat pump.
7. Disconnect the CxA/CxW 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. Apply power to the pump and throttle the outlet valve to allow the vinegar to circulate at an approximate rate of 2 gallons per minute (7.0 l/m).
9. If the cleaning solution in the bucket is discoloring or scale particles are observed, it is cleaning satisfactorily.
10. Continue de-liming action for 1/2 hour or until foaming stops then turn off the heat pump.
11. When the de-liming process is completed, the heat pump should be flushed with clean water to remove residual scale and cleaning solution.

NOTICE **Areas with particularly hard water may require a stronger chemical.** Food grade cleaners bearing USDA acceptance seals are available through your local water softener dealer or refrigeration supply house. The procedure for using stronger cleaner is the same as above; however, the cleaner container will provide additional information and instructions on the product's characteristics and usage. These instructions must also be followed.

7.2 Flushing Procedure

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 the end of 10 minutes, shut off the heat pump.
2. After rinsing the bucket out, place the bucket under a fresh water tap and let the water run into the bucket at about the pumping rate of the heat pump.

3. Place the outlet hose/pipe to the discharge drain.
4. Apply power to the pump and allow fresh water to circulate through the heat pump for 5 minutes or until discharged water is clear. Shut off the heat pump.
5. Reconnect the heat pump to the water tank and purge air from the piping.
6. Reconnect wiring to fan and compressor.
7. Reconnect power to the heat pump and resume normal operation.

7.3 Vent the Piping System

After the pump has been installed and the electrical connections made, the piping system must be vented.

CAUTION **Never operate the pump dry – the system must first be filled with liquid and vented.**

NOTICE **Do not vent the piping system through the pump.**

Fill and pressurize the system with liquid and vent all trapped air from the piping by suitable means.

If any isolation valves are used, make sure they are OPEN.

WARNING **SCALDING HOT LIQUID!** IF THE VENT SCREW/PLUG IS TO BE LOOSENED, CARE SHOULD BE TAKEN TO ENSURE THAT THE ESCAPING SCALDING HOT LIQUID DOES NOT CAUSE PERSONAL INJURY OR DAMAGE TO COMPONENTS.

Vent the pump by removing the vent plug. When water exits through the port, the pump is fully vented/primed. Reinstall the vent plug once venting has finished.

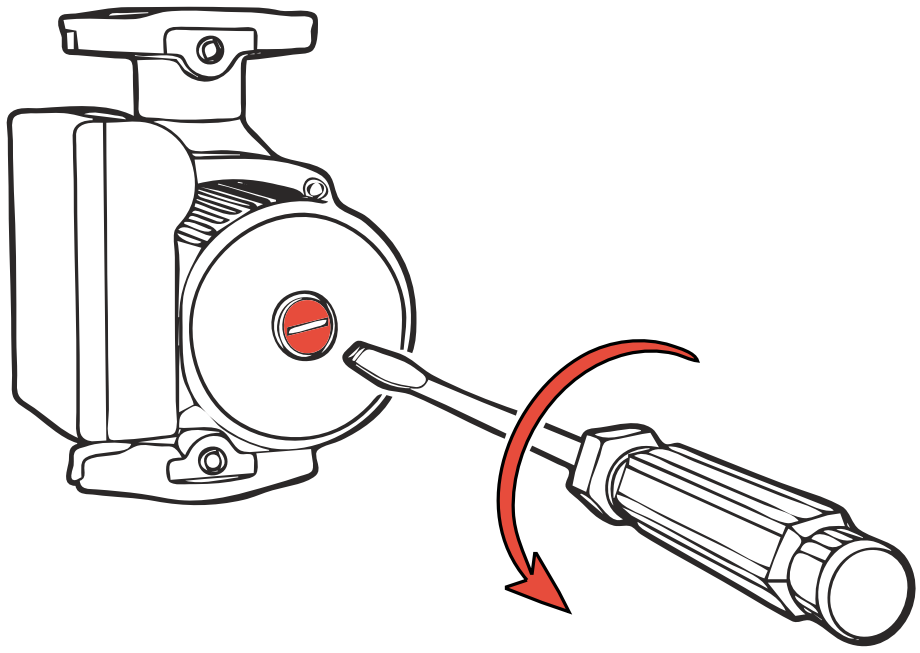

Figure 6: Vent screw/plug removal for pump venting.

7.4 Evaporator Coil Maintenance Procedure

The evaporator coil(s) must be cleaned quarterly following the procedure described below.

Surface Preparation

Avoid pushing or driving built up contaminants on the coils surface deeper into the coil while cleaning. Use a soft bristle brush and/or a shop vac to remove as much debris as possible from the surface of the coil. If necessary, adhere to the guidelines of number four under "Procedure" and wash the face of the coil using a pressure washer.

Cleaning Methods

1. High pressure air can be used to clean particulates from the coil(s).
2. High pressure water can be used to clean dirt and grime. For noncoated coils, general detergents can be used, but chemical cleaning should be avoided. For detergent products, it is recommended to use microchannel specific cleaners from Nu-Calgon such as Evap-Green. Do not use detergents on coated coils.

Procedure

WARNING **DO NOT USE BLEACH, HOUSEHOLD CLEANERS OR CONTAMINATED WATER ON THE EVAPORATOR COIL(S).** THIS WILL REDUCE SERVICE LIFE AND VOID WARRANTIES.

1. Before cleaning, disconnect power to the machine. Use of the "Lockout-Tagout" method is suggested (Section 1.3 Electrical, Figure 1).
2. All cleaning must be done in the direction of the fin stock to reduce fin damage.
3. Be Gentle.
4. Any pressurized cleaning systems can damage the fins if used aggressively. Keep the pressure nozzle 8-16 inches away from the coil with a 40° angular tip to prevent fins from folding over. The maximum pressure is 900 psi. Test a small section along the edge of the coil to establish distance and direction.
5. Use Chlor*Rid DTS on coated coils to remove chlorides, sulfates, nitrates and soluble salts. Follow the procedure outlined in "Soluble Salt Removal" below.

Soluble Salt Removal

Chlor*Rid DTS is used for soluble salt removal and is only to be applied to coated coils. Follow the manufacturer's instructions for the handling, application, and removal of Chlor*Rid DTS and ensure the guidelines in this section are not violated during this process.

NOTICE During the removal of Chlor*Rid DTS, thoroughly rinse the coil from the front and back side. Chlor*Rid DTS must be completely flushed from the coil when finished cleaning.

7.5 Saturation Tables for R-134a

To Calculate suction superheat: read suction pressure using standard service gauges. Find R-134a Saturated Suction Temperature (SST) from the tables below. Measure the Suction Gas Temperature (SGT) directly using a surface temperature probe near the inlet to the compressor.

Suction Superheat = SGT – SST

Suction Pressure psig	SST °F	Suction Pressure psig	SST °F	Suction Pressure psig	SST °F
0	-15	24	27	48	52
2	-10	26	30	50	54
4	-5	28	32	55	58
6	-1	30	35	60	62
8	3	32	37	65	66
10	7	34	39	70	69
12	10	36	41	75	73
14	13	38	43	80	76
16	16	40	45	85	79
18	19	42	47	90	82
20	22	44	49	95	85
22	25	46	51	100	88

Table 2: R-134a Pressure-Temperature, IP 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

Table 3: R-134a Pressure-Temperature, SI units

7.6 Saturation Tables for R410A

To Calculate suction superheat: read suction pressure using standard service gauges. Find R-410A Saturated Suction Temperature (SST) from the tables below. Measure the Suction Gas Temperature (SGT) directly using a surface temperature probe near the inlet to the compressor.

Suction Superheat = SGT – SST

Suction Pressure psig	SST °F	Suction Pressure psig	SST °F	Suction Pressure psig	SST °F
0	-61	220	75	450	125
20	-27	240	81	460	127
40	-7	260	86	480	130
60	8	280	91	500	134
70	15	300	96	520	137
90	26	320	100	540	140
110	36	330	102	560	143
130	45	350	107	580	145
150	53	370	111	590	147
170	60	390	115	610	149
190	66	410	118	630	152
200	69	430	122	650	155

Table 4: R-410A Pressure-Temperature, IP units

Suction Pressure kPa	SST °C	Suction Pressure kPa	SST °C	Suction Pressure kPa	SST °C
0	-51	1560	25	3120	52
130	-34	1690	28	3250	54
260	-23	1820	31	3380	56
390	-14	1950	33	3510	57
520	-8	2080	36	3640	59
650	-2	2210	38	3770	60
780	3	2340	40	3900	62
910	8	2470	42	4030	63
1040	12	2600	44	4160	65
1170	15	2730	46	4290	66
1300	19	2860	48	4420	68
1430	22	2990	50	4550	69

Table 5: R-410A Pressure-Temperature, SI units

Colmac Owner Warranty Registration Card

Important Product Warranty Information

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

Owner's Name:_____

Address: City:_____

State/Province:_____Postal Code:_____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?

Heat Pump Performance Test Data (Installer to complete)

YES NO

___ ___ Does the Service correspond to the unit nameplate?
Volts_____ Hz_____ Phase_____.
___ ___ Is the unit mounted level?
___ ___ Is the condensate line trapped? *(Air Source)*
___ ___ Fill Drain pan, does it drain freely with the machine running? *(Air Source)*
___ ___ 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. _____°F or _____°C *(Air Source)*
4. Inlet Air Wet Bulb Temp. _____°F or _____°C *(Air Source)*
5. Inlet Air Relative Humidity _____**%** *(Air Source)*
6. Leaving Air Dry Bulb Temp. _____°F or _____°C *(Air Source)*

7. Entering Source Water Temp. _____°F or _____°C *(Water Source)*
8. Leaving Source Water Temp. _____°F or _____°C *(Water Source)*
9. Potable Inlet Water Temp. _____°F or _____°C
10. Potable Outlet Water Temp. _____°F or _____°C
11. Tank Aquastat Model _____
12. Tank Aquastat Setpoint Temp. _____°F or _____°C
13. Tank Aquastat Differential _____°F or _____°C
14. Head Pressure _____psig or _____kPa
15. Suction Pressure _____psig or _____kPa
16. Suction Gas Temp. _____°F or _____°C
17. Discharge Gas Temp. _____°F or _____°C
18. Liquid Line Temp. _____°F or _____°C
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:_____

Installer's Printed Name: _____

While the following information is not required to validate the warranty of your Colmac 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 we can.

Thank you.

This is a: ☐New Installation ☐Retrofit ☐Replacement
If a replacement, what type of system was replaced? (brand, type, etc.)

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

Why did you purchase a Colmac heat pump?
_____ Advice from dealer
_____ Advice from friend
_____ Personal knowledge
_____ Energy savings
Other:

Where did you first see or hear about Colmac 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 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@colmacwaterheat.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?