Installation, Operation, and Maintenance Information

Air-Cooled Condensers

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GENERAL SAFETY INFORMATION

1. Installation and maintenance are to be performed only by qualified personnel who are familiar with this type of equipment.
2. Make sure that all field wiring conforms to the requirements of the equipment and all applicable national and local codes.
3. Avoid contact with sharp edges and coil surfaces. They are potential injury hazards.
4. All power sources must be disconnected prior to any servicing or maintenance of this unit. After disconnecting power, allow 5 minutes for capacitor discharge before servicing motors.
5. Refrigerant recovery devices must be used during installation and service of this equipment. It is illegal for some refrigerants to be released into the atmosphere.

INSPECTION

Check all items against the bill of lading to make sure all crates or cartons have been received. If there is any damage, report it immediately to the carrier and file a claim. Make sure the voltage on the unit nameplate agrees with the power supply available.

INSTALLATION

Rigging and Assembly

Leave the units in the carton or on the skid until they are as close as possible to the installation location. Never lift any of the units by the headers, return bends, or electrical boxes. All condensers are provided with lifting points located in the top of each leg channel and bottom of each leg, above and below the side panel. The actual method of rigging depends on the equipment available, the size of the unit, and where the unit is to be located. It is up to the installer to decide the best way to handle each unit. A spreader bar should always be used and should be at least as long as the distance between the lifting points.

Rig the unit as shown in Figure 1. More than two lifting points are required for longer units (refer to Table 1). **Never use a lifting point where there is no support connecting leg channels.** Unbolt the unit from the skid and lower into normal operating position, making sure the coil surface is not damaged. Remove the two 3/8" bolts in each leg and raise the unit to approximately 18 inches above ground. Reinstall the bolts in the new locations shown in Figure 2 and fasten securely. After condenser is installed, supports between leg channels on top of units may be removed and discarded.

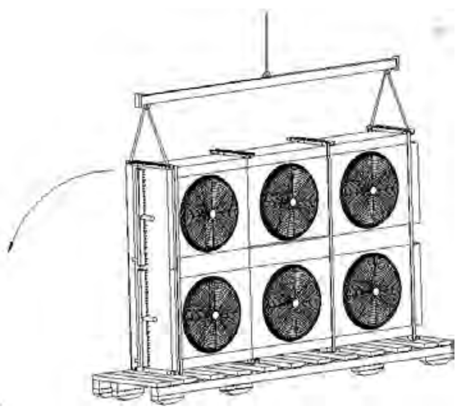


Figure 1: Lowering Unit Into Vertical Discharge Position

Table 1: Lifting Points

Unit length	Number of Lifting Points	Location of Lifting Point
1 - 3 Fans	2	each end
4 Fans	3	each end and center
5 -7 Fans	4	each end and two in center

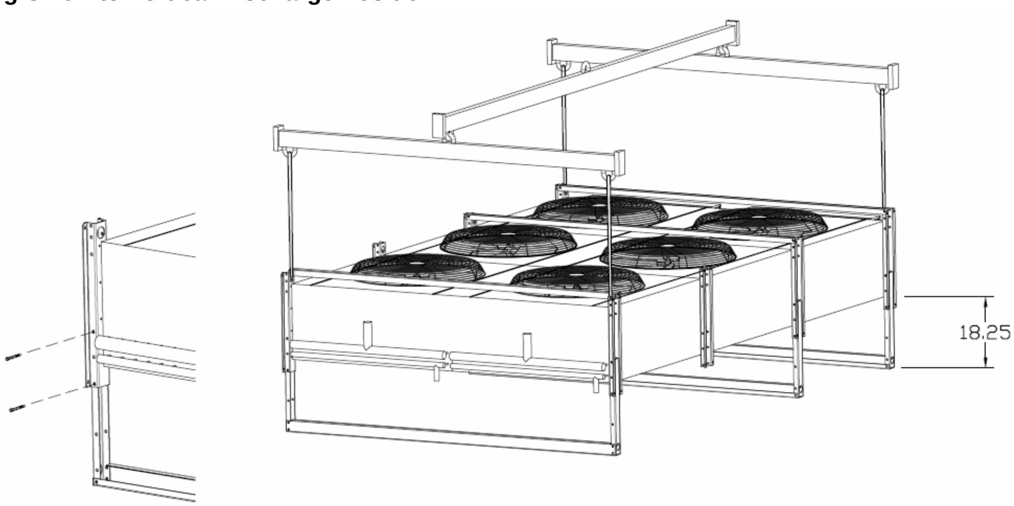


Figure 2: Leg Extension

Unit Location

General

These units are designed for outdoor applications. All units must be installed level for proper drainage of liquid refrigerant and oil. When units are installed on a roof, they must be mounted on support beams that span load walls. Ground mounted units should be installed on concrete pads. When selecting a location for an air-cooled condenser, be sure to allocate space for maintenance and service work.

Space Requirements

All sides of the condenser should be no closer than the width of the unit, B, to a wall or other obstruction. If the unit is surrounded by more than 2 walls, it should be treated as an installation in a pit.

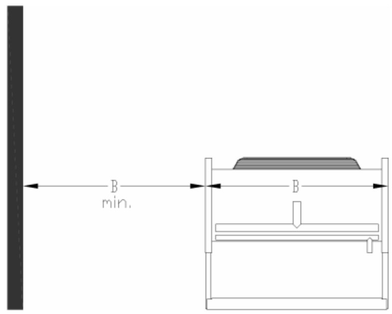


Figure 3: Wall or Obstruction

When units are installed side by side, the distance between them should be at least the width of the larger unit, B. If units are installed end to end, the minimum distance between them should be 4 feet.

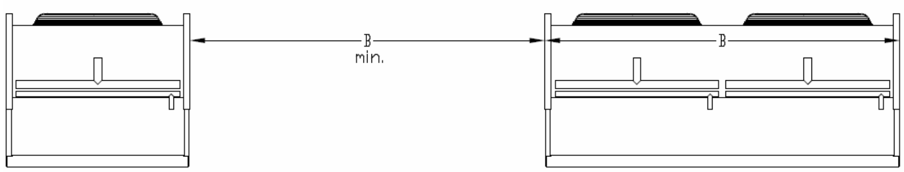


Figure 4: Other Units

If a unit is to be located in a pit, the height of the walls of the pit must not exceed the unit height. If the walls do exceed the height of the unit, stacks must be installed so that the discharge air exits above the walls. The distance between the unit and wall should be at least twice the width of the unit.

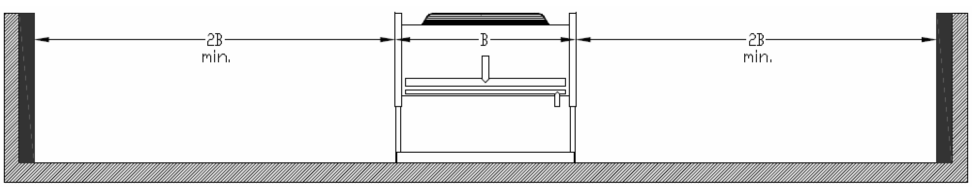


Figure 5: Installation in a Pit

Fences surrounding condensers must be a minimum distance of B, the width of the unit, from the condenser. The fence must have 50% free area or more and cannot exceed the height of the unit. The distance between the bottom of the fence and the ground must be at least 1 ft. If the free area of the fence is less than 50%, requirements for installation in a pit apply.

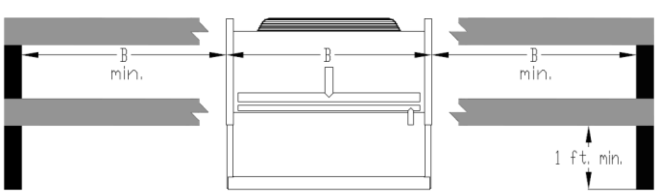


Figure 6: Decorative Fences

PIPING RECOMMENDATIONS

The following are general guidelines for routing and sizing lines to air-cooled condensers. For further information please consult the ASHRAE Handbook or other accepted piping handbooks.

Discharge Lines

Consider the following three issues when designing and sizing discharge lines.

1. Pressure Drop

Lines should be sized for a reasonable pressure drop. Pressure drop increases the required horsepower per ton of refrigeration and decreases the compressor capacity. Table 2 shows discharge line capacities for pressure drop equivalent to 1° F per 100 feet of line.

Table 2: Discharge Line Sizing

Line Size (O.D.) Type L Tubing	Discharge Line Capacity* (MBH @ Evaporator)														
	R-22			R-134A			R-404A R-507			R-407A R-407C			R-410A		
	Saturated Suction Temperature, °F														
	-40	0	40	-40	0	40	-40	0	40	-40	0	40	-40	0	40
1/2	9	10	10	5	6	7	7	8	9	9	10	11	14	15	16
5/8	17	18	19	11	12	13	14	16	18	17	18	20	26	28	30
7/8	44	47	50	29	32	35	36	41	47	44	49	53	69	74	78
1 1/8	90	96	102	59	65	71	72	84	94	89	98	106	140	150	158
1 3/8	157	168	178	101	113	125	126	145	164	155	171	185	243	261	275
1 5/8	248	265	281	161	179	197	198	229	258	245	270	292	383	412	434
2 1/8	514	548	582	332	370	408	408	473	532	506	557	603	791	849	895
2 5/8	905	965	1025	587	653	719	718	833	936	893	984	1064	1391	1494	1574
3 1/8	1442	1538	1634	934	1040	1146	1143	1326	1490	1422	1566	1695	2215	2380	2508
3 5/8	2141	2283	2425	1392	1548	1704	1695	1965	2210	2106	2319	2510	3282	3527	3716

* Based on condensing temperature of 105°F. For other condensing temperatures, multiply by the appropriate correction factor listed in Table 2.

* Based on pressure drop equivalent to 1°F per 100 ft. of line.

Source: ASHRAE Refrigeration Handbook

2. Oil Trapping

Lines must be sized and routed so that oil is carried through the system. Normally, sizing according to Table 2 will be satisfactory. However, when the condenser is located at a higher level than the compressor, it may be necessary to take special precautions, especially if the system is designed to operate at reduced compressor capacity.

A vertical hot gas line sized to transport oil at minimum load conditions may have excessive pressure drop at full load. If this is the case, a double hot gas riser, as shown in Figure 7 should be used. Size Riser No. 1 for the minimum load condition. Size Riser No. 2 so that the combined cross-sectional area of both risers is equal to the cross-sectional area of a single riser having acceptable pressure drop at full load.

Install a trap between the two risers, as shown in Figure 7. During partial load, the trap will fill up with oil until riser Number 2 is sealed off. Keep the trap as small as possible to limit its oil holding capacity.

Table 3: Discharge Line Correction Factors

Condensing Temp. (°F)	Discharge Line					
	R-22	R-134A	R-404A	R-407C	R-410A	R-507
80	0.790	0.804	0.870	0.787	0.815	0.873
90	0.880	0.882	0.922	0.872	0.889	0.924
100	0.950	0.961	0.974	0.957	0.963	0.975
110	1.040	1.026	1.009	1.036	1.032	1.005
120	1.100	1.078	1.026	1.109	1.096	1.014
130	1.180	1.156	1.043	1.182	1.160	1.024

3. Compressor Head Protection

Discharge lines should be designed to prevent condensed refrigerant and oil from draining back to the compressor during off cycles. Use the following guidelines:

A. The highest point in the discharge line should be above the highest point in the condenser coil. A purge valve should be located at this point.

B. The hot gas line should loop to the floor if the condenser is located above the compressor, especially if the hot gas riser is long.

C. If the condenser is located where the ambient temperature could be higher than the ambient at the compressor location, a check valve should be installed in the hot gas line.

D. A check valve should be installed in each discharge line of a multiple compressor arrangement to prevent refrigerant from an active compressor from condensing on the heads of an idle compressor.

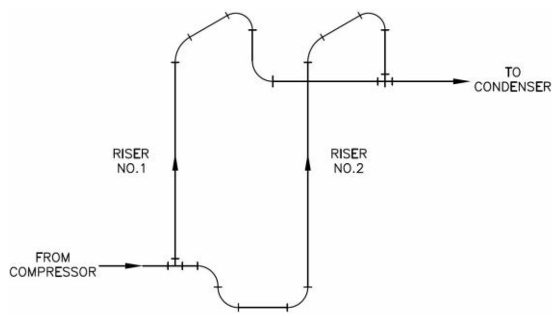


Figure 7: Double Hot Gas Riser

Liquid Lines

Liquid lines from the receiver to the expansion valve can generally be sized for pressure drop equivalent to a 1° F to 2° F change in saturation temperature. If there is substantial sub cooling, or the line is short, it can be sized at the high end of this range. If the opposite is true, a more conservative selection should be made. A receiver, if used in the system, should be located below the condenser and the condenser-to-receiver liquid line must be sized to allow free drainage from the condenser to the receiver. This line should be sized so the velocity does not exceed 100 FPM. Generous sizing of this liquid (condensate) line is especially important if the receiver is exposed at any time to a warmer ambient temperature than the condenser. It must be large enough for the liquid to flow to the receiver and at the same time allow venting of refrigerant vapor in the opposite direction back to the condenser. The receiver can become vapor-locked under these conditions if the re-evaporated gas is not allowed to flow back to the condenser for re-condensation. All liquid (condensate) lines should be free of any traps or loops.

Table 4 shows liquid line capacity in evaporator MBH. Line sizing is shown for both condenser-to-receiver lines and receiver-to-expansion valve lines. All capacities are for 100 equivalent feet of tubing. The selections based on pressure drop are for an equivalent to a 1° F change in saturation temperature. They can be converted to capacities based on a 2° F equivalent drop by using the factor given below the table.

See Table 5 for the weight of refrigerant in liquid, suction and discharge lines.

Table 4: Liquid Line Sizing

Line Size (O.D.) Type L Tubing	Net Refrigerating Effect (MBH)									
	Condenser To Receiver Piping*					Receiver To Exp. Valve Piping†				
	R-22	R-134A	R-404A R-507	R-407A R-407C	R-410A	R-22	R-134A	R-404A R-507	R-407A R-407C	R-410A
1/2	28	26	16	25	24	43	33	31	46	55
5/8	44	41	25	41	38	80	63	58	85	103
7/8	94	85	52	83	80	218	168	152	224	271
1 1/8	158	145	88	142	137	444	341	307	224	550
1 3/8	242	221	135	216	209	776	600	535	455	956
1 5/8	342	313	190	306	295	1230	943	846	794	1511
2 1/8	595	544	331	533	514	2556	1956	1752	1256	3128
2 5/8	918	839	510	822	792	-	-	-	-	-
3 1/8	1310	1200	728	1172	1130	-	-	-	-	-
3 5/8	1774	1620	985	1586	1529	-	-	-	-	-

* Based on 100 FPM refrigerant velocity.

† Based on refrigerant pressure drop of 1°F per 100 feet of line. For 2°F per 100 feet of line, multiply by

Source: ASHRAE Refrigeration Handbook

Table 5: Weight of Refrigerant in 100 Feet of Line (Lbs.)

Line Size (O.D.) Type L Tubing	Liquid Line 110°F						Suction Line 40°F						Discharge Line 115°F					
	R-22	R-134A	R-404A	R-407A R-407C	R-410A	R-507	R-22	R-134A	R-404A	R-407A R-407C	R-410A	R-507	R-22	R-134A	R-404A	R-407A R-407C	R-410A	R-507
5/8	11.3	11.5	9.7	10.6	9.8	9.6	0.2	0.2	0.3	0.2	0.3	0.4	0.8	0.6	1.2	0.9	1.2	1.3
7/8	23.4	23.8	20.1	22.0	20.3	19.8	0.5	0.4	0.6	0.4	0.7	0.8	1.6	1.2	2.4	2.0	2.5	2.7
1 1/8	39.8	40.5	34.3	37.6	34.5	33.8	0.9	0.6	1.1	0.7	1.1	1.3	2.8	2.1	4.1	3.3	4.2	4.6
1 3/8	60.7	61.7	52.3	57.2	52.6	51.5	1.3	0.9	1.6	1.1	1.7	2.0	4.2	3.2	6.2	5.1	6.4	7.0
1 5/8	85.9	87.3	74.0	81.0	74.5	72.9	1.9	1.3	2.3	1.6	2.4	2.9	6.0	4.6	8.8	7.2	9.1	10.0
2 1/8	149.4	151.9	128.7	140.9	129.6	126.8	3.3	2.3	4.0	2.8	4.2	5.0	10.4	8.0	15.4	12.5	15.9	17.4
2 5/8	230.4	234.3	198.4	217.3	199.8	195.5	5.0	3.5	6.2	4.3	6.5	7.7	16.1	12.3	23.7	19.3	24.4	26.8
3 1/8	328.9	334.4	283.3	310.2	285.2	279.0	7.2	5.0	8.8	6.1	9.2	11.0	22.9	17.6	33.8	27.5	34.9	38.2
3 5/8	444.8	452.3	383.1	419.6	385.7	377.4	9.7	6.7	11.9	8.2	12.5	14.8	31.0	23.8	45.8	37.2	47.2	51.7

Multiple Condensers

Often two condensers are piped in parallel to the same refrigeration system. It is important that the units have approximately the same capacity so that the pressure drop through each is equal. The piping should be arranged so that the lengths of runs and bends to each are equal on both the inlet and outlet of the condensers. A drop leg should be included from each liquid outlet of sufficient height to prevent backup of liquid into one coil. This will overcome any difference in pressure drop that may exist between the two coils.

Routing of Piping

Piping should be routed to avoid excessive strain on system components or the piping itself. Discharge lines must be supported with rigid pipe supports to prevent transmission of vibration and movement of the line. The discharge line should be well supported near the condenser hot gas connection. Use offsets in inter-connecting lines between two condensers and provide isolation where pipes pass through building walls or floors.

HEAD PRESSURE CONTROL OPTIONS AND CHARGE CALCULATIONS

Flooded Condenser

The Flooded Condenser Head Pressure Control Option maintains adequate condensing pressure while operating in low ambient temperatures. By flooding the condenser with liquid refrigerant, the amount of coil surface available for condensing is reduced. The resulting reduction in capacity ensures proper operation of the thermal expansion valve.

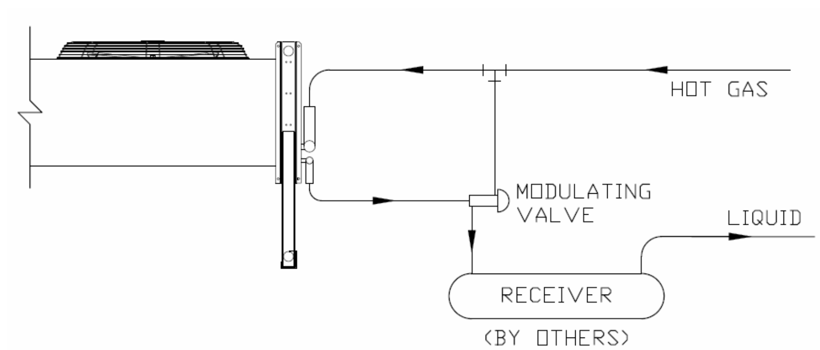


Figure 8: Flooded Condenser Valve Piping

This option requires a modulating three-way valve, dependent on refrigerant discharge pressure, be placed at the condenser outlet. A fall in ambient temperature causes a corresponding fall in discharge pressure. The valve modulates allowing discharge gas to flow to the receiver, creating a higher pressure at the condenser outlet. This higher pressure reduces the flow out of the condenser, causing liquid refrigerant to back up in the coil. Flooding the condenser reduces the available condensing surface and raises the condensing pressure so that adequate high-side pressure is maintained. Various types and combinations of flooding control valves are available. Contact the valve manufacturer for specific recommendations.

A larger receiver and additional refrigerant are required for systems with flooded condenser control. The receiver can be conveniently installed directly under the condenser in most applications. However, if the system will be operational in ambient temperatures below 55° F, the receiver should be located in a warm environment or heated. In this situation, a check valve must be installed in the line between the receiver and expansion valve. This prevents refrigerant migration from the receiver to the condenser.

The amount of additional refrigerant charge is based on the lowest expected winter operating temperature and the design TD. In addition to the condenser charge, the operating charges of the evaporator, receiver and refrigerant lines must be added to determine the total system refrigerant charge. The pump-down capacity (80% of full capacity) of the receiver must be at least equal to the total system charge.

Table 6 shows the standard summer condenser charge when using R-404A. The additional charge required for flooded condenser operation with a design TD of 15°F is also shown. Additional charge for alternate design TDs can be found using the correction factors in Table 7.

For flooded condenser control only,

total charge = summer charge (Table 6) + additional charge (Table 6) × design TD correction factor (Table 7)

Example: Single Section Unit with Flooded Condenser Head Pressure Control

Given:

An RDD054*B condenser with an R-404A summer charge of 24.4 lbs. (See Table 6) has a design TD of 10° F and will operate at a minimum ambient of 0° F.

Solution:

The additional charge needed to operate at 0° F can be found in Table 6 (63.3 lbs.). Because the unit has a design TD of 10° F, the additional charge must be multiplied by a correction factor of 1.04 as shown in Table 7. Therefore, the required additional charge is

63.3 × 1.04 = 65.8 lbs. The total operating charge for a minimum ambient of 0° F and a 10° design TD is 24.4 + 65.8 = 90.2 lbs.

Example: Multi-Section Unit with Flooded Condenser Head Pressure Control

Given:

An RDS015*B condenser split into two sections. One section has 22 face tubes of R-404A at a 10° TD and the other section has 14 face tubes of R-22 at a 15° TD. The unit will operate at a minimum ambient of 20° F.

Solution:

To calculate the winter charge for each section, the summer charge and additional charge for low ambient must be found. The summer charge can be calculated by multiplying the number of face tubes in the section by the charge per face tube value in Table 6. Next, divide the number of face tubes in the section by the total number of face tubes and multiply by the additional charge required for a minimum ambient of 20° F. Make sure to apply correction factors for design TDs other than 15° and for refrigerants other than R-404A or R-507. Adding the summer charge and additional charge for low ambient will yield the total winter charge.

For the R-404A section, the summer charge is 22 tubes × 0.23 lbs. per face tube = 5.06 lbs. The additional charge equals the ratio of tubes in the section to total tubes times the additional charge at 20° F with a 15° F TD times the TD correction factor from Table 7, or 22/36 × 19.1 × 1.05 = 12.26 lbs. The winter charge is 5.06 + 12.26 = 17.32 lbs.

For the R-22 section, the summer charge must be multiplied by a refrigerant correction factor of 1.13 as seen in the Table 6 footnotes. The summer charge is 14 × 0.23 × 1.13 = 3.64 lbs. The additional charge calculation also requires the use of the correction factor. The additional charge is

14/36 × 19.1 × 1.13 = 8.39 lbs. The winter charge is 3.64 + 8.39 = 12.02 lbs.

Table 6: Additional Refrigerant Charge for Flooded Condensers

Unit Size — Motor Speed (RPM)				Number of Face Tubes	R-404A & R-507*: Charge Per Face Tube (Lbs.)	R-404A & R-507*: Total Summer Charge (Lbs.)	Additional Charge Required for Low Ambient Temperatures, 15° F Design TD†				
SINGLE FAN-WIDTH UNITS							MINIMUM AMBIENT TEMPERATURE (° F)				
1140	850	550	VSEC				60	40	20	0	-20
009	010, 012	008	014	36	0.11	4.1	5.9	8.3	9.6	10.5	11.2
013	013, 014	010	017		0.17	6.1	9.1	12.7	14.5	15.8	16.9
014	018	011	021		0.23	8.1	12.0	16.0	18.3	20.7	21.8
015, 019	016, 023	017	026		0.23	8.1	11.8	16.6	19.1	20.9	22.4
020, 028	017, 027	020	029		0.34	12.2	18.2	25.3	29.0	31.7	33.8
036	031	022	038		0.45	16.2	24.0	31.9	36.6	41.3	43.7
041	039	028	044		0.51	18.3	27.3	38.0	43.5	47.5	50.7
050	049	032	051		0.68	24.3	36.0	47.9	54.9	62.0	65.5
053	051	037	054		0.68	24.4	36.5	50.7	58.1	63.3	67.6
065	058	043	066		0.90	32.4	48.0	63.8	73.2	82.7	87.4
077	069	050	080		1.41	50.9	80.3	111.0	126.9	138.2	147.4
081	077	052	083		1.93	69.6	93.2	135.8	159.1	175.8	189.1
096	092	062	098		2.32	83.5	111.8	163.0	190.9	211.0	226.9
124	114	071	127		2.71	97.4	130.5	190.1	222.7	246.1	264.7
DOUBLE FAN-WIDTH UNITS											
047	048	043	034	72	0.23	16.2	23.7	33.2	38.3	41.9	44.8
054	052	040	048		0.34	24.4	36.5	50.7	58.1	63.3	67.6
066	059	044	055		0.45	32.4	48.0	63.8	73.2	82.7	87.4
080	082	076	056		0.51	36.6	96.3	133.2	152.3	165.9	176.9
099	101	091	064		0.68	48.6	72.0	95.8	109.7	124.0	131.0
108	109	103	074		0.68	48.8	72.9	101.3	116.1	126.7	135.2
132	134	118	086		0.90	64.8	96.0	127.7	146.3	165.4	174.7
154	156	138	100		1.41	101.7	160.6	222.0	253.8	276.5	294.9
162	163	155	104		1.93	139.2	186.4	271.6	318.2	351.6	378.2
193	195	183	124		2.32	167.0	223.7	325.9	381.8	421.9	453.8
247	250	228	142		2.71	194.8	261.0	380.2	445.5	492.2	529.5

† Based on 90° F condensing temperature.

* For R-22, multiply by 1.13.
* For R-134A, multiply by 1.15.
* For R-410A, multiply by 1.02.
* For R-407A or R-407C, multiply by 1.09.

Table 7: Low Ambient Design TD Correction Factors

Minimum Ambient Temperature (°F)	Design T.D.				
	30	25	20	15	10
60	0.00	0.40	0.76	1.00	1.24
40	0.73	0.84	0.92	1.00	1.09
20	0.86	0.92	0.95	1.00	1.05
0	0.91	0.94	0.97	1.00	1.04
-20	0.93	0.96	0.98	1.00	1.02

Splitting Controls

Condenser splitting controls assist in maintaining head pressure while minimizing the amount of refrigerant required for the system. A single condenser is split into two parallel circuits, allowing half of the condenser to be removed from the refrigerant circuit during low ambient operation. This is achieved by installing a three way solenoid valve at the condenser inlet, regulated by either a temperature sensing controller or pressure switch. Additional controls are required for the Splitting Control Option on double wide units to shut off the fan motors on the unused portion of the coil.

Fan Cycling Control Option

The cycling of condenser fans provides an automatic means of maintaining condensing pressure control at low ambient air temperature conditions. It also results in substantial fan motor power savings in lower ambient. Temperature sensing thermostats or pressure controls determine whether the motor is on or off. The minimum ambient temperatures for units with the Fan Cycling Control Option can be found in Table 8.

The Fan Cycling Control Option consists of a weatherproof enclosure, fan contactors, and either ambient thermostat(s) or pressure control(s). The enclosure is factory mounted and completely factory wired. Power must be supplied from a fused disconnect switch to the power circuit terminal block; control circuit power must be supplied to the control terminal block.

Table 9 shows the recommended temperature set points for the thermostats. The recommended cut-in and differential settings for fan cycling using pressure controls are listed in table 10. Thermostat 1 is for the second fan from the header end, Thermostat 2 for the third fan from the header end, etc. The fan(s) nearest the header end must run continuously, and cannot be cycled.

Table 8: Minimum Ambient with Fan Cycling Control

# of Fans Long	Design TD*	Minimum Ambient Temp. (°F)	
		Without Fan Speed Control	With Fan Speed Control
2	30	35	10
	25	45	23
	20	54	37
	15	63	50
	10	72	63
3	30	15	-16
	25	28	2
	20	40	19
	15	53	37
	10	65	55
4	30	-2	-25
	25	13	-15
	20	28	6
	15	44	27
	10	59	48
5	30	-17	-25
	25	1	-25
	20	19	-5
	15	36	19
	10	54	42
6	30	-25	-25
	25	-10	-25
	20	10	-14
	15	30	12
	10	50	38
7	30	-25	-25
	25	-19	-25
	20	3	-22
	15	24	6
	10	46	34

* Based on approximately 90°F condensing temperature.

Table 9: Recommended Fan Cycling Thermostat Settings

# of Fans Long	Design TD	Thermostat Setpoint (°F)					
		1	2	3	4	5	6
2	30	60					
	25	65					
	20	70					
	15	75					
	10	80					
3	30	47	60				
	25	54	65				
	20	61	70				
	15	69	75				
	10	76	80				
4	30	35	51	60			
	25	45	58	65			
	20	54	64	70			
	15	63	71	75			
	10	72	77	80			
5	30	25	43	53	60		
	25	36	51	60	65		
	20	47	59	66	70		
	15	57	67	72	75		
	10	68	74	78	80		
6	30	15	35	47	55	60	
	25	28	45	54	61	65	
	20	40	54	61	66	70	
	15	53	63	69	72	75	
	10	65	72	76	78	80	
7	30	6	28	41	50	56	60
	25	20	39	49	56	61	65
	20	34	49	57	63	67	70
	15	48	59	66	70	73	75
	10	62	69	74	77	79	80

* Thermostat setpoint is the temperature at which the fan(s) will shut off due to a fall in ambient temperature. Fan(s) will restart when the ambient temperature rises 3 to 4°F above the setpoint.

Table 10: Recommended Fan Cycling Pressure Control Settings

# of Fans Long	Design TD	Ref. Type	Differential (PSIG)	Pressure Switch Control Setpoints*, Cut-In 1 Cut-In (PSIG)	2 Cut-In (PSIG)	3 Cut-In (PSIG)	4 Cut-In (PSIG)	5 Cut-In (PSIG)	6 Cut-In (PSIG)
2	30	R-22	85	250					
		R-404A†	55	260					
		R-410A	50	325					
	20	R-22	65	230					
		R-404A†	35	240					
		R-410A	35	310					
	10	R-22	35	200					
		R-404A†	35	240					
		R-410A	35	310					
3	30	R-22	105	260	270				
		R-404A†	80	270	280				
		R-410A	75	340	350				
	20	R-22	75	230	240				
		R-404A†	50	245	255				
		R-410A	45	300	310				
	10	R-22	40	195	205				
		R-404A†	40	235	245				
		R-410A	35	300	310				
4	30	R-22	125	280	290	300			
		R-404A†	105	295	305	315			
		R-410A	140	395	405	415			
	20	R-22	105	260	270	280			
		R-404A†	85	275	285	295			
		R-410A	90	345	355	365			
	10	R-22	65	220	230	240			
		R-404A†	35	225	235	245			
		R-410A	80	335	345	355			
5	30	R-22	135	290	300	310	320		
		R-404A†	125	315	325	335	345		
		R-410A	155	410	420	430	440		
	20	R-22	120	275	285	295	305		
		R-404A†	95	285	295	305	315		
		R-410A	120	375	385	395	405		
	10	R-22	85	240	250	260	270		
		R-404A†	60	250	260	270	280		
		R-410A	45	300	310	320	330		
6	30	R-22	135	290	300	310	320	330	
		R-404A†	130	320	330	340	350	360	
		R-410A	175	430	440	450	460	470	
	20	R-22	125	280	290	300	310	320	
		R-404A†	115	305	315	325	335	345	
		R-410A	165	420	430	440	450	460	
	10	R-22	100	255	265	275	285	295	
		R-404A†	75	265	275	285	295	305	
		R-410A	80	335	345	355	365	375	
7	30	R-22	150	305	315	325	335	345	355
		R-404A†	150	340	350	360	370	380	390
		R-410A	165	420	430	440	450	460	470
	20	R-22	145	300	310	320	330	340	350
		R-404A†	140	330	340	350	360	370	380
		R-410A	160	415	425	435	445	455	465
	10	R-22	110	265	275	285	295	305	315
		R-404A†	95	285	295	305	315	325	335
		R-410A	105	360	370	380	390	400	410

* Setpoints shown will maintain a minimum of aproximately 90°F Condensing Temperature.

† For R-407A or C and R-507, use settings for R-404A.

Fan Speed Control Option

Available only with Fan Cycling Control Option

Designed to enhance the performance of the Fan Cycling Control Option by reducing the RPM and air volume of the lead (header end) fan motor(s) after all other (lag) fans have cycled off. The lead fan(s) must run continuously, even in the lowest ambient temperature. By reducing their CFM, adequate head pressure can be maintained at lower ambient temperatures without resorting to flooded condenser head pressure controls. This option includes a Johnson P66 or P266 Speed Controller, 24 volt transformer, single phase fan motor and pressure line piped from the last return bend in the circuit opposite the header end to the speed control. Double fan-width models require two controllers for the two lead fan motors. All components are factory mounted and wired. Controller decreases fan motor RPM as head pressure decreases. See Table 8 for minimum ambient temperatures for units with both the Fan Cycling Control Option and Fan Speed Control Option.

Flooded Condenser Option with Fan Cycling

Fan cycling control can also be used in conjunction with the Flooded Condenser Control Option to greatly reduce the required operating charge typical of flooded condenser operation. The additional charge needed for condensers equipped with the Fan Cycling and Flooded Condenser Controls operating in low ambient temperatures can be found in Table 11. For refrigerants other than R-404A or R-507, see correction factors in the footnotes.

Table 11: Additional Charge for Flooded Condensers with Fan Cycling at Low Ambient Temperatures, R-404A & R-507(Lbs.)

UNIT SIZE / MOTOR SPEED (RPM)				TOTAL SUMMER CHARGE (LBS.)	10° F DESIGN TD†				15° F DESIGN TD†				20° F DESIGN TD†				25° F DESIGN TD†				30° F DESIGN TD†			
SINGLE FAN-WIDTH UNITS					AMBIENT TEMP. (° F)				AMBIENT TEMP. (° F)				AMBIENT TEMP. (° F)				AMBIENT TEMP. (° F)				AMBIENT TEMP. (° F)			
1140	850	550	VSEC		40	20	0	-20	40	20	0	-20	40	20	0	-20	40	20	0	-20	40	20	0	-20
015, 019	016, 023	017	026	8.1	17.3	19.7	21.4	22.8	13.9	17.5	19.7	21.4	10.9	15.4	18.1	20.1	7.1	13.0	16.4	18.7	3.0	10.3	14.4	17.2
020, 028	017, 027	020	029	12.2	26.2	29.7	32.3	34.4	21.0	26.5	29.9	32.5	15.7	23.1	27.3	30.3	8.3	18.7	24.2	27.9	2.2	13.9	20.9	25.4
036	031	022	038	16.2	35.7	40.3	43.6	46.4	29.4	36.6	41.0	44.3	22.0	32.1	37.7	41.6	10.5	26.5	33.9	38.7	2.2	20.5	30.2	36.0
041	039	028	044	18.3	35.7	42.2	46.5	49.9	24.2	35.2	41.4	45.8	8.1	25.6	34.8	40.8	0.0	13.3	26.3	34.5	0.0	3.7	16.5	26.8
050	049	032	051	24.3	48.0	56.8	62.6	67.1	28.8	46.3	55.2	64.4	4.6	30.0	45.1	54.0	0.0	10.0	29.7	43.4	0.0	0.3	13.5	29.3
053	051	037	054	24.4	43.3	53.6	60.1	65.0	20.0	41.2	51.5	58.3	0.0	22.2	39.6	49.7	0.0	5.1	23.7	38.4	0.0	0.0	9.5	25.1
065	058	043	066	32.4	56.4	71.6	80.5	87.1	0.4	31.7	60.5	73.8	0.0	14.1	43.7	61.8	0.0	0.0	15.2	38.2	0.0	0.0	0.0	16.1
077	069	050	080	50.9	75.7	108.0	125.6	137.9	0.0	19.8	68.6	100.7	0.0	8.6	43.5	76.7	0.0	0.0	9.7	35.4	0.0	0.0	0.0	10.5
081	077	052	083	69.6	83.3	139.4	165.3	182.6	0.0	6.7	54.7	118.0	0.0	0.0	24.8	69.5	0.0	0.0	0.0	16.8	0.0	0.0	0.0	0.0
096	092	062	098	83.5	37.4	143.6	185.2	210.0	0.0	10.8	72.7	138.5	0.0	0.0	2.2	34.1	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
124	114	071	127	97.4	7.2	127.0	197.8	233.4	0.0	0.0	35.5	108.4	0.0	0.0	0.0	12.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
DOUBLE FAN-WIDTH UNITS																								
047	048	043	034	16.2	34.6	39.3	42.8	45.6	27.9	34.9	39.4	42.8	21.8	30.8	36.2	40.2	14.3	26.1	32.7	37.4	6.0	20.6	28.9	34.4
054	052	040	048	24.4	52.4	59.5	64.6	68.7	42.0	53.0	59.9	65.0	31.4	46.1	54.6	60.7	16.6	37.4	48.5	55.9	4.4	27.8	41.9	50.9
066	059	044	055	32.4	71.5	80.7	87.3	92.7	58.8	73.2	82.0	88.6	44.0	64.3	75.3	83.2	21.0	52.9	67.9	77.5	4.4	41.0	60.4	71.9
080	082	076	056	36.6	71.5	84.4	93.1	99.9	48.4	70.3	82.8	91.6	16.3	51.1	69.7	81.6	0.0	26.5	52.5	68.9	0.0	7.5	32.9	53.7
099	101	091	064	48.6	96.0	113.7	125.2	134.3	57.6	92.6	110.4	128.7	9.1	60.1	90.2	108.0	0.0	19.9	59.5	86.7	0.0	0.6	27.1	58.7
108	109	103	074	48.8	86.6	107.2	120.2	130.0	40.0	82.3	102.9	116.6	0.0	44.4	79.1	99.5	0.0	10.1	47.4	76.8	0.0	0.0	19.1	50.2
132	134	118	086	64.8	112.8	143.1	161.0	174.2	0.8	63.4	121.0	147.6	0.0	28.3	87.5	123.7	0.0	0.0	30.5	76.4	0.0	0.0	0.0	32.2
154	156	138	100	101.7	151.4	216.0	251.1	275.9	0.0	39.5	137.2	201.4	0.0	17.2	87.0	153.5	0.0	0.0	19.3	70.8	0.0	0.0	0.0	21.1
162	163	155	104	139.2	166.6	278.8	330.6	365.2	0.0	13.4	109.3	235.9	0.0	0.0	49.5	139.0	0.0	0.0	0.0	33.6	0.0	0.0	0.0	0.0
193	195	183	124	167.0	74.7	287.3	370.3	420.0	0.0	21.6	145.4	277.0	0.0	0.0	4.5	68.2	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
247	250	228	142	194.8	14.4	253.9	395.5	466.8	0.0	0.0	71.1	216.8	0.0	0.0	0.0	24.1	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0

† Based on 90° F condensing temperature.

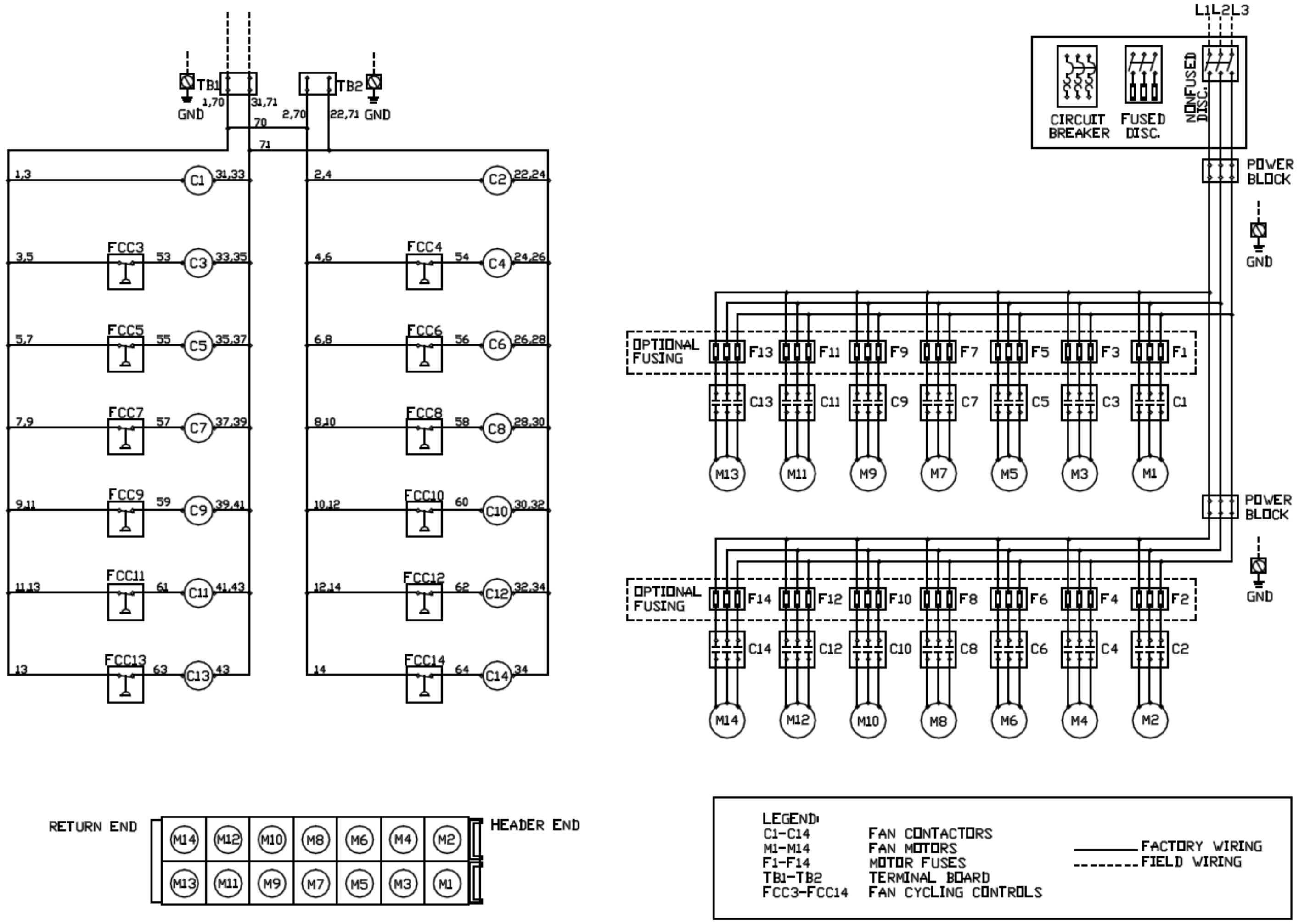
* For R-22, multiply by 1.13.

* For R-134A, multiply by 1.15.

* For R-410A, multiply by 1.02.

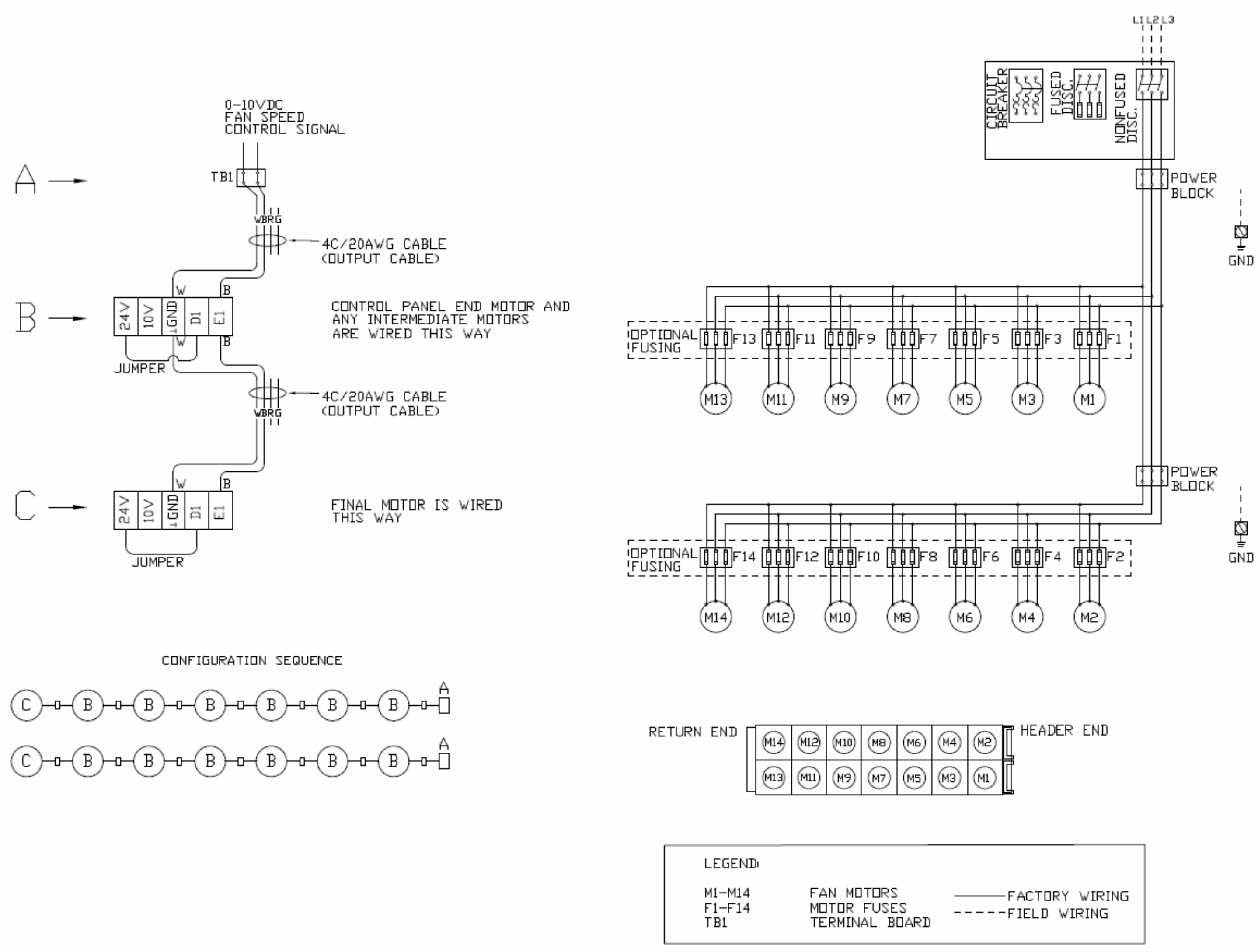
* For R-407A or R-407C, multiply by 1.09.

WIRING DIAGRAMS



*FCC3 – FCC14 are only present in units with the Fan Cycling Control Option, and can be either ambient temperature controls or pressure controls.

Figure 9: Typical Wiring Diagram with Optional Fan Cycling Control



* When splitting controls are used, odd numbered motors are all season and even numbered motors are split season.
* Reverse acting, parallel control signal circuit shown.

Figure 10: Typical Variable Speed EC Motor Diagram

START-UP PROCEDURE

Before starting the refrigeration system, check the following items:

1. Make sure the condenser is wired as shown in the Field Wiring section of this bulletin and in accordance with applicable codes and local ordinances.

2. Make sure all electrical connections are tight.

3. Make sure the piping to the condenser is in accordance with the Refrigerant Piping information section of this bulletin and good piping practice.

4. Make sure all motors are mounted securely and all fan setscrews are tight.

5. Make sure all fans rotate freely.

6. Make sure the unit is located so that it has free access for proper air flow, see the Unit Location section of this bulletin.

7. After start-up, make sure all fans are rotating in the proper direction. Fans should draw air through the coil.

MAINTENANCE

General

Air-Cooled Condensers require very little maintenance. Keeping the coil surface clean and free of debris is important for extended life, peak performance, and corrosion resistance. It is also important to periodically check all electrical connections to make sure they are secure. All motors have permanently sealed ball bearings which do not require any maintenance.

Condenser coils should be cleaned every three months in coastal or industrial environments and every six months in all other environments. We recommend applying clean water from a garden hose with a spray wand to the outlet side of the coil, after using a soft-bristle brush or vaccuum cleaner to remove dirt or other fibrous material.The use of high velocity water or compressed air could bend the coil surface, resulting in a decrease in performance. If a cleaning agent is used, make sure it is non-acidic or non-caustic. If the coil is coated, make sure the cleaner is compatible with the coating.

"Flip-Top" Units

Cleaning the coil or servicing the fans or motors is easier on units provided with hinged "flip-top" fan panels because they can be raised by removing five bolts with self-retained nuts. The panels are hinged and provided with pivoting rods that hold them securely in the upright position. With the panels raised, the coil can be cleaned by washing it down from the top. Also, access to the fans and motors is greatly improved.

REPLACEMENT PARTS

Table 12: Replacement Motors, Blades, and Guards

Motor Data					Motor Mount	Fan Data*		Fan Guard
RPM	Size	Voltage	Notes	Part No.		Dia. (in.)	Part No.	
1140	1.5 HP	208-230/460/3		110204000	08522568	30	08221151	08397044
		575/3		118570001	08522568	30	08221151	08397044
		208-230/460/3	Totally Enclosed	08216154	08522568	30	08221151	08397044
	1.0 HP	208-230/460/1	Use with P66	08216098	08522568	30	08221180	08397044
	0.5 HP	208-230/460/3	Totally Enclosed	08216068	08519019	22	08221023	08397012
		208-230/460/1	Totally Enclosed	08216081	08519019	22	08221023	08397012
	1/3 HP	208-230/3		08216106	08397056	22	08221154	08397012
						18	08221076	08397011
		460/3		08216107	08397056	22	08221154	08397012
						18	08221076	08397011
		208-230/1	Use with P66	08216008	08397056	22	08221154	08397012
						18	08221076	08397011
				205051004	08397056	22	08221154	08397012
						18	08221076	08397011
		460/1	Use with P66	08216009	08397056	22	08221154	08397012
						18	08221076	08397011
850	1.5 HP	208-230/460/3		08216100	08522568	30	08221152	08397044
	1.0 HP	208-230/460/3		114105000	08522568	30	08221151	08397044
		380/3		114105001				
		575/3		114105002				
	1/4 HP	208-230/460/3		08216075	08519019	22	08221023	08397012
					08519022	18	08221022	08397011
		208-230/460/1		08216076	08519019	22	08221023	08397012
					08519022	18	08221022	08397011
550	1/3 HP	208-230/460/3		119226000	08522568	30	08221152	08397044
							08221181	08518318
							121424000	
VSEC (900 max.)	1.44 kW	460/3	Fan/Motor Assembly	08216161	-	-	-	-
		208-230/3	Fan/Motor Assembly	08216160	-	-	-	-

Service Record

Date	Maintenance Performed	Components Required

Part # 08499024

NOTES