Installation, Operation and Maintenance Manual	IOMM ALR-3
	Group: **Chiller**
	Part Number: **330145710**
	Effective: **September 2001**
	Supersedes: **IM ALR-2**

Packaged Air-Cooled Water Chiller

ALR 110F - ALR 150F
Refrigerant R-22, 60 Hertz

McQuay®
Air Conditioning

Table of Contents

Introduction

General Description

McQuay air-cooled water chillers are complete, self-contained, automatic refrigerating units. Every unit is completely assembled, factory wired, charged, and tested. Each unit consists of twin air-cooled condensers with integral subcooler sections, two accessible hermetic compressors per circuit, replaceable tube, dual circuit shell-and-tube evaporator, and complete refrigerant piping. Liquid line components include manual liquid line shutoff valves, sight-glass/moisture indicators, solenoid valves, and double diaphragm hydraulic element thermal expansion valves. Other features include compressor crankcase heaters, an evaporator heater for chilled water freeze protection, limited pumpdown during "on" or "off" periods, compressor lead-lag switch to alternate the compressor starting sequence, and sequenced starting of compressors.

The electrical control center includes all detection and operating controls necessary for dependable automatic operation. Condenser fan motors are fused in all three phases and started by their own three-pole contactors. Compressors are protected by circuit breakers. Optional factory installed or field installed fused disconnect switches are available.

Operator information on the standard UNT controller can be found in IOM UNT33n. Information on the optional MicroTech control can be found in the latest version of OM-RCPMICRO.

Inspection

Check all items carefully against the bill of lading. Inspect all units for damage upon arrival. Report shipping damage and file a claim with the carrier. Check the unit nameplate before unloading, making certain it agrees with the power supply available. McQuay is not responsible for physical damage after unit leaves the factory.

Note: Unit shipping and operating weights are available in the Physical Data tables beginning on page 13.

Installation

Note: Installation is to be performed by qualified personnel who are familiar with local codes and regulations.

WARNING

Sharp edges and coil surfaces are a potential hazard. Avoid contact with them.

Handling

Be careful to avoid rough handling of the unit. Do not push or pull the unit from anything other than the base. Block the pushing vehicle away from the unit to prevent damage to the sheet metal cabinet and end frame.

To lift the unit, 2 1/2" (64mm) diameter lifting holes are provided in the base of the unit. Arrange spreader bars and cables to prevent damage to the condenser coils or cabinet (see Figure 2).

Figure 1, Suggested Pushing Arrangement

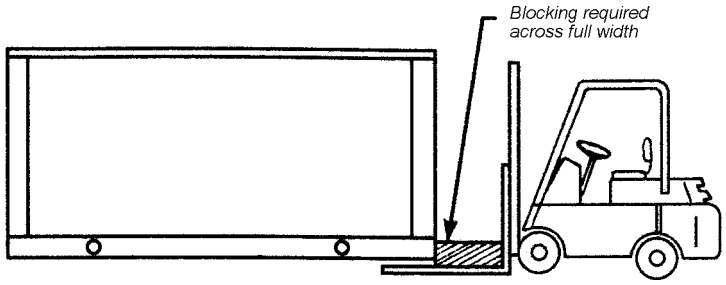
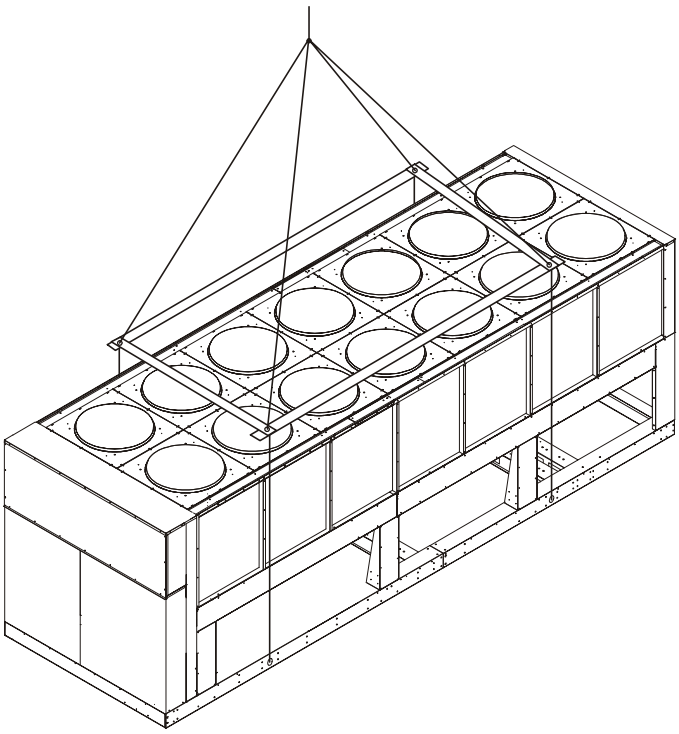


Figure 2, Required Lifting Arrangement



NOTES:

1. All four rigging points on a unit must be used. See Figure 5 for location, and weight at lifting points for a specific size unit.
2. Crosswise and lengthwise spreader bars must be used to avoid damage to unit. Lifting cables from the unit mounting holes up must be vertical.
3. The number of condenser fans can vary from this diagram.

Location

Unit Placement

ALR units are for outdoor applications and can be mounted on a roof or ground level. Set units on a solid and level foundation. For roof mounted applications, install the unit on a steel channel or I-beam frame to support the unit above the roof. For ground level applications, install the unit on a substantial base that will not settle. A one piece concrete slab with footings extended below the frost line is recommended. Be sure the foundation is level (within 1/2" [13 mm] over its length and width). The foundation must support the operating weights listed in the Physical Data tables beginning on page 13.

On ground level applications protect the unit against vandalism by using the optional lower wire mesh guards or by erecting a screen fence. The fence must allow free flow of air to the condenser coil for proper unit operation.

Clearances

The flow of air to and from the condenser coils must not be limited. Restricting air flow or allowing air recirculation will result in a decrease in unit performance and efficiency. There must be no obstruction above the unit that would deflect discharge air downward where it could be recirculated back to the inlet of the condenser coil. The condenser fans are propeller type and will not operate with ductwork on the fan outlet.

Install the unit with enough side clearance for air entrance to the coil and for servicing. Provide service access to the evaporator, compressors, electrical control panel and piping components as shown in Figure 3.

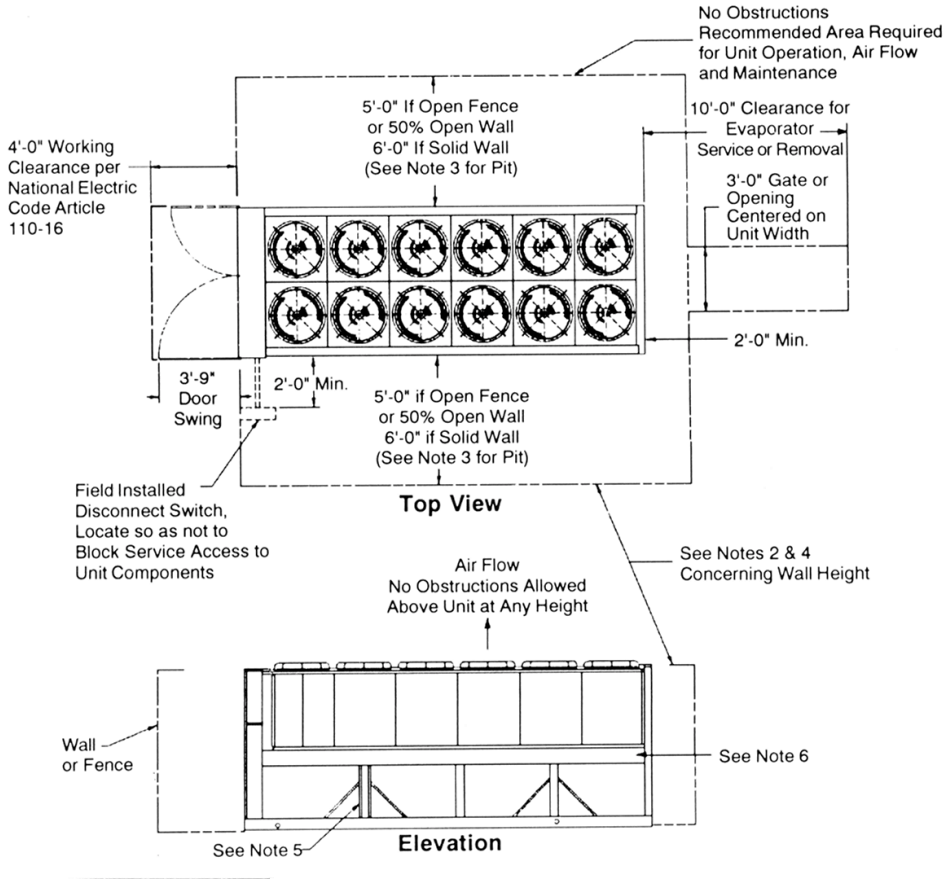
Do not allow debris to accumulate near the unit. Air movement can draw debris into the condenser coil causing air starvation. Give special consideration to low ambient operation where snow can accumulate. Keep condenser coils and fan discharge free of snow or other obstructions to permit adequate airflow.

Service Access

Each end of the unit must be accessible after installation for periodic service. Compressors, filter-driers, and manual liquid line shutoff valves are accessible on each side of the unit adjacent to the control box. High pressure, low pressure, and motor protector controls are on the compressor. Freezestats and cooler barrel thermostats are near the cooler. Most other operational, detection and starting controls are located in the unit control box.

The condenser fan and motors can be removed from the top of the unit.

Figure 3, Clearance Requirements



Notes:

1. Minimum side clearance between two units is 12 feet.
2. Unit must not be installed in a pit or enclosure that is deeper or taller than the height of the unit unless extra clearance is provided per note 4.
3. Minimum clearance on each side is 8 feet when installed in a pit no deeper than the unit height.
4. Minimum side clearance to a side wall or building taller than the unit height is 8 feet provided no solid wall above 6 feet is closer than 12 feet to the opposite side of the unit.
5. The evaporator can be removed from the side of the unit.
6. Do not mount electrical conduits, etc, above the side rail on either side if the unit.
7. There must be no obstruction of the fan discharge.

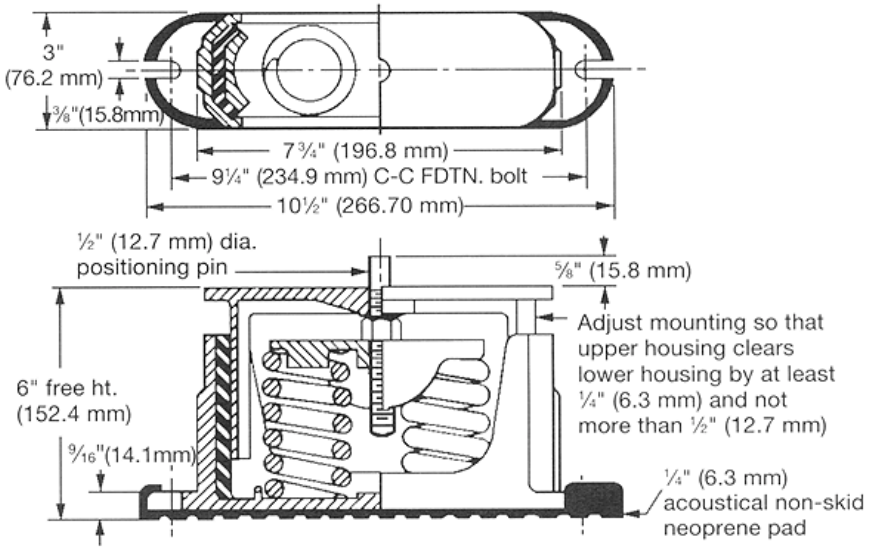
Sound Isolation

The low sound level of the ALR reciprocating chiller is suitable for most applications. When additional sound reduction is necessary, locate the unit away from sound sensitive areas. Avoid locations beneath windows or between structures where normal operating sounds can be objectionable. Reduce structurally transmitted sound by isolating water lines, electrical conduit and the unit itself. Use wall sleeves and rubber isolated piping hangers to reduce transmission of water or pump noise into occupied spaces. Use flexible electrical conduit to isolate sound through electrical conduit. Spring isolators are effective in reducing the low amplitude sound generated by reciprocating compressors and for unit isolation in sound sensitive areas.

Vibration Isolators

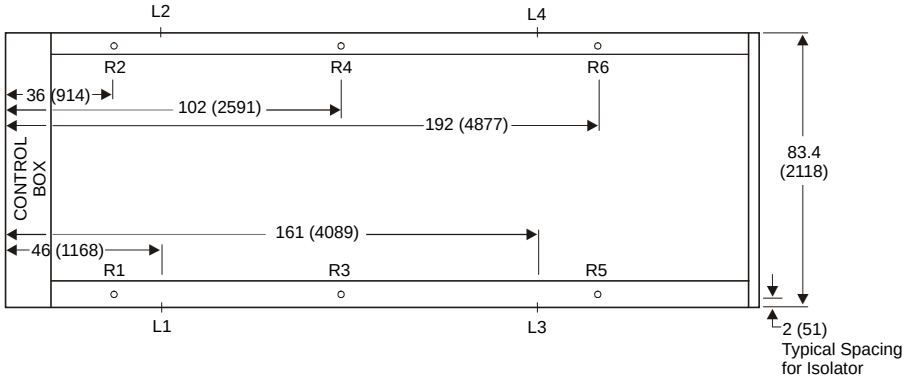
Vibration isolators are recommended for all roof mounted installations or wherever vibration transmission is a consideration.

Figure 4, Spring Flex Isolators



Lifting and Mounting Weights

Figure 5, ALR 110-150 Lifting and Mounting Locations



NOTES:
2 ½ in. (63.5 mm) lifting holes at location "L" on sides of base rails.
1 in. (25.4 mm) mounting holes at location "M" on bottom of base rails.

ALR Model	Lifting Weight for Each Point lb (kg)		Mounting Loads for Each Point lb. (kg)			Operating Wt lb. (kg)	Shipping Wt. lb. (kg)	Copper Fin Add
	L1 & L2	L3 & L4	R1 & R2	R3 & R4	R5 & R6			
110	2585 (1171)	2125 (963)	1835 (831)	1785 (809)	1230 (557)	9700 (4394)	9420 (4267)	1370 (620)
120	2570 (1164)	2205 (999)	1830 (829)	1805 (818)	1305 (591)	9880 (4476)	9550 (4326)	1370 (620)
130	2570 (1164)	2205 (999)	1830 (829)	1805 (818)	1305 (591)	9880 (4476)	9550 (4326)	1370 (620)
135	2570 (1164)	2205 (999)	1830 (829)	1805 (818)	1305 (591)	9880 (4476)	9550 (4326)	1370 (620)
140	2570 (1166)	2210 (1001)	1830 (829)	1805 (818)	1310 (593)	9890 (4478)	9560 (4340)	1370 (620)
145	2570 (1166)	2210 (1001)	1830 (829)	1805 (818)	1310 (593)	9890 (4480)	9560 (4330)	1370 (620)
150	2600 (1178)	2280 (1032)	1860 (842)	1840 (833)	1345 (609)	10090 (4571)	9760 (4421)	1370 (620)

Water Piping

Local authorities can supply the installer with the proper building and safety codes required for safe and proper installation.

Install piping with minimum bends and changes in elevation to minimize pressure drop. Consider the following when installing water piping:

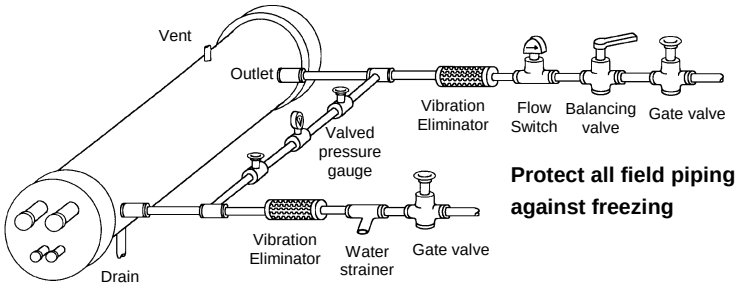
1. Vibration eliminators to reduce vibration and noise transmission to the building.
2. Shutoff valves to isolate the unit from the piping system during unit servicing.
3. Manual or automatic air vent valves at the high points of the system. Install drains at the lowest points in the system.
4. A means of maintaining adequate system water pressure (expansion tank or regulating valve).
5. Temperature and pressure indicators located at the unit to aid in unit servicing.
6. A strainer or other means of removing foreign matter from the water before it enters the pump. Place the strainer far enough upstream to prevent cavitation at the pump inlet (consult pump manufacturer for recommendations). The use of a strainer will prolong pump life and keep system performance up.
7. Place a strainer in the water line just before the inlet of the evaporator. This will help prevent foreign material from entering and decreasing the performance of the evaporator.

CAUTION

If separate disconnect is used for the 110V supply to the evaporator heating cable, mark the disconnect clearly to ensure disconnect is not accidentally shut off during cold seasons.

8. The shell-and-tube evaporator has a thermostat and heating cable to prevent freeze-up down to -20°F (-29°C). It is suggested that the heating cable be wired to a separate 110V supply circuit. As shipped from the factory, the heating cable is wired to the control circuit. All water piping to the unit must also be protected to prevent freezing.
9. If the unit is used as a replacement chiller on a previously existing piping system, flush the system thoroughly before unit installation. Regular water analysis and chemical water treatment on the evaporator is recommended immediately at equipment start-up.
10. The total water quantity in the system should be sufficient to prevent frequent "on-off" cycling. For air-conditioning systems, system gallons equal to 7 time the flow rate is recommended.
11. When glycol is added to the water system for freeze protection, the refrigerant suction pressure will be lower, cooling performance less, and water side pressure drop greater. If the percentage of glycol is high, or if propylene is used instead of ethylene glycol, the added pressure drop and loss of performance could be substantial. Reset the freezestat and low leaving water alarm temperatures. The freezestat is factory set to default at 36°F (2.2°C). Reset the freezestat setting to approximately 4 to 5 degrees F (2.3 to 2.8 degrees C) below the leaving chilled water setpoint temperature. See the section titled “Glycol Solutions” for additional information concerning glycol.
12. Perform a preliminary leak check before insulating the piping and filling the system.
13. Piping insulation should include a vapor barrier to prevent condensation and possible damage to the building structure.

Figure 6, Typical Evaporator Water Piping



Flow Switch

Mount a water flow switch in either the entering or leaving water line to shut down the unit when water flow is interrupted.

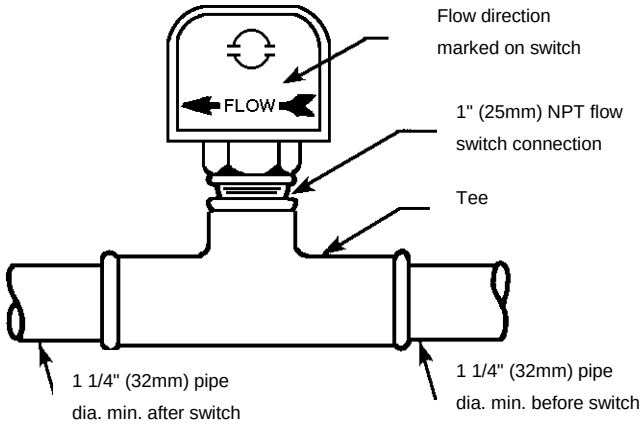
A flow switch is available from McQuay (part number 017503300). It is a "paddle" type switch and adaptable to any pipe size from 3" (76mm) to 8" (203mm) nominal. Certain minimum flow rates are required to close the switch and are listed in Table 1. Installation should be as shown in Figure 7. Connect the normally open contacts of the flow switch in the unit control center at terminals 5 and 6. There is also a set of normally closed contacts on the switch that can be used for an indicator light or an alarm to indicate when a "no flow" condition exists. Freeze protect any flow switch that is installed outdoors.

NOTE: Differential pressure switches are not recommended for outdoor installation.

Table 1, Flow Switch Minimum Flow Rates

NOMINAL PIPE SIZE INCHES (MM)	MINIMUM REQUIRED FLOW TO ACTIVATE SWITCH - GPM (L/s)
3 (76.20)	30 (1.9)
4 (101.6)	39 (2.5)
5 (127.0)	59 (3.7)
6 (152.4)	79 (5.0)
8 (203.0)	140 (8.8)

Figure 7, Flow Switch Installation



Water Connections

Bring water piping to the evaporator from the bottom of the unit or through the side between the vertical supports.

Refrigerant Charge

All units designed for use with HCFC-22 are shipped with an operating charge (remote evaporator applications are shipped with a unit operating charge and can require additional charge for field piping). The operating charge (using HCFC-22) for each unit is shown in the Physical Data tables beginning on page 13.

Glycol Solutions

The system glycol capacity, glycol solution flow rate, and pressure drop through the cooler can be calculated using the following formulas and Table 4.

Note: *The procedure does not specify the type of glycol. Use the derate factors found in Table 2 for corrections when using ethylene glycol and those in Table 3 for propylene glycol.*

1. **Capacity** -- Find the reduced capacity by multiplying the chiller capacity with water by the capacity correction factor "Cap".
2. **Flow** -- To determine evaporator flow (or Delta-T) knowing Delta-T (or GPM) and capacity:

   $$\text{Glycol GPM} = \frac{24 \times capacity(glycol)}{Delta - T} \times Flow\ Factor \text{ (from table 2,3)}$$

   For Metric Applications -- To determine evaporator L/s (or Delta-T) knowing Delta-T (or L/s) and kW:

   $$\text{Glycol L/s} = \frac{kW}{4.18 \times Delta - T} \times Flow\ Factor \text{ (from table 2,3)}$$

3. **Pressure drop** -- To determine pressure drop through the evaporator, when using glycol, enter the water pressure drop curve on page 12 at the water flow. Multiply the water pressure drop by "PD" correction factor from Table 2 or Table 3 to obtain corrected glycol pressure drop.
4. To determine the unit's power consumption when using glycol, multiply the water system kW by glycol factor "kW".

Test coolant with a clean, accurate glycol solution hydrometer (similar to that found in service stations) to determine the freezing point. Obtain the percent glycol from the freezing point table below. It is normally recommended by the supplier that a minimum of 25% glycol solution by weight be used for protection against corrosion.

CAUTION

Do not use automotive grade antifreeze. Industrial grade glycols must be used. Automotive antifreeze contains inhibitors that will cause plating on the copper tubes within the chiller evaporator. The type and handling of glycol used must be consistent with local codes.

Table 2, Ethylene Glycol

%	Freeze Point					
E.G.	°F	°C	Cap.	kW	Flow	PD
10	26	-3	0.991	0.996	1.013	1.070
20	18	-8	0.982	0.992	1.040	1.129
30	7	-14	0.972	0.986	1.074	1.181
40	-7	-22	0.961	0.976	1.121	1.263
50	-28	-33	0.946	0.966	1.178	1.308

Table 3, Propylene Glycol

%	Freeze Point					
P.G.	°F	°C	Cap.	kW	Flow	PD
10	26	-3	0.987	0.992	1.010	1.068
20	19	-7	0.975	0.985	1.028	1.147
30	9	-13	0.962	0.978	1.050	1.248
40	-5	-21	0.946	0.971	1.078	1.366
50	-27	-33	0.929	0.965	1.116	1.481

Table 4, Capacity and Power Derates

ALTITUDE	Chilled Water Delta-T		Fouling Factor							
			0.0001 (0.0176)		0.00025 (0.044)		0.00075 (0.132)		0.00175 (0.308)	
	°F	°C	Cap.	Power	Cap.	Power	Cap.	Power	Cap.	Power
SEA LEVEL	6	3.3	0.992	0.995	0.985	0.993	0.962	0.986	0.919	0.972
	8	4.4	0.995	0.997	0.988	0.995	0.965	0.988	0.922	0.974
	10	5.6	1.000	1.000	0.993	0.998	0.970	0.991	0.927	0.977
	12	6.7	1.005	1.002	0.998	1.000	0.975	0.993	0.932	0.979
	14	6.8	1.010	1.005	1.003	1.003	0.980	0.996	0.936	0.982
	16	8.9	1.014	1.007	1.007	1.005	0.984	0.998	0.940	0.984
2000 feet (610 m)	6	3.3	0.978	1.005	0.971	1.003	0.949	0.996	0.906	0.982
	8	4.4	0.982	1.007	0.975	1.005	0.953	0.998	0.910	0.984
	10	5.6	0.986	1.009	0.979	1.007	0.956	1.000	0.914	0.986
	12	6.7	0.992	1.011	0.985	1.009	0.962	1.002	0.919	0.988
	14	6.8	0.997	1.014	0.990	1.012	0.967	1.005	0.924	0.991
	16	8.9	1.000	1.016	0.993	1.014	0.970	1.007	0.927	0.993
4000 feet (1220 m)	6	3.3	0.966	1.016	0.959	1.014	0.937	1.007	0.895	0.993
	8	4.4	0.969	1.018	0.962	1.016	0.940	1.009	0.898	0.995
	10	5.6	0.973	1.021	0.966	1.019	0.944	1.012	0.902	0.998
	12	6.7	0.978	1.025	0.971	1.023	0.949	1.016	0.906	1.002
	14	6.8	0.982	1.027	0.975	1.025	0.953	1.018	0.910	1.004
	16	8.9	0.986	1.028	0.979	1.026	0.956	1.019	0.914	1.005
6000 feet (1830 m)	6	3.3	0.953	1.025	0.946	1.023	0.924	1.016	0.883	1.002
	8	4.4	0.955	1.028	0.948	1.026	0.926	1.019	0.885	1.005
	10	5.6	0.959	1.031	0.952	1.029	0.930	1.022	0.889	1.008
	12	6.7	0.963	1.034	0.956	1.032	0.934	1.024	0.893	1.011
	14	6.8	0.968	1.036	0.961	1.034	0.939	1.026	0.897	1.013
	16	8.9	0.972	1.037	0.965	1.035	0.943	1.027	0.901	1.014

Evaporator Water Flow and Pressure Drop

Evaporator flow rate must fall between the minimum and maximum values shown in the evaporator pressure drop curve. Flow rates below the minimum values will result in laminar flow that will reduce efficiency, cause erratic operation of the expansion valve and could cause low temperature cutouts. Flow rates exceeding the maximum values can cause erosion on the evaporator water connections and tubes.

Measure the chilled water pressure drop through the evaporator at field installed pressure taps. It is important not to include the effect of valves or strainers in these readings.

Variable Water Flow

Variable water flow involves changing the water flow through the evaporator as the load changes. McQuay chillers are designed for this duty provided that the rate of change in water flow is slow and the minimum and maximum flow rates for the vessel are not exceeded.

Ten percent is the maximum allowable percent per minute change of flow. The ALR control logic has timers that limit the rate of unloading or loading allowed. Slow changes allow the chiller the opportunity to sense a change, react to the change and stabilize preventing operational problems.

Figure 8, Evaporator Water Pressure Drops

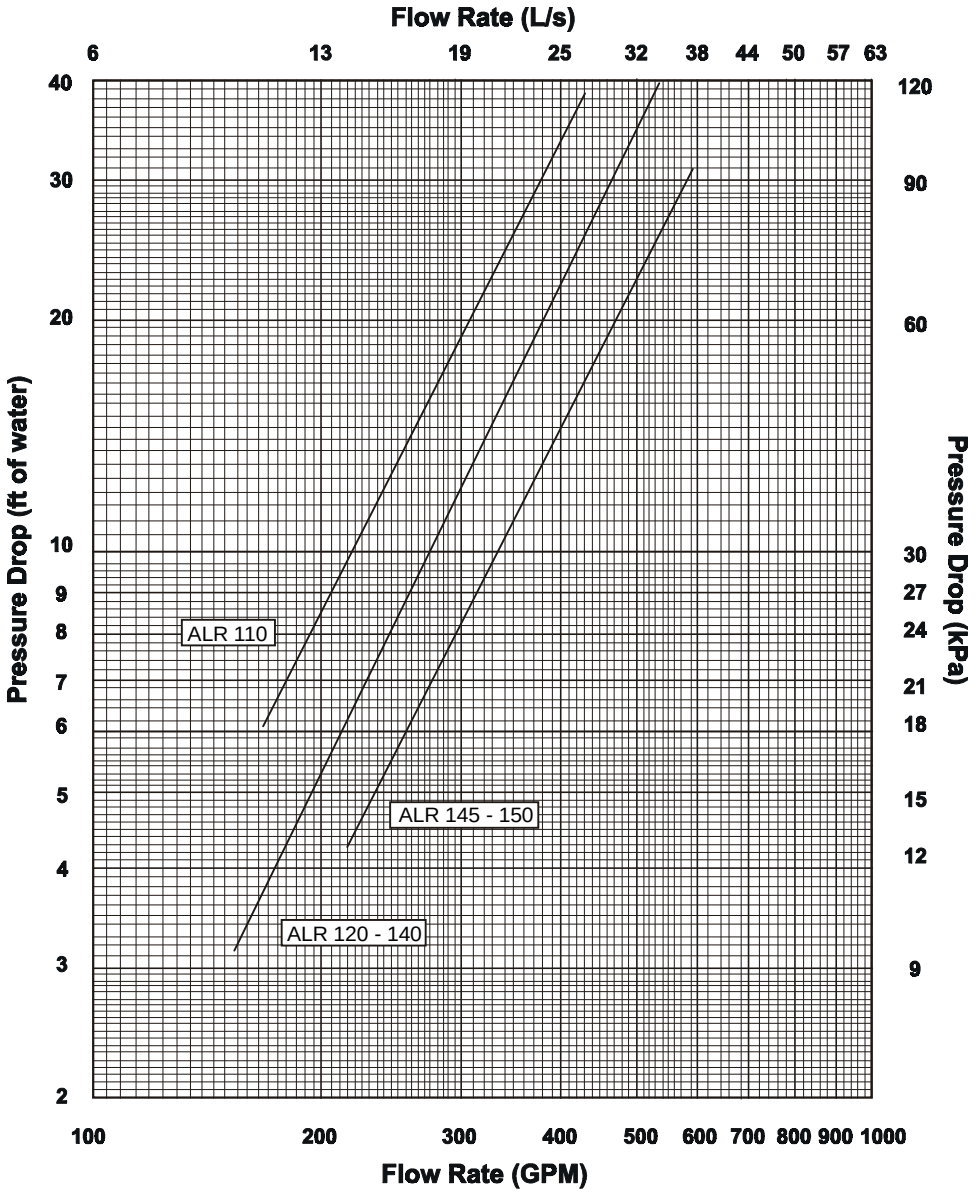


Table 5, Minimum/Maximum Flow Rates

ALR Unit Size	Minimum Flow gpm (l/s)	Pressure Drop ft. (kPa)	Maximum Flow gpm (l/s)	Pressure Drop ft. (kPa)
110	165 (10.4)	6.0 (17.9)	435 (27.4)	39.0 (116.0)
120	180 (11.4)	4.3 (12.8)	480 (30.3)	30.5 (90.0)
130	195 (12.3)	5.1 (15.2)	520 (32.8)	37.5 (111.8)
135	200 (12.6)	5.3 (15.8)	535 (33.8)	40.0 (119.2)
140	205 (13.0)	5.8 (17.3)	550 (34.7)	42.0 (125.2)
145	215 (13.6)	4.3 (12.8)	570 (36.0)	29.5 (87.9)
150	220 (13.9)	4.5 (13.4)	590 (37.2)	31.0 (92.4)

Physical Data

Table 6, Physical Data ALR 110F through 135F

PHYSICAL DATA	ALR MODEL NUMBER							
	110F		120F		130F		135F	
BASIC DATA	Ckt.1	Ckt.2	Ckt.1	Ckt.2	Ckt.1	Ckt.2	Ckt.1	Ckt.2
Unit Capacity @ ARI Conditions, Tons (kW) (1)	110.9 (388.1)		122.2 (427.7)		129.6 (453.6)		133.7 (468.0)	
Number Of Refrigerant Circuits	2		2		2		2	
Unit Operating Charge, R-22, lbs.	115	115	120	120	120	120	120	120
Unit Operating Charge, R-22, (kg)	(52.1)	(52.1)	(54.4)	(54.4)	(54.4)	(54.4)	(54.4)	(54.4)
Cabinet Dimensions, LxWxH, in.	229 x 83 x 89		229 x 83 x 89		229 x 83 x 89		229 x 83 x 89	
Cabinet Dimensions, LxWxH, (mm)	(5809 x 2118 x 2210)		(5809 x 2118 x 2210)		(5809 x 2118 x 2210)		(5817 x 2118 x 2210)	
Unit Operating Weight, lbs. (kg)	9700 (4394)		9880 (4476)		9880 (4476)		9880 (4476)	
Unit Shipping Weight, lbs. (kg)	9420 (4267)		9550 (4326)		9550 (4326)		9550 (4326)	
Add'l Weight If Copper Finned Coils, lbs. (kg)	1370 (620)		1370 (620)		1370 (620)		1370 (620)	
COMPRESSORS								
Type	Semi-Hermetic		Semi-Hermetic		Semi-Hermetic		Semi-Hermetic	
Nominal Horsepower	30-30	30-35	30-35	35-35	35-35	35-35	35-40	35-40
Number Of Cylinders Per Compressor	6 - 6	6 - 6	6 - 6	6 - 6	6 - 6	6 - 6	6 - 6	6 - 6
Oil Charge Per Compressor, oz.	140 - 140	140 - 140	140 - 140	140 - 140	140 - 140	140 - 140	140 - 255	140 - 255
Oil Charge Per Compressor, (l)	(4.1-4.1)	(4.1–4.1)	(4.1–4.1)	(4.1–4.1)	(4.1–4.1)	(4.1–4.1)	(4.1–6.5)	(4.1–6.5)
CAPACITY REDUCTION STEPS - PERCENT OF COMPRESSOR DISPLACEMENT								
Staging - Circuit #1 in Lead	0-16-32-40-48 64-84-92-100		0-15-32-39-48 67-84-91-100		0-17-33-42-50 67-83-92-100		0-16-32-40-48 66-84-92-100	
Staging - Circuit #2 in Lead	0-16-32-40-48 8-84-92-100		0-17-32-41-48 5-84-91-100		0-17-33-42-50 67-83-92-100		0-16-32-40-48 66-84-92-100	
CONDENSERS - HIGH EFFICIENCY FIN AND TUBE TYPE WITH INTEGRAL SUBCOOLING								
Coil Face Area, sq. ft.	115	115	115	115	115	115	115	115
Coil Face Area, (m^2)	(10.3)	(10.3)	(10.3)	(10.3)	(10.3)	(10.3)	(10.3)	(10.3)
Finned Height x Finned Length, in.	80 x 208	80 x 208	80 x 208	80 x 208	80 x 208	80 x 208	80 x 208	80 x 208
Finned Height x Finned Length, (mm)	(2032 x 5283)	(2032 x 5283)	(2032 x 5283)	(2032 x 5283)	(2032 x 5283)	(2032 x 5283)	(2032 x 5283)	(2032 x 5283)
Fins Per Inch x Rows Deep	16 x 3	16 x 3	16 x 3	16 x 3	16 x 3	16 x 3	16 x 3	16 x 3
Maximum Relief Valve Pressure Setting, psig (kPa)	450 (3103)	450 (3103)	450 (3103)	450 (3103)	450 (3103)	450 (3103)	450 (3103)	450 (3103)
CONDENSER FANS - DIRECT DRIVE PROPELLER TYPE								
Number Of Fans - Fan Diameter, In. (mm)	10 - 28 (711)		10 - 28 (711)		12 - 28 (711)		12 - 28 (711)	
Number Of Motors - HP (kW)	10 - 1.5 (1.1)		10 - 1.5 (1.1)		12 - 1.5 (1.1)		12 - 1.5 (1.1)	
Fan And Motor RPM, 60 Hz	1140		1140		1140		1140	
60 Hz Fan Tip Speed, fpm	8357		8357		8357		8357	
60 Hz Total Unit Airflow, cfm	90200		90200		108240		108240	
DIRECT EXPANSION EVAPORATOR - BAFFLED SHELL AND THRU-TUBE								
Diameter, in. - Length, in.	12.8 x 94.6		14.0 x 95.5		14.0 x 95.5		14.0 x 95.5	
Diameter, (mm) - Length, (mm)	325 x 2403		356 x 2426		356 x 2426		356 x 2426	
Water Volume, Gallons, (L)	34 (127)		40 (150)		40 (150)		40 (150)	
Maximum Water Pressure, psig (kPa)	152 (1047)		152 (1047)		152 (1047)		152 (1047)	
Maximum Refrigerant Working Pressure, psig (kPa)	300 (2066)		300 (2066)		300 (2066)		300 (2066)	
Water Inlet / Outlet Victaulic Connections, in. (mm)	5 (127)		8 (203)		8 (203)		8 (203)	
Drain - NPT int, in. (mm)	.5 (12.7)		.5 (12.7)		.5 (12.7)		.5 (12.7)	
Vent - NPT int, in. (mm)	.5 (12.7)		.5 (12.7)		.5 (12.7)		.5 (12.7)	

NOTE:
1. Nominal capacity based on 95°F ambient air and 54°F/44°F water range.

Table 7, Physical Data ALR 140F through 150F

PHYSICAL DATA	ALR MODEL					
	140F		145F		150F	
BASIC DATA	Ckt.1	Ckt.2	Ckt.1	Ckt.2	Ckt.1	Ckt.2
Unit Capacity @ ARI Conditions (1), Tons (kW)	139.7 (489.0)		143.2 (501.2)		149.5 (523.3)	
Number Of Refrigerant Circuits	2		2		2	
Unit Operating Charge, R-22, lbs.	125	125	130	130	130	130
Unit Operating Charge, R-22, (kg)	(56.6)	(56.6)	(58.9)	(58.9)	(58.9)	(58.9)
Cabinet Dimensions, LxWxH, in.	229 x 83 x 89		229 x 83 x 89		229 x 83 x 89	
Cabinet Dimensions, LxWxH, (mm)	(5817 x 2118 x 2210)		(5817 x 2118 x 2210)		(5817 x 2118 x 2210)	
Unit Operating Weight, Lbs. (kg)	9885 (4478)		9890 (4480)		10090 (4571)	
Unit Shipping Weight, Lbs. (kg)	9555 (4328)		9560 (4330)		9760 (4421)	
Add'l Weight If Copper Finned Coils, lbs. (kg)	1370 (620)		1370 (621)		1370 (621)	
COMPRESSORS						
Type	Semi-Hermetic		Semi-Hermetic		Semi-Hermetic	
Nominal Horsepower	40-40	40-40	40-40	40-40	40-40	40-50
Number Of Cylinders Per Compressor	6 - 6	6 - 6	6 - 6	6 - 6	6 - 6	6 - 8
Oil Charge Per Compressor, oz.	255 - 255	255 - 255	255 - 255	255 - 255	255 - 255	255 - 255
Oil Charge Per Compressor, (l)	(6.5 – 6.5)	(6.5 – 6.5)	(6.5 – 6.5)	(6.5 – 6.5)	(6.5 – 6.5)	(6.5 – 6.5)
CAPACITY REDUCTION STEPS - PERCENT OF COMPRESSOR DISPLACEMENT						
Staging - Circuit #1 in Lead	0-17-33-42-50 67-83-92-100		0-17-33-42-50 67-83-92-100		0-15-32-40-64 64-84-92-100	
Staging - Circuit #2 in Lead	0-17-33-42-50 67-83-92-100		0-17-33-42-50 67-83-92-100		0-15-32-40-48 68-84-92-100	
CONDENSERS - HIGH EFFICIENCY FIN AND TUBE TYPE WITH INTEGRAL SUBCOOLING						
Coil Face Area,Sq. Ft.	115	115	115	115	115	115
Coil Face Area, (m^2)	(10.3)	(10.3)	(10.3)	(10.3)	(10.3)	(10.3)
Finned Height x Finned Length, in.	80 x 208	80 x 208	80 x 208	80 x 208	80 x 208	80 x 208
Finned Height x Finned Length, (mm)	(2032 x 5283)	(2032 x 5283)	(2032 x 5283)	(2032 x 5283)	(2032 x 5283)	(2032 x 5283)
Fins Per Inch x Rows Deep	16 x 3	16 x 3	16 x 3	16 x 3	16 x 3	16 x 3
Maximum Relief Valve Pressure Setting, psig (kPa)	450 (3103)	450 (3103)	450 (3103)	450 (3103)	450 (3103)	450 (3103)
CONDENSER FANS - DIRECT DRIVE PROPELLER TYPE						
Number Of Fans - Fan Diameter, In. (mm)	12 - 28 (711)		12 - 28 (711)		12 - 28 (711)	
Number Of Motors - HP (kW)	12 - 1.5 (1.1)		12 - 1.5 (1.1)		12 - 1.5 (1.1)	
Fan And Motor RPM, 60 HZ	1140		1140		1140	
60 Hz Fan Tip Speed, fpm	8357		8357		8357	
60 Hz Total Unit Airflow, cfm	108240		108240		108240	
DIRECT EXPANSION EVAPORATOR - BAFFLED SHELL AND THRU-TUBE						
Diameter, in. - Length, in.	14.0 x 95.5		16.0 x 96.8		16.0 x 96.8	
Diameter, (mm) - Length, (mm)	356 x 2426		406 x 2459		406 x 2459	
Water Volume, Gallons, (L)	40 (150)		55 (208)		55 (208)	
Maximum Water Pressure, psig (kPa)	152 (1047)		152 (1047)		152 (1047)	
Maximum Refrigerant Working Pressure, psig (kPa)	300 (2066)		300 (2066)		300 (2066)	
Water Inlet / Outlet Victaulic Connections, in. (mm)	8 (203)		8 (203)		8 (203)	
Drain - NPT int, in. (mm)	.5 (12.7)		.5 (12.7)		.5 (12.7)	
Vent - NPT int, in. (mm)	.5 (12.7)		.5 (12.7)		.5 (12.7)	

NOTE:
1. Nominal capacity based on 95°F ambient air and 54°F/44°F water range.

Electrical Data

Field Wiring

CAUTION

Internal power wiring to the compressors for single and multiple point option are different. Field wiring must be installed according to unit wiring diagram.

Wiring must comply with all applicable codes and ordinances. Warranty is void if wiring is not in accordance with specifications. Copper wire is required for all power lead terminations at the unit. Aluminum or copper can be used for all other wiring.

ALR units can be ordered with internal power wiring for either single or multiple point power connection. If single point power connection is ordered, a single large power terminal block is provided and wiring within the unit is sized in accordance with the National Electrical Code. A single field supplied fused disconnect is required. If multiple point power wiring is ordered, three power connections, one per compressor circuit, one for condenser fans, and control circuit, are required. Separate field supplied fused disconnects are required for each of the three circuits. A single power block is provided for all of the condenser fans and the 115V control transformer.

If the evaporator heater is on a separate disconnect switch from the main unit power supply, the unit can be shut down without defeating the freeze protection provided by the cooler heater.

Table 8, ALR 110F – 150F Electrical Data, Single Point

ALR Unit Size	Volts	Hz	Min. Circuit Ampacity (MCA)	Field Wire		Hub (Conduit Connection)		Fuse or HACR Breaker Size	
				Quantity	Wire Gauge	Quantity	Size	Recommended	Maximum
110F	208	60	503	6	400	1	4.00 (102)	600	600
	230		492	6	350	1	4.00 (102)	600	600
	460		248	3	250	1	2.50 (64)	300	300
	575		188	3	3/0	1	2.00 (51)	200	225
120F	208	60	555	6	500	1	4.00 (102)	600	600
	230		526	6	400	1	4.00 (102)	600	500
	460		274	3	300	1	2.50 (64)	300	300
	575		200	3	4/0	1	2.00 (51)	225	225
130F	208	60	592	6	500	1	4.00 (102)	700	700
	230		554	6	500	1	4.00 (102)	600	600
	460		293	3	350	1	2.50 (64)	300	350
	575		210	3	4/0	1	2.00 (51)	225	250
135F	208	60	626	6	400	2	2.50 (64)	700	700
	230		590	6	350	2	2.50 (64)	700	700
	460		302	3	350	1	2.50 (64)	350	350
	575		224	3	4/0	1	2.00 (51)	250	250
140F	208	60	656	6	400	2	3.00 (76)	700	700
	230		622	6	400	2	3.00 (76)	700	700
	460		310	3	400	1	2.50 (64)	350	350
	575		236	3	250	1	2.50 (64)	250	250
145F	208	60	656	6	400	2	3.00 (76)	700	700
	230		622	6	400	2	3.00 (76)	700	700
	460		310	3	400	1	2.50 (64)	350	350
	575		236	3	250	1	2.50 (64)	250	250
150F	208	60	690	6	500	2	3.00 (76)	800	800
	230		666	6	500	2	3.00 (76)	800	800
	460		334	3	400	1	3.00 (76)	350	400
	575		261	3	300	1	2.50 (64)	300	300

1. See page 21 for all Electrical Data notes.
2. A “HACR” breaker is designed for use on equipment with multiple motors. It stands for Heating, Air Conditioning, Refrigeration

Table 9, ALR 110F – 150F Electrical Data, Multiple Point

ALR Unit Size	Volts	Min. Ckt. Amp MCA	Power Supply Fans and Controls				Field Fusing(1)		Min. Ckt Amp MCA	Power Supply Circuit #1				Field Fusing (1)		Min. Ckt Amp MCA	Power Supply Circuit #2				Field Fusing (1)	
			Field Wire		Hub		Rec. Fuse Size	Max. Fuse Size		Field Wire		Hub		Rec. Fuse Size	Max. Fuse Size		Field Wire		Hub		Rec. Fuse Size	Max. Fuse Size
			Qty.	Wire Size	Qty.	Hub Size				Qty.	Wire Size	Qty	Hub Size				Qty.	Wire Size	Qty.	Hub Size		
110F	208	60	3	6	1	1.50 (38)	60	60	218	3	4/0	1	2.00 (51)	250	300	251	3	250	1	2.50 (64)	300	350
	230	60	3	6	1	1.50 (38)	60	60	218	3	4/0	1	2.00 (51)	250	300	240	3	250	1	2.50 (64)	225	350
	460	29	3	10	1	1.00 (25)	30	30	108	3	2	1	1.25 (32)	125	150	124	3	1	1	1.25 (32)	150	175
	575	24	3	10	1	1.00 (25)	25	25	83	3	4	1	1.00 (25)	100	110	91	3	3	1	1.25 (32)	110	125
120F	208	60	3	6	1	1.50 (38)	60	60	251	3	250	1	2.50 (64)	300	300	277	3	300	1	2.50 (64)	300	400
	230	60	3	6	1	1.50 (38)	60	60	240	3	250	1	2.50 (64)	300	300	257	3	300	1	2.50 (64)	250	350
	460	29	3	10	1	1.00 (25)	30	30	124	3	1	1	1.25 (32)	150	150	137	3	1/0	1	1.50 (38)	175	175
	575	24	3	10	1	1.00 (25)	25	25	91	3	3	1	1.25 (32)	110	125	97	3	3	1	1.25 (32)	110	125
130F	208	71	3	4	1	2.00 (51)	80	80	277	3	300	1	2.50 (64)	350	400	277	3	300	1	2.50 (64)	300	400
	230	71	3	4	1	2.00 (51)	80	80	257	3	300	1	2.50 (64)	300	350	257	3	300	1	2.50 (64)	250	350
	460	35	3	8	1	1.25 (32)	35	35	137	3	1/0	1	1.50 (38)	175	175	137	3	1/0	1	1.50 (38)	175	175
	575	28	3	10	1	1.00 (25)	30	30	97	3	3	1	1.25 (32)	110	125	97	3	3	1	1.25 (32)	110	125
135F	208	71	3	4	1	2.00 (51)	80	80	296	3	350	1	2.50 (64)	350	400	296	3	350	1	2.50 (64)	350	400
	230	71	3	4	1	2.00 (51)	80	80	277	3	300	1	2.50 (64)	350	350	277	3	300	1	2.50 (64)	300	400
	460	35	3	8	1	1.25 (32)	35	35	142	3	1/0	1	1.50 (38)	175	200	142	3	1/0	1	1.50 (38)	175	200
	575	28	3	10	1	1.00 (25)	30	30	104	3	2	1	1.25 (32)	125	125	104	3	2	1	1.25 (32)	125	150
140F	208	71	3	4	1	2.00 (51)	80	80	311	3	400	1	2.50 (64)	350	400	311	3	400	1	3.00 (76)	350	400
	230	71	3	4	1	2.00 (51)	80	80	293	3	350	1	2.50 (64)	350	400	293	3	350	1	2.50 (64)	300	400
	460	35	3	8	1	1.25 (32)	35	35	146	3	1/0	1	1.50 (38)	175	200	146	3	1/0	1	1.50 (38)	175	200
	575	28	3	10	1	1.00 (25)	30	30	110	3	2	1	1.25 (32)	125	150	110	3	2	1	1.25 (32)	125	150
145F	208	71	3	4	1	2.00 (51)	80	80	311	3	400	1	2.50 (64)	350	400	311	3	400	1	3.00 (76)	350	400
	230	71	3	4	1	2.00 (51)	80	80	293	3	350	1	2.50 (64)	350	400	293	3	350	1	2.50 (64)	300	400
	460	35	3	8	1	1.25 (32)	35	35	146	3	1/0	1	1.50 (38)	175	200	146	3	1/0	1	1.50 (38)	175	200
	575	28	3	10	1	1.00 (25)	30	30	110	3	2	1	1.25 (32)	125	150	110	3	2	1	1.25 (32)	125	150
150F	208	71	3	4	1	2.00 (51)	80	80	311	3	400	1	2.50 (64)	350	400	344	3	500	1	3.00 (76)	400	500
	230	71	3	4	1	2.00 (51)	80	80	293	3	350	1	2.50 (64)	350	400	336	3	500	1	3.00 (76)	350	500
	460	35	3	8	1	1.25 (32)	35	35	146	3	1/0	1	1.50 (38)	175	200	170	3	2/0	1	2.00 (51)	200	250
	575	28	3	10	1	1.00 (25)	30	30	110	3	2	1	1.25 (32)	125	150	135	3	1/0	1	1.50 (38)	175	200

Table 10, ALR 110F –150F Compressor and Condenser Fan Motor Amp Draw

ALR Unit Size	Volts	Rated Load Amps					No. Of Fan Motor	Locked Rotor Amps							
		Compressors				Fan Motors (Each)		Fan Motors (Each)	Compressors							
									Across-The-Line				Reduced Inrush			
		No. 1	No. 2	No. 3	No. 4				No. 1	No. 2	No. 3	No. 4	No. 1	No. 2	No. 3	No. 4
110F	208	97	97	97	123	5.8	10	23.7	565	565	565	650	340	340	340	400
	230	97	97	97	114	5.8	10	21.4	565	565	565	594	340	340	340	340
	460	48	48	48	61	2.8	10	10.7	283	283	283	297	156	156	156	195
	575	37	37	37	43	2.3	10	11.5	230	230	230	245	138	138	138	152
120F	208	97	123	123	123	5.8	10	23.7	565	650	650	650	340	400	400	400
	230	97	114	114	114	5.8	10	21.4	565	594	594	594	340	340	340	340
	460	48	61	61	61	2.8	10	10.7	283	297	297	297	156	195	195	195
	575	37	43	43	43	2.3	10	11.5	230	245	245	245	138	152	152	152
130F	208	123	123	123	123	5.8	12	23.7	650	650	650	650	400	400	400	400
	230	114	114	114	114	5.8	12	21.4	594	594	594	594	340	340	340	340
	460	61	61	61	61	2.8	12	10.7	297	297	297	297	195	195	195	195
	575	43	43	43	43	2.3	12	11.5	245	245	245	245	152	152	152	152
135F	208	123	123	138	138	5.8	12	23.7	650	650	754	754	400	400	463	463
	230	114	114	130	130	5.8	12	21.4	594	594	594	594	340	340	340	340
	460	61	61	65	65	2.8	12	10.7	297	297	297	297	195	195	195	195
	575	43	43	49	49	2.3	12	11.5	245	245	245	245	152	152	152	152
140F	208	138	138	138	138	5.8	12	23.7	754	754	754	754	463	463	463	463
	230	130	130	130	130	5.8	12	21.4	594	594	594	594	340	340	340	340
	460	65	65	65	65	2.8	12	10.7	297	297	297	297	195	195	195	195
	575	49	49	49	49	2.3	12	11.5	245	245	245	245	152	152	152	152
145F	208	138	138	138	138	5.8	12	23.7	754	754	754	754	463	463	463	463
	230	130	130	130	130	5.8	12	21.4	594	594	594	594	340	340	340	340
	460	65	65	65	65	2.8	12	10.7	297	297	297	297	195	195	195	195
	575	49	49	49	49	2.3	12	11.5	245	245	245	245	152	152	152	152
150F	208	138	138	138	165	5.8	12	23.7	754	754	754	1070	463	463	463	654
	230	130	130	130	165	5.8	12	21.4	594	594	594	1070	340	340	340	654
	460	65	65	65	84	2.8	12	10.7	297	297	297	510	195	195	195	330
	575	49	49	49	69	2.3	12	11.5	245	245	245	405	152	152	152	262

See page 21 for all Electrical Data notes.

Table 11, ALR 110F – 150F Field Wiring Data, Single Point Power

ALR Unit Size	Volts	Wiring to Standard Power Block		Wiring to Optional Factory Mounted Disconnect Switch	
		Terminal Amps	Connector Wire Range/Phase (Copper Wire Only)	Terminal Amps	Connector Wire Range/Phase (Copper Wire Only)
110F	208	840	(2 qty.) 1/0 - 600 MCM	600	(2 qty.) 400 - 500 MCM
	230	840	(2 qty.) 1/0 - 600 MCM	600	(2 qty.) 250 - 350 MCM
	460	335	(1 qty.) #4 - 400 MCM	400	(1 qty.) 250 - 500 MCM
	575	335	(1 qty.) #4 - 400 MCM	250	(1qty.) #4 - 350 MCM
120F	208	840	(2 qty.) 1/0 - 600 MCM	600	(2 qty.) 250 - 500 MCM
	230	840	(2 qty.) 1/0 - 600 MCM	600	(2 qty.) 400 - 500 MCM
	460	335	(1 qty.) #4 - 400 MCM	400	(1 qty.) 250 - 500 MCM
	575	335	(1 qty.) #4 - 400 MCM	250	(1qty.) #4 - 350 MCM
130F	208	840	(2 qty.) 1/0 - 600 MCM	800	(2 qty.) 500 - 700 MCM
	230	840	(2 qty.) 1/0 - 600 MCM	800	(2 qty.) 500 - 700 MCM
	460	335	(1 qty.) #4 - 400 MCM	400	(1 qty.) 250 - 500 MCM
	575	335	(1 qty.) #4 - 400 MCM	250	(1qty.) #4 - 350 MCM
135F	208	840	(2 qty.) 1/0 - 600 MCM	800	(2 qty.) 500 - 700 MCM
	230	840	(2 qty.) 1/0 - 600 MCM	800	(3 qty.) 3/0 - 400 MCM
	460	335	(1 qty.) #4 - 400 MCM	400	(1 qty.) 250 - 500 MCM
	575	335	(1 qty.) #4 - 400 MCM	250	(1qty.) #4 - 350 MCM
140F	208	840	(2 qty.) 1/0 - 600 MCM	800	(2 qty.) 500 - 700 MCM
	230	840	(2 qty.) 1/0 - 600 MCM	800	(2 qty.) 500 - 700 MCM
	460	335	(1 qty.) #4 - 400 MCM	400	(1 qty.) 250 - 500 MCM
	575	335	(1 qty.) #4 - 400 MCM	400	(1 qty.) 250 - 500 MCM
145F	208	840	(2 qty.) 1/0 - 600 MCM	800	(2 qty.) 500 - 700 MCM
	230	840	(2 qty.) 1/0 - 600 MCM	800	(2 qty.) 500 - 700 MCM
	460	335	(1 qty.) #4 - 400 MCM	400	(1 qty.) 250 - 500 MCM
	575	335	(1 qty.) #4 - 400 MCM	400	(1 qty.) 250 - 500 MCM
150F	208	840	(4 qty.) 1/0 - 600 MCM	800	(2 qty.) 500 - 700 MCM
	230	840	(4 qty.) 1/0 - 600 MCM	800	(2 qty.) 500 - 700 MCM
	460	840	(2 qty.) 1/0 - 600 MCM	400	(1 qty.) 250 - 500 MCM
	575	840	(2 qty.) 1/0 - 600 MCM	400	(1 qty.) 250 - 500 MCM

See page 21 for all other Electrical Data notes.

Table 12, ALR 110F – 150F, Field Wiring Data, Multiple Point Power with Power Blocks

ALR Unit Size	Volts	Wiring to Standard Power Block					
		Terminal Amps			Connector Wire Range Per Phase (Copper Wire Only)		
		Circuit 1	Circuit 2	Circuit 3	Circuit 1 (Fans)	Circuit 2	Circuit 3
110F	208	175	335	335	(1 qty.) #12 - 2/0	(1 qty.) #4 - 400 MCM	(1 qty.) #4 - 400 MCM
	230	175	335	335	(1 qty.) #12 - 2/0	(1 qty.) #4 - 400 MCM	(1 qty.) #4 - 400 MCM
	460	175	175	175	(1 qty.) #12 - 2/0	(1 qty.) #12 - 2/0	(1 qty.) #12 - 2/0
	575	175	175	175	(1 qty.) #12 - 2/0	(1 qty.) #12 - 2/0	(1 qty.) #12 - 2/0
120F	208	175	335	335	(1 qty.) #12 - 2/0	(1 qty.) #4 - 400 MCM	(1 qty.) #4 - 400 MCM
	230	175	335	335	(1 qty.) #12 - 2/0	(1 qty.) #4 - 400 MCM	(1 qty.) #4 - 400 MCM
	460	175	175	175	(1 qty.) #12 - 2/0	(1 qty.) #12 - 2/0	(1 qty.) #12 - 2/0
	575	175	175	175	(1 qty.) #12 - 2/0	(1 qty.) #12 - 2/0	(1 qty.) #12 - 2/0
130F	208	175	335	335	(1 qty.) #12 - 2/0	(1 qty.) #4 - 400 MCM	(1 qty.) #4 - 400 MCM
	230	175	335	335	(1 qty.) #12 - 2/0	(1 qty.) #4 - 400 MCM	(1 qty.) #4 - 400 MCM
	460	175	175	175	(1 qty.) #12 - 2/0	(1 qty.) #12 - 2/0	(1 qty.) #12 - 2/0
	575	175	175	175	(1 qty.) #12 - 2/0	(1 qty.) #12 - 2/0	(1 qty.) #12 - 2/0
135F	208	175	335	335	(1 qty.) #12 - 2/0	(1 qty.) #4 - 400 MCM	(1 qty.) #4 - 400 MCM
	230	175	335	335	(1 qty.) #12 - 2/0	(1 qty.) #4 - 400 MCM	(1 qty.) #4 - 400 MCM
	460	175	175	175	(1 qty.) #12 - 2/0	(1 qty.) #12 - 2/0	(1 qty.) #12 - 2/0
	575	175	175	175	(1 qty.) #12 - 2/0	(1 qty.) #12 - 2/0	(1 qty.) #12 - 2/0
140F	208	175	840	840	(1 qty.) #12 - 2/0	(2 qty.) 1/0 - 600 MCM	(2 qty.) 1/0 - 600 MCM
	230	175	840	840	(1 qty.) #12 - 2/0	(2 qty.) 1/0 - 600 MCM	(2 qty.) 1/0 - 600 MCM
	460	175	335	335	(1 qty.) #12 - 2/0	(1 qty.) #4 - 400 MCM	(1 qty.) #4 - 400 MCM
	575	175	335	335	(1 qty.) #12 - 2/0	(1 qty.) #4 - 400 MCM	(1 qty.) #4 - 400 MCM
145F	208	175	840	840	(1 qty.) #12 - 2/0	(2 qty.) 1/0 - 600 MCM	(2 qty.) 1/0 - 600 MCM
	230	175	840	840	(1 qty.) #12 - 2/0	(2 qty.) 1/0 - 600 MCM	(2 qty.) 1/0 - 600 MCM
	460	175	335	335	(1 qty.) #12 - 2/0	(1 qty.) #4 - 400 MCM	(1 qty.) #4 - 400 MCM
	575	175	335	335	(1 qty.) #12 - 2/0	(1 qty.) #4 - 400 MCM	(1 qty.) #4 - 400 MCM
150F	208	175	840	840	(1 qty.) #12 - 2/0	(2 qty.) 1/0 - 600 MCM	(2 qty.) 1/0 - 600 MCM
	230	175	840	840	(1 qty.) #12 - 2/0	(2 qty.) 1/0 - 600 MCM	(2 qty.) 1/0 - 600 MCM
	460	175	335	335	(1 qty.) #12 - 2/0	(1 qty.) #4 - 400 MCM	(1 qty.) #4 - 400 MCM
	575	175	335	335	(1 qty.) #12 - 2/0	(1 qty.) #4 - 400 MCM	(1 qty.) #4 - 400 MCM

See page 21 for all Electrical Data notes.

Table 13, ALR 110F – 150F, Field Wiring Data, Multiple Point Power with Non-fused Disconnect

ALR Unit Size	Volts	Wiring to Optional Non-Fused Disconnect					
		Terminal Amps			Connector Wire Range Per Phase (Copper Wire Only)		
		Circuit 1	Circuit 2	Circuit 3	Circuit 1 (Fans)	Circuit 2	Circuit 3
110F	208	100	225	225	(1 qty.) #14 - 1/0	(1 qty.) #4 – 4/0	(1 qty.) #4 – 4/0
	230	100	225	250	(1 qty.) #14 - 1/0	(1 qty.) #4 – 4/0	(1 qty.) #4 - 350 MCM
	460	100	150	150	(1 qty.) #4 - 1/0	(1 qty.) #4 – 4/0	(1 qty.) #4 – 4/0
	575	100	150	150	(1 qty.) #14 - 1/0	(1 qty.) #4 – 4/0	(1 qty.) #4 – 4/0
120F	208	100	400	400	(1 qty.) #14 - 1/0	(1 qty.) 250 - 400 MCM	(1 qty.) 250 - 400 MCM
	230	100	250	400	(1 qty.) #14 - 1/0	(1 qty.) #4 - 350 MCM	(1 qty.) 250 - 400 MCM
	460	100	150	150	(1 qty.) #14 - 1/0	(1 qty.) #4 – 4/0	(1 qty.) #4 – 4/0
	575	100	150	150	(1 qty.) #14 - 1/0	(1 qty.) #4 – 4/0	(1 qty.) #4 – 4/0
130F	208	100	400	400	(1 qty.) #14 - 1/0	(1 qty.) 250 - 400 MCM	(1 qty.) 250 - 400 MCM
	230	100	400	400	(1 qty.) #14 - 1/0	(1 qty.) 250 - 400 MCM	(1 qty.) 250 - 400 MCM
	460	100	150	150	(1 qty.) #14 - 1/0	(1 qty.) #4 – 4/0	(1 qty.) #4 – 4/0
	575	100	150	150	(1 qty.) #14 - 1/0	(1 qty.) #4 – 4/0	(1 qty.) #4 – 4/0
135F	208	100	400	400	(1 qty.) #14 - 1/0	(1 qty.) 250 - 400 MCM	(1 qty.) 250 - 400 MCM
	230	100	400	400	(1 qty.) #14 - 1/0	(1 qty.) 250 - 400 MCM	(1 qty.) 250 - 400 MCM
	460	100	150	150	(1 qty.) #14 - 1/0	(1 qty.) #4 – 4/0	(1 qty.) #4 – 4/0
	575	100	150	150	(1 qty.) #14 - 1/0	(1 qty.) #4 – 4/0	(1 qty.) #4 – 4/0
140F	208	100	400	400	(1 qty.) #14 - 1/0	(1 qty.) 250 - 400 MCM	(1 qty.) 250 - 400 MCM
	230	100	400	400	(1 qty.) #14 - 1/0	(1 qty.) 250 - 400 MCM	(1 qty.) 250 - 400 MCM
	460	100	225	225	(1 qty.) #14 - 1/0	(1 qty.) #4 – 4/0	(1 qty.) #4 – 4/0
	575	100	150	150	(1 qty.) #14 - 1/0	(1 qty.) #4 – 4/0	(1 qty.) #4 – 4/0
145F	208	100	400	400	(1 qty.) #14 - 1/0	(1 qty.) 250 - 400 MCM	(1 qty.) 250 - 400 MCM
	230	100	400	400	(1 qty.) #14 - 1/0	(1 qty.) 250 - 400 MCM	(1 qty.) 250 - 400 MCM
	460	100	225	225	(1 qty.) #14 - 1/0	(1 qty.) #4 – 4/0	(1 qty.) #4 – 4/0
	575	100	150	150	(1 qty.) #14 - 1/0	(1 qty.) #4 – 4/0	(1 qty.) #4 – 4/0
150F	208	100	400	400	(1 qty.) #14 - 1/0	(1 qty.) 250 - 400 MCM	(1 qty.) 250 - 400 MCM
	230	100	400	400	(1 qty.) #14 - 1/0	(1 qty.) 250 - 400 MCM	(1 qty.) 250 - 400 MCM
	460	100	225	225	(1 qty.) #14 - 1/0	(1 qty.) #4 – 4/0	(1 qty.) #4 – 4/0
	575	100	150	150	(1 qty.) #14 - 1/0	(1 qty.) #4 – 4/0	(1 qty.) #4 – 4/0

See page 21 for all Electrical Data notes.

Notes for "Electrical Data Single Point" and "Electrical Data Multiple Point" Power:

1. Unit wire size ampacity (MCA) is equal to 125% of the largest compressor-motor RLA plus 100% of RLA of all other loads in the circuit including the control transformer.
2. If the control transformer option is furnished, no separate 115V power is required.
3. If a separate 115V power supply is used for the control circuit, then the wire sizing is 12 amps.
4. Recommended power lead wire sizes for 3 conductors per conduit are based on 100% conductor ampacity in accordance with NEC. Wire sizes for 6 conductors per conduit are based on 80% conductor ampacity in accordance with NEC. Voltage drop has not been included. Therefore, it is recommended that power leads be kept short. All terminal block connections must be made with copper (type THW) wire.
5. The unit power terminal block can have 2 lugs per phase. Single or parallel conductors should be used for power connections as listed under "Recommended Power Lead Wire Size."
6. "Recommended Fuse Sizes" are selected at approximately 150% of the largest compressor RLA, plus 100% of all other loads in the circuit.
7. "Maximum Fuse Sizes" are selected at approximately 225% of the largest compressor RLA, plus 100% of all other loads in the circuit.
8. The recommended power lead wire sizes are based on an ambient temperature of 86°F. Ampacity correction factors must be applied for other ambient temperatures. Refer to the National Electrical Code Handbook.

Voltage Limitations:

Unit Nameplate - 208V/60Hz/3Ph: 187V to 220V

Unit Nameplate - 230V/60Hz/3Ph: 207V to 253V

Unit Nameplate - 460V/60Hz/3Ph: 414V to 506V

Unit Nameplate - 575V/60Hz/3Ph: 517V to 633V

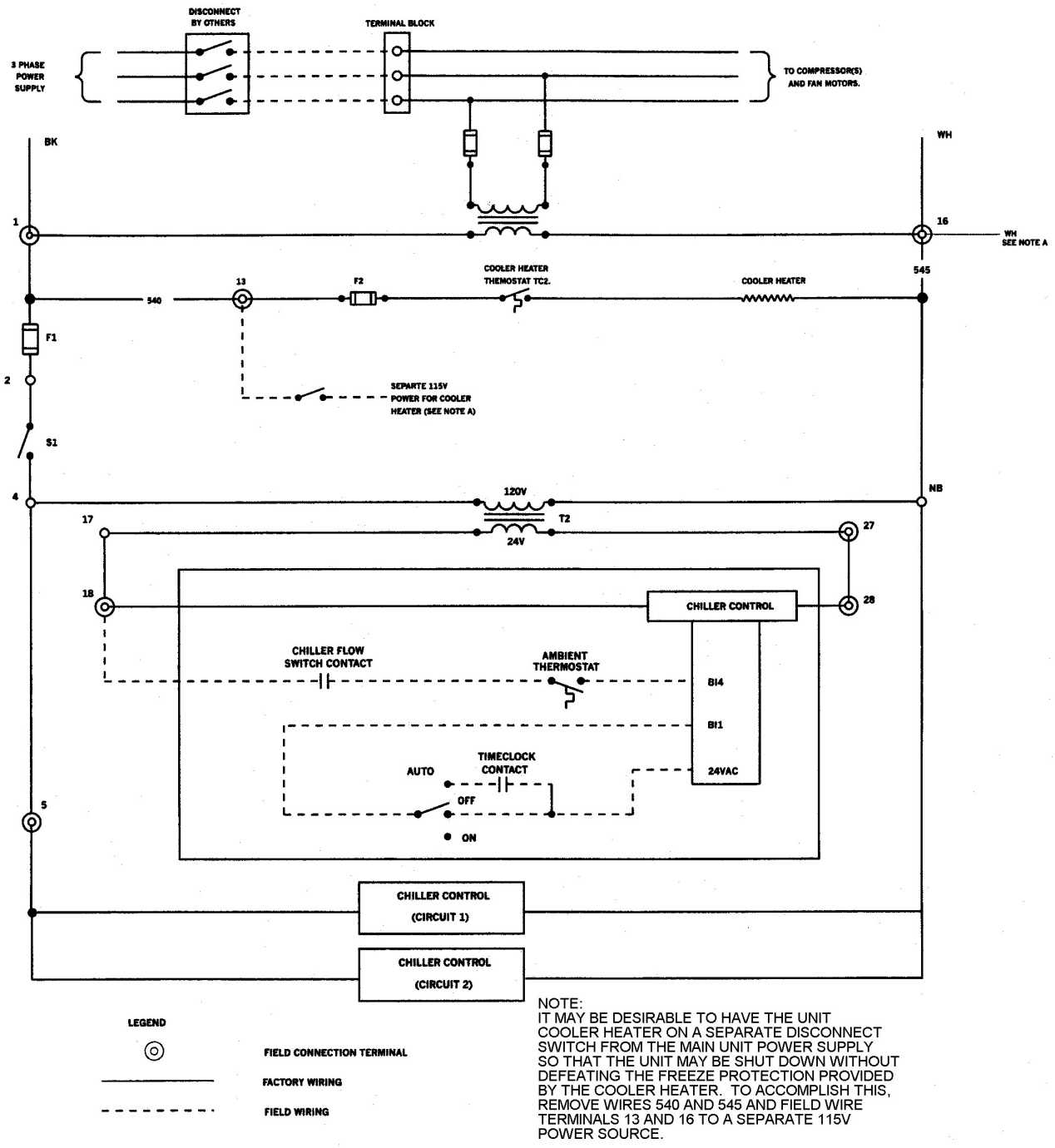
Notes for "Compressor and Condenser Fan Amp Draw":

1. Compressor RLA values are for wiring sizing purposes only but do not reflect normal operating current draw at rated capacity. If unit is equipped with SpeedTrol condenser fan motors, the first motor on each refrigerant circuit is a single phase, 1hp motor, with a FLA of 2.8 amps at 460 volts, 5.6 amps at 208, 230, and 575 volts.
2. Compressor LRA for reduced inrush start are for the first winding only. If the unit is equipped with SpeedTrol motors, the first motor is a single phase, 1 hp motor, with a LRA of 7.3 amps at 460 volts, 14.5 amps at 208, 230 and 575 volts.

Notes for "Field Wiring Data" - Both Single and Multiple Point Power:

1. Single point power supply requires a single disconnect to supply electrical power to the unit. This power must be fused.
2. Multiple point power supply requires two independent power circuits each with separate disconnects and a separate control circuit.
3. All field wiring to unit power block or optional non-fused disconnect switch must be copper.
4. All field wire size values apply to 75°C rated wire per NEC.

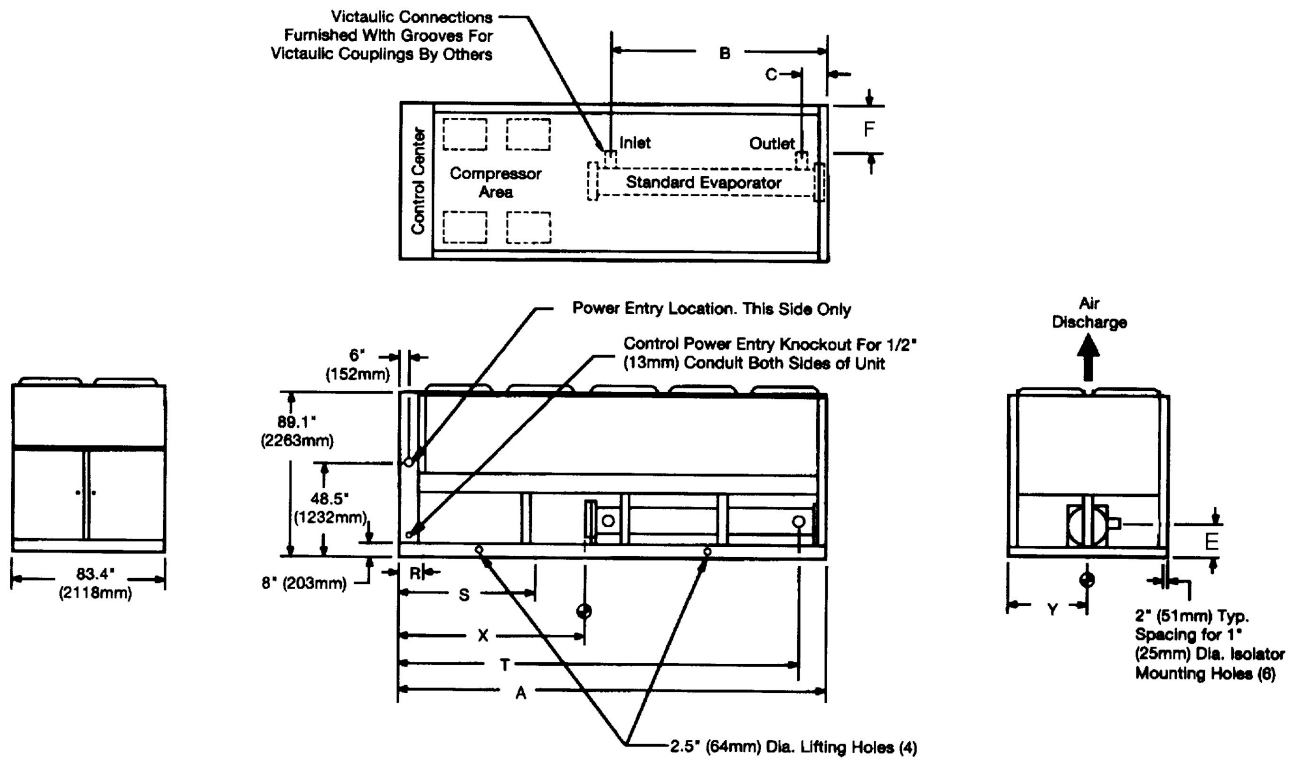
Figure 9, ALR 110F through 150F, Typical Field Wiring Diagram, Single Source Power



NOTE:
IT MAY BE DESIRABLE TO HAVE THE UNIT COOLER HEATER ON A SEPARATE DISCONNECT SWITCH FROM THE MAIN UNIT POWER SUPPLY SO THAT THE UNIT MAY BE SHUT DOWN WITHOUT DEFEATING THE FREEZE PROTECTION PROVIDED BY THE COOLER HEATER. TO ACCOMPLISH THIS, REMOVE WIRES 540 AND 545 AND FIELD WIRE TERMINALS 13 AND 16 TO A SEPARATE 115V POWER SOURCE.

Dimensional Data

Figure 10, ALR 110F through ALR 150F Dimensions

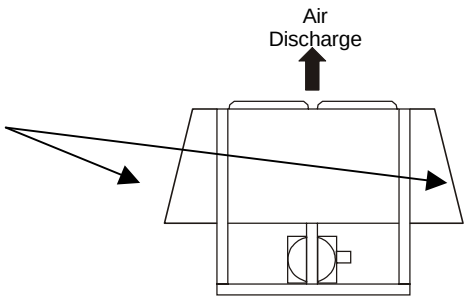


ALR SIZE	"A" LENGTH	CONN. SIZE (1)	WATER CONNECTIONS				CENTER OF GRAVITY		ISOLATOR LOCATION			NO. OF FANS
			B	C	E	F	X	Y	R	S	T	
110F	229 (5809)	5 (127.0)	95.8 (2433)	17.1 (434)	16.3 (414)	31.4 (798)	95.5 (2426)	41.7 (1059)	36.0 (914)	102 (2591)	192 (4877)	10
120F	229 (5809)	8 (203.2)	94.7 (2405)	17.5 (445)	16.3 (414)	30.7 (780)	97.0 (2464)	41.7 (1059)	36.0 (914)	102 (2591)	192 (4877)	10
130F	229 (5809)	8 (203.2)	94.7 (2405)	17.5 (445)	16.3 (414)	30.7 (780)	97.0 (2464)	41.7 (1059)	36.0 (914)	102 (2591)	192 (4877)	12
135F	229 (5809)	8 (203.2)	94.7 (2405)	17.5 (445)	16.3 (414)	30.7 (780)	97.0 (2464)	41.7 (1059)	36.0 (914)	102 (2591)	192 (4877)	12
140F	229 (5809)	8 (203.2)	94.7 (2405)	17.5 (445)	16.3 (414)	30.7 (780)	97.0 (2464)	41.7 (1059)	36.0 (914)	102 (2591)	192 (4877)	12
145F	229 (5809)	8 (203.2)	94.8 (2408)	17.2 (437)	18.3 (465)	29.8 (757)	99.0 (2515)	41.7 (1059)	36.0 (914)	102 (2591)	192 (4877)	12
150F	229 (5809)	8 (203.2)	94.8 (2408)	17.2 (437)	18.3 (465)	29.8 (757)	99.0 (2515)	41.7 (1059)	36.0 (914)	102 (2591)	192 (4877)	12

NOTE: Only left hand evaporator connections (as shown) are available.

NOTE: Add 22 in. (559 mm)

to each side for hail guards.



Wind Baffles and Hail Guards

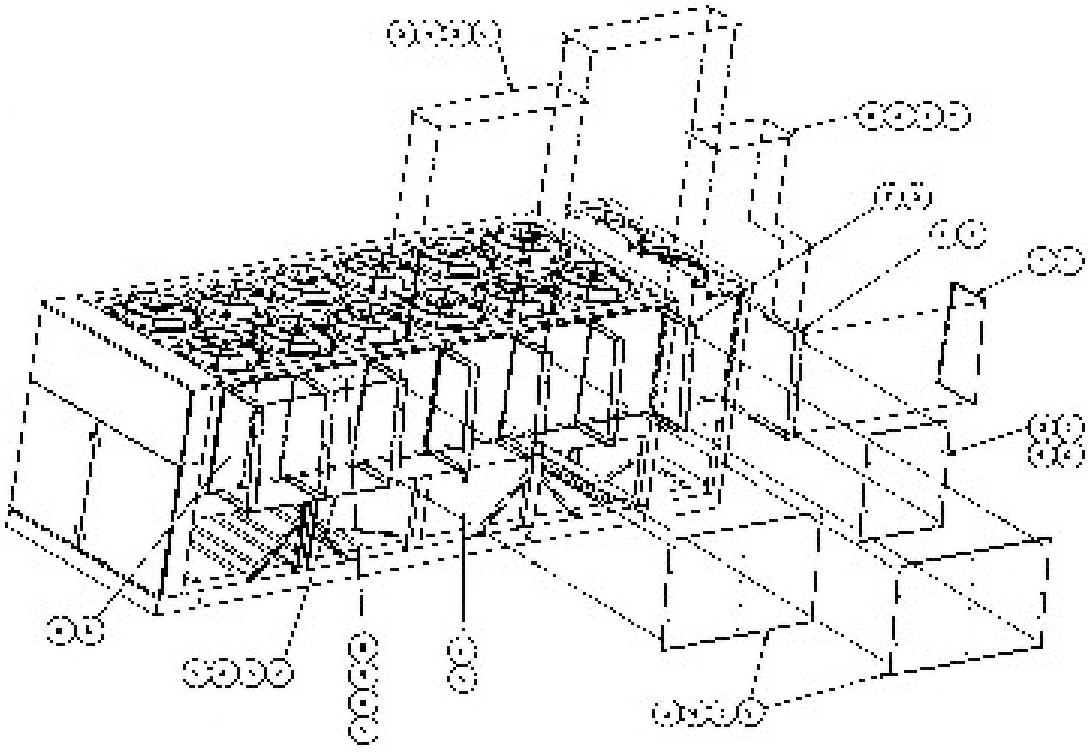
Wind Baffles/Hail Guards are a field installed option that is used to stabilize unit operation in high wind areas and to assist in operation at low ambient temperatures. Figure 11 is a sketch of a typical panel assembly on an ALR unit. The parts are shown in the table to the right and referenced by balloon numbers.

Balloon Number	Part Description
1	Channel/Support
2	Panel/Wind Baffle
3	Screw, ¼-20 x ¾
4	Hex Nut, ¼-20
5	Lock Washer, ¼
6	Panel/End (L.H.)
7	Panel/End (R.H.)
8	Panel/Hail Guard
9	Screw, 10-24 x ½
10	Panel/Wind Baffle
11	Panel/Hail Guard

Installation Instructions

1. The assembly consists of channel supports that are fastened to the coil frame, wind baffles that are parallel to the coil, end panels and horizontal hail guard panels located at the top of the coil.
2. Prepare pilot holes for mounting channel supports to the coil frame. Use the prepunched holes in the channel supports to locate the holes. Drill 0.221 (#2 drill) holes in the frame at the top and bottom of the condenser coil, exercising care not to damage the coil itself.
3. Starting at the control box end, install the supports using (4) ¼-20 x ¼ self-threading screws. These ¼ inch screws are required for adequate strength.
4. The horizontal hail guards are installed next. Starting at the control box end, install the hail guard panels on top of the supports using (4) ¼-20 x ¾ self-threading screws, lock washers, and hex nuts.
5. Starting at the control box end, install the wind baffle panels on the front of the supports using (4) ¼-20 x ¾ self-threading screws, lock washers, and hex nuts. Each panel overlaps the adjacent one.
6. Install the end panels by drilling three holes in the coil end frame and securing the end panel with ¼ inch screws. Use the holes at the top, bottom and front of the end panel as a template and drill 0.166 (#19 drill) holes into the flange of the supports. Install the #10-24 self-threading screws.

Figure 11, Panel Layout



Remote Evaporator

General

NOTE: Remote evaporator arrangements are not included in the ARI Certification Program and capacities are therefore not ARI certified.

The ALR air-cooled chillers are available with remote evaporator on R-22 service only. This allows the main unit to be installed outdoors to save interior room and eliminates the need for anti-freeze solutions and heat tracing of chilled water lines since the chilled water system is indoors. There are some general guidelines to review before proceeding:

1. R-22 only.
2. Maximum line length of 100 ft (30 m) and Total Equivalent Length (TEL) of 200 ft (61 m).
3. No underground piping.
4. Careful attention should be given to piping layout and employment of insulation and check valves when using hot gas bypass.
5. Units with remote evaporator are not included in the ARI Certification Program.

The remote evaporator is shipped separately, ready for quick and easy installation at the job site. Refrigerant accessories such as liquid line shut-off valves, replaceable core filter-driers, liquid line solenoid valves, expansion valves, and sightglasses are shipped in a kit for field installation and wiring. The evaporator is equipped with entering and leaving chilled water temperature sensor wells. The sensors leads are pre-wired to the ALR unit and must be field connected to the evaporator thermowells.

- Units with Microtech Control will have 100-foot cables.
- Units with UNT Control will require field splicing the cables.

ALR units are shipped with an operating charge of refrigerant. Field piping must be leak tested, evacuated and charged during installation. Do not exceed 150 psig test pressure unless the unit is blanked off from the piping.

Standard insulation is ¾ inch Armaflex or equal UL approved insulation. Double insulation is available as an option and is recommended in high humidity locations or for ice-making duty.

Performance Derate Factors

All performance tables and adjustment factors found in this catalog are applicable for remote evaporator installations, however, a performance derate must be applied to the R-22 performance data due to additional pressure drops in the suction and liquid lines which cause a loss of compressor performance. These derates are based on a suction line pressure drop equivalent of approximately 2°F (1°C) change in saturation temperature.

For R-22 applications:

Capacity = Tons (kW) x 0.97

Power = Compressor kW x 0.99

Line Sizing

Line sizing and layout should follow procedures found in the ASHRAE Handbooks or other recognized design manuals. Nominal circuit capacities are listed in Table 14. Unloading steps are found in the Physical Data tables.

***Table 14,* Nominal Circuit Capacities**

ALR Model	Circuit 1	Circuit 2
	Tons (kW)	Tons (kW)
110F	53 (185)	57 (200)
120F	60 (210)	60 (210)
130F	65 (227)	65 (227)
135F	68 (238)	68 (238)
140F	70 (245)	70 (245)
145F	73 (255)	73 (255)
150F	70 (245)	80 (280)

Dimensions

Use the ALR dimension drawing for the condensing unit section (no evaporator) and Figure 12 for the remote evaporator. The refrigerant connections are located approximately where the refrigerant connections to the unit mounted evaporator are on a packaged chiller. The remote evaporator dimensions are on Figure 12.

Weights

Weights for the remote evaporators are listed on the following dimension page. Weights for the outdoor unit can be calculated by subtracting the evaporator weight from the total unit weight found in the Physical Data section.

Connection Sizes

Table 15, Connection Sizes

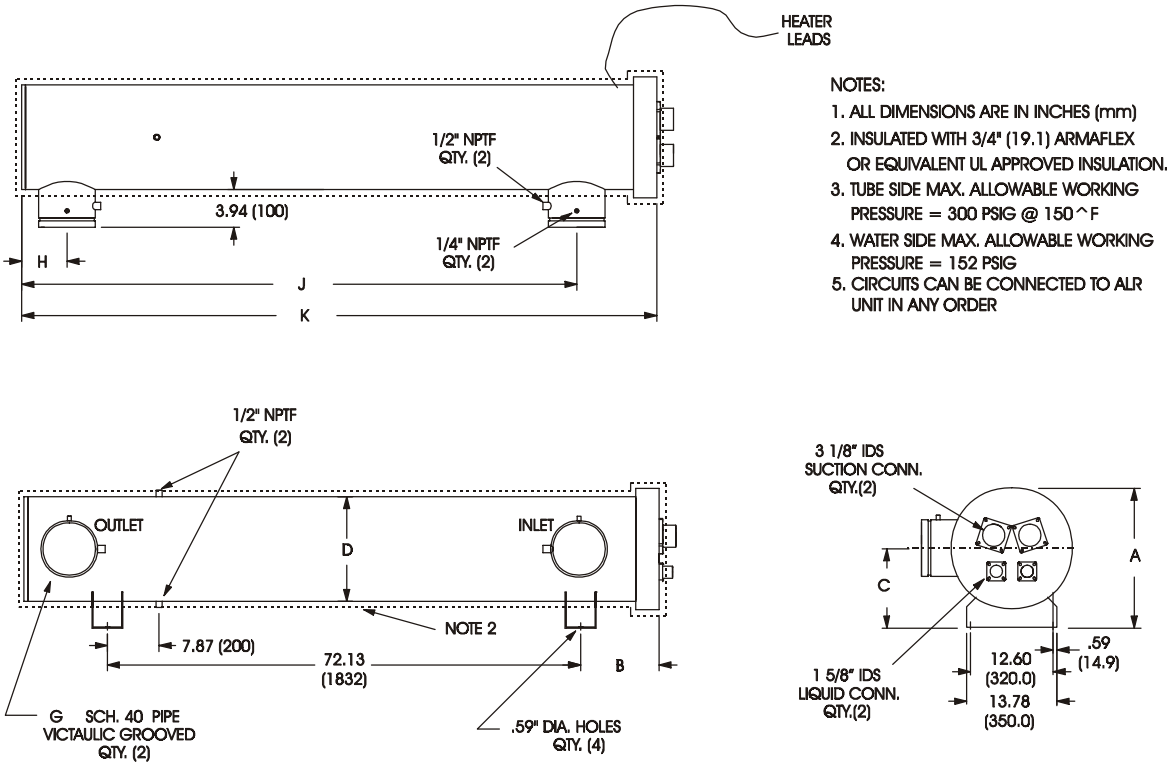
Unit Size	ALR Unit		Remote Evaporator		
	Suction (IDS)	Liquid (IDS)	Suction (IDS)	Liquid (IDS)	Water (in.)
110	2 5/8	1 1/8	3 1/8	1 5/8	5
120	2 5/8	1 1/8	3 1/8	1 5/8	8
130	2 5/8	1 1/8	3 1/8	1 5/8	8
135	2 5/8	1 1/8	3 1/8	1 5/8	8
140	2 5/8	1 1/8	3 1/8	1 5/8	8
145	2 5/8	1 1/8	3 1/8	1 5/8	8
150	2 5/8	1 1/8	3 1/8	1 5/8	8

Refrigerant Piping

Field installed refrigerant piping should be leak checked and evacuated in accordance with good practice. The refrigerant specialties (solenoid valve, expansion valve, filter-drier, and sight glass) are shipped in a kit with the evaporator. All other valves and fittings are supplied by the contractor.

Dimensions, Remote Evaporator

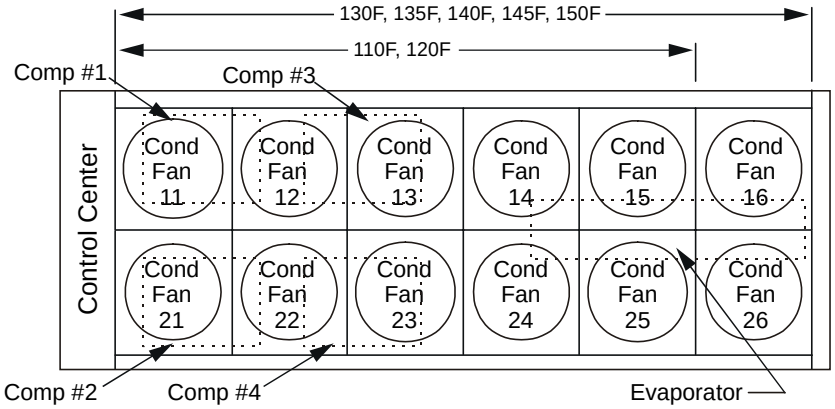
Figure 12, Remote Evaporator for ALR 110 - ALR 150



ALR Model	Evaporator Model	Water Volume Gal. (l)	Refrigerant Volume Cu.Ft. (L)	Unit Weights lb. (kg)		R-22 Operating Charge lb. (kg)	
				Operating	Shipping	Circuit 1	Circuit 2
110	CDE350332801	34 (128)	1.4 (40.0)	934 (423)	635 (288)	34 (15.4)	34 (15.4)
120-140	CDE350332901	40 (150)	1.8 (52.4)	1127 (510)	758 (343)	45 (20.4)	45 (20.4)
145-150	CDE350281651	55 (208)	2.4 (67.2)	1464 (663)	943 (427)	57 (25.8)	57 (25.8)

ALR Model	Overall Dimensions In. (mm)		Dimensions					Conn.
	Length "K"	Height "A"	"C"	"D"	"J"	"H"	"B"	"G"
110	94.6 (2403)	17.8 (452)	10.2 (259)	12.8 (325)	85.2 (2164)	6.4 (163)	11.0 (279)	5 (152)
120-140	95.5 (2426)	18.4 (467)	10.2 (259)	14.0 (356)	84.0 (2134)	6.8 (173)	12.0 (305)	8 (203)
145-150	96.8 (2459)	21.4 (544)	12.1307)	16.0 (406)	84.6 (2149)	6.9 (175)	12.8 (325)	8 (203)

Figure 13, Major Component Locations



Control Center

All electrical controls are enclosed in a weather-resistant control center with keylocked, hinged access doors. The control center has two separate compartments, high voltage and low voltage. All high voltage components are located in the compartment on the right side of the unit when facing the control panel.

The low voltage components are located on the left side with the live terminals behind the deadfront panel. This protects service personnel from live terminals when accessing the adjustable controls.

Control Center Layouts, ALR 110F through 150F

Figure 14, Left Side, 115V Control Section

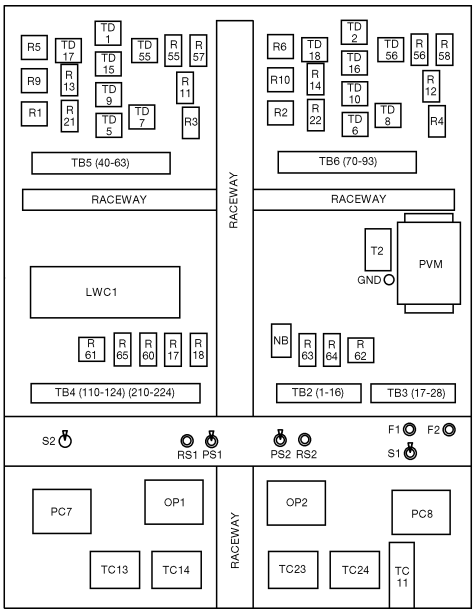
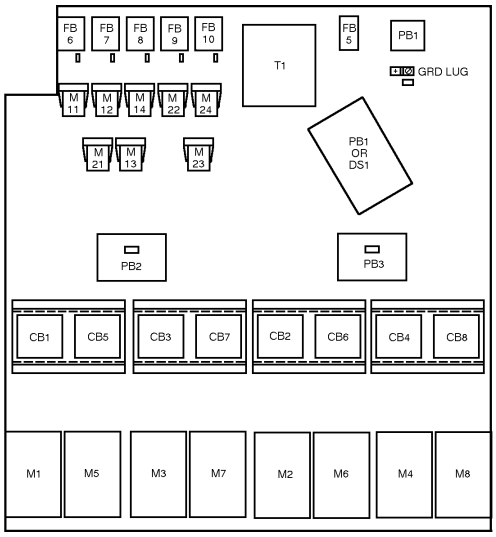


Figure 15, Right Side, High Voltage Power Section



Note: 1. PB1, PB2, PB3 are used with multiple point power wiring.
2. Some illustrated components can be optional equipment.

Start-up and Shutdown

Pre Start-up

1. Open all electric disconnects and check all electric connections for tightness. Check all compressor valve connections for tightness.
2. Inspect all water piping for flow direction and correct connections at the evaporator.
3. Verify thermostat water temperature sensor is installed in the leaving water line (supply to building). On all ALR units the sensor well and sensor are factory mounted.
4. Check compressor oil level. The oil level should be visible in the oil sightglass.
5. Check voltage of the unit power supply and make certain voltage is within ±10% of nameplate rating.
6. Check unit power supply wiring for proper ampacity and a minimum insulation temperature of 75°C.
7. Verify all mechanical and electrical inspections have been completed according to local codes.
8. Verify all auxiliary control equipment is operative and an adequate cooling load is available.
9. Open compressor suction and discharge shutoff valves until backseated. Always replace valve seal caps.
10. Open control stop switch S1(off) and place pumpdown switches PS1 and PS2 on "manual pumpdown". Turn on the main power and control disconnect switches. This will energize crankcase heaters. Wait at least 12 hours before starting up unit.
11. Open all water flow valves and start the chilled water pump. Check all piping for leaks and vent the air from the evaporator as well as from the system piping. Flush the evaporator and system piping to obtain clean, noncorrosive water in the evaporator.

NOTE: If LWC1 is a UNT 33 Metasys control, the control must be energized before the chilled water flow switch is closed.

CAUTION

Most relays and terminals in the unit control center are energized with S1 and the control circuit disconnect on. Do not close S1 until start-up.

Start-up

1. Verify compressor suction and discharge shutoff valves are backseated. Always replace valve seal caps.
2. Open oil equalization line valves.
3. Open manual liquid line shutoff valve at the outlet of the condenser subcooler.
4. Set temperature controller LWC1 to the desired chilled water temperature. Set the control band.
5. Start auxiliary equipment by turning on the following:
   - Time clock
   - Ambient thermostat and/or remote on/off switch
   - Chilled water pump.
6. Verify pumpdown switches PS1 and PS2 are in "manual pumpdown" (open) position. If pressures on the low side of the system are above 60 psig (414 kPa), the unit will start and pump down.

7. After compressor lockout timer TD1 has timed out, start the system by moving pumpdown switches PS1 and PS2 to “auto pumpdown” position.
8. After running the unit for a short time, check the following:
   - Oil level in each compressor crankcase
   - Rotation of fans
   - Flashing in refrigerant sightglass.
9. Verify superheat temperature is at the factory setting of 8 to 12 degrees F (4.4 to 6.7 degrees C).
10. After system performance has stabilized, complete the “Compressorized Equipment Warranty Form” (Form No. 415415Y) to obtain full warranty benefits. Return the form to McQuay International through your sales representative.

Sequence of Operation

The following sequence of operation is typical for ALR air-cooled water chiller, Models ALR 110F through ALR 150F. The sequence varies depending upon options.

Start - up

With the control circuit power on and the control stop switch S1 closed, 115V power is applied through the control circuit fuse F1 to the compressor crankcase heaters HTR1, HTR2, HTR3, and HTR4, the compressor motor protections MP1, MP2, MP3 and MP4, and the primary of the 24V control circuit transformer. The 24V transformer provides power to the contacts of the low pressure controls LP1 and LP2 and the compressor lockout timer TD1 and TD2.

When the remote time clock or manual shutdown switch turns on the chilled water pump, the flow switch closes and 115V power is applied to the relay contacts on the leaving water control LWC1. The unit will automatically operate in response to the LWC1 if the manual pumpdown switches PS1 and PS2 are closed (in the “auto” position); the compressor lockout time relays R5, R6, R7, and R8; and the freezestats FS1 and FS2, high pressure controls HP1 and HP2, and the compressor motor protectors MP1, MP2, MP3, and MP4 do not sense failure conditions.

On a call for cooling, the leaving water control LWC1 completes the circuit to the liquid line solenoid valve SV1 for refrigerant circuit #1, opening the valve and allowing refrigerant to flow through the expansion valve and into the evaporator. As the evaporator refrigerant pressure increases, the low pressure control LP1 closes. This energizes the compressor starting relay R9, starting the compressor via the compressor contactors M1 and M5. Closing the R9 contacts also energizes the condenser fan motor contacts M11 and M12 starting the fan motors.

As additional stages of cooling capacity are required, the leaving water control LWC1 energizes the liquid line solenoid valve SV2 of the refrigerant circuit #2. After the compressor sequencing time delay TD11 has closed, the same starting sequence is initiated in refrigerant circuit #2.

If still more cooling is required, the leaving water control will start the remaining compressors and then de-energize unloader solenoids until the capacity requirement is met.

Pumpdown

As the leaving water control is satisfied, it will unload the compressor(s) and then de-energize the liquid line solenoid valve(s) SV1 and SV2, causing the valve(s) to close. When the compressor has pumped most of the refrigerant out of the evaporator and into the condenser, the low pressure control(s) LP1 and LP2 will open. If the refrigerant leaks into the low side causing the pressure to close the low pressure controls LP1 and LP2, the compressor will start after a two-hour time delay. For normal temperature controlled operation, the timer is bypassed and the compressor will start on a refrigerant pressure rise.

Note: Do not shut the unit down without going through the pumpdown cycle. Flow switch, time clock, and ambient lockout thermostat must be wired to allow pumpdown when unit is turned off.

Unit Maintenance

CAUTION

1. Service on this equipment is to be performed by qualified refrigeration personnel familiar with equipment operation, maintenance, correct servicing procedures, and the safety hazards inherent in this work. Causes for repeated tripping of equipment protection controls must be investigated and corrected.
2. Disconnect all power before doing any service inside the unit.
3. Anyone servicing this equipment shall comply with the requirements set forth by the EPA in regards to refrigerant reclamation and venting.

General

On initial start-up and periodically during operation, it will be necessary to perform certain routine service checks. Among these are checking the liquid line sightglasses, taking condensing and suction pressure readings, and checking to see that the unit has normal superheat and subcooling readings. A recommended maintenance schedule is located at the end of this section.

It is suggested that the Maintenance Log be completed on a weekly basis. The log will serve as a useful tool for a service technician in the event service is required.

Compressor Maintenance

The reciprocating compressors are semi-hermetic and require no maintenance.

Lubrication

No routine lubrication is required ALR units. The fan motor bearings are permanently lubricated and no further lubrication is required. Excessive fan motor bearing noise is an indication of a potential bearing failure.

Compressor oil for R-22 use should be standard refrigeration mineral oil such as Suniso 3GS. For R-134a use POE Mobile EAL ARTIC 22CC lubricant.

Electrical Terminals

WARNING

Electric shock hazard. Turn off all power before continuing with following service.

Electrical terminals should be checked semi-annually for tightness.

Condensers

The condensers are air-cooled and constructed of 3/8" (9.5mm) O.D. internally finned copper tubes bonded in a staggered pattern into louvered aluminum fins. No maintenance is ordinarily required except the routine removal of dirt and debris from the outside surface of the fins. McQuay recommends the use of foaming coil cleaners available at most air conditioning supply outlets. Use caution when applying such cleaners as they can contain potentially harmful chemicals. Care should be taken not to damage the fins during cleaning.

If the service technician has reason to believe that the refrigerant circuit contains noncondensables, purging can be required strictly following Clean Air Act regulations governing refrigerant discharge to the atmosphere. The purge Schrader valve is located on the vertical coil headers. Purge with the unit off, after shutdown of 15 minutes or longer, to allow air to collect at the top of the coil. Restart and run the unit for a brief period. If necessary, shut unit off and repeat the procedure. **NOTE:** Follow all environment regulations when removing refrigerant from the unit.

Refrigerant Sightglass

The refrigerant sightglasses should be observed periodically. (A weekly observation should be adequate.) A clear glass of liquid indicates that there is adequate refrigerant charge in the system to provide proper feed through the expansion valve. Bubbling refrigerant in the sightglass, during stable run conditions, indicates that the system can be short of refrigerant charge. Refrigerant gas flashing in the sightglass could also indicate an excessive pressure drop in the liquid line, possibly due to a clogged filter-drier or a restriction elsewhere in the liquid line. See Table 16 for maximum allowable pressure drops. If subcooling is low add charge to clear the sightglass. If subcooling is normal (10°-15°F) and flashing is visible in the sightglass check the pressure drop across the filter-drier. Subcooling should be checked at full load with 70°F to 80°F (21°C to 27°C) outdoor air temperature and all fans running.

An element inside the sightglass indicates the moisture condition corresponding to a given element color. If the sightglass does not indicate a dry condition after about 12 hours of operation, the circuit should be pumped down and the filter-drier changed.

Preventive Maintenance Schedule

PREVENTIVE MAINTENANCE SCHEDULE			
OPERATION	WEEKLY	MONTHLY (Note 1)	ANNUAL (Note 2)
General			
Complete unit log and review (Note 3)	X		
Visually inspect unit for loose or damaged components		X	
Inspect thermal insulation for integrity			X
Clean and paint as required			X
Electrical			
Check terminals for tightness, tighten as necessary			X
Clean control panel interior			X
Visually inspect components for signs of overheating		X	
Verify compressor heater operation		X	
Test and calibrate all safety on operating controls			X
Megger compressor motor every five years *			
Refrigeration			
Leak test		X	
Check sight glasses for clear flow	X		
Check filter-drier pressure drop (see manual for spec)		X	
Perform compressor vibration test			X
Condenser			
Clean condenser coils (Note 4)			X
Check fan blades for tightness on shaft (Note 5)			X
Check fans for loose rivets and cracks			X
Check coil fins for damage			X

Notes:

1. Monthly operations include all weekly operations.
2. Annual (or spring start-up) operations includes all weekly and monthly operations.
3. Log readings can be taken daily for a higher level of unit observation.
4. Coil cleaning can be required more frequently in areas with a high level of airborne particles.
5. Be sure fan motors are electrically locked out.

* Never Megger motors while they are in a vacuum.

Filter-Driers

A replacement of the filter-drier is recommended any time excessive pressure drop is read across the filter-drier and/or when bubbles occur in the sightglass with normal subcooling. The maximum recommended pressure drops across the filter-drier are as follows:

Table 16, Filter-Drier Pressure Drop

PERCENT CIRCUIT LOADING (%)	MAXIMUM RECOMMENDED PRESSURE DROP ACROSS FILTER DRIER PSIG (KPA)
100%	10 (69)
75%	8 (55.2)
50%	5 (34.5)
25%	4 (27.6)

The filter-drier should also be changed if the moisture indicating liquid line sightglass indicates excess moisture in the system.

During the first few months of operation the filter-drier replacement can be necessary if the pressure drop across the filter-drier exceeds the values listed in the paragraph above. Any residual particles from the condenser tubing, compressor and miscellaneous components are swept by the refrigerant into the liquid line and are caught by the filter-drier.

Liquid Line Solenoid Valve

The liquid line solenoid valves that shut off refrigerant flow in the event of a power failure do not normally require any maintenance. The solenoids can, however, require replacement of the solenoid coil or of the entire valve assembly.

The solenoid coil can be checked to see that the stem is magnetized when energized by touching a screwdriver to the top of the stem. If there is no magnetization either the coil is bad or there is no power to the coil.

The solenoid coil can be removed from the valve body without opening the refrigerant piping after pumpdown. For personal safety shut off and lock out the unit power.

The coil can then be removed from the valve body by simply removing a nut or snap-ring located at the top of the coil. The coil can then be slipped off its mounting stud for replacement.

To replace the entire solenoid valve follow the steps involved when changing a filter-drier.

Evaporator

The evaporator is the direct expansion, shell-and-tube type with refrigerant flowing through the tubes and water flowing through the shell over the tubes. The tubes are internally finned to provide extended surface as well as turbulent flow of refrigeration through the tubes. Normally no service work is required on the evaporator.

Refrigerant Charging

ALR air-cooled chillers are shipped factory charged with a full operating charge of refrigerant but there can be times that a unit must be recharged at the job site. Units ordered with remote evaporator for indoor installation are shipped with a holding charge of refrigerant. The system must be field charged by the contractor. Follow these recommendations when field charging. Refer to the unit operating charge found in the Physical Data Tables.

Unit charging can be done at any steady load condition (preferably at 75 to 100% load) and at any outdoor temperature (preferably higher than 70°F (21.1°C). Unit must be allowed to run 5 minutes or longer so that the condenser fan staging is stabilized at normal operating discharge pressure. For best results charge with two or more condenser fans operating on each refrigerant circuit.

The ALR units have a condenser coil design with approximately 15% of the coil tubes located in a subcooler section of the coil to achieve liquid cooling to within 5°F (3°C) of the outdoor air temperature when all condenser fans are operating. This is equal to about 15°F-20°F (8.3°C-11.1°C) subcooling below the saturated condensing temperature when the pressure is read at the liquid valve between the condenser coil and the liquid line filter drier. Once the subcooler is filled, extra charge will not lower the liquid temperature and does not help system capacity or efficiency. However, a little extra (10-15 lbs) will make the system less sensitive.

Note: As the unit changes load or fans cycle on and off, the subcooling will vary but should recover within several minutes and should never be below 6°F (3.3°C) subcooling at any steady state condition. Subcooling will vary somewhat with evaporator leaving water temperature and suction superheat. As the evaporator superheat decreases the subcooling will drop slightly.

One of the following three scenarios will be experienced with an undercharged unit:

1. If the unit is slightly undercharged the unit will show bubbles in the sightglass. Recharge the unit as described in the charging procedure below.
2. If the unit is moderately undercharged it will normally trip on freeze protection. Recharge the unit as described in the charging procedure below. However, freezestat trips can also be an indication of low flow or poor heat transfer due to tube fouling. Anti-freeze solutions can also cause freezestat trips.
3. If the unit is severely undercharged the unit will trip due to lack of liquid flow to the expansion valve. In this case either remove the remaining charge by means of a proper reclamation system and recharge the unit with the proper amount of refrigerant as stamped on the unit nameplate, or add refrigerant through the suction valve on the compressor slowly. Feed liquid into the suction valve when the compressor is running. If the unit is severely undercharged the unit can nuisance trip during this charging procedure. If this happens close off the refrigerant from the tank and restart the unit. Once the unit has enough charge so that it does not trip out, continue with step 2 of the charging procedure below.

Procedure to charge a moderately undercharged ALR unit:

1. 1. If a unit is low on refrigerant you must first determine the cause before attempting to recharge the unit. Locate and repair any refrigerant leak. Evidence of oil is a good indicator of leakage, however oil can not be visible at all leaks. Liquid leak detector fluids work well to show bubbles at medium size leaks but electronic leak detectors can be needed to locate small leaks.
2. 2. Add the charge to the system through the suction shutoff valve or through the Schrader fitting on the tube entering the evaporator between the compressor and the evaporator head.
3. 3. The charge can be added at any load condition between 25-100% load per circuit but at least two fans should be operating per refrigerant circuit if possible. The suction superheat should be in the 6°F-12°F (3.3°C-6.6°C) range.
4. 4. Add sufficient charge to clear the liquid line sightglass and until all flashing stops in the sightglass. Add an extra 15-20 lbs. of reserve to fill the subcooler if the compressor is operating at 50-100% load.
5. 5. Check the unit subcooling value by reading the liquid line pressure and temperature at the liquid line near the filter-drier. The subcooling values should be between 6°F-20°F (6.6°C-11.1°C). The subcooling values will be highest at 75-100% load, approximately 12°F-20°F (6.6°C-11.1°C) and lowest at 50% load, approximately 6°F-12°F (3.3°C-6.6°C).
6. 6. With outdoor temperatures above 60°F (15.6°C) all condenser fans should be operating and the liquid line temperature should be within 5°F-10°F (2.8°C-5.6°C) of the outdoor air temperature. At 25-50% load the liquid line temperature should be within 5°F (2.8°C) of outdoor air temperature with all fans on. At 75-100% load the liquid line temperature should be within 10°F (5.6°C) of outdoor air temperature with all fans on.
7. 7. Overcharging of refrigerant will raise the compressor discharge pressure due to filling of the condenser tubes with excess refrigerant.

ALR Troubleshooting Chart

PROBLEM	POSSIBLE CAUSES	POSSIBLE CORRECTIVE STEPS
Compressor will not Run	1. Main Switch. 2. Fuse Blown. Circuit breakers open 3. Thermal overloads tripped 4. Defective contactor or coil. 5. System Shutdown by safety devices 6. No cooling required 7. Liquid line solenoid will not open 8. Motor electrical trouble 9. Loose wiring	1. Close Switch. 2. Check electrical circuits and motor windings for shorts or grounds. Investigate for possible overloading. Replace fuse or reset breakers after fault is corrected. Check for loose or corroded connections. 3. Overloads are auto-reset Check unit closely when unit comes back on line. Allow time for auto-reset. 4. Repair or replace 5. Determine type and cause of shutdown and correct it before resetting safety switch 6. None. Wait until unit class for cooling 7. Repair or replace solenoid coil. Check wiring 8. Check motor for opens, shorts, or burnout 9. Check all wire junctions. Tighten all terminal screws
Compressor noisy or vibrating	1. Compressor running in reverse 2. Improper piping support on suction or discharge 3. Worn compressor isolator bushing 4. Worn Compressor	1. Check unit and compressor for correct phasing 2. Relocate, add, or remove hangers 3. Replace 4. Replace
High Discharge Pressure	1. Noncondensables in system 2. System overcharged with refrigerant 3. Discharge shutoff valve partially closed 4. FanTrol wiring not correct 5. Fan not running 6. Dirty condenser coil	1. Purge the noncondensables used accepted practice 2. Remove excess, check liquid subcooling 3. Open valve 4. Check FanTrol wiring 5. Check electrical circuit, Check fan motor 6. Clean coil
Low Discharge Pressure	1. Wind blowing into coil at low ambient 2. Faulty condenser temperature regulation 3. Insufficient refrigerant in system 4. Low suction pressure 5. Only one compressor operating	1. Shield coil from direct wind 2. Check condenser control operation 3. Check for leaks. Repair and add charge 4. See corrective steps for Low Suction Pressure 5. See corrective steps for Compressor Will Not Stage Up
High Suction Pressure	1. Excessive water temperature 2. Excessive load 3. Expansion valve overfeeding 4. Compressors running in reverse	1. Check control settings 2. Reduce load or add additional equipment 3. Check remote bulb. Regulate superheat 4. Check for proper phasing
Low Suction Pressure	1. Lack of refrigerant 2. Clogged liquid line filter drier 3. Expansion valve malfunctioning 4. Condensing temperature to low 5. Compressor will not unload 6. Insufficient water flow 7. Evaporator head ring gasket slippage 8. Evaporator dirty	1. Check for leaks, Repair and add charge. Check liquid sightglass 2. Check pressure drop across filter drier. Replace 3. Check and reset for proper superheat 4. Check means for regulating condenser temperature 5. See corrective steps for Compressor Staging Intervals Too Low 6. Adjust flow 7. Take pressure drop across vessel and contact factory to obtain design pressure drop for that vessel 8. Clean chemically
Compressor will not stage up	1. Defective capacity control 2. Faulty thermostat stage or broken wire 3. Stages not set for application	1. Replace 2. Replace 3. Reset thermostat setting for application
Compressor Staging Intervals to Short	1. Thermostat control band not set properly 2. Erratic water thermostat 3. Insufficient water flow	1. Set control band wider 2. Replace 3. Adjust flow
Compressor Oil Level Too high or Too Low	1. Low oil level 2. Loose fitting on oil line 3. Level too high 4. Insufficient water flow - Level too high 5. Excessive liquid in crankcase - Level too high	1. Check and add oil 2. Check and tighten system 3. Adjust thermal expansion valve 4. Adjust flow 5. Check crankcase heater. Reset expansion valve for higher superheat. Check liquid line solenoid valve operation.
Compressor loses Oil	1. Lack of refrigerant 2. Excessive compression ring blow-by 3. Suction superheat too high 4. Crankcase heater burnout	1. Check for leaks and repair. Add refrigerant 2. Replace compressor 3. Adjust superheat 4. Replace crankcase heater
Motor Overload Relays or Circuit Breakers Open	1. Low voltage during high load conditions 2. Defective or grounded wiring in motor 3. Loose power wiring 4. High condenser temperature 5. Power line fault causing unbalanced voltage	1. Check supply voltage for excessive line drop 2. Replace compressor motor 3. Check all connections and tighten 4. See corrective steps for High Discharge Pressure 5. Check supply voltage. Notify power company. Do not start until fault is corrected.
Compressor Thermal Protection Switch Open	1. Operating beyond design conditions 2. Discharge valve partially shut 3. Blown compressor internal gasket	1. Add facilities so conditions are within allowable limits 2. Open valve 3. Replace gasket

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