

Liebert® Challenger™ ITR

Installation Manual - Nominal Capacities 23 or 33 kW, 50 & 60Hz

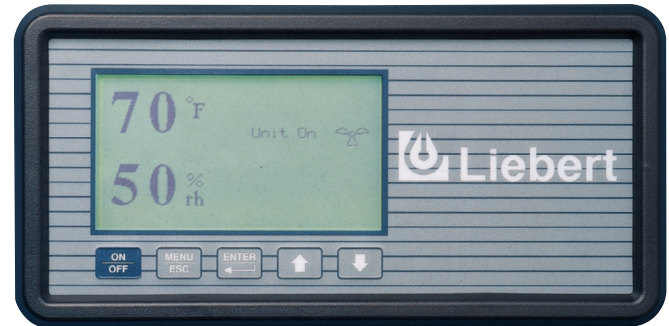


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1.0 INTRODUCTION

1.1 System Descriptions

Liebert Challenger ITR™ environmental control systems are available in three main system configurations:

- self contained system with a scroll compressor in the room unit
- self contained chilled water system
- split system with an evaporator section and a remote condensing unit

All three types are available in horizontal flow configurations. Each model requires three-phase power. Units are available in 208, 230, 460, or 575 V, 60 Hz; and 200, 230 or 380/415 V, 50 Hz.

The following features are included as standard in all room units regardless of the type of system: V-frame coil, infrared humidifier, finned tubular stainless steel electric reheat, 2" filter, individual high voltage fused protection, and fan assembly.

Each configuration can operate with either Advanced Microprocessor Controls (A), or Advanced Microprocessor Controls with Graphics (G). A brief description of each, including operational differences, is listed below. Check model numbers to see what is supplied with your unit.

1.1.1 Self Contained Systems

Air-Cooled Models

Complete refrigeration system including hot gas bypass and crankcase heater with standard condenser and fan speed control for 95°F (35°C) ambient at sea level.

Water-Cooled Models

Complete refrigeration system including hot gas bypass with water/glycol-cooled condenser and two-way water regulating valve with bypass.

Glycol-Cooled Models

The water-cooled model as described above plus pump package and 95°F (35°C) design ambient dry-cooler.

GLYCOOL Models

Complete refrigeration system including hot gas bypass with glycol condenser and three-way water regulating valve plus an integrally piped Econ-O-Coil with three-way modulating control valve.

1.1.2 Chilled Water Models

Chilled Water models include chilled water piping, three-way modulating valve and actuator assembly.

1.1.3 Split Systems

Each Air-Cooled split system consists of an evaporator section and one of the following condensing units.

Prop Fan

Includes scroll compressor, condenser coil, prop fan, high pressure switch, and Lee-Temp head pressure control. Unit is designed for outdoor location.

Centrifugal Fan

Includes scroll compressor, condenser coil, centrifugal blower assembly, high pressure switch, head pressure control valve, Lee-Temp receiver and liquid line solenoid valve. Unit must be mounted indoors. Duct flanges are optional.

Water/Glycol Condensing Units

Each water-cooled split system consists of an evaporator section and a water/glycol condensing unit, which includes scroll compressor, coaxial condenser, water regulating valve, and high pressure switch. Design pressure is 150 psi (1034 kPa) as standard and 350 psi (2413 kPa) as optional.

Each glycol-cooled split system consists of an evaporator section, a water/glycol condensing unit (as described above), a pump package and a 95°F (35°C) design ambient drycooler.

2.0 INSTALLATION

2.1 Room Preparation

The room should be well insulated and must have a sealed vapor barrier. The vapor barrier in the ceiling can be a polyethylene film type. Use a rubber or plastic base paint on concrete walls and floors. Doors should not be undercut or have grilles in them.

Outside (or fresh) air should be kept to an absolute minimum. Outside air adds to the heating, cooling, humidifying and dehumidifying loads of the site. It is recommended that outside air be kept below 5% of the total air circulated in the room and be preconditioned.

2.2 Equipment Inspection

Upon arrival of the unit, inspect all items for visible and concealed damage. Damage should be immediately reported to the carrier and a damage claim filed with a copy sent to Liebert or to your sales representative.

2.3 Location Considerations

The Liebert Challenger ITR can sit on top of an accessible elevated flooring system. It may be necessary to furnish additional pedestal support below the unit to ensure maximum structural support (see **Table 1**). A separate floor stand for the unit may be used as support, independent of the elevated floor and installed prior to the flooring system.

Provide approximately 34" (864 mm) service clearance in the front and rear of the unit.

The unit can be installed between equipment racks or at the end of a row of racks. Consideration should be given before installing refrigerant and liquid lines next to, under or above electronic equipment. Avoid placing the Liebert Challenger ITR in an alcove. Placing units too close together will reduce the effectiveness of the air distribution.



NOTE

Locate and remove shipping screw on fan motor base.

2.3.1 Remote Sensor Installation Location

The remote temperature and humidity sensor should be installed in the cold aisle in front of the equipment to be cooled. It should be mounted at the farthest point from the cooling unit that supply air needs to reach but still within the unit's area of influence. The sensor should be installed at the highest point that equipment will draw in cooled air.

2.4 Equipment Handling



WARNING

Risk of equipment tipping over. Can cause damage, injury or death.

The instructions listed below must be adhered to when handling this unit with or without the skid. There is the potential for this unit to tip over if handled improperly.

2.4.1 Handling With Skid

- Always keep the Liebert Challenger ITR upright, indoors and protected from damage.
- Do not use the extended rear door frame to lift the unit.
- If possible, transport the unit using a fork lift; otherwise, use a crane with belts or cables, avoiding pressing on the top edges of the packaging.
- If using a fork lift, make sure that the forks, if adjustable, are spread to the widest allowable distance to still fit under the skid.

NOTICE

Do not attempt to lift the Liebert Challenger ITR with the extended rear door frame. Attempting to do so will damage the unit. Lift the unit only from its main base.

NOTICE

While on the skid, the Liebert Challenger ITR is too tall to fit through a standard height doorway (83 inches or 2108 mm tall). Any attempt to move the unit, while on the skid, through a standard doorway will damage the unit.

2.4.2 Removal of Skid

1. Remove the plywood skirting that keeps the skid and unit in place.
2. Raise the Liebert Challenger ITR off the skid. Liebert recommends using a fork lift (see **Figure 1**) or similar machine to ensure that the unit is lifted properly.



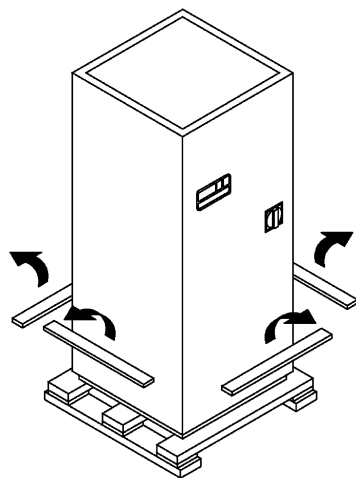
NOTE

Lift the Liebert Challenger ITR only from its main base. Do not use the extended rear door frame to lift the unit.

3. Once the unit is raised, the skid can be removed.

Figure 1 Removing Liebert Challenger ITR from skid

Remove plywood skirting holding unit and skid in place.



Raise unit with fork lift or similar machine.

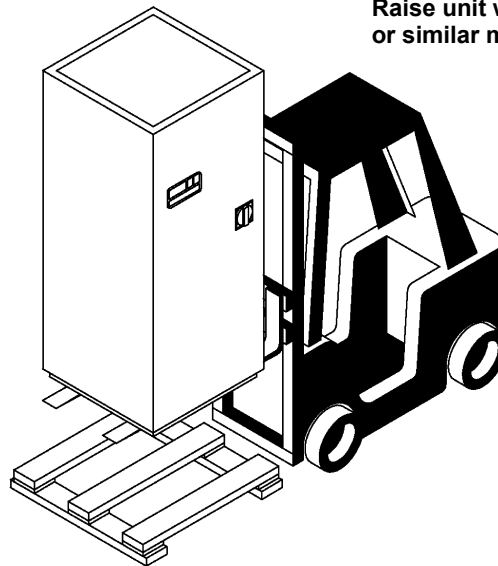


Table 1 Unit shipping weights

Model	Domestic	Export	Model	Domestic	Export
	lb (kg)	lb (kg)		lb (kg)	lb (kg)
50Hz Models			60Hz Models		
BR059E	650 (295)	750 (340)	BR060E	650 (295)	750 (340)
BR065A	745 (340)	845 (385)	BR067A	745 (340)	845 (385)
BR070WG	815 (370)	915 (415)	BR071WG	815 (370)	915 (415)
BM058G	855 (390)	955 (435)	BM061G	855 (390)	955 (435)
BR101C	660 (300)	760 (345)	BR102C	660 (300)	760 (345)

Figure 2 Cabinet dimensions

Unit Weight		
50 Hz Models	60 Hz Models	lb. (kg)
BR059E	BR060E	649 (294)
BR065A	BR067A	744 (337)
BR070WG	BR071WG	814 (369)
BR101C	BR102C	659 (299)
BM058G	BM061G	854 (387)

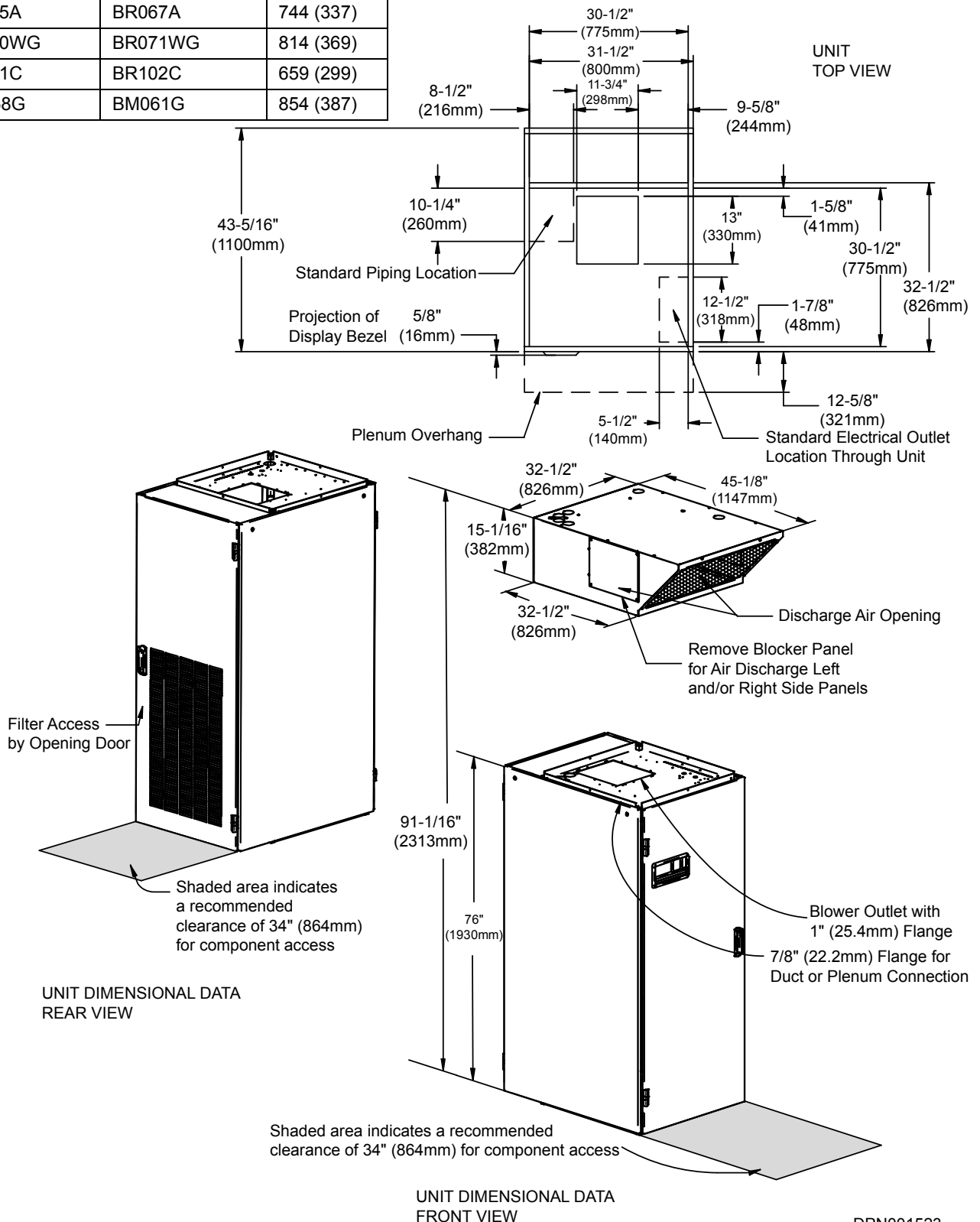
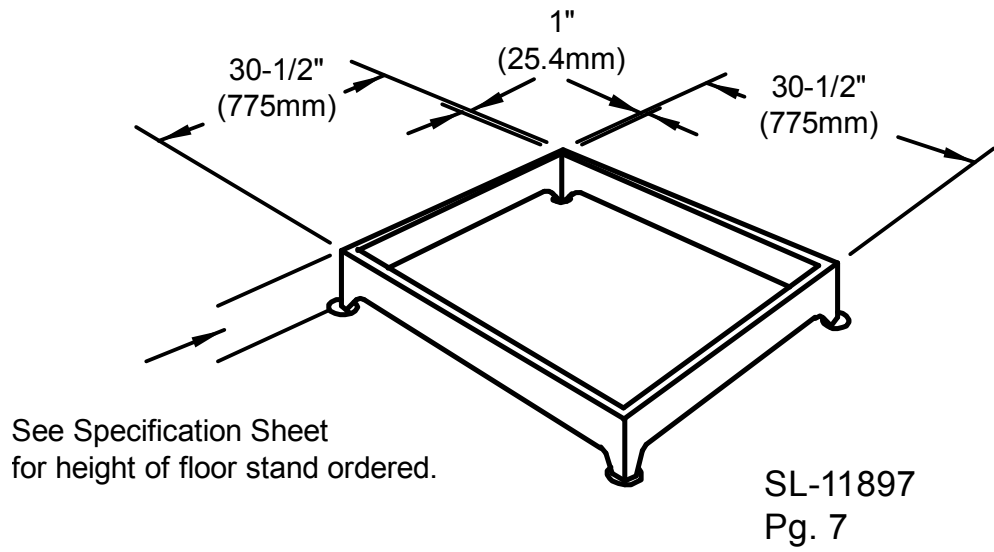


Figure 3 Optional floor stand dimensions



2.5 Piping Considerations

Consideration should be given before installing refrigerant and liquid lines next to, under or above electronic equipment.

2.5.1 Drain Line

A 3/4" (19.1 mm) female pipe thread (FPT) connection is provided for the evaporator coil condensate drain. This drain line also drains the humidifier, if applicable. The drain line must be located so it will not be exposed to freezing temperatures. The drain should be at least the full size of the drain connection and pitched a minimum of 1/8" per ft. (11 mm per meter).



NOTE

This line may contain boiling water. Select appropriate drain system materials.

The Challenger ITR comes standard with a condensate pump will require a field-supplied trap downstream from the pump. The drain line must comply with all applicable codes.

Table 2 Piping connection size

Air-Cooled Unit Connection Sizes—in.				
Model No. BR/BM 60Hz (50Hz)	Liquid Line O.D. Copper L	Hot Gas Line O.D. Copper HG		
067A (065A)	1/2	7/8		
Split System Fan Coil Unit Connection Sizes—in.				
Model No. BR/BM 60Hz (50 Hz)	Liquid Line L	Suction Line SC		
060E (059E)	1/2 O.D. Cu	1-1/8 O.D. Cu		
All Units: Connection Sizes—in.				
Humidifier Line O.D. Copper H	Condensate Drain Line C	Condensate Pump Line O.D. Copper P	Hot Water Reheat O.D. Copper	
1/4	1/2 OD Cu	1/2	Supply HWS 5/8	Return HWR 5/8
Water/Glycol-Cooled Unit Connection Sizes—in.				
Model No. BR/BM 60Hz (50 Hz)	Supply Line S	Return Line R		
071WG (070WG)	1-1/8	1-1/8		
GLYCOOL Unit Connection Sizes—in.				
Model No. BR/BM 60Hz (50 Hz)	Supply Line S	Return Line R		
061G (058G)	1-1/8	1-1/8		
Chilled Water Unit Connection Sizes—in.				
Model No. BR/BM 60Hz (50 Hz)	Supply Line CWS	Return Line CWR		
102C (101C)	1-1/8	1-1/8		

Figure 4 Piping connections for air-cooled units

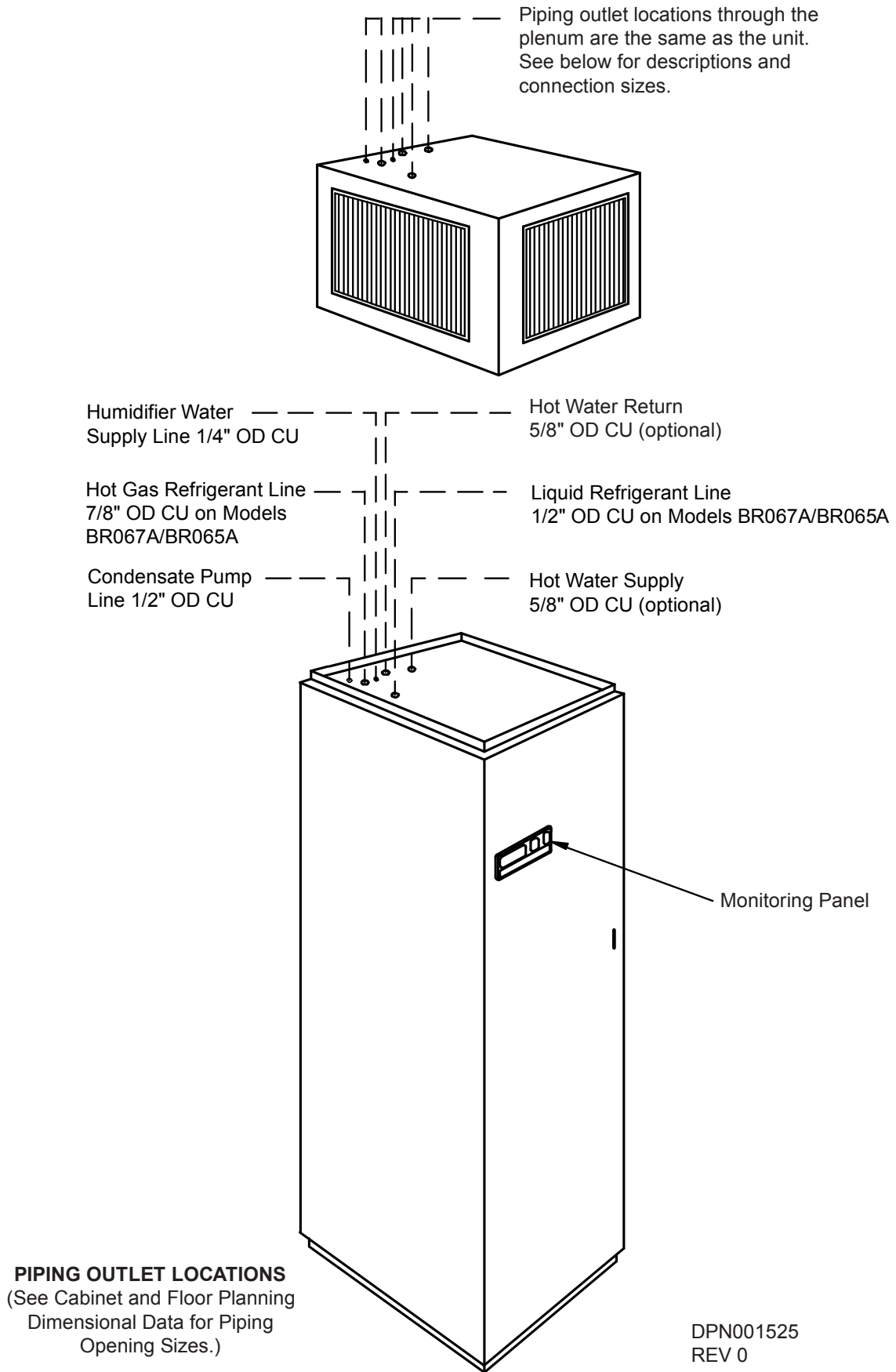


Figure 5 Piping connections for split system fan coil units

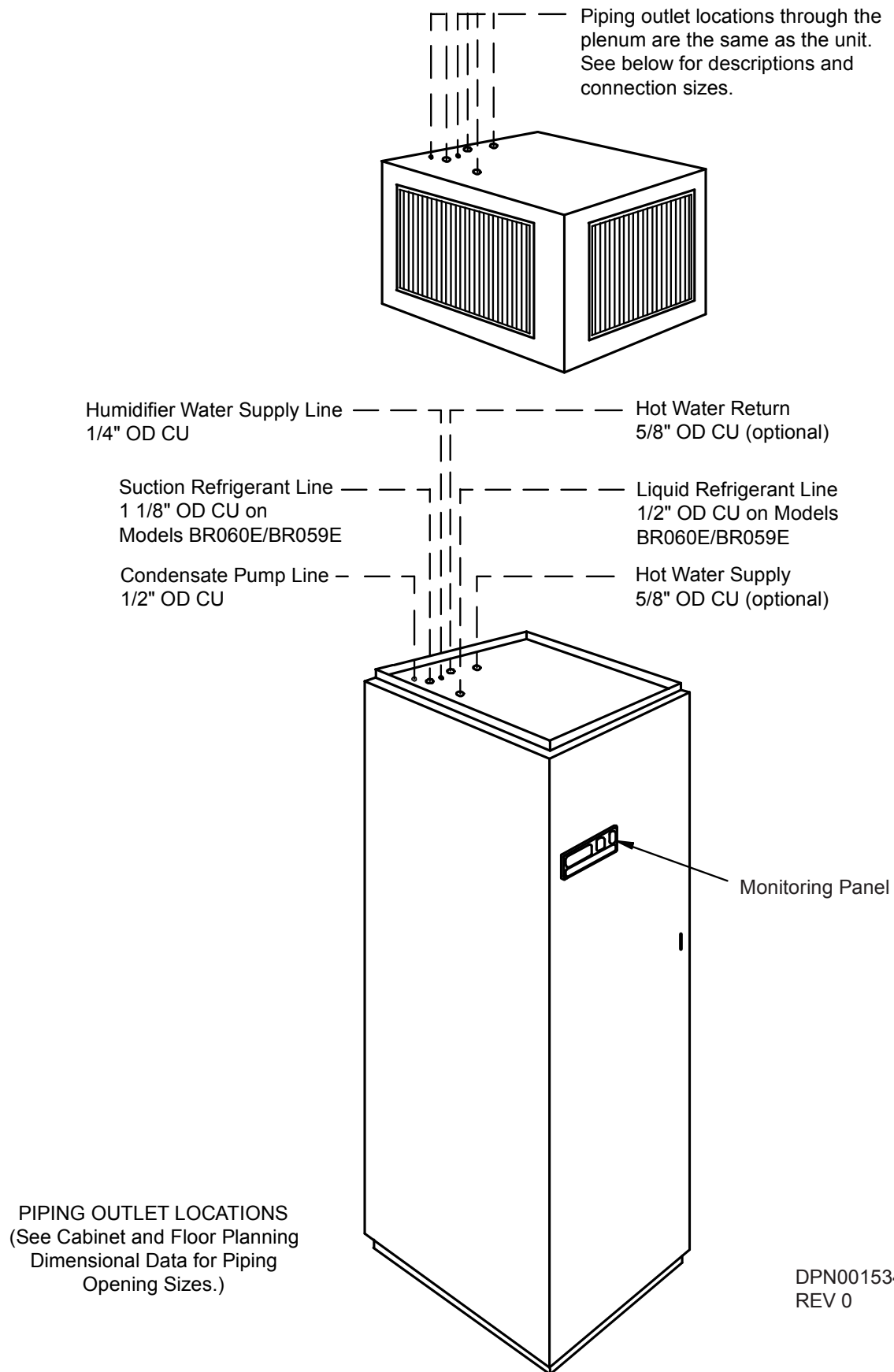


Figure 6 Piping connections for water/glycol and GLYCOOL units

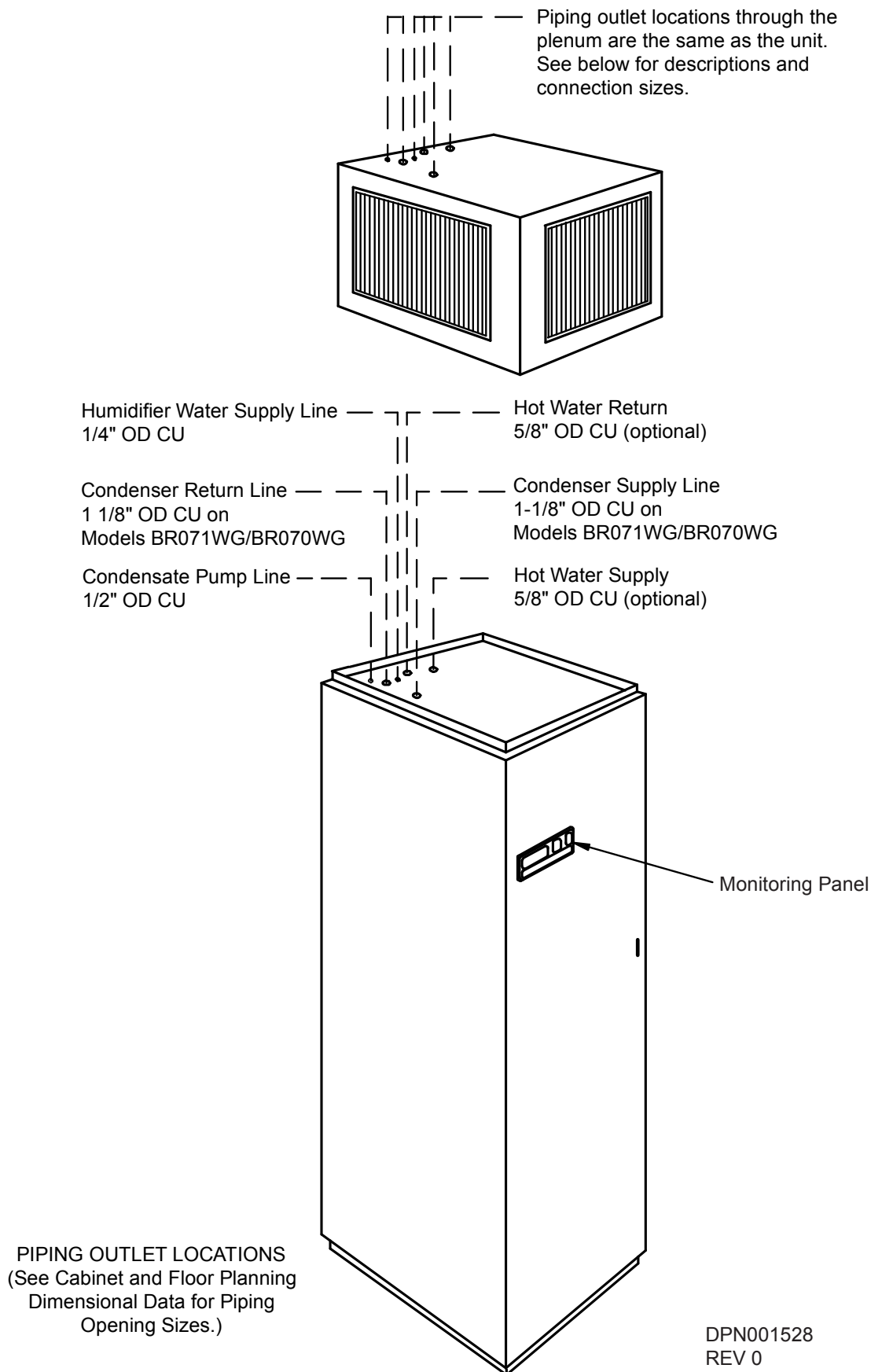
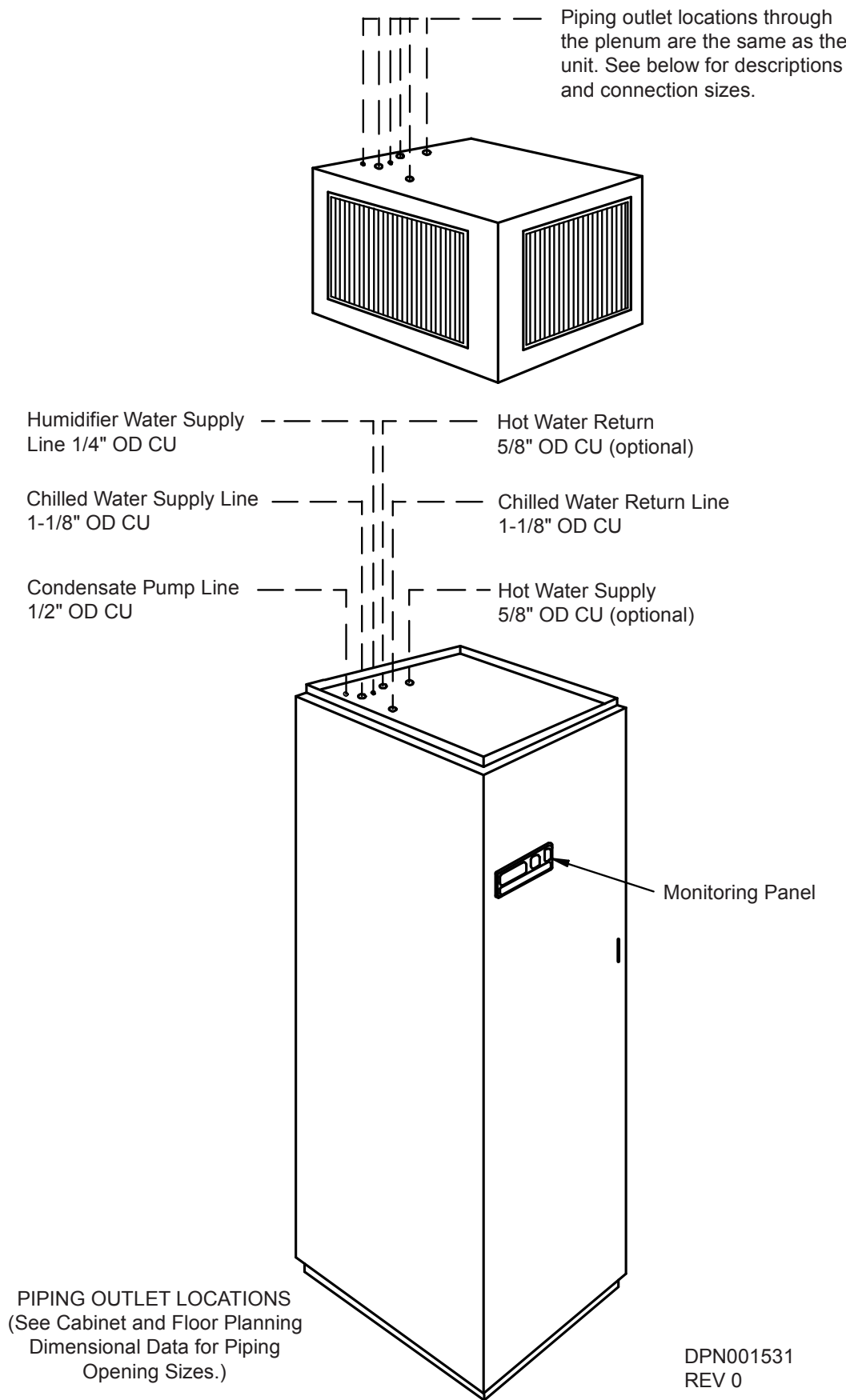


Figure 7 Piping connections for chilled water self-contained units



2.6 Electrical Connections

Three-phase electrical service is required for all models in either 208, 230, 460, or 575 V, 60 Hz; or 200, 230, or 380/415 V, 50 Hz. Electrical service shall conform to national and local electrical codes. Refer to equipment nameplate regarding wire size and circuit protection requirements. Refer to electrical schematic when making connections.

A manual electrical disconnect switch should be installed within 5 feet (1.6 m) of the Liebert Challenger ITR in accordance with codes. A factory-supplied, locking disconnect switch is factory-mounted within the unit behind the front door.



WARNING

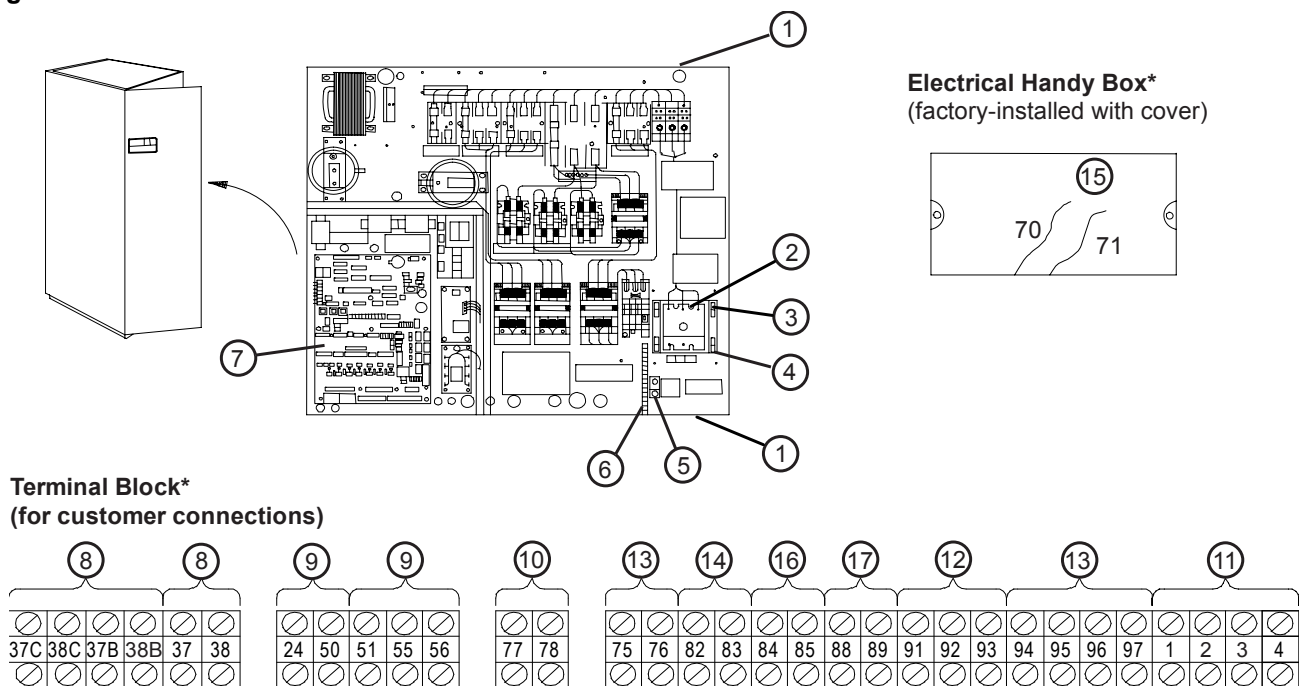
Risk of electric shock. Can cause injury or death.

Disconnect all local and remote electric power before working within the unit. Use a voltmeter to make sure power is turned off before making any electrical connections.

NOTICE

Three-phase power must be connected to the Liebert Challenger ITR line voltage terminals in the proper sequence so that scroll the compressor rotates in the proper direction.

Figure 8 Electrical connections



DPN001524
REV 0

1. **Electric conduit knockouts** on top and bottom of electric box. Knockout size 1-3/4" (44.5mm).
2. **Three phase connection.** Electric service connection terminals when factory disconnect switch is supplied.
3. **Factory-installed locking disconnect switch.**
4. **Three-phase electric** service not by Liebert.
5. **Earth ground connection** (50/60Hz). Connection terminal for field-supplied earth grounding wire.
6. **Earth ground bar** (50Hz only). Connection terminals with factory ground from each high voltage component for field supplied earth grounding wire.
7. **Control and monitoring section** of electric box.
8. **Remote unit shutdown.** Replace existing jumper between Terminals 37 + 38 with normally closed switch having a minimum 75VA, 24VAC rating. Use field-supplied Class 1 wiring. Two additional contact pairs available as an option (labeled as 37B & 38B, 37C & 38C). Replace existing jumper for appropriate pair as done for 37 & 38.

9. **Special alarm connections.** Field-supplied 24V Class 1 wiring for special alarm. Connection made by adding normally open contacts between terminals 24 + 50. Optional additional connections available with Advanced or Advanced with Graphics controls and appropriate optional accessories (connections 51, 55, and 56).
10. **Liebert SiteScan[®]** connection. Terminals 77 (-) and 78 (+) are for connection of a 2-wire, twisted pair, communication cable (available from Liebert or others) to optional Liebert SiteScan.
11. **Remote condensing unit connection.** Field-supplied 24V Class 1 wiring to remote condensing unit terminals 1, 2, 3, & 4 from (R2) relay (split system only).
12. **Smoke detector alarm connections.** Field-supplied 24V Class 1 wiring to remote alarm circuits. Factory-wired contacts from optional smoke detector are #91-comm., #92-NO, and #93-NC.
13. **Common alarm connection.** Field-supplied 24V Class 1 wiring to common alarm terminals 75 + 76 (and optional 94 + 95, and 96 + 97), which are factory-connected to common alarm relay (R3).
14. **Reheat and Humidifier Lockout.** Optional emergency power lockout of reheat and/or humidifier: connections provided for remote 24V AC source.
15. **Heat rejection connection.** Field-supplied 24V Class 1 wiring to interlock heat rejection from pigtailed 70 + 71 which are factory-connected to compressor side switch (self-contained units only and to Glycool relay (R5), Glycool units only).
16. **Main Fan Auxiliary Switch.** Optional main fan auxiliary side switch. Terminals located in field wiring compartment for remote indication that the evaporator fan motor/unit is on. Field to connect 24V maximum.
17. **Optional Condensate Alarm (Dual Float Condensate Pump only).** Relay terminals located in field wiring compartment for remote indication.

*Located inside Liebert Challenger ITR on top.

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

2.7 Balancing the Air Distribution

2.7.1 Ducted Applications

For ducted applications, the duct work may be attached to the top perimeter of the Liebert Challenger ITR (see **Figure 2**).

The duct work must allow access to the motors/blowers for maintenance. The duct work must be designed within the capacity of the Liebert Challenger ITR, otherwise air flow and performance will be compromised.

2.7.2 Plenum Installation

A solid plenum or plenum with discharge grille(s) may be installed. The plenum and instructions for its installation ship separately from the Liebert Challenger ITR.

2.8 Checklist for Completed Installation

- 1. Unpack and check received material.
- 2. Proper clearance for service access has been maintained around the equipment.
- 3. Equipment is level and mounting fasteners are tight.
- 4. Piping completed to refrigerant or coolant loop (if required). Piping has been leak checked, evacuated and charged (if required).
- 5. Check piping within the Liebert Challenger ITR and outside of the unit. Remove potential of rub-through or chaffing.
- 6. Condensate pump installed.
- 7. Drain line connected.
- 8. Water supply line connected to humidifier (if required).
- 9. Field provided pan with drain installed under all ceiling mounted fluid condensing units (if installed).
- 10. Ducting completed (if applicable).
- 11. Filter(s) installed.
- 12. Line voltage to power wiring matches equipment serial tag.
- 13. Power wiring connections completed between disconnect switch, evaporator and condensing unit, including earth ground.
- 14. Power line circuit breakers or fuses have proper ratings for equipment installed.
- 15. Control wiring connections completed to evaporator and condensing unit.
- 16. Verify water detection is properly installed around all units (if installed).
- 17. All wiring connections are tight.
- 18. Control panel DIP switches set based on customer requirements.
- 19. Foreign materials have been removed from, in and around all equipment installed (literature, shipping materials, construction materials, tools, etc.).
- 20. Fans and blowers rotate freely.
- 21. Inspect all piping connections for leaks during initial operations. Correct as needed.
- 22. Verify that a blank start-up sheet has been sent with the unit(s) and is ready to be completed by the installer.

3.0 AIR-COOLED MODELS

3.1 Condenser Location

The air-cooled condenser should be located for maximum security and maintenance accessibility. Avoid ground level sites with public access or areas that contribute to heavy snow or ice accumulations. Utilize centrifugal condensers whenever interior building locations must be used. To assure adequate air supply, it is recommended that condensers be located in a clean air area, away from loose dirt and foreign matter that may clog the coil. In addition, condensers should not be located in the vicinity of steam, hot air, or fume exhausts. Also, condensers should be located no closer than three feet (1 meter) from a wall, obstruction, or adjacent unit.

Install condensers in a level position to assure proper refrigerant flow and oil return. For roof installation, mount condensers on steel supports in accordance with local codes. To minimize sound and vibration transmission, mount steel supports across load bearing walls. For ground installation, a concrete pad will provide adequate support. Condenser legs have mounting holes for securing the condenser to the steel supports or concrete pad.

3.2 Electrical Connections

Refer to equipment nameplate regarding wire size and circuit protection requirements. Refer to electrical schematic when making connections. Make all wiring and electrical connection in accordance with local and national codes.



WARNING

Risk of electric shock. Can cause injury or death.

Disconnect all local and remote electric power before working within the unit. Use a voltmeter to make sure power is turned off before making any electrical connections.

3.2.1 Line Voltage

Line voltage electrical service is required for all air-cooled condensers at the location of the condenser. This power supply does not have to be the same voltage as the indoor unit. This separate power source may be 208, 230, 460, or 575 V, 60 Hz; or 200, 230, or 380/415 V, 50 Hz. The disconnect switch may be factory-supplied and mounted in the electrical panel or field-supplied and mounted per local and national codes.

3.2.2 Low Voltage

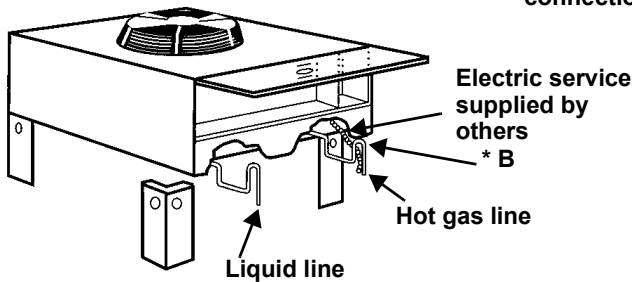
A control interlock between the condenser and the indoor unit is required and is connected between 70 and 71 in the handy box of the indoor unit and the electric panel of the air-cooled condenser. NEC Class 1 wiring is required.

3.2.3 Lee-Temp/Flood Back Head Pressure Control Condensers

Lee-Temp condensers require a separate power supply for the heated receivers. This power supply is connected to the electrical connection box on the end of the receiver.

Figure 9 Air-cooled condensers

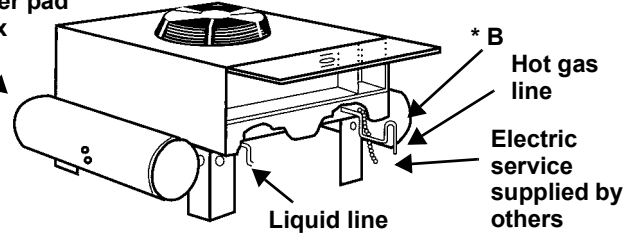
FAN SPEED CONDENSER



Secure each leg to condenser frame at all points shown using hardware provided.

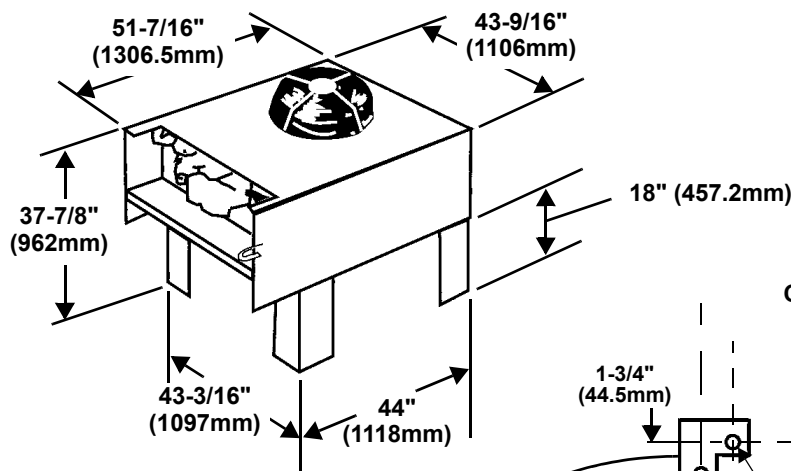
Lee-Temp heater pad connection box

LEE-TEMP CONDENSER

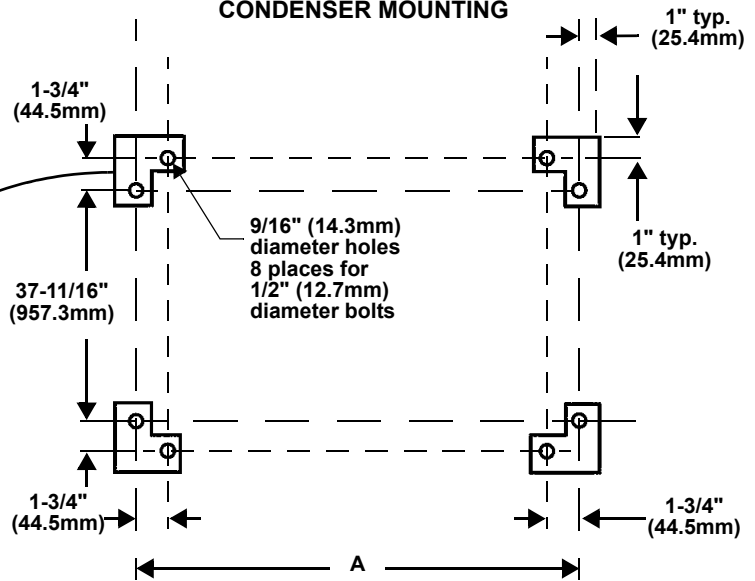


* B - Inverted traps are to be field-supplied and installed (typ). When installing traps, provide clearance for swing end of access door. Traps are to extend above base of coil by a minimum of 7-1/2" (190 mm)

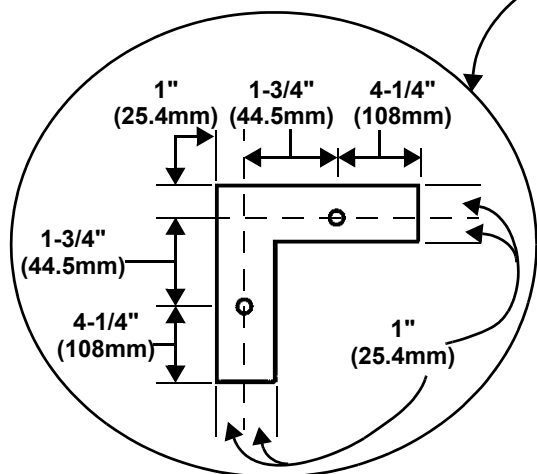
SINGLE FAN AIR-COOLED CONDENSERS



CONDENSER MOUNTING



Common to all models. See Table 3 below for key to "A" dimension.



TYPICAL FOOTPRINT

Table 3 Air-cooled condenser statistics

Model	Number of Fans	Connection Sizes (OD Copper)		Net Weight lb (kg)	"A" Dimension in (mm)
		Hot Gas (in.)	Liquid (in.)		
083	1	7/8	5/8	295 (133.8)	42 (1067)
104	1	1-1/8	5/8	315 (142.8)	42 (1067)

3.3 Refrigerant Piping

All refrigeration piping should be installed with high temperature brazed joints. Prevailing good refrigeration practices should be employed for piping supports, leak testing, dehydration and charging of the refrigeration circuits.

Unit refrigeration components and piping are shipped from the factory with a nitrogen holding charge.



NOTE

The refrigeration piping should be isolated from the building by the use of vibration isolating supports.



NOTE

Piping, including inverted trap(s), must be routed to allow unobstructed access to the panel per the NEC.



NOTE

When installing field piping, care must be taken to protect all refrigerant lines from the atmosphere, especially when using refrigerants with POE oils. Do not allow the piping to stand open to air for more than 15 minutes. Units designed for R407C have a compressor that contains POE oil that is very hygroscopic; that is, it quickly absorbs water from the air. The longer the compressor piping is left open to air, the harder it will be to fully evacuate. If left open too long, the POE oil may need to be replaced before achieving the required vacuum level.



NOTE

Keep the evaporator unit and condenser closed with their factory charge of dry nitrogen while all field piping is installed. Keep the field piping clean and dry during installation, and do not allow it to stand open to the atmosphere. When all the field interconnecting piping is in place, vent the condenser dry nitrogen charge and connect to the field piping. Finally, vent the evaporator unit dry nitrogen charge and make its piping connections last.

Follow all proper brazing practices including a dry nitrogen purge to maintain system cleanliness.

Traps should be installed in the hot gas line on vertical risers at the base and every 25 feet (7.6 meters) in elevation. These traps will collect condensed refrigerant and refrigerant oil during the off cycle of the unit and ensure flow of refrigerant oil during operation.

A check valve is factory-supplied with the unit to be field-installed on the discharge side of the scroll compressor. Be sure to install the check valve with the refrigerant flow in the proper direction. When soldering or brazing the valve, it is very important to protect the internal parts by wrapping the valve with a damp cloth to keep the valve temperature below 250°F (121°C).

Approval is required whenever:

- a refrigerant piping run exceeds 150 ft. (46 m) equivalent length
- an R22 system condenser must be located more than 15 ft. (4.6 m) below the level of the cooling coil
- an R407C system condenser must be located below the level of the cooling coil.

Total discharge line pressure drop must not exceed 10 PSIG (69 kPa).

Consult your local Liebert representative when considering installations outside these guidelines.

Table 4 Recommended line sizes — OD copper (inches)*

Equivalent Length	23 & 33 kW 067A (065A)	
	Hot Gas Line	Liquid Line
50 ft. (15 m)	7/8	1/2
100 ft. (30 m)	7/8	5/8
150 ft. (45 m)	7/8	5/8

*Recommended vertical line sizes must be used for proper oil return at all cooling and dehumidification steps.

Table 5 Equivalent lengths (feet) for various pipe fittings

Copper Pipe O.D. in.	90 Degree Elbow Copper	90 Degree Elbow Cast	45 Degree Elbow	Tee	Gate Valve	Globe Valve	Angle Valve
1/2	0.8	1.3	0.4	2.5	0.26	7.0	4.0
5/8	0.9	1.4	0.5	2.5	0.28	9.5	5.0
3/4	1.0	1.5	0.6	2.5	0.3	12.0	6.5
7/8	1.45	1.8	0.8	3.6	0.36	17.2	9.5
1-1/8	1.85	2.2	1.0	4.6	0.48	22.5	12.0
1-3/8	2.4	2.9	1.3	6.4	0.65	32.0	16.0
1-5/8	2.9	3.5	1.6	7.2	0.72	36.0	19.5

Refrigerant trap = 4 times equivalent length of pipe per this table.

Table 6 Indoor unit refrigerant charge lb (kg) R22 or R407C (per unit serial tag)

Model	R22	R407C
	Approximate Charge lb (kg)	Approximate Charge lb (kg)
67A/65A	1.5 (0.68)	1.4 (0.6)

Table 7 Line charges - refrigerant per 100 ft (30 m) of Type "L" copper tube

O.D.	R22		R407C	
	Liquid Line lb (kg)	Hot Gas Line lbs (kg)	Liquid Line lb (kg)	Hot Gas Line lb (kg)
1/2"	7.3 (3.3)	1.3 (0.6)	6.9 (2.9)	-
5/8"	11.7 (5.3)	2.1 (1.0)	11.0 (4.6)	2.2 (0.9)
3/4"	16.6 (7.5)	3.0 (1.4)	15.7 (6.5)	3.1 (1.3)
7/8"	24.4 (11.1)	4.4 (2.0)	23.0 (9.6)	4.5 (1.9)

Table 8 Condenser refrigerant (per serial tag)

Model	R22		R407C	
	Approximate Charge lb (kg)		Approximate Charge lb (kg)	
	Fan Speed	Lee-Temp*	Fan Speed	Lee-Temp*
083	5 (2.27)	27 (12.3)	8 (3)	25 (12)
104	8 (3.63)	39 (17.7)	9 (4)	37 (17)

* Charge includes the receiver charge.

3.4 Fan Speed Control Systems

Fan Speed Control provides an infinite number of speed variations on specially designed, permanent split-capacitor motors. The control module varies the air quantity passing over the condenser coil by monitoring refrigerant pressure.

3.4.1 Materials Supplied

1. Built-in pre-wired condenser control box
2. Air-cooled condenser
3. Piping access cover to be reinstalled when piping is complete
4. Bolts (four per leg) 3/8" x 5/8"
5. Terminal block for two-wire, 24-volt interlock connection between unit and condenser
6. Condenser legs, four on one-fan models

3.4.2 Dehydration/Leak Test and Charging Procedures for R22 (standard) or R407C (Optional)

Fan Speed Control Type Condenser



CAUTION

All local codes for handling refrigerant must be followed.



NOTE

As R22 and R407C are similar in properties, proper safety equipment and proper refrigeration tools are required on both types. Check unit nameplate for correct refrigerant type before topping off or recharging a system.



NOTE

Refrigerant R407C uses a POE (polyol ester) lubricant. The R407C refrigerant must be introduced and charged from the cylinder only as a liquid.



NOTE

When installing field piping, care must be taken to protect all refrigerant lines from the atmosphere, especially when using refrigerants with POE oils. Do not allow the piping to stand open to air for more than 15 minutes. Units designed for R407C have a compressor which contains POE oil that is very hygroscopic; that is, it quickly absorbs water from the air. The longer the compressor piping is left open to air, the harder it will be to fully evacuate. If left open too long, the POE oil may need to be replaced before achieving the required vacuum level.

Dehydration/Leak Test

1. Make sure unit is OFF. Open all disconnects and remove all fuses except control fuses. On units supplied with circuit breakers, open all breakers except for the transformer.
2. Add a jumper to the Fan Safety Switch between Common and Normal Open and disconnect the wire connected to the Normally Closed. Turn unit disconnect ON. (Fan operation not required.)

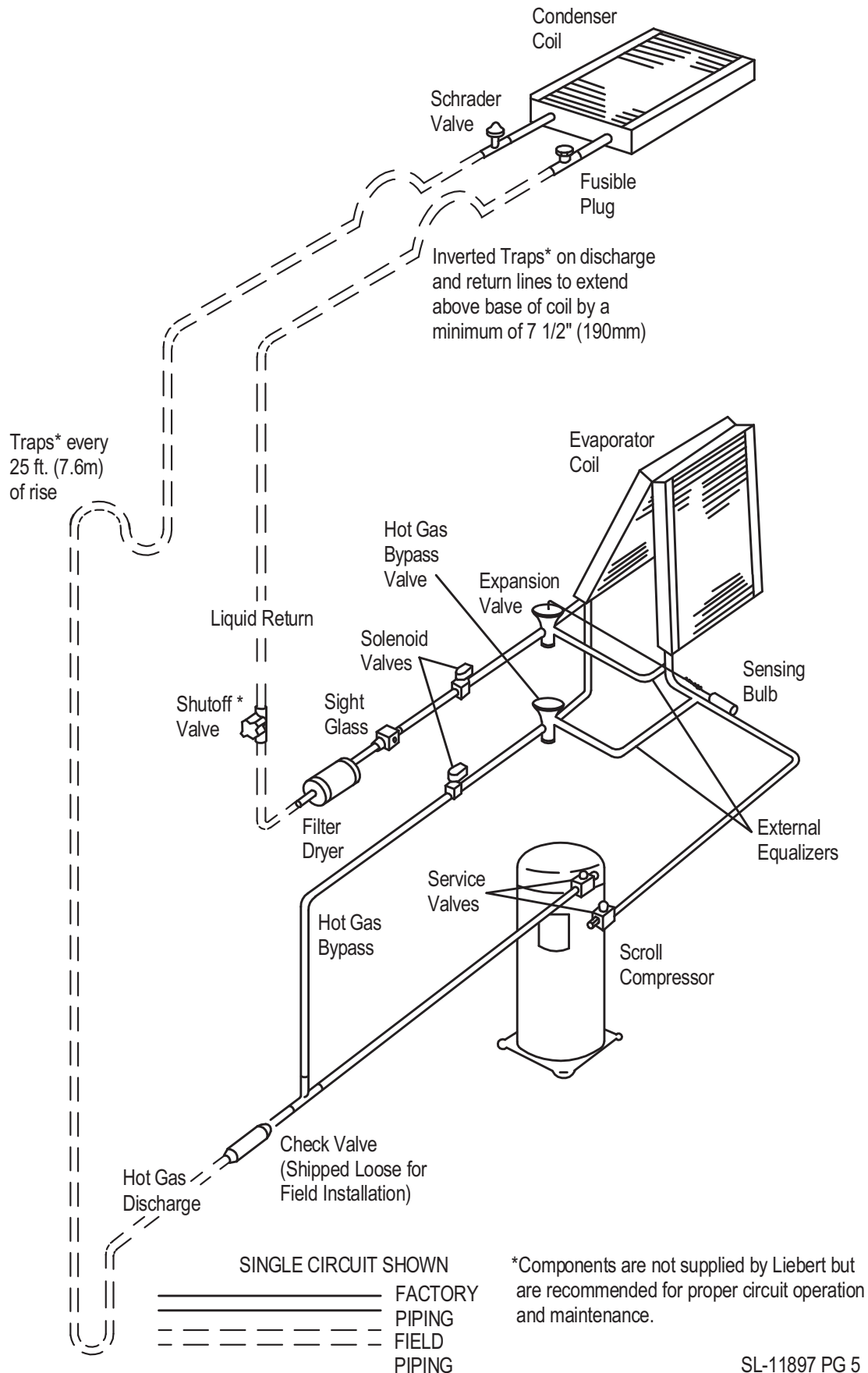


NOTE

The above allows the technician to use unit 24 VAC power and controls to open liquid line solenoid valve(s) and hot gas bypass solenoid valve(s) for the dehydration process. If no power is at the unit disconnect, the technician is to use a separate 24 VAC source rated at 75 VA and connect to the system liquid line solenoid valve(s) and hot gas bypass solenoid valve(s) directly.

3. Connect refrigeration gauges to the suction and discharge service valves of the compressor. Open all compressor service valves.
4. To energize the liquid line solenoid valves through the control system power, set the control temperature setpoint (see operation manual) to 60°F (15°C) and set the % relative humidity setpoint higher than the conditioned room ambient to ensure that solenoid valves and hot gas bypass valves are open during the dehydration process.
5. Pressurize the system circuit(s) to 150 PSIG (1034 kPa) by using dry nitrogen with a trace of refrigerant. Check system for leaks with suitable leak finder.
6. After completion of leak testing, release the test pressure (per local code) and pull a deep vacuum on the system with a suitable pump.
7. After four hours, check the pressure readings, and if they have not changed, break vacuum with refrigerant. Pull another vacuum to 250 microns or less. Recheck the pressure after two hours. After completing this step, pressurize the circuits with refrigerant (R407C liquid or R22 vapor per unit nameplate) until suction and discharge pressures have equalized.

Figure 10 Air-cooled fan speed control general arrangement



SL-11897 PG 5

3.4.3 Charging

1. Make sure unit is OFF. Open all disconnect switches and, on units supplied with circuit breakers, open all breakers. Replace all fuses for the Fan and Compressors or close breakers.
2. Remove jumper on the Fan Safety Switch and reconnect the system wire connections. Ensure that all operational components are clear of debris. Turn unit ON. (Fan operation is required.) Check the evaporator fan for proper rotation and correct if necessary.
3. Connect the refrigerant gauge charging hose to the drum of refrigerant and to the suction and discharge service valves of the compressor.
4. Calculate the amount of charge for the system. Weigh in as much of the system charge as possible. Refer to the unit, condenser and refrigerant line charge tables.
5. Set the control temperature setpoint (see operation manual) to 60°F (15°C) and set the % relative humidity setpoint higher than the conditioned room ambient to ensure that solenoid valves and hot gas bypass valves are open during the charging procedure. You may have to bypass the LP Switch (low pressure switch) to start the compressors and stop short cycling. Reset the Head Pressure switch(es) if open.
6. Add refrigerant (R407C liquid, or R22 vapor per unit nameplate) to the suction side of the compressor until there is sufficient pressure to energize the low-pressure switch.



NOTE

When adding refrigerant to an operating system, it may be necessary to add the refrigerant through the compressor suction service valve. Because the refrigerant leaving the refrigerant cylinder must be in a liquid state, care must be exercised to avoid damage to the compressor. It is suggested that a sight glass be connected 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.

Then you may remove the manual bypass you applied earlier.

7. Charge the unit until the liquid line sight glass becomes clear. Then add one additional pound of refrigerant.
8. As head pressure builds, the condenser fan starts rotating. The fan becomes fully energized when sufficient head pressure is developed. (Fan starts to rotate at 190 psi and is full speed at 250 psi.)

Table 9 Refrigerant control settings psi (kPa)

Low Pressure Cut Out	Low Pressure Cut In	High Pressure Cut Out
20 (137.9)	65 (448.2)	360 (2482)

3.5 Lee-Temp/Flood Back Head Pressure Control Systems

The Lee-Temp system consists of a modulating type head pressure control valve and insulated receiver with heater pad to ensure operation at ambient temperatures as low as -30°F (-34.4°C).

3.5.1 Piping

Lee-Temp systems have two factory-supplied, field-installed check valves: one on the discharge side of the scroll compressor and one on the inlet side of the receiver. Be sure to install the check valves with the refrigerant flow in the proper direction. When soldering or brazing the valves, it is very important that the internal parts be protected by wrapping the valve with a damp cloth to keep the valve temperature below 250°F (121°C).

3.5.2 Materials Supplied

1. Built-in pre-wired condenser control box
2. Air-cooled condenser
3. Piping access cover to be reinstalled when piping is complete
4. Bolts (four per leg) 3/8" x 5/8"
5. Terminal block for two-wire 24V interlock connection between the unit and the condenser
6. Condenser legs: four on one-fan models
7. Lee-Temp system:
 - a. Insulated storage receiver
 - b. Head pressure control valve with integral check valve
 - c. Adapter assembly
 - d. Rotalock valve
 - e. Pressure relief valve
 - f. Liquid level sight glass
 - g. Check valve
8. Bolts - (six per receiver) 3/8" x 1"



NOTE

Lee-Temp heater pad requires a separate, continuous electrical source of either 115 VAC or 200/208/230 VAC.

3.5.3 Dehydration/Leak Test and Charging Procedures for R22 (Standard) or R407C (Optional)

Lee-Temp Control Type Condenser



CAUTION

All local codes for handling refrigerant must be followed.



NOTE

As R22 and R407C are similar in properties, proper safety equipment and proper refrigeration tools are required on both types. Check unit nameplate for correct refrigerant type and oil type before topping off or recharging a system.



NOTE

Refrigerant R407C uses a POE (polyol ester) lubricant. The R407C refrigerant must be introduced and charged from the cylinder only as a liquid.



NOTE

When installing field piping, care must be taken to protect all refrigerant lines from the atmosphere, especially when using refrigerants with POE oils. Do not allow the piping to stand open to air for more than 15 minutes. Units designed for R407C have a compressor which contains POE oil that is very hygroscopic; that is, it quickly absorbs water from the air. The longer the compressor piping is left open to air, the harder it will be to fully evacuate. If left open too long, the POE oil may need to be replaced before achieving the required vacuum level.

Dehydration/Leak Test

1. Make sure unit is OFF. Open all disconnect switches and pull all fuses except control fuses. On units supplied with circuit breakers, open all breakers except for the transformer.
2. Add a jumper to the Fan Safety Switch between Common and Normal Open and disconnect the wire connected to the Normally Closed. Turn unit disconnect ON. (Fan operation not required.)



NOTE

The above allows the technician to use unit 24 VAC power and controls to open liquid line solenoid valve(s) and hot gas bypass solenoid valve(s) for the dehydration process. If no power is at the unit disconnect, the technician is to use a separate 24 VAC source rated at 75 VA and connect to the system liquid line solenoid valve(s) and hot gas bypass solenoid valve(s) directly.

3. Connect refrigeration gauges to the suction and discharge service valves of the compressor and open.
4. Attach a “jumper” hose from the Rotalock fitting on the outlet of the receiver and the Schrader fitting on the liquid header of the condenser. Front seat the Rotalock valve approximately two turns.
5. To energize the liquid line solenoid valve(s) through the control system, set the temperature setpoint (see operation manual) to 60°F (15°C) and set the % relative humidity setpoint higher than the conditioned room ambient to ensure that solenoid valves and hot gas bypass valves are open during the dehydration process.
6. Pressurize system circuit(s) to 150 PSIG (1034 kPa) by using dry nitrogen with a trace of refrigerant. Check system for leaks with suitable leak finder.
7. After completion of leak testing, release test pressure (per local code) and pull a vacuum on the system.
8. After 4 hours, check pressure readings and, if they have not changed, break vacuum with refrigerant. Pull a second and third vacuum of 250 microns or less. Recheck pressure after 2 hours.

3.5.4 Charging

1. Make sure unit is OFF. Open all disconnect switches and, on units supplied with circuit breakers, open all breakers. Replace all fuses for the Fan and Compressors or close breakers.
2. Remove jumper on the Fan Safety Switch and reconnect the system wire connections. Ensure that all operational components are clear of debris. Turn unit ON. (Fan operation is required.) Check the evaporator fan for proper rotation and correct if necessary.
3. Connect the refrigerant gauge charging hose to the drum of refrigerant and to the suction and discharge service valves of the compressor(s).
4. Calculate the amount of charge for the system. Weigh in as much of the system charge as possible. Refer to the unit, condenser and refrigerant line charge tables.
5. Set the control temperature setpoint (see operation manual) to 60°F (15°C) and set the % relative humidity setpoint higher than the conditioned room ambient to ensure that solenoid valves and hot gas bypass valves are open during the charging procedure. You may have to bypass the LP Switch (low pressure switch) to start the compressors and stop short cycling. Reset the Head Pressure switch(es) if open.
6. Add refrigerant (R407C liquid or R22 vapor per unit nameplate) to the suction side of the compressor until there is sufficient pressure to energize the low pressure switch.



NOTE

When adding refrigerant to an operating system, it may be necessary to add the refrigerant through the compressor suction service valve. Because the refrigerant leaving the refrigerant cylinder must be in a liquid state, care must be exercised to avoid damage to the compressor. It is suggested that a sight glass be connected 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.

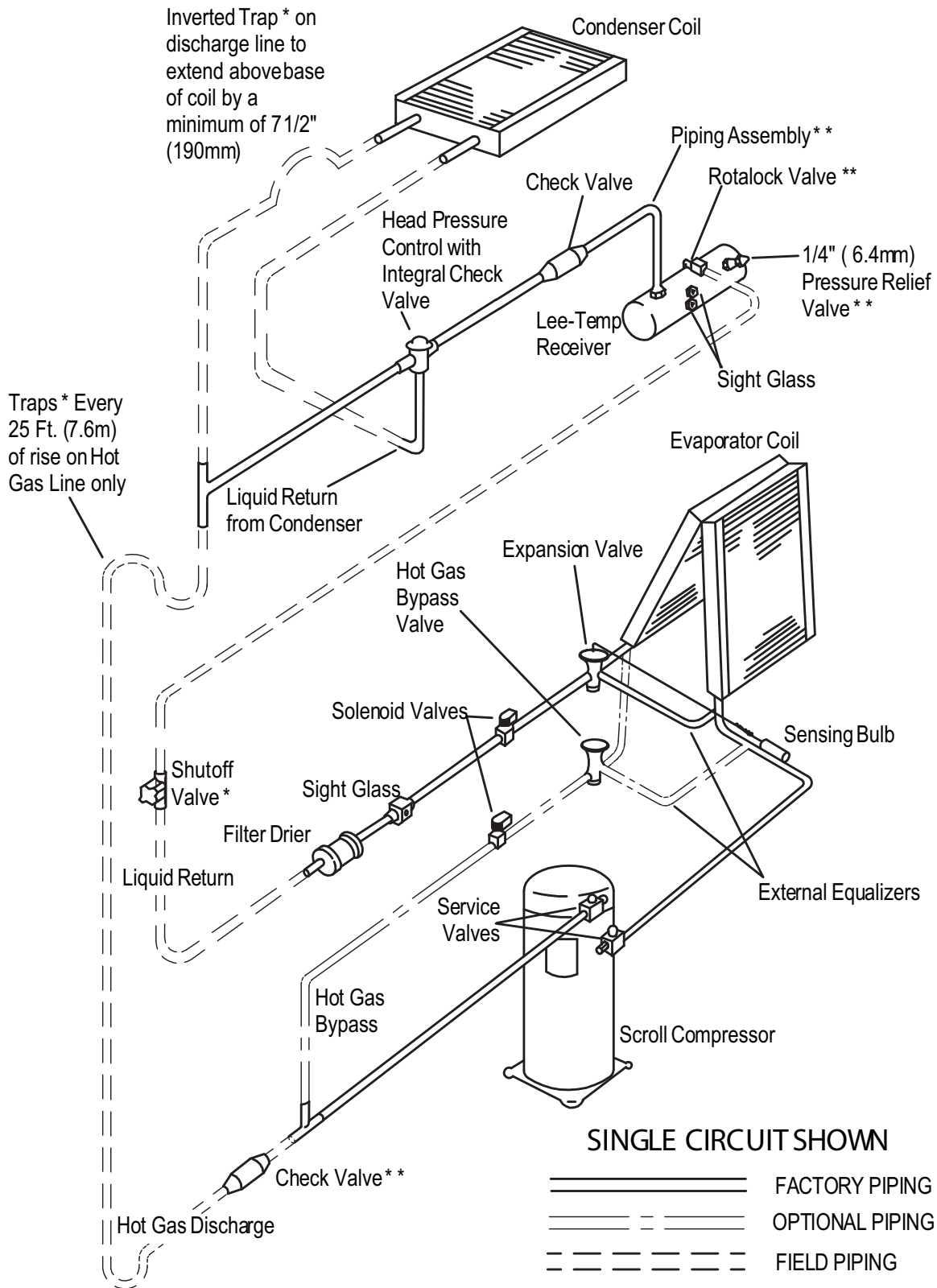
Then you may remove the manual bypass you applied earlier.

7. Charge the unit until the proper charge is weighed in.

Table 10 Refrigerant control settings psi (kPa)

Low Pressure Cut Out	Low Pressure Cut In	High Pressure Cut Out
20 (137.9)	65 (448.2)	360 (2482)

Figure 11 Air-cooled, Lee-Temp general arrangement



* Components are not supplied by Liebert but are recommended for proper circuit operation and maintenance.

** Components supplied by Liebert and must be field installed.

4.0 WATER-COOLED MODELS

4.1 Piping Considerations

Manual shut-off valves should be installed at the supply and return lines of each unit. This will provide for routine maintenance or emergency isolation of the unit.

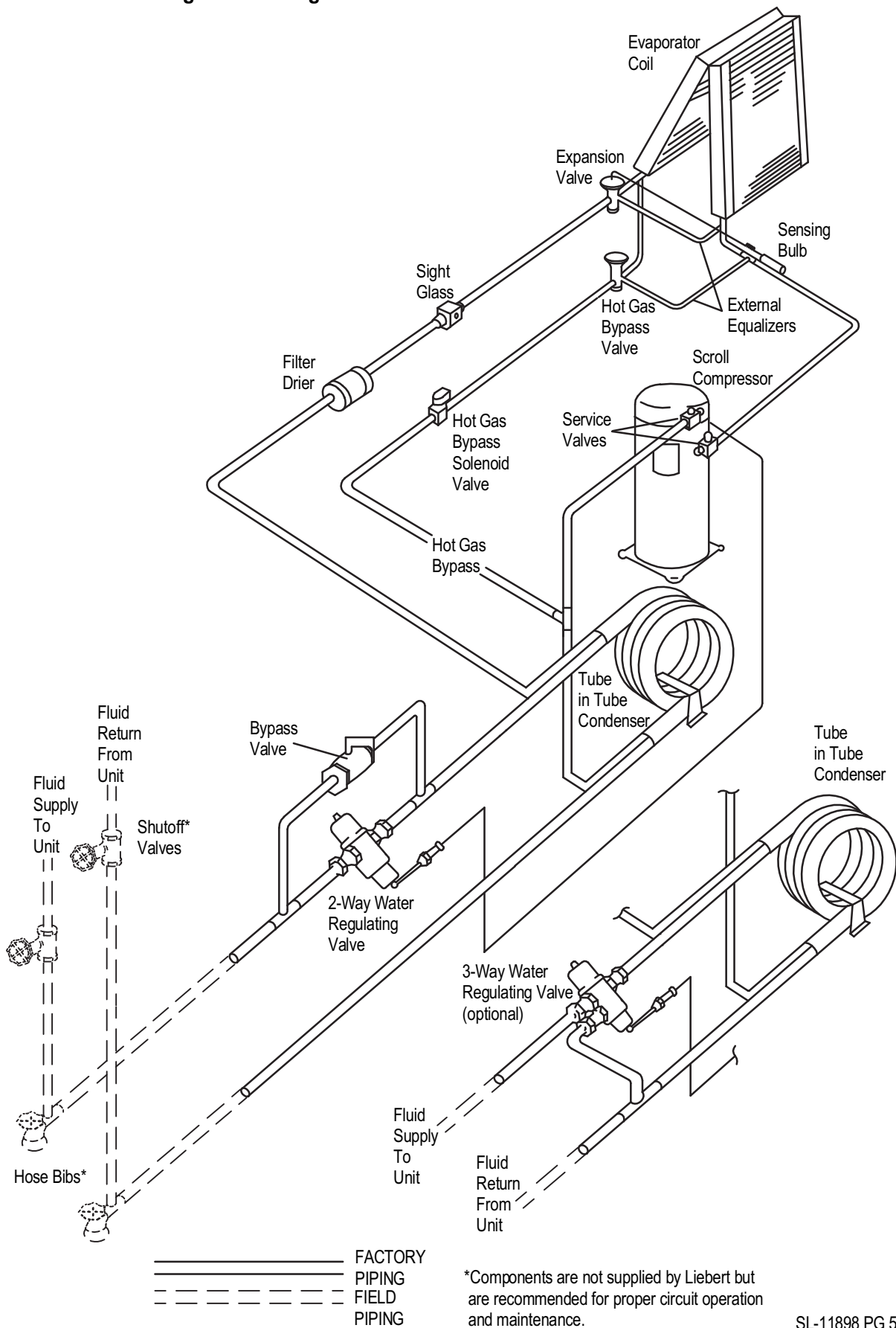
When the water source for the condenser is of poor quality, it is good practice to provide cleanable filters in the supply line. These filters will trap the particles in the water supply and extend the service life of the water-cooled condenser.

To provide for the emergency of water leaks and the consequences of sub-floor flooding, floor drains should be provided with wet traps or a water detection system such as a Liqui-tect sensor that is installed near the base of the unit or below the elevated floor.

4.2 Condenser

The condenser is designed to operate in conjunction with either a cooling tower or city water. The maximum water pressure is 150 psig (1034 kPa). A high pressure system rated at 350 psig (2413 kPa) is available as an option.

Figure 12 Water-cooled general arrangement



4.3 Water Regulating Valve

The water regulating valve automatically regulates the amount of fluid necessary to remove the heat from the refrigeration system, permitting more fluid to flow when load conditions are high and less fluid to flow when load conditions are low. The valve consists of a brass body, balance spring, valve seat, valve disc holders, capillary tube to discharge pressure, and adjusting screw.

4.3.1 Water Regulating Valve Adjustment

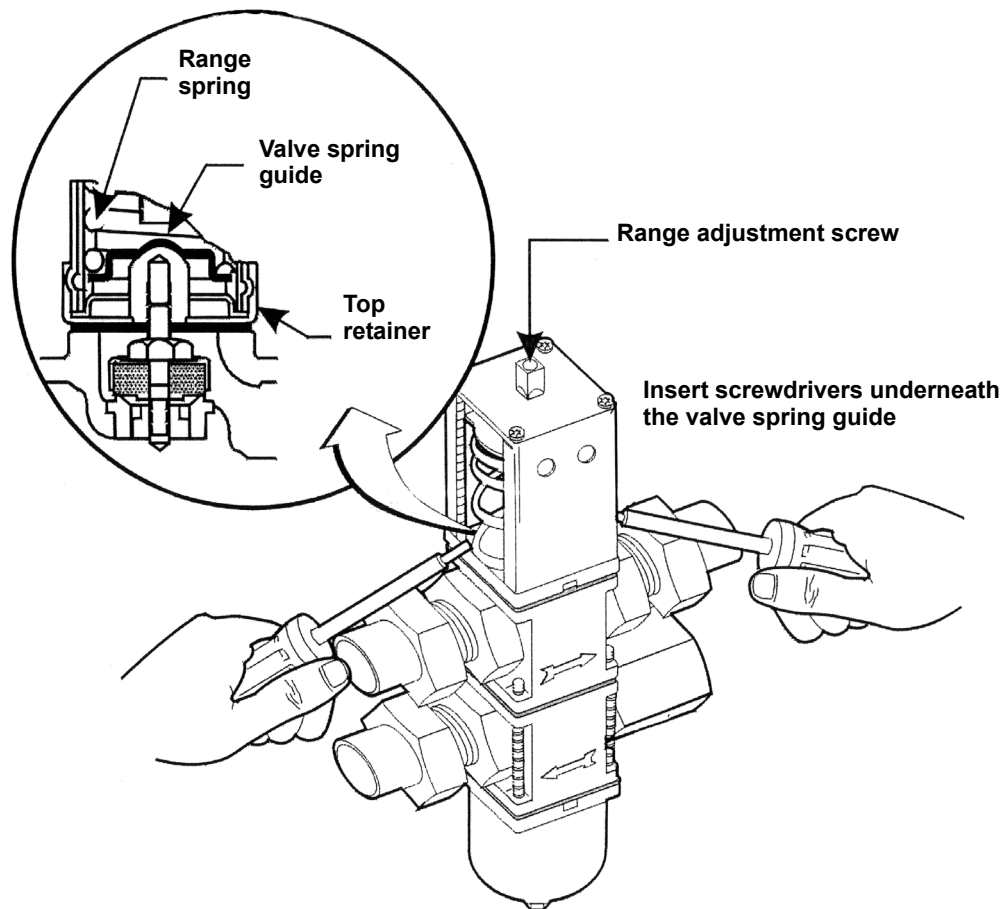
The Liebert Challenger ITR may be equipped with either a standard Johnson Controls valve, 150 psig (1034 kPa) or with a high-pressure Johnson Controls valve, 350 psig (2413 kPa).

The valve may be adjusted with a standard refrigeration service valve wrench or screw driver.

To lower the head pressure setting, turn the square adjusting screw clockwise until the high pressure gauge indicates the desired setting.

To raise the head pressure setting, turn the adjusting screw counterclockwise until the desired setting is obtained.

Figure 13 Johnson Controls valve adjustment



4.3.2 Water Regulating Valve Manual Flushing

The valve may be flushed by inserting screwdrivers or similar tools under the opposing sides of the main spring and lifting. This action will open the valve seat and flush any dirt particles from the seat. If this fails, the valve must be disassembled for cleaning the seat.

4.3.3 Testing Valve Function

When the refrigeration system has been off for 10-15 minutes, the water flow should stop.

Should the water continue to flow, the valve is either improperly adjusted or the pressure sensing capillary is not properly connected to the condenser.

5.0 GLYCOL/GLYCOOL-COOLED MODELS

5.1 Drycooler Location

The drycooler should be located for maximum security and maintenance accessibility. Avoid ground-level sites with public access or areas which contribute to heavy snow or ice accumulations. To assure adequate air supply, it is recommended that drycoolers be located in a clean air area, away from loose dirt and foreign matter that may clog the coil. In addition, drycoolers should not be located in the vicinity of steam, hot air or fume exhausts. Also, drycoolers should not be located closer than 3 feet (1 meter) from a wall, obstruction or adjacent unit.

5.2 Drycooler Installation

For roof installation, mount drycoolers on steel supports in accordance with local codes. To minimize sound and vibration transmission, mount steel supports across load bearing walls. For ground installation, a concrete pad will provide adequate support. Drycooler legs have mounting holes for securing the drycooler to steel supports or concrete pad.

5.3 Electrical Connections

Refer to equipment nameplate regarding wire size and circuit protection requirements. Refer to electrical schematic when making connections. Make all wiring and electrical connections in accordance with local and national codes.



WARNING

Risk of electric shock. Can cause injury or death.

Disconnect all local and remote electric power before working within the unit. Use a voltmeter to make sure power is turned off before making any electrical connections.

5.3.1 Line Voltage

Line voltage electrical service is required for all drycoolers at the location of the drycooler. This power supply does not have to be the same voltage as the indoor unit. This separate power source may be 208, 230, 460, or 575 V, 60 Hz; or 200, 230, or 380/415 V, 50 Hz. The disconnect switch is factory-supplied and mounted in the electric panel.

5.3.2 Low Voltage

A control interlock between the drycooler and the indoor unit is required and is connected between 70 and 71 in the handy box of the indoor unit and the pump and drycooler control box of the drycooler. NEC Class 1 wiring is required.

5.3.3 Pump and Drycooler

All wiring to the pump and drycooler from the control box should be done in accordance with the electrical schematic on the inside lid of the drycooler control box and with local and national codes.

5.4 Glycol Piping

NOTICE

Galvanized pipe must not be used in or with systems or units that contain glycol. The phosphates in the inhibitor can react with the zinc in the galvanized pipe, precipitating an insoluble material that can eventually foul the system.

To help prevent piping failures, supply and return lines must be supported in a way that keeps their weight from bearing on the piping of the unit, drycooler or pumps.

To avoid the possibility of burst pipes, it is necessary to install a relief valve in the system. This valve may be obtained from the supplier as an option or obtained from another vendor.

Fluid-cooled condensers have small internal flow passages. To avoid clogging and other resulting system operation problems, install a 16-20 mesh filter in the fluid supply line to the indoor unit. The filter should be located where it can be easily serviced or replaced.

Do not install unit on open-loop systems. Debris carried by the fluid will clog the brazed plate condenser.

It is recommended that manual service shut-off valves be installed at the supply and return connections to each unit. This enables routine service and/or emergency isolation of the unit. In addition, multiple pump packages require a check valve at the discharge of each pump to prevent back flow through the standby pump(s).

To facilitate filling, installation of hose bibs at the lowest point of the system is recommended.

Consideration of the minimum glycol temperature to be supplied from the drycooler will determine if the need exists to insulate the glycol supply and return lines. Insulation will prevent condensation on the glycol lines in low ambient conditions.

All fluid piping must comply with local codes. Care in sizing pipes will help reduce pumping power and operating costs.

Table 11 Room dew point temperatures

Dry Bulb °F (°C)	Wet Bulb °F (°C)	Relative Humidity	Dew Point* °F (°C)
70 (21.1)	57.2 (14.0)	45	48.0 (8.9)
70 (21.1)	58.5 (14.7)	50	50.5 (10.3)
72 (22.2)	58.9 (24.9)	45	50.0 (10.0)
72 (22.2)	60.0 (15.5)	50	52.4 (11.3)
75 (23.8)	61.2 (16.2)	45	52.4 (11.3)
75 (23.8)	62.5 (16.9)	50	55.0 (12.7)

* Minimum glycol temperature before condensation will occur.

5.4.1 Expansion Tanks, Fluid Relief Valves and Other Devices

An expansion tank must be provided for expansion and contraction of the fluid due to temperature change in this closed system. Vents are required at system high points to vent trapped air when filling the system. A relief valve is also a necessary piping component.

Depending on the complexity of the system, various other devices may be specified. Pressure gauges, flow switches, automatic air separator, tempering valves, standby pumps, sensors for electrical controls, and flow switches are just a few of these devices.

NOTICE

Immediately following the use of water for leak testing or system cleaning, charge the tested system with the proper percentage of glycol and water for the application's coldest design ambient. Complete system drain-down cannot be assured, and equipment damage could result from freezing of residual water.

5.5 Filling Instructions

5.5.1 Preparing the System for Filling

It is important to remove any dirt, oil or metal filings that may contaminate the cooling system piping in order to prevent contamination of the fresh glycol solution and fouling of the drycooler piping. The system should be flushed thoroughly using a mild cleaning solution or high-quality water and then completely drained before charging with glycol. Cleaning new systems is just as important as cleaning old ones. New systems can be coated with oil or a protective film; dirt and scale are also common. Any residual contaminants could adversely affect the heat transfer stability and performance of your system. In many cases, in both old and new systems, special cleaners are needed to remove scale, rust and hydrocarbon foulants from pipes, manifolds and passages. Clean heat transfer surfaces are important in maintaining the integrity of the heating/cooling system. For more information on cleaners and degreasers, contact your sales representative. Follow the manufacturer's instructions when using these products.

Calculate the internal volume of the system as closely as possible. See **Table 12** and **Table 14** for unit volumes. Use volume in **Table 13** for glycol piping volumes.

Table 12 Indoor unit glycol volume approximate gallons (liters) max.

Model (50 Hz)	Glycol-Cooled	GLYCOOL
071WG/(070WG)	2.0 (7.5)	—
061G/(058G)	—	4.0 (15.1)

Table 13 Volume in standard Type “L” copper piping

Diameter (in.)		Volume
Outside	Inside	Gal/Ft L/M
1/2	0.123	0.008 (0.01)
5/8	0.555	0.012 (0.15)
3/4	0.666	0.018 (0.22)
7/8	0.785	0.025 (0.31)
1-1/8	1.025	0.043 (0.53)

5.5.2 Glycol Solutions



NOTE

Glycol solutions should be considered for protection of the coil. When it is not used, damage can occur from either freezing or corrosion from water.

When considering the use of any glycol products in a particular application, you should review the latest Material Safety Data Sheets and ensure that the use you intend can be accomplished safely. For Material Safety Data Sheets and other product safety information, contact the supplier nearest you. Before handling any other products mentioned in the text, you should obtain available product safety information and take necessary steps to ensure safety of use.

NOTICE

When mishandled, glycol products pose a threat to the environment. Before using any glycol products, review the latest Material Safety Data Sheets and ensure that you can use the product safely.

Glycol manufacturers request that the customer read, understand and comply with the information on the product packaging and in the current Material Safety Data Sheets. Make this information available to anyone responsible for operation, maintenance and repair of the drycooler and related equipment.

No chemical should be used as or in a food, drug, medical device, or cosmetic, or in a product or process in which it may contact a food, drug, medical device, or cosmetic until the user has determined the suitability and legality of the use. Since government regulations and use conditions are subject to change, it is the user's responsibility to determine that this information is appropriate and suitable under current, applicable laws and regulations.

NOTICE

Automotive antifreeze is unacceptable and must NOT be used.

Typical inhibited formula ethylene glycol and propylene glycol manufacturers and suppliers are Union Carbide (Ucartherm) or Dow Chemical (Dowtherm SR-1, Dowfrost). These glycols are supplied with corrosion inhibitors and do not contain a silicone anti-leak formula. Commercial ethylene glycol, when pure, is generally less corrosive to the common metals of construction than water itself. Aqueous solutions of these glycols, however, assume the corrosivity of the water from which they are prepared and may become increasingly corrosive with use if not properly inhibited.

There are two basic types of additives: corrosion inhibitors and environmental stabilizers. The corrosion inhibitors function by forming a surface barrier that protects the metals from attack. Environmental stabilizers, while not corrosion inhibitors in the strictest sense of the word, decrease corrosion by stabilizing or favorably altering the overall environment. An alkaline buffer such as borax is a simple example of an environmental stabilizer since its prime purpose is to maintain an alkaline condition (pH above 7).

The percentage of glycol to water must be determined by using the lowest design outdoor temperature in which the system is operating. **Table 14** indicates the solution freeze point at several concentration levels of ethylene glycol. Propylene glycol concentrations should be 1% higher than the ethylene glycol table values to find the freeze point. For example, 41% propylene glycol freezes at -10°F (-23°C).

Table 14 Ethylene glycol concentrations

% Glycol by Volume	0 *	10	20	30	40	50
Freezing Point °F (°C)	32 (0)	25 (-3.9)	16 (-8.9)	5 (-15.0)	-10 (-23.3)	-32 (-35.5)
Apparent Specific Gravity @ 50°F (10°C)	1	1.014	1.028	1.042	1.057	1.071

* A minimal amount of glycol should be considered for inhibitive coil protection.

NOTICE

The quality of water used for dilution must be considered because water may contain corrosive elements that reduce the effectiveness of the inhibited formulation. Water classified as soft (low in chloride and sulfate ion content less than 100 parts per million each) should be used.

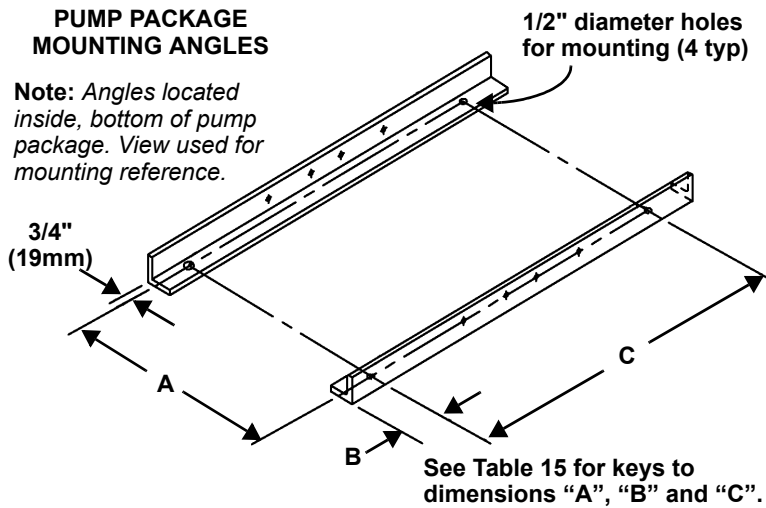
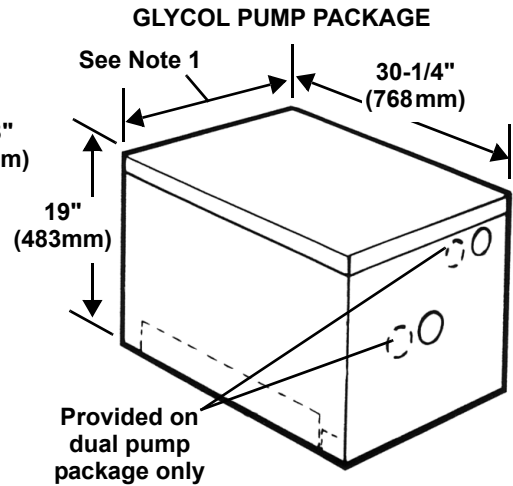
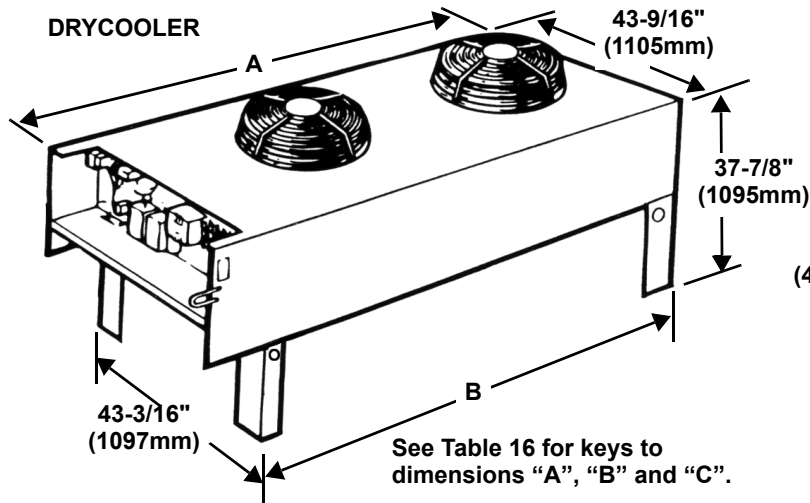
5.5.3 Filling the System

Installation of hose bibs at the lowest point of the system is recommended. When filling a glycol system keep air to a minimum. Air in glycol turns to foam and is difficult and time-consuming to remove. (Anti-foam additives are available and may be considered.) Open all operating systems to the loop. With the top vent(s) open, fill the system from the bottom of the loop. This will allow the glycol to push the air out of the top of the system, minimizing trapped air. Fill to approximately 80% of calculated capacity. Fill slowly from this point, checking fluid levels until full.

**NOTE**

For glycol solution preparation and periodic testing, follow manufacturer's recommendations. Do not mix products of different manufacturers.

Figure 14 Drycoolers and pump packages



Notes

1. Single pump packages are 17-1/4" (438 mm) wide. Dual pump packages are 32-1/4" (819 mm) wide.
2. Mounting holes are 15-1/4" (387 mm) apart on single pump packages and 30-1/4" (768 mm) apart on dual pump packages.
3. Connection sizes apply to primary pump supplier.

For expansion tank dimensions, see Figure 15 on page -33.

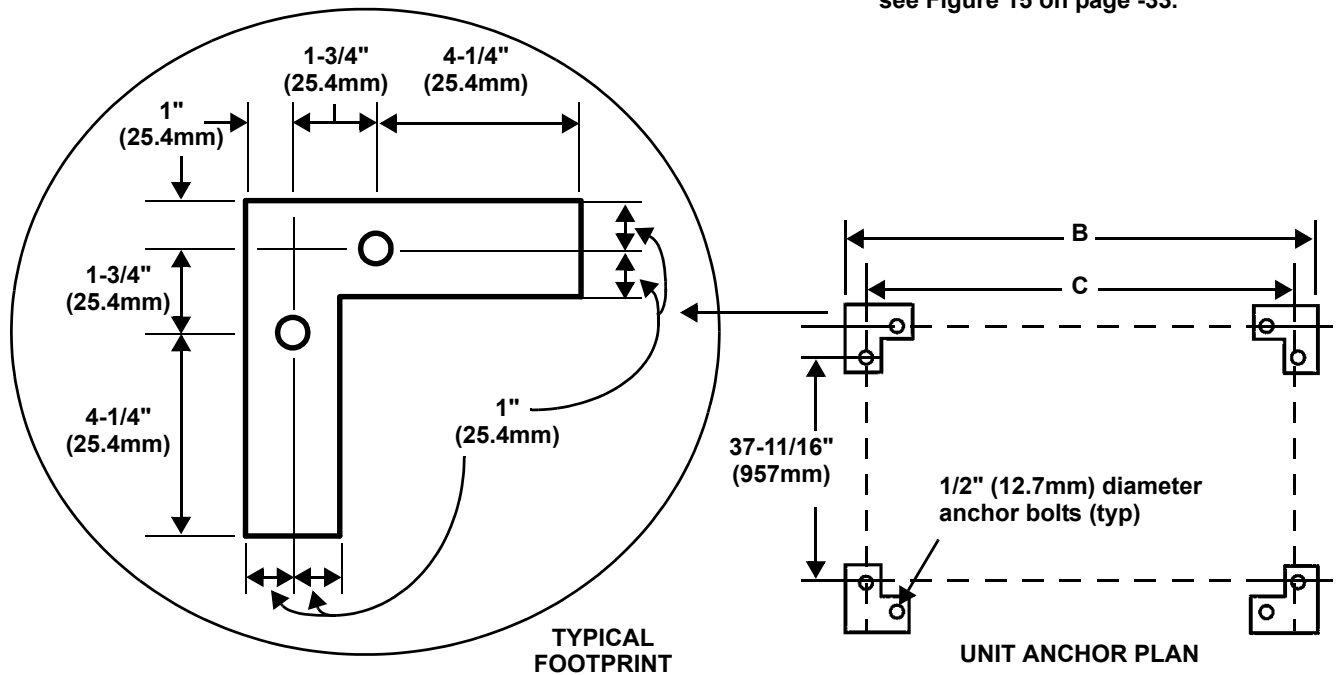


Figure 15 Pump packages—expansion tank

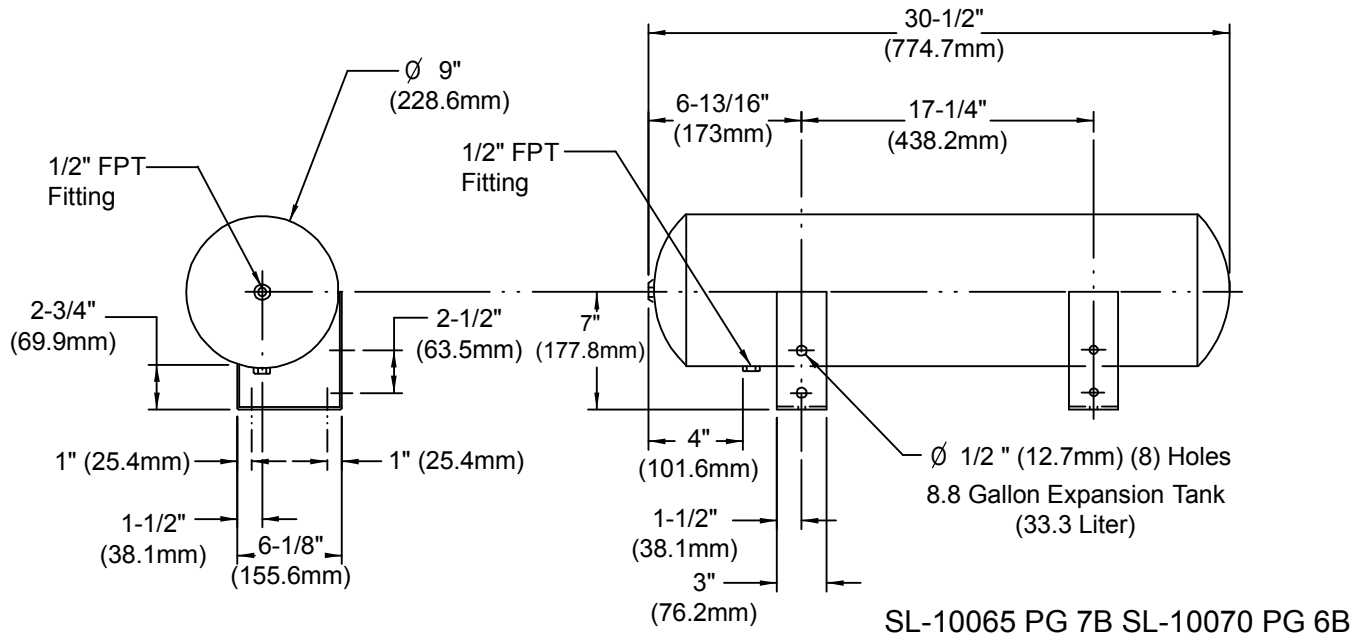


Table 15 Mounting hole dimensional data

PUMP PACKAGE	A in (mm)	B in (mm)	C in (mm)
SINGLE (0.75 - 7.5 hp)	15-1/4 (387.4)	2-1/2 (63.5)	22-1/2 (571.5)
DUAL (0.75 - 5 hp)	30-1/4 (768.4)	2-1/2 (63.5)	22-1/2 (571.5)
DUAL (7.5 hp)	39-5/16 (998.5)	1-3/4 (44.5)	26-7/8 (682.6)

Table 16 Drycooler data

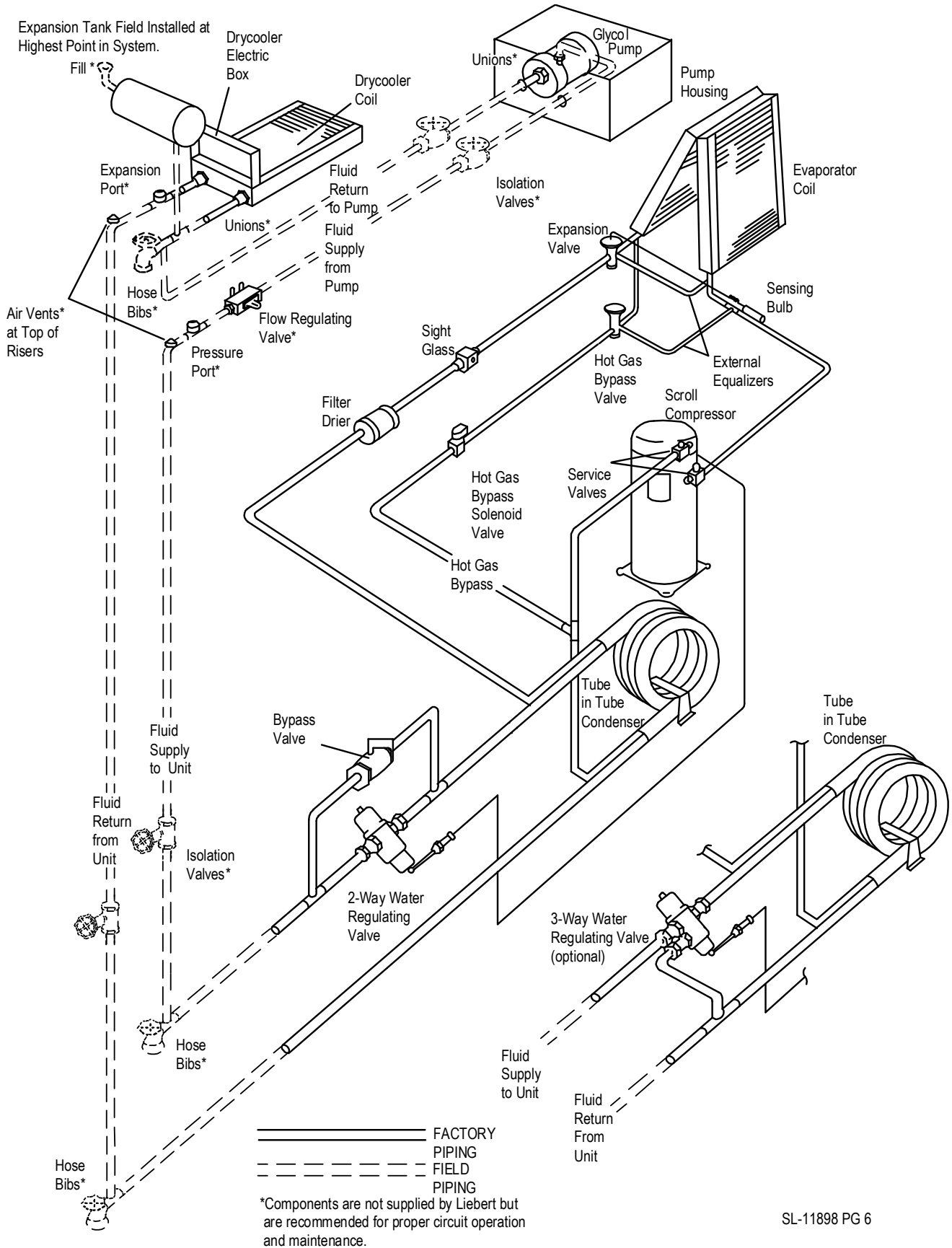
Model No.	No. of Fans	Weight lb (kg)	Drycooler Conn. Sizes (Suct. & Disc.) in.	“A” Dimension in. (mm)	“B” Dimension in. (mm)	“C” Dimension in. (mm)	Coil Internal Volume, gal. (l)
-069	1	410 (186)	1-1/4	51-1/2 (1308)	44 (1118)	42 (1067)	2.4 (9.2)
-092	1	430 (195)	1-1/2	51-1/2 (1308)	44 (1118)	42 (1067)	3.7 (13.9)
-109	1	450 (204)	2	51-1/2 (1308)	44 (1118)	42 (1067)	4.9 (18.6)
-112	1	470 (213)	2	51-1/2 (1308)	44 (1118)	42 (1067)	5.8 (22.0)
-139	2	565 (256)	2	91-1/2 (2324)	84 (2134)	82 (2083)	4.8 (18.2)
-197	2	605 (274)	2	91-1/2 (2324)	84 (2134)	82 (2083)	9.0 (34.1)

Table 17 Glycol pump data*

Pump		Pump Suction Connection in.	Pump Discharge Connection in.
Hp	Hz		
1-1/2	60	1-1/4	3/4
2	60		
3	60		
5	60		
1	50	1-1/4	3/4
1-1/2	50		
2	50		
3	50		

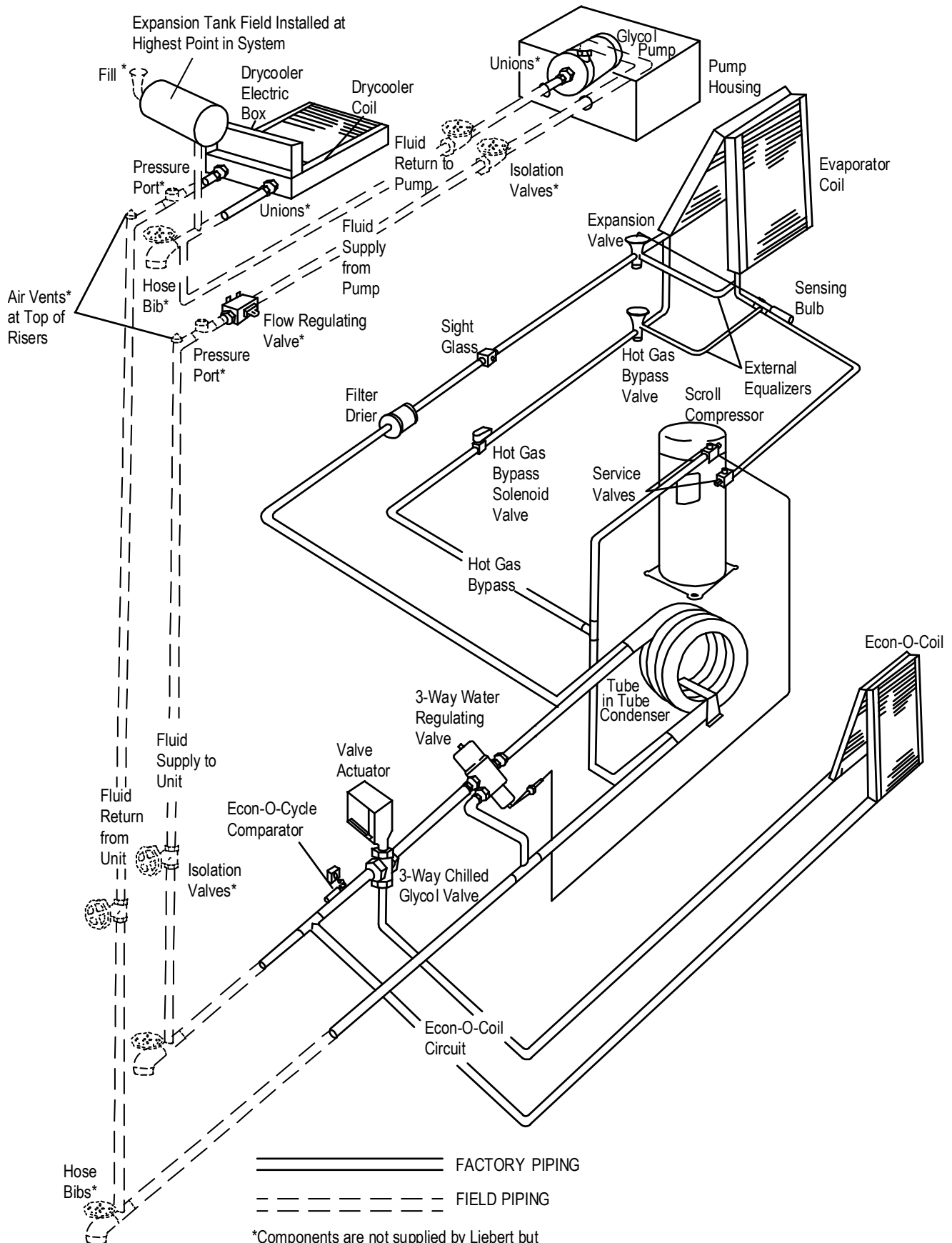
* Connection sizes apply to primary pump supplier

Figure 16 Glycol general arrangement



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Figure 17 GLYCOOL general arrangement



5.6 Condenser

The condenser is designed to operate in conjunction with a drycooler. The maximum coolant pressure is 350 psig (2413 kPa).



NOTE

For pressures above 150 psig (1034 kPa), the high pressure option for high pressure valve(s) is required.

5.7 Glycol Regulating Valve

The glycol regulating valve automatically regulates the amount of coolant necessary to remove the heat from the refrigeration system, permitting more fluid to flow when load conditions are high and less fluid to flow when load conditions are low. The valve consists of a brass body, balance spring, valve seat, valve disc holders, capillary tube to discharge pressure, and adjusting screw.

5.7.1 Glycol Regulating Valve Adjustment

The Liebert Challenger ITR may be equipped with either a standard Johnson Controls valve, 150 psig (1034 kPa) or with a high-pressure Johnson Controls valve, 350 psig (2413 kPa). For details on adjusting the valve, refer to **4.3.1 - Water Regulating Valve Adjustment**.

5.7.2 Testing Valve Function

When the refrigeration system has been off for approximately 10-15 minutes, the coolant flow should stop.

Should the coolant continue to flow, the valve is either improperly adjusted or the pressure sensing capillary is not connected properly to the condenser.

Table 18 Refrigerant control settings psi (kPa)

Low Pressure Cut Out	Low Pressure Cut In	High Pressure Cut Out
20 (137.9)	65 (448.2)	360 (2482)

6.0 CHILLED WATER MODELS

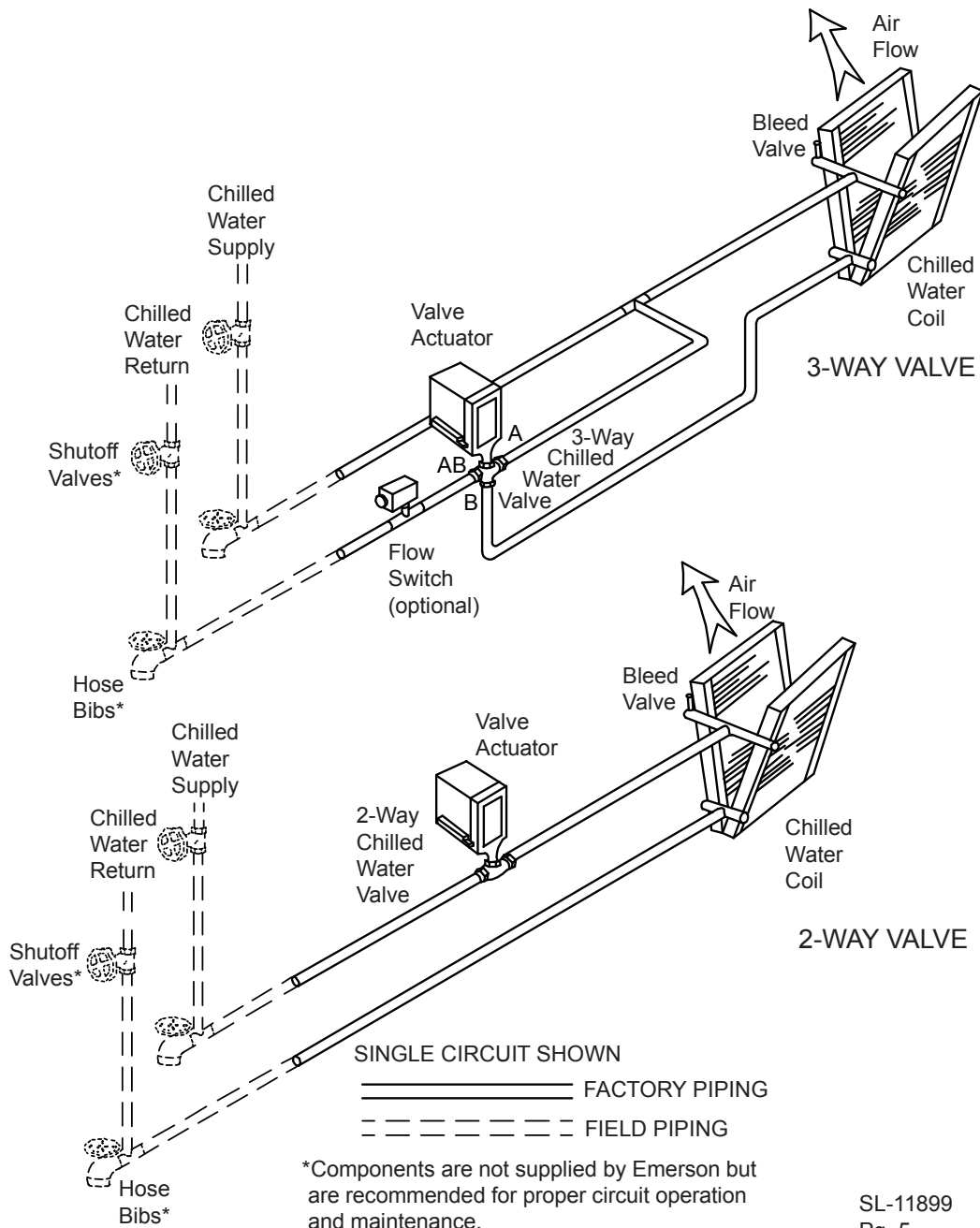
6.1 Piping Considerations

Manual shut-off valves should be installed at the supply and return lines to each unit. This will provide for routine service and emergency isolation of the unit.

Consideration of the minimum water temperature to be supplied from the chiller will determine if the need exists to insulate supply and return lines. Insulation will prevent condensation on the supply and return lines.

To provide for the emergency of water leaks and the consequences of sub-floor flooding, floor drains should be provided with wet traps or a water detection system, such as a Liqui-tect, that is installed near the base of the unit or below the elevated floor.

Figure 18 Chilled water general arrangement - horizontal flow (BR)



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7.0 SPLIT SYSTEM MODELS

Three (3) condensing unit styles are available: two (2) air-cooled and one (1) water/glycol-cooled condensing unit.

7.1 Location Considerations

7.1.1 Air-Cooled Condensing Units

To assure an adequate air supply, it is recommended that all condensing units be located in a clean air area, 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" from a wall, obstruction, or adjacent unit.

The outdoor condensing unit should be located for maximum security and maintenance accessibility. Avoid ground-level sites with public access or areas that will contribute to heavy snow accumulations. Do not allow the discharge air to blow into another condensing unit.

A solid base, capable of supporting the weight of the condenser and at least 2" (51 mm) higher than the surrounding grade and at least 2" (51 mm) larger than the condensing unit base dimensions, should be installed at the pre-determined location. In snow areas, a base of sufficient height to clear snow accumulation must be installed.

The centrifugal fan air-cooled condensing unit may be located above the dropped ceiling or any remote indoor area. If noise is of concern, the condensing unit should be located away from personnel. Normal operating sound may be objectionable if the condensing unit is placed near quiet work areas.

To mount the unit in the ceiling, refer to **7.5.1 - Installing the Indoor Condensing Unit** for hanging guidelines and to **Figure 23 - Detail of ceiling hanging bracket** for dimensional data.

7.1.2 Water/Glycol-Cooled Condensing Units

The condensing unit may be located above the dropped ceiling or any remote indoor area. If noise is of concern, the condensing unit should be located away from personnel. Normal operating sound may be objectionable if the condensing unit is placed near quiet work areas. To mount the unit in the ceiling, refer to **7.5.1 - Installing the Indoor Condensing Unit**.

7.2 Electrical Connections

Refer to equipment nameplate regarding wire size and circuit protection requirements. Refer to electrical schematic when making connections. Make all wiring and electrical connections in accordance with local and national codes.



WARNING

Risk of electric shock. Can cause injury or death.

Disconnect all local and remote electric power before working within the unit. Use a voltmeter to make sure power is turned off before making any electrical connections.

7.2.1 Line Voltage

Line voltage electrical service is required for all condensing units at the location of the condensing unit. This power supply does not have to be the same voltage as the indoor unit. This separate power source may be 208, 230, 460 or 575V, 60 Hz; or 200, 230, or 380/415V, 50 Hz. A disconnect switch is required and must be mounted per local and national codes to isolate the unit for maintenance.

7.2.2 Low Voltage

The control cable between the condensing unit and the evaporator unit is connected between terminals 1,2 and 3 on the terminal strip in the evaporator unit and the condensing unit control box. A fourth wire is required on systems with hot gas bypass. NEC Class 1 wiring is required. Glycol-cooled units also require a two-wire control connection to the drycooler and pump package.

7.3 Piping Considerations

7.3.1 Refrigerant Loop



CAUTION

All local codes for handling refrigerant must be followed.



NOTE

As R22 and R407C are similar in properties, proper safety equipment and proper refrigeration tools are required on both types. Check unit nameplate for correct refrigerant type before topping off or recharging a system.



NOTE

Refrigerant R407C uses a POE (polyol ester) lubricant. The R407C refrigerant must be introduced and charged from the cylinder only as a liquid.



NOTE

When installing field piping, care must be taken to protect all refrigerant lines from the atmosphere, especially when using refrigerants with POE oils. Do not allow the piping to stand open to air for more than 15 minutes. Units designed for R407C have a compressor which contains POE oil that is very hygroscopic; that is, it quickly absorbs water from the air. The longer the compressor piping is left open to air, the harder it will be to fully evacuate. If left open too long, the POE oil may need to be replaced before achieving the required vacuum level.



NOTE

Complete all piping and evacuate lines before connecting quick connects when using an optional sweat adapter kit and field installed hard piping.

Follow all proper brazing practices including a dry nitrogen purge to maintain system cleanliness.

All split systems require two refrigerant lines (an insulated copper suction line and a copper liquid line) between the evaporator and the condensing unit.

Two possible methods exist for installing the copper suction and liquid lines.

1. Using an optional Sweat Adapter Kit and hard piping between the two units.
2. Using optional pre-charged line sets.

All refrigeration piping should be installed with high temperature brazed joints. Prevailing good refrigeration practices should be employed for piping supports, leak testing, evacuation, dehydration, and charging of the refrigeration circuits. The refrigeration piping should be isolated from the building by the use of vibration isolating supports.

It is important to handle the pre-charged lines with care so they will not get kinked or damaged. Use tube benders and make all bends before making connections to either end. Coil any excess tubing in a horizontal plane with the slope of the tubing toward the condensing unit.

To prevent tube damage when sealing openings in walls and to reduce vibration transmission, use a soft flexible material to pack around the tubes.

When installing remote condensing units mounted above the evaporator, the suction gas line should be trapped at the evaporator. This trap will retain refrigerant oil in the off cycle. When the unit starts, oil in the trap is carried up the vertical riser and returns to the compressor.

Refrigerant charge requirements: Total refrigerant charge will be required only if units are evacuated during installation or maintenance. Total refrigerant charge = evaporator + lines + condensing unit.



NOTE

*All condensing units and 3-ton evaporator units are fully charged with refrigerant. All 23 and 33 kW evaporator units include a nitrogen holding charge only. See **Table 19** for field charge required. If field-supplied refrigerant piping is installed, refrigerant must be added to the system.*

Once all piping is complete, check for leaks and dehydrate the field piping as follows:

1. Pressurize the field piping to 150 PSIG (1034 kPa) using dry nitrogen with a trace of refrigerant. Check system for leaks with a suitable leak detector.
2. After completion of leak testing, release the test pressure (per local code) and pull a deep vacuum on the field piping with a suitable pump.
3. After 15 minutes, check the pressure readings and, if they have not changed, break vacuum with dry nitrogen. Pull a second vacuum to 250 microns or less. Recheck the pressure after 15 minutes.

Table 19 Unit refrigerant charge

Model	R22 Charge	R407C Charge	Model	R22 Charge	R407C Charge
	lb (kg)	lb (kg)		lb (kg)	lb (kg)
060E	0.81 (0.37)	0.8 (0.4)	PF_Z67A-_L	51.69 (23.45)	50.1 (22.7)
059E	0.81 (0.37)	0.8 (0.4)	PF_Z66A-_L	51.69 (23.45)	50.1 (22.7)
MC_65/64A	27.00 (12.25)	26.1 (11.8)	PF_067A-_H	51.69 (23.45)	50.1 (22.7)
PF_067A-_L	26.63 (12.08)	25.8 (11.7)	PF_066A-_H	51.69 (23.45)	50.1 (22.7)
PF_066A-_L	26.63 (12.08)	25.8 (11.7)	MC_69/68W	5.88 (2.67)	n/a

Table 20 Line charges - refrigerant per 100 ft (30 m) of Type "L" copper tube

O.D.	R22		R407C	
	Liquid Line lb (kg)	Suction Line lb (kg)	Liquid Line lb (kg)	Suction Line lb (kg)
1/2"	7.3 (3.3)	0.2 (0.1)	6.9 (2.9)	-
5/8"	11.7 (5.3)	0.3 (0.2)	11.0 (4.6)	0.4 (0.2)
7/8"	24.4 (11.1)	0.7 (0.3)	23.0 (9.6)	1.0 (0.4)
1-1/8"	41.6 (18.9)	1.2 (0.6)	39.3 (16.3)	1.7 (0.7)
1-3/8"	63.3 (28.7)	1.9 (0.8)	59.8 (24.8)	2.7 (1.1)

Table 21 Recommended refrigerant lines (R22 or R407C) sizes OD copper

Equivalent Feet (m)	3.5 Tons 036E (035E)		23 & 33 kW 060E (059E)	
	Suction	Liquid	Suction	Liquid
0-50 (0-15)	7/8"	1/2"	1-1/8"	1/2"
51-100 (16-30)	1-1/8"	1/2"	1-1/8"	5/8"
101-150 (31-45)	1-1/8"	5/8"	1-3/8"	5/8"

Table 22 Line coupling sizes

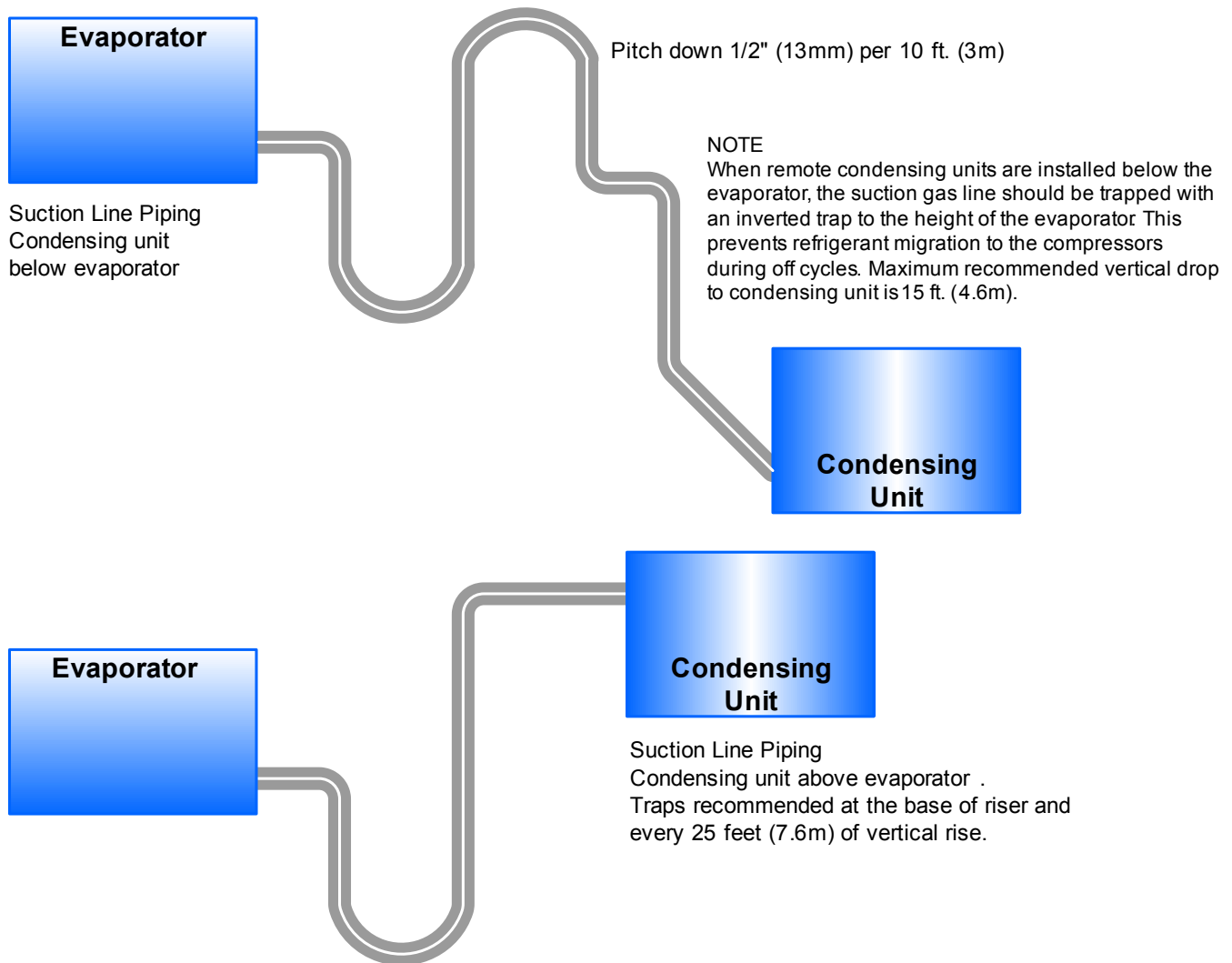
Line Size OD Cu, in.	Coupling Size	Torque lb-ft.
1/2 & 5/8	#10	35-45
1-1/8	#12	50-65

Table 23 Equivalent lengths (feet) for various pipe fittings

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	1.3	0.4	2.5	0.26	7.0	4.0
5/8	0.9	1.4	0.5	2.5	0.28	9.5	5.0
3/4	1.0	1.5	0.6	2.5	0.3	12.0	6.5
7/8	1.45	1.8	0.8	3.6	0.36	17.2	9.5
1-1/8	1.85	2.2	1.0	4.6	0.48	22.5	12.0
1-3/8	2.4	2.9	1.3	6.4	0.65	32.0	16.0
1-5/8	2.9	3.5	1.6	7.2	0.72	36.0	19.5

Refrigerant trap = 4 times equivalent length of pipe per this table

Figure 19 Refrigerant piping diagram



7.3.2 Quick Connect Fittings

**NOTE**

When hard piping is used, complete all piping and evacuate lines before connecting quick connects.

Be especially careful when connecting the quick connect fittings. Read through the following steps before making the connections.

1. Remove protector caps and plugs.
2. Carefully wipe coupling seats and threaded surfaces with a clean cloth.
3. Lubricate the male diaphragm and synthetic rubber seal with refrigerant oil.
4. Thread the coupling halves together by hand to ensure that the threads mate properly.
5. Tighten the coupling body hex nut and union nut with the proper sized wrench until the coupling bodies “bottom out” or until a definite resistance is felt.
6. Using a marker or pen, make a line lengthwise from the coupling union nut to the bulkhead.
7. Tighten the nuts an additional quarter turn; the misalignment of the lines shows how much the coupling has been tightened. This final quarter turn is necessary to ensure that the joint will not leak. Refer to **Table 22** for torque requirements.
8. Add charge for the additional piping (refer to **Table 20**).

7.4 Outdoor Air-Cooled Condensing Units

Figure 20 Outdoor air-cooled condensing unit—horizontal air discharge models

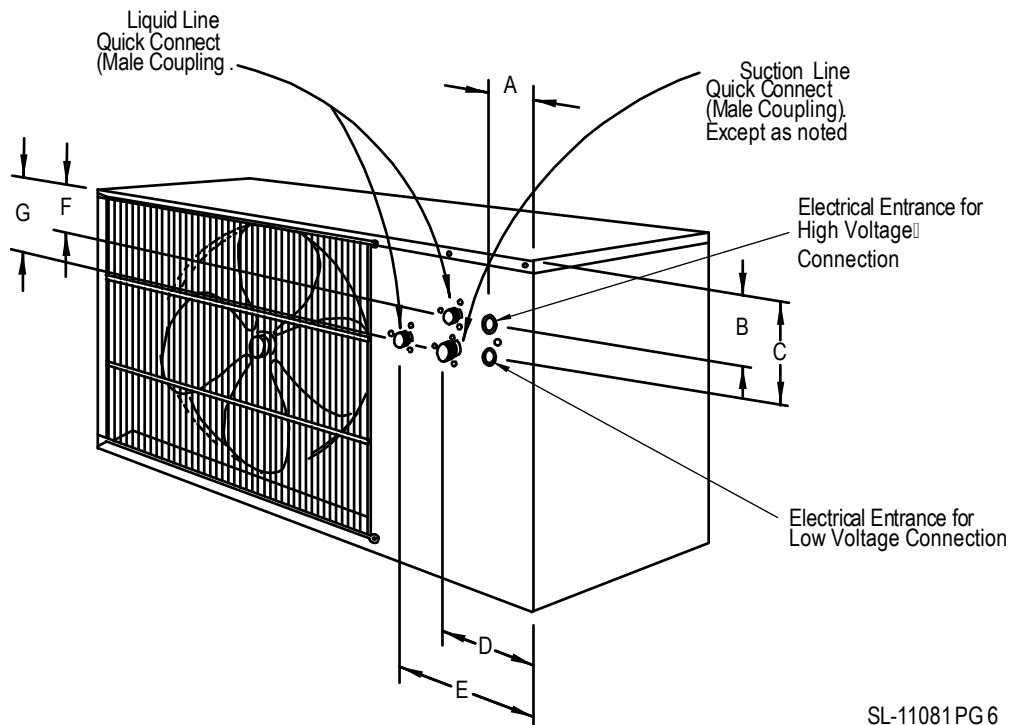
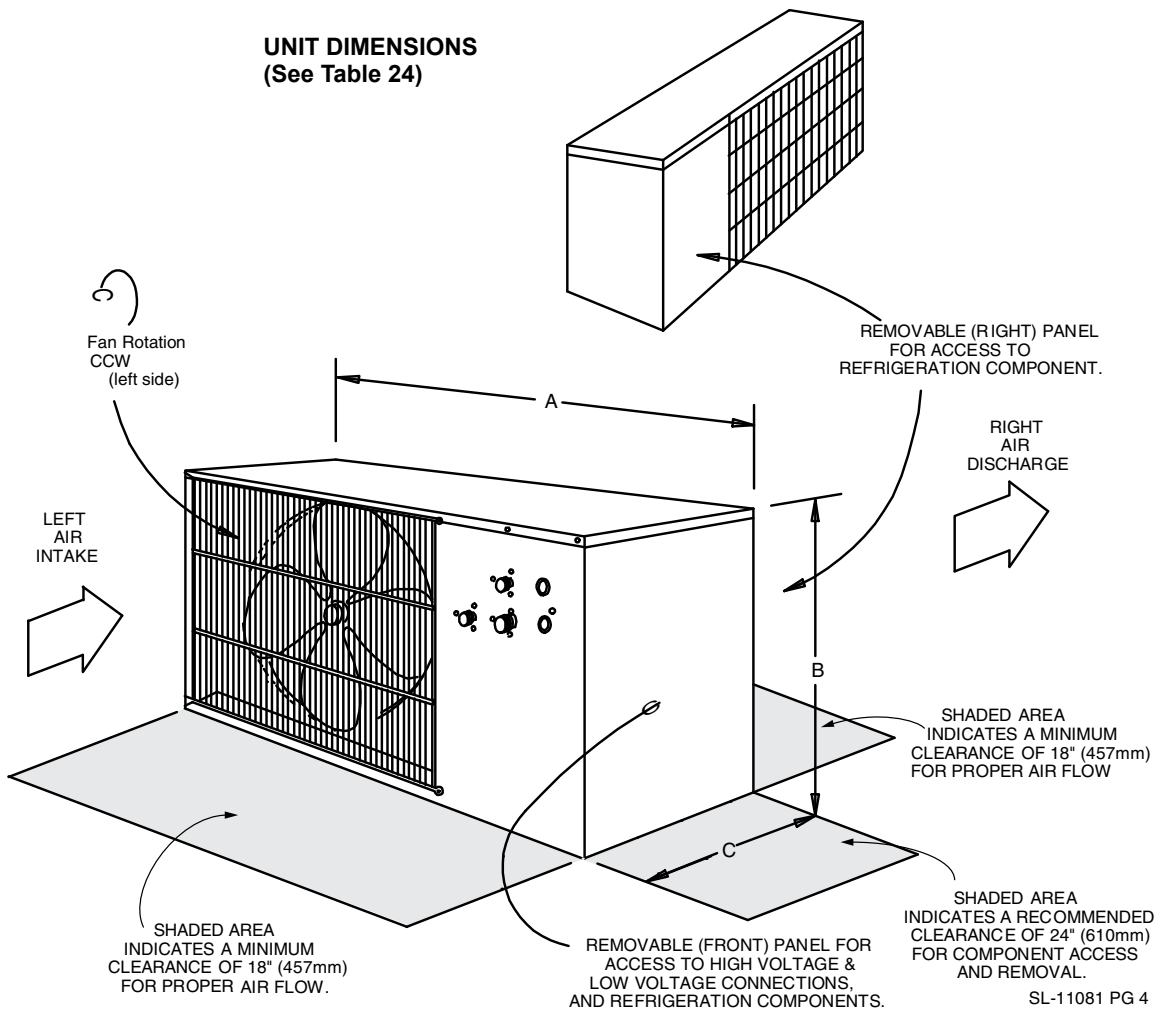


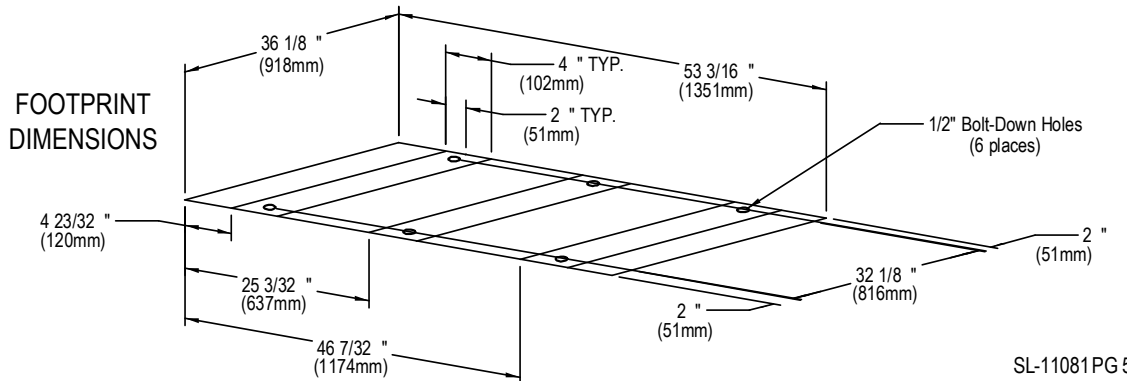
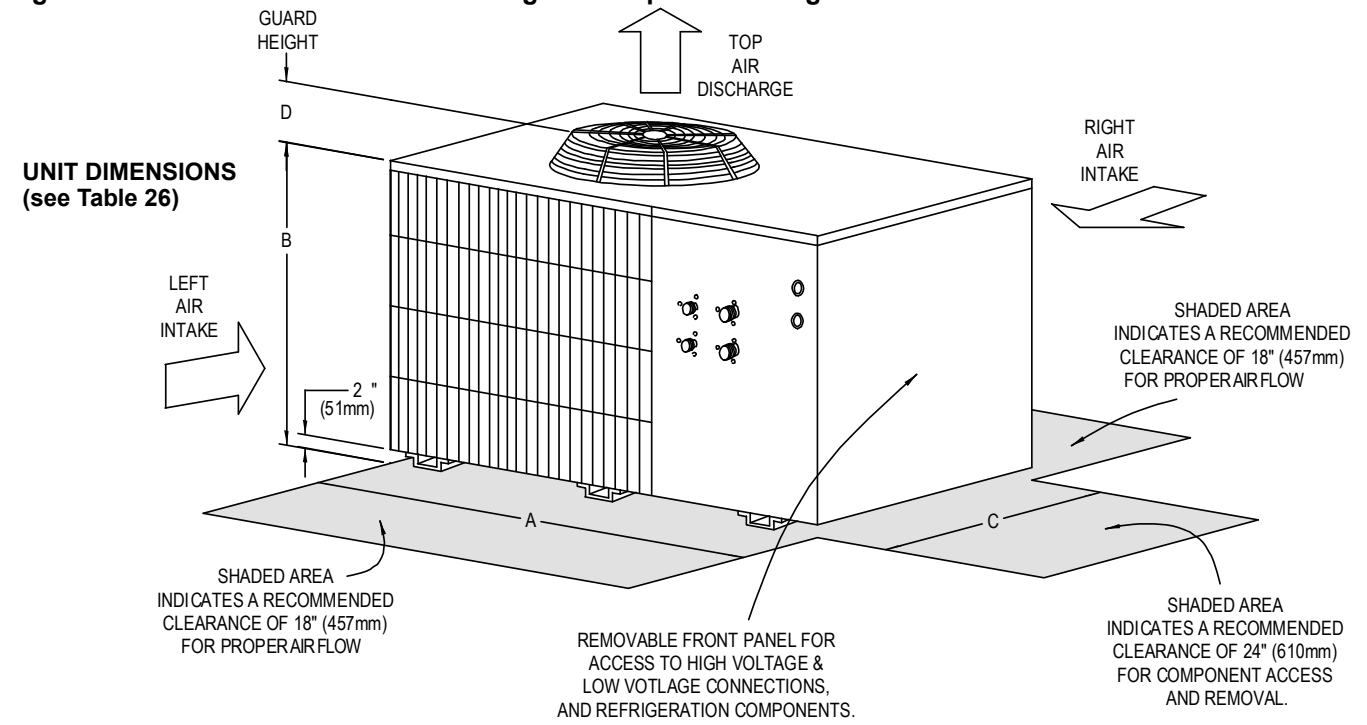
Table 24 Horizontal air discharge cabinet and floor planning dimensional data

Model Numbers		Dimensional Data in. (mm)			Module Weight lb (kg) net
60 Hz	50 Hz	A	B	C	
PFC067A-_L	PFC066A-_L	53 (1343)	36-1/4 (918)	18 (457)	351 (159)
PFH067A-_L					

Table 25 Horizontal air discharge piping and electrical connection data

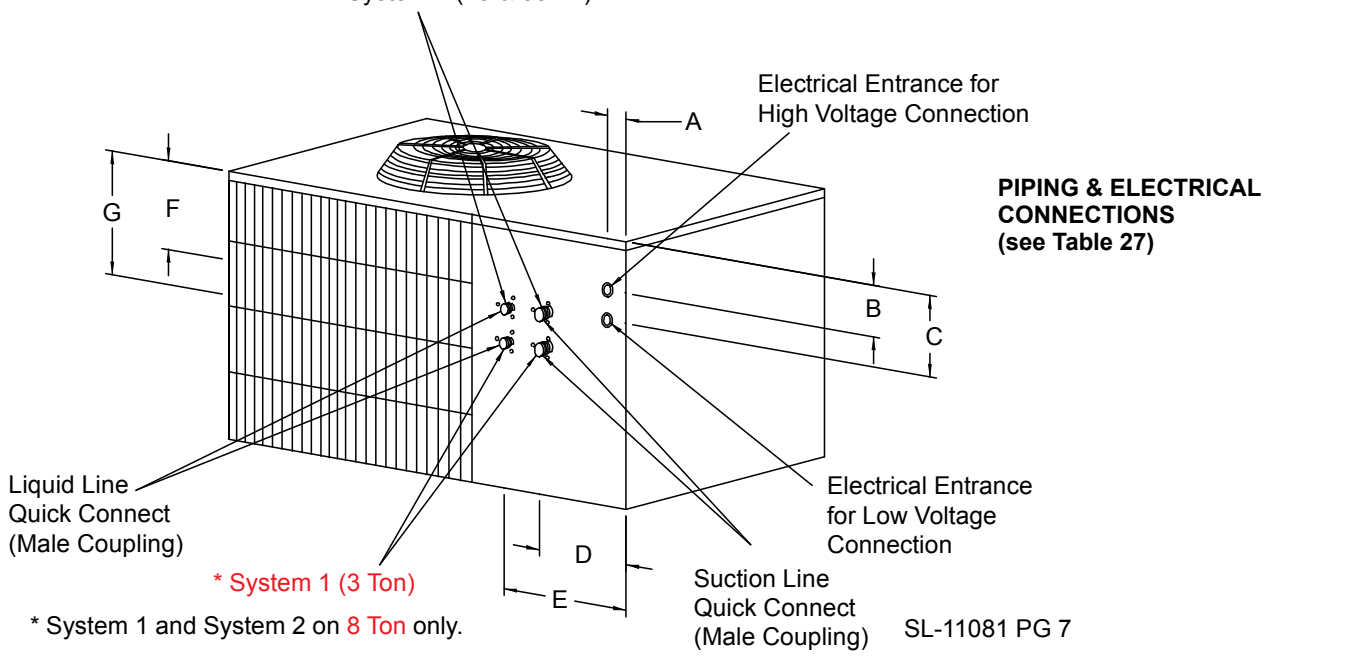
Model Numbers		Dimensional Data in. (mm)			Piping Connections in. (mm)			
60 Hz	50 Hz	A	B	C	D	E	F	G
PFC067A-_L	PFC066A-_L	2 (51)	6 (152)	8-1/2 (216)	4-3/4 (121)	7-3/4 (197)	-	8-1/2 (216)
PFH067A-_L								

Figure 21 Outdoor air-cooled condensing unit—top air discharge models



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* System 2 (23 & 33kW)



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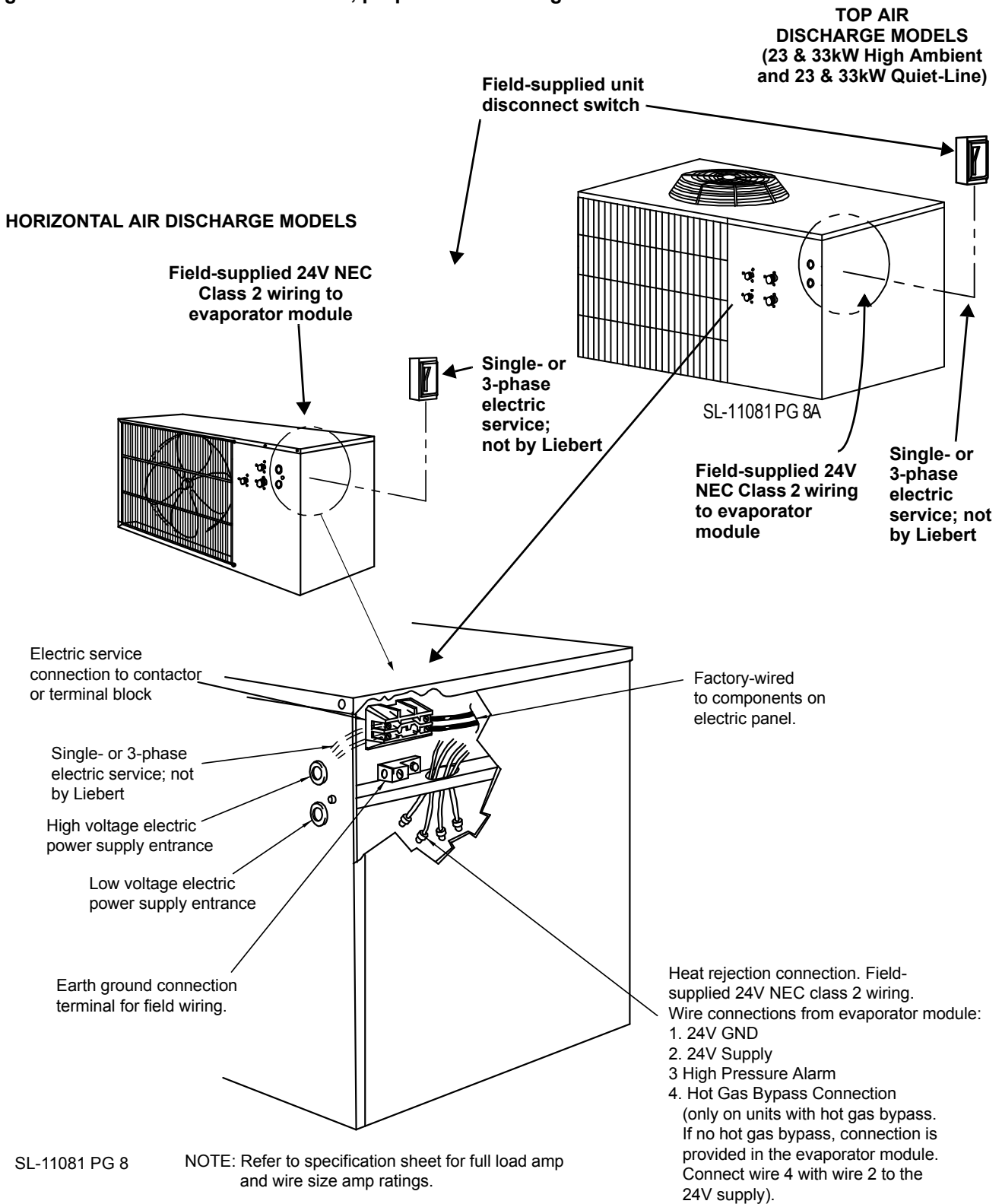
Table 26 Cabinet and floor planning dimensional data - prop fan condensing modules, top air discharge

Model Numbers		Dimensional Data, in. (mm)				Module Weight lb (kg) net
60 Hz	50 Hz	A	B	C	D	
PFC067A-_H	PFC066A-_H	53 (1343)	36-1/4 (918)	38-1/2 (978)	5-1/2 (140)	488 (222)
PFH067A-_H						
PFCZ67A-_L	PFCZ66A-_L					

Table 27 Piping and electrical connections - top air discharge

Model Numbers		Dimensional Data in. (mm)			Piping Connections, in. (mm)		
60 Hz	50 Hz	A	B	C	D	E	F
PFC067A-_H	PFC066A-_H	2 (51)	6 (152)	8-1/2 (216)	4-3/4 (121)	7-3/4 (197)	8-1/2 (216)
PFH067A-_H							
PFCZ67A-_L	PFCZ66A-_L						

Figure 22 Electrical field connections, prop fan condensing module



7.5 Centrifugal Air-Cooled Condensing Units

7.5.1 Installing the Indoor Condensing Unit

Refer to drawings for unit dimensions and component locations.



WARNING

Risk of structure collapse. Can cause equipment damage, injury or death.

Before beginning installation, make sure that the supporting roof structure is capable of supporting the weight of the unit(s) and the accessories during installation and service. (See **Table 28 - Indoor centrifugal condensing unit.**)

Be sure to securely anchor the top ends of the suspension rods. Make sure all nuts are tight.

The indoor condensing unit is usually mounted above the ceiling and must be securely mounted to the roof structure. The ceiling and ceiling supports of existing buildings may require reinforcements. Be sure to follow all applicable codes. Use field-supplied threaded suspension rods and 3/8"-16 factory hardware kit.

Recommended clearance between ceiling grids and building structural members is unit height plus three inches.

Install the four field-supplied rods by suspending them from suitable building structural members. Locate the rods so that they will align with the four mounting holes in the flanges that are part of the unit base.

Using a suitable lifting device, raise the unit up and pass the threaded rods through the four mounting holes in the flanges that are part of the unit base.

Attach the threaded rods to the unit flanges using the supplied nuts and grommets. (See **Figure 23 - Detail of ceiling hanging bracket, Threaded Rod and Hardware Kit Installation.**) The rubber grommets provide vibration isolation.

1. Use the plain nuts to hold unit in place. Adjust these nuts so that the weight of the unit is supported evenly by the four rods, does not rest on the ceiling grid, and is level.



NOTE

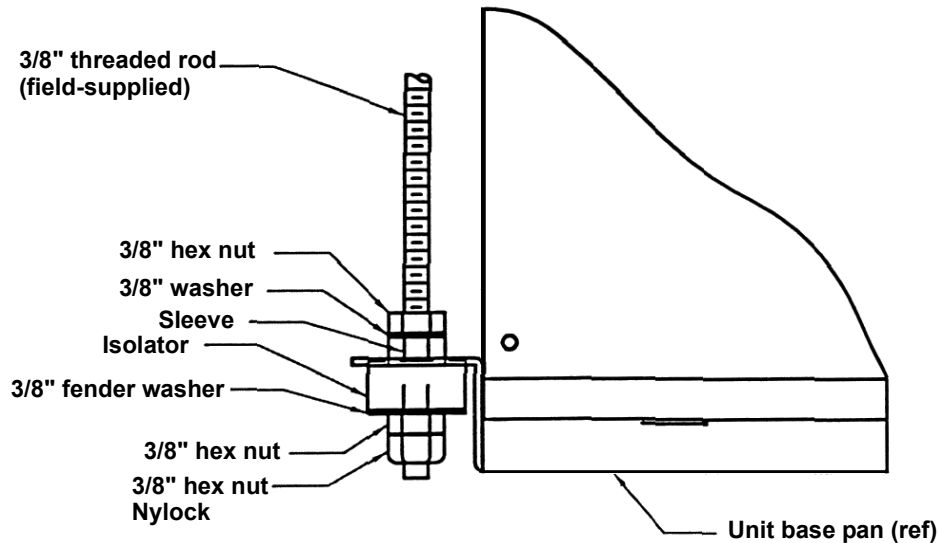
The units must be level in order to operate properly.

2. Use the Nylock nuts to “jam” the plain nuts.

Table 28 Indoor centrifugal condensing unit

Model		Net Weight lb (kg)
60 Hz	50 Hz	
MC_65A	MC_64A	449 (204)
MC_69W	MC_68W	282 (128)

Figure 23 Detail of ceiling hanging bracket



7.5.2 Ducting

The total external static pressure for the inlet and outlet ducts, including grille, must not exceed 0.5 inches of H₂O. Hood intake dimensions should be the same as the condensing unit duct dimensions.

If the condensing unit is located close to the outside of the building, rain hoods must be installed. In addition, install a triple layer bird screen over rain hood openings to eliminate the possibility of insects, birds, water, or debris entering the unit.

Use flexible ductwork or nonflammable cloth collars to attach ductwork to the unit and to control vibration transmission to the building. Attach the ductwork to the unit using the flanges provided. Locate the unit and ductwork so that the return air does not short circuit to the supply air inlet.

Avoid directing the hot exhaust air toward adjacent doors or windows.

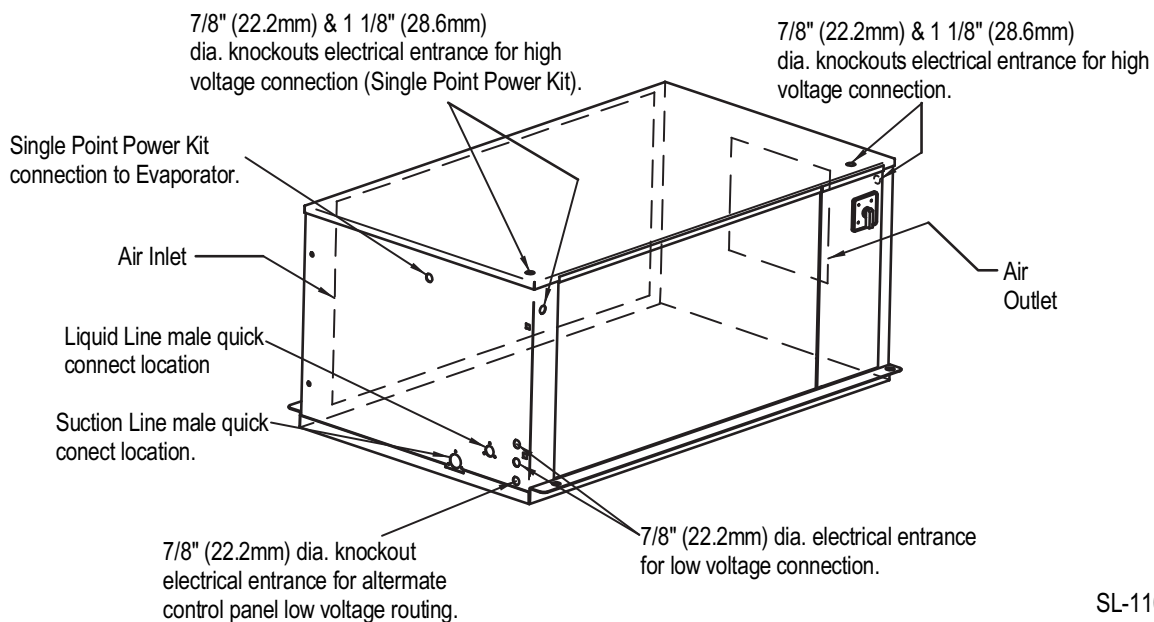
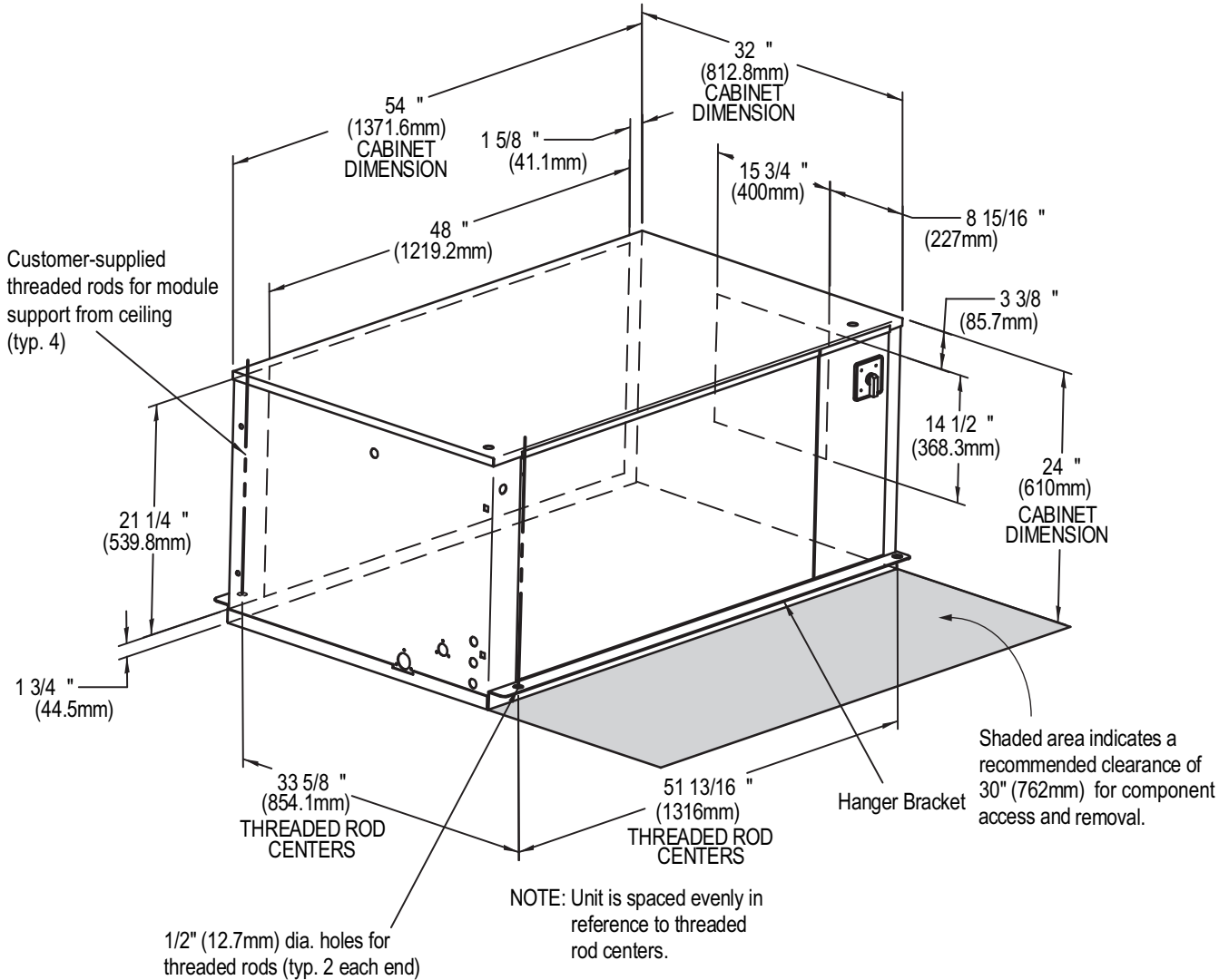
Normal operating sound may be objectionable if the condensing unit is placed directly over quiet work areas. Ductwork that runs through a conditioned space or is exposed to areas where condensation may occur must be insulated. Whenever possible, ductwork should be suspended using flexible hangers. Ductwork should not be fastened directly to the building structure. In applications where the ceiling plenum is used as the heat rejection domain, the discharge air must be directed away from the condensing unit air inlet and a screen must be added to the end of the discharge duct to protect service personnel.

For multiple unit installations, space the units so that the hot condensing unit exhaust air is not directed toward the air inlet of an adjacent unit.

Table 29 Airflow CFM (CMH)

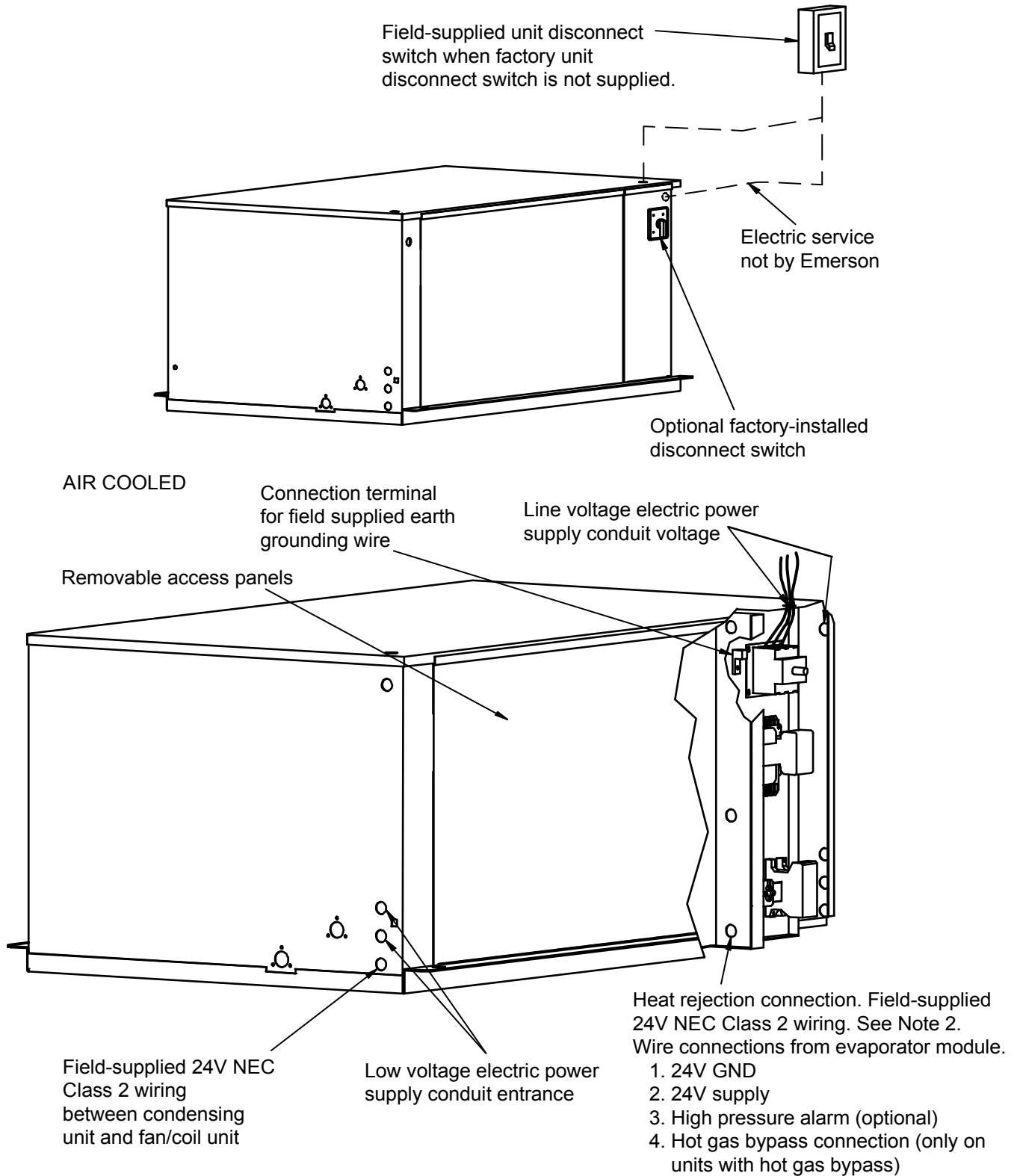
23 & 33 kW	
60 Hz	3500 (5947)
50 Hz	3500 (5947)

Figure 24 Centrifugal air-cooled condensing unit dimensional data



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Figure 25 Centrifugal air-cooled condensing unit dimensional data (con't.)

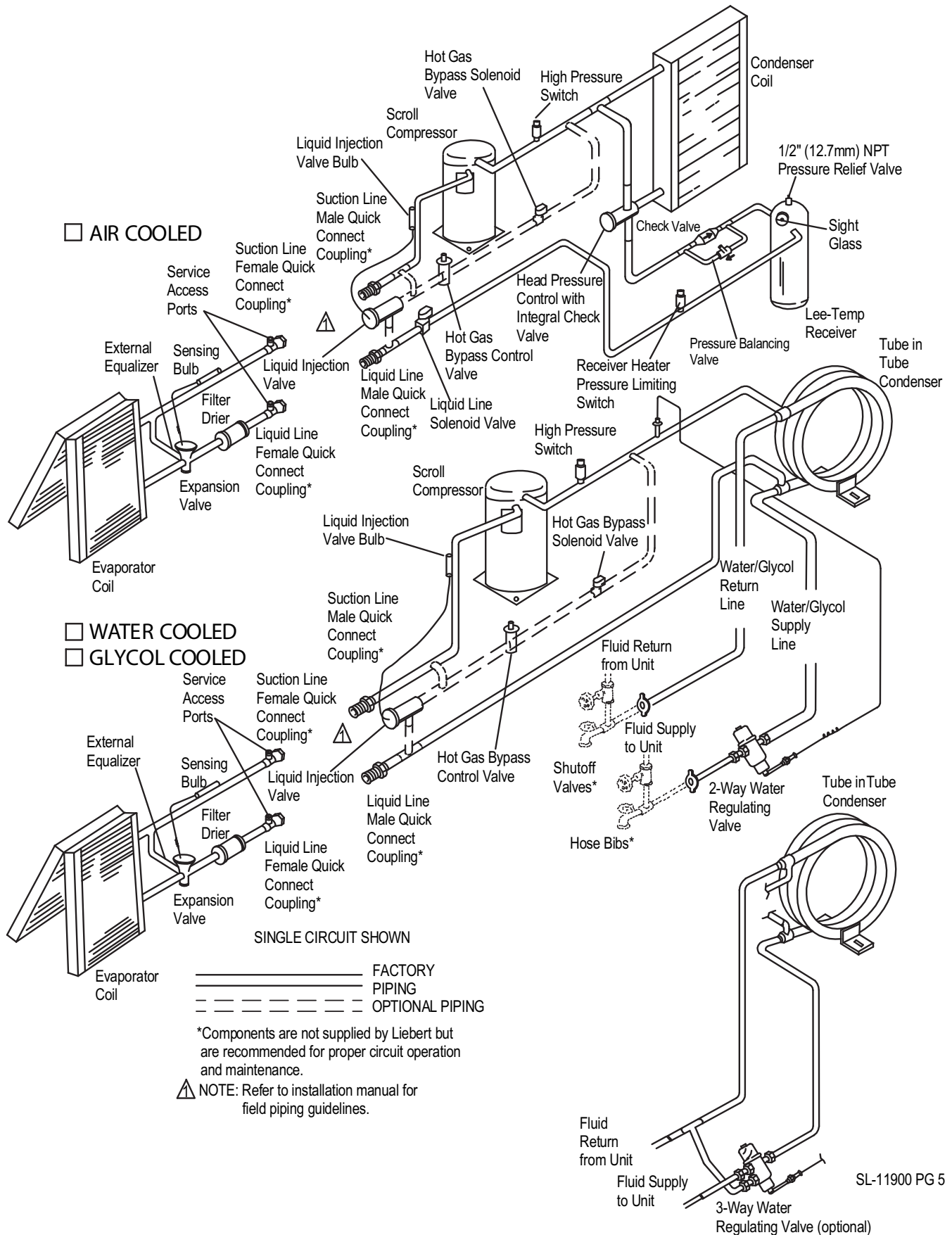


DPN000226
Rev. 0

NOTES:

1. Refer to specification sheet for full load amp and wire size amp ratings.
2. Control voltage wiring must be a minimum of 16 GA (1.6mm) for up to 75' (23m) or not to exceed 1 volt drop in control line.

Figure 26 Split systems general arrangement



SL-11900 PG 5

7.6 Water and Glycol-Cooled Condensing Units

For installation guidelines, refer to **Installing the Indoor Condensing Unit on page 48.**

7.6.1 Piping Considerations

It is recommended that manual service shut-off valves be installed at the supply and return line to each unit. This will provide for routine service or emergency isolation of the unit.

When the water source for the condenser is of poor quality, it is good practice to provide cleanable filters in the supply line. These filters will trap the particles in the water supply and extend the service life of the water-cooled condenser.

Table 30 Water and glycol-cooled unit connection sizes

Connection	Size and Type
Condenser Water Inlet	1-1/8" OD Cu
Condenser Water Outlet	1-1/8" OD Cu
Suction Line	1-7/16" - 16 male #12 quick connect
Liquid Line	1-1/16" - 12 male #10 quick connect

Table 31 Water and glycol-cooled condensing unit data

Model	Net Weight		Glycol Volume	
	lb	kg	gal	liters
MC_69W MC_68W	282	128	2.0	7.6

7.6.2 Condenser Water Requirements

The standard maximum water pressure is 150 psig (1034 kPa). For applications above this pressure, consult the factory about high pressure systems.

The system will operate in conjunction with a cooling tower, city water, or drycooler.

7.6.3 Regulating Valve Adjustment and Testing

Refer to **4.3.1 - Water Regulating Valve Adjustment** and **4.3.3 - Testing Valve Function.**

7.6.4 Glycol Systems

For split system glycol systems, use drycooler and pump data found in **5.0 - Glycol/GLYCOOL-Cooled Models.** See **Table 16 - Drycooler data.**

Electrical control interconnect to drycooler is wired from water/glycol condensing unit.

Figure 27 Water/glycol-cooled condensing unit dimensions

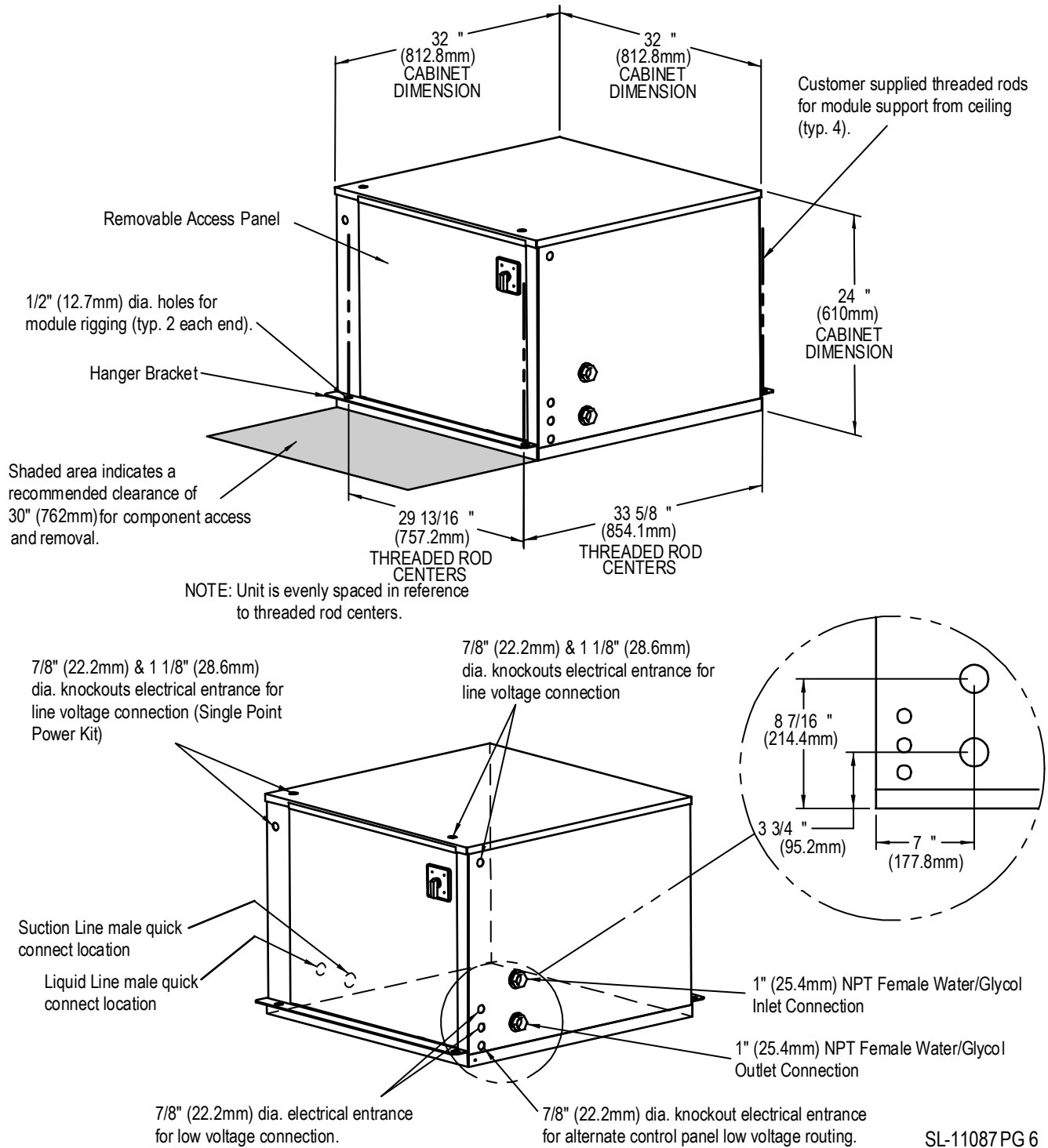
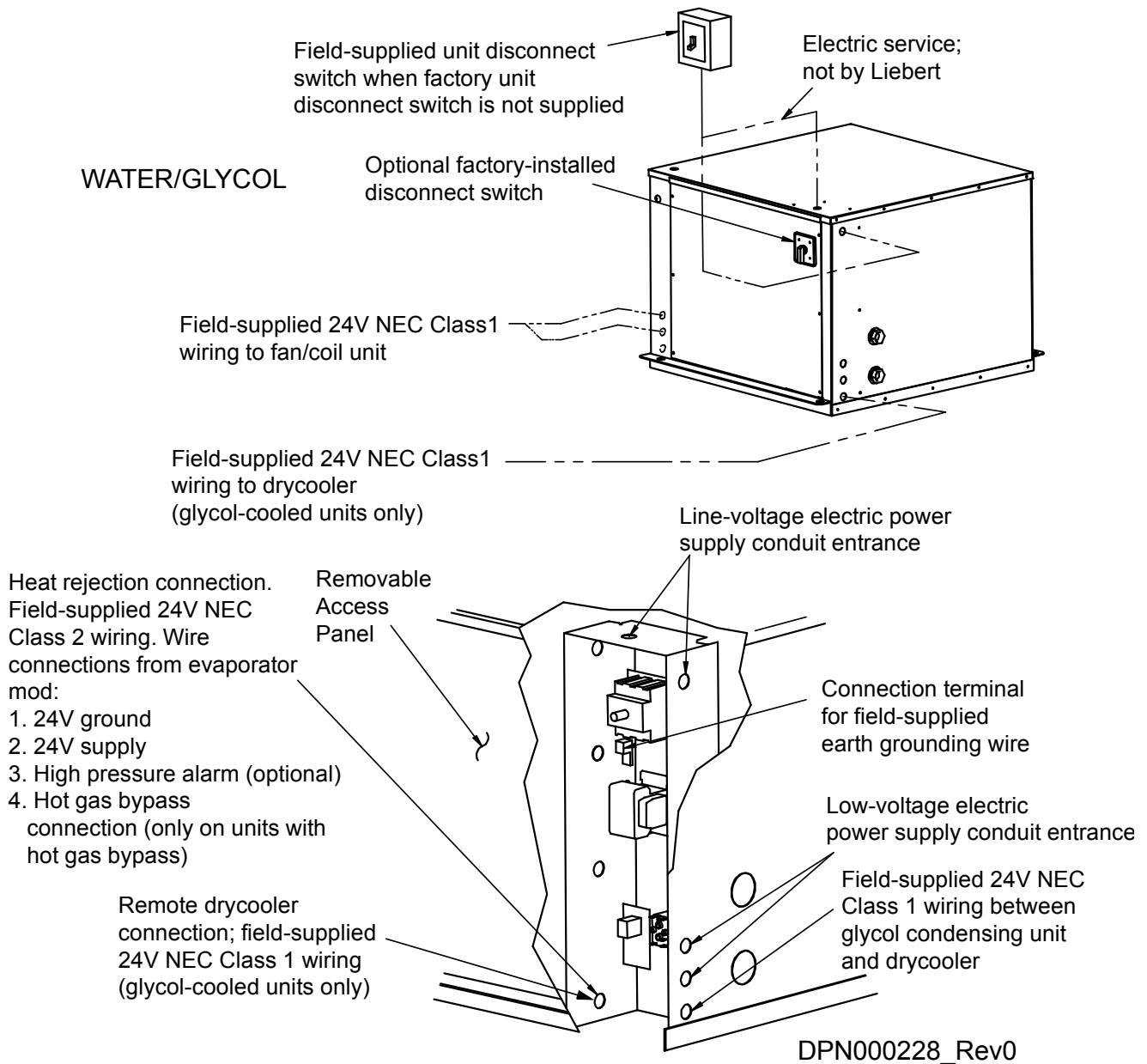


Figure 28 Water/glycol-cooled condensing unit (con't.)



NOTES

1. Refer to specification sheet for full load amp. and wire size amp. ratings.
2. Control voltage wiring must be a minimum of 16 GA (1.6mm) for up to 75' (23m) or not to exceed 1 volt drop in control line.

8.0 R407C REFRIGERANT

Table 32 R407C pressure/temperature chart for operation and superheat (discharge/hot gas and suction gas)

Temperature		Gauge Pressure		Temperature		Gauge Pressure		Temperature		Gauge Pressure	
°F	°C	Psig	kPa	°F	°C	Psig	kPa	°F	°C	Psig	kPa
0.0	-17.8	18.9	130	35.0	1.7	54.8	378	70.0	21.1	114.9	792
1.0	-17.2	19.6	135	36.0	2.2	56.1	387	72.0	22.2	119.3	822
2.0	-16.7	20.4	141	37.0	2.8	57.5	396	74.0	23.3	124	853
3.0	-16.1	21.2	146	38.0	3.3	58.9	406	76.0	24.4	128	885
4.0	-15.6	22.0	152	39.0	3.9	60.3	415	78.0	25.6	133	917
5.0	-15.0	22.8	157	40.0	4.4	62.2	429	80.0	26.7	138	950
6.0	-14.4	23.6	163	41.0	5.0	63.1	435	82.0	27.8	143	984
7.0	-13.9	24.5	169	42.0	5.6	64.6	445	84.0	28.9	148	1019
8.0	-13.3	25.4	175	43.0	6.1	66.1	456	86.0	30.0	153	1054
9.0	-12.8	26.2	181	44.0	6.7	67.6	466	88.0	31.1	158	1091
10.0	-12.2	27.1	187	45.0	7.2	69.1	476	90.0	32.2	164	1128
11.0	-11.7	28.0	193	46.0	7.8	70.7	487	92.0	33.3	169	1167
12.0	-11.1	28.9	200	47.0	8.3	72.2	498	94.0	34.4	175	1206
13.0	-10.6	29.9	206	48.0	8.9	73.8	509	96.0	35.6	181	1246
14.0	-10.0	30.8	213	49.0	9.4	75.4	520	98.0	36.7	187	1287
15.0	-9.4	31.8	219	50.0	10.0	77.1	531	100.0	37.8	193	1329
16.0	-8.9	32.8	226	51.0	10.6	78.7	543	102.0	38.9	199	1372
17.0	-8.3	33.8	233	52.0	11.1	80.4	554	104.0	40.0	205	1416
18.0	-7.8	34.8	240	53.0	11.7	82.1	566	106.0	41.1	212	1461
19.0	-7.2	35.8	247	54.0	12.2	83.9	578	108.0	42.2	219	1507
20.0	-6.7	36.9	254	55.0	12.8	85.6	590	110.0	43.3	225	1553
21.0	-6.1	38.0	262	56.0	13.3	87.4	603	112.0	44.4	232	1601
22.0	-5.6	39.0	269	57.0	13.9	89.2	615	114.0	45.6	239	1650
23.0	-5.0	40.1	277	58.0	14.4	91.0	628	116.0	46.7	247	1701
24.0	-4.4	41.3	284	59.0	15.0	92.9	640	118.0	47.8	254	1752
25.0	-3.9	42.4	292	60.0	15.6	94.8	653	120.0	48.9	262	1804
26.0	-3.3	43.6	300	61.0	16.1	96.7	666	122.0	50.0	269	1858
27.0	-2.8	44.7	308	62.0	16.7	98.6	680	124.0	51.1	277	1912
28.0	-2.2	45.9	317	63.0	17.2	100.5	693	126.0	52.2	285	1968
29.0	-1.7	47.1	325	64.0	17.8	102.5	707	128.0	53.3	294	2025
30.0	-1.1	48.4	333	65.0	18.3	104.5	721	130.0	54.4	302	2083
31.0	-0.6	49.6	342	66.0	18.9	106.5	735	132.0	55.6	311	2143
32.0	0.0	50.9	351	67.0	19.4	108.6	749	134.0	56.7	320	2203
33.0	0.6	52.1	359	68.0	20.0	110.7	763	136.0	57.8	329	2265
34.0	1.1	53.5	369	69.0	20.6	112.8	778	138.0	58.9	338	2329
-	-	-	-	-	-	-	-	140.0	60.0	347	2393



NOTE

Use this table for superheat and for control adjustment (e.g., pressure switches). See **Table 33** for subcooling.

Table 33 R407C pressure/temperature chart for subcooling only (liquid measurements)

Temperature		Pressure Gauge		Temperature		Pressure Gauge		Temperature		Pressure Gauge	
°F	°C	Psig	kPa	°F	°C	Psig	kPa	°F	°C	Psig	kPa
36.0	2.2	73	500	59.0	15.0	114	786	94.0	34.4	203	1402
37.0	2.8	74	511	60.0	15.6	116	801	96.0	35.6	209	1444
38.0	3.3	76	522	61.0	16.1	118	815	98.0	36.7	216	1488
39.0	3.9	77	533	62.0	16.7	120	830	100.0	37.8	222	1532
40.0	4.4	79	544	63.0	17.2	123	845	102.0	38.9	229	1578
41.0	5.0	81	556	64.0	17.8	125	860	104.0	40.0	236	1624
42.0	5.6	82	567	65.0	18.3	127	875	106.0	41.1	242	1671
43.0	6.1	84	579	66.0	18.9	129	891	108.0	42.2	249	1720
44.0	6.7	86	591	67.0	19.4	131	906	110.0	43.3	257	1769
45.0	7.2	87	602	68.0	20.0	134	922	112.0	44.4	264	1819
46.0	7.8	89	615	69.0	20.6	136	938	114.0	45.6	271	1870
47.0	8.3	91	627	70.0	21.1	138	954	116.0	46.7	279	1922
48.0	8.9	93	639	72.0	22.2	143	987	118.0	47.8	287	1975
49.0	9.4	95	652	74.0	23.3	148	1021	120.0	48.9	294	2029
50.0	10.0	96	664	76.0	24.4	153	1055	122.0	50.0	302	2085
51.0	10.6	98	677	78.0	25.6	158	1090	124.0	51.1	310	2141
52.0	11.1	100	690	80.0	26.7	163	1126	126.0	52.2	319	2198
53.0	11.7	102	704	82.0	27.8	169	1163	128.0	53.3	327	2256
54.0	12.2	104	717	84.0	28.9	174	1201	130.0	54.4	336	2315
55.0	12.8	106	730	86.0	30.0	180	1239	132.0	55.6	345	2376
56.0	13.3	108	744	88.0	31.1	185	1279	134.0	56.7	354	2437
57.0	13.9	110	758	90.0	32.2	191	1319	136.0	57.8	363	2500
58.0	14.4	112	772	92.0	33.3	197	1360	138.0	58.9	372	2563
-	-	-	-	-	-	-	-	140.0	60.0	381	2628

**NOTE**

Use this table for subcooling calculation *ONLY*. See **Table 32** for superheat or control adjustment.

8.1 Calculating Subcooling

Example

Measure the liquid pressure (e.g., 200 psig). Find the liquid saturation temperature at that pressure on **Table 33** (e.g., 93°F). Measure the temperature of the liquid line (e.g., 90°F). Subtract the actual temperature from the liquid saturation temperature to obtain the subcooling (e.g., 93 – 90 = 3°F). If the actual temperature is greater than the liquid saturation temperature, then there is no subcooling, and the fluid may be a mixture of liquid and vapor.

Why There Are Two R407C Temperature and Pressure Tables

R407C is a blend of refrigerants that exhibits a temperature “glide” of approximately 8 to 12°F (4 to 7°C). This “glide” is the difference between the liquid and vapor saturation temperatures at a given pressure. Use the correct table for the saturation temperature you need. **Table 32** is for superheat or operating controls. **Table 33** is for subcooling only.

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