POLARCRAFT

REFRIGERATION PRODUCTS

Operation & Maintenance Manual

1/2 - 6 HP AIR-COOLED CONDENSING UNITS



AWEF-Compliant

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TABLE OF CONTENTS

I. GENERAL SAFETY INFORMATION 2

II. RECEIVING, HANDLING AND INSPECTION 4

III. IN-WARRANTY PARTS AND PROCEDURES 4

IV. COMPRESSOR GUARANTEE POLICY (OPTIONAL) 4

V. RECOMMENDATIONS OF GOOD PRACTICE 5

VI. PRESSURE AND TEMPERATURE SETTINGS 5

VII. PLACEMENT OF CONDENSING UNIT 6

VIII. PLACEMENT OF EVAPORATOR(S) IN WALK-IN 8

IX. REFRIGERANT 9

X. REFRIGERANT PIPING 9

XI. LEAK CHECK 11

XII. EVACUATION 11

XIII. ELECTRICAL 11

XIV. CHECK-OUT AND START-UP 15

XV. OPERATIONAL CHECK 15

XVI. MAINTENANCE 16

XVII. TROUBLESHOOTING 17

XVIII. Appendix: SYSTEM CHECKLIST 19

I. GENERAL SAFETY INFORMATION

Safety Instructions

The Refrigeration Design Technologies, Inc. (RDT) Polarcraft condensing units are manufactured according to the latest U.S. and European Safety Standards. Particular emphasis has been placed on the user's safety and energy efficiency. Safety icons are explained below and safety instructions applicable to the products in this bulletin are grouped on next pages. These instructions should be retained throughout the lifetime of the product. **You are strongly advised to follow these safety instructions.**

Safety Icon Explanation

DANGER	DANGER indicates a hazardous situation which, if not avoided, will result in death or serious injury.
WARNING	WARNING indicates a hazardous situation which, if not avoided, could result in death or serious injury.
CAUTION	CAUTION, used with the safety alert symbol, indicates a hazardous situation which, if not avoided, could result in minor or moderate injury.
NOTICE	NOTICE is used to address practices not related to personal injury.
CAUTION	CAUTION, without the safety alert symbol, is used to address practices not related to personal injury.

WARNING

Warning: Electrical Shock Hazard

- Disconnect and lock out power before servicing.
- Discharge all capacitors before servicing
- Use compressor with grounded system only
- Molded electrical plug must be used when required
- Refer to original equipment wiring diagrams
- Electrical connections must be made by qualified electrical personnel.
- Failure to follow these warnings could result in serious personal injury

Warning: System Hazard

WARNING

- System contains refrigerant and oil under pressure
- Remove refrigerant from both the high and low compressor sides before removing compressor
- Use appropriate back-up wrenches on rotalock fittings when servicing
- Never install a system and leave it unattended when it has no charge, a holding charge, or with the service valves closed without electrically locking out the system.
- Use only approved refrigerants and refrigeration oils
- Personal safety equipment must be used
- Failure to follow these warnings could result in serious personal injury

Warning: Burn Hazard

WARNING

- Do not touch the compressor until it has cooled down
- Ensure that materials and wiring do not touch high temperature areas of the compressor
- Use caution when brazing system components
- Personal safety equipment must be used
- Failure to follow these warnings could result in serious personal injury or property damage.

Caution: Compressor Handling



- Use the appropriate lifting devices to move compressors
- Personal safety equipment must be used
- Failure to follow these warnings could result in personal injury or property damage

Safety Statements

- Refrigerant compressors must be employed only for their intended use
- Only qualified and authorized refrigeration personnel are permitted to install, commission, and maintain this equipment
- Electrical connections must be made by qualified electrical personnel
- All valid standards and codes for installing, servicing, and maintaining electrical and refrigeration equipment must be observed

II. Receiving, Handling and Inspection

Upon receipt of equipment:

A. Check for shortages and damages. Report any damages or shortages to the delivery carrier.
NOTE: **Damaged material is the carrier's responsibility and cannot be returned without prior approval.**
B. Lift condensing unit with pallet jack or fork lift. If rigged, use proper spreader bar to space lifting cable to protect unit from damage.
C. Upon receiving the equipment, check the model number and serial number against invoice and record these numbers and the date of delivery for future reference. Take pictures if necessary and keep the records on file.

III. In-Warranty Parts and Procedures

RDT WARRANTY POLICY: Equipment price includes 1-year parts warranty and 90-day labor warranty following the installation completion date, or 18 months from the date of shipment, whichever comes first.

(Parts/Labor Warranty not intended to mitigate the responsibility of the Installer for normal start-up procedures. When an in-warranty part replacement is needed, prior authorization is required. A Return Material Tag for the return of the inoperative part must be filled out and attached to the part.

IV. Compressor Guarantee Policy (Optional)

FIVE YEAR PROTECTION POLICY
PROCEDURE FOR CLAIMS

To properly process your five-year warranty for compressors, we must have the following:
A. Original order on which the units were purchased from RDT, INC.
B. The condensing unit serial number from which the defective compressor was removed.
C. Invoice and credit memo containing serial number of replacement compressor.
D. Service report with cause of failure

DEDUCTION FROM PAYMENTS
If the above is adhered to, there should be no reason why any organization would make deductions from remittances.

V. Recommendations of Good Practice

A. Do not remove factory seals until unit is ready to be connected.
B. Inspect all tubing, valves and fittings to ensure cleanliness.
C. Use refrigerant grade tubing and fittings only.
D. Evacuate system before charging (see Evacuation Section).
E. Check for correct electrical supply to condensing unit.
Check voltage at motor-compressor terminals with unit running at full load and during start-up to ensure that it is plus or minus 10% nameplate rating.

VI. Pressure and Temperature Settings

DOE Walk-In Cooler and Freezer AWEF Settings

All POLARCRAFT condensing units pass DOE energy efficiency tests under the below conditions and operational set points.

1. Head Pressure Control Valve setting = 100 PSIG for low temperature and medium temperature applications
2. Medium Temperature Evaporator Dew Point = 23°F; Suction Vapor Temperature = 41°F; Condenser Sub-Cooling = 3°F Minimum
3. Low Temperature Evaporator Dew Point = -22°F; Suction Vapor Temperature = 5°F; Condenser Sub-Cooling = 3°F Minimum

Factory Recommended Default Set Points

1 Medium Temperature Low Pressure Cut-Out = 5 PSI, Cut-In = 20 PSI (Fixed); High Pressure Cut-Out = 400 PSI, Cut-In = 350 PSI (Fixed)
2 Low Temperature Low Pressure Cut-Out = 5 PSI, Cut-In = 18 PSI (Adjustable); High Pressure Cut-Out = 400 PSI, Cut-In = 350 PSI (Fixed)
3 Medium Temperature Room Temperature Set Point = 35°F, Differential = 3°F
4 Low Temperature Room Temperature Set Point = -10°F, Differential = 5°F
5 Medium Temperature Off Cycle Defrost Termination Temperature = 40°F
6 Low Temperature Electric Defrost Termination Temperature = 55 to 75°F, depending on where the defrost sensor is mounted and the frost thickness

Note:

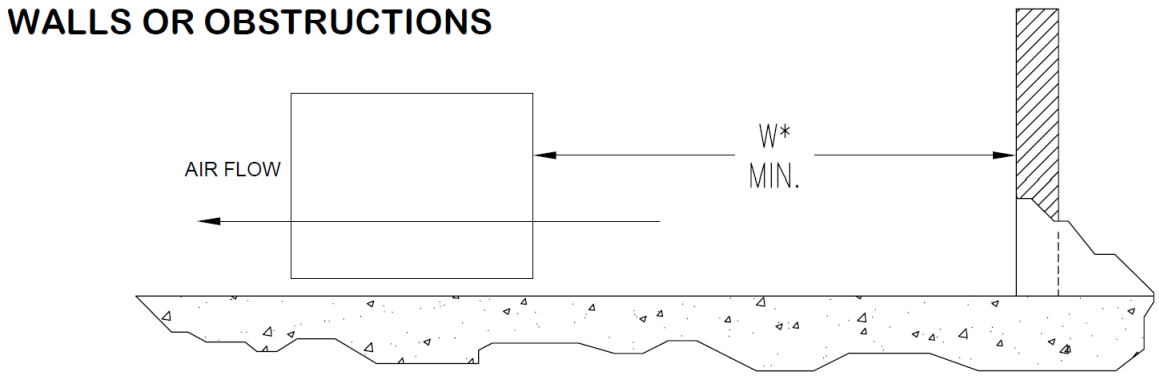
1 Medium temperature adjustable low pressure control is optional.
2 Number of Defrost can be demand defrost or scheduled defrost.

VII. Placement of Condensing Unit

The following factors should be considered when placing a condensing unit:

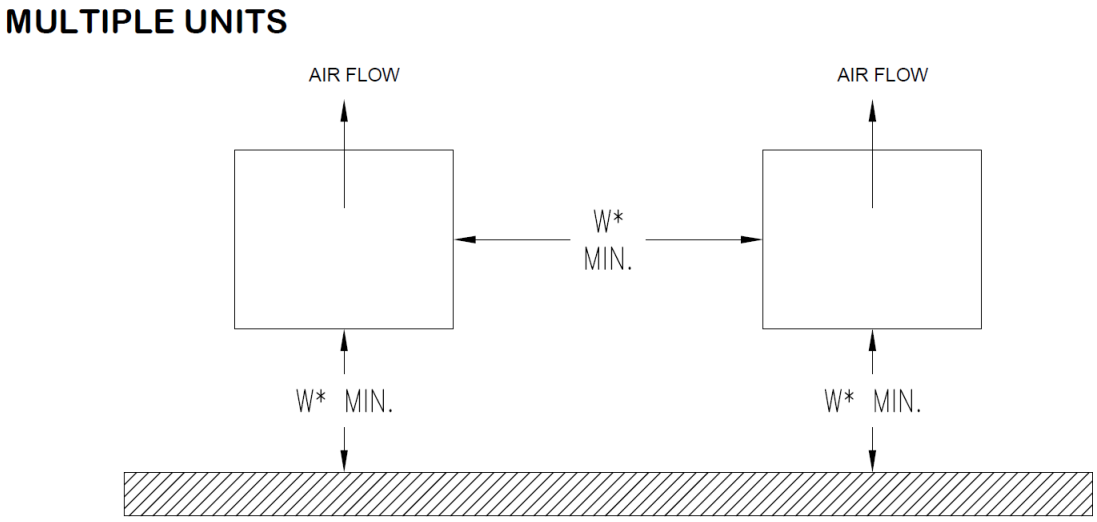
1. Free ambient air flow to condenser inlet. This is to prevent heated air from circulating back to the condenser to avoid increase of condensing temperature.
2. Easy and safe access to the unit for service and maintenance.
3. Placement of a condensing unit should be away from vibration, noise and security from theft should be considered. In areas with high wind situation like some Florida coasts, a special design of metal mount should be used to secure the unit per local codes.

Polarcraft's design for condensers uses horizontal air flow. Figure 1 below shows typical placements of Polarcraft condensing unit(s).



*Note: For units placed side by side, the minimum distance between units is the width of the largest unit "W".

Figure 1a



***Note: For proper air flow and access, all sides of the unit should be a minimum of "W" away from any wall or obstruction.**

Figure 1b

Dimensions and Weights of Condensing Units

Below Table 1 and Figure 2 show the dimensions and weight of each unit of each frame.

Table 1. Dimensions and Weights

Model	Compressor	HP	Frame	Air Flow	Refrigerant Line Connections (In, OD)		Receiver Cap 90% Full (LBS)	Dimensions (In)			Net Weight (Est.)
				CFM	Liquid	Suction		Depth	Width	Height	(LBS)
PCM005ZC^^A	ZB06KAE	0.5	P1	1,696	3/8	5/8	8	33.0	27.0	20.0	189
PCM008ZC^^A	ZB07KAE	0.8	P1	1,696	3/8	5/8	8	33.0	27.0	20.0	189
PCM009ZC^^A	ZB08KAE	0.9	P1	1,696	3/8	5/8	8	33.0	27.0	20.0	189
PCM010ZC^^A	ZS09KAE	1.0	P1	1,696	3/8	5/8	8	33.0	27.0	20.0	189
PCM013ZC^^A	ZS11KAE	1.3	P2	3,166	1/2	7/8	15	33.0	40.5	20.0	251
PCM015ZC^^A	ZS13KAE	1.5	P2	3,166	1/2	7/8	15	33.0	40.5	20.0	251
PCM020ZC^^A	ZS15KAE	2.0	P2	3,166	1/2	7/8	15	33.0	40.5	20.0	251
PCM025ZC^^A	ZS19KAE	2.5	P2	3,166	1/2	7/8	15	33.0	40.5	20.0	251
PCM030ZC^^A	ZS21KAE	3.0	P3	5,195	1/2	7/8	20	33.5	46.0	30.0	349
PCM035ZC^^A	ZS26KAE	3.5	P3	5,195	1/2	7/8	20	33.5	46.0	30.0	349
PCM045ZC^^A	ZS29KAE	4.5	P3	5,195	1/2	1-1/8	20	33.5	46.0	30.0	349
PCM050ZC^^A	ZS33KAE	5.0	P3	5,195	1/2	1-1/8	20	33.5	46.0	30.0	349
PCM055ZC^^A	ZS38K4E	5.5	P3	5,195	1/2	1-1/8	20	33.5	46.0	30.0	349
PCM060ZC^^A	ZS45K4E	6.0	P3	5,195	1/2	1-1/8	20	33.5	46.0	30.0	349
PCL006ZC^^A	ZF03KAE	0.6	P1	1,696	3/8	7/8	8	33.0	27.0	20.0	189
PCL008ZC^^A	ZF04KAE	0.8	P1	1,696	3/8	7/8	8	33.0	27.0	20.0	189
PCL010ZC^^A	ZF05KAE	1.0	P1	1,696	3/8	7/8	8	33.0	27.0	20.0	189
PCL022ZC^^A	ZF07KAE	2.2	P1	1,696	3/8	7/8	8	33.0	27.0	20.0	189
PCL025ZC^^A	ZF08K4E	2.5	P2	3,166	1/2	7/8	15	33.0	40.5	20.0	251
PCL030ZC^^A	ZF09K4E	3.0	P2	3,166	1/2	7/8	15	33.0	40.5	20.0	251
PCL035ZC^^A	ZF11K4E	3.5	P2	3,166	1/2	1-1/8	15	33.0	40.5	20.0	251
PCL045ZC^^A	ZF13K4E	4.5	P3	5,195	1/2	1-1/8	20	33.5	46.0	30.0	349
PCL055ZC^^A	ZF15K4E	5.5	P3	5,195	1/2	1-1/8	20	33.5	46.0	30.0	349
PCL060ZC^^A	ZF18K4	6.0	P3	5,195	1/2	1-1/8	20	33.5	46.0	30.0	349

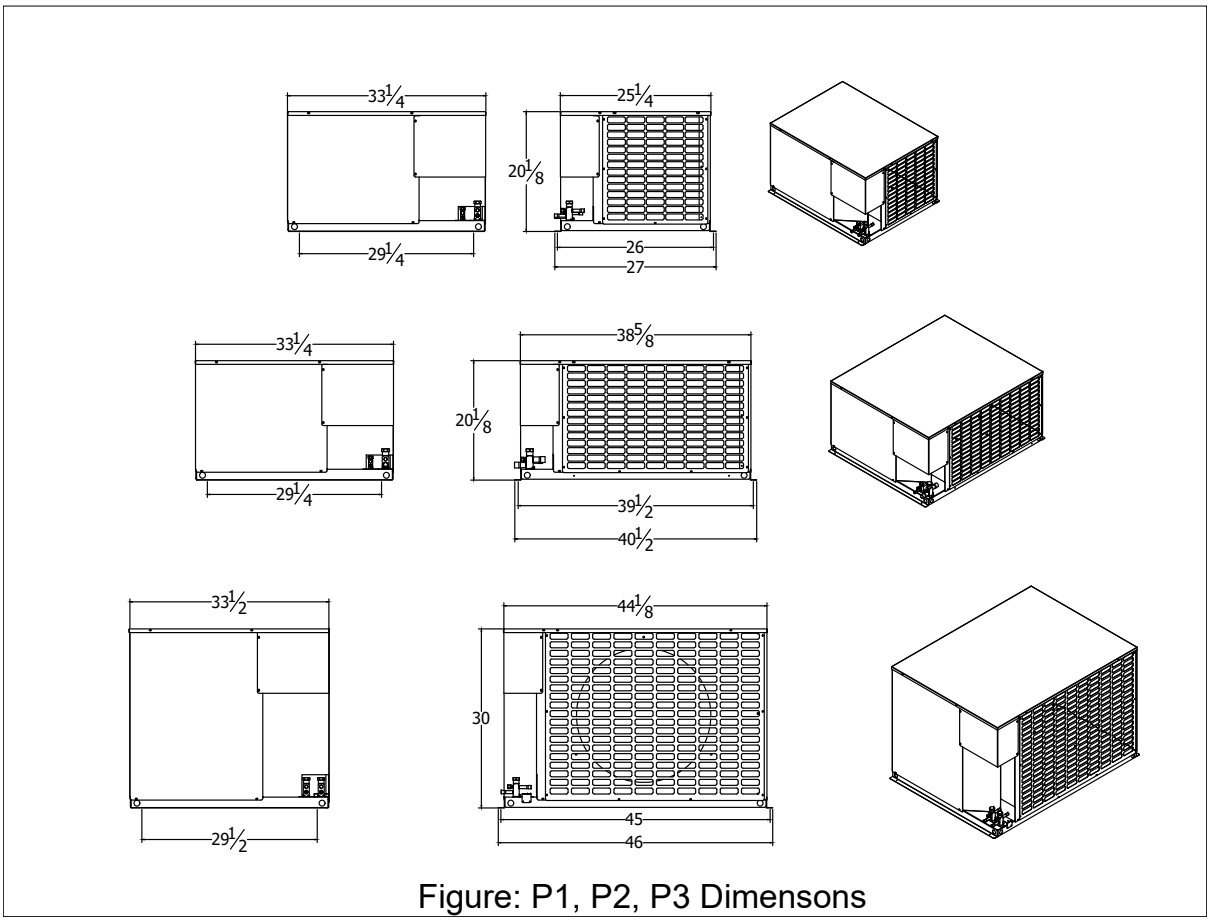
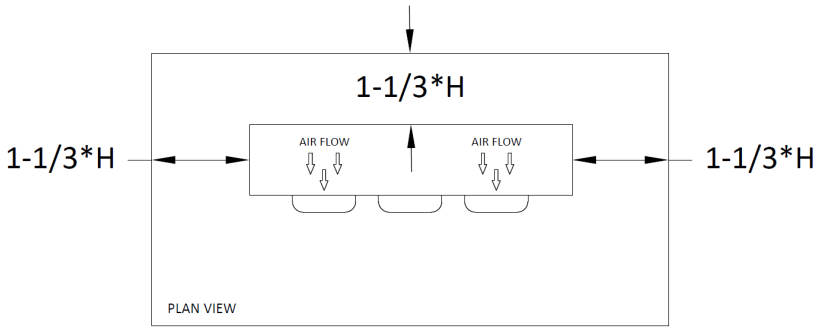


Figure: P1, P2, P3 Dimensons

Figure 2 Dimensions

VIII. Placement of Evaporator(s) in Walk-In

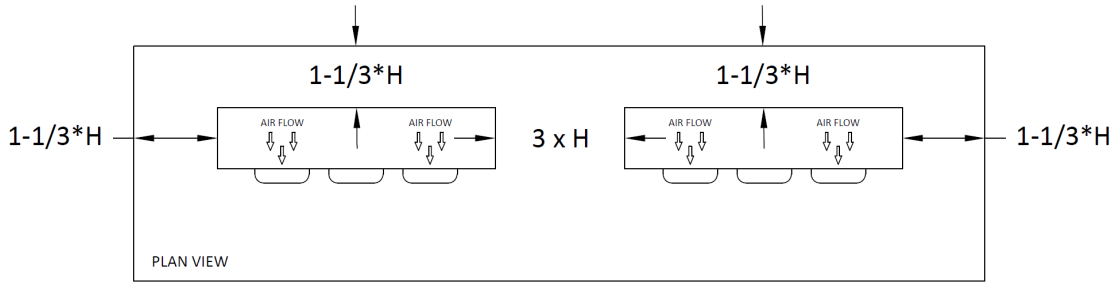
General guidelines to place evaporator(s) inside a walk-in can be found in evaporator manufacturer's I&O manuals. Below Figure 3 shows several typical placements of evaporator(s).



SINGLE EVAPORATOR

***Note:** **H = TOTAL HEIGHT OF THE EVAP. COIL**

Figure 3a



MULTIPLE EVAPORATORS

Figure 3b

Several practical rules can be followed to maximize performance of the evaporators:

- Air throw of evaporator fans. Low profile evaporators use 20 ft; medium profile evaporators use 40 to 60 ft; high profile evaporators use 90 ft. When placing evaporators, be sure the air flow can cover entire room.
- Do not place an evaporator over an entrance door since negative suction pressure will attract ambient air into the evaporator and cause icing problems. Place the evaporator on the opposite side of the room instead.
- A 6" deep P-Trap must be installed at the outlet of a condensate drain pipe. If the condensate drain pipe is connected to multiple evaporators, each evaporator must be isolated with a minimum 6" P-Trap. See below Figure 4 for reference.
- A drain line heater must be used for room temperature lower than 34^{o}F application.

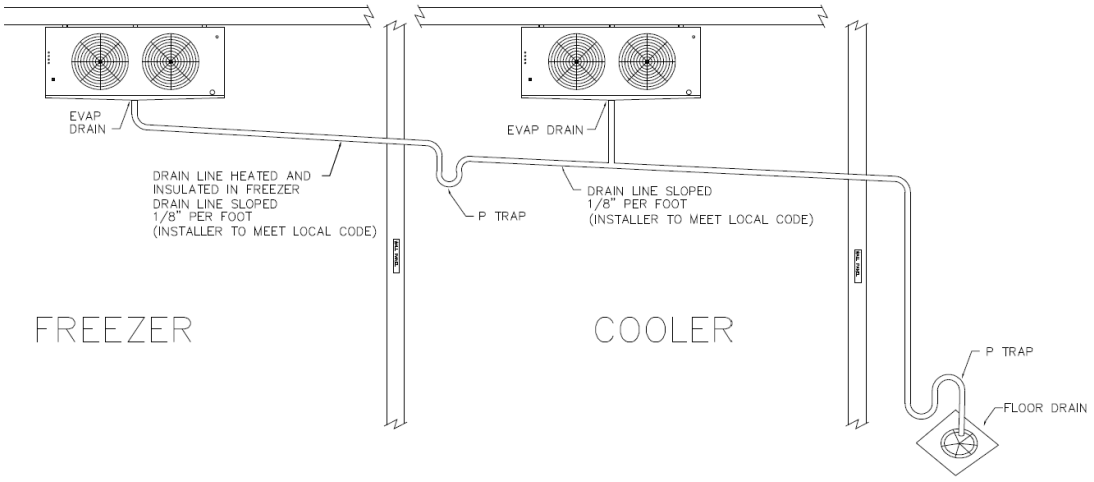


Figure 4

IX. Refrigerant

Use only refrigerant specified on unit. Polarcraft condensing units are rated with refrigerants R448A, R449A and R404A. Do not mix refrigerants in any one system. For areas where the R448A/R449A and R404A are not available, please contact our factory for recommendation of alternative refrigerants.

X. Refrigerant Piping

A. Use refrigerant grade copper tubing, or ACR copper tubing only.
B. Install suction line filter or suction accumulator when the options are selected.
C. Install P-type oil traps at the base of each suction riser.
D. Suction line should have a slope of one-half inch (½") for every ten feet (10') of run approaching the condensing unit.
E. The following should be observed when brazing:

1) Use a 15% "Silfos" solder on all copper-to-copper connections.
2) Use a 45% silver solder when connecting vibration eliminators to avoid internal joint damage and when connecting any dissimilar materials and/or steel hand valves to copper. Flux may be required for these applications to ensure proper flow of the filler metal.

CAUTION: Most vibration eliminators are assembled with "Silfos" (melting temperature 1300° F)

3) Avoid excessive use of soldering paste or flux to prevent internal contamination.
4) Insulate all suction lines where condensation can occur.
5) Insulate liquid lines in high ambient temperature areas to prevent formation of flash gas.

a. Line Sizing:

Reference Table 2 for Polarcraft liquid and suction line sizing based on 100 feet of line run.

Table 2. Polarcraft Liquid Line and Suction Line Sizes for 100 Ft Line Run

Condensing Unit Model Number	Condensing Temperature: 110F, Refrigerant: R448A		Net Refrigeration Effect		Frame	100FT Liquid Line Size inch	100FT Suction Line Size	
	COMPRESSOR	Evap Temp	Cooling Capacity				In Unit	In Field
		°F	BTUH	TONS			in	in
PCM005ZCT**	ZB06KAE	25	6,350	0.529	P1	3/8	5/8	7/8

PCM008ZCT**	ZB07KAE	25	7,590	0.633	P1	3/8	5/8	7/8
PCM009ZCT**	ZB08KAE	25	8,940	0.745	P1	3/8	5/8	7/8
PCM010ZCT**	ZS09KAE	25	9,430	0.786	P1	3/8	5/8	7/8
PCM013ZCT**	ZS11KAE	25	11,300	0.942	P2	1/2	7/8	7/8
PCM015ZCT**	ZS13KAE	25	12,900	1.075	P2	1/2	7/8	7/8
PCM020ZCT**	ZS15KAE	25	15,600	1.300	P2	1/2	7/8	1-1/8
PCM025ZCT**	ZS19KAE	25	17,300	1.442	P2	1/2	7/8	1-1/8
PCM030ZCT**	ZS21KAE	25	25,300	2.108	P31	1/2	7/8	1-1/8
PCM035ZCT**	ZS26KAE	25	27,200	2.267	P31	1/2	7/8	1-1/8
PCM045ZCT**	ZS29KAE	25	32,100	2.675	P32	1/2	7/8	1-3/8
PCM050ZCT**	ZS33KAE	25	35,400	2.950	P32	1/2	7/8	1-3/8
PCM055ZCT**	ZS38K4E	25	41,900	3.492	P32	1/2	1-1/8	1-3/8
PCM060ZCT**	ZS45K4E	25	50,200	4.183	P32	1/2	1-1/8	1-3/8
PCL006ZCT**	ZF03KAE	-20	2,400	0.200	P1	3/8	7/8	7/8
PCL008ZCT**	ZF04KAE	-20	3,160	0.263	P1	3/8	7/8	7/8
PCL010ZCT**	ZF05KAE	-20	3,780	0.315	P1	3/8	7/8	7/8
PCL022ZCT**	ZF07KAE	-20	5,930	0.494	P1	3/8	7/8	1-1/8
PCL025ZCT**	ZF08K4E	-20	7,100	0.592	P2	3/8	7/8	1-1/8
PCL030ZCT**	ZF09K4E	-20	7,920	0.660	P2	3/8	7/8	1-3/8
PCL035ZCT**	ZF11K4E	-20	9,850	0.821	P2	1/2	1-1/8	1-3/8
PCL045ZCT**	ZF13K4E	-20	11,300	0.942	P31	1/2	1-1/8	1-3/8
PCL055ZCT**	ZF15K4E	-20	14,100	1.175	P31	1/2	1-1/8	1-5/8
PCL060ZCT**	ZF18K4E	-20	17,200	1.433	P31	1/2	1-1/8	1-5/8

b. Suction Line Riser

When piping suction line, oil return should be considered. If condensing unit is located lower than evaporator, oil is drawn back to compressor by gravity. If condensing unit is located higher than evaporator, the vertical section of suction line is considered one size smaller than the horizontal suction line. For example, if 1-3/8" suction line size is selected, 1-1/8" on the vertical section should be considered to increase suction vapor velocity to bring oil back to compressor. Moreover, a P-Trap should be installed at the bottom of every riser. Additional P-Traps are needed if the vertical length is higher than 20'. Figure 5 illustrates a typical layout of such refrigeration system.

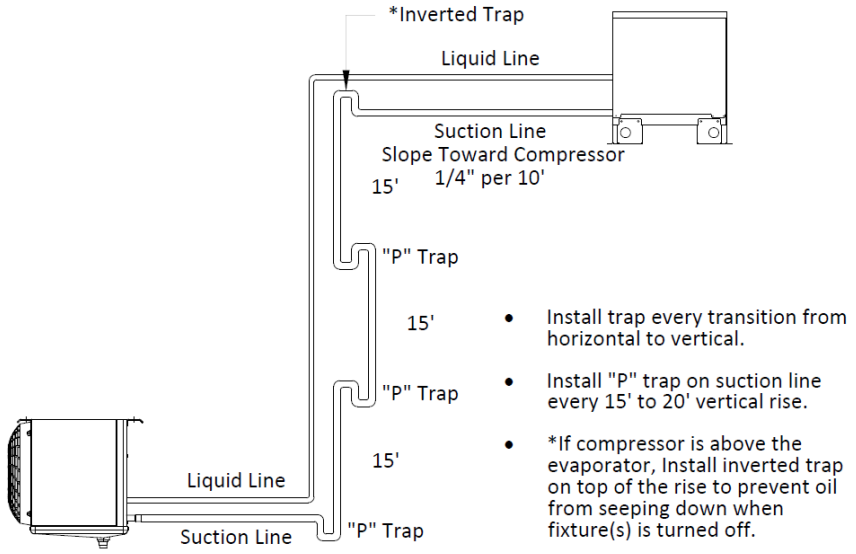


Figure 5

XI. Leak Check

After all connections are made, perform the following:

A. Pressurize system with dry nitrogen to 150 psig.
B. When necessary, use an accepted leak detector to locate and repair any leaks.
C. Evacuate system to one PSIA (27.9" Mercury vacuum) or below 500 microns.
D. If vacuum decreases, pressurize system again and repair leaks and repeat the above procedures.

NOTE: Check all flare nuts and Schrader valves for leaks, tighten as required.
NOTE: Pressures given are minimum recommended values. Specified local codes that differ should take precedence.

XII. Evacuation

At start-up, the following procedure should be repeated three times to remove any moisture scale, dirt, etc.:

A. Blow out all lines using dry nitrogen or carbon dioxide.

CAUTION: Pressure should not exceed 250 psig.

B. Re-connect all lines and leak test all connections (See Leak Check).
C. Connect vacuum pump to evacuation valves on condensing unit using copper tubing or high vacuum hose.
D. Operate pump to a vacuum of 1500 microns (.06 inches of Mercury) absolute.

(NOTE: Use a high vacuum gauge calibrated in microns.)

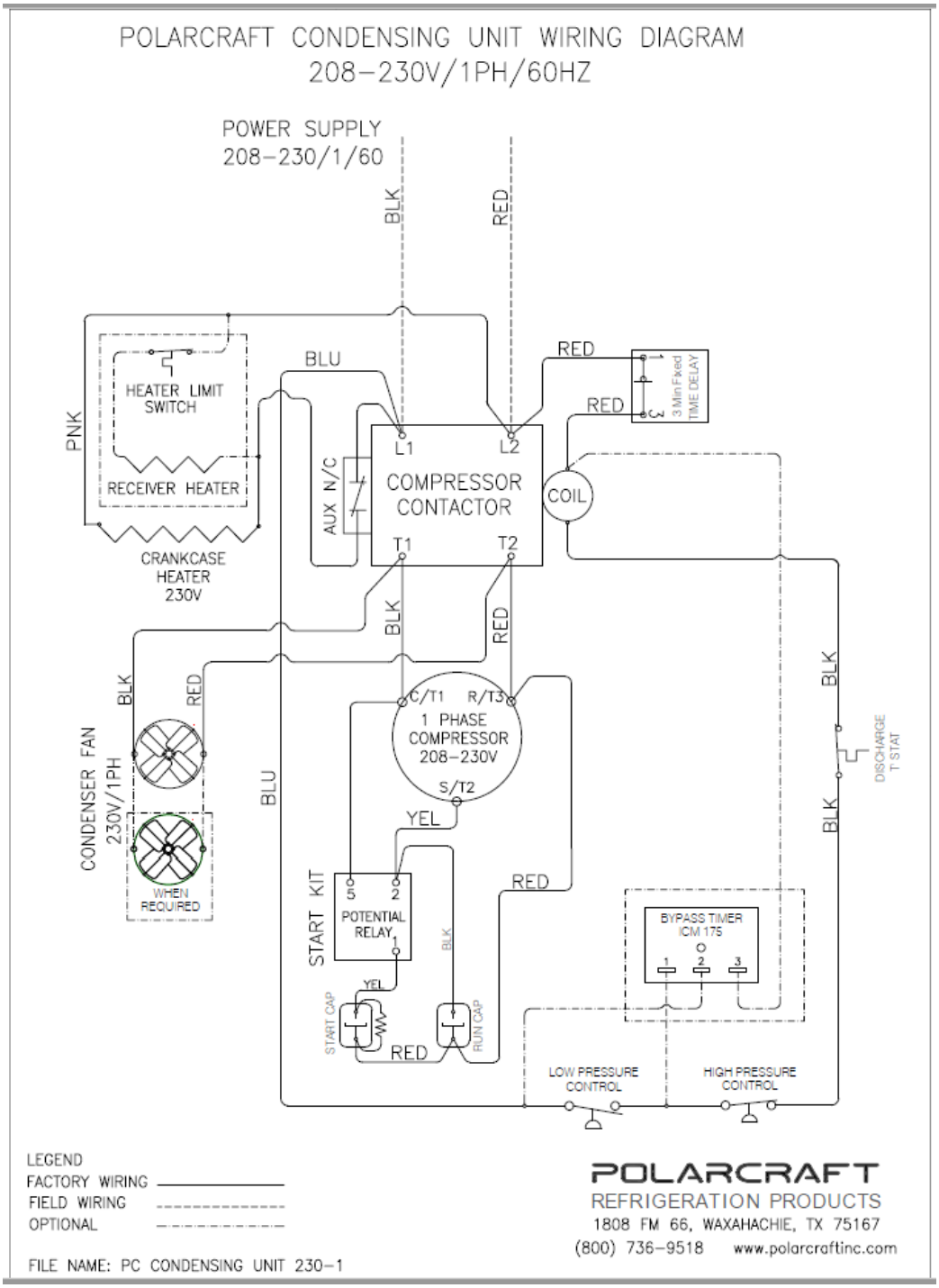
E. At 1500 microns, introduce dry nitrogen into the system until pressure reads 0 psig.
F. On third evacuation, reduce pressure to 500 microns (0.02 inches of Mercury) absolute. System is now ready to be charged.

XIII. Electrical

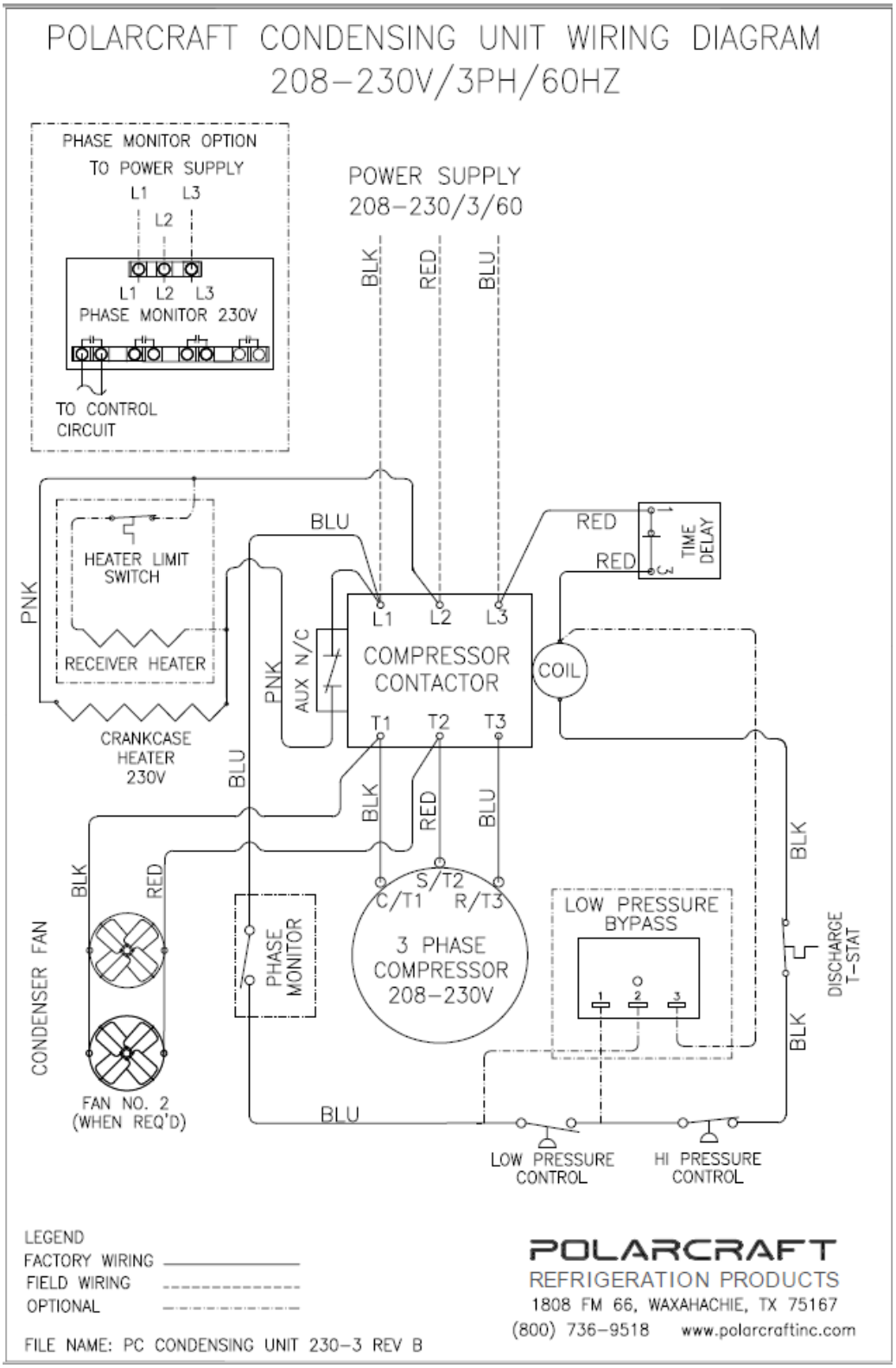
Three voltages, 208-230V/1Ph/60Hz, 208-230V/3Ph/60Hz and 460V/3Ph/60Hz, are available in Polarcraft condensing units. See below typical wiring diagrams for reference.

A. Check the voltage, phase and frequency of electrical supply to be sure they meet the specification indicated on the motor compressor nameplate.
B. Check that voltage at start-up and during operating conditions meet nameplate voltage plus or minus 10%; if limits are exceeded, check with power company.

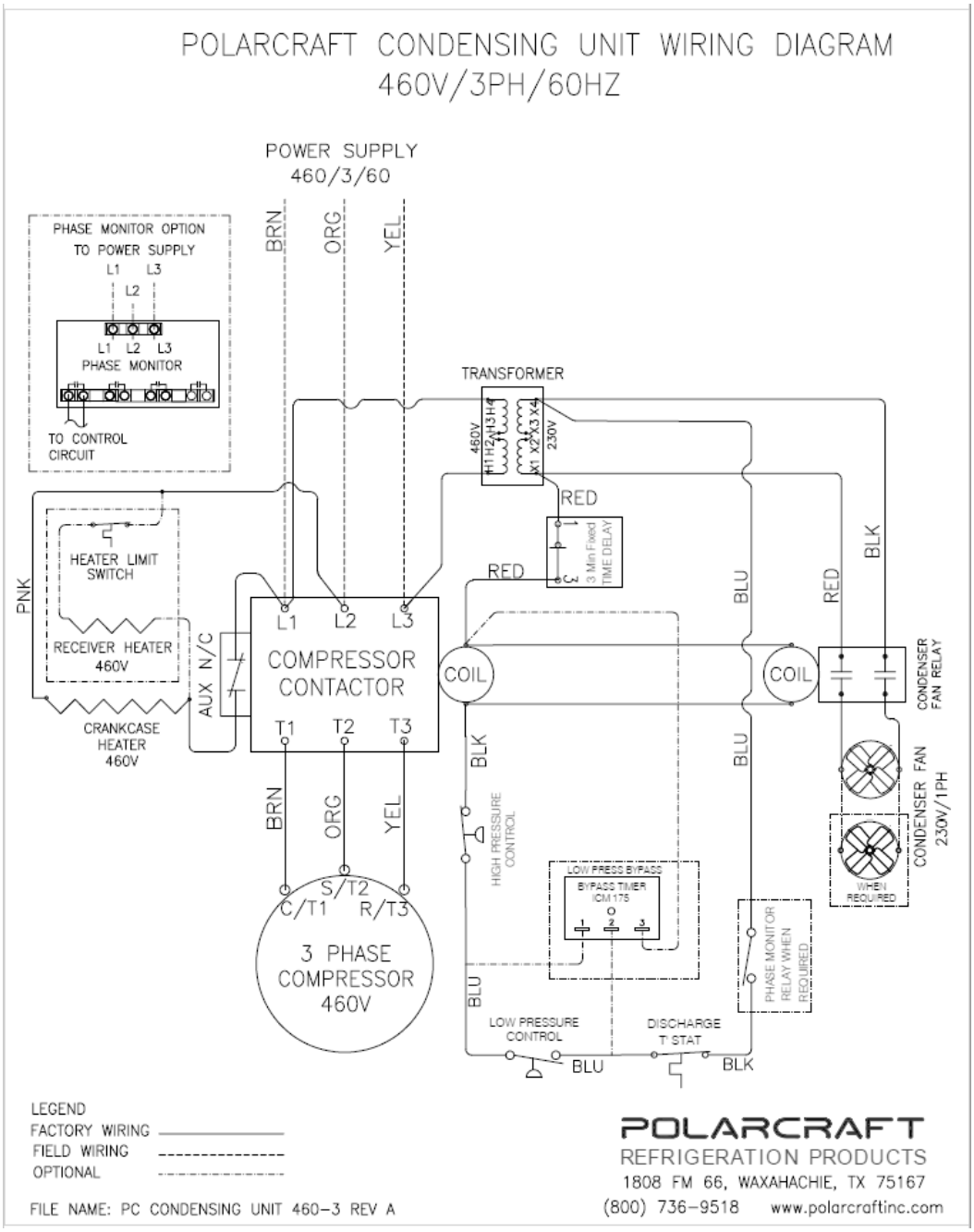
1. Typical Electrical Wiring Diagram for 208-230V/1PH/60HZ Application



2. Typical Electrical Wiring Diagram for 208-230V/3PH/60HZ Application



3. Typical Electrical Wiring Diagram for 460V/3PH/60HZ Application



CAUTION: Excessive or reduced voltage can result in motor failure.

XIV. Check-Out and Start-Up

After system has been evacuated, perform the following:

A. Check that all electrical connections are tight.
B. Check that compressor oil level is above center of sight glass when applicable.
C. Check that compressor mounting grommets are installed, mounting nuts are secure.
D. Check high and low pressure controls, pressure regulating valves, fixture thermostat, and all other controls. Adjust as necessary.
E. Check that proper refrigerant is being used.
F. Check that fixture or coil circulating fans are operating.
G. Close circuit breaker and place condensing unit in operation.
H. Charge system with refrigerant.
I. Continue charging system until bubbles in liquid line sight glass disappear.

CAUTION: Do not over-charge. Bubbles in sight glass can also be due to a restriction.

J. After system is fully charged, check oil level and adjust as necessary.

XV. Operational Check

After system has been running for twelve hours, perform the following check-out procedure:

A. Check compressor head and suction pressures. Correct if necessary.
B. Check liquid line sight glass. If refrigerant level is low, check and correct any leaks and recharge system.
C. Check compressor oil level if applicable.
D. Check expansion valves for proper operation.

1) Check that sensing bulbs are in positive contact with suction line.

CAUTION: If super heat setting is too low, it can cause liquid slugging in compressor. Typical evaporator superheat settings are:

Table 2. Recommended Superheat Set Points for Evaporators

Applications	High Temperature Applications	Commercial Refrigeration Applications	Low Temperature Applications
Suction Temperature	40° to 50 °F	0° to 40 °F	-40° to 0 °F
Superheat Set Point	8° to 12 °F	6° to 10 °F	5° to 10 °F

E. Check line voltage and amperage. Adjust phase voltage/phase monitor if needed.
1) Voltage must be within 10% plus or 10% minus of nameplate voltage.
2) On three phase compressors, check each phase for balanced load.

F. Check all condenser and evaporator fan motors for the following:
1) Proper rotation
2) Secure mounting and proper alignment
3) Proper lubrication (as required)

G. Check high pressure controls as follows:
1) Connect accurate gauge to monitor head pressure.
2) With condensing units running, stop condenser air flow.
3) Check that cut-out occurs at proper pressure. Adjust as necessary.
4) High pressure controls settings are as follows:

For Refrigerant: R-448A/449A and R-404A, Air cooled: Cut-In = 350 psig; Cut-Out= 400 psig

H. Re-check operation of all safety controls. Adjust as necessary.
I. Check defrost time clock settings per fixture manufacturer's recommendations. Adjust as necessary.
J. Where applicable, check fan cycling or head pressure controls for proper operation.

RE-STARTING

A. The following are possible causes for shut down with pump down inoperative:
1) Stoppage or overload, high head or other lockout device.
2) Disconnect switch inadvertently pulled.
3) Power failure.
4) New installation with charged system.

B. If any of the above result in long off cycles, liquid refrigerant may flood the evaporator or compressor crankcase. It is necessary to carefully clear these components of liquid to prevent damage to the compressors. This can be accomplished by doing the following:
1) Energize crankcase heater for 24 hours before running compressor.
2) Close liquid solenoid or receiver outlet valve.
3) Reset those controls which may have tripped.
4) Operate the compressor in very short bursts, starting with 1 or 2 seconds and gradually increasing these periods until the liquid is cleared out.

WARNING: Use compressor on-off switch to accomplish this. Stop the machine instantly if knocking is observed.

5) Watch the oil level and suction pressure carefully. Rapid boiling of refrigerant in the crankcase may lower the oil level dangerously. Add oil if necessary. Do not operate continuously at extra low vacuum.
6) After liquid refrigerant is boiled off, re-start evaporator fans and re-open liquid solenoids. Attend the system just as you would during initial start-up. Do not turn machines on and walk away.

XVI. Maintenance

AIR COOLED CONDENSERS

Brush and vacuum clean all air-cooled condensers every four to six months to remove all accumulations of dust, dirt, leaves, and other debris. Where air cooled condensers must operate in unusually dusty locations, cleaning should be done as often as conditions dictate.

WARNING: Check that main disconnect switch is in the off position before cleaning the condensers.

ELECTRICAL AND PIPING CONNECTIONS

A. Check all electrical connections periodically to be sure they are tight.
B. Check refrigerant level at sight glass. Whenever it is necessary to add refrigerant, a careful leak check of all refrigerant connections should be made.

CRANKCASE LUBRICATION

A. Check that oil level in the motor compressor crankcase where applicable is at the center of the sight glass at all times. Add oil as required.
B. If oil is dirty, or discolored, check for the following:
1) Contaminants such as moisture, acid, air, etc. trapped in the system – If discoloration is not severe, replace new liquid line filter-drier. If the discoloration is severe, replace oil and liquid line filter-drier.

NOTE: If the oil is still dirty, replace the filter-drier again.

2) Excessive system pressure drop or improper control settings may allow compressor to operate in a vacuum with the result that the compressor overheats due to lack of suction cooling and the oil discolors. Re-adjust settings.
3) Insufficient air cooling or restricted air blast on a suction cooled compressor operating below 0° F saturated suction temperature may cause overheating. Correct improper air cooling.

XVII. Troubleshooting

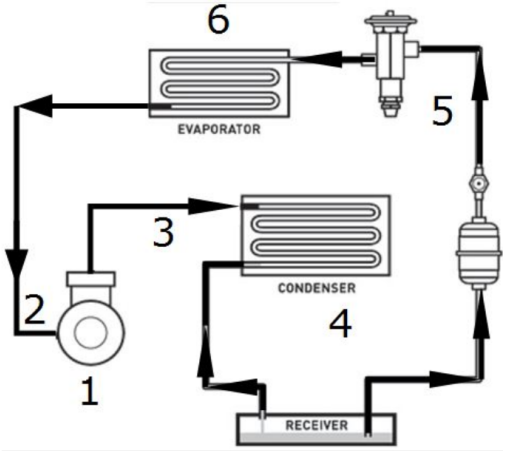
Problem	Reason	Solution
Compressor does not run	Motor line open	Close start or disconnect switch
	Fuse blown	Replace fuse
	Tripped overload	See electrical section
	Control contacts dirty or jammed in open position	Repair or replace
	Frozen compressor or motor bearings	Repair or replace
	Control in "off" position because of cold location	Use thermostatic control or move control to warmer location
	Defective starting component (single phase compressor only)	Locate and replace
Unit short cycles	Control differential set too closely	Widen differential
	Discharge valve leaking	Compressor may be bad
	Motor compressor overload	Check for high head pressure
	Refrigerant shortage	Repair leak and recharge
	Cycling on high pressure cut-out	May be dirty condenser, refrigerant overcharge
Compressor will not start - "hums" intermittently (cycling on overload)	Improperly wired	Check wiring against diagram
	Low line voltage	Check main line voltage
	Relay contacts not closing	Check by operating manually. Replace relay if defective.
	Open circuit in starting winding	Check starter leads. If leads are all right, replace starter
	Starting winding grounded	Check starter leads. If leads are all right, replace starter
	High pressure discharge	Eliminate cause of excessive pressure. Make sure discharge shut-off valve is open.
Unit operates long or continuously	Refrigerant shortage	Repair leak and recharge
	Control contacts sticking in closed position	Clean points or replace control
	Dirty condenser	Clean condenser
	Air in system	Re-evacuate and re-charge system
	Compressor inefficient	Check valves and pistons
	Improper wiring	Check wiring and correct if necessary
Fixture temperature too high	Refrigerant shortage	Repair leak and recharge
	Control set too high	Reset control
	Control wiring loose	Check wiring to control
	Expansion valve or strainer plugged	Clean and replace
	Expansion valve set too high superheat	Lower setting
	Iced or dirty coil	Defrost or clean
	Unit too small	Add unit or replace
	Clogged or small refrigerant lines	Clear clogging or increase line size
	Oil logged system	Remove excess oil, check refrigerant charge

Head pressure too high	Refrigerant overcharged	Reclaim
	Air in system	Re-evacuate and re-charge the system
	Dirty air-cooled condenser	Clean (clean area around air cooled condenser and inspect for air borne dirt source).
	Recirculating cooling air	Seal off unit from other machines and provide intake isolated from air outlet
	High side restriction	Remove blockage
	Head pressure control valve set incorrectly	Re-adjust
Head pressure too low	Refrigerant shortage	Repair leak and recharge
	Compressor suction or discharge valves inefficient	Clean or replace leaky valve plates
	Head pressure control valve set wrong or no head pressure valve installed	Re-adjust or install a head pressure control valve.
Noisy unit	Insufficient compressor oil	Add oil to proper level
	Tubing rattle	Bend tubes away from contact
	Mountings loose	Tighten
	Oil slugging or refrigerant flooding back	Adjust oil level or refrigerant charge. Check expansion valve for leak or oversized orifice.
	Unbalanced fan or defective fan motor.	Replace bent or broken fan blades. Check motor bearings.
Compressor loses oil	Shortage of refrigerant	Repair leak and recharge
	Gas: Oil ratio low	Add 1 pt. oil for each 10 lbs. Of refrigerant added to factory charge.
	Plugged expansion valve or strainer	Clean or replace
	Oil trapping in lines	Drain tubing toward compressor
	Short cycling	Refer to part B" "
	Superheat too high at compressor suction	Change location of expansion valve bulb or adjust valve to return wet gas to compressor
Frosted or sweating suction line	Expansion valve admitting excess refrigerant, or bad suction insulation	Adjust expansion valve to maintain 10F superheat. Insulate suction line well
Hot liquid line	Shortage of refrigerant	Repair leak and recharge
	Expansion valve open too wide	Adjust expansion valve
Frosted liquid line	Receiver shut-off valve partially closed or restricted	Open valve or remove obstruction
	Clogged dehydrator or strainer	Replace clogged part
Unit in vacuum. Frost on expansion valve	Ice plugging expansion valve orifice	Apply hot wet cloth to the expansion valve. If suction pressure now increases, there is moisture in the system and a drier should be installed in the line.
	Plugged expansion valve	Clean strainer or replace expansion valve

XVIII. Appendix: SYSTEM CHECKLIST

System checklist needs to be filled out after the installation is finished. The information can be used for troubleshooting and warranty claim.

Company Name		Compressor Model	
Contact Name		Compressor Serial #	
Contact Phone #		Unit Model #	
Contact Email		Unit Serial #	
Date of Issue		Oil Type	
Install Date/ Run Time		Expansion Device Type	
Application Description		Defrost Type	
Refrigeration Type		Evaporator Set Point	
Refrigeration Charge Amount		Pump Down Set Point	



1- Compressor Electrical Readings. (1PH or 3PH)		**4- Reading At Condenser**	
Voltage		Inlet Air Temperature	
Amperage		Outlet Air Temperature	
Winding Resistance		Ambient Temperature	
System Controller		**5-Reading At Liquid Line/ Expansion Valve Inlet**	
Any Alarms Or Breaker Trips		Temperature At Inlet Of Drier	
Level In Oil Sight Glass		Temperature At Outlet Of Drier	
2- Reading At Compressor Suction Inlet		Liquid Line Pressure	
Suction Pressure		Saturated condensing Temperature	
Saturation Suction Temperature		Liquid Line Temperature	
Suction Temperature		Calculated Liquid Sub Cooling**	
Calculated Superheat*		Sight Glass Condition	
Compressor Sump Temperature		**6- Reading At Evaporator Outlet**	
Low Pressure Cut Out Set Point		Suction Pressure	
3 -Reading at Compressor Discharge Outlet		Saturation Suction Pressure	
Discharge Pressure		Suction Temperature	
Saturation Discharge Temperature		Calculated Superheat at Evaporator*	
Discharge Temperature		Current Box Temperature	
Calculated Discharge Superheat		Coil Discharge Air Temperature	
DLT Design Limit		Defrost Type	

*Suction pressure converted to temperature minus suction temperature

** Liquid Pressure converted to temperature minus liquid line temperature.