Precision Cooling
For *Business-Critical Continuity™*

Liebert Mini-Mate2™

User Manual - 2 & 3 Tons, 50 & 60Hz

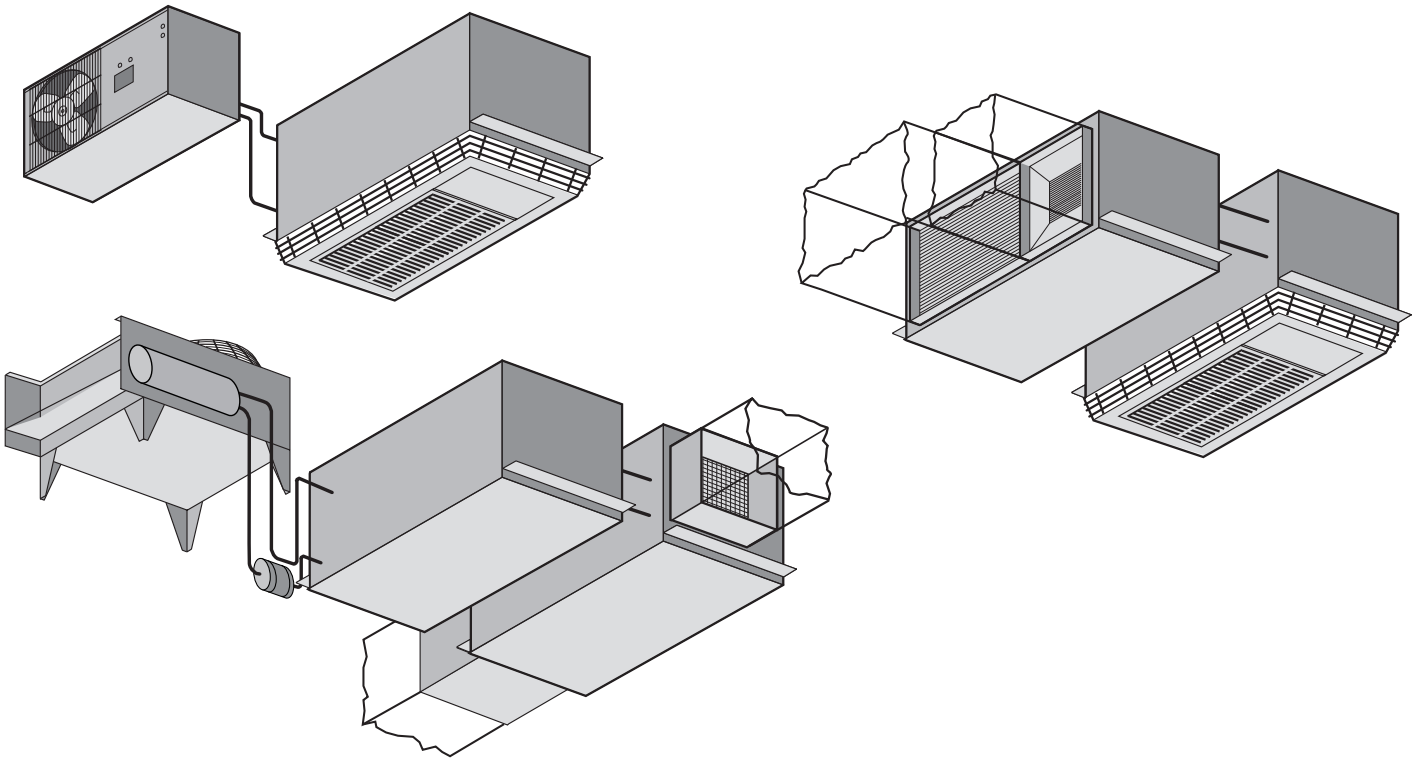

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TABLE OF CONTENTS

FIGURES

TABLES

IMPORTANT SAFETY INSTRUCTIONS

SAVE THESE INSTRUCTIONS

This manual contains important safety instructions that should be followed during the installation and maintenance of the Liebert Mini-Mate2. Read this manual thoroughly before attempting to install or operate this unit. Only qualified personnel should move, install or service this equipment.

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

WARNING

Arc flash and electric shock hazard. Disconnect all electric power supplies and wear protective equipment per NFPA 70E before working within electric control enclosure. Failure to comply can cause serious injury or death.

Customer must provide earth ground to unit, per NEC, CEC and local codes, as applicable.

Before proceeding with installation, read all instructions, verify that all the parts are included and check the nameplate to be sure the voltage matches available utility power.

The Liebert microprocessor control does not isolate power from the unit, even in the Unit Off mode. Some internal components require and receive power even during the Unit Off mode.

The line side of the disconnect switch on the front of the unit contains live high-voltage. The only way to ensure that there is NO voltage inside the unit is to install and open a remote disconnect switch and check the internal power supply wires with a voltmeter. Refer to unit electrical schematic. Follow all applicable local and national electric codes.

WARNING

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

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

WARNING

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

If a pressure relief device is not provided with the condenser unit, the system installer must provide and install a discharge pressure relief valve per local and national codes in the high side refrigerant circuit. Do not install a shutoff valve between the compressor and the field installed relief valve. Do not isolate any refrigerant circuits from overpressurization protection.

WARNING

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

Open all local and remote electrical power disconnect switches before working in the unit and component electrical enclosures.

CAUTION

Risk of contact with hot surfaces. Can cause injury.

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

CAUTION

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

This unit requires a water drain connection. It may also require an external water supply to operate. Improper installation, application and service practice can result in water leakage from the unit. Water leakage can result in severe property damage and loss of critical data center equipment. Do not locate unit directly above any equipment that could sustain water damage. Emerson recommends installing leak detection equipment for unit and supply lines and in the secondary drain pan. Check drain lines periodically for leaks, sediment buildup, obstructions, kinks and/or damage and verify that they are free running.

CAUTION

Risk of sharp edges, splinters and exposed fasteners. Can cause injury.

Only properly trained and qualified personnel wearing appropriate safety headgear, gloves, shoes and glasses should attempt to move the unit, lift it, remove packaging from or prepare the unit for installation.

NOTICE

Risk of a leaking coil due to freezing and/or corrosion. Can cause equipment and serious building damage.

Cooling coils and piping systems that are connected to open cooling towers or other open water/glycol systems are at high risk for freezing and premature corrosion. Fluids in these systems must contain the proper antifreeze and inhibitors to prevent freezing and premature coil corrosion. The water or water/glycol solution must be analyzed by a competent water treatment specialist before startup to establish the inhibitor requirement. The water or water/glycol solution must be analyzed every six months to determine the pattern of inhibitor depletion. The complexity of water-caused problems and their correction makes it important to obtain the advice of a water treatment specialist and follow a regularly scheduled maintenance program.

NOTICE

Risk of damage from forklift. Can cause unit damage.

Keep tines of the forklift level and at a height suitable to fit below the skid and/or unit to prevent exterior and/or underside damage.

NOTICE

Risk of improper storage. Can cause unit damage.

Keep the Liebert Mini-Mate2 upright, indoors and protected from dampness, freezing temperatures and contact damage.

PRODUCT NUMBER NOMENCLATURE

Figure 1 Model number nomenclature—Evaporator units

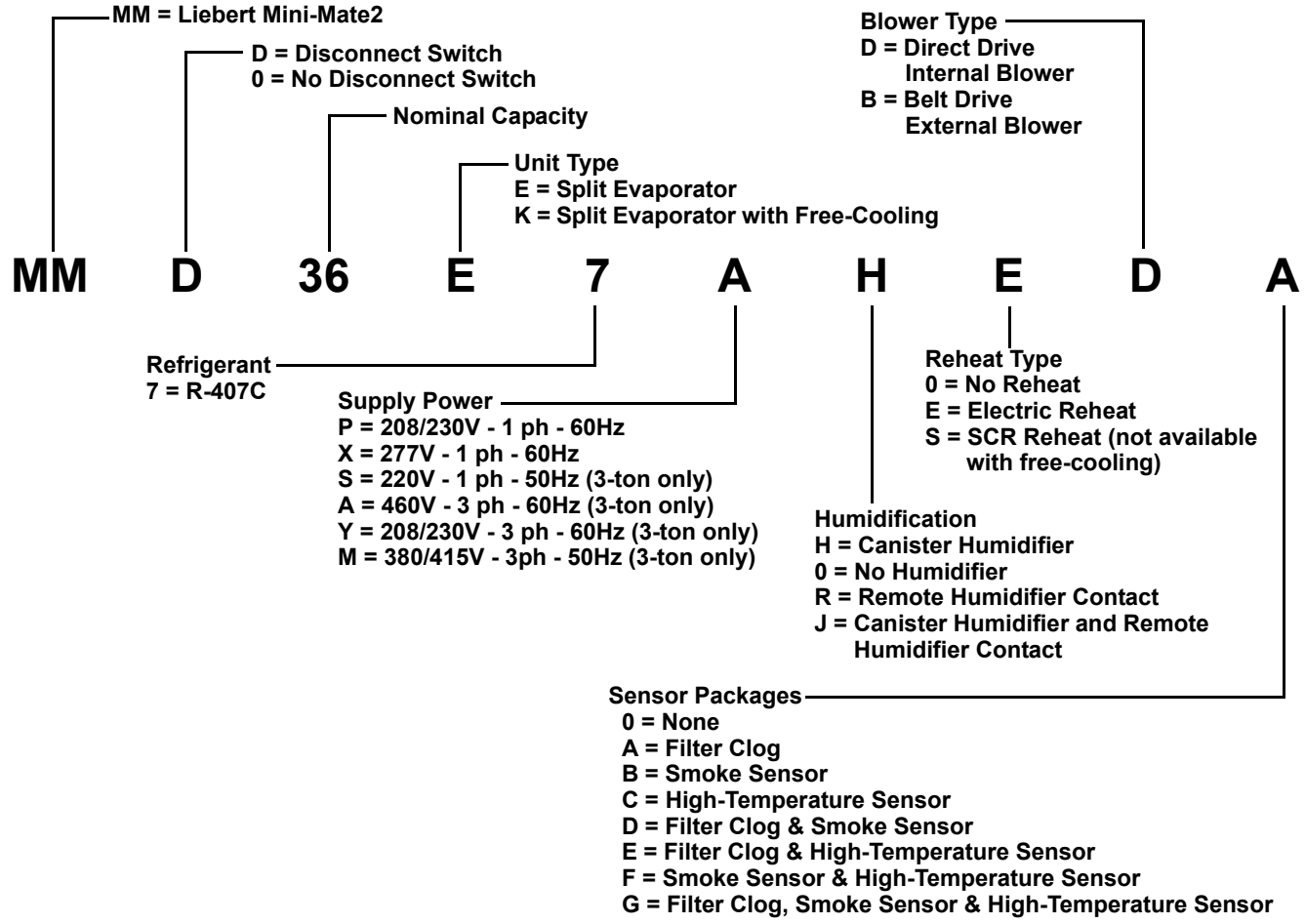


Figure 2 Model number nomenclature—Air-cooled, indoor condensing units

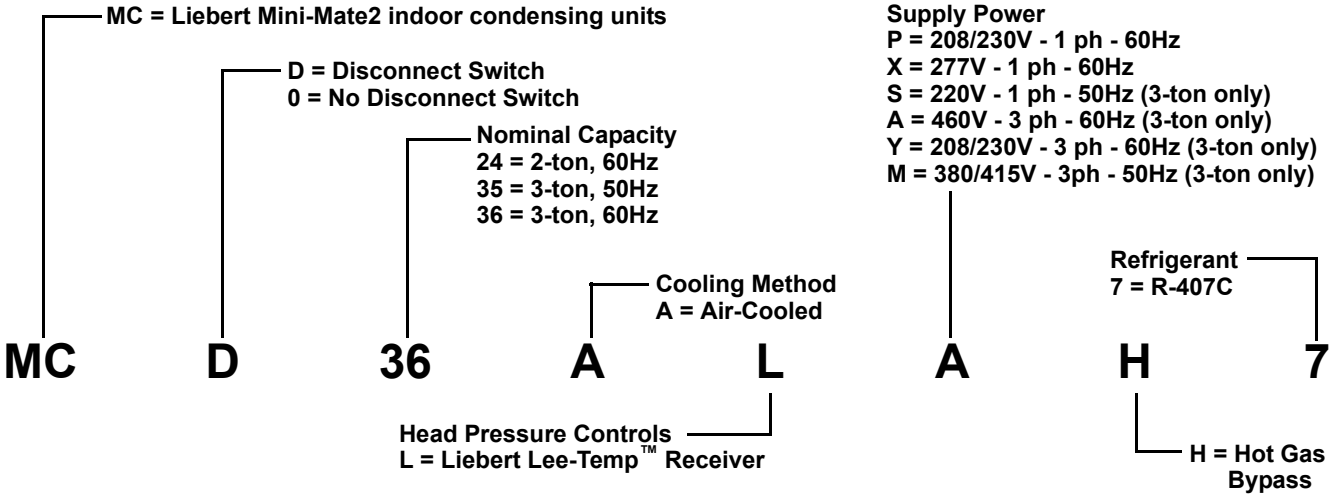


Figure 3 Model number nomenclature—Outdoor air-cooled prop fan condensing units

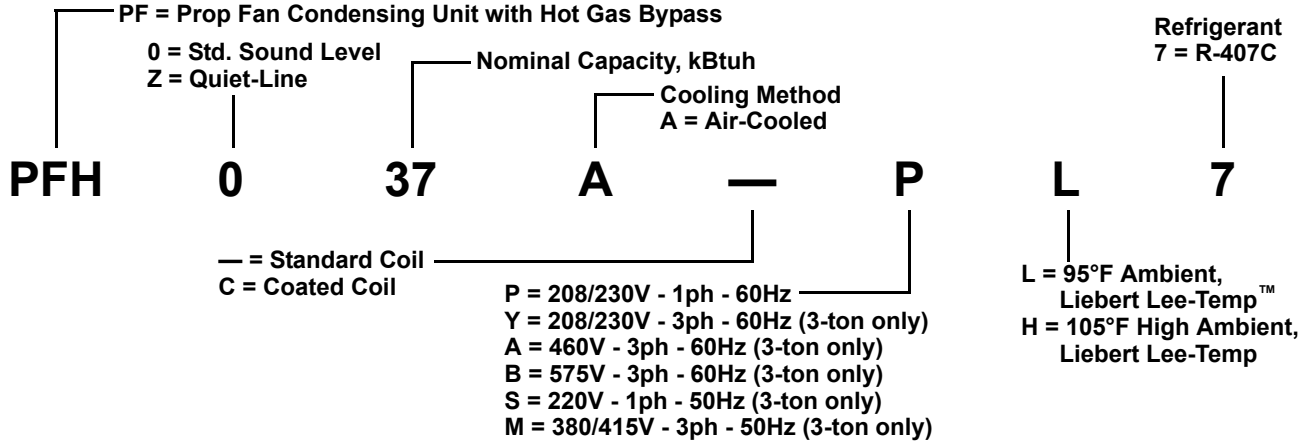


Figure 4 Model number nomenclature—Water/glycol-cooled condensing units

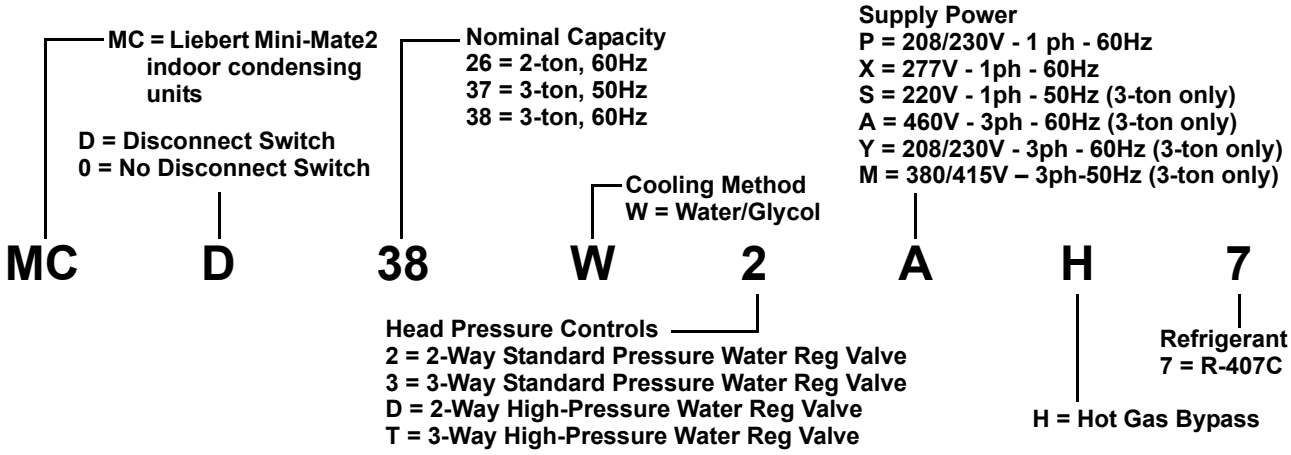
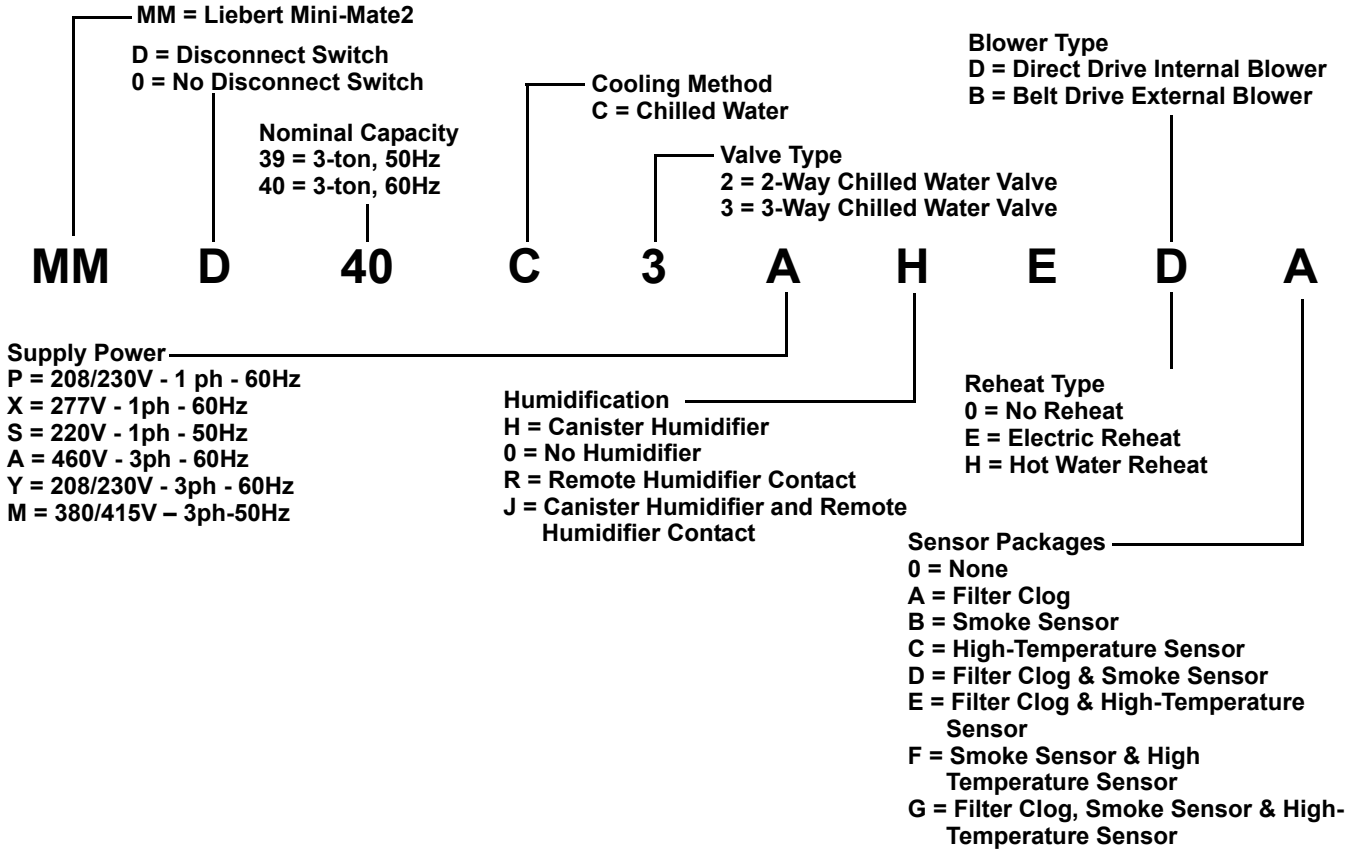


Figure 5 Model number nomenclature—Chilled water units



1.0 INTRODUCTION

1.1 Designed to Match Computer and Electronic Equipment Needs—From Installation to Operation

Installed above the ceiling, Liebert Mini-Mate2 Precision Cooling systems control the cooling, humidity and air distribution required by sensitive electronic equipment. A range of sizes and configurations is available to meet varying sites' needs.

The Liebert Mini-Mate2 is also easy to use. Advanced microprocessor technology allows easy, precise control, and menu-driven monitoring keeps you informed of system operation through the LCD readout. These features, combined with Emerson quality construction and reliable components, guarantee satisfaction from installation through operation.

Liebert Precision Cooling

Liebert Precision Cooling systems are designed to control the environment required for computers and other sensitive electronic equipment. The Liebert Mini-Mate2 provides complete control on an around-the-clock basis and the high sensible heat ratio required by sensitive electronic equipment.

Easy Installation

The Liebert Mini-Mate2 is a split-system evaporator combined with an air-, water- or glycol-cooled condensing unit or is a self-contained, chilled water unit. Each split system has thermostat-type wiring to controls and condensing unit. System components are pre-charged with refrigerant and can be connected together with optional pre-charged line sets or optional sweat adapters for field refrigerant piping.

Easy to Service

Low-maintenance components are easily accessed through removable front panels. Spare parts are always in Emerson inventory and available on short notice.

Advanced Control Technology

A menu-driven microprocessor control system provides precise temperature and humidity control and accurate alarm setpoints. Using touch-sensitive buttons, the wall-mounted monitor/control panel allows you to select and display temperature and other monitored parameters.

High Efficiency

High sensible heat ratio, scroll compressor and precise microprocessor control allow the system to operate efficiently.

Space Saving Design

All indoor components are installed above the ceiling, so no floor space is required.

Reliable

The Liebert Mini-Mate2 family installed base is a testimony to the system reliability. Components include a rugged scroll compressor, high-efficiency copper tube, aluminum-fin evaporator coil and a double inlet, direct drive fan.

Agency Listed

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

Location

When considering installation locations, consider that these units contain water and that water leaks can cause damage to sensitive equipment below. Do not mount these units above sensitive equipment. A field-supplied pan with drain must be supplied beneath cooling units and water/glycol condensers.

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

2.0 STANDARD FEATURES—2 & 3 TON SYSTEMS

2.1 Evaporator Section - Split Systems

The evaporator section is designed for ceiling installation. The cabinet and chassis are constructed of heavy gauge galvanized steel. The unit can be serviced using only one side increasing its versatility in mounting locations. Mounting brackets are factory-attached to the cabinet. Internal cabinet insulation meets ASHRAE 62.1 requirements for Mold Growth, Humidity & Erosion, tested per UL 181 and ASTM 1338 standards.

The evaporator section includes the evaporator coil, R-407C unit charge, filter-drier, factory-mounted disconnect switch, two-speed direct-drive blower assembly and microprocessor control with wall-mounted control box. The unit is provided with supply and return air openings for field-supplied ducting or supply/return plenum. Evaporators can be configured with canister humidifier and/or reheat. An indoor or outdoor condensing unit must be selected for each evaporator.

2.2 Condensing Unit Section—Split Systems

2.2.1 Indoor Centrifugal Fan Condensing Units

Indoor Air-Cooled Centrifugal Fan Condensing Units include scroll compressor, factory-mounted disconnect switch, condenser coil, R-407C unit charge, belt-driven centrifugal blower assembly, high-pressure switch, Liebert Lee-Temp™ head pressure control system, hot gas bypass and liquid-line solenoid valve. Unit must be mounted indoors. Condensing unit is designed to use outdoor air with temperatures ranging from -30°F to 95°F (-34°C to 35°C).

2.2.2 Outdoor Prop Fan Condensing Units

Outdoor Prop Fan Condensing Units include scroll compressor, condenser coil, R-407C unit charge, prop fan, liquid-line solenoid valve, high pressure switch, Liebert Lee-Temp head pressure control and hot gas bypass. Condensing unit is designed for outdoor locations with operating ambients ranging from -30°F to 95°F (-34°C to 35°C).

2.2.3 Indoor Water/Glycol Condensing Units

Indoor Water/Glycol Condensing Units includes scroll compressor, R-407C unit charge, factory-mounted disconnect, coaxial condenser, hot gas bypass, high head pressure switch and two-way water regulating valve designed for 150psi (1034.3kPa). Condensing units can be used on either a water or glycol cooling loop.

2.3 Chilled Water Units

Chilled Water Units are designed for ceiling installation. The cabinet and chassis are constructed of heavy gauge galvanized steel. The unit can be serviced using only one side increasing its versatility in mounting locations. Mounting brackets are factory-attached to the cabinet. Internal cabinet insulation meets ASHRAE 62.1 requirements for Mold Growth, Humidity & Erosion, tested per UL 181 and ASTM 1338 standards. Chilled water models are self-contained and include a chilled water coil, two-speed, direct-drive centrifugal blower, factory-mounted disconnect switch and two-way, slow-close motorized valve. Design pressure is 300psi (2068kPa), 60psi (414kPa) close-off differential.

2.4 System Controls

System controls include a microprocessor control board mounted in the evaporator/chilled water unit and a wall-mounted interface with a two-line, 16-character liquid crystal display. An eight-key, membrane keypad for setpoint/program control, unit On/Off, fan speed and alarm silence is below the LCD screen. It provides temperature setpoint and sensitivity adjustment, humidity setpoint and sensitivity adjustment, digital display of temperature, humidity, setpoints, sensitivities, fan speed and alarm conditions.

The wall-box is field-wired to the microprocessor control using standard four-conductor thermostat wire (field-supplied). The temperature and humidity sensors are in the wall box, which can be installed up to 300 feet (91.4m) from the evaporator unit. The unit-mounted control board also includes common alarm terminals and shutdown terminals. The unit automatically restarts after a power outage.

Figure 6 Wall-box

2.4.1 Other Standard Control Features

- Adjustable auto restart
- 5 day/2 day setback
- Password protection
- Alarm enable/disable
- Self-diagnostics
- Calibrate sensors
- Predictive humidity control
- Common alarm output
- Remote shutdown terminals

3.0 OPTIONAL FACTORY-INSTALLED FEATURES—EVAPORATOR/CHILLED WATER UNITS

3.1 Reheat

Electric Reheat includes 304/304 stainless steel finned tubular reheat elements, with high limit safety switch.

SCR Electric Reheat uses an SCR controller and unit control software to provide full cooling with modulating of the electric reheat elements to control air temperatures. Reheat capacity is up-sized to offset the cooling capacity. (The SCR Electric Reheat is not available on chilled water, free-cooling or 575V units.)

Hot Water Reheat includes hot water coil, 2-way solenoid valve and Y-strainer.

NOTE
This option is available only on Chilled Water units, but not with other reheat options.

3.2 Humidifier

The **Canister Humidifier** includes a steam-generating type humidifier with automatic flushing circuit, inlet strainer, drain, 1" (25.4mm) air gap on fill line and solenoid valves. Humidifier problem alarm annunciates at the wall-mounted display panel.

Remote Humidifier Contact allows the unit's humidity controller to control a humidifier outside the unit. Power to operate the remote humidifier does not come from the Liebert Mini-Mate2. Available on units with or without internal humidifier.

3.3 Sensors

Smoke Sensor checks return air, shuts down the unit upon sensing smoke and activates visual and audible alarms at the wall-box display. This smoke sensor is not intended to function as or replace any smoke sensor system that may be required by local or national codes.

High-Temperature Sensor senses the return air temperature and shuts down unit if the temperature reaches 125°F (52°C). This device is not meant to replace any fire detection system that may be required by local or national codes.

3.4 Switches and Motors

Filter Clog senses pressure drop across the filters and activates visual and audible alarms at the wall-box display. The wall-box display annunciates the alarm and flashes a notification upon reaching a customer setpoint.

A **Factory-Installed Non-Fused Disconnect Switch** allows unit to be turned off for maintenance. A disconnect switch is standard for the evaporators, chilled water units and indoor condensing units, but these units may be specified without the switch.

Direct-Drive blower can be factory-eliminated from the evaporator/chilled water cabinet for high static applications (0.9 to 1.5in. [23 to 38mm] w.g.). See **4.0 - Ship-Loose Accessories—Field-Installed** for the optional, externally mounted high static blower assembly.

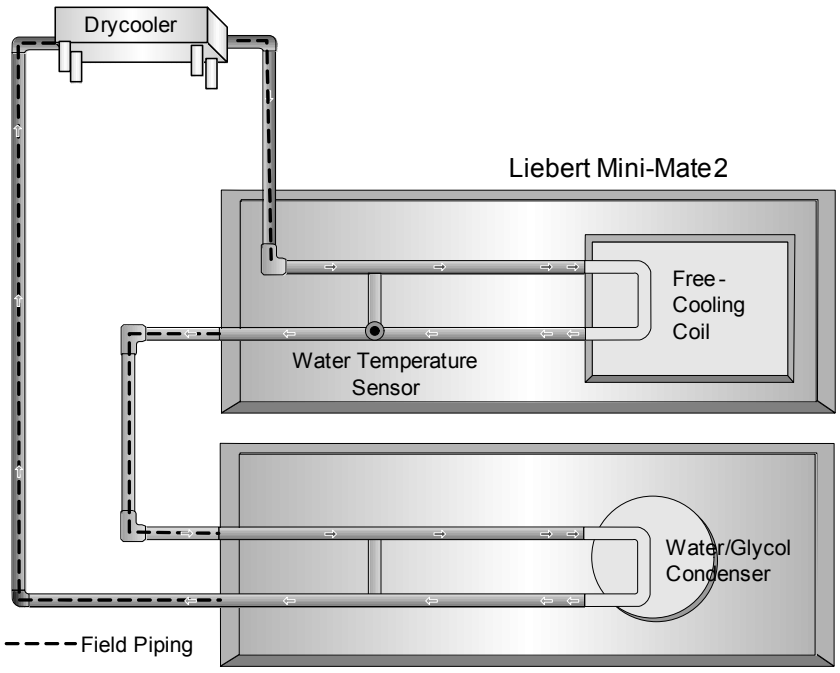
3.5 Free-Cooling

Free-cooling option includes separate cooling coil, three-way slow-close valve and separate supply and return piping. Free-cooling is activated when the water temperature reaches a field-adjustable temperature, typically 45°F (7°C). The valve is rated for 300psi (2068kPa) working pressure.

Air-cooled condensing units can be matched with evaporators using free-cooling coils with chilled water sources to serve as backup cooling. When matched with a water/glycol condensing unit, a three-way water regulating valve is recommended for the condensing unit to simplify piping to the main supply pipes. The coil is designed for closed-loop applications using properly treated and circulated fluid. Not available with SCR reheat options.

Figure 7 Free-cooling arrangement

Free-cooling option: A second cooling coil allows the system to take advantage of colder outdoor temperatures and bypass compressor operation.
When the water temperature goes below 45°F (7°C), cooling switches over to free-cooling operation. A separate chilled water source can also be used with air-cooled systems.



NOTE
If free-cooling is applied to an open water tower, an optional copper-nickel (CuNi) coil is required to prevent premature corrosion, or a heat exchanger must separate the tower water from the free-cooling loop. The copper-nickel coil requires an extended lead time.

3.6 Optional Configurations—Prop Fan Condensing Units

Outdoor Prop Fan Condensing Units are also available in the following optional configurations:

- High ambient models for providing catalog capacities at ambient temperatures up to 105°F (40°C).
- Quiet-Line models for low noise level conditions (below 56 dBA) and for providing catalog capacities at ambient temperatures up to 95°F (35°C).
- Condenser coils can be phenolic-coated for extended coil life in coastal areas.

3.7 Optional Configurations—Water/Glycol Condensing Units

Indoor Water/Glycol Condensing Units are also available with the following piping options:

- Two-way water reg. valve with 350 psi (2413kPa) design pressure.
- Three-way water reg. valve with 150psi (1034kPa) design pressure.
- Three-way water reg. valve with 350psi (2413kPa) design pressure.

3.8 Optional Configurations—Chilled Water Units

Chilled Water Units are also available with the following valve option:

- Three-way, slow-close, motorized chilled water valve rated for 300 psi (2068 kPa) working pressure. Valve is non-spring return.

4.0 SHIP-LOOSE ACCESSORIES—FIELD-INSTALLED

A **High Static Blower Assembly** can be field-attached to the evaporator to provide up to 2.0" (51mm) of external static pressure on the discharge side of the evaporator. The blower box contains a centrifugal-type double-inlet blower. This blower is equipped with a belt drive and 1.5 hp single speed motor mounted to an adjustable motor base. **Note:** Unit must be ordered without the internal direct drive motor and the high static blower disables the two-speed fan operation feature.

Filter box kit (for ducted applications) includes filter box with duct flange connection, one MERV 8 (ASHRAE 52.2-2007) filter (20"x20"x4" [508mm x 508mm x 102mm]), and a duct flange for use on the supply air opening of the unit

Air Distribution Plenum includes molded plastic three-way discharge plenum, 16"x25"x4" (406mm x 535mm x 102mm) MERV 8 filter (ASHRAE 52.2-2007), and sheet metal block-off plates for covering the duct openings on the evaporator unit. Plenum mounting requires T-bar ceiling grid.

The **Condensate Pump** is field-mounted external to the cabinet, wired to the unit power block and is equipped with a check valve. A secondary float can be field-wired to shut down the unit upon high condensate level.

A **Remote Temperature and Humidity Sensor** package includes sensors in an attractive case with 30 ft. (9 m) of cable. Can be wall or duct mounted. Remote sensors should be used when the wall box is not located in the space to be conditioned.

NOTE
Installing the remote sensors disables the sensors included in the wall box.

Field-Installed Kits available for filter clog, smoke sensor, high-temperature sensor, electric reheat and humidifier. The kits include installation instructions and are designed to be added to the evaporator unit before it is installed in the ceiling. Electric reheat kits cannot be installed in units with free-cooling.

277-to-208V step-down transformer (37.5 amps) allows use of 277-1-60 supply power with a 208-1-60 Prop Fan Condensing unit. The transformer is coated with epoxy and contained in an enclosed, non-ventilated electrical box with adaptable mounting brackets.

Single-Point Power Kit contains the necessary electrical components to interconnect the high-voltage sections of a close-coupled evaporator and an MCD condensing unit.

Pre-Charged Refrigerant Line Set (R-407C) contains an insulated copper suction line and a copper liquid line for interconnection of the indoor and outdoor sections. Available in 15-foot (4.5m) and 30-foot (9m) sections.

The **Refrigerant-Line Sweat Adapter Kit** contains two suction and two liquid line fittings that allow field-supplied refrigerant piping between the evaporator and condensing unit.

4.1 Remote Monitoring, Autochangeover and Leak Detection Equipment

The **Liebert RCM4™** is a four-point, normally open, dry contact monitoring panel. One Form-C, dry contact common alarm relay output (rated at 24 VAC, 3 Amp) is provided. Four red LEDs illuminate on the respective alarm and the alarm buzzer is silenced by a front panel switch. The RCM4 requires a 24VAC or 24VDC power source. Power supply is not included.

The **Liebert AC4™ Autochangeover Controller** provides autochangeover and autosequence control for up to four Liebert Mini-Mate2 units within a room. The Liebert AC4 will enable redundant units in an alarm condition, balance usage and test standby units at programmed intervals. Two common alarm relay outputs are available. A built-in LCD and RS-232 port for direct PC/terminal connection provides two options for configuration and monitoring of the product. The Liebert AC4 requires 24VAC input power.

The **Liebert AC8™** is ideal for coordinated control of systems with redundant units. The Liebert AC8 enables redundant devices during an alarm condition, balances usage of devices and tests standby devices at programmable intervals. Supports four zones and can use the 4-20mA temperature sensor (TW420) for temperature staging in each zone. Two programmable output control relays are available for auxiliary control such as humidity lockout. Emergency power operation input provided for device control during an emergency. Two common alarm relay outputs are available. A built-in LCD and RS-232 port for direct PC/terminal connection provides two options for configuration and monitoring of the product.

The **Liebert ENV-DO™** interface card provides 16 discrete outputs, corresponding to status and major alarm conditions of Environmental units. The Liebert ENV-DO-ENCL1 packages one Environmental DO interface card in its own steel enclosure and the ENV-DO-ENCL2 packages two Environmental DO interface cards in one enclosure for installation external to the Liebert Mini-Mate2. The self-contained kit includes an external 120VAC-to-24VAC power transformer. Wiring harnesses are not provided. Power and communication wiring is field-provided.

The Liebert Liqui-tect® 410 Point Leak Detection Sensor detects the presence of conductive liquid using a pair of corrosion-resistant, gold-plated probes mounted in a painted, height-adjustable enclosure. Dual Form-C, dry contact common alarm relays (rated at 24VAC, 3A) signal a leak detected as well as loss of power and cable fault. The Liebert Liqui-tect 410 requires an external 24VAC or 24VDC power source.

Liebert LT460 Zone Leak Detection Kits include one LT460 sensor, a specified length of LT500-xxY cable (maximum length is 100 ft [30.5m]) and a corresponding number of hold-down clips. The Liebert LT460 requires an external 24VAC, 0.12A power source, such as EXT-XFMR or XFMR24.

Liebert SiteScan® is a monitoring solution that gives you decision-making power to effectively manage the equipment critical to your business.

Liebert SiteScan enables communication from Liebert environmental and power units, as well as many other pieces of analog or digital equipment, to a front-end software package that provides real-time status and alarms so you can react quickly to changing situations.

Liebert SiteScan is designed with flexibility for both small systems and large, complex systems such as those in computer rooms, telecommunications facilities or industrial process control rooms. Contact your local Emerson representative for assistance with a Liebert SiteScan system.

The **NIC-ENCL1 and NIC-ENCL2** package one or two Liebert IntelliSlot® Web/485 Cards with Adapters, respectively, in one steel enclosure for installation external to the Liebert Mini-Mate2. The Liebert IntelliSlot Web/485 Card with Adapter provides communication with the Liebert Mini-Mate2™ via SNMP, HTTP, RTU Modbus 485 and BACnet IP. The self-contained kit includes an external 120VAC-to-24VAC transformer as a power source. Wiring harnesses are not provided. Power and communication wiring are field-provided.

5.0 SITE PREPARATION AND INSTALLATION

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

5.1 Installation Considerations

The evaporator unit is usually mounted above the suspended ceiling of the space to be conditioned. Ducted systems may be installed in a different room.

5.1.1 System Configurations

The typical system configuration has a separate evaporator or cooling unit and a condensing unit. Chilled water systems are self-contained units. Refer to **Tables 1** and **2** and to **Figures 8**, **9** and **10** for different system combinations and unit configurations that are possible.

Table 1 System configurations - 60Hz

Nominal Capacity	Cooling Unit	Condensing Unit		
		Indoor Air-Cooled Centrifugal fan	Outdoor Air-Cooled Propeller Fan	Indoor Water/Glycol
2 Tons	MM_24E	MC_24A	PFH_27A	MC_26W
3 Tons	MM_36E	MC_36A	PFH_37A	MC_38W
	MM_40C	Self-Contained - Chilled Water		

Table 2 System configurations - 50Hz

Nominal Capacity	Cooling Unit	Condensing Unit		
		Indoor Air-Cooled Centrifugal fan	Outdoor Air-Cooled Propeller Fan	Indoor Remote Water/Glycol-Cooled
3 Tons	MM_35E	MC_35A	PFH_36A	MC_37W
	MM_39C	Self-Contained - Chilled Water		

Table 3 Application limits, evaporator and chilled water units*

Input Voltage		Range of Return Air Conditions to Unit	
Minimum	Maximum	Dry Bulb Temperature	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 of conditions.

Table 4 Application limits, indoor and outdoor air-cooled condensing units

Input Voltage		Condensing Units	Entering Dry Bulb Air Temperature	
Minimum	Maximum		Minimum	Maximum
-5%	+10%	Outdoor Prop Fan Condensing Unit	-30°F (-34°C)	115°F (46°C) standard unit* 125°F (52°C) high ambient unit*
		Indoor Air-Cooled Condensing Unit		115°F (46°C)*

* Unit capacity ratings are stated for 95°F (35°C) for standard units and 105°F (41°C) for high ambient PFH units only. Exceeding these rating points by 20°F (11°C) will result in lower cooling capacities, but will not damage the equipment.

Table 5 Application limits, indoor water/glycol-cooled condensing units

Input Voltage		Entering Fluid Temperature	
Minimum	Maximum	Minimum	Maximum
-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.

5.1.2 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 contain either rubber or plastic.

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.

5.1.3 Location Considerations

CAUTION
Risk of leaking water/glycol. Can cause building and equipment damage.

Do not mount units over equipment and furniture that can be damaged by leaking water/glycol. Install a watertight drain pan with a drain connection under the cooling unit and water/glycol condenser unit. Route the drain to a frequently used maintenance sink so that running water can be observed and reported in a timely manner. Post a sign to alert people to report water flowing from the secondary drain pan.

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

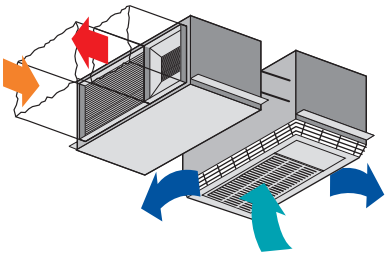
Install the evaporator unit over an unobstructed floor space if possible. This will allow easy access for routine maintenance or service. Do not attach additional devices (such as smoke detectors, etc.) to the housing, as they could interfere with the maintenance or service.

NOTE
Temperature and humidity sensors are in the wall box. Install the wall box where discharge air DOES NOT blow directly on the sensors.

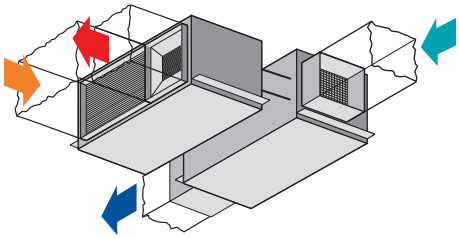
When using the optional air distribution plenum, avoid locating the evaporator unit in confined areas that affect the air flow pattern. Such locations could cause short cycles, downdrafts and air noise. Avoid locating the unit in an alcove or at the extreme end of a long, narrow room. Avoid installing multiple units close to each other. This could result in crossing air patterns, uneven loads and competing operating modes.

When installing an air-cooled or water/glycol-cooled unit inside a space, ensure that national and local codes are met for refrigerant concentration limits that might vary with building type and use.

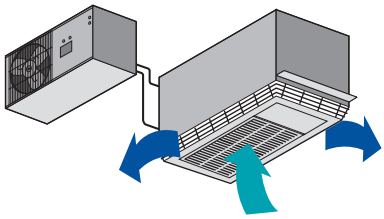
Figure 8 Air-cooled systems, 2 and 3 tons



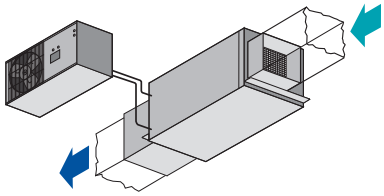
Split System Evaporator
Supply and Return Air Plenum
Indoor Air-cooled Condensing Unit



Split System Evaporator
Supply and Return Air Ducted
Indoor Air-cooled Condensing Unit

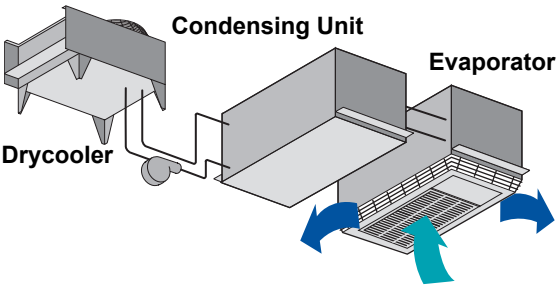


Split System Evaporator
Supply and Return Air Plenum
Outdoor Air-Cooled Condensing Unit

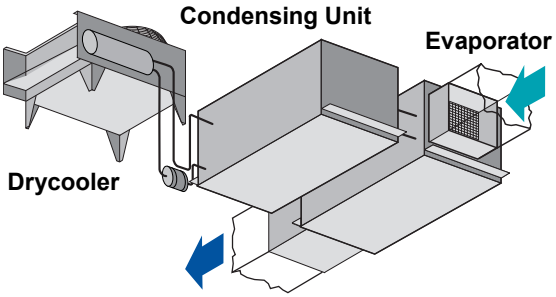


Split System Evaporator
Supply and Return Air Ducted
Outdoor Air-Cooled Condensing Unit

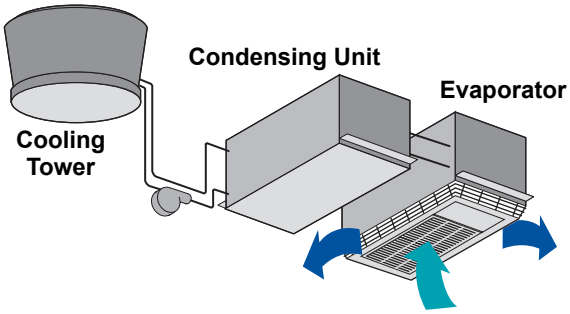
Figure 9 Water/glycol-cooled systems, 2 and 3 tons



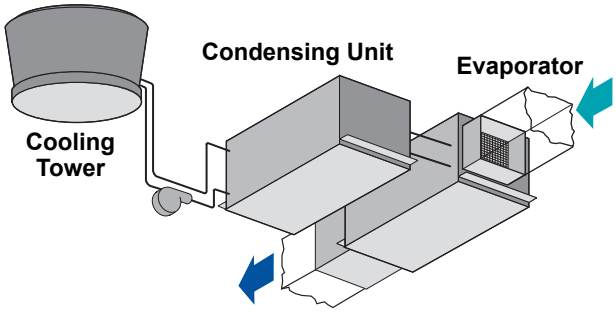
Split System Evaporator
Supply and Return Air Plenum
Remote Water/Glycol Condensing Unit



Split System Evaporator
Supply and Return Air Ducted
Remote Water/Glycol Condensing Unit

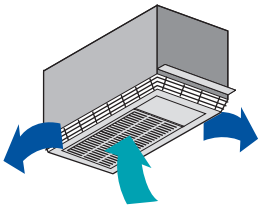


Split System Evaporator
Supply and Return Air Plenum
Remote Water/Glycol Condensing Unit



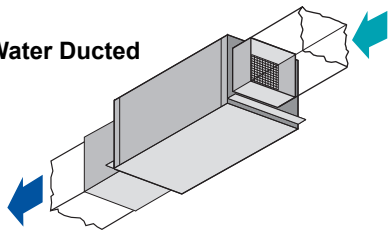
Split System Evaporator
Supply and Return Air Ducted
Remote Water/Glycol Condensing Unit

Figure 10 Chilled water systems, 3 tons



Chilled Water
Supply and Return Plenum

Chilled Water Ducted



5.2 Ceiling Unit Weights

Table 6 Ceiling unit weights

Model #	Weight lb (kg)
Cooling Units *	
MMD24E	225 (102)
MMD35E	225 (102)
MMD36E	225 (102)
MMD39C	230 (104)
MMD40C	230 (104)
Indoor Condensing Units	
MCD24A	270 (125)
MCD35A	280 (130)
MCD36A	280 (130)
MCD26W	190 (90)
MCD37W	200 (95)
MCD38W	200 (95)
MCD38W	200 (95)

* Add 20 lb. (9kg) to units with free-cooling or hot water reheat coils.

5.3 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 damaged, report it to the shipper and to your Liebert supplier.

5.4 Packaging Material

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

5.5 Installing the Ceiling Units

WARNING

Risk of ceiling collapse and heavy unit falling. Can cause building and equipment damage, serious injury or death.

Verify that the supporting roof structure is capable of supporting the weight of the unit(s) and the accessories. (see **5.2 - Ceiling Unit Weights**.)

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

The evaporator unit and 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 national and local codes. Use field-supplied threaded suspension rods and 3/8-16 factory hardware kit.

Recommended clearance between ceiling grids and building structural members is unit height plus 3 in (76mm).

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 that is rated for the weight of the unit (see **5.2 - Ceiling Unit Weights**), raise the unit and pass the threaded rods through the four mounting holes in the flanges that are part of the unit base.

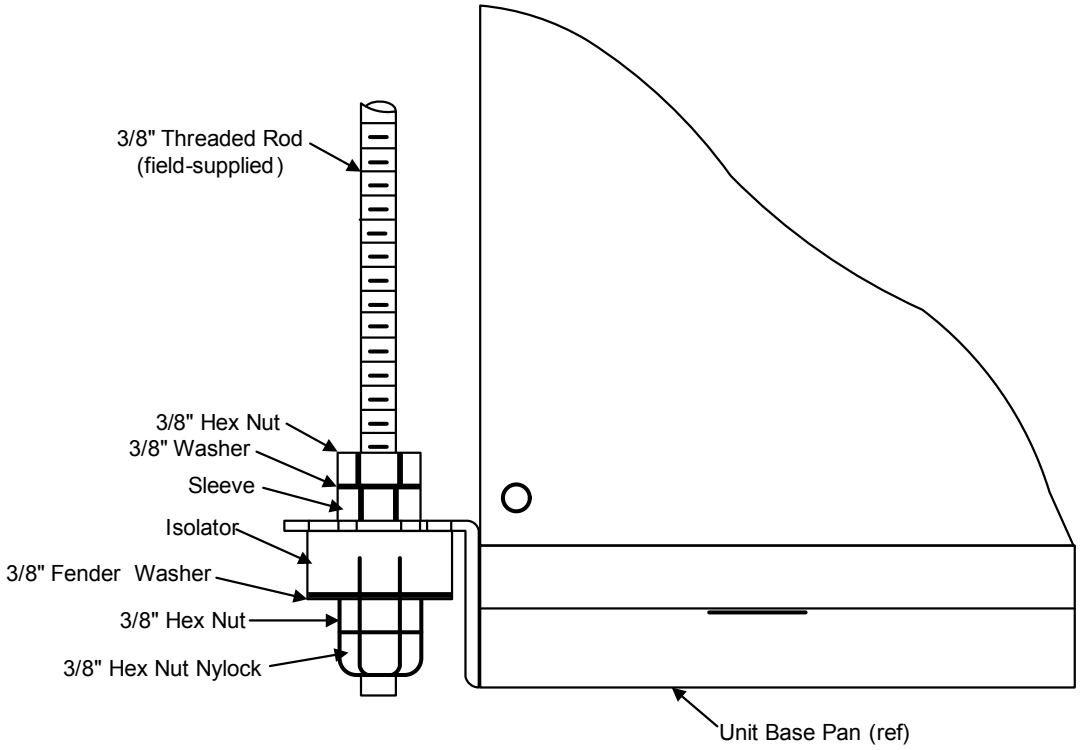
Attach the threaded rods to the unit flanges using the supplied nuts and grommets. (See **Figure 11**). The rubber grommets provide vibration isolation.

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

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

2. Second, use the shake-proof nuts to "jam" the plain nuts.

Figure 11 Threaded rod and hardware kit installation



5.5.1 Close-Coupled Installations

If the evaporator and indoor condensing units are to be mounted back-to-back (close-coupled), hang each unit before connecting them together. Align four bolt holes in the condensing unit with cage nuts in the evaporator. Insert rubber spacers and secure with provided hardware. Align the refrigerant connections and tighten them as described in **5.5.3 - Piping Connections and Coolant Requirements** (see **Figure 17**).

Close-coupled installations may take advantage of a single-point power kit to allow one power feed to provide input for both evaporator and condensing units. Kit should be mounted in evaporator unit before raising unit into ceiling area.

5.5.2 Evaporator Air Distribution

Filter Box

The optional filter box is available for the unit and mounts directly to the return air opening of the evaporator. The 2 and 3 ton filter box is supplied with a MERV 8 filter (per ASHRAE 52.2-2007) measuring 20 in. x 20 in. x 4 in. (508x508x102mm).

Plenum Installation

The 2- and 3-ton non-ducted evaporators can use the optional ceiling-mounted plenum to provide four-way air distribution. The plenum fastens to the bottom of the evaporator. The plenum includes a 16 in. x 25 in x 4 in (406x635x102mm) MERV 8 filter (per ASHRAE 52.2-2007).

1. The evaporator should be mounted above the bottom of the T-bar supports with at least 30 in. (762mm) clearance from return air end to wall (for replacing filter).
2. Check the contents of the plenum kit.
3. Follow the installation instructions included with the plenum kit.

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

Connections for Ducted Systems

In a ducted configuration, the direct drive evaporator has a maximum allowable external static pressure of 0.3" wg (7.6 mm). Use flexible ductwork or non-flammable cloth collars to attach ductwork to the unit and to help control the transmission of vibrations to building structures. Insulation of ductwork 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 inside the duct. Ductwork should be fabricated and installed in accordance with local and national codes.

Table 7 Cooling unit air flow at 0.3 IWG (75PA) ESP

Fan Speed	2 Ton CFM (CMH)	3 Ton CFM (CMH)
High	885 (1504)	1250 (2124)
Low	800 (1359)	1000 (1699)

5.5.3 Piping Connections and Coolant Requirements

The following pipe connections are required:

- A drain line from the evaporator coil drain pan (This line also serves as the drain for the optional humidifier.)
- A drain line from the secondary drain pan beneath the unit.
- A water supply line to the optional humidifier (if applicable).
- Refrigerant piping connections between the evaporator unit and the condensing unit (air, water, or glycol). If the evaporator unit is chilled water, connections to the building chilled water source are required.

Drain Line

NOTICE

Risk of water backing up in the evaporator coil drain line. Can cause building and equipment damage from overflowing water.

Do not install an external trap in the drain line. This line already has a factory-installed trap inside the cabinet.

This line may contain boiling water. Use copper or other suitable material for the drain line.

A 3/4 in. (19.1 mm) NPT female 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 operation if drain becomes blocked.

The optional condensate pump kit is required when the evaporator is installed below the level of the gravity-fed drain line.

NOTE
Remove any shipping band from the float switch in the evaporator pan before operating unit.

Humidifier Water Supply Line

Units supplied with the optional humidifier package have a 1/4 in. (6.4 mm) compression fitting with ferrule at the water supply connection 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.

Assembly Instructions

1. Cut tube square and remove cutoff burr.
2. Slide nut then sleeve on tube, threaded end on nut facing end of tube.
3. Insert tube into fitting seating it against stop shoulder and thread nut to body “hand-tight.”
4. With proper wrench tighten 1-1/4 to 2-1/4 turns.

NOTICE

Risk of improper tightening of the piping fittings. Can cause fitting damage and leaks that can result in building and equipment damage.

Do not over tighten the piping fittings

Chilled Water Loop

On chilled water units, install manual service shutoff valves at the supply and return lines of each unit. These shutoff valves are used for routine service or emergency isolation of the unit.

Chilled water supply and return lines must be insulated. Insulating them will prevent condensation of the water supply and return lines to the unit.

The minimum recommended water temperature is 42¡F. Design pressure is 300psig (2068 kPag). Connection sizes are 7/8 in (22.2mm) OD copper for 3 ton units.

Water/Glycol Loop

Emerson recommends installing manual service shutoff valves at the supply and return line to each unit. This permits routine service and emergency isolation of the unit. Install 1/2" (13mm) diameter condensing fluid inlet and 1/2" (13mm) diameter condensing fluid outlet.

When the condensing fluid quality is poor, Emerson recommends placing proper filters in the supply line to extend the service life of the condenser. These filters must be easily replaced or cleaned. The standard maximum fluid pressure is 150 psig (1034 kPa) or optional 350 psig (2413 kPa) systems. For applications above this pressure, consult the factory.

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

NOTICE

Risk of frozen pipes and corrosion from improper coolant mixture. Can cause equipment and building damage.

When piping or the Liebert Mini-Mate2 may be exposed to freezing temperatures, charge the system with the proper percentage of glycol and water for the coldest design ambient. Automotive antifreeze is unacceptable and must NOT be used in any glycol fluid system. Use only an HVAC glycol solution only that has been prepared according to industry practices.

Refrigerant (R-407C) Loop

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

The refrigerant lines can be piped by installing:

- an optional sweat adapter kit and hard piping between the two units
- optional pre-charged line sets (maximum combined length of 45' [13.7m])
- close coupling the units together using the quick connects. (See **Figure 17**)

WARNING

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

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

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 with 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.

NOTICE

Risk of twisted or kinked piping. Can cause flow restriction or leaks.

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

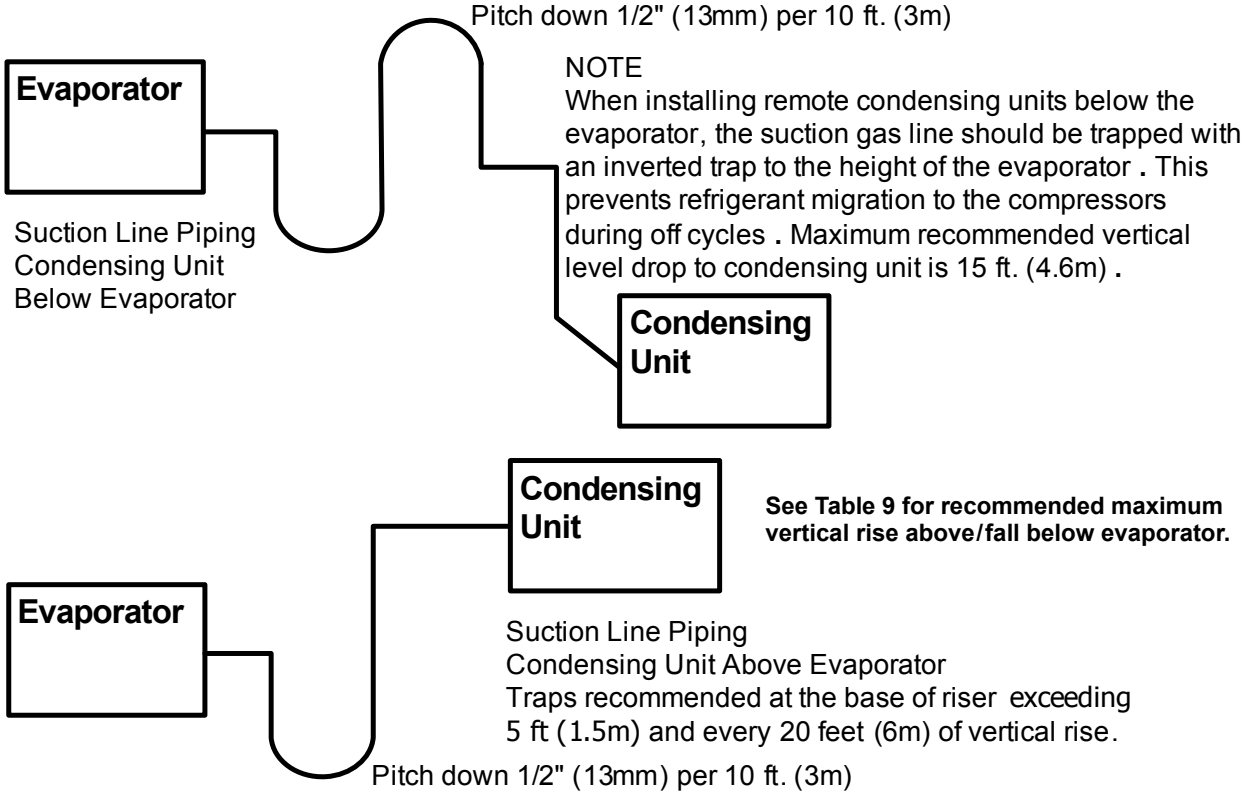
Field-Fabricated Piping

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

1. Use sweat adapter kit matched to the Liebert Mini-Mate2 and outdoor condensing unit refrigerant connection sizes.
2. Measure pipe runs and calculate pipe size and equivalent feet of suction and liquid lines per **Tables 8** and **12**.
3. Use a flow of dry nitrogen through the piping during brazing to prevent formation of copper oxide scale inside the piping. Copper oxide forms when copper is heated in the presence of air. POE oil will dissolve these oxides from inside the copper pipes and deposit them throughout the system, clogging filter driers and affecting other system components. A pure dry nitrogen flow of 1-3 ft^3/min (0.5-1.5 l/s) inside the pipe during brazing is sufficient to displace the air. Control the flow using a suitable metering device.
4. Pressurize and leak-test the completed lines at approximately 150 psig (1034kPa) pressure.
5. Evacuate each line twice to 250 microns. Break the vacuum each time with clean, dry nitrogen.
6. Evacuate the lines a third time to 250 microns.
7. See **Quick Connect Fittings on page 23** for the proper procedure to connect lines to each unit of the split system.
8. Add refrigerant (R-407C) to the completed system as calculated per **Table 10** for both liquid and suction line sizes used.

When installing remote condensing units above the evaporator, the suction gas line should be trapped at the evaporator. This trap will retain refrigerant oil during the Off cycle. When the unit starts, oil in the trap is carried up the vertical riser and returns to the compressor (see **Figure 12**).

Figure 12 Refrigerant piping diagram



NOTE

When installing remote condensing units below the evaporator, the suction gas line should be trapped with an inverted trap the height of the evaporator. This prevents refrigerant migration to the compressor during off cycles.

Table 8 Recommended refrigerant line sizes

Equivalent Length, ft (m)	2 Ton		3 Ton	
	Suction	Liquid	Suction	Liquid
50 (15.2)	7/8"	3/8"	7/8"	1/2"
100 (30.5)	7/8"	1/2"	1-1/8" [2]	1/2"
150 (45.7)	7/8"	1/2"	1-1/8" [2]	1/2"

1. Suction line and liquid line sizing based on < 3 psi pressure drop in each and horizontal suction line refrigerant velocities >700FPM (3.6m/s).
2. Suction size should be reduced one pipe size for vertical riser sections to maintain suction line velocity > 1000FPM (5.1m/s) for proper oil return.

Table 9 Pipe length and condenser elevation relative to evaporator

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

Maximum recommended total equivalent pipe length is 150 ft (46m). Suction and liquid lines may require additional specialty items when vertical lines exceed 20 ft. (6m) and/or condensing unit installation is more than 15 ft. (4.6m) below the evaporator. Contact Emerson Application Engineering for assistance.

Table 10 Line charges - refrigerant per 100 ft. (30m) of Type L copper tube

Line Size, O.D., in.	R-407C, lb/100 ft. (kg/30m)	
	Liquid Line	Suction Line
3/8	3.7 (1.7)	—
1/2	6.9 (3.1)	—
5/8	11.0 (5.0	0.4 (0.2)
3/4	15.7 (7.1)	0.6 (0.3)
7/8	23.0 (10.4)	1.0 (0.4)
1-1/8	—	1.7 (0.7)
1-3/8	—	2.7 (1.1)

Table 11 Refrigerant charge in Liebert pre-charged R-407C line sets

Line Size, in.	Length, ft. (m)	Charge R-407C, oz (kg)
3/8 liquid	15 (4.5)	5 (0.14)
	30 (9)	10 (0.28)
5/8 or 7/8 suction	15 (4.5)	5 (0.14)
	30 (9)	10 (0.28)

Table 12 Equivalent lengths for various pipe fittings, ft (m)

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

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

Refrigerant Charge Requirements

Total R-407C refrigerant charge will be required only if units are evacuated during installation or maintenance. For safe and effective operation, refer to pressures in **5.5.3 - Piping Connections and Coolant Requirements.**

Total Refrigerant = Units and Lines

Table 13 Refrigerant charge

Model #		Charge R-407C oz (kg)
60Hz	50Hz	
MM*24E/K	—	7 (0.198)
MM*36E/K	MM*35E/K	7 (0.198)
MC*24AL_H7	—	134 (3.80)
MC*36AL_H7	MC*35AL_H7	213 (6.04)
MC*26W_H7	—	41 (1.16)
MC*38W_H7	MC*37W_H7	54 (1.54)
PFH027-_L7	—	134 (3.80)
PFH027-_H7	—	213 (6.04)
PFHZ27-_L7	—	213 (6.04)
PFH037-_L7	PFH036-_L7	213 (6.04)
PFH037-_H7	PFH036-_H7	426 (12.08)
PFHZ37-_L7	PFHZ36-_L7	426 (12.08)

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 14** for torque requirements.

Table 14 Connection sizes and torque

Size OD Cu	Model Tons	Coupling Size	Torque lb-ft.
3/8	2 and 3	#6	10-12
5/8	2 and 3	#11	35-45

Figure 13 Dimensions, evaporator and chilled water units with direct drive blower

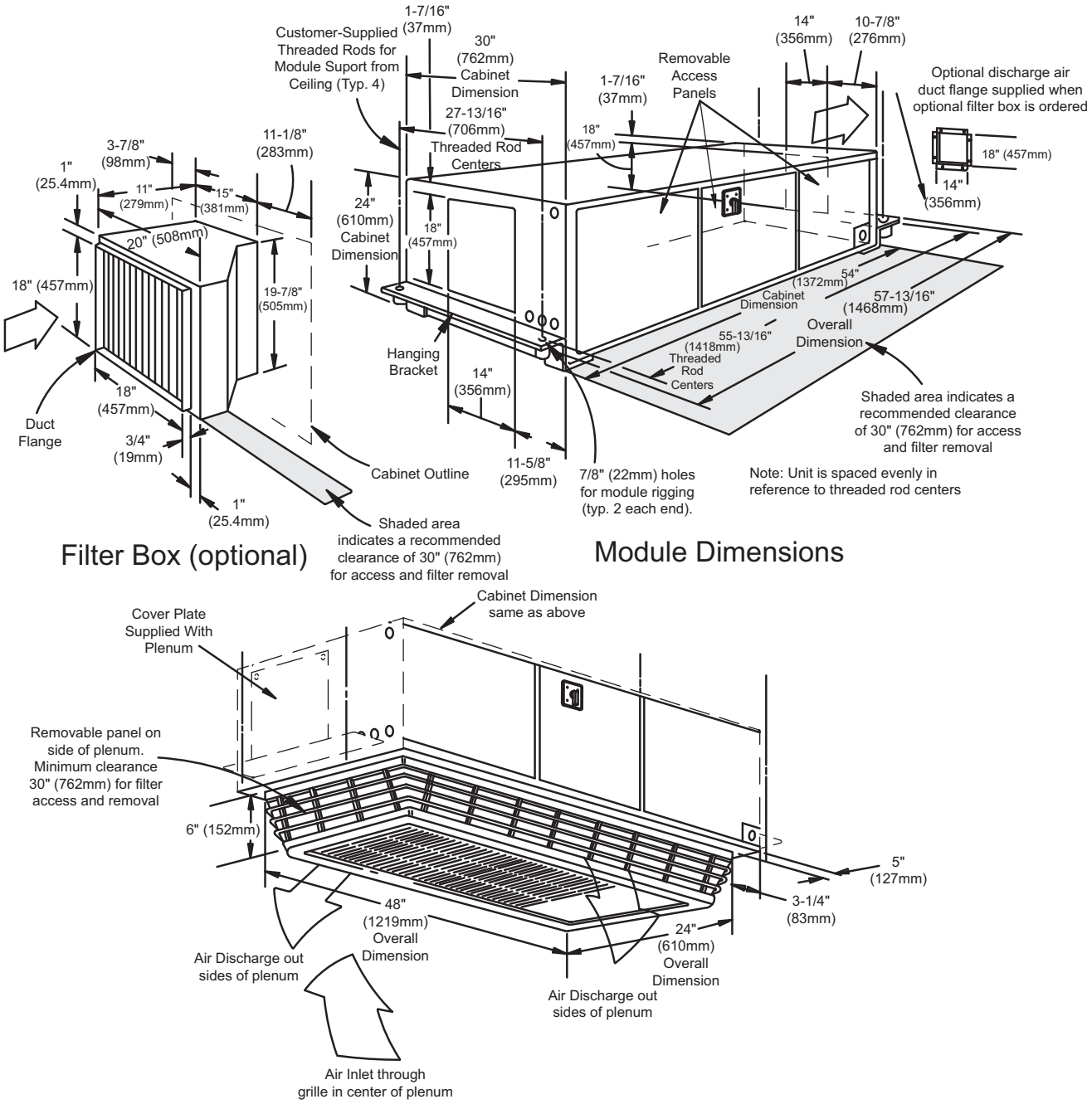


Table 15 Net weights—evaporator and chilled water units

Model #		Weight, lb (kg)
60Hz	50Hz	
MM*24E	—	225 (102)
MM*24K	—	245 (111)
MM*36E	MM*35E	225 (102)
MM*36K	MM*35K	245 (111)
MM*40C	MM*39C	230 (104)

Source: DPN000193, Rev. 3

Figure 14 Dimensions, evaporator units with optional belt drive blower assembly

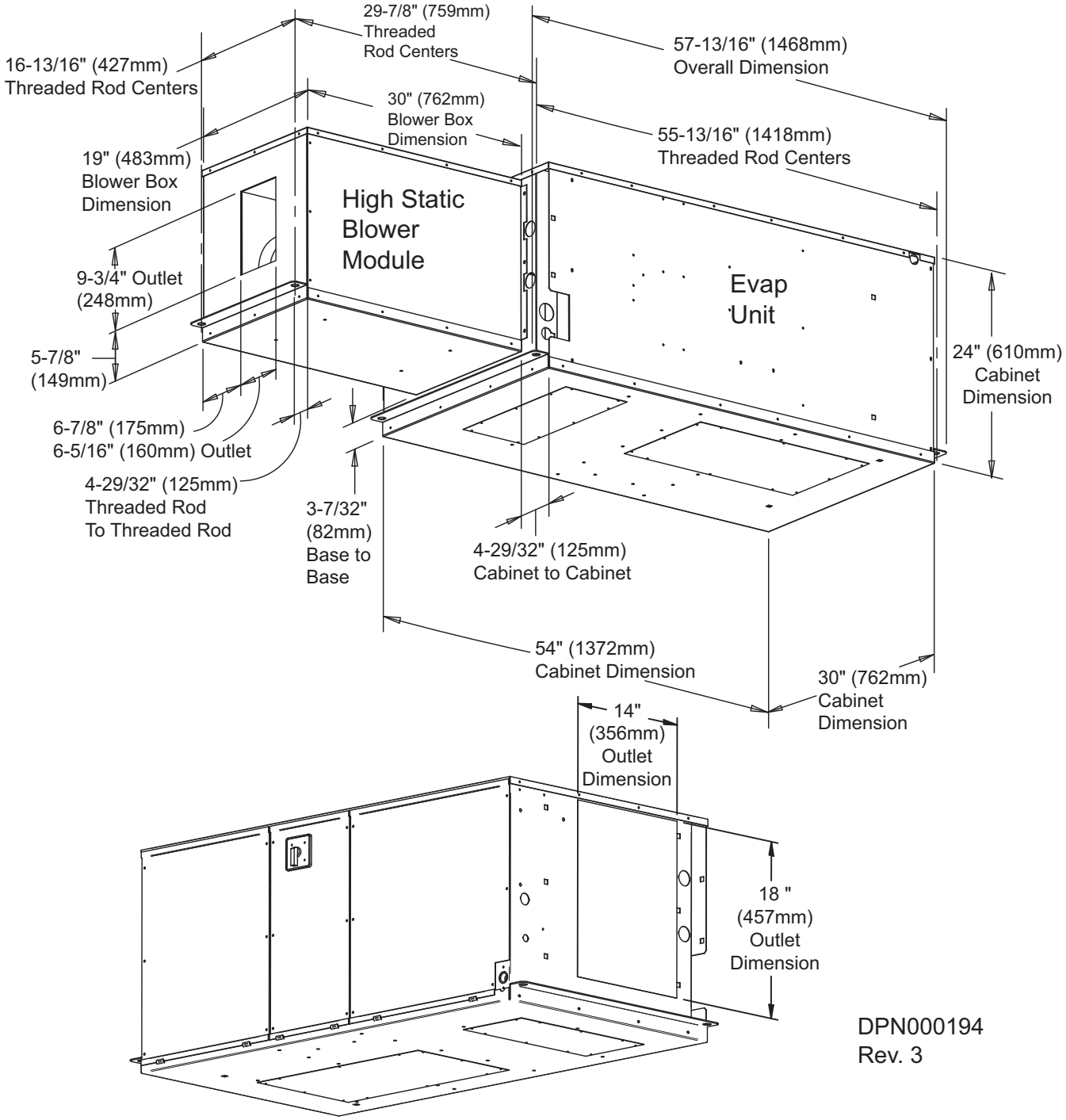
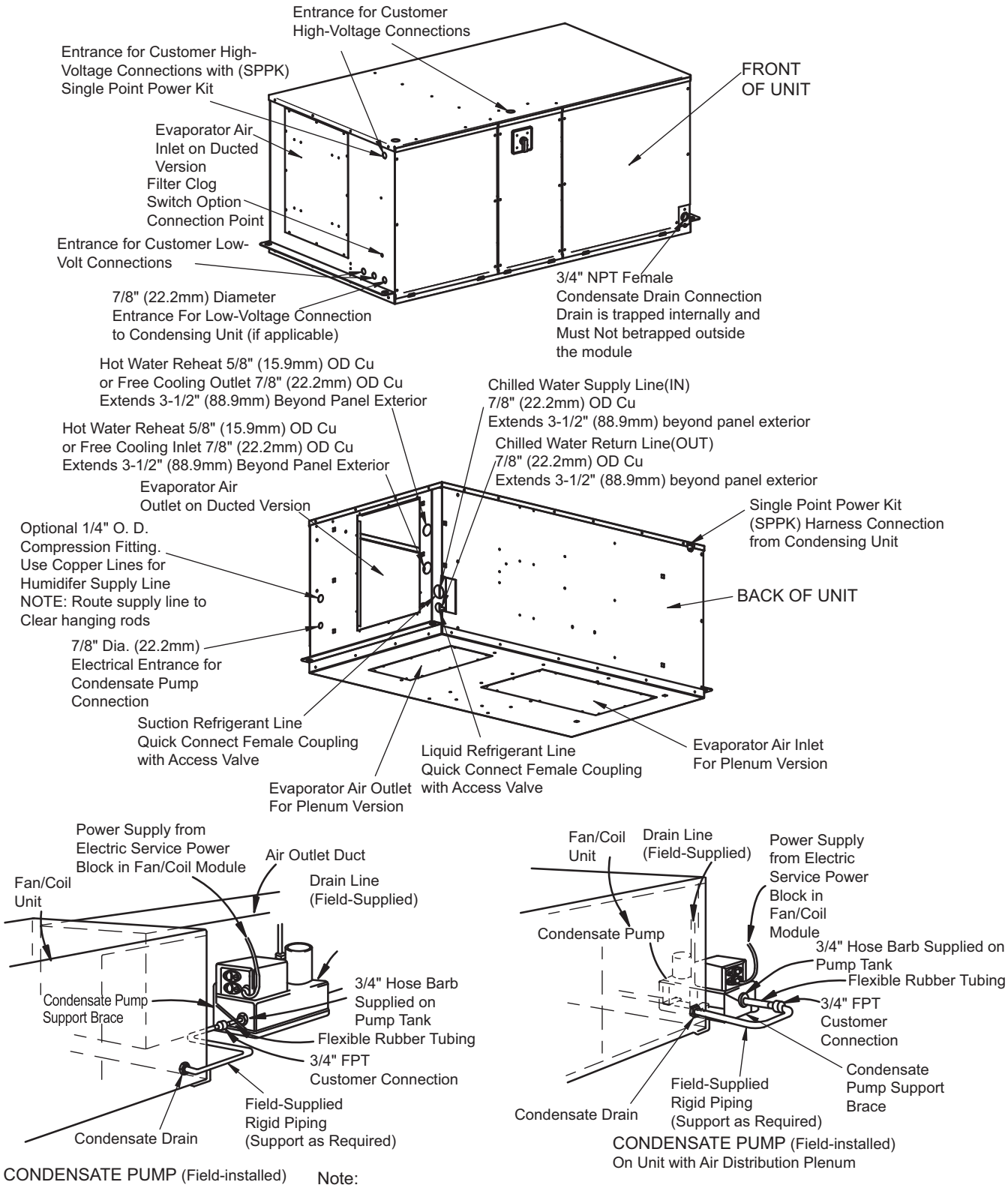


Table 16 Net weight, high static blower module

Unit	Net Weight lb (kg)
High Static Blower Module	85 (39)

Source: DPN000194, Rev. 3

Figure 15 Evaporator and chilled water unit piping data



CONDENSATE PUMP (Field-installed)
On Unit with Air Outlet Ductwork

CONDENSATE PUMP (Field-installed)
On Unit with Air Distribution Plenum

Note:
3/4" (19.1mm) Flexible Rubber Tubing Assembly (Supplied with Pump Kit) must be installed on pump end of rigid piping; support as required.

DPN00192
Rev. 1

5.5.4 Condensate Pump Kit Installation—All Units

WARNING

Risk of electric shock. Can cause injury or death.

Open all local and remote electric power disconnect switches before making electrical wiring connections.

1. Refer to detail instructions and drawings supplied with the pump.
2. Disconnect all power to the unit.
3. Remove access panels.

NOTE

Remove any shipping bands from float switch in evaporator pan

4. Use mounting brackets if pump is not attached to ductwork. Pump inlet must be at least 1/2 in. (12.7mm) below evaporator drain. Mount the pump to unit exterior as shown in **Figure 15**.
5. Connect 3/4 in. flexible rubber tubing with hose clamp (both supplied with pump kit) to 3/4 in. hose barb fitting on pump.
6. Connect evaporator drain to 3/4 in. NPT-Female hose assembly on pump inlet using 3/4 in. hard pipe with no trap in the line. Provide at least 1 in. (25.4mm) clearance between the access panel and the drain line. Support piping as required.
7. Connect a drain line to the pump discharge 3/8 in. O.D. Cu (compression fitting provided).
8. Connect electric leads L1 and L2 to the line voltage terminal block in the cooling unit. Connect the ground lead to the lug near the terminal block.
9. Connect wires from the Auxiliary Pump contacts to terminals TB1-8 and TB1-9 to shut down unit at the occurrence of a high water condition in the pump.
10. Reinstall the access panels.
11. Reconnect power to the unit.
12. Run the unit to make sure the pump works properly. Operate the pump and check the drain line and discharge line for leaks. Correct as needed.

NOTE

3/4" flexible rubber tubing assembly (supplied with pump kit) must be installed on pump end of rigid piping (field-provided and supported as required).

5.5.5 Electrical Connections

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

WARNING

Arc flash and electric shock hazard. Open all local and remote electric power disconnect switches and wear protective equipment per NFPA 70E before working within the electric control enclosure. Failure to comply can cause injury or death.

Unit contains hazardous voltage/electric power.

Line side of factory disconnect remains energized when factory disconnect is Off.

- Power supply to each ceiling unit.
- Control wiring between the evaporator unit and the condensing unit, if applicable.
- Control wiring between the control panel (wall box) and the evaporator unit control board. Entrance locations for these connections are noted on drawing in each installation section.

Power Connections

All power and control wiring and ground connections must be in accordance with the National Electrical Code and local codes. Refer to electrical schematic on unit for electrical requirements.

WARNING

Risk of loose electrical wiring connections. Can cause over heating of wire, smoke, and fire resulting in building and equipment damage, serious injury or death.

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

Voltage supplied must agree with the voltage specified on the unit name plate. If a field-supplied disconnect switch is required, it may be bolted to the ceiling unit but not to any of the removable panels. This would interfere with access to the unit. Make sure that no refrigerant lines are punctured when mounting the disconnect switch.

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. For 208VAC applications, the low voltage transformer tap must be changed. Refer to the electrical schematic.

An optional single point power kit is available for units that are installed close-coupled. This kit should be mounted inside the evaporator before installing the unit in the ceiling (See **Figure 17**). Specific installation instructions are included with the single point power kit.

Control Connections

A field-supplied 4-wire control connection (24 VAC) is required between the evaporator and the condensing unit. Control wiring must be installed in accordance with the National Electrical Code (NEC) Class 2 circuit. Glycol cooled units also require a two-wire control connection to the drycooler and pump. A Class 1 circuit is required for Water/Glycol units.

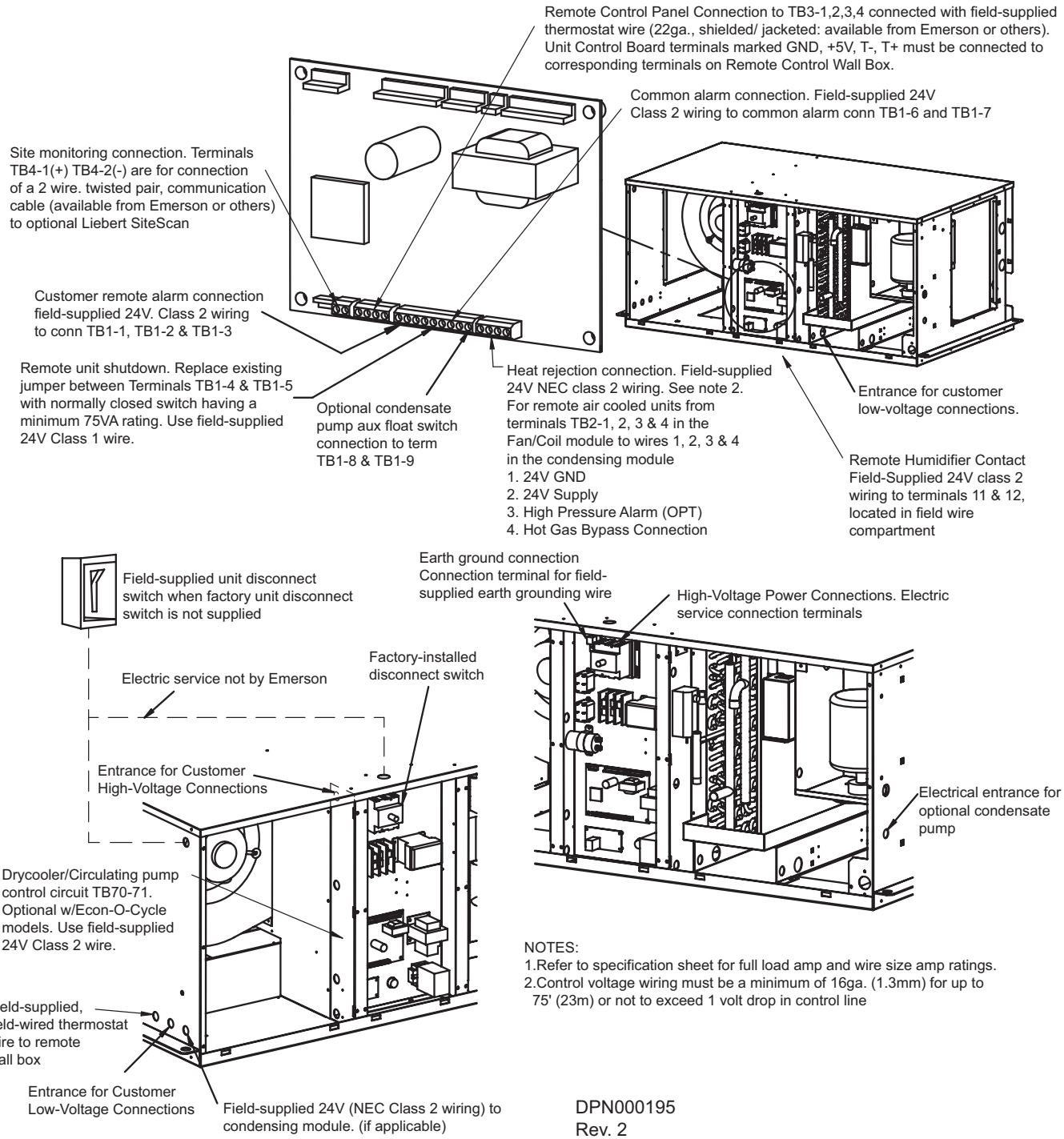
Control wiring between the evaporator and the condensing unit must not allow a voltage drop in the line of more than 1 volt (16 gauge minimum for 75 feet). Do not connect additional electrical devices to the control circuit. The circuit breaker, contained in the transformer housing, is sized only for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

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

NOTE

Refer to specifications for full load amp. and wire size amp. ratings.

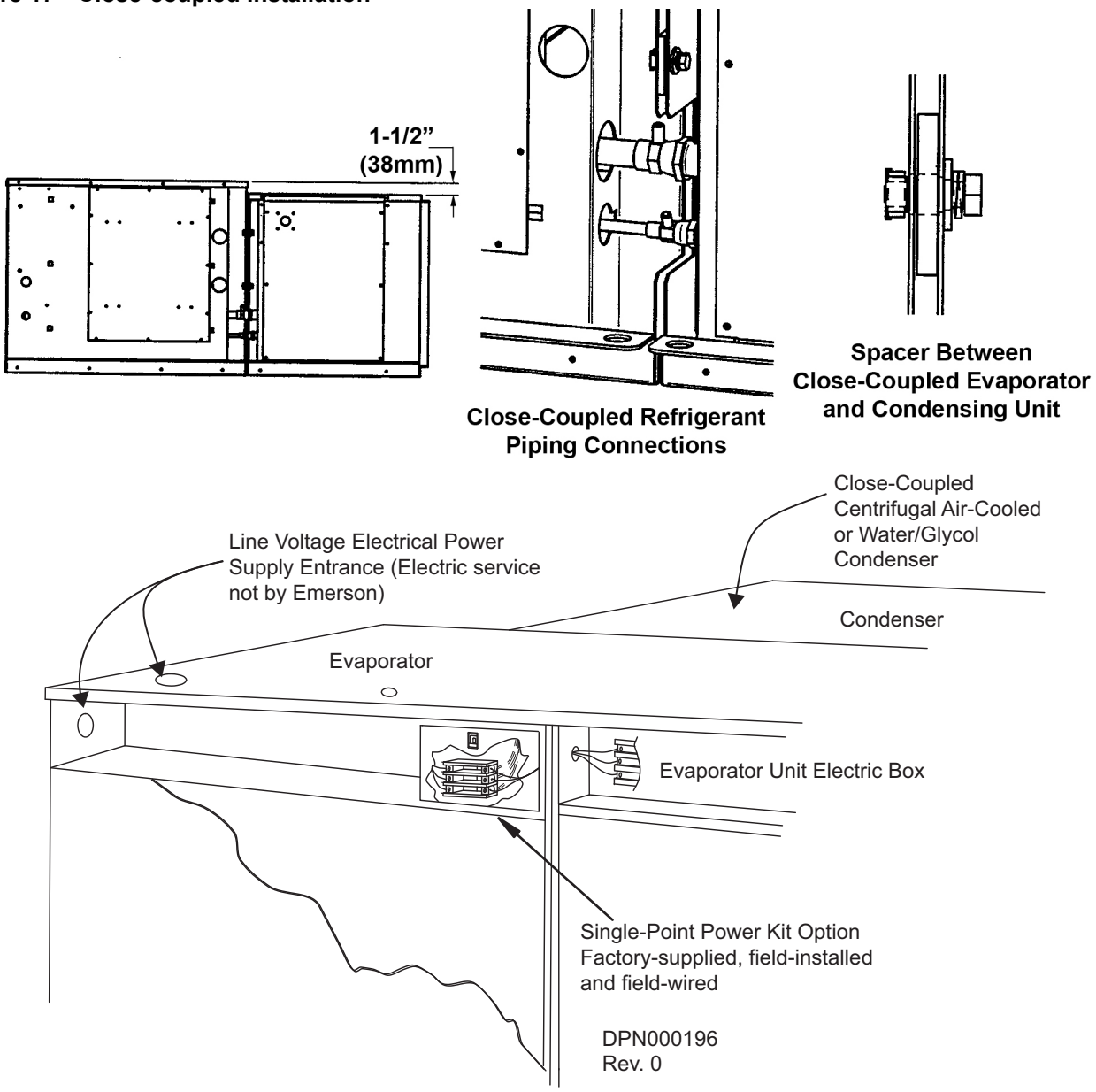
Figure 16 Evaporator and chilled water unit electrical connections



NOTES:
1.Refer to specification sheet for full load amp and wire size amp ratings.
2.Control voltage wiring must be a minimum of 16ga. (1.3mm) for up to 75' (23m) or not to exceed 1 volt drop in control line

DPN000195
Rev. 2

Figure 17 Close-coupled installation



5.6 Indoor Air-Cooled Centrifugal Fan Condensing Unit Installation

5.6.1 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. Refer to **Table 9** for maximum refrigerant line lengths.

To mount the unit in the ceiling, refer to **5.5 - Installing the Ceiling Units**.

5.6.2 Electrical Connections

Refer to **5.5.5 - Electrical Connections** for general wiring requirement and cautions. Refer to the unit's electrical schematic when making connections. Refer to the unit's specifications for full load amp and wire size amp ratings.

5.6.3 Piping Connections

Details for refrigerant (R-407C) loop piping are in **5.5.3 - Piping Connections and Coolant Requirements**.

5.6.4 Ducting

The total external static pressure for the inlet and outlet ducts, including grille, must not exceed 0.5 inches of water.

General Considerations

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

Ductwork that runs through a conditioned space or is exposed to areas where condensation may occur must be insulated. Ductwork should be suspended using flexible hangers. Ductwork 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.

Table 17 Indoor condensing unit airflow, CFM at 0.5 iwg esp

2 Ton	3 Ton
1000	1430

Figure 18 Indoor air-cooled centrifugal condenser dimensions and pipe connections

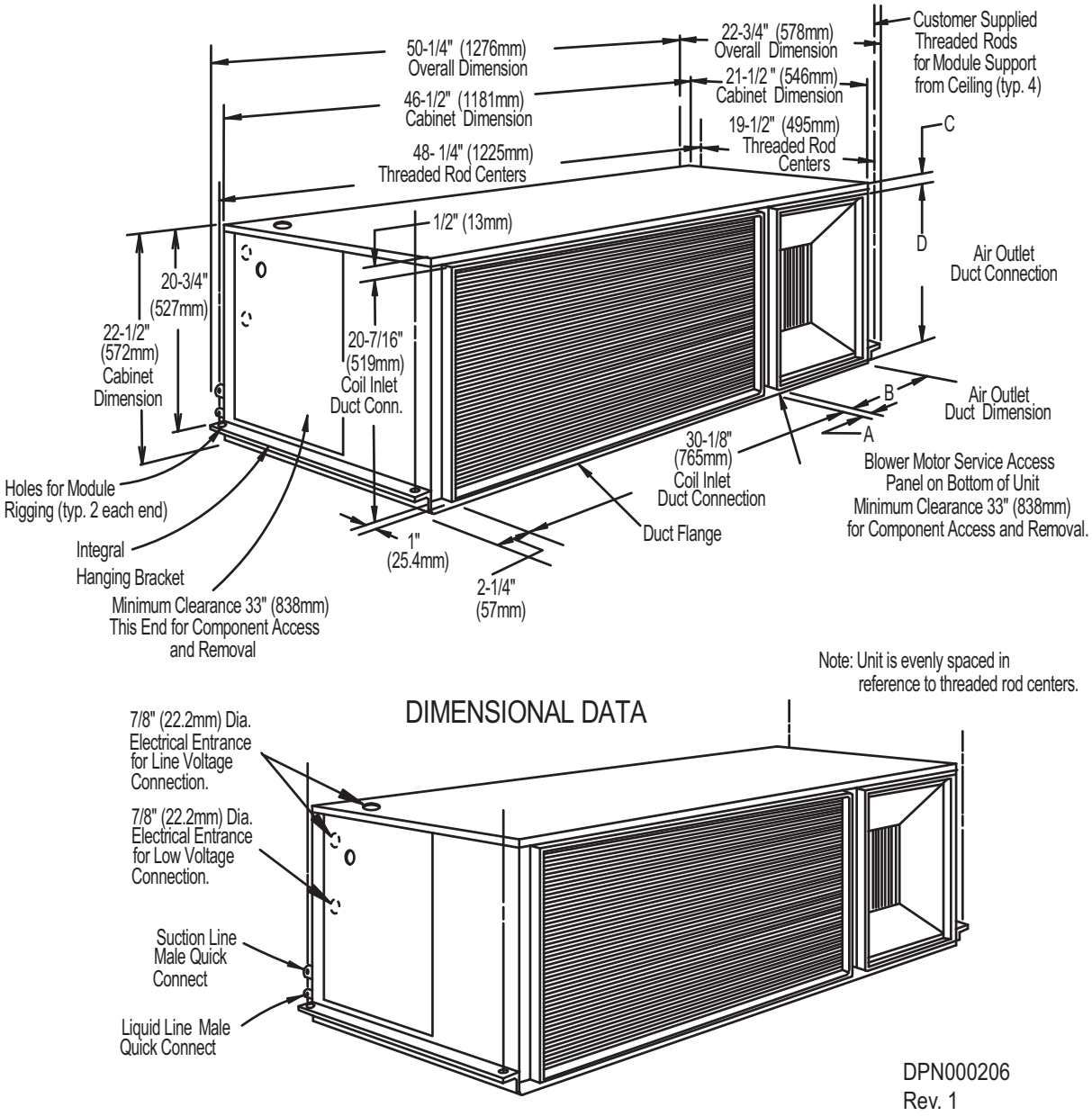
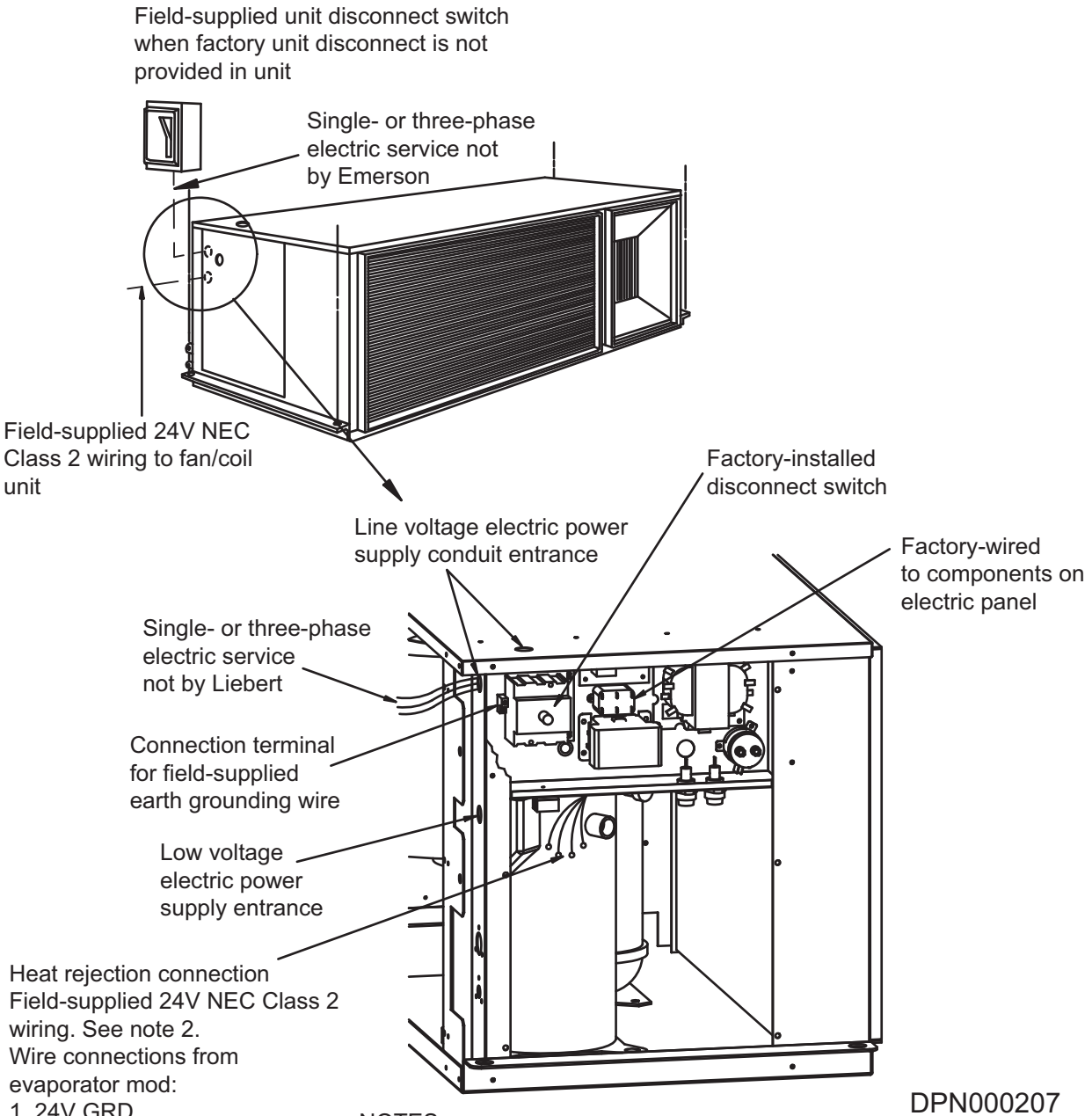


Table 18 Centrifugal condenser dimensions, weights

Model	A	B	C	D	Net Weight lb (kg)
MC*24A	1-7/16 (37)	11-7/16 (290)	1/2 (13)	20-7/16 (519)	230 (104)
MC*35A					240 (109)
MC*36A					

Source: DPN000206, Rev. 1

Figure 19 Centrifugal condenser electrical connections



NOTES:
1. Refer to specification sheet for full load amp and wire size amp. ratings.
2. Control voltage wiring must be a minimum of 16GA (1.3mm) for up to 75' (23m) or not to exceed 1 volt drop in control line.

5.7 Outdoor Air Cooled Condensing Unit Installation

5.7.1 Location Considerations

NOTE
Follow all national and local building, electrical and plumbing codes.

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

The condensing unit should be located for maximum security and maintenance accessibility. Avoid ground-level sites with public access. Refer to **Table 9** for maximum refrigerant line lengths.

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.

Figure 20 Cabinet and floor planning dimensional data, outdoor condensing unit

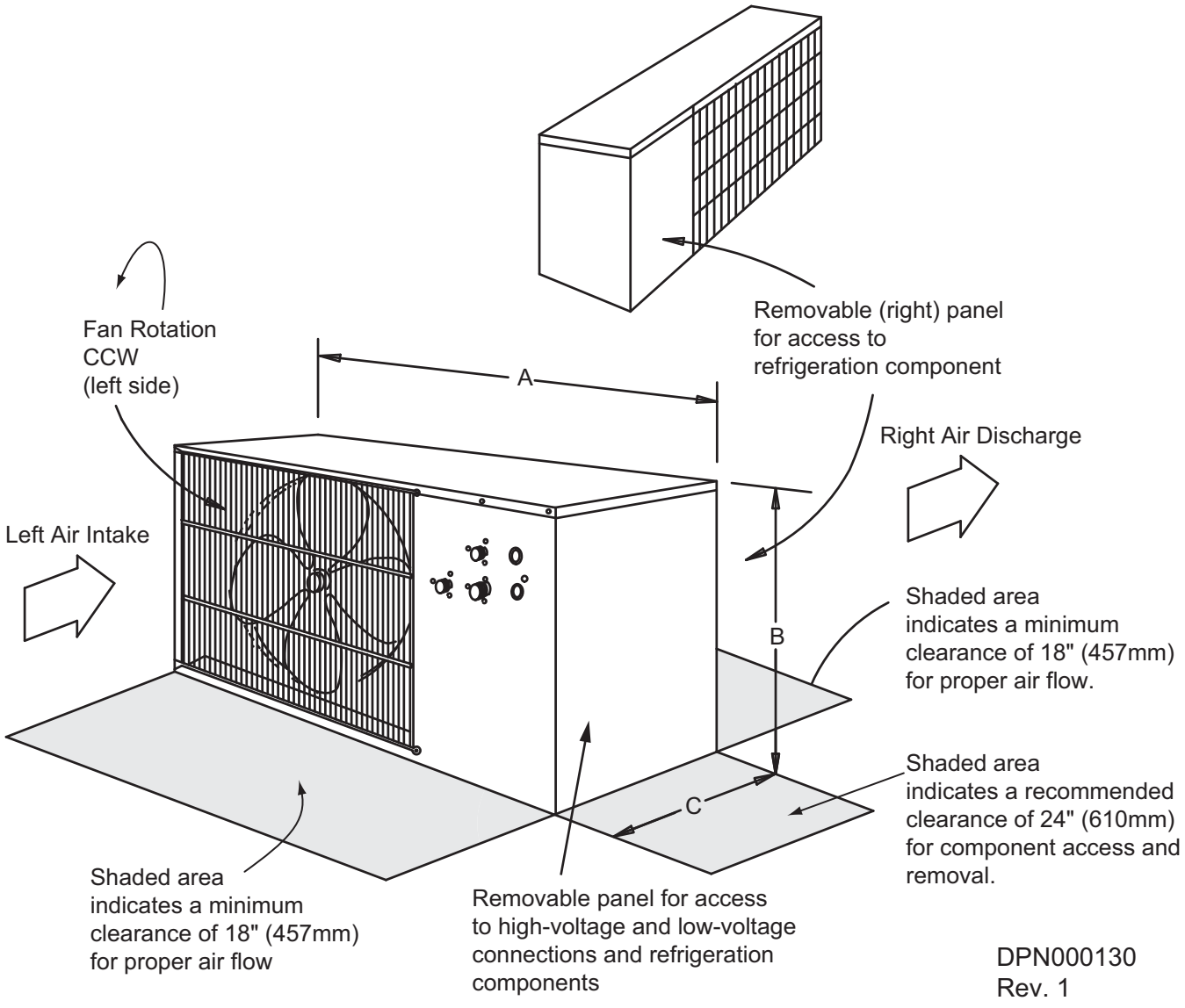


Table 19 Dimensions and net weights—air-cooled outdoor condensing units

Model Numbers		Dimensions, inches (mm)			Module Net Weight lb (kg)
60Hz	50Hz	A	B	C	
PFH027A-L	—	40 (1016)	23-1/2 (597)	18 (457)	200 (91)
PFH027A-H	—	48 (1219)	31 (787)	18 (457)	241 (109)
PFHZ27A-L	—				
PFH037A-L	PFH036A-L				
PFH037A-H	PFH036A-H	53 (1343)	36-1/4 (918)	18 (457)	351 (159)
PFHZ37A-L	PFHZ36A-L				

Source: DPN000130, Rev. 1

5.7.2 Piping Connections

Details for Refrigerant (R-407C) Loop piping are in **5.5.3 - Piping Connections and Coolant Requirements**.

5.7.3 Electrical Connections

Refer **5.5.5 - Electrical Connections** for general wiring requirements and cautions. Refer to electrical schematic when making connections.

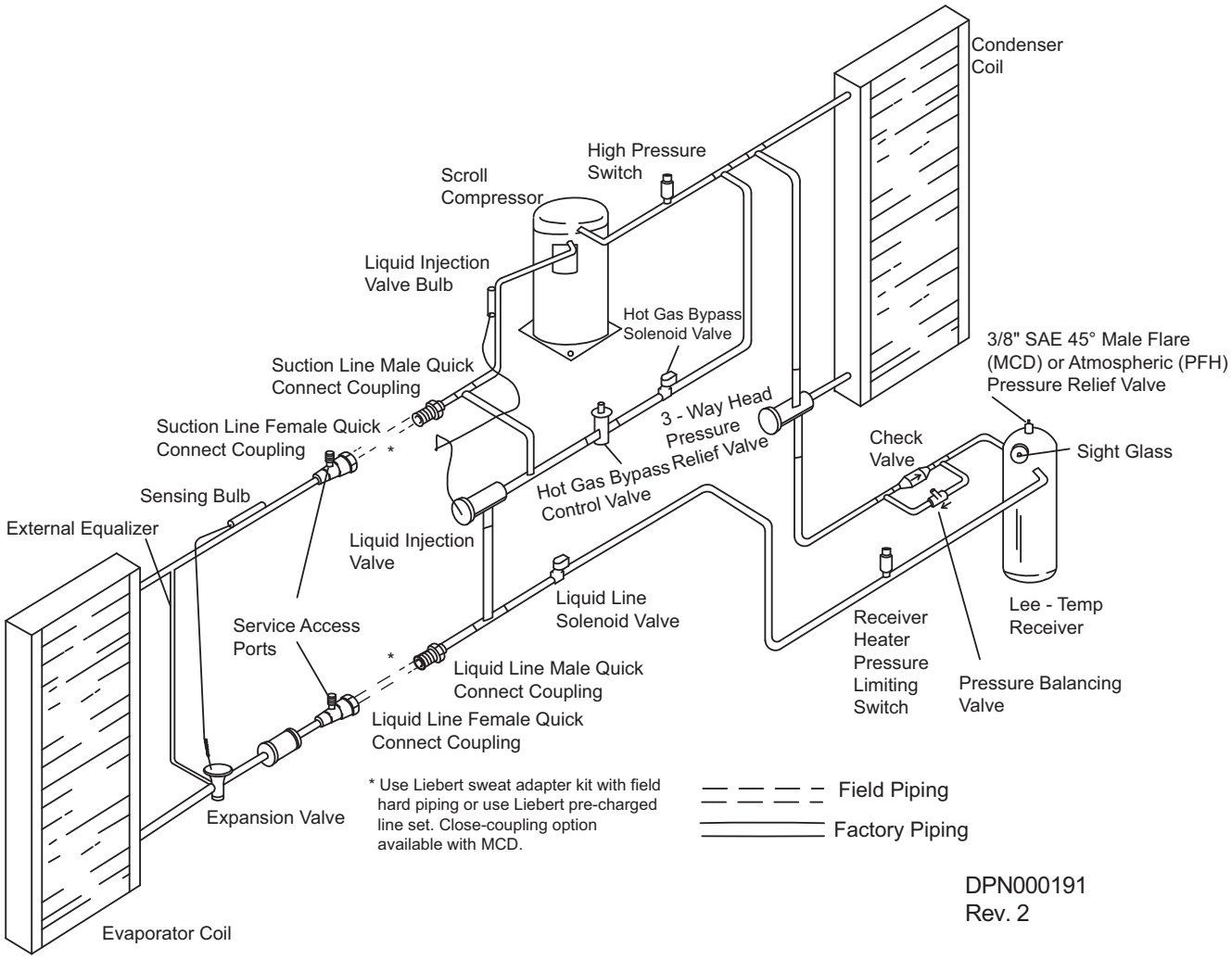
Power Connections

The outdoor condensing unit requires its own power source and earth ground, with a disconnect switch (field supplied) to isolate the unit for maintenance. A transformer is available for 277 VAC, single phase, applications (2- and 3-ton).

Control Connections

Field-supplied control wires must be connected between the evaporator and the condensing unit. (See **Figure 16** and the electrical schematic on the units for more details.) Four wires are required between the evaporator and condensing unit.

Figure 21 General arrangement (air- cooled condensing unit)



5.8 Water and Glycol Cooled Condensing Unit

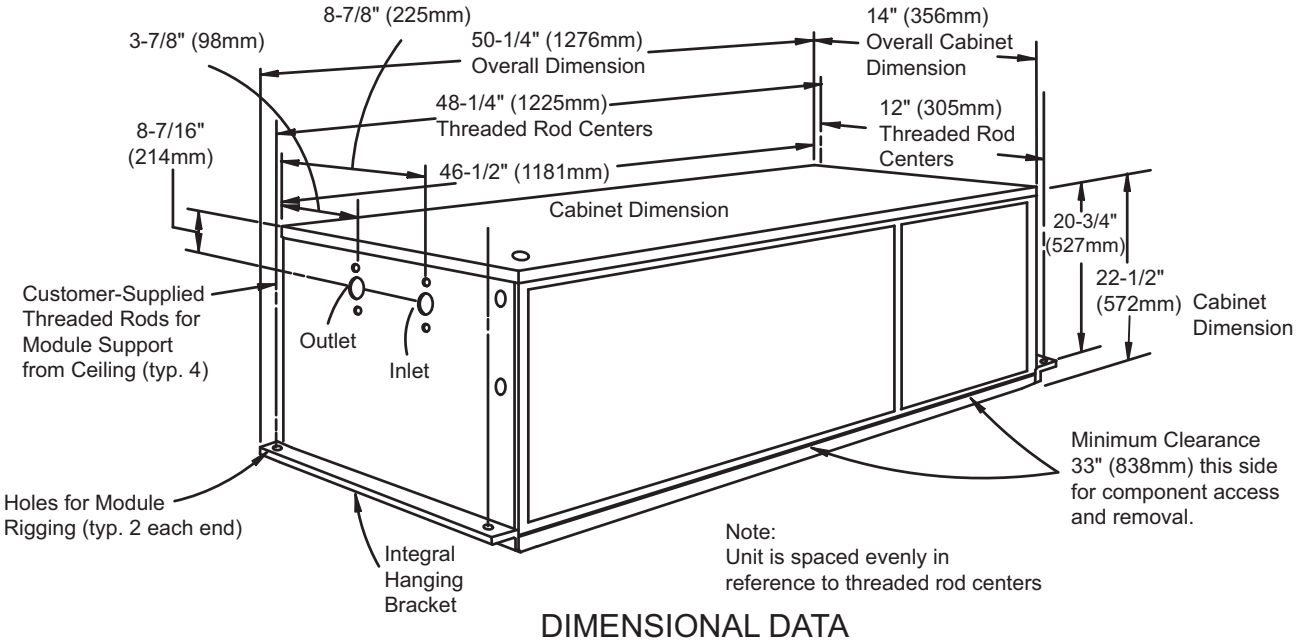
NOTE
Follow all national and local building, electrical and plumbing codes.

5.8.1 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. Refer to **Table 9** for maximum refrigerant line lengths.

To mount the unit in the ceiling, refer to **5.5 - Installing the Ceiling Units**.

Figure 22 Cabinet dimensions and piping data, water/glycol indoor condensing module



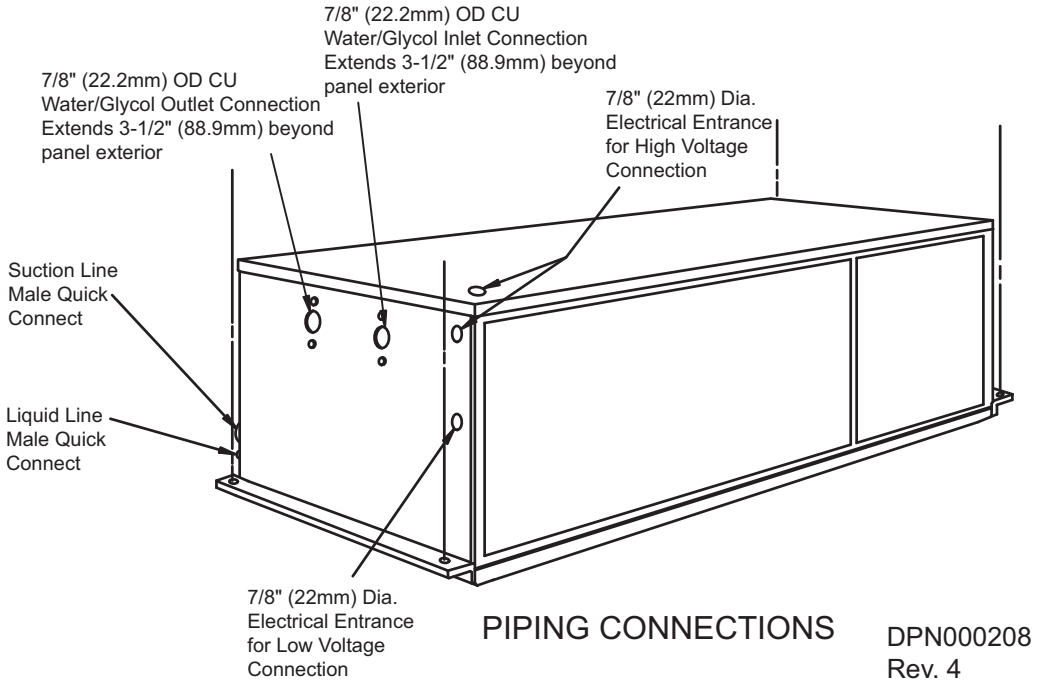


Table 20 Net weight, indoor water/glycol-cooled condensing unit

Model #		Weight lb (kg)
60Hz	50Hz	
MC*26W	—	175 (79)
MC*38W	MC*37W	220 (100)

Source: DPN000208, Rev. 4

5.8.2 Electrical Connections

Refer to **5.5.5 - Electrical Connections** for general wiring requirements and cautions. Refer to electrical schematic when making connections. Refer to specifications for full load amp. and wire size amp. ratings.

Control Connections

A 4-wire control connection is required from the evaporator unit to the condensing unit. Glycol cooled units also require a two-wire control connection to the drycooler and pump package.

5.8.3 Piping Connections

Details for refrigerant (R-407C) loop piping are in **5.5.3 - Piping Connections and Coolant Requirements**.

Water/Glycol Piping Considerations

Manual service shutoff valves should be installed at the supply and return line to each unit. This enables routine service and/or emergency isolation of the unit. When the condensing unit fluid quality is poor, filters that can be easily serviced should be placed in the supply line. These filters extend the service life of the condensing unit.

Condensing Unit Fluid Requirements

The maximum fluid pressure is 150 PSI standard pressure and 350 PSI for high pressure units (refer to unit nameplate and model number description page at beginning of this manual). The water cooled system will operate in conjunction with either a cooling tower or city water. Glycol cooled systems will operate in conjunction with a cooling tower, city water, or drycooler.

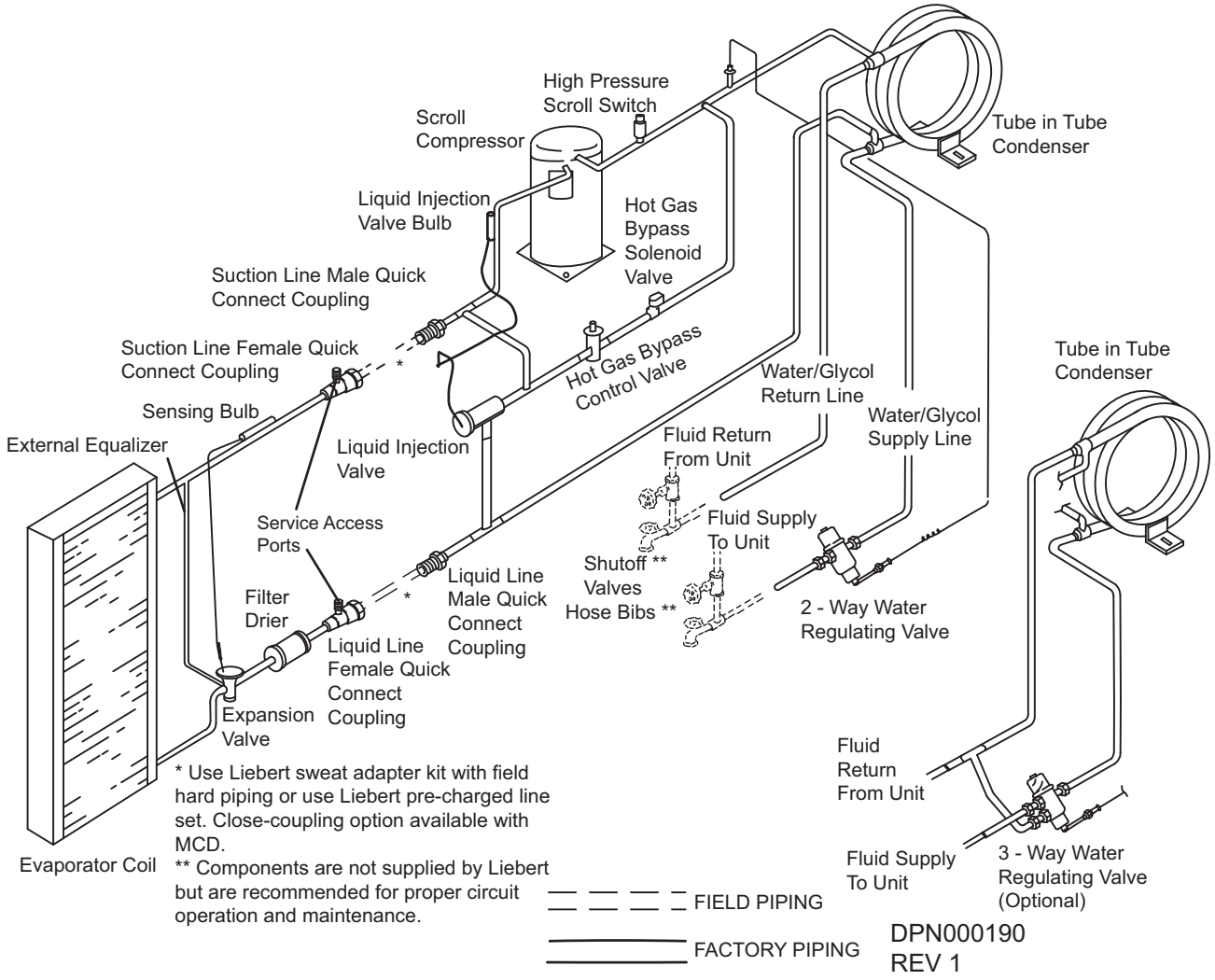
Automotive anti-freeze must not be used in glycol systems. Prepare glycol solution using customary practices.

Regulating Valve

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

Standard pressure and high pressure valves are adjusted differently. Contact Emerson Network Power® Liebert Services before making any adjustments.

Figure 23 General arrangement, water/glycol split systems



5.9 Optional Equipment Piping

5.9.1 Free-Cooling Coil

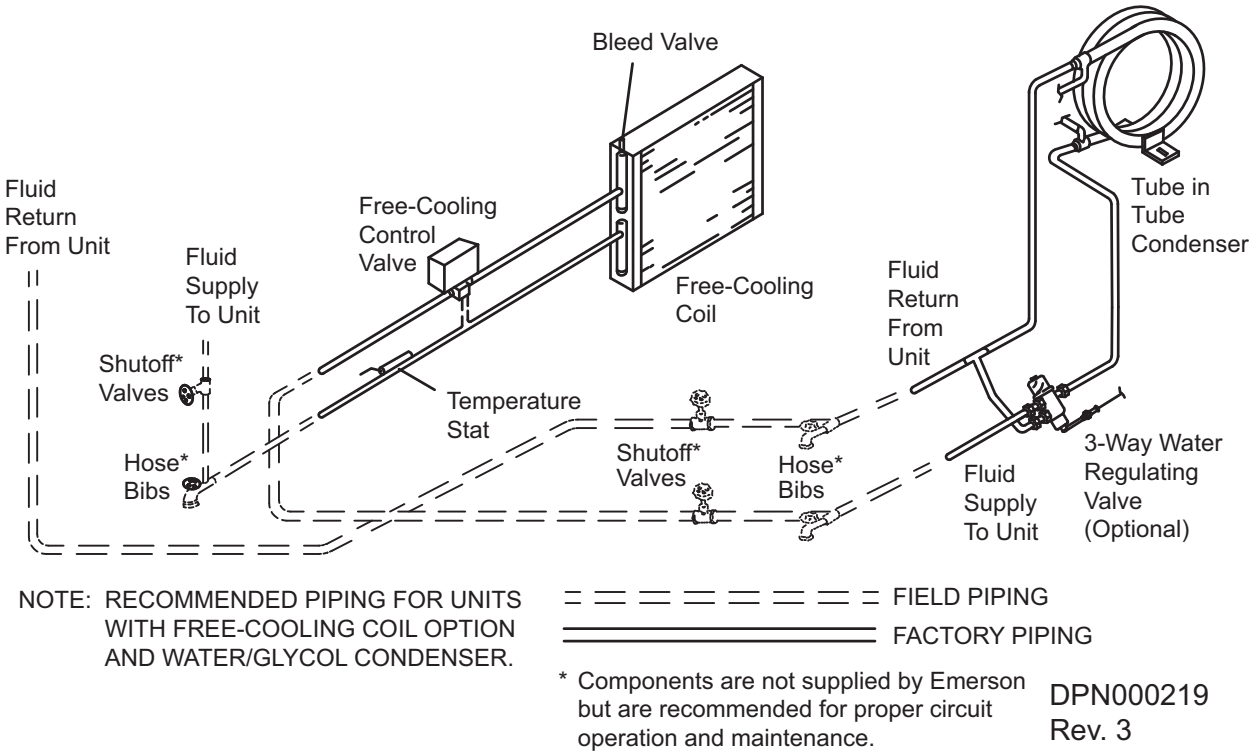
The free-cooling coil is a secondary coil located downstream of the DX coil. The free-coiling coil does not operate at the same time as the DX coil. A temperature sensor is factory-mounted to the free-cooling piping. If the water temperature is less than the set temperature (usually 45°F [7.2°C]), the 3-way valve opens to allow chilled water flow to the free-cooling coil and the compressor is locked off. If the water temperature is above the set temperature, the 3-way valve closes (bypasses) and enables the compressor. To keep deposits from building up in the free-cooling coil, an adjustable timer is factory-set to flush every 400 minutes.

NOTE

If the free-cooling coil is piped to an open water tower, a CU/NI (copper-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 24**).

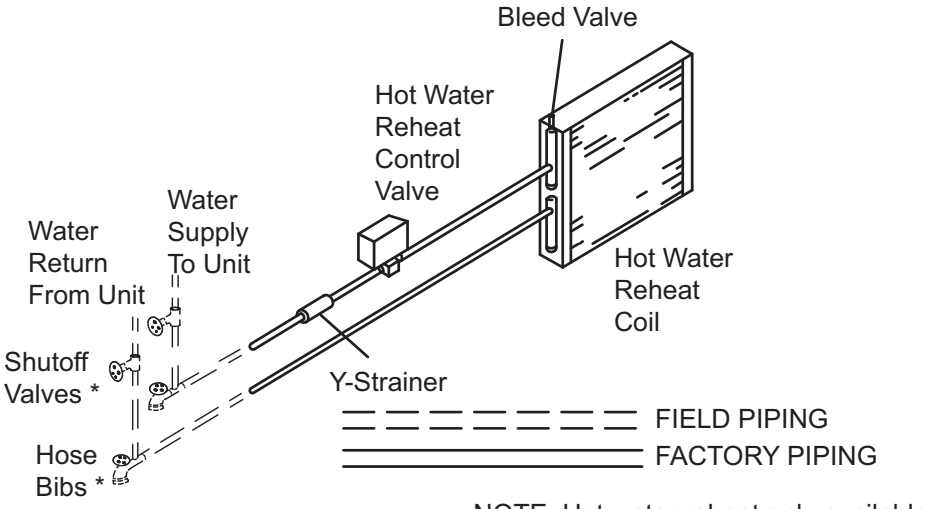
Figure 24 Optional free-cooling coil (3-way valve) on water/glycol units



5.9.2 Hot Water Reheat Coil

Building hot water can be piped to a factory-installed hot water reheat coil, located downstream of the cooling coil. A factory-installed solenoid valve opens upon a call for reheat.

Figure 25 Optional hot water reheat (two-way valve)



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

NOTE: Hot water reheat only available on chilled water units.

DPN000197
Rev. 2

5.10 Checklist for Completed Installation

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

___ 2. Equipment is level and mounting fasteners are tight.

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

___ 4. Condensate pump installed (if required).

___ 5. Drain line(s) connected/and checked for leaks.

___ 6. Water supply line connected to humidifier (if required).

___ 7. All piping connections are tight.

___ 8. Field provided pan with drain installed under all ducted cooling units and water/glycol condensing units.

___ 9. Filter box installed on ducted units.

___ 10. Ducting completed or optional plenum installed.

___ 11. Filter(s) installed in return air duct.

___ 12. Line voltage to power wiring matches equipment nameplate.

___ 13. Power wiring connections completed between disconnect switch, evaporator and condensing unit, including earth ground.

___ 14. Power line circuit breakers or fuses have proper ratings for equipment installed.

___ 15. Control wiring connections completed to evaporator and condensing unit (if required, including wiring to wall-mounted control panel and optional controls).

___ 16. Control panel DIP switches set based on customer requirements.

___ 17. All wiring connections are tight.

___ 18. Foreign materials have been removed from in and around all equipment installed (shipping materials, construction materials, tools, etc.)

___ 19. Fans and blowers rotate freely without unusual noise.

___ 20. Inspect all piping connections for leaks during initial operations. Correct as needed.

___ 21. Drain pan is installed under ducted cooling unit and ceiling mounted condensing unit.

___ 22. Rubber band is removed from evaporator condensate pan float switch.

6.0 MICROPROCESSOR CONTROL

The Microprocessor Control for the Liebert Mini-Mate2 features an easy to-use, menu-driven liquid crystal display. The menus, control features and circuit board details are described in this section. Detailed information concerning controls (**7.0 - System Performance Microprocessor Controls**) and alarms (**8.0 - Alarms**) are provided.

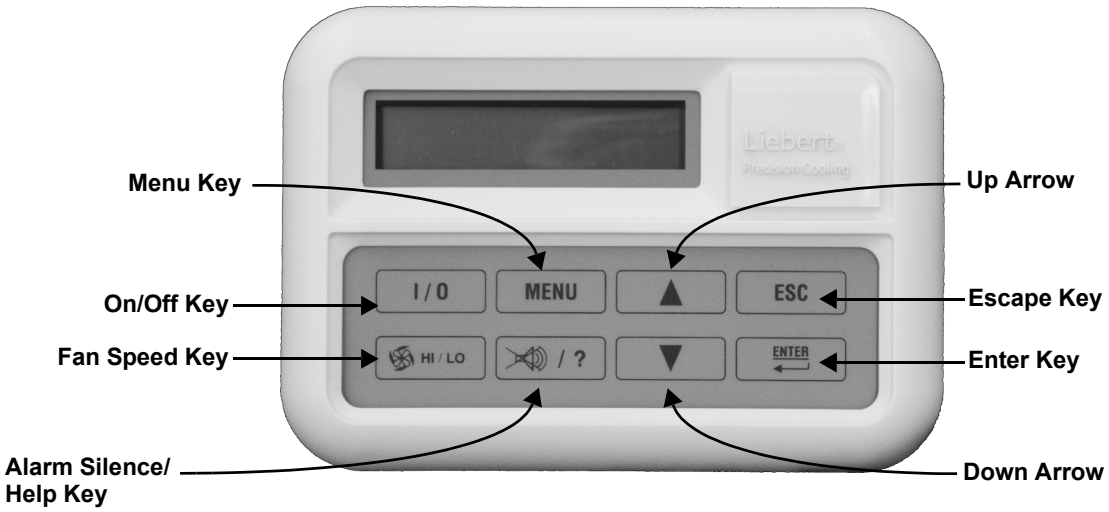
6.1 Feature Overview

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:

- 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).
- Up Arrow: Increases the value of displayed parameter while in a set mode (setpoints, time, etc.) (Arrow-top near right).
- Fan Speed (HI/LO): Changes the fan speed between high and low fan speed on direct-drive blower models; not available on high-static belt-driven motor (bottom far left, when present).
- Escape (ESC): Allows user to move back to a previous menu (top far right).
- Alarm Silence/? (Help): If an alarm is present, pressing this key will silence he alarm. If this key is pressed when no alarms are present, help text will appear (bottom near left).
- Down Arrow: Decreases the value of displayed parameter while in a set mode (bottom near right).
- Enter (ENTER): After setting a control point, press Enter to store the information in the microprocessor (bottom far right).

Figure 26 Control key locations—all-mounted display box



Active alarms appear on the LCD 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), normal fan speed/low fan speed and active alarms. The Status Display may also be selected from the Main Menu.

6.2 Main Menu <Menu>

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

SETPOINTS	CALIBRATE SENSORS
STATUS	ALARM ENABLE
ACTIVE ALARMS	ALARM TIME DELAY
TIME	COMMON ALARM ENABLE
DATE	CUSTOM ALARMS
SETBACK	CUSTOM TEXT
SETUP OPERATION	DIAGNOSTICS
SETPOINT PASSWORD	END OF MENU
SETUP PASSWORD	

Use the Up/Down arrow to scroll through the selections. When ready to select a particular function press Enter.

6.3 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 submenu by using the Up/Down arrow, then press Enter to select a particular function. To change a particular value, press Enter and use the Up/Down arrows to change the value. 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 the Menu key to display the main menu.
2. Scroll to “SETPOINTS” using the Up/Down arrow key. Press the Enter key.
3. Scroll to “TEMP SETPOINT” using the Up/Down arrow key. Press the Enter key.
4. Use the Up/Down arrow to change the value. Press the Enter key.

Table 21 View 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%	15-84% RH

6.4 Status

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

6.5 Active Alarms

The operator can monitor the alarms status by selecting "ALARMS" which will display a "No Alarm Present" or "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, while the "YY" reference is the total number of alarms activated).

6.6 Time

The controller clock must be set to allow for the setback control. The clock uses the 24-hour system (i.e., 12 midnight is displayed as 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 to change the section character, press Enter to store, etc. THERE IS A BATTERY BACKUP FOR THE DATE AND TIME FEATURES.

6.7 Date

The controller date must be set to allow for the 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 button to change the second character, etc.

6.8 Setback

The microprocessor can be programmed for night and weekend setback. Two (2) events can be programmed per day for a five-day workweek and two (2) events can be programmed for a two-day weekend. **Table 22** can be used to devise a setback plan.

Table 22 Microprocessor night and weekend setback

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

6.9 Setup Operation

Selecting Setpoint/Setup from the Main Menu will display the following selections:

- RESTART TIME DELAY
- C/F DEGREES
- HUMIDITY CONTROL METHOD

Use the Up/Down Arrow to scroll through the submenu. Press Enter to select a particular function.

6.9.1 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 to 9.9 minutes (6 to 594 seconds). 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.

6.9.2 C/F Degrees

The control may be selected to show readings and setpoints in either degrees Fahrenheit (°F) or 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.

6.9.3 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 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. The predictive humidity control can greatly reduce energy consumption by minimizing compressor/reheat operation. Use the Up/Down Arrow key to select the desired humidity control method.

Table 23 Setup functions, default values and allowable ranges

Function	Default	Range
Restart Time Delay	0.1 minute	0 to 9.9 min (0 = manual restart)
C/F Degrees	°F	°C or °F
Humidity Control	Rel	Relative or Absolute

6.10 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 wall box to ON, then resetting power to the unit.

6.11 Calibrate Sensors

The temperature and humidity sensor can be calibrated by selecting the CALIBRATE SENSORS menu item. The temperature sensor can be calibrated ±5°F (2.8°C), 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 time delay. If the sensors are located too close to the air discharge, they will likely experience rapid swings in measurement. Another method in reducing compressor cycling is to increase the temperature and/or humidity sensitivity.

6.12 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 wall box beeper or the common alarm relay.

NOTE

The high water alarm will automatically shut the unit off, even if the alarm is disabled. similarly, optional factory-installed smoke sensor is wired to shut the evaporator unit Off, regardless of the enable/disable status.

6.13 Alarm Time Delay

Each individual alarm can be programmed with a time delay, causing the unit to delay a specified amount of time (0-255 seconds) before recognizing the alarm. See **Table 24** for the default times. 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 time 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 24 Alarm default time delays

Alarm	Default Time Delay (seconds)
Humidifier Problem	2
High Head Pressure	2
Custom Alarm #1	0
Custom Alarm #2	6
High Temperature	30
Low Temperature	30
High Humidity	30
Low Humidity	30
Short Cycle	0
Loss of Power	0

6.14 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 annunciated and de-energized when the alarm condition is diverted after the alarm has been recognized. 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 button again to select Yes or No.

6.15 Custom Alarms

The custom alarm messages can be selected from a list of standard alarm messages, or the operator may write his/her own message. A MAXIMUM OF TWO (2) ALARM MESSAGES CAN BE CUSTOMIZED. The two custom alarm messages will initially display the previously programmed message but can be changed.

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 or 2. Using the Up/Down Arrows, step through the list of five standard alarm messages (listed below) and two custom alarms. Select the alarm message desired and store it by pressing Enter.

6.15.1 Standard Custom Alarm Messages

- WATER FLOW LOSS
- SMOKE DETECTED
- LOSS OF AIR FLOW
- HUMIDIFIER PROBLEM
- FILTER CLOG

6.16 Custom Text

To modify the two custom alarm messages select "CUSTOM TXT". Then select "CUS TXT #1" or "CUS TXT #2". Text can be up to 20 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 again use the Up/Down Arrows to select another character, etc.

LCD Contrast

The level of contrast due to the viewing angle of the Liquid Crystal Display (LCD) 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 on the control board near TB1. 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.

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

Table 25 Equipment switch settings (unit control board)

Switch	OFF Position	ON Position
1	Compressor	Chill Water
2	Staged Reheat	SCR Reheat
3	Not Used--Must remain in OFF position	
4	Not Used--Must remain in OFF position	
5	Enable Reheat	Disable Reheat
6	Enable Humidifier	Disable Humidifier
7	Enable Dehumidifier	Disable Dehumidifier
8	Electric Reheat	Gas Reheat

Table 26 Switch settings (wall box board)

Switch	OFF Position	ON Position
1	Disable Beeper	Enable Beeper
2	Not Used--Must remain in OFF position	
3	Not Used--Must remain in OFF position	
4	Not Used--Must remain in OFF position	
5	Not Used--Must remain in OFF position	
6	Compressor on continuously for tight control	Economy Mode
7	Disable Setback	Enable Setback
8	Enable Password	Disable Password

6.17 Run Diagnostics (Available On Rev 1.001.0 and Higher)

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.

Show Inputs

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

High Water Alarm: Normally off unless High Water Alarm is active.

- High Head Pressure Alarm: Normally Off unless High head Pressure alarm is active.
- Custom alarm #1: Normally Off unless this special customer selectable alarm is active.
- Custom alarm #2: Normally Off unless this special customer selectable alarm is active.
- Power: Normally On unless unit is turned off through the wall box, or any of these optional devices: high temperature sensor, smoke detector, high water alarm or remote shutdown

Test Outputs

When this feature is selected, the unit 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.)

NOTICE

Risk of overheating the compressor during the Test Outputs mode. Can cause compressor damage.

Testing the compressor output for more than a few seconds can damage the compressor. Do not operate the unit in the Test Outputs mode any longer than is necessary for troubleshooting.

NOTICE

Risk of extended unit operation in the Test Outputs mode for troubleshooting. Can cause damage to unit.

DO NOT operate unit in the Test Outputs mode any longer than is necessary for troubleshooting

The outputs are:

- Normal Fan: Normal speed fan contactor
- Low Speed Fan: Low speed fan contactor
- Humidifier: Humidifier contactor
- Cool: Compressor contactor
- HGBP: Hot gas bypass valve
- Reheat: Reheat contactor
- Common Alarm: Common alarm relay

NOTE
Fan turned on with all loads.

Test Control Board

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 vision number.

Figure 27 Control menu

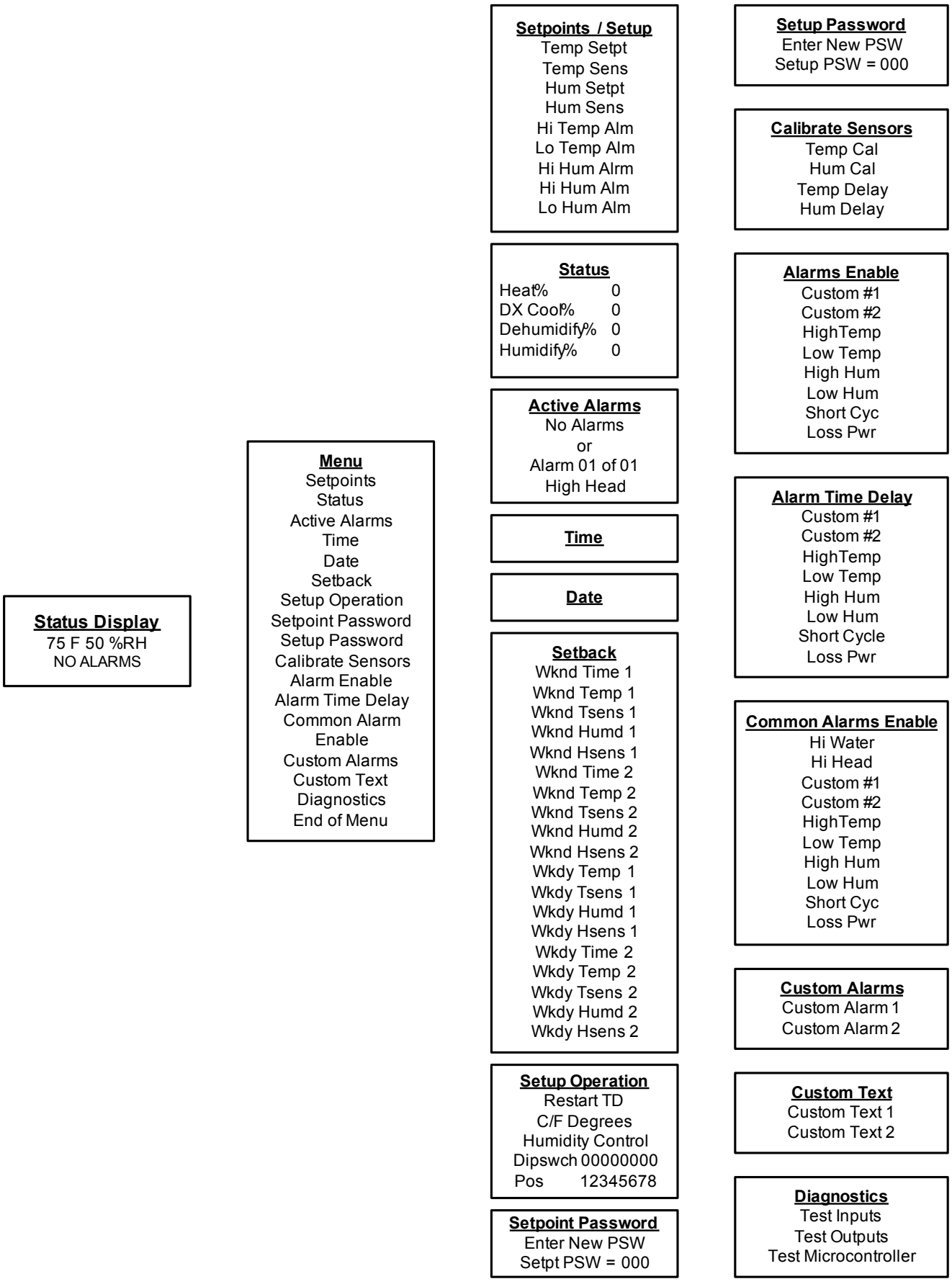
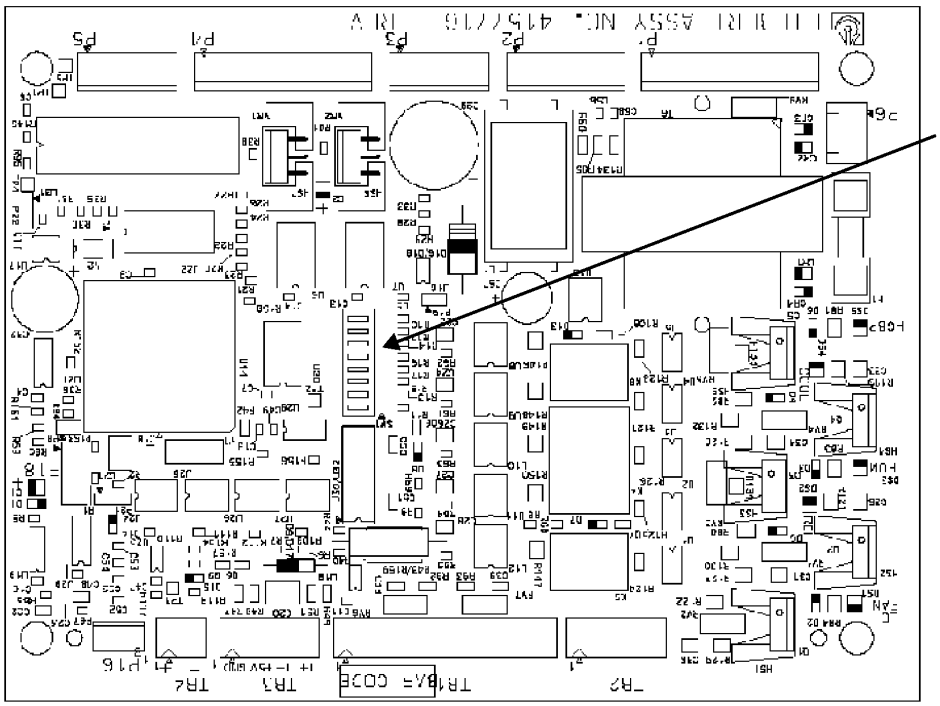
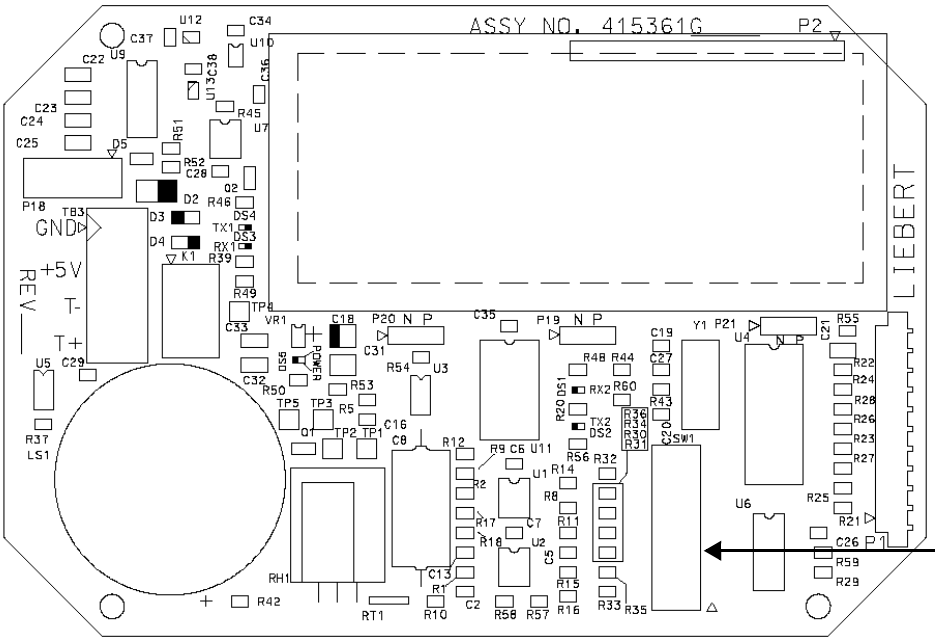


Figure 28 Control board (inside evaporator)



TB2-4	Hot Gas Bypass	TB1-3	Customer Alarm Connection #2
TB2-3	High Head Alarm Connection	TB1-2	Customer Alarm Connection # 1
TB2-2	Heat Rejection	TB1-1	Customer Alarm Connection (Common)
TB2-1	Heat Rejection	TB3-4	Connection to TB3 Pin 4 of wall box
TB1-9	Condensate Pump Aux Alarm	TB3-3	Connection to TB3 Pin 3 of wall box
TB1-8	Condensate Pump Aux Alarm	TB3-2	Connection to TB3 Pin 2 wall box
TB1-7	Common Alarm Connection	TB3-1	Connection to TB3 Pin 1 of wall box
TB1-6	Common Alarm Connection	TB4-2	Site Monitoring Connection (-)
TB1-5	Remote Shutdown	TB4-1	Site Monitoring Connection (+)
TB1-4	Remote Shutdown	P16	Remote Sensor Connection

Figure 29 Wall box board



7.0 System Performance Microprocessor Controls

This section provides a detailed description of how the Liebert Mini-Mate2 responds to operator inputs and room conditions.

7.1 Temperature Control

7.1.1 Cooling/Heating Required

The temperature control program for the microprocessor is based on a calculated percentage requirement for cooling/heating.

7.1.2 Cooling Operation (Cooling, Compressorized Direct Expansion and Chilled Water)

Cooling is ACTIVATED when the temperature control calculates a requirement for cooling of 100%. It is DEACTIVATED when the cooling requirement drops below 50%. The optional hot gas bypass is energized when a call for cooling occurs, unless there is also a call for dehumidification.

Table 27 Cooling and dehumidification load response of hot gas bypass

Situation	Response
Cooling only	ON
Dehumidification only	OFF
Cooling with Dehumidification	OFF

7.1.3 Heating Operation

Electric Heat or Hot Water

The reheat stage is ACTIVATED when the temperature control calculates a requirement of 100%. Conversely, the reheat is DEACTIVATED when the heat requirement is 50% less than the activation point.

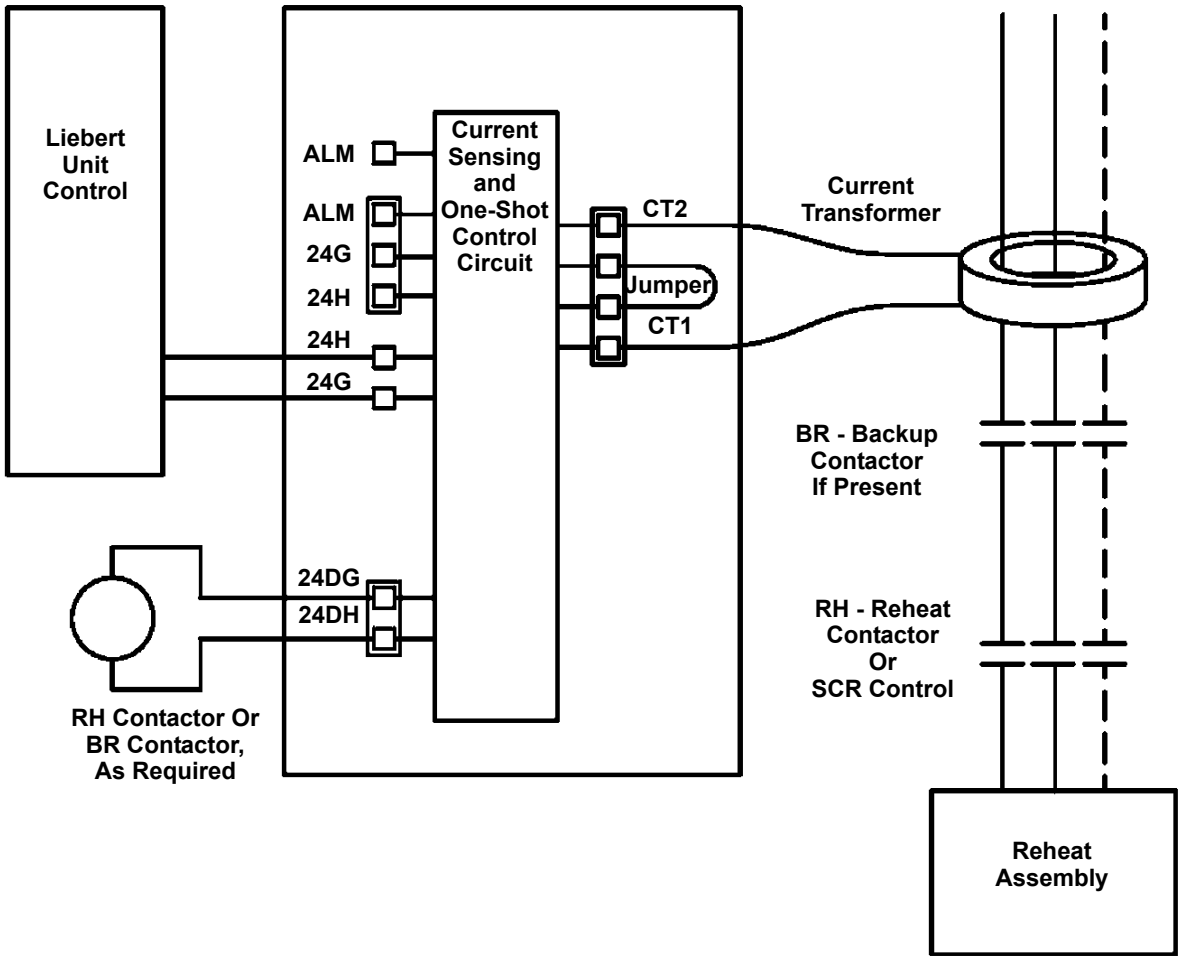
Ground Current Detector (GCD)

A Ground Current Detector is factory-installed on all 1-ton through 3-ton Liebert Mini-Mate2 units with reheat. The GCD detects reheat leakage current and shuts down operation of the reheat. A steady green LED indicates that the reheat is operating properly. A red LED indicates that the reheat has failed and both the reheat element and GCD need to be replaced.

WARNING

Do not remove or disable the ground current detector. Failure to leave the GCD in place could result in smoke or fire.

Figure 30 Ground current detector



WARNING

Risk of heater element failure, smoke and fire. Can cause building and equipment damage, injury or death.

Do not remove or disable the ground current detector.

SCR Electric Reheat

The SCR (Silicon Controlled Rectifier) controller proportionally controls the stainless steel reheat feature to maintain the selected room temperature. The rapid cycling made possible by the SCR controller provides precise temperature control, while the constant element temperature improves heater life. During operation of the SCR control, THE COMPRESSOR OPERATES CONTINUOUSLY. The heaters are modulated to provide temperature control. The display status will show when the unit is cooling and heating. The control will automatically lock the compressor cooling to "ON" position, except when the temperature falls below the low temperature alarm setpoint. Cooling will then be disabled until the room temperature reaches this minimum temperature setpoint.

7.2 Humidity Control

7.2.1 Dehumidification/Humidification Required

The humidity control is based on a calculated percentage requirement for dehumidification or humidification (i.e., the difference between the return air humidity and the humidity setpoint). As the return air humidity rises above the humidity setpoint, the percent dehumidification required increases proportionally from 0% to 100% over a humidity band equal to the humidity sensitivity setting. The converse is true for percent humidification requirement.

7.2.2 Dehumidification Operation, Compressorized Direct Expansion (DX) Systems

Dehumidification with the standard configuration is accomplished by operating the compressor without the hot gas bypass active. On cooling units with direct drive motors, the fan will operate at low speed unless the cooling requirement reaches 100%. At that point, the low speed fan is disabled (unless manually overridden by the user) until the cooling requirement decreases to 0%. Dehumidification will also be disabled if the heating requirement exceeds 125%. It will be re-enabled when the heating requirement reaches 50%.

7.2.3 Humidification Operation

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

7.3 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-on cycle occurs too often (e.g., 10 times in a one-hour period), a Short Cycle Alarm will occur.

7.3.1 Communication

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
- SILENCE ALARM

8.0 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 TB1-1 through a normally open contact to either TB1-2 (alarm 1) or TB1-3 (alarm 2). The alarms can be enabled/disabled (refer to **6.0 - 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 represented and only after it has been acknowledged by being "Silenced." The exceptions are:

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

8.1 Standard Alarms: Definitions and Troubleshooting

The following list provides a definition and troubleshooting suggestions for each type of alarm. Refer to **11.0 - 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.

8.1.1 Custom Alarms

Custom alarm(s) messages are programmed at the LCD. The message displayed may be included in a list of provided alarms or it may be customized text (for up to 2 alarms). IF CUSTOMIZED TEXT IS USED, MAINTENANCE PERSONNEL SHOULD BE INFORMED OF THE ALARM FUNCTION AND THE REQUIRED ACTION.

8.1.2 High Head Pressure

Compressor head pressure is monitored with a pressure-sensor switch. (One SPDT pressure switch is used) for the compressor in the unit.

If head pressure exceeds 400 psig (2785 kPa), the switch opens the compressor contactor and sends an input signal to the control. The high head pressure condition is acknowledged by pressing the alarm silence button on the wall box, which will clear the alarm if the high head pressure condition no longer exists. If the compressor is off for 1 hour, the control goes into a special cold start mode. In the cold start mode on a call for cooling or dehumidification, the liquid line solenoid valve (LLSV) is energized. If the high pressure switch does NOT trip within 10 seconds, the control returns to normal operation of monitoring the high head pressure switch for three occurrences in a 12 hour period. It is a rolling timer and after the third high head alarm occurs and is acknowledged by the user, it will lock off the compressor.

If while in the cold start mode, the high head pressure switch DOES trip within 10 seconds of the activation of the LLSV, the control does not annunciate the alarm. The control will turn off the LLSV and delay 10 seconds. The control will permit this occurrence two more times or a total of 3 times. If on the fourth try, the high head pressure switch trips within 10 seconds, the control will annunciate the alarm, turn off the LLSV, wait for the user to acknowledge the alarm and hold the compressor off for 3 minutes, the length of the normal short cycle control. The control will permit this occurrence three times. On the third occurrence, the control will lock the compressor off until the control power is reset.

Air-Cooled Systems

Check for power shut off to the condensing unit, condenser fans not working, defective head pressure control valves, closed service valves, dirty condenser coils or crimped lines. Also, make sure that when the compressor contactor is energized, the side switch on the contactor closes to energize the control circuit on the condensing unit.

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?

8.1.3 Humidity Level

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

- **High**: The room return air humidity exceeds the pre-set high humidity alarm set point. Is the unit set up for dehumidification? Check DIP switch.
- **Low**: The room return air humidity decreases to the high humidity alarm set point. Is the unit set up 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.

8.1.4 Temperature

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

- **High**: The room return air temperature increases to the high temperature alarm set point. Check for proper set point 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 set point. Check for proper set point 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.

8.1.5 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 the humidifier control board:

- Constant LED on = Overcurrent
- 1 second LED Flash = Fill System
- 1/2 second LED Flash = Replace Tank

8.1.6 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.

8.1.7 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.

8.1.8 Short Cycle

A Short Cycle Alarm will occur if the compressor system has exceeded 10 cooling start attempts in a one-hour period. This can be caused by low refrigerant level or room cooling load is small compared to capacity of the unit. Check for leaks, crimped lines and defective components. If room load is low, increase sensitivity to reduce cycle.

8.2 Optional/Custom Alarms

8.2.1 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.

8.2.2 High Temperature Sensor

The optional high temperature sensor feature is a bimetal 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.

8.2.3 Smoke Detected

The smoke detector senses the return air, shuts down the unit upon detection and sends visual and audible alarm. This smoke detector is not intended to function as or replace any room smoke detection system that may be required by local or national codes. Locate source of smoke and follow appropriate emergency procedures.

9.0 SYSTEM 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

Risk of electric shock. Can cause injury or death. Open all local and remote electric power disconnect switches before working within the electrical enclosures.

Line side of factory disconnect remains energized when factory disconnect is Off.

9.1 System Testing

9.1.1 Environmental Control Functions

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

9.1.2 Cooling

To test the cooling function, set the set point 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.

9.1.3 Heating

Reheat may be tested by setting the setpoint for 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 set point to the desired temperature.

9.1.4 Humidification

To check humidification, set the humidity set point 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 set point to the desired humidity.

9.1.5 Dehumidification

The dehumidification performance can be tested by setting the humidity set point at R.H. 10% below room relative humidity. On cooling units with direct drive motor, the compressor should turn on and the fan should switch to low speed. Upon completion of testing, return humidity set point to the desired humidity.

9.1.6 High Temperature Sensor—Optional

The optional high temperature sensor 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 when the inlet air temperature exceeds a preset point.

9.1.7 Smoke Detector Sensor

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

9.1.8 Remote Shutdown

A connection point is provided for remote shutdown devices supplied by the customer. This terminal strip is located on the printed circuit board. (Terminals TB1-4 and TB1-5 are fitted with a jumper when no remote shutdown device is installed).

9.2 Maintenance

9.2.1 Electric Panel

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

9.2.2 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 can be replaced by opening either the hinged door on the return air filter box or the return air grille (plenum version only). Replacement filters are commercially available in several efficiencies.

9.2.3 Direct Drive Blower Package

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

Fan Impellers and Motor Bearings

Fan impellers should be thoroughly inspected and any debris removed. Check whether they are tightly mounted on the fan shaft and do not rub against the fan housing during rotation. Although the unit's motor bearings are permanently sealed and self-lubricating, they should be inspected monthly for signs of wear.

For units with the optional belt drive motor/blower, 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 25mm) 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. Note that high efficiency filters can reduce air performance and evaporator capacity.

9.2.4 High Static Belt Drive Blower Package (Option)

The High Static Blower option is a belt-driven blower box that is attached to the evaporator box. Belt drive should be checked monthly for signs of wear and proper tension. The motor sheave should be adjusted per the following chart.

Table 28 External static pressure available

Sheave		2-Ton Units @ 885 CFM (1504 CMH) ESP	3-Ton Units @ 1250 CFM (2124 CMH) ESP
Turns	RPM	in. (mm)	in. (mm)
5	1450	1.0 (25.4)	0.4 (10.2)
4.5	1510	1.1 (28.8)	0.5 (13.6)
4	1570	1.3 (32.4)	0.7 (17.2)
3.5	1630	1.4 (36.1)	0.8 (20.9)
3	1690	1.6 (40.0)	1.0 (24.7)
2.5	1750	1.7 (44.0)	1.1 (28.7)
2	1810	1.9 (48.1)	1.3 (32.8)
1.5	1870	2.1 (52.4)	1.5 (37.1)
1	1930	2.2 (56.8)	1.6 (41.5)
0.5	1990	2.4 (61.3)	1.8 (46.1)
0	2050	2.6 (66.0)	2.0 (50.8)

9.2.5 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 58psi to 75psi (405kPa to 517kPa).

Discharge Pressure

The discharge pressure will vary greatly with load and ambient conditions (see **Table 29**). The high-pressure switch will shut the compressor down at its cut-out setting

Table 29 Typical discharge pressure

System Design	Discharge Pressure, psig (kPa)
Air-Cooled	200-300 (1380-2070)
Water-Cooled 65 to 85°F water (18 to 29.4°C)	200-250 (1380-1725)
Glycol-Cooled	250-350 (1725-2415)
High-Pressure Cut-Out	400 (2760)

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).

Air-Cooled Condensing Units

Restricted airflow through the condensing unit 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 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 Only)

Each water or glycol-cooled module 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 cleaned or replaced.

Regulating Valves

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 valve consists of a brass body, balance spring, valve seat, valve disc holders, capillary tube to discharge pressure and adjusting screw.

The water regulating valve is designed to begin opening at 180 psi (1240kPa) and be fully opened at 240 psi (1655kPa). The valve is factory-set and should not need adjustment. There is significant difference in the way standard pressure and high pressure valves are adjusted. Consult Liebert Services.

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 more severe problems than simply using none.

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

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.

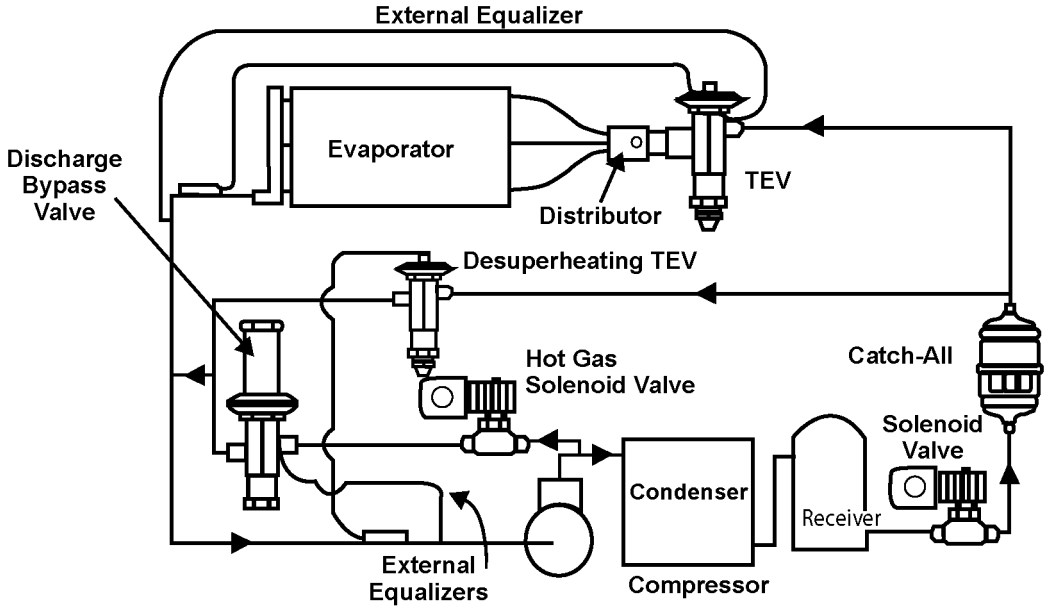
During normal operation, when the evaporator is under full load the hot gas bypass equalizer pressure will remain high enough to keep the valve port closed. If the evaporator load decreases, the evaporator temperature and pressure will drop. When the suction pressure reduces below the hot gas bypass 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, 50-60°F (19-15°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 are necessary.
5. After obtaining the suction pressure required, reinstall cap tightly making sure there are no leaks.
6. Let the evaporator operate for approximately 10 to 15 minutes to make sure the suction pressure is within the range desired.
7. There may be a fluctuation of approximately 3 to 6 PSIG (21 to 41kPa) on the evaporator due to the differential on the hot gas bypass.
8. Return temperature setpoint to the desired setting.

Figure 31 Hot gas bypass



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 an amperage set point 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 when a manual drain sequence is required, such as 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. Operations 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 set point. 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 set point 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. This allows for maintenance scheduling. 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.

9.2.6 Humidifier Circuit Board Adjustments

WARNING

Risk of electric shock. Can cause injury or death. Open all local and remote electric power disconnect switches before working on the humidifier printed circuit board. The printed circuit board contains hazardous voltage. Use extreme caution. Circuit board adjustment should be performed by properly trained and qualified personnel only.

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 set point. 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 3 to 4 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 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 30 DIP switch settings for humidifier control board (2- and 3-ton unit

Voltage	SW1	SW2	SW3	SW4	Amps
208/230	Off	On	Off	On	6.4
220/240	Off	On	Off	On	6.4
277	On	Off	Off	On	5.7
380/415	Off	Off	On	Off	3.7
460	On	On	Off	Off	3.4

9.3 Replacement Procedures

9.3.1 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:

WARNING

Risk of contacting caustic substances. Can cause injury.

Avoid touching or contacting the gas and oils with exposed skin. Severe burns will result. Wear protective clothing, safety goggles and long rubber gloves when 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.

WARNING

Risk of explosive discharge of high pressure refrigerant. Can cause serious injury.

This unit contains fluids and gasses under high pressure. Relieve pressure before working with piping/connections.

Mechanical Failure: If a mechanical failure has occurred, the compressor must be replaced. If a burnout occurs, correct the problem and clean the system. It is important to note that successive burnouts OF THE SAME SYSTEM are usually caused by improper cleaning. If a severe burnout has occurred, the oil will be black and acidic.

9.3.2 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.

Replace a Failed Compressor

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. Use a filter-drier when charging the system with recovered refrigerant.

NOTE

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

4. Remove failed compressor.
5. Install replacement compressor and make all connections. Use a flow of dry nitrogen through the piping during brazing to prevent formation of copper oxide scale inside the piping. Copper oxide forms when copper is heated in the presence of air. POE oil will dissolve these oxides from inside the copper pipes and deposit them throughout the system, clogging filter driers and affecting other system components.

   A pure dry nitrogen flow of 1-3 ft^3/min (0.5-1.5 l/s) inside the pipe during brazing is sufficient to displace the air. Control the flow using a suitable metering device.Pressurize and leak test the system at approximately 150 psig (1034kPa) pressure.
6. Follow manufacturer's instructions for clean out kits.
7. Evacuate the system twice to 250 microns. Break the vacuum each time with clean, dry nitrogen.
8. Evacuate the system a third time to 250 microns.
9. Charge the system with refrigerant (R-407C) based on requirements of the evaporator, condensing unit and lines. Refer to the unit nameplate.
10. Apply power and operate the system. Check for proper operation. Refer to **Table 29.**

9.3.3 Replacing the Humidifier Canister

CAUTION

Risk of contact with extremely hot surfaces. Can cause injury.

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

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. Place the RUN/DRAIN switch in the DRAIN position to drain the water from the canister.
3. Return the RUN/DRAIN switch to the RUN position after the canister has drained.
4. Turn OFF the power at the main unit electric power disconnect switch.
5. Remove the cover from the humidifier cabinet.
6. 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 two (2) power wires and the canister full wire. Do not loosen the screws that secure the electrodes.
7. Loosen the steam outlet hose clamps and slide the steam hose away from the canister fitting. Release the canister clamp along the base of the canister.
8. Remove the canister.
9. Reverse previous steps to re-assemble humidifier, paying special attention to the following:

- When replacing the wiring, connect the red wire from terminal #1 on the interface to the red tip terminal on the canister. Reconnect the power wires as before (#2 on the left and #1 on the right).
- When replacing the canister, always check the fill and drain solenoids for proper operation.

10.0 MAINTENANCE INSPECTION CHECKLIST

Date: _____ Prepared By: _____

Model #: _____ Serial Number: _____

NOTE

Reheat element sheaths 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 reheating element replacement may be required to meet specific application requirements.

Monthly Inspection Items

Filters

___ 1. Check for restricted airflow.

___ 2. Check for filter.

___ 3. Wipe section clean.

Fan Section

___ 1. Impellers free of debris

___ 2. Bearings in good condition

Humidifier

___ 1. Check canister for mineral deposits.

___ 2. Check condition of electrodes.

___ 3. All hoses and fittings tight.

___ 4. Check water make-up valve for leaks.

Drain Lines

___ 1. Check for obstructions and sediment build up.

___ 2. Check for external damage and/or corrosion.

___ 3. Check for leaks.

Semiannually

Compressor Section

___ 1. Signs of oil leaks

___ 2. Vibration isolation.

Refrigeration Cycle

___ 1. Suction pressure

___ 2. Head pressure

___ 3. Superheat

___ 4. Evaporator coil clean

___ 5. Insulation intact

Air-Cooled Condensing Unit (if applicable)

___ 1. Condenser coil clean.

___ 2. Motor mount tight.

___ 3. Bearings in good condition.

___ 4. Refrigerant lines properly supported.

Flood Back Head Pressure Control (if applicable)

___ 1. Check refrigerant level.

Water or Glycol-Cooled Condensing

___ 1. Water valve adjustment.

___ 2. Water flow

___ 3. Water leaks

Glycol Pump (if applicable)

___ 1. Glycol leaks

___ 2. Pump operation

___ 3. Glycol solution

___ 4. pH level

Electric Panel

___ 1. Check electrical connections.

___ 2. Operational sequence

Notes:_____

Signature:

Make photocopies of this form for your records

11.0 TROUBLESHOOTING

Table 31 Troubleshooting

Symptom	Possible Cause	Check Or Remedy
Unit will not start	No power to unit	Check voltage at input terminal block.
	Control voltage circuit breaker (at transformer) open	Locate short and reset circuit breaker.
	Float switch relay has closed due to high water in the condensate pan.	Has rubber band been removed from float switch? Check drain and line. Access from bottom through discharge air gills. Power must be cycled at the disconnect to reset.
	Jumper not in place	Check terminal TB1-4 and TB1-5 for jumper or N/C contact. Check pins 1-8 and 1-9 for jumper, or N/C high temperature sensor contact. Check pins 5-4 and 5-5 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 P4-8 and P4-4. If voltage, check contactor. If no voltage at P4-8 and P4-4, check at terminals P2-3 and P2-8. If voltage, check freezestat.
	Compressor high head pressure.	See below for cause.
	Plugged filter/drier.	Replace filter/dryer.
	Low refrigerant charge.	Check pressure gauges. See **Table 11** and **Table 13** for recommended pressures. 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.
	Self-Contained, Air-Cooled only: Condenser fan not operating	Check fan operation.
Humidifier does not operate	DIP switch not set to enable humidifier option	See DIP switch setting **Table 30**.
	"HUMIDIFY" not displayed at control panel	Increase humidity control setpoint and sensitivity to require humidification.
	Defective board	Check voltage at P3-1 and P1-9 on interface board for 24VAC ± 2VAC. 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 wall box 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).

Table 31 Troubleshooting *(continued)*

Symptom	Possible Cause	Check Or Remedy
Reheat will not operate	DIP switch not set to enable reheat option	See DIP switch settings **Table 30**
	"HEAT" not displayed at the control panel	Increase temperature set point to require heating.
	Reheat safety open, defective reheat contact or defective board	Check voltage at P2-1 and P1-9 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.
	GCD has tripped	Replace GCD and heating element.
Fan will not operate at low speed when selected from control panel.	Open wiring or failed board	Verify "LOW FAN" is displayed at the control panel. Check for 24 VAC ± 2 VAC at terminals P3-4 and P1-9. If no voltage, check wiring and/or replace interface board. Check fan relays.
Fan will not operate at low speed during dehumidification	Temperature requirement is too high.	Verify with display. Cooling requirement overrides Dehumidification.
Cooling cycle too short	Sensor response delay too short	Increase sensor response delay. See **6.11 - 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 wall box. Replace temperature/humidity circuit board (remote sensors) or wall box.
Continuous Heating* Dehumidification* Humidification*	Shorted wiring or failed control board	Check wiring and/or replace control board.
Display Problem	Incorrect wiring	Review section **5.5.5 - Electrical Connections**. Verify VDC between 5 and 6 Volts at TB-3 Pin 1 (Ground) and TB-3 Pin 2 of the control board and wall box. If the transmit lines (TB-3 Pin 3 & 4) are not connected, only the power LED will be lit. It will flash once every 10-12 second. If T- is connected, but not T+, TX1 will flash approximately every 2-3 second. And the power LED will flash once every 10-12 second. If T+ and T- are reversed, the power LED and RX1 Will be lit and flash every 10-12 second. **NOTE**: Erratic operation of the unit could occur. If no LED is lit, there is no power or the +5VDC polarity is reversed. If any of these conditions occur, remove power from the evaporator using the disconnect switch, and correct wiring from the control board to the wall box. **NOTE**: It may take up to 20 seconds for the display to appear on the wall box LCD after power is applied.

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