



# ***Polar - Flo Heavy Duty Unit Cooler***

Installation  
Operation  
Maintenance  
Information

***August, 2003***

Models: P•U, P•L, P•M, & PAH  
1 Thur 6 Fans  
Air, Electric, & Hot Gas Defrost

## **Table of Contents**

Inspection.....	2
General Safety Information.....	2
Installation	
Piping Considerations.....	2-4
Expansion Valve Selection And Installation.....	5
Unit Cooler (Internal) Wiring Diagrams.....	6-8
Typical Field Wiring — Sequence of Operations	
General Information.....	9
Air Defrost.....	9
Hot Gas Defrost.....	10
Electric Defrost.....	11-13
Start-Up Procedure.....	14
Maintenance.....	14
Troubleshooting Chart.....	15
Replacement Parts and Nomenclature.....	16



# INSPECTION

Equipment listed on the bill of lading but not received, along with any equipment damaged in transit, should be reported immediately to the carrier and a claim filed.

Also, check unit nameplates to make sure the voltage is correct before installing.

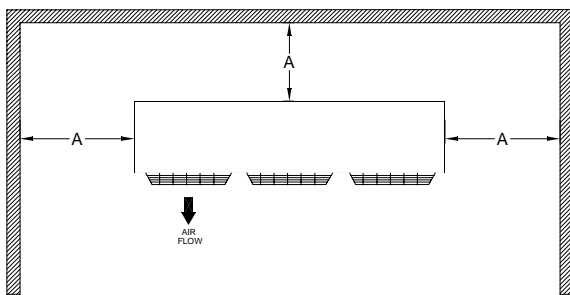
## GENERAL SAFETY INFORMATION

1. Installation and maintenance are to be performed by qualified personnel who are familiar with this type of equipment.
2. Make sure all field wiring conform to the equipment requirements and all applicable national and local codes.
3. Avoid contact with sharp edges and coil surface. They are a potential injury hazard.
4. Disconnect all power sources before performing service or maintenance.

## INSTALLATION

Our unit coolers are designed to draw air in through the coil and discharge it through the fans. For most efficient operation, units should be located so that air from an open door cannot be drawn directly into the coil.

FIGURE 1



A = 2.0 Ft. for P•U1-118 to 2-236; P•M1-164 to 2-329  
P•L1-125 to 2-304; UAH1-182 to 2-365  
A = 3.0 Ft. for P•U3-474 to 6-1620; P•L2-361 to 6-2070  
P•M2-390 to 6-2480; UAH2-433 to 6-2730

Figure 1 shows the air flow direction and recommended minimum clearances to walls or other obstructions.

All units, except single-fan type, are shipped upright as in the mounting position. Remove the top and sides of the crate from the unit leaving the unit sitting on the shipping skid. Using the fastener slot/holes in the unit mounting hangers as a guide, locate the mounting fasteners in the ceiling of the refrigerated room. 5/16" threaded rod is sufficient.

Single-fan units can be lifted into place by hand. All other units can be lifted into place by sliding the forks of a fork lift under the skid to avoid damage to the drain pan.

**IMPORTANT:** Hot Gas units must be mounted using the galvanized steel channel "Pitching Spacer" (one provided per unit) to allow proper drainage of condensate coming off the evaporator coil. The unit may be pitched toward either end since two drain connections are provided. The unused connection should be capped off with the plastic cap supplied. See the instructions attached to the "Pitching Spacer" channel.

### Drain Line

The condensate drain line should be at least 3/4" I.P.S. and should be installed with a minimum of 1/2" of slope per foot of horizontal run. Keep the length of drain line within the refrigerated space as short as possible. Provide a trap in the line outside of the refrigerated space. On freezer units, the drain line within the refrigerated space must be wrapped with heat tape and insulated to prevent water from freezing in the line during the defrost cycle.

### Refrigerant Piping

Install all refrigeration components in accordance with accepted piping practices. Liquid and suction lines should be sized according to ASHRAE recommendations for the intended conditions of operation.

All horizontal suction lines should be sloped toward the compressor at the rate of 1/8" per foot for good oil return. Vertical suction risers of more than five feet should be trapped with a P-Trap at the bottom.

### Hot Gas Piping

Hot Gas defrost systems can be described as either Re-Evap Type "H" (three-pipe) or Reverse Cycle Type "G" (two-pipe) types. Figures 2 and 3 represent typical piping arrangements for hot gas defrost units.

Hot Gas Defrost units may be ordered so that they are capable of operating on either of the two systems mentioned above. All units are equipped with a hot gas drain pan loop.

Re-Evap System — Uses three pipes as shown in Figure 2 - one for the liquid, one for the suction and one for the hot gas. In addition, a heat exchanger/re-evaporator is used at the suction line outlet of the evaporator. The hot gas is taken from the discharge line between the compressor and the condenser, through a hot gas solenoid valve, then to the evaporator drain pan loop. From there it enters the distributor at the side inlet then goes through the coil in the same direction as the normal refrigeration flow. The condensed refrigerant is trapped in the

Table 1: Liquid Line Selection

Line Size (O.D.)	Equiv. Lgth. (Ft.)	Unit Cooler Capacity BTUH	
		R-22	R-404A
3/8	25	48,000	25,000
	50	30,500	17,000
	100	18,000	10,000
	150	15,200	7,000
1/2	25	90,350	65,000
	50	61,450	42,000
	100	42,100	35,000
	150	33,650	30,000
5/8	25	165,100	125,000
	50	112,350	85,000
	100	76,800	68,000
	150	61,450	59,000
7/8	25	438,000	310,000
	50	299,150	215,000
	100	204,100	165,000
	150	163,100	125,000
1 1/8	25	750,000	625,000
	50	600,500	440,000
	100	180,000	275,000
	150	360,500	240,000

Table 2: Suction Line Selection

Line Size (O.D.)	Equiv. Lgth. (Ft.)	Unit Cooler Capacity — BTUH							
		R-22			R-404A				
		Suction Temperature °F			Suction Temperature °F				
		-20	0	20	-40	-20	0	20	
5/8	25	7,800	12,000	18,000	8,500	8,500	12,000	16,000	
	50	3,575	5,500	12,000	4,000	6,000	9,000	12,000	
	100	2,600	4,000	9,000	3,000	3,000	6,000	7,500	
	150	2,275	3,500	6,500	1,000	2,000	3,000	5,000	
7/8	25	16,835	25,900	48,000	19,500	17,000	28,000	35,000	
	50	11,700	18,000	30,200	11,000	15,000	20,000	28,000	
	100	9,880	15,200	24,100	9,500	1,000	15,000	19,500	
	150	7,865	12,100	18,200	8,000	6,000	1,100	14,000	
1 1/8	25	44,700	68,150	103,650	45,000	52,000	73,000	80,000	
	50	30,500	46,500	70,750	21,000	38,000	49,000	63,000	
	100	21,100	32,100	48,450	18,000	20,000	33,000	40,000	
	150	16,750	25,400	38,820	14,000	15,000	25,000	29,500	
1 3/8	25	77,350	118,550	180,750	67,000	75,000	110,000	130,000	
	50	53,000	81,000	124,120	55,000	60,000	85,000	98,000	
	100	36,200	55,120	84,100	45,000	37,000	55,000	70,000	
	150	29,500	44,350	67,150	29,000	33,000	42,000	55,000	
1 5/8	25	123,120	186,100	264,100	110,000	125,000	160,000	250,000	
	50	84,150	127,000	180,100	85,000	95,000	125,000	160,000	
	100	57,400	87,100	123,200	72,000	77,000	84,000	93,000	
	150	46,120	69,500	98,750	64,000	71,000	78,000	87,000	
2 1/8	25	257,100	391,100	597,000	220,000	250,000	325,000	450,000	
	50	175,000	267,100	408,100	125,000	175,000	230,000	335,000	
	100	120,100	182,100	278,120	110,000	125,000	175,000	235,000	
	150	96,150	146,100	223,110	88,000	96,000	135,000	180,000	
2 5/8	25	452,100	683,100	1,040,100	350,000	475,000	750,000	1,087,500	
	50	308,100	467,100	710,100	350,000	350,000	575,000	835,000	
	100	210,000	318,100	484,100	200,000	240,000	425,000	300,000	
	150	168,120	254,500	387,100	140,000	175,000	220,000	240,000	
3 1/8	25	698,100	1,120,100	1,660,100	550,000	750,000	975,000	1,490,000	
	50	477,100	762,100	1,351,500	320,000	600,000	785,000	1,140,000	
	100	325,120	520,100	774,120	250,000	300,000	575,000	851,000	
	150	260,100	416,500	620,150	210,000	225,000	350,000	475,000	

re-evaporator as it leaves the coil, there to be metered as a heavy vapor into suction line flow back to the compressor.

*Reverse Cycle* - Is a technique in which the hot gas flows backwards (i.e. opposite to the normal refrigerating flow) through the evaporator. Systems employing the reverse cycle principle are divided into two types:

Alternating Evaporator and Heat Pump systems.

*Alternating Evaporator System* — This is the system commonly referred to as “Reverse Cycle Defrost”. It must have multiple evaporator coils on the same system to operate.

Evaporator coils are defrosted in groups of one or more coils per group. 65% to 75% of the coils will continue to refrigerate while 25% to 35% are on defrost. The defrosting coils produce liquid refrigerant which is used to operate the coils which are still refrigerating.

The simplest design is a system with one condensing unit and three evaporator coils. One coil will defrost at a time, while the other two continue to refrigerate.

A hot gas line is run from the discharge line of the compressor close to the junction of the main suction line with the three individual suction lines. There the hot gas line branches into three hot gas lines. Each of these three lines has a hot gas solenoid valve; the leaving side of each solenoid valve is teed into one of the three branch suction lines. Each suction line has a suction-stop valve installed between the main suction line and the hot gas tee-in to keep hot gas from entering the main suction line to the compressor. In this way, each evaporator coil has a source for hot gas, controlled by its own defrost solenoid valve. A modular multi-circuit defrost timer is normally employed to synchronize the three defrosts.

The timer initiates defrost on a given coil, opening its hot gas solenoid (and closing its suction-stop valve), allowing hot gas to flow backwards through the suction line towards the coil. Utilizing the piping shown in Figure 3, the hot gas goes first to the drain pan loop of the unit, then into the suction inlet of the coil. As it leaves the coil, the condensed liquid flows through a bypass line around the expansion valve into the liquid line. It flows backwards through the branch liquid line until it reaches the main liquid line, where

it is re-introduced into the refrigerating part of the system. The main liquid line is made to operate at a lower pressure during defrost so that it will accept the liquid from the defrosting coil.

A much larger Alternating Evaporator system will still operate in much the same way. Such a system might have a larger compressor or a parallel compressor rack operating with many more evaporator coils than described above. Now there will be a *groups of coils* defrosting at once instead of just one. It is important, however, that no one defrost group is larger in refrigerating capacity than 25% to 35% of the total. A given hot gas line and solenoid valve will now service its evaporator group instead of only one evaporator.

**Heat Pump System** — It is not recommended for refrigeration defrost purposes.

**Table 3: Hot Gas Defrost Line Selection**  
Total Maximum Evaporator Capacity - Tons

Line Size	R-22		R-404A	
	Short	Long	Short	Long
1/2	1.5	1.0	1.3	0.8
5/8	2.8	2.0	2.5	1.5
7/8	7.0	5.0	6.0	3.5
1 1/8	16.0	11.0	13.0	9.0
1 3/8	23.0	17.0	21.0	15.0
1 5/8	40.0	27.0	30.0	23.0
2 1/8	76.0	52.0	66.0	44.0
2 5/8	145.0	100.0	130.0	80.0

NOTE: Short - Runs under 50 equivalent feet  
Long - Runs over 50 equivalent feet

Figure 2 - Re-Evap Type

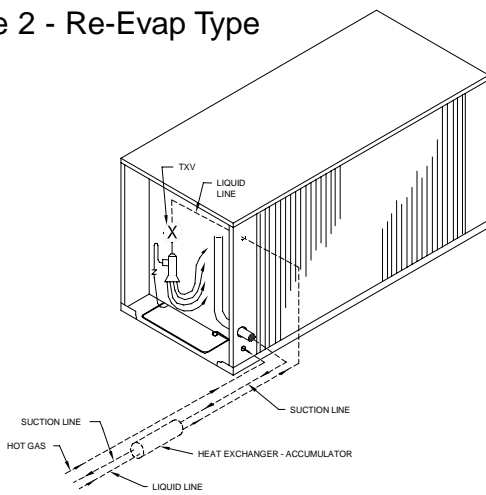
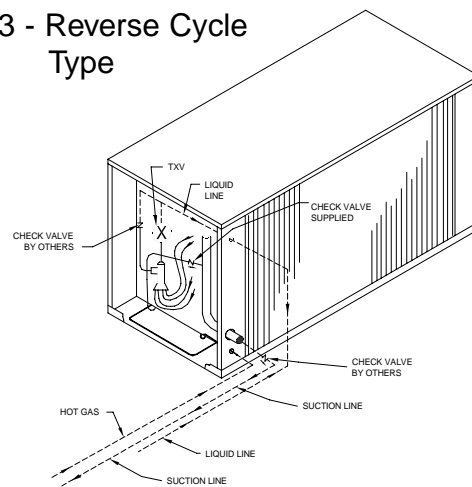
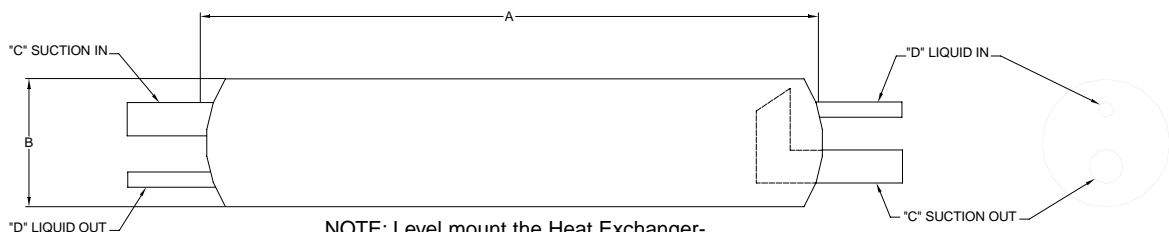


Figure 3 - Reverse Cycle Type



**HEAT EXCHANGER-ACCUMULATOR**



NOTE: Level mount the Heat Exchanger-Accumulator within refrigerator space as close to evaporator as possible.

EVAPORATOR CAPACITY	CAPACITY AND DIMENSIONS			
	MODEL NO.	A	B	D (OD)
UP TO 6,000	HEA-1A	9-3/4	5	7/8
6,000 TO 12,000	HEA-2A	15-3/4	5	1-1/8
12,000 TO 24,000	HEA-3A	27-3/4	5	1-3/8
24,000 TO 36,000	HEA-4A	37-3/4	5	1-5/8
36,000 TO 55,000	HEA-5A	45-3/8	6	2-1/8
55,000 TO 80,000	HEA-6A	64-3/8	6	2-5/8

**Expansion Valve Installation**

All units use an externally equalized type valve. See tables 4 and 5 for expansion valve selection. It may be desirable to use a pressure-limiting type expansion valve on low temperature systems to prevent possible overloading of the compressor on initial start-up or after defrost. Mount the valve directly on the distributor of the unit.

Locate the expansion valve bulb on a horizontal section of the suction line as close to the suction header as possible. If a P-Trap is installed, locate the expansion valve bulb between the trap and the unit. Make sure the surfaces of the suction line and bulb are clean and make good contact for the full length of the bulb when the bulb is mounted. Insulate the bulb to insure accurate superheat control.

**TABLE 4:**

**Expansion valve selection @ -20°F Suction Temperature**

Model	BTU/HR @ 10° TD	R-22		R-404A, 507	
		Sprolan	Alco	Sprolan	Alco
<b>Low Temperature Units — P•U</b>					
P*U1-118	12400	SBFVE-A-ZP40	HFESC-1-1/2-HW35	SBFSE-A-ZP	HFESC-1-1/4-SW45
P*U2-236	24700	SBFVE-B-ZP40	HFESC-2-1/2-HW35	SBFSE-C-ZP	HFESC-3-1/2-SW45
P*U2-355	37100	SBFVE-C-ZP40	HFESC-5-1/2-HW35	EBSSE-6-ZP	HFESC-3-1/2-SW45
P*U3-474	49500	SBFVE-C-ZP40	HFESC-5-1/2-HW35	EBSSE-7-1/2-ZP	HFESC-5-SW45
P*U4-711	72800	EBSVE-11-ZP40	HFESC-8-HW35	EBSSE-10-ZP	HFESC-10-SW45
P*U4-851	89000	(2) EBSVE-8-ZP40	(2) HFESC-5-1/2-HW35	(2) EBSSE-6-ZP	(2) HFESC-5-SW45
P*U4-1080	112900	(2) EBSVE-8-ZP40	(2) HFESC-5-1/2-HW35	(2) EBSSE-7-1/2-ZP	(2) HFESC-7-SW45
P*U5-1350	141000	(2) EBSVE-8-ZP40	(2) HFESC-8-HW35	(2) EBSSE-10-ZP	(2) HFESC-10-SW45
P*U6-1620	169400	(2) EBSVE-11-ZP40	(2) HFESC-10-HW35	(2) EBSSE-13-ZP	(2) HFESC-10-SW45
<b>Low Temperature Units — P•L</b>					
P*L1-125	11700	SBFVE-A-ZP40	HFESC-1-1/2-HW35	SBFSE-A-ZP	HFESC-1-1/4-SW45
P*L1-152	14200	SBFVE-A-ZP40	HFESC-1-1/2-HW35	SBFSE-A-ZP	HFESC-1-1/2-SW45
P*L1-193	18100	SBFVE-B-ZP40	HFESC-1-1/2-HW35	SBFSE-B-ZP	HFESC-2-SW45
P*L2-240	22400	SBFVE-B-ZP40	HFESC-1-1/2-HW35	SBFSE-C-ZP	HFESC-2-SW45
P*L2-304	28400	SBFVE-C-ZP40	HFESC-1-1/2-HW35	SBFSE-C-ZP	HFESC-3-1/2-SW45
P*L2-361	33800	SBFVE-C-ZP40	HFESC-1-1/2-HW35	EBSSE-6-ZP	HFESC-3-1/2-SW45
P*L2-408	38200	SBFVE-C-ZP40	HFESC-1-1/2-HW35	EBSSE-6-ZP	HFESC-3-1/2-SW45
P*L3-445	41600	SBFVE-C-ZP40	HFESC-1-1/2-HW35	EBSSE-6-ZP	HFESC-5-SW45
P*L3-540	50500	EBSVE-8-ZP40	HFESC-1-1/2-HW35	EBSSE-7-1/2-ZP	HFESC-5-SW45
P*L3-613	57300	EBSVE-8-ZP40	HFESC-1-1/2-HW35	EBSSE-7-1/2-ZP	HFESC-7-SW45
P*L3-660	61700	EBSVE-8-ZP40	HFESC-1-1/2-HW35	EBSSE-7-1/2-ZP	HFESC-7-SW45
P*L4-722	67500	EBSVE-8-ZP40	HFESC-1-1/2-HW35	EBSSE-10-ZP	HFESC-7-SW45
P*L4-817	76400	EBSVE-11-ZP40	HFESC-1-1/2-HW35	EBSSE-10-ZP	HFESC-10-SW45
P*L4-950	88900	(2) EBSVE-8-ZP40	(2) HFESC-5-1/2-HW35	(2) EBSSE-6-ZP	(2) HFESC-5-SW45
P*L4-1100	102900	(2) EBSVE-8-ZP40	(2) HFESC-5-1/2-HW35	(2) EBSSE-7-1/2-ZP	(2) HFESC-5-SW45
P*L4-1260	117800	(2) EBSVE-8-ZP40	(2) HFESC-5-1/2-HW35	(2) EBSSE-7-1/2-ZP	(2) HFESC-7-SW45
P*L4-1380	129000	(2) EBSVE-8-ZP40	(2) HFESC-8-HW35	(2) EBSSE-10-ZP	(2) HFESC-7-SW45
P*L5-1575	147300	(2) EBSVE-11-ZP40	(2) HFESC-8-HW35	(2) EBSSE-10-ZP	(2) HFESC-10-SW45
P*L5-1725	161300	(2) EBSVE-11-ZP40	(2) HFESC-8-HW35	(2) EBSSE-10-ZP	(2) HFESC-10-SW45
P*L6-1890	176700	(2) EBSVE-11-ZP40	(2) HFESC-10-HW35	(2) EBSSE-13-ZP	(2) HFESC-10-SW45
P*L6-2070	193500	(2) EBSVE-15-ZP40	(2) HFESC-10-HW35	(2) EBSSE-13-ZP	(2) HFESC-10-SW45

**TABLE 5:**

**Expansion valve selection @ +20°F Suction Temperature**

Model	BTU/HR @ 10° TD	R-22		R-404A, 507	
		Sprolan	Alco	Sprolan	Alco
<b>Medium Temperature Units — P•M</b>					
P*M1-164	16400	SBFVE-A-C	HFESC-1-1/2-HC	SBFSE-A-C	HFESC-1-SC
P*M1-209	20900	SBFVE-A-C	HFESC-1-1/2-HC	SBFSE-B-C	HFESC-1-1/4-SC
P*M2-270	27000	SBFVE-B-C	HFESC-2-HC	SBFSE-B-C	HFESC-1-1/2-SC
P*M2-329	32900	SBFVE-B-C	HFESC-2-1/2-HC	SBFSE-B-C	HFESC-2-SC
P*M2-390	39000	SBFVE-B-C	HFESC-2-1/2-HC	SBFSE-C-C	HFESC-3-1/2-SC
P*M2-441	44100	SBFVE-B-C	HFESC-3-HC	SBFSE-C-C	HFESC-3-1/2-SC
P*M3-583	58300	SBFVE-C-C	HFESC-5-1/2-HC	EBSSE-6-C	HFESC-3-1/2-SC
P*M3-662	66200	SBFVE-C-C	HFESC-5-1/2-HC	EBSSE-6-C	HFESC-5-SC
P*M4-780	78000	SBFVE-C-C	HFESC-5-1/2-HC	EBSSE-6-C	HFESC-5-SC
P*M4-882	88200	EBSVE-8-C	HFESC-5-1/2-HC	EBSSE-6-C	HFESC-7-SC
P*M4-1100	110000	EBSVE-8-C	HFESC-8-HC	EBSSE-7-1/2-C	HFESC-7-SC
P*M4-1320	132000	EBSVE-8-C	HFESC-10-HC	EBSSE-10-C	HFESC-10-SC
P*M4-1656	165600	EBSVE-11-C	HFESC-15-HC	EBSSE-13-C	HFESC-10-SC
P*M5-2065	206500	EBSVE-11-C	HFESC-15-HC	EBSSE-13-C	HFESC-13-SC
P*M6-2480	248000	EBSVE-15-C	HFESC-15-HC	OSE-21-C	TRAE-20-SC
<b>High Temperature Units — PAH</b>					
PAH1-182	18200	SBFVE-A-C	HFESC-1-1/2-HC	SBFSE-A-C	HFESC-1-1/4-SC
PAH1-232	23200	SBFVE-A-C	HFESC-1-1/2-HC	SBFSE-B-C	HFESC-1-1/2-SC
PAH2-300	30000	SBFVE-B-C	HFESC-2-HC	SBFSE-B-C	HFESC-2-SC
PAH2-365	36500	SBFVE-B-C	HFESC-2-1/2-HC	SBFSE-B-C	HFESC-3-1/2-SC
PAH2-433	43300	SBFVE-B-C	HFESC-3-HC	SBFSE-C-C	HFESC-3-1/2-SC
PAH2-490	49000	SBFVE-C-C	HFESC-3-HC	SBFSE-C-C	HFESC-3-1/2-SC
PAH3-530	53000	SBFVE-C-C	HFESC-3-HC	EBSSE-6-C	HFESC-3-1/2-SC
PAH3-648	64800	SBFVE-C-C	HFESC-5-1/2-HC	EBSSE-6-C	HFESC-5-SC
PAH3-736	73600	SBFVE-C-C	HFESC-5-1/2-HC	EBSSE-6-C	HFESC-5-SC
PAH4-866	86600	EBSVE-8-C	HFESC-5-1/2-HC	EBSSE-6-C	HFESC-5-SC
PAH4-980	98000	EBSVE-8-C	HFESC-8-HC	EBSSE-7-1/2-C	HFESC-7-SC
PAH4-1100	110000	EBSVE-8-C	HFESC-8-HC	EBSSE-7-1/2-C	HFESC-7-SC
PAH4-1452	145200	EBSVE-11-C	HFESC-10-HC	EBSSE-10-C	HFESC-10-SC
PAH4-1821	182100	EBSVE-11-C	HFESC-15-HC	EBSSE-13-C	HFESC-10-SC
PAH5-2275	227500	EBSVE-15-C	HFESC-15-HC	OSE-21-C	TRAE-20-SC
PAH6-2730	273000	EBSVE-20-C	HFESC-20-HC	OSE-21-C	TRAE-20-SC

# FACTORY WIRING — STANDARD UNIT COOLERS

## Air And Hot Gas Defrost

The following 3 pages show the standard factory (internal) wiring for Air, Hot Gas and Electric Defrost in both 230 and 460 volt configurations.

All standard heaters are delta wired for three phase.

All standard fan motors are PSC type single phase. (Inherent three phase motors are optional). one and two fan unit motors are wired single phase. Three-through six fan unit motors are wired three phase. Refer to back cover for determining number of fans using the model number nomenclature.

### Hot Gas Defrost

### Air Defrost

DIAGRAM 1 — 1 & 2 FAN UNITS

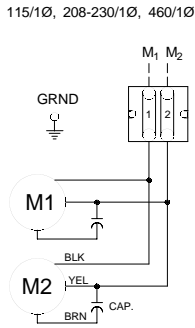


DIAGRAM 2 — 3 - 6 FAN UNITS

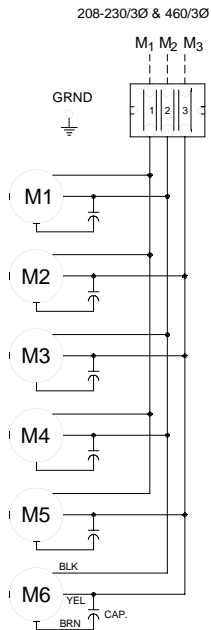


DIAGRAM 3 — 1 & 2 FAN UNITS

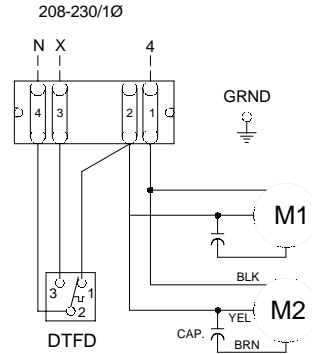


DIAGRAM 4 — 1 & 2 FAN UNITS

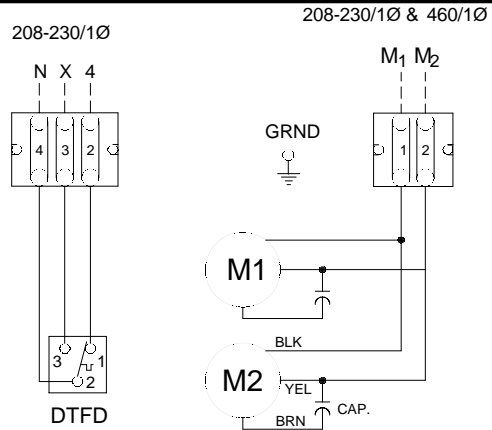
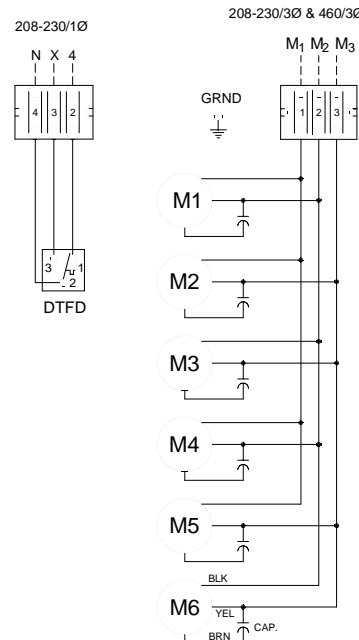


DIAGRAM 5 — 3 - 6 FAN UNITS



# FACTORY WIRING — STANDARD UNIT COOLERS

## Electric Defrost

### Fan and Defrost Control Circuits

### Defrost Heater Circuits

DIAGRAM 6 — 1 & 2 FAN UNITS

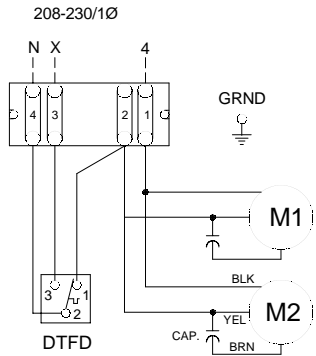


DIAGRAM 7 — 1 & 2 FAN UNITS

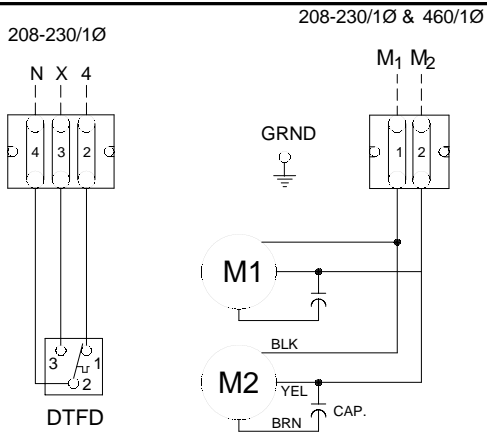


DIAGRAM 8 — 3 - 6 FAN UNITS

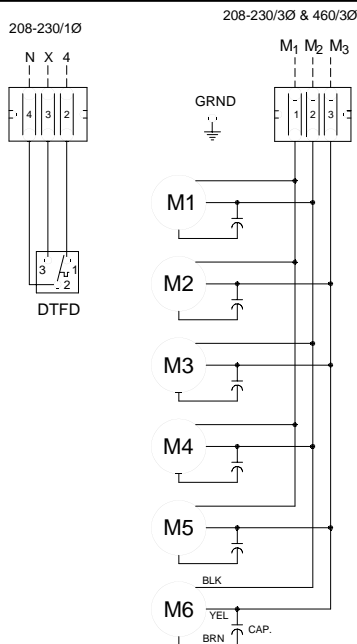


DIAGRAM 9 — 1,2, & 3 FAN UNITS

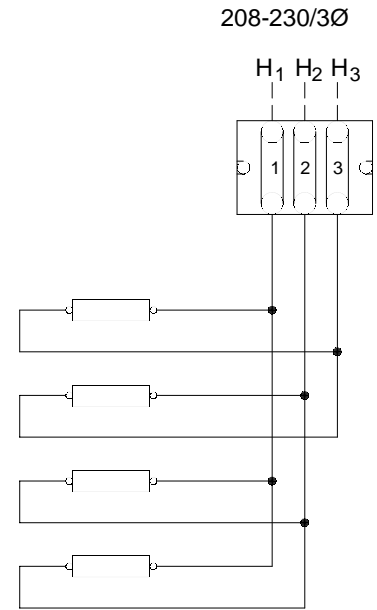
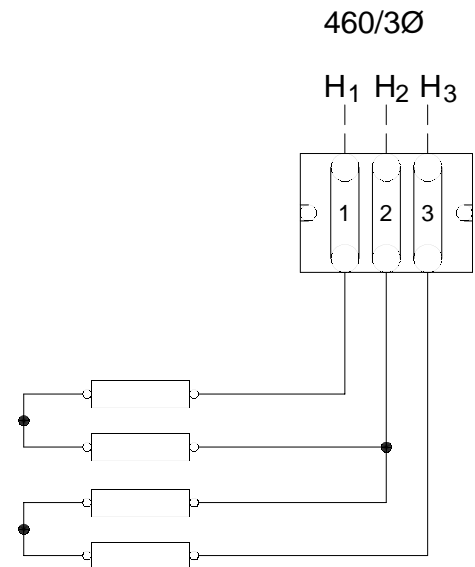


DIAGRAM 10 — 1,2, & 3 FAN UNITS



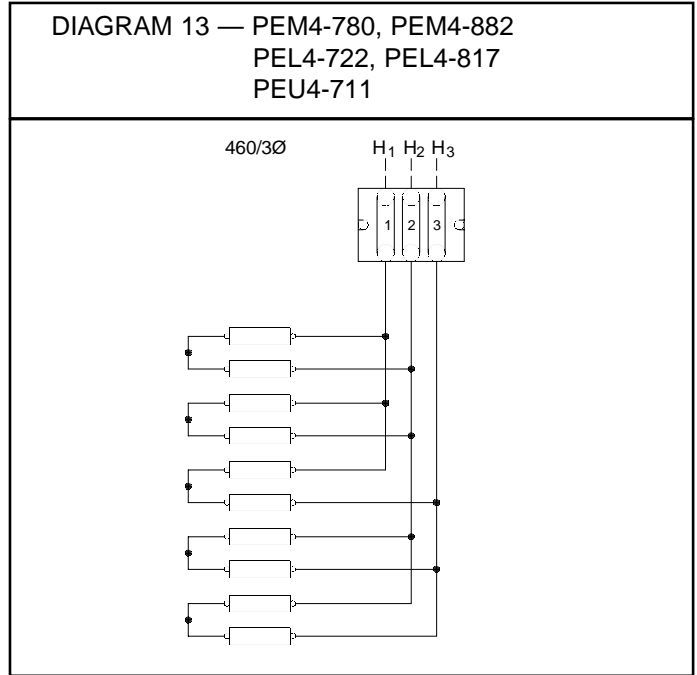
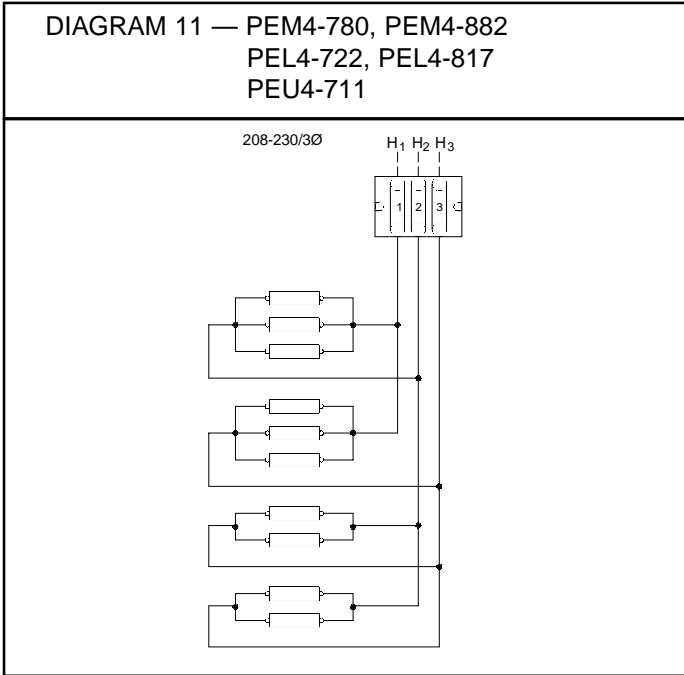
NOTE: See Diagrams 11 through 14 for 3 - 6 Fan Defrost Heater Circuits

# FACTORY WIRING — STANDARD UNIT COOLERS

## Electric Defrost

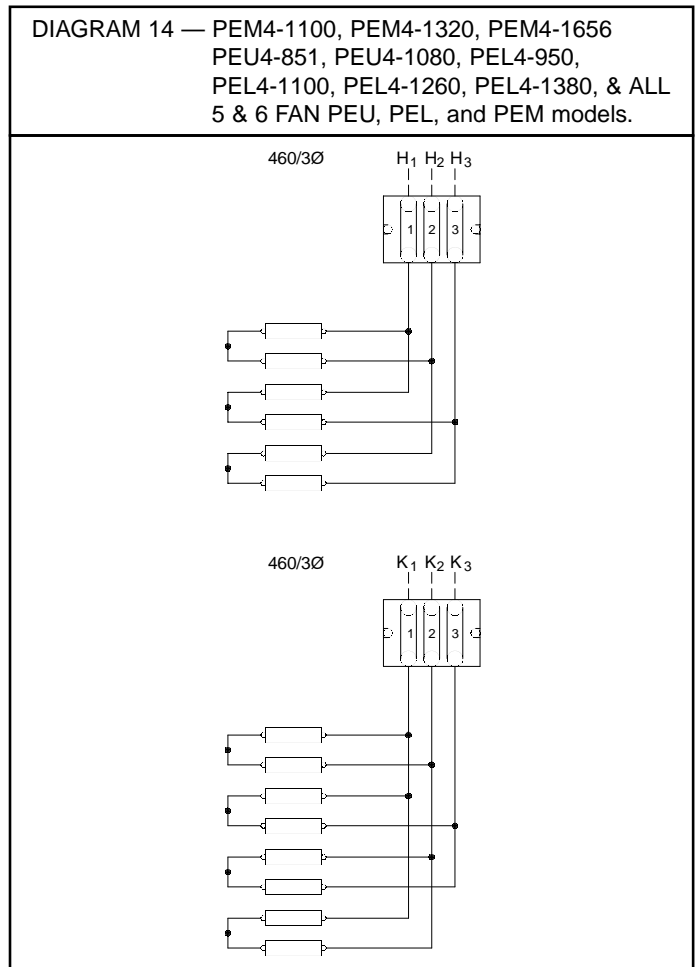
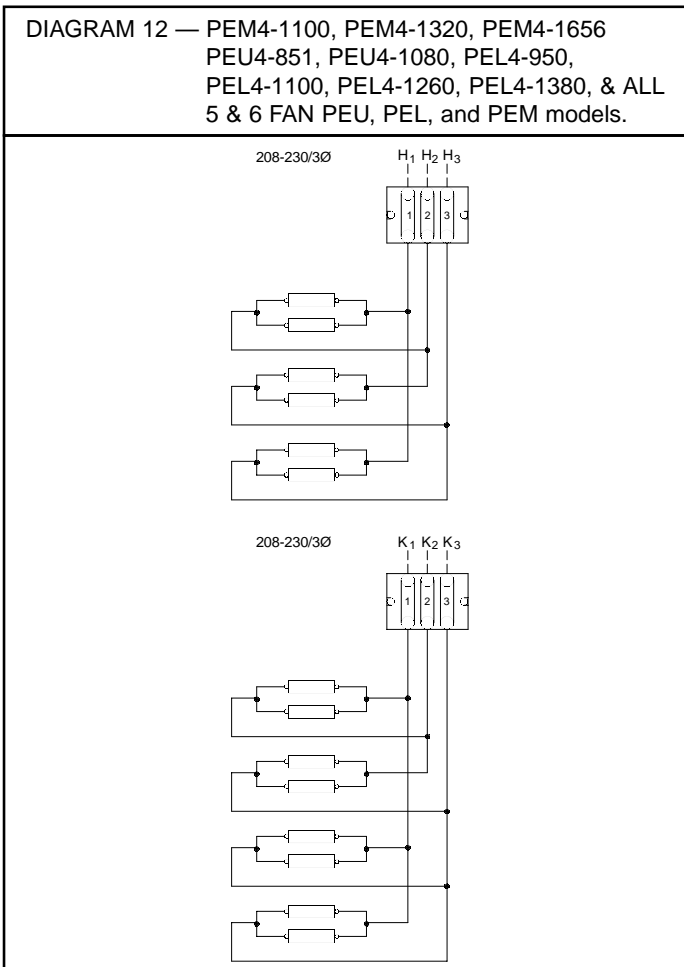
### Defrost Heater Circuits - 230/3

### Defrost Heater Circuits - 460/3



### Defrost Heater Circuits - 230/3

### Defrost Heater Circuits - 460/3





# TYPICAL FIELD WIRING — SEQUENCE OF OPERATION

## General Information

**IMPORTANT:** All wiring must be done in accordance with applicable codes and local ordinances. Refer to the unit cooler nameplate to determine the required ampacities of motor and heater circuits.

Note: The wiring diagrams on Page 9 to 13 are shown to provide visual support for the field wiring considerations and sequence of operations discussed below. They are generic relative to the high-side, showing only the defrost timer. *They do not represent as-built unit cooler wiring.* (e.g. the fan motors on a multi-fan unit are shown as one motor). Refer to pages 6 to 8 for details of internal unit cooler wiring. Refer to the back cover for the number of fans vs. model number.

The basic sequence of operation for electric defrost is given on Page 11 - all other electric defrost diagrams refer back to that sequence with exceptions noted.

### Wiring Legend

The following is a legend of the wiring symbols and designations used in diagrams 15 through 23.

°	Field terminal block connection
— —	Field wiring
--- ---	Phantom wiring shows alternate methods of terminating defrost - pressure control in condensing unit or thermostat in unit cooler.
HTRS "C"	Heater contactor
MTRS "C"	Fan Motor contactor
"S"	Solenoid
R1	Lockout relay
R2	Sequencing relay
R3	Sequencing relay

## Air Defrost

Air Defrost units will require the connection of power to the fan motor circuit.

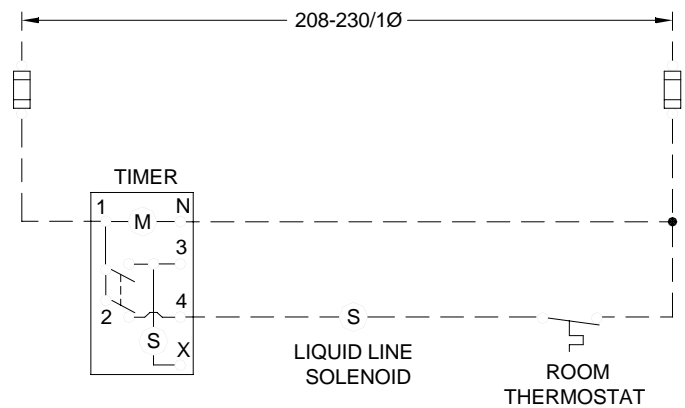
An air defrost system is wired so that the evaporator fans run continuously unless manually de-energized. Whenever the compressor stops, the room air (minimum +34 degrees) warms the coil to room temperature, melting the frost.

It is essential that the frost completely melts and drains each time the compressor cycles off. If it does not, a *partial air defrost* results, and the residual water and slush re-freeze into ice during the next run cycle. Ice removal usually requires manual defrost methods.

Adequate off-cycle (defrost) time is a function of system capacity. If the system is too small for the application, ice build-up will usually result. Use of an air defrost timer is sometimes successful on undersized systems in avoiding coil icing. A temporary loss of room temperature will occur during defrost.

Optional timers are available to assist in air defrost application.

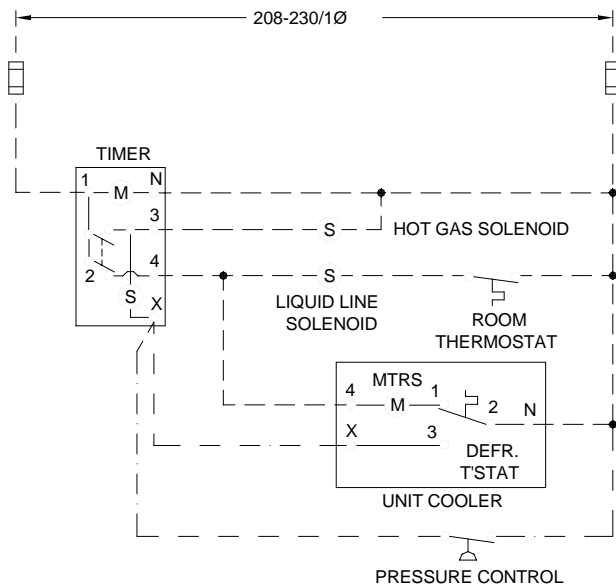
*Wiring Diagram 15 — Time Termination* is done by setting the fail-safe dial of the timer to the desired defrost duration.



# TYPICAL FIELD WIRING — SEQUENCE OF OPERATION

## Hot Gas Defrost — Re-Evap Type

*Wiring Diagram 16* — One and two fan units with single phase motor(s) wired for single phase.



**Normal Refrigeration** — The liquid line solenoid valve (LLS) receives power from terminal #4 of the defrost timer through the room thermostat. The thermostat will close on rise of room temperature, energizing the LLS, allowing refrigerant flow to the unit cooler. Pressure will build up in the low-side and the low pressure control (not shown) will close, starting the compressor.

The room thermostat will open when it reaches its cut-out set point, breaking power to the LLS. The LLS will close, stopping refrigerant flow to the unit cooler. The system will pump down and the compressor will stop.

**Defrost** — The defrost timer will switch to the defrost position at the preset time. Timer contact to terminal #4 will open, breaking power to the LLS and the unit cooler fan motor(s). Timer contact to terminal #3 will close at the same time, supplying power to the hot gas solenoid valve (HGS), allowing hot gas to flow to the unit cooler. A normally open solenoid valve installed in the discharge line to the condenser (not shown) is typically wired in parallel with the HGS.

**NOTE:** Both temperature and pressure terminations are shown in the same wiring diagram for the sake of brevity - only one would actually be employed. The pressure control would be eliminated for temperature termination - the field wire from terminal "X" on the unit cooler to terminal "X" on the timer would be eliminated on pressure termination.

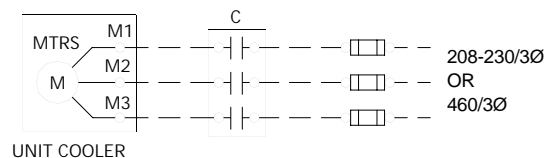
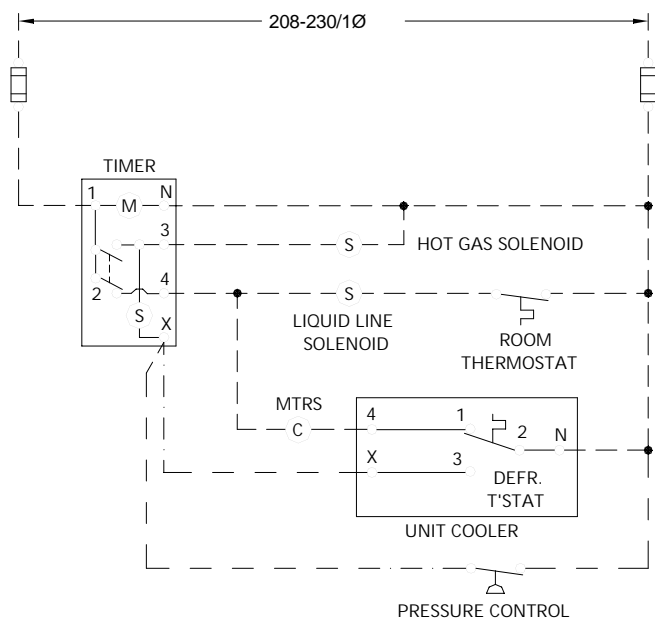
**Temperature Termination** — The Defrost Termination Fan Delay (DTFD) control installed in the unit cooler will sense the completion of defrost (recommended set point is 55°F) and close its contact 3-2, supplying

power to terminal "X" on the timer. The termination solenoid in the timer will switch the timer back into the normal (refrigerating) position, opening the contact to timer terminal #3 (de-energizing the HGS); and closing the contact to terminal #4 (energizing the LLS and bringing power to one side of the unit cooler fan motors).

**Pressure Termination** — The pressure control (by others) will sense the completion of defrost (recommended set point is the refrigerant pressure equivalent to 45°F) and close its contact, supplying power to terminal "X" on the timer. The balance of the termination sequence is identical to Temperature Termination above.

The system will begin to refrigerate without the unit cooler fans running. This prevents water droplets and steam from blowing into the room. The fan delay function of the DTFD will sense when the coil cools down to 25°F and will close contact 1-2, energizing the fan motors. Thus normal refrigeration is resumed.

*Wiring Diagram 17* — Three to six fan units with single phase motors delta-wired for three phase, and all 460 volt units.

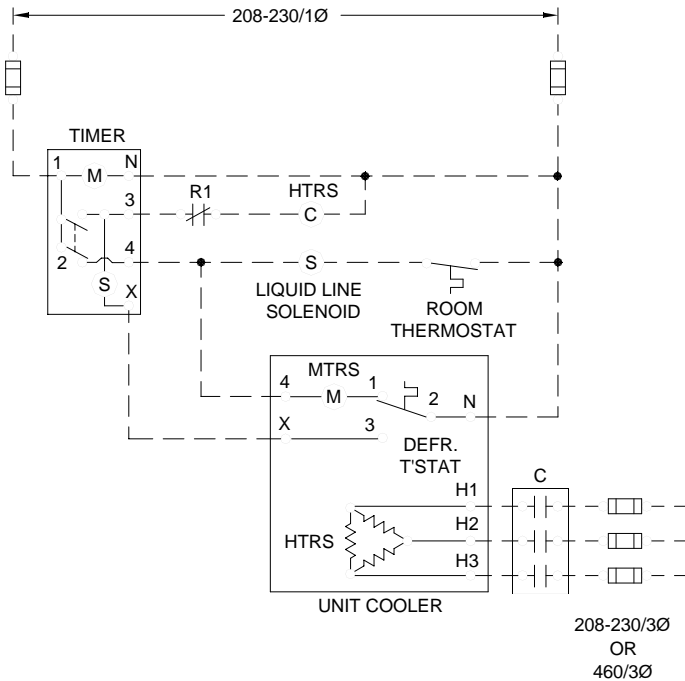


Identical to Diagram 16 except that terminal #4 on the defrost timer will supply power to the holding coil of (three phase) motor contactor instead of supplying power to the fan motors directly.

# TYPICAL FIELD WIRING — SEQUENCE OF OPERATION

## Electric Defrost

**Wiring Diagram 18** — One and two fan units with single phase motor(s) wired for single phase.



**Normal Refrigeration** — The liquid line solenoid valve (LLS) receives power from terminal #4 of the defrost timer through the room thermostat. The thermostat will close on rise of room temperature, energizing the LLS, allowing refrigerant flow to the unit cooler. Pressure will build up in the low-side and the low pressure control (not shown) will close, starting the compressor.

The room thermostat will open when it reaches its cut-out set point, breaking power to the LLS. The LLS will close, stopping refrigerant flow to the unit cooler. The system will pump down and the compressor will stop.

**Defrost** — The defrost timer will switch to the defrost position at the preset time. Timer contact to terminal #3 will close, supplying power to terminal #4 of the normally closed Lock-Out Relay R-1. The holding coil of R1 (not shown) is to be wired in parallel with the compressor contactor holding coil. R-1 will thereby remain open as long as the compressor is running, preventing the heaters from operating at the same time as the compressor. This eliminates the need for oversized wiring to the condensing unit. R-1 can also represent a normally closed auxiliary contact in the compressor contactor.

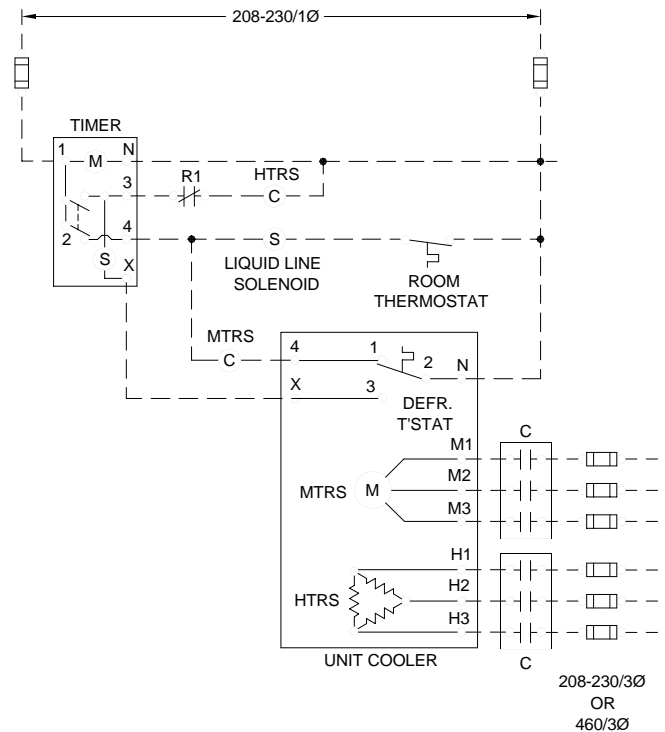
Timer contact to terminal #4 will open at the same time, breaking power to the LLS and the unit cooler fan motors. Refrigerant flow to the unit cooler will stop. The compressor will continue to run until the system pumps down on the low pressure control, stopping the compressor. Relay R-1 will close at that time,

energizing the holding coil of contactor for the defrost heaters. The defrost heaters will energize to defrost the coil.

**Temperature Termination** — The Defrost Termination Fan Delay (DTFD) control installed in the unit cooler will sense the completion of defrost (recommended set point is 55°F) and close its contact 3-2, supplying power to terminal "X" on the timer. The termination solenoid in the timer will switch the timer back into the normal (refrigerating) position, opening the contact to terminal #3 (de-energizing the heater contactor); and closing the contact to terminal #4 (energizing the LLS and bringing power to one side of the unit cooler fan motors). *Caution: Coolers warmer than 32°F are susceptible to partial air defrost resulting in ice build-up. Time termination may be required.*

The system will begin to refrigerate without the unit cooler fans running. This prevents water droplets and steam from blowing into the room. The fan delay function of the DTFD will sense when the coil cools down to 25°F and will close contact 1-2, energizing the fan motors. Thus normal refrigeration is resumed.

**Wiring Diagram 19** — Three to six fan units with 1-phase motors delta wired for 3-phase, and all 460 volts units.



Identical to Diagram 18 except that terminal #4 on the defrost timer will supply power to the holding coil of (three phase) motor contactor instead of supplying power to the fan motors directly.

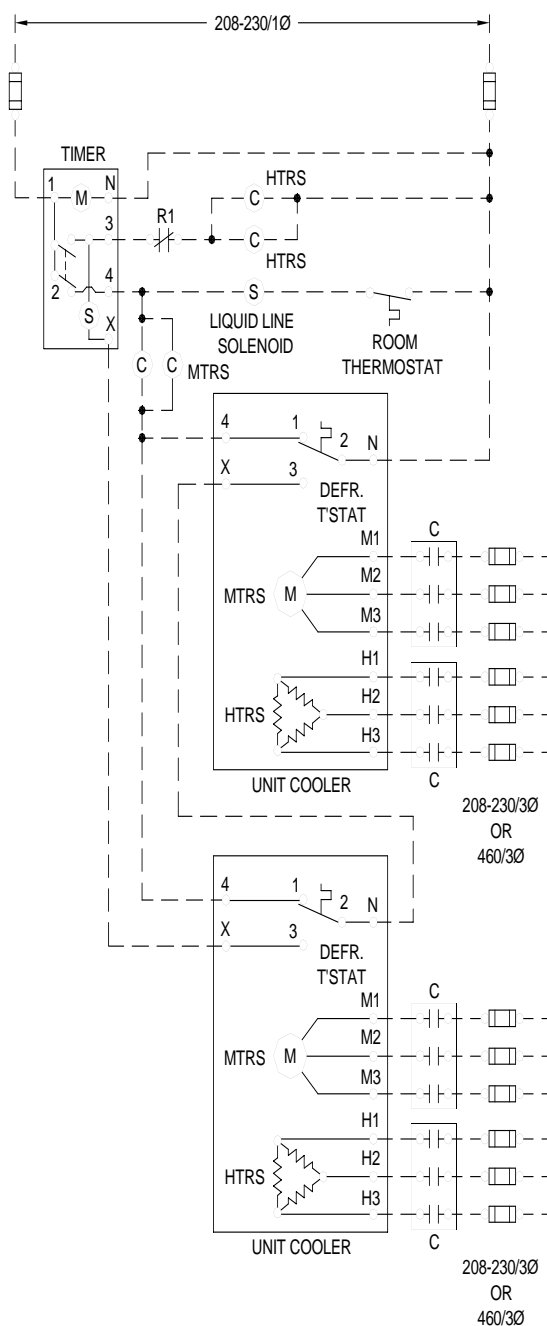
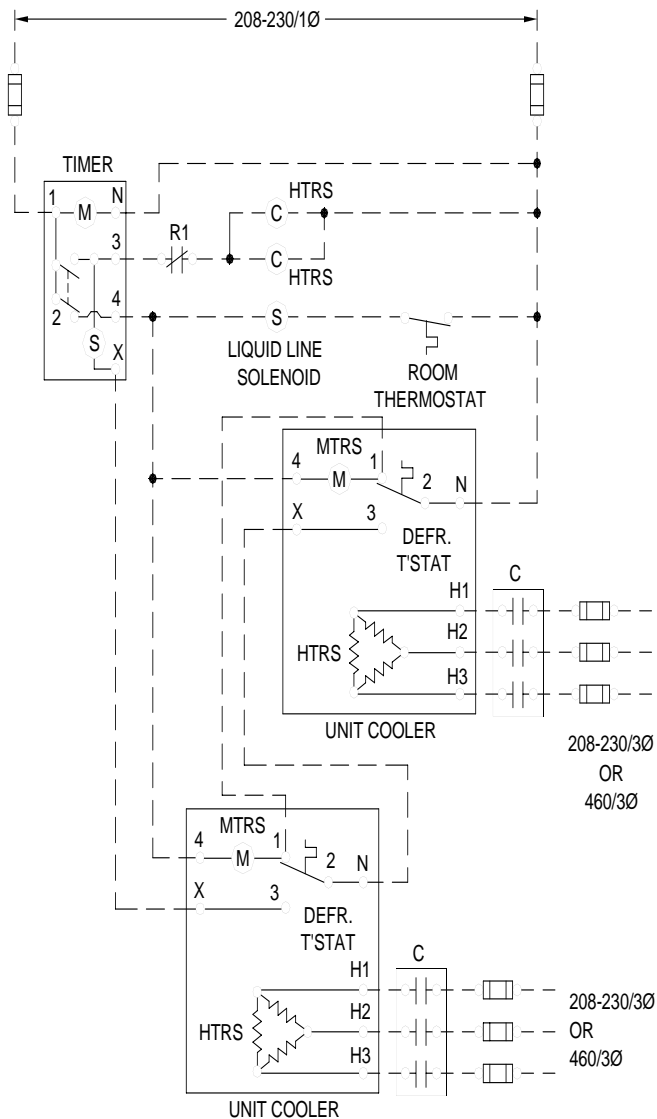
# TYPICAL FIELD WIRING — SEQUENCE OF OPERATION

## Electric Defrost

### Dual Unit Cooler Systems — Without Sequencing Relays

*Wiring Diagram 20* — One and two fan units with single phase motor(s) wired for single phase.

*Wiring Diagram 21* — Three to six fan units with single phase motors delta-wired for three phase, and all 460 volt units.



Sequence of operation is the same as Wiring Diagram 18, except:

1. DTFD contacts 3-2 are wired in series - both units coolers must terminate to terminate the timer.
2. The DTFD contact 1-2 for Unit B is not used - the fan delay function for both units is controlled by the fan delay on Unit A.
3. Each unit cooler is shown with its own defrost heater contactor with holding coils parallel. A single (large) contactor could be used.

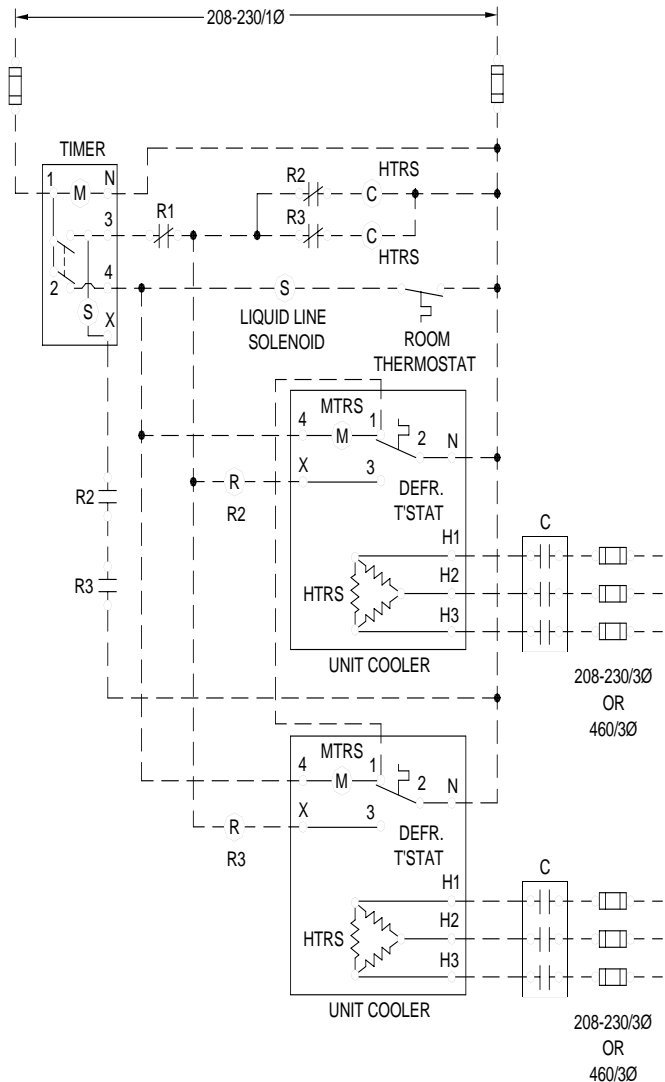
Identical to Diagram 20 except that each unit is shown with its own fan motor contactor, and terminal #4 on the defrost timer will supply power to the holding coils of those contactors instead of supplying power to the fan motors directly. A single (larger) contactor could be used.

# TYPICAL FIELD WIRING — SEQUENCE OF OPERATION

## Electric Defrost

### Dual Unit Cooler Systems — Without Sequencing Relays

*Wiring Diagram 22* — One and two fan units with single phase motor(s) wired for single phase.



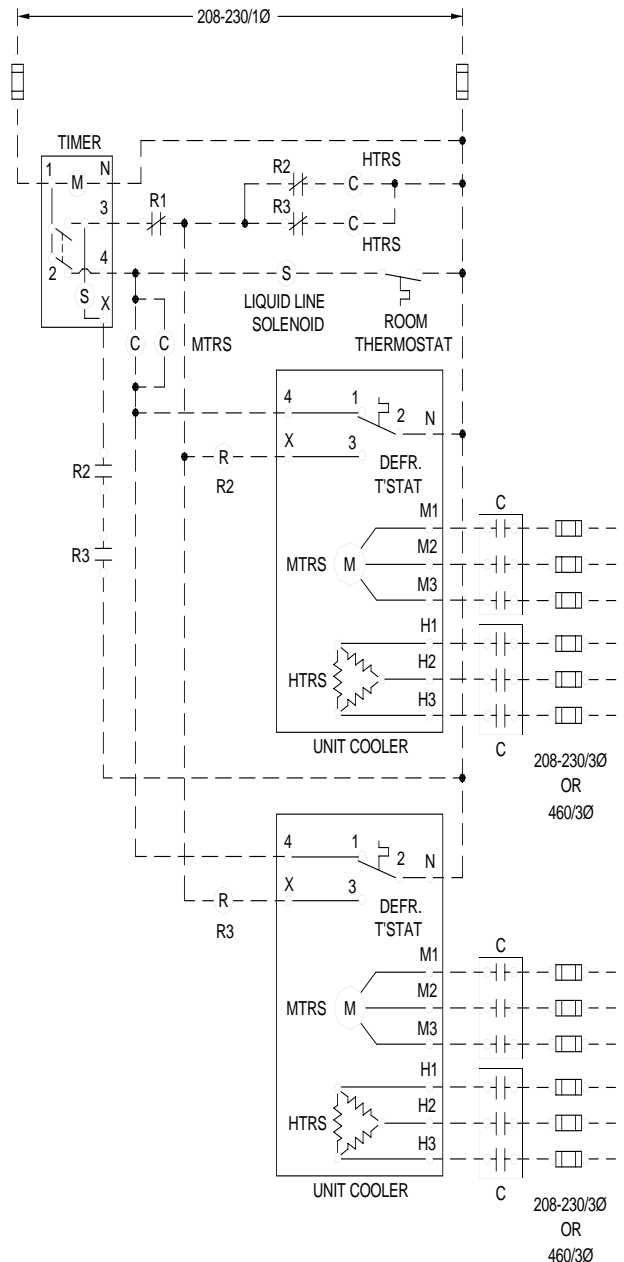
Identical to Wiring Diagram 20 except that termination is accomplished through sequencing relay R2 and R3.

The heater of one unit can de-energize when the coil is clean while the other unit can continue to defrost if required. This eliminates steaming of the unit that completes defrost first.

Unit A will energize R2 when it terminates. R2 normally closed (N.C.) contact will open, de-energizing heater contactor. R2 normally open (N.O.) contact closes. The timer cannot terminate, however, until *both* (N.O.) R2 and R3 contacts close they are wired in series to timer terminal "X".

Unit B continues defrost until termination temperature is reached. R3 will then energize - its (N.C.) contact opens (de-energizing M4) and its (N.O.) contact closes (bringing power to timer terminal "X") which terminates defrost.

*Wiring Diagram 23* — Three to six fan units with single phase motors delta-wired for three phase, and all 460 volt units.



Identical to Diagram 22 except that each unit has its own (three phase) fan motor contactor, and terminal #4 on the defrost timer will supply power to the holding coils of those contactors instead of supplying power to the fan motors directly.

# START-UP PROCEDURE

## System Check

Before starting the refrigeration system, check the following items:

1. The system is properly wired as shown in the diagrams in the Installation Section of this bulletin.
2. Make sure all electrical connections are tight.
3. Check that all piping is done as described in the Installation Section of this bulletin and in accordance with good piping practice.
4. All fan set screws are tight.
5. Make sure that the service valves on the compressor and receiver are open.
6. Set the unit so it is mounted securely and pitched properly. Pour water into drain pan to verify that the drain pan and drain line drain completely.
7. Make sure that the drain line is adequately heated.
8. Properly evacuate the system.
9. Follow proper procedures for handling and start-up of systems using polyol ester based lubricants.

## Initial Start-up

Check the following items after initial unit start-up:

1. After the initial start-up, the fans will not start until the coil temperature pulls down to about 25°F. The fans may cycle several times until the room temperature is pulled down.
2. Check the system for refrigeration charge and oil level.
3. Make sure that the expansion valve superheat is set correctly. It should be about 8° to 10°F
4. Check that the drain line heater is functioning properly.
5. During initial start-up it is not unusual to have very heavy frost loads. It may be necessary to manually initiate defrost cycles as needed until the moisture level in the room is reduced.
6. Observe the first defrost cycle to make sure that all system components are functioning properly. Check the amp draw of the defrost heaters to make sure that the defrost cycle is terminated by the termination thermostat and not by the "fail-safe" on the timer.

# MAINTENANCE

## General

Check unit at least once a month for proper defrosting. The amount and pattern of frosting can vary greatly. It is dependent on room temperature, product being stored, turnover of product, percentage of time the door is open and temperature and humidity conditions surrounding the room. It may be necessary to periodically to change the number or duration of defrost cycles.

At least once every six months, check the following items:

1. Tighten all electrical connections.
2. Tighten fan set screws.
3. Clean the coil surface.
4. Check the system refrigerant charge and oil level.
5. Make sure the defrost controls are functioning properly.
6. Clean the drain pan and check the drain pan and drain line for proper drainage.
7. Check the drain line heaters for proper operation.

## Fan and Motor Replacement

**WARNING:** Make sure all electrical power to the unit is disconnected before replacing fans or motors.

The fan may be removed as follows:

1. Remove the four screws that hold the fan guard in place and remove guard.
2. Loosen the set screw(s) in the fan blade.
3. Remove fan.

The motor may be removed as follows:

1. Remove fan per above procedures.

2. Disconnect motor leads in motor junction box.
3. Remove the 2 bolts that hold the motor in its mounting bracket.
4. Remove motor.
5. Re-install by reversing the above procedures.

## Defrost Heater Replacement

**WARNING:** Shut off all electrical power to the unit before replacing the heater(s).

1. Disconnect the leads in the electrical junction box of the heater to be replaced.
2. *To replace a coil heater:* Lower the hinged drain pan; remove the clips that hold the heater to the coil; remove the heater.
3. *To replace a coil heater - 3 fan units & smaller:* Open the end compartment at the end opposite the refrigerant connections and disconnect the heater from the retaining clips.  
*To replace a coil heater - 4 fan units & larger:* Same as smaller units except that the retaining clips are located at the refrigerant connection end.  
*460 volt units:* The heaters are wired in series and will have to be separated at the connection.
4. Slide the heater out from the refrigerant connection end of the coil. *A minimum of 12" clearance must be provided to remove the heater.*
5. Replacement heaters for the coil may be sent coiled up. TO install, simply push the heater into the coil - it will straighten as it slides in.
6. The rest of the installation can be completed by reversing the above procedures.

# TROUBLESHOOTING CHART

<i>Symptoms</i>	<i>Possible Causes</i>	<i>Corrective Action</i>
Fan(s) will not operate.	<ol style="list-style-type: none"> <li>1. Main switch open.</li> <li>2. Blown fuses.</li> <li>3. Defective motor(s)</li> <li>4. Defective timer or defrost thermostat.</li> <li>5. Unit in defrost cycle.</li> <li>6. Defrost thermostat bulb not sensing coil temperature.</li> </ol>	<ol style="list-style-type: none"> <li>1. Close switch</li> <li>2. Replace fuses. Check for short circuits or overload conditions.</li> <li>3. Replace motor(s)</li> <li>4. Replace defective component.</li> <li>5. Wait for completion of cycle.</li> <li>6. Make sure bulb is properly positioned so it senses the coil return bend temperature.</li> </ol>
Room temperature too high.	<ol style="list-style-type: none"> <li>1. Room thermostat set too high.</li> <li>2. Superheat too high.</li> <li>3. System low on refrigerant.</li> <li>4. Coil iced-up.</li> </ol>	<ol style="list-style-type: none"> <li>1. Adjust thermostat.</li> <li>2. Adjust thermal expansion valve.</li> <li>3. Add refrigerant.</li> <li>4. Manually defrost coil. Check defrost controls for malfunction.</li> </ol>
Defrost heaters will not operate.	<ol style="list-style-type: none"> <li>1. Main switch open.</li> <li>2. Blown fuses.</li> <li>3. Defective heater(s).</li> <li>4. Defective timer.</li> </ol>	<ol style="list-style-type: none"> <li>1. Close switch.</li> <li>2. Replace fuses. Check for short circuits or overload conditions.</li> <li>3. Replace heater(s).</li> <li>4. Replace timer.</li> </ol>
Coil not clearing frost during defrost cycle.	<ol style="list-style-type: none"> <li>1. Defective heater(s).</li> <li>2. Not enough defrost cycles per day.</li> <li>3. Defrost cycle too short.</li> <li>4. Defective defrost thermostat.</li> <li>5. Defrost thermostat bulb not sensing coil area that is not clearing.</li> <li>6. Fail-safe on timer set too short.</li> </ol>	<ol style="list-style-type: none"> <li>1. Replace heater(s).</li> <li>2. Adjust timer for more defrost cycles.</li> <li>3. Adjust defrost thermostat for longer cycles.</li> <li>4. Replace thermostat.</li> <li>5. Relocate bulb.</li> <li>6. Lengthen fail-safe time setting - do not exceed 40 minutes.</li> </ol>
Ice accumulating in drain pan.	<ol style="list-style-type: none"> <li>1. Defective heater.</li> <li>2. Unit not pitched properly.</li> <li>3. Drain plugged.</li> <li>4. Defective drain line heater.</li> </ol>	<ol style="list-style-type: none"> <li>1. Replace heater.</li> <li>2. Check and adjust if necessary.</li> <li>3. Clean drain.</li> <li>4. Replace heater.</li> </ol>
Units stays in prolonged defrost cycle.	<ol style="list-style-type: none"> <li>1. Defective timer or thermostat.</li> <li>2. Defrost thermostat set for termination temperature that is too high.</li> <li>3. Fail-safe on timer set too long.</li> </ol>	<ol style="list-style-type: none"> <li>1. Replace defective component.</li> <li>2. Adjust thermostat for lower setting.</li> <li>3. Shorten fail-safe setting.</li> </ol>

# REPLACEMENT PARTS

## POLAR - FLO — MODELS P\*U, P\*L, P\*M, PAH

MODEL NUMBER	DESCRIPTION	PART #s
ALL MODELS	DEFROST CONTROL, ADJUSTABLE, RANCO F-25	204464037
ALL 1 FAN MODELS	DEFROST HEATERS, CORE, 1378 WATTS, 40" LENGTH, 208-230/460 V. (4 REQ'D)	206240003
	DEFROST HEATERS, CORE, 1378 WATTS, 40" LENGTH, 575 V. (4 REQ'D)	206240025
ALL 2 FAN MODELS	DEFROST HEATERS, CORE, 2458 WATTS, 70" LENGTH, 208-230/460 V. (4 REQ'D)	206240004
	DEFROST HEATERS, CORE, 2458 WATTS, 70" LENGTH, 575 V. (4 REQ'D)	206240026
ALL 3 FAN MODELS	DEFROST HEATERS, CORE, 3538 WATTS, 100" LENGTH, 208-230/460 V. (4 REQ'D)	206240005
	DEFROST HEATERS, CORE, 3538 WATTS, 100" LENGTH, 575 V. (4 REQ'D)	206240027
PEU4-711, PEL4-817, PEL4-722	DEFROST HEATERS, CORE, 2305 WATTS, 132" LENGTH, 208-230/460 V. (8 REQ'D)	206240002
PEM4-780, PEM4-882	DEFROST HEATERS, CORE, 2305 WATTS, 132" LENGTH, 575 V. (8 REQ'D)	206240024
PEU4-851, PEU4-1080, PEL4-950, PEL4-1100,	DEFROST HEATERS, CORE, 2305 WATTS, 132" LENGTH, 208-230/460 V. (12 REQ'D)	206240002
PEL4-1260, PEL4-1380, PEM4-1100	DEFROST HEATERS, CORE, 2305 WATTS, 132" LENGTH, 575 V. (12 REQ'D)	206240024
PEM4-1320, PEM4-1656		
PEU5-1350, PEL5-1575	DEFROST HEATERS, CORE, 2837 WATTS, 162" LENGTH, 208-230/460 V. (12 REQ'D)	206240017
PEL5-1725, PEM5-2065	DEFROST HEATERS, CORE, 2837 WATTS, 162" LENGTH, 575 V. (12 REQ'D)	N/A
PEU6-1620, PEL6-1890	DEFROST HEATERS, CORE, 3369 WATTS, 192" LENGTH, 208-230/460 V. (12 REQ'D)	206240018
PEL6-2070, PEM6-2480	DEFROST HEATERS, CORE, 3369 WATTS, 192" LENGTH, 575 V. (12 REQ'D)	N/A
ALL MODELS	DEFROST HEATER, DRAIN PLUG, 27 WATTS, 208-230/460 V.	107807003

### FOLLOWING DRAIN PAN HEATERS ARE FOR UNITS PRODUCED AFTER JULY 31, 1995\*\*

1-3 FAN MODELS*	NOT AVAILABLE	N/A
4 FAN MODELS	DRAIN PAN HEATER, 133-1/2" LENGTH, SPEC. MOD# AND S/N. ( 2 REQ. ), 540 WATTS	115098000
5 FAN MODELS	DRAIN PAN HEATER, 163-1/2" LENGTH, SPEC. MOD# AND S/N. ( 2 REQ. ), 660 WATTS	115099000
6 FAN MODELS	DRAIN PAN HEATER, 196-1/2" LENGTH, SPEC. MOD# AND S/N. ( 2 REQ. ), 780 WATTS	115100000

### FOLLOWING FAN BLADES ARE FOR UNITS PRODUCED AFTER APRIL 1, 1990.

P*U1-118, P*U2-236, P*L1-125	FAN BLADES, 20" DIAM., 23° PITCH, CCW , 1/2" BORE	202147008
P*L1-152, P*L1-193, P*L2-240, P*L2-304		
P*U2-355, P*L2-361, P*L2-408,	FAN BLADES, 24" DIAM., 32° PITCH, CW, 1/2" BORE	213455000
P*M4-1100, P*M4-1320, P*M4-1656,		
PAH4-1452, PAH4-1821, PAH5-2275,		
PAH6-2730, & ALL 3, 4, 5, & 6 FAN		
P*U AND P*L MODELS		
P*M1-164, P*M1-209, P*M2-270,	FAN BLADES, 20" DIAM., 25° PITCH, CW, 1/2" BORE	213456000
P*M2-239, PAH1-182, PAH1-232,		
PAH2-300, PAH2-365		
P*M2-390, P*M2-441, PAH2-433, PAH2-490,	FAN BLADES, 24" DIAM., 14° PITCH, CW , 1/2" BORE	214041000
ALL 3 FAN P*M, & PAH MODELS, P*M4-780,		
P*M4-882, P*M5-2065, P*M6-2480,		
PAH4-866, PAH4-980, PAH4-1100		
P*U1-118, P*U2-236, P*L1-125, P*L1-152,	FAN GUARD, AIR STRAIGHTENER (20" FANS)	10692300
P*L1-193, P*L2-240, P*L2-304, P*M1-164,		
P*M1-209, P*M2-270, P*M2-329, PAH1-182,	FAN GUARD, WIRE, EPOXY COATED, 20"	213484000
PAH1-232, PAH2-300, PAH2-365		
P*U2-355, P*L2-361, P*L2-408, P*M2-390,	FAN GUARD, AIR STRAIGHTENER (24" FANS)	10709900
P*M2-441, PAH2-433, PAH2-490, & ALL 3, 4,		
5, & 6 FAN P*U, P*L, P*M, PAH MODELS	FAN GUARD, WIRE, EPOXY COATED, 24"	202136005

### FOLLOWING MOTORS ARE FOR UNITS PRODUCED AFTER APRIL 1, 1990.

ALL 1, 2, 3, FAN P*M, AND PAH	MOTOR, PSC, 1/3 HP, 1075 RPM, 115V (5 MFD CAPACITOR NOT INCLUDED)	205051005
MODELS, AND P*M4-780,	MOTOR, PSC, 1/3 HP, 1075 RPM, 208-230/60/1 ( 5 MFD CAPACITOR NOT INCLUDED)	205051004
P*M4-882, PAH4-866, PAH4-980,	MOTOR, PSC, 1/3 HP, 1075 RPM, 460/60/1 (7.5 MFD CAPACITOR NOT INCLUDED)	205051006
PAH4-1100	MOTOR, PSC, 1/3 HP, 1075 RPM, 575/60/1 (7.5 MFD CAPACITOR NOT INCLUDED)	115950000
P*U2-355, P*L2-361, P*L2-408, AND ALL 3, 4,	MOTOR, PSC, 3/4 HP, 1075RPM, 208-230/60/1 (5 MFD CAPACITOR NOT INCLUDED)	205051009
5, & 6 FAN P*U, & P*L MODELS, P*M4-1100,	MOTOR, PSC, 3/4 HP, 1075RPM, 460/60/1 (5 MFD CAPACITOR NOT INCLUDED)	205051002
P*M4-1320, P*M4-1656, PAH4-1452,		
PAH4-1821, PAH5-2275, PAH6-2730	MOTOR, PSC, 1/2 HP, 1075RPM, 575/60/1 (5 MFD CAPACITOR NOT INCLUDED)	115952000
P*U1-118, P*U2-236, P*L1-125,	MOTOR, PSC, 3/4 HP, 1625 RPM, 208-230/60/1 (7.5 MFD CAPACITOR NOT INCLUDED)	205051007
P*L1-152, P*L1-193, P*L2-240,	MOTOR, PSC, 3/4 HP, 1625 RPM, 460/60/1 (7.5 MFD CAPACITOR NOT INCLUDED)	205051008
P*L2-304	MOTOR, PSC, 1/2 HP, 1075RPM, 575/60/1 (5 MFD CAPACITOR NOT INCLUDED)	115952000
ALL MODELS	MOTOR, MOUNT, 24"	205269000
ALL MODELS	CAPACITOR, 5 MFD	202163004
	CAPACITOR, 7.5 MFD	202163006

## Nomenclature

