HUSSMANN®

PROTO-AIRE XP

Installation and Operation Manual

P/N 3059050_B
August 2018

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⚠ WARNING

— LOCK OUT / TAG OUT —

To avoid serious injury or death from electrical shock, always disconnect the electrical power at the main disconnect when servicing or replacing any electrical component. This includes, but is not limited to, such items as doors, lights, fans, heaters, and controllers.

Installation

Overview

This section is limited to the information needed to setup the Proto-Aire XP Unit.

Shipping Damage

All equipment should be thoroughly examined for shipping damage before and while unloading.

This equipment has been carefully inspected at our factory, and the carrier has assumed responsibility for safe arrival. If damaged, either apparent or concealed, the claim must be made to the carrier.

Apparent Loss or Damage

If there is an obvious loss or damage, it must be noted on the freight bill or XP receipt and signed by the carrier's agent; otherwise, carrier may refuse claim. The carrier will supply the necessary claim forms.

Concealed Loss or Damage

When loss or damage is not apparent until after equipment is uncrated, a claim for concealed damage is made. Upon discovering damage, make request in writing to carrier for inspection within 15 days and retain all packing. The carrier will supply inspection report and required claim forms.

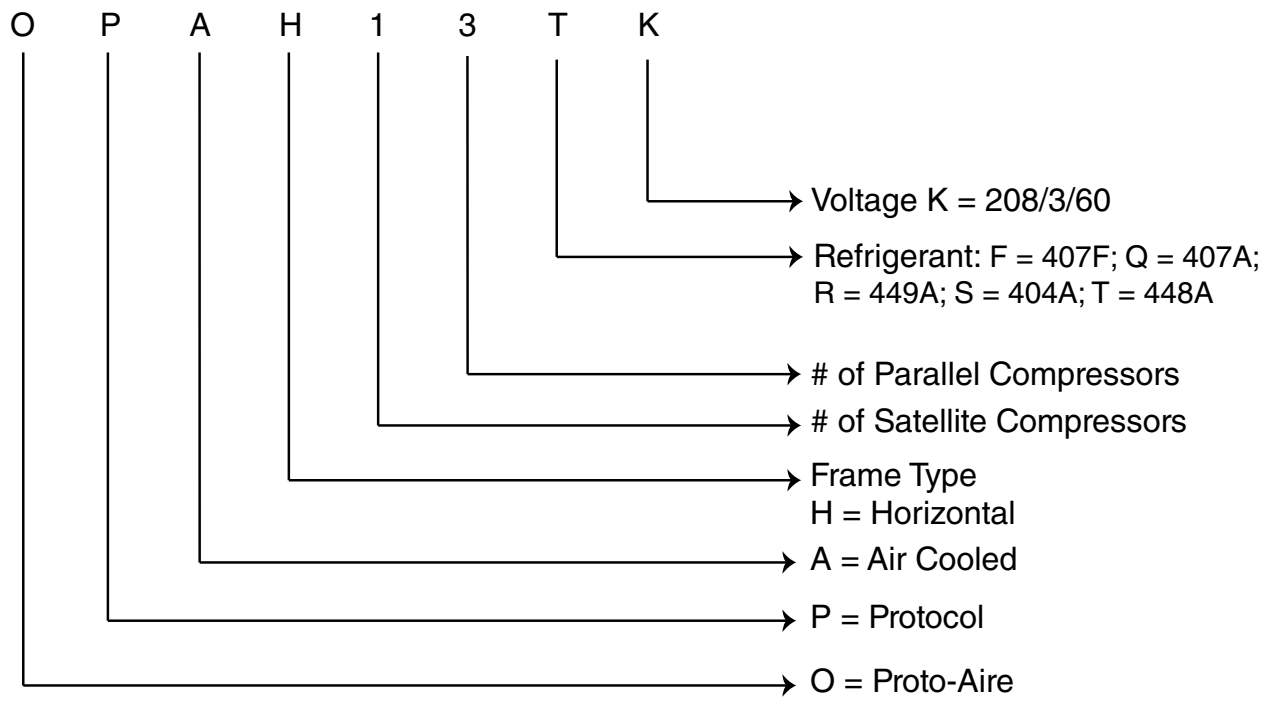
On Site Damage Control

The Proto-Aire XP Unit is shipped on skids with panels installed. Remove panels to access lifting points on frame. Do not attempt to move the unit from the skids without first removing the panels.

This warning does not mean that Hussmann products will cause cancer or reproductive harm, or is in violation of any product-safety standards or requirements. As clarified by the California State government, Proposition 65 can be considered more of a 'right to know' law than a pure product safety law. When used as designed, Hussmann believes that our products are not harmful. We provide the Proposition 65 warning to stay in compliance with California State law. It is your responsibility to provide accurate Proposition 65 warning labels to your customers when necessary. For more information on Proposition 65, please visit the California State government website.

PROTO-AIRE UNIT NOMENCLATURE

The model numbers for Proto-Aire XP units are shown on the legend in modular form. The nomenclature is interpreted as follows:



The unit nomenclature is part of the UL code requirements and must be included on the legend as well as the data plate for each unit.

It is the responsibility of the installer to ensure that the final equipment installation meets all applicable code requirements.

N.E.C. and local electrical code restrictions must be followed for electrical clearances and all other installation requirements.

Proto-Aire XP — Physical Data

Dimensions for the three fan units are typical for the following:

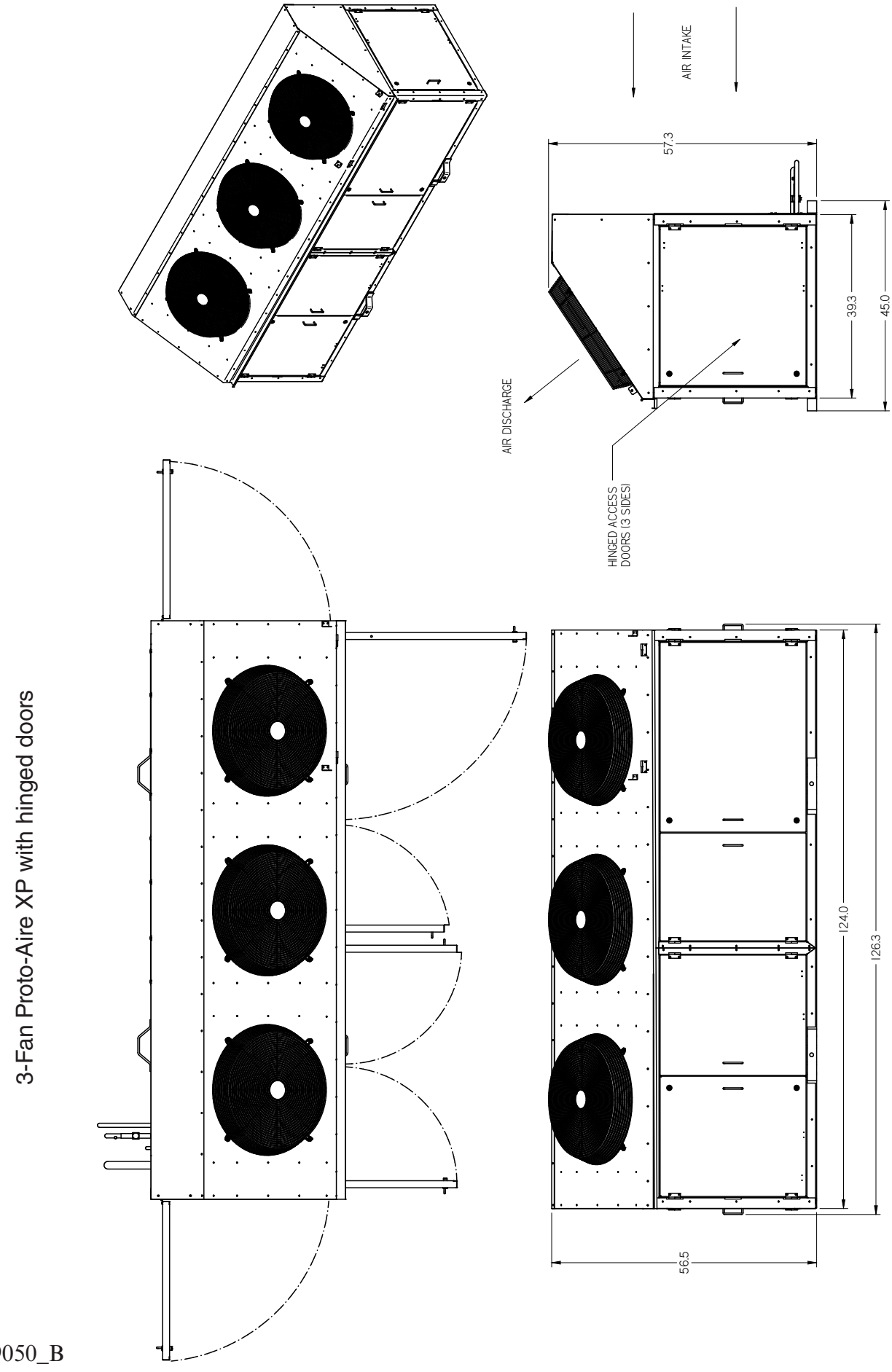
MODEL

PAE-LO3.0M12.0
PAE-LO4.0M14.0
PAE-LO6.0M12.0
PAE-LO7.0M15.0

Dimensions for the four fan units are typical for the following:

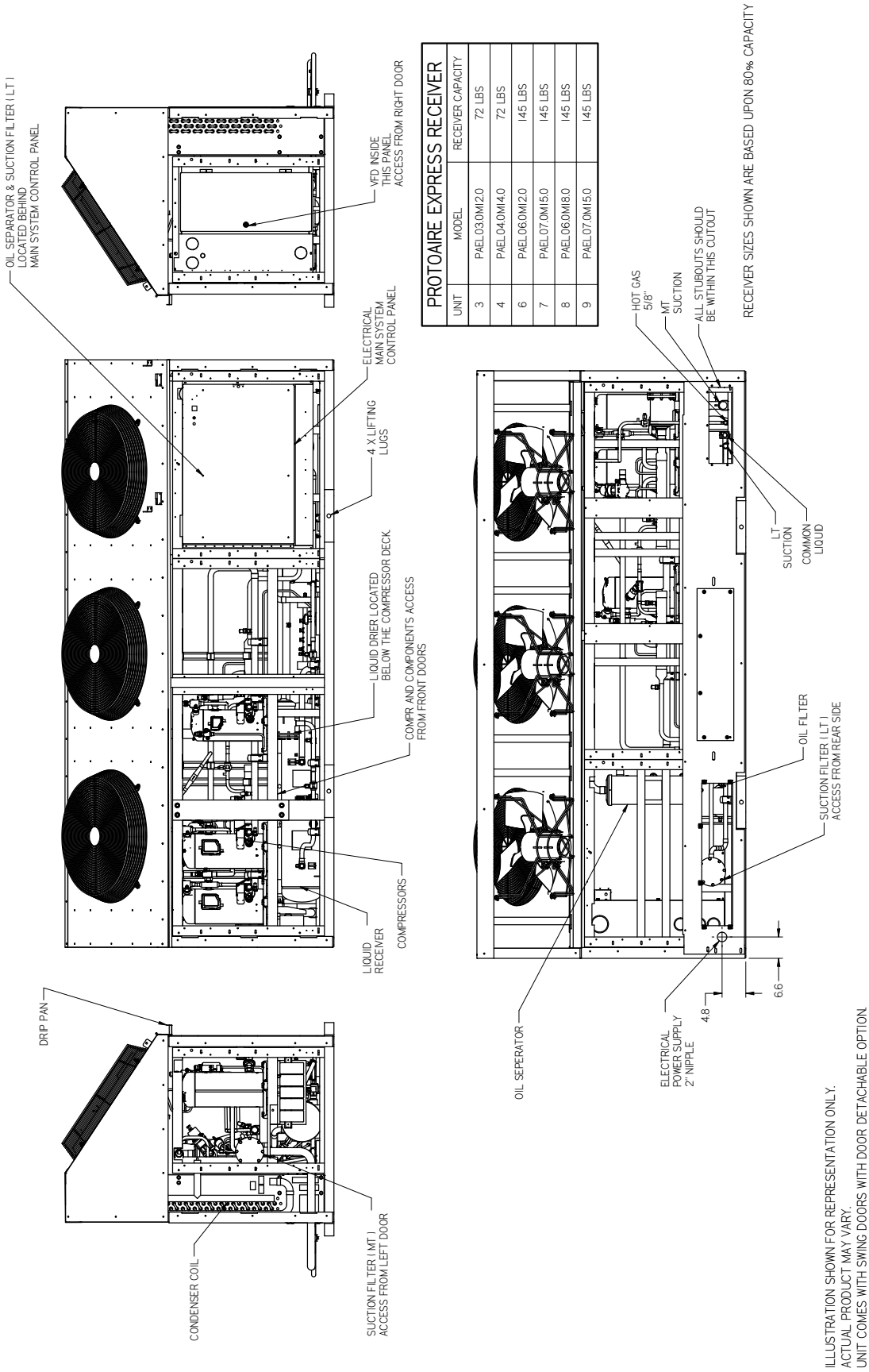
MODEL

PAE-LO6.0M18.0
PAE-LO7.5M15.0



3-Fan Proto-Aire XP with hinged doors

3-Fan Proto-Aire XP with hinged doors



PROTOAIRE EXPRESS RECEIVER		
UNIT	MODEL	RECEIVER CAPACITY
3	PAEL03.0MI2.0	72 LBS
4	PAEL04.0MI4.0	72 LBS
6	PAEL06.0MI2.0	145 LBS
7	PAEL07.0MI5.0	145 LBS
8	PAEL06.0MI8.0	145 LBS
9	PAEL07.0MI5.0	145 LBS

RECEIVER SIZES SHOWN ARE BASED UPON 80% CAPACITY

ILLUSTRATION SHOWN FOR REPRESENTATION ONLY.
ACTUAL PRODUCT MAY VARY.
UNIT COMES WITH SWING DOORS WITH DOOR DETACHABLE OPTION.

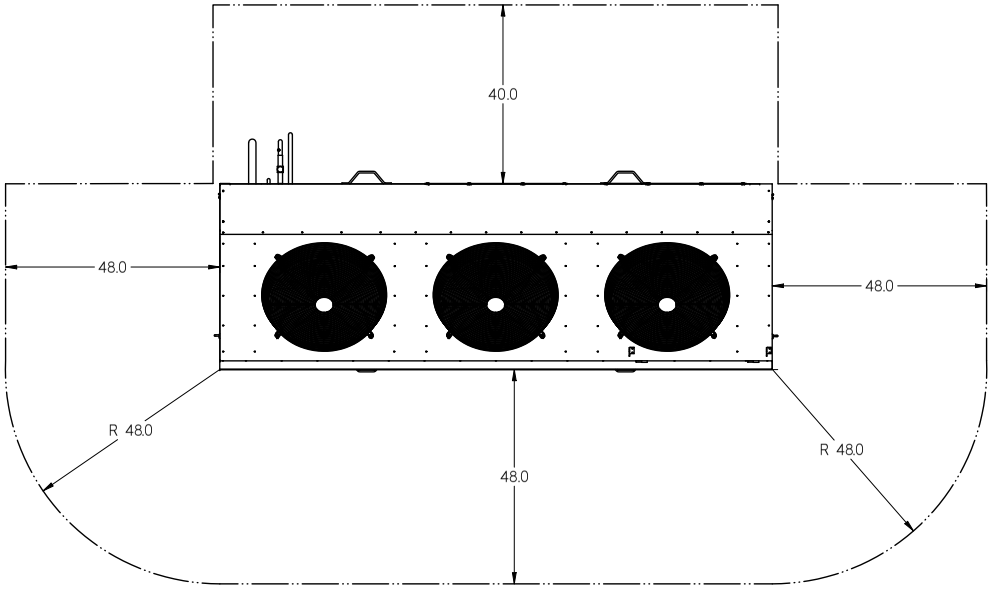
3-Fan Proto-Aire XP with hinged doors

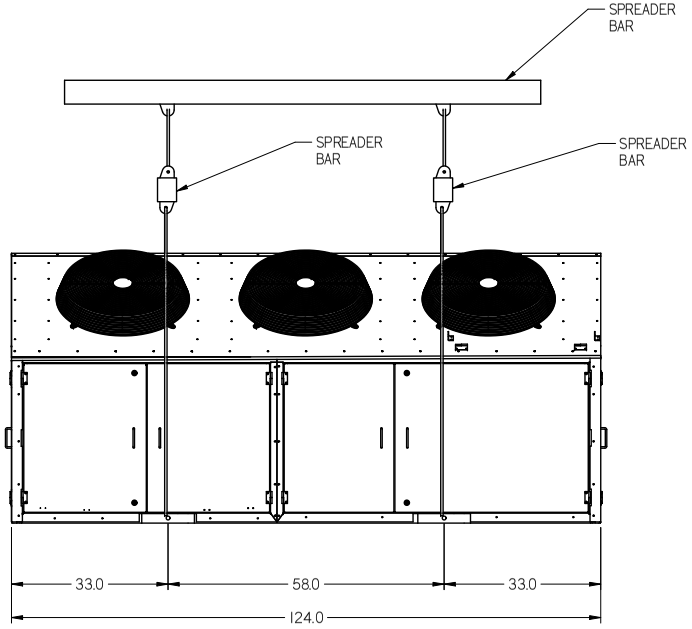
MINIMUM CLEARANCE REQUIREMENTS :
PROVIDE CLEARANCES AS SHOWN TO ENSURE ADEQUATE AIRFLOW, REDUCE THE POTENTIAL FOR AIR RECIRCULATION, FACILITATE SERVICE ACCESSIBILITY, AND TO MAINTAIN COMPLIANCE WITH ELECTRICAL CODE REQUIREMENTS

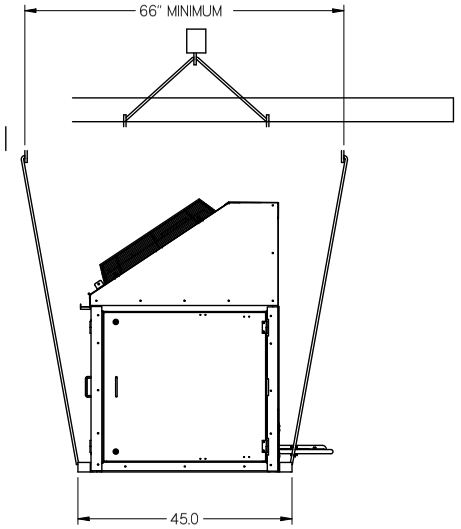
IT IS THE RESPONSIBILITY OF THE INSTALLER TO ENSURE THAT THE FINAL EQUIPMENT INSTALLATION MEETS ALL APPLICABLE CODE REQUIREMENTS.

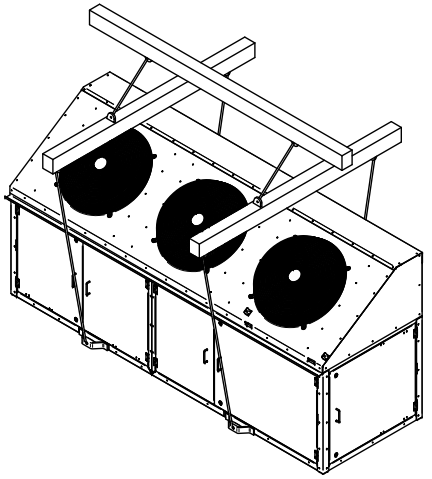
SUGGESTED RIGGING SETUP IS ILLUSTRATED.
BE SURE THAT LIFTING CABLES/STRAPS DO NOT DAMAGE PIPING STUBS, COIL SURFACE, OR RAIN GUARD.FULL PERIMETER SUPPORT FOUNDATION REQUIRED

PROTOAIRE EXPRESS WEIGHTS			
UNIT	MODEL	SHIPPING WEIGHT (LBS)	OPERATING WEIGHT (LBS)
3	PAEL03.0MI2.0	2597	2708
4	PAEL04.0MI4.0	2597	2708
6	PAEL06.0MI2.0	2704	2933
7	PAEL07.0MI5.0	2704	2933
8	PAEL06.0MI8.0	2788	3024
9	PAEL07.5MI5.0	2788	3024



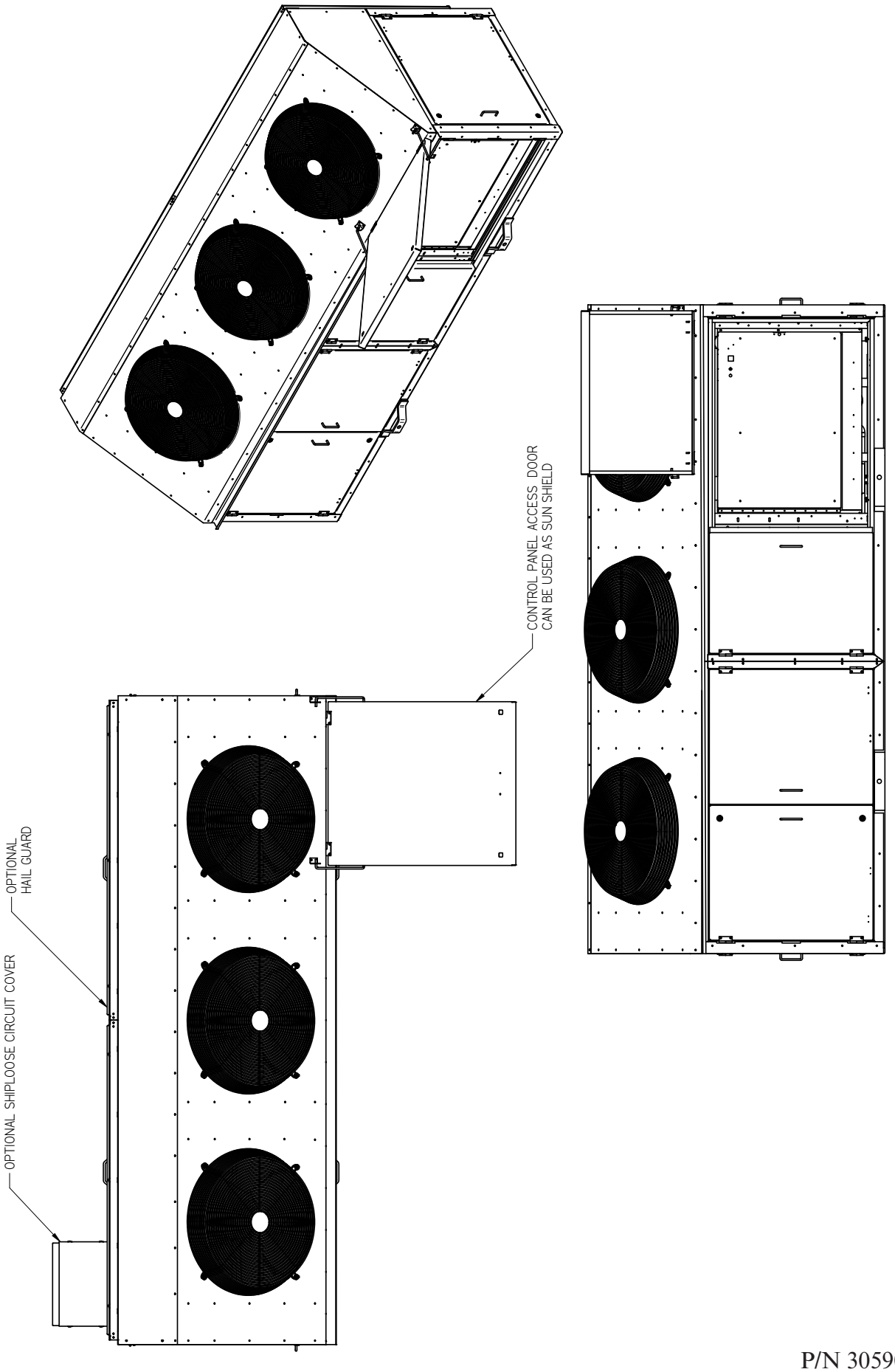


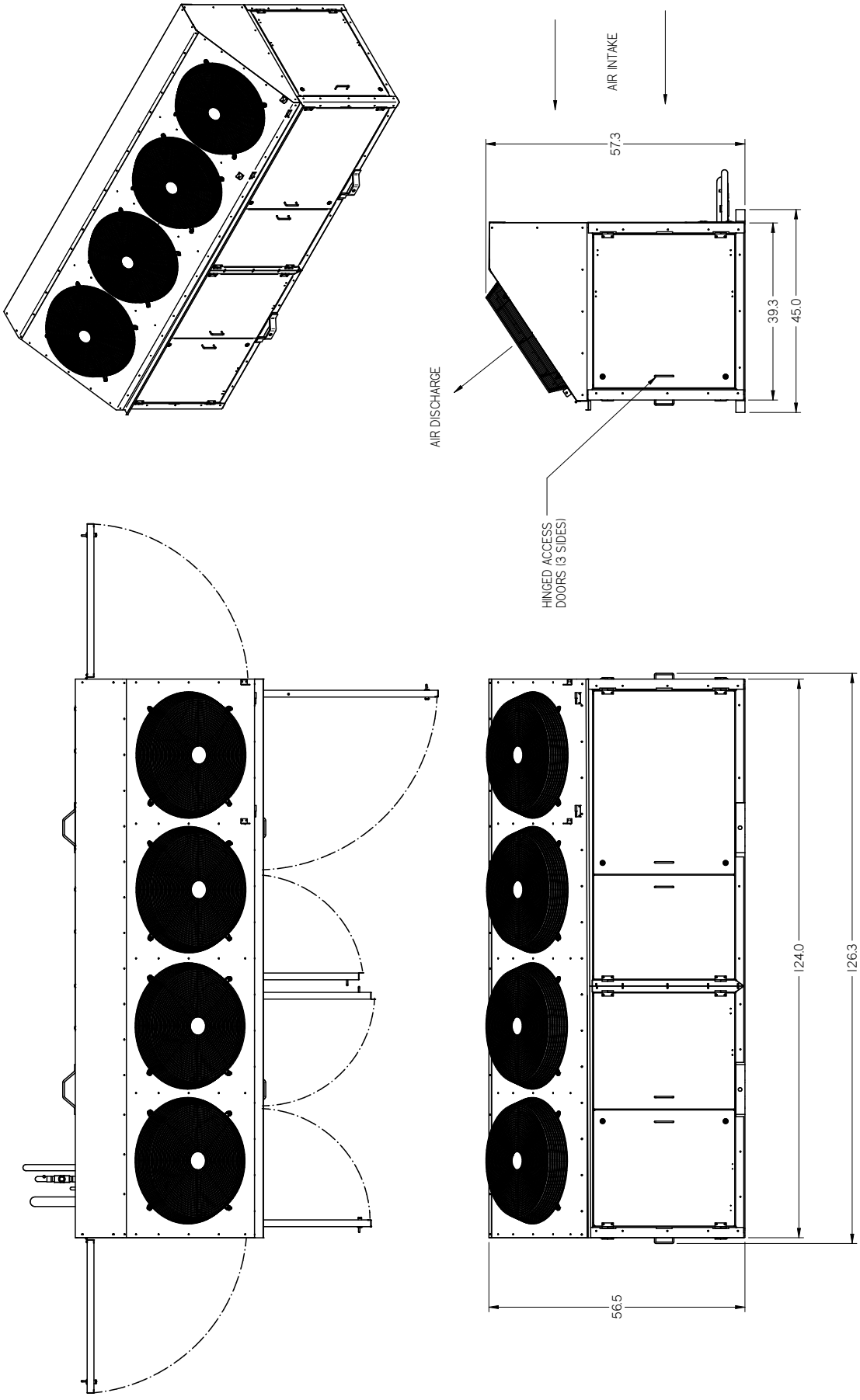




For installation of Proto-Aire Units, full perimeter support is required.

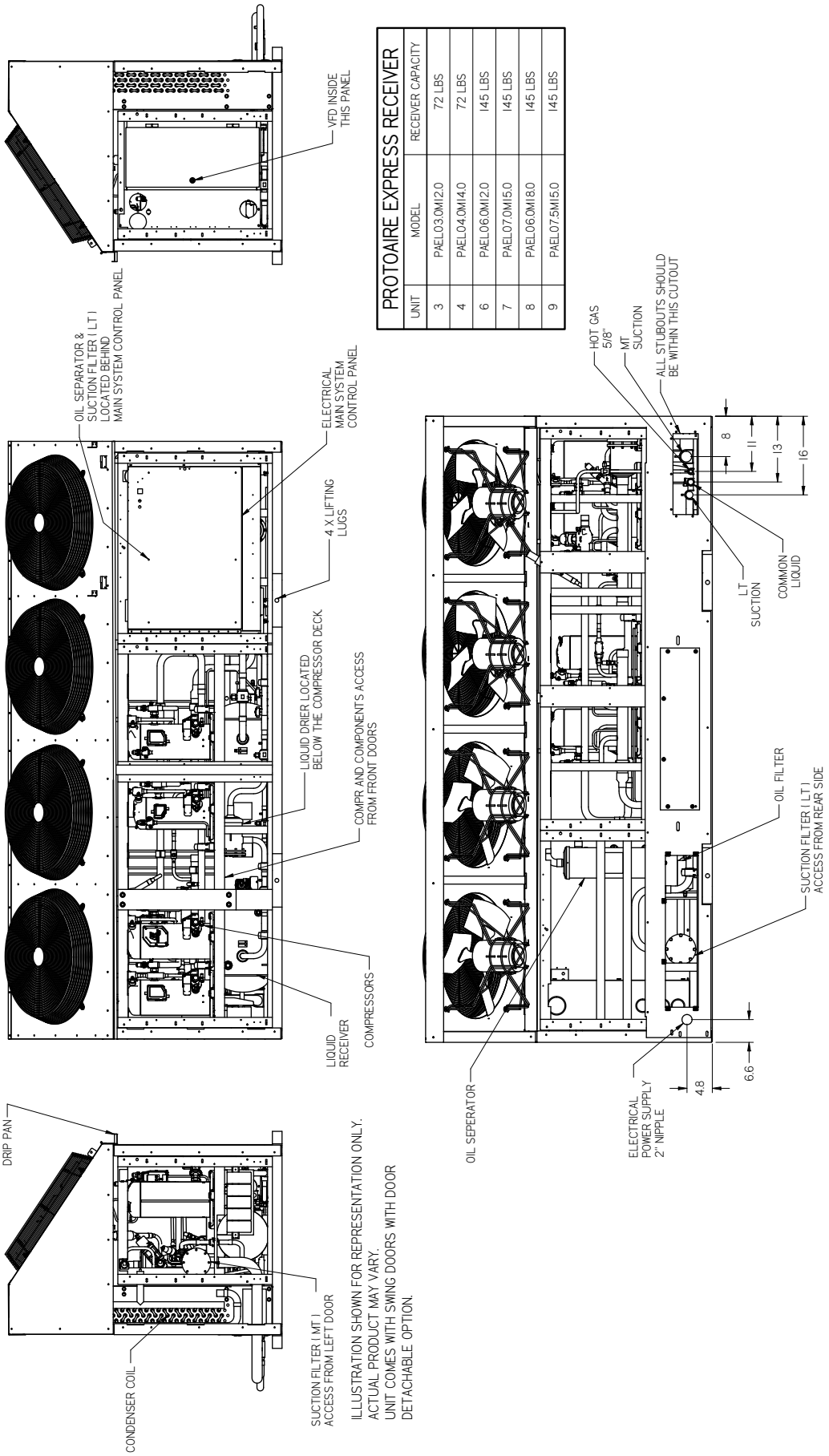
3-Fan Proto-Aire XP with hinged doors





4-Fan Proto-Aire XP with hinged doors

4-Fan Proto-Aire XP with hinged doors



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4-Fan Proto-Aire XP with hinged doors

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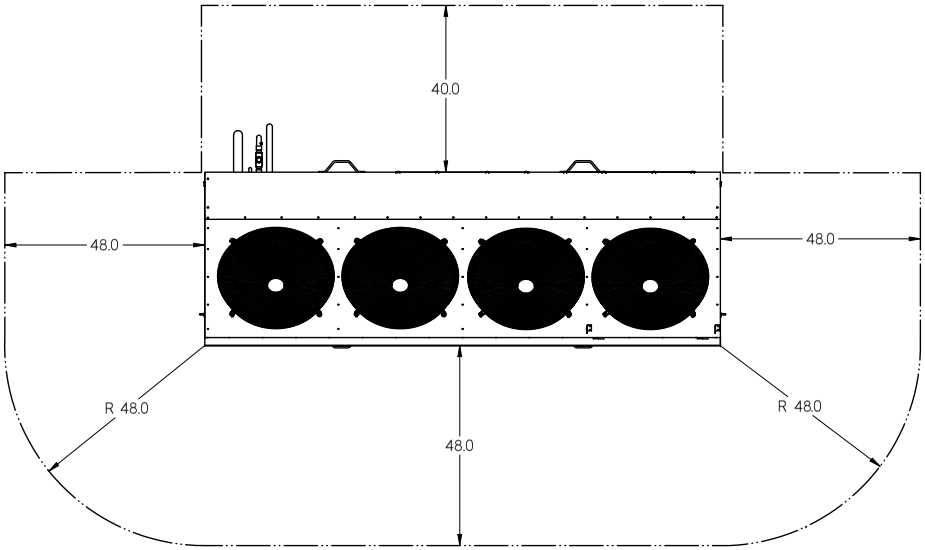
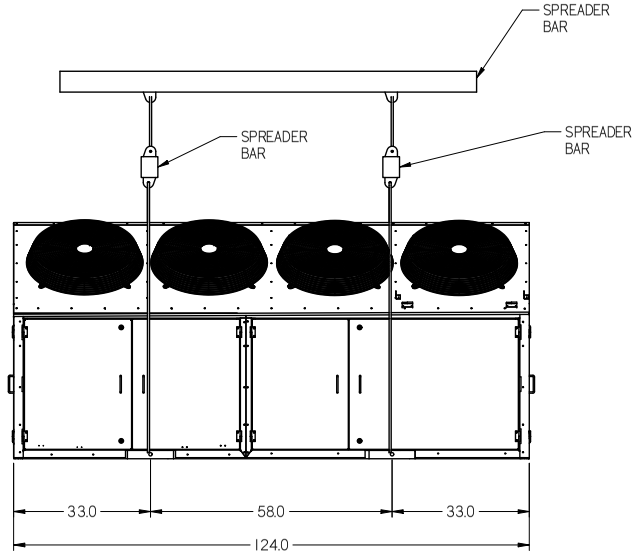
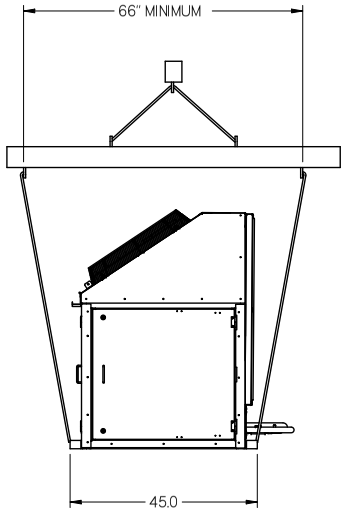
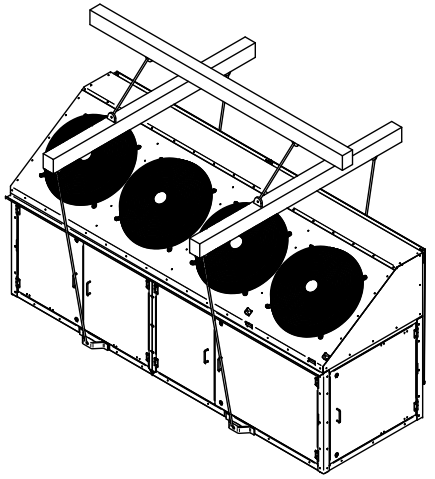
8	PAEL06.0MI8.0	2788	3024
9	PAEL07.5MI5.0	2788	3024



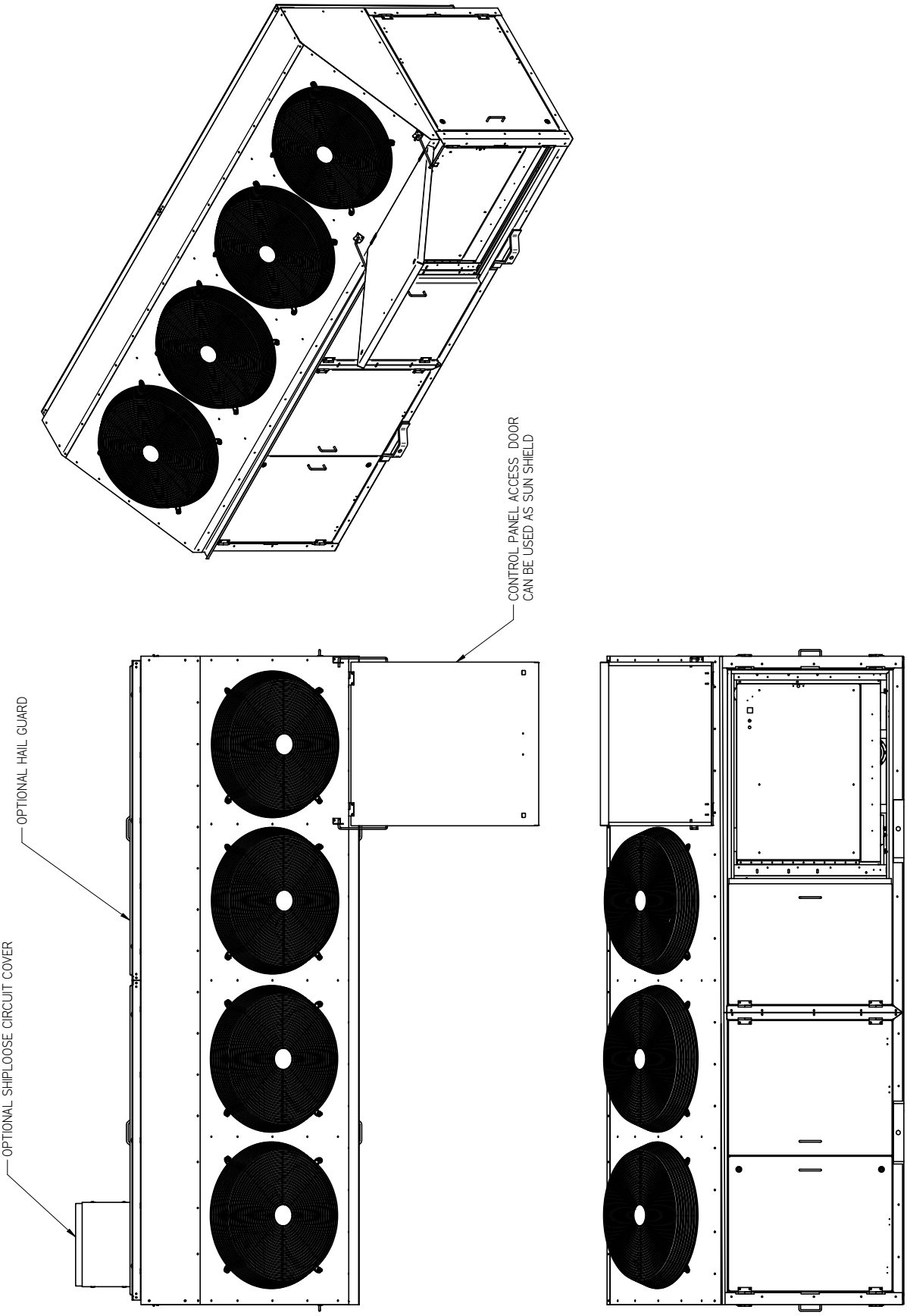






For installation of Proto-Aire Units, full perimeter support is required.

4-Fan Proto-Aire XP with hinged doors



REFRIGERATION PIPING

Important: Since Hussmann has no direct control over the installation, providing freeze-burst protection is the responsibility of the installing contractor.

Always use a pressure regulator with a nitrogen tank. Do not exceed 2 psig and vent lines when brazing. Do not exceed 350 psig for leak testing high side. Do not exceed 150 psig for leak testing low side.

Always recapture test charge in approved recovery vessel for recycling.

Overview

This section details the major refrigeration components and their locations in each piping system.

Refrigeration Line Piping

Use only clean, dehydrated, sealed refrigeration grade copper tubing. Use dry nitrogen in the tubing during brazing to prevent the formation of copper oxide. All joints should be made with silver alloy brazing material, and use 35% silver solder for dissimilar metals.

Liquid and suction lines must be free to expand and contract independently of each other. Do not clamp or solder them together. Run supports must allow tubing to expand and contract freely. Do not exceed 100 feet without a change of direction or an offset. Plan proper pitching, expansion allowance, and P-traps at the base of all suction risers. Use long radius elbows to reduce flow resistance and breakage. Avoid completely the use of 45° elbows. Install service valves at several locations for ease of maintenance and reduction of service costs. These must be UL approved for 450 psig minimum working pressure.

All Protoaire XP units have one-inch drip pan at the bottom of the unit. DO NOT run piping through the bottom of this pan.

Return Gas Superheat

Return gas superheat should be 10 to 30 °F on all units.

Suction Line

1. Install a downward slope in direction of flow. A P-trap is required for all vertical risers.
2. Line may be reduced by one size after first third of case load and again after the second third. Do not reduce below evaporator connection size.
3. Suction returns from evaporators must enter at the top of the line.

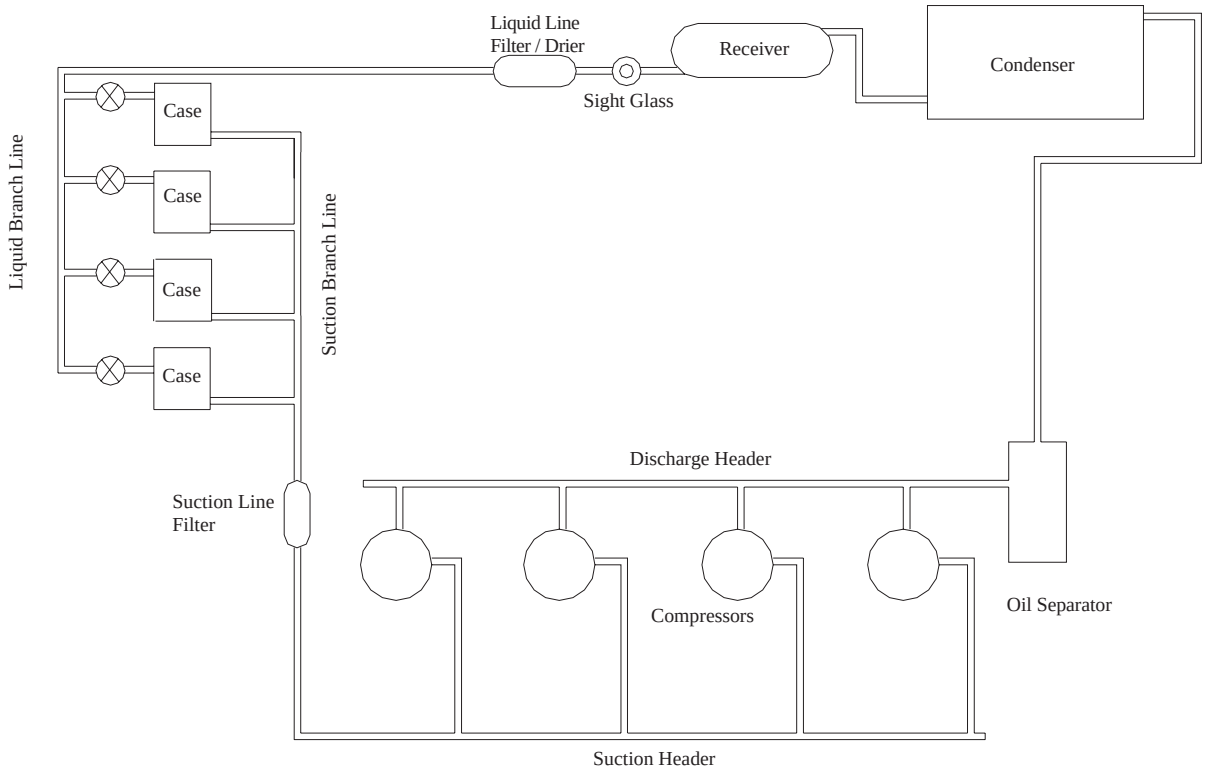
Liquid Line

1. Take-offs to evaporators must exit the bottom of the liquid line. Provide an expansion loop for each evaporator take-off (minimum 3-inch diameter).
2. Off-time and Electric Defrost may be reduced by one size after one half the case load. Do not reduce below evaporator connection size.

Refrigeration Cycle
Oil Return System Not shown

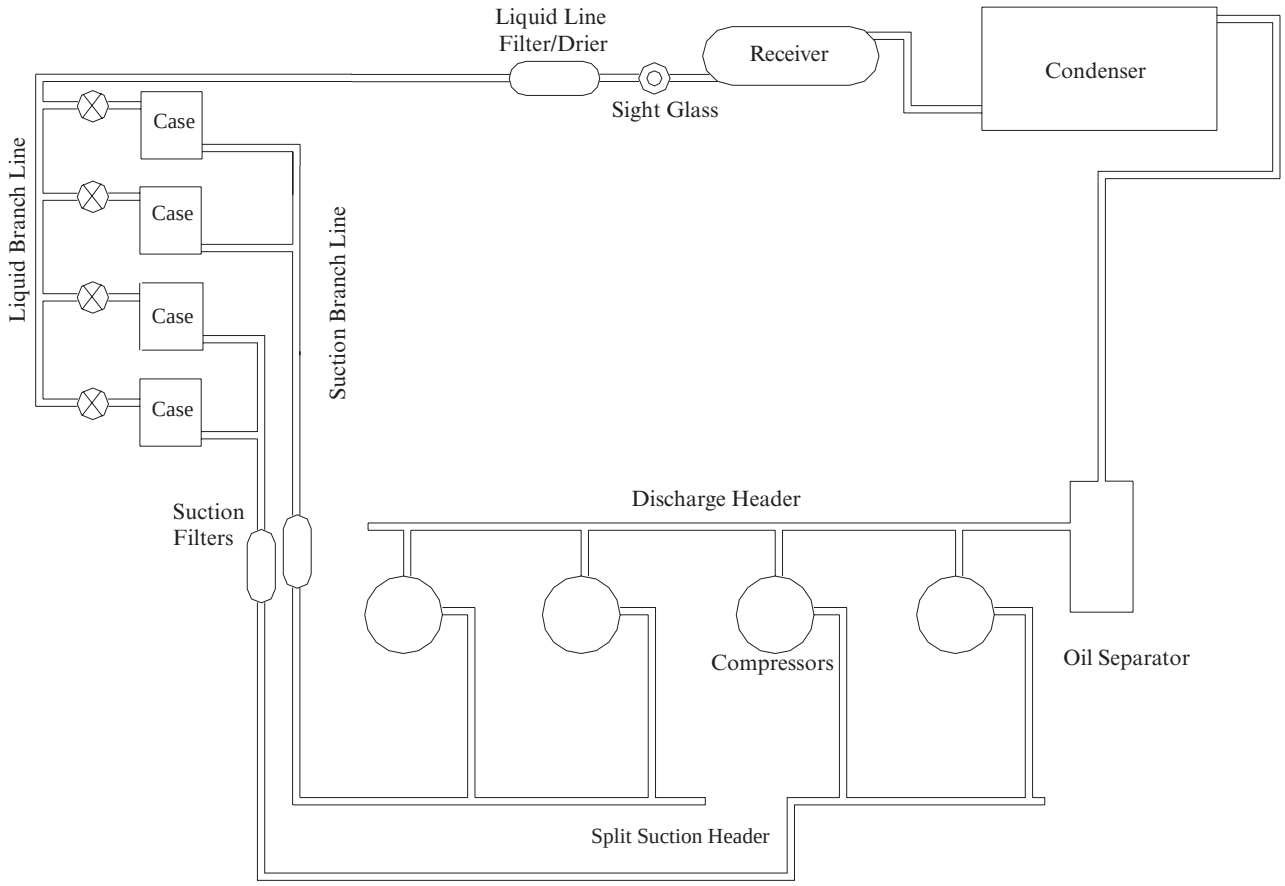
Beginning with Compressors, refrigerant vapor is compressed into the Discharge Header. The oil separator effectively divides the refrigerant from the lubricant in the system. The lubricant is then returned to the compressors. The Condenser dissipates the unwanted heat from the refrigerant into an air-cooled condenser.

The receiver acts as a vapor trap and supplies the Liquid Line with quality liquid refrigerant. A Liquid Line Filter/Drier removes water and other contaminants from the refrigerant. The liquid branch line supplies liquid refrigerant to the Thermostatic Expansion Valve (TXV), which in turn feed refrigerant to the cases (evaporator coils). These coils pick up heat from the product stored in the cases. A Suction Filter removes system contaminants from return vapor, which is factory supplied but field installed. It is also a good idea to install isolation valves for ease of service. The oil return system is not shown in the following illustration.



Proto-Aire XP with Split Suction
Oil Return System and Crossover not shown

Split suction is used when two temperatures are required from the same Proto-Aire XP unit. The use of split suction allows for greater efficiency due to the fact that the compressors are operating closer to the desired suction temperature.

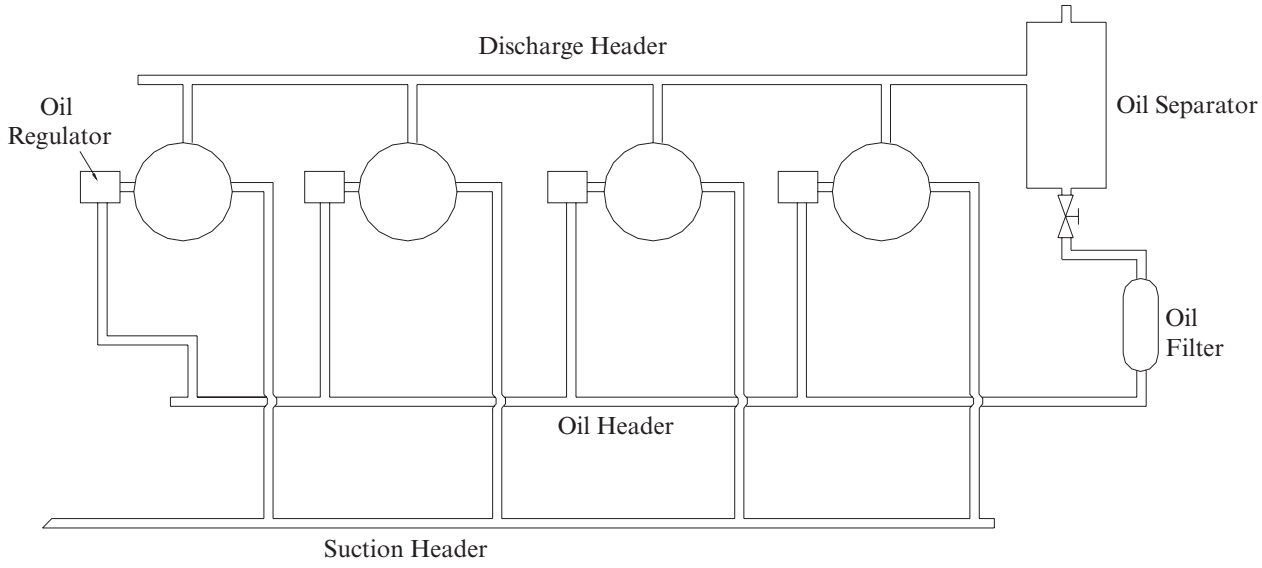


Oil Cycle

Discharge refrigerant carries droplets of oil from the compressor's outlet. The Oil Separator separates the oil from the refrigerant. The oil is stored in the Oil Separator until needed. The oil returns to the system through the high-pressure line and oil filter.

The oil filter removes impurities from the oil. The high-pressure oil is distributed to the electronic oil level control, which feeds oil into the compressor through a solenoid valve.

Electronic oil regulators monitor oil levels. The units are powered by a 24V power supply. When the oil level in the compressor drops below ½ sightglass, the fill light comes on, and the oil solenoid is energized. If after 90 seconds the oil level does not rise above ½ sightglass, the unit opens the compressor control circuit. If oil becomes available, the electronic oil level control will automatically re-set and the compressor will resume operation.



<u>Compressors with Pre-Charged Oil as Standard</u>

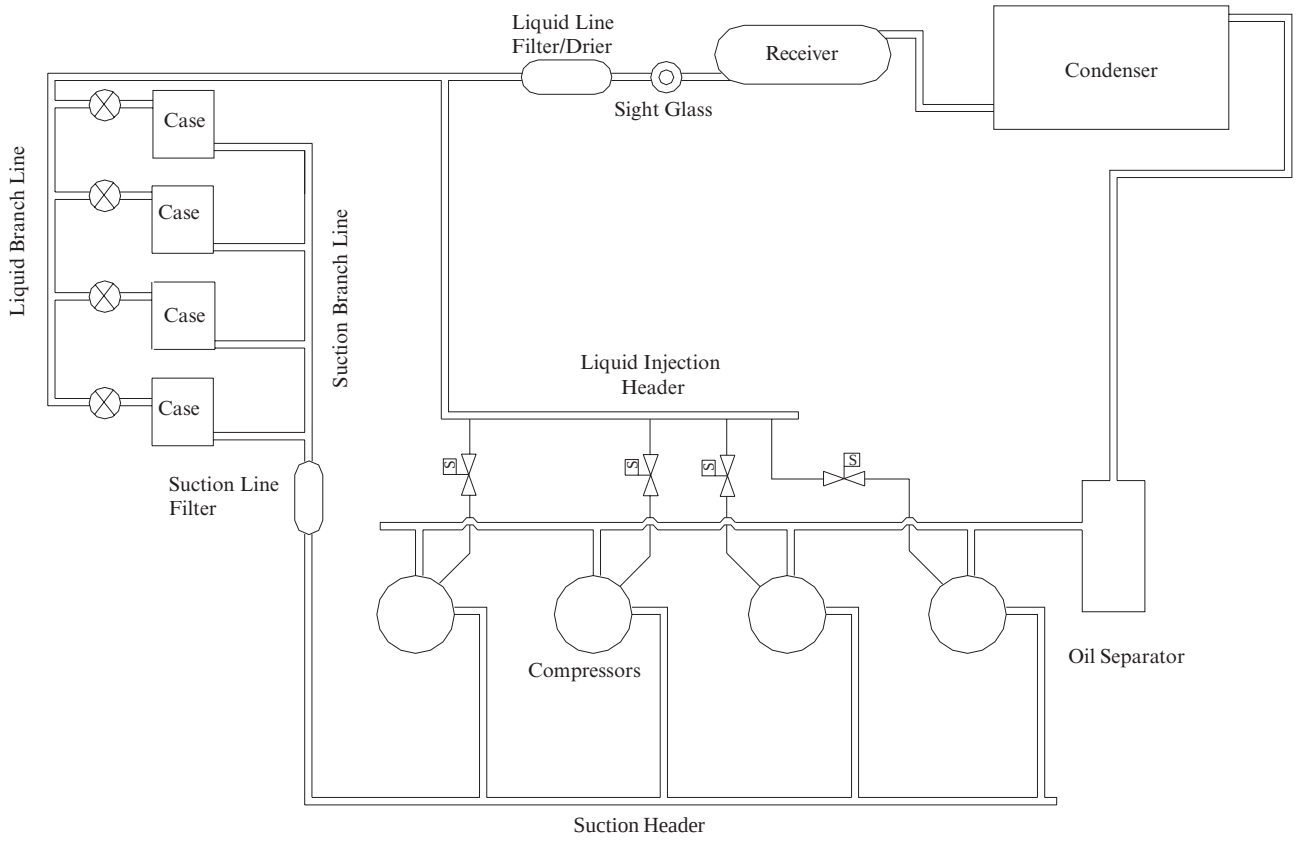
Proto-Aire
Proto-Aire XP

Liquid Injection

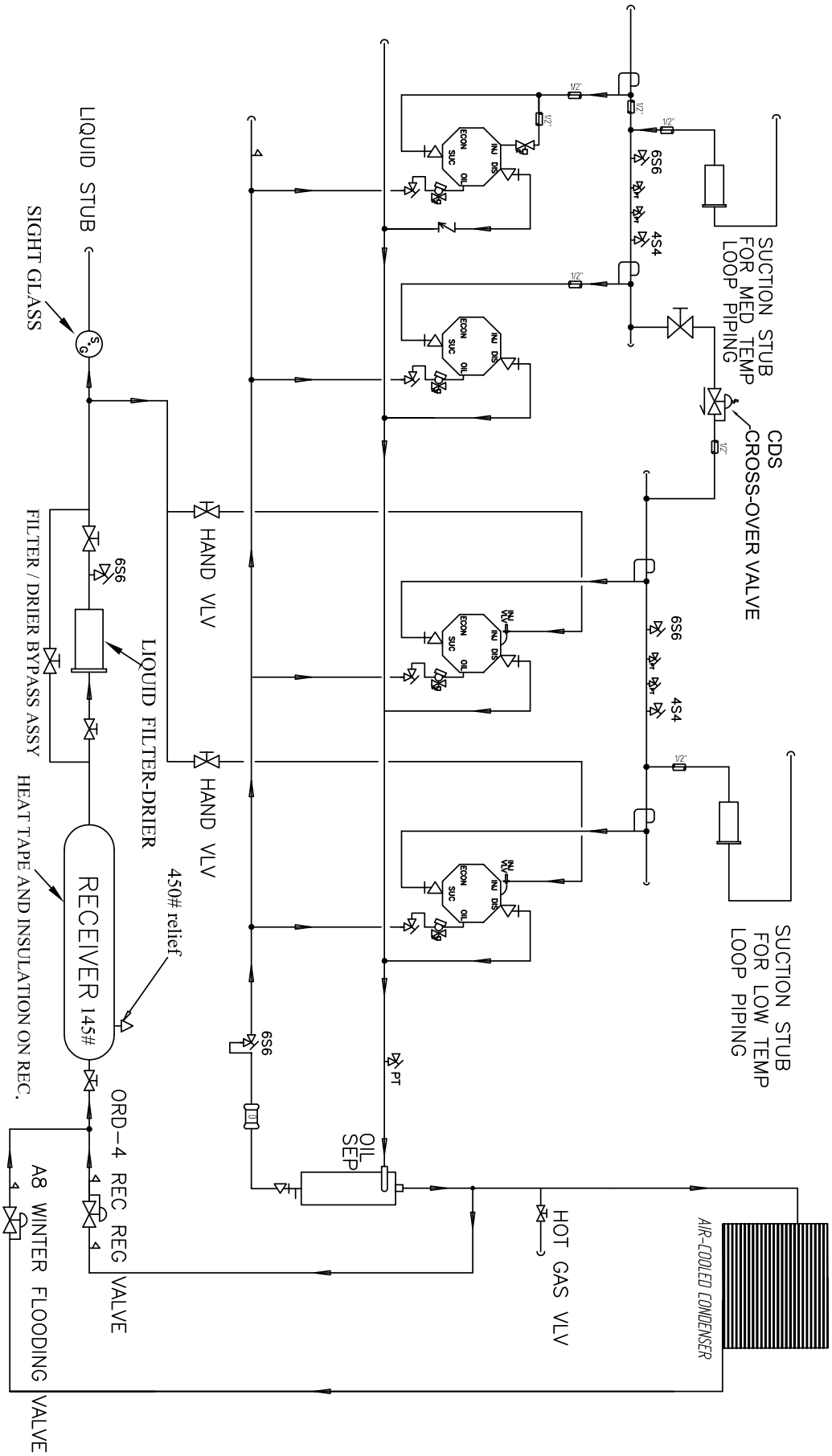
When operating at high compression ratios, injecting liquid partway through the compression process is a method of cooling the scroll compressor. A discharge temperature control (DTC) valve or an EXV (Electronic Expansion Valve) must be applied for liquid injection. The EXV valve requires an injection solenoid valve.

Each compressor liquid injection line has its own shutoff valve, injection solenoid valve with EXV or DTC valve, and supply hose. When the compressor is off, the solenoid valve is de-energized via a current sensing relay mounted at the compressor contactor. If the DTC valve is used, the DTC valve will close when the compressor is off.

Note: On units with remote receivers, liquid refrigerant must be piped to the liquid injection stub-out at the back of the Proto-Aire XP unit.



PROTO-AIRE XP PIPING DIAGRAM



Electrical

Field Wiring

Maximum Field Wire Size
Based on the total load amperes, the largest connectable wire sizes for the terminals on the convenience switch are listed below. (Wire size is based on the serial plate minimum circuit ampacity.)

Total Connected RLA	Largest Connectable Wire
200 A (max)	3 /0 per Ø
400 A (max)	2 x (3 /0) per Ø

Refer to National Electric Code for temperature derating factors.

Sizing Wire and Overcurrent Protectors
Check the legend for Minimum Circuit Ampacity (MCA), Maximum Overcurrent Protective Devices (MOPD), and total RLAs. Follow NEC guidelines.

A Branch Circuit must be built to the unit using information supplied on the unit data plate for Minimum Current Ampacity (MCA) and Maximum Over Current Protective Device (MOPD).

Proto-Aire XP components are wired as completely as possible at the factory with all work completed in accordance with the National Electrical Code. All deviations required by governing electrical codes will be the responsibility of the installer.

For 208-230/3/60 Compressor Units:
To each Proto-Aire XP provide:
- One 208-230/3/60 branch circuit
- One 120/1/60 neutral
- One ground wire to earth ground

Alarm Wiring

Proto-Aire XP provides one NO/NC pilot duty relay for remote alarm. Relay located in the remote panel.

Temperature Sensors and Defrost Termination Thermostats

Use a shielded and grounded Belden Cable #8762, or equivalent between control panel and case sensors or thermostats.

Important:
Shielded cable must be used. The shield wire must be attached to the panel liner on the control panel door.

Terminal Connections

Wire number assignments and corresponding terminal number assignments in the Power Distribution Box differ from the smaller panel arrangement.

120V Circuit Logic

The Proto-Aire XP includes as standard a Service Receptacle (5 Amp Max)

Electronic Oil Level Control

Only the alarm contact is 120V. See pages for typical wiring diagrams.

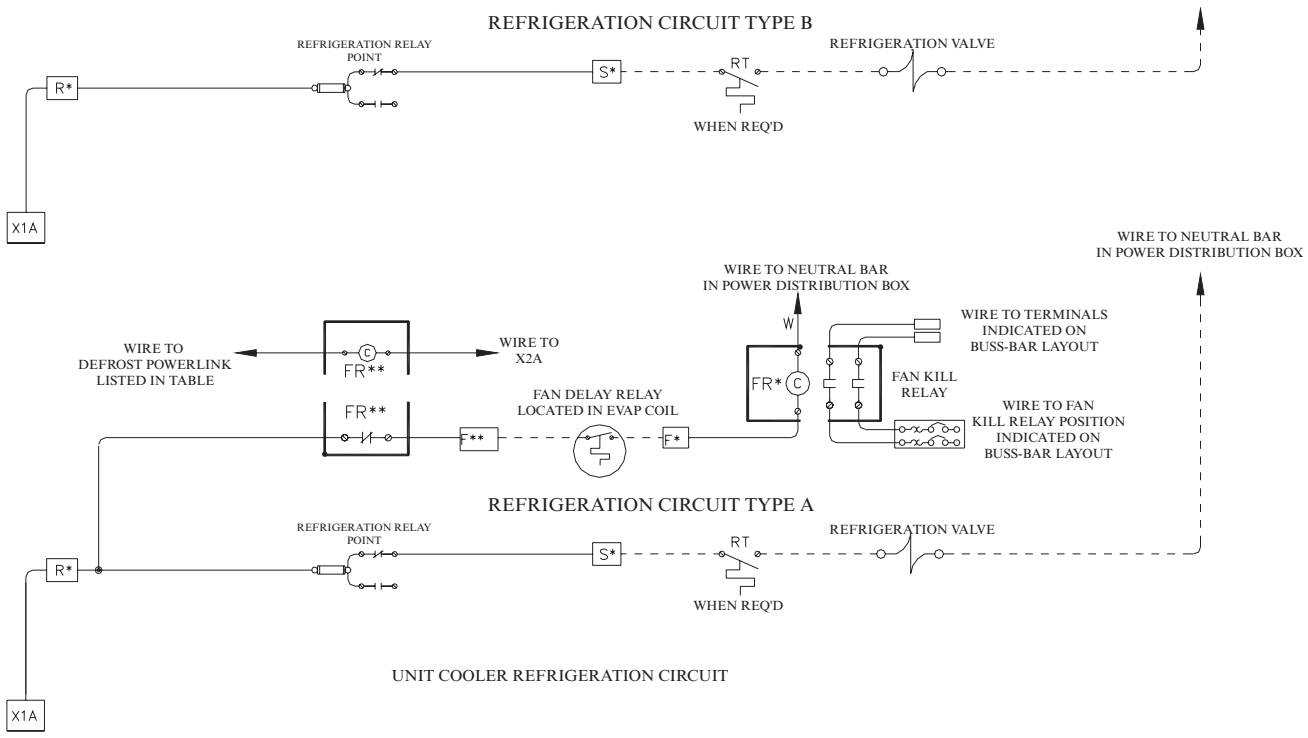
Satellite Short Cycle Control Relay

See “Proto-Aire XP Sequence of Operation” Manual, Section 2a, Compressor Staging Low Temp Single Compressor

Defrost Schedule

Refrigeration Circuit Control

The following circuits show the electrical connections during the refrigeration cycle. Power comes into the control board from X1A. The refrigeration solenoid valve and thermostat (if needed) are wired to the terminal pin. The unit cooler circuit is the same as a simple refrigeration circuit but it has an additional fan control circuit. The fan control circuit ensures that the fans will not turn on during the defrost cycle. It should be noted that off time defrost is achieved by turning the refrigeration valve off. For unit cooler fan wiring.



Defrost Circuit Control

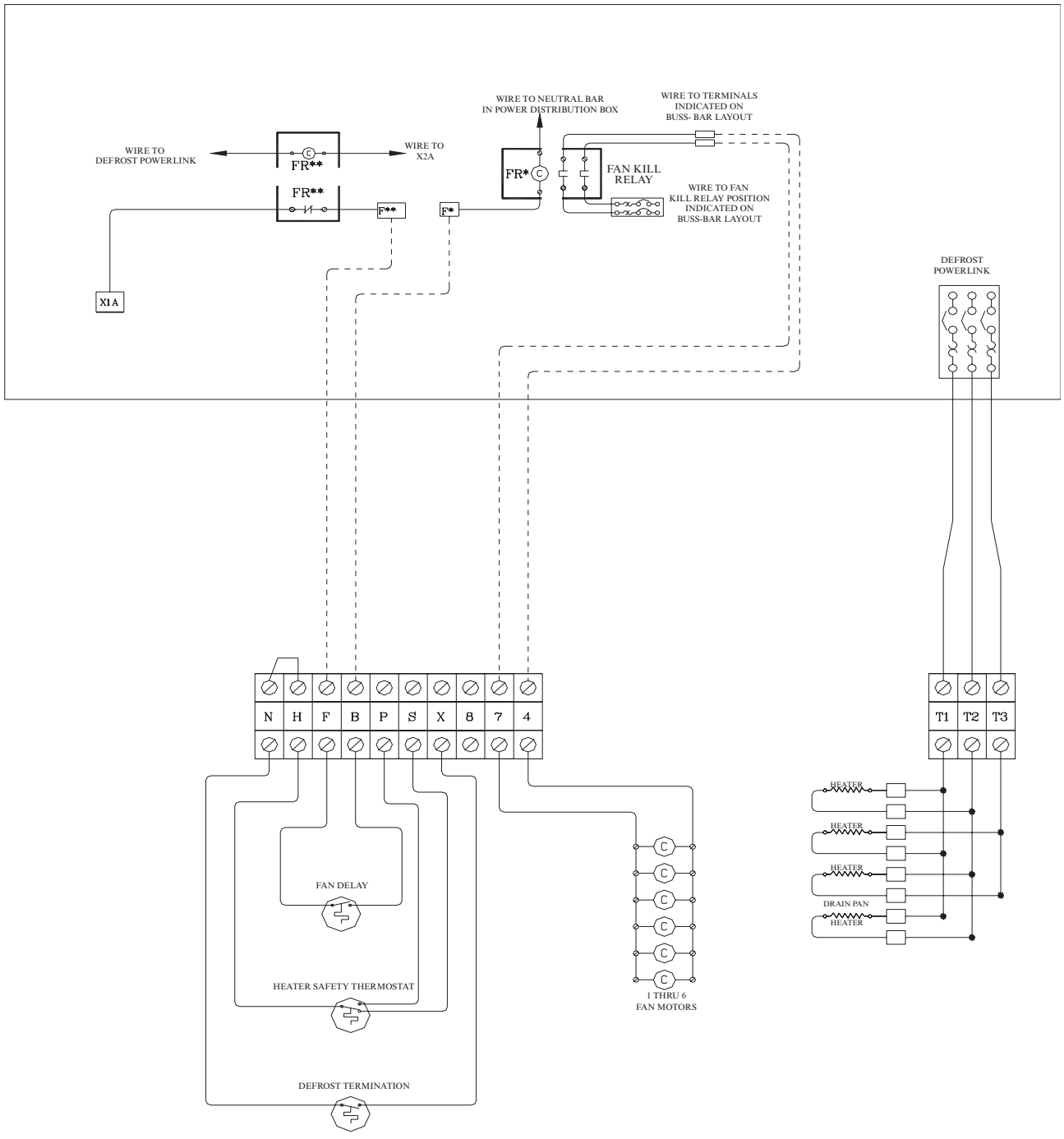
Off time & Electrical Defrost Sequence of Operation:

See “Proto-Aire XP Sequence of Operation” Manual, Section 8b, Defrost Control.

Unit Cooler Fan Wiring

The following drawing shows the wiring to control the fans in a unit cooler. Defrost termination by Klixon may connect back to the controller relay board based on individual customer specs. See job specific board layout sheets and wiring diagrams for your individual installation.

Unit Cooler Fan Wiring



Startup

Important: Since Hussmann has no direct control over the installation, providing freeze-burst protection is the responsibility of the installing contractor.

Know whether or not a circuit is open at the power supply. Remove all power before opening control panels. Note: SOME EQUIPMENT HAS MORE THAN ONE POWER SUPPLY.

Always use a pressure regulator with a nitrogen tank. Do not exceed 2 psig and vent line when brazing. Do not exceed 350 psig for leak testing high side. Do not exceed 150 psig for leak testing low side.

Always recapture test charge in approved recovery vessel for recycling.

Startup

Charging the Refrigeration Side

Leak Testing

Visually inspect all lines and joints for proper piping practices.

Open Power Supply
Compressors – Open circuit breakers to all compressors.

Isolate
Compressors – Front seat service valves on suction and discharge.

Pressure Transducers – Close angle valves.

Open
Valves – to condenser, heat reclaim, receiver.

Liquid Line Solenoid Valve(s) – Solenoid should be energized.

Verify
Refrigerant requirements for system, compressors, and TXV's in merchandisers and coolers.

Electrical supply and component requirements.

Test Charge
Using properly regulated dry nitrogen and refrigerant mixture, pressurize the system with vapor only. Bring the system pressure up to 150 psig. Use an electronic leak detector to inspect all connections. If a leak is found, isolate, repair, and retest. Be sure system is a 150 psig and all valves closed to repair the leak are re-opened. After the last leak is repaired and retested, the system must stand unaltered for at least 12 hours with no pressure drop from 150 psig.

Evacuation
Nitrogen and moisture will remain in the system unless proper evacuation procedures are followed. Nitrogen left in the system may cause excessive head pressure. Moisture causes TXV ice blockage, wax build up, acid, oil, and sludge formation.

Do not simply purge the system because this procedure is illegal, expensive, harmful to the environment, and may leave moisture and nitrogen.

Do not run the compressor to evacuate because this procedure introduces moisture into the compressors crankcase oil and does not produce adequate vacuum to remove moisture from the rest of the system at normal temperatures.

Setup
Using an 8 CFM or larger vacuum pump, connect to the access port on both the suction and discharge header of the Proto-Aire XP unit. Connect one micron vacuum gauge at the pump, and one at the furthest point in the system from the compressor. Plan procedures so breaking the vacuum with refrigerant will not introduce contaminates into the system. The vacuum pump must be in good condition and filled with fresh oil to achieve desire results.

Procedure – Triple Evacuation

Pull a vacuum to 1500 microns. If the vacuum fails to hold, determine the cause and correct. Begin again and pull a vacuum to 1500 microns.

Break the vacuum with refrigerant vapor to a pressure of about 2 psig. Do not exceed the micron gauge transducer's maximum pressure surge to the transducer of the micron gauge.

Pull a second vacuum to 1500 microns.

Break the vacuum with refrigerant vapor to a pressure of about 2 psig.

Pull a third vacuum to 500 microns. Close vacuum header valves and allow system to stand for a minimum of 12 hours. If the 500 micron vacuum holds, charging may begin. If not, the cause must be determined and corrected. Repeat the entire evacuation procedure from the first step.

Pre-charge Check List
During any of the pull downs, check:

Merchandisers
- Electrical requirements and power supply
- Electrical connections tight and clean
- Proper fan operation
- Thermostat setting

Walk-in Coolers and Freezers
- Electrical requirements and power supply
- Electrical connections tight and clean
- Proper fan operation
- Thermostat setting

Refrigerant Charge
Remember the condenser in the Proto-Aire XP holds only a small amount of refrigerant. It is therefore very easy to overcharge the Proto-Aire XP unless care is taken during the charging process.

Charging until the liquid sight glass is clear of bubbles will often overcharge the system causing head pressure alarms.

Because the HFC refrigerants are less dense than the refrigerants they replace, they will tend to "flash" or bubble more easily, even when the correct charge is in the system. Therefore, charge only until the sight glass on the receiver is covered with refrigerant when the system is operating in a balanced refrigeration mode. Proto-Aire XP units with gas defrost should also be monitored during defrost to ensure that the receiver does not completely empty. Add enough refrigerant, if necessary, to maintain a liquid seal on the receiver outlet if the receiver empties during defrost.

Oil Charge

Charge the Oil Separator with oil.

Use only Mobil EAL Arctic 22 CC, ICI Emkarate RL 32 CF, or Copeland Ultra 22 CC
Oil Separator is shipped without oil charge.

Oil Levels
Compressor top half of the sight glass
Oil Separator between the two sight glasses

Important Notice to the Installer
The compressors and Oil Separator must be closely monitored during startup because the POE oil does not return from the evaporators as quickly as mineral oil

Compressor Motor Rotation
To check compressor rotation, use the following procedure:

1. Install gauges on suction and discharge headers. Be aware of Satellite and Split-Suction Proto-Aire XP units when making hookup. A momentary compressor run should cause a drop in suction pressure and a rise in discharge pressure.

2. Switch OFF all breakers in the control panel EXCEPT the control circuit breaker.

3. Turn ON main power switch.

4. Look for the green light on the single-phase protector. If the light is red, turn OFF the main power switch. All Protoaire XP™ 3-phase wiring is connected L1 to T1, L2 to T2, and L3 to T3. Have the field connections corrected so the phase protector indicates phase alignment. (The light is green.)

5. Turn ON main power switch.

6. Turn all compressors ON using the electronic controller.

7. Momentarily turn ***ON*** compressor breaker #1 and verify correct pumping direction. Check all compressors before switching any wires. If all compressors are rotating backwards, change two legs at the field side of the convenience switch. For individual compressor, change the Legs on the load side of the compressor contactor.

8. **Remove Forced Conditions**

Final Checks

Return Gas Superheat

Return gas superheat should be 10 to 30 °F on all units

Once system is up and running, it is the responsibility of the installer to see that all the final adjustments are made so the Proto-Aire XP delivers maximum temperature performance and efficiency for the customer. These include:

Thermostatic Expansion Valve superheat adjustment
Electronic Pressure Regulator settings
Defrost scheduling and timing
Condenser flow balance
High and low pressure controls
Thermostat settings
Adjustments to electronic controls
Electronic oil level controls

Thoroughly inspect all field piping while the equipment is running and add supports where line vibration occurs. Be sure additional supports do not conflict with pipe expansion and contraction.

When merchandisers are completely stocked, check the operation of the system again.

At 90 days recheck the entire system, including all field wiring.

Caution
Never run the compressors in a vacuum as this may quickly damage the compressors.

Control Settings

High Pressure Safety – 395 psig
Vacuum Pressure Safety – 0 psig
Discharge Temperature Sensor – 240 °F

It is mandatory that the mechanical low-pressure controls be set in the field

Electronic Oil Level Control

Electronic oil regulators monitor oil levels. The units are powered by a 24V power supply. When the oil level in the compressor drops below ½ sightglass, the fill light comes on and the oil solenoid is energized. If after 90 seconds the oil level does not rise above ½ sightglass, the unit opens the compressor control circuit. If oil becomes available, the control will re-set and the compressor will resume operation.

Auxiliary Systems

This form of sensor inputs can be programmed for analog operation (case temperature sensor) or digital operation (such as Klixon). The auxiliary sensors are typically used to provide information to control regarding a particular defrost circuit. The auxiliary sensors can also be used to provide monitoring inputs from some external device; i.e. glycol temperature, computer room thermostat, or pump station alarm relay closure.

It is important to remember that the auxiliary sensors, when used to provide information regarding a particular defrost circuit, must be located in the correct defrost circuit lineup of cases. Sensor A1 can only be used on Defrost Circuit #1. Sensor A2 can only be used on Defrost Circuit #2. The same attachment of sensors to defrost circuits can be repeated for A3 through A6.

NOTE: In the following examples, the #( ) refers to a defrost circuit and/or Aux sensor # between 1 and 6. The same screens apply for all circuit and sensor attachments.

Temperature Termination (Digital Mode)

When an Auxiliary Sensor is used to connect a defrost termination thermostat (Klixon*) device to the control in order to terminate defrost on high temperature, the following information is required for proper operation.
(*No case temperature sensor present.)

Note: When temperature termination is Enabled, the control will automatically alarm on a non-defrost mode contact closure from the defrost termination thermostat device. It is assumed that while in refrigeration, the defrost termination thermostat (which is a close on rise device) should be open.

Temperature Termination (Analog Mode)

In some applications of the Proto-Aire XP, there are not enough inputs to provide all the information to the control for terminating defrost, alarming and monitoring purposes. When this is the case, a temperature sensor and a defrost termination thermostat can be wired in parallel at the case and then one cable run back to the Proto-Aire XP control and connected Auxiliary input. Under this application, the temperature sensor is used to provide alarming and monitoring of discharge air while the defrost termination thermostat provides the termination input.

Electric Defrost

Application

Electric defrost is the same with Protoaire XP as with any other system. This breaker will provide overload protection, and also be the contactor that switches the defrost heaters on and off. Liquid solenoids should be used to control temperature and defrost for each circuit. This prevents a possible pump down problem. The defrost solenoid and breakers are controlled by independent output relays on the defrost board, but will be assigned (programmed) so the same defrost circuit so that they will be energized simultaneously. The amp draw for each circuit must be entered into the controller so that a defrost shedding of compressors can occur reducing the overall amp draw of the unit. Isolation ball valves for each case lineup are recommended for ease of servicing.

ALSO SEE "Proto-Aire XP Sequence of Operation" Manual, Section 8b, Defrost Control.

Defrost Operation

1. The control board will de-energize the solenoid (suction or liquid) when a defrost occurs while simultaneously energizing the relay controlling the defrost breakers.

Offtime Defrost

Application

Offtime defrost is the simplest defrost type. A relay is used to de-energize a solenoid valve at specific times. Suction stop solenoid valves should be used to control temperature on long lineups due to the limited receiver capacity. Isolation ball valves for each case lineup are recommended for ease of servicing.

Defrost Operation

1. To initiate a defrost, the control board will de-energize the specific circuit solenoid.

2. After the preset time for defrost has elapsed, the unit will energize the solenoid allowing normal refrigeration.

Sensor Applications

Suction Pressure Sensor
This suction pressure input provides the electronic controller the necessary information to cycle the compressors on and off to maintain an overall setpoint.

ALSO SEE "Proto-Aire XP Sequence of Operation" manual, section 2, COMPRESSOR STAGING

Suction Pressure Input
This suction pressure input can provide the electronic controller the necessary information to cycle the compressors on and off under a split suction configuration.

ALSO SEE "Proto-Aire XP Sequence of Operation" manual, section 2, COMPRESSOR STAGING.

ALSO SEE "Reference Setpoint Chart" at the end of this manual.

All Additional Pressure/Temperature Inputs
This temperature input has a dual function operation: 1) pressure input for monitoring discharge pressure or 2) alarming and monitoring of temperature for a display case. Since this input can operate as a temperature or pressure, you will need to configure both the hardware (input circuitry) and software (memory settings) for proper operation. When operating as a pressure input, the following should be programmed: Input mode (Set to pressure), High Alarm, Low Alarm, Alarm Activation (Enable/Disabled).

When operating as a temperature input, the following should be programmed: Input mode (Set to temperature), High Alarm, Low Alarm, Alarm Activation (Enable/Disabled), Circuit Attachment.

Troubleshooting Guide

This section is to aid in the troubleshooting of electrical and electronic considerations of the Proto-Aire XP Refrigeration System. The manual assumes that the reader has a working knowledge of the electronic controller communications platform used in networking the Proto-Aire XP electronic controls. It will be necessary to have a copy of the control manuals on hand to facilitate the troubleshooting process.

The structure of this troubleshooting guide is based on a Question/Answer format. In most cases, the electronic controller will be used to determine whether the problem lies within the electronic control, or external to the control – most likely contained in the control panel. You will need to follow the instructions carefully to ensure a quick method of solving the problem or question.

IMPORTANT
The current draw required by analog meters (Volt-Ohm Meters or VOMs) **can permanently damage electronic equipment.**

Never use a VOM to check computer components or computer controlled systems. Use a Digital Multi-meter (DMM) to measure voltage, amperage, milliamperes, or ohms. If a range is exceeded, the display will show OL (overload).

Electrical Questions

Problem A: The compressor will not turn ON or will not run.

Step A1 Visually observe if the Alarm on the control board is **ON**. If it **ON**, go to step A2. If it is OFF, go to Step A9.

Step A2 Access the Proto-Aire XP and enter the Force Comp On submenu. Enter the compressor number you wish to turn **ON**. Visually observe if the correct compressor relay output LED on the control board is turned **ON**. If turned **ON**, go to Step A3. If it does not turn **ON**, go to step A7.

Step A3 If the compressor contactor is energized, verify that the compressor turned **ON** by cycling the compressor circuit breaker (the compressor should turn **ON** and **OFF** with the circuit breaker) or use an amp probe and measure all three phase wires between the contactor and the compressor. If the compressor contactor did not energize, go to **Step A6.**

Step A4 If the compressor contactor energized, but the compressor cannot be cycled with the circuit breaker, you will need to open up the compressor terminal box located on the side of the compressor, and ensure that the power wires are tightened down. **Important: you should turn the compressor circuit breaker off before implementing this check.**

Step A5 If the compressor wires are tight with the terminal box, the compressor may be damaged internally and may need to be replaced.

Step A6 Problem appears to be located in the control circuit wiring, most likely in one of the safeties. Referring to the supplied customized wiring diagram, use a digital voltmeter and determine where the circuit is being broken. The control circuit originates from the phase monitor, passes through the control board safety switch, the discharge line thermostat, and finally through the electronic oil level control safety.

Step A7 If you cannot force the compressor **ON** through the controller parameters:

1. No electric defrost is currently engaged. Electric defrosts implement a compressor shedding routine, which may be keeping the particular compressor you want to energize off-line.
2. The correct number of compressors is installed.
3. Check that the suction pressure is not below 2 psi activate the vacuum prevention routine which will not allow the compressors to turn **ON**.

Step A8 If the preceding parameters check out, you may need to replace the electronic control board.

Step A9 At this point, it is assumed that the electronic control board is in switchback (see page 6-6 for details describing switchback). If the compressor you are trying to turn ON is not wired to the switchback control circuit (refer to the supplied customized wiring diagram), you will need to investigate the cause of this switchback condition and correct the existing problem.

Step A10 If the compressor you are trying to turn ON is wired into the switchback control circuit, use a digital voltmeter and determine where the circuit is being broken. The switchback control circuit originates from the phase monitor, passes through the switchback relay on the control board, through the low pressure mechanical backup switch, then back through the control board relay and fuse, through the high pressure safety switch, the discharge line thermostat and finally through the electronic oil level control safety.

Problem B: Evaporator is not defrosting.

Step B1 Visually observe if the Alarm Relay LED on the control board is ON. If LED is ON, got to step B2. If LED is OFF, refer to the Troubleshooting Alarms section of this document.

Step B2 Verify that the Clock contained in the Proto-Aire XP is keeping time. Access and select the Set the Clock submenu. If the clock is running, go to step B3. If the clock is not running, try changing the time to the correct setting. You may want to consult the section on Electrical Noise contained within this manual.

Step B3 Enter the defrost circuit number you wish to turn ON and activate it. Now exit and go to the Defrost Menu. Observe the circuit you forced into defrost. If the status indicates defrost proceed to Step B4. If the status does not indicate defrost, go to Step B7.

Step B4 Visually observe which defrost relay located on the defrost board is energized. The corresponding indicator light on the defrost board should be ON. If the indicator light is ON, proceed to Step B5. If the indicator light is OFF, proceed to Step B10.

Step B5 At this point, we have assumed that the control is responding correctly and the problem lies within the control panel. Use a digital voltmeter to check that voltage is present at the correct terminal blocks in the power distribution box. You will need to refer to the supplied customized wiring diagram to determine which terminal blocks are providing power for the particular case load you are defrosting. If voltage is present at the terminal blocks, verify that the case is in defrost by visual inspection and then return to Step B6. If voltage is not present at the terminal blocks, go to Step B11.

Step B6 If the status of this defrost circuit indicates it is deactivated, reactivate the circuit and verify the programming of this circuit as outlined in controller manual. If the status of this defrost circuit indicates that it is not installed, N/A, go to the Proto-Aire XP Configuration Menu and access the Proto-Aire XP Setup Submenu. Enter

the DEFR Setup program the control with the correct number of defrost circuits. Repeat this step to verify that the circuit is activated.

Step B7 Verifying the defrost circuit configuration. Check the number of defrosts per day, the defrost length and defrost start times to ensure proper configuration. Go to Step B9.

Step B8 Verifying the Defrost Output Assignments. Verify that the correct output(s) have been assigned to the appropriate defrost circuit. Now that all programming information has been verified, return to Step B3 to force the defrost on.

Step B9 Verifying the Defrost Output Assignments. Verify that the correct output(s) have been assigned to the appropriate defrost circuit. If the correct outputs have been assigned, and the status reveals the circuit is in defrost, and check the ribbon cable between the control board and defrost board. Try replacing the ribbon cable with one from another ™ to verify they cable is good or bad. If the cable is good, replace the control board. The defrost output drive chip has possibly been damaged. If the correct outputs have not been assigned, enter the correct programming and repeat this step.

Step B10 Electrical Wiring Check. Use a digital voltmeter to verify where the circuit is being broken. Power for defrost solenoids originates from the 'X1' terminal block, passes through the fuse relay located on the defrost board, and ends at the terminal block located in the power distribution block. If the fuse on the defrost board has blown, try replacing it with another fuse and repeat the voltage checks.

For electric defrosts, a minimum of two defrost outputs will be used for defrost: one for the solenoid and one for the defrost heaters. The power for the solenoid can be checked as described previously in this step. To verify the defrost heater wiring go to Step B12.

Step B11 POWERLINK™ wiring. You may want to first familiarize yourself with information on POWERLINK™ Operation as detailed in this manual. Visually inspect that the circuit breaker handles of the POWERLINK™(S), located on the bus bars within the control panel, are in the ON position. If the handle is in the ON position, use a digital meter and check for voltage at the terminals of the POWERLINK™ device and again at the terminal blocks in the power distribution panel. If voltage is not present at these two points, got to Step B13.

Step B12 POWERLINK™ Power Supply Check. Using a digital meter, inspect the POWERLINK™ Power Supply, which provides power for the POWERLINK™ device. Set your digital meter for DC voltage. There should be 24 VDC across the terminals of the POWERLINK™ Power Supply. If 24 VDC is not present, replace the POWERLINK™ Power Supply. If 24 VDC is present, go to Step B14.

Step B13 Check fuse on defrost relay board. Replace fuse if it is blown. If fuse is good, measure the voltage present at the white connector on the defrost relay board. Place the positive test lead of you meter (typically the red wire) on the normally open (N.O.) contact of the defrost relay board connector. Place the negative test lead of your meter (typically the black wire) on the common (COM) contact of the defrost relay board connector. Your digital meter should read +24 volts DC. If +24 volts DC is present, the POWERLINK™ Device must be replaced. If +24 volts DC is not present, verify that wiring is correct as compared with the supplied customized wiring diagram.

Problem C: Pressure transducer is not reading properly.

The transducer cable is shielded and should not have the bare drain wire attached to door panel liner. The mechanical ground connection is achieved through the threaded fitting on the suction and/ or discharge header.

Step C1 Use a service gauge to verify the actual pressure reading. If the pressure reading of the gauge and the reading of the Hand-Held controller is more than 2 psi, check the pressure transducer offset, which is available on the electronic control.

Step C2 Verify that the transducer range is set properly. Select the pressure input you are currently having problems with and observe the transducer range. Suction transducers should be selected for a 200 psi range while discharge transducers require a 500 psi range. If the range is not set properly, make the programming change and reevaluate the transducer. If the range is set properly, go to Step C3.

Step C3 Use a digital volt meter with the scale set for DC volts to measure the excitation voltage and signal voltage of the transducer.

Step C4 If the excitation voltage is not within the limits set by the controller manufacturer.

Step C5 If the pressure reading, as indicated by the above formula matches the reading of the Hand-Held Device replace the transducer. If the pressure reading, as indicated by the above formula does not match the reading of the Hand-Held Device, replace the control board.

Step C6 Use a digital voltmeter to measure the control transformer secondary voltage. With the scale of your meter set for AC volts, remove the power plug connected to the Proto-Aire XP control and place your test leads of the meter to the two outside pins. The voltage present at these two pins should be between 20 and 27 VAC. If the secondary voltage is within limits replace the control board. If the secondary voltage is out of limits, investigate supply voltage to the control transformer.

Problem D: Temperature Sensor is not reading properly.

The temperature sensor used on Proto-Aire XP is typically used to sense discharge air temperatures at the evaporator load. The sensor contains a NTC (Negative Temperature Coefficient) thermistor, which will increase resistance as temperature falls and decrease resistance as temperature rises.

Trouble Shooting Alarms

The following section gives information on diagnosing specific alarms. The first step in analyzing alarms is to determine when the alarm occurred. The alarms will appear in the controller. The cause, time and date of the alarm will be shown.

There are two types of alarms: switchback and non-switchback. A switchback alarm is normally the result of some external failure as seen or interpreted by the electronic control. When a switchback alarm occurs, the electronic control removes itself from control of the compressors. Operation and cycling of the compressors will be controlled by a low pressure mechanical switch located inside the Proto-Aire XP system, which will cycle one half of the compressors. The indication of alarm will be dependent upon which alarm device has been installed: auto dialer, in store alarm or computer system. Note that under a switchback alarm no defrosts will occur. There are three types of switchback alarms: (1) High Suction Pressure, (2) Low Suction Pressure or (3) All compressors off for more than 60 minutes.

All other types of alarms fall under the "non-switchback" category, such as high discharge temperatures. The control will continue to cycle compressors and manage defrosts under this category of alarms.

Alarm: High Suction Pressure

This alarm is one of the three "switchback" alarms. The time delay for this condition is 30 minutes. High suction pressures are ignore during defrosts.

Possible Causes
One or more compressors are operational.
High alarm limit is not set properly.

Step 1 Enter the Alarm Menu. Observe the time and date of the alarm. You will be prompted as to whether or not you want to clear the current alarm.

Step 2 Proceed to the Status Menu for this Proto-Aire XP. Observe the operation of compressors turning ON, and watch for suction pressure to come down. If the suction pressure does not come down when a compressor comes on, it is an indication that some external device is keeping the compressors off line (high pressure safety, oil safety, phase monitor, etc.) You will need to go to this Proto-Aire XP and investigate whether or not compressors are running.

Alarm: Low Suction Pressure

This alarm is one of the three "switchback" alarms (See the paragraph describing switchback). The time delay for this condition is 30 minutes. Low suction pressures are ignored during defrost.

Possible Causes:
Low Refrigerant Charge
Low Alarm Limit is Not Set Properly

Step 1 Enter the Alarm Menu. Observe the time and date of the alarm. You will be prompted as to whether or not you want to clear the current alarm. Press the DEL key to remove the current alarm condition.

Step 2 Proceed to the Proto-Aire XP. Observe the operation of compressor turning ON, as indicated by X's. The Proto-Aire XP should begin to operate the compressors and suction pressure should be maintained. If this does not occur you will need to further investigate the Proto-Aire XP operation.

Alarm: All Compressors Off

This alarm is one of the three "switchback" alarms (See the paragraph describing switchback). The time delay for this condition is 60 minutes. When the electronic control has not turned on a compressor for one hour, this alarm will be triggered. This condition exists when the suction pressure, as read by the electronic control is above the low alarm limit and below the suction pressure setpoint.

Possible Causes:
An external influence has turned ON one or more compressors
Faulty reading from the pressure transducer

Step 1 Enter the Alarm Menu. Observe the time and date of the alarm. You will be prompted as to whether or not you want to clear the current alarm.

Step 2 Proceed to the Proto-Aire XP. Observe the operation of compressors turning ON, as indicated by X's. The Proto-Aire XP should begin to operate the compressors and suction pressure should be maintained. If this does not occur you will need to further investigate the Proto-Aire XP operation.

Service and Maintenance

IMPORTANT: Since Hussmann has no direct control over the installation, providing the freeze-burst protection is the responsibility of the installing contractor.

Know whether or not a circuit is open at the power supply. Remove all power before opening control panels. Note: SOME EQUIPMENT HAS MORE THAN ONE POWER SUPPLY.

Always use a pressure regulator with a nitrogen tank. Do not exceed 2 psig and vent lines when brazing. Do not exceed 350 psig for leak testing high side. Do not exceed 150 psig for leak testing low side.

Always recapture test charge in approved recovery vessel for recycling.

Service

Compressor Replacement

Before beginning removal of old compressor prepare replacement compressor as follows:

Verify

Replacement compressor
- Electrical requirements
- Refrigerant application
- Capacity
- Piping hookup location and design
- Suction and discharge gaskets
- Mounting requirements

Have compressor in an easily accessible position, uncrated and unbolted from shipping pallet.

Disconnect Electrical Supply

Turn off motor and control panel power supplies to the Unit.

Turn off control circuit and open all compressor circuit breakers.

Tag and remove electrical wires from the compressor.

Isolate Compressor

Frontseat Suction and Discharge Service Valves.
Bleed compressor pressure through both discharge and suction access ports into an **approved recovery vessel.**

Remove externally mounted components that will be re-used on the replacement compressor.

Remove suction and discharge rotolocks.

Remove mounting bolts.

Plug holes per compressor manufacturer's specifications.

Install the new compressor in reverse order of removal. Do not open the new compressor to the system until the system has been leak tested and triple evacuated.

Replacing Drier

Shut down the system. Isolate the Drier to be replaced and bleed off pressure into an **approved recovery vessel**. Replace. Pressurize, leak test and bring back on line.

Use this form as a guide for your store's checklist on the following page.

Sample Proto-Aire XP Checklist

Store: Joe's Market	Location: Anytown, USA							
Date: 6/7/2004	Time:							
Unit	K							
Model Number	OPAH04TK / PAELO7.5M15.0							
Serial Number								
Factory Order Number								
Manufacture Date	04/11/18							
Defrost								
Circuit NO.	1	2	3	4	5 / 6	7 / 8	9 / 10	11 /
Type	Off	Off	Off	Off	Off /	Off /	/	/
No./Day	4	3	3	2	1 /	3 /	/	/
Length	40m	45m	45m	45m	60m /	45m /	/	/
Superheat	42°							
Suction Set Point	52 psig							
Suction Pressure	52.0 psig / 17°F Saturated							
Suction Temperature	59 °							
Split/Satellite Superheat								
Suction Set Point								
Suction Pressure								
Suction Temperature								
Oil	POE							
Oil Separator	Between Glasses							
Pressure Differential								
Condenser								
Head Pressure	214.9 psig							
Water Temperature In	OK							
Water Temperature Out	OK							
Refrigerant	404a							
Receiver Level								
Liquid Sight Glass	Foamy							
Compressor No.	1	2	3	4				
Model No.	ZF11K4E	ZF13K4E	ZBD57KCE	ZB57KCE				
Discharge Temperature	173	166	166	165				
Amp Draw	10.2	10.7	10.8	11.2				
Shell Temp at Oil Connect	hot	hot	warm	warm				
Float or Oil Connect	¾	full	7/8	3/4				
Oil Control Magnet Cond.								
Controller								
Alarms								
Time & Date Displayed								
	Notes: L.L. Filter changed All valves adjusted. 4 PEXH4s, 2 C-store Reach Ins, 1 ND5 would not adjust Removed T-stats from PEXH4s, ND5s, and DM. Raised suction S.P. from 48 psig to 52 psig. All PEXH4s cleaned.							

Proto-Aire XP Checklist								
Store:				Location:				
Date:				Time:				
Unit								
Model Number								
Serial Number								
Factory Order Number								
Manufacture Date								
Defrost								
Circuit NO.	1	2	3	4	5 / 6	7 / 8	9 / 10	11
Type					/	/	/	
No./Day					/	/	/	
Length					/	/	/	
Superheat								
Suction Set Point								
Suction Pressure								
Suction Temperature								
Oil								
Oil Separator								
Pressure Differential								
Condenser								
Head Pressure								
Water Temperature In								
Water Temperature Out								
Refrigerant								
Receiver Level								
Liquid Sight Glass								
Compressor No.	1	2	3	4				
Model No.								
Discharge Temperature								
Amp Draw								
Shell Temp at Oil Connect								
Float or Oil Connect								
Oil Control Magnet Cond.								
Controller								
Alarms								
Time & Date Displayed								
Notes:								

SETPOINT PARAMETER DESCRIPTIONS

Parameter Name	Description	Unit	Default	Min	Max
GPG Temp Alarm Delay	Time before the system registers an over temp or under temp alarm.	min:sec	10:00	00:00	99:00
AL Suction Target	Suction target for the low temp group	PSI	14	0	500
AL Transducer Offset	Adjustable offset for the low temp suction transducer	PSI	0	-50	30000
AL HP Alarm	High suction pressure setpoint for the low temp group	PSI	60	0	500
AL LP Alarm	Low suction pressure setpoint for the low temp group	PSI	8	0	500
AL Pressure Alarm Delay	Pressure alarm delay for the low temp group, pressure must remain above/below the HP/LP bounds for this period of time.	min:sec	01:00	00:00	99:00
AM Suction Target	The suction pressure target for the medium temp group	PSI	45	0	30000
AM Transducer Offset	Adjustable offset for the medium temp suction transducer	PSI	0	-50	30000
AM HP Alarm	High suction pressure setpoint for the medium temp group	PSI	60	0	500
AM LP Alarm	Low suction pressure setpoint for the medium temp group	PSI	8	-50	30000
AM Pressure Alarm Delay	Pressure alarm delay for the medium temp group, pressure must remain above/below the HP/LP bounds for this period of time.	min:sec	05:00	00:00	99:00
Cond Transducer Offset	The adjustable offset for the discharge transdcuer for the condense group	PSI	0	-50	50
Cond HP Alarm	High pressure setpoint for discharge pressure, exceeding this value will raise an alarm after an adjustable duration	PSI	260	0	500
Cond LP Alarm	Low pressure setpoint for the discharge pressure, falling below this value will raise an alarm after an adjustable duration	PSI	90	0	500
Cond Pressure Alarm Delay	Duration a high or low pressure state must persist before an alarm is raised	min:sec	01:00	00:00	99:00
Cond VFD Fail Setting	VFD will run at this percentage upon a discharge transducer fail	%	50	0	100
Cond Stage 1 Fail On	On/Off parameter, decides whether stage runs on a transducer fail alarm	none	On	Off	On
Cond Stage 2 Fail On	On/Off parameter, decides whether stage runs on a transducer fail alarm	none	off	Off	On
Cond Stage 3 Fail On	On/Off parameter, decides whether stage runs on a transducer fail alarm	none	off	Off	On
ERC Max Run Time	The maximum run time which ERC will persist once activated	hr:min	24:00	20	28