Contact your local Colmac Coil
Representative for factory approved parts.

Installation, Operation, and Maintenance

Air Cooled Condensers

Contents

1. SAFETY INSTRUCTIONS

To avoid serious personal injury, accidental death, or major property damage, read and follow all safety instructions in the manual and on the equipment. Maintain all safety labels in good condition. If necessary, replace labels using the provided part numbers.

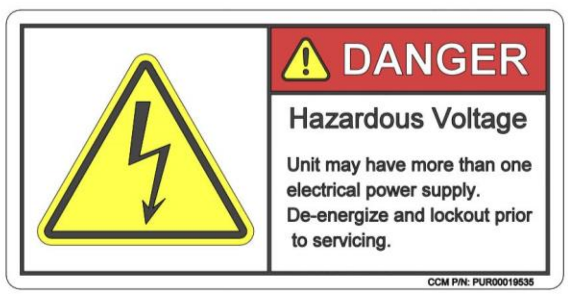
This is the safety alert symbol. It is used to alert you to potential personal injury hazards. Obey all safety messages that follow this symbol to avoid possible injury or death.

DANGER indicates a hazardous situation which, if not avoided, will result in death or serious injury.

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

CAUTION indicates a hazardous situation which, if not avoided, could result in minor or moderate injury.

NOTICE indicates instructions that pertain to safe equipment operation. Failure to follow these instructions could result in equipment damage.



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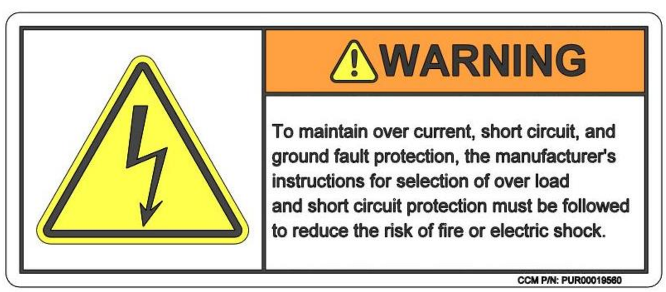

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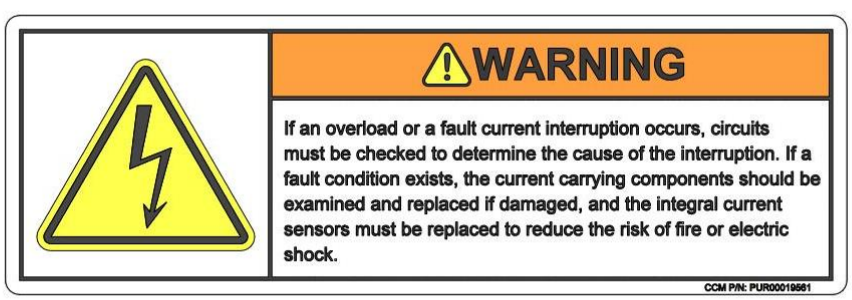

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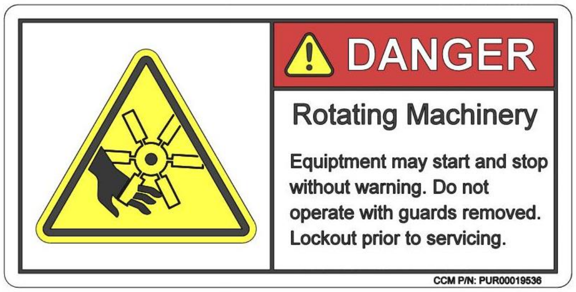

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2. GENERAL DESCRIPTION

2.1. Colmac air-cooled condensers are multiple row compact finned tube condenser coils with direct drive fans. The units are designed to for use in standard commercial and industrial refrigeration, and air conditioning systems. These units reject heat from the refrigerant to ambient air as the refrigerant leaves the compressor. Typically, the refrigerant is first de-superheated, and then condensed from vapor to liquid within the condenser.

2.2. The fan motors are heavy-duty, rigid foot mounted, direct drive, totally enclosed fan motors with moisture protected rain shields (slingers) suitable for an industrial environment.

2.3. The published fan sound level is based on free field conditions with no sound reflecting surfaces. If the cooler sound level is important, avoid installing the cooler within 30 feet of any large reflecting surface such as a building or wall. If this is not possible, the installed sound level must be recalculated for the actual site condition.

3. INSTALLATION

3.1. Inspection

3.1.1. Damage or Shortage – Upon receipt of equipment, inspect for shortages and damage. Any shortage or damage found during initial inspection should be noted on delivery receipt. This action notifies the carrier that you intend to file a claim. Any damaged equipment is the responsibility of the carrier, and should not be returned to Colmac Coil without prior notification. If any shortage or damage is discovered after unpacking the unit, call the deliverer for a concealed damage or shortage inspection. The inspector will need related paperwork, delivery receipt, and any information indicating his liability for the damage.

3.1.2. Specified Equipment – Check unit nameplate for: Electrical specifications to ensure compatibility with electrical power supply. Check model nomenclature and other information to ensure that the equipment matches the original order.

3.2. Mounting & Rigging

3.2.1. **NOTICE: In no circumstances should coil headers or return bends be used in lifting or moving condensers.**

3.2.2. **NOTICE: Use shipping container, or use hangers to lift unit into mounting position.**

3.2.3. The air cooled condensers are fitted with lifting eyes on the top face of the unit. Use lifting beams as illustrated in Figures 8 and 9.

3.2.4. All lifting must be done perpendicular to top of coil face with lifting straps attached to the lifting brackets in a vertical configuration as illustrated in Figures 8 and 9.

3.2.5. **NOTICE: Do not lift units with lifting straps attached to the lifting brackets in an A-frame configuration.**

3.2.6. Level the condenser and install steel shims to fill any gaps under the support feet.

3.3. **Storage**

3.3.1. If the condenser units are to be stored or not operated for an extended period of time, the fan motors may ingress moisture if they are not protected or operated regularly. In severe cases, the moisture will reduce the insulation level of the windings or cause rusting of the bearings necessitating removal for repairs at a motor repair facility.

3.3.2. The simplest remedy for installed condensers is to operate the fan motors for a few hours every week during the downtime period until regular operation resumes. The fan motors on stored condensers must be protected from the elements by covering them with waterproof tarps.

3.4. **Location**

3.4.1. Colmac condensers have been designed primarily for outdoor installations. When locating the unit on a roof, it must be mounted on support beams which span load-bearing walls. Failure to do so may lead to excessive vibration on a resilient roof and possible damage to the unit. Refer to unit weights indicated on the submittal drawing or shipping documents and to the refrigerant line weights referenced below.

3.4.2. Locate the condenser no closer than the unit's width from a wall or other obstruction. When two or more units occupy the same area, space them apart by a minimum distance of one unit's width to allow free air circulation around the coils.

3.4.3. The condenser must be installed level and be securely anchored to the building structure or concrete pad.

Table 1
Refrigerant Line Capacities (TONS)

Line Size Type L Copper Tubing O.D.	Discharge Line Saturation Suction Temp °F(R-22)			Liquid Line Condenser to Receiver @ Velocity 100 fpm R-22
	-40	0	+40	
5/8	2.11	2.25	2.39	3.57
7/8	5.60	5.96	6.33	7.41
1 1/8	11.20	12.00	12.70	12.70
1 3/8	19.50	20.80	22.10	19.20
1 5/8	29.20	31.90	34.60	27.20
2 1/8	64.50	68.70	73.00	47.30
2 5/8	112.70	120.10	127.50	73.20
3 1/8	175.80	187.50	199.20	104.10
3 5/8	262.20	279.80	297.40	141.10
4 1/8	376.50	401.40	426.30	183.00

Table 2
Weight of Refrigerant in Type L Copper Lines

Line Size O.D.	Pounds per 100 Lineal Feet, R-22		
	100°F	**40°F**	**115°F**
5/8	11.3	0.25	0.80
7/8	23.4	0.51	1.68
1 1/8	40.0	0.87	2.86
1 3/8	60.5	1.31	4.34
1 5/8	85.0	1.84	6.10
2 1/8	150.0	3.25	10.70
2 5/8	232.0	5.03	16.60
3 1/8	330.0	7.15	23.60
3 5/8	446.0	9.65	31.90
4 1/8	585.0	12.6	41.60

4. **PIPING**

4.1. When designing system piping, remember to size for the lowest head pressure condition anticipated. Insulate liquid as well as suction lines. Use good piping practices as described in the ASHRAE Refrigeration Handbook, and other industry publications. See Figures 3 thru 5 “Recommended Subcooler Piping” below for specific information about subcoolers.

4.2. Colmac condensers have copper sweat connections and have one circuit standard. Multiple circuits are available. All piping should meet local and national codes for proper operation of the system.

4.3. **Subcooler Piping**

4.3.1. Refrigerant liquid leaving the condenser is typically at saturation temperature and pressure. If the liquid has not been subcooled before it enters the liquid line, any drop in pressure, or any heat input, will cause the liquid to boil, and “flash gas” is formed. This flash gas will cause an excessive pressure drop in the liquid line, and will greatly reduce the capacity of the TX valve and the system. Adequate subcooling of the liquid will prevent the formation of flash gas.

4.3.2. To maximize the benefits of subcooled liquid, be sure to follow these rules:

- Size piping and valves for the maximum refrigerant flow condition anticipated, i.e.: lowest head/highest suction pressure.
- Use a subcooling method that will provide required amount of subcooling at ALL operating conditions.
- ALWAYS insulate liquid lines.
- Locate subcooler downstream of the receiver at the entrance to the liquid line, NOT between condenser and receiver. See Figures 3, 4, and 5.
- Use good piping practice as can be found in ASHRAE (Systems, and Refrigeration Handbooks), and other industry publications.

4.3.3. Subcooling the liquid after it leaves the receiver is obviously a necessity for proper system operation. Again, note that subcooling done between the condenser and the receiver will be eliminated in the receiver and is generally poor practice. The amount of subcooling required corresponds to the liquid line pressure drop. This pressure drop is the sum of: 1) the loss in pressure due to elevation gain in the liquid line, and 2) liquid line pressure drop due to friction. Table 3 shows the pressure drop in liquid lines produced by elevation gain between the receiver and evaporators.

4.3.4. Liquid lines should also be sized using reliable design data and methods. "Refrigerant Line Sizing" by D.D. Wile, ASHRAE RP 185, is recommended and can be purchased from ASHRAE, Atlanta, Georgia.

4.3.5. Once the total liquid line pressure drop (the sum of elevation pressure drop plus friction pressure drop) is calculated, the required amount of subcooling to prevent flash gas in the line can be determined from Table 4. Note that the amount of subcooling required for a given pressure drop increases as condensing temperature decreases.

Table 3
Pressure Drop in Liquid Lines due to Elevation Gain

Elevation Gain (Feet)	Pressure Drop R22/R502 (psi)
1	0.56
5	2.78
10	5.56
15	8.33
20	11.1
25	13.9
30	16.7
35	19.4
40	22.2
45	25.0
50	27.8

Table 4
Liquid Subcooling Required to Prevent Flash Gas

Total Liquid Line Pressure Drop (psi)	Required Amount of Subcooling, R22/R502, (°F)		
	110°F Condensing	70°F Condensing	30°F Condensing
1	0.328	0.490	0.815
4	1.31	1.96	3.26
6	1.97	2.94	4.89
8	2.62	3.92	6.52
10	3.28	4.90	8.15
12	3.94	5.88	9.78
14	4.59	6.86	11.4
16	5.25	7.84	13.0
18	5.90	8.82	14.7
20	6.56	9.80	16.3
25	8.20	12.3	20.4
30	9.84	14.7	24.5
35	11.5	17.2	28.5
40	13.1	19.6	32.6
45	14.8	22.1	36.7
50	16.4	24.5	40.8

4.4. **Methods of Subcooling -** There are three ways to effectively subcool the liquid refrigerant leaving the receiver: Ambient subcooling, Liquid pump, and/or Mechanical subcooling.

4.4.1. **Ambient Subcooling –** Requires the addition of a separate subcooling coil to the ACV condenser. One fan must be left running continuously to draw air through the subcooler coil during all operating conditions. The amount of subcooling that can be achieved with this method is limited by the condenser operating TD. See Figure 3 "Recommended Subcooler Piping". For engineering information, see Colmac Bulletin 1400.

4.4.2. **Liquid Pump** – Is a centrifugal refrigerant pump installed at the outlet of the receiver to boost the pressure of the liquid before it enters the liquid line. This increase in pressure effectively "subcools" the liquid. See Figure 4 "Recommended Subcooler Piping". For engineering information, see Colmac Bulletin 1400.

4.4.3. **Mechanical Subcooling** – Refers to using a portion of liquid refrigerant, boiled to cool the remaining liquid in the liquid line. A special heat exchanger is used which cools the liquid refrigerant on one side of the exchanger with a small amount of refrigerant metered to the other side of the exchanger. The cooling refrigerant is metered by a TXV, boiled and returned to the suction line. See Figure 5 "Recommended Subcooler Piping". For engineering information, see Colmac Bulletin 1400.

Figure 3
Recommended Subcooler Piping,
System with Ambient Subcooler

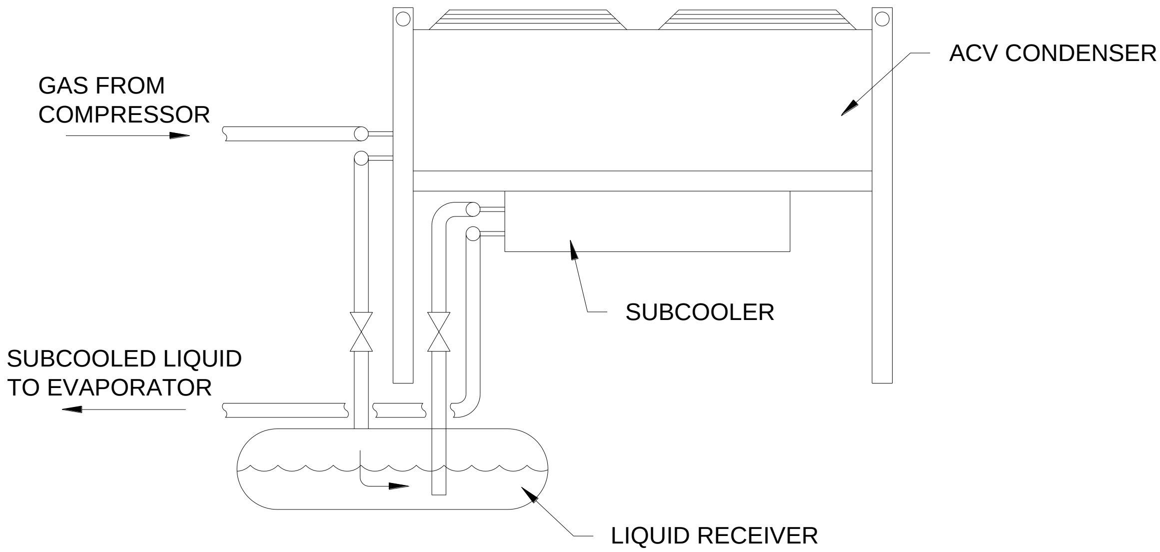


Figure 4
Recommended Subcooler Piping,
System with Liquid Pump

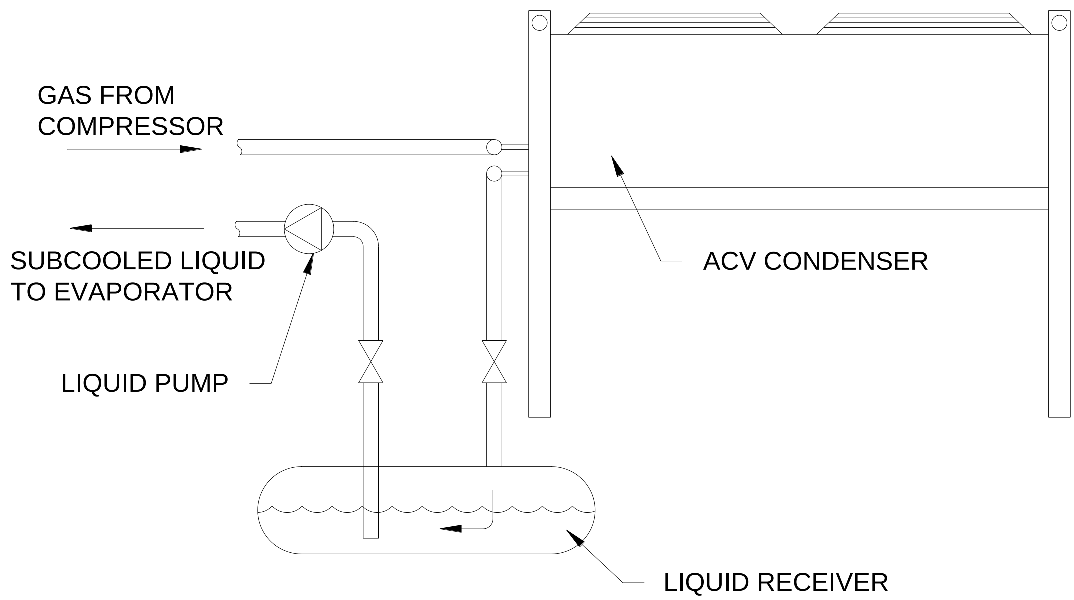
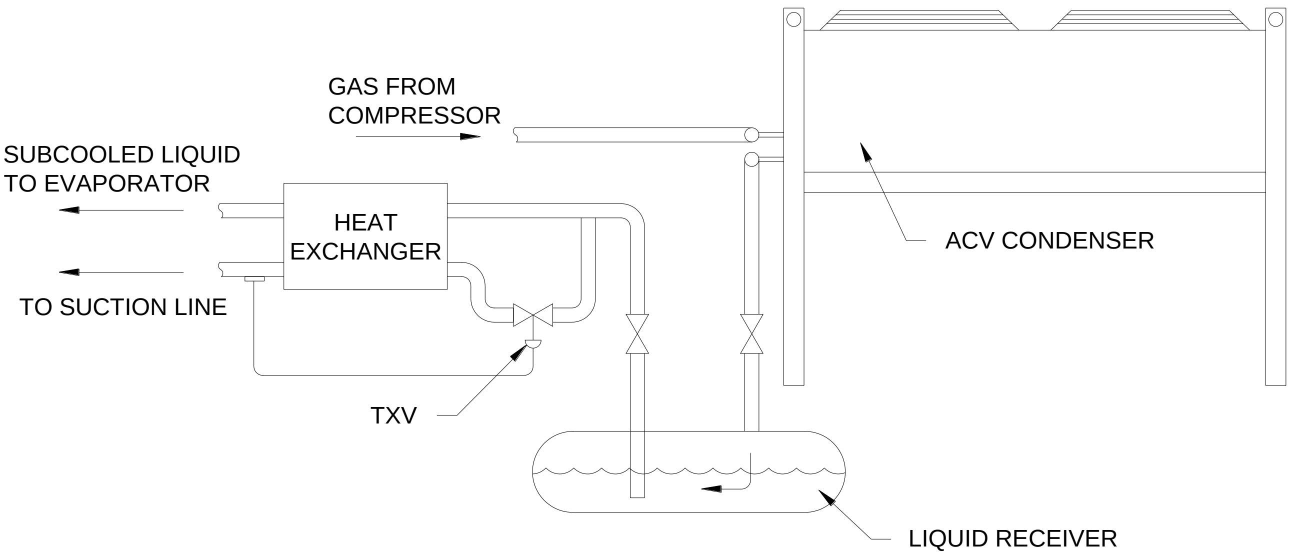


Figure 5
Recommended Subcooler Piping,
System with Mechanical Pump



4.5. **Refrigerant Charge**

4.5.1. Because Colmac Type FC, MS, and LP controls do not require flooding of the condenser for head pressure control, refrigerant charge remains relatively small. Internal volume and operating charge for ACV/ACH condensers can be found in the submittal drawings.

4.6. **Receiver Sizing**

4.6.1. A liquid receiver is required on all subcooled systems, and on systems with a liquid solenoid/pump down feature. The receiver must be made large enough to accommodate the liquid present in liquid lines, and in the evaporator. Calculate liquid line charge inventory as: Internal Volume of the lines times Liquid Density, in lbs. Direct expansion evaporator charge inventory can be estimated as: Internal Volume of the evaporator times Liquid Density times 0.30, in lbs.

- Example, Receiver Sizing
  (R22 @ 241 psig, 110°F Sat. Liq.)
  Liquid density = 69.5 lb/cu. ft.

- Liquid line internal volume = 1 cu. ft.
  [1] Liquid Line Inventory = 1 x 69.5 = 69.5 lbs.

- Evaporator internal volume = 2.4 cu. ft.
  [2] Estimated Evap. Inventory = 2.4 x 69.5 x .3 = 50 lbs.

- Total Charge Inventory = [1] + [2] = 119.5 lbs.

5. ELECTRICAL

5.1. Each Colmac ACV/ACH condenser is factory wired for single-point connections in the field to the weatherproof terminal box on each cooler or to each individual motor at each fan bay depending on customer specification. Fan motors greater than 1 Hp do not have internal thermal overload protection controls; they must be provided by others. Fan Motors 1 Hp and smaller do have internal thermal overload protection. Standard construction does not include fan cycling and fused disconnects which must be supplied by others. Individual motor protection and fan cycling controls are available as optional extras.

5.2. All field wiring must comply with National Electrical Code and all other state and local regulations. This includes providing proper and safe motor protection, fusing, disconnects, and other basic equipment.

5.3. Check that the supply voltage matches the motor rated voltage. After the motors are connected, jog them to check for fan clearance and for proper fan rotation. Rotation can be reversed by swapping two of the three incoming line conductors on a three phase system. Operate all the fan motors for several hours to allow the motors to dry.

5.4. For condensers equipped with FC (fan cycling) controls, refer to the wiring diagram included with the unit for control and connection details.

6. OPERATION

6.1. Low Ambient Operation

6.1.1. While allowing head pressure to “float” with ambient temperatures is desirable from an energy standpoint, there are cases where some minimum head pressure must be maintained. There are two basic reasons for using Colmac low ambient head pressure controls on ACV and ACH air cooled condensers: 1) Maintaining condensing pressure, and 2) maintaining condensing temperature. During winter months, in colder climates the controls will:

- Provide enough **pressure** difference between condensing and suction pressure to overcome system pressure drops, and to operate control valves, and/or

- Keep the saturated condensing **temperature** high enough to provide adequate heat for heat reclaim (typical in supermarket refrigeration), and/or hot gas defrosting of evaporator coils. Typical minimum condensing temperatures for these cases are shown below:

System	Typical Minimum Condensing Temperature
Heat Reclaim	90°F
Hot Gas Defrost	60°F

6.1.2. Two types of head pressure controls available from Colmac:

- **Liquid Pumping -** Colmac type LP (liquid pumping) control increases liquid line pressure by 12 to 15 psi. This pressure increase is used to offset system pressure drop, and will prevent “flash gas” in liquid lines.

- **Fan Control -** Colmac type FC and MS controls effectively maintain condensing temperature by cycling and/or modulating the speed of condenser fans. Remember that Colmac type LP (liquid pumping) control can be used in conjunction with fan controls. For more information about head pressure controls, see Colmac Bulletin 1400.

6.2. **Before Startup**

6.2.1. Make sure unit voltage agrees with supply voltage.

6.2.2. Make sure system is wired correctly and in accordance with the guidelines laid out in this IOM, as well as local and national standards that may apply.

6.2.3. Check torque on all electrical connections.

6.2.4. Make sure all piping is done completely and in accordance with the guidelines laid out in this IOM, as well as in accordance with standard good practice.

6.2.5. Make sure unit is mounted securely using all hangers, and is level.

6.2.6. Make sure that all fan set screws are tight.

6.3. **After Startup**

6.3.1. Check fan rotation of all fans to make sure air is moving in proper direction.

6.4. **Fan Cycling Setup Checklist**

6.4.1. Heating/Cooling Mode Adjustment: As shipped from the factory, the fan cycling controller is set up for cooling mode.

6.4.2. Setpoint Adjustment: Set point is defined as the temperature setting at which the temperature controller output relay will de-energize.

6.4.3. Differential Adjustment: Differential is defined as the change in sensor temperature between energization and de-energization of the relay. In cooling mode, the temperature controller will energize the output relay at a temperature equal to the setpoint plus the differential. The temperature controller will de-energize the output relay at a temperature equal to the setpoint.

6.4.4. Offset: On temperature controllers with offset functionality, the offset adjustment sets the temperature offset from the control module setpoint, at which the stage module's output relay will de-energize.

6.4.5. Temperature Sensor

- For sensing fluid temperature: Insert sensor into sensor well in outlet header utilizing thermal paste to ensure good heat transfer.
- For sensing ambient temperature: Attach sensor to unit leg away from fan induced air flow and out of direct sunlight.

6.4.6. Control Settings

Master Setpoint & Differential Table
(Values supplied by sales and/or engineering)

Type F.C Controls			
Setpoint 1		Differential 1	
Bulb Location			
Cond. Leaving Fluid Temp.			
Ambient Air Temp.			

Stage Differential & Offset Table
(Values supplied by sales and/or engineering)

Type F.C Controls			
Offset 1		Differential 1	
Offset 2		Differential 2	
Offset 3		Differential 3	
Offset 4		Differential 4	
Offset 5		Differential 5	
Offset 6		Differential 6	
Offset 7		Differential 7	
Offset 8		Differential 8	
Offset 9		Differential 9	

7. MAINTENANCE

7.1. The direct drive fan motors are provided with double sealed shaft bearings. Periodic lubrication is not required.

7.2. Check the fan blades annually and remove any accumulations of dirt.

7.3. Remove any debris that collects on the air inlet side of the finned tubes as this will reduce the airflow. The debris can often be removed by shutting off the fans and blowing air or a water spray in the reverse direction. A soft bristled brush with a water-detergent solution may be required to remove oily deposits followed by rinsing with clean water. Straighten any fins that may have bent during cleaning.

7.4. Replacement Parts

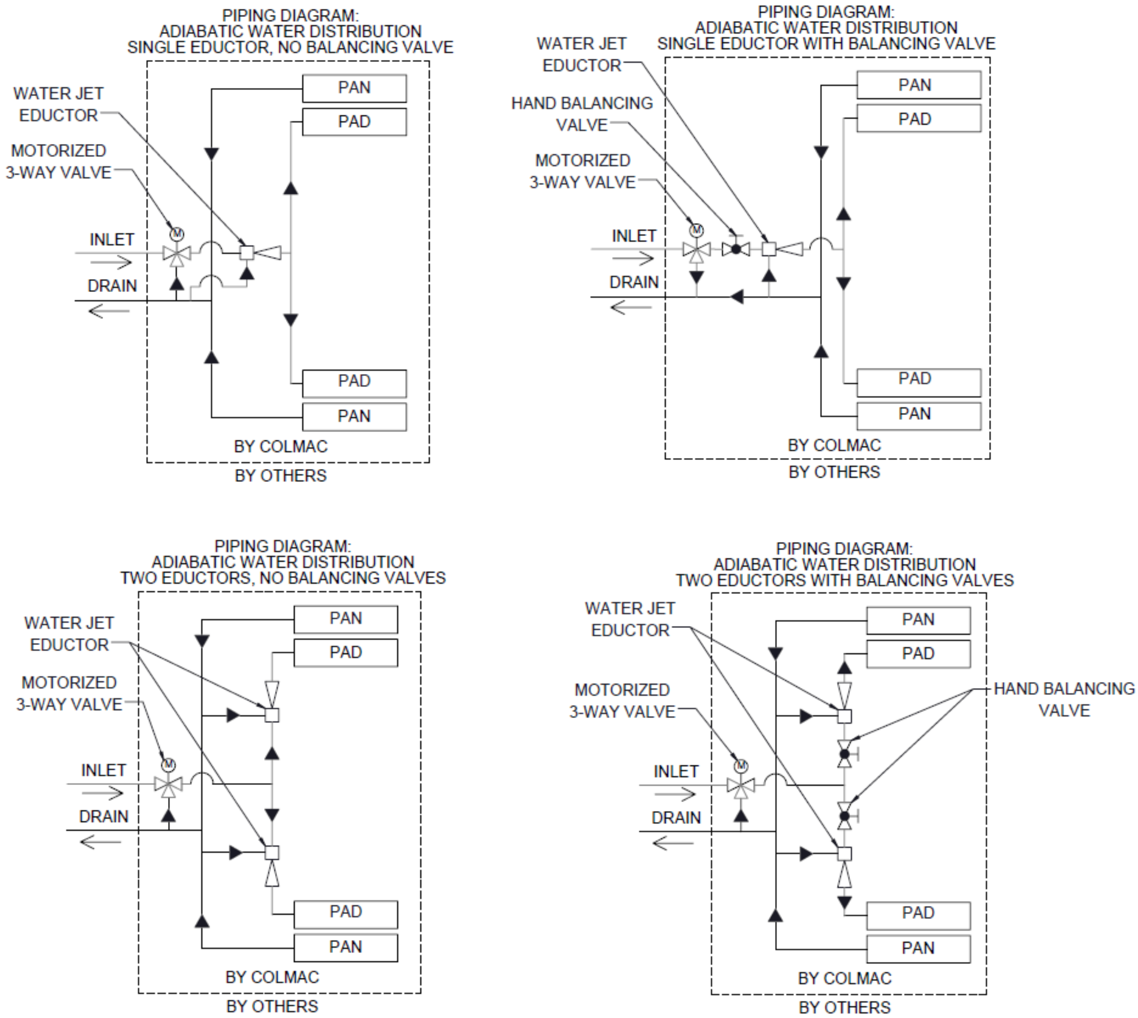
7.4.1. Replacement parts which are covered under the conditions of Colmac Coil's warranty (see Limited Warranty) will be reimbursed at the part cost only. For replacement parts, warranted or otherwise, contact Colmac Coil directly. When contacting Colmac Coil with the explanation of failure, have the complete model number, serial number, date of installation, and date of failure at hand.

8. **ADIABATIC PRE-COOLING SYSTEM**

8.1. INSTALLATION

8.1.1. Colmac Adiabatic Condensers are piped in one of four configurations, depending on the specific model and design. See Figure 6 below:

Figure 6
Adiabatic Cooling Water Piping Configurations.
See project documentation for specific configuration notes.



8.1.1.1. All piping must be fully supported.

8.1.1.2. Water supply must be 50-80 psig. See project documentation for required line size.

8.1.1.3. Backflow prevention to be installed as needed per local and national code.

8.1.1.4. Drainage piping should be free draining to prevent backup at the condenser.

8.1.2. Inspect components and water distribution pads for damage.

8.1.3. Prior to first operation, water flow should be adjusted using the factory-provided balancing valves if selected, or a field-installed valve otherwise.

8.1.3.1. With the balancing valves closed, begin supplying water to the system.

8.1.3.2. Open the valves until the provided flow-meter indicates the design flow rate based on the submittal document.

8.1.3.3. Observe the system until the pads are completely wet. As the adiabatic pads become saturated, excess water will drain and the eductor will begin to pull water from the drain to recirculate. Once the system is fully saturated, observe and adjust the balancing valves again to meet design flow condition.

8.1.3.3.1. If any portion of the pad is dry, open the upper cover and check for clogs in the distribution pipe.

8.2. OPERATION

8.2.1. Colmac Adiabatic Condensers are optionally equipped with a factory-programmed Carel PLC controller. The variables and setpoints described here are used, and we recommend using a similar control scheme if the optional controller is not selected.

8.2.2. System control variables

8.2.2.1. Setpoints

8.2.2.1.1. Maximum design outlet fluid temperature (TFmax). This is the target refrigerant temperature at the outlet of the condenser, and should be used to regulate fan speed.

8.2.2.1.2. Ambient air temperature minimum design point (TAD). This is the design point minimum for adiabatic cooling operation.

8.2.2.1.3. Ambient air lower limit (Tamin). Ambient air temperature below which freezing becomes a concern. Setpoint to prevent adiabatic water supply and initiate system draining. This should be set no lower than 40°F.

8.2.2.1.4. Ambient air dead band (DB). Dead band temperature range to prevent short cycling and increase the life cycle of system components.

8.2.2.1.5. Maximum fan speed (SFmax). Factory set maximum fan speed.

8.2.2.1.6. Minimum fan speed (SFmin). This should be set at no lower than 20% of SFmax. Below this value, the fan may seize or fail to overcome static friction when starting.

8.2.2.2. Inputs

8.2.2.2.1. Outlet fluid temperature (TF). Measured refrigerant temperature at the condenser outlet.

8.2.2.2.2. Ambient air temperature (TA). Measured ambient air temperature.

8.2.2.3. Outputs

8.2.2.3.1. Fan speed (SF). Fan operation point determined by controller, between SFmax and SFmin.

8.2.2.3.2. Make-up water on/off. Colmac Adiabatic Condensers require constant water supply for adiabatic operation, adjusting flow rate with the control system is not recommended and can negatively impact performance and system longevity.

8.2.3. Fan Speed Control

8.2.3.1. The condenser is designed with EC fans, which will be set with a max speed Smax from the factory.

8.2.3.2. Fan speed SF will be modulated by the system controller (provided by others) using a 0-10VDC signal to the onboard fan speed controller, with 0V corresponding to fans off and 10V corresponding to fans operating at SF = Smax.

8.2.3.3. Cycling the fans off will be accomplished by setting this signal to 0VDC. Do not cycle the fans on and off using the fan power supply.

8.2.3.4. Fan speed should be modulated based on outlet fluid temperature TF, operating at SFmax when TF >= TFmax. As TF falls below TFmax, fan speed can will reduce until fans are cycled off.

8.2.4. Adiabatic Make-Up Water Control

8.2.4.1. When ambient air temperature TA rises above the design point for adiabatic cooling operation TAD, make-up water cycles on. Motorized 3-way valve is powered to move to “Supply” position.

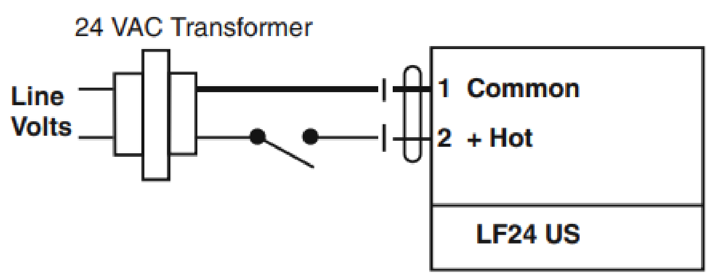
8.2.4.2. When ambient air temperature TA falls below TAD - DB, make-up water cycles off.

8.2.4.3. Below the lower temperature limit TAmin, the make-up water should remain off to prevent freezing of the pipework and adiabatic media. Motorized 3-way valve set to “Drain” position.

8.2.5. Motorized 3-Way Valve Control

8.2.5.1. The factory-provided motorized 3-way valve will be connected to the PLC controller if selected. Otherwise it will need to be field wired per figure 7 below. Supply power to move the valve to the “Supply” position. Valve will automatically move to “Drain” position when unpowered.

Figure 7
Motorized 3-Way Valve Wiring



8.2.5.2. When adiabatic cooling operation is enabled (see section 8.2.4), the valve should be positioned to allow supply water through the unit. When it is disabled, the valve should be positioned to allow water in the unit to drain.

8.3. MAINTENANCE

8.3.1. Maintenance Schedule

Weekly	**Monthly**	**Quarterly**
Visually inspect adiabatic pads for bowing, sagging, or dry streaks	Visually inspect adiabatic pads for excessive fouling and scaling	Drain, flush and disinfect water distribution system
Check water distribution pipe for clogged holes	Verify adiabatic supply water flow rate	Clean strainers in water supply piping

8.3.2. Adiabatic pads should be allowed to dry out completely every 24 hours to mitigate algae growth.

8.3.3. Adiabatic pads showing signs of fouling and scaling can be removed and cleaned using a standard garden hose. Gently rinse the pad until runoff is clean and clear of debris. Do not use a high-pressure sprayer or brush, these can damage the adiabatic pads.

8.3.4. Cleaning and disinfecting should be done only with the following chemicals. Consult local regulations and consider all affected materials and chemical interactions before utilizing:

Purpose	Chemical Name	Company	Chemical Family	Active Ingredient Level	Recommended Dosage
Algae Control	Physan 20	Maril Products, Inc	Quaternary Ammonia	20%	1 tsp per 15 gal water
Algae Control	Triathlon	OHP, Inc	Quaternary Ammonia	20%	1 oz per 30 gal water
Algae Control	Green-Shield	Whitmire Research Laboratories	Quaternary Ammonia	20%	1 oz per 6 gal water
Clean and Sanitize	Aqua Max XL	Neogen Corporation	Detergent and Mild Acid	5%	0.5 oz per gal water
Clean and Sanitize	Cool -N-Klean	Ivesco, LLC	Quaternary Ammonia, Detergent, Mild Acid	5%	0.5 oz per gal water
Clean and Sanitize	Virocid or CID-20	BVS/CIDLines USA	Quaternary Ammonia and gluteraldeyde	36%	VIROCID – initial 2.5 oz per 100 gal, then 1.25 oz per 100 gal weekly CID 20 – initial 5 oz per 100 gal, then 2.5 oz per 100 gal weekly

8.3.5. Cold Weather

8.3.5.1. When ambient temperature drops below 40°F, steps must be taken to prevent equipment damage due to freezing.

8.3.5.2. Water supply control will disable water supply to the unit and allow the system to drain.

8.3.5.3. All exposed external piping should be drained if it does not have heat trace to prevent freezing.

8.3.5.4. Adiabatic pads may be subject to damage and should be removed and stored.

8.3.5.4.1. Unscrew the retaining bolts on the distribution pipe cover, allowing it to hinge open.

8.3.5.4.2. Remove upper distribution pad.

8.3.5.4.3. Lift and remove the main adiabatic pad, angling it outward as needed to clear the distribution piping above.

FIGURE 8

Vertical Fluid Cooler
Rigging

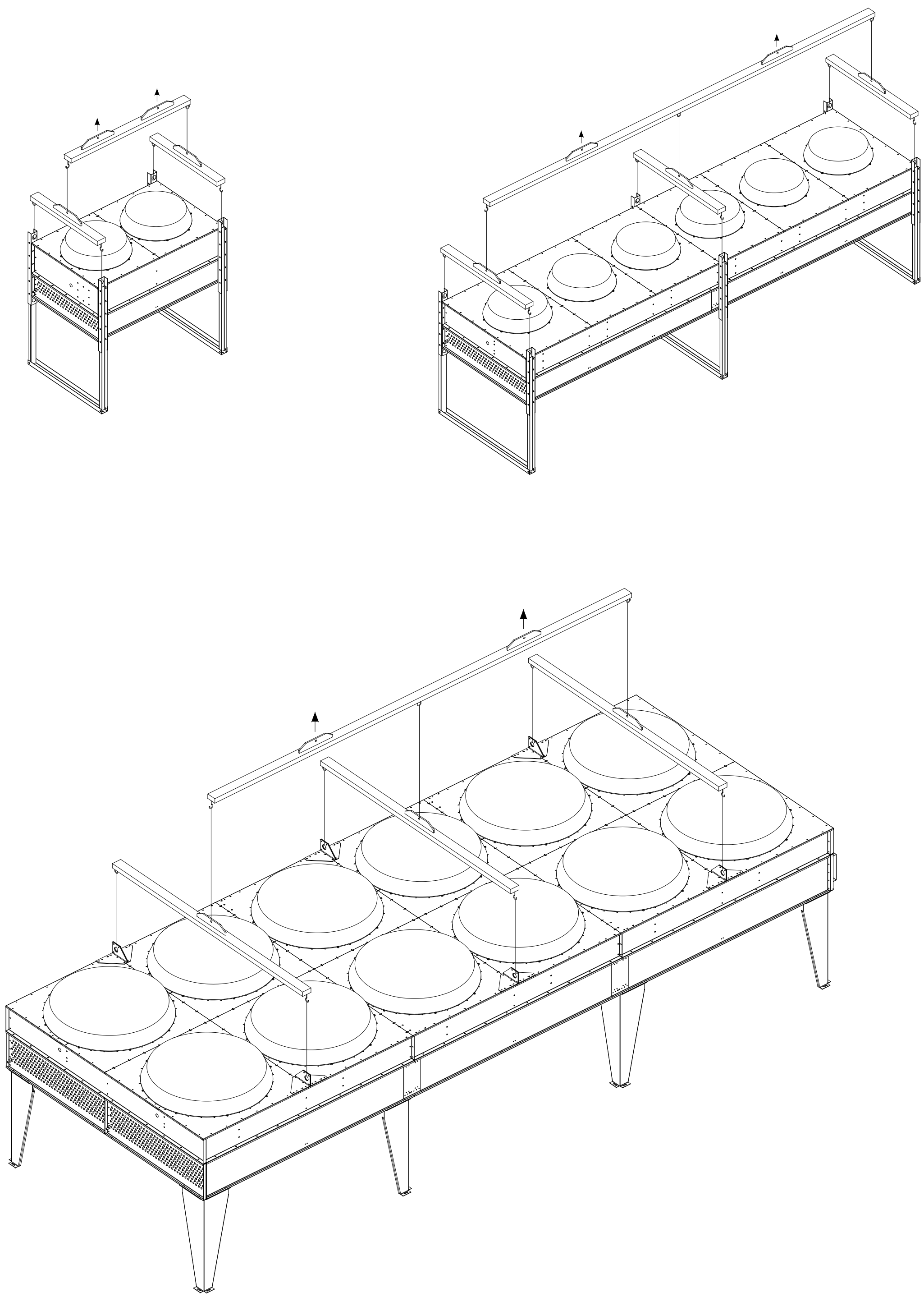


FIGURE 9

Horizontal Fluid Cooler
Rigging