



Liebert®

PFH™

Installer/User Guide

Prop-fan Condensing Unit, 50 Hz and 60 Hz

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Technical Support Site

If you encounter any installation or operational issues with your product, check the pertinent section of this manual to see if the issue can be resolved by following outlined procedures.

Visit <https://www.VertivCo.com/en-us/support/> for additional assistance.

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1 IMPORTANT SAFETY INSTRUCTIONS

SAVE THESE INSTRUCTIONS

This manual contains important safety instructions that should be followed during the installation and maintenance of the Liebert® PFH. Read this manual thoroughly before attempting to install or operate this unit.

Only qualified personnel should move, install or service this equipment.

Adhere to all warnings, cautions, notices and installation, operating and safety instructions on the unit and in this manual. Follow all installation, operation and maintenance instructions and all applicable national and local building, electrical and plumbing codes.



WARNING! Arc flash and electric shock hazard. Open all local and remote electric power-supply disconnect switches, verify with a voltmeter that power is Off and wear appropriate, OSHA-approved personal protective equipment (PPE) per NFPA 70E before working within the electric control enclosure. Failure to comply can cause serious injury or death. Customer must provide earth ground to unit, per NEC, CEC and local codes, as applicable. Before proceeding with installation, read all instructions, verify that all the parts are included and check the nameplate to be sure the voltage matches available utility power. The Liebert® controller does not isolate power from the unit, even in the "Unit Off" mode. Some internal components require and receive power even during the "Unit Off" mode of the controller. The only way to ensure that there is NO voltage inside the unit is to install and open a remote disconnect switch. Refer to unit electrical schematic. Follow all local codes.



WARNING! Risk of over-pressurization of the refrigeration system. Can cause piping rupture, explosive discharge of high-pressure refrigerant, loss of refrigerant, environmental pollution, equipment damage, injury, or death. This unit contains fluids and gases under high pressure. Use extreme caution when charging the refrigerant system. Do not pressurize the system higher than the design pressure marked on the unit's nameplate. Relieve pressure before cutting into or making connections/disconnections to the piping system. Local building or plumbing codes may require installing a pressure-relief device in the system.

Consult local building and plumbing codes for installation requirements of additional pressure-relief devices when isolation valves are field installed. Do not isolate any refrigerant circuits from over pressurization protection. The PFH condensing units include a factory-installed pressure-relief valve mounted on top of the receiver. The valve is rated for a maximum working pressure of 475 psig.



WARNING! Risk of contact with high-speed, rotating fan blades. Can cause injury or death. Open all local and remote electric power-supply disconnect switches, verify with a voltmeter that power is off, and verify that all fan blades have stopped rotating before working in the unit cabinet.



WARNING! Risk of electric shock. Can cause serious injury or death. The microprocessor does not isolate power from the unit, even in the "Unit Off" mode. Some internal components require and receive power even during the "unit off" mode of the control. Open all local and remote electric power disconnect switches and verify with a voltmeter that power is Off before working on any component of the system.



WARNING! Risk of improper wire and loose electrical connections. Can cause overheated wire and electrical connection terminals resulting in smoke, fire, equipment and building damage, injury or death. Use correctly sized copper wire only and verify that all electrical connections are tight before turning power On. Check all electrical connections periodically and tighten as necessary.



CAUTION: Risk of excessive refrigerant line pressure. Can cause tubing and component rupture resulting in equipment damage and personal injury. Do not close off any field-installed refrigerant-line isolation valve for repairs unless a pressure-relief valve is field- installed in the line between the isolation valve and the check valve. The pressure-relief valve must be rated 5% to 10% higher than the system-design pressure. An increase in ambient temperature can cause the pressure of the isolated refrigerant to rise and exceed the system-design pressure rating (marked on the unit nameplate).



CAUTION: Risk of contact with sharp edges, splinters, and exposed fasteners. Can cause injury. Only properly trained and qualified personnel wearing appropriate, OSHA-approved PPE should attempt to move, lift, remove packaging from or prepare the unit for installation.



CAUTION: Risk of contact with hot surfaces. Can cause injury. The compressor, refrigerant discharge lines, fan motor, and some electrical components are extremely hot during unit operation. Allow sufficient time for them to cool to a touch-safe temperature before working within the unit cabinet. Use extreme caution and wear appropriate, OSHA-approved PPE when working on or near hot components.



CAUTION: Risk of contacting caustic substances. Can cause injury. Avoid touching or contacting the gas and oils with exposed skin. Severe burns will result. Wear appropriate, OSHA-approved PPE when handling contaminated parts.

NOTICE

Risk of oil contamination with water. Can cause equipment damage.

Liebert® PFH systems require the use of POE (polyolester) oil. POE oil absorbs water at a much faster rate when exposed to air than previously used oils. Because water is the enemy of a reliable refrigeration system, extreme care must be used when opening systems during installation or service. If water is absorbed into the POE oil, it will not be easily removed and will not be removed through the normal evacuation process. If the oil is too wet, it may require an oil change. POE oils also have a property that makes them act as a solvent in a refrigeration system. Maintaining system cleanliness is extremely important because the oil will tend to bring any foreign matter back to the compressor.

1.1 Agency Listed

Standard 60-Hz units are CSA Certified to the harmonized U.S. and Canadian product safety standard CSA C22.2 No 236/UL 1995 for “Heating and Cooling Equipment” and are marked with the CSA c-us logo.



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2 NOMENCLATURE AND COMPONENTS

This section describes the model-number configuration for Liebert® PFH units and components.

2.1 Nomenclature for Prop-fan Condensing Units

Table 2.2 below describes each digit of the model number.

Table 2.1 Prop-fan Condensing Unit Nomenclature Example

1	2	3	4	5	6	7	8	9	10	11
P	F	H	0	3	7	A	—	P	L	N

Table 2.2 Nomenclature Digit Definitions for Outdoor, Prop-fan Condensing Units

Digit	Description
Digits 1 to 3 = the base unit	PFH = Prop-fan condensing unit with hot-gas bypass
Digit 4 = Sound level	0 = Standard Z = Quiet-Line
Digit 5 and 6 = Nominal Capacity, 1,000 BTU/hr	
Digit 7 = Cooling type	A = Air-cooled
Digit 8 = Coil type	— = Standard coil C = Coated coil (epoxy with UV topcoat)
Digit 9 = Supply power	A = 460 V / 3 ph / 60 Hz B = 575 V / 3 ph / 60 Hz M = 380/415 V / 3 ph / 50 Hz P = 208/230 V / 1 ph / 60 Hz S = 220 V / 1 ph / 50 Hz Y = 208/230 V / 3 ph / 60 Hz
Digit 10 = Ambient rating/Control	L = 95°F Ambient, Liebert® Lee-Temp™ H = 105° Ambient, Liebert® Lee-Temp
Digit 11 = Refrigerant	N = R-407C field-supplied

2.2 Prop Fan Condensing Units

Liebert® propeller-fan condensing units are available in a range of sizes and configurations to offer flexibility in designing a precision thermal-management system. The appropriate propeller-fan condensing unit paired with a corresponding Liebert® fan coil evaporator model such as Liebert® DataMate™ or Liebert® Mini-Mate2™ is an effective solution for your environmental-control application requirements.

Split-system condensing units are connected to the evaporator unit by two refrigerant lines (four in 8-ton systems) and a low-voltage control cable. The condensing unit requires a separate power source and power disconnect switch.

2.2.1 Base System 95°F (35°C) Ambient Models

The heart of the refrigeration system is a quiet, high-efficiency scroll compressor with internal, vibration-isolation mountings, pressure-safety controls, and built-in overload protection. Standard features include crank-case heater, high-pressure switch, condenser coil, receiver with sight glass, hot-gas bypass system with liquid quenching valve, direct-drive propeller fan and motor, and Liebert® Lee-Temp™ flood-back head-pressure control. These models provide catalog capacity of the appropriate evaporator section up to 95°F (35°C) outside ambient temperature.

2.2.2 105°F (41°C) Ambient Models

These models are similar to the base models with coils and fans sized to provide catalog capacity of the appropriate evaporator section up to 105°F (41°C) outside ambient temperature.

2.2.3 Liebert Quiet-Line™ Models

These models are similar to the base models with coils and fans sized to provide catalog capacity of the appropriate evaporator section up to 95°F (35°C) outside ambient temperature with a noise level of less than 58 dBA.

2.3 Optional Equipment

2.3.1 Coated Coil

Each condenser coil has an epoxy-coating with UV topcoat for extended coil life in corrosive environments, such as coastal areas.

2.3.2 277-V Step-down Transformer

A 37.5-A, 277-V step-down transformer is available for 1- to 3-ton 60-Hz condensing units that need 277/1/60 input power. Apply this transformer to a 208-230/1/60 condensing unit. The transformer is coated with epoxy and contained in an enclosed, non-ventilated electrical box with adaptable mounting brackets.

3 SITE PREPARATION AND EQUIPMENT HANDLING

NOTE: Before installing unit, determine whether any building alterations are required to run piping, wiring and ductwork. Follow all unit dimensional drawings and refer to the submittal engineering dimensional drawings of individual units for proper clearances.

3.1 Planning Dimensions

The unit dimensions are described in the submittal documents included in the [Submittal Drawings](#) on page 45.

The following table lists the relevant documents by number and title.

Table 3.1 Dimension Planning Drawings

Document Number	Title
DPN004418	Cabinet Dimensions, Prop-fan Condensing Unit with horizontal air discharge
DPN004419	Cabinet Dimensions, Prop-fan Condensing Unit with top air discharge
DPN003094	Optional Anchorage Plan, Prop-fan Condensing Unit with horizontal air discharge

3.2 Application Limits and Designed Refrigerant Pressures

Table 3.2 Application Limits for Outdoor Air-cooled Condensing Unit

Model	Input voltage		Entering dry-bulb air temperature	
	Minimum*	Maximum	Minimum	Maximum
Standard Ambient and Quiet-Line	-10%	+10%	-30°F (34°C)	115°F (48°C)
High Ambient	-10%	+10%	-30°F (34°C)	125°F (52°C)
* Single-phase units -5%				

Table 3.3 Design Refrigerant Pressures

Suction	Discharge (at design-ambient)	High-pressure cut-out
58 to 75 psig (405 to 517 kPa)	280 psig (1930 kPa)	400 psig (2760 kPa)

3.3 Location Considerations

Do not install units in areas where normal unit operation might disturb the working environment.

Read this entire section, as well as the piping and electrical sections before starting installation. This manual details dimensional, piping information, and specifications that affect the placement of the PFH unit in relation to the connected evaporator unit, other outside units, barriers, and walls.

Be particularly mindful of service and air-flow clearances, maximum-equivalent-piping distances, and elevation differences between the PFH and connected evaporator unit. Consult and confirm applications with your Vertiv representative when applications exceed any of these specifications.

3.3.1 Location Considerations for an Outdoor Condensing Unit

Observe the following when planning the installation of the outdoor unit:

- To ensure a satisfactory air supply, locate air-cooled condensing units in an environment with clear air, away from loose dirt and foreign matter that may clog the coil.
- Condensing units must not be located in the vicinity of steam, hot air or fume exhausts or closer than 18 inches from a wall, obstruction or adjacent unit.
- Avoid areas where heavy snow will accumulate at air inlet and discharge locations.
- The condensing unit should be located for maximum security and maintenance accessibility. Avoid ground-level sites with public access. Install a solid base, capable of supporting the weight of the condensing unit.
- The base should be at least 2 in. (51 mm) higher than the surrounding grade and 2 in. (51 mm) larger than the dimensions of the condensing-unit base. For snowy areas, a base of sufficient height to clear snow accumulation must be installed.
- Securely attach the unit to the base using the holes provided in the unit mounting rails to prevent unit movement that might stress refrigerant piping and electrical wiring.

Before beginning, refer to [Piping and Refrigerant Requirements](#) on page 9 for unit placement, piping guidelines, and refrigerant-charge requirements for your system.

The condensing unit must be located within the maximum distance from evaporator guidelines listed in [4.11](#) on page 11.

3.4 Equipment Inspection and Handling



CAUTION: Risk of contact with sharp edges, splinters, and exposed fasteners. Can cause injury. Only properly trained and qualified personnel wearing appropriate, OSHA-approved PPE should attempt to move, lift, remove packaging from or prepare the unit for installation.

Do not uncrate the equipment until it is close to its final location. All required assemblies are banded and shipped in corrugated containers. If any damage is discovered when the unit is un-crated, report it to the shipper immediately. If any concealed damage is later discovered, report it to the shipper and to your Vertiv representative.

3.5 Packaging Material

All material used to package this unit is recyclable. Save it for future use or dispose of the material appropriately.

4 PIPING AND REFRIGERANT REQUIREMENTS

All field-supplied refrigeration piping to the unit must be sweat copper. Use prevailing good piping practices for all connections which include brazing copper pipes using a brazing alloy of minimum temperature of 1350 °F (732 °C) and adhering to all local codes. Factory-installed piping brackets must not be removed. Field-installed piping must be installed in accordance with local codes and must be properly assembled, supported, isolated and insulated. Avoid piping runs through noise-sensitive areas, such as office walls and conference rooms.

The pipe connection locations, piping general arrangement and schematics are described in the submittal documents included in the [Submittal Drawings](#) on page 45.

The following tables list the relevant documents by number and title.

Table 4.1 Piping General-arrangement Drawings

Document Number	Title
DPN004407	Piping Schematic, Prop Fan Condensing Unit

Table 4.2 Piping Connection Drawings

Document Number	Title
DPN004308	Piping Connections, Prop-fan Condensing Unit, Horizontal Discharge
DPN004307	Piping Connections, Prop-fan Condensing Unit, Top Discharge

4.1 Refrigerant Piping



WARNING! Risk of over-pressurization of the refrigeration system. Can cause piping rupture, explosive discharge of high-pressure refrigerant, loss of refrigerant, environmental pollution, equipment damage, injury, or death. This unit contains fluids and gases under high pressure. Use extreme caution when charging the refrigerant system. Do not pressurize the system higher than the design pressure marked on the unit's nameplate. Relieve pressure before cutting into or making connections/disconnections to the piping system. Local building or plumbing codes may require installing a pressure-relief device in the system.

Consult local building and plumbing codes for installation requirements of additional pressure-relief devices when isolation valves are field installed. Do not isolate any refrigerant circuits from over pressurization protection. The PFH condensing units include a factory-installed pressure-relief valve mounted on top of the receiver. The valve is rated for a maximum working pressure of 475 psig.

NOTICE

Risk of oil contamination with water. Can cause equipment damage.

Liebert® PFH systems require the use of POE (polyolester) oil. POE oil absorbs water at a much faster rate when exposed to air than previously used oils. Because water is the enemy of a reliable refrigeration system, extreme care must be used when opening systems during installation or service. If water is absorbed into the POE oil, it will not be easily removed and will not be removed through the normal evacuation process. If the oil is too wet, it may require an oil change. POE oils also have a property that makes them act as a solvent in a refrigeration system. Maintaining system cleanliness is extremely important because the oil will tend to bring any foreign matter back to the compressor.

NOTICE

Risk of improper refrigerant charging. Can cause equipment damage.

Refrigerant charge must be weighed into compressorized systems before they are started.

1-ton to 5-ton Split systems require 2 refrigerant lines between the evaporator and the condensing unit:

- 1 insulated copper suction line
- 1 copper liquid line

8-ton Split systems require 4 refrigerant lines between the evaporator and the condensing unit:

- 2 insulated copper suction lines
- 2 copper liquid lines

Observe the following requirements for all field-supplied refrigeration piping:

- All piping must be ACR-type copper.
- For all piping connections, use prevailing good piping practices, which includes brazing copper pipes using a brazing alloy of a minimum temperature of 1350°F (732°C) and adhere to local codes.
- Factory-installed piping brackets must not be removed.
- Piping must be installed in accordance with local codes, and must be properly assembled, supported, isolated, and insulated.
- Use prevailing good refrigeration practices such as piping supports, leak testing, evacuation, dehydration and charging of the refrigeration circuits.
- Isolate the refrigeration piping from the building with vibration-isolating supports.
- Avoid piping runs through noise-sensitive areas such as office walls and conference rooms.
- When sealing openings in walls and to reduce vibration transmission, use a soft, flexible material to pack around the tubes to prevent tube damage.
- When installing remote condensing units above the evaporator, the suction gas lines should be trapped at the evaporator. These traps will retain refrigerant oil in the off cycle. When the unit starts, oil in the traps is carried up the vertical risers and returns to the compressors.
- When installing remote condensing unit below the evaporator, the suction gas lines should be trapped with an inverted trap to the height of the evaporator. This prevents refrigerant migration to the compressors during off cycles. Maximum recommended vertical level drop to condensing unit is 15 ft (4.6 m).

4.1.1 Piping when Condensing Unit is Above or Below Evaporator

Refer to **Table 4.3** below, for the maximum vertical rise/fall between condensing unit and evaporator.

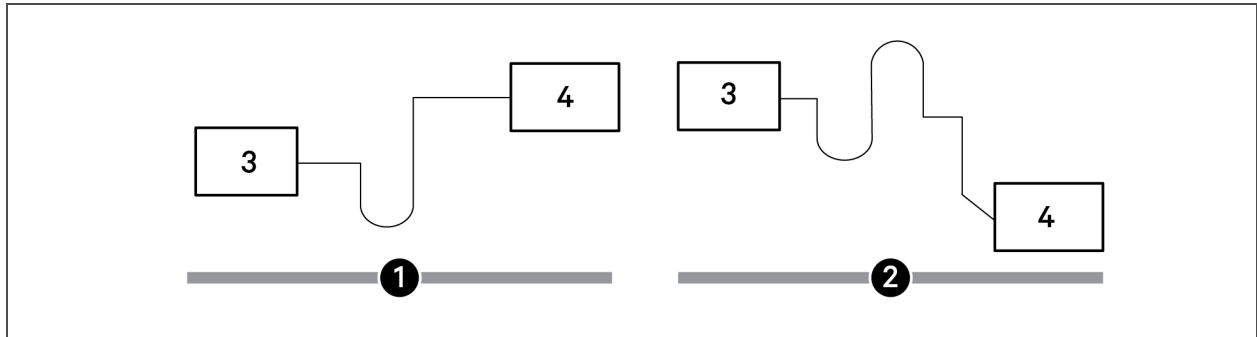
When installing remote condensing units above the evaporator, trap the suction gas line at the evaporator as shown in **Figure 4.1** on the next page. This trap will retain refrigerant oil during the "Off" cycle. When the unit starts, oil in the trap is carried up the vertical riser and returns to the compressor. For rises over 25 ft (7.6 m), trap every 20 ft (6 m) or evenly divided.

When installing remote condensing units below the evaporator, trap the suction gas line with an inverted trap the height of the evaporator as shown **Figure 4.1** on the next page. This prevents refrigerant migration to the compressor during "Off" cycles. The maximum recommended vertical-level drop to condensing unit is 15 ft (4.6 m).

Table 4.3 Pipe length and condenser elevation relative to evaporator

Nominal System Size Tons	Max. Equiv. Pipe Length, ft (m)	Maximum PFH Level Above Evaporator, ft (m)	Maximum PFH Level Below Evaporator, ft (m)
1, 1.5, 2	150 (45)	40 (12)	15 (4.6)
3, 3.5, 5, 8	150 (45)	50 (15)	15 (4.6)

Figure 4.1 Refrigerant piping diagram when condenser is above or below evaporator



NOTE: Any horizontal pipe must be pitched down toward the condensing unit at a minimum rate of 1/2 in. (13mm) per 10 ft. (3m) to assure oil return to compressor.

Item	Description
1	Condensing unit above evaporator
2	Condensing unit below evaporator
3	Evaporator
4	Condensing unit

4.1.2 Refrigerant-line Sizes and Equivalent Lengths

The following tables list information required to field-install the refrigerant piping for the system.

The pipe connection sizes for your equipment are included in the appropriate submittal documents included in the [Submittal Drawings](#) on page 45.

Table 4.4 Recommended line sizes, OD Cu

Equiv. ft (m)	PFH_14A		PFH_20A		PFH_27A		PFH_36A PFH_37A 3-ton circuit of 8-ton model		PFH_42A PFH_41A		PFH_67A PFH_66A 5-ton circuit of 8-ton model	
	Suction	Liquid	Suction	Liquid	Suction	Liquid	Suction	Liquid	Suction	Liquid	Suction	Liquid
50 (15.2)	5/8"	3/8"	5/8"	3/8"	7/8"	3/8"	7/8"	1/2"	7/8"	1/2"	1-1/8"	1/2"
75 (22.9)	5/8"	3/8"	7/8"	3/8"	7/8"	3/8"	7/8"	1/2"	7/8"	1/2"	1-1/8"	5/8"
100 (30.5)	7/8"	3/8"	7/8"	3/8"	7/8"	1/2"	1-1/8" ²	1/2"	1-1/8"	1/2"	1-1/8"	5/8"
125 (38.1)	7/8"	3/8"	7/8"	1/2"	7/8"	1/2"	1-1/8" ²	1/2"	1-1/8"	1/2"	1-3/8"	5/8"
150 (45.7)	7/8"	3/8"	7/8"	1/2"	7/8"	1/2"	1-1/8" ²	1/2"	1-1/8"	5/8"	1-3/8"	5/8"

1. Suction and liquid line sizing based on < 3 psi pressure drop in each, minimum horizontal suction line velocity > 700FPM (3.6m/s).

2. Suction size should be reduced one pipe size for vertical riser sections to maintain suction line velocity > 1000FPM (5.1m/s) for proper oil return.

Source: DPN000788 Rev. 13

Table 4.5 Equivalent lengths for various pipe fittings, ft (m)

Copper Pipe OD, in.	90 Degree Elbow Copper	90 Degree Elbow Cast	45 Degree Elbow	Tee	Gate Valve	Globe Valve	Angle Valve
1/2	0.8 (0.24)	1.3 (0.39)	0.4 (0.12)	2.5 (0.76)	0.26 (0.07)	7.0 (2.13)	4.0 (1.21)
5/8	0.9 (0.27)	1.4 (0.42)	0.5 (0.15)	2.5 (0.76)	0.28 (0.08)	9.5 (2.89)	5.0 (1.52)
3/4	1.0 (0.3)	1.5 (0.45)	0.6 (0.18)	2.5 (0.76)	0.3 (0.09)	12.0 (3.65)	6.5 (1.98)
7/8	1.45 (0.44)	1.8 (0.54)	0.8 (0.24)	3.6 (1.09)	0.36 (0.1)	17.2 (5.24)	9.5 (2.89)
1-1/8	1.85 (0.56)	2.2 (0.67)	1.0 (0.3)	4.6 (1.4)	0.48 (0.14)	22.5 (6.85)	12.0 (3.65)
1-3/8	2.4 (0.73)	2.9 (0.88)	1.3 (0.39)	6.4 (1.95)	0.65 (0.19)	32.0 (9.75)	16.0 (4.87)
1-5/8	2.9 (0.88)	3.5 (1.06)	1.6 (0.48)	7.2 (2.19)	0.72 (0.21)	36.0 (10.97)	19.5 (5.94)

Refrigerant trap = Four times equivalent length of pipe per this table

4.2 Refrigerant Charge Requirements

Table 4.6 R-407C unit charge levels

60 Hz	50 Hz	Charge R-407C, lb-oz (kg)
95°F (35°C) Standard Sound		
PFH014A_LN	—	8-6 (3.80)
PFH020A_LN	—	
PFH027A_LN	—	
PFH037A_LN	PFH036A_LN	13-5 (6.04)
PFH042A_LN	PFH041A_LN	
PFH067A_LN	PFH066A_LN	26-10 (12.08)
PFH096A_LN - 3-ton Circuit	PFH095A_LN - 3-ton Circuit	22-9 (10.23)
PFH096A_LN - 5-Ton Circuit	PFH095A_LN - 5-Ton Circuit	36-5 (16.47)
105°F (41°C) High Ambient		
PFH027A_HN	—	13-5 (6.04)
PFH037A_HN	PFH036A_HN	26-10 (12.08)
PFH042A_HN	PFH041A_HN	
PFH067A_HN	PFH066A_HN	51-11 (23.45)
Quiet-Line		
PFHZ27A_LN	—	13-5 (6.04)
PFHZ37A_LN	PFHZ36A_LN	26-10 (12.08)
PFHZ42A_LN	PFHZ41A_LN	
PFHZ67A_LN	PFHZ66A_LN	51-11 (23.45)

Table 4.7 Line charges of R-407C refrigerant using Type-L copper tube

Line Size, OD, in.	Liquid Line, lb/100 ft (kg/30 m)	Suction Line, lb/100 ft (kg/30 m)
3/8	3.6 (1.6)	—
1/2	6.7 (3.0)	0.2 (0.1)
5/8	10.8 (4.8)	0.3 (0.1)
3/4	16.1 (7.2)	0.4 (0.2)
7/8	22.3 (10.0)	0.5 (0.3)
1-1/8	38.0 (17.0)	0.9 (0.4)
1-3/8	57.9 (25.9)	1.4 (0.7)

Source: DPN003099 Rev. 1

4.2.1 Field-fabricated Refrigeration Piping

Use copper pipe with high-temperature brazed joints for all field-fabricated refrigeration piping. Use a brazing alloy with a minimum temperature of 1350°F (732°C), such as Sil-Fos. Avoid soft solders such as 50/50 or 95/5.

1. Measure pipe runs and calculate pipe size and equivalent feet of suction and liquid lines per the tables in [Refrigerant-line Sizes and Equivalent Lengths](#) on page 12.
2. Determine the type of trap to use on the suction line next to the evaporator based on the position of the condensing unit per [Piping when Condensing Unit is Above or Below Evaporator](#) on page 11.
3. Determine the number and placement of traps on vertical rises, and install traps on the suction-line piping at the base of a rise over 5-ft (1.5-m) and every 20-ft (6-m) of vertical rise.
4. The evaporator and condensing units come with an inert-gas holding charge. Release pressure before cutting the spun-closed end of the piping.

NOTE: You can only evacuate the system properly if you open the hot-gas by-pass and liquid-line solenoid valves (if equipped) inside the condensing unit and you account for all check valves, see [Figure 4.2](#) on the next page. Connect manifold-gauge hoses to the discharge- and suction-line Schrader ports, remove the solenoid-valve holding coils from the hot-gas by-pass and liquid-line solenoid valves (if equipped), and apply a solenoid-valve service magnet to the valves to obtain a proper vacuum.

5. Use a flow of dry nitrogen through the piping during brazing to prevent formation of copper-oxide scale inside the piping. A pure dry-nitrogen flow of 1 to 3 ft³/min (0.5 to 1.5 l/s) inside the pipe during brazing is sufficient to displace the air. Control the flow using a suitable metering device.

NOTE: Copper oxide forms when copper is heated in the presence of air. POE oil will dissolve these oxides from inside the copper pipes and deposit them throughout the system, clogging filter driers and affecting other system components.

4.2.2 Evacuation and Leak-testing Air-cooled Systems

For proper leak-check and evacuation, you must open all system valves and account for all check valves, see [Figure 4.2](#) on the next page.

Item	Description
11	Hot-gas bypass control valve
12	Liquid injection
13	3-way head-pressure control valve
14	Check valve
15	Pressure-balancing valve
16	Sight glass
17	Pressure-relief valve
18	Lee-Temp receiver
19	Receiver-heater pressure-limiting switch
20	Liquid-line solenoid valve
21	Liquid line

To evacuate and leak-test the system:

1. Open the liquid-line solenoid valve and hot-gas by-pass solenoid valve by removing the holding coils, and apply a solenoid-valve service magnet to the valves.
2. Connect manifold-gauge hoses on the discharge- and suction-line Schrader ports, open the service valves, and place a 150 Psig (1034 kPa) charge of dry nitrogen with a tracer of refrigerant, then check the system for leaks with a suitable leak detector.
3. After completion of leak testing, release the test pressure, (observe local code) and pull an initial deep vacuum of 500 microns on the system with a suitable pump.
4. After 4 hours, check the pressure readings and, if they have not changed, break vacuum with dry nitrogen. Pull a second and third vacuum to 500 microns or less. Re-check the pressure after 2 hours. When the 3 checks are complete, proceed to [Charging Air-cooled Systems](#) below.

4.2.3 Charging Air-cooled Systems

NOTICE

Risk of improper refrigerant charging. Can cause equipment damage.

R-407C is a blended refrigerant and must be introduced and charged from the cylinder only as a liquid.

When adding liquid refrigerant to an operating system, it may be necessary to add the refrigerant through the valve in the compressor suction line. Care must be exercised to avoid damage to the compressor. We recommend connecting a sight glass between the charging hose and the compressor suction service valve. This will permit adjustment of the cylinder hand valve so that liquid can leave the cylinder while allowing vapor to enter the compressor.

To calculate the charge for the system:

1. Check the nameplate on the indoor unit for refrigerant type to use.
2. Refer to **Table 4.6** on page 14, and **Table 4.7** on page 14, and calculate the amount of charge for the system including the evaporator, condensing unit, and interconnecting piping.
3. Accurately weigh-in as much of the system charge as possible before re-installing coils on liquid-line solenoid valve and hot-gas by-pass solenoid valve, and starting the unit.

4.2.4 Field Charge Verification for Air-cooled Systems

An integral sight glass is provided with the receiver to assist in field-charge verification. During charge verification, set the control temperature down to keep the system running. If the system is equipped with hot-gas bypass, de-energize it by removing power from the hot-gas solenoid valve coil. To remove power, disconnect the solenoid leads from the unit contactor in the electric box, see **Figure 4.2** on page 16. When charge verification is complete, replace and secure all wire connections and covers.

During operation at design ambient temperatures, (95 or 105°F; 35 or 41°C) the charge level is above the sight glass in the receiver. If levels are below the sight glass, an under-charge condition is likely. If levels are above the sight glass and higher discharge pressures than normal are observed, an overcharge condition may be likely. However, verify that other high-discharge pressure causes such as dirty coil and restricted air flow are not responsible before removing charge.

At temperatures below design ambient temperature, refrigerant backs into the condenser coil and the level in the receiver drops below the sight glass. If you are trying to verify charge level at lower ambient temperatures, block the condenser coil to maintain 240 psig (1655 kPa) discharge pressure to ensure the head-pressure-control valve is closed. At these conditions the charge level should be above the sight glass in the receiver.

NOTE: If no level is visible in the sight glass, add charge until the level is in the middle of the sight glass. Check the discharge pressure during this procedure and adjust coil restrictions to maintain 240 psig (1655 kPa). Once the charge is in the middle of the sight glass, add additional system charge per **Table 4.8 below. After charging, unblock the coil and allow the unit to operate normally. After conditions have stabilized, restrict the coil if required to maintain 240 psig (1655 kPa) discharge pressure and verify that the charge level is above the sight glass.**

NOTE: The 5-ton high-ambient, 5-ton Quiet-Line, and 8-ton models consist of two condenser coils and two receivers. When restricting airflow on these units, the coils should be blocked off proportionally. If one coil is restricted significantly more than the other, liquid can remain in the restricted coil causing lower levels in the receivers. The receiver liquid level should be above the sight glasses in both receivers. There may be some variation in charge level between the two receiver sight glasses due to piping and assembly variations. When adding charge, determine which receiver level is lower and use that sight glass to gauge charge level.

Table 4.8 Field verification charge addition

Model Numbers		R-407C
60Hz	50Hz	oz (kg)
PFH014A-_L	—	4 (0.11)
PFH020A-_L	—	4 (0.11)
PFH027A-_L	—	4 (0.11)
PFH027A-_H	—	18 (0.51)
PFHZ27A-_L	—	18 (0.51)
PFH037A-_L	PFH036A-_L	18 (0.51)
PFH042A-_L	PFH041A-_L	18 (0.51)
PFH037A-_H	PFH036A-_H	8 (0.23)
PFHZ37A-_L	PFHZ36A-_L	8 (0.23)
PFH042A-_H	PFH041A-_H	8 (0.23)
PFHZ42A-_L	PFHZ41A-_L	8 (0.23)

Table 4.8 Field verification charge addition (continued)

Model Numbers		R-407C
60Hz	50Hz	oz (kg)
PFH067A-_L	PFH066A-_L	18 (0.51)
PFH067A-_H	PFH066A-_H	50 (1.42)
PFHZ67A-_L	PFHZ66A-_L	50 (1.42)
PFH096A-_L 3-ton circuit	PFH095A-_L 3-ton circuit	18 (0.51)
PFH096A-_L 5-ton circuit	PFH095A-_L 5-ton circuit	18 (0.51)

See **Table 4.6** on page 14, for base charge amount of the condensing unit.

4.3 Installing a Replacement R-407C PFH Condensing Unit in an R-22 System

When replacing the condensing unit of a Liebert® split system that contains R-22 refrigerant and mineral oil, consider the following:

- Before replacing the condensing unit, check for proper operation of the system. If you are unable to verify proper operation, at minimum, perform a leak check to make sure that the remaining components (line set, evaporator) are leak-tight.
- Check for acid or contaminants in the mineral oil.

4.3.1 Removing the Condensing Unit to be Replaced

1. Recover refrigerant in system using proper refrigeration practices.
2. Oil removal: The majority of the oil will be in the old condensing unit (compressor, condenser and receiver), which will be replaced with the new unit.
3. Remove high-voltage and low-voltage wiring.

NOTE: Wiring should be removed by a licensed electrician.

NOTE: Existing low-voltage wiring may have a 3-wire lead. A 4-wire lead is required for hot-gas-bypass control on the new condensing unit.

4. Cut the line set before the Aeroquip fittings entering the condensing unit.
5. Remove the existing filter drier in evaporator unit and discard. The filter drier may contain contaminants that can be released out of the drier because of the POE oil.

4.3.2 Select and Install a Filter Drier

We recommend that you install a replaceable-core filter drier that is approved for POE oil.

1. Remove the existing drier because the replaceable-core drier will not fit in the same location.
2. Ensure that there is enough clearance for replacing cores when choosing a location.
3. Replace the core a week after start-up and inspect the removed replaceable core for contaminants to determine if another replacement is needed. If the system experienced a burnout, shorter interval replacements are needed.

4.3.3 Install the Replacement Condensing Unit

1. Connect the condensing unit to the evaporator and piping, see [Piping and Refrigerant Requirements](#) on page 9, for condenser piping connections and line sizing, and [Refrigerant Charge Requirements](#) on page 14, for charging.
2. Evacuate the system twice to a minimum 500 microns, and break the vacuum with dry nitrogen each time.
3. Evacuate a third time to 500 microns, and verify that the above levels are maintained for at least one minute after the unit is isolated from the vacuum pump by a shutoff valve.
4. Charge the system with R-407C, see [Charging Air-cooled Systems](#) on page 17.
 - If connecting to a non-standard evaporator, refer to the evaporator-unit serial tag for charge amounts and use 1 oz (0.0283 kg) R-407C for every 1 oz (0.0283 kg) of R-22 used in the previous evaporator and piping.

5 ELECTRICAL CONNECTION REQUIREMENTS



WARNING! Arc flash and electric shock hazard. Open all local and remote electric power-supply disconnect switches, verify with a voltmeter that power is Off and wear appropriate, OSHA-approved personal protective equipment (PPE) per NFPA 70E before working within the electric control enclosure. Failure to comply can cause serious injury or death. Customer must provide earth ground to unit, per NEC, CEC and local codes, as applicable. Before proceeding with installation, read all instructions, verify that all the parts are included and check the nameplate to be sure the voltage matches available utility power. The Liebert® controller does not isolate power from the unit, even in the “Unit Off” mode. Some internal components require and receive power even during the “Unit Off” mode of the controller. The only way to ensure that there is NO voltage inside the unit is to install and open a remote disconnect switch. Refer to unit electrical schematic. Follow all local codes.



WARNING! Risk of improper wire and loose electrical connections. Can cause overheated wire and electrical connection terminals resulting in smoke, fire, equipment and building damage, injury or death. Use correctly sized copper wire only and verify that all electrical connections are tight before turning power On. Check all electrical connections periodically and tighten as necessary.

NOTICE

Risk of improper electrical supply connection. Can cause equipment damage.

See transformer label for primary tap connections. Installer will need to change transformer primary taps if applied unit voltage is other than pre-wired tap voltage.

NOTICE

Risk of incorrect phase sequencing. Can cause equipment damage. Three-phase power must be connected to the unit line voltage terminals in proper sequence so that the scroll compressor rotates in the correct direction.

The three-phase scroll compressor requires proper phasing to ensure correct motor rotation. The component connections have been phase synchronized at the factory. Power phasing should be changed only at the line voltage supply to the unit. To change phasing, switch any two power leads to the unit. Observe system pressures to determine whether the unit is operating properly.

NOTICE

Risk of compressor slugging. Can cause equipment damage.

Apply power to condenser 8 hours before operating the system. This time is required to allow liquid refrigerant to be driven out of the compressor. This is especially important at low ambient temperatures.

Each unit is shipped from the factory with internal wiring completed. Refer to the unit's electrical schematic when making connections. Electrical connections to be supplied by the users and made at the installation site are:

- Control wiring (shielded) between the evaporator unit and condensing unit.
- Power supply to outdoor condensing unit, if applicable.

NOTE: Install a manual, electrical-disconnect switch within 5 ft (1.6 m) of the unit and in accordance with local codes.

NOTE: Refer to [Electrical Data](#) below, for full-load amp. and wire-size amp. ratings.

The electrical connections are described in the submittal documents included in the [Submittal Drawings](#) on page 45.

The following table lists the relevant documents by number and title.

Table 5.1 Electrical Field-connection Drawings

Document Number	Title
DPN004300	Electrical Connections, 1- to 5-ton models
DPN004296	Electrical Connections, 8-ton models
DPN004308	Electrical Connection locations, Horizontal air-discharge models
DPN004307	Electrical Connection locations, Top air-discharge models
DPN000647	277-V Step-down Transformer

5.1 Electrical Data

Table 5.2 Electrical data—Standard-sound and Standard-ambient models (95°F/35°C) 60-Hz

Model Number	Nominal Capacity Tons	* Electrical Characteristic	Input Voltage- Phase			
			208/230-1	208/230-3	460-3	575-3
PFH_14	1	FLA	9.1	—	—	—
		WSA	11.0	—	—	—
		OPD	15	—	—	—
PFH_20	1.5	FLA	12.1	—	—	—
		WSA	14.8	—	—	—
		OPD	25	—	—	—
PFH_27	2	FLA	13.4	—	—	—
		WSA	16.4	—	—	—
		OPD	25	—	—	—
PFH_37	3	FLA	18.5	13.4	7.1	5.8
		WSA	22.8	16.4	8.7	7.0
		OPD	35	25	15	15

Table 5.2 Electrical data—Standard-sound and Standard-ambient models (95°F/35°C) 60-Hz (continued)

Model Number	Nominal Capacity Tons	* Electrical Characteristic	Input Voltage- Phase			
			208/230-1	208/230-3	460-3	575-3
PFH_42	3.5	FLA	—	15.0	7.1	6.0
		WSA	—	18.4	8.7	7.2
		OPD	—	30	15	15
PFH_67	5	FLA	—	24.1	11.7	9.1
		WSA	—	29.3	14.2	11.1
		OPD	—	45	20	15
PFH_96	8	FLA	—	36.2	18.1	13.4
		WSA	—	41.4	20.6	15.3
		OPD	—	60	30	20

* FLA = Full Load Amps, WSA = Wire Size Amps (minimum supply circuit current capacity), OPD = Overcurrent Protection Device (fuse or circuit breaker)

Table 5.3 Electrical data—High-ambient models (105°F/41°C) 60-Hz

Model Number	Nominal Capacity, Tons	* Electrical Characteristic	Input Voltage-Phase			
			208/230-1	208/230-3	460-3	575-3
PFH_27	2	FLA	15.4	—	—	—
		WSA	18.4	—	—	—
		OPD	30	—	—	—
PFH_37	3	FLA	20.5	15.4	8.1	5.8
		WSA	24.8	18.4	9.7	7.0
		OPD	40	30	15	15
PFH_42	3.5	FLA	—	17.0	8.1	6.0
		WSA	—	20.4	9.7	7.2
		OPD	—	30	15	15
PFH_67	5	FLA	—	24.2	11.7	9.3
		WSA	—	29.4	14.2	11.3
		OPD	—	50	20	15

* FLA = Full Load Amps, WSA = Wire Size Amps (minimum supply circuit current capacity), OPD = Overcurrent Protection Device (fuse or circuit breaker)

NOTE: Models 14, 20 and 96 are not available in high-ambient versions.

Table 5.4 Electrical data—Quiet-Line models (95°F/35°C) 60-Hz

Model Number	Nominal Capacity, Tons	* Electrical Characteristic	Input Voltage-Phase			
			208/230-1	208/230-3	460-3	575-3
PFH_27	2	FLA	12.9	—	—	—
		WSA	15.9	—	—	—
		OPD	25	—	—	—
PFH_37	3	FLA	18.0	12.9	7.1	—
		WSA	22.3	15.9	8.7	—
		OPD	35	25	15	—
PFH_42	3.5	FLA	—	14.5	6.9	—
		WSA	—	17.9	8.5	—
		OPD	—	30	15	—
PFH_67	5	FLA	—	22.5	10.9	8.3
		WSA	—	27.7	13.4	10.2
		OPD	—	45	20	15

* FLA = Full Load Amps, WSA = Wire Size Amps (minimum supply circuit current capacity), OPD = Overcurrent Protection Device (fuse or circuit breaker)

NOTE: Models 14, 20 and 96 are not available in Quiet-Line versions.

Table 5.5 Electrical data—Standard-sound and Standard-ambient models (95°F/35°C) 50-Hz

Model Number	Nominal Capacity, Tons	* Electrical Characteristic	Input Voltage-Phase	
			220-1	380/415-3
PFH_36	3	FLA	18.4	7.0
PFH_41	3.5	FLA	—	8.5
PFH_66	5	FLA	—	11.7
PFH_95	8	FLA	—	18.1

* FLA = Full Load Amps

Table 5.6 Electrical data—High-ambient models (105°F/41°C) 50-Hz

Model Number	Nominal Capacity, Tons	* Electrical Characteristic	Input Voltage-Phase	
			220-1	380/415-3
PFH_36	3	FLA	20.5	8.1
PFH_41	3.5	FLA	—	9.6
PFH_66	5	FLA	—	11.7
PFH_95	8	FLA	—	—

* FLA = Full Load Amps

Table 5.7 Electrical data—Quiet-Line models (95°F/35°C) 50-Hz

Model Number	Nominal Capacity, Tons	* Electrical Characteristic	Input Voltage-Phase	
			220-1	380/415-3
PFH_36	3	FLA	18.0	6.9
PFH_41	3.5	FLA	—	8.4
PFH_66	5	FLA	—	10.9
PFH_95	8	FLA	—	—

* FLA = Full Load Amps

5.2 Electrical Schematics

Figure 5.1 Single-phase, 1-ton to 3-ton model schematic, typical

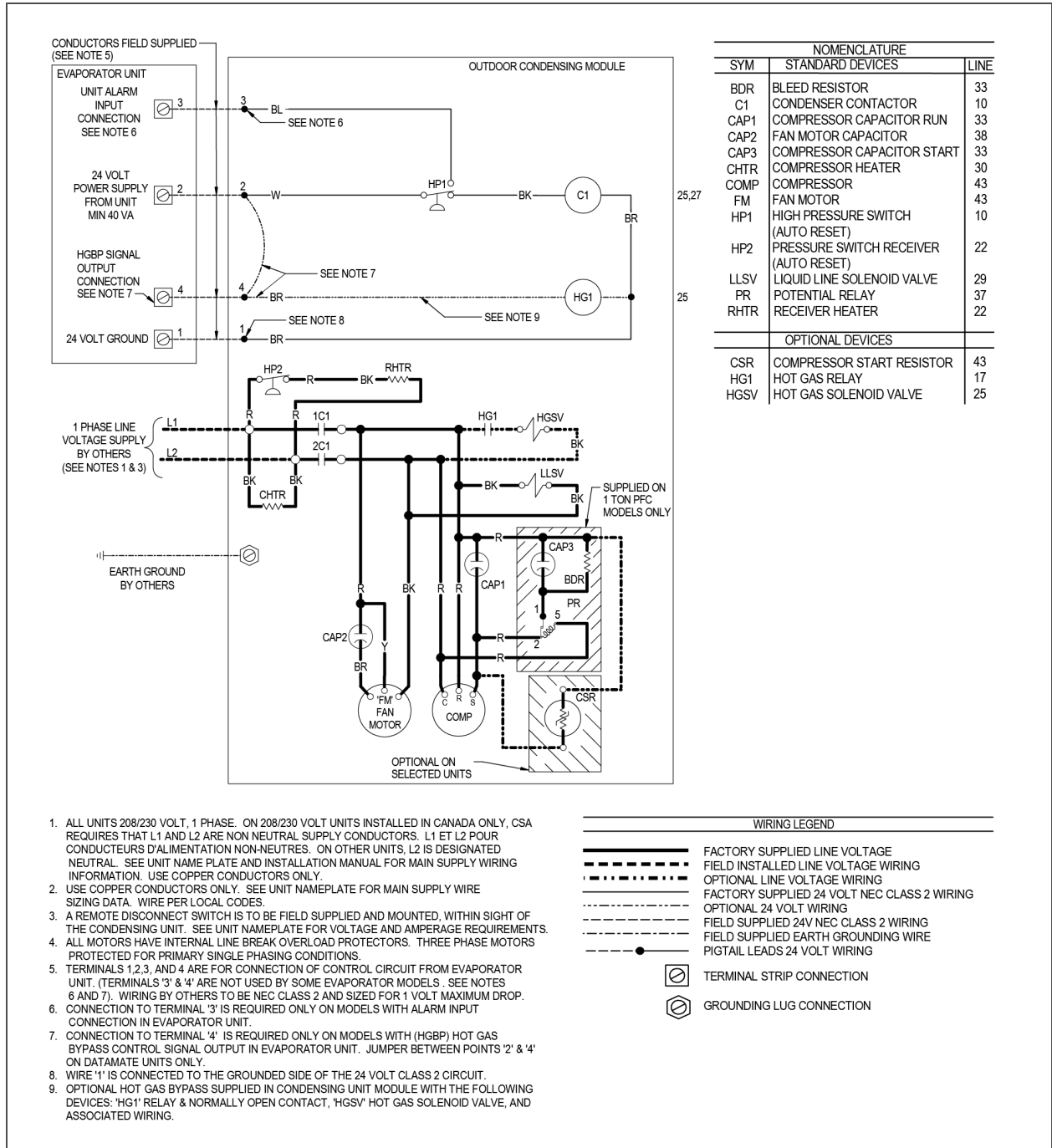


Figure 5.2 Three-phase, 3-ton to 5-ton model schematic, typical

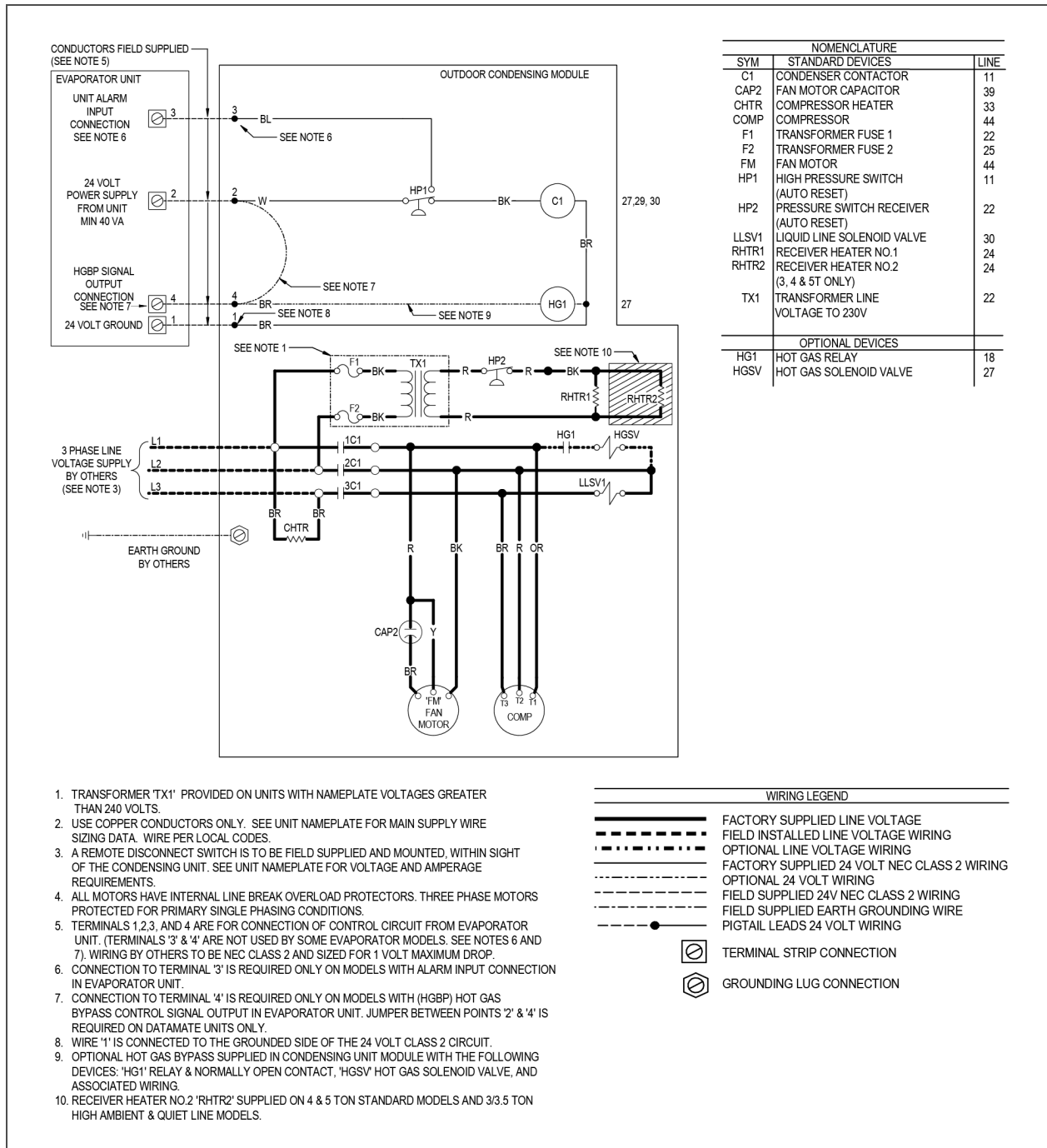
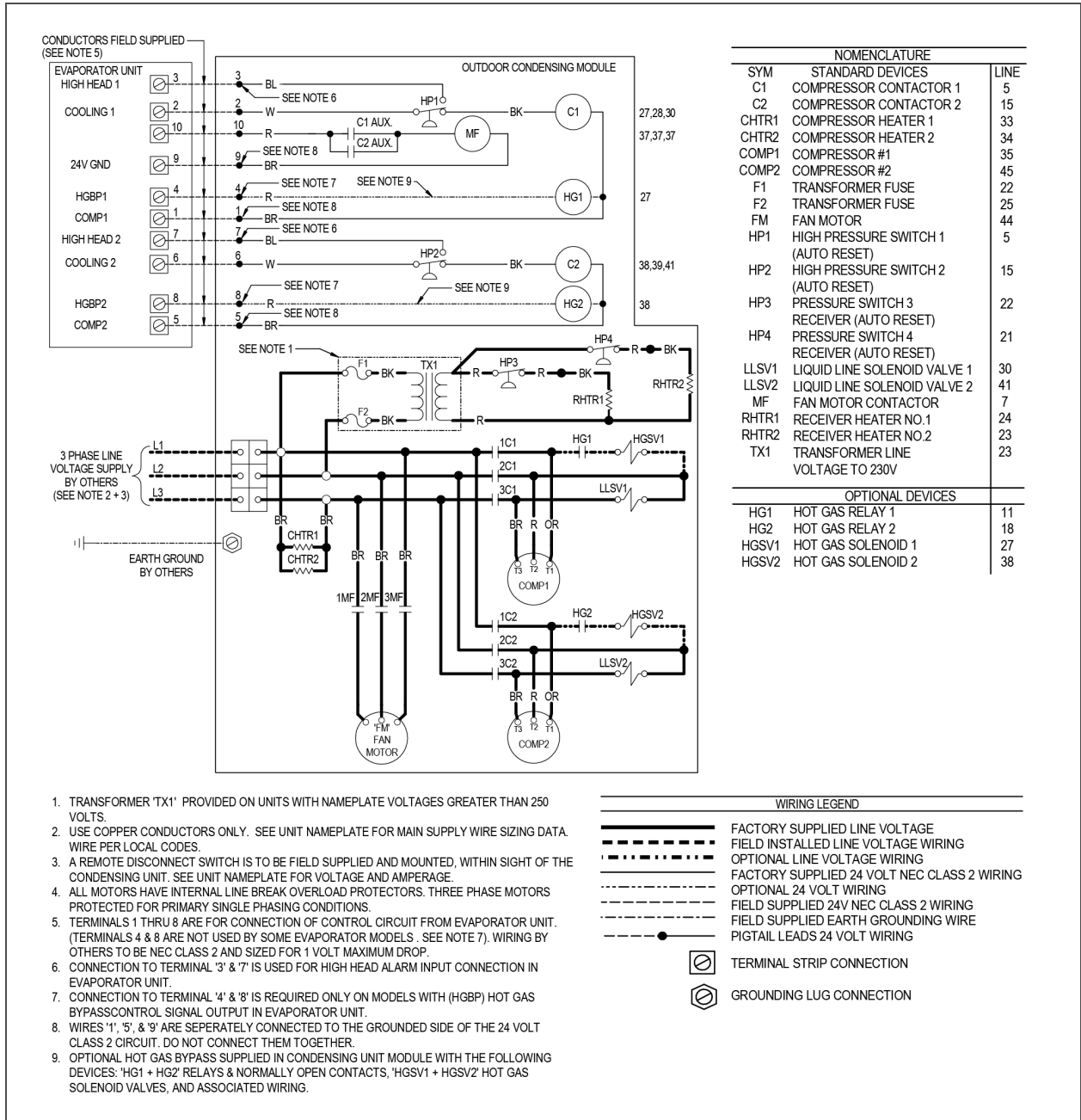


Figure 5.3 Three-phase, 8-ton model schematic, typical



5.3 Control-wiring Connection Requirements

5.3.1 Control Connections

On 1-ton to 5-ton units, a field-supplied, shielded, 4-wire control connection (24 VAC) is required between the evaporator and the condensing unit.

On 8-ton units, a field-supplied, shielded, 10-wire control connection (24 VAC) is required between the evaporator and the condensing unit.

Control wiring must be installed in accordance with the National Electrical Code (NEC) Class 1 circuit according to wire-routing conditions chosen and local codes.

Control wiring between the evaporator and the condensing unit must be shielded and sized for a voltage drop of less than 1 volt, see **Table 5.8** below, for recommended minimum gauge by distance. Connect the shield wire to earth (ground) at the Liebert® equipment. Avoid running the low-voltage connections near high-voltage lines or loads such as light ballasts.

NOTE: Do not connect additional electrical devices to the control circuit. The internal-control transformer is only sized for factory-supplied components. Refer to the appropriate submittal drawings for your system for electrical connections. See Table 5.1 on page 22.

Table 5.8 Recommended minimum wire size

Maximum Distance,* ft (m)	Minimum Wire Gauge, AWG (mm ²)
50 (15)	20 (0.75)
100 (30)	18 (1.0)
150 (45)	16 (1.5)
* One-way control wire run between outdoor condensing unit and evaporator.	

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6 CHECKLIST FOR COMPLETED INSTALLATION

1. All items unpacked and checked.
2. Proper clearances for service access maintained around equipment.
3. Equipment is level and mounting fasteners are tight.
4. Piping completed to refrigerant loop.
5. All piping connections are tight.
6. Piping routed to prevent chafing and rub-through.
7. Piping has been evacuated and refrigerant charge added (if required).
8. Line voltage to power wiring matches equipment nameplate.
9. Power wiring connections completed, including earth ground.
10. Power line circuit breakers or fuses have proper ratings for equipment installed.
11. Control wire to condensing unit is shielded, connections completed, including shield wire connected to earth (ground) at Liebert units.
12. All wiring connections are tight.
13. Foreign materials have been removed from area: in and around all equipment installed (shipping materials, construction materials, tools, etc.).
14. Fans and blowers rotate freely and in the proper direction.
15. Blank start-up sheet has been sent with the evaporator unit and is ready to be completed by the installer.

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7 OPERATION

7.1 Compressor Operation

The scroll compressor is equipped with a band type crankcase heater to resist liquid-refrigerant migration into the compressor during the Off cycle. The three-phase scroll compressor requires proper phasing to ensure correct motor rotation. The component connections are phase synchronized at the factory.

7.2 High Head Pressure Operation

High head pressure in the compressor is monitored with an SPDT pressure switch for each compressor in the unit. If head pressure exceeds 400 psig (2760 kPa), the switch opens the compressor contactor and sends an input signal to the evaporator wall-box control. The high-head-pressure condition is acknowledged by pressing the alarm-silence button, which clears the alarm if the high-head-pressure condition no longer exists.

If the compressor is off for 1 hour, the control goes into a special cold-start mode. On a call for cooling or dehumidification in cold-start mode, the liquid-line solenoid valve (LLSV) is energized.

- If the high-pressure switch *does not* trip within 10 seconds, the control returns to normal operation (monitor the high-head-pressure switch for 3 occurrences in a 12-hour period). It is a rolling timer, and after the third high-head-pressure alarm occurs and is acknowledged, it locks off the compressor.
- If the high-head pressure switch *does* trip within 10 seconds of activation of the LLSV, the control does not annunciate the alarm. The control turns off the LLSV and delays 10 seconds. The control turns-off and delays a total of three times.
- If, on the fourth try, the high-head-pressure switch trips within 10 seconds, the control annunciates the alarm, turns off the LLSV, waits for alarm acknowledgment, and holds the compressor off for the normal, 3-minute short-cycle control. The control allows this sequence 3 times. On the third occurrence, the control locks the compressor off until the control power is reset.

Check for these conditions:

- Power shut off to the condensing unit
- Condensing unit fan not working
- Defective head pressure control valves
- Closed services valves
- Dirty condensing coils
- Crimped lines

7.3 Liebert® Lee-Temp™ Flood-back Head-pressure Control

The components for head-pressure control include a receiver, heater, and 3-way head-pressure control valve. The head-pressure control valve maintains a minimum condensing pressure. During low-ambient-temperature operation, the valve meters discharge gas into the receiver to maintain a discharge pressure operating against the valve dome. This closes the condenser port, backing liquid refrigerant into the condenser coil, and reducing the area available for condensing. The receiver is sized to hold the additional charge required to flood the condenser.

A temperature-compensated heater maintains the liquid-refrigerant pressure during Off cycles. A liquid-pressure switch turns off the heater during operation when the receiver pressure is high. The heater pressure switch has a cut-out of 150 psig (1034 kPa) and a cut-in of 100 psig (690 kPa). The receiver includes a pressure-relief valve that is set for 475 psig (3275 kPa).

7.3.1 Hot Gas Bypass Operation and Maintenance

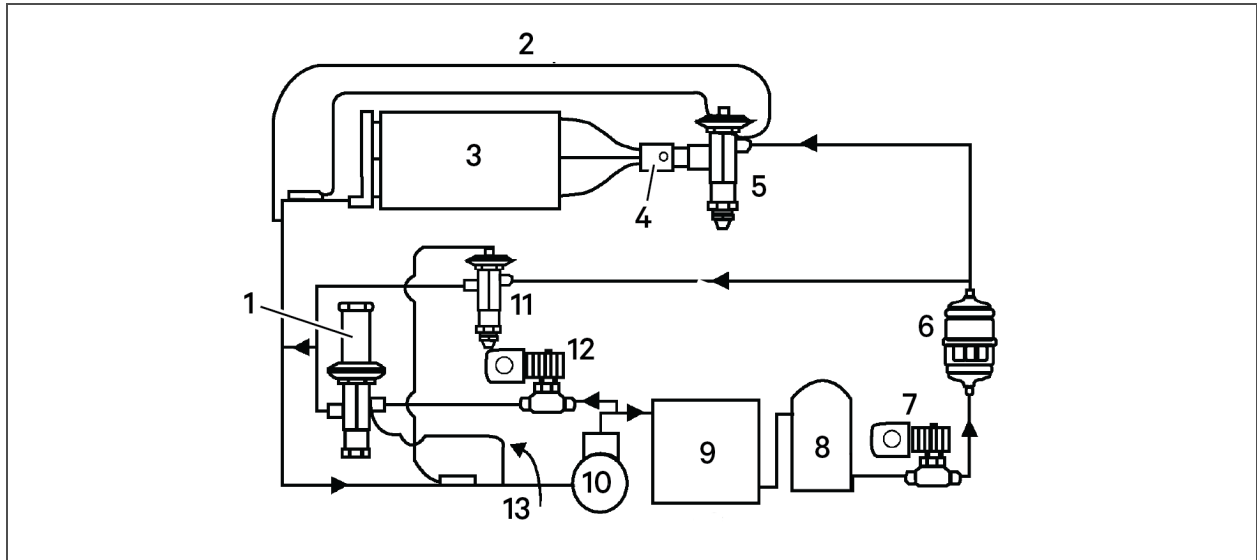
When applying hot-gas bypass with split system condensing units, bypassing discharge gas to the compressor suction line offers more flexibility than conventional hot-gas bypass to the evaporator unit.

The hot-gas bypass valve is installed between the compressor discharge piping and suction piping, bypassing the condenser and evaporator coils. The discharge gas mixes with the suction gas, raising the suction temperature and pressure and decreasing the mass flow through the evaporator. The higher suction temperatures could cause compressor overheating, therefore a separate, liquid-quenching valve is provided to mix refrigerant from the system liquid line with the discharge gas before mixing with the suction gas entering the compressor.

During normal operation, when the evaporator is under full load, the hot-gas bypass equalizer pressure will remain high enough to keep the valve port closed. If the evaporator load decreases, the evaporator temperature and pressure will drop. When the suction pressure reduces below the hot-gas-bypass valve setting the hot-gas-bypass valve opens diverting some of the refrigerant flow back to the compressor suction. The liquid-quenching valve bulb senses this increased superheat and opens, allowing liquid refrigerant to mix with the discharge gas, de-superheating it.

Proper mixing of the three refrigerant paths ensures stable operation and system performance. The liquid-quenching valve bulb must be located downstream of all these connections to control superheat at the compressor inlet. Superheat settings for the liquid-quenching valve are chosen to maintain consistency with the system expansion valve. During hot-gas bypass operation, higher superheats, 50 to 60°F (28 to 33°C), may be observed at the compressor. The liquid-quenching valve is internally equalized and superheat is not adjustable.

Figure 7.1 Hot-gas bypass components and flow



Item	Description
1	Discharge bypass valve
2	External equalizer
3	Evaporator
4	Distributor
5	TEV
6	Catch-all
7	Solenoid valve
8	Receiver
9	Condenser coil
10	Compressor
11	De-superheating TEV
12	Hot-gas solenoid valve
13	External equalizers

To adjust hot-gas bypass:

1. Install the suction and discharge pressure gauge.
2. Adjust temperature setpoint to call for cooling so that the refrigeration compressor will run continuously.
3. Remove the TOP adjusting nut from the valve.
4. Insert an Allen wrench in the brass hole at top of valve in adjusting port, and turn CLOCKWISE if a higher evaporator temperature is required. Adjust no more than 1/4 turn at a time. Let the system stabilize for 15 minutes before determining if additional adjustment are necessary.
5. After obtaining the suction pressure required, reinstall cap tightly making sure there are no leaks.

6. Let the evaporator operate for approximately 10 to 15 minutes to make sure the suction pressure is within the range desired.
7. There may be a fluctuation of approximately 3 to 6 psig (21 to 41 kPa) on the evaporator due to the differential on the hot gas bypass.
8. Return temperature setpoint to the desired setting.

8 MAINTENANCE

Use copies of the Preventive Maintenance Checklist found in the User Guide for the indoor unit to record preventive maintenance inspections.



WARNING! Arc flash and electric shock hazard. Open all local and remote electric power-supply disconnect switches, verify with a voltmeter that power is Off and wear appropriate, OSHA-approved personal protective equipment (PPE) per NFPA 70E before working within the electric control enclosure. Failure to comply can cause serious injury or death. Customer must provide earth ground to unit, per NEC, CEC and local codes, as applicable. Before proceeding with installation, read all instructions, verify that all the parts are included and check the nameplate to be sure the voltage matches available utility power. The Liebert® controller does not isolate power from the unit, even in the “Unit Off” mode. Some internal components require and receive power even during the “Unit Off” mode of the controller. The only way to ensure that there is NO voltage inside the unit is to install and open a remote disconnect switch. Refer to unit electrical schematic. Follow all local codes.



WARNING! Risk of electric shock. Can cause equipment damage, injury or death. Open all local and remote electric power supply disconnect switches and verify with a voltmeter that power is off before working within any electric connection enclosures. Service and maintenance work must be performed only by properly trained and qualified personnel and in accordance with applicable regulations and manufacturers’ specifications. Opening or removing the covers to any equipment may expose personnel to lethal voltages within the unit even when it is apparently not operating and the input wiring is disconnected from the electrical source.



WARNING! Risk of improper wiring, piping, moving, lifting and handling. Can cause equipment damage, serious injury or death. Installation and service of this equipment should be done only by qualified personnel, wearing appropriate, OSHA-approved PPE, who have been specially-trained in the installation of air-conditioning equipment.



WARNING! Risk of contact with high-speed, rotating fan blades. Can cause injury or death. Open all local and remote electric power-supply disconnect switches, verify with a voltmeter that power is off, and verify that all fan blades have stopped rotating before working in the unit cabinet.



CAUTION: Risk of contact with hot surfaces. Can cause injury. The compressor, refrigerant discharge lines, fan motor, and some electrical components are extremely hot during unit operation. Allow sufficient time for them to cool to a touch-safe temperature before working within the unit cabinet. Use extreme caution and wear appropriate, OSHA-approved PPE when working on or near hot components.



CAUTION: Risk of excessive refrigerant line pressure. Can cause tubing and component rupture resulting in equipment damage and personal injury. Do not close off any field-installed refrigerant-line isolation valve for repairs unless a pressure-relief valve is field- installed in the line between the isolation valve and the check valve. The pressure-relief valve must be rated 5% to 10% higher than the system-design pressure. An increase in ambient temperature can cause the pressure of the isolated refrigerant to rise and exceed the system-design pressure rating (marked on the unit nameplate).

NOTICE

Risk of compressor slugging. Can cause equipment damage.

Apply power to condenser 8 hours before operating the system. This time is required to allow liquid refrigerant to be driven out of the compressor. This is especially important at low ambient temperatures.

The Liebert® PFH units are single components in the facility heat-removal system. The system includes air distribution (duct systems), cooling unit (evaporator), heat rejection (condensing units), and indoor cooling and humidity loads (equipment load, location, outside air infiltration). Proper application and maintenance of the entire system is critical to the life and reliability of the thermal-management units.

- Good maintenance practices are essential to minimizing operation costs and maximizing product life.
- Read and follow monthly and semi-annual maintenance schedules included in this manual. These MINIMUM maintenance intervals may need to be more frequent based on site-specific conditions.
- We recommend the use of trained and authorized service personnel, extended service contracts and factory-specified replacement parts. Contact your Vertiv sales representative.

8.1 General Condensing Unit Maintenance

Monthly and semi-annual inspections and maintenance are recommended for proper system operation.

Periodic attention is necessary for continued satisfactory operation of your unit. Restricted air flow through the condenser coil, reduced airflow from non-functioning fans and low refrigerant system charge levels will reduce the operating efficiency of the unit and can result in high condensing temperatures and loss of cooling. In winter, do not permit snow to accumulate around the sides or underneath the condenser coil.

Access the condensing unit by removing the unit housing panel and perform the following:

- Clean the air cooled condenser coil of all debris that will inhibit airflow using compressed air or plain water.
- Check for bent or damaged coil fins and repair as necessary.
- During winter, do not permit snow to accumulate on or around the condensing unit.
- Check all refrigerant lines and capillaries for vibration isolation and support as necessary.
- Check all refrigerant lines for signs of leaks.

8.2 Compressor Maintenance



WARNING! Risk of over-pressurization of the refrigeration system. Can cause piping rupture, explosive discharge of high-pressure refrigerant, loss of refrigerant, environmental pollution, equipment damage, injury, or death. This unit contains fluids and gases under high pressure. Use extreme caution when charging the refrigerant system. Do not pressurize the system higher than the design pressure marked on the unit's nameplate. Relieve pressure before cutting into or making connections/disconnections to the piping system. Local building or plumbing codes may require installing a pressure-relief device in the system.

Consult local building and plumbing codes for installation requirements of additional pressure-relief devices when isolation valves are field installed. Do not isolate any refrigerant circuits from over pressurization protection. The PFH condensing units include a factory-installed pressure-relief valve mounted on top of the receiver. The valve is rated for a maximum working pressure of 475 psig.



CAUTION: Risk of contacting caustic substances. Can cause injury. Avoid touching or contacting the gas and oils with exposed skin. Severe burns will result. Wear appropriate, OSHA-approved PPE when handling contaminated parts.

Infrequently, a fault in the motor insulation may result in a motor burnout (if system is properly installed, motor burnout rarely occurs). Primarily, this type of failure is due to mechanical or lubrication problems, where the burnout is a secondary consequence.

Early detection can prevent a large percentage of the problems that can cause compressor failures. Periodic maintenance inspections that identify abnormal operation can be a major factor in reducing maintenance costs. It is easier and more cost-effective to implement the necessary preventative steps that ensure proper system operation, rather than ignore a problem until it results in compressor failure and costly replacement. When troubleshooting a compressor problem, check all electrical components for proper operation:

- Check all fuses and circuit breakers.
- Check pressure switch operation.
- If a compressor failure has occurred, determine whether its cause is an electrical or mechanical problem.

8.2.1 Mechanical Failure of the Compressor

If you determine that a mechanical failure has occurred, the compressor must be replaced. If a burnout occurs, correct the problem and clean the system. It is important to note that successive burnouts of the same system are usually caused by improper cleaning. If a severe burnout has occurred, the oil will be black and acidic.

8.2.2 Electrical Failure of the Compressor

In the event of an electrical failure and subsequent burnout of the refrigeration compressor motor, proper procedures must be followed to thoroughly remove any acids that would cause a future failure. There are two kits that can be used with a complete compressor burnout - Sporlan System Cleaner and Alco Dri-Kleener. Follow the manufacturer's procedure.

NOTE: Damage to a replacement compressor due to improper system cleaning constitutes abuse under the terms of the warranty, thereby voiding the warranty.

8.2.3 Replacement Compressors

Replacement compressors are available from your Vertiv supplier and are shipped to the job site in a reusable crate (as required by the service contractor). If the compressor is under warranty, you must return it to Vertiv, to receive proper warranty credit. Return it in the same container in which the replacement compressor was shipped. Record the possible cause(s) or condition(s) of the damage on the provided return tag.

8.2.4 Replacing a Failed Compressor

1. Disconnect power
2. Attach suction and discharge gauges to access fittings.
3. Recover refrigerant using standard recovery procedures and equipment. Use a filter-drier when charging the system with recovered refrigerant.

NOTE: Release of refrigerant to the atmosphere is harmful to the environment and unlawful. Refrigerant must be recycled or discarded in accordance with federal, state and local regulations.

4. Remove failed compressor.
5. Install replacement compressor and make all connections.
 - Use a flow of dry nitrogen through the piping during brazing to prevent formation of copper oxide scale inside the piping. Copper oxide forms when copper is heated in the presence of air. POE oil will dissolve these oxides from inside the copper pipes and deposit them throughout the system, clogging filter driers and affecting other system components.
 - A pure dry nitrogen flow of 1-3 ft³/min (0.5-1.5 l/s) inside the pipe during brazing is sufficient to displace the air. Control the flow using a suitable metering device. Pressurize and leak test the system at approximately 150 psig (1034 kPa) pressure.
6. Follow manufacturer's instructions for clean-out kits.
7. Evacuate the system twice to 500 microns. Break the vacuum each time with clean, dry nitrogen.
8. Evacuate the system a third time to 500 microns.
9. Charge the system with refrigerant (R-407C) based on requirements of the evaporator, condensing unit, and lines. Refer to the unit nameplate.
10. Apply power and operate the system. Check for proper operation. Refer to **Table 3.3** on page 7, for the design pressures.

9 TROUBLESHOOTING

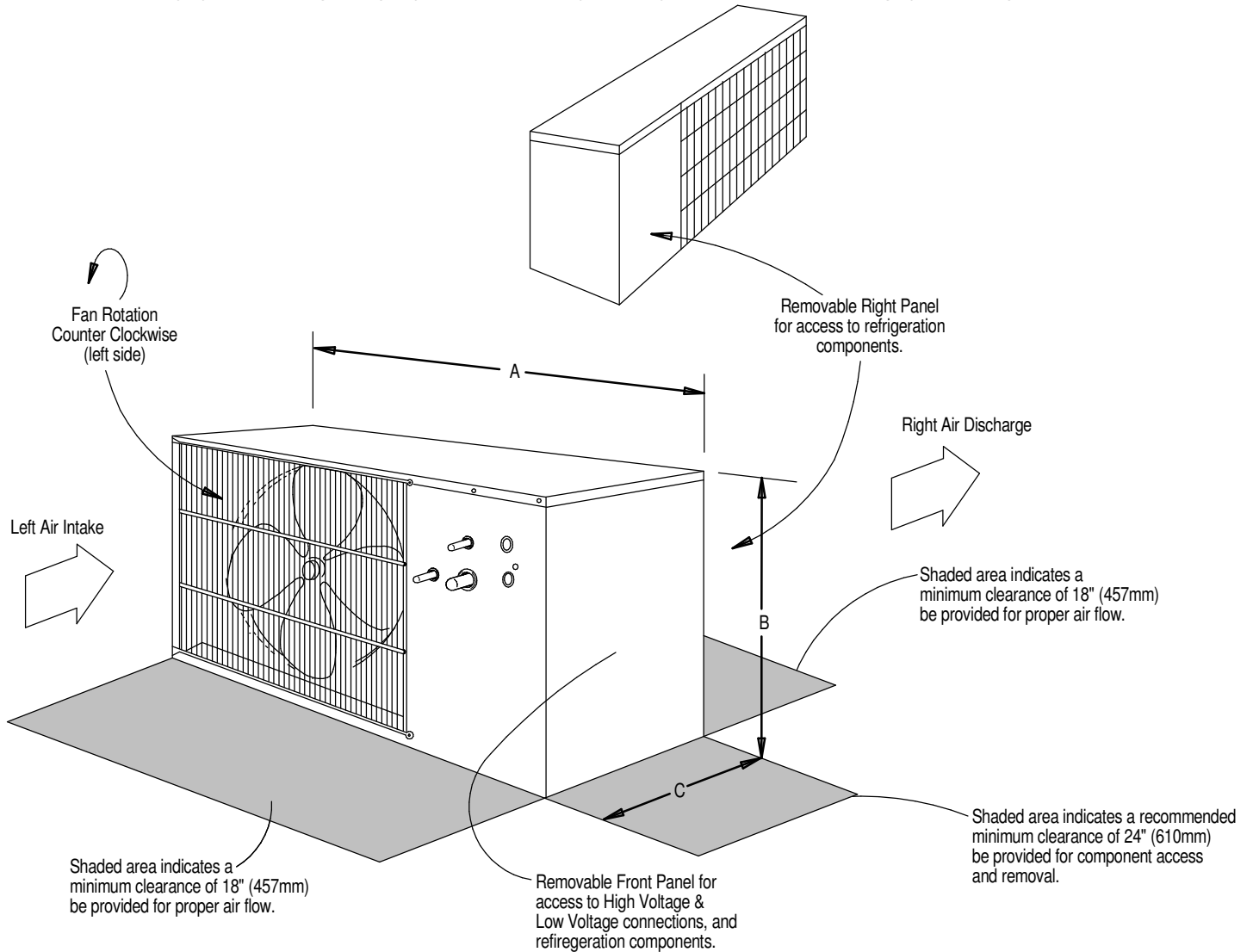
Table 9.1 Troubleshooting

Problem	Cause	Remedy
Unit will not start	No power to unit	Check voltage at input terminal block.
	Compressor contactor not pulling in	Check for 24VAC \pm 2VAC at control connections 1 & 2. If no voltage, check control setting requires cooling. If there is voltage, lockout relay may be energized. Check for 24VAC at control connections 2 & 3. If there is voltage, see compressor high-discharge pressure/lockout relay.
	Control voltage circuit breaker (at transformer in evaporator module) open	Locate short and reset circuit breaker.
	Short cycle prevention control	Control software delays compressor 3 minutes from stop to start.
	Compressor high discharge pressure/lockout relay	Check for 24VAC \pm 2VAC at control connections 2 & 3. Remove 24VAC signal at Connection 2 by turning indoor unit control off, then back on, or by raising the setpoint to remove the call for cooling, then resetting to re-establish operation.
High discharge pressure	Insufficient air flow across condenser coil	Check fan operation. Remove debris from coil and air inlets.
	High refrigerant charge	Check refrigerant charge.
	Un-shielded control wires used between split-system units.	Check that shielded control wires are used and shield wire is connected to the earth (ground) at the Liebert equipment. Route low-voltage wires separately from high-voltage lines and away from loads such as light ballasts.
Low discharge pressure	Faulty head pressure control valve	Replace if defective.
	Compressor rotation in reverse direction	Check for proper power phase wiring to unit and to compressor motor.
Low suction pressure / compressor cycling	Insufficient refrigerant in system	Check for leaks; repair and add refrigerant.
	Plugged filter drier	Replace filter drier.
	Improper superheat adjustment	Reset expansion valve for 10-15°F (5.6 to 8.4°C) superheat at evaporator.
	Defective liquid line solenoid valve	Check valve and coil; replace if necessary.
Low compressor capacity/ no cooling	Defective liquid line solenoid valve	Check valve and coil; replace if necessary.
	Plugged filter drier	Check pressure drop across filter drier. Replace filter drier.
	Low refrigerant charge	Check for normal system operating pressures. Refer to abnormal pressure causes if applicable. Check for leaks. Proper refrigerant charge is very important at low ambient operation.
Compressor noisy	Loose compressor or piping support	Tighten clamps.
	Compressor rotation in reverse direction	Check for proper power phase wiring to unit and to compressor motor.
Pipe Rattle	Loose pipe connections	Check pipe connections.
Compressor running hot	Compression ratio too high	Check for normal system operating pressures. Refer to abnormal pressure causes if applicable.

Table 9.1 Troubleshooting (continued)

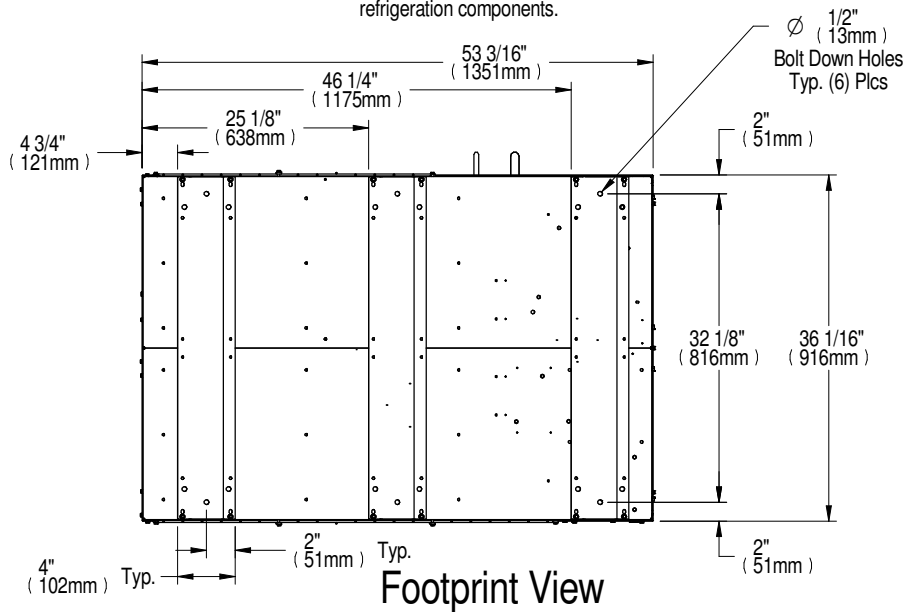
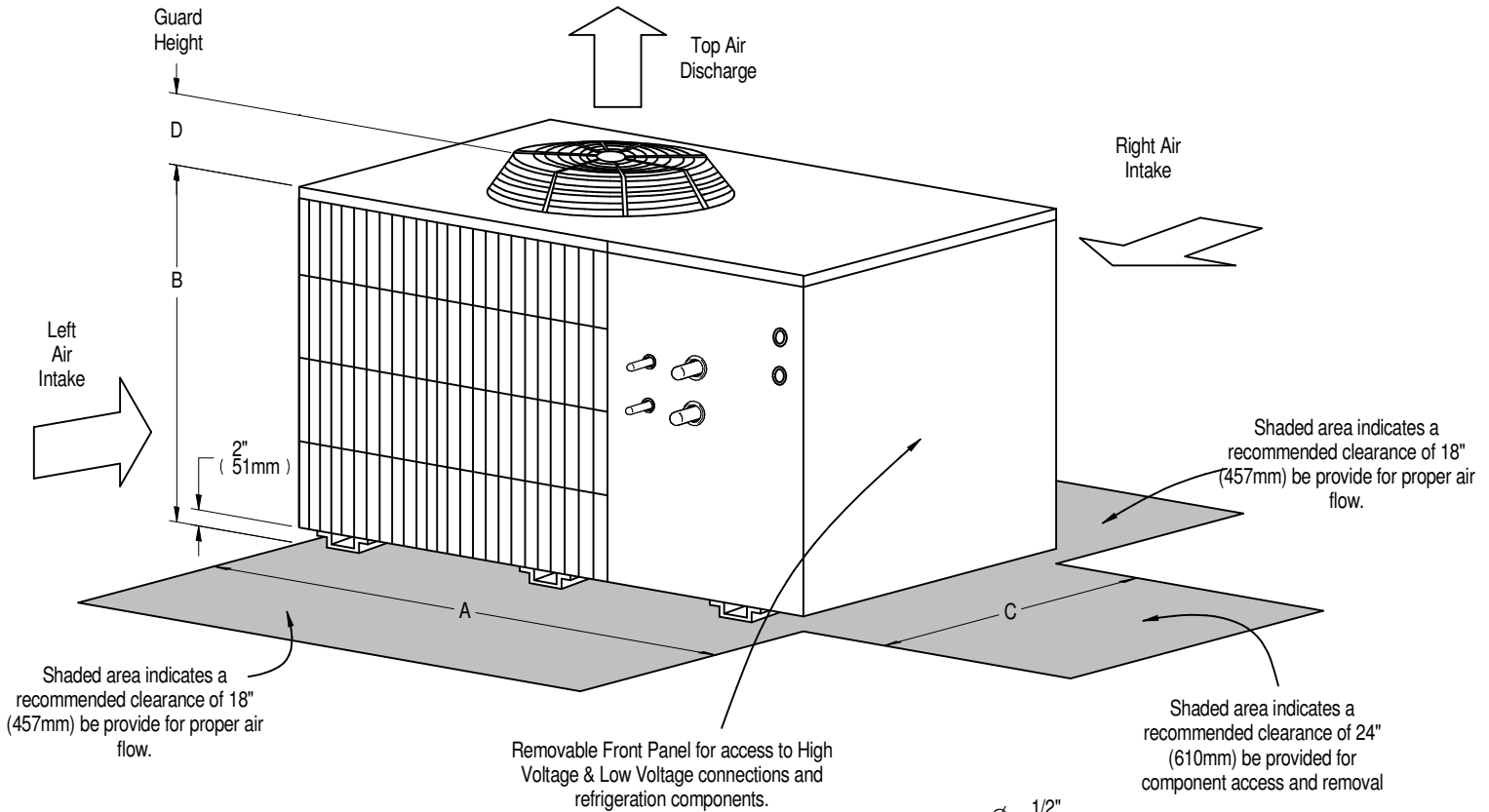
Problem	Cause	Remedy
Compressor motor protectors tripping or cycling	High discharge pressure	Check for blocked condenser fan or coil.
	High suction temperature	Check expansion valve and hot gas bypass valve setting. Check liquid quenching valve operation.
	Loose power or control circuit wiring connection	Check all power and control circuit connections.
	Defective motor	Check for motor ground or short. Replace compressor if either condition is found.
Compressor cycles on locked rotor	Low line voltage	Check line voltage and determine location of voltage drop.
	Compressor motor defective	Check for motor winding short or ground.
	Single phasing	Check voltage across all 3 legs at contactor. Correct source of problem.
Motor burnout	Check control panel for welded contactor contacts or welded overload contacts.	Replace defective components.

CABINET DIMENSIONAL DATA CONDENSING UNIT W/ HORIZONTAL AIR DISCHARGE



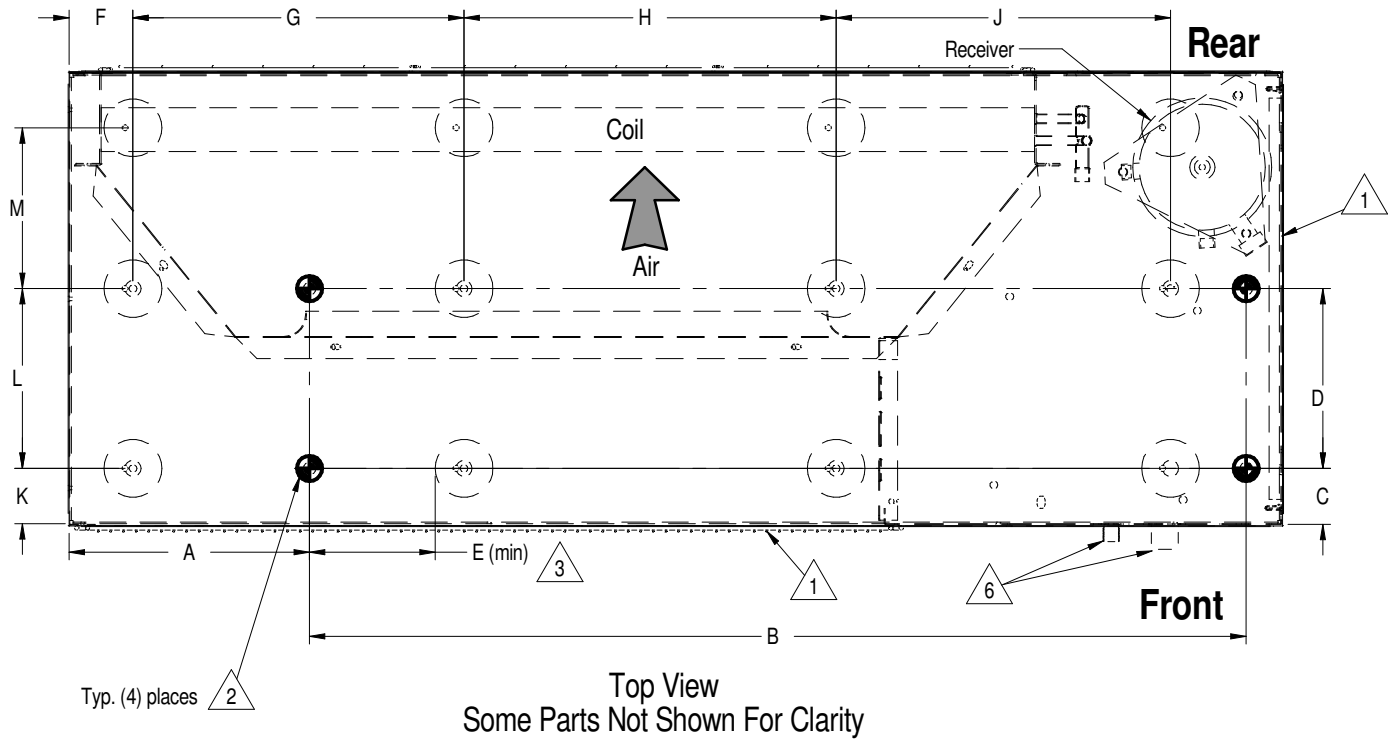
MODEL NUMBERS		DIMENSIONAL DATA IN. (mm)			MODULE WEIGHT
60 HZ	50HZ	A	B	C	lbs. (kg) net
PFH014A-L	NA	40 (1016)	23 1/2 (597)	18 (457)	200 (91)
PFH020A-L	NA				
PFH027A-L	NA				
PFH027A-H	NA	48 (1219)	31 (787)	18 (457)	241 (109)
PFHZ27A-L	NA				
PFH037A-L	PFH036A-L				
PFH042A-L	PFH041A-L	53 (1343)	36 1/4 (918)	18 (457)	351 (159)
PFH037A-H	PFH036A-H				
PFHZ37A-L	PFHZ36A-L				
PFH042A-H	PFH041A-H				
PFHZ42A-L	PFHZ41A-L				
PFH067A-L	PFH066A-L				

CABINET DIMENSIONAL DATA CONDENSING MODULES W/ TOP AIR DISCHARGE



MODEL NUMBERS		DIMENSIONAL DATA IN. (mm)				MODULE WEIGHT
60HZ	50HZ	A	B	C	D	lbs. (kg) net.
PFH067A- H	PFH066A- H	53 (1343)	36 1/4 (918)	38 1/2 (978)	5 1/2 (140)	488 (222)
PFHZ67A- L	PFHZ66A- L					570 (259)
PFH096A- L	PFH095A- L					

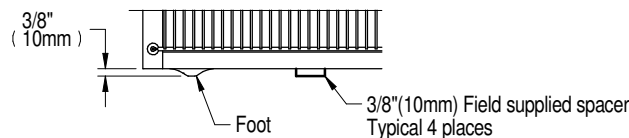
OPTIONAL ANCHORAGE PLAN



MODEL NUMBERS		DIMENSIONAL DATA IN. (mm)											
60 HZ	50HZ	A	B	C	D	E (min)	F	G	H	J	K	L	M
PFH014A-L	NA	8-5/8 (219)	30-1/4 (769)	2-1/2 (64)	8-1/2 (216)	1 (25)	6-1/2 (165)	13-13/16 (351)	15 (381)	NA	2-1/2 (64)	15-1/16 (382)	NA
PFH020A-L													
PFH027A-L													
PFH027A-H													
PFHZ27A-L	PFH036A-L	9-9/16 (242)	37-1/8 (943)	2-1/4 (57)	7-1/8 (181)	1-7/8 (47)	2-9/16 (64)	13-1/8 (333)	14-3/4 (375)	13-1/4 (337)	2-1/4 (57)	7-1/8 (181)	6-3/8 (162)
PFH037A-L													
PFH042A-L	PFH041A-L	9-5/16 (236)	43 (1092)	2-5/16 (58)	7-1/8 (181)	2-9/16 (65)	2-1/2 (63)	15-1/16 (383)	15-11/16 (398)	15-3/8 (391)	2-5/16 (58)	7-1/8 (181)	6-3/8 (162)
PFH037A-H	PFH036A-H												
PFHZ37A-L	PFHZ36A-L												
PFH042A-H	PFH041A-H												
PFHZ42A-L	PFHZ41A-L	9-5/16 (236)	43 (1092)	2-5/16 (58)	7-1/8 (181)	2-9/16 (65)	2-1/2 (63)	15-1/16 (383)	15-11/16 (398)	15-3/8 (391)	2-5/16 (58)	7-1/8 (181)	6-3/8 (162)
PFH067A-L	PFH066A-L												

Notes:

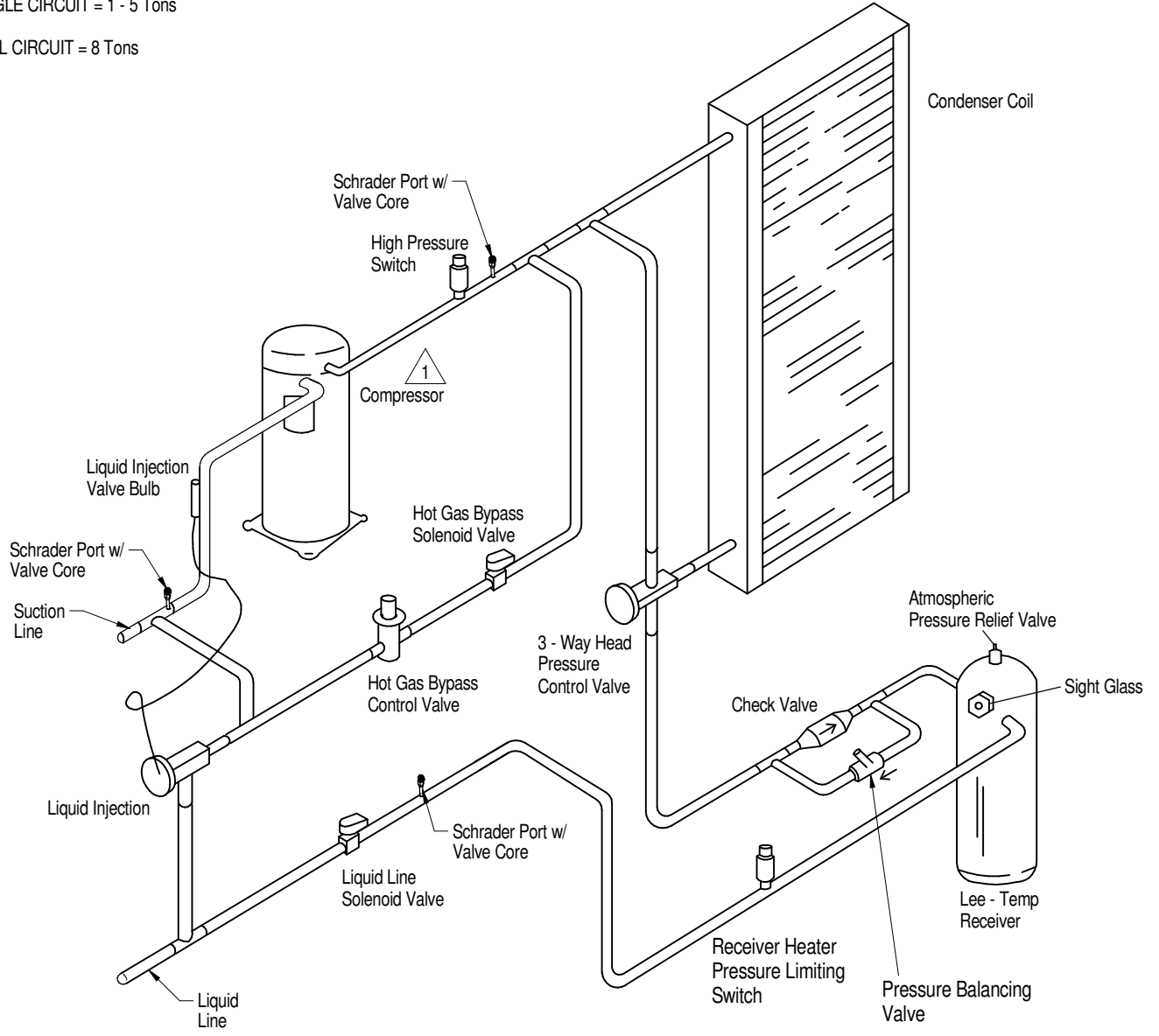
1. Front Grille and Right End Panel will need to be removed to access anchor holes, Top panel may be removed for additional access. All removed parts must be reinstalled.
2. 1/2"(13mm) Diameter hole, use for unit anchor.
3. All dimensions have a tolerance of $\pm 1/16"$.
4. F, G, H, J, K, L and M dimensions are for the foot locations.
5. The use of this anchor plan is optional and installer will assume responsibility for suitable anchorage.
6. Supply and return piping connections



Partial Front View

GENERAL ARRANGEMENT DIAGRAM

- SINGLE CIRCUIT = 1 - 5 Tons
- DUAL CIRCUIT = 8 Tons

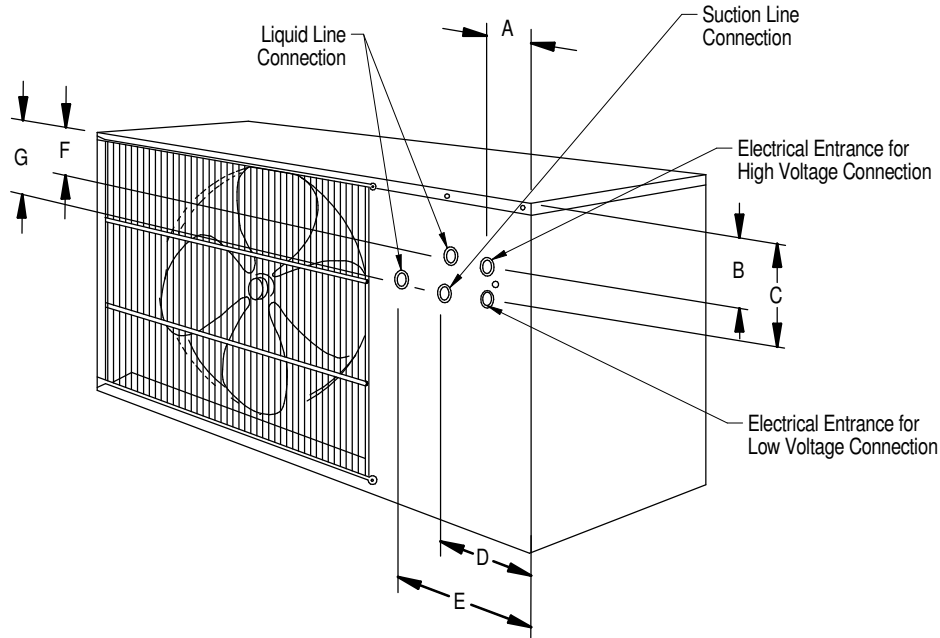


SINGLE CIRCUIT SHOWN

Notes:

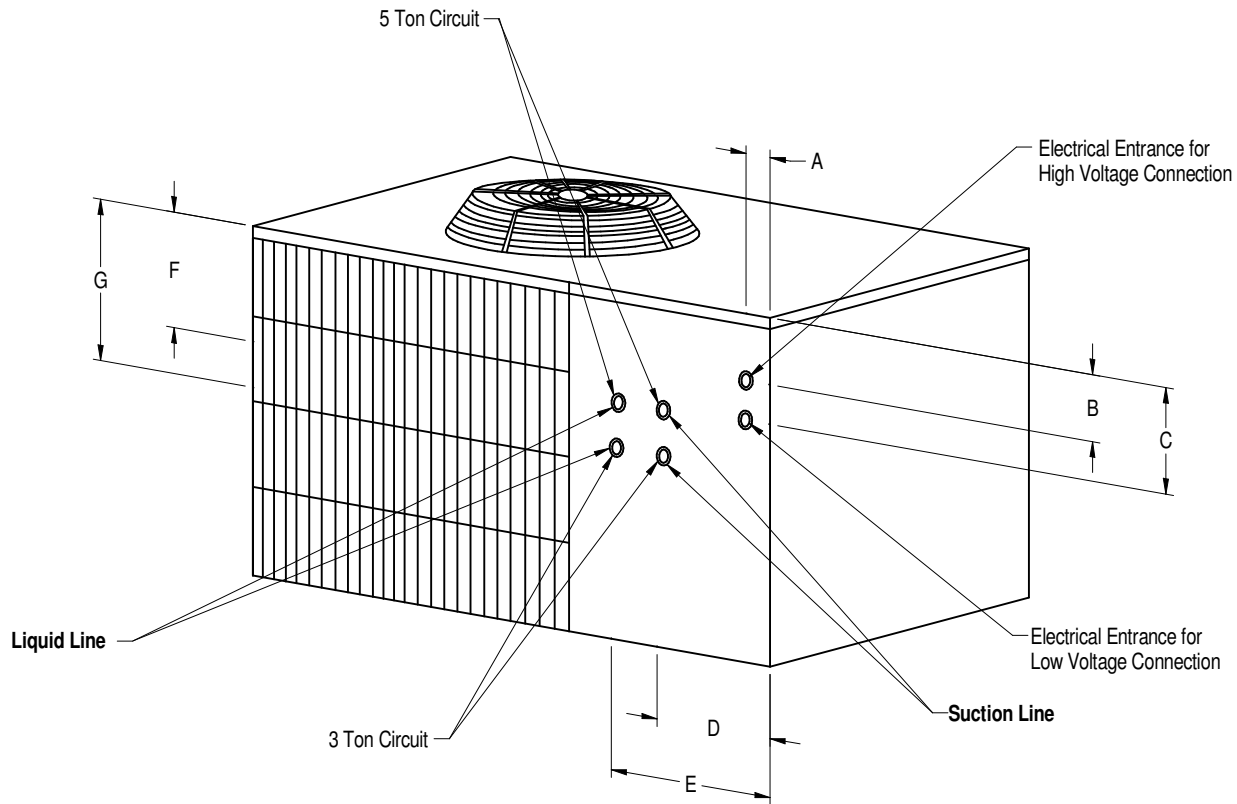
- 1. Reciprocating compressor 1 Ton.
Scroll compressor 1 1/2 - 8 Tons.

PRIMARY CONNECTION LOCATIONS CONDENSING UNIT W/ HORIZONTAL AIR DISCHARGE



MODEL NUMBERS		ELECTRICAL CONNECTIONS INCH (MM)			PIPING CONNECTION LOCATION INCH (MM)				PIPING CONNECTION SIZES O.D. CU	
60Hz	50Hz	A	B	C	D	E	F	G	Liquid	Suction
PFH014A-L	N/A	2-1/4 (57)	5-1/4 (133)	7-3/4 (197)	8-3/4 (222)	N/A	5 (127)	7-1/4 (184)	3/8"	5/8"
PFH020A-L	N/A		5-3/4 (146)	8-1/2 (216)	4-3/4 (12)	N/A	8-1/2 (216)	1/2"		
PFH027A-L	N/A								2 (51)	6 (152)
PFH027A-H	N/A									
PFHZ27A-L	N/A									
PFH037A-L	PFH036A-L									
PFH042A-L	PFH041A-L									
PFH037A-H	PFH036A-H									
PFHZ37A-L	PFHZ36A-L									
PFH042A-H	PFH041A-H									
PFHZ42A-L	PFHZ41A-L									
PFH067A-L	PFH066A-L									

PRIMARY CONNECTION LOCATIONS CONDENSING UNIT W/ TOP AIR DISCHARGE

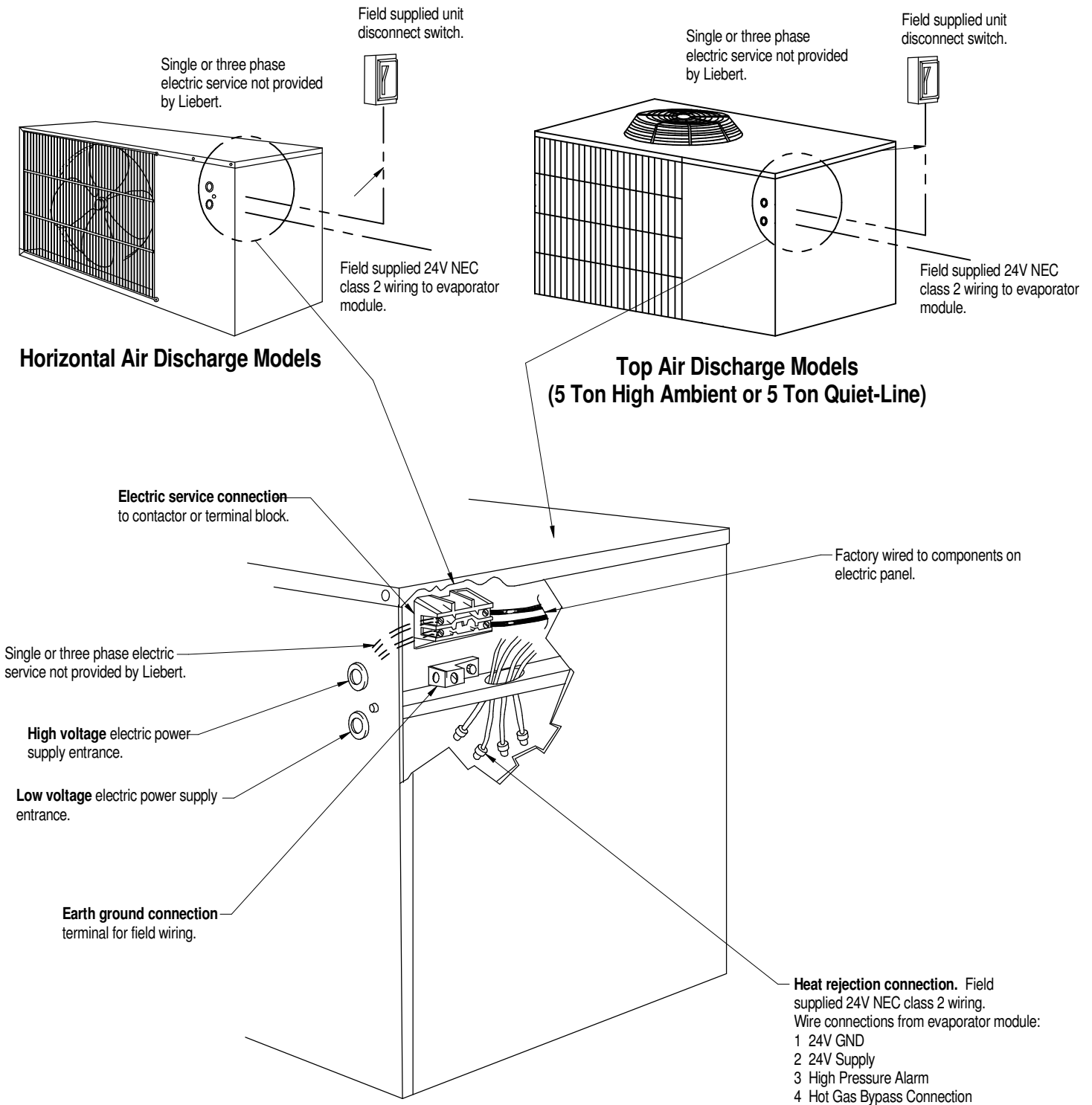


MODEL NUMBERS		ELECTRICAL CONNECTIONS IN. (mm)			PIPING CONNECTIONS IN. (mm)			
60HZ	50HZ	A	B	C	D	E	F	G
PFH067A- H	PFH066A- H	2 (51)	6 (152)	8 1/2 (216)	4 3/4 (121)	7 3/4 (197)	8 1/2 (216)	N/A
PFHZ67A- L	PFHZ66A- L							11 1/2 (292)
PFH096A- L	PFH095A- L							

MODEL NUMBERS		PIPING CONNECTION SIZES O.D.CU	
60HZ	50HZ	5 TON CIRCUIT	
		LIQUID	SUCTION
PFH067A- H	PFH066A- H	1/2"	7/8"
PFHZ67A- L	PFHZ66A- L		

MODEL NUMBERS		PIPING CONNECTION SIZES O.D.CU			
60HZ	50HZ	5 TON CIRCUIT		3 TON CIRCUIT	
		LIQUID	SUCTION	LIQUID	SUCTION
PFH096A- L	PFH095A- L	1/2"	7/8"	3/8"	7/8"

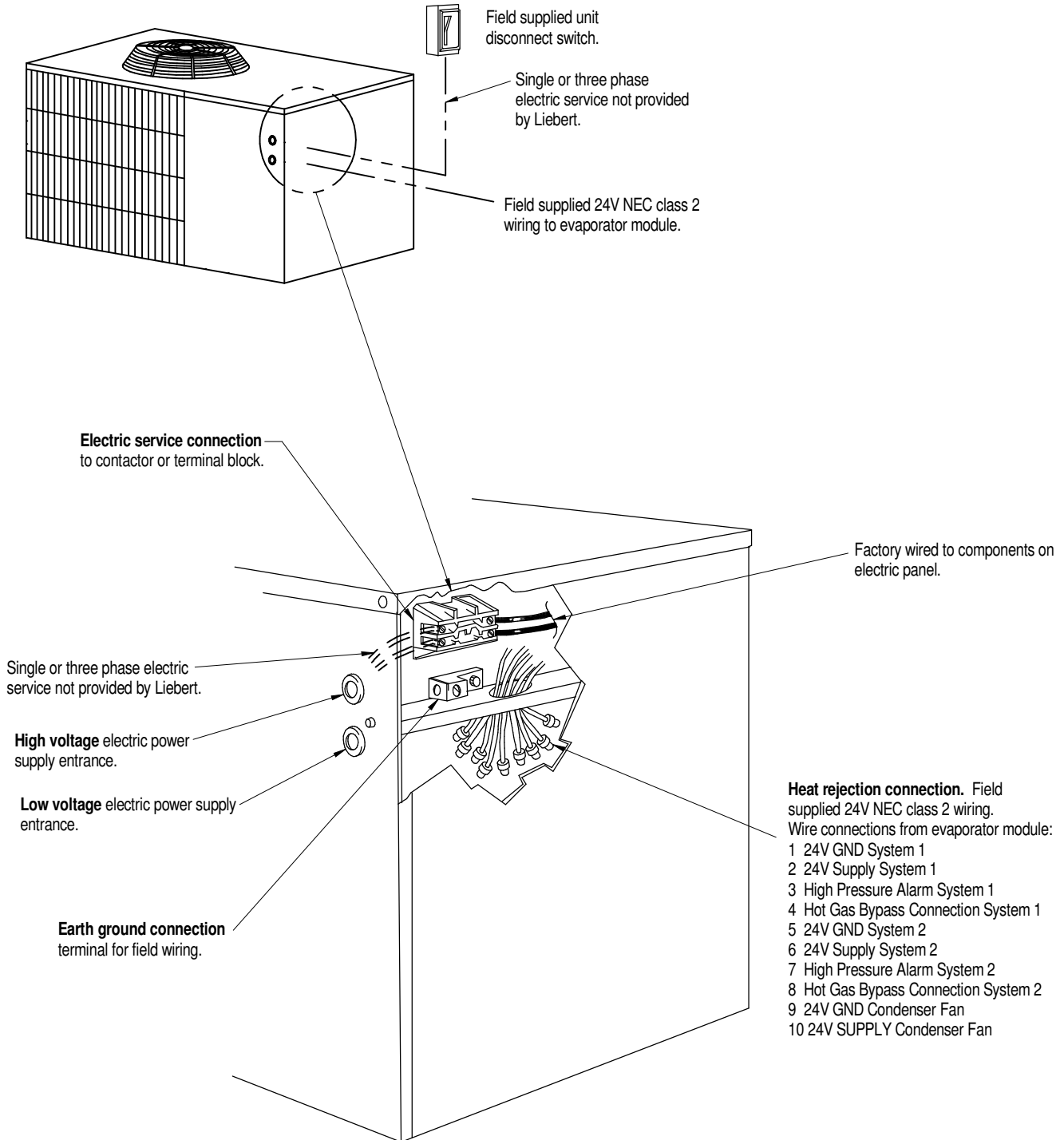
ELECTRICAL FIELD CONNECTIONS 1-5 TON CONDENSING MODULE



Notes:

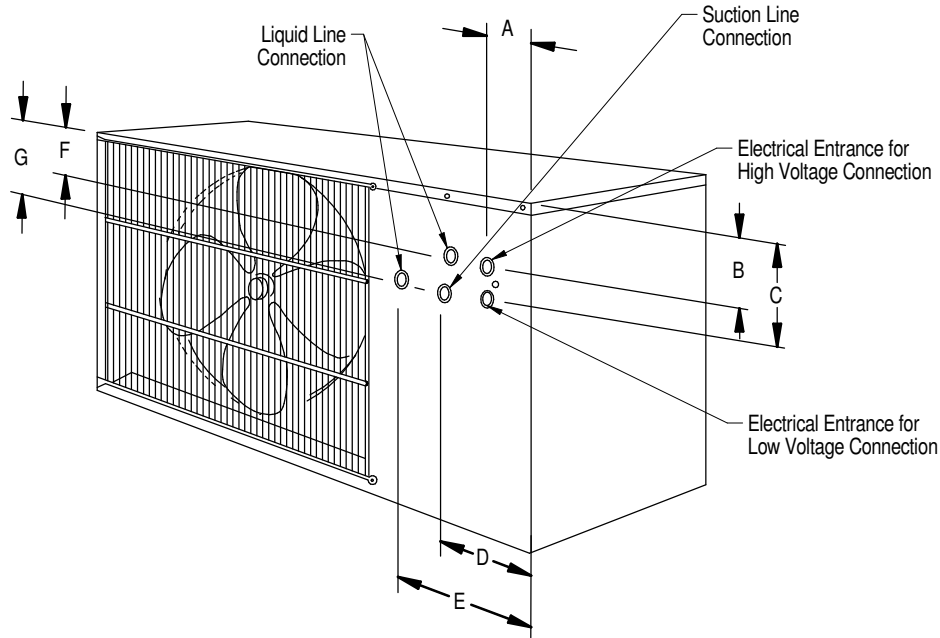
1. Refer to specification sheet for full load amp. and wire size amp. ratings

ELECTRICAL FIELD CONNECTIONS 8 TON CONDENSING MODULE



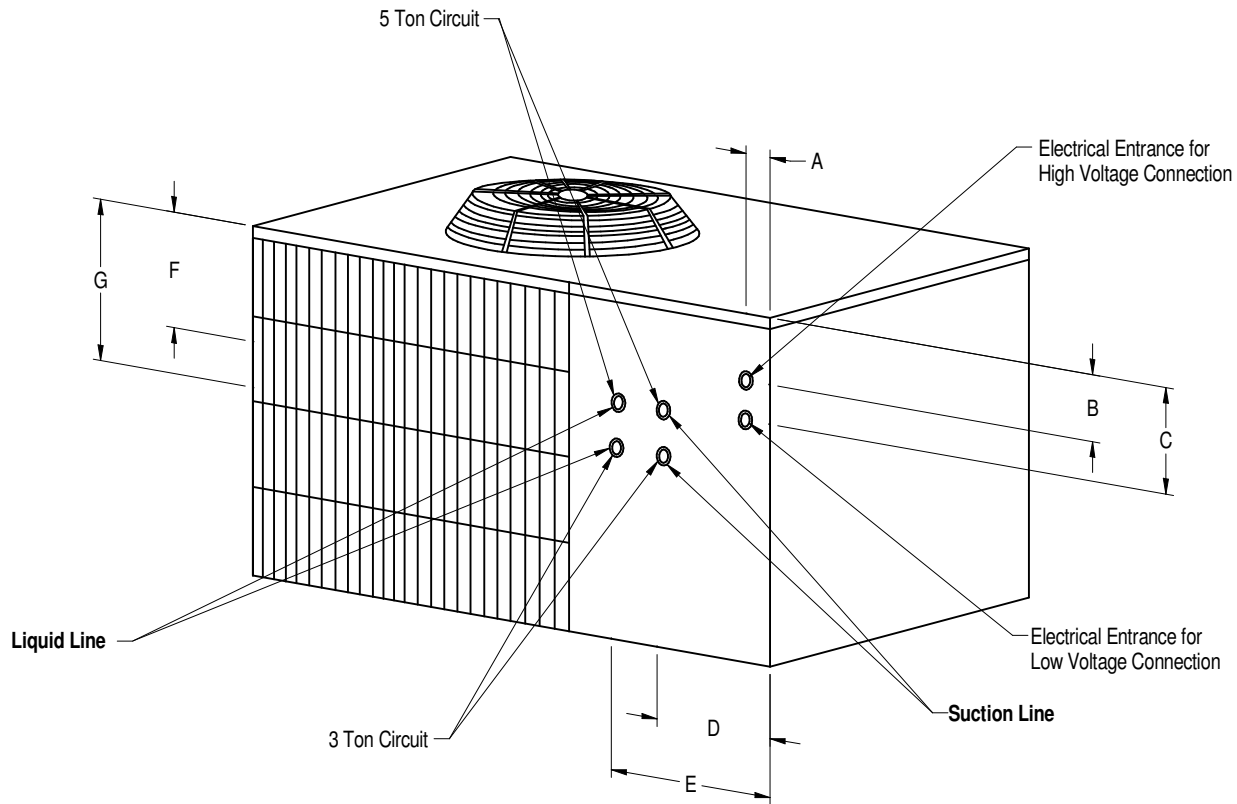
NOTE: Refer to specification sheet for full load amp. and wire size amp. ratings

PRIMARY CONNECTION LOCATIONS CONDENSING UNIT W/ HORIZONTAL AIR DISCHARGE



MODEL NUMBERS		ELECTRICAL CONNECTIONS INCH (MM)			PIPING CONNECTION LOCATION INCH (MM)				PIPING CONNECTION SIZES O.D. CU	
60Hz	50Hz	A	B	C	D	E	F	G	Liquid	Suction
PFH014A-L	N/A	2-1/4 (57)	5-1/4 (133)	7-3/4 (197)	8-3/4 (222)	N/A	5 (127)	7-1/4 (184)	3/8"	5/8"
PFH020A-L	N/A		5-3/4 (146)	8-1/2 (216)	4-3/4 (12)	N/A	8-1/2 (216)	1/2"		
PFH027A-L	N/A								2 (51)	6 (152)
PFH027A-H	N/A									
PFHZ27A-L	N/A									
PFH037A-L	PFH036A-L									
PFH042A-L	PFH041A-L									
PFH037A-H	PFH036A-H									
PFHZ37A-L	PFHZ36A-L									
PFH042A-H	PFH041A-H									
PFHZ42A-L	PFHZ41A-L									
PFH067A-L	PFH066A-L									

PRIMARY CONNECTION LOCATIONS CONDENSING UNIT W/ TOP AIR DISCHARGE



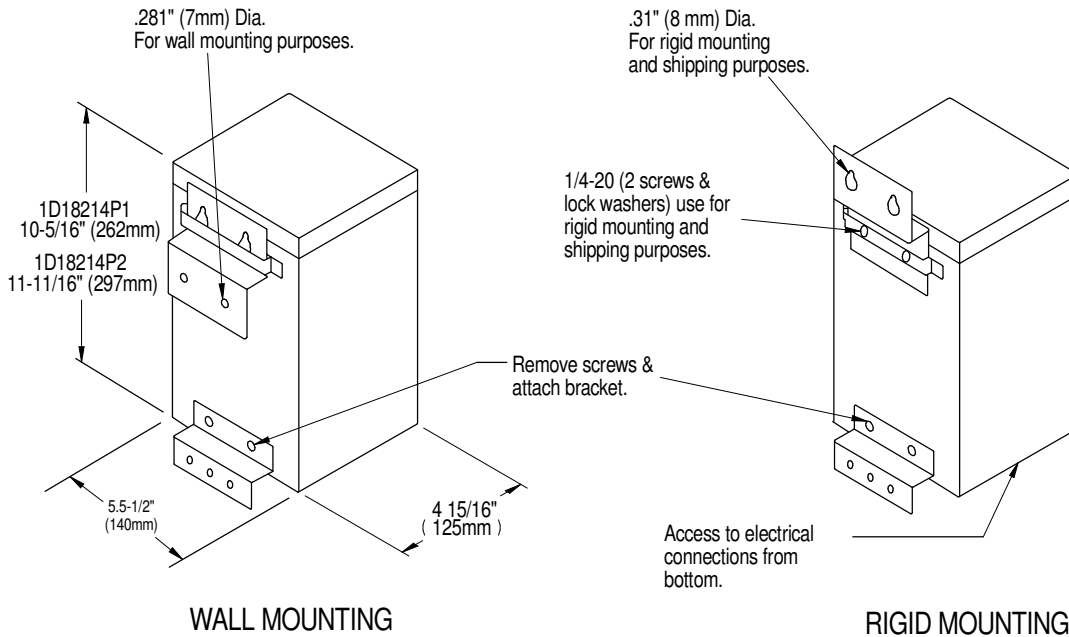
MODEL NUMBERS		ELECTRICAL CONNECTIONS IN. (mm)			PIPING CONNECTIONS IN. (mm)			
60HZ	50HZ	A	B	C	D	E	F	G
PFH067A- H	PFH066A- H	2 (51)	6 (152)	8 1/2 (216)	4 3/4 (121)	7 3/4 (197)	8 1/2 (216)	N/A
PFHZ67A- L	PFHZ66A- L							11 1/2 (292)
PFH096A- L	PFH095A- L							

MODEL NUMBERS		PIPING CONNECTION SIZES O.D.CU	
60HZ	50HZ	5 TON CIRCUIT	
		LIQUID	SUCTION
PFH067A- H	PFH066A- H	1/2"	7/8"
PFHZ67A- L	PFHZ66A- L		

MODEL NUMBERS		PIPING CONNECTION SIZES O.D.CU			
60HZ	50HZ	5 TON CIRCUIT		3 TON CIRCUIT	
		LIQUID	SUCTION	LIQUID	SUCTION
PFH096A- L	PFH095A- L	1/2"	7/8"	3/8"	7/8"

MOUNTING & WIRING INSTRUCTIONS

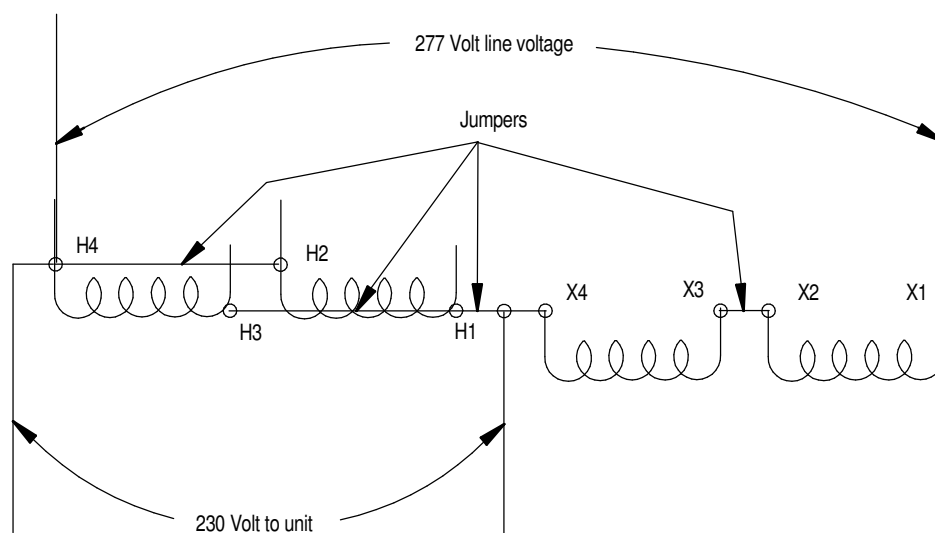
AUTOTRANSFORMER FOR 277 VOLT - 230 VOLT APPLICATIONS



Notes:

1. 1D18214P1 = Acme catalog no. T-1-37921 for all small systems except 3-ton DataMate with integral condenser.
2. 1D18214P2 = Acme catalog no. T-1-37922 for 3-ton DataMate with integral condenser.
3. Epoxy encapsulated. Suitable for indoor/outdoor service. Horizontal or vertical mount. Totally enclosed, non-ventilated.
4. Both brackets are shipped loose with transformer.

WIRING FOR TRANSFORMER



Notes:

1. Jumper as shown.
2. Connect 277 volt line to H4 and X1
3. Connect 230 volt load to H1 and H4

APPENDICES

Appendix A: Technical Support and Contacts

A.1 Technical Support/Service in the United States

Vertiv Services, Inc.

24x7 dispatch of technicians for all products.

1-800-543-2378

Liebert Thermal Management Products

1-800-543-2778

Liebert Channel Products

1-800-222-5877

Liebert AC and DC Power Products

1-800-543-2378

A.2 Locations

United States

Vertiv Headquarters

1050 Dearborn Drive

Columbus, OH, 43085, USA

Europe

Via Leonardo Da Vinci 8 Zona Industriale Tognana

35028 Piove Di Sacco (PD) Italy

Asia

7/F, Dah Sing Financial Centre

3108 Gloucester Road, Wanchai

Hong Kong

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Appendix B: Submittal Drawings

The submittal drawings are in the order of document part number (DPN). **Table B.1** below, groups the drawings by topic/application.

Table B.1 Submittal-drawings Contents

Document Number	Title
Planning Dimensions	
DPN004418	Cabinet Dimensions, Prop-fan Condensing Unit with horizontal air discharge
DPN004419	Cabinet Dimensions, Prop-fan Condensing Unit with top air discharge
DPN003094	Optional Anchorage Plan, Prop-fan Condensing Unit with horizontal air discharge
Piping General Arrangement	
DPN004407	Piping Schematic, Prop Fan Condensing Unit
Piping Connections	
DPN004308	Piping Connections, Prop-fan Condensing Unit, Horizontal Discharge
DPN004307	Piping Connections, Prop-fan Condensing Unit, Top Discharge
Electrical Connections	
DPN004300	Electrical Connections, 1-ton and 1.5-ton models
DPN004296	Electrical Connections, 8-ton models
DPN004308	Electrical Connection locations, Horizontal air-discharge models
DPN004307	Electrical Connection locations, Top air-discharge models
DPN000647	277-V Step-down Transformer

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SL-10059_REV12/590-1692-501C