Precision Cooling
For *Business-Critical Continuity™*

# *Liebert Challenger™ 3000 with iCOM*

*Installation Manual - 3 & 5 Tons, 50 & 60Hz*

EMERSON
Network Power

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# SAVE THESE INSTRUCTIONS

This manual contains important safety instructions that should be followed during the installation and maintenance of the Liebert Challenger 3000™. 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 and installation, operating and safety instructions on the unit and in this manual. Follow all operating and user instructions.

## WARNING

Risk of electric shock. Can cause injury or death.

Disconnect local and remote power supplies before working within.

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 iCOM® 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 Liebert iCOM control.

The factory-supplied optional disconnect switch is inside the unit. The line side of this switch contains live high-voltage.

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 explosive discharge from high-pressure refrigerant. Can cause injury or death.

This unit contains fluids and gases under high pressure. Relieve pressure before working with piping.

## WARNING

Risk of refrigerant system rupture or explosion from overpressurization. Can cause equipment damage, injury or death.

Local building or plumbing codes may require that a fusible plug or other type of pressure relief device be installed in the system.

For systems requiring EU CE compliance (50Hz), the system installer must provide and install a discharge pressure relief valve rated for a maximum of 500psig (34bar) in the high side refrigerant circuit. Do not install a shutoff valve between the compressor and the field-installed relief valve. The pressure relief valve must be CE certified to the EU Pressure Equipment Directive by an EU "Notified Body."

**NOTE**

*The Liebert indoor cooling unit has a factory-installed high-pressure safety switch in the high side refrigerant circuit. A pressure relief valve is provided with Liebert Lee-Temp™ condensers. Consult local building codes to determine whether the Liebert Fan Speed Control and VFD condensers will require field-provided pressure relief devices. A fusible plug kit for Liebert FSC and VFD condensers is available for field installation.*

# WARNING

Risk of high-speed moving parts. Can cause injury or death.

Disconnect all local and remote electric power supplies before working in the unit.

Do not operate upflow units without installing a plenum, ductwork or guard over the blower opening(s) on the top surface of the unit cabinet.

Ductwork must be connected to the blower(s), or a plenum must be installed on the blower deck for protection from rotating blower wheel(s) on upflow units.

# CAUTION

Risk of contact with hot surfaces. Can cause injury.

The compressor, refrigerant discharge lines, humidifiers and reheats are extremely hot during unit operation. Allow sufficient time for them to cool before working within the unit cabinet. Use extreme caution and wear protective gloves and arm protection when working on or near hot compressors, discharge lines, humidifiers and reheats.

# NOTICE

Risk of leaking water. Can cause equipment and building damage.

This unit requires a water drain connection. It may also require an external water supply to operate.

Improper installation, application and service practice can result in water leakage from the unit. Water leakage can result in severe property damage and loss of critical data center equipment.

Do not locate unit directly above any equipment that could sustain water damage.

Emerson recommends installing leak detection equipment for unit and supply lines.

# 1.0 INTRODUCTION

## 1.1 System Descriptions

Challenger 3000™ 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 upflow or downflow configurations. The standard upflow configuration is front return. All models require three-phase power. Units are available in 208, 230, 460, or 575V, 60Hz; and 200, 230 or 380/415V, 50Hz.

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

### 1.1.1 Self-Contained Systems

#### Air-Cooled Models

Complete refrigeration system including hot gas bypass and crankcase heater with standard scroll compressor, standard condenser and fan speed control for 95°F (35°C) ambient at sea level. Optional Digital scroll compressor with unloading solenoid valve is also available. Digital scroll compressor systems do not include hot gas bypass.

#### Water-Cooled Models

Compete refrigeration system including hot gas bypass with standard scroll compressor, water/glycol-cooled condenser and two-way water regulating valve with bypass. Optional digital scroll compressor with unloading solenoid valve is also available. Digital scroll compressor systems use a 2-way motorized ball valve in lieu of the regulating valve; they do not include hot gas bypass.

#### Glycol-Cooled Models

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

#### GLYCOOL Models (5-Ton Only)

Complete refrigeration system including hot gas bypass with standard scroll compressor, glycol condenser and three-way water regulating valve plus an integrally piped Econ-O-Coil with three-way modulating control valve. Optional digital scroll compressor with unloading solenoid valve is also available. Digital scroll compressor systems use a 3-way motorized ball valve in lieu of the regulating valve; they do not include hot gas bypass.

### 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 Air-Cooled

Prop Fan units include scroll compressor, condenser coil, prop fan, high pressure switch, hot gas bypass and Liebert Lee-Temp head pressure control. Unit is designed for outdoor location.

#### Centrifugal Fan Air-Cooled

Centrifugal Fan units include scroll compressor, condenser coil, centrifugal blower assembly, high-pressure switch, hot gas bypass and Liebert Lee-Temp head pressure control. Unit must be mounted indoors. Duct flanges are optional.

#### Water-Cooled

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, hot gas bypass and high-pressure switch. Design pressure is 150 psi (1034 kPa) as standard and 350 psi (2413 kPa) as optional.

#### Glycol-Cooled

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 (APPLICABLE TO ALL MODELS)

## 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 unit 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 on the front of the unit.

**NOTE**
*GLYCOOL units require 34" (864 mm) service clearance on the right side of the unit in addition to front service clearance.*

Avoid placing units in an alcove or at the extreme end of a room that has a high aspect ratio (long, narrow room). Ducted units can be placed in room corners or ends as long as front access is maintained. Placing units too close together will reduce the effectiveness of the air distribution.

**NOTE**
*Locate and remove shipping screw on fan motor base.*

## 2.4 Equipment Handling

**WARNING**
Risk of top-heavy unit falling over. Improper handling can cause equipment damage, injury or death.

Read all of the following instructions before attempting to move, lift, remove packaging from or preparing unit for installation.

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

### 2.4.1 Handling With Skid

- Always keep the unit upright, indoors and protected from damage.
- 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 the forks, if adjustable, are spread to the widest allowable distance to still fit under the skid.

# NOTICE

Risk of overhead interference. Can cause unit and/or structure damage. Refer to the installation plans prior to moving the unit to verify clearances.

While on the skid, the unit 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 cause damage to the unit.

### 2.4.2 Removal of Skid

- Remove the plywood skirting that keeps the skid and unit in place.
- Raise the Challenger 3000 off the skid. **Liebert recommends using a fork lift (see Figure 1) or similar machine to ensure that the unit is lifted properly**.
- Once the unit is raised, the skid can be removed.

**Figure 1 Removing Challenger from skid**

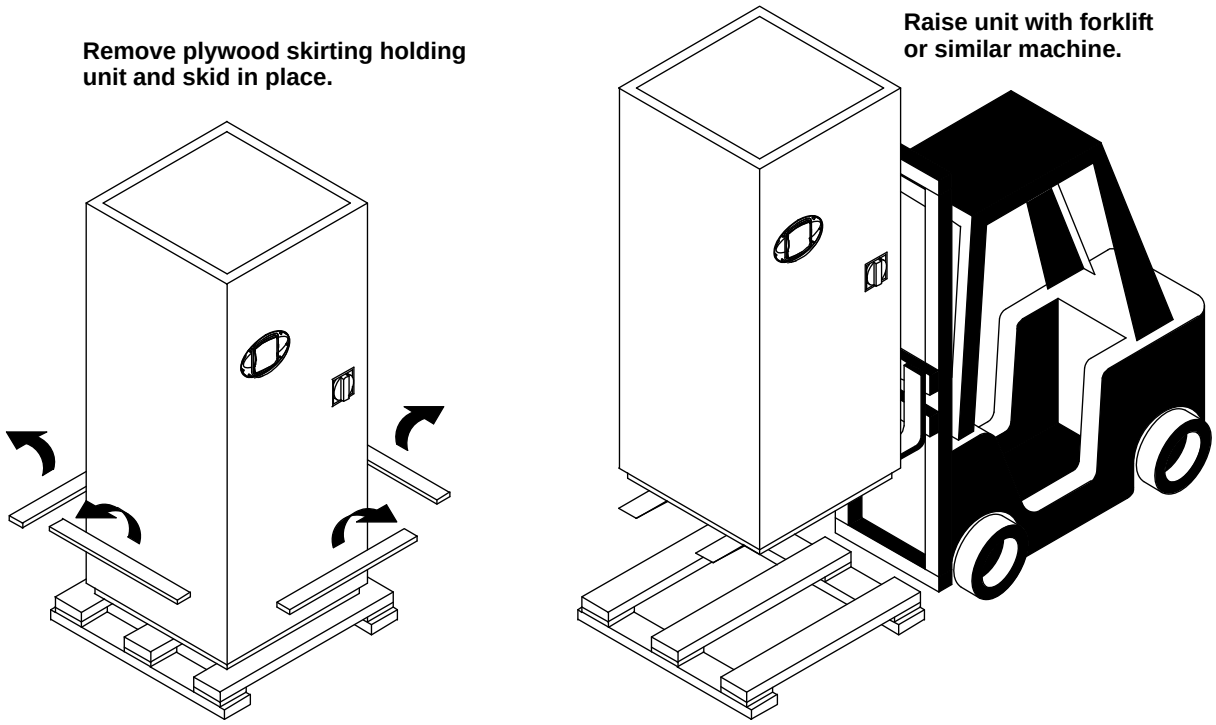



**Table 1 Unit net weight**

| Model | Lb. (kg) |
|---|---|
| 036E/035E | 535 (243) |
| 060E/059E | 545 (247) |
| 042A/040A | 615 (279) |
| 067A/065A | 670 (304) |
| 046WG/045WG | 700 (318) |
| 071WG/070WG | 750 (340) |
| 061G/058G | 785 (356) |
| 068C/072C | 545 (247) |
| 102C/101C | 555 (252) |

**Figure 2 Upflow (BU) cabinet dimensions**

| | A |
|---|---|
| STD 3 & 5T | 11-3/4 (299mm) |
| Hi Static 3T | 8 5/8 (219mm) |
| Hi Static 5T | 11-3/4 (299mm) |

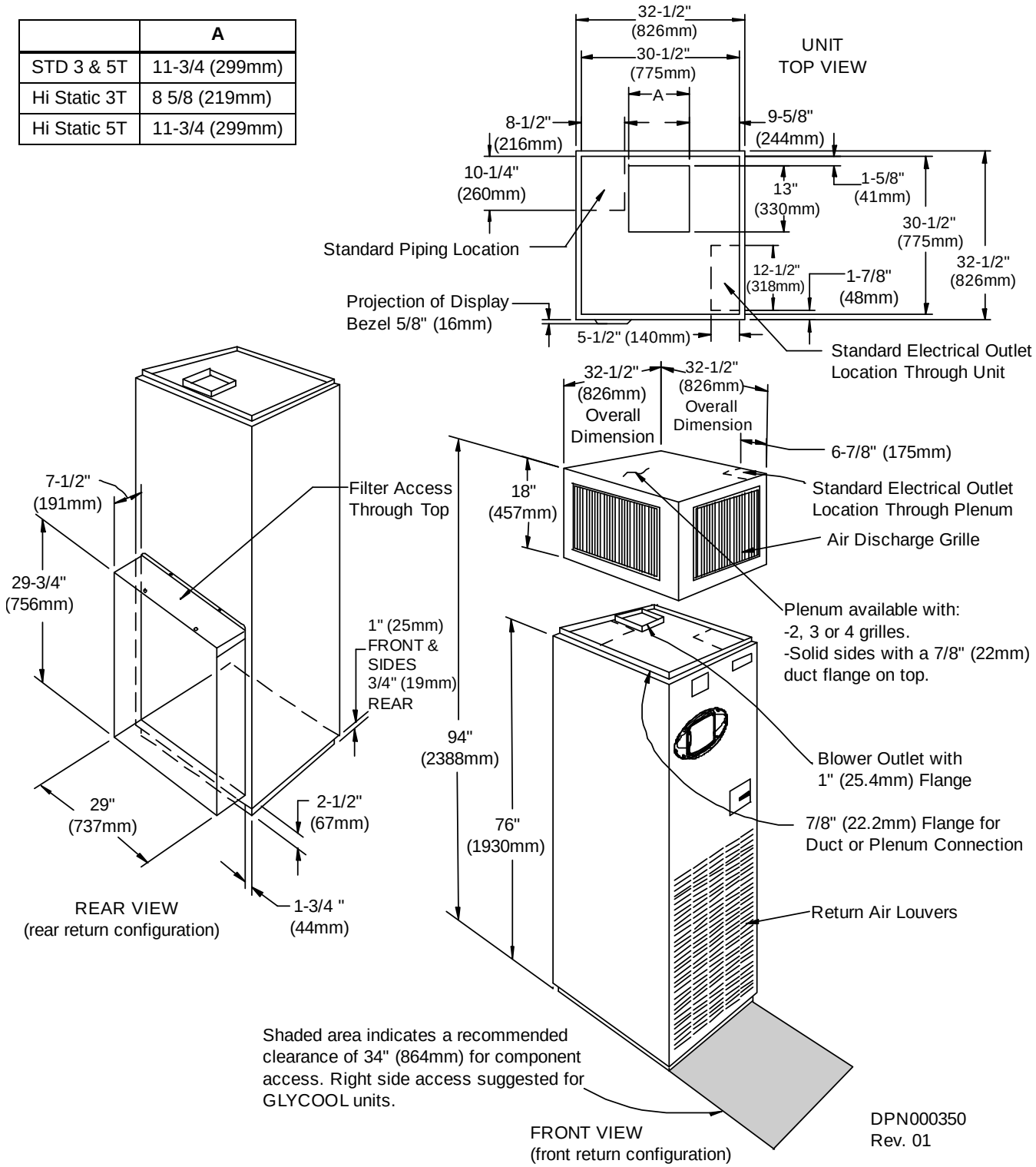
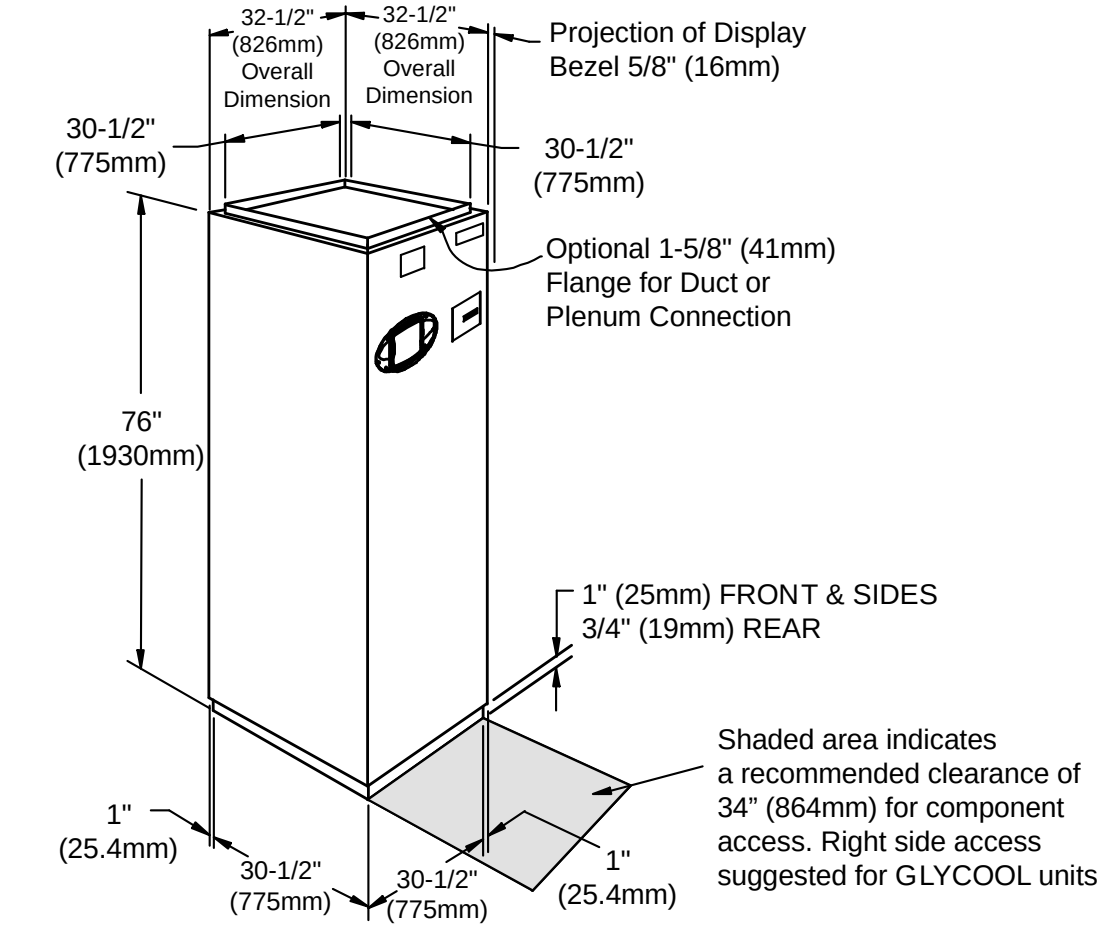
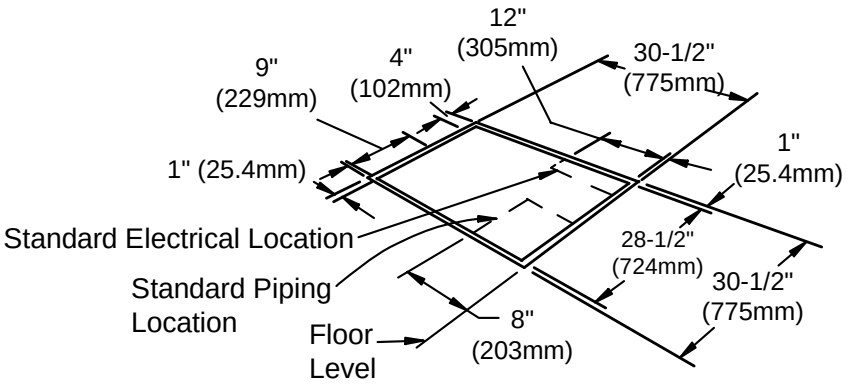
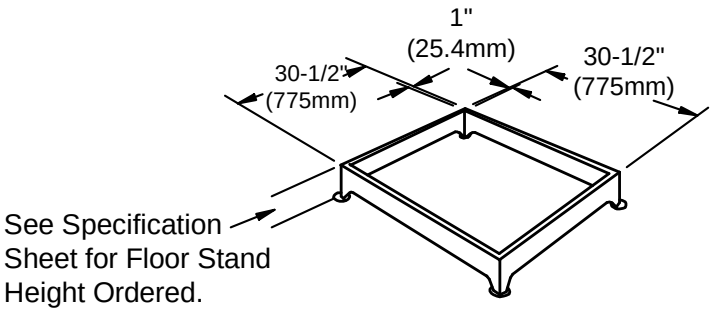


**Figure 3 Downflow (BF) cabinet dimensions**




FLOOR CUTOUT DIMENSIONS

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OPTIONAL FLOOR STAND DIMENSIONAL DATA

## 2.5 Piping Considerations

All piping below the elevated floor must be located so that it offers the least resistance to air flow. Careful planning of the piping layout under the raised floor is required to prevent the air flow from being blocked. When installing piping on the subfloor, it is recommended that the pipes be mounted in a horizontal plane rather than stacked one above the other. Whenever possible, the pipes should be run parallel to the air flow.

Condensate pumps for downflow units are shipped separately to be field-installed under the raised floor. Pump height is 11 inches (279 mm).

### 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 drain line must include one and only one trap. Units without a condensate pump have a factory-supplied trap in the unit, so a field trap should not be added. Units 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. BF/BU (50 Hz) | Liquid Line O.D. Copper L | Hot Gas Line OD Copper HG | | |
| 042A (040A) | 3/8 | 5/8 | | |
| 067A (065A) | 1/2 | 7/8 | | |
| **Split System Fan Coil Unit Connection Sizes—in.** | | | | |
| Model No. BF/BU (50 Hz) | Liquid Line L | Suction Line SC | | |
| 036E (035E) | 5/8 - 18 Female (#6 QC) | 1-1/8 - 12 Female (#11 QC) | | |
| 060E (059E) | 1/2 OD Cu | 1-1/8 OD Cu | | |
| **All Units: Connection Sizes—in.** | | | | |
| Humidifier Line OD Copper H | Condensate Drain Line C | Condensate Pump Line OD Copper P | Hot Water Reheat OD Copper | |
| 1/4 | 3/4 FPT | 1/2 | Supply HWS | Return HWR |
| | | | 5/8 | 5/8 |
| **Water/Glycol-Cooled Unit Connection Sizes—inches** | | | | |
| Model No. BF/BU (50 Hz) | Supply Line S | Return Line R | | |
| 046WG (045WG) | 7/8 | 7/8 | | |
| 071WG (070WG) | 1-1/8 | 1-1/8 | | |
| **GLYCOOL Unit Connection Sizes —in.** | | | | |
| Model No. BE/BK (50 Hz) | Supply Line S | Return Line R | | |
| 061G (058G) | 1-1/8 | 1-1/8 | | |
| **Chilled Water Unit Connection Sizes—in.** | | | | |
| Model No. BF/BU (50 Hz) | Supply Line CWS | Return Line CWR | | |
| 068C (072C) | 1-1/8 | 1-1/8 | | |
| 102C (101C) | 1-1/8 | 1-1/8 | | |

**Figure 4 Piping connections for air-cooled units - Downflow models**

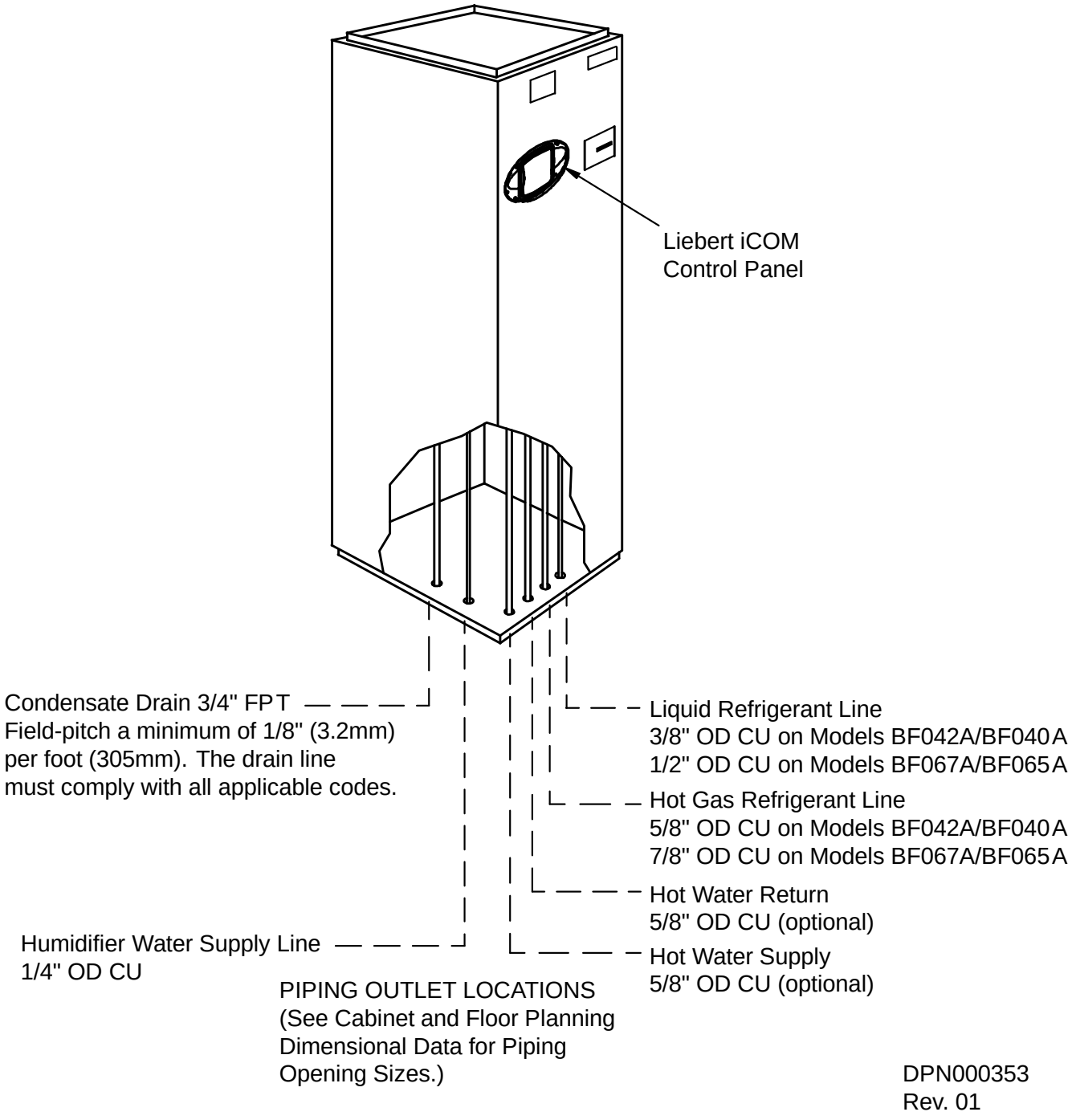

**Figure 5 Piping connections for air-cooled units - Upflow models**

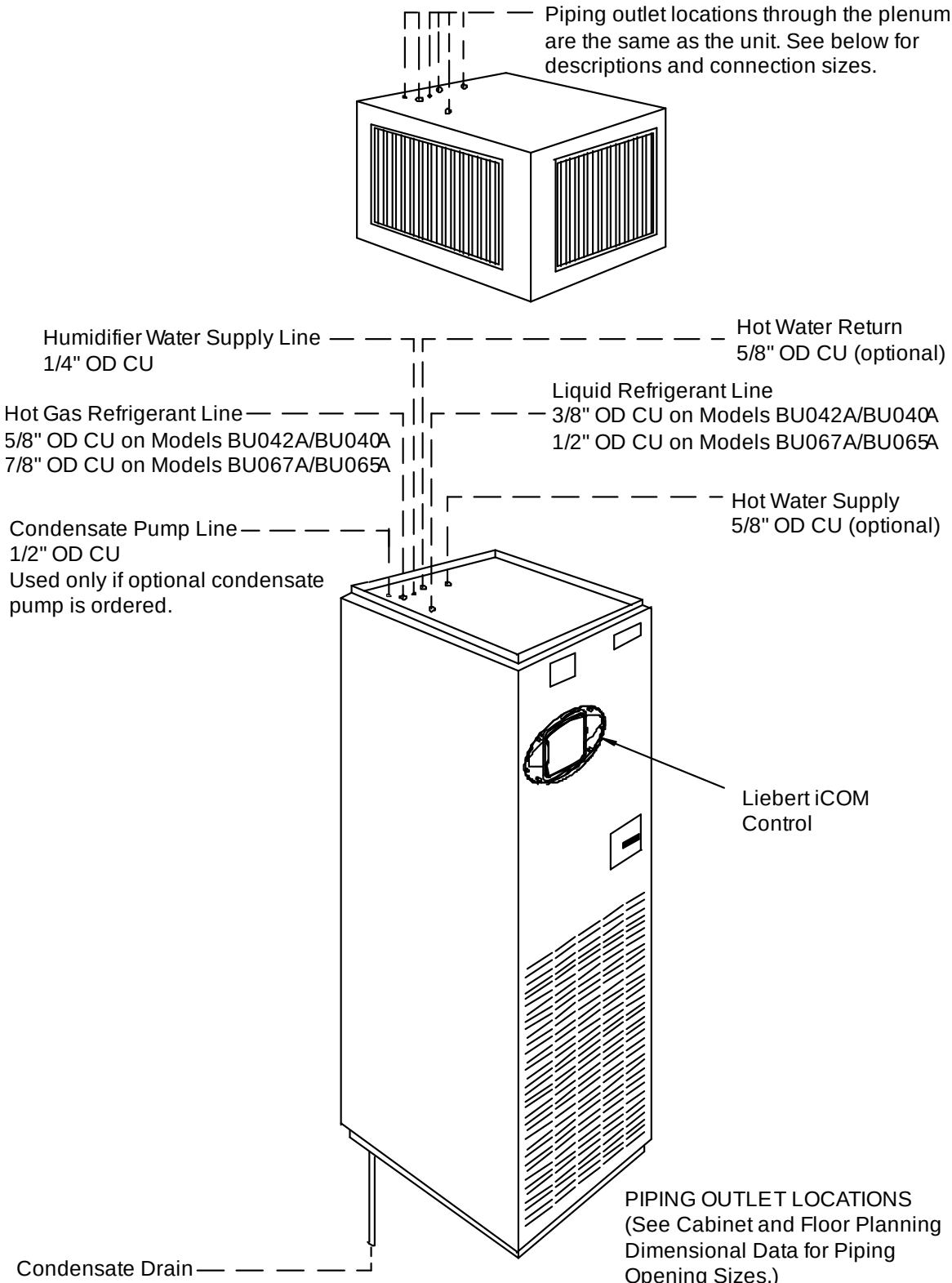

**Figure 6 Piping connections for split system fan coil units - Downflow models**

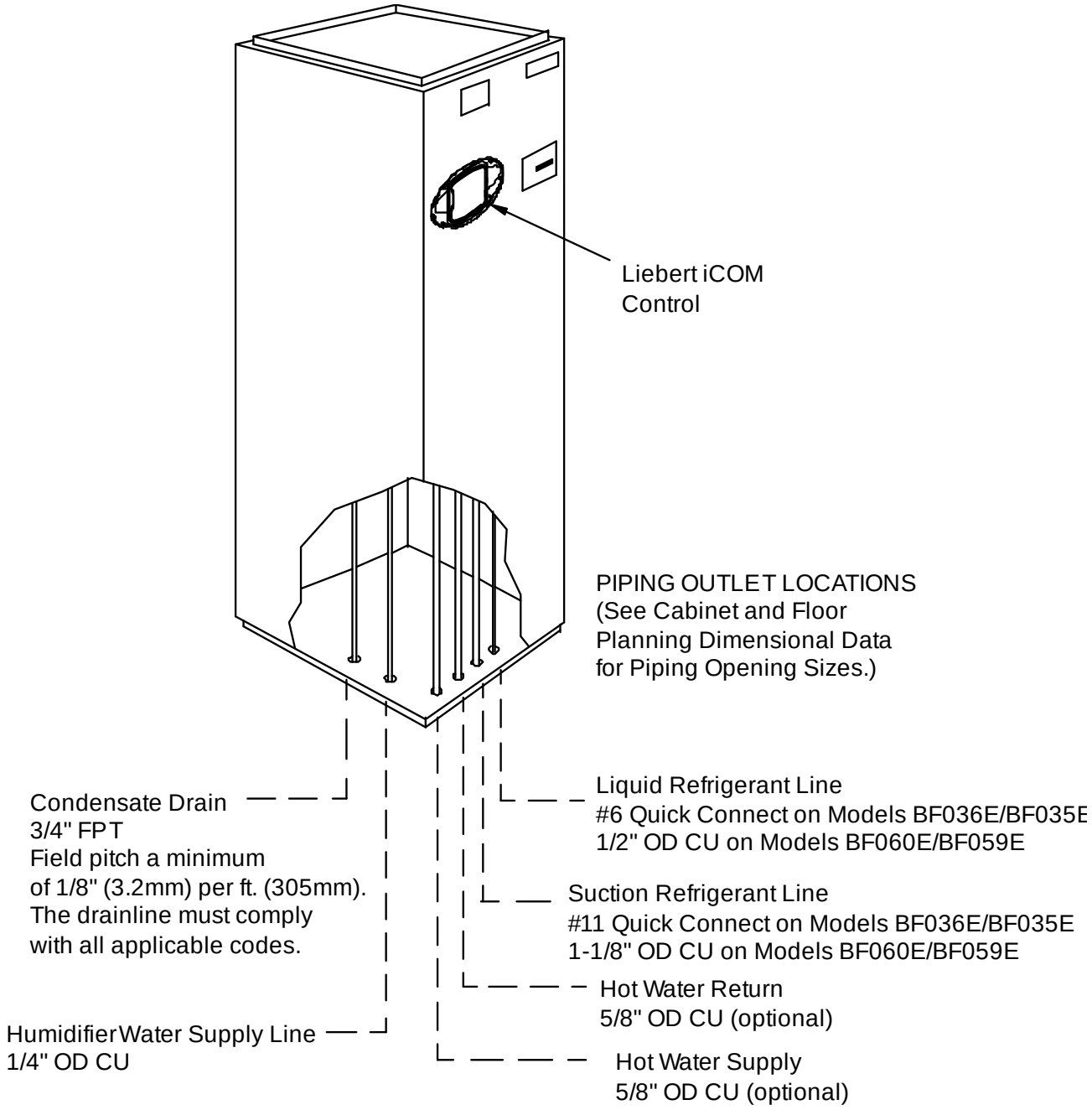


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**Figure 7 Piping connections for split system fan coil units - Upflow models**

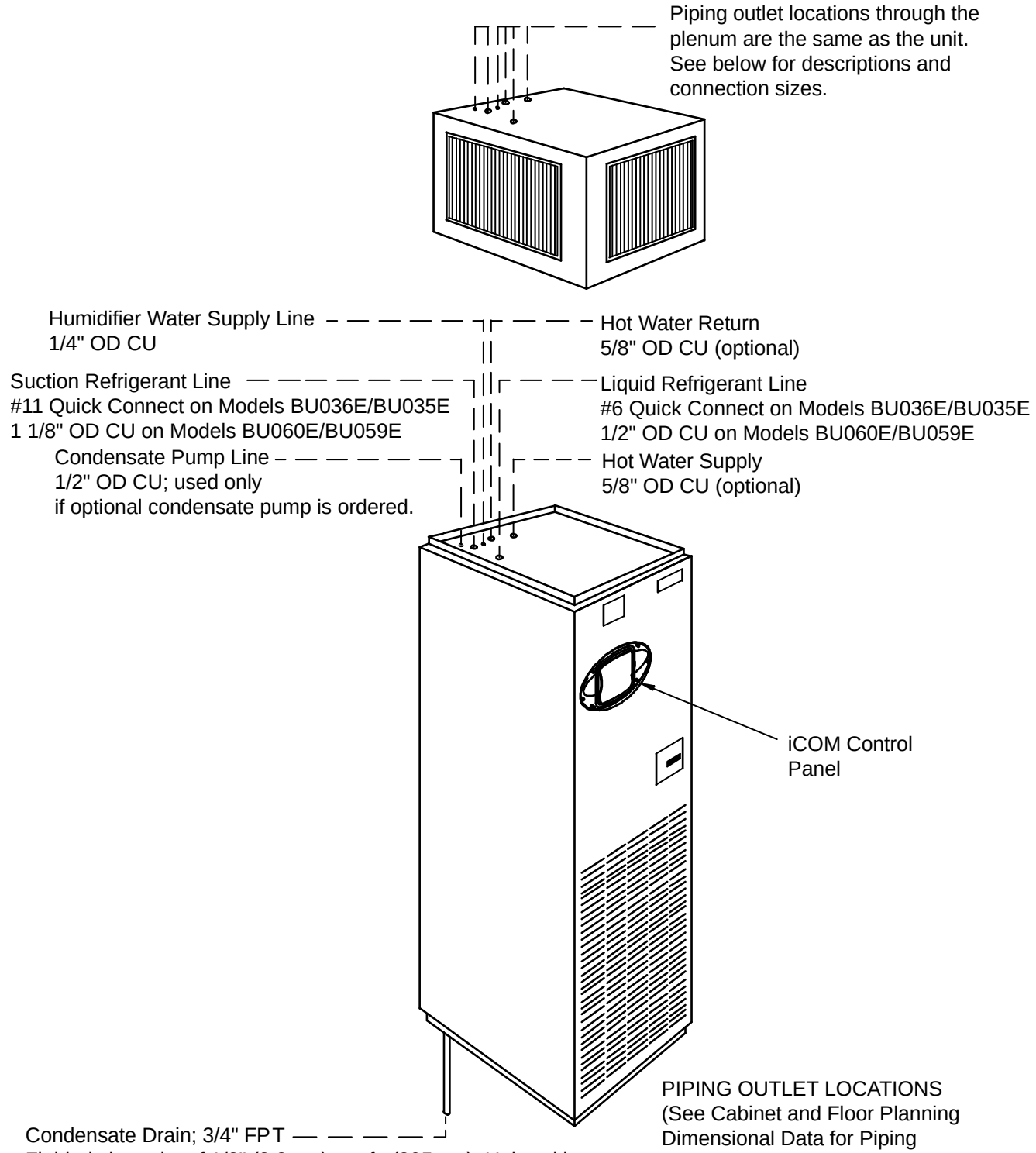

**Figure 8 Piping connections for water/glycol and GLYCOOL units - Downflow models**

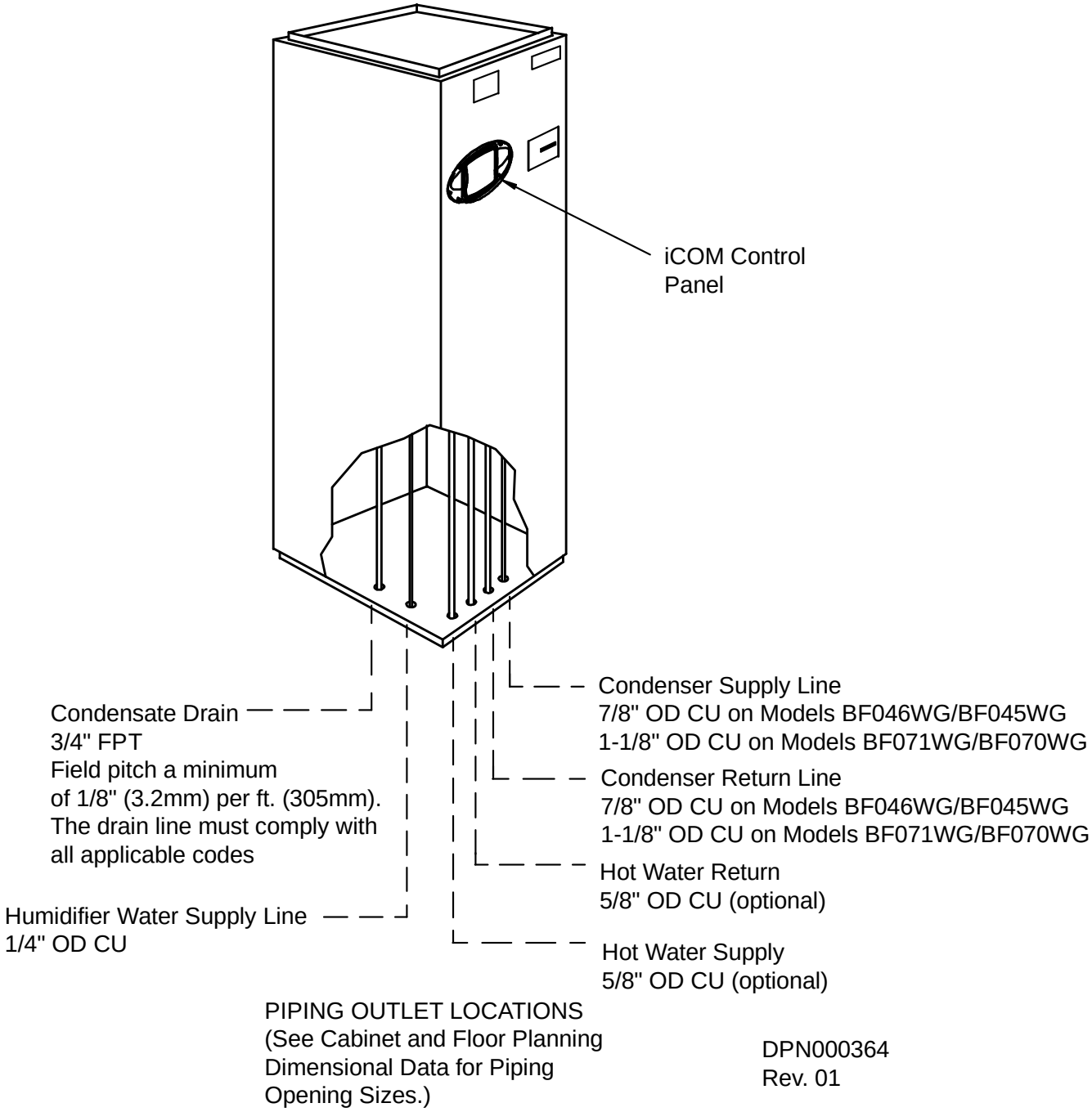

**Figure 9 Piping connections for water/glycol and GLYCOOL units - Upflow models**

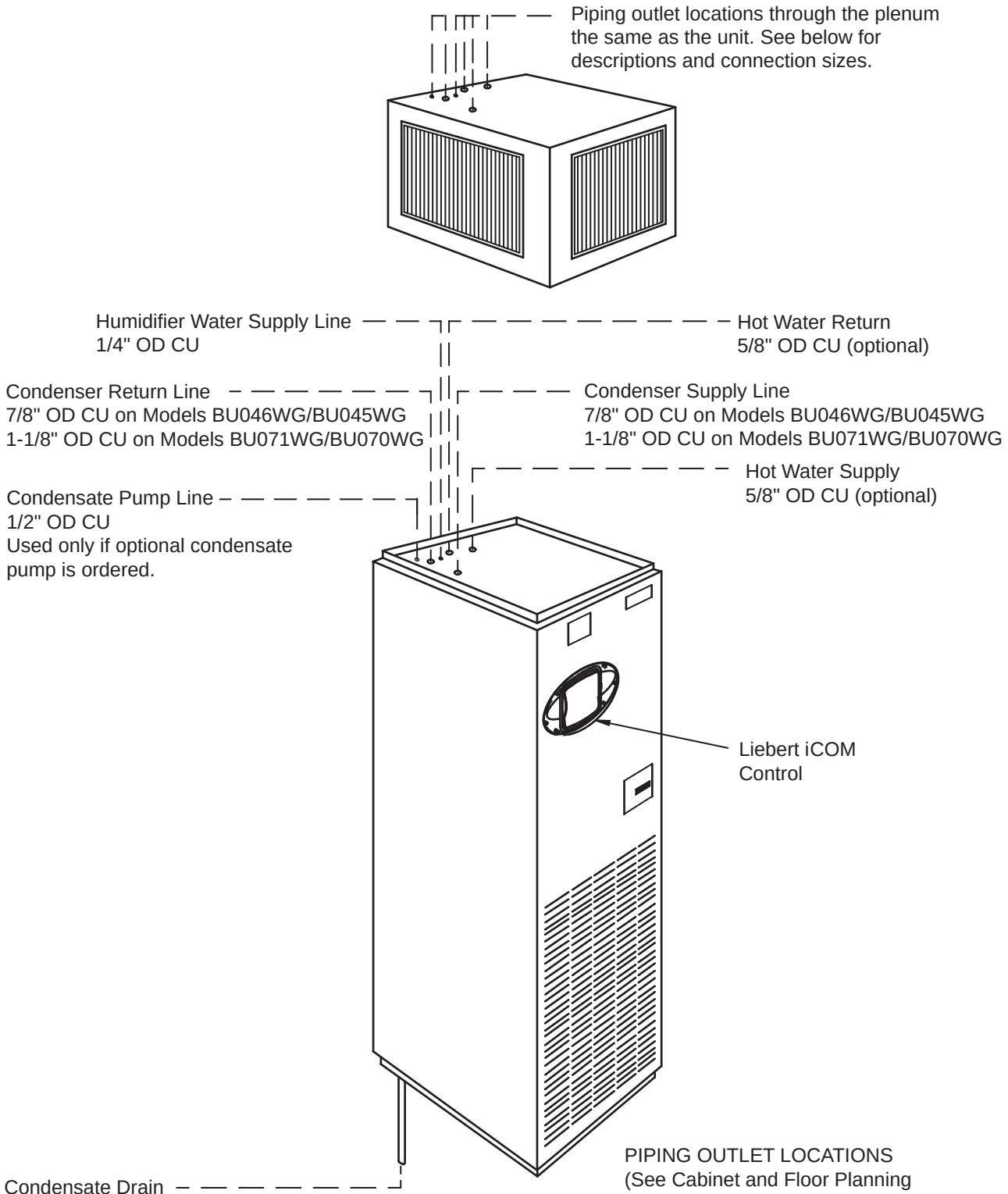


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**Figure 10 Piping connections for chilled water self-contained units - Downflow models**

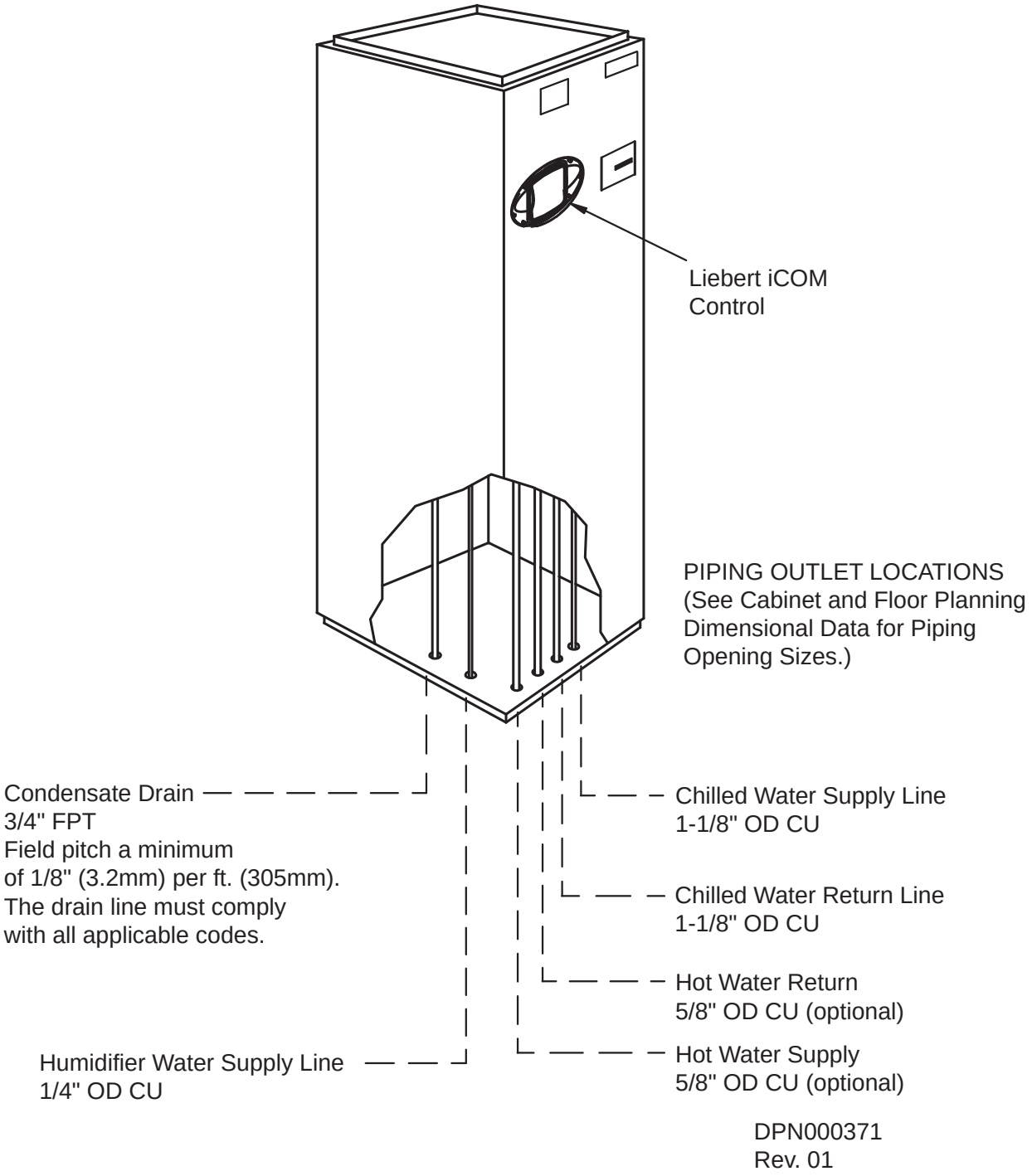
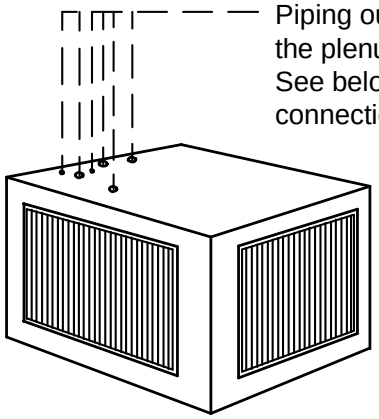


**Figure 11 Piping connections for chilled water self-contained units - Upflow models**



Piping outlet locations through the plenum are the same as the unit. See below for descriptions and connection sizes.

Humidifier Water Supply Line
1/4" OD CU

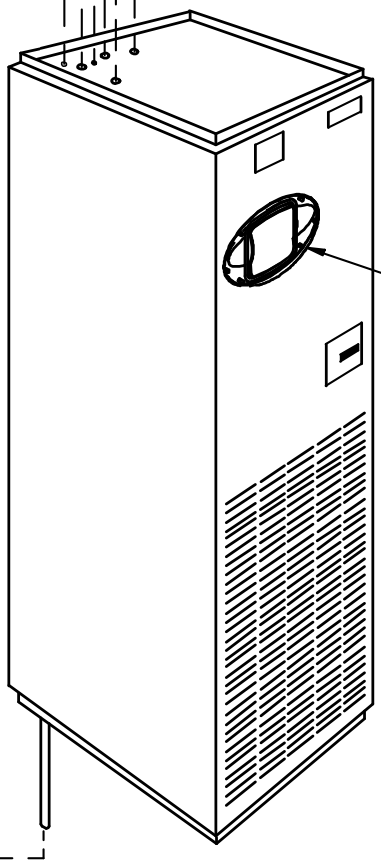
Hot Water Return
5/8" OD CU (optional)

Chilled Water Supply Line
1-1/8" OD CU

Chilled Water Return Line
1-1/8" OD CU

Condensate Pump Line
1/2" OD CU; used only if optional condensate pump is ordered.

Hot Water Supply
5/8" OD CU (optional)



iCOM Control Panel

PIPING OUTLET LOCATIONS
(See Cabinet and Floor Planning Dimensional Data for Piping Opening Sizes.)

Condensate Drain 3/4" FPT
Field-pitch a min. of 1/8" (3.2mm) per ft. (305mm). Units without a condensate pump have a factory-supplied trap in the unit, so a field trap should not be added. Units with a condensate pump will require a field-supplied trap downstream from the pump. The drain line must comply with all applicable codes. (If condensate pump is ordered, piping is out top of unit).

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### 2.5.2 Humidifier Supply Water—Optional Infrared

- 1/4" supply line; maximum water pressure is 150 psi (1034kPa)
- Size humidifier supply line for 1 gpm (3.8 l/m), with a minimum water pressure of 20 psi (138kPa)
- Do not supply de-ionized water to the humidifier

## 2.6 Facility Fluid and Piping Maintenance

Facility water and glycol quality remain a requirement throughout the life of the piping system. Fluid and piping system maintenance schedules must be established and performed. A local fluid maintenance program must be established that will evaluate fluid chemistry and apply necessary treatment. A periodic leak inspection of facility and unit fluid piping is recommended. Refer to **5.4 - Glycol Piping**.

## 2.7 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 unit in accordance with codes, or a factory-supplied disconnect switch may be factory mounted within the unit accessible from the exterior.

# WARNING

Risk of electric shock. Can cause injury or death.

Potentially lethal voltages exist within this equipment during operation. Observe all cautions and warnings on unit and in this manual.

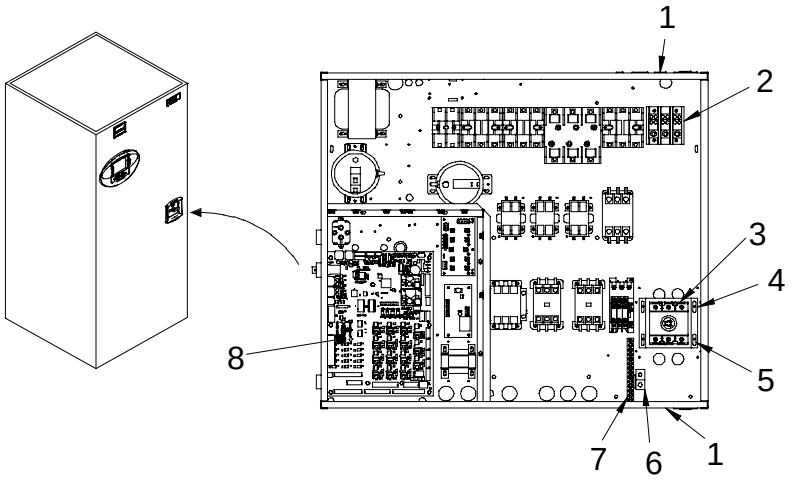
The Liebert iCOM microprocessor does not isolate power from the unit, even in the “Unit Off” mode. The only way to ensure that there is NO voltage inside the unit is to install and open a remote disconnect switch. Refer to unit electrical schematic.

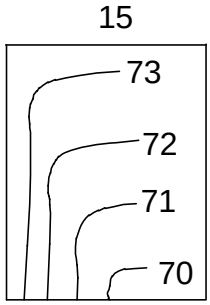
# NOTICE

Risk of improper scroll compressor installation. Could cause poor performance and compressor damage.

Three-phase power must be connected to the unit line voltage terminals in the proper sequence so that the scroll compressor rotates in the proper direction. Rotation in the wrong direction will result in poor performance and compressor damage. Use a phase sequence and motor rotation sensor to ensure that the three-phase power is correctly connected and the compressor is rotating properly.

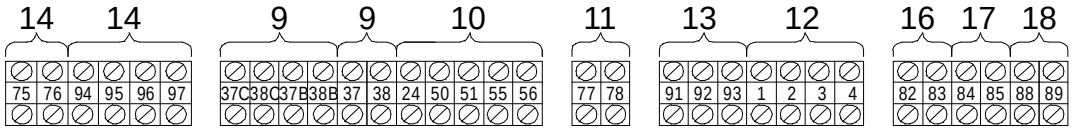
**Figure 12 Electrical connections**




Electrical Handy Box (factory-installed with cover; inside unit on top for upflow and on base for downflow.)

Terminal Block - for customer connections

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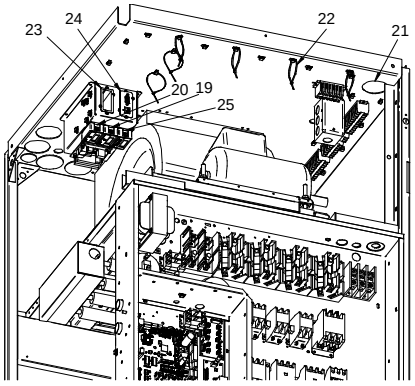
1. **Electric conduit knockouts** on top and bottom of electric box. Knockout size 1-3/4" (44.5mm).
2. **Three-phase connection**. Electric service connection terminals when factory disconnect is NOT supplied.
3. **Three-phase connection**. Electric service connection terminals when factory disconnect switch is supplied.
4. **Factory-installed disconnect switch**. (Optional).
5. **Three-phase electric service** field-supplied.
6. **Earth ground connection** (50/60Hz). Connection terminal for field-supplied earth grounding wire.
7. **Earth ground bar** (50Hz only). Connection terminals with factory ground from each high voltage component for field supplied earth grounding wire.
8. **Control and monitoring section** of electric box.
9. **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.
10. **Special alarm connections**. Field-supplied 24V Class 1 wiring for special alarm. Connection made by adding normally open contacts between terminals 24 + 50. Special alarm connections may be factory-wired or field-wired. See schematic for factory wired special alarms. For field-wired special alarms, use 24V Class 1 wiring to connect normally open contacts between Terminals 24 & 50, 24 & 51, 24 & 55, or 24 & 56.
11. **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®.
12. **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).
13. **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.
14. **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).

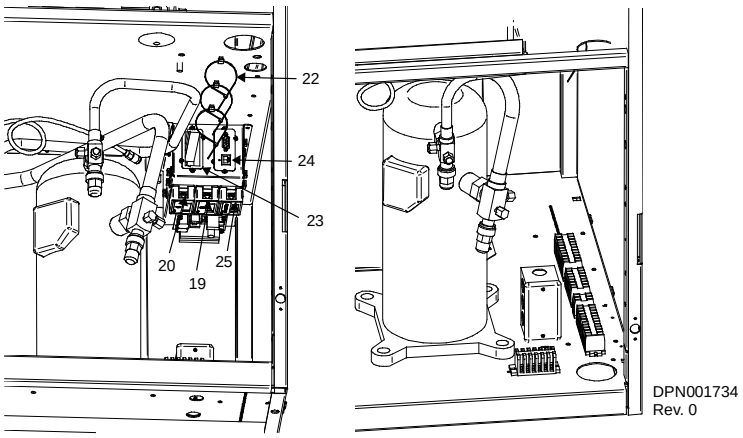
15. **Heat rejection connection**. Field-supplied 24V Class 1 wiring to interlock heat rejection from pigtails 70 + 71 which are factory-connected to compressor side switch (self-contained units only) or to GLYCOOL relay (K11, GLYCOOL units only). On Dual Cool units only, pigtails 72 + 73 connect auxiliary cooling source to GLYCOOL relay K11.
16. **Reheat and Humidifier Lockout**. Optional emergency power lockout of reheat and/or humidifier: connections provided for remote 24V AC source.
17. **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.
18. **Optional Condensate Alarm** (Dual Float Condensate Pump only). Relay terminals located in field wiring compartment for remote indication.

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

**Figure 13 Electrical field connections for Liebert iCOM**




**Upflow Models with Liebert iCOM**




**Downflow Models with Liebert iCOM**

19. **Network Cable "C" Connection**. Eight-wire Ethernet cable from U2U networking switch.
20. **Network Cable "D" connection**. Eight-wire Ethernet cable from U2U networking switch. Cable "D" connection supplied on units with large Liebert iCOM display only.
21. **Opening for Field Wiring**. Suggested entry point for all field wiring to unit. Hole size Ø2.5" (63.5mm)
22. **Loose Wire Ties**. To secure field-supplied network cables. Tighten after all field-supplied wires have been installed.
23. **Vacant Liebert IntelliSlot®**. May contain optional Liebert IntelliSlot cards.
24. **Populated Liebert IntelliSlot**. Optional Liebert IntelliSlot cards may be placed in either of the two supplied Liebert IntelliSlot locations.
25. **Remote Temperature / Humidity Sensor Connection**. Six-wire CAN cable supplied with optional remote T/H sensor

## 2.8 Balancing the Air Distribution

### 2.8.1 Under-Floor Discharge Systems

The systems are designed for constant air delivery, therefore any unusual restrictions within the air circuit must be avoided. For under-floor air distribution, observe the following guidelines:

- Select the air supply grilles and perforated panels for the raised floor to ensure minimum loss of pressure in the circuit. Air volume dampers on grilles, which extend several inches below the surface of the raised floor, are usually detrimental to airflow.
- Consideration of the height of the damper on the grille in conjunction with the floor height will determine whether this type of grille may be used.
- The grilles used in raised floors vary in size, the largest being approximately 18" x 6" (457 x 152 mm). A larger grille size would be detrimental to the structural capacity of the raised floor panel. An 18" x 6" (457 x 152 mm) heavy duty, pencil-proof type grille typically has 56 square inches (0.036 $m^2$) of free area.
- Perforated panels are available from various manufacturers of raised floors. These panels are usually 2' x 2' (610 x 610 mm) square and have a nominal free area of approximately 108 to 144 square inches (0.07 to 0.09 $m^2$). Use caution in selecting perforated panels as some manufacturers have only 36 to 40 square inches (0.023 to 0.026 $m^2$) of free area, requiring four times as many panels.
- Avoid floor elevations below 7-1/2" (190.5 mm), loosely installed flooring systems, and below-floor obstructions such as: electrical wiring chases, unusually long electronic system cables, or piping clusters.
- Always check specifications of the floor supplier before specifying the total number of perforated panels and grilles required to handle the air flow. The proper specifications for grilles and perforated panels should indicate the total free area required for air delivery rather than the number of panels and grilles. (See **Table 3** for recommended free area required for each model.) This table indicates the recommended free area based on having the supply air grilles and perforated panels sized to handle approximately 75% of the total cubic feet per minute (CFM) of the units at a velocity of 550 to 600 ft./min. (2.8 - 3.1 m/s). The remaining 25% of the air flow in the raised floor passes through cable cutouts, cracks between the panels, and other leakage areas.

**Table 3 Recommended free area $ft^2$ ($m^2$) for grilles or perforated panels at output velocities of 550 and 600 fpm (2.8 and 3.1 m/s)**

| 50 Hz Units | | | | |
|---|---|---|---|---|
| Model | 550 FPM | 2.8 m/s | 600 FPM | 3.1 m/s |
| 3-ton | 2.5 | (0.01) | 2.3 | (0.01) |
| 5-ton | 3.5 | (0.02) | 3.3 | (0.02) |

| 60 Hz Units | | | | |
|---|---|---|---|---|
| Model | 550 FPM | 2.8 m/s | 600 FPM | 3.1 m/s |
| 3-ton | 2.5 | (0.01) | 2.3 | (0.01) |
| 5-ton | 3.8 | (0.02) | 3.5 | (0.02) |

### 2.8.2 Ducted Applications

For ducted supply applications on upflow units, the duct work should be attached to the blower discharge flanges of the unit. For ducted return air applications, the duct work should be attached to the filter box flanges on upflow rear return units and on the unit top flange for downflow units. Refer to **Figure 2** for information on upflow units and to **Figure 3** for downflow units.

The duct work on upflow units must allow access to the motors/blowers for maintenance. The duct work on upflow units must be designed within the capacity of the unit, otherwise air flow and performance will be compromised.

### 2.8.3 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 unit.

## 2.9 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 unit & outside of the unit. Remove potential of rub-through or chaffing.

___ 6. Condensate pump installed (if required).

___ 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. Filter box installed (if applicable).

___ 11. Ducting completed (if applicable).

___ 12. Filter(s) installed.

___ 13. Line voltage to power wiring matches equipment serial tag.

___ 14. Power wiring connections completed between disconnect switch, evaporator and condensing unit, including earth ground.

___ 15. Power line circuit breakers or fuses have proper ratings for equipment installed.

___ 16. Control wiring connections completed to evaporator and condensing unit.

___ 17. Verify water detection is properly installed around all units (if installed).

___ 18. All wiring connections are tight.

___ 19. Control panel DIP switches set based on customer requirements.

___ 20. Foreign materials have been removed from, in and around all equipment installed (literature, shipping materials, construction materials, tools, etc.).

___ 21. Fans and blowers rotate freely.

___ 22. Inspect all piping connections for leaks during initial operations. Correct as needed.

___ 23. Verify that a blank startup sheet has been sent with the unit(s) and is ready to be completed by the installer.

# 3.0 AIR-COOLED MODELS—SELF-CONTAINED COMPRESSOR

## 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 by 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.

**NOTE**

*If the condenser is located below the level of the room unit, the factory should be consulted.*

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.

Potentially lethal voltages exist within this equipment during operation. Observe all cautions and warnings on unit and in this manual.

The Liebert iCOM microprocessor does not isolate power from the unit, even in the "Unit Off" mode. 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.

Use 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 Liebert Lee-Temp/Flood Back Head Pressure Control Condensers

Liebert 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 14 Air-cooled condensers**

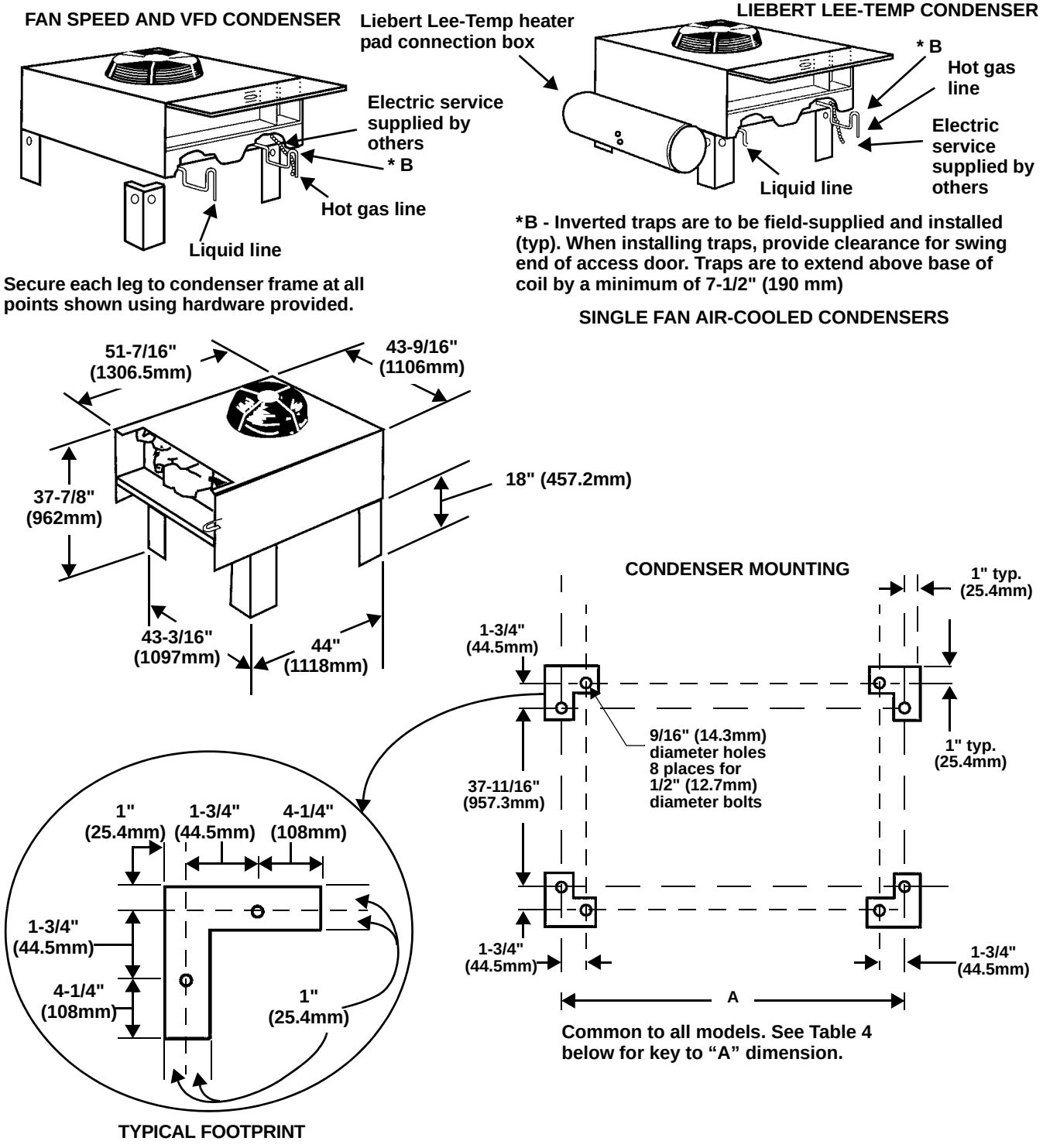



**Table 4 Air-cooled condenser statistics**

| 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) |
| 165 | 2 | 1-1/8 | 7/8 | 425 (193) | 82 (2083) |

## 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.

# NOTICE

Risk of improper installation. Can cause equipment and property damage.

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

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.

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.

**NOTE**

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

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 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 5 Recommended line sizes — OD copper (inches)***

| Equivalent Length | 3.5-ton 042A (040A) | | 5-ton 067A (065A) | |
|---|---|---|---|---|
| | Hot Gas Line | Liquid Line | Hot Gas Line | Liquid Line |
| 50 ft. (15 m) | 5/8 | 1/2 | 7/8 | 1/2 |
| 100 ft. (30 m) | 3/4 | 1/2 | 7/8 | 5/8 |
| 150 ft. (45 m) | 3/4 | 5/8 | 7/8 | 5/8 |

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

**Table 6 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 7 Indoor unit refrigerant charge lb (kg)**

| Model | R407C |
|---|---|
| | Approximate Charge lb (kg) |
| 42A/40A | 0.9 (0.4) |
| 67A/65A | 1.4 (0.6) |

**Table 8 Line charges - refrigerant per 100 ft. (30 m) of Type “L” copper tube**

| O.D. | R407C | |
|---|---|---|
| | Liquid Line lb (kg) | Hot Gas Line lb (kg) |
| 1/2" | 7.3 (3.3) | 1.3 (0.6) |
| 5/8" | 11.7 (5.3) | 2.1 (1.0) |
| 3/4" | 16.6 (7.5) | 3.0 (1.4) |
| 7/8" | 24.4 (11.1) | 4.4 (2.0) |

**Table 9 Condenser refrigerant (per serial tag)**

| Model | R407C | |
|---|---|---|
| | Approximate Charge lb (kg) | |
| | Fan Speed | Liebert Lee-Temp* |
| 083 | 5 (2.3) | 26 (11.8) |
| 104 | 8 (3.6) | 37 (16.8) |
| 165 | 15 (6.8) | 50 (22.7) |

* Charge includes the receiver charge.

## 3.4 Fan Speed Control Systems

The Variable Fan Speed Control systems (FSC & VFD) uses pressure-activated electronic fan speed control systems and remotely located thermostat(s) to ensure operation at ambient temperatures as low as 0°F (-18°C). For this ambient temperature range, the VFD Control Condenser must be used with digital scroll indoor units and can be used for energy savings with any Liebert Challenger 3000 unit.

### Variable Fan Speed Control Piping

A discharge line and a liquid line must be field-installed between the indoor unit and the outdoor condenser. See **Figures 15** and **16** for details.

### Variable Fan Speed Control Materials Supplied

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

### Variable Fan Speed Control Leak Check and Evacuation Procedure

Proper leak check and evacuation can be accomplished only with all system solenoid valves open and check valves accounted for.

**NOTE**

*Systems with a scroll or digital scroll compressor include a factory-installed check valve and an additional downstream Schrader valve with core in the compressor discharge line. Proper evacuation of the condenser side of the compressor can be accomplished only using the downstream Schrader valve. See piping schematic (**Figures 15** and **16**).*

1. If unit power is available, open the unit liquid line solenoid valves using the evacuation function in the diagnostic section of the Liebert iCOM control (refer to the Liebert iCOM user manual, SL-18835). If unit power is not available, a field-supplied 24VAC / 75VA power source must be directly connected to each of the unit solenoid valves.
2. For scroll and digital scroll compressors, connect refrigerant gauges to the suction rotalock valves and discharge line Schrader valves (see **Note** above) on the compressor.
3. Open the service valves and place a 150 PSIG (1034 kPa) of dry nitrogen with a tracer of refrigerant. Check system for leaks with a suitable leak detector.
4. After completion of leak testing, release the test pressure (per local code) and pull an initial deep vacuum on the system with a suitable pump.
5. After four hours, check the pressure readings and, if they have not changed, break vacuum with dry nitrogen. Pull a second and third vacuum to 250 microns or less. Recheck the pressure after two hours. After completing this step, proceed to **Variable Fan Speed Charging on page 28**.

### Variable Fan Speed Charging

1. Check unit nameplate for refrigerant type to be used. Unit control configurations differ depending on refrigerant type.
2. Refrigerant charging requires unit operation. Refer to **2.9 - Checklist for Completed Installation**.
3. Calculate the amount of charge for the system. Refer to the unit, condenser and refrigerant line charge data in **Tables 6**, **7**, **8** and **9**.
4. Weigh in as much of the system charge as possible before starting the unit.

**CAUTION**

Risk of improper refrigerant charging. Can cause equipment damage.

Refrigerant R407C is a blend of three components 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 compressor suction service valve. Care must be exercised to avoid damage to the compressor. Emerson recommends 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.

5. Turn on unit disconnect switch. Operate the unit for 30 minutes using the charging function for the system in the diagnostic section of the Liebert iCOM control (see Liebert iCOM user manual, SL-18835). The charging function operates the compressor at full capacity and energizes the blower motor and the liquid line solenoid valve. The reheat and humidifier are disabled. A minimum 20psig (138kPa) must be established and maintained for the compressor to operate. The charging function can be reset as many times as required to complete unit charging.

**Table 10 Fan speed suction pressure transducer settings**

| Function | R-407C | |
|---|---|---|
| | Gauge (Sea Level) | Absolute |
| | psiG (kPa) | psiA (kPa) |
| **Pump-Down Cutout** | 20 (138) | 35 (241) |
| **Pump-Down Reset** | 65 (448) | 80 (552) |
| **Minimum to Start-Cooling** | 35 (241) | 50 (344) |
| **Low-Pressure Cutout (DX only)** | 52 (358) | 67 (461) |

6. Charge the unit until the liquid line sight glass becomes clear. Then add one additional pound (2.2kg) of refrigerant.

**NOTE**

*A digital scroll compressor will have a clear sight glass only when operating at 100% capacity. When operating below 100%, the sight glass may show bubbles with each 15-second unloading cycle.*

7. As head pressure builds, the variable fan speed controlled condenser fan begins rotating. The fan will run at full speed when sufficient head pressure is developed—fan starts to rotate at 190 psig (1310 kPA) and is full speed at 250 psig (1724 kPA).

**Figure 15 General arrangement—Air-cooled models with fan speed control**

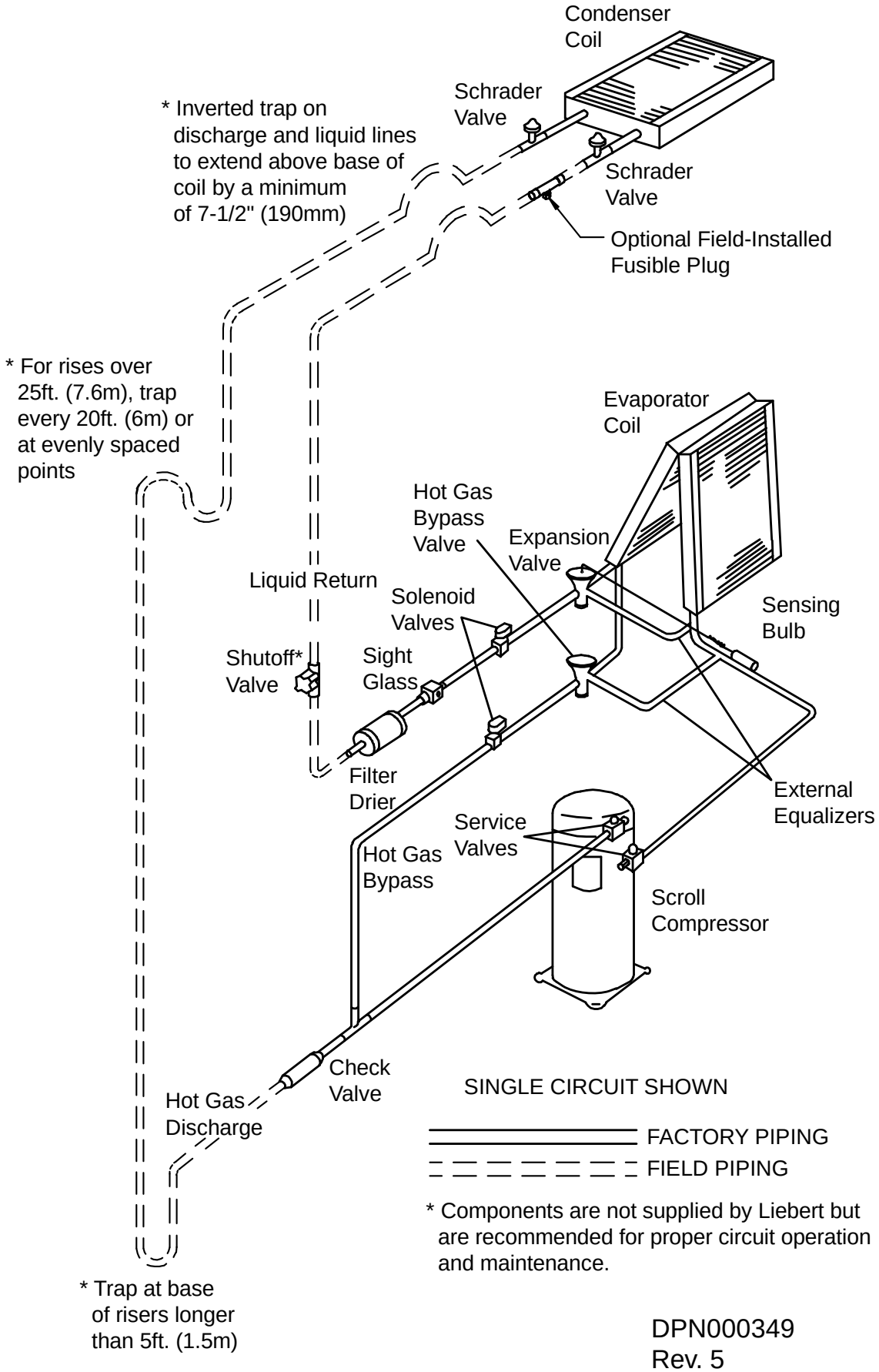
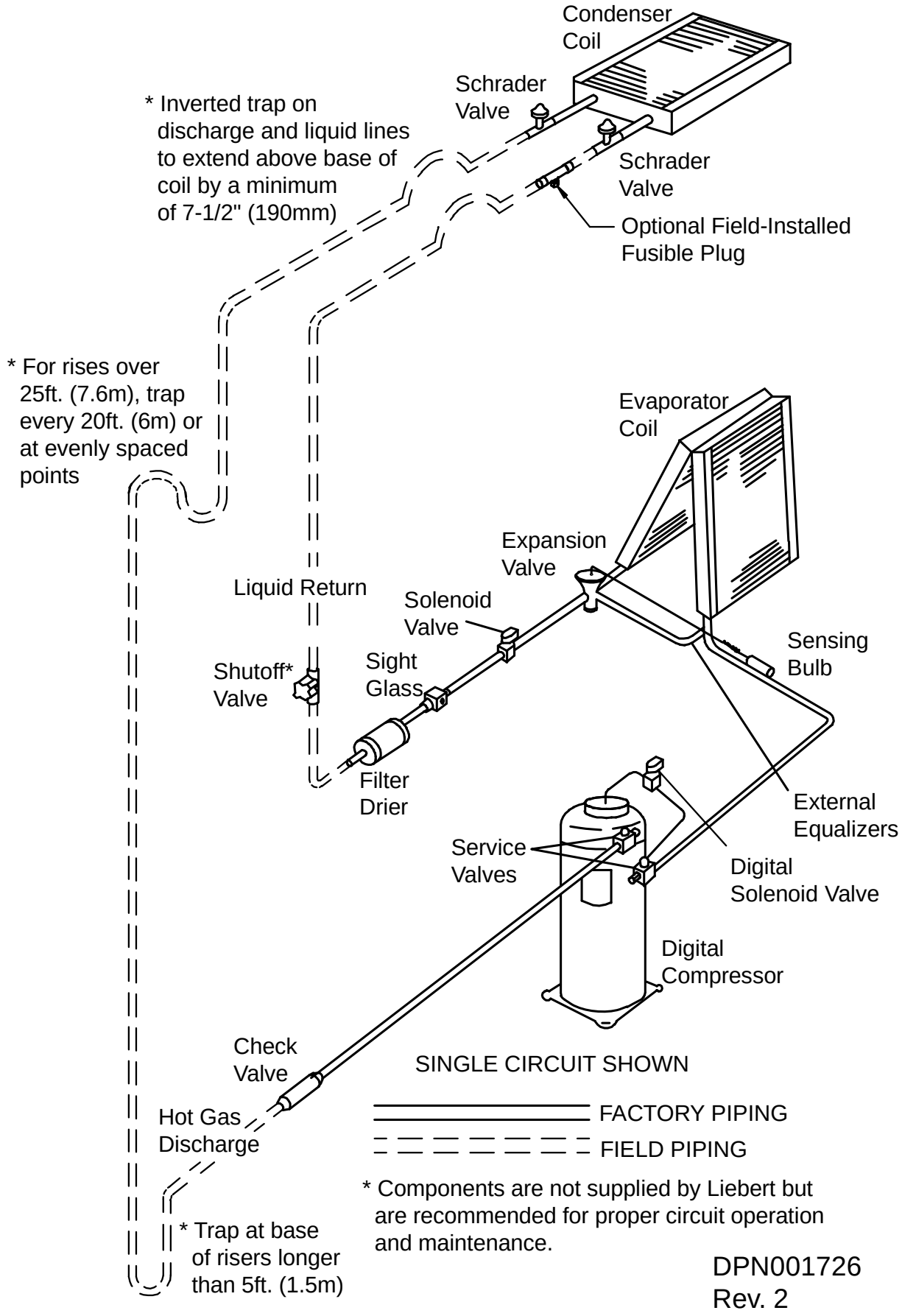


**Figure 16 General arrangement—Air-cooled models with digital scroll and fan speed control**



## 3.5 Air-Cooled Condenser with Liebert Lee-Temp "Flooded Condenser" Head Pressure Control System

The Liebert Lee-Temp system consists of a modulating type head pressure control valve and insulated receivers with heater pads to ensure operation at ambient temperatures as low as -30°F (-34.4°C). The Liebert Lee-Temp system can be used with any compressor choice.

### Liebert Lee-Temp Piping

A discharge line and a liquid line must be field-installed between the indoor unit and the outdoor condenser. See **Figures 17** and **18** for details.

### Liebert Lee-Temp Controlled Materials Supplied

- Built-in, pre-wired condenser control box
- Air-Cooled condenser
- Piping access cover to be reinstalled when piping is complete (models with one to four fans only)
- Bolts—four per leg (3/8" x 5/8")
- Terminal block for two-wire, 24V interlock connection between unit and condenser
- Condenser legs—four with 1-fan, six on two-, three- and six-fan models and eight on four- and eight-fan models
- Bolts—six per receiver (3/8" x 1")
- Liebert Lee-Temp system:
  - Insulated storage receiver
  - Head pressure control valve with integral check valve
  - Service valve
  - Pressure relief valve
  - Liquid level sight glass
  - Check valve

**NOTE**

*Liebert Lee-Temp heater pads require a separate, continuous electrical source. See nameplate on unit for proper voltage.*

### Liebert Lee-Temp Leak Check and Evacuation Procedure

Proper leak check and evacuation can be accomplished only with all system solenoid valves open and check valves accounted for.

**NOTE**

*Systems with scroll or digital scroll compressors include a factory-installed check valve and an additional downstream Schrader valve with core in the compressor discharge line. Proper evacuation of the condenser side of the compressor can be accomplished only using the downstream Schrader valve. See piping schematic (**Figure 18**).*

1. If unit power is available, open the unit liquid line solenoid valves using the evacuation function in the diagnostic section of the Liebert iCOM control. If unit power is not available, a field-supplied 24VAC / 75VA power source must be directly connected to each of the unit solenoid valves.
2. Attach a jumper hose from the service valve fitting on the outlet of the receiver and the Schrader fitting on the discharge header of the condenser. Front-seat the service valve approximately two (2) turns.
3. For scroll and digital scroll compressors, connect refrigerant gauges to the suction rotalock valves and discharge line Schrader valves (see **Note** above).
4. Open the service valves and place a 150 PSIG (1034 kPa) of dry nitrogen with a tracer of refrigerant. Check system for leaks with a suitable leak detector.
5. After completion of leak testing, release the test pressure (per local code) and pull an initial deep vacuum on the system with a suitable pump.

6. After four hours, check the pressure readings and, if they have not changed, break vacuum with dry nitrogen. Pull a second and third vacuum to 250 microns or less. Recheck the pressure after two hours.
7. Remove the jumper hose installed previously from between the service valve fitting and the condenser. After completing this step, proceed to **Liebert Lee-Temp Charging**.

### Liebert Lee-Temp Charging

1. Check unit nameplate for refrigerant type to be used. Unit control configurations differ depending on refrigerant type.
2. Refrigerant charging requires unit operation. Refer to **2.9 - Checklist for Completed Installation**.
3. Calculate the amount of charge for the system. Refer to the unit, condenser and refrigerant line charge data in **Tables 6**, **7**, **8** and **9**.
4. Weigh in as much of the system charge as possible before starting the unit.

**CAUTION**

Risk of improper refrigerant charging. Can cause equipment damage.

Refrigerant R407C is a blend of three components 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 compressor suction service valve. Care must be exercised to avoid damage to the compressor. Emerson recommends 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.

5. Turn on unit disconnect switch. Operate the unit for 30 minutes using the charging function for the system in the diagnostic section of the Liebert iCOM control. The charging function operates the compressor at full capacity and energizes the blower motor and liquid line solenoid valve. The reheat and humidifier are disabled. A minimum 20psig (138kPa) must established and maintained for the compressor to operate. The charging function can be reset as many times as required to complete unit charging.

**Table 11 Liebert Lee-Temp suction pressure transducer settings**

| Function | R-407C | |
|---|---|---|
| | Gauge Reading (Sea Level) | Absolute |
| | psiG (kPa) | psiA (kPa) |
| Pump-Down Cutout | 20 (138) | 35 (241) |
| Pump-Down Reset | 65 (448) | 80 (552) |
| Minimum to Start-Cooling | 50 (345) | 65 (448) |
| Low-Pressure Cutout (DX only) | 52 (358) | 67 (461) |

6. Charge the unit until the liquid line sight glass becomes clear. Then add one additional pound (2.2 kg) of refrigerant.

**NOTE**

*A digital scroll compressor will have a clear sight glass only when operating at 100% capacity. When operating below 100%, the sight glass may show bubbles with each 15-second unloading cycle.*

### Liebert Lee-Temp Receiver Refrigerant Level

On each receiver at the condenser are two refrigerant-level sight glasses. Refrigerant level will vary with outside temperature. Check refrigerant level after the unit has been on for at least 15 minutes.

**Sight Glass Levels**

40°F (4.5°C) and lower—bottom sight glass is 3/4 full

40 to 60°F (4.5 to 15.5°C)—bottom sight glass is full

60°F (15.5°C) and higher—top sight glass is 3/4 full.

**Figure 17 General arrangement—Air-cooled models with Liebert Lee-Temp**

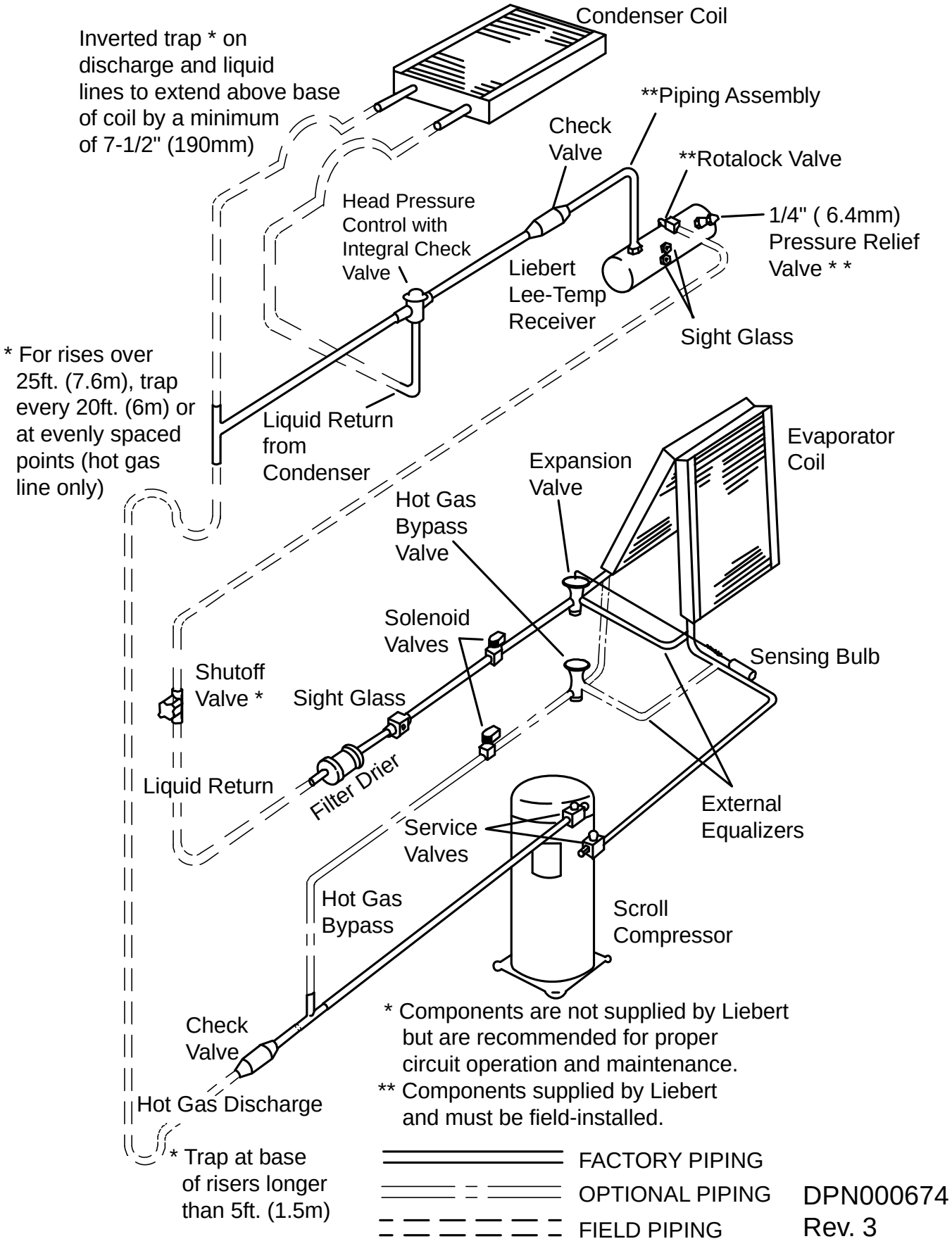
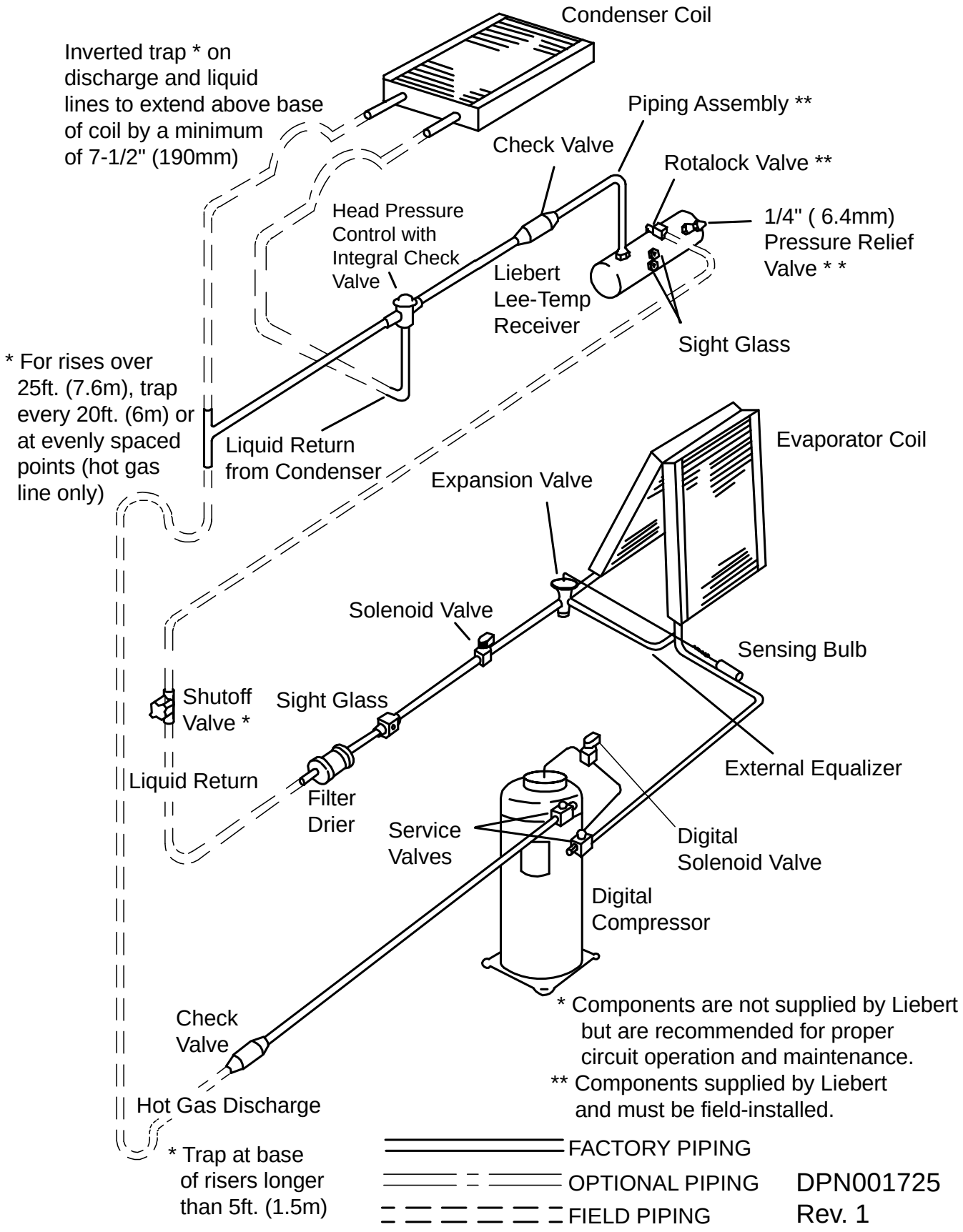


**Figure 18 General arrangement—Air-cooled models with digital scroll and Liebert Lee-Temp**



# 4.0 WATER-COOLED MODELS—SELF-CONTAINED COMPRESSOR

## 4.1 Piping Considerations

Manual shutoff 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 Liebert 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 19 General arrangement—Water-cooled models with scroll compressor**

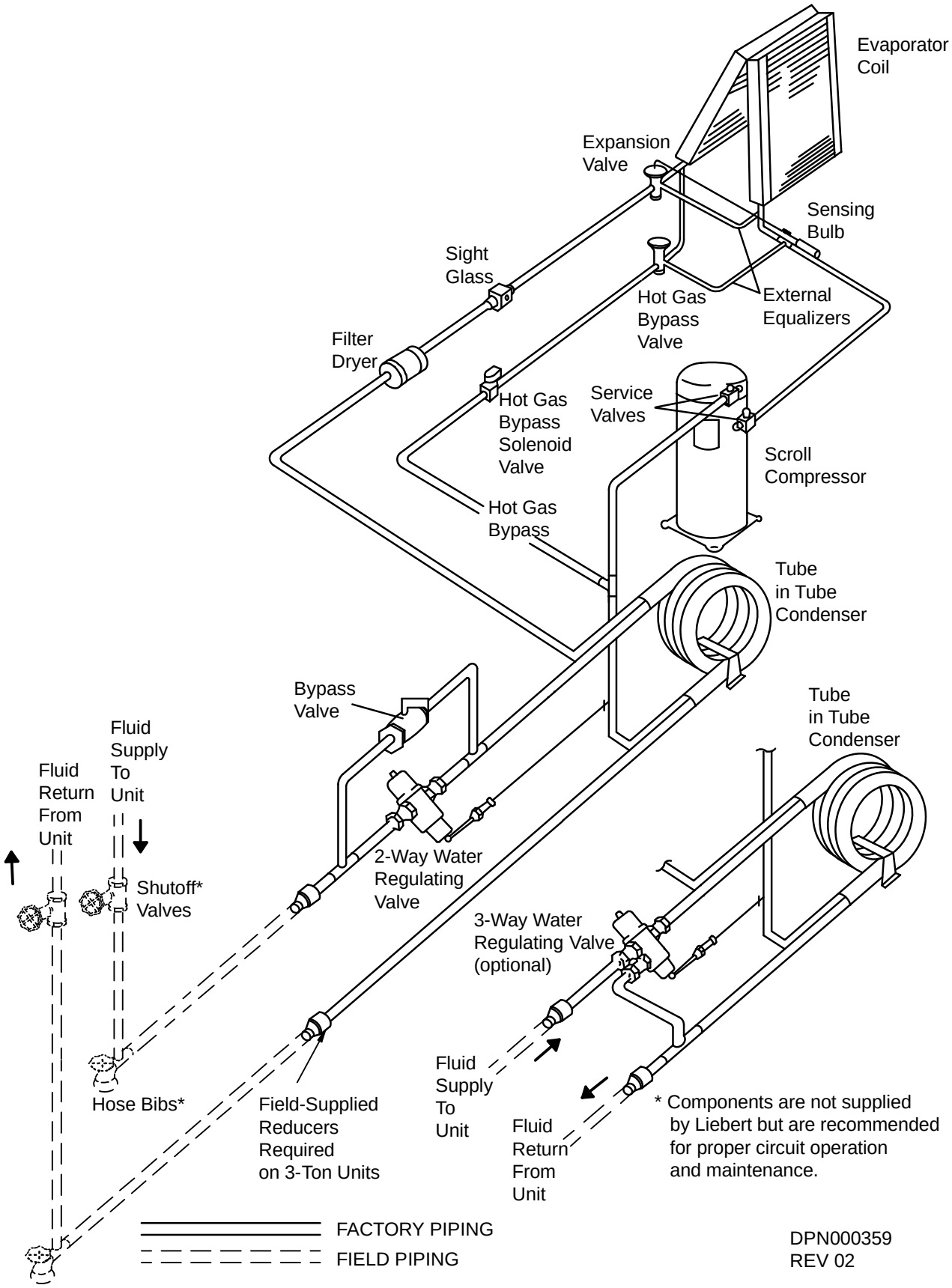
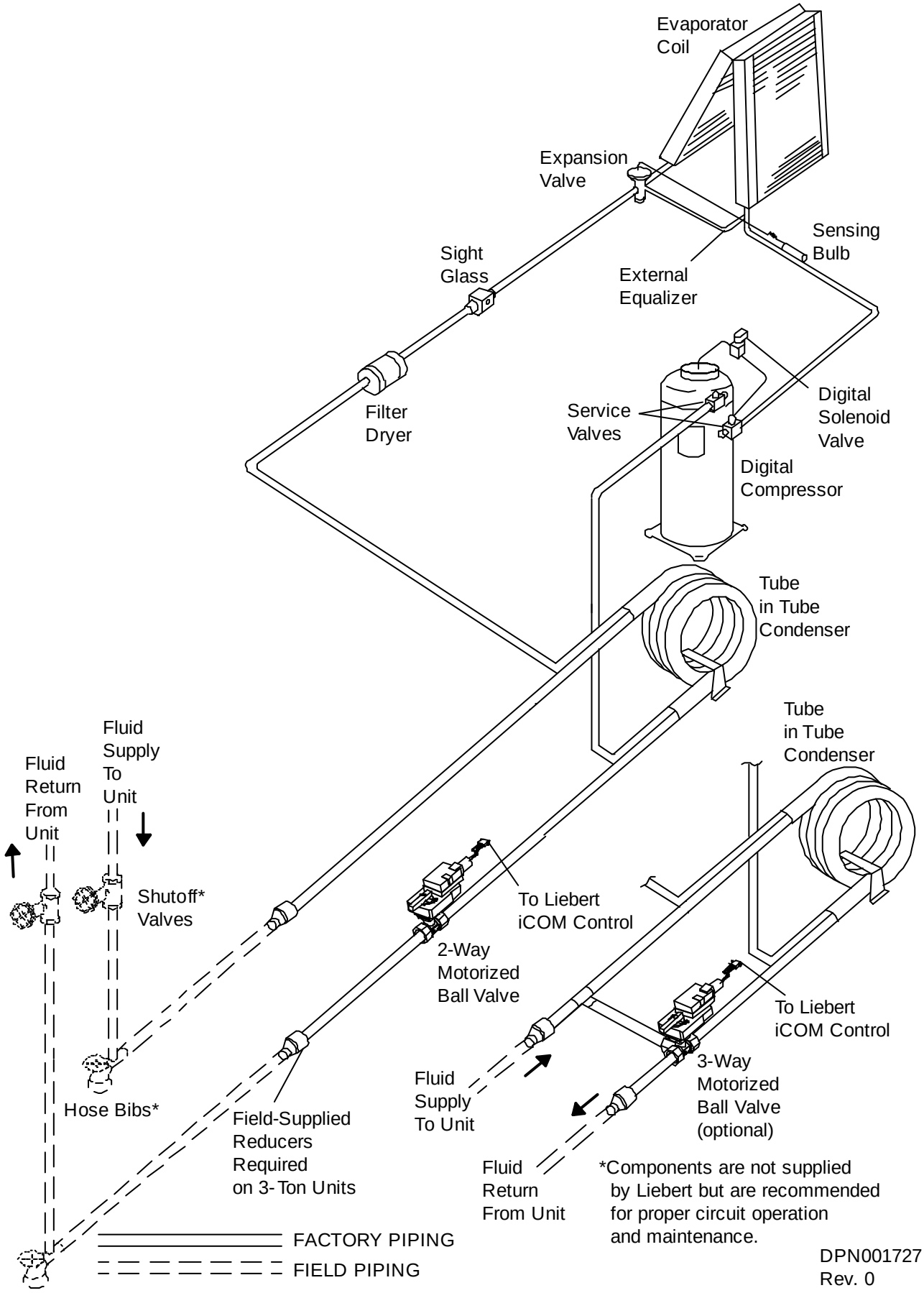


**Figure 20 General arrangement diagram—Water-cooled models with digital scroll**



## 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 Standard Valve - 150 psig (1034 kPa) System for 3 & 5-Ton Units (Johnson Controls Valve) High Pressure Valve - 350 psig (2413 kPa) System for 5-Ton Units (Johnson Controls Valve)

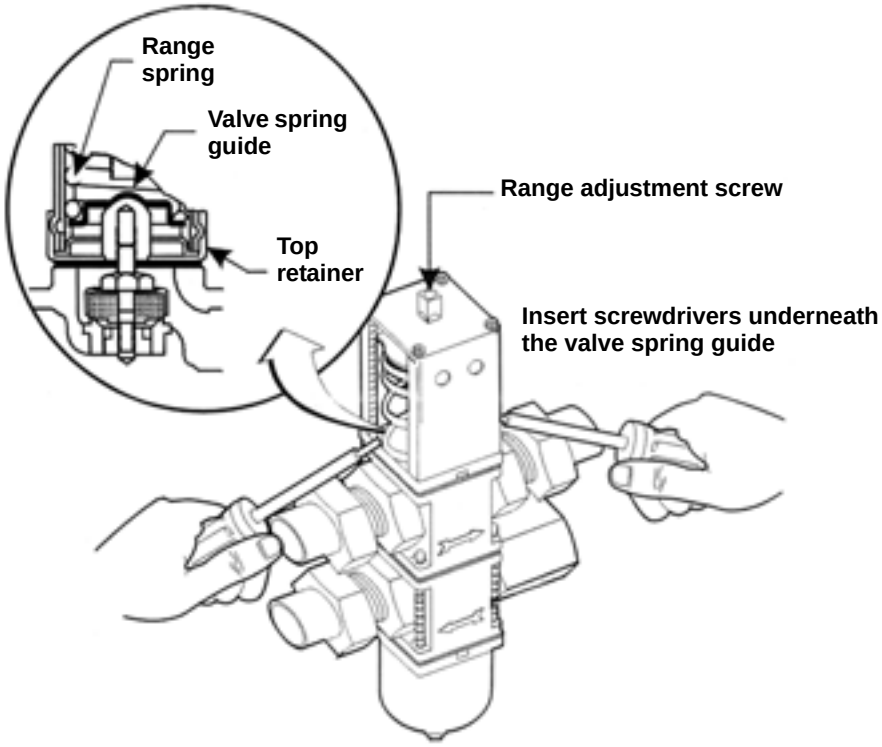
#### Adjustment

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 21 Johnson Controls valve adjustment**




### 4.3.2 High Pressure Valve - 350 psig (2413 kPa) System for 3-Ton Units (Metrex Valve)

#### Adjustment

The valve may be adjusted using a 1/8" diameter rod. Turn the adjusting collar nut counterclockwise to raise head pressure; turn it clockwise to lower head pressure. Rotation directions are viewed from top of valve spring housing.

**Figure 22 Metrex Valve adjustment**

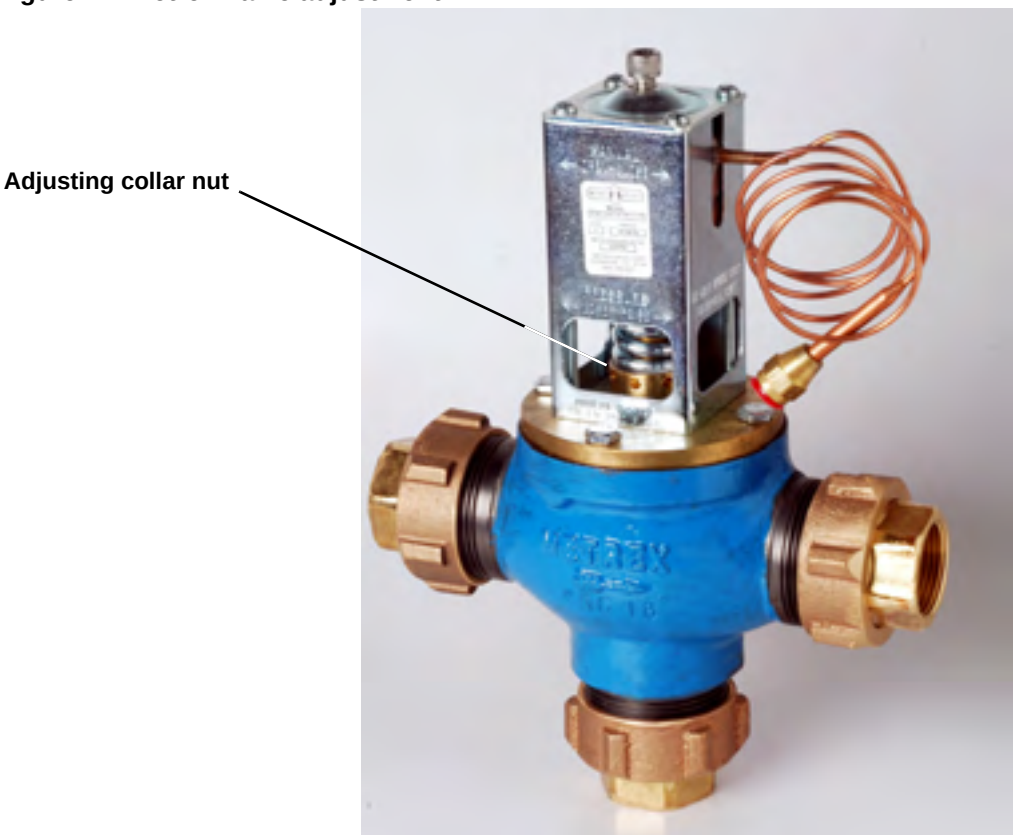



**Table 12 Refrigerant control settings psi (kPa)**

| Low Pressure Cut Out | Low Pressure Cut In | High Pressure Cut Out |
|---|---|---|
| 20 (137.9) | 65 (448.2) | 400 (2758) |

### Manual Flushing

The valve may be flushed by rotating the socket head screw clockwise. This screw must be in the OUT position (counterclockwise) for normal valve operation.

## 4.4 Motorized Ball Valve—Digital Scroll Compressors

On digital scroll units, discharge pressure is controlled by a motorized ball valve. During unloaded operation, the pressure changes during each digital cycle could cause excessive repositions with a pressure-operated water regulating valve. The control algorithm for the motorized ball valve uses an intelligent sampling rate and adjustable pressure thresholds to reduce valve repositions. The valve assembly consists of the brass valve, linkage and actuator.

### 4.4.1 Control

The valve actuator operates on 24VAC power and is controlled by a 2-10VDC proportional control signal. The valve will move from fully open to fully closed in 60 seconds. At 2VDC, the valve is closed; at 10VDC, the valve is fully open. There is a 20-second delay to position the motorized ball valve before starting the compressor.

### Control Method

The control utilizes an upper and lower pressure threshold with a 35psi (241kPa) deadband to reduce valve movement. If the liquid pressure is between the upper and lower threshold, the valve remains at the current position. If the liquid pressure exceeds the upper threshold the valve opens, and if the pressure falls below the lower threshold the valve closes. There are multiple adjustment bands to ease discharge pressure back into control range.

### 4.4.2 Adjustment

Both pressure thresholds can be shifted simultaneously over a 50psi (345kPa) range (the 35psi [241kPa] differential remains constant). The ball valve setpoint offset parameter in the Liebert iCOM Service menu can be adjusted from 0 to 50 PSI (345 kPa) to raise or lower the control band similar to the pressure adjustment on a water regulating valve. Changing the setpoint offset will adjust the pressure thresholds for both circuits. Units are factory-set at a 30psi (207 kPa) setpoint offset (30psi [207 kPa] above minimum). This results in a 220psiA (1517kPa) lower threshold and a 255psiA (1758kPa) upper threshold pressure.

### 4.4.3 Startup

The setpoint offset is adjusted to the minimum value during startup, then changes to the set value once the compressor reaches normal operating pressures. Changes in fluid temperature could cause pressure changes that do not result in valve movement within the deadband. Fan cycling stats should be set to prevent continuous fluid temperature swings greater than 10°F (5.6°C).

### 4.4.4 Location

The motorized ball valve is located in the condenser fluid return line. Three-way valves are piped in a mixing arrangement with the common port at the valve outlet.

### 4.4.5 Manual Control

The valve can be manually set by disconnecting AC power, depressing the manual override button on the valve actuator and adjusting the valve position with the handle. The motorized ball also can be controlled through the Liebert iCOM's Service menu using manual mode to override the normal control.

# 5.0 GLYCOL/GLYCOOL-COOLED MODELS—SELF-CONTAINED COMPRESSOR

## 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.

Potentially lethal voltages exist within this equipment during operation. Observe all cautions and warnings on unit and in this manual.

The Liebert iCOM microprocessor does not isolate power from the unit, even in the "Unit Off" mode. 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.

Use 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

These guidelines apply to the field leak checking and fluid requirements for field piping systems.

### General Guidelines

- Equipment damage and personal injury can result from improper piping installation, leak checking, fluid chemistry and fluid maintenance.
- Follow local piping codes, safety codes.
- Qualified personnel must install and inspect system piping.
- Contact a local water consultant regarding water quality, corrosion protection and freeze protection requirements.
- Install manual shutoff valves at the supply and return line to each indoor unit and drycooler to permit routine service and emergency isolation of the unit.

**CAUTION**

Risk of frozen fluids. Can cause equipment damage and building damage.

Freezing system fluids can rupture piping. Complete system drain-down cannot be ensured. When the field piping or unit may be exposed to freezing temperatures, charge the system with the proper percentage of glycol and water for the coldest design ambient.

Automotive antifreeze is unacceptable and must NOT be used in any glycol fluid system.

**CAUTION**

Risk of corrosion. Can cause equipment damage.

Read and follow individual unit installation instructions for precautions regarding fluid system design, material selection and use of field-provided devices. Liebert systems contain iron and copper alloys that require appropriate corrosion protection.

Contact a local water consultant regarding water quality, corrosion and freeze protection requirements.

Water chemistry varies greatly by location, as do the required additives, called inhibitors, that reduce the corrosive effect of the fluids on the piping systems and components. The chemistry of the water used must be considered, because water from some sources may contain corrosive elements that reduce the effectiveness of the inhibited formulation. Preferably, surface waters that are classified as soft and are low in chloride and sulfate ion content should be employed. Proper inhibitor maintenance must be performed in order to prevent corrosion of the system. Consult glycol manufacturer for testing and maintenance of inhibitors.

Commercial ethylene glycol (Union Carbide Ucartherm, Dow Chemical Dowtherm SR-1 and Texaco E.G. Heat Transfer Fluid 100), when pure, is generally less corrosive to the common metals of construction than water itself. It will, however, assume the corrosivity of the water from which it is prepared and may become increasingly corrosive with use if not properly inhibited.

**CAUTION**

Risk of oxide layer formation. Can cause equipment damage.

Idle fluid allows the collection of sediment that prevents the formation of a protective oxide layer on the inside of tubes. Keep unit switched ON and system pump operating.

# NOTICE

Risk of debris or precipitate clogging pipes. Can cause equipment damage.

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.

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.

# NOTICE

Risk of improper installation. Can cause equipment or structural damage.

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. Failure to support piping can strain the equipment's structural integrity.

A relief valve must be installed in the system to avoid the possibility of burst pipes. This valve may be obtained from the supplier as an option or obtained from another vendor.

Emerson recommends installing manual service shut-off valves 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 13 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 a 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

Risk of freezing temperatures. Can cause equipment and piping damage.

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 your coldest design ambient. Complete system drain-down cannot be assured and damage to the system 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 14** and **Table 16** for unit volumes. Use volume in **Table 15** for glycol piping volumes.

**Table 14 Indoor unit glycol volume approximate gallons (liters) max.**

| Model (50 Hz) | Glycol-Cooled | GLYCOOL |
|---|---|---|
| 046WG/(045WG) | 1.2 (4.5) | — |
| 071WG/(070WG) | 2.0 (7.5) | — |
| 061G/(058G) | — | 4.0 (15.1) |

**Table 15 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

Risk of improper handling of glycol. Can cause environmental damage and violate national, regional and local laws.

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

Risk of using improper cooling agent. Can cause reduced cooling performance and damage to equipment and piping.

Proper formulations of inhibited formula ethylene glycol and propylene glycol must be used in the Challenger 3000 system. 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 16** 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.

**Table 16 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

Risk of corrosion from water impurities. Can cause equipment damage.

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

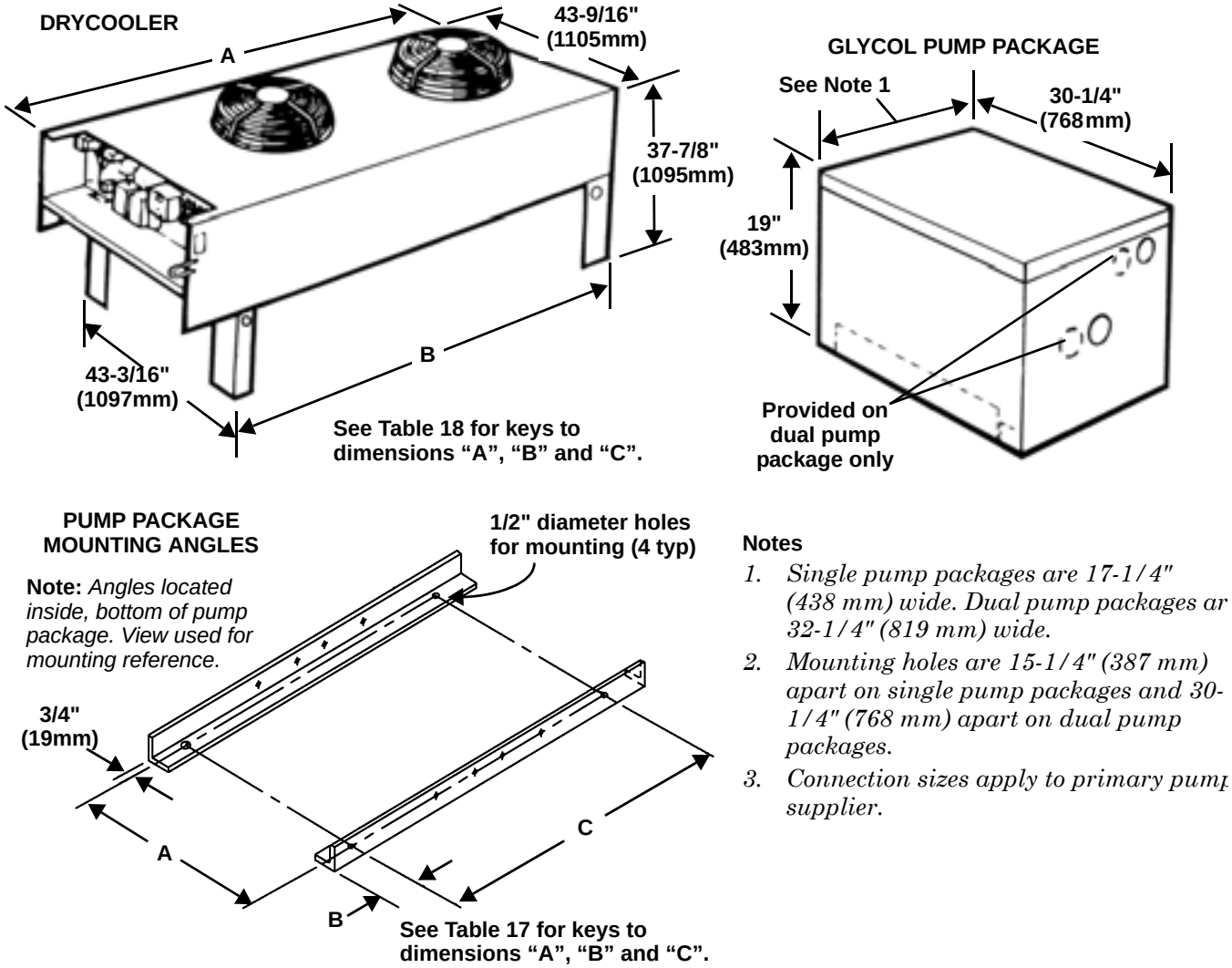
### 5.5.3 Filling the System

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 23 Drycoolers and pump packages**




**Notes**

1. *Single pump packages are 17-1/4" (438 mm) wide. Dual pump packages ar 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 24 on page -48.**

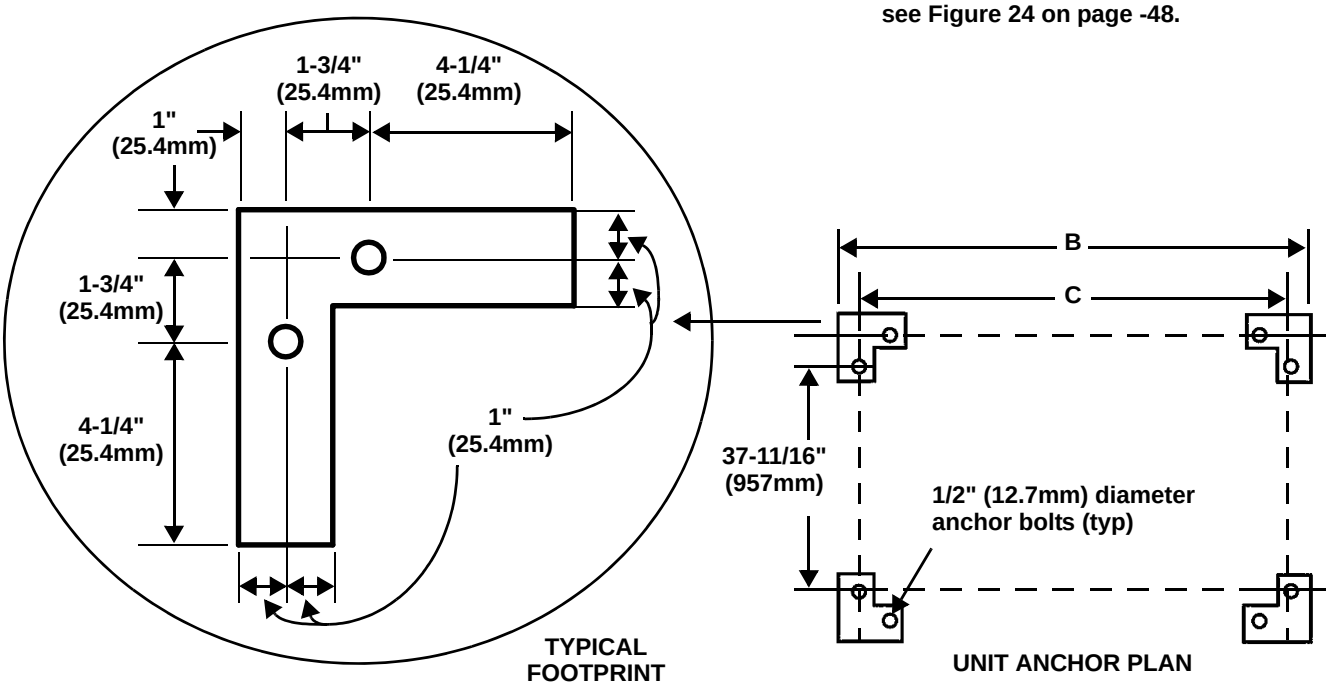


**Figure 24 Pump packages—expansion tank**

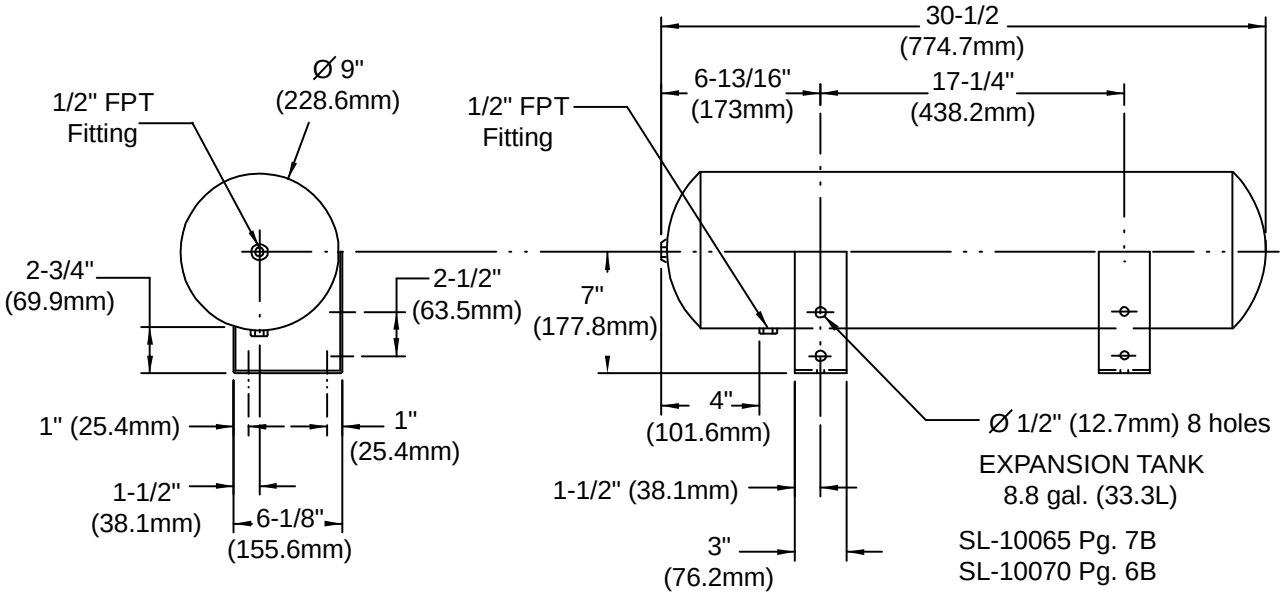



**Table 17 Mounting hole dimensional data**

| 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) |

**Table 18 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 19 Glycol pump data***

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

* Connection sizes apply to primary pump supplier

**Figure 25 General arrangement—Glycol-cooled models with scroll compressor**

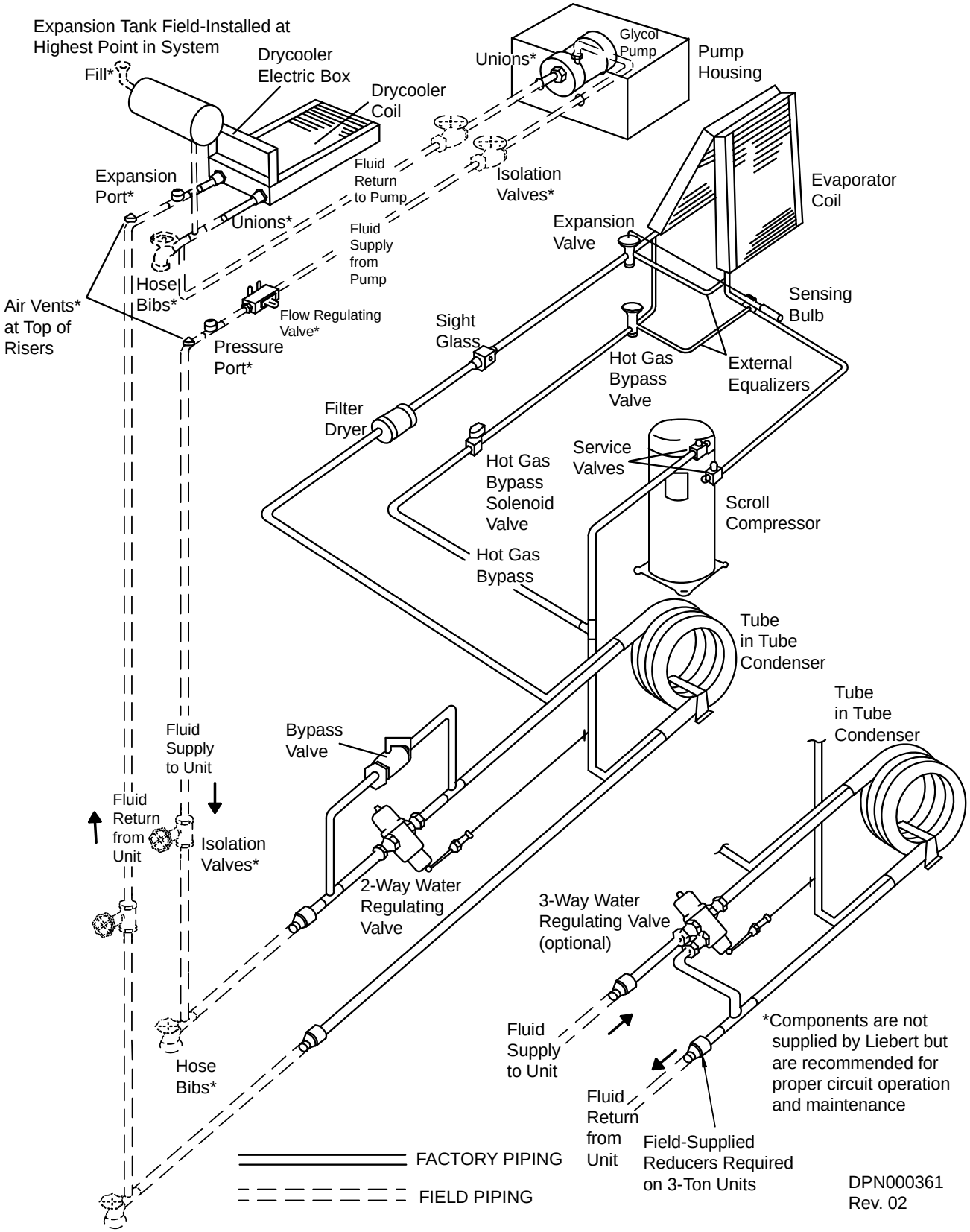


**Figure 26 General arrangement—Glycol-cooled models with digital scroll**

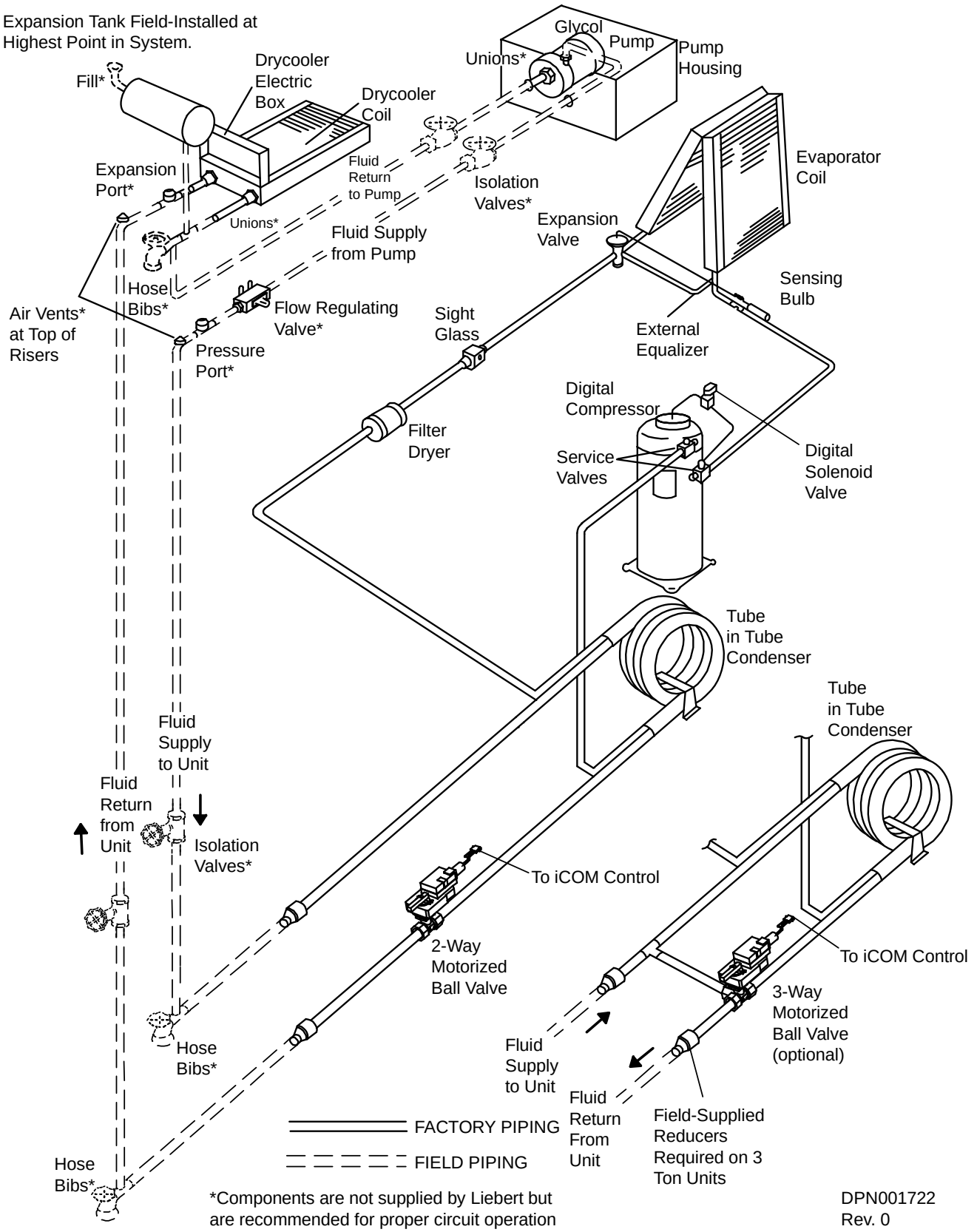


**Figure 27 General arrangement—GLYCOOL models with scroll compressor**

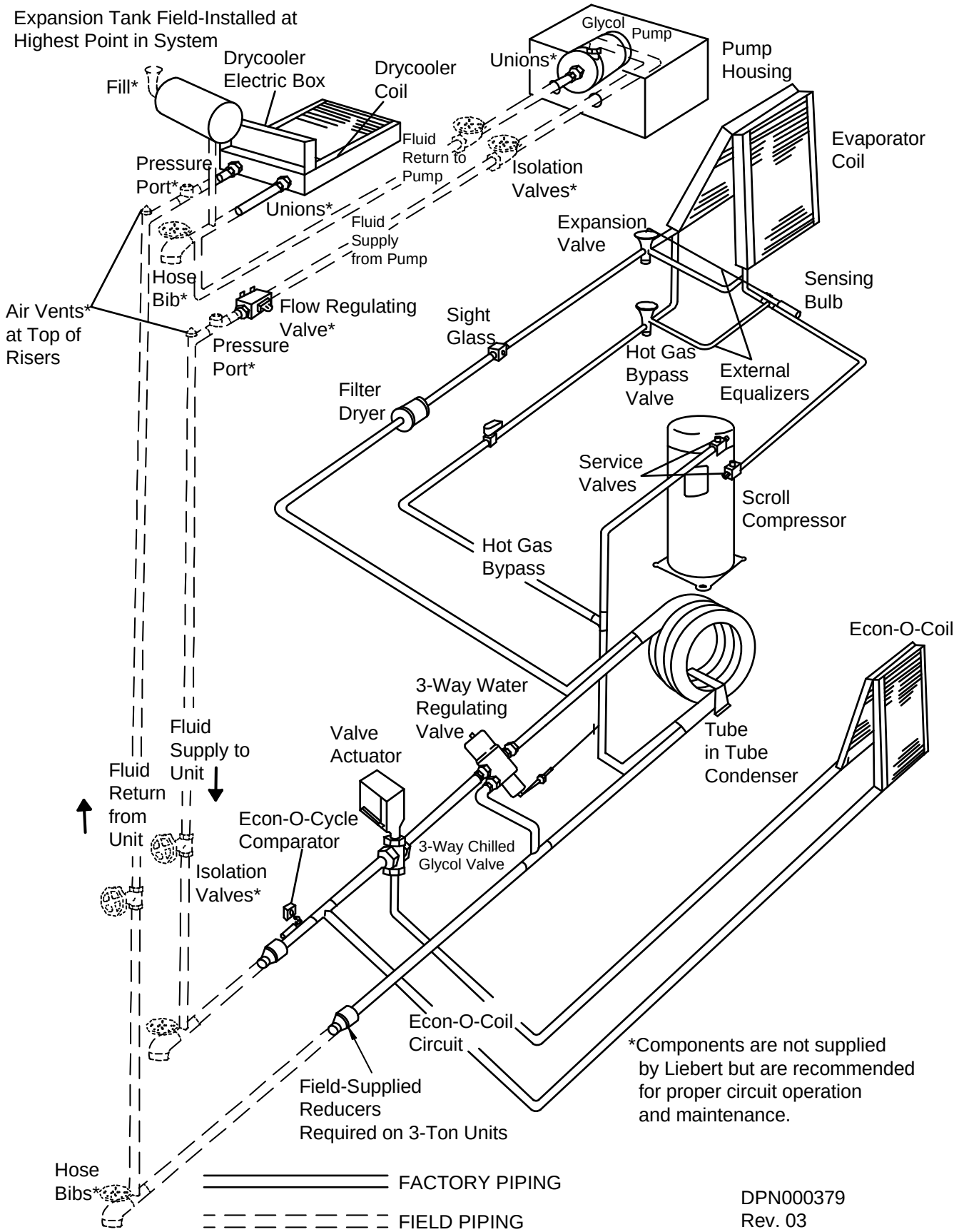
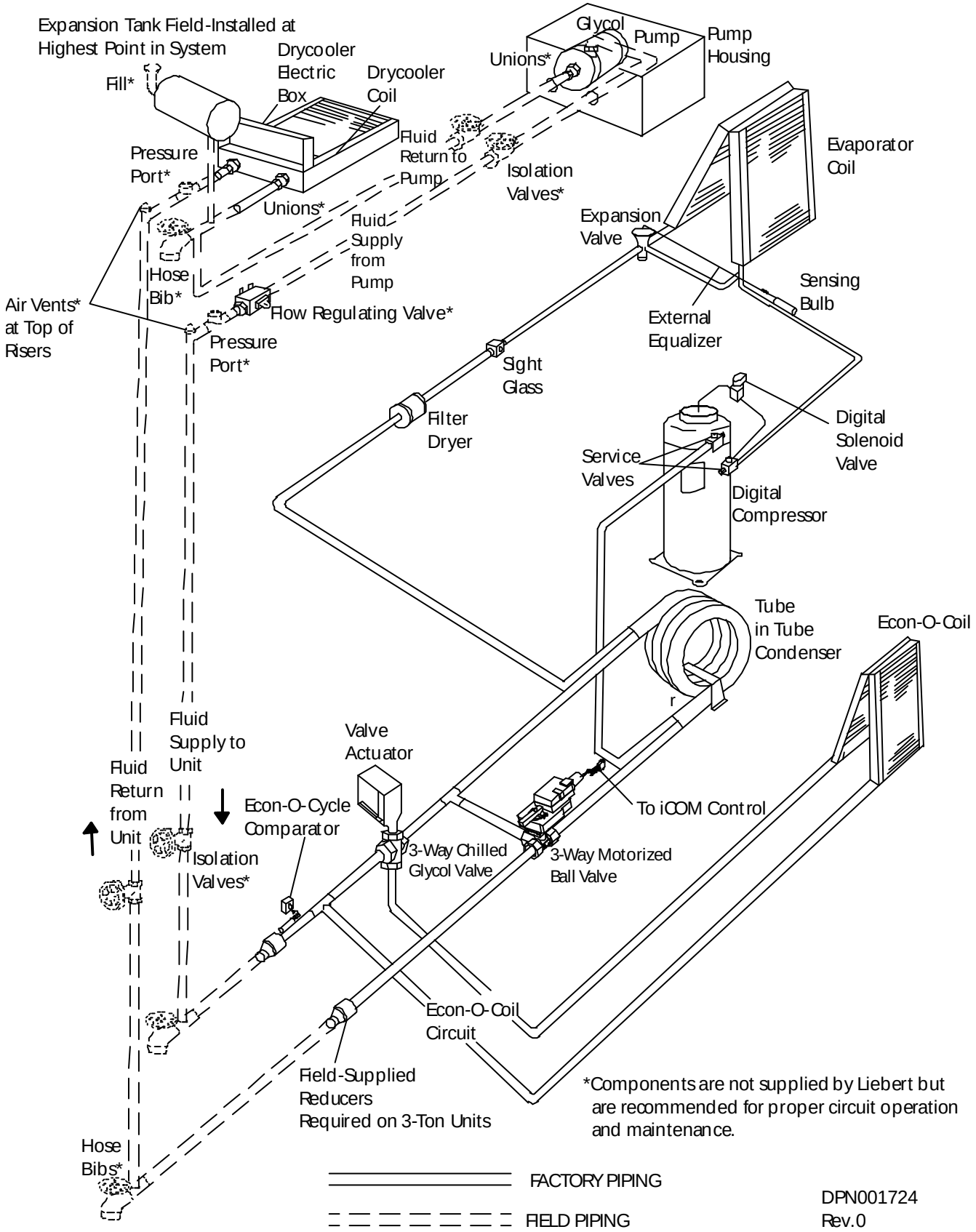


**Figure 28 General arrangement—GLYCOOL models with digital scroll compressor**



### 5.5.4 Motor Ball Valve—Digital Scroll Compressors

Refer to **4.4 - Motorized Ball Valve—Digital Scroll Compressors** for details on the motorized ball valve.

## 5.6 Condenser

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

## 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 Standard Valve - 150 psig (1034 kPa) System for 3 & 5-Ton Units (Johnson Controls Valve) High Pressure Valve - 350 psig (2413 kPa) System for 5-Ton Units (Johnson Controls Valve)

For details, refer to **4.3.1 - Standard Valve - 150 psig (1034 kPa) System for 3 & 5-Ton Units (Johnson Controls Valve) High Pressure Valve - 350 psig (2413 kPa) System for 5-Ton Units (Johnson Controls Valve)**.

### 5.7.2 High Pressure Valve - 350 psig (2413 kPa) System for 3-Ton Units (Metrex Valve)

For details, refer to **4.3.2 - High Pressure Valve - 350 psig (2413 kPa) System for 3-Ton Units (Metrex Valve)**.

### 5.7.3 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 (head pressure is too low) or the pressure sensing capillary is not connected properly to the condenser.

**Table 20 Refrigerant control settings psi (kPa)**

| Low Pressure Cut Out | Low Pressure Cut In | High Pressure Cut Out |
|---|---|---|
| 20 (137.9) | 65 (448.2) | 400 (2758) |

# 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 Liebert Liqui-tect, that is installed near the base of the unit or below the elevated floor.

**Figure 29 Chilled water general arrangement - Upflow (BU)**

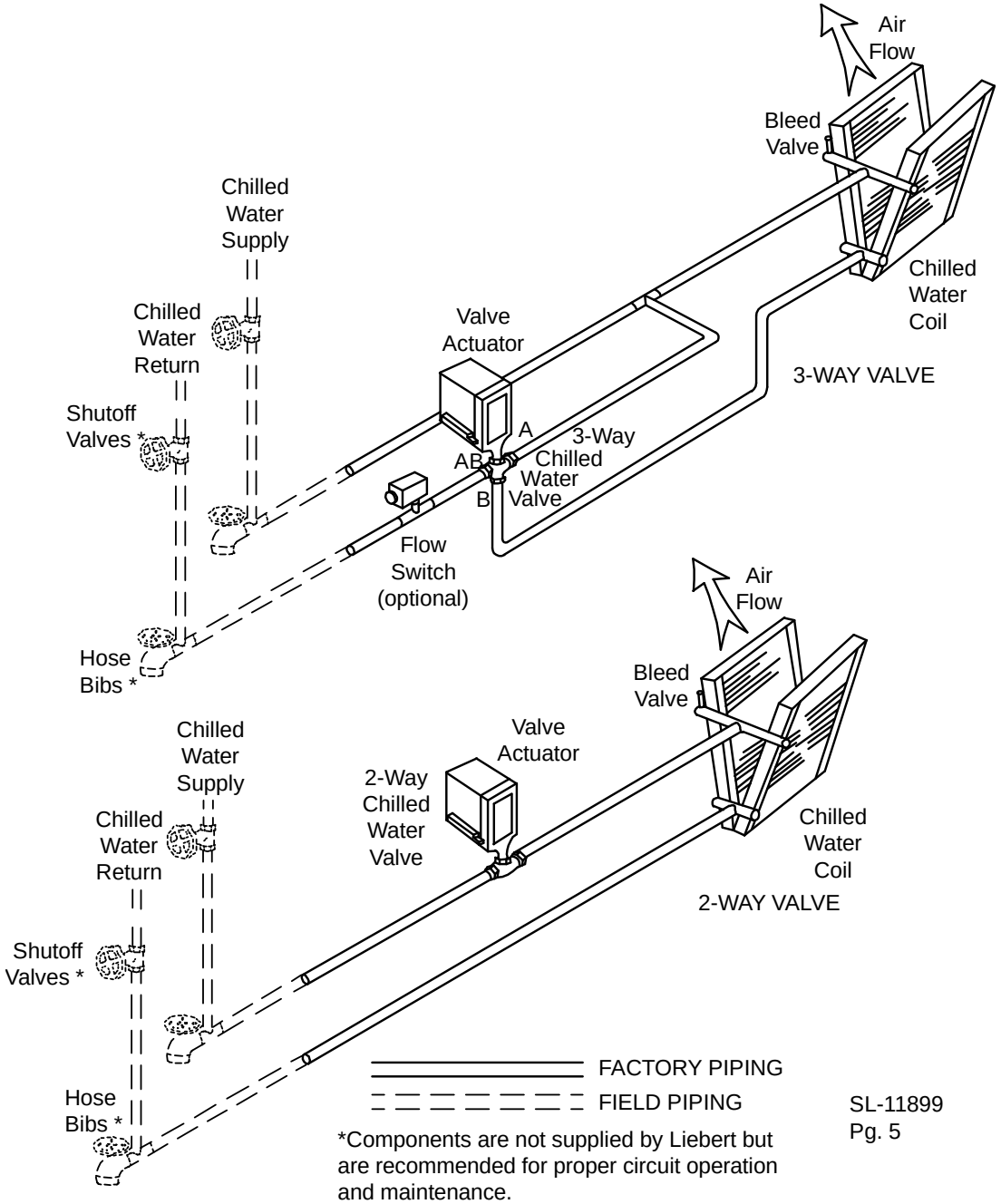
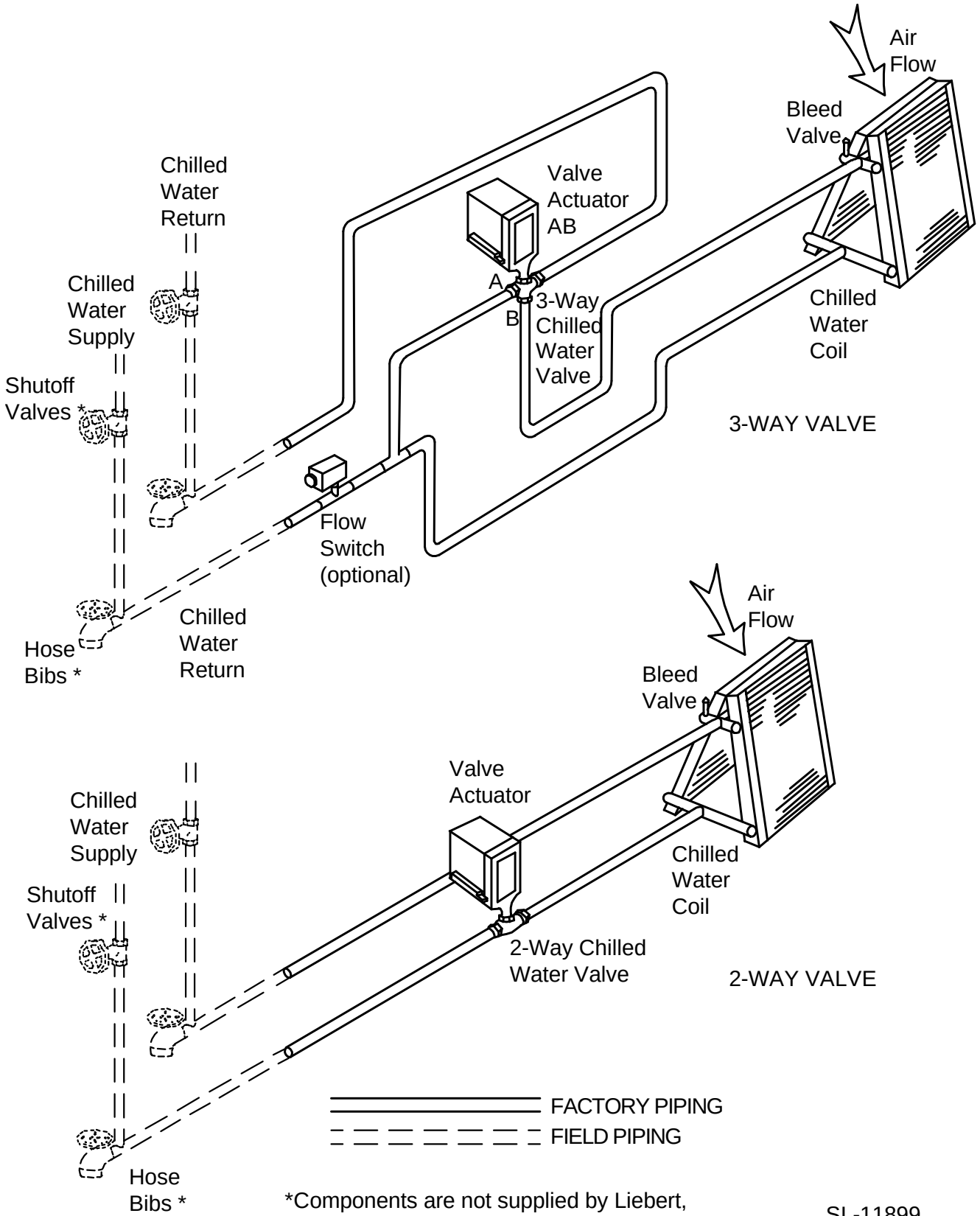


**Figure 30 Chilled water general arrangement - Downflow (BF) models**




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

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# 7.0 SPLIT SYSTEM MODELS

Three condensing unit styles are available: two air-cooled and one 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.

The outdoor condensing unit 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.

The outdoor condensing unit must be located at the same level or above the indoor Liebert Challenger 3000 unit. It must NOT be located below the indoor 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 35 - 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 the in 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.

Potentially lethal voltages exist within this equipment during operation. Observe all cautions and warnings on unit and in this manual.

The Liebert iCOM microprocessor does not isolate power from the unit, even in the “Unit Off” mode. 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.

Use 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

# NOTICE

Risk of improper refrigerant charge. Risk of equipment damage, environmental degradation and violation of national, state and local law.

Follow all applicable codes for handling refrigerant.

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.

R407C refrigerant must be introduced and charged from the cylinder only as a liquid.

# NOTICE

Risk of improper piping installation. Can cause contamination of hygroscopic oil with water.

When installing field piping, care must be taken to protect all refrigerant lines from the atmosphere, especially when using refrigerants, such as R407C which requires use of polyol ester 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 polyol ester oil, which 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 polyol ester 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 (for 3-ton models only).

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 for 3-ton units 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 5 ton evaporator units include a nitrogen holding charge only. See* ***Table 21*** *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 21 Unit refrigerant charge**

| Model | R407C Charge lb (kg) | Model | R407C Charge lb (kg) |
|---|---|---|---|
| BF/BU 036E | 0.5 (0.2) | PF_042A-_H | 25.8 (11.7) |
| BF/BU 035E | 0.5 (0.2) | PF_041A-_H | 25.8 (11.7) |
| BF/BU 060E | 0.8 (0.4) | PF_067A-_L | 25.8 (11.7) |
| BF/BU 059E | 0.8 (0.4) | PF_066A-_L | 25.8 (11.7) |
| MC_40/39A | 12.9 (5.8) | PF_Z67A-_L | 50.1 (22.7) |
| MC_65/64A | 26.1 (11.8) | PF_Z66A-_L | 50.1 (22.7) |
| PF_042A-_L | 12.9 (5.8) | PF_067A-_H | 50.1 (22.7) |
| PF_041A-_L | 12.9 (5.8) | PF_066A-_H | 50.1 (22.7) |
| PF_Z42A-_L | 25.8 (11.7) | MC_44/43W | 3.4 (1.5) |
| PF_Z41A-_L | 25.8 (11.7) | MC_69/68W | 5.9 (2.7) |

**Table 22 Line charges - refrigerant per 100 ft. (30 m) of Type “L” copper tube**

| O.D. | R407C | |
|---|---|---|
| | Liquid Line lb (kg) | Suction Line lb (kg) |
| 1/2" | 7.3 (3.3) | - |
| 5/8" | 11.7 (5.3) | 0.4 (0.2) |
| 7/8" | 24.4 (11.1) | 1.0 (0.4) |
| 1-1/8" | 41.6 (18.9) | 1.7 (0.7) |
| 1-3/8" | 63.3 (28.7) | 2.7 (1.1) |

**Table 23 Recommended refrigerant lines (R407C) sizes OD copper**

| Equivalent Feet (m) | 3.5-Ton 036E (035E) | | 5-Ton 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 24 Line coupling sizes**

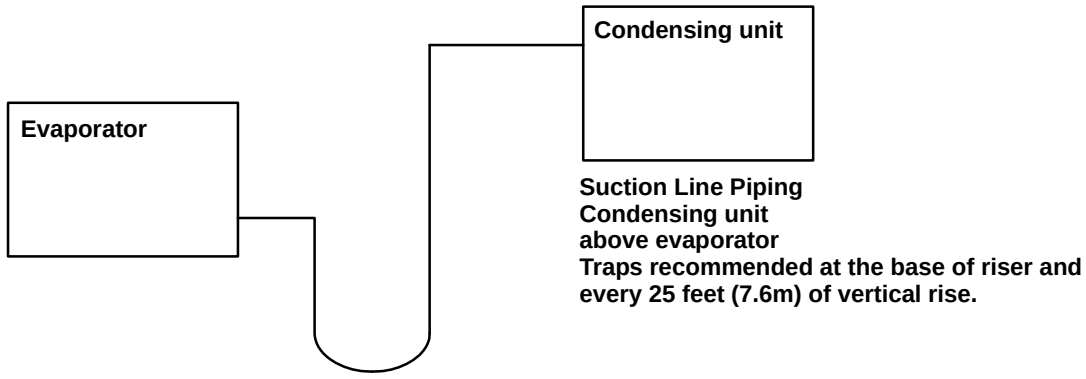
| Model (Tons) | Line Size OD Cu, in. | Coupling Size | Torque lb-ft. |
|---|---|---|---|
| 3 | 3/8 | #6 | 10-12 |
| 5 | 1/2 & 5/8 | #10 | 35-45 |
| 3 | 7/8 | #11 | 35-45 |
| 5 | 1-1/8 | #12 | 50-65 |

**Table 25 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 31 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 24** for torque requirements.
8. Add charge for the additional piping (refer to **Table 22**).

## 7.4 Outdoor Air-Cooled Condensing Units

**Figure 32 Outdoor air-cooled condensing unit—horizontal air discharge models**

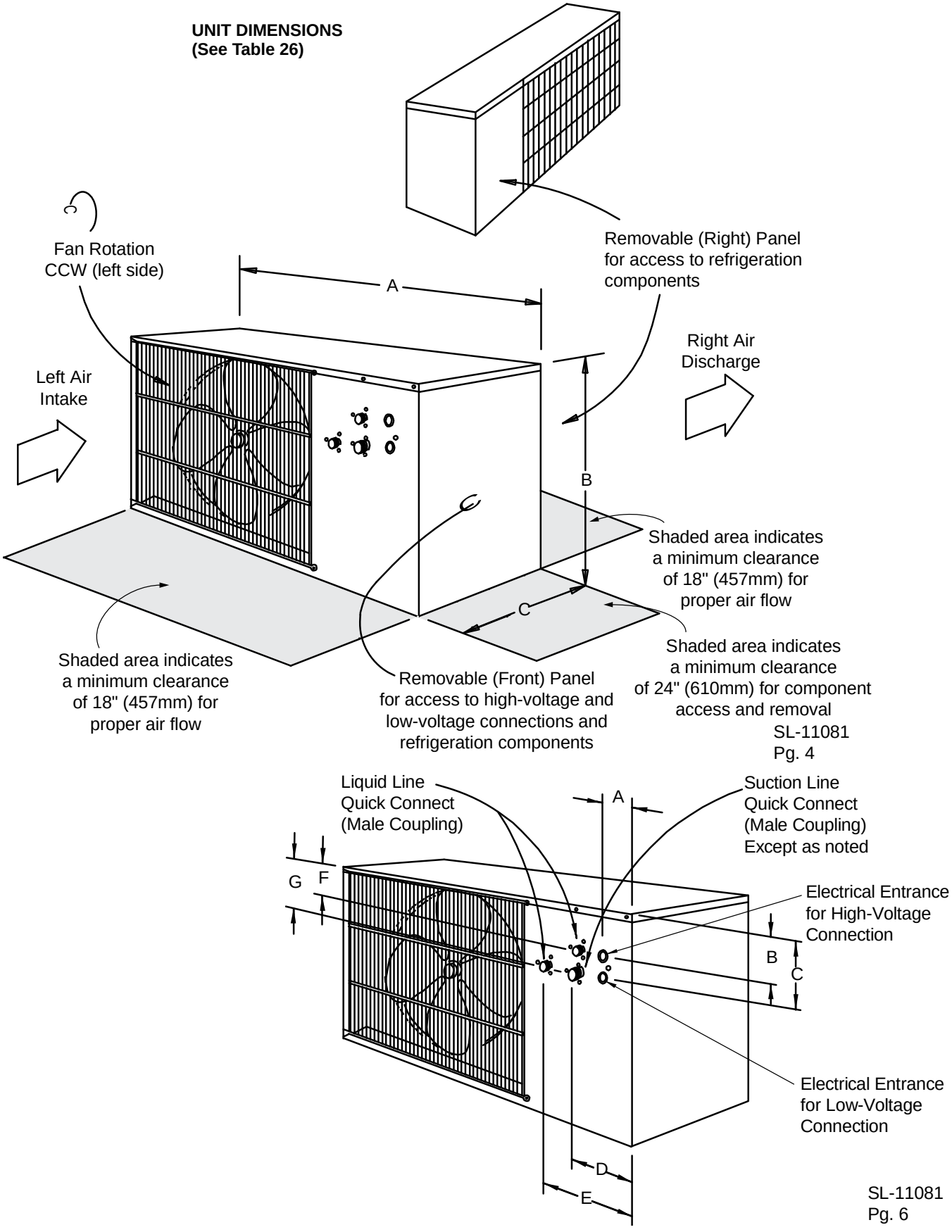


**Table 26 Horizontal air discharge cabinet and floor planning dimensional data**

| Model Numbers | | Dimensional Data in. (mm) | | | Module Weight lb (kg) net |
|---|---|---|---|---|---|
| 60 Hz | 50 Hz | A | B | C | |
| PFC042A-_L | PFC041A-_L | 48 (1219) | 31 (787) | 18 (457) | 241 (109) |
| PFH042A-_L | — | | | | |
| PFC042A-_H | PFC041A-_H | 53 (1343) | 36-1/4 (918) | 18 (457) | 351 (159) |
| PFH042A-_H | — | | | | |
| PFCZ42A-_L | PFCZ41A-_L | | | | |
| PFC067A-_L | PFC066A-_L | | | | |
| PFH067A-_L | — | | | | |

**Table 27 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 |
| PFC042A-_L | PFC041A-_L | 2 (51) | 5-3/4 (146) | 8-1/2 (216) | 4-3/4 (121) | 6-3/4 (171) | — | 8-1/2 (216) |
| PFH042A-_L | — | | | | | | | |
| PFC042A-_H | PFC041A-_H | 2 (51) | 6 (152) | 8-1/2 (216) | 4-3/4 (121) | 7-3/4 (197) | — | 8-1/2 (216) |
| PFH042A-_H | PFCZ41A-_L | | | | | | | |
| PFCZ42A-_L | — | | | | | | | |
| PFC067A-_L | PFC066A-_L | | | | | | | |
| PFH067A-_L | — | | | | | | | |

**Figure 33 Outdoor air-cooled condensing unit—top air discharge models**

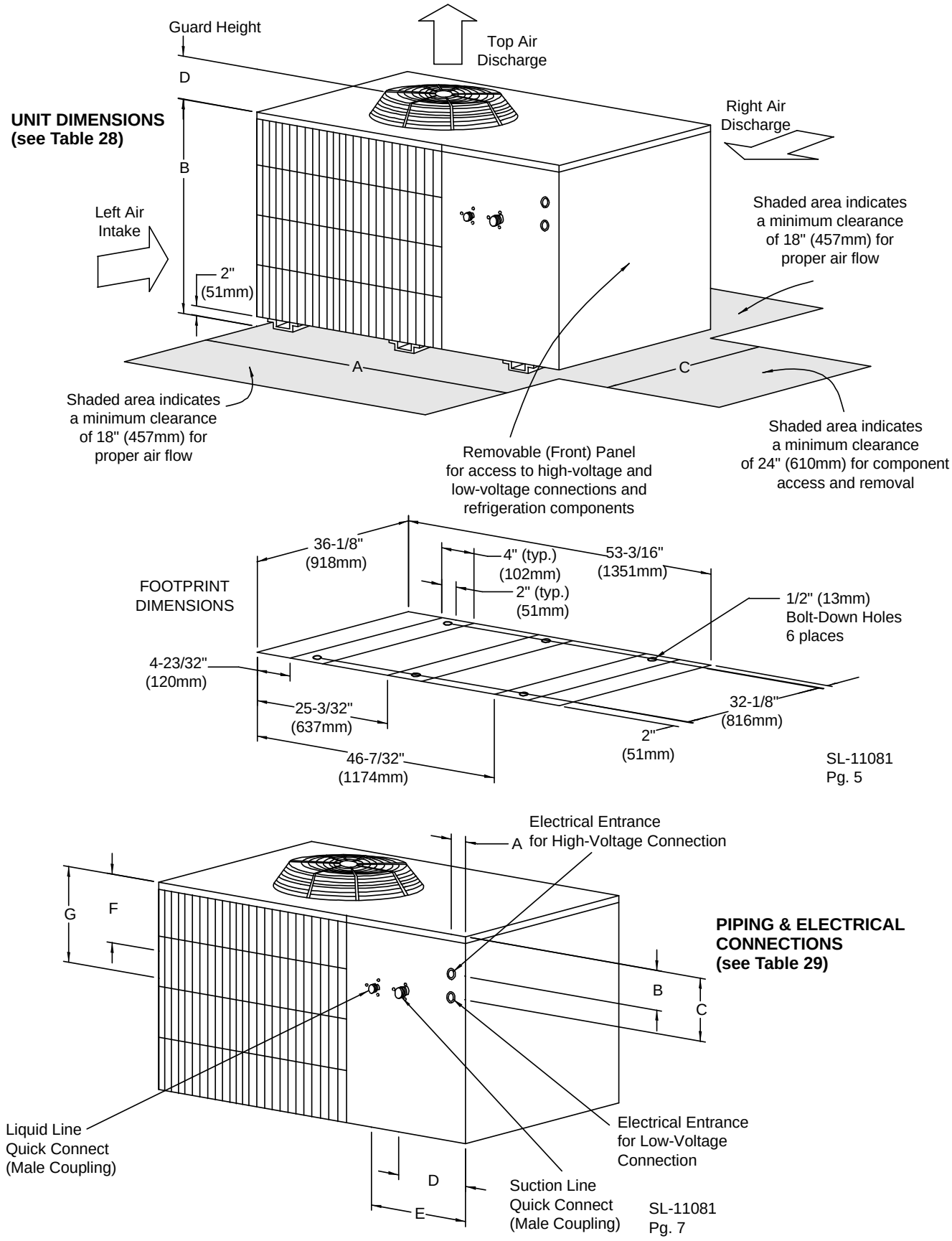


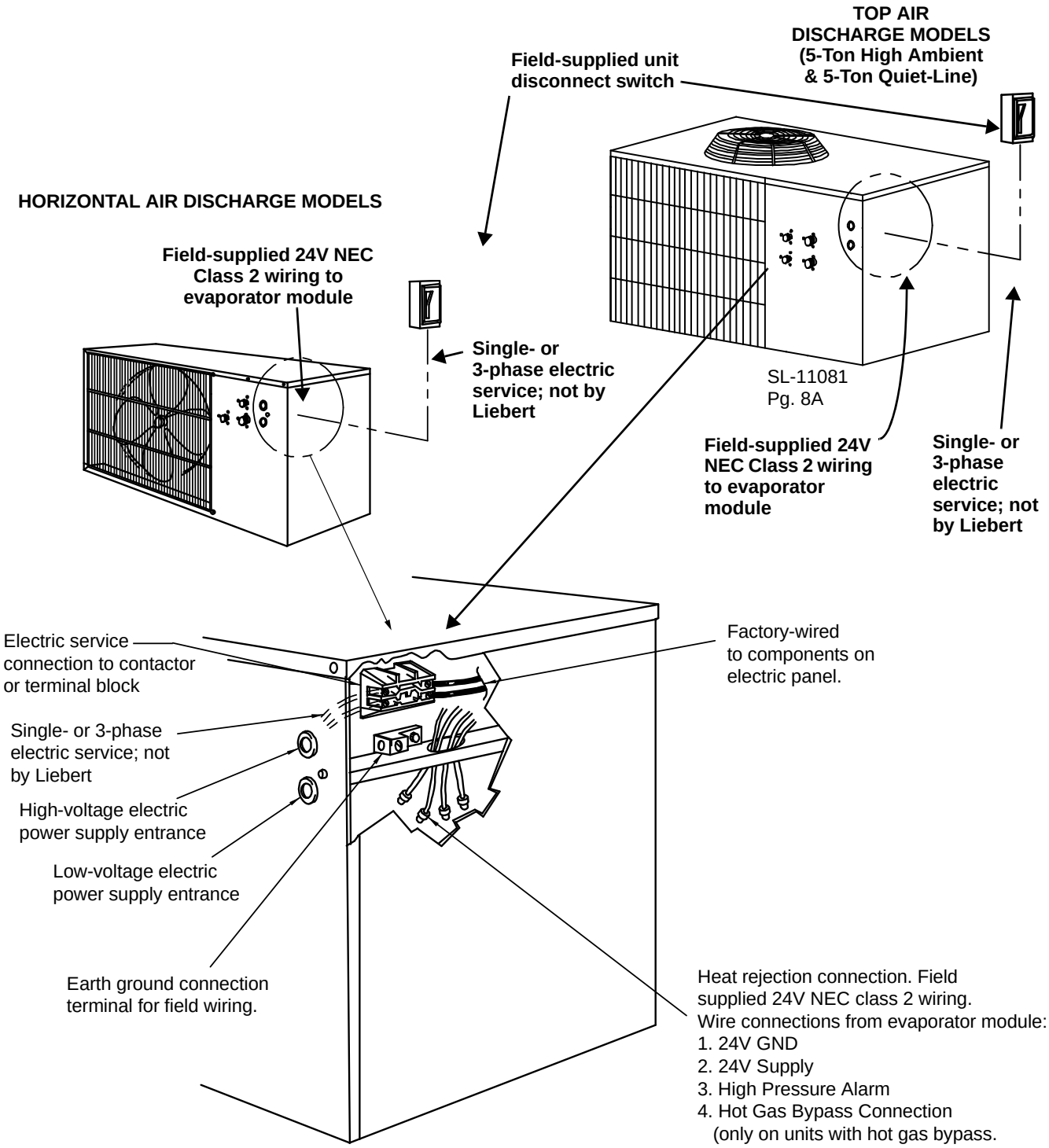
**Table 28 Cabinet and floor planning dimensional data - prop fan condensing modules, top air discharge**

| 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 29 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 34 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 heavy unit falling from supports. Can cause equipment and building damage, injury and death.

Be sure the supporting roof structure is capable of supporting the weight of the unit(s) and the accessories during installation and service. (See **Table 30 - 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.

The indoor condensing unit must be located at the same level or above the Liebert Challenger 3000 unit. It must NOT be located below the Liebert Challenger 3000.

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 35 - 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**

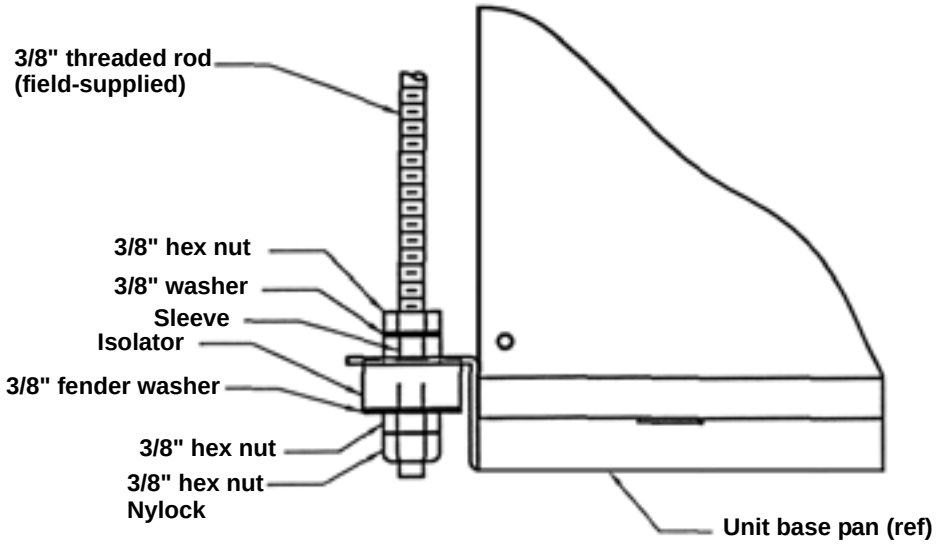
*The units must be level in order to operate properly.*

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

**Table 30 Indoor centrifugal condensing unit**

| Model | | Net Weight lb (kg) |
|---|---|---|
| 60 Hz | 50 Hz | |
| MC_40A | MC_39A | 240 (109) |
| MC_65A | MC_64A | 449 (204) |

**Figure 35 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 $H_2O$. 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.

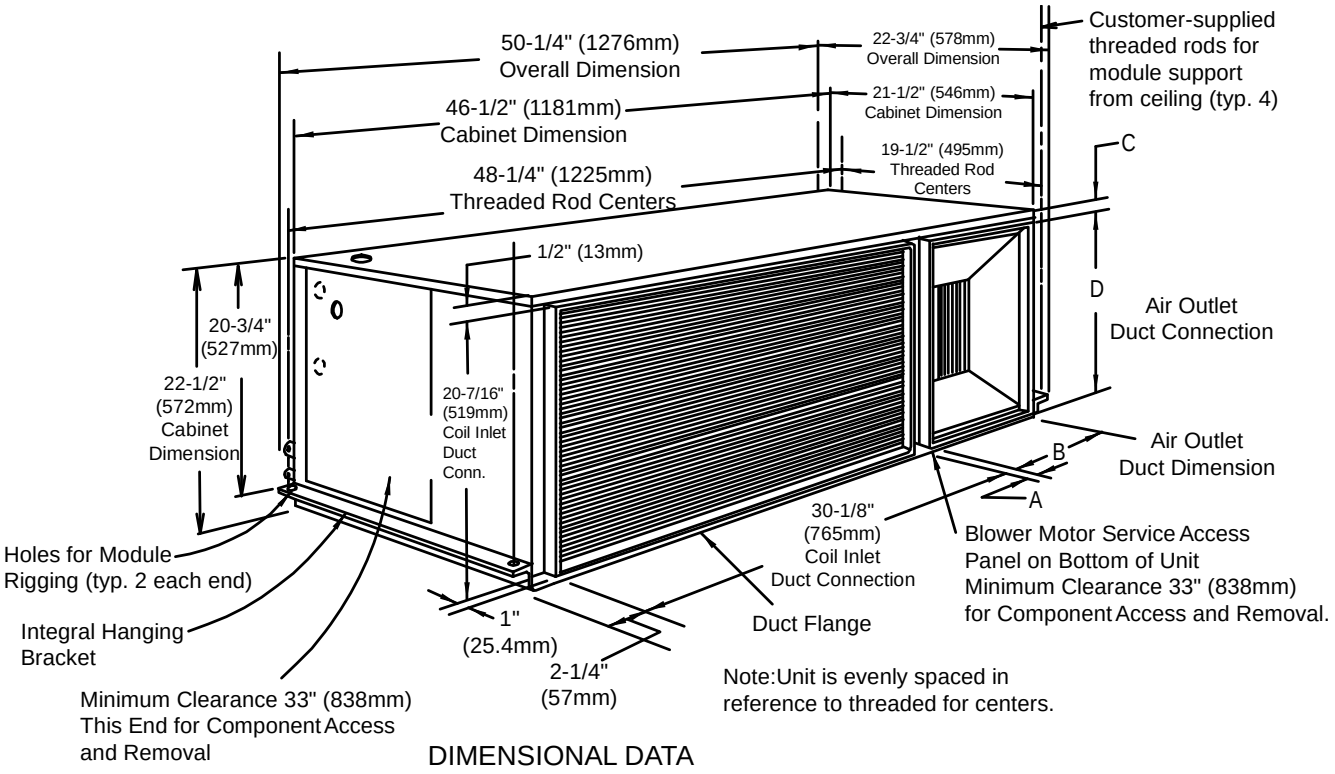
Normal operating sound may be objectionable if the condensing unit is placed directly over quiet work areas. Ductwork that runs through a conditioned space or is exposed to areas where condensation may occur must be insulated. Whenever possible, ductwork should be suspended using flexible hangers. Ductwork 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 31 Airflow CFM (CMH)**

| | 3-Ton | 5-Ton |
|---|---|---|
| 60 Hz | 2000 (3398) | 3500 (5947) |
| 50 Hz | 1650 (2800) | 3500 (5947) |

**Figure 36 3-ton centrifugal air-cooled condensing unit dimensional data & piping connections**




DIMENSIONAL DATA

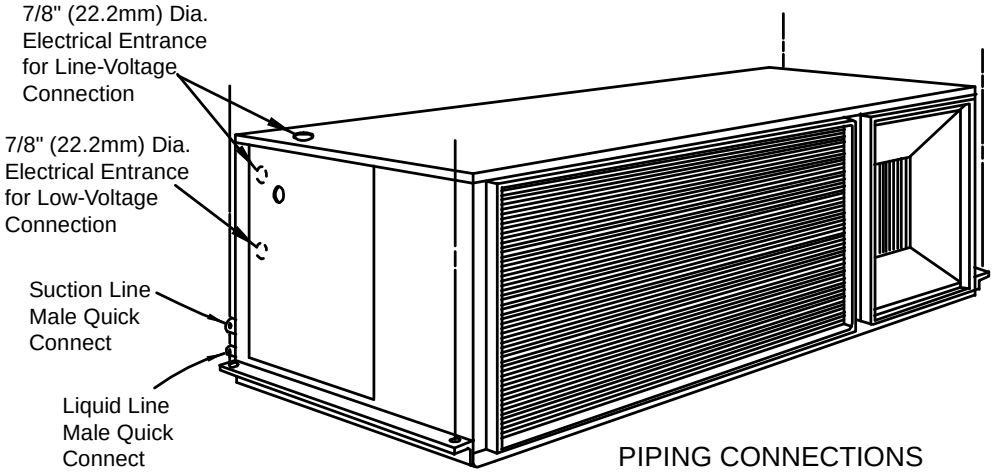



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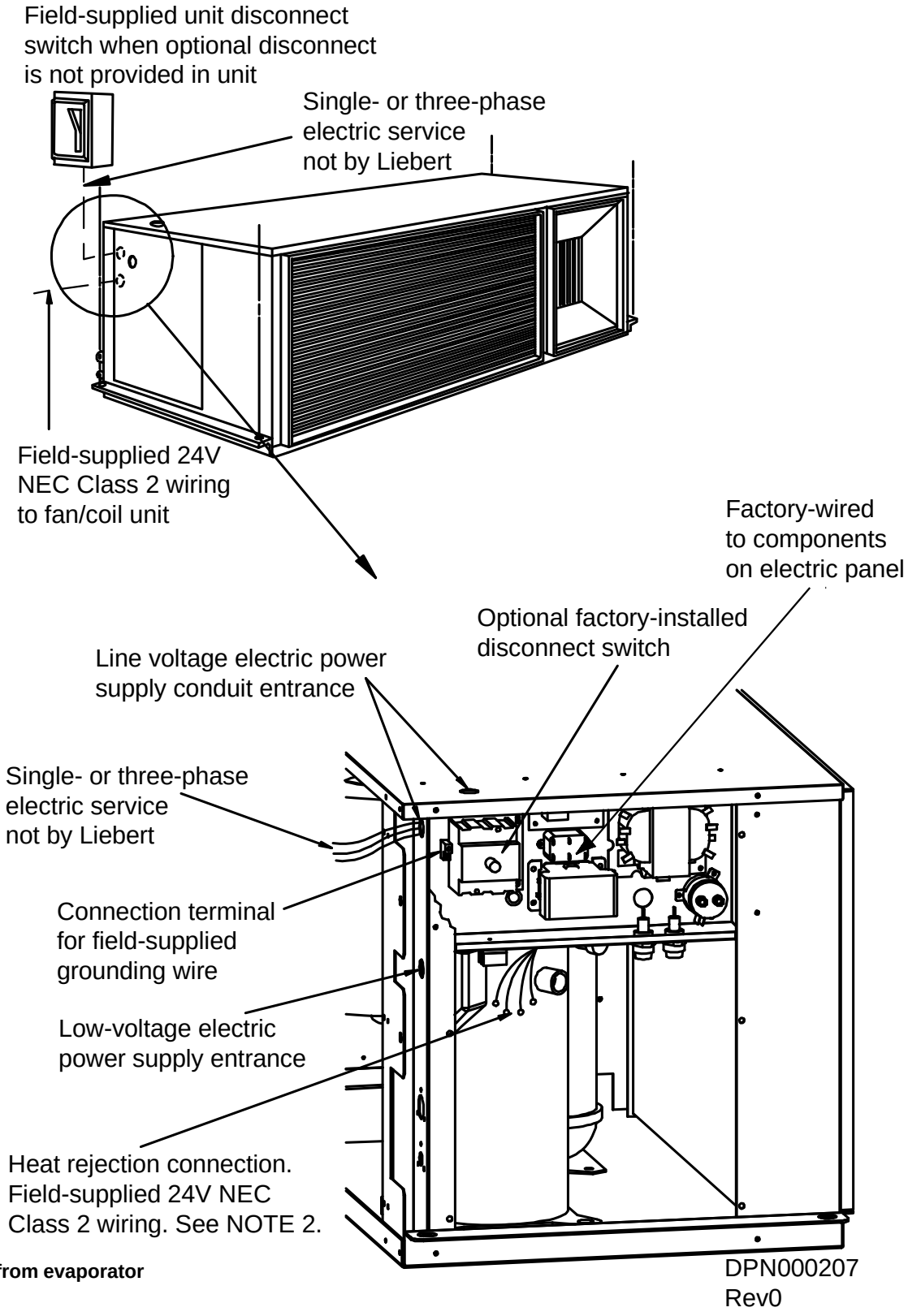
**Figure 37 3-ton centrifugal air-cooled condensing unit (con't.)**




**Wire connections from evaporator mod:**
1. **24V ground**
2. **24V supply**
3. **High-pressure alarm (optional)**
4. **Hot gas bypass connection (only on units with hot gas bypass)**

**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 38 5-ton centrifugal air-cooled condensing unit dimensional data**

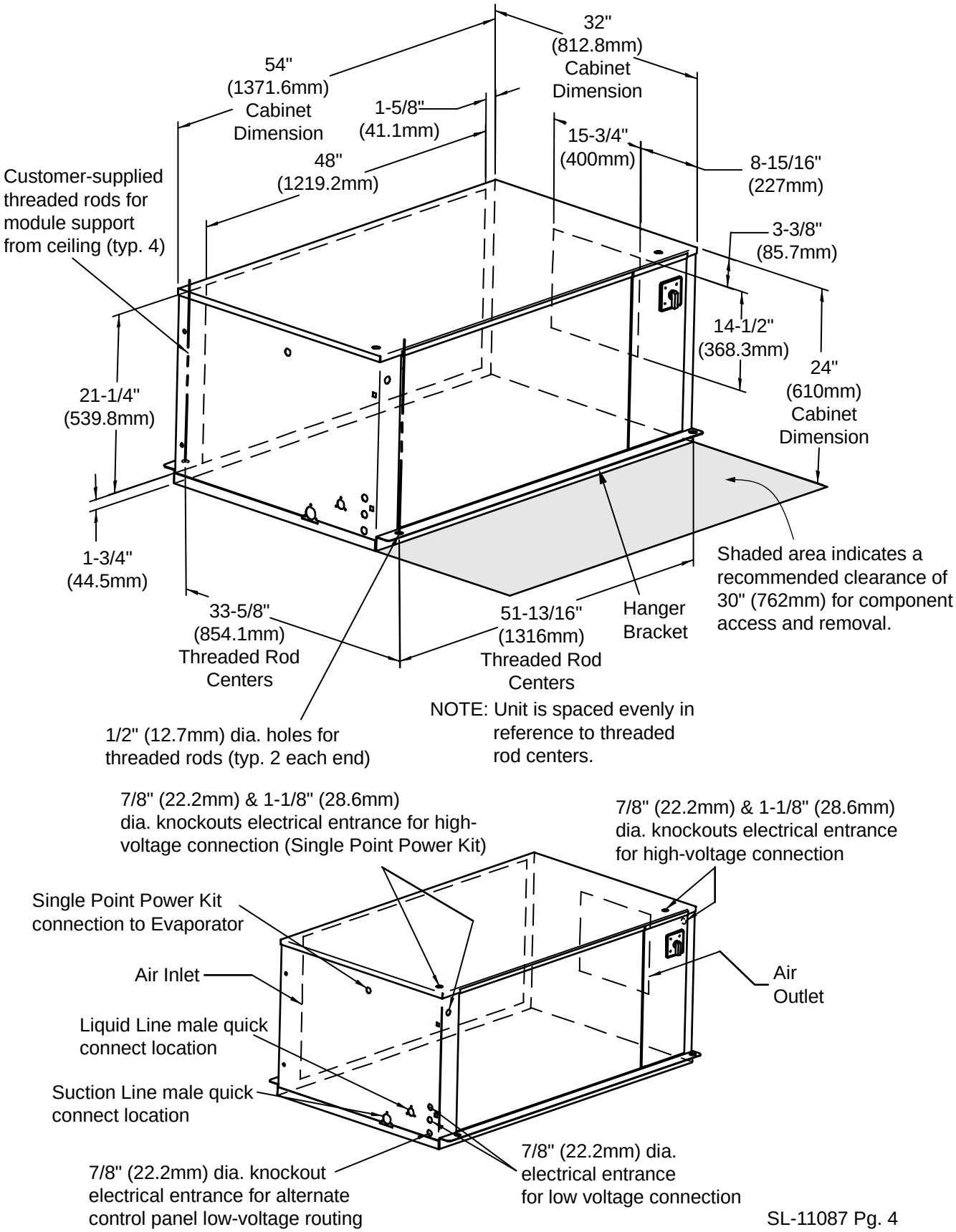
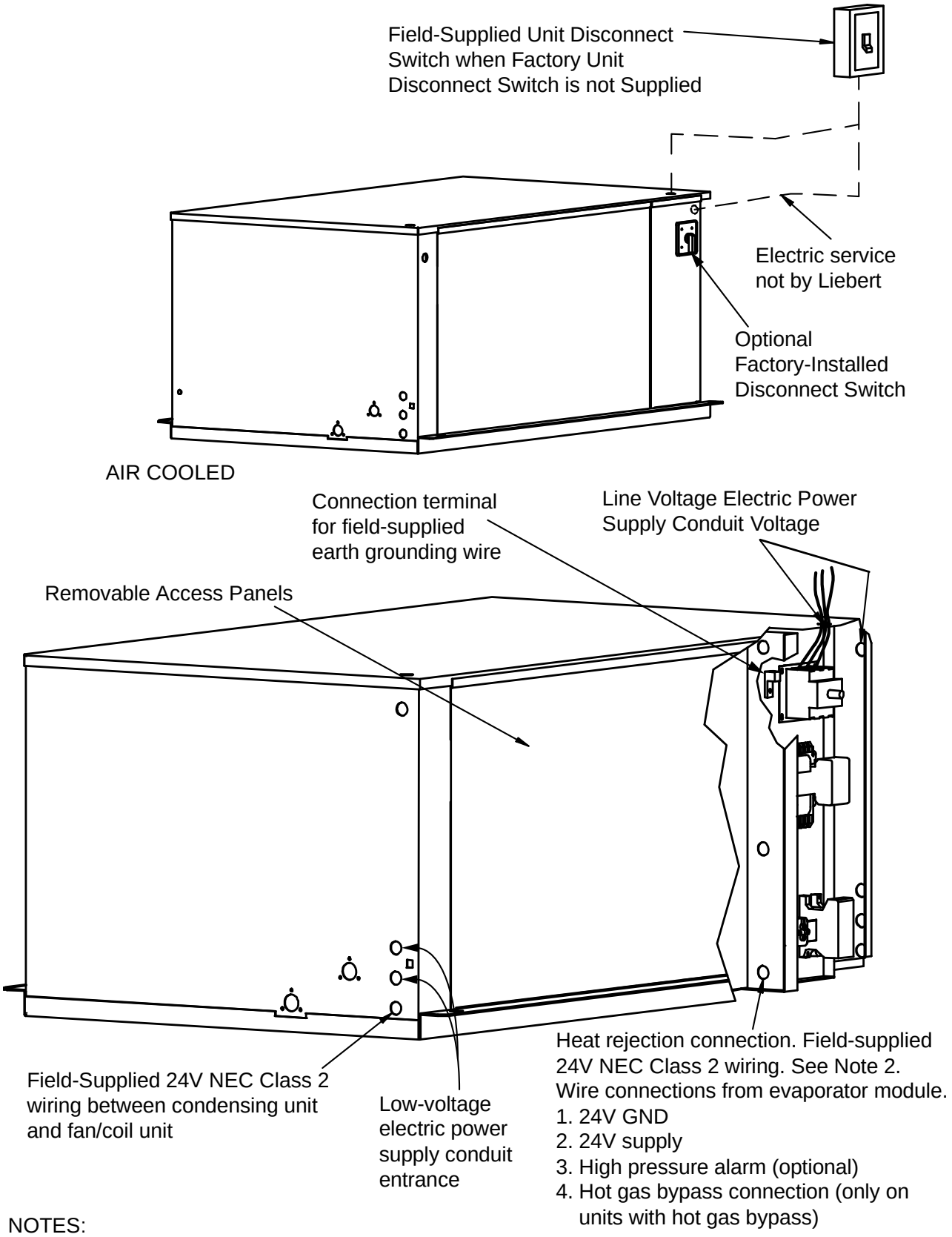


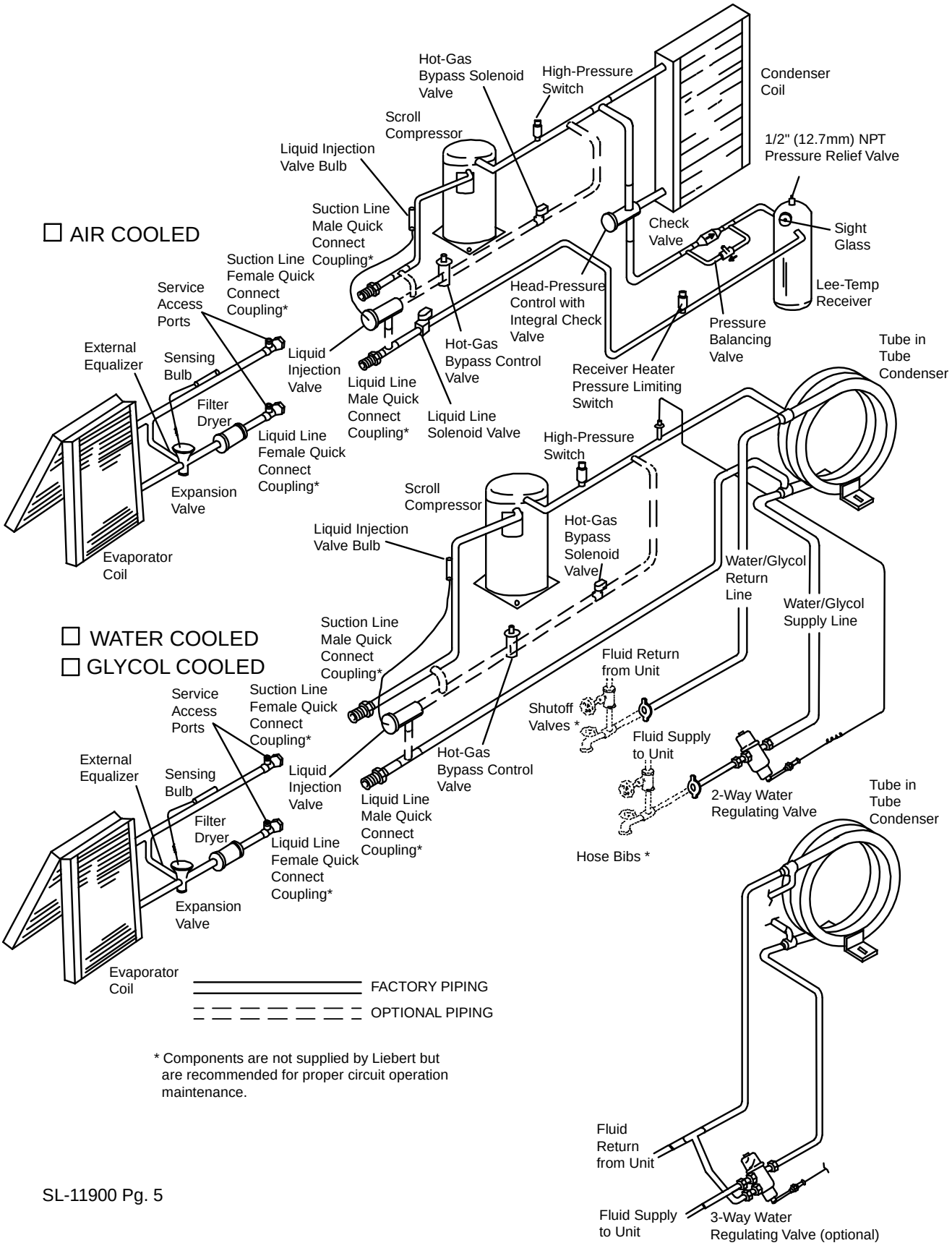
**Figure 39 5-ton centrifugal air-cooled condensing unit dimensional data (con't.)**




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

DPN000226_Rev0

**Figure 40 Split systems general arrangement**




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

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## 7.6 Water and Glycol-Cooled Condensing Units

For installation guidelines, refer to **Installing the Indoor Condensing Unit on page 65.**

### 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.

**3-Ton Connection Sizes**

| | |
|---|---|
| Condenser Water Inlet | 7/8" OD Cu |
| Condenser Water Outlet | 7/8" OD Cu |
| Suction Line | 1-1/8 - 12 male #11 quick connect |
| Liquid Line: | 5/8 - 18 male #6 quick connect |

**5-Ton Connection Sizes**

| | |
|---|---|
| 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 32 Water and glycol-cooled condensing unit data**

| Model | Net Weight, lb (kg) | Glycol Volume, gal (l) |
|---|---|---|
| MC_44W<br>MC_43W | 200 (91) | 1.7 (6.4) |
| MC_69W<br>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

For details, refer to sections **4.3.1 - Standard Valve - 150psig (1034kPa) System for 3 & 5-Ton Units (Johnson Controls Valve) High Pressure Valve - 350psig (2413kPa) System for 5-Ton Units (Johnson Controls Valve)** and **4.3.2 - High Pressure Valve - 350 psig (2413 kPa) System for 3-Ton Units (Metrex Valve)**.

### 7.6.4 Glycol Systems

For split system glycol systems, use drycooler and pump data found in **5.0 - Glycol/GLYCOOL-Cooled Models—Self-Contained Compressor**. See **Table 18 - Drycooler data**.

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

**Figure 41 3-ton water/glycol-cooled condensing unit**

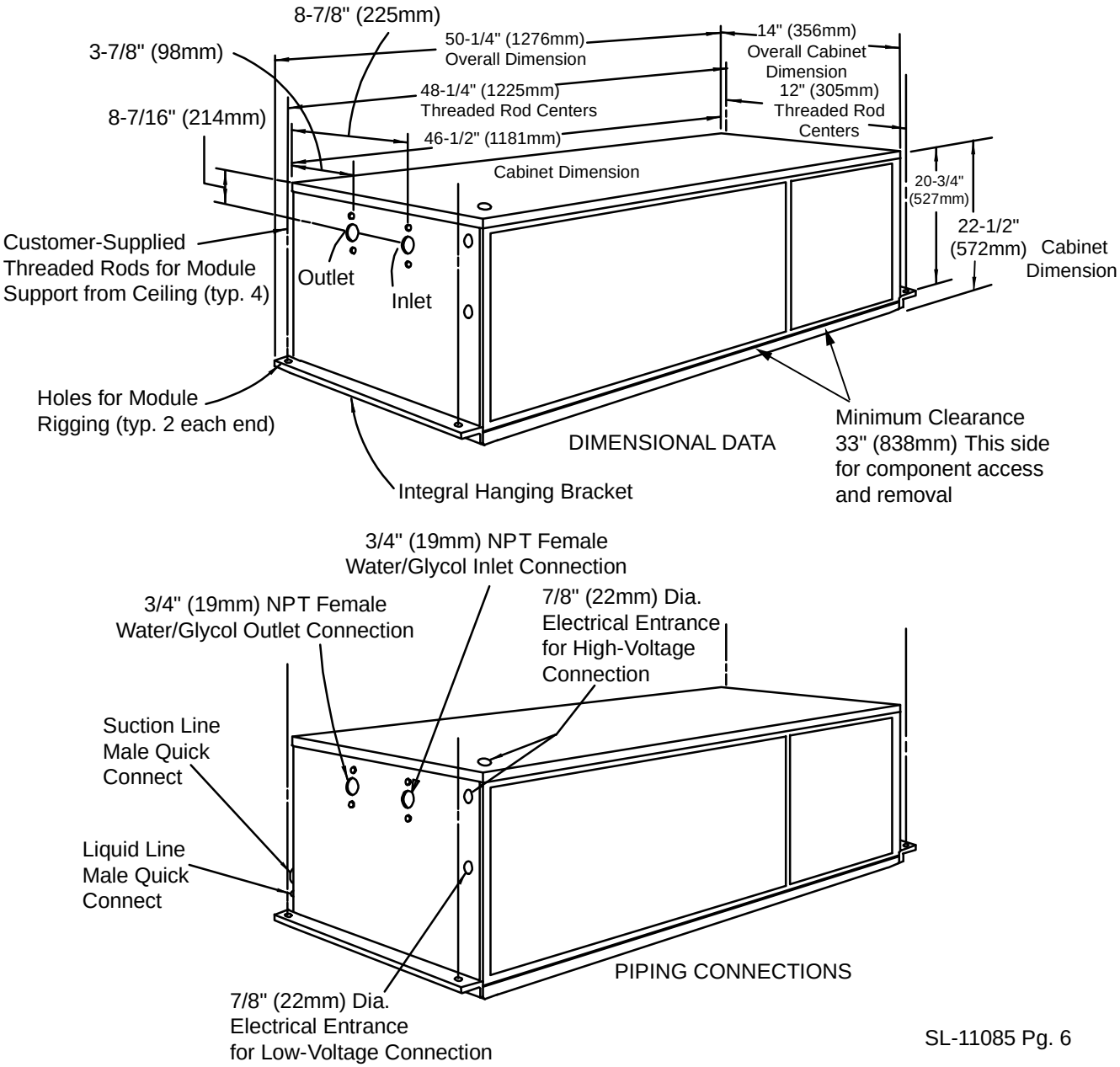
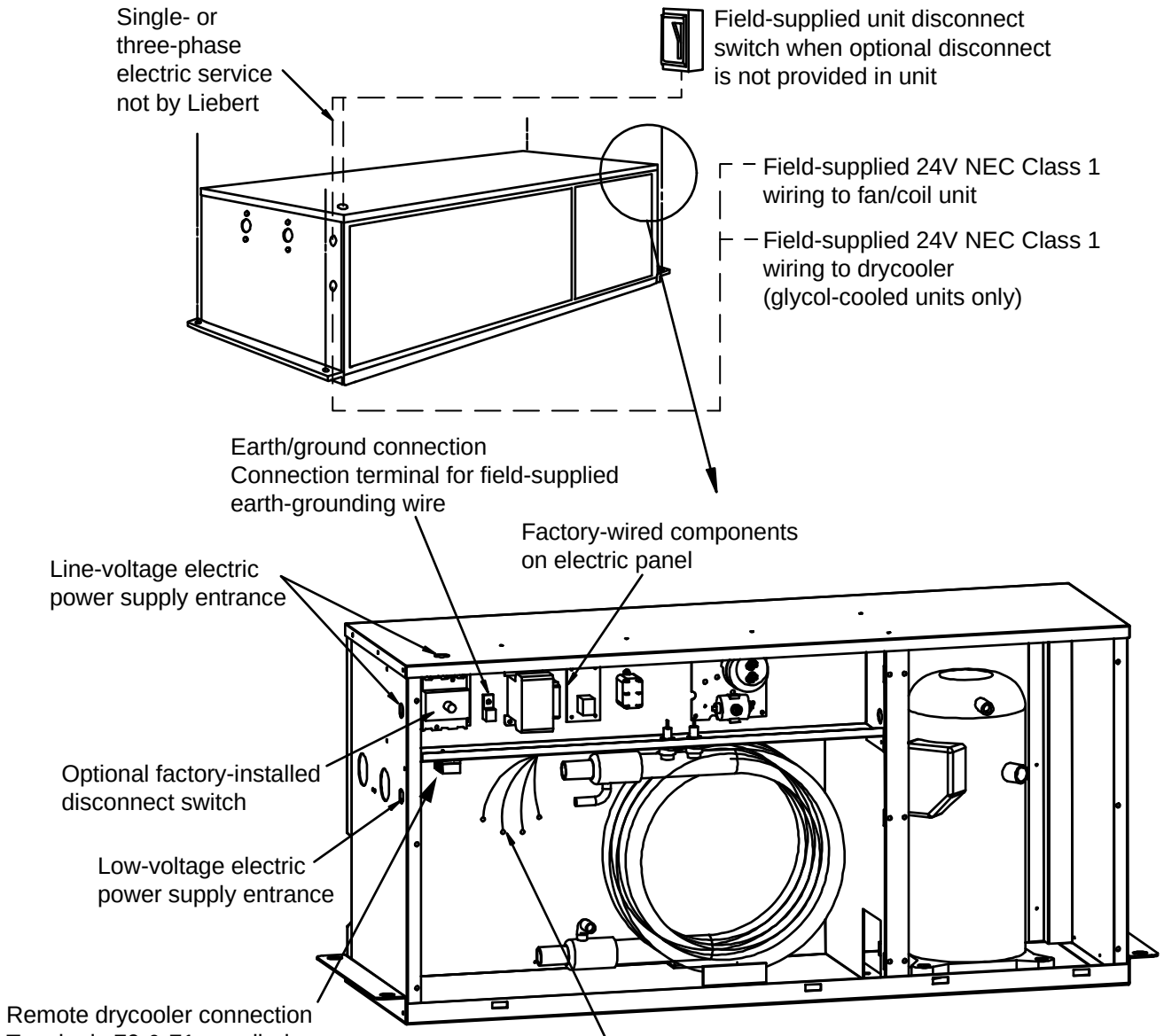


**Figure 42 3-ton water/glycol-cooled condensing unit (con't.)**




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.

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**Figure 43 5-ton water/glycol-cooled condensing unit dimensional data**

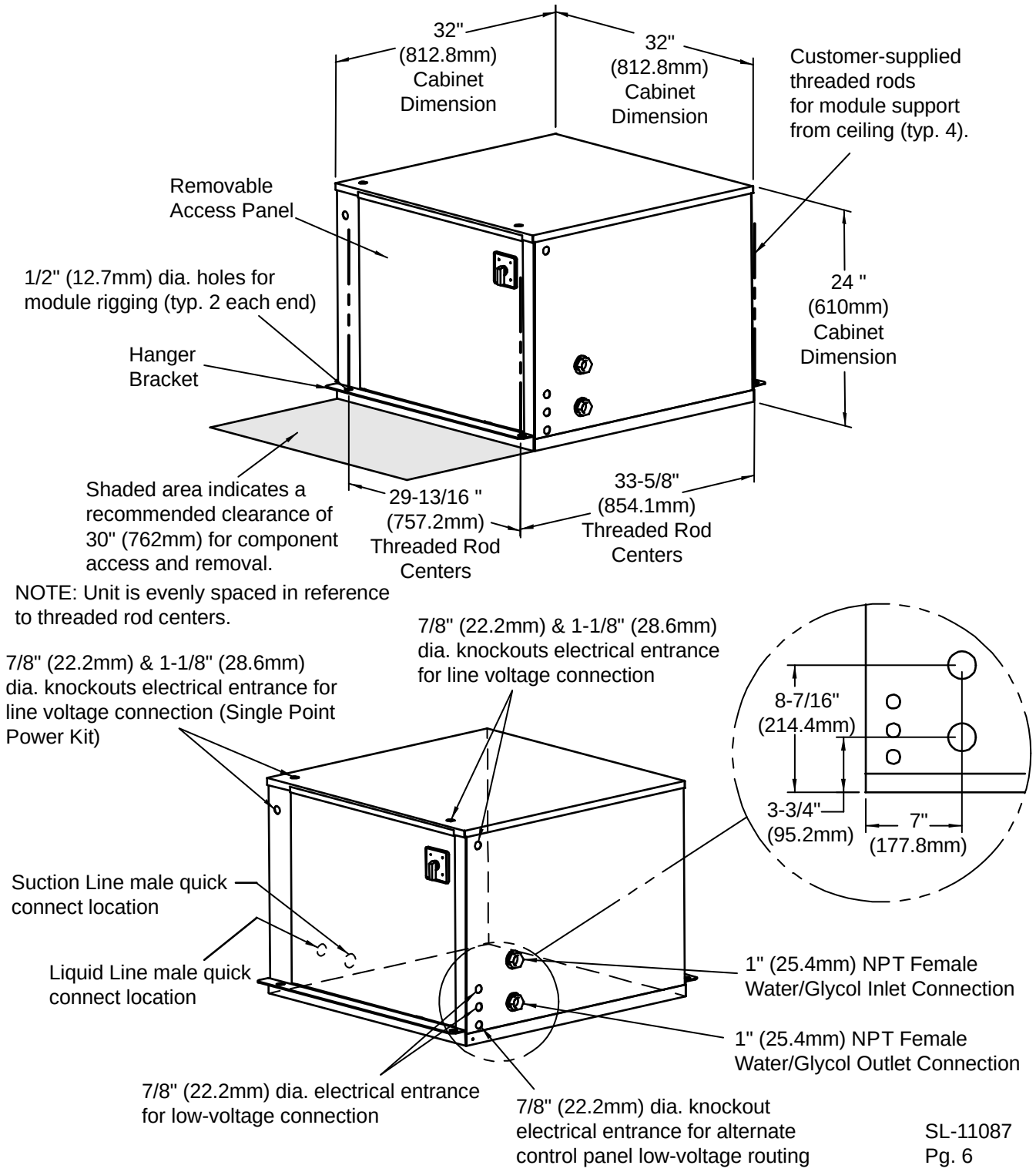
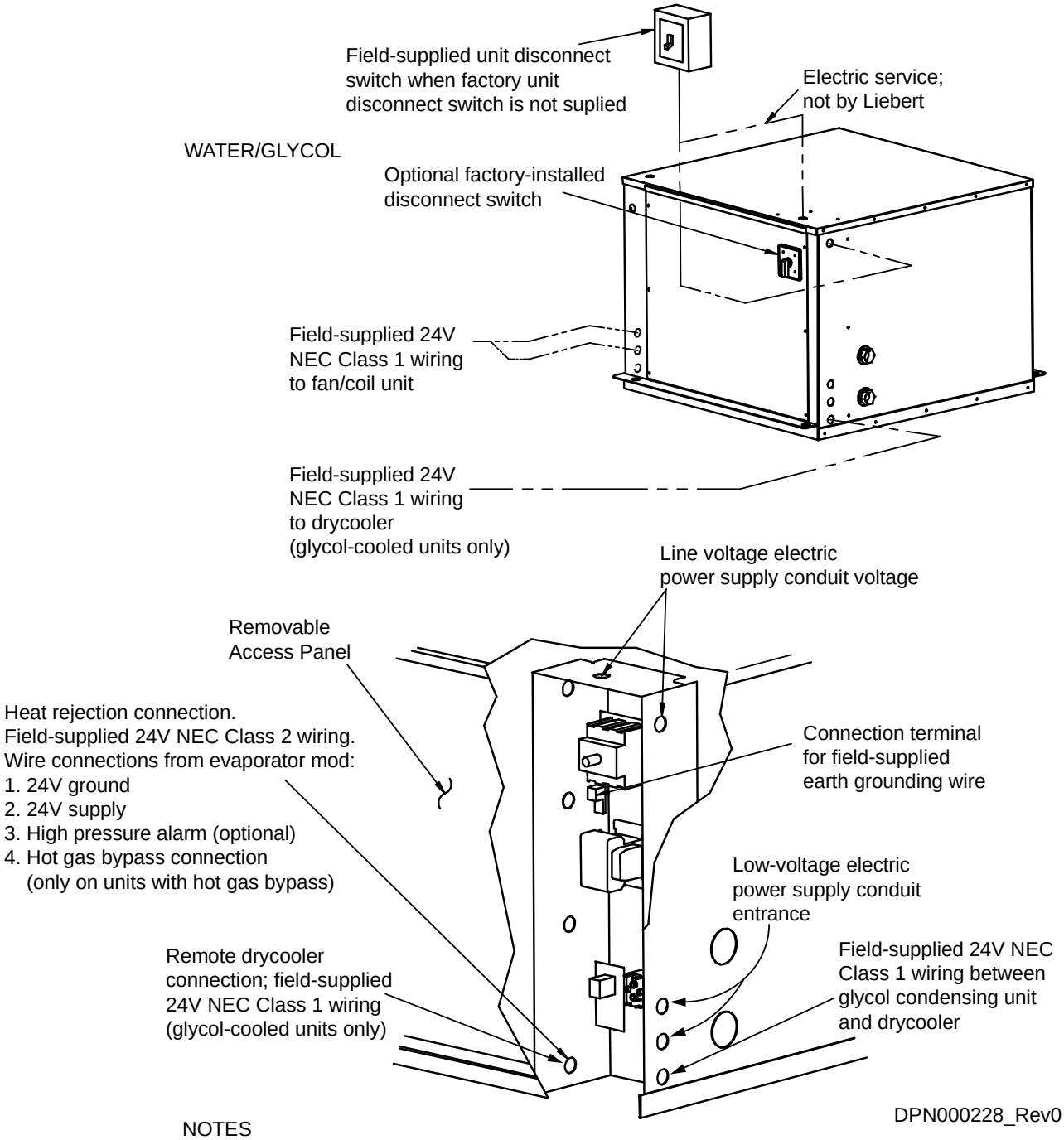


**Figure 44 5-ton water/glycol-cooled condensing unit (con't.)**




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 G A (1.6mm) for up to 75' (23m) or not to exceed 1 volt drop in control line.

# 8.0 R407C REFRIGERANT

**Table 33 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 34*** *for subcooling.*

**Table 34 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 33** 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 34** (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 33** is for superheat or operating controls. **Table 34** is for subcooling only.

# NOTES

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