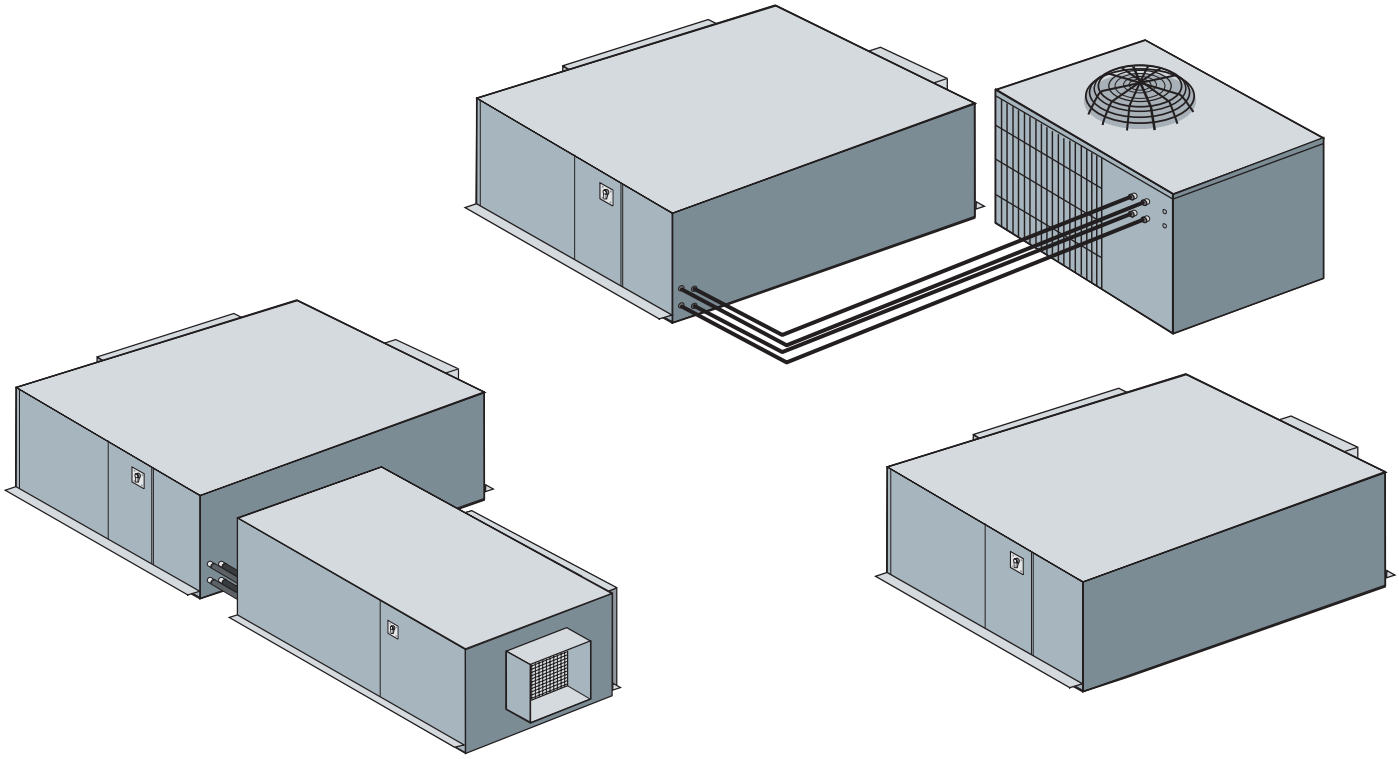
Precision Cooling
For *Business-Critical Continuity™*

Liebert Mini-Mate2™

User Manual - 8 Tons, 50 & 60Hz



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MODEL NUMBER NOMENCLATURE

Evaporators and Chilled-Water Units MMD96E-AHEL0 (example)	
MM	Mini-Mate2
D	0 = No Disconnect
	D = Disconnect
96E-	96E- = 8-ton Evaporator, 60 Hz
	95E- = 8-ton Evaporator, 50 Hz
	8TCD = 8-ton Chilled-Water w/ 2-way valve
	8TCT = 8-ton Chilled-Water w/ 3-way valve
A	A = 460V-3ph-60 Hz
	B = 575V-3ph-60 Hz
	C = 208V-3ph-60 Hz
	D =230V-3ph-60 Hz
	M = 380/415V-3ph-50 Hz
H	0 = No Humidifier
	H = Humidifier
E	0 = No Reheat
	E= Electric Reheat
	S = SCR Reheat
L	L = Low Fan Speed Drive, 2 hp
	H = High Fan Speed Drive, 3 hp
0	0 = None
	A = Filter Clog
	B = Smoke Detector
	C = Firestat
	D = Filter Clog & Smoke Detector
	E = Filter Clog & Firestat
	F = Smoke Detector & Firestat
	G = Filter Clog, Smoke Detector, & Firestat

Indoor Condensing Units MCD96ALA00 (example)	
MC	Mini-Mate2 Indoor Condensing Unit
D	0 = No Disconnect
	D= Disconnect
96A	96A = 8-ton Air-Cooled Centrifugal, 60 Hz
	95A = 8-ton Air-Cooled Centrifugal, 50 Hz
	98W = 8-ton Water/Glycol-Cooled, 60 Hz
	97W = 8-ton Water/Glycol, 50 Hz
L	L = Lee-temp Head Pressure Control (Air-Cooled)
	2 = 2-way Water/Glycol reg valve, 150 psi
	3 = 3-way, Water/Glycol reg valve, 150 psi
	D = 2-way, Water/Glycol reg valve, 350 psi
	T = 3-way, Water/Glycol reg valve, 350 psi
A	A = 460V-3ph-60 Hz
	B = 575V-3ph-60 Hz
	Y = 208/230V-3ph-60 Hz
	M = 380/415-3ph-50 Hz
H	0 = No Hot Gas Bypass
	H = Hot Gas Bypass
0	0 = Revision Level

Prop Fan Condensing Units PFC096A-AL0 (example)	
PF	Prop Fan Condensing Unit
H	H = Hot Gas Bypass
096A	096A = 8-ton Air-Cooled, 60 Hz
	095A = 8-ton Air-Cooled, 50 Hz
-	- = Standard Coil
	C = Coated Coil
A	A = 460V-3ph-60 Hz
	B = 575V-3ph-60 Hz
	Y = 208/230V-3ph-60 Hz
	M = 380/415V-3ph-50 Hz
L	L = 95°F Ambient, Lee-temp
0	0 = Revision Level

Table iii Heat rejection matchup – 60 Hz

Nominal Capacity	Cooling Unit	Condensing Unit		
		Indoor Air-Cooled Centrifugal Fan	Outdoor Air-Cooled Propeller Fan	Indoor Water/Glycol
8 Tons	MMD96E	MCD96A	PFC096A	MCD98W
8 Tons	MMD8TC	Chilled Water Unit		

Table iv Heat rejection matchup – 50 Hz

Nominal Capacity	Cooling Unit	Condensing Unit		
		Indoor Air-Cooled Centrifugal Fan	Outdoor Air-Cooled Propeller Fan	Indoor Remote Water/Glycol Cooled
8 Tons	MMD95E	MCD95A	PFC095A	MCD97W
	MMD8TC	Chilled Water Unit		

1.0 PRODUCT FEATURES

1.1 Standard Product Features

The Mini-Mate2 is a temperature/humidity control system designed to be installed above a ceiling grid system. The unit is available as a split system evaporator to be matched with an Indoor Centrifugal Fan Condensing Unit, Outdoor Prop Fan Condensing Unit, or Indoor Water/Glycol Condensing Unit. A self-contained Chilled Water Fan Coil is also available.

1.1.1 Controls

The Mini-Mate2 system includes a wall-mounted display panel with a liquid crystal display (LCD) screen and a 7 membrane keypad. The control is menu-driven for ease of use. **Figure 24**, **Section 3**, depicts the complete menu tree for the control. All control setpoints and alarm setpoints are programmable.

1.1.2 Evaporator System Components

DX Evaporator Section

The evaporator section includes the evaporator coil, thermostatic expansion valves, filter dryers, and blower. The evaporator coil is constructed of copper tubes and aluminum fins and is designed for the high sensible heat ratio required for electronic equipment. Room air circulation is accomplished by a double inlet, belt driven centrifugal blower that has been dynamically balanced. The blower has self-aligning bearings. Both the blower and motor have permanently lubricated ball bearings.

Chilled-Water Model

The Chilled-Water model is self-contained and is designed for use with an existing chilled-water loop. It contains a chilled-water coil and a proportional modulating valve to control the flow of chilled water.

1.1.3 Condensing Unit Components

The condensing unit is connected to the evaporator unit by four refrigerant lines and low voltage control wires. The condensing unit requires a power source and a power disconnect switch. A single point power kit is available for close coupled (attached) units.

Air-Cooled Condensing Unit (Indoor Centrifugal)

The Air-Cooled Condensing units (MC models) include: 3-ton and 5-ton scroll compressors with motor, belt-driven centrifugal blower, crankcase heaters, high pressure switches, condenser coils, and Lee-Temp head pressure control with receivers.

Air-Cooled Condensing Unit (Outdoor Prop Fan)

Outdoor Air-Cooled Condensing Units (PFC models) include: 3-ton and 5-ton scroll compressors with crankcase heaters, high-pressure switch, condenser coils, direct-driven propeller fan, and Lee-Temp head pressure control with receivers.

Water/Glycol Condensing Unit (Indoor)

The Water/Glycol-Cooled Condensing units include: 3-ton and 5-ton scroll compressors with crankcase heaters, high pressure switches, coaxial condensers, and regulating valves. Drycooler and pumps are selected separately for glycol systems.

1.2 Optional Equipment

1.2.1 Canister Humidifier

The optional, factory-installed steam generating humidifier adds pure water vapor to the room air to control humidity. Room humidity setpoints are established by the user. The humidifier components include: a steam canister (replaceable), control board, inlet strainer, fill and drain valves.

1.2.2 Electric Reheat

The 304/304 stainless steel electric reheat is energized when required to heat room air or to control room temperature during dehumidification. A safety switch prevents the reheat from exceeding temperature limits.

1.2.3 SCR Electric Reheat

The 304/304 stainless steel reheat is pulsed rapidly to provide precise temperature control, while cooling is locked on. A safety switch prevents the reheat from exceeding temperature limits.

1.2.4 Hot Gas Bypass (Condensing Units)

This optional system bypasses compressor discharge around the condenser directly to suction to provide capacity control and reduce compressor cycling. System includes liquid injection valve to maintain proper suction superheat. Hot gas bypass is provided on both circuits.

1.2.5 Free-Cooling Coil (GLYCOOL)

When ambient temperatures are low enough, cold fluid is piped to a secondary coil or a separate source of chilled-water may be piped to this coil.

1.2.6 Smoke Detector

If smoke is detected in the return air, the unit display sounds an audible signal and the unit shuts down.

1.2.7 Firestat

When the return air temperature limit of approximately 125°F (51.7°C) is exceeded, the unit shuts down.

1.2.8 Filter Clog

If high pressure differential is detected across the return air filter, an adjustable pressure differential switch sounds an audible signal.

1.3 Ancillary (Ship Loose Accessories)

1.3.1 Single Point Power Kit

A Single Point Power Kit allows the connection of a system (Evaporator and indoor condensing unit) to a single power source when the units are close coupled. The kit includes a junction box with power distribution, sub-fusing, and evaporator and condenser wiring.

1.3.2 Refrigerant Line Sweat Adapter Kits

This kit includes the compatible fittings required (four suction and four liquid line connections) when using field supplied interconnecting refrigerant piping.

1.3.3 Return Air Filter Box with Duct Collar Kit

A return air filter box with duct flange, 4" (102 mm) filter, and a supply air duct flange are provided for ducting the evaporator air.

1.3.4 Condensate Pump Kit

A condensate pump is required when the evaporator is installed below the level of the gravity-fed drain line. Components include: the pump; check valve; sump; level sensor; float switch; and controls. Refer to detailed instructions and drawings supplied with the pump.

1.3.5 Remote Monitoring and Control

Liebert can provide a variety of remote monitoring and control devices to enhance your Mini-Mate2 system. These include water detection, remote monitoring of a single unit, and remote control/monitoring of multiple units.

1.3.6 Remote Sensors

Remote temperature/humidity sensors can be mounted in the controlled space or in duct work and includes 30 feet of control cable.

2.0 SITE PREPARATION AND INSTALLATION

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

2.1 Installation Considerations

The evaporator unit is usually mounted above the suspended ceiling using field supplied threaded rods. Refer to **Figure 1** for possible configurations. The condensing unit may be:

- Indoor Air-Cooled Centrifugal Fan Condensing Unit mounted remotely or close coupled to the evaporator in the ceiling space.
- Outdoor Air-Cooled Propeller Fan Condensing Unit.
- Indoor Water/Glycol-Cooled Condensing Unit, mounted remotely or close coupled to the evaporator.

Table 1 Application limits, evaporator and chilled-water units*

Input Voltage		Range of Return Air Conditions to Unit	
Min	Max	Dry Bulb Temp.	Relative Humidity
-5%	+10%	65°F to 85°F (18°C to 29°C)	20% to 80%

*Unit will operate at these conditions but will not control to these extremes.

Table 2 Application limits, indoor and outdoor air-cooled condensing units

Input Voltage		Condensing Units	Entering Dry Bulb Air Temperature	
Min	Max		Min	Max
-5%	+10%	Outdoor Prop Fan Condensing Unit	-30°F (-34°C)	120°F (49°C)
		Indoor Air-Cooled Centrifugal Condensing Unit	-20°F (-29°C)	115°F (46°C)

Table 3 Application limits, indoor water/glycol-cooled condensing units

Input Voltage		Entering Fluid Temperature	
Min	Max	Min	Max
-5%	+10%	65°F (18.3°C) *	115°F (46°C)
*Operation below 65°F (18°C) may result in reduced valve life and fluid noise.			

2.1.1 Room Preparation

The room should be well-insulated and must have a sealed vapor barrier. The vapor barrier in the ceiling and walls can be a polyethylene film. Paint on concrete walls and floors should be vapor resistant.

NOTE
The single most important requirement for maintaining environmental control in the conditioned room is the vapor barrier.

Outside or fresh air should be kept to a minimum when tight temperature and humidity control is required. Outside air adds to the cooling, heating, dehumidifying and humidifying loads of the site. Doors should be properly sealed to minimize leaks and should not contain ventilation grilles.

2.1.2 Location Considerations

CAUTION

Units contain water. Water leaks can cause damage to sensitive equipment below. DO NOT MOUNT UNITS OVER SENSITIVE EQUIPMENT. A field-supplied pan with drain must be installed beneath cooling units and water/glycol-cooled condensing unit.

NOTE

Do not mount units in areas where normal unit operating sound may disturb the working environment.

Locate the evaporator unit over an unobstructed floor space if possible. This will allow easy access for routine maintenance or service. Do not attach additional devices to the exterior of the cabinet, as they could interfere with maintenance or service.

Figure 1 System configurations—air cooled systems

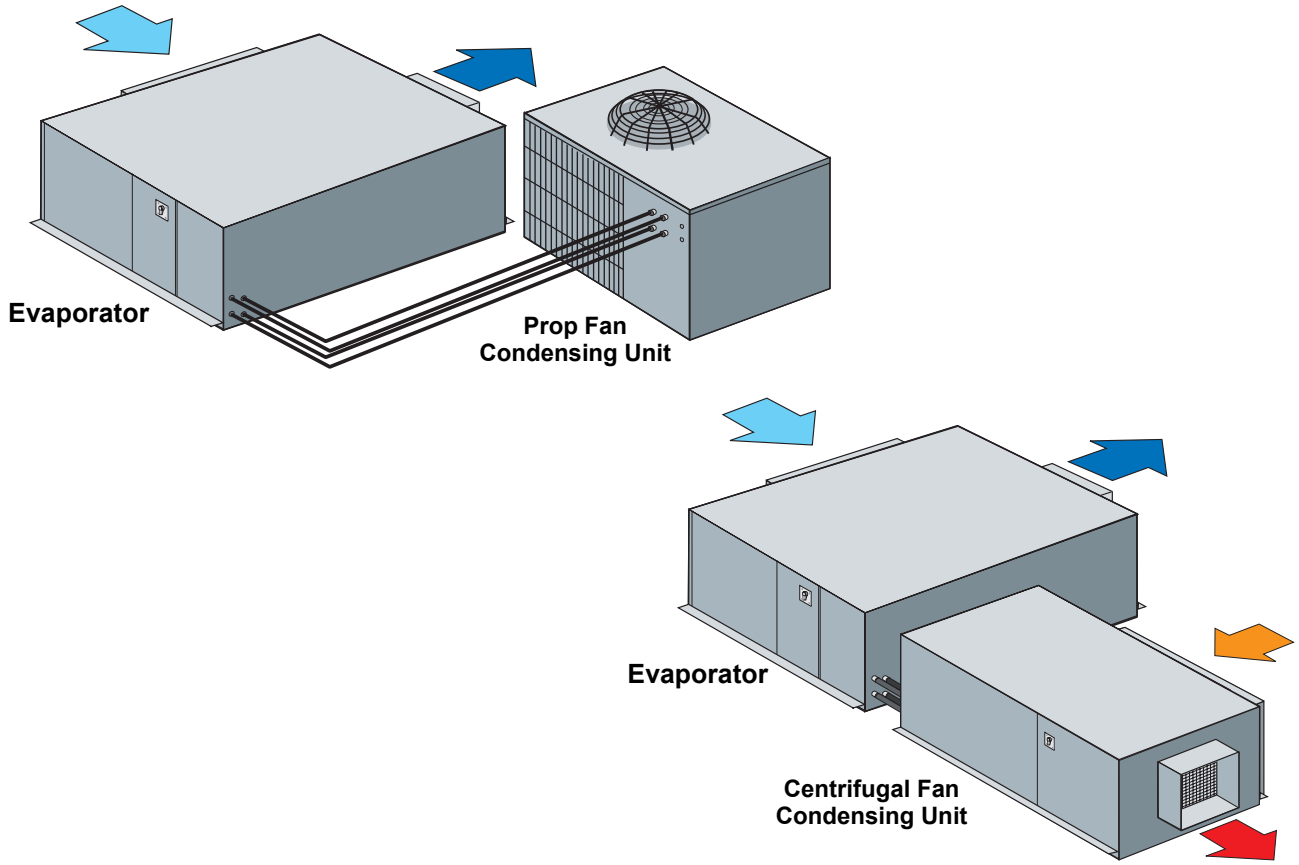


Figure 2 System Configurations—water/glycol systems

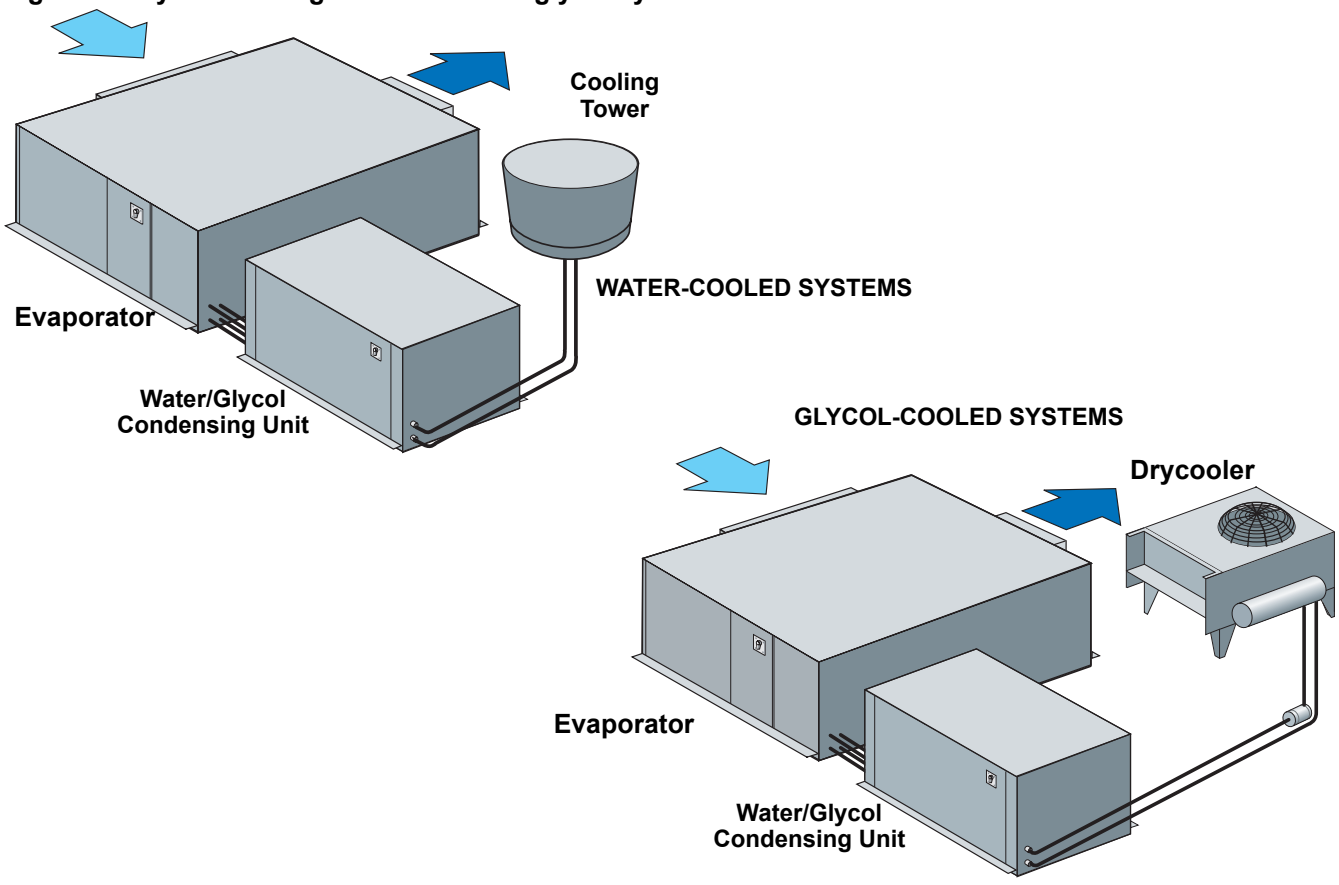
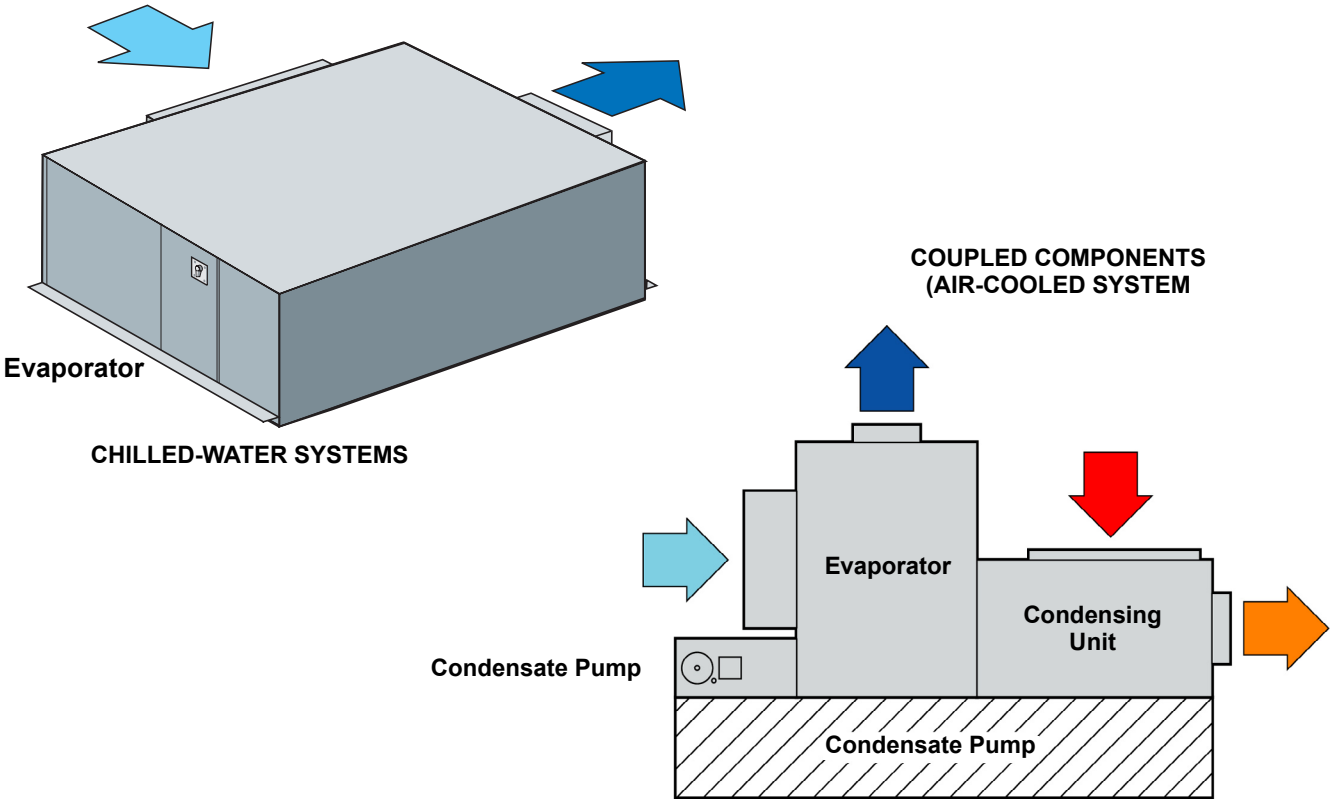


Figure 3 System Configurations—chilled water systems



2.2 System Weights

Table 4 Unit weights

Cooling Units*	lbs	kg
MMD96E	665	302
MMD95E	665	302
Condensing Units	**lbs**	**kg**
MCD96A	530	241
MCD95A	530	241
MCD98W	470	213
MCD97W	470	213

*Add 40 lbs. (20 kg.) to units with free cooling or hot water reheat coils.

2.3 Equipment Inspection upon receipt

When the unit arrives, do not uncrate equipment until it is close to its final location. All required assemblies are banded and shipped in corrugated containers. If you discover any damage when you uncrate the unit, report it to the shipper immediately. If you later find any concealed damage, report it to the shipper and to your Liebert supplier.

2.4 Installing the Evaporator or Chilled-Water Units

WARNING

Be sure the supporting roof structure is capable of supporting the weight of the unit(s) and the accessories during installation and service. (See **2.2 - System Weights**.)

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

The evaporator unit and indoor condensing unit are 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 1/2"-13 tpi threaded suspension rods and 1/2"-13 tpi hardware kit.

Recommended clearance between ceiling grids and building structural members is unit height plus 3 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, springs, and washers. (**See Figure 4**). The coil springs provide vibration isolation.

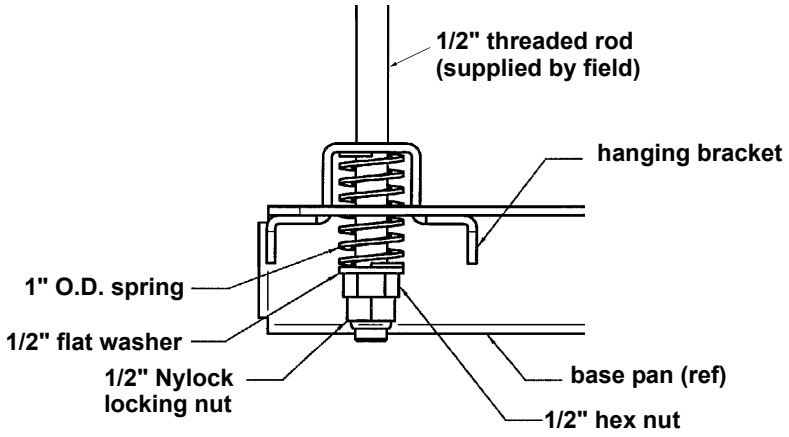
1. Use the plain nuts to hold unit in place. Adjust these nuts so that the weight of the unit is supported by the four rods, does not rest on the ceiling grid, and is level. Ensure none of the springs are compressed to solid height. The coil side of the unit is heavier, so these springs will be compressed more than the other side.

NOTE

The units must be level in order to drain condensate properly.

2. Use the Nylock nuts to "jam" the plain nuts.

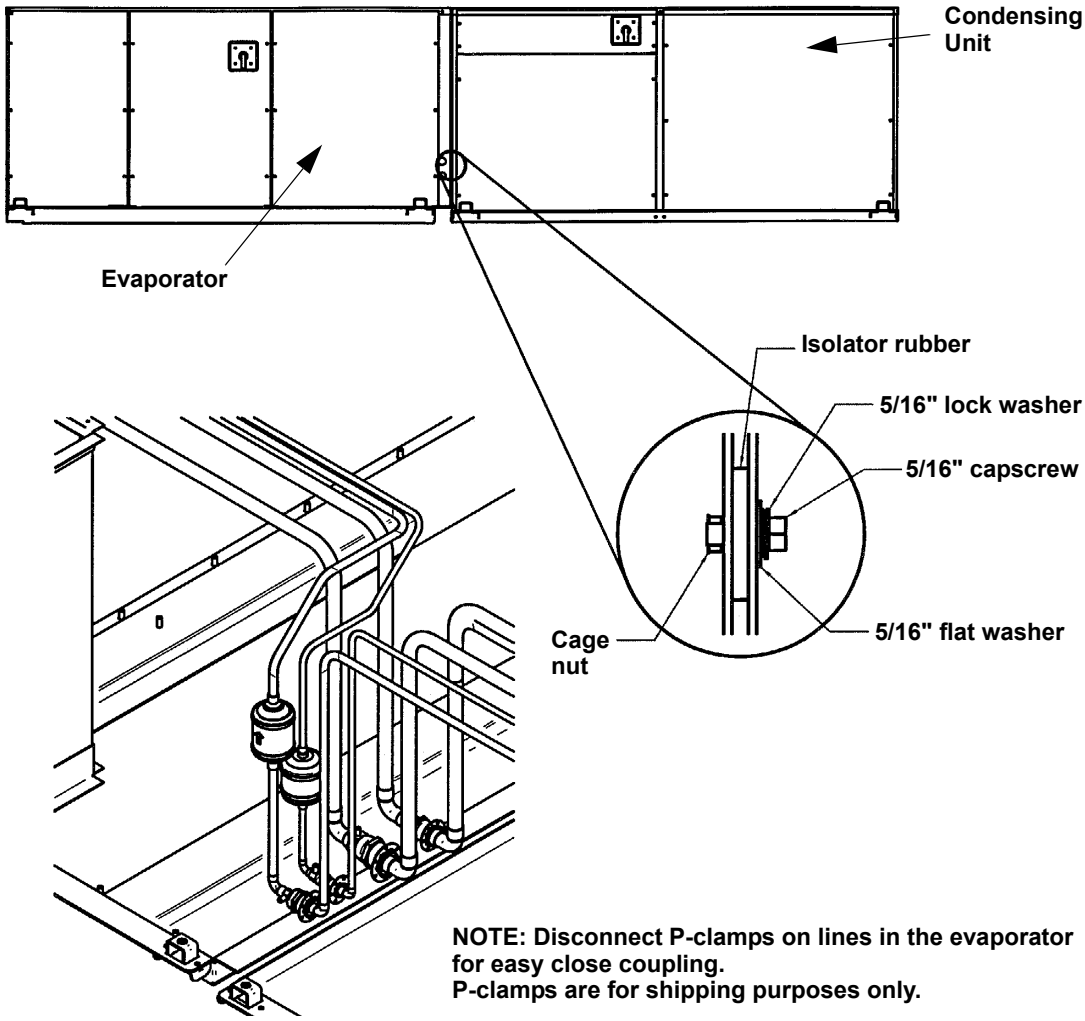
Figure 4 Threaded rod and hardware kit installation



2.4.1 Close Coupled Installations

If the evaporator and condensing units are to be mounted side-to-side (close coupled), hang each unit before connecting them together (See **Figure 5**). If Single Point Power Kit is used, install the box into the evaporator prior to suspending the units. Route power wire flex conduit into condensing unit as units are suspended. Refer to instructions supplied with kit for details. Align bolt holes in the condensing unit and in the evaporator. Insert rubber spacers and secure four (4) sets of hardware provided. Align the refrigerant connections and tighten them as described in **2.4.3 - Piping Connections and Coolant Requirements**. Remove "P" clamps from piping to aid fitting alignment.

Figure 5 Close coupled installation



2.4.2 Evaporator Air Distribution

Filter Box

The optional filter box mounts directly to the return air opening of the evaporator. The filter box is supplied with two (2) 20% (Liebert part no. A-0320) or 30% (Liebert part no. A-0400) 25" x 20" x 4" filters.

NOTE
Do not operate the unit without filters installed in return air system.

Connections for Ducted Systems

Use flexible duct work or non-flammable cloth collars to attach duct work to the unit and to help control the transmission of vibrations to building structures. Insulation of duct work is vital to prevent condensation during the cooling cycle. The use of a vapor barrier is required to prevent absorption of moisture from the surrounding air into the insulation.

If the return air duct is short, or if noise is likely to be a problem, sound-absorbing insulation should be used on the duct. Duct work should be fabricated and installed in accordance with local and national codes.

Table 5 Evaporator external static pressure (60) at 3750 CFM (6371 CMH)

Turns Open	2 hp Motor (std)		3 hp Motor (opt)	
	RPM	External Static, in.	RPM	External Static, in.
0	n/a	n/a	1146	1.9
0.5	n/a	n/a	1125	1.8
1	n/a	n/a	1104	1.7
1.5	946	0.9	1083	1.6
2	922	0.8	1063	1.5
2.5	972	0.7	1042	1.4
3	899	0.6	1021	1.3
3.5	851	0.5	1000	1.2
4	828	0.4	979	1.1
4.5	804	0.3	958	1.0
5	780	0.2	938	0.9
5.5	757	0.1	917	0.8
6	733	0	896	0.7

If free-cooling or hot water coil is ordered, reduce available external static pressure by 0.3" (8 mm). Contact Liebert Representative for other Air Volumes. Factory setting is 0.5" (13 mm) with 2 hp motor. Field adjust to suit application.

NOTE
Maximum return air static pressure should not exceed 0.3" (8 mm) to provide proper drainage of the unit.

2.4.3 Piping Connections and Coolant Requirements

Drain Line

CAUTION

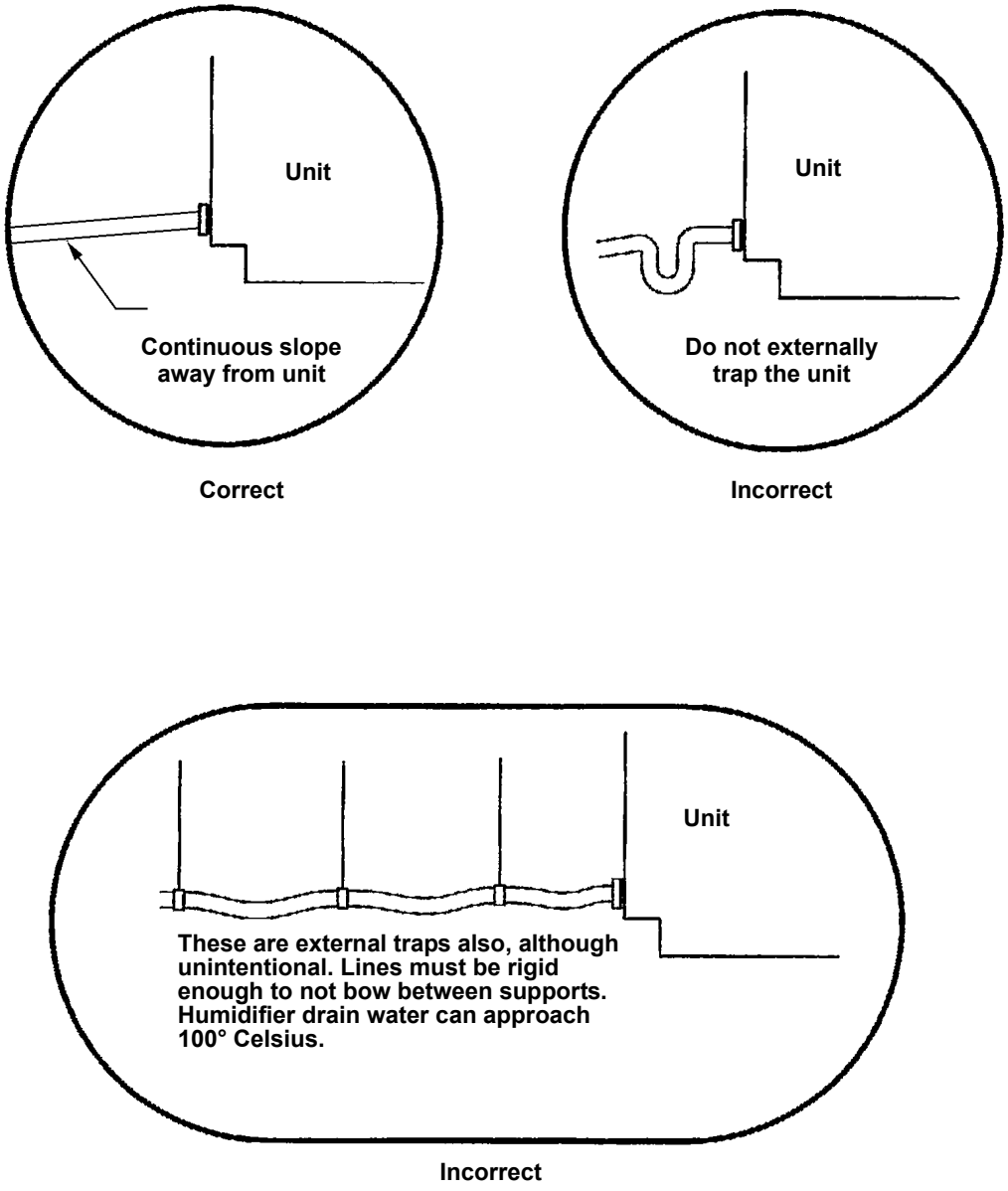
The drain line must not be trapped outside the unit, or water may back-up in drain pan. Drain is internally trapped.

This line may contain boiling water. Use copper or other suitable material for the drain line. Sagging condensate drain lines may inadvertently create an external trap.

A 3/4 in. (19.1 mm) female pipe thread (FPT) connection is provided for the evaporator coil condensate drain. This 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 the full size of the drain connection.

The evaporator drain pan includes a float switch to prevent unit operation if drain becomes blocked.

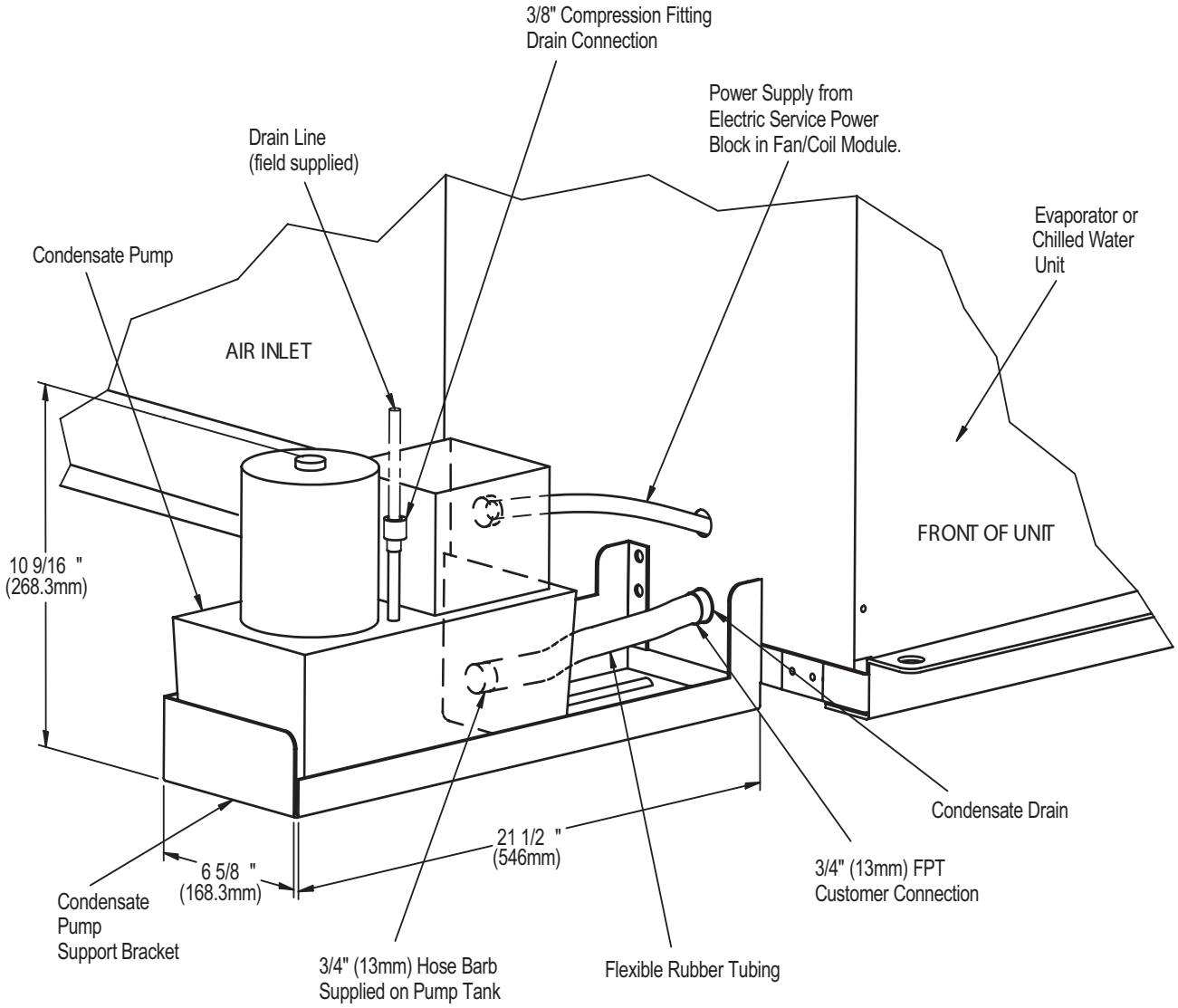
Figure 6 Drain installation



Condensate Pump

The optional condensate pump kit is required when the evaporator is installed below the level of the gravity-fed drain line. Refer to the installation instructions provided with the condensate pump kit.

Figure 7 Condensate pump installation



Notes:
1. 3/4" (13mm) Flexible Rubber Tubing Assembly (Supplied with Pump Kit) must be installed on pump end.
2. The High Water Safety Float included with pump must be interlocked with unit control. Wire to terminals 60 & 61 on Evaporator terminal strip to shut down unit.

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Humidifier Water Supply Line

Units supplied with the optional humidifier package have a 1/4 in. (6.4 mm) FPT connection for water inlet. Supply pressure range is 10 psig to 150 psig. Required flow rate is 1 gpm. A shut-off valve should be installed in this line to isolate the humidifier for maintenance.

NOTE
DO NOT route humidifier supply line in front of filter box access panel.

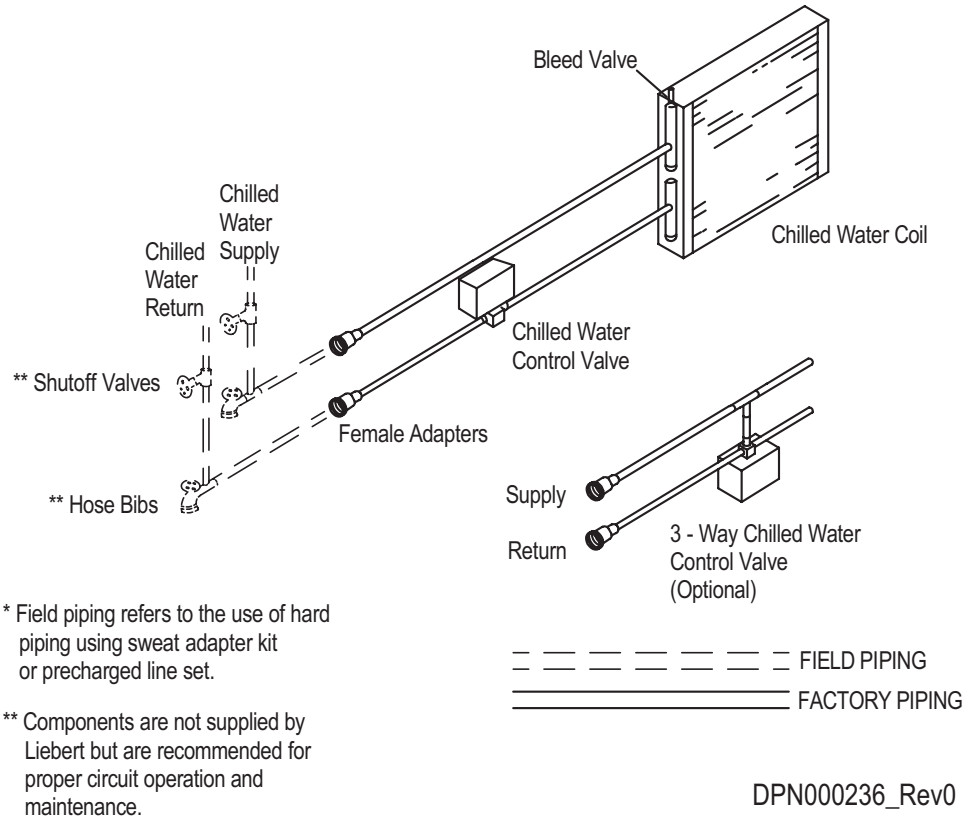
Chilled-Water Piping—Chilled-water Systems Only

Refer to **Figure 8** for recommended field installed hardware such as shut-off valves and hose bibs.

Chilled-water supply and return lines must be insulated to prevent condensation.

The minimum recommended water temperature is 42°F. Connection sizes are 1-1/4" FPT.

Figure 8 General arrangement diagram - chilled-water systems



Refrigerant (R-22) Piping

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

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

- Close coupling the units together using the quick connects.
- Using an optional Sweat Adapter Kit and hard piping between the two units.

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. 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 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.

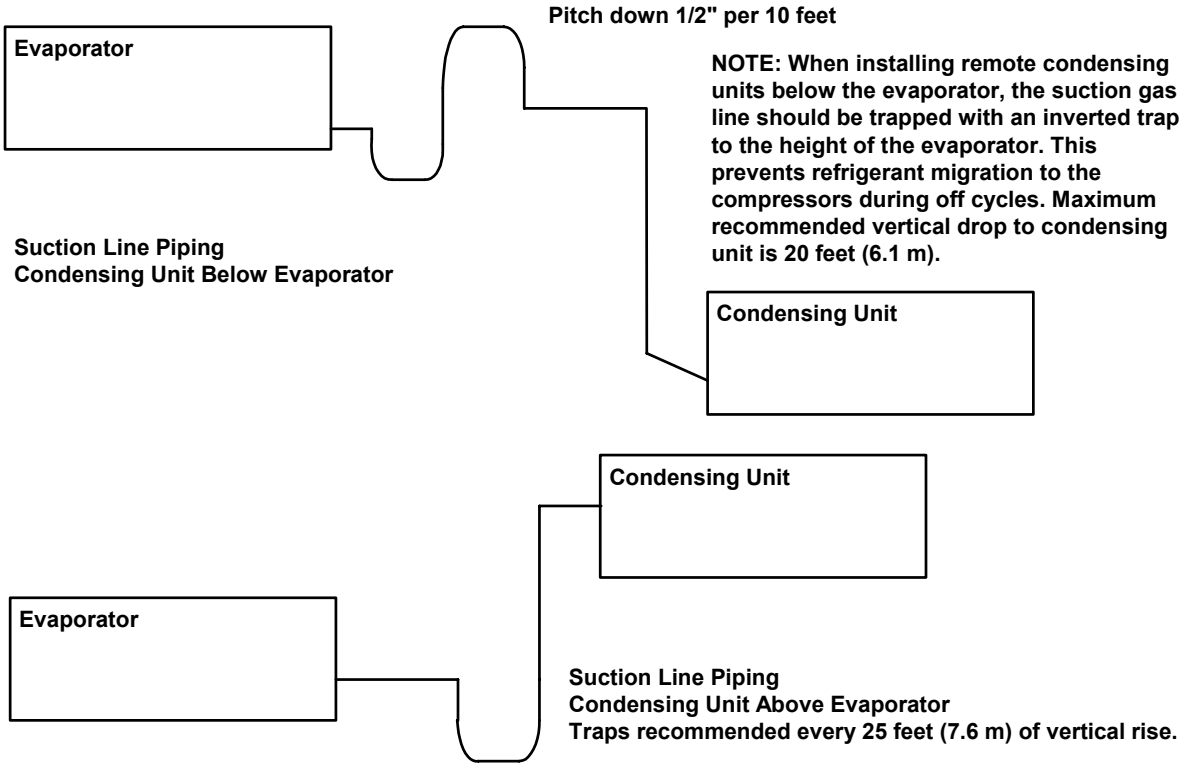
Table 6 Recommended refrigerant line sizes

Equivalent Feet	Circuit	Liquid Line	Suction Line
50 feet	3-ton	3/8" O.D.	7/8" O.D.
100 feet	3-ton	1/2" O.D.	7/8" O.D
150 feet	3-ton	5/8" O.D.	1-1/8" O.D
50 feet	5-ton	1/2" O.D.	1-1/8" O.D
100 feet	5-ton	5/8" O.D.	1-1/8" O.D
150 feet	5-ton	5/8" O.D.	1-3/8" O.D

Consult your Liebert representative for longer line lengths.

NOTE
If field supplied refrigerant piping is installed, refrigerant (R-22) must be added to the system.

Figure 9 Refrigerant piping diagram



Refrigerant Charge Requirements: Total refrigerant charge (R-22) will be required only if units are evacuated during installation or maintenance. For safe and effective operation, refer to **2.4.3 - Piping Connections and Coolant Requirements**.

Total refrigerant = Units and Lines

Table 7 8-ton unit refrigerant charge

Evaporator		
	Charge (ounces)	
Model No.	3-ton circuit	5-ton circuit
MMD96E	7	7
MMD95E	7	7
Condensing Units		
Model No	**Charge (ounces)**	
MCD96A	361	581
MCD95A	361	581
MCD98W	54	94
MCD97W	54	94

Table 8 Line charges (field piping)*

O.D.	Liquid Line	Suction Line
1/2"	7.3 (1.1)	0.2 (0.1)
5/8"	11.7 (1.7)	0.3 (0.1)
7/8"	24.4 (3.6)	0.7 (0.1)
1-1/8"	41.6 (6.2)	1.2 (0.2)

*weight of R-22 in type “L” copper tube: lb per 100 ft (kg per 10 m)

Quick Connect Fittings

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

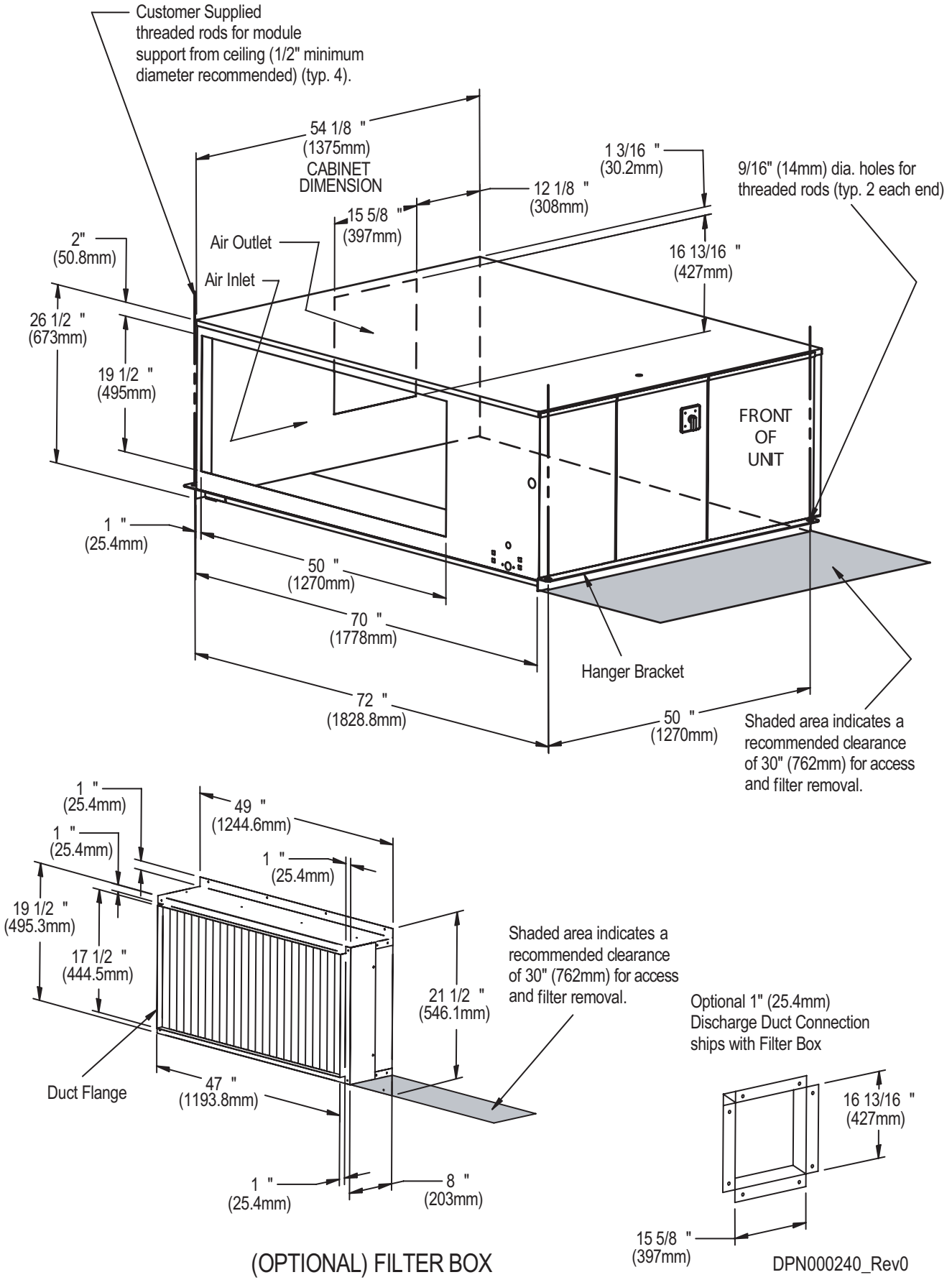
Be especially careful when connecting the quick connect fittings. Read through the following steps before making the connections.

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 insure that the threads mate properly.
5. Tighten the coupling body hex nut and union nut with the proper size 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 insure that the joint will not leak. Refer to **Table 9** for torque requirements.

Table 9 Refrigerant quick connect sizes and torque

Size O.D. Cu	Coupling Size	Torque (lb-ft)
3/8"	#6	10-12
1/2"	#10	35-45
7/8"	#11	35-45
1-1/8"	#12	50-65

Figure 10 Evaporator or chilled-water unit dimensional data



2.4.4 Electrical Connections, Evaporator or Chilled-Water Unit

WARNING

Unit contains hazardous electrical voltage. Disconnect power supply before working within. Line side of factory disconnect remains energized when disconnect is off.

WARNING

UNIT CONTAINS HAZARDOUS ELECTRICAL VOLTAGE. More than one disconnect may be required to remove power. Evaporator and condensing units may have separate disconnects. Open all disconnects before working within.

Each unit is shipped from the factory with internal wiring completed. Refer to electrical schematic, **Figure 11, Figure 25, and Figure 26** when making connections. Electrical connections to be made at the installation site are:

- Power supply to each ceiling unit and control wiring between the evaporator unit and the condensing unit, if applicable.
- Control wiring between the control panel (wallbox) and the evaporator or chilled-water unit control board.

Power Connections

All power and control wiring and ground connections must be in accordance with the National Electrical Code (NEC) and local codes. Refer to Unit serial tag data for electrical requirements.

CAUTION

Use copper wiring only. Make sure that all connections are tight.

Voltage supplied must agree with the voltage specified on the unit serial tag. A field supplied disconnect switch may be required. Consult local code.

Route the electrical service conduit through the hole provided in the cabinet and terminate it at the electric box. Make connections at the factory terminal block or disconnect switch, L1, L2, L3. Connect earth ground to lug provided. See transformer label for primary tap connections. Installer will need to change transformer primary taps if applied unit voltage is other than prewired tap voltage.

An optional single point power kit is available for units that are close coupled (refer to **Figure 11** and **2.4.3 - Piping Connections and Coolant Requirements**). This kit should be mounted inside the evaporator unit before installing the unit in the ceiling. Specific installation instructions are included with the single point power kit.

Control Connections (10-wire on air-cooled, 8-wire on water/glycol cooled)

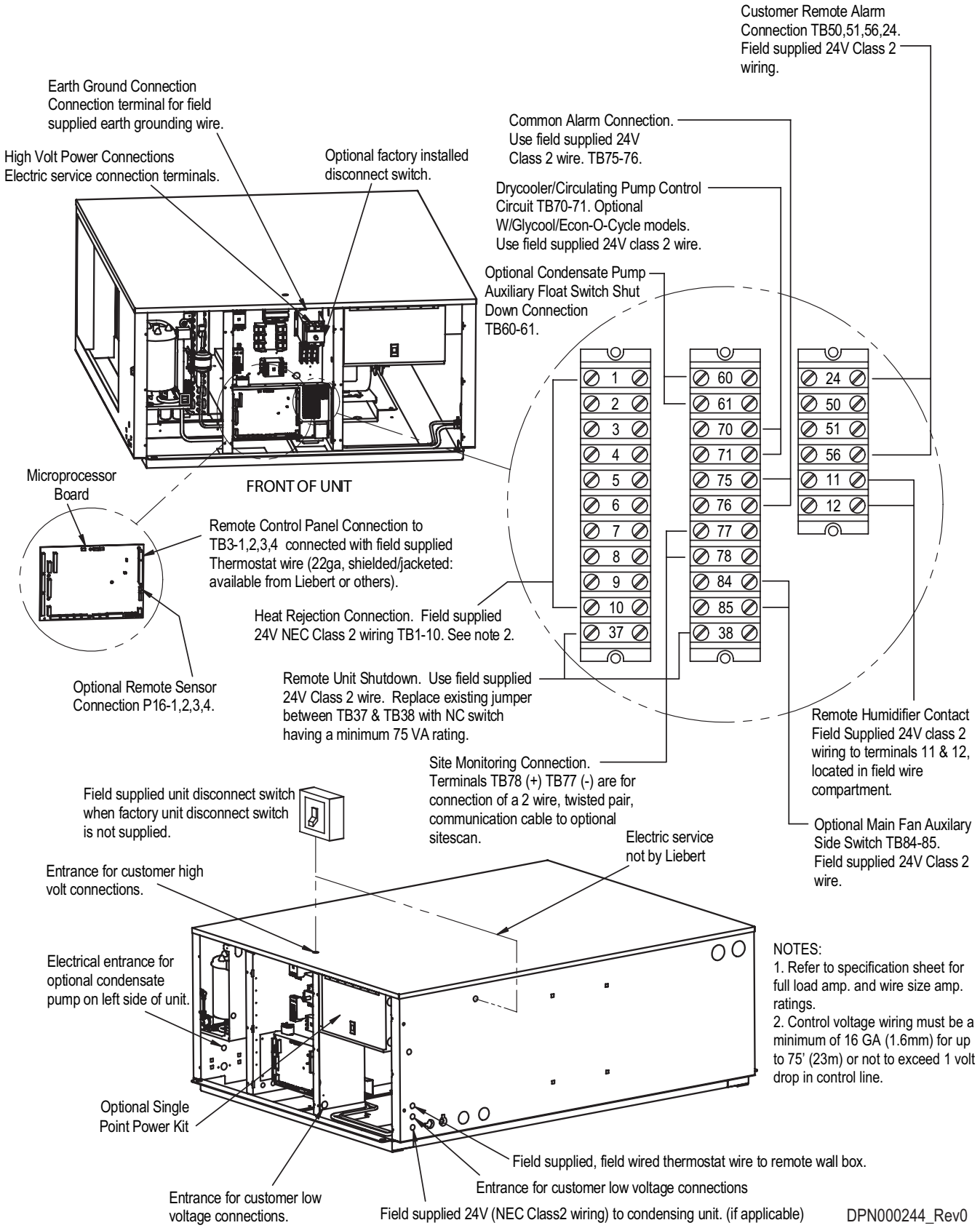
A field-supplied control connection (24 VAC) is required between the evaporator and the condensing unit. Control wiring must be installed in accordance with the National Electrical Code (NEC) Class 2 circuit. Glycol-cooled units also require a two-wire control connection to the drycooler and pump.

Control wiring between the evaporator and the condensing unit must not allow a voltage drop in the line of more than 1 volt (16 gauge minimum for 75 feet). **Do not connect additional electrical devices to the control circuit.** The internal control transformer is only sized for factory-supplied components.

Additional control wiring will be required if your system includes other optional monitoring and control devices.

Four (4) wire (thermostat type) must be connected between the evaporator control board and the wall box. See **Figure 25** and **Figure 26** and see **Figure 11** for electrical connections.

Figure 11 Evaporator unit electrical connections



2.5 Indoor Air-Cooled Centrifugal Fan Condensing Unit Installation

2.5.1 Location Considerations

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 **2.4 - Installing the Evaporator or Chilled-Water Units** for hanging guidelines and to **Figure 13** for dimensional data.

2.5.2 Ducting

Fan operation is designed for 5000 CFM (8495 CMH) at 0.5" external static pressure.

General Considerations

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

Duct work that runs through a conditioned space or is exposed to areas where condensation may occur must be insulated. Duct work should be suspended using flexible hangers. Duct work should not be fastened directly to the building structure.

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.

Considerations for Specific Applications

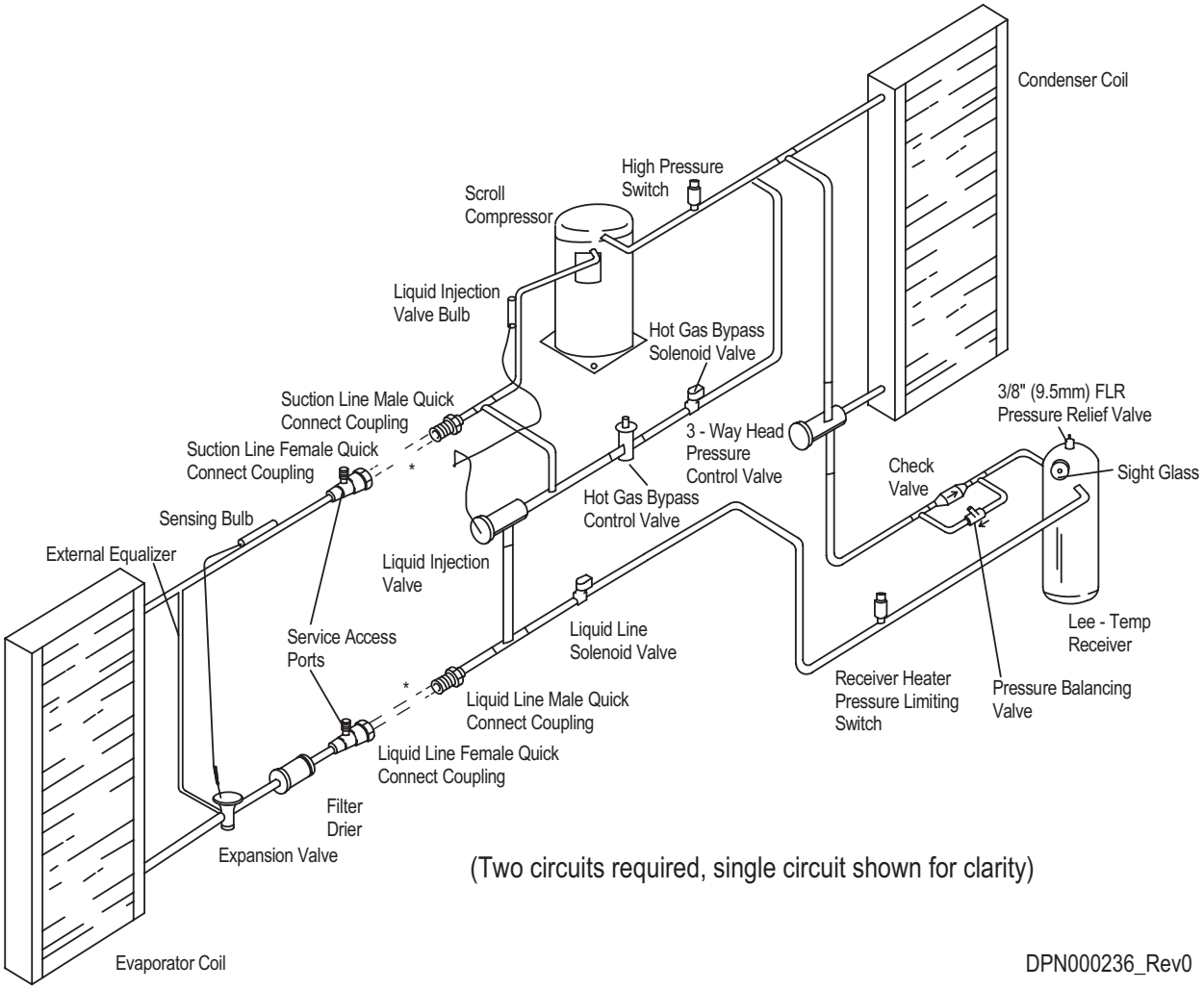
In applications where the ceiling plenum is used as the heat rejection domain, the discharge air must be directed away from the condensing unit air inlet and a screen must be added to the end of the discharge duct to protect service personnel. Locate the air discharge a minimum of 4 feet from an adjacent wall. Failure to do so may result in reduced air flow and poor system performance.

If the condensing unit draws air from the outside of the building, rain hoods must be installed. Hood intake dimensions should be the same as the condensing unit duct dimensions. 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. Avoid directing the hot exhaust air toward adjacent doors or windows.

2.5.3 Piping Connections

Details for refrigerant (R-22) loop piping are in **2.4.3 - Piping Connections and Coolant Requirements**.

Figure 12 Piping connections - indoor air-cooled centrifugal fan condensing unit



2.5.4 Electrical Connections - Condensing Unit

Refer to **2.4.4 - Electrical Connections, Evaporator or Chilled-Water Unit** and **Figure 14** for general wiring requirements and cautions. Refer to electrical schematic when making connections. Refer to unit serial tag for full load amp and wire size amp ratings.

Power Connections

The condensing unit requires its own power source and earth ground, with a disconnect switch to isolate the unit for maintenance.

NOTE
Refer to serial tag for full load amp and wire size amp ratings

Control Connections

Field-supplied control wires must be connected between the evaporator and the condensing unit (See **Figure 14** and the electrical schematic on the units for more details.) Seven (7) wires are required between the evaporator and condensing unit. Eighth and ninth wires are required on systems with hot gas bypass.

Figure 13 Indoor air-cooled centrifugal condensing unit dimensions and pipe connections

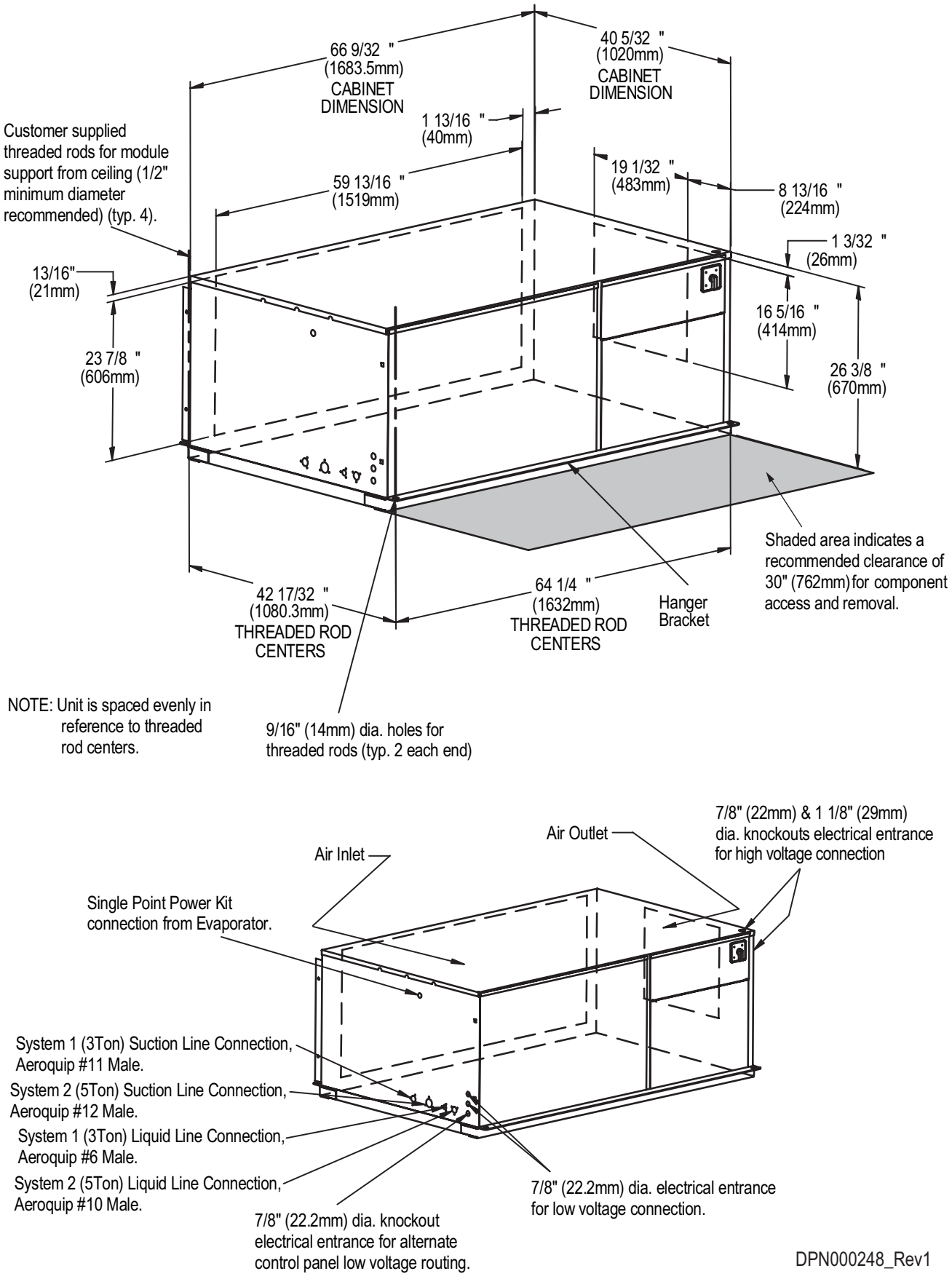
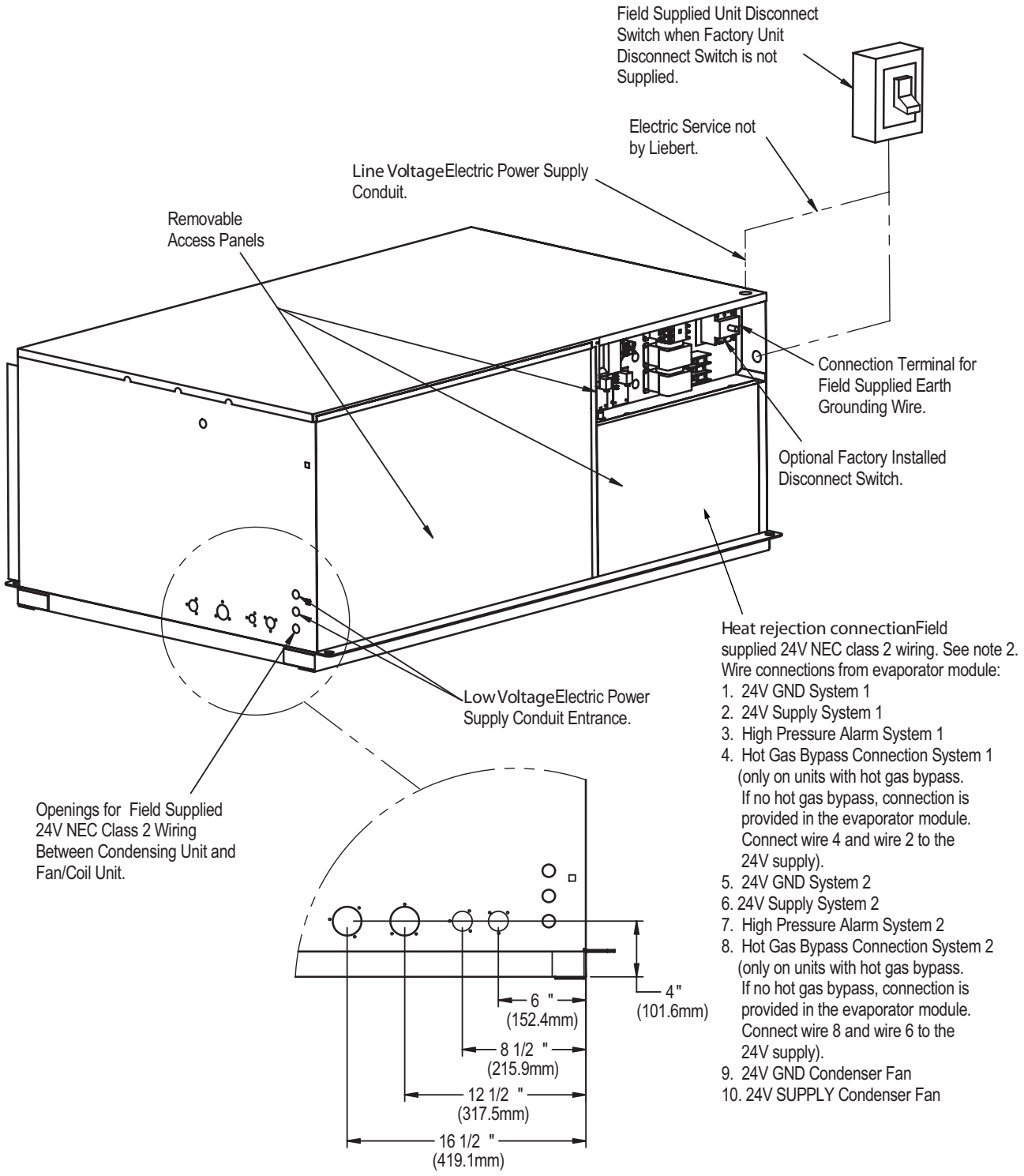


Figure 14 Indoor air-cooled centrifugal condenser electrical connections



Heat rejection connection Field supplied 24V NEC class 2 wiring. See note 2.
Wire connections from evaporator module:

1. 24V GND System 1
2. 24V Supply System 1
3. High Pressure Alarm System 1
4. Hot Gas Bypass Connection System 1 (only on units with hot gas bypass. If no hot gas bypass, connection is provided in the evaporator module. Connect wire 4 and wire 2 to the 24V supply).
5. 24V GND System 2
6. 24V Supply System 2
7. High Pressure Alarm System 2
8. Hot Gas Bypass Connection System 2 (only on units with hot gas bypass. If no hot gas bypass, connection is provided in the evaporator module. Connect wire 8 and wire 6 to the 24V supply).
9. 24V GND Condenser Fan
10. 24V SUPPLY Condenser Fan

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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2.6 Outdoor Air-Cooled Condensing Unit Installation

2.6.1 Location Considerations

To insure a satisfactory air supply, locate air-cooled propeller fan condensing units in an environment providing clean air, away from loose dirt and foreign matter that may clog the coil. Condensing units must not be located in the vicinity of steam, hot air, or fume exhausts, or closer than 18 inches from a wall, obstruction, or adjacent unit. Avoid areas where heavy snow will accumulate at air inlet and discharge locations.

The condensing unit should be located for maximum security and maintenance accessibility. Avoid ground-level sites with public access.

Install a solid base, capable of supporting the weight of the condensing unit. The base should be at least 2 inches higher than the surrounding grade and 2 inches larger than the dimensions of the condensing unit base. For snowy areas, a base of sufficient height to clear snow accumulation must be installed.

2.6.2 Piping Connections

Details for refrigerant (R-22) loop piping are in **Figure 12 - Piping connections - indoor air-cooled centrifugal fan condensing unit**.

2.6.3 Electrical Connections

Refer to **2.4.4 - Electrical Connections, Evaporator or Chilled-Water Unit** for general wiring requirements and cautions. Refer to electrical schematic when making connections.

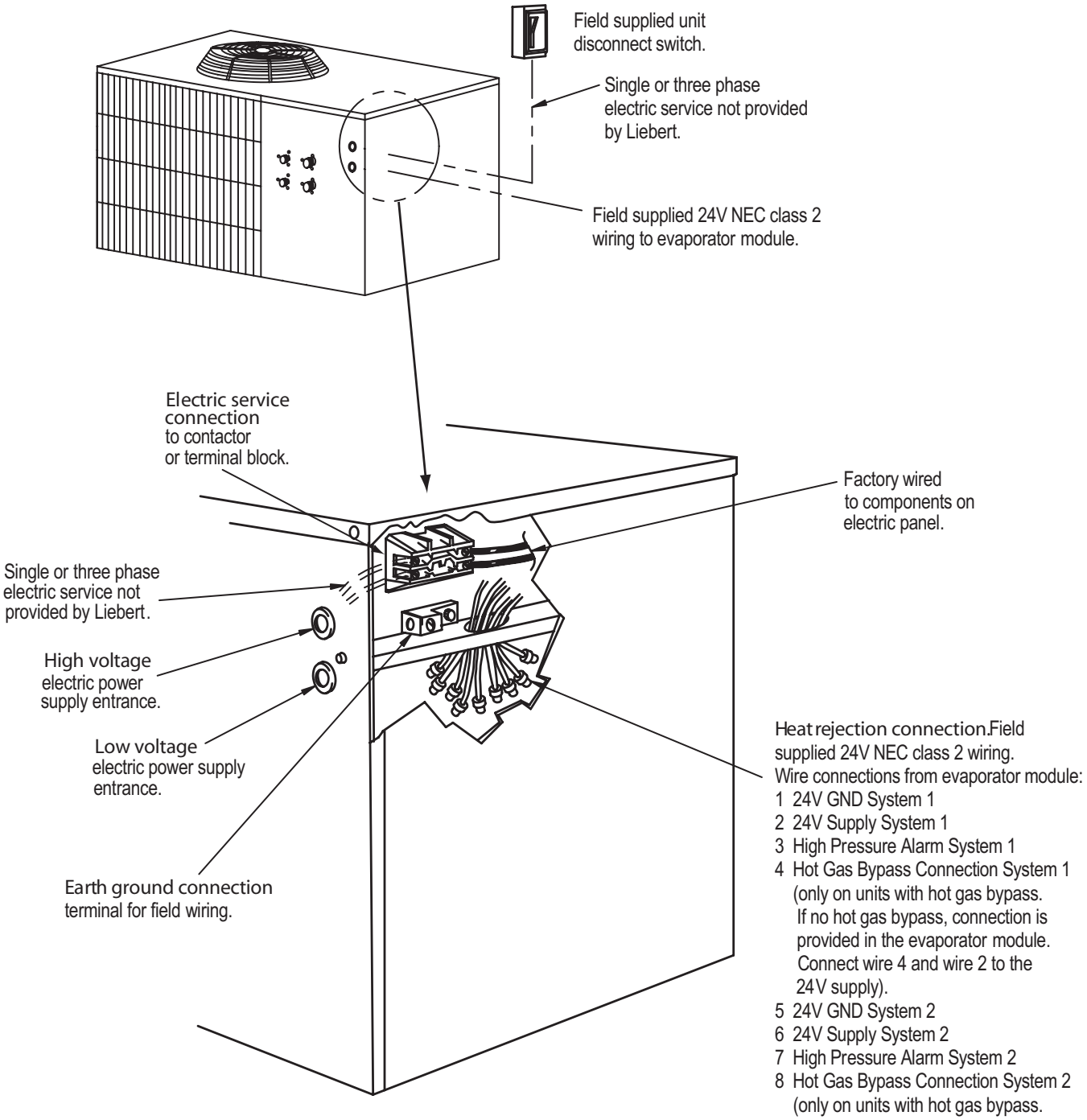
Power Connections

The outdoor condensing unit requires its own power source and earth ground, with a disconnect switch (field supplied) to isolate the unit for maintenance.

Control Connections

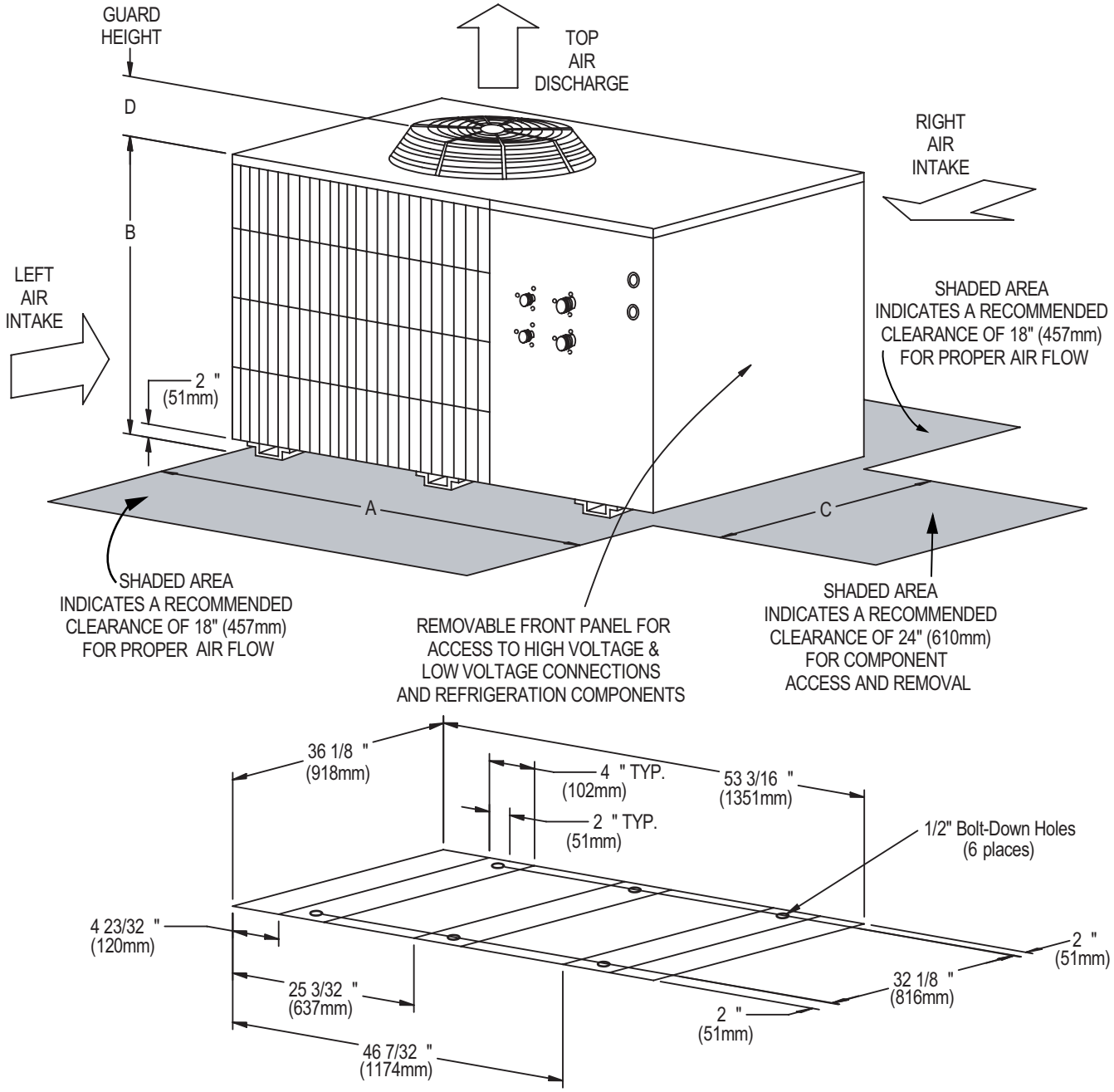
Field-supplied control wires must be connected between the evaporator and the condensing unit. (See **Figure 6** and the electrical schematic on the units for more details.) Seven (7) wires are required between the evaporator and condensing unit. Eighth and ninth wires are required on systems with hot gas bypass.

Figure 15 Electrical field connections - outdoor condensing unit



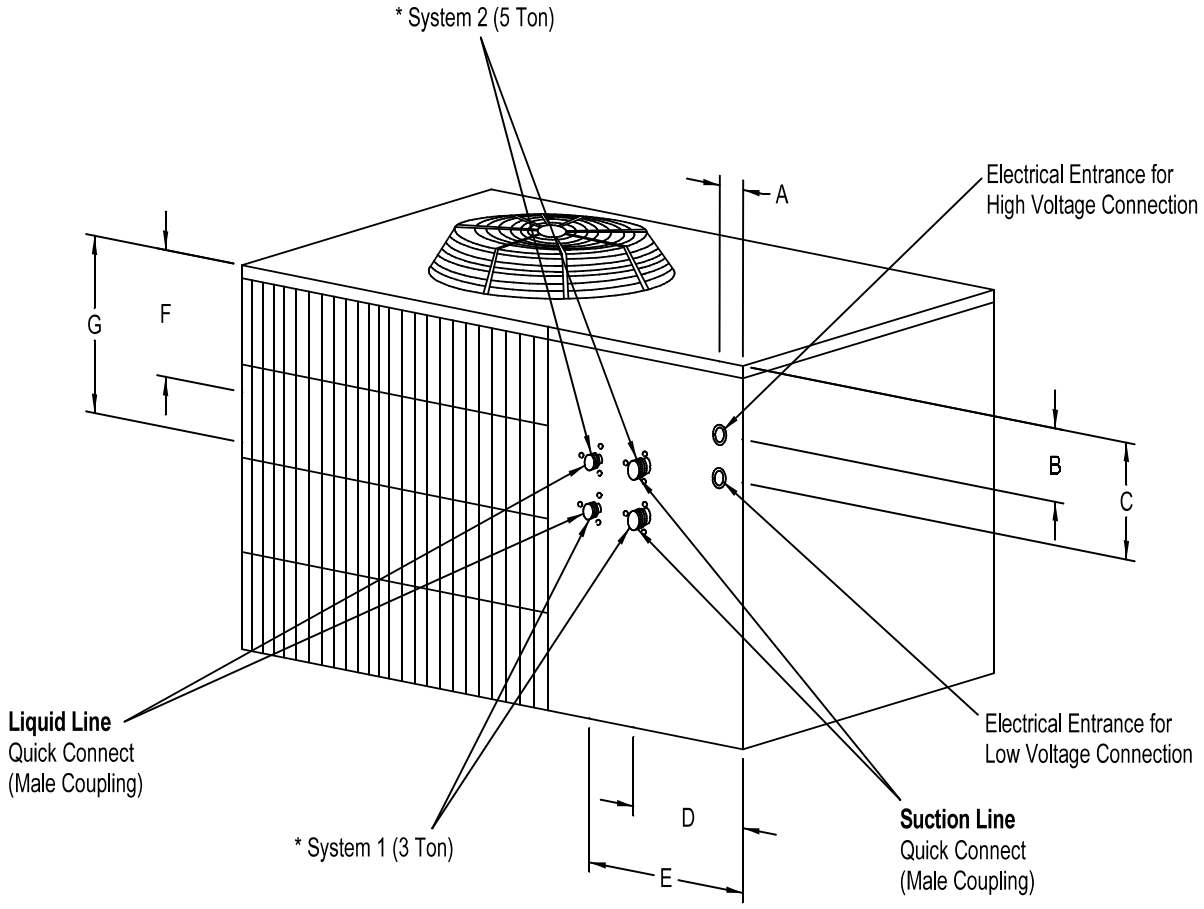
NOTE: Refer to specification sheet for full load amp and wire size amp ratings.

Figure 16 Footprint dimensions - outdoor condensing unit



Model		Dimensional Data in. (mm)			Net Weight lbs (kg)
60 Hz	**50 Hz**	**Width (A)**	**Height (B)**	**Depth (C)**	
PFC096A-_L PFH096A-_H	PFC095A-_L PFH095A-_L	53 (1343) 53 (1343)	36-1/4 (918) 36-1/4 (918)	38-1/2 (978) 38-1/2 (978)	488 (222) 488 (222)

Figure 17 Piping and electrical connections - outdoor condensing unit



* System 1 and System 2 on 8 Ton only.

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Model Numbers		Electrical Connections In. (mm)			Piping Connections In. (mm)			
60 Hz	**50 Hz**	**A**	**B**	**C**	**D**	**E**	**F**	**G**
PFC096A-L	PFC095A-L	2 (51)	6 (152)	8-1/2 (216)	4-3/4 (121)	7-3/4 (197)	8-1/2 (216)	11-1/2 (292)

2.7 Indoor Water- and Glycol-Cooled Condensing Unit Installation

2.7.1 Location Considerations

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

To mount the unit in the ceiling, refer to **2.4 - Installing the Evaporator or Chilled-Water Units**.

2.7.2 Piping Connections

Details for Refrigerant (R-22) Loop piping are in **2.4.3 - Piping Connections and Coolant Requirements**.

Water/Glycol Piping Considerations

Refer to **Figure 20** for recommended field installed piping hardware such as shut-off valves and hose-bibs. Water filters should be installed if water quality is poor. Filters will extend the service life and efficiency of the condensers.

Condensing Unit Fluid Requirements

The maximum fluid pressure is 150 psi standard pressure or 350 psi for high pressure units (Refer to unit serial tag and model number description page at beginning of this manual).

NOTE
HVAC grade ethylene or propylene glycol should be used on glycol systems. Automotive antifreeze must not be used.

Regulating Valve

Water/Glycol-cooled units include a coolant flow regulating valve which is factory adjusted and should not need field adjustment.

Standard water pressure and high water pressure valves are adjusted differently. Contact Liebert Service before making any adjustments.

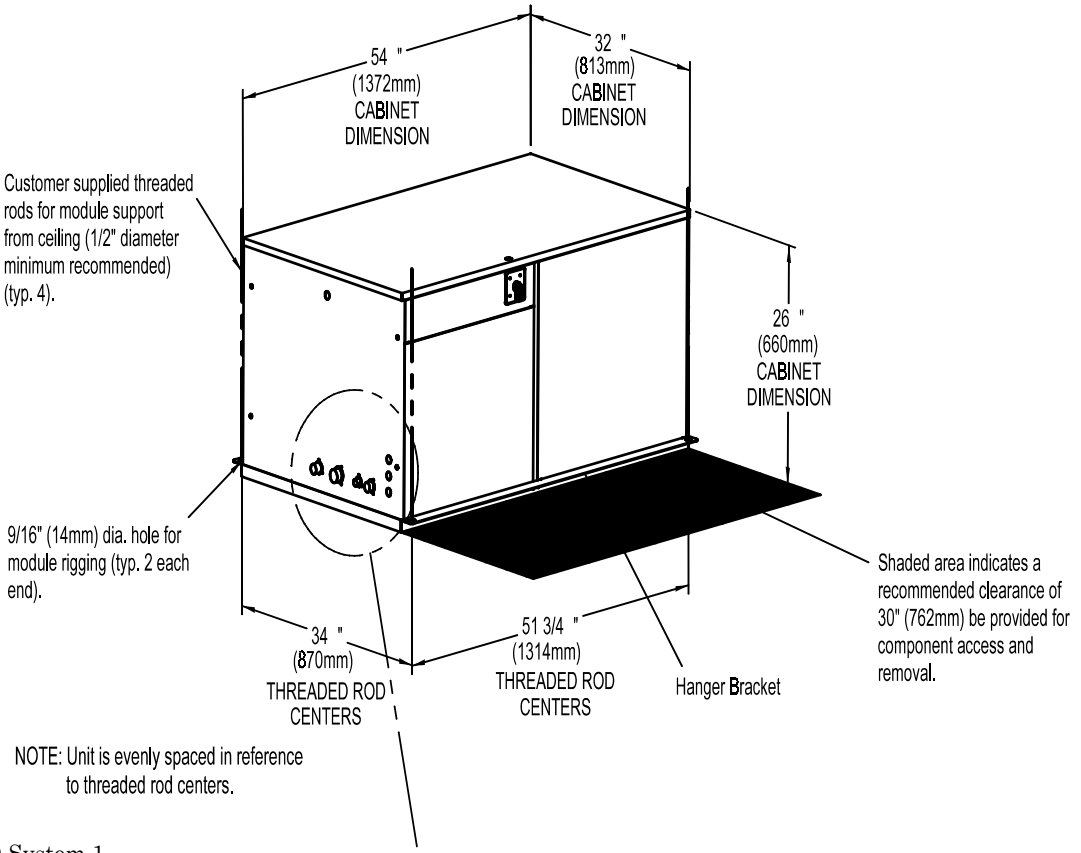
2.7.3 Electrical Connections

Refer to **2.4.4 - Electrical Connections, Evaporator or Chilled-Water Unit** for general wiring requirements and cautions. Refer to electrical schematic when making connections. Refer to serial tag for full load amp and wire size amp ratings.

Control Connections

A six-wire control connection is required from the evaporator unit to the water/glycol condensing unit. Two (2) additional wires are required when hot gas bypass is ordered. **Glycol-cooled units also require a two-wire control connection to the drycooler and pump package.**

Figure 18 Indoor water/glycol condensing unit dimensional data



1. 24V GND System 1
2. 24V Supply System 1
3. High-Pressure Alarm System 1
4. Hot Gas Bypass Connection System 1 (only on units with hot gas bypass. If no hot gas bypass, connection is provided in the evaporator module. Connect wire 4 and wire 2 to the 24V supply).
5. 24V GND System 2
6. 24V Supply System 2
7. High-Pressure Alarm System 2
8. Hot Gas Bypass Connection System 2 (only on units with hot gas bypass. If no hot gas bypass, connection is provided in the evaporator module. Connect wire 8 and wire 6 to the 24V supply).

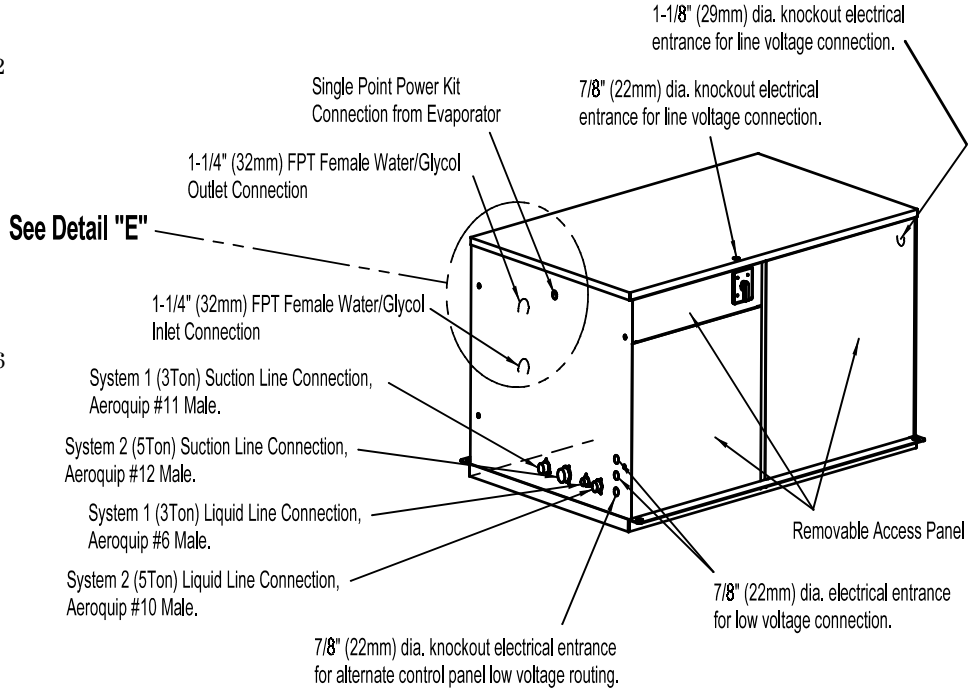


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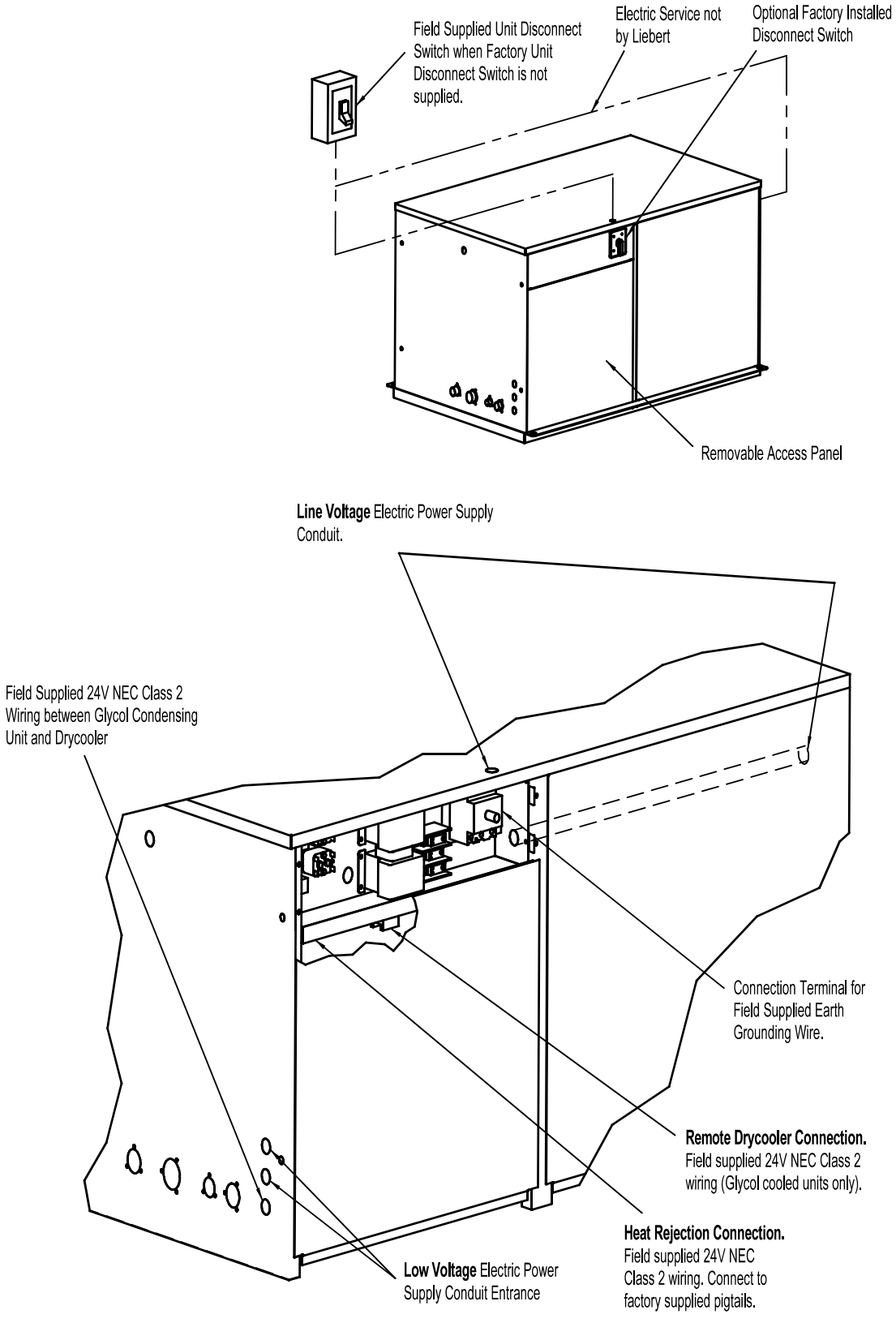
Figure 19 Indoor water/glycol condensing unit electrical field connections



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

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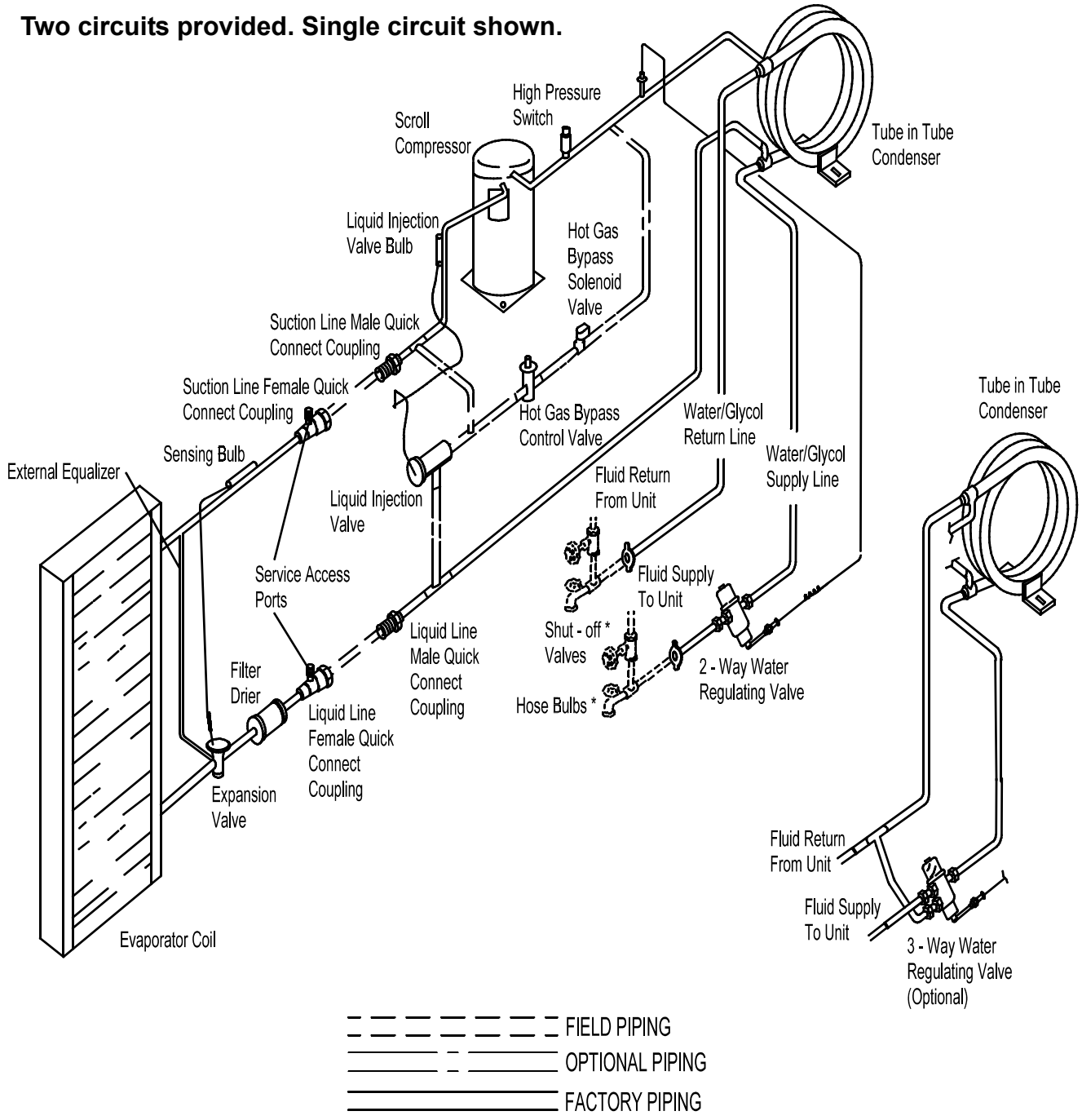
Figure 20 System piping with indoor water/glycol-cooled condensing unit



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

Note: Condenser water circuits are headered together to form one (1) supply connection and one (1) return connection.

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2.8 Optional Equipment Piping

2.8.1 Free-Cooling Coil (GLYCOOL)

The free-cooling coil is a secondary coil located upstream of the DX coil. To take maximum advantage of available free-cooling, the secondary coil may operate at the same time as the DX coil. A temperature sensor is factory-mounted to the free-cooling piping. When fluid temperature is sufficiently below the room temperature, cooling is provided by circulating the fluid through the secondary cooling coil (flow is controlled by a motorized valve). Compressors are staged on if needed to supplement the free-cooling. To keep deposits from building up in the free-cooling coil, the coil is flushed periodically.

NOTE
If the free-cooling coil is piped to an open water tower, a CU/NI (cupro-nickel) type coil must be ordered to prevent corrosion of the copper tubes; or a heat exchanger must separate the tower water from the free-cooling loop.

On water-cooled systems, the free-cooling coil outlet can be field piped to the condensing unit inlet, provided a 3-way regulating valve has been installed within the water/glycol condensing unit (see **Figure 21**).

Figure 21 Optional free cooling coil (3-way valve) on water/glycol units

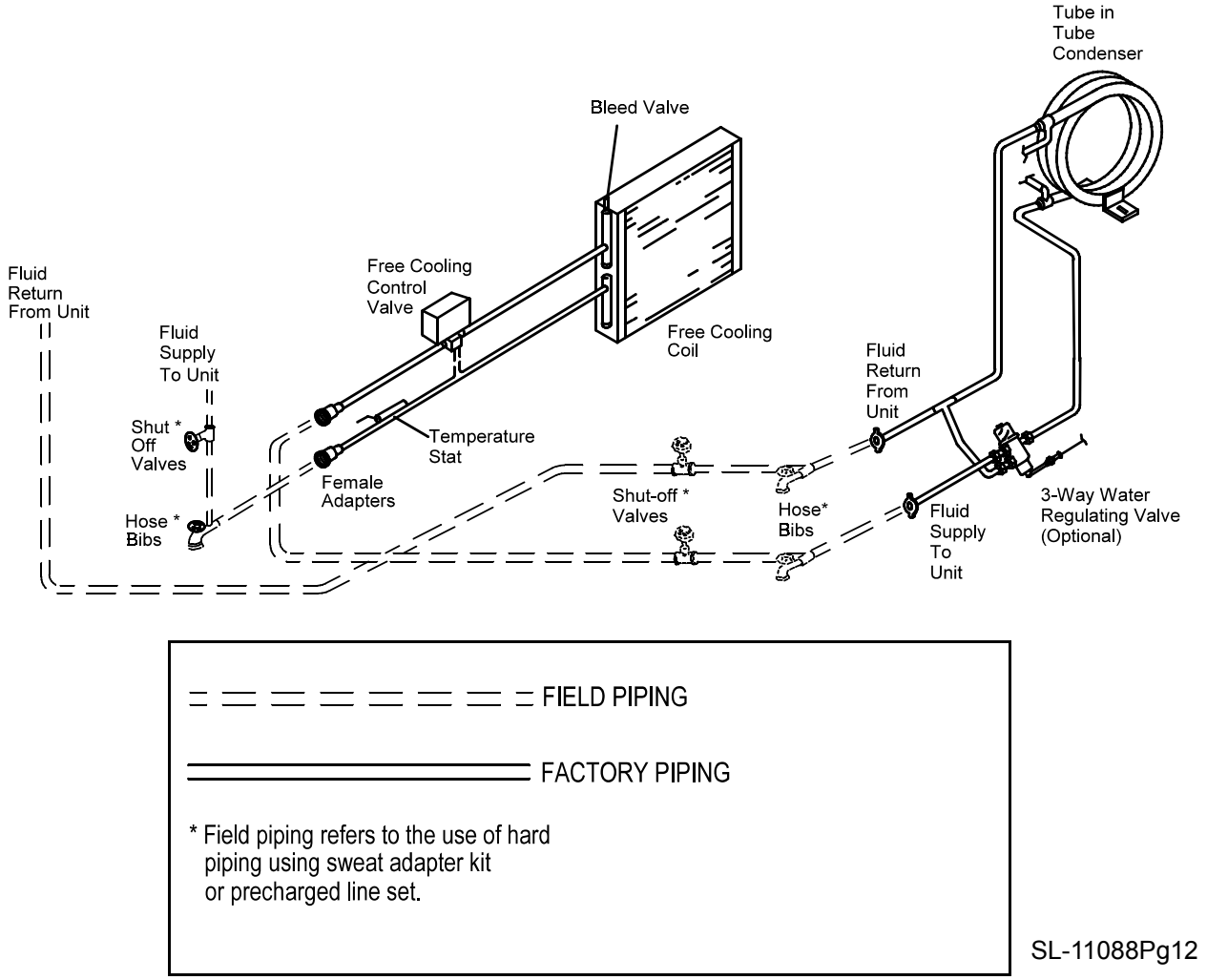
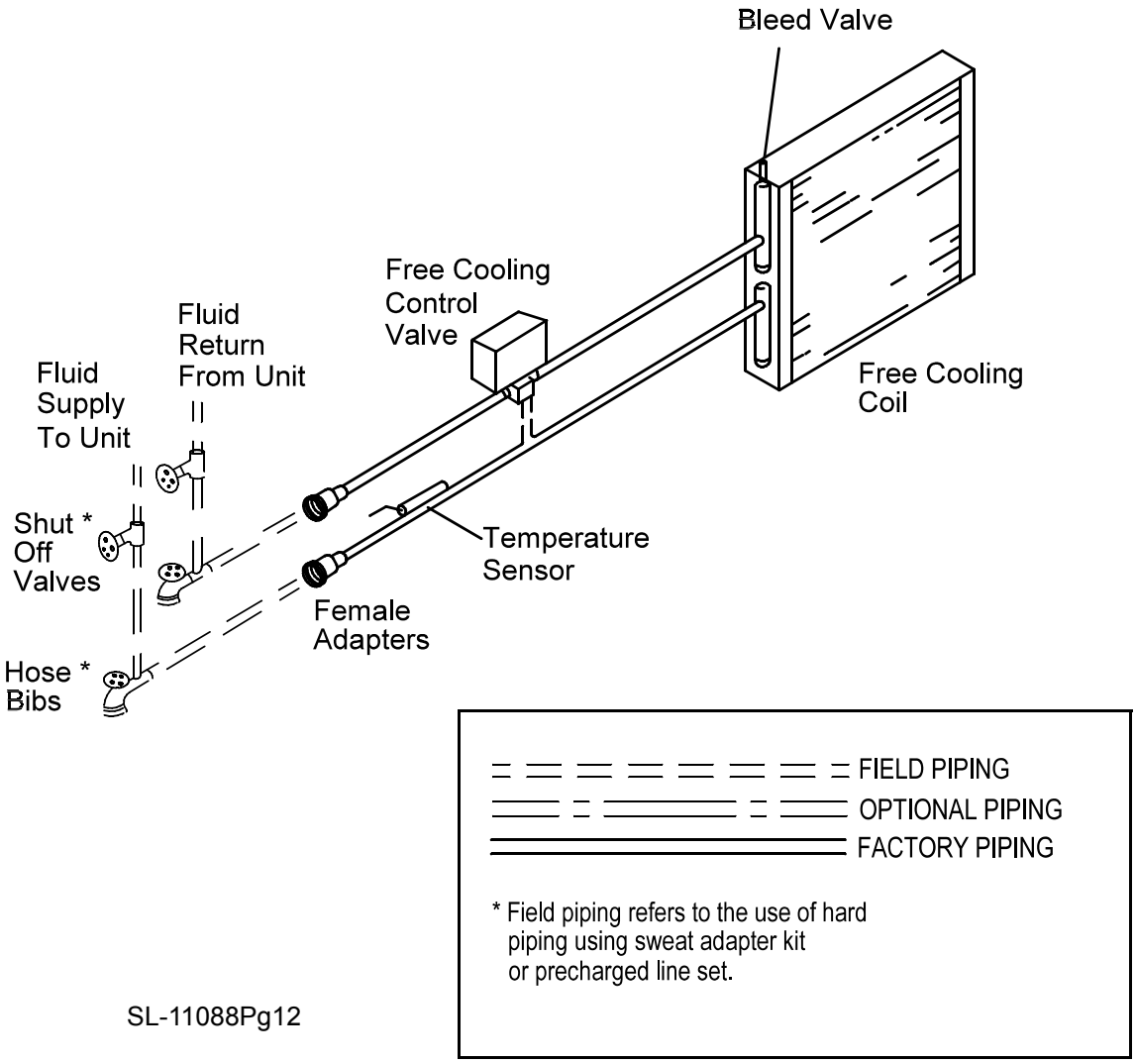


Figure 22 Optional free cooling coil (3-way valve) on air-cooled units



2.9 Checklist for Completed Installation

___ 1. Proper clearance for service access has been maintained around the equipment.

___ 2. Equipment is level and lock-nuts are installed with the leveling nuts on the spring isolators.

___ 3. Piping completed to refrigerant or coolant loop (if required). Refrigerant charge added (if required).

___ 4. Condensate pump installed (if required).

___ 5. Drain line Connected.

___ 6. Water supply line connected to humidifier (if required). Route to allow air filter removal.

___ 7. Field provided pan with drain installed under all cooling units and water/glycol condensing units.

___ 8. Filter box installed.

___ 9. Ducting completed.

___ 10. Filter(s) installed in return air duct.

___ 11. Line voltage to power wiring matches equipment serial tag.

___ 12. Power wiring connections completed and phased correctly between disconnect switch, evaporator, and condensing unit, including earth ground.

___ 13. Power line circuit breakers or fuses have proper ratings for equipment installed.

___ 14. Control wiring connections completed to evaporator and condensing unit (if required, including wiring to wall-mounted control panel and optional controls).

___ 15. Control panel DIP switches set based on customer requirements.

___ 16. All wiring connections are tight.

___ 17. Foreign materials have been removed from in and around all equipment installed (shipping materials, construction materials, tools, etc.)

___ 18. Fans and blowers rotate freely without unusual noise.

___ 19. Inspect all piping connections for leaks during initial operations. Correct as needed.

3.0 MICROPROCESSOR CONTROL

The Microprocessor Control for the Liebert Mini-Mate2 unit features an easy to use menu-driven LCD display. The menus, control features, and circuit board details are described in this section. Detailed information concerning controls (**4.0 - System Performance Microprocessor Controls**) and alarms (**5.0 - Alarms**) are provided.

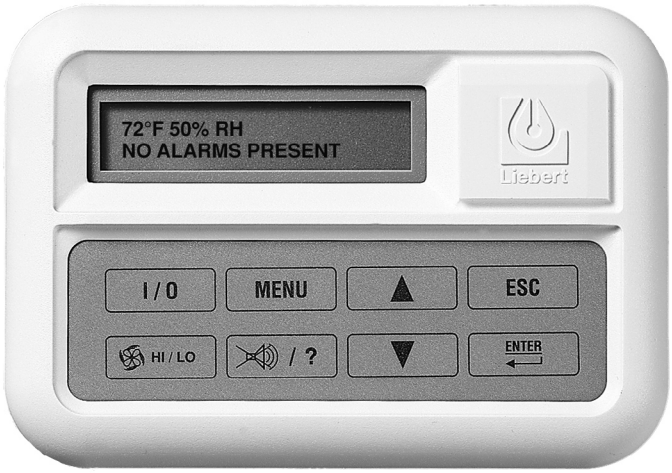
3.1 Feature Overview

To turn the unit ON, press the ON/OFF (I/O) key after power is applied. To turn the unit OFF, press the ON/OFF (I/O) key before power is disconnected.

The following control keys may be used to move through the menus, as prompted on the LCD display:

- ON/OFF (I/O) – turns unit on or off (top far left).
- Menu – Enables user to access the program menu to change control parameters, alarms, setback schedule, etc. (top near left).
- Increase (UP) – Raises the value of displayed parameter while in a set mode (setpoints, time, etc.) (Arrow-top near right) and navigates the program menu.
- Escape (ESC) – Allows user to move back to a previous menu (top far right).
- Alarm Silence/Help – If an alarm is present, pressing this keypad will silence he alarm. If this key is pressed when no alarms are present, help text will appear (bottom near left).
- Decrease (DOWN) Arrow – Lowers the value of displayed parameter while in a set mode (bottom near right) and navigates the program menu.
- Enter – After setting a control point, press **ENTER** to store the information in the microprocessor (bottom far right) Also, press **ENTER** to select a menu item.

Figure 23 Wall box



Active alarms are displayed on the LCD screen and sound an audible beeper. To silence an alarm, press the Alarm Silence/Help key as prompted on the display.

Setpoints, DIP switch settings, and other selections were made during factory testing of your unit and are based upon typical operating experience. (Other default selections were made according to options included with your unit). MAKE ADJUSTMENTS TO THE FACTORY DEFAULT SELECTIONS ONLY IF THEY DO NOT MEET YOUR SPECIFICATIONS.

Allowable ranges are displayed by pressing the help key. A password will be required (if enabled) to change setpoints, time delays, etc.

The display normally shown includes the present room temperature, humidity, active status functions (cooling, heating, dehumidifying, humidifying), and active alarms. More detailed status and alarm information is available from the menu.

3.2 Main Menu <Menu>

Press the **MENU** key to display the Main Menu. The Menu selections (in the following order) include:

- SETPOINTS
- STATUS
- ACTIVE ALARMS
- ALARM HISTORY
- TIME
- DATE
- SETBACK
- SETUP OPERATION
- SETPT PASSWORD
- SETUP PASSWORD
- CALIBRATE SENSOR
- ALARM ENABLE
- ALARM TIME DELAY
- COM ALARM ENABLE
- CUSTOM ALARMS
- CUSTOM TEXT
- DIAGNOSTICS
- end of MENU

Use the **UP/DOWN** arrow to scroll through the selections, then, when ready to select a particular function, press **ENTER**.

3.3 Setpoints

Setpoints and system setup parameters are kept in nonvolatile memory. Selecting SETPOINTS from the Main Menu will display the following selections:

- TEMPERATURE SETPOINT
- TEMPERATURE SENSITIVITY
- HUMIDITY SETPOINT
- HUMIDITY SENSITIVITY
- HIGH TEMPERATURE ALARM
- LOW TEMPERATURE ALARM
- HIGH HUMIDITY ALARM
- LOW HUMIDITY ALARM

Scroll through this sub-menu by using the **UP/DOWN** arrow, then press **ENTER** to select a particular function. To change a value, press **ENTER** and use the **UP/DOWN** arrows. When the value has been changed, press **ENTER** to store the value. For example, to change the temperature setpoint from the main status display:

1. Press **MENU** key to display main menu.
2. Scroll to "SETPOINTS" using the **UP/DOWN** arrow key. Press **ENTER**.
3. Scroll to "TEMP SETPT" using the **UP/DOWN** arrow key. Press **ENTER**.
4. Use the **UP/DOWN** arrow to change the value. Press **ENTER**.

Table 10 Default setpoints and allowable ranges

Setpoint	Default	Range
Temperature Setpoint	72°F	40-90°F (5-32°C)
Temperature Sensitivity	2.0°F	1-9.9°F (0.6-5.6°C)
Humidity Setpoint	50%	20-80% RH
Humidity Sensitivity	5%	1-30% RH
High Temperature Alarm	80°F	35-95°F (2-35°C)
Low Temperature Alarm	65°F	35-95°F (2-35°C)
High Humidity Alarm	60%	15-85% RH
Low Humidity Alarm	40%	15-85% RH

3.4 Status

The operator can monitor the percentage heating, cooling, dehumidifying, and humidifying status of the unit by selecting "STATUS" from the main menu.

3.5 Active Alarms

The operator can monitor the alarms status by selecting "ACTIVE ALARMS" which will display a "Alarm XX of YY" alert and description. If more than one alarm is activated, use the **Up/Down** arrow to scroll through the alarms list. ("XX" reference is the number of the alarm shown, and the "YY" reference is the total number of alarms activated).

3.6 Alarm History

A history of the 10 most recent alarms is kept in non-volatile memory complete with the date and time of their occurrence. The first alarm in the history is the most recent, and the 10th is the oldest. If the ALARM HISTORY is full (10 alarms) and a new alarm occurs, the oldest is lost and the newest is saved in ALARM HISTORY location 1.The rest are moved down the list by 1. ALARM HISTORY on new units may show the results of factory testing.

3.7 Time

The controller time clock must be set to allow for the setback control. The clock uses the 24-hour system (i.e., 12 midnight is entered 24:00). To change the time press **ENTER** to select the function, then use the **UP/DOWN** arrow to change the first character, press **ENTER** to store, then press the **UP/DOWN** arrow key to change the character, press **ENTER** to store, etc. The real time clock is backed-up.

3.8 Date

The controller date must be set to allow for setback control. To change the date press **ENTER**, then use the **UP/DOWN** arrow to change the first character, press **ENTER** to store, press the **UP/DOWN** arrow key to change the second character, etc.

3.9 Setback

The microprocessor can be programmed for night and weekend setback. Two (2) events can be programmed for a five-day workweek and two (2) events can be programmed for a two-day weekend. The following table can be used to devise a setback plan.

Table 11 Night and weekend setback plan

Event	Weekend	Weekday
Time 1		
Temperature1		
Sensitivity 1		
Humidity 1		
Humidity Sensitivity 1		
Time 2		
Temperature 2		
Sensitivity 2		
Humidity 2		
Humidity Sensitivity 2		

3.10 Setup Operation

Selecting **SETUP OPERATION** from the Main Menu will display the following selections:

- RESTART TIME DELAY
- C/F DEGREES
- HUMIDITY CONTROL METHOD
- LEAD COMPRESSOR
- SHOW DIP SWITCH
- VALVE TIME (if valve present)
- CW FLUSH (if valve present)

Use the **UP/DOWN ARROW** to scroll through the submenu. Press **ENTER** to select a particular function.

3.10.1 Restart Time Delay

This function delays unit restart after main power is restored to the unit. If several systems are operating, the time delays should be set to different values to cause a sequential start. Delay can be set from 0.1 minutes (6 seconds to 9.9 minutes. Setting the value to zero (0) will prevent unit restart when power is restored. In this case, the unit must be restarted manually by pressing the **ON/OFF** button on the keypad.

3.10.2 C/F Degrees

The control may be selected to show readings and setpoints in either degrees Fahrenheit (°F) or in degrees Celsius (°C). To change the value use **ENTER** to select this function, then use the **UP/DOWN** arrow to change the value. Press **ENTER** to store the value.

3.10.3 Humidity Control Method

The operator may select either relative (direct) or absolute (predictive) humidity control. If "relative" is selected, the RH control is taken directly from the RH sensor. If "absolute" is selected, the RH control is automatically adjusted whenever return air temperature deviates from the desired temperature setpoint (i.e., predictive humidity control). The LCD display will indicate percentage relative humidity for both methods of control. If the "absolute" feature is selected, the adjusted humidity reading will also be shown. When utilizing the predictive humidity control feature, the humidity level is automatically adjusted ~2% RH for each degree difference between the return air temperature and the temperature setpoint.

Unnecessary dehumidification can result when overcooling occurs during a dehumidification cycle. This is due to a higher than normal RH reading caused by overcooling the room (about 2% RH for each degree of overcooling). This drop in temperature extends the dehumidification cycle. Later, when the dehumidification ends and the temperature rises to the setpoint, the RH reading falls. The final RH reading will then be lower than actually desired. If the temperature drop was significant enough, the percentage RH could be low enough to activate the humidifier.

If the absolute humidity control is selected, over-dehumidification may be avoided. When overcooling occurs (i.e., causing an increase in the RH reading) the humidity control program estimates what the RH will be when the dehumidification cycle ends and temperature returns to the setpoint. This allows the dehumidification cycle to end at the proper time. Predictive humidity control can greatly reduce energy consumption by minimizing both compressor/reheat operation. Use the **UP/DOWN ARROW** key to select the desired humidity control method.

3.10.4 Lead Compressor

This function allows the user to select which compressor is the lead: Compressor 1 (3 ton), Compressor 2 (5 ton), or Auto. The factory default is Auto. If Auto is selected, the control will determine which compressor is to be the lead compressor based on the average room load over the previous one hour of operation.

3.10.5 Show DIP Switch

This function shows the position of the DIP switches which are located on the control board in the unit. 1 = Switch is "ON" and 0 = Switch is "OFF". For more information on the DIP switches and their functions, see Table 17 Equipment Switch Settings.

3.10.6 Valve Time (For Systems With a Modulating Chilled-Water Valve)

This function shows the full valve travel time of the modulating valve on a chilled-water system. This is the time it takes for the valve to travel from full closed to full open. It is programmable from 50 to 250 seconds; factory default time is 165 seconds and should not be changed unless actual valve travel time is not correct. The full valve travel time is used by the control to determine the appropriate valve position. For example, if the valve travel time is 165 seconds and 50% cooling is being called for, the valve will open for 83 seconds to achieve 50% open.

3.10.7 CW Flush (For Systems With a Modulating Chilled-Water Valve)

This function shows the interval time at which the system will perform a modulating chilled-water valve system flush cycle. The factory default is 24 (hours) and is programmable from 0 (hours) which signifies to never flush, to 99 (hours) which signifies to flush after every 99 hours of valve non-use. If the valve is called on by the control to open within the programmed interval time, the timer will be reset to 0. The flush cycle is active even when the fan is turned off, but power is applied to the unit. When the interval timer reaches the programmed time, the valve will be opened for 3 minutes to flush any contaminates which may have collected in the system.

Table 12 Setup functions, default values and allowable ranges

Function	Default	Range
Restart Time Delay	0.1	0 to 9.9 min (0 = manual restart)
C/F Degrees	°F	°C or °F
Humidity Control	Rel	Relative or Absolute
Valve Time	165	50 to 250 sec(s)
CW Flush	24	0 to 99 hours

3.11 Change Passwords

The display will prompt the operator to enter a three digit password when attempting to make changes. The system includes two (2) passwords, one for setpoints and one for setup. The system allows the password to be changed by first entering the default password set at the factory (1-2-3) for setpoints and (3-2-1) for setup. The password function provides system security, so that only authorized personnel are allowed to make changes to the system. (If unauthorized changes are being made, the passwords may be compromised and new ones should be selected). The password function can be disabled by setting DIP switch 8 in the wallbox to OFF, then resetting power to the unit.

3.12 Calibrate Sensors

The temperature and humidity sensors can be calibrated by selecting the CALIBRATE SENSORS menu item. The temperature sensor can be calibrated ±5°F, while the humidity sensor can be calibrated ±10% RH. When calibrating the humidity sensor, the value shown will always be % RH, even though absolute humidity control may be selected. If absolute humidity control is selected, the Normal Status Display will display the adjusted reading. This reading may not agree with the relative humidity reading displayed while in calibration.

If the sensors are subject to frequent wide temperature and humidity swings, it may be necessary to shorten the cycling by increasing the sensor response time delay. If the sensors are located too close to the air discharge, they will likely experience rapid swings in measurement. The factory default is 30 seconds. Another method in reducing compressor cycling is to increase the temperature and/or humidity sensitivity.

3.13 Alarm Enable

Each alarm can be disabled or enabled. Use the **UP/DOWN ARROW** to select a particular alarm, press Enter to select either enable or disable. Then press Enter again to store the change. When the alarm is disabled it will NOT report to either the wallbox beeper or the common alarm relay. The high water in condensate pan and high head alarms cannot be disabled.

NOTE
The high-water alarm will automatically shut the unit off.

3.14 Alarm Time Delay

Each individual alarm can be programmed with a time delay (**Table 13**), causing the unit to delay a specified amount of time (0-255 seconds) before recognizing the alarm. The alarm condition must be present for the full amount of the time delay before the alarm will sound. If the alarm condition is diverted prematurely, the alarm will not be recognized and the time delay will automatically reset.

NOTE
For software alarms such as "loss of power" and "short cycle," the time delay should be left at the factory default of 0.

Table 13 Alarm default time delays

Alarm	Default Time Delay (seconds)
Hum Prob	2
Chng Fltr	2
Custom Alarm #1	0
Custom Alarm #2	0
Custom Alarm #3	0
High Temperature	30
Low Temperature	30
High Humidity	30
Low Humidity	30
Short Cycle 1 & 2	0
Loss of Power	0

3.15 Common Alarm Enable

Each individual alarm can be selected to activate/deactivate the common alarm relay. If the energize common alarm function is set to **YES**, the relay is energized immediately as the alarm is enunciated, and de-energized when the alarm condition has cleared. If the alarm is completely DISABLED, the alarm has no effect on the common alarm relay. Use the **UP/DOWN** arrows to scroll to a particular alarm, press the **ENTER** button to select it, then press the **ENTER** key again to select Yes or No.

3.16 Custom Alarms

The custom alarm messages can be selected from a list of standard alarm messages, or the operator can write his/her own message. A MAXIMUM OF THREE (3) ALARM MESSAGES CAN BE CUSTOMIZED.

The text for custom alarms can be changed at any time by selecting "CUSTOM ALARMS". To change the text for a custom alarm, select the alarm you would like to change, 1, 2 or 3. Using the **UP/DOWN** arrows, step through the list of seven standard alarm messages (listed below) and two custom alarms. Select the alarm message desired and store it by pressing **ENTER**.

- SMOKE DETECTED
- CUSTOM 2
- CUSTOM 3
- STANDBY GC PUMP
- WATER FLOW LOSS
- STANDBY UNIT ON
- CUSTOM 1

3.17 Custom Text

To modify the two custom alarm messages select “CUSTOM TEXT”. Then select “Custom Text #1,” “Custom Text #2” or “Custom Text #3.” Text can be up to 16 characters in length and can be either a blank space or any of the following alphanumeric characters and symbols:

- A,B,C,D,E,F,G,H,I,J,K,L,M,N,O,P,Q,R,S,T,U,V,W,X,Y,Z
- #,%,*,-
- 0,1,2,3,4,5,6,7,8 or 9

Use the **UP/DOWN arrows** to select a character, then press **ENTER**. The cursor will move to the next space where you may once use the **UP/DOWN arrows** to select another character, etc. The custom text alarm will be displayed only if the alarm is selected in Custom Alarms.

LCD Display Contrast

The level of contrast due to the viewing angle of the LCD display can be adjusted using a potentiometer screw, inside the wall box next to the display.

Nonvolatile Memory

All critical information is stored in nonvolatile memory. Setpoints and setup parameters are kept inside the microcontroller in EEPROM.

Equipment Options Switches

Equipment options are selected and enabled using DIP switches 1 through 7. These are located on the control board near TB3. These switches are factory set and should not require any user changes. The setting and function of the switches can be individually read on the LCD display.

NOTE
In order to update the DIP switch settings, power must be cycled off, then on, from the unit disconnect switch.

Table 14 Equipment switch settings (unit control board)

Switch	OFF Position	ON Position
1	Step Cool	Ramp Cool
2	Step Heat	Ramp Heat
3	Not Used	Not Used
4	No GLYCOOL	GLYCOOL
5	Disable 1 stage CW	Enable 1 stage CW
6	Not used	Not used
7	1-stage dehumidification	2-stage dehumidification
8	Disable SCR Reheat	Enable SCR Reheat

Table 15 Switch settings (wallbox board)

Switch	OFF Position	ON Position
1	Beeper Disable	Beeper Enable
2	Not Used	Not Used
3	Not Used	Not Used
4	Enable Reheat	Disable Reheat
5	Enable Hum.	Disable Hum.
6	Enable Dehum.	Disable Dehum.
7	Disable Setback	Enable Setback
8	Enable Password	Disable Password

3.18 Run Diagnostics

By selecting Run Diagnostics, maintenance personnel can check system inputs, outputs, and conduct a test of the microcontroller circuit board from the wall box control. A review of the system inputs and the microcontroller test can be done without interrupting normal operation.

Test Outputs

- When this feature is selected, the controller is effectively turned off. When stepping from one load to the next, the previous load is automatically turned off. The loads can also be toggled on/off by selecting “ENTER”. Once turned on, the output will remain on for five minutes unless toggled off or the test outputs function is exited by selecting “MENU/ESC” (Compressor is limited to 15 seconds on to prevent damage.

CAUTION

Testing compressor output for more than a few seconds could damage the compressor. To eliminate damaging the compressor during testing, DO NOT test compressor output for more than a few seconds.

CAUTION

Extended unit operation in the test outputs mode for troubleshooting may cause damage to unit. DO NOT operate unit in the test outputs mode any longer than is necessary for troubleshooting.

NOTE

Fan turned on with all loads.

The outputs are:

- Main Fan
- Compr1 (3-ton)
- Compr1 & HGBP1
- Compr2
- Compr2 & HGBP2
- Compr1 & Compr2
- Chill Water/Gly (if present)
- Reheat 1
- Reheat 2
- SCR Reheats (if present)
- Humidifier
- Common Alarm

Test Inputs

With the unit on and the fan running, the input states may be displayed for the following devices:

- Input Power
- High Water in Pan
- High Head Comp1
- High Head Comp2
- Air Sail Switch (requires additional factory-installed components)
- Filter Clog
- Humidifier Prob.
- Custom Alarm #1
- Custom Alarm #2
- Custom Alarm #3

Test Micro

By selecting this function, the microcontroller will perform a self test lasting approximately 10 seconds. When the test is complete, the display will show the ROM checksum, ROM part number, and firmware revision number.

Figure 24 Control menu

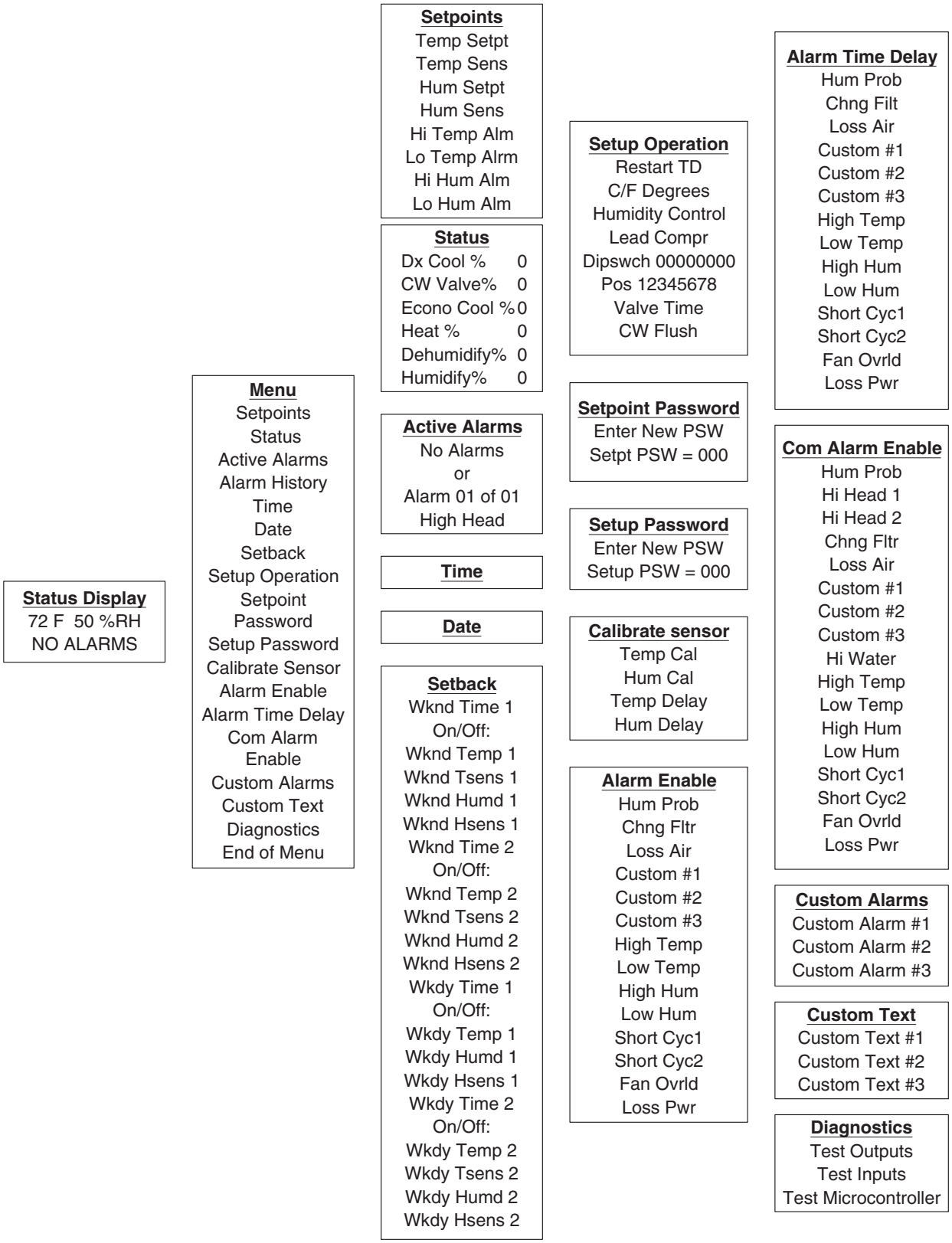
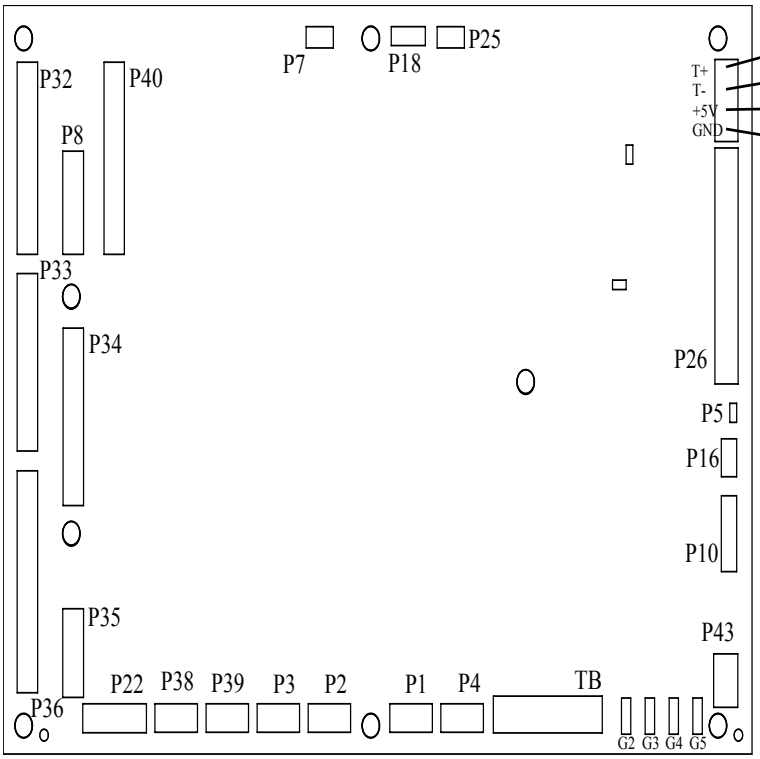


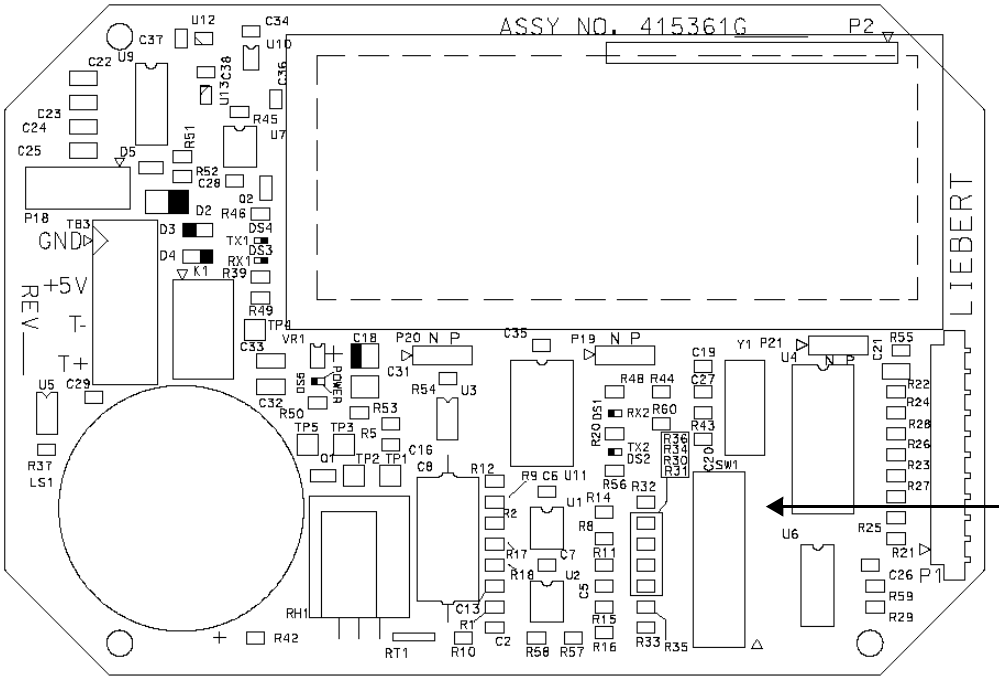
Figure 25 Control board (inside evaporator)



TB3-4 Connection to Terminal #4 Wallbox
TB3-3 Connection to Terminal #3 Wallbox
TB3-2 Connection to Terminal #2 Wallbox
TB3-1 Connection to Terminal #1 Wallbox

P16 Remote Sensor Connection

Figure 26 Wall box board



TB3-1
TB3-2
TB3-3
TB4-4

Wall Box DIP Switches (1-8)

4.0 System Performance Microprocessor Controls

4.1 Control Type Response Proportional Control

The percent requirement is determined by the difference between the return air temperature and the temperature setpoint. As the return air temperature rises above the temperature setpoint, the percent cooling required increases proportionally (from 0 to 100%) over a temperature band equal to the temperature sensitivity plus 1 degree Fahrenheit. The heating requirement is determined in a similar manner as the temperature decreases below the setpoint. With this control type the temperature at which the room is controlled increases as the room load increases. At full load the room would be controlled at a temperature equal to the setpoint plus the sensitivity.

4.2 Cooling

4.2.1 Multi-Step Cooling, Compressorized Direct Expansion (DX) Systems

The system will use the 3-ton (compressor #1) and 5-ton (compressor #2) compressors in an 8-ton system. The control will determine the average cooling requirement updated every hour and select the lead compressor or, the user can select the lead compressor through the “Setup Operation” menu. At startup, the 3-ton compressor will be the lead compressor. The compressors will be staged on with hot gas bypass energized at 50 and 100% cooling requirements. The compressors will turn off at 75% and 25% requirements.

4.2.2 Chilled-Water Cooling (8 Ton)

The chilled-water control valve is adjusted proportionally as the temperature control varies the requirement for cooling from 0% to 100%. This is based on the full valve travel time programmed in the “Setup Operation” menu.

4.2.3 GLYCOOL Cooling (8 Ton)

When GLYCOOL is available, the temperature control will calculate a total cooling requirement of 200%. Assuming that full GLYCOOL capacity is available, the GLYCOOL valve opens proportionally as the requirement for cooling rises from 0 to 100%. If the call for cooling continues to increase, the control will energize the compressors as needed to match the average cooling requirement. As long as GLYCOOL is available, the control will leave the valve 100% open. If GLYCOOL cooling is not available, the temperature control will operate the compressors in the same manner as the Multi-Step without GLYCOOL.

4.3 Reheat

4.3.1 Electric Reheat - Staged

For 2-stage electric reheat, they are activated when the temperature control calculates a requirement of 50% and 100%. They are deactivated when the requirement decreases to 75% (reheat 2) and 25% (reheat 1).

4.3.2 SCR Electric Reheat

The SCR (Silicon Controlled Rectifier) controller shall proportionally control the stainless steel reheats to maintain the selected room temperature. The rapid cycling made possible by the SCR controller provides precise temperature control, and the more constant element temperature extends heater life. During operation of the SCR control, the compressor(s) operate(s) continuously. The heaters are modulated to provide temperature control. If overcooling occurs, the compressor(s) will be locked off when the temperature drops to the low temperature alarm. SCR reheats are 15 kW.

4.4 Dehumidification / Humidification Percent Required

The humidity control for the MM2 is based on a calculated percent requirement for dehumidification or humidification. The percent requirement is calculated from the difference between the sensor reading and the humidity setpoint, divided by the sensitivity. The control method is selectable between relative and absolute. Relative humidity control is the default.

4.4.1 Staged Dehumidification, Compressorized Direct Expansion (DX) Systems

For the 8-ton unit operation, 1 or 2 stage dehumidification is selected through DIP switch #7. For 2 stages, the 5-ton compressor is the lead compressor when dehumidifying. Dehumidification will be staged on at 50 and 100% call. The electric reheats are turned on at 25% cooling (reheat 1) and 25% heating (reheat 2) for improved temperature control. The reheats are deactivated at 0% and 50% cooling requirement, respectively. If overcooling occurs, the first stage of dehumidification is disabled at 125% call for heating. If 1 stage or 2 stage is selected, dehumidification is disabled at 200% call for heating. Dehumidification is re-enabled at 66% call for 2 stage and 33% call for 1 stage. For optional hot water heating, the valve is energized at its normal point, 100% heating requirement.

4.4.2 Humidification Operation

System Activation

The humidifier is activated when the humidity control calculates a requirement for 100% humidification, and is deactivated when the requirement falls below 50%.

4.4.3 Dehumidification Lockout

Dehumidification is locked out if overcooling occurs. Dehumidification on the 8-ton unit is disabled at 125% (first stage) and 200% (all stages) heating requirement. Dehumidification is re-enabled at 66% and 33% heating requirement.

4.5 Load Control Features

The control system monitors the compressor and prevents it from turning on within a 3-minute period of being off. If this on-off cycle occurs to often (e.g. 10 times within a one hour period) a Short Cycle Alarm will occur.

4.6 Communications

The control system uses a two-wire, RS-422 channel to communicate with Liebert Site Products via a proprietary protocol. A converter board (ECA2) is available to allow communications with a “dumb” terminal or a computer using RS-232 channel. More details are provided in the Site Products and ECA2 User Manual.

The communications channel provides both monitoring and control options, including:

- TEMPERATURE/HUMIDITY: Current temperature and humidity readings.
- STATUS (%), Cooling/heating and humidify/dehumidify operating status.
- PRESENT ALARMS: Alarms currently activated.
- SETPOINTS:
  - Temperature Setpoint
  - Temperature Sensitivity
  - Humidity Setpoint
  - Humidity Sensitivity
  - High Temperature Alarm
  - Low Temperature Alarm
  - High Humidity Alarm
  - Low Humidity Alarm
- ON/OFF STATUS and CONTROL
- SILENCE ALARM

5.0 ALARMS

The microprocessor control system will audibly and visually signal all ENABLED Alarms (including two (2) custom alarms). These special alarms can be chosen from the optional alarm list and/or can have their own fully custom text. The custom alarm inputs are contact closures wired from terminal 24 through a normally open contact to either 50 (alarm 1), 51 (alarm 2), or 56 (alarm 3). The alarms can be enabled/disabled (refer to **3.0 - Microprocessor Control**) and a time delay of 0-255 seconds can be set. The alarms can also be programmed to either sound the alarm & activate the common alarm relay OR to sound the alarm only.

When a new alarm occurs, it is displayed on the screen and the audible alarm is activated. (If communicating with a Liebert Site Product, the alarm is also transmitted). The message "PRESS ALARM SILENCE" will prompt the operator to silence the alarm. After the alarm is silenced, the display will return to the Normal Status Display. Alarms can be reviewed by selecting the "ACTIVE ALARMS" feature. The alarms can also be silenced through communications with a Liebert Site Products Unit.

Many alarms will reset automatically when the alarm condition is no longer present and only after it has been acknowledged by being "Silenced." The exceptions are:

1. Software alarms, i.e., Loss of Power and Short Cycle alarms will reset automatically 30 seconds and 90 minutes respectively, after being silenced or acknowledged; and
2. Specific alarms monitoring overload or high pressure switches may require a manual reset depending upon the model.

5.1 Alarms: Definitions and Troubleshooting

The following list provides a definition and troubleshooting suggestions for each type of alarm. Refer to **8.0 - Troubleshooting** for additional details. If you need further assistance, contact your Liebert supplier. THE CUSTOMER MUST SPECIFY ALARM(S) AT THE TIME OF ORDER. OTHER DEVICES AND WIRING MAY BE REQUIRED AT THE FACTORY FOR SOME OF THE ALARMS.

5.1.1 Custom Alarms

Custom alarm(s) messages are programmed at the LCD display. The message displayed may be included in a list of provided alarms or it may be customized text (for up to three alarms). IF CUSTOMIZED TEXT IS USED, MAINTENANCE PERSONNEL SHOULD BE INFORMED OF THE ALARM FUNCTION AND THE REQUIRED ACTION.

5.1.2 High Head Pressure

Compressor head pressure is monitored with a pressure switch. (One SPDT pressure switch is used). If head pressure exceeds 360 psig, the switch turns off the compressor contactor and sends an input signal to the control. The condition is acknowledged by pressing the alarm silence button on the wall box, which will clear if the head pressure is alleviated. If the head pressure alarm has activated three times, the alarm will lock until the unit is serviced. After the head-pressure problem is fixed, reset the control by disconnecting power to the evaporator unit.

Air-Cooled Systems

Check for power shut off to the condenser, condenser fans not working, defective head pressure control valves, dirty condenser coils or crimped lines.

Water/Glycol Systems

Check water regulating valves. Verify water/glycol flow (i.e., pumps operating and service valves open). Is water tower or drycooler operating? Is the coolant temperature entering the condenser at or below design conditions? Is AUX relay (terminals 70 & 71) operating during cooling to turn on the drycooler?

5.1.3 Humidity

The humidity alarm may be activated under the following conditions:

- **High:** The room return air humidity exceeds the pre-set high humidity alarm setpoint. Is the unit set up for dehumidification? Check DIP switch.
- **Low:** The room return air humidity decreases to the low humidity alarm setpoint. Is the unit setup for humidification? Check DIP switch.
- **High and Low Humidity (simultaneously):** The simultaneous display of two alarms results in loss of the humidity input signal. DASHES WILL BE DISPLAYED IN THE HUMIDITY READING DISPLAY. Under these conditions, the control system deactivates both humidification and dehumidification. Check for a disconnected cable or failed sensor.

NOTE
Check for proper setpoints. Does the room have a vapor barrier to seal it from outdoor humidity? Are doors or windows open to outside air?

5.1.4 Temperature

The temperature level alarm may be activated under the following conditions:

- **High:** The room return air temperature increases to the high temperature alarm setpoint. Check for proper setpoint value. Is the room load more than the unit can handle (i.e., capacity too small)? Make sure cooling components are operating (compressor or valves).
- **Low:** The room return air temperature decreases to the low temperature alarm setpoint. Check for proper setpoint value. Make sure all heating components are operating (e.g., contactors, reheats, etc.). Are reheats drawing the proper current (refer to amp rating on nameplate).
- **High and Low (simultaneously):** The simultaneous display of these two alarms results in loss of the temperature input signal (or the humidity is out of sensor range-15 to 85% RH). Dashes will be displayed for the temperature reading. The control system will initiate 100% cooling. Check for a disconnected cable or a failed sensor.

5.1.5 Humidifier Problem Alarm

The Humidifier Problem Alarm will sound and display a message if any of the following humidifier conditions occur: overcurrent detection; fill system fault or end of cylinder life.

Check fault indicator LED on humidifier control board:

- Constant LED on = Overcurrent
- 1 second LED Flash = Fill System Fault
- 1/2 second LED Flash = End of cylinder life, replace tank

5.1.6 High-Water Alarm

A float switch in the evaporator pan will shutdown the evaporator on a high water level. Clear the drain and reset power to the unit in order to clear the alarm.

5.1.7 Loss of Power

The Loss of Power Alarm will activate (after power is restored to the unit) if the unit has lost power or the disconnect switch was incorrectly turned off before the unit ON/OFF switch was pressed. A Liebert remote monitoring unit (optional) will immediately indicate loss of power.

5.1.8 Short Cycle

A Short Cycle Alarm will occur if a compressor system has exceeded 10 cooling start attempts in a one-hour period. This can be caused by room cooling load is small compared to capacity of the unit. If room load is low, increase temperature sensitivity to reduce cycle.

5.2 Optional/Custom Alarms

5.2.1 Change Filter

Periodically, the return air filters in the evaporator must be changed. The Change Filter alarm notifies the user that filter replacement is necessary. A differential air pressure switch closes when the pressure drop across the filters becomes excessive. The switch is adjustable using the procedure on the switch label.

5.2.2 Firestat

The optional firestat feature is a bi-metal operated sensing device with a closed switch under normal conditions. Connected between pins 1-8 and 1-9, this device will shut down the entire unit.

5.2.3 Smoke Detector

The smoke detector is located in the unit, the optional smoke detector power supply is located in the electric panel. It constantly samples return air through a tube. No adjustments are required.

6.0 SYSTEM OPERATION, TESTING, AND MAINTENANCE

This section describes system testing, maintenance and replacement procedures. Use copies of the **Maintenance Inspection Checklist** to record preventive maintenance inspections.

WARNING

Unit contains hazardous electrical voltage. Disconnect power supply before working within. Line side of factory disconnect remains energized when disconnect is off.

6.1 System Testing

6.1.1 Environmental Control Functions

The performance of all control circuits can be tested by changing the setpoints, which activates each of the main functions.

6.1.2 Cooling

To test the cooling function, set the setpoint to a temperature of 10°F (5°C) below room temperature. A call for cooling should register and prompt the equipment to begin cooling cycle. (Disregard any temperature alarms). Upon completion of testing, return setpoint to the desired temperature.

6.1.3 Heating

Reheat may be tested by setting the setpoint 10°F (5°C) above room temperature. A call for heating should register and prompt the equipment to begin heating cycle. (Disregard any temperature alarms). Upon completion of testing, return setpoint to the desired temperature.

6.1.4 Humidification

To check humidification, set the humidity setpoint at RH 10% above the room humidity reading. After a short delay, the canister will fill with water and steam will be produced. Upon completion of testing, return the humidity setpoint to the desired humidity.

6.1.5 Dehumidification

The dehumidification performance can be tested by setting the humidity setpoint at RH 10% below room relative humidity. The compressor should turn on. Upon completion of testing, return humidity setpoint to the desired humidity.

6.1.6 Remote Shutdown

A connection point is provided for remote shutdown devices supplied by the customer. This terminal strip is located in the electric panel. (Terminals 37 and 38 are fitted with a jumper when no remote shutdown device is installed).

6.2 Maintenance and Component Operation

6.2.1 Electric Panel

The electric panel should be inspected on a semi-annual basis for any loose electrical connections.

6.2.2 Filters

Filters are usually the most neglected item in an environmental control system. In order to maintain efficient operation, they should be checked monthly and changed as required. ALWAYS TURN POWER OFF BEFORE REPLACING FILTERS.

Filters are replaced by opening the hinged door on the return air filter box.

6.2.3 Blower System

Monthly inspection of the blower package includes: motor mounts, belts, fan bearings, and impellers.

Fan impellers should be thoroughly inspected and any debris removed. Check to see if they are tightly mounted on the fan shaft and do not rub against the fan housing during rotation. Motor and fan bearings are permanently sealed and self-lubricating and do NOT need lubricated.

The drive belt should be checked monthly for signs of wear and proper tension. Pressing on belts midway between the sheave and pulley should produce from 1/2" to 1" (12 to 25 mm) of deflection. Belts that are too tight can cause excessive bearing wear.

Belt tension can be adjusted by raising or lowering the fan motor base. Loosen nut above motor mounting plate to remove belt. Turn nut below motor mounting plate to adjust belt tension. If belt appears cracked or worn, it should be replaced with a matched belt (identically sized). With proper care, a belt should last several years.

NOTE
After adjusting or changing the belt, always be certain that motor base nuts are tightened. The bottom adjustment nut should be finger tight. The top locking nut should be tightened with a wrench.

Air Distribution

Since all unit models are designed for constant volume air delivery, any unusual restrictions within the air circuit must be avoided. High efficiency filters can reduce air performance and evaporator capacity.

Blower Removal (Evaporator)

If the blower or bearings must be removed or serviced, use the following procedure.

1. Prepare the main center section of the three (3) piece electric panel by first marking and disconnecting all power and control wiring entering the panel.
2. Remove the electric panel by removing screws from top and bottom sections
3. Remove the bottom electric panel mounting flange from unit base.
4. Remove the belt, motor, motor mounting plate, and tensioning bolt.
5. Remove the four (4) screws holding the blower mounting rails to the sled.

CAUTION
Protect refrigerant and water piping from damage.

6. Remove the (4) screws holding the blower mounting rails to the sled.
7. Slide the blower/rail assembly forward and rotate approximately 45 degrees and remove from unit.
8. Replace failed parts.

6.2.4 Electric Reheat

Reheat element sheets and fins are manufactured with stainless steel. Regular inspections are necessary to assure proper cleanliness of the reheating element. Should inspection reveal corrosion particles on the reheating element or adjoining surfaces (including ducts and plenums), appropriate cleaning should be performed. Periodic replacement of the reheating element may be necessary to meet specific application requirements.

6.2.5 Refrigeration System

Each month the components of the refrigeration system should be inspected for proper function and signs of wear. Since in most cases evidence of malfunction is present prior to component failure, periodic inspections can be a major factor in the prevention of most system failures. Refrigerant lines must be properly supported and not allowed to vibrate against ceilings, floors, or the unit frame. Inspect all refrigerant lines every six months for signs of wear and proper support. Inspect the capillary and equalizer lines from the expansion valve.

Suction Pressure

Suction pressure will vary with load conditions. Suction pressure normally ranges from 58 psi to 75 psi (405 kPa to 517 kPa). When the 3-ton circuit is operating alone, the upper range of suction pressure may approach 100 psig. This is a function of the unit design and is acceptable for scroll compressors.

Discharge Pressure

The discharge pressure will vary greatly with load and ambient conditions (**Table 16**). The high-pressure switch will shut the compressor down at its cut-out setting.

Table 16 Typical discharge pressures

System Design	psig	(kPa)
Air-Cooled	180-275	(1242-1895)
Water-Cooled 65ºF to 85ºF water (18 to 29.4ºC)	200-225	(1380-1550)
Glycol-Cooled	210-275	(1445-1895)
Maximum	330	(2275)
High Pressure Cut-Out	360	(2480)

Thermostatic Expansion Valve

The thermostatic expansion valve keeps the evaporator supplied with enough refrigerant to satisfy load conditions. Proper valve operation can be determined by measuring superheat level. If too little refrigerant is being fed to the evaporator, then the superheat will be high. Conversely, if too much refrigerant is being supplied, then the superheat will be low. The correct superheat setting is between 10 and 15°F (5.6 and 8.3°C). Only the 5-ton valve is adjustable.

Air-Cooled Condensing Units

Restricted airflow through the condenser coil will reduce the operating efficiency of the unit. Additionally, it can result in high compressor head pressure and loss of cooling. Using compressed air or commercial coil cleaner, clean the condenser coil of all debris that will inhibit airflow. In winter, do not permit snow to accumulate around the side or underneath the condenser. At the same time check for bent or damaged coil fins and repair as necessary. Check all refrigerant lines and capillaries for vibration and support as necessary. Carefully inspect all refrigerant lines for signs of oil leaks.

Coaxial Condensers (Water/Glycol-Cooled Condensing Units)

Each water or glycol-cooled condensing unit has a coaxial condenser consisting of an exterior steel tube and an interior copper tube. If the water supply is clean, coaxial condensers do not normally require maintenance or replacement. Should your system begin to operate at high head pressure with reduced capacity, and all other causes have been eliminated, the condenser may be obstructed or fouled and should be replaced.

Regulating Valves (Water/Glycol Condensing Units)

The water regulating valve automatically regulate 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 water regulating valve is designed to begin opening at 180 psi (1240 kPa) and be fully opened at 240 psi (1655 kPa). The valve is factory set and should not need adjustment.

Glycol Solution Maintenance

It is difficult to establish a specific schedule of inhibitor maintenance since the rate of inhibitor depletion depends upon local water conditions. Analysis of water samples at time of installation and every six (6) months should help to establish a pattern of depletion. A visual inspection of the solution and filter residue is often helpful in judging whether or not active corrosion is occurring. The complexity of problems caused by water requires expert advice from a water treatment specialist plus a regular maintenance program schedule. It is important to note that improper use of water treatment chemicals can cause severe problems.

Proper inhibitor maintenance must be performed in order to prevent corrosion of the glycol system. Consult your glycol manufacturer for proper testing and maintenance procedures. Do not mix products from different manufacturers.

Hot Gas Bypass (Optional)

Operation

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

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

Proper mixing of the three refrigerant paths ensures stable operation and system performance. The liquid quenching valve bulb must be located downstream of all these connections to control superheat at the compressor inlet. Superheat settings for the liquid quenching valve are chosen to maintain consistency with the system expansion valve. During hot gas bypass operation higher superheats, 25-40°F (14-22°C), may be observed at the compressor. The liquid quenching valve is internally equalized and superheat is not adjustable.

Adjustment

1. Install the suction and discharge pressure gauge.
2. Adjust temperature setpoint to call for cooling so that the refrigeration compressor will run continuously.
3. Remove the TOP adjusting nut from the valve.
4. Insert an Allen wrench in the brass hole at top of valve in adjusting port, and turn CLOCKWISE if a higher evaporator temperature is required. Adjust no more than 1/4 turn at a time. Let the system stabilize for 15 minutes before determining if additional adjustment is necessary.
5. After obtaining the suction pressure required, reinstall cap tightly making sure there are no leaks.
6. Let the evaporator operate for approximately 10 to 15 minutes to make sure the suction pressure is within the range desired.
7. There may be a fluctuation of approximately 3 to 6 psig (21 to 41 kPa) on the evaporator due to the differential on the hot gas bypass.
8. Return temperature setpoint to the desired setting.

Replacement Procedures

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

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

CAUTION

Avoid touching or contacting the gas and oils with exposed skin. Severe burns will result. Use long rubber gloves in handling contaminated parts.

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

CAUTION

System contains refrigerant. Recover refrigerant before maintenance

Mechanical Failure: If you have determined that a mechanical failure has occurred, the compressor must be replaced.

Electrical Failure: In the event of an electrical failure and subsequent burnout of the refrigeration compressor motor, proper procedures must be followed to thoroughly remove any acids that would cause a future failure. There are two kits that can be used with a complete compressor burnout: Sporlan System Cleaner and Alco Dri-Kleener. Follow the manufacturer's procedure. DAMAGE TO A REPLACEMENT COMPRESSOR DUE TO IMPROPER SYSTEM CLEANING CONSTITUTES ABUSE UNDER THE TERMS OF THE WARRANTY, THEREBY VOIDING THE WARRANTY.

Replacement compressors are available from your Liebert supplier and will be shipped to the job site in a reusable crate (as required by the service contractor). If the compressor is under warranty, it must be returned to Liebert in order to receive proper warranty credit. It should be returned in the same container the replacement was shipped in. The possible cause(s) or condition(s) of the damage should be legibly recorded on the provided return tag.

Proper procedures to remove and replace the failed compressor are:

1. Disconnect power
2. Attach suction and discharge gauges to access fittings.
3. Recover refrigerant using standard recovery procedures and equipment.

NOTE

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

4. Remove failed compressor.
5. Install replacement compressor and make all connections. Pressurize and leak test the system at approximately 150 psig (1034kPa) pressure.
6. Follow manufacturer's instructions for clean out kits.
7. Evacuate the system twice to 1500 microns, and the third time to 500 microns. Break the vacuum each time with clean, dry refrigerant to 2 psig (13.8 kPa).
8. Charge the system with refrigerant (R-22) based on requirements of the evaporator, condensing unit, and lines. Refer to the installation manual or the unit nameplate.
9. Apply power and operate the system. Check for proper operation. Refer to **Table 16** for discharge pressure.

6.2.6 Steam Generating Humidifier - Operation Procedures

Steam generating humidifiers operate efficiently over a wide range of water quality conditions and automatically adjust to changes in the conductivity of water. The system will automatically drain and refill to maintain a current setpoint and alert the operator when the humidifier canister needs to be replaced.

The humidifier RUN/DRAIN switch is located in the humidifier assembly. This switch should be in the RUN position when the humidifier is in normal operation, and in the DRAIN position during service. The electronic control board for the humidifier is also located in the humidifier assembly. When the unit is energized, power is available to humidifier. Operation involves the following steps:

1. During start-up, when the humidity control calls for humidification, the fill valve will open, allowing water to enter the canister. When the water level reaches the electrodes, current flows and the water will begin to warm. The canister fills until the amperage reaches the setpoint and the fill valve closes. As the water warms, its conductivity increases and the current flow, in turn, rises. If the amperage reaches 115% of the normal operating amperage, the drain valve opens and flushes some of the water out of the canister. This reduces electrode contact with the water and lowers the current flow to the amperage setpoint. Boiling soon commences and the canister operates normally.
2. If the conductivity of the water is low, the canister fills and the water level reaches the canister full electrode before the amperage setpoint is reached. The humidifier stops filling to prevent overflow. Boiling should commence in time. As water is boiled off, the mineral concentration in the canister increases and current flow also increases. The canister eventually reaches full output and goes to normal operation. No drain is permitted until then.
3. When full output is reached the circuit board starts a time cycle which is factory set at 60 seconds. During this repeating time cycle, the fill valve will open periodically to replenish the water being boiled off and maintain a “steady state” output at the setpoint. The amperage variance will depend on the conductivity of the water.
4. After a period of time, the mineral concentration in the canister becomes too high. When this occurs, the water boils too quickly. As the water quickly boils off and less of the electrode is exposed, the current flow decreases. When the current crosses the low threshold point (factory set at 85%) before the end of the time cycle, the drain valve opens, draining the mineral laden water out and replacing it with fresh water. This lowers the mineral concentration and returns the canister to “steady state” operation and prolongs canister life. The frequency of drains depends on water conductivity.
5. Over a period of time, the electrode surface will become coated with a layer of insulating material, which causes a drop in current flow. As this happens, the water level in the canister will slowly rise exposing new electrode surface to the water to maintain normal output. Eventually, the steady state water level will reach the canister full electrode and indicate so by activating the canister full alarm. At this point, all of electrode surface has been used up and the canister should be replaced.
6. After the entire electrode surface has been coated, the output will slowly decrease. During these last hours of electrode life, the mineral concentration can increase and arcing can occur. If the electrodes start to arc, turn off the humidifier immediately and replace the canister with the identical part.

Replacing the Humidifier Canister

The proper procedure to replace the humidifier canister is:

1. Turn off the humidifier by lowering the humidity setpoint below the ambient humidity level. Record the original setpoint.
2. Turn unit off at wallbox.
3. Place the RUN/DRAIN switch in the DRAIN position to drain the water from the canister.
4. Return the RUN/DRAIN switch to the RUN position after the canister has drained.
5. Turn OFF the power at the main unit.
6. Remove the cover from the humidifier cabinet.
7. Locate the power wires to the steam canister. They are connected to the canister with 1/4" quick connects. Make note of the wiring configuration before removing any wires. Refer to schematic on unit. Slide the rubber boot back to expose the connections. Remove the three (3) power wires and the canister full wire. Do not loosen the screws that secure the electrodes.

WARNING

Canister and steam hose may be hot! Allow time for the humidifier to cool before replacing parts.

8. Loosen the steam outlet hose clamps and slide the steam hose away from the canister fitting.
9. Remove the canister.
10. Reverse Previous steps to re-assemble humidifier, paying special attention to the following:

WARNING

Hazardous voltage! use extreme caution. Circuit board adjustment should be performed by qualified personnel only.

Power should be disconnected prior to the procedure.

6.2.7 Circuit Board Adjustments

The humidifier control board governs humidifier operation. There are three potentiometers mounted on the board and can be used to adjust for extreme water conductivity conditions.

POT2 controls the amperage at which the drain will energize and is clearly marked in percentages. This adjustment is factory set at 85%, which indicates that the unit will drain when the amperage falls off to 85% of the capacity setpoint. Raising the value increases the frequency of drain cycles. Lowering the value decreases the frequency of drain cycles.

The frequency should be increased for highly conductive water and decreased for less conductive water. If adjustment is necessary, and a change of three to four percent in either direction does not permit normal operation of the unit, consult your Liebert supplier.

The POT1 controls the duration of the drain cycle. This adjustment is factory set at 60 seconds (1 VDC) and should not be readjusted without consulting your Liebert supplier.

The DIP switch settings are used to set the capacity of the humidifier. If the humidifier is replaced in the field the DIP switches should be set to the required settings described below.

Table 17 Humidifier control board DIP switch settings

Voltage	SW1	SW2	SW3	SW4	Amps
208	On	On	On	Off	8.9
240	Off	On	On	Off	8.5
380/415	Off	Off	Off	Off	5.2
460	On	On	On	Off	4.5
575	On	On	Off	Off	3.4

7.0 MAINTENANCE INSPECTION CHECKLIST

JOB NAME: _____ ROOM TEMP/HUM: _____

SERIAL: _____ DATE: _____

UNIT MODEL: _____ COND. MODEL: _____

FILTERS

___ 1. Check/Replace Filters
___ 2. Check Filter Switch
___ 3. Wipe Section Clean

BLOWER SECTION

___ 1. Impellers Free of Debris & Spins Freely
___ 2. Check Belt Tension and Condition
___ 3. Check/Lube Bearings
___ 4. Check Pulleys and Motor Mounts
___ 5. Amp Draw ____ / ____ / ____

REHEAT

___ 1. Amp Draw ____ / ____ / ____
___ 2. Inspect elements for cleanliness

HUMIDIFIER

___ 1. Check for Clogs
___ 2. Check Humidifier Lamps/tank
___ 3. Check for Mineral Deposits
___ 4. Check Water Make-Up Valve for Leaks
___ 5. Check Drain & Trap for Debris
___ 6. Check Amp Draw ____ / ____ / ____

REFRIGERATION CYCLE/SECTION

___ 1. Check Refrigerant Lines (rubbing)
___ 2. Suction Pressure 1._____ 2._____
___ 3. Discharge Pressure 1._____ 2._____
___ 4. Check Thermostatic Expansion Valve
___ 5. Check Superheat 1._____ 2._____
___ 6. Check Refrigerant Level (Site Glass)

ELECTRICAL PANEL

___ 1. Check Fuses
___ 2. Check Electrical Connections
___ 3. Check Operation Sequence
___ 4. Check Contactors for Pitting

COMPRESSOR

___ 1. Amp Draw 1. ____ / ____ / ____
___ 2. Amp Draw 2. ____ / ____ / ____
___ 3. Check For Leaks/Oil Level
___ 4. Vibration
___ 5. Noise
___ 6. Cap Tubes (Not Rubbing)

CONTROLS

___ 1. Check/Test Changeover Panel
___ 2. Check/Test Water Detection
___ 3. Check/Test Condensate Pump Operation
___ 4. Check/Verify Control Settings

AIR-COOLED CONDENSER/ DRYCOOLER

___ 1. Coil Clean
___ 2. Motor Mounts Tight
___ 3. Bearings in Good Condition
___ 4. Piping in Good Condition
___ 5. Ambient Settings ____ / ____ / ____
___ 6. Motor Amp Draws ____ / ____ / ____
___ 7. Check Electrical Connections
___ 8. Refrigerant/Glycol Level _____
___ 9. Cap. Tubes (Not Rubbing)

WATER/GLYCOL CONDENSER

___ 1. Copper Tube Clean
___ 2. Water Regulating Valve Functions
___ 3. Glycol Solution
___ 4. Check for Water/Glycol Leaks

GLYCOL PUMP

___ 1. Pump Rotation
___ 2. Glycol Leaks
___ 3. Pump Operation
___ 4. Amp Draw ____ / ____ / ____
___ 5. Pump Changeover (If Dual)

COMMENTS

_____

_____

8.0 TROUBLESHOOTING

Table 18 Troubleshooting

Symptom	Possible Cause	Check or Remedy
Unit will not start	No power to unit	Check voltage at input terminal block.
	Control voltage fuses (at transformer) open	Locate and repair short. Replace fuses.
	Float switch relay has closed due to high water in the condensate pan.	Check drain and line. Access through left panel. Power must be cycled at the disconnect to reset. Check return air static pressure is less than 0.3" wg.
	Jumper not in place	Check terminal 37 and 38 for jumper or N/C contact. Check pins P39-1 and P39-2 for jumper, or N/C firestat contact. Check pins P40-12 and 1HWAR-Com for jumper or N/C smoke detector contact.
No cooling	"Cooling" is not displayed at the control panel.	Adjust TEMP control setpoint and sensitivity to require cooling.
	Short cycle prevention control.	Control software delays compressor 3 minutes cooling, from stop to start
	Compressor contactor not pulling in.	Check for 24 VAC ± 2 VAC at terminals TB2 to TB1 for Compressor 1; TB6 to TB5 for Compressor 2. If voltage, check contactor. If voltage, check freeze stat (FR1 and FR2).
	Compressor high head pressure.	See below for cause.
	Plugged filter/dryer.	Replace filter/dryer.
	Low refrigerant charge.	Check pressure gauges. At low ambient temperatures, proper refrigerant charge is very important on units with Lee-Temp receivers.
Compressor high head pressure	Insufficient air flow across condenser coil	Remove debris from coil and air inlets.
	Water/Glycol-Cooled only: No fluid flowing through condenser.	Check fluid supply to regulating valve. Adjust valve if necessary.
	Condenser fan not operating	Check fan operation.
Humidifier does not operate	DIP switch not set to enable humidifier option	See DIP switch settings **Table 17**.
	"HUMIDIFY" not displayed at control panel	Increase humidity control setpoint and sensitivity to require humidification.
	Defective board	Check voltage at 35-1 and 35-5 on interface board for 24 VAC ±2 VAC. If no voltage, check wiring and/or replace board. Check wiring from control panel to board.
	Failed humidity sensor	Humidity display will indicate dashes. Check wiring from temperature/ humidity board to the control board and from the wall box to the control board. Replace wallbox or temperature/humidity circuit board (if remote).
	No water flow	Make sure switch is in Run position. Check humidifier water supply (including filter screen) and check nylon overflow line if canister is full.
	Canister fill rate is not keeping up with the steam output	Check fill valve screen opening and capillary tube for obstructions. Check water supply pressure (minimum 10 psig).
Reheat will not operate	DIP switch not set to enable reheat option	See DIP switch settings **Table 17**.
	"HEAT" not displayed at the control panel	Increase temperature setpoint to require heating.
	Reheat safety open, defective reheat contact or defective board	Check voltage at P34-4 or P34-6 to P34-10 on interface board for 24 VAC ± 2 VAC. If voltage, check reheat contactor and reheat safety. If no voltage, check wiring and/or replace board.
	Element is burned out	Turn off power. Check element continuity with Ohm meter.

Table 18 Troubleshooting (continued)

Symptom	Possible Cause	Check or Remedy
Cooling cycle too short	Sensor response delay too short	Increase sensor response delay. See **3.12 - Calibrate Sensors**.
Display freezes and control pads do not respond	Static discharge	During period of low humidity, static electricity can cause the control program to freeze or display incorrect information. Although this is unlikely, the control can be reset by cycling power from the disconnect switch.
Condensate pump does not operate	Open or short circuit in wiring	Find open or short circuit and repair power to pump.
Continuous Cooling	Failed temperature sensor	Temperature display will indicate dashes. Check wiring from temperature/humidity board (remote sensors) to the control board or from control board to wallbox. Replace temperature/humidity circuit board (remote sensors) or wallbox.
Continuous Heating Dehumidification Humidification	Shorted wiring or failed control board	Check wiring and/or replace control board.

NOTES

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