



# Liebert® Mini-Mate2

## System Design Catalog

1.5-ton (5-kW) Capacity, Air, Water, Glycol, Chilled Water; 60 Hz

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Vertiv recommends installing a monitored fluid detection system that is wired to activate the automatic closure of field-installed coolant fluid supply and return shut off valves, where applicable, to reduce the amount of coolant fluid leakage and consequential equipment and building damage. Refer to local regulations and building codes relating to the application, installation, and operation of this product. The consulting engineer, installer, and/or end user is responsible for compliance with all applicable laws and regulations relating to the application, installation, and operation of this product.

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### **Technical Support Site**

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

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

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# 1 Introduction

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

Installed above the ceiling, Vertiv™ Liebert® Mini-Mate2 Thermal Management systems control the cooling, humidity and air distribution required by sensitive electronic equipment. A range of sizes and configurations is available to meet varying site 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 Vertiv quality construction and reliable components, guarantee satisfaction from installation through operation.

### Liebert® Thermal Management

Liebert® Thermal Management systems control the temperature and humidity 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

Self-contained systems have all refrigerant piping factory installed. Split systems are 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.

### Easy to Service

Low maintenance components are easily accessed through removable front panels. Spare parts are always in Vertiv 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.

## 1.2 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.



## 2 Features and Options

### 2.1 Standard Features

#### 2.1.1 Self-Contained Systems

The self-contained system 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 and erosion, tested per UL 181 and ASTM 1338 standards. Unit can be configured with canister humidifier and/or reheat and various sensor options.

##### **Air Cooled Unit**

The air cooled unit includes the evaporator coil, condenser coil, compressor, all refrigerant piping, R-407C unit charge, hot gas bypass, filter drier, high head pressure switch, two-speed direct drive blower assembly, microprocessor control with wall-mounted control box, and factory mounted disconnect switch. MM2CF is a centrifugal blower box with a fan speed controlled motor that ships separately and field mounts on the cabinet to provide condenser head pressure control down to -20°F (-29°C) ambient.

##### **Water/Glycol Cooled Unit**

The water/glycol cooled unit includes the evaporator coil, coaxial condenser, compressor, all internal refrigerant and water/glycol piping, R-407C unit charge, hot gas bypass, filter drier, high head pressure switch, two-speed direct drive blower assembly, microprocessor control with wall-mounted control box and factory mounted disconnect switch.

##### **Chilled Water Unit**

The chilled water unit includes the chilled water coil, two-speed, direct drive centrifugal blower, two-way, slow close motorized, spring return valve and factory-mounted disconnect switch. Design pressure is 300 psi (2068 kPa) with a 40 psi (276 kPa) close-off differential.

#### 2.1.2 Evaporator Section—Split Systems

The Vertiv™ Liebert® Mini-Mate2 systems consist of an evaporator section matched with an outdoor air cooled condensing unit, indoor air cooled condensing unit or indoor water/glycol cooled condensing unit. The system is also available as a self-contained chilled water unit. Unit insulation meets ASHRAE 62.1 requirements for mold growth, humidity and erosion, tested per UL 181 and ASTM 1338 standards.

The evaporator unit includes an evaporator coil, filter drier, factory-mounted disconnect switch, two-speed direct drive blower assembly, and microprocessor control with wall-mounted display panel. Evaporators are designed for R-407C refrigerant and can be configured with canister humidifier and/or reheat. Suction and liquid lines are spun closed, and filled with an inert gas holding charge.

## 2.1.3 Condensing Unit Section—Split Systems

The outdoor prop fan condensing unit includes scroll compressor, condenser coil, propeller fan, liquid line solenoid valve, high pressure switch, Vertiv™ Liebert® Lee-Temp head pressure control, and hot gas bypass. The condensing unit is designed for R-407C refrigerant and operates in outdoor locations at ambient temperatures ranging from -30°F to 95°F (-34°C to 35°C). Suction and liquid lines are spun closed, and filled with an inert gas holding charge.

## 2.1.4 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, shielded thermostat wire (field supplied). The temperature and humidity sensors are in the wall box, which can be installed up to 300 ft (91.4 m) from the evaporator unit when using a remote temperature/humidity sensor in the conditioned space. The unit-mounted control board also includes common alarm terminals and shutdown terminals. The unit automatically restarts after a power outage.

**Figure 2.1 Wall Box**



### Other Standard Control Features

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



## 2.1.5 Sensors and Switches

**High-Temperature Sensor** senses the return air temperature and shuts down the 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.

**Filter Clog** senses pressure drop across the filter 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.

**Non-Fused Disconnect Switch** allows unit to be turned off for maintenance and is factory installed on evaporators, chilled water units, and indoor condensing units.

## 2.2 Optional Factory Installed Features

### 2.2.1 Self-Contained and Evaporator Units

#### Reheat

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

**SCR Electric Reheat** provides tight temperature control by rapidly pulsing the 304/304 stainless steel reheat elements in small increments. A solid state relay is factory installed and wired to the microprocessor control. The compressor is locked on, with the reheat modulated to track the load. (The SCR Electric Reheat is not available on chilled water, free cooling, or with other reheat options.)

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

**NOTE: Hot water reheat is available only on chilled water units, but not with other reheat options.**

**Hot Gas Reheat** can be ordered on self-contained models. This option includes the coil and necessary piping and the control valve. This option is not available with chilled water, free cooling or other reheat options. Hot gas reheat operates only during dehumidification and cannot be used for space heating.

#### Humidifier

The **Canister Humidifier** includes a steam generating type humidifier with automatic flushing circuit, inlet strainer, drain, 1-in. (25.4-mm) 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 Vertiv™ Liebert® Mini-Mate2. Available on units with or without internal humidifier.

#### 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.

#### Liebert® IS-UNITY-DP BMS Monitoring Solution

The IS-UNITY-DP card is a factory-installed option, providing full building management system (BMS) access via BACnet/Modbus IP and BACnet/Modbus 485. Card provides access and supports SNMP v1/v2c/v3 and Vertiv™ Liebert® Nform. The card is factory-installed in a unit mounted external enclosure and is factory wired for communication to and powered from the Vertiv™ Liebert® Mini-Mate2 unit. Field wiring to other systems required to access features.

### 2.2.2 Free Cooling for Evaporator Units

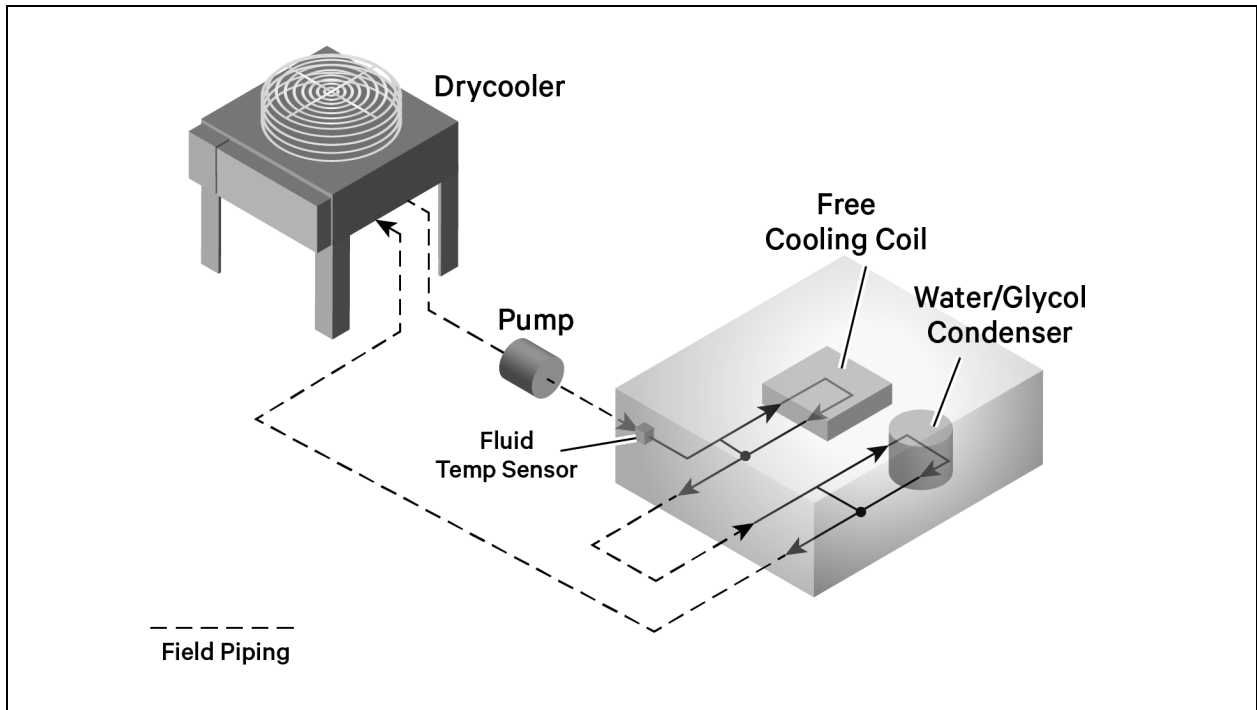
The free cooling option includes separate cooling coil, three-way slow close valve, and separate supply and return piping. Free cooling is activated when the water temperature reaches a field adjustable temperature, typically 45°F (7°C). The valve is rated for 300 psi (2068 kPa) working pressure.

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 free cooling sources, such as external chilled water or glycol from a drycooler loop. The coil is designed for closed loop applications using properly treated and circulated fluid. Not available with SCR reheat options.

**Figure 2.2** below, shows how a second cooling coil takes advantage of colder outdoor temperatures and bypasses compressor operation when using a drycooler loop. When the glycol temperature drops below the set threshold, cooling switches from compressor to free cooling operation.

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

**Figure 2.2 Free Cooling Arrangement**



### 2.2.3 Optional Configurations—Prop Fan Condensing Units

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

- Condenser coils can be epoxy coated with UV topcoat at the factory for extended coil life in corrosive environments, such as coastal areas.

## 2.2.4 Optional Configurations—Water/Glycol Condensing Units

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

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

## 2.2.5 Optional Configurations—Chilled Water Units

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

- Two-way, slow close, motorized, chilled water valve rated for 300 psi (2068 kPa) working pressure and 50 psig (345 kPa) close off pressure. Valve is spring return.

## 2.3 Ship Loose Accessories—Field Installed

**Supply and Return Grille Kit** includes supply and return grilles, 1-in. x 20-in. x 20-in. (25 mm x 508 mm x 508 mm) MERV 8 rated filter to ASHRAE 52.2-2007, for installation into a 2 ft x 4 ft (610 mm x 1220 mm) ceiling grid.

**Duct Kit** includes return air filter box with 3/4-in. duct flange, 1-in. duct collar for supply air, and air block off plates. Duct kit is supplied with a 4-in. x 16-in. x 20-in. (102 mm x 406 mm x 508 mm) MERV 8 filter (based on ASHRAE 52.2-2007)

**Duct Collar Kit** (no filter) includes 1-in. supply duct collar, a 1-in. return collar and the necessary block off plates to make the Vertiv™ Liebert® Mini-Mate2 a ducted configuration. Filter box and filter are not included.

The **Condensate Pump** is field-mounted outside the cabinet, wired to the unit power block, and equipped with a discharge 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-mounted or duct-mounted. Remote sensors must 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.**

### 2.3.1 Remote Monitoring, Auto Changeover, and Leak Detection Equipment

The **IS-UNITY-DP BMS Monitoring Solution** provides full building management system (BMS) access via BACnet/Modbus IP and BACnet/Modbus 485. Card provides access and supports SNMP v1/v2c/v3 and Vertiv™ Liebert® Nform. The unit-mount kit for field installation includes the IS-UNITY-DP card, power/communication interface card, enclosure, all required power and communication wires to the Vertiv™ Liebert® Mini-Mate2 unit, and full instructions. Field supplied wiring to other systems required to access features. The wall-mount kit for field installation includes the IS-UNITY-DP card, power/communication interface card, painted enclosure, 120-V wall outlet transformer with 6-ft (2-m) low voltage power wire, and full instructions. Field-supplied wiring for communication to Liebert® Mini-Mate2 and to other systems is required to access features.

The **Vertiv™ 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 Liebert® RCM4 requires a 24-VAC or 24-VDC power source. Power supply is not included.

The **Vertiv™ 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 24 VAC, 3 A) signal a leak detected as well as loss of power and cable fault.

The Liebert® Liqui-tect 410 requires an external 24-VAC or 24-VDC power source.

**Liebert® Liqui-tect 460 Zone Leak-Detection Kits** include one LT460 sensor, a specified length of LT500-xxY cable (maximum length is 100 ft [30.5 m]) and a corresponding number of hold-down clips. The Liebert LT460 requires an external 24-VAC, 0.12-A power source such as EXT-XFMR or XFMR24.

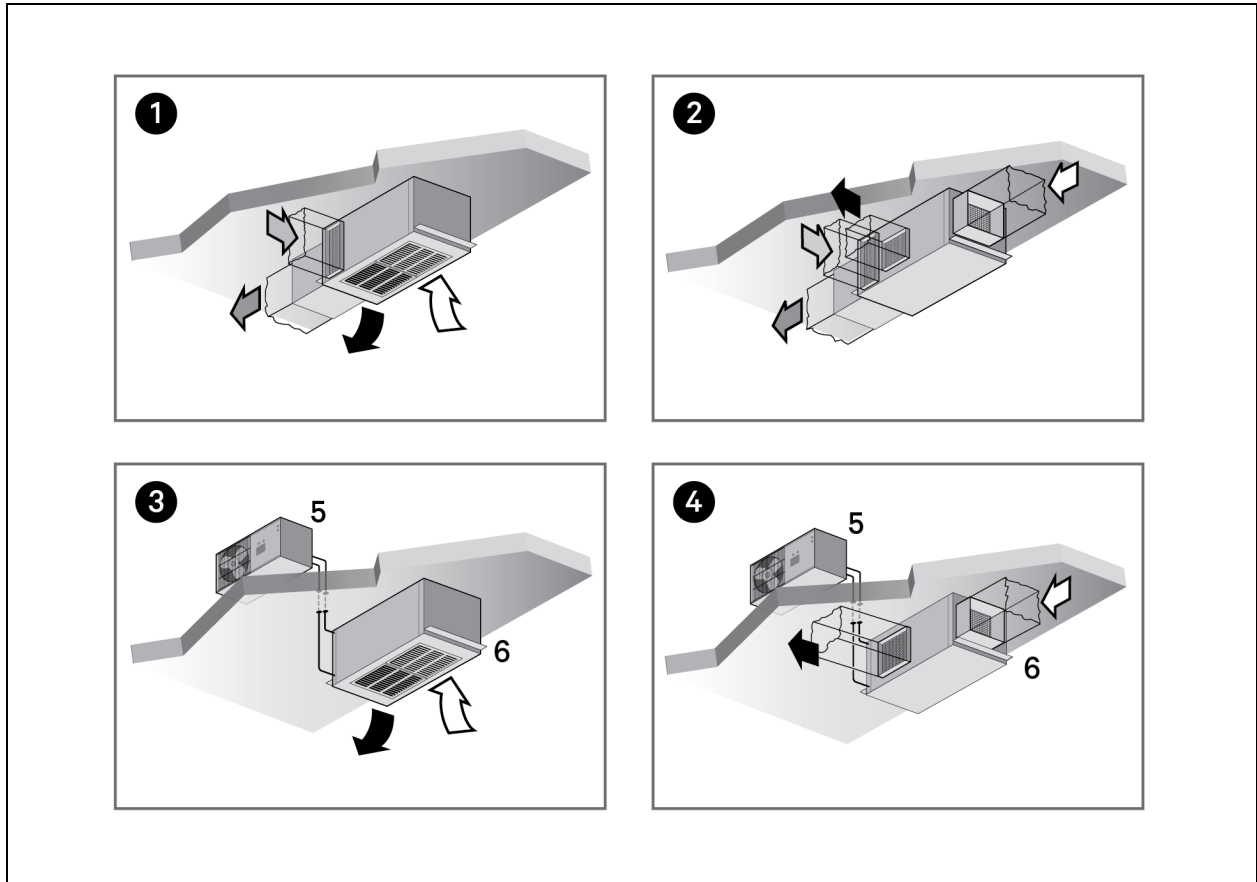
## 3 Nomenclature

This section describes the model number configuration for Vertiv™ Liebert® Mini-Mate2 units and components.

### 3.1 System Configurations

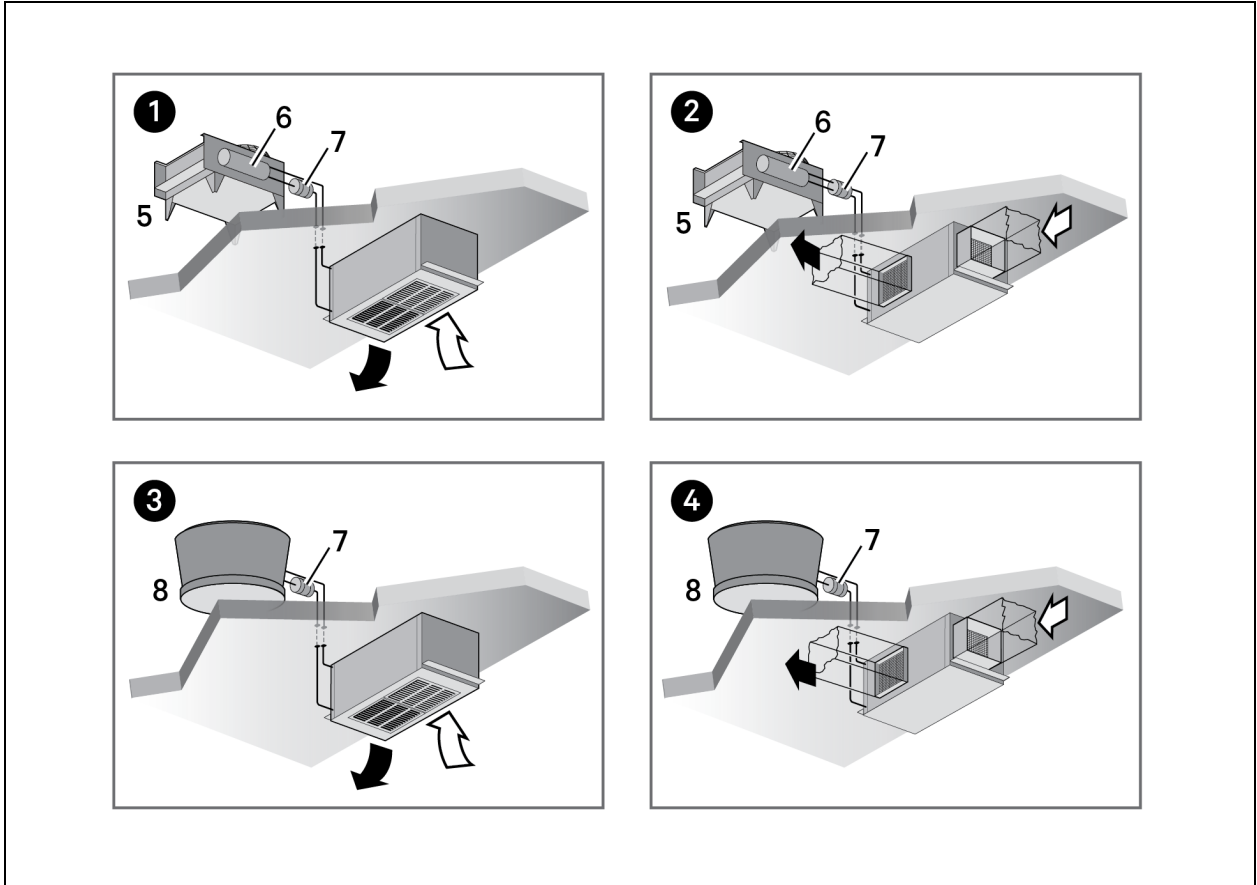
The following figures show the available capacity and cooling options for the Liebert® Mini-Mate2.

Figure 3.1 Air Cooled Units



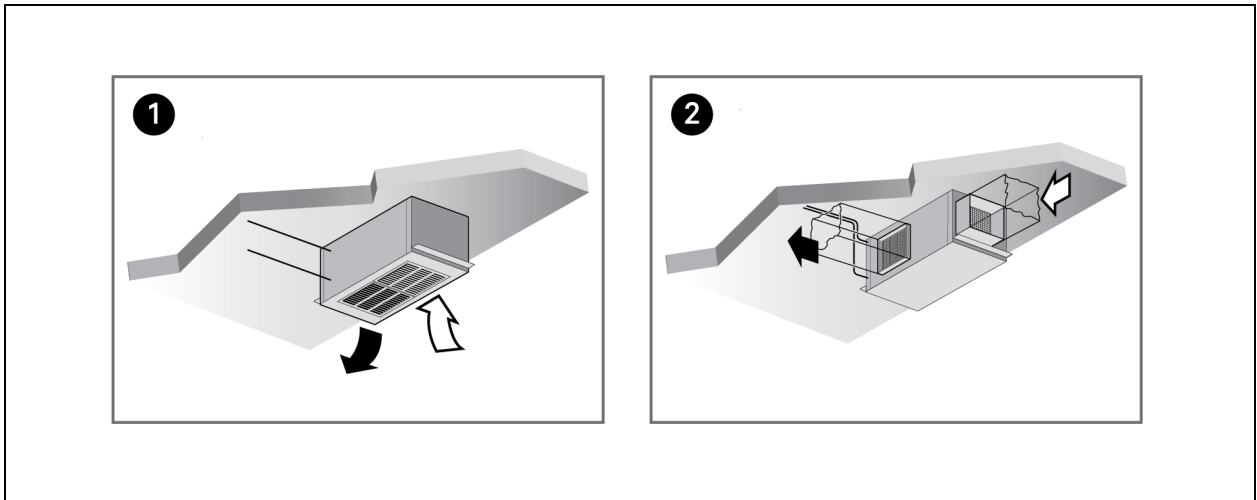
Item	Description
1	Self-contained with grille
2	Self-contained with optional filter box
3	Split system with grille and outdoor condensing unit
4	Split system ducted with outdoor condensing unit
5	Outdoor condensing unit
6	Evaporator

Figure 3.2 Water/Glycol Cooled Units



Item	Description
1	Glycol cooled with grille
2	Glycol cooled with ducted supply/return air
3	Water cooled with grille
4	Water cooled with ducted supply/return air
5	Liebert® Drycooler
6	Expansion tank
7	Pump
8	Cooling tower

Figure 3.3 Chilled Water Units



Item	Description
1	Chilled water with grille
2	Chilled water with ducted supply/return air

## 3.2 Nomenclature for Self-Contained Air Cooled and Water/Glycol Units

Table 3.2 below describes each digit of the model number.

**Table 3.1 Nomenclature Example**

1	2	3	4	5	6	7	8	9	10	11	12
M	M	D	1	8	A	—	P	R	E	7	5

**Table 3.2 Nomenclature Digit Definitions for Self-Contained Units**

Digit	Description
Digits 1 and 2 = the base unit	MM = Mini-Mate2
Digit 3 = Disconnect	D = Disconnect switch
Digit 4 and 5 = Nominal Capacity	18 = 18 kBtuh, 1.5 ton, 60 Hz (air cooled) 20 = 20 kBtuh, 1.5 ton, 60 Hz (water/glycol cooled)
Digit 6 = Cooling type	A = Air cooled F = Air cooled with free cooling unit G = Water/Glycol cooled with free cooling coil W = Water/Glycol cooled
Digit 7 = Valve type	— = Placeholder for air cooled units 2 = 2-way standard-pressure fluid regulating valve 3 = 3-way standard-pressure fluid regulating valve D = 2-way high-pressure fluid regulating valve T = 3-way high-pressure fluid regulating valve
Digit 8 = Supply power	P = 208/230 V / 1 ph / 60 Hz X = 277 V / 1 ph / 60 Hz
Digit 9 = Humidification	R = Remote humidifier contact (without canister humidifier) J = Canister humidifier and remote humidifier contact



**Table 3.2 Nomenclature Digit Definitions for Self-Contained Units (continued)**

Digit	Description
Digit 10 = Reheat	<ul style="list-style-type: none"> <li>0 = No reheat</li> <li>E = Electric reheat</li> <li>S = SCR reheat(not available on water/glycol cooled with free cooling option)</li> <li>G = Hot-gas reheat (not available with free cooling option)</li> </ul>
Digit 11 = Refrigerant and Hot-gas bypass	<ul style="list-style-type: none"> <li>7 = R-407C (factory charged) and Hot-gas bypass</li> </ul>
Digit 12 = Sensor packages	<ul style="list-style-type: none"> <li>N = Base package of filter clog and high-temperature sensor</li> <li>2 = Smoke sensor + Base package</li> <li>4 = IS-UNITY-DP (BMS) + Base Package</li> <li>5 = IS-UNITY-DP (BMS) + Smoke sensor + Base package</li> </ul>

### 3.3 Nomenclature for Split System Air Cooled and Chilled Water Units

Table 3.4 below describes each digit of the model number.

**Table 3.3 Nomenclature Example**

1	2	3	4	5	6	7	8	9	10	11	12
M	M	D	1	8	E	N	P	R	E	0	5

**Table 3.4 Nomenclature Digit Definitions for Split System and Chilled Water Units**

Digit	Description
Digits 1 and 2 = the base unit MM = Mini-Mate2	
Digit 3 = Disconnect D = Disconnect switch	
Digit 4 and 5 = Nominal Capacity 18 = 18 kBtuh, 1.5 ton, 60 Hz (air cooled) 23 = 23 kBtuh, 1.5 ton, 60 Hz (chilled water cooled)	
Digit 6 = Cooling type C = Chilled water cooled E = Air cooled, split evaporator (See <a href="#">Outdoor Prop Fan Condensing Units for Air Cooled Split Systems</a> on page 16.) K = Air cooled, split evaporator with free cooling (See <a href="#">Outdoor Prop Fan Condensing Units for Air Cooled Split Systems</a> on page 16.)	
Digit 7 = Refrigerant/Valve N = R-407C field supplied (evaporator units) 2 = 2-way standard close-off pressure valve (chilled-water units) D = 2-way high close-off pressure valve (chilled-water units)	
Digit 8 = Supply power P = 208/230 V / 1 ph / 60 Hz X = 277 V / 1 ph / 60 Hz	
Digit 9 = Humidification R = Remote humidifier contact (without canister humidifier) J = Canister humidifier and remote humidifier contact	

**Table 3.4 Nomenclature Digit Definitions for Split System and Chilled Water Units (continued)**

Digit	Description
Digit 10 = Reheat	<ul style="list-style-type: none"> <li>0 = No reheat</li> <li>E = Electric reheat</li> <li>S = SCR reheat (available only with E cooling type, not available with chilled water units)</li> <li>H = Hot water reheat (chilled water units only)</li> </ul>
Digit 11 = Hot-gas bypass	<ul style="list-style-type: none"> <li>0 = Not in unit</li> </ul>
Digit 12 = Sensor packages	<ul style="list-style-type: none"> <li>N = Base package of filter clog and high-temperature sensor</li> <li>2 = Smoke sensor + Base package</li> <li>4 = IS-UNITY-DP (BMS) + Base Package</li> <li>5 = IS-UNITY-DP (BMS) + Smoke sensor + Base package</li> </ul>

### 3.3.1 Outdoor Prop Fan Condensing Units for Air Cooled Split Systems

Table 3.6 below describes each digit of the model number.

**Table 3.5 Prop Fan Condensing Unit Nomenclature Example**

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

**Table 3.6 Nomenclature Digit Definitions for Outdoor, Prop Fan Condensing Units**

Digit	Description
Digits 1 to 3 = the base unit	PFH = Prop fan condensing unit with hot gas bypass
Digit 4 = Sound level	0 = Standard
Digit 5 and 6 = Nominal Capacity	20 = 20 kBtuh
Digit 7 = Cooling type	A = Air cooled
Digit 8 = Coil type	— = Standard coil C = Coated coil (epoxy with UV topcoat)
Digit 9 = Supply power	P = 208/230 V / 1 ph / 60 Hz
Digit 10 = Ambient rating/Control	L = 95°F Ambient, Liebert® Lee-Temp
Digit 11 = Refrigerant	N = R-407C field charged

## 4 System Data

### 4.1 Air Cooled Systems—Capacity and Performance Data

Table 4.1 Air Cooled Data, 60-Hz

Evaporator Model	MMD18E	MMD18E	
Cabinet Type	Self-Contained	Split System	
Liebert® DX Evaporator - Net Capacity Data - kW (Btu/hr) @ High Speed CFM			
80°F DB, 62.8°F WB (26.7°C DB, 17.1°C WB) 38% RH	Total	5.19 (17,700)	5.56 (19,000)
	Sensible	5.02 (17,100)	5.33 (18,200)
75°F DB, 61°F WB (23.9°C DB, 16.1°C WB) 45% RH	Total	4.96 (16,900)	5.33 (18,200)
	Sensible	4.48 (15,300)	4.77 (16,200)
72°F DB, 60°F WB (22.2°C DB, 15.5°C WB) 50% RH	Total	4.84 (16,500)	5.20 (17,700)
	Sensible	4.12 (14,000)	4.41 (15,000)
Fan Data - Evaporator			
CFM (CMH) - High Speed	750 (1274)		
CFM (CMH) - Low Speed	600 (1019)		
Fan Motor hp (W)	0.2 (149)		
External Static Pressure, in. (mm) water gauge	0.1 (2.5)		
Evaporator Coil - Copper Tube/Aluminum Fin			
Face Area ft. <sup>2</sup> (m <sup>2</sup> )	2.44 (0.23)		
Coil Rows	3		
Max Face Velocity-fpm (m/s)	232 (1.2)		
Unit Refrigerant Charge, oz. (kg)	49 (1.39)	4 (0.11)	
Unit Operating Weight	300 (136)	225 (102)	
Electric and SCR Reheat Capacities (Includes Fan Motor)-kW (Btu/hr)			
Input Voltage 208-1-60	3.6 (12,160)		
Input Voltage 230-1-60	4.4 (14,875)		
Input Voltage 277-1-60	4.8 (16,285)		
Hot Gas Reheat Capacities - kW (Btu/hr) *			
Based on 103°F (39.4°C) return gas temperature	4.7 (16,050)	N/A	
Humidifier Data - Steam Generator Type			
Steam capacity - lb/hr (kg/hr)	2.5 (1.14)		
Electrical Input Power - kW	0.88		

**Table 4.1 Air Cooled Data, 60-Hz (continued)**

Evaporator Model	MMD18E	MMD18E
Cabinet Type	Self-Contained	Split System
<b>Evaporator Connection Sizes</b>		
Liquid line Diameter, O.D. Cu	N/A	3/8"
Suction Line Diameter, O.D. Cu		5/8"
Humidifier Supply	1/4" OD Cu Compression Fitting	
Evaporator/Condensate Drain	3/4" NPT-Female	
MERV 8 Filter, Supply/Return Grille, qty. (1), Nom. Size-in. (mm)	1x20x20 (25x508x508)	
MERV 8 Filter, Return Air Filter Box, qty. (1), Nom. Size-in. (mm)	4x16x20 (102x406x508)	
Condensing Unit Model Number	N/A	PFH020A-_LN
Condenser Fan Model Number	MM2CF	N/A
Condenser Coil Face Area ft. <sup>2</sup> (m <sup>2</sup> )	2.25 (0.21)	4.1 (0.38)
Rows of Coil	3	2
CFM (CMH)	950 (1614)	2200 (3738)
Motor hp (W)	0.25 (186)	0.20 (149)
External Static Pressure, in wg. (mm)	0.5 (13)	0
Condensing Unit Refrigerant Charge, oz. (kg)	N/A	134 (3.8)
Unit Operating Weight, lb. (kg)	63 (29)	200 (91)
<b>Condensing Unit Connection Sizes</b>		
Liquid line Diameter, O.D. Cu	N/A	3/8"
Suction Line Diameter, O.D. Cu	N/A	5/8"
<b>Free Cooling Coil Option Net Capacity Data - kW (Btu/hr) using 45°F EWT with 10° rise</b>		
80°F DB, 62.8°F WB (26.7°C DB, 17.1°C WB) 38% RH	Total	4.39 (15,000)
	Sensible	4.39 (15,000)
75°F DB, 61°F WB (23.9°C DB, 16.1°C WB) 45% RH	Total	3.72 (12,700)
	Sensible	3.72 (12,700)
72°F DB, 60°F WB (22.2°C DB, 15.5°C WB) 50% RH	Total	3.34 (11,400)
	Sensible	3.34 (11,400)
Flow Rate - GPM (l/m)	2.6 (9.9)	
Pressure Drop - ft. water (kPa)	6.6 (19.7)	

**Table 4.1 Air Cooled Data, 60-Hz (continued)**

Evaporator Model	MMD18E	MMD18E
Cabinet Type	Self-Contained	Split System
Free Cooling Coil - Copper Tube/Aluminum Fin		
Face Area ft. <sup>2</sup> (m <sup>2</sup> )	2.44 (0.23)	
Coil Rows	2	
Max Face Velocity-fpm (m/s)	291 (1.5)	
Internal Fluid Volume - gal (l)	1.7 (6.4)	
Free-cooling Coil supply and return connections, in. O.D. Cu	5/8	
<p>The net capacity data has fan motor heat factored in for all ratings and the entering air conditions of 75°F (23.9°C), 45% RH, is the standard rating condition for ASHRAE 127-2007. All capacities are nominal values; actual performance will be ±5%.</p> <p>*Hot Gas Reheat operates only during dehumidification. Capacity shown is offset by cooling capacity; cannot be used for space heating and is for reference only.</p>		

## 4.2 Water/Glycol Cooled Systems—Capacity and Performance Data

Table 4.2 Water/Glycol Data, 60-Hz

Evaporator Model (Self-Contained)		MMD20W	
Condensing Unit Fluid		Water Cooled	Glycol Cooled
Vertiv™ Liebert® DX Evaporator- Net Capacity Data - kW (Btu/hr) @ High Speed CFM			
80°F DB, 62.8°F WB (26.7°C DB, 17.1°C WB) 38% RH	Total	6.48 (22,100)	5.85 (20,000)
	Sensible	6.04 (20,600)	5.63 (19,200)
75°F DB, 61°F WB (23.9°C DB, 16.1°C WB) 45% RH	Total	6.21 (21,200)	5.56 (19,000)
	Sensible	5.42 (18,500)	5.07 (17,300)
72°F DB, 60°F WB (22.2°C DB, 15.5°C WB) 50% RH	Total	6.06 (20,700)	5.41 (18,500)
	Sensible	5.01 (17,100)	4.69 (16,000)
Fan Data - Evaporator			
CFM (CMH) - High Speed		750 (1,274)	
CFM (CMH) - Low Speed		600 (1,019)	
Fan Motor hp (W)		0.2 (149)	
External Static Pressure, in. (mm) water gauge		0.1 (2.5)	
Evaporator Coil - Copper Tube/Aluminum Fin			
Face Area ft. <sup>2</sup> (m <sup>2</sup> )		2.44 (0.23)	
Coil Rows		3	
Max Face Velocity-fpm (m/s)		232 (1.2)	
Unit Refrigerant Charge, oz. (kg)		34 (0.96)	
Unit Operating Weight		295 (134)	
Electric and SCR Reheat Capacities (Includes Fan Motor)-kW (Btu/hr)			
Input Voltage 208-1-60		3.6 (12,160)	
Input Voltage 230-1-60		4.4 (14,875)	
Input Voltage 277-1-60		4.8 (16,285)	
Hot Gas Reheat Capacities - kW (Btu/hr) *			
Based on 103°F (39.4°C) return gas temperature		4.7 (16,050)	
Humidifier Data - Steam Generator Type			
Steam capacity - lb./hr (kg/hr)		2.5 (1.14)	
Electrical Input Power - kW		0.88	
Unit Connection Sizes			
Water/Glycol Condenser Connection Sizes, in. O.D. Cu		1/2	
Humidifier Supply		1/4" OD Cu Compression Fitting	



**Table 4.2 Water/Glycol Data, 60-Hz (continued)**

Evaporator Model (Self-Contained)	MMD20W		
Condensing Unit Fluid	Water Cooled	Glycol Cooled	
Evaporator/Condensate Drain	3/4" NPT-Female		
MERV 8 Filter, Supply/Return Grille, qty. (1), Nom. Size - in. (mm)	1x20x20 (25x508x508)		
MERV 8 Filter, Return Air Filter Box, qty. (1), Nom. Size - in. (mm)	4x16x20 (102x406x508)		
Condenser Fluid Requirements	83°F (28.3°C) EWT	104°F (40°C) EGT - 40% PG	
THR - kW (Btu/hr) @ 75°F/45% RH	7.85 (26,700)	7.6 (25,900)	
Flow Rate - GPM (l/m)	4.5 (17.0)	5.1 (19.3)	
Pressure Drop - ft. of H2O (kPa)	11 (32.9)	16 (47.8)	
Water Cooled Condensing Temperature	105°F (40.6°C)	NA	
Water/Glycol Condenser Loop Volume - gal (l)	0.5 (1.9)		
<b>Free Cooling Coil Option Net Capacity Data - kW (Btu/hr) using 45°F EWT with 10° rise</b>			
80°F DB, 62.8°F WB (26.7°C DB, 17.1°C WB) 38% RH	Total	4.25 (14,500)	3.55 (12,100)
	Sensible	4.25 (14,500)	3.55 (12,100)
75°F DB, 61°F WB (23.9°C DB, 16.1°C WB) 45% RH	Total	3.60 (12,300)	3.00 (10,200)
	Sensible	3.60 (12,300)	3.00 (10,200)
72°F DB, 60°F WB (22.2°C DB, 15.5°C WB) 50% RH	Total	3.25 (11,100)	2.65 (9,100)
	Sensible	3.15 (10,800)	2.65 (9,100)
Flow Rate - GPM (l/m)	2.6 (9.9)	4.6 (17.4)	
Pressure Drop - ft. water (kPa)	6.6 (19.7)	29.0 (86.7)	
<b>Free Cooling Coil - Copper Tube/Aluminum Fin</b>			
Face Area ft. <sup>2</sup> (m <sup>2</sup> )	2.44 (0.23)		
Coil Rows	2		
Max Face Velocity-fpm (m/s)	291 (1.5)		
Internal Fluid Volume - gal (l)	1.7 (6.4)		
Free Cooling Coil supply and return connections, in. O.D. Cu	5/8		
<p>The net capacity data has fan motor heat factored in for all ratings and the entering air conditions of 75°F (23.9°C), 45% RH, is the standard rating condition for ASHRAE 127-2007. All capacities are nominal values; actual performance will be ±5%.</p> <p>*Hot Gas Reheat operates only during dehumidification. Capacity shown is offset by cooling capacity; cannot be used for space heating and is for reference only.</p>			

## 4.3 Chilled Water Systems—Capacity and Performance Data

**Table 4.3 Vertiv™ Liebert® Mini-Mate2 Capacity Document AHRI**

Model Number	MMD23C			
Volts/Phase/Hz	208/230-1-60 or 277-1-60			
Return Air Conditions	75°F DB, 61°F WB, 52°F DP (24°C DB, 16°C WB, 11°C DP), 44% RH*	80°F DB, 63°F WB, 52°F DP (27°C DB, 17°C WB, 11°C DP), 38% RH	75°F DB, 61°F WB, 52°F DP (24°C DB, 16°C WB, 11°C DP), 44% RH	72°F DB, 60°F WB, 52°F DP (22°C DB, 16°C WB, 11°C DP), 50% RH
	Net Capacity Data - based on 50°F (10°C) Entering Water Temperature with 12°F (6.7°C) Rise*	Net Capacity Data - based on 45°F (7.2°C) Entering Water Temperature with 10°F (5.6°C) Rise		
Net Total Cooling Capacity, kW (Btuh)	1.37 (4,675)	5.13 (17,504)	4.01 (13,683)	3.46 (11,806)
Net Sensible Cooling Capacity, kW (Btuh)	1.32 (4,504)	5.13 (17,504)	4.01 (13,683)	3.46 (11,806)
Net Sensible Coefficient of Performance, kW/kW	4.70	17.5	14.2	12.1
Unit Airflow Rate, ACFM (ACMH)	770 (1,308)			
Unit Airflow Rate, SCFM (SCMH)	758 (1,288)	745 (1,266)	752 (1,278)	756 (1,284)
External Static Pressure, in. (mm) water gauge	0.1 (2.5)*			
Fluid Flow Rate, GPM (l/m)	0.88 (3.3)	3.7 (14)	3.0 (11)	2.5 (9.6)
Fluid Pressure Drop, ft water (kPa)	0.87 (2.6)	12 (36)	8.0 (24)	6.0 (18)
<p><b>*NOTE: Certified in accordance with the AHRI Datacom Cooling Certification Program at AHRI Standard 1360 (I-P) Standard Rating Conditions. Certified units may be found in the AHRI Directory at <a href="http://www.ahrirectory.org">www.ahrirectory.org</a>.</b></p>				

**Table 4.4 Chilled Water Data, 60-Hz**

Model Number, 60 Hz	MMD23C	
<b>Net Capacity Data - kW (Btu/hr) based on 45°F (7.2°C) EWT &amp; 10°F (5.6°C) temp. rise</b>		
80°F DB, 62.8°F WB (26.7°C DB, 17.1°C WB) 38% RH	Total	4.85 (16,400)
	Sensible	4.80 (16,300)
Flow Rate - GPM (l/m)		3.4 (12.9)
Pressure Drop - ft. water (kPa)		10.7 (32.0)
75°F DB, 61°F WB (23.9°C DB, 16.1°C WB) 45% RH	Total	3.85 (13,100)
	Sensible	3.80 (13,000)
Flow Rate - GPM (l/m)		2.8 (10.6)
Pressure Drop - ft. water (kPa)		7.2 (21.5)
72°F DB, 60°F WB (22.2°C DB, 15.5°C WB) 50% RH	Total	3.20 (11,000)
	Sensible	3.20 (10,900)
Flow Rate - GPM (l/m)		2.3 (8.7)
Pressure Drop - ft. water (kPa)		5.3 (15.8)
<b>Fan Data - Evaporator</b>		
CFM (CMH) - High Speed		750 (1274)
CFM (CMH) - Low Speed		600 (1019)
Fan Motor hp (W)		0.2 (149)
External Static Pressure, in. (mm) water gauge		0.3 (8)
CW Coil - Copper Tube/Aluminum Fin		
Face Area ft. <sup>2</sup> (m <sup>2</sup> )		2.44 (0.23)
Coil Rows		2
Max Face Velocity-fpm (m/s)		291 (1.5)
<b>Electric Reheat Capacity (Includes Fan Motor)-kW (Btu/hr)</b>		
Input Voltage 208-1-60		3.6 (12,160)
Input Voltage 230-1-60		4.4 (14,875)
Input Voltage 277-1-60		4.8 (16,285)
<b>Hot Water Reheat Coil - Copper Tube/Aluminum Fin</b>		
Capacity (with fan motor heat) using 180°F (82°C) EWT-kW (Btu/hr)		9.5 (32,400)
Flow Rate - GPM (l/m)		1.5 (5.7)
Pressure Drop - ft. water (kPa)		1.5 (4.5)
Face Area ft. <sup>2</sup> (m <sup>2</sup> )		2.44 (0.23)
Coil Rows		1
HWRH supply and return connections, in. O.D. Cu		5/8

**Table 4.4 Chilled Water Data, 60-Hz (continued)**

Model Number, 60 Hz	MMD23C
<b>Humidifier Data - Steam Generator Type</b>	
Steam capacity - lb./hr (kg/hr)	2.5 (1.14)
Electrical Input Power - kW	0.88
<b>Unit Connection Sizes</b>	
CW supply and return connections, in. O.D. Cu	5/8
Humidifier Supply	1/4" OD Cu Compression Fitting
Evaporator/Condensate Drain	3/4" NPT-Female
Unit Internal Fluid Volume - gal (l)	1.7 (6.4)
MERV 8 Filter, Supply/Return Grille, qty. (1), Nom. Size-in. (mm)	1x20x20 (25x508x508)
MERV 8 Filter, Return Air Filter Box, qty. (1), Nom. Size-in. (mm)	4x16x20 (102x406x508)
Unit Operating Weight, lb. (kg.)	220 (99.8)
Unit Valve Types	On/Off Slow Close - 2 & 3-Way
Valve Size	1/2"
Valve Cv	2.5
Max. Operating Pressure, psi (kPa)	300 (2068)
Close-Off Pressure, psi (kPa)	40 (276)
The net capacity data has fan motor heat factored in for all ratings and the entering air conditions of 75°F (23.9°C), 45% RH, is the standard rating condition for ASHRAE 127-2007. All capacities are nominal values; actual performance will be ±5%.	

**Table 4.5 Capacity Correction Factors (Based on 10°F (5.6°C) Water Rise)**

EWT	72°F (22.2°C) 50% RH		75°F (23.9°C) 45% RH	
	Total	Sensible	Total	Sensible
42°F (5.6°C)	1.30	1.14	1.25	1.11
43°F (6.1°C)	1.19	1.10	1.17	1.07
44°F (6.7°C)	1.09	1.05	1.08	1.04
45°F (7.2°C)	1.00	1.00	1.00	1.00
46°F (7.8°C)	0.94	0.95	0.95	0.96
47°F (8.3°C)	0.88	0.89	0.90	0.90
48°F (8.9°C)	0.82	0.82	0.85	0.85
49°F (9.4°C)	0.75	0.75	0.80	0.81

## 4.4 Planning Dimensions

The unit dimensions are described in the submittal documents included in the [Submittal Drawings](#) on page 39 .

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

**Table 4.6 Dimension Planning Drawings**

Document Number	Title
<b>Self-contained Units and Split System Evaporators/Chilled Water Units</b>	
DPN000172	Cabinet Dimensions
DPN000173	Filter Box and Grille Option Dimensions
DPN000177	Condenser Fan Module Dimensions
<b>Outdoor Condensing Units</b>	
DPN004418	Cabinet Dimensions, Prop Fan Condensing Unit with Horizontal Air Discharge
DPN003094	Optional Anchorage Plan, Prop Fan Condensing Unit with Horizontal Air Discharge

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## 5 Electrical Data

### 5.1 Self-Contained Evaporators and Chilled Water Units Electrical Data

Table 5.1 Self-Contained, Air Cooled Units Electrical Data, 60-Hz

Base Evaporator Model Number	208/230 - 1Ph - 60Hz		277 - 1Ph - 60Hz	
		MMD18A		MMD18A
<b>Cooling Only</b>				
	FLA	14.2		11.8
	WSA	16.9		14.0
	OPD	25		20
<b>With Electric Reheat</b>				
	FLA	33.0		28.1
	WSA	40.4		34.4
	OPD	45		35
<b>With SCR Reheat<sup>5</sup></b>				
	FLA	33.0		28.1
	WSA	40.4		34.4
	OPD	45		35
<b>With Humidifier</b>				
	FLA	19.0		15.4
	WSA	21.7		17.6
	OPD	30		25
<b>With Electric Reheat and Humidifier</b>				
	FLA	33.0		28.1
	WSA	40.4		34.4
	OPD	45		35
<b>With SCR Reheat and Humidifier<sup>5</sup></b>				
	FLA	37.8		31.7
	WSA	45.2		38.0
	OPD	50		40
<ol style="list-style-type: none"> <li>1. Electrical values are not affected by hot gas reheat or free cooling options.</li> <li>2. FLA = Full Load Amps, WSA = Wire Size Amps, OPD = Maximum Overcurrent Protection Device</li> <li>3. Self-contained air cooled units include MM2CF blower box.</li> <li>4. Hot gas reheat not available with electric or SCR reheat or free cooling options</li> <li>5. SCR Reheat not available with free cooling models.</li> </ol>				

**Table 5.2 Split System Evaporator or Self-Contained Chilled Water Units, 60-Hz**

		208/230 - 1Ph - 60Hz	277 - 1Ph - 60Hz
Base Evaporator Model Number		MMD18E; MMD23C	MMD18E; MMD23C
<b>Cooling Only</b>			
	FLA	1.4	1.4
	WSA	1.8	1.8
	OPD	15	15
<b>With Electric Reheat</b>			
	FLA	20.2	17.7
	WSA	25.3	22.1
	OPD	30	25
<b>With SCR Reheat<sup>4</sup></b>			
	FLA	20.2	17.7
	WSA	25.3	22.1
	OPD	30	25
<b>With Humidifier</b>			
	FLA	6.2	5.0
	WSA	7.8	6.3
	OPD	15	15
<b>With Electric Reheat and Humidifier</b>			
	FLA	25.0	21.3
	WSA	31.3	26.6
	OPD	35	30
<b>With SCR Reheat and Humidifier<sup>4</sup></b>			
	FLA	25.0	21.3
	WSA	31.3	26.6
	OPD	35	30

1. For units with hot water reheat (available only on MMD23C), use appropriate values from “Cooling Only” or “with Humidifier” categories.
2. FLA = Full Load Amps, WSA = Wire Size Amps, OPD = Maximum Overcurrent Protection Device
3. Use MMD18E values for models with free cooling options, except with SCR reheat.
4. SCR reheat not available with free cooling models.



**Table 5.3 Self-Contained Water/Glycol Unit Electrical Data, 60-Hz**

Base Evaporator Model Number	208/230 - 1Ph - 60Hz		277 - 1Ph - 60Hz	
		MMD20W		MMD20W
<b>Cooling Only</b>				
	FLA	12.1		10.3
	WSA	14.8		12.5
	OPD	25		20
<b>With Electric Reheat</b>				
	FLA	30.9		26.6
	WSA	38.3		32.9
	OPD	40		35
<b>With SCR Reheat<sup>4</sup></b>				
	FLA	30.9		26.6
	WSA	38.3		32.9
	OPD	40		35
<b>With Humidifier</b>				
	FLA	16.9		13.9
	WSA	19.6		16.1
	OPD	30		25
<b>With Electric Reheat and Humidifier</b>				
	FLA	30.9		26.6
	WSA	38.3		32.9
	OPD	40		35
<b>With SCR Reheat and Humidifier<sup>4</sup></b>				
	FLA	35.7		30.2
	WSA	43.1		36.5
	OPD	45		40
<ol style="list-style-type: none"> <li>1. Electrical values are not impacted by hot gas reheat, and free cooling options</li> <li>2. FLA = Full Load Amps, WSA = Wire Size Amps, OPD = Maximum Overcurrent Protection Device</li> <li>3. Hot gas reheat not available with electric or SCR reheat or free cooling options</li> <li>4. SCR reheat not available with free cooling models.</li> </ol>				

## 5.2 Outdoor Condensing Units Electrical Data

**Table 5.4 Outdoor Condensing Unit Electrical Data, 60-Hz**

Model #	Nominal Capacity Tons	Electrical Characteristic*	Input Voltage Phase
			208/230-1
PFH_20	1.5	FLA	12.1
		WSA	14.8
		OPD	25
* FLA = Full Load Amps, WSA = Wire Size Amps (minimum supply circuit current capacity), OPD = Maximum Overcurrent Protection Device (fuse or circuit breaker)			

## 5.3 Electrical Field Connections

Electrical service must conform to national and local electrical codes.

The electrical connections are described in the submittal documents included in the [Submittal Drawings](#) on page 39 .

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

**Table 5.5 Electrical Field Connection Drawings**

Document Number	Title
<b>Evaporator and Chilled Water Units</b>	
DPN000175	Electrical Connections, Air-cooled, Water/Glycol Cooled and Chilled Water Units
DPN000176	Electrical Connections, Air-cooled, Water/Glycol Cooled and Chilled Water Units
DPN004850	Arrangement and Dimensions, Unit-mounted IS-UNITY-DP for BMS Communication
DPN004911	Arrangement and Dimensions, Wall-mounted IS-UNITY-DP for BMS Communication
DPN004854	Electrical Connections, IS-UNITY-DP for BMS Communication
<b>Air-cooled Condenser Blower</b>	
DPN000177	Electrical Connections, Air-cooled Condenser Blower

## 6 Piping

The pipe connection locations, piping general arrangement and schematics are described in the submittal documents included in the [Submittal Drawings](#) on page 39 .

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

**Table 6.1 Piping General Arrangement Drawings**

Document Number	Title
DPN004408	General Arrangement, Split System, Air Cooled
DPN000168	General Arrangement, Self-contained , Air Cooled
DPN000166	General Arrangement, Self-contained, Water/Glycol Cooled
DPN000169	General Arrangement, Water/Glycol Cooled with Free Cooling and Hot Water Reheat Options
DPN000167	General Arrangement, Self-contained, Chilled-water
DPN003822	Multiple Drycoolers and Cooling Units on Common Glycol Loop

**Table 6.2 Piping Connection Drawings**

Document Number	Title
Evaporator and Chilled Water Units	
DPN004302	Piping Connections
Condensate Pump Connection	
DPN000174	Field-installed Pump Connection

## 6.1 Refrigerant Piping Data

### 6.1.1 Refrigerant Charge Requirements

**Table 6.3 R-407C Refrigerant Unit Charge<sup>1</sup>**

Model #		Charge R-407C, oz (kg)
60 Hz	Unit Type	
MMD18A/F	Self-contained, air cooled	49 (1.39)
MMD20W/G	Self-contained, water/glycol cooled	28 (0.79)
MMD18E/K	Split system evaporator, air cooled	4 (0.11)
PFH020A-LN	Split system condensing unit	134 (3.80)

- Self-contained DX units are pre-charged with R-407C refrigerant.
- Split system units must be field charged. Use **Table 6.4** below to determine the charge to be added for field fabricated refrigerant lines.
- For units with hot gas reheat coil, add 18-oz (0.51 kg) refrigerant to listed values.

**Table 6.4 Line Charges of R-407C Refrigerant Using Type-L Copper Tube**

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

Source: DPN003099 Rev. 1

## 6.1.2 Refrigerant Line Sizes and Equivalent Lengths

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

The pipe connection sizes for your equipment are included in the appropriate submittal documents included in the [Submittal Drawings](#) on page 39.

**Table 6.5 Recommended Refrigerant Line Sizes, O.D. cu by Equivalent Length**

Equivalent Length, ft (m)	1 Ton		1.5 Ton	
	Suction	Liquid	Suction	Liquid
50 (15)	5/8"	3/8"	5/8"	3/8"
75 (23)	5/8"	3/8"	7/8"	3/8"
100 (30)	7/8"	3/8"	7/8"	3/8"
125 (38)	7/8"	3/8"	7/8"	1/2"
150 (45)	7/8"	3/8"	7/8"	1/2"

1. Consult factory for proper line sizing for runs longer than 150 ft (45 m).

2. Suction line and liquid line sizing based on < 3-psi pressure drop in each and on suction line refrigerant velocities >700 FPM(3.6 m/s), horizontal and 1000 FPM (5.1 m/s) vertical.

Source: DPN000788 Rev. 16

**Table 6.6 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

## 6.1.3 Piping When Condensing Unit is Above or Below Evaporator

Refer to **Table 6.7** on the next page, for the maximum vertical rise/fall between condensing unit and evaporator.

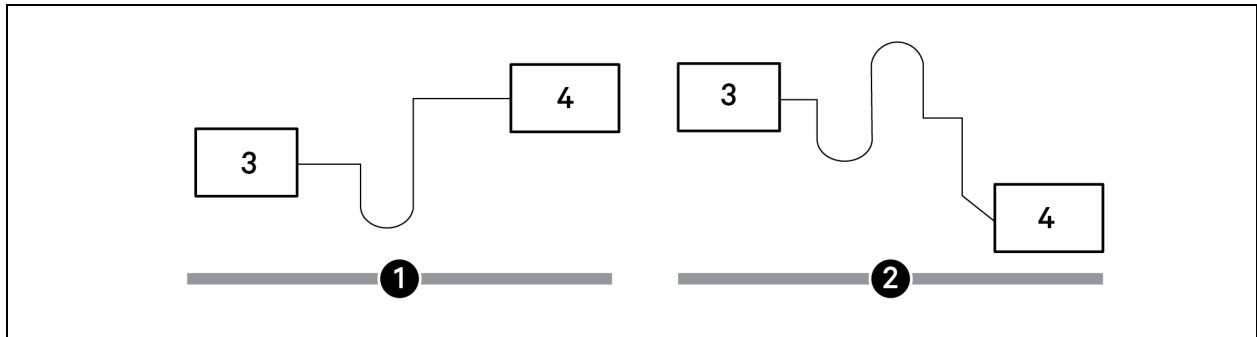
When installing remote condensing units above the evaporator, trap the suction gas line at the evaporator as shown in **Figure 6.1** on the next page. This trap will retain refrigerant oil during the "Off" cycle. When the unit starts, oil in the trap is carried up the vertical riser and returns to the compressor. For rises over 25 ft (7.6 m), trap every 20 ft (6 m) or evenly divided.

When installing remote condensing units below the evaporator, trap the suction gas line with an inverted trap the height of the evaporator as shown **Figure 6.1** on the next page. This prevents refrigerant migration to the compressor during "Off" cycles. The maximum recommended vertical-level drop to condensing unit is 15 ft (4.6 m).

**Table 6.7 Pipe Length and Condensing Unit Elevation Relative to Evaporator**

Maximum Equivalent Pipe Length, ft (m)	Maximum Condensing Unit Level Above Evaporator, ft (m)	Maximum Condensing Unit Level Below Evaporator, ft (m)
150 (45)	40 (12)	15 (4.6)
Maximum recommended total equivalent pipe length is 150 ft (46 m). Suction and liquid lines may require additional specialty items when vertical lines exceed 20 ft. (6 m) and/or condensing unit installation is more than 15 ft. (4.6 m) below the evaporator. Contact Vertiv™ Technical Support for assistance.		

**Figure 6.1 Refrigerant Piping Diagram When Condenser is Above or Below Evaporator**



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

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

## 6.2 Glycol Loop Piping

Contact Vertiv Application Engineering for assistance in choosing correct drycooler models. See DPN003822 included in the [Submittal Drawings](#) on page 39.

# Appendices

## Appendix A: Technical Support and Contacts

### A.1 Technical Support/Service in the United States

Vertiv Group Corporation

24x7 dispatch of technicians for all products.

1-800-543-2378

Liebert® Thermal Management Products

1-800-543-2378

Liebert® Channel Products

1-800-222-5877

Liebert® AC and DC Power Products

1-800-543-2378

### A.2 Locations

#### United States

Vertiv Headquarters

505 N. Cleveland Ave.

Westerville, OH 43082, USA

#### Europe

Via Leonardo Da Vinci 8 Zona Industriale Tognana

35028 Piove Di Sacco (PD) Italy

#### Asia

7/F, Dah Sing Financial Centre

3108 Gloucester Road, Wanchai

Hong Kong

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## **Appendix B: Guide Specifications**

The following are the guide specifications for the Liebert® Vertiv™ Liebert® Mini-Mate2.

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# Vertiv™ Liebert® Mini-Mate2 - 1.5 Ton GUIDE SPECIFICATIONS

## 1.0 GENERAL

### 1.1 Summary

These specifications describe requirements for a ceiling-mounted Thermal Management system. The system shall be designed to control temperature conditions in rooms containing electronic equipment, with good insulation and vapor barrier. The system is also available with an optional humidity control system.

The manufacturer shall design and furnish all equipment in the quantities and configurations shown on the project drawings.

### 1.2 Design Requirements

The Thermal Management system shall be a Liebert® Mini-Mate2 factory assembled unit. On direct expansion models, the refrigeration system shall be self-contained or shall be split, with the compressor located in a condensing unit.

The self-contained and split evaporator units shall be designed for above-dropped-ceiling installation and serviceable from the front and bottom of the system. Condensing unit for split system shall be designed for outdoor installation. Refer to section 2.2.2 for condensing unit guide specifications.

The system shall have a net total cooling capacity of \_\_\_\_\_ Btu/hr (kW), and a net sensible cooling capacity of \_\_\_\_\_ Btu/hr (kW), based on entering air conditions of \_\_\_\_\_°F (°C) dry bulb, and \_\_\_\_\_°F (°C) wet bulb. Net capacities shall include losses due to fan motor heat. The system cooling capacity shall be factory-certified per ASHRAE 127-2007 testing.

The unit is to be supplied for operation using a \_\_\_\_\_ volt, \_\_\_\_\_ phase, \_\_\_\_\_ Hz power supply.

System shall be supplied with CSA Certification to the harmonized U.S. and Canadian product safety standard CSA C22.2 No 236/UL 1995 for "Heating and Cooling Equipment" and marked with the CSA c-us logo (60 Hz only).

The system model number(s) shall be:

Evaporator \_\_\_\_\_

Condensing Unit \_\_\_\_\_

### 1.3 Submittals

Submittals shall be provided after the agreement of the proposal and shall include: Single-Line Diagrams; Dimensional, Electrical and Capacity data; Piping and Electrical Connection Drawings.

### 1.4 Quality Assurance

The specified system shall be factory-tested before shipment. Testing shall include, but shall not be limited to: Quality Control Checks, "HiPot" Test (two times rated voltage plus 1000 volts, per NRTL agency requirements) and Metering Calibration Tests. The system shall be designed and manufactured according to world class quality standards. The manufacturer shall be ISO 9001 certified.

## 1.5 Acceptable Alternatives

Acceptable alternatives shall be permitted with engineer's prior approval only. Contractor to submit a detailed summary form listing all variations to include size deviations, electrical load differences, functional and component changes, and savings to end user.

## 2.0 PRODUCT

### 2.1 Standard Features/All Systems

#### 2.1.1 Cabinet Construction

The cabinet and chassis shall be constructed of heavy gauge galvanized steel and designed for easy installation and service access from front and bottom of unit only (water cooled units require end access). Mounting brackets shall be integral to the cabinet design. Internal cabinet insulation shall meet ASHRAE 62.1 requirements for Mold Growth, Humidity & Erosion, tested per UL 181 and ASTM 1338 standards.

#### 2.1.2 Air Distribution

The air distribution system shall be constructed with a quiet, direct-drive fan assembly equipped with double-inlet blower, self-aligning ball bearings and lifetime lubrication. Fan motor shall be 1/5hp (149W), permanent-split capacitor, high efficiency type, equipped with two speeds for air flow modulation. The microprocessor controller shall use the lower fan speed for precise dehumidification control. Fan speed shall also be user selectable from the wall controller.

Air delivery shall be minimum \_\_\_\_ CFM (\_\_\_\_ CMH) at high fan speed. For ducted applications air delivery shall be \_\_\_\_ CFM (\_\_\_\_ CMH) at \_\_\_\_ " (\_\_\_\_ mm) external static pressure.

System shall be suitable for supply and return air plenum or ducted supply and return air distribution. Refer to 2.4.2 – Supply and Return Grille, 2.4.3 – Filter Box and Duct Kit, and 2.4.4 – Duct Collar Kit.

#### 2.1.3 Microprocessor Control

The control system shall be microprocessor-based, factory-wired into the system and tested prior to shipment. The wall-mounted controller shall include a 2-line by 16-character liquid crystal display (LCD) providing continuous display of operating status and alarm condition and shall be capable of displaying values in °F or °C. An 8-key membrane keypad for setpoint/ program control, fan speed selection and unit On/Off shall be located below the display. Controller shall be password protected to prevent unauthorized set point adjustments. Field-supplied 4-conductor thermostat wire shall be used to connect the wall-mounted controller to the unit control board.

Temperature and humidity sensors shall be located in the wall box, which shall be capable of being located up to 300 ft (91.4m) from the evaporator unit when using a remote temperature/humidity sensor in the conditioned space.

#### Monitoring

The LCD shall provide On/Off indication, operating mode indication (cooling, heating, humidifying, dehumidifying), fan speed indication and current day, time, temperature and humidity (if applicable) indication. The monitoring system shall be capable of relaying unit operating parameters and alarms to the Vertiv™ Liebert® IS-Unity-DP.

## Control Setpoint Parameters

- Temp. Setpoint 65-85°F (18-29°C)
- Temp. Sensitivity 1-9.9 °F (1-5°C)
- Humidity Setpoint 20-80% RH
- Humidity Sensitivity 1-30% RH

## Unit Controls

### 1. Compressor Short-Cycle Control

The control system shall prevent compressor short-cycling by a 3-minute timer from compressor stop to the next start.

### 2. Common Alarm and Remote On/Off

A common alarm relay shall provide a contact closure to a remote alarm device. Two (2) terminals shall also be provided for remote On/Off control. Individual alarms shall be “enabled” or “disabled” from reporting to the common alarm.

### 3. Setback Control

The control shall be user-configurable to use a manual setpoint control or a programmable, time-based setback control. The setback control will be based on a 5 day/2 day programmed weekly schedule with capability of accepting 2 events per program day.

### 4. Temperature Calibration

The control shall include the capabilities to calibrate the temperature and humidity sensors and adjust the sensor response delay time from 10 to 90 seconds. The control shall be capable of displaying temperature values in °F or °C.

### 5. System Auto Restart

For start-up after power failure, the system shall provide automatic restart with a programmable (up to 9.9 minutes in 6-second increments) time delay. Programming can be performed either at the wall-mounted controller or from the central, site-monitoring system.

## 2.1.4 Factory Installed Sensors

### Filter Clog Switch

The filter clog switch senses pressure drop across the filters and shall annunciate the wall controller upon reaching the adjustable setpoint. The filter clog switch shall be factory installed in every cooling unit.

### High-Temperature Sensor

The high-temperature sensor shall immediately shut down the system when high temperatures (125°F, 51.7°C) are detected. The high-temperature sensor shall be mounted with the sensing element in the return air of every cooling unit.

## 2.1.5 Alarms

### Unit Alarm

The control system shall monitor unit operation and activate an audible and visual alarm in the event of the following factory preset alarm conditions:

- High Temperature
- Low Temperature
- High Humidity
- Low Humidity
- High Water Alarm - Lockout Unit Operation
- High Head Pressure
- Loss of Power
- Compressor Short Cycle

### Custom Alarms (2x)

- Humidifier Problem
- Filter Clog
- Water Detected
- Smoke Detected
- Custom #1
- Custom #2

User-customized text can be entered for the two (2) custom alarms.

### Alarm Controls

Each alarm (unit and custom) shall be individually enabled or disabled (except for high head pressure and high water in condensate pan) and can be programmed for a time delay of 0 to 255 seconds of continuous alarm condition to be recognized as an alarm. Each alarm can also be enabled or disabled to activate the common alarm (except high head pressure and high water in condensate pan).

### Audible Alarm

The audible alarm shall annunciate at the wall-mounted controller any alarm that is enabled by the operator.

### Common Alarm

A programmable common alarm shall be provided to interface user selected alarms with a remote alarm device. Alarms shall be enabled or disabled from reporting to the common alarm.

### Remote Monitoring

All alarms shall be communicated to the Liebert remote monitoring system with the following information: date and time of occurrence, unit number and present temperature and humidity.

## 2.2 Direct Expansion Self-Contained System Components

### 2.2.1 Refrigeration System

The refrigeration system shall consist of a scroll compressor with vibration isolating grommets, evaporator coil, condenser coil, externally equalized thermostatic expansion valve, high pressure safety switch, filter drier, hot gas bypass circuit, factory R-407C refrigerant charge and externally equalized expansion valve.

Hot gas bypass shall be provided to reduce compressor cycling and optimize performance under low load conditions. The hot gas bypass shall be completely contained within the unit. Field installed third refrigerant line shall not be acceptable. Hot gas bypass shall be automatically deactivated upon a call for dehumidification.

High pressure switch shall protect the unit from abnormal refrigerant pressure conditions and shall deactivate the compressor and annunciate an alarm at the wall controller. The blower shall continue to circulate air. The wall controller shall be used to manually restart the compressor function after the automatic pressure switch resets. Three high head pressure alarms in a rolling 12-hour period shall lock out the manual restart feature until power is cycled to the evaporator unit.

### 2.2.2 Evaporator Coil

The evaporator coil shall have 2.4 sq.ft. (0.23 sq.m) face area, \_\_\_\_ rows deep. It shall be constructed of copper tubes and aluminum fins and have a maximum face velocity of \_\_\_ ft. per minute (\_\_\_\_ m/s) at \_\_\_\_ CFM ( \_\_\_\_ CMH).

The coil shall be mounted in a condensate drain pan with internally trapped drain line. The evaporator drain pan shall include a factory-installed float switch to shut down the evaporator upon high water condition.

### 2.2.3 Air-Cooled Condenser Coil

The air-cooled condenser section shall contain a factory mounted and piped condenser coil constructed of copper tubes and aluminum fins. No piping, brazing, dehydration or charging shall be required. The condenser coil shall be factory-mounted within the unit cabinet.

#### Air-Cooled Condenser Fan

A factory-supplied condenser fan shall be field-mounted to the end of the evaporator cabinet. The system shall be provided with a fan speed control system to permit operation at -20°F (-28.9°C) inlet ambient air temperature and sized to provide full rated cooling capacity at 95°F (35°C) entering air from plenum space. The centrifugal condenser fan shall deliver \_\_\_\_CFM (\_\_\_\_ CMH) at \_\_\_\_inches (\_\_\_\_mm) external static pressure at maximum speed.

Condenser fan electrical and refrigerant pressure connections shall be field attached to the cooling chassis using factory-provided wiring harness and capillary tube/fitting.

### 2.2.4 Water/Glycol-Cooled Condenser

The water/glycol-cooled condenser section shall contain a factory-mounted and piped coaxial condenser constructed of steel and copper tubing. No piping, brazing, dehydration or charging of refrigerant shall be required. The condenser coil shall be factory-mounted within the unit cabinet.

The total system pressure drop of the water/glycol system shall be\_\_\_\_\_ ft. of water (kPa) and a flow rate of \_\_\_\_\_ GPM (l/s) with \_\_\_\_\_ °F (°C) entering water/glycol temperature.

The condenser circuit shall be pre-piped with a [(2-way) (3-way)] regulating valve which is head-pressure actuated.

The condenser water/glycol circuit shall be designed for a static operating pressure of [(150PSI (1034kPa)) (350PSI (2413kPa))].



## 2.3 Direct Expansion Split System Components

### 2.3.1 Evaporator Unit

The evaporator section shall include evaporator coil, thermostatic expansion valve and filter drier. The evaporator coil shall have 2.4 sq.ft. (0.23 sq.m) face area, \_\_ rows deep. It shall be constructed of copper tubes and aluminum fins and have a maximum face velocity of \_\_\_ ft. per minute (\_\_\_ m/s) at \_\_\_ CFM ( \_\_\_ CMH). An externally equalized thermostatic expansion valve shall control refrigerant flow. The refrigerant piping shall be spun-closed and filled with a nitrogen holding charge. Field relief of the Schrader valves shall indicate a leak-free system. Evaporator and condensing unit shall be field piped using copper lines, brazed, evacuated and field charged with R-407C refrigerant. The coil shall be mounted in a condensate drain pan with internally trapped drain line. The evaporator drain pan shall include a factory-installed float switch to shut down the evaporator upon high water condition.

### 2.3.2 Outdoor Air-Cooled Prop Fan Condensing Unit

The condensing unit shall be designed for outdoor use with either roof or ground level mounting. The condensing unit is constructed of galvanized and galvanneal painted steel for corrosion resistance. Removable exterior panels shall allow access to the electric panel or refrigeration components for service or maintenance. Both inlet and outlet air grilles shall be heavy duty steel with a durable polyester coating.

Condensing unit components shall include a condenser coil, a direct-drive propeller-type fan, a scroll compressor with vibration-isolating grommets, high pressure switch, Liebert® Lee-Temp receiver and head pressure control valve, hot gas bypass system, pressure balancing valve and liquid line solenoid valve. The condenser coil shall be constructed of copper tubes and aluminum fins.

A hot gas bypass system shall be provided to reduce compressor cycling and improve operation under low load conditions. The system shall be completely contained in the condensing unit. A field-installed third refrigerant line shall not be acceptable. Hot gas bypass shall be automatically deactivated upon a call for dehumidification.

High pressure switch shall protect the unit from abnormal refrigerant pressure conditions and shall deactivate the compressor and annunciate an alarm at the wall controller. The blower shall continue to circulate air. The wall controller shall be used to manually restart the compressor function after the automatic pressure switch resets. Three high head pressure alarms in a rolling 12-hour period shall lock out the manual restart feature until power is cycled to the evaporator unit.

A pressure balancing valve shall be factory installed to reduce the chance of high-pressure cut-out due to excessive refrigerant migration to the receiver due to changing outdoor temperatures during off-cycles.

The refrigerant piping shall be nitrogen holding charge. Field relief of the Schrader valves shall indicate a leak-free system. Evaporator and condensing unit shall be field piped using copper lines, brazed, evacuated and field charged with R-407C refrigerant. Condensing unit shall be designed for 95°F (35°C) ambient and be capable of operation to -30°F (-34.4°C).

(Option) The coils shall be epoxy-coated for extended coil life in corrosive environments, such as coastal areas. Factory-applied E-coat using immersion and baking process shall provide a flexible epoxy-coating to all coil surfaces. Coil color shall be black and shall be protected from solar UV ray degradation with a factory-applied UV topcoat.

## 2.4 Chilled Water System Components

### 2.4.1 Chilled Water Control Valve

The control valve shall be a motorized, slow-close, spring-return type to reduce water hammer. Design working pressure shall be 300psi (2067kPa), with a maximum close-off pressure of 40psi (276kPa).

(Option) The control valve shall be a motorized, slow-close, spring-return type to reduce water hammer. Design working pressure shall be 300psi (2067kPa), with a maximum close-off pressure of 50psi (345kPa).

### 2.4.2 Chilled Water Coil

The cooling coil shall have a minimum of 2.4 sq.ft. (0.23 sq.m) face area, 2 rows deep. It shall be constructed of copper tubes and aluminum fins and have a maximum face velocity of \_\_\_\_ ft. per minute (\_\_\_\_ m/s) at \_\_\_\_ CFM (\_\_\_\_ CMH). The coil shall be supplied with 45°F (7.2°C) entering water temperature. The coil shall be supplied with \_\_\_\_\_ GPM (l/s) of chilled water and the pressure drop shall not exceed \_\_\_\_\_ PSI (kPa).

The coil assembly shall be mounted in a condensate drain pan with internally trapped drain line. The evaporator drain pan shall include a factory-installed float switch to shut down the unit upon high water condition.

## 2.5 Factory – Installed Options

### 2.5.1 Steam Generating Humidifier

The Thermal Management system shall be equipped with a steam generating humidifier that is controlled by the microprocessor control system. It shall be complete with disposable canister, all supply and drain valves, 1" (25.4mm) air gap on fill line, inlet strainer, steam distributor and electronic controls. The need to change canister shall be annunciated on the wall controller. The humidifier shall have a capacity of 2.5 lb/hr (1.1 kg/h). An LED light on the humidifier assembly shall indicate cylinder full, overcurrent detection, fill system fault and end of cylinder life conditions. The canister flush water shall not drain into the coil drain pan, due to risk of aggressive corrosion of the evaporator coil. The humidifier wand shall be mounted over the coil drain pan.

### 2.5.2 Electric Reheat

The electric reheat shall be low-watt density, 304/304 stainless steel, finned-tubular and shall be capable of maintaining room dry bulb temperature conditions when the system is calling for dehumidification. The reheat section shall include a UL-approved safety switch to protect the system from overheating. A ground current detector shall be factory installed to shut-down the entire unit if a ground fault in the reheat system is detected. The capacity of the reheat coils shall be \_\_\_\_\_ Btu/hr (kW), with unit input voltage of \_\_\_\_ V, controlled in one stage.

### 2.5.3 Hot Water Reheat

The hot water reheat coil shall have copper tubes and aluminum fins with a capacity of \_\_\_\_\_ Btu/hr (kW) when supplied with \_\_\_\_\_ °F (°C) entering water temperature at \_\_\_\_\_ GPM (l/s) flow rate. Maximum pressure drop shall be \_\_\_\_\_ PSI (kPa). The control system shall be factory prepiped with a 2-way solenoid valve and cleanable Y-strainer. The hot water reheat coil shall only be available on chilled water units.

### 2.5.4 SCR Electric Reheat

The electric reheat shall be low-watt density, 304/304 stainless steel, finned-tubular and shall be capable of maintaining room dry bulb conditions when the system is calling for dehumidification. The reheat section shall include a UL-approved safety switch to protect the system from overheating. A ground current detector shall be factory installed to shut-down the entire unit if a ground fault in the reheat system is detected.

The SCR (Silicon Controlled Rectifier) controller shall proportionally control the reheat elements to maintain the selected room temperature. The rapid cycling made possible by the SCR controller provides precise temperature control, and the more constant element temperature improves heater life. The unit microprocessor control shall operate the SCR controller, while cooling is locked on. The capacity of the reheat coils shall be \_\_\_\_\_ Btu/hr (kW), with input power of \_\_\_\_\_ V. Not available on chilled water or free-cooling units.

### 2.5.5 Hot Gas Reheat

The complete hot gas reheat system shall include a copper tube, aluminum fin coil, three-way solenoid valve, and refrigerant check valve. The capacity of the coil shall be \_\_\_\_\_ Btu/hr (kW). Hot gas reheat shall operate only during dehumidification and capacity shall be offset by cooling coil capacity. Hot gas reheat shall not be used for space heating.

### 2.5.6 Remote Monitoring and Control-IS-UNITY-DP And BMS

The IS-UNITY-DP BMS Monitoring Solution shall provide SNMP v1/v2c/v3, BACnet IP, BACnet MSTP, Modbus TCP/IP, and Modbus RTU monitoring capability to the Vertiv™ Liebert® Mini-Mate2 system. Card shall employ Ethernet and RS-485 networks to monitor and manage a wide range of operating parameters pertaining to the cooling system. The Unity card shall provide access to the Vertiv™ Liebert® Mini-Mate2 remotely via a web interface and shall support Vertiv™ Liebert® Nform connectivity. The Vertiv™ Liebert® IS-UNITY-DP card shall be factory mounted inside an enclosure on the outside of the Liebert® Mini-Mate2 unit and shall be factory wired for power and unit communications. Ethernet cable providing network access to the world-wide web or to a BMS shall be field wired.

### 2.5.7 Smoke Sensor

The smoke sensor shall immediately shut down the Thermal Management system and activate the alarm system when activated. The sensing element shall be located in the return air compartment. This smoke sensor shall not function or replace any room smoke detection system that may be required by local or national codes.

### 2.5.8 Free-Cooling Coil

A free-cooling coil shall be integral to the evaporator cabinet, and shall be constructed of copper tubes and aluminum fins. The coil shall be rated at \_\_\_\_\_ Btu/hr (kW) sensible cooling capacity with a 45°F (22°C), \_\_\_% glycol solution. The coil shall require \_\_\_\_\_ GPM (l/s) and the total unit pressure drop shall not exceed \_\_\_\_\_ feet of water (kPa) when in the free cooling mode. Free-cooling shall be activated by an adjustable aquastat, and shall include a factory-piped, three-way valve and separate supply and return piping.

Coil shall be designed for closed-loop applications using properly treated and circulated fluid. A field-supplied heat exchanger system shall be installed to prevent premature corrosion if applied to open water tower loop. Not available with SCR reheat.

## 2.6 Ship-Loose Accessories

### 2.6.1 Remote Sensors

The unit shall be supplied with remote temperature and humidity sensors. The sensors shall be connected to the unit by \_\_\_\_\_ ft. (m) shielded cable.

### 2.6.2 Supply and Return Grille

A factory-supplied supply and return grille kit shall be provided for supply and return air delivery through a 2' x 4' (0.6m x 0.6m) T-bar ceiling grid. Kit shall include an air baffle plate, supply grille, hinged return grille, 1" x 20 x 20" (25.4mm x 508mm x 508mm) MERV 8 (ASHRAE 52.2-2007) filter and mounting frame.

### 2.6.3 Filter Box and Duct Kit

A return air filter box shall be provided with hinged filter access, and 3/4" (19 mm) duct flange. A 1" (25.4 mm) duct flange shall also be provided for air discharge. Filter shall be 4" x 16" x 20" (102mm x 406mm x 508mm) MERV 8 per ASHRAE 52.2-2007.

### 2.6.4 Duct Collar Kit

1" (25.4 mm) duct flanges shall be provided for each of the discharge and return air openings. Filters and filter box shall be field supplied.

### 2.6.5 Condensate Pump

The condensate pump shall have the capacity of \_\_\_\_ GPH (\_\_\_ l/h) at \_\_\_ ft. head (\_\_\_ kPa). It shall be complete with integral float switch, discharge check valve, pump, motor assembly and reservoir. A secondary float switch on the condensate pump shall tie into the unit to provide an alarm on the wall-mounted controller and shut down the unit upon high water in the basin of the pump. Condensate pump shall be powered from the Vertiv™ Liebert® Mini-Mate2. A separate electrical feed is not acceptable.

### 2.6.6 Remote Monitoring and Control-IS-UNITY-DP And BMS - Field-Installed Unit-Mount Kit

The IS-UNITY-DP BMS Monitoring Solution shall provide SNMP v1/v2c/v3, BACnet IP, BACnet MSTP, Modbus TCP/IP, and Modbus RTU monitoring capability to the Liebert® Mini-Mate2 system. Card shall employ Ethernet and RS-485 networks to monitor and manage a wide range of operating parameters pertaining to the cooling system. The Unity card shall provide access to the Liebert Mini-Mate2 remotely via a web interface and shall support Vertiv™ Liebert® Nform connectivity. The unit-mount external enclosure kit for field-installation shall include the Vertiv™ Liebert® IS-UNITY-DP card, power/communication interface card, galvanized steel enclosure, power and communication wire harnesses and full instructions. Field-supplied wiring for communication from the Liebert® Mini-Mate2 to other systems shall be required to access features.

### 2.6.7 Remote Monitoring and Control-IS-UNITY-DP And BMS - Field-Installed Wall-Mount Kit

The IS-Unity-DP card shall provide SNMP v1/v2c/v3, BACnet IP, BACnet MSTP, Modbus TCP/IP, and Modbus RTU monitoring protocols for BMS Monitoring of the Liebert® Mini-Mate2 system. Card shall employ Ethernet and RS-485 networks to monitor and manage a wide range of operating parameters pertaining to the cooling system. The Unity card shall provide access to the Liebert® Mini-Mate2 remotely via a web interface and shall support Liebert® Nform connectivity. The wall-mount kit for field-installation shall include the Liebert® IS-UNITY-DP card, power/communication interface card, painted enclosure, 120V wall outlet transformer with 6ft (2m) low voltage power wire, and full instructions. Power shall be supplied from unit using field-supplied wiring or from single phase power (120 V) source using included transformer. Field-supplied wiring for communication to the Liebert® Mini-Mate2 and to other systems shall be required to access features.

Provide indicated quantities of the following:

Leak Detection System(s) Model\_\_\_\_\_

Remote Monitor(s) Model\_\_\_\_\_

Auto-changeover Control(s) Model\_\_\_\_\_

### 2.6.8 Drycooler

The Liebert drycooler shall be a low-profile, direct-drive propeller fan-type air-cooled unit. The drycooler shall be constructed with an aluminum cabinet and a copper-tube aluminum fin coil and single direct drive fan. All electrical connections and controls shall be enclosed in an integral, NEMA 3R rated electrical panel section of the drycooler. The drycooler shall be quiet and corrosion resistant. The drycooler shall be designed for \_\_\_\_ °F (\_\_\_ °C) ambient.

### 2.6.9 Glycol Pump Package

The system shall include a centrifugal pump mounted in a weatherproof and vented enclosure. The pump shall be rated for \_\_\_\_ GPM (l/s) at \_\_\_\_ ft. (kPa) of head, and operate on \_\_\_\_ volt, \_\_\_\_ phase, \_\_\_\_Hz.

## 3.0 EXECUTION

### 3.1 Installation of Air Conditioning Unit

#### 3.1.1 General

Install air conditioning unit in accordance with manufacturer's installation instructions. Install unit plumb and level, firmly anchored in location indicated, and maintain manufacturer's recommended clearances.

#### 3.1.2 Electrical Wiring

Install and connect electrical devices furnished by manufacturer but not specified to be factory-mounted. Furnish copy of manufacturer's electrical connection diagram submittal to electrical contractor. Install and wire per local and national codes.

#### 3.1.3 Piping Connections

Install and connect devices furnished by manufacturer but not specified to be factory-mounted. Furnish copy of manufacturer's piping connection diagram submittal to piping contractor.

#### 3.1.4 Supply and Drain Water Piping

Connect water supply and drains to air conditioning unit. Unit drain shall be trapped internally and shall not be trapped externally.

#### 3.1.5 Field-Supplied Pan

A field-supplied pan with drain shall be installed beneath ducted cooling units.

### 3.2 Field Quality Control

Startup air conditioning unit in accordance with manufacturer's start-up instructions. Test controls and demonstrate compliance with requirements.

## Appendix C: Submittal Drawings

The submittal drawings are in the order of document part number (DPN). [Submittal Drawings Contents](#) below, groups the drawings by topic/application.

**Table C.1 Submittal Drawings Contents**

Document Number	Title
<b>Planning Dimensions - Self-contained Units and Split System Evaporators/Chilled Water Units</b>	
DPN000172	Cabinet Dimensions
DPN000173	Filter Box and Grille Option Dimensions
DPN000177	Condenser Fan Module Dimensions
<b>Planning Dimensions - Outdoor Condensing Units</b>	
DPN004418	Cabinet Dimensions, Prop Fan Condensing Unit with Horizontal Air dScharge
DPN003094	Optional Anchorage Plan, Prop Fan Condensing Unit with Horizontal Air Discharge
<b>Piping General Arrangement</b>	
DPN004408	General Arrangement, Split System, Air Cooled
DPN000168	General Arrangement, Self-contained, Air Cooled
DPN000166	General Arrangement, Self-contained, Water/Glycol Cooled
DPN000169	General Arrangement, Water/Glycol Cooled with Free Cooling and Hot Water Reheat Options
DPN000167	General Arrangement, Self-contained, Chilled Water
DPN003822	Multiple Drycoolers and Cooling Units on Common Glycol Loop
<b>Piping Connections - Evaporator and Chilled Water Units</b>	
DPN004302	Piping Connections
<b>Condensate Pump Connection</b>	
DPN000174	Field-installed Pump Connection
<b>Electrical Connections - Evaporator and Chilled Water Units</b>	
DPN000175	Electrical Connections, Air Cooled Units
DPN000176	Electrical Connections, Water/Glycol Cooled and Chilled Water Units
DPN004850	Arrangement and Dimensions, Unit-mounted IS-UNITY-DP for BMS Communication
DPN004911	Arrangement and Dimensions, Wall-mounted IS-UNITY-DP for BMS Communication
DPN004854	Electrical Connections, IS-UNITY-DP for BMS Communication
<b>Electrical Connections - Air Cooled Condenser Blower</b>	
DPN000177	Electrical Connections, Air Cooled Condenser Blower

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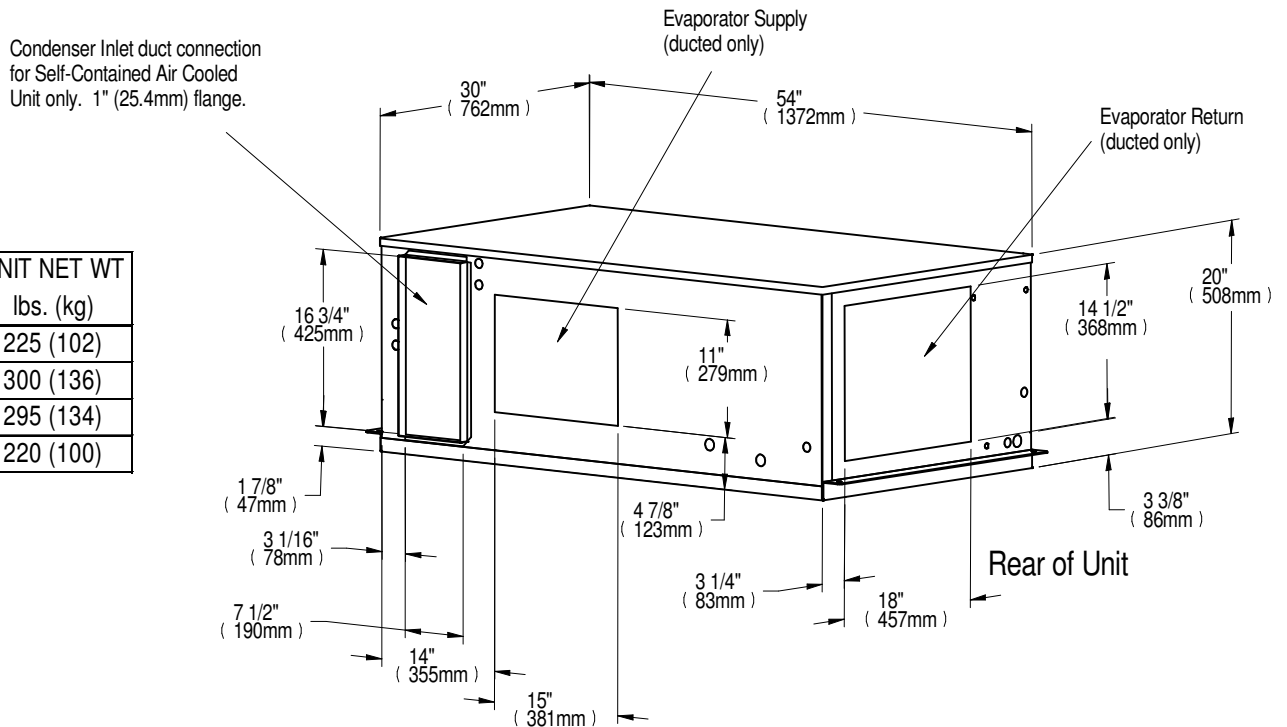
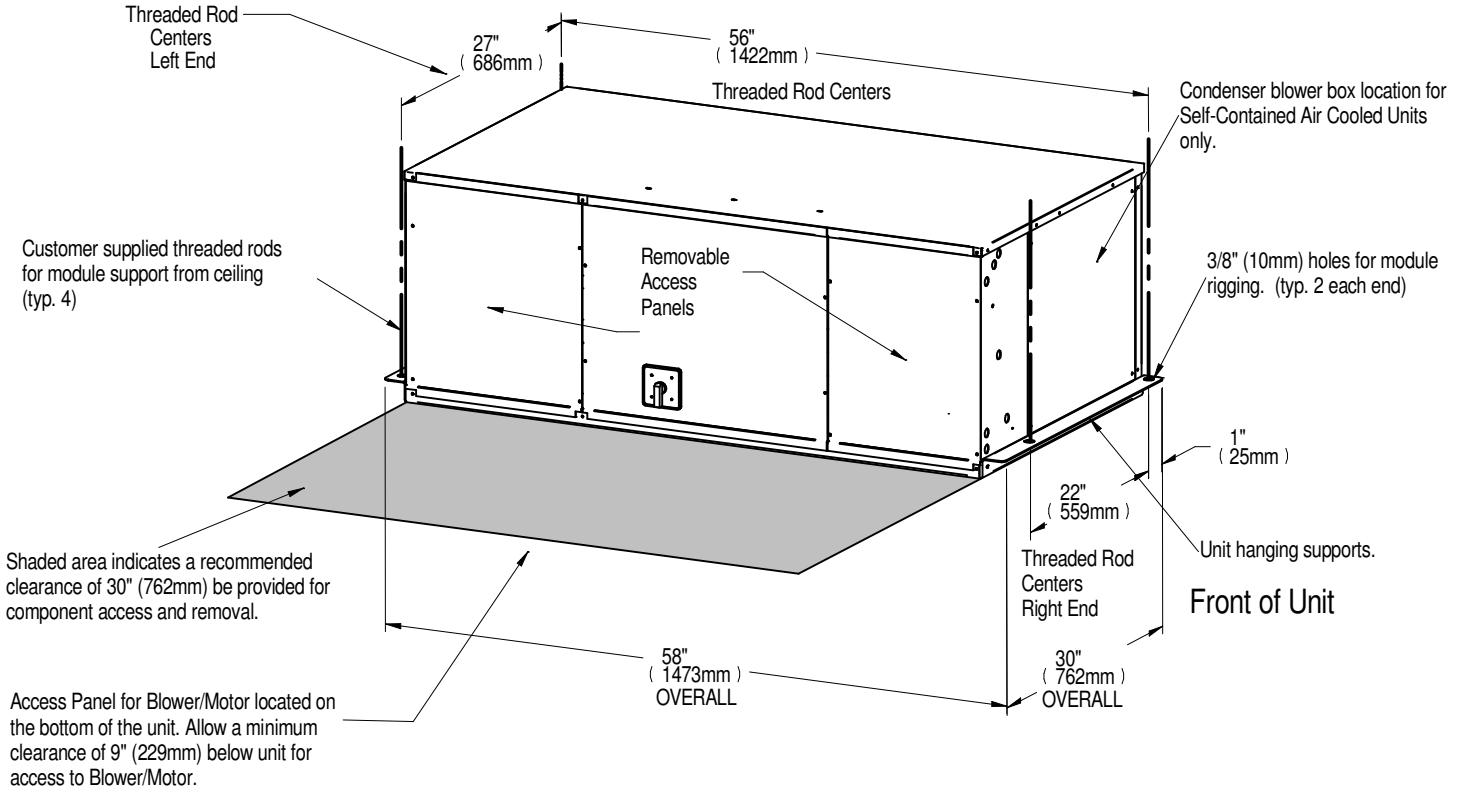


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# LIEBERT® MINI-MATE2

## CABINET DIMENSIONAL DATA

### 1.5 TON AIR, WATER/GLYCOL & CHILLED WATER MODELS



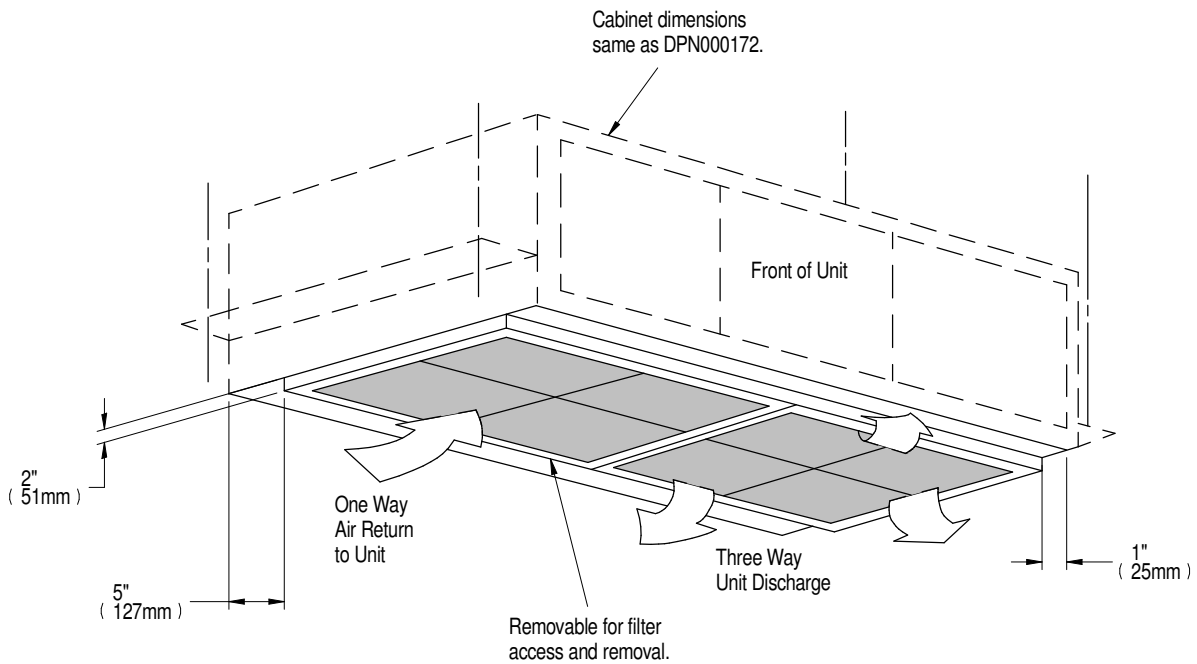
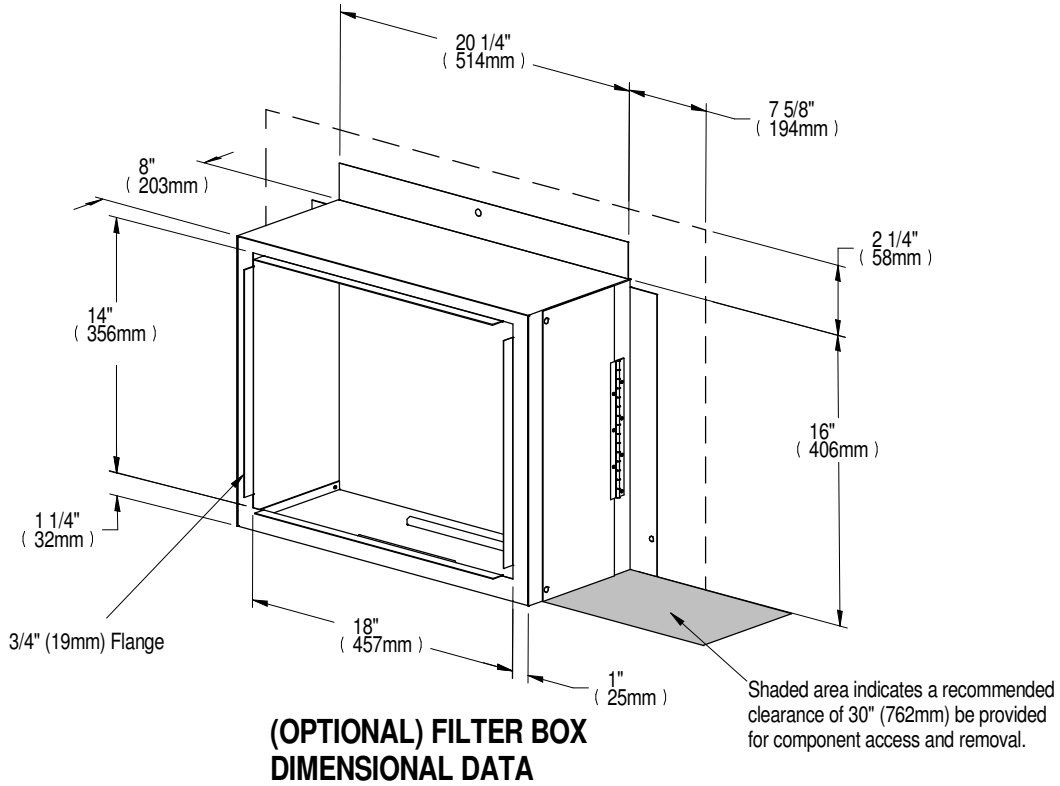
MODEL #	UNIT NET WT
	lbs. (kg)
60 HZ	
MM*18E	225 (102)
MM*18A	300 (136)
MM*20W	295 (134)
MM*23C	220 (100)



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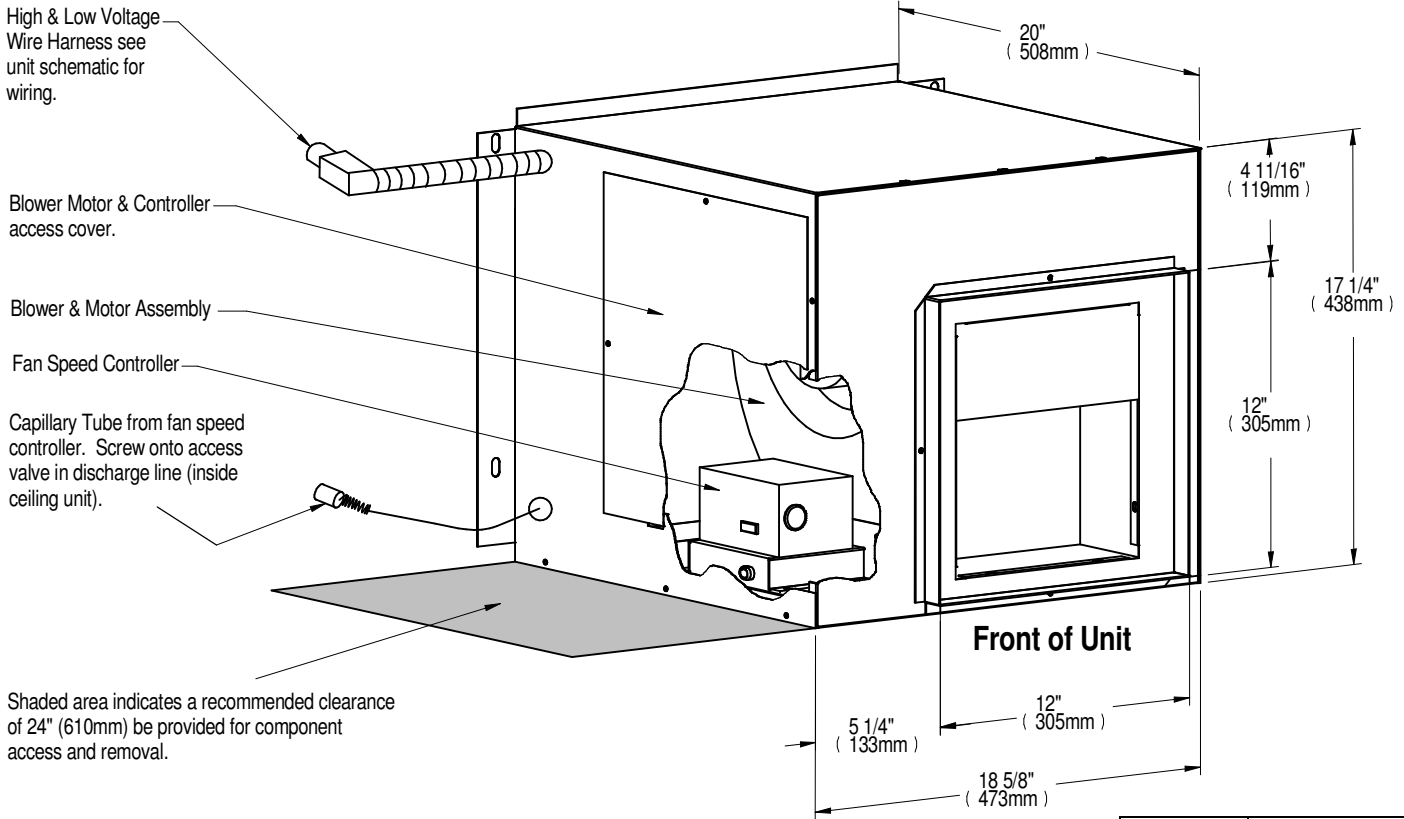
# LIEBERT® MINI-MATE2

## UNIT OPTIONS DIMENSIONAL DATA 1.5 TON AIR, WATER/GLYCOL & CHILLED WATER MODELS

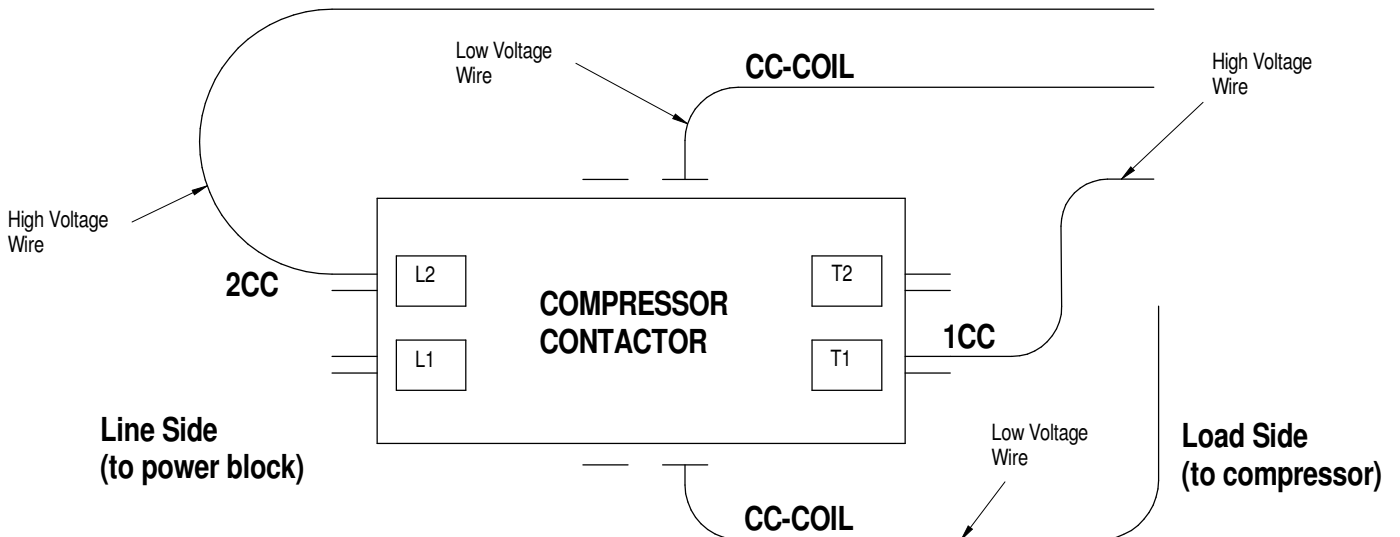


# LIEBERT® MINI-MATE2

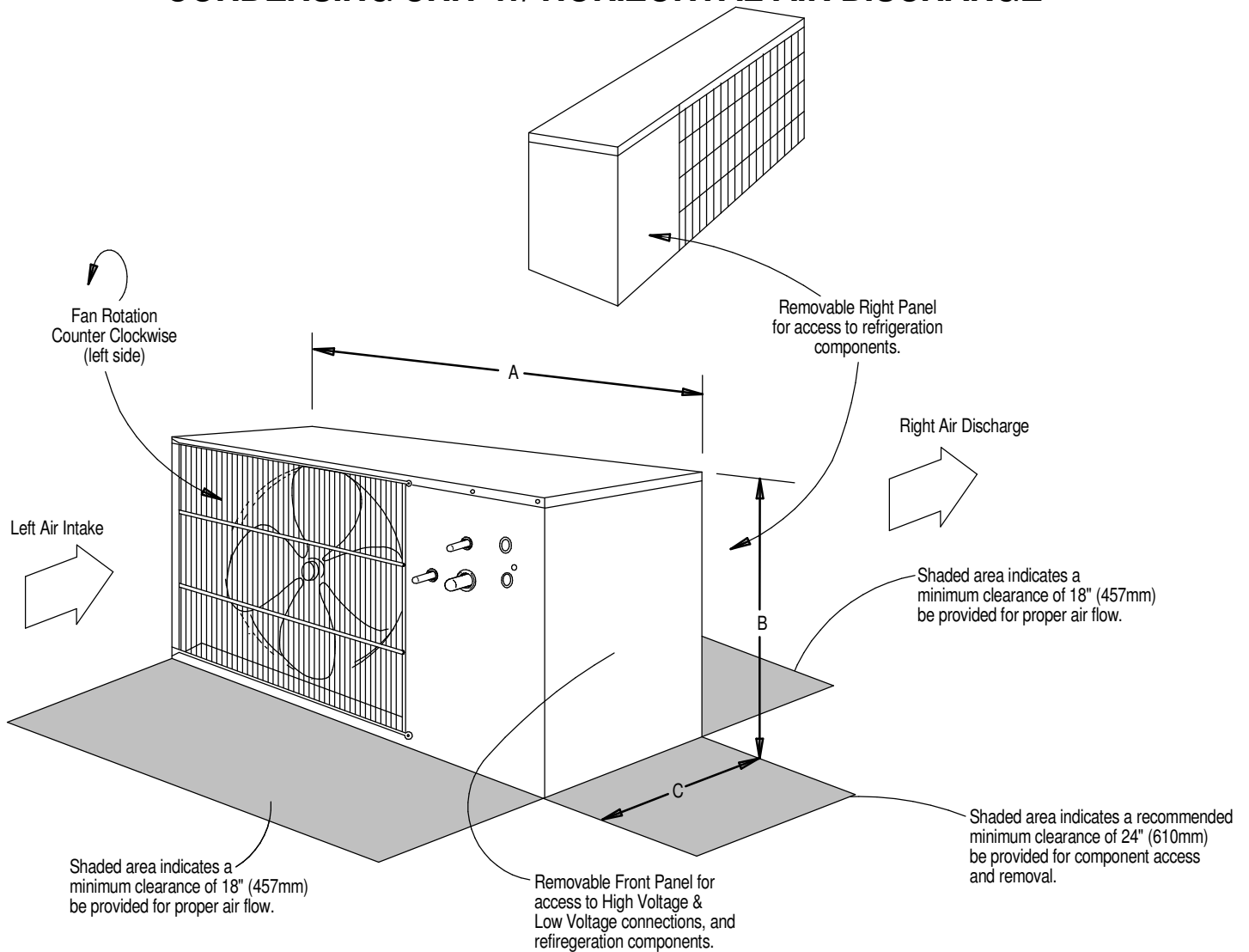
## CABINET DIMENSIONAL DATA & ELECTRICAL FIELD CONNECTIONS 1.5 TON FSC CONDENSER FAN MODULE



Model	Unit Net Weight lbs. (kg)
MM2CF	63 (29)

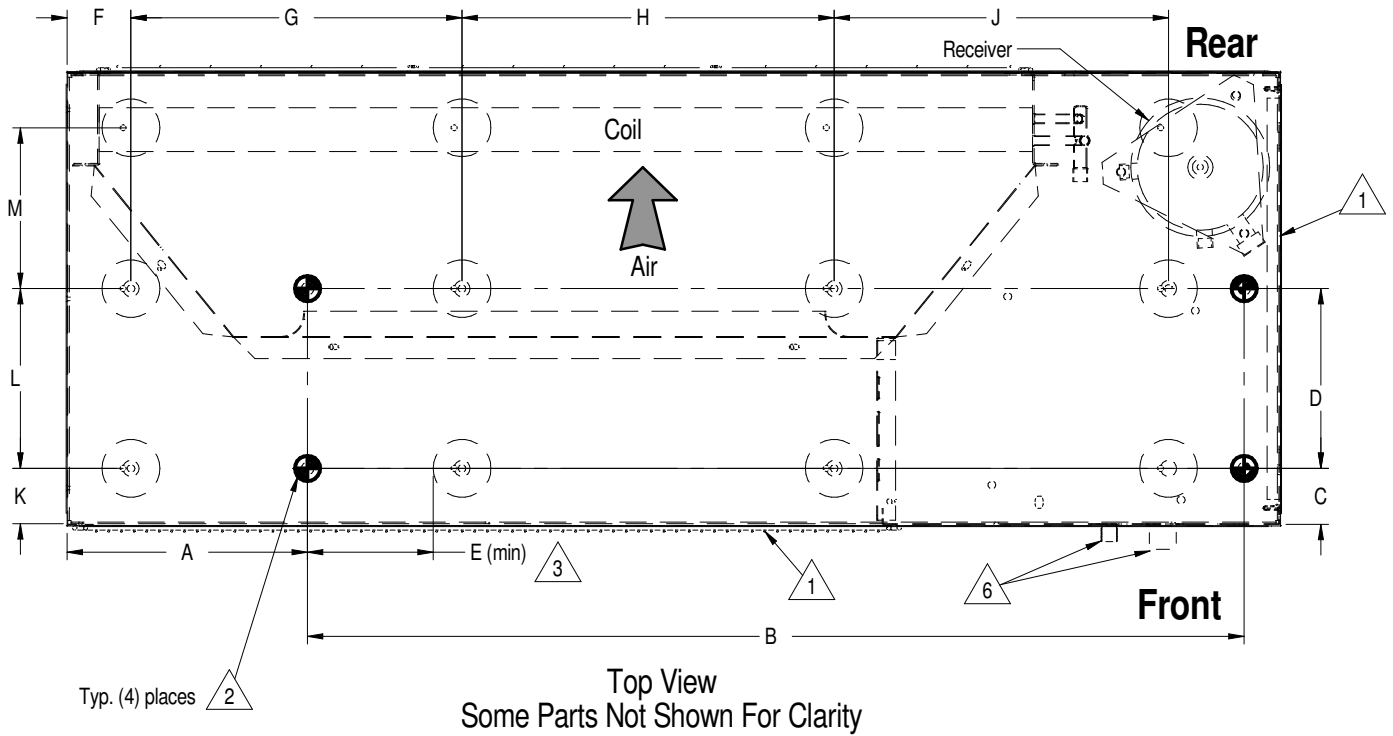


## CABINET DIMENSIONAL DATA CONDENSING UNIT W/ HORIZONTAL AIR DISCHARGE



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

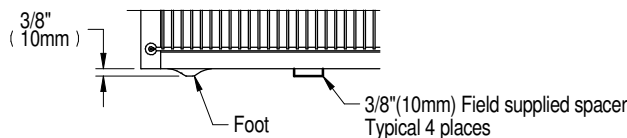
## OPTIONAL ANCHORAGE PLAN



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

Notes:

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



Partial Front View

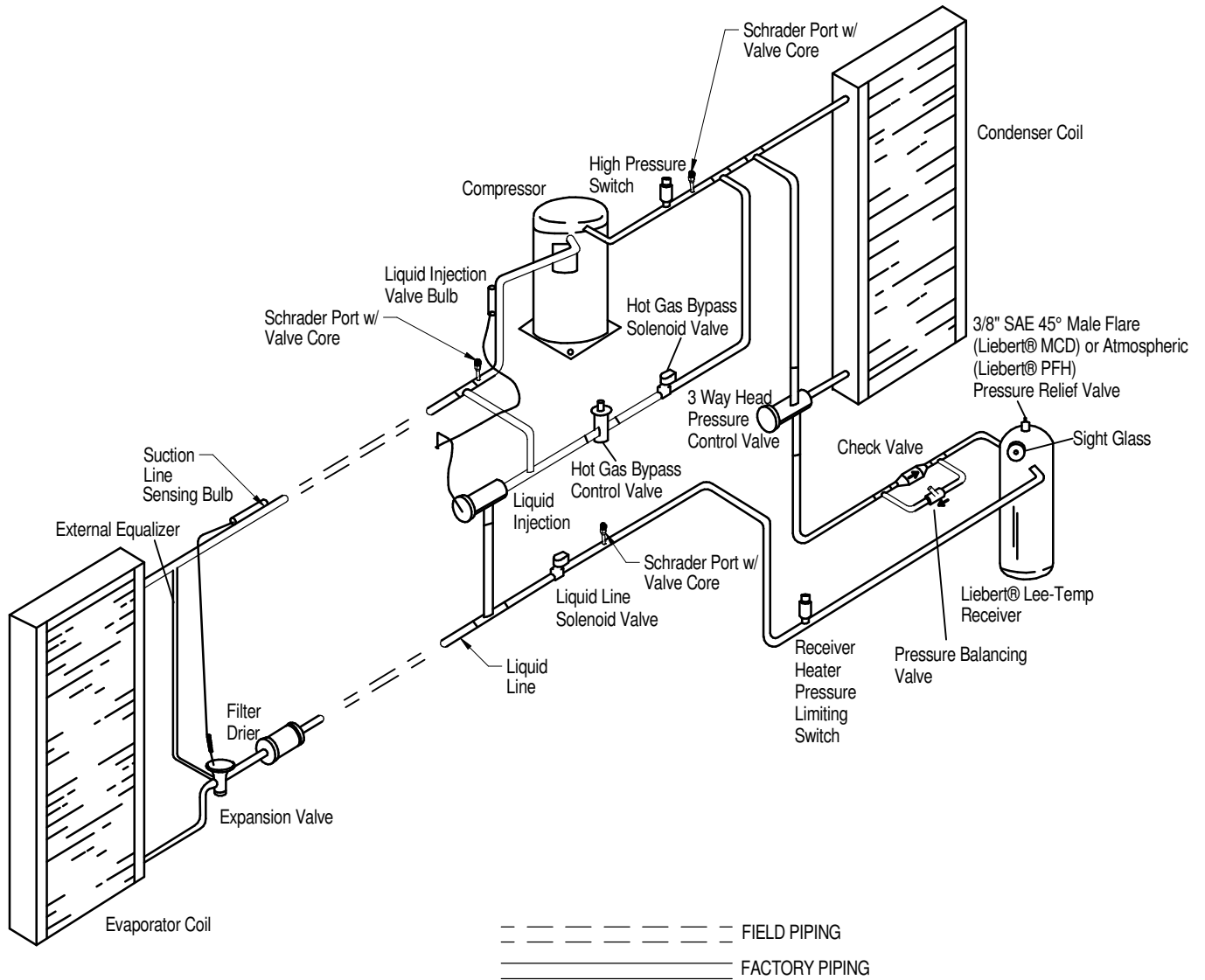


**VERTIV**

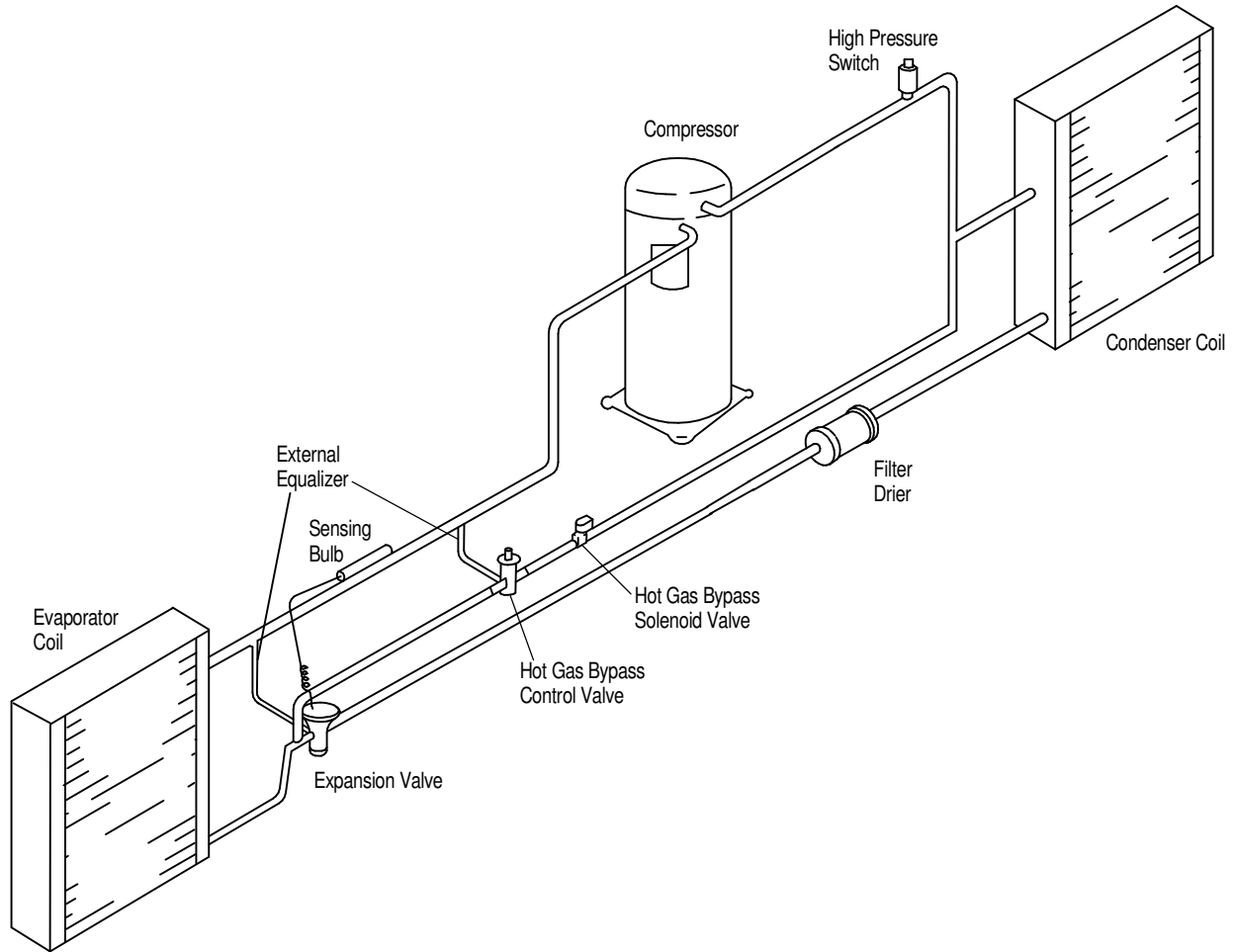
# LIEBERT® MCD & LIEBERT® PFH

## GENERAL ARRANGEMENT DIAGRAM

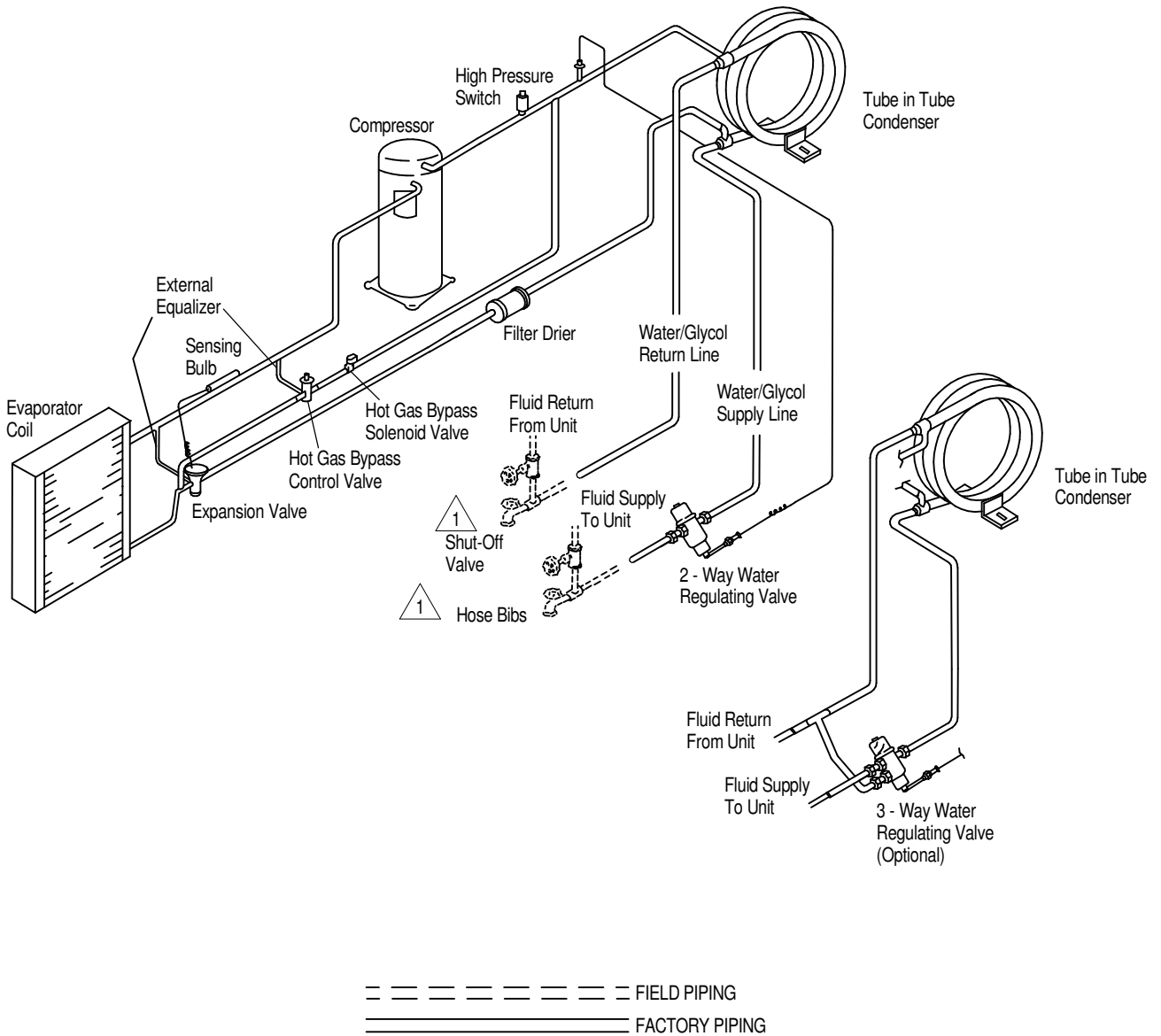
### 1.5 TON SPLIT SYSTEMS W/ AIR COOLED CONDENSING UNIT



## GENERAL ARRANGEMENT DIAGRAM 1.5 TON SELF CONTAINED AIR COOLED SYSTEM



## GENERAL ARRANGEMENT DIAGRAM 1.5 TON SELF CONTAINED WATER/GLYCOL COOLED SYSTEM

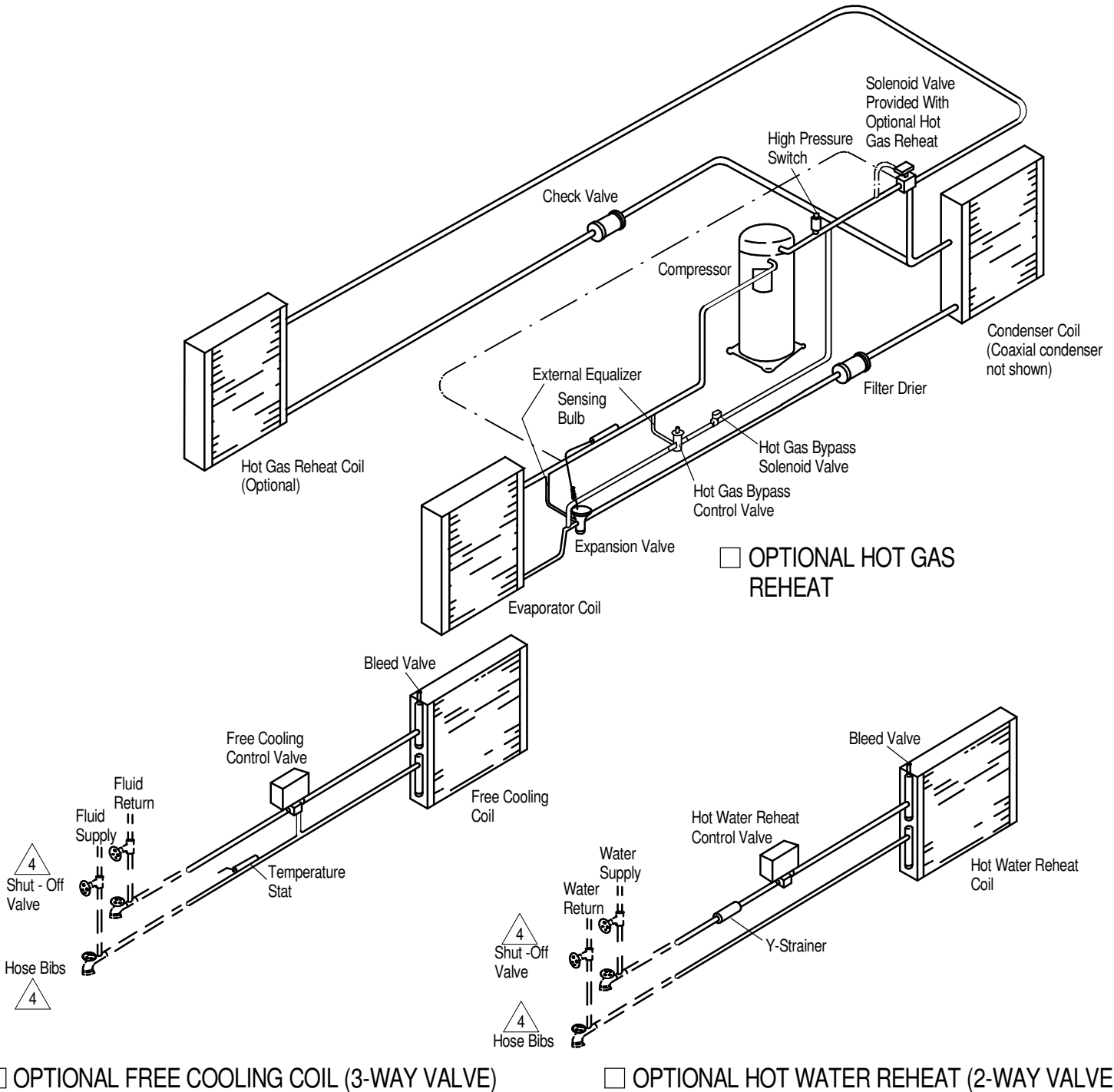


Notes:

1. Components are not supplied by Vertiv but are required for proper circuit operation and maintenance.




## GENERAL ARRANGEMENT DIAGRAM 1.5 TON FREE COOLING OR HOT WATER REHEAT COIL OPTIONS



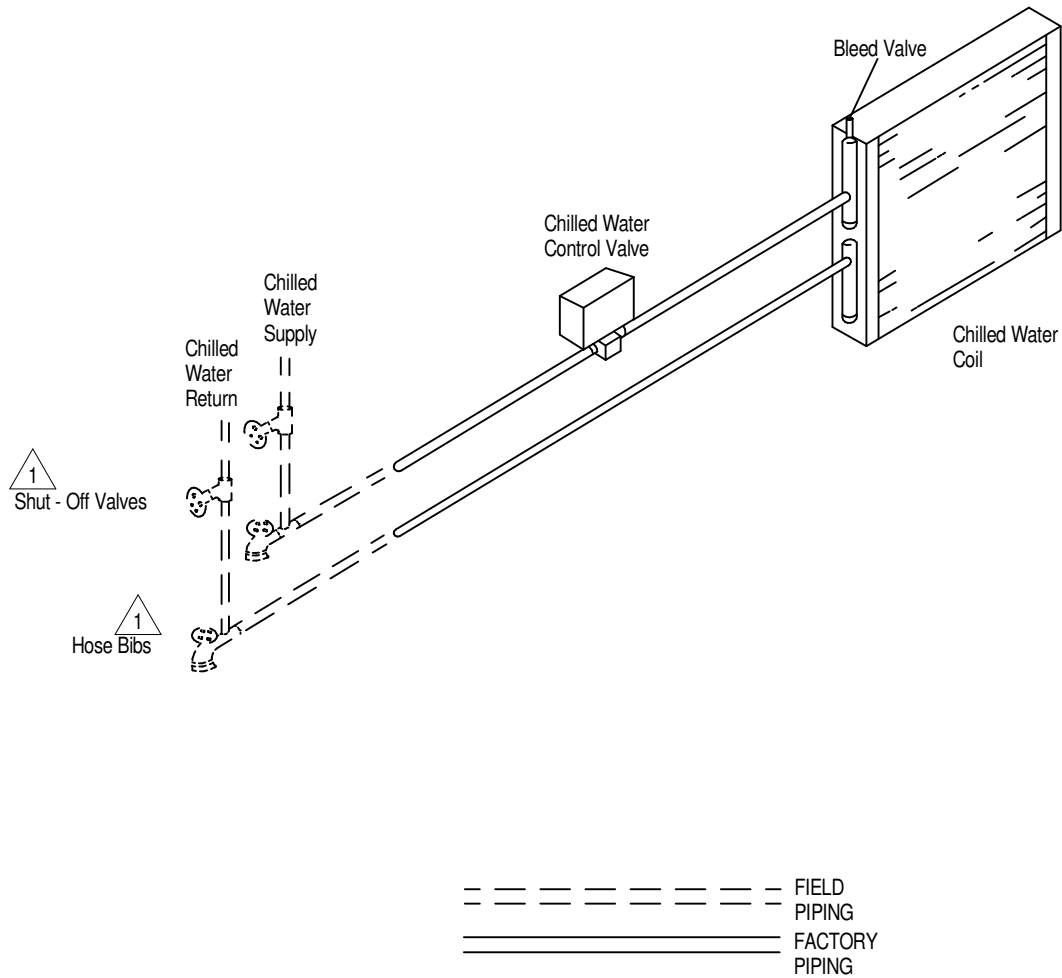
**Notes:**

1. Hot Gas Reheat is available only on self contained "DX" modules. Air Cooled piping shown, Also available on water and glycol models.
2. Hot Water Reheat Coil only available on Chilled Water units.
3. Each module is available with only one (1) of the above listed options.

 Components are not supplied by Vertiv but are required for proper circuit operation and maintenance.

--- FIELD PIPING  
 - - - - - OPTIONAL PIPING  
 \_\_\_\_\_ FACTORY PIPING

## GENERAL ARRANGEMENT DIAGRAM 1.5 TON SELF CONTAINED CHILLED WATER SYSTEM



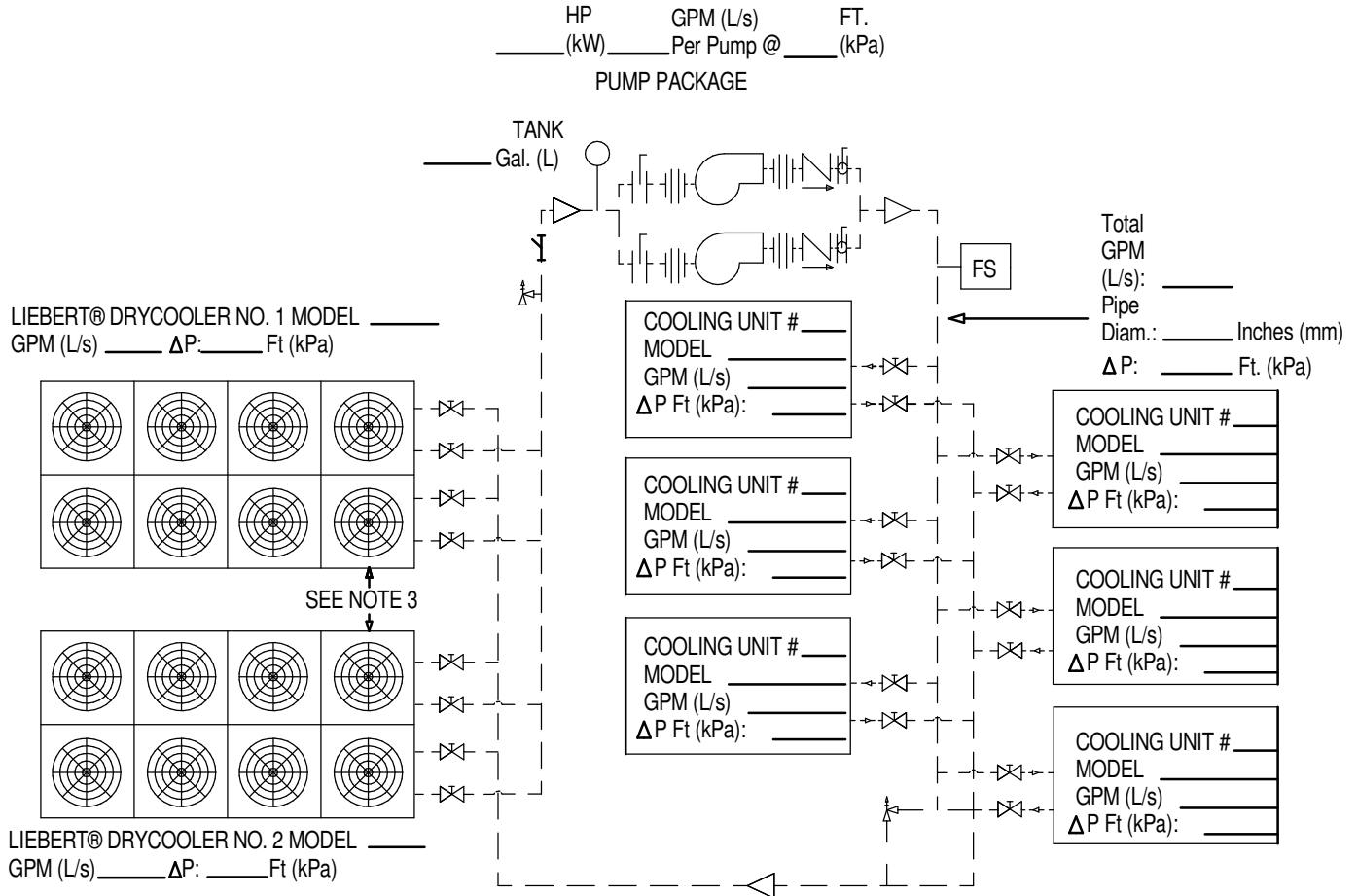
Notes:

1. Components are not supplied by Vertiv but are required for proper operation and maintenance.



# LIEBERT® DRYCOOLER

## PIPING SCHEMATIC MULTIPLE DRYCOOLERS & COOLING UNITS ON COMMON GLYCOL LOOP



### LEGEND

- GATE VALVE
- CHECK VALVE
- BUTTERFLY VALVE
- RELIEF VALVE
- UNION
- BALL OR FLOW CONTROL VALVE
- FLOW SWITCH
- $\Delta P$ : PRESSURE DROP
- STRAINER/FILTER

### NOTES:

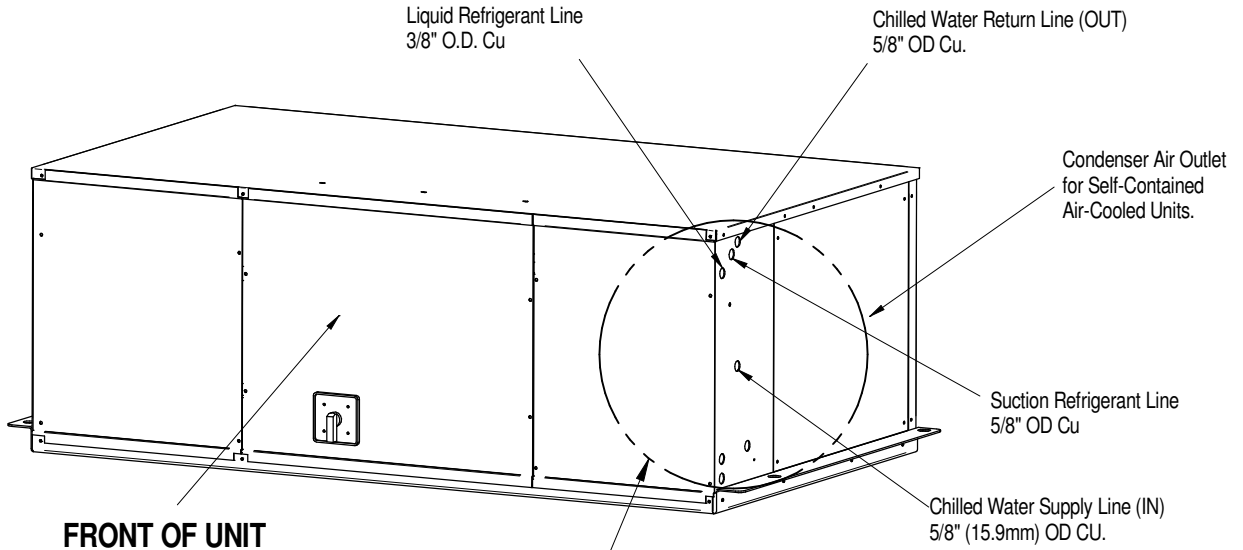
1. PRESSURE AND TEMPERATURE GAUGES (OR PORTS FOR SAME) ARE RECOMMENDED TO MONITOR COMPONENT PRESSURE DROPS AND PERFORMANCE.
2. FLOW MEASURING DEVICES, DRAIN AND BALANCING VALVES TO BE SUPPLIED BY OTHERS AND LOCATED AS REQUIRED.
3. SEE PRODUCT LITERATURE FOR INSTALLATION GUIDELINES AND CLEARANCE DIMENSIONS.
4. DRAWING SHOWS DUAL PUMP PACKAGE. ALTERNATE PUMP PACKAGES WITH MORE PUMPS MAY BE CONSIDERED, CONSULT SUPPLIER.
5. DEPENDING ON THE LIEBERT® DRYCOOLER COIL CIRCUITING IT MAY HAVE 2 IN/OUT OR 4 IN/OUT CONNECTION POINTS.
6. INSTALL EXPANSION OR COMPRESSION TANK AT THE HIGHEST POINT OF THE SYSTEM.



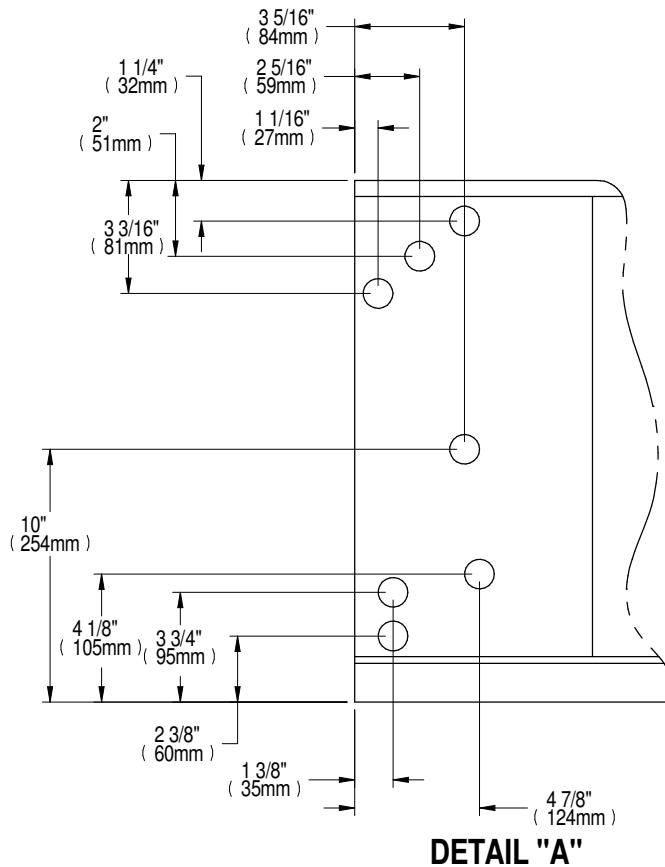
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# LIEBERT® MINI-MATE2

## PRIMARY CONNECTION LOCATIONS 1.5 TON AIR, WATER/GLYCOL & CHILLED WATER MODELS



**See Detail A**

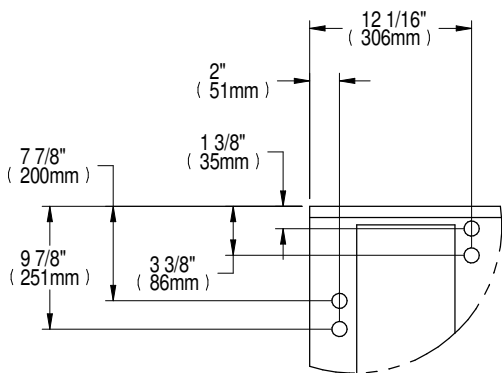
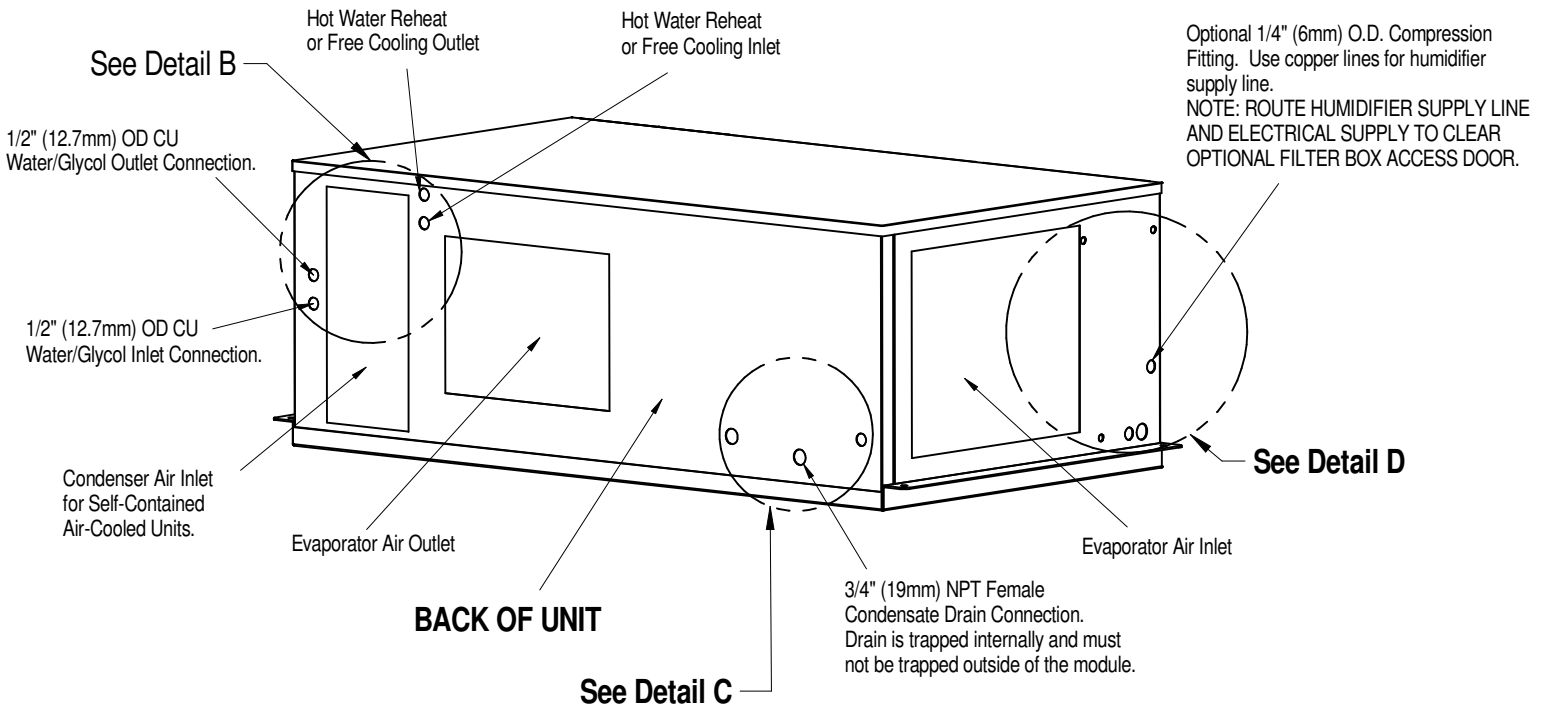




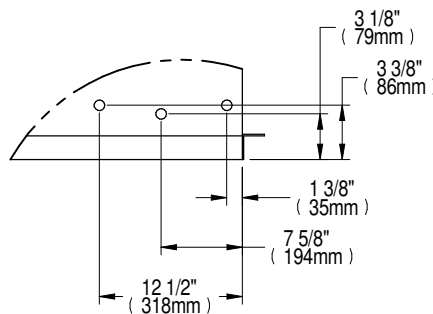
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# LIEBERT® MINI-MATE2

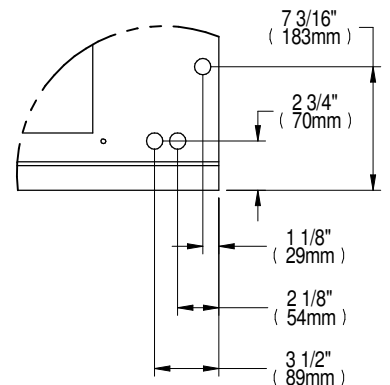
## PRIMARY CONNECTION LOCATIONS 1.5 TON AIR, WATER/GLYCOL & CHILLED WATER MODELS



**DETAIL "B"**



**DETAIL "C"**



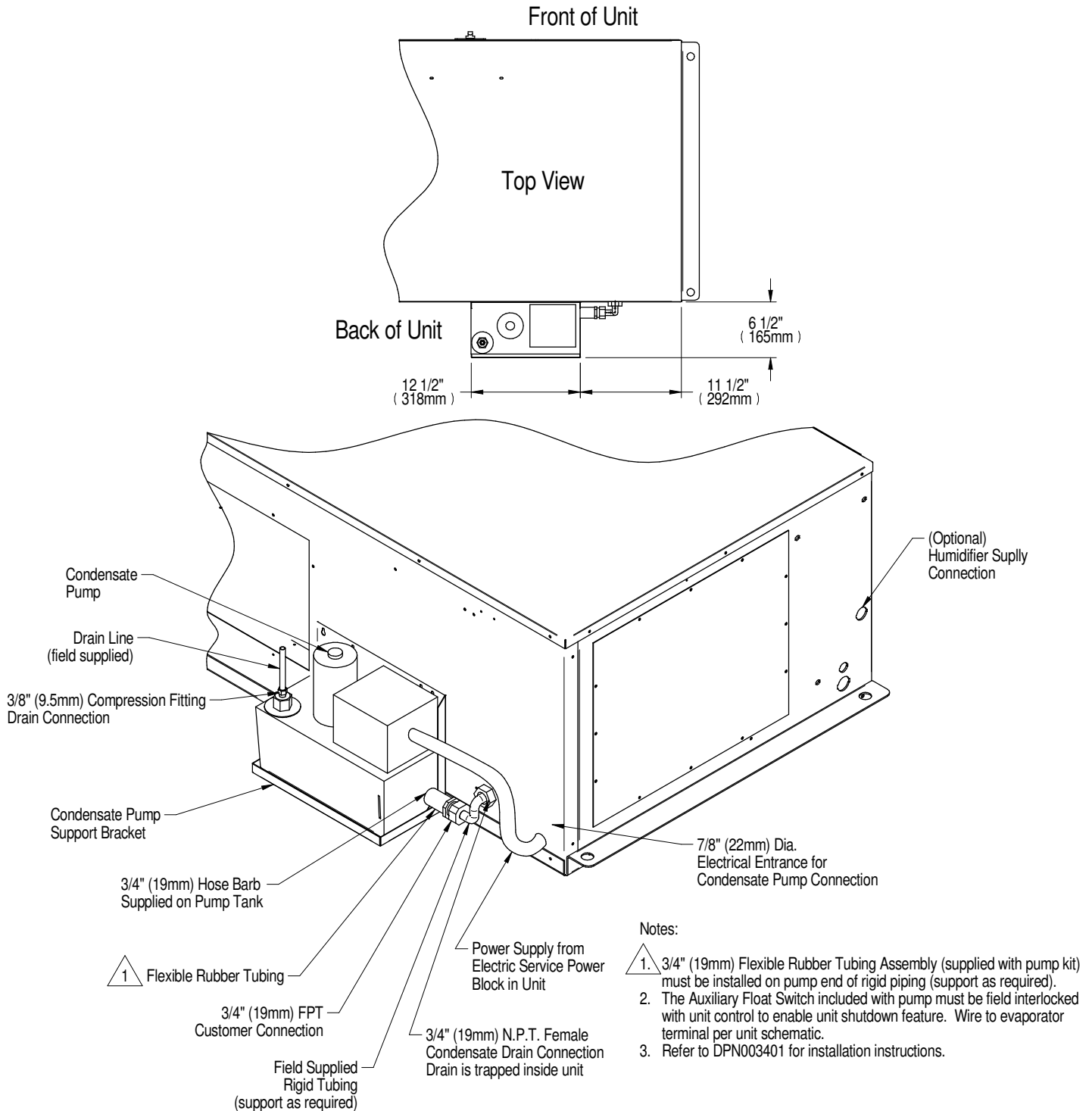
**DETAIL "D"**



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# LIEBERT® MINI-MATE2

## OPTIONAL FIELD INSTALLED CONDENSATE PUMP CONNECTION 1.5 TON MODELS



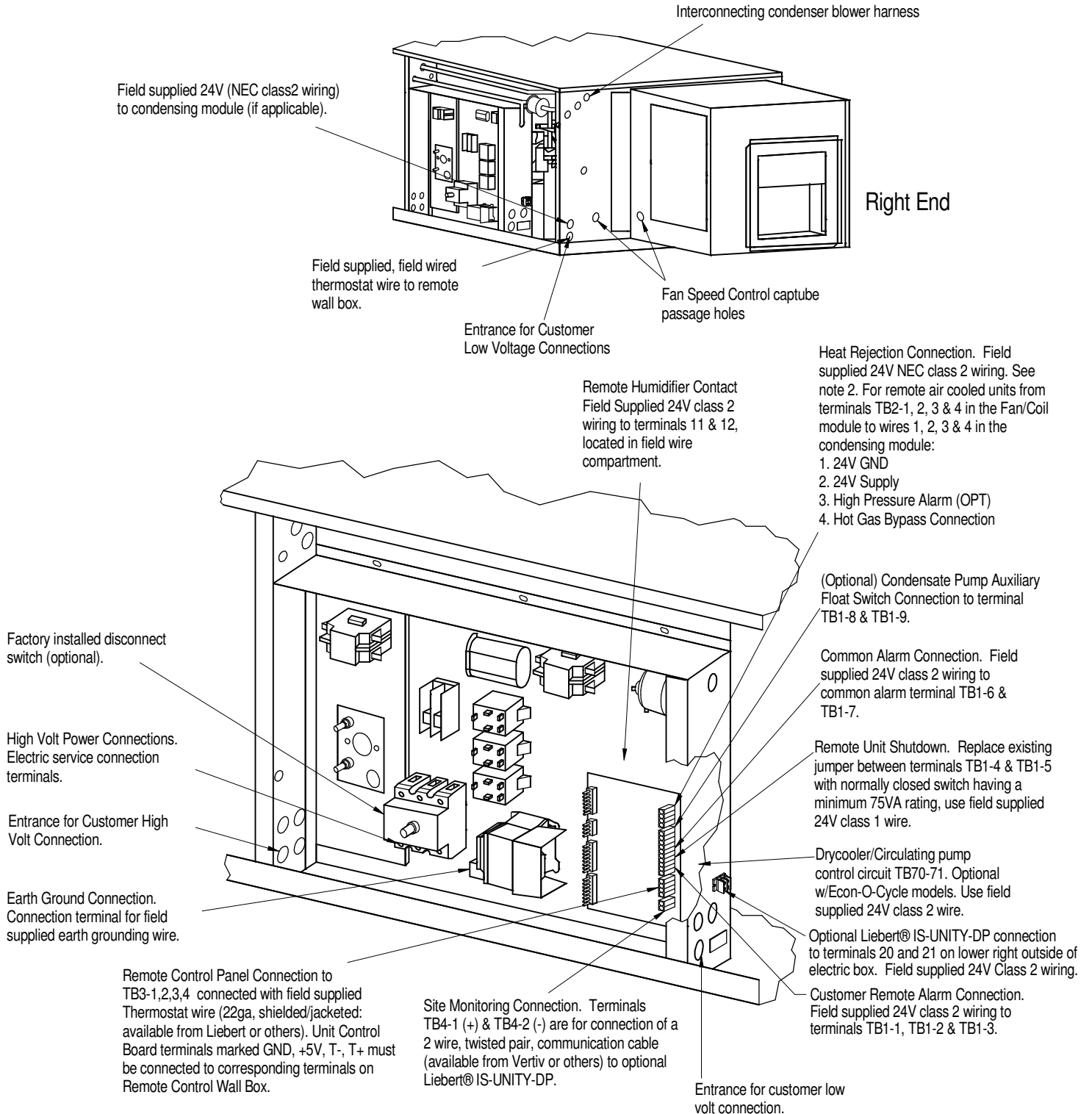


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# LIEBERT® MINI-MATE2

## ELECTRICAL FIELD CONNECTIONS

### 1.5 TON AIR, WATER/GLYCOL & CHILLED WATER MODELS



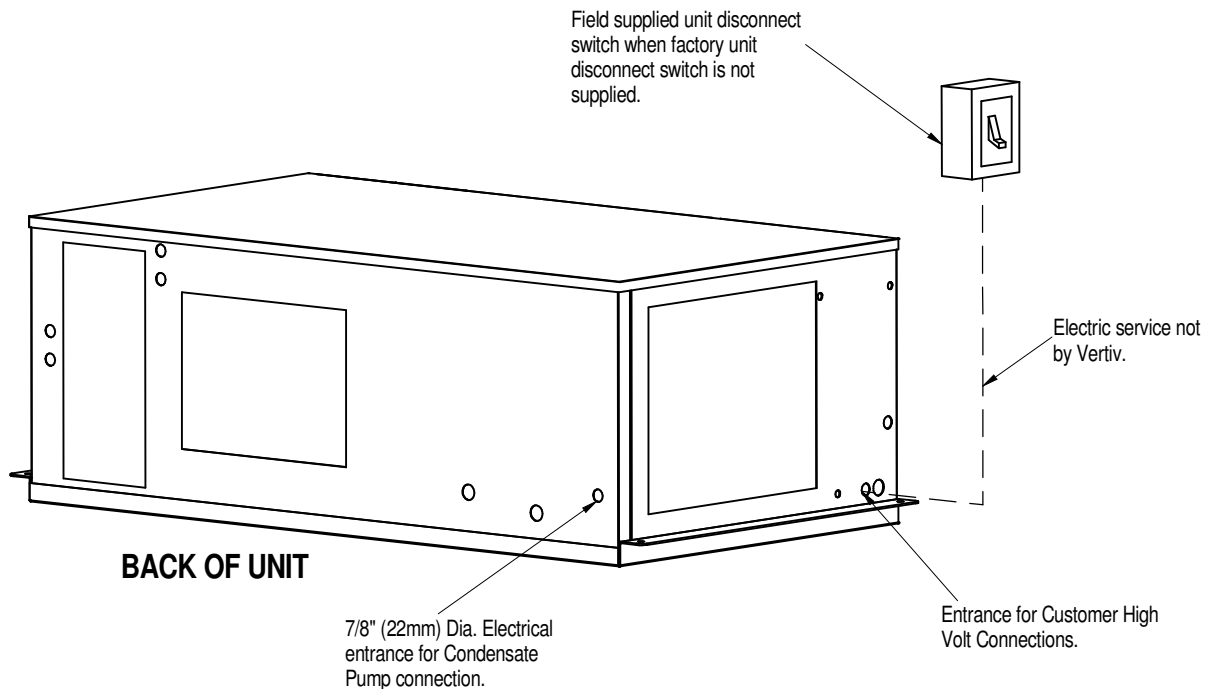
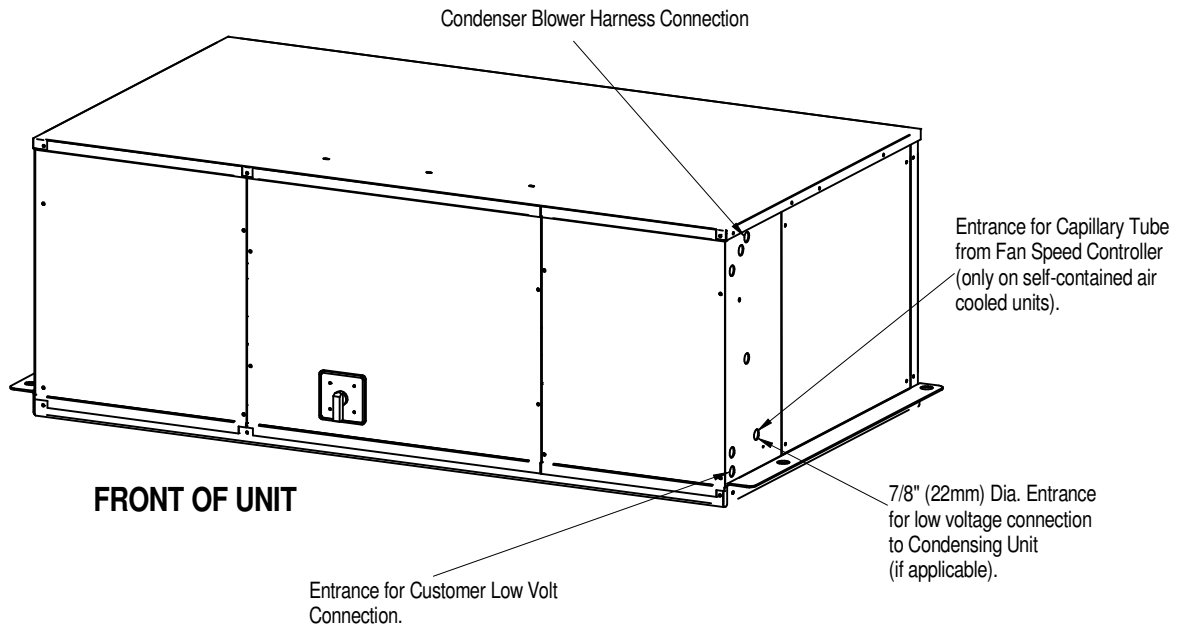
**NOTES:**

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

Form No.: DPN001040\_REV14

# LIEBERT® MINI-MATE2

## ELECTRICAL FIELD CONNECTIONS 1.5 TON AIR, WATER/GLYCOL & CHILLED WATER MODELS



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

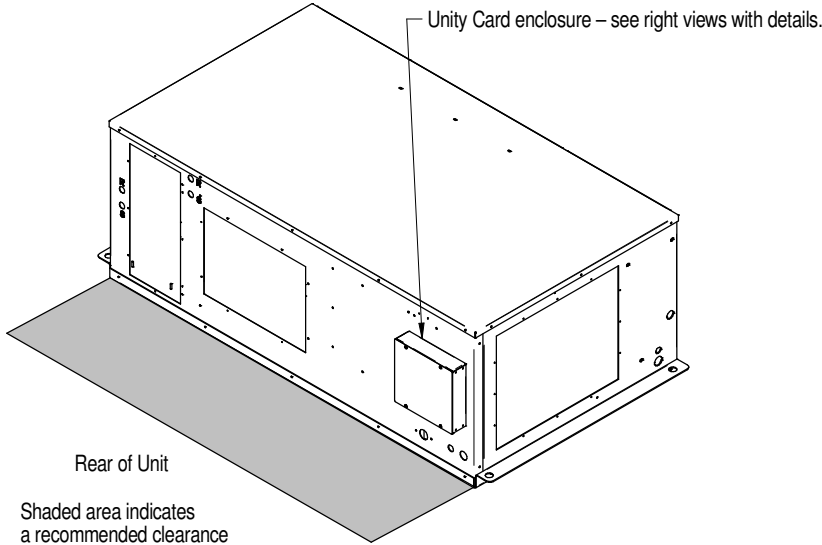




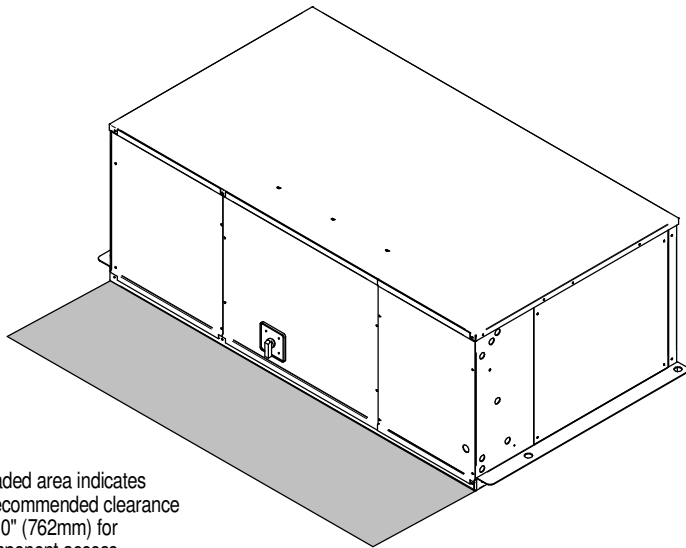
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# LIEBERT® MINI-MATE2

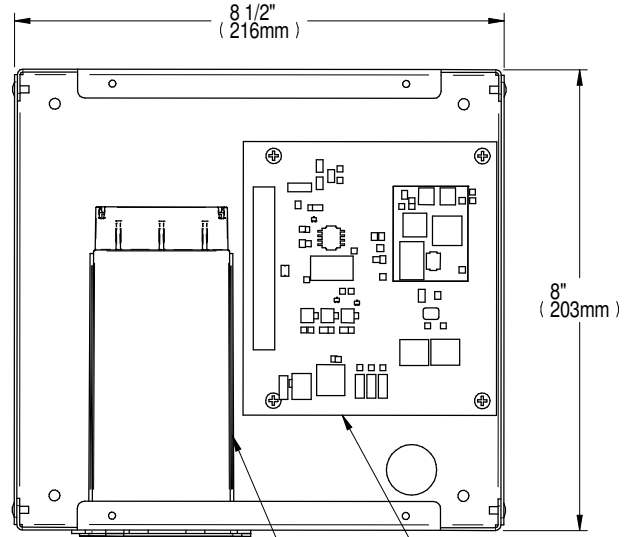
## GENERAL ARRANGEMENT & DIMENSIONAL DATA UNIT MOUNTED LIEBERT® IS-UNITY-DP ON 1.5 TON FOR BMS CONNECTIVITY



Shaded area indicates a recommended clearance of 30" (762mm) for component access and removal

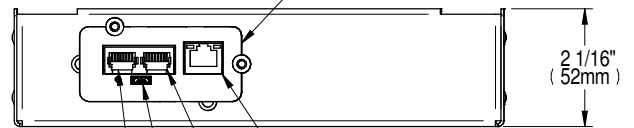


Shaded area indicates a recommended clearance of 30" (762mm) for component access and removal



Cover removed for clarity. Removal not required for making field communication connections.

Liebert® IS-UNITY-DP CARD



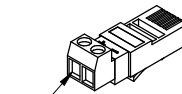
ETHERNET port

RS-485 port (using adaptor)

NOT USED

NOT USED

### BOTTOM VIEW



Adaptor plugged into BMS 485 port when unit is shipped

#### Notes:

1. Refer to DPN004854 for field communication connections.

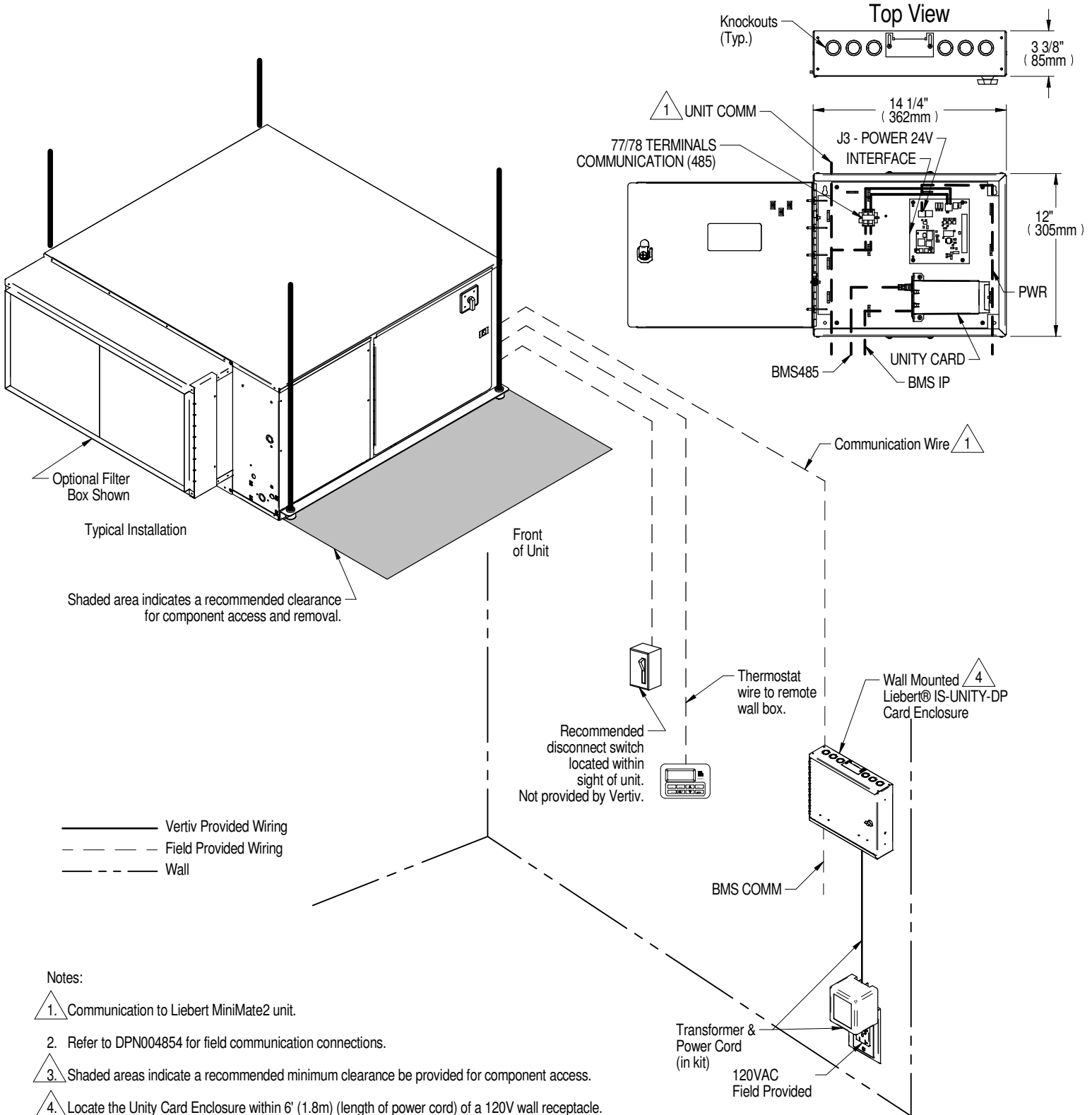


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# LIEBERT® MINI-MATE2

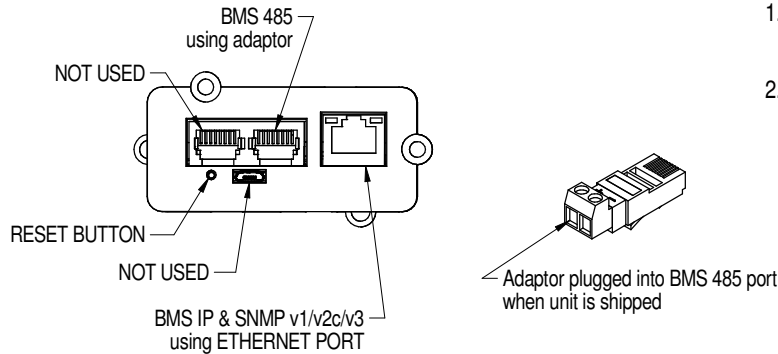
## GENERAL ARRANGEMENT & DIMENSIONAL DATA

### WALL MOUNTED LIEBERT® IS-UNITY-DP CARD FOR BMS CONNECTIVITY



## BMS COMMUNICATION CONNECTION OPTIONS LIEBERT® MINI-MATE2 & LIEBERT® DATAMATE

**BMS IP/485**  
(1 Cooling Unit only)



1. Building Management System (BMS) Protocols
  - \*BACNet over IP/485
  - \*Modbus over IP/485
2. Communication wiring is field supplied
  - IP - use CAT5e cable or greater
  - 485 - use EIA 485 rated, shielded, twisted pair cable, 22-18AWG.
  - Must be rated to meet local codes and conditions.

### UNIT TO INTERFACE BOARD CONNECTIONS

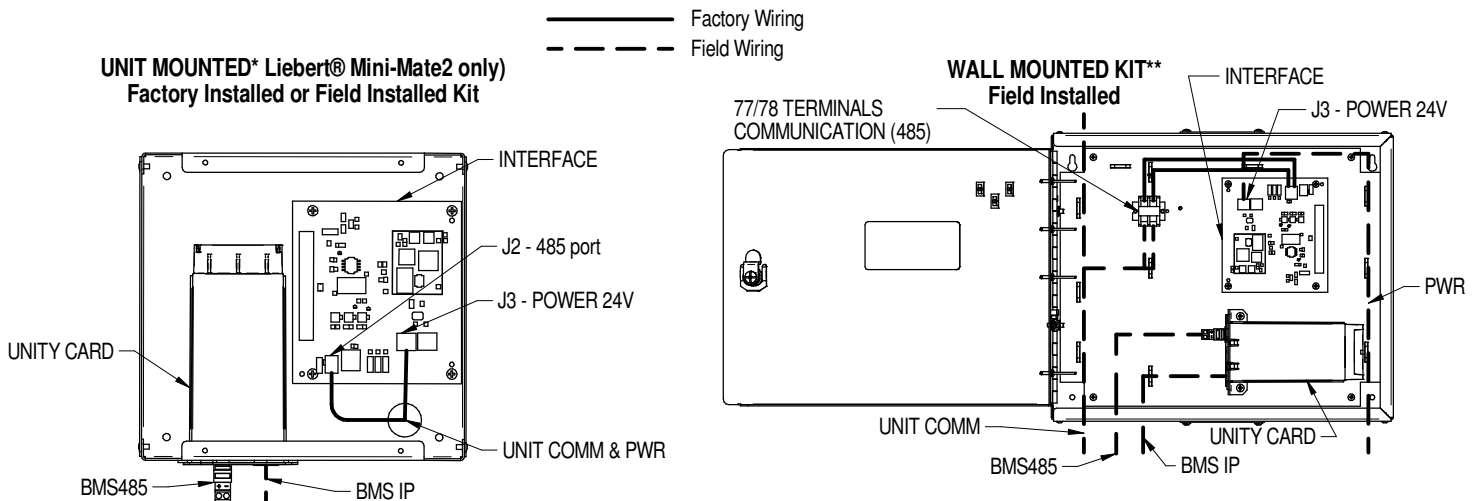
	UNIT		UNIT MOUNTED KITs*		WALL MOUNTED KITs**	
	TERMINAL/PLUG	POSITION	TERMINAL/PLUG	POSITION	TERMINAL/PLUG	POSITION
<b>Liebert® Mini-Mate2 1-5 Ton</b>						
COMMUNICATION (485)	TB4	1 / 2	J2	2 / 1	77 / 78	N/A
POWER 24V	20, 21	N/A	J3	1 / 2	J3	1 / 2
<b>Liebert® Mini-Mate2 8 Ton</b>						
COMMUNICATION (485)	77, 78	N/A	J2	2 / 1	77 / 78	N/A
POWER 24V	TB1	4 / 8	J3	1 / 2	J3	1 / 2
<b>Liebert® DataMate</b>						
COMMUNICATION (485)	TB5	77 / 78	N/A	N/A	77 / 78	N/A
POWER 24V	N/A	N/A	N/A	N/A	J3	1 / 2

#### Notes

Terminals are presented in order of connection. For example, TB4-1 connects to J2-2.

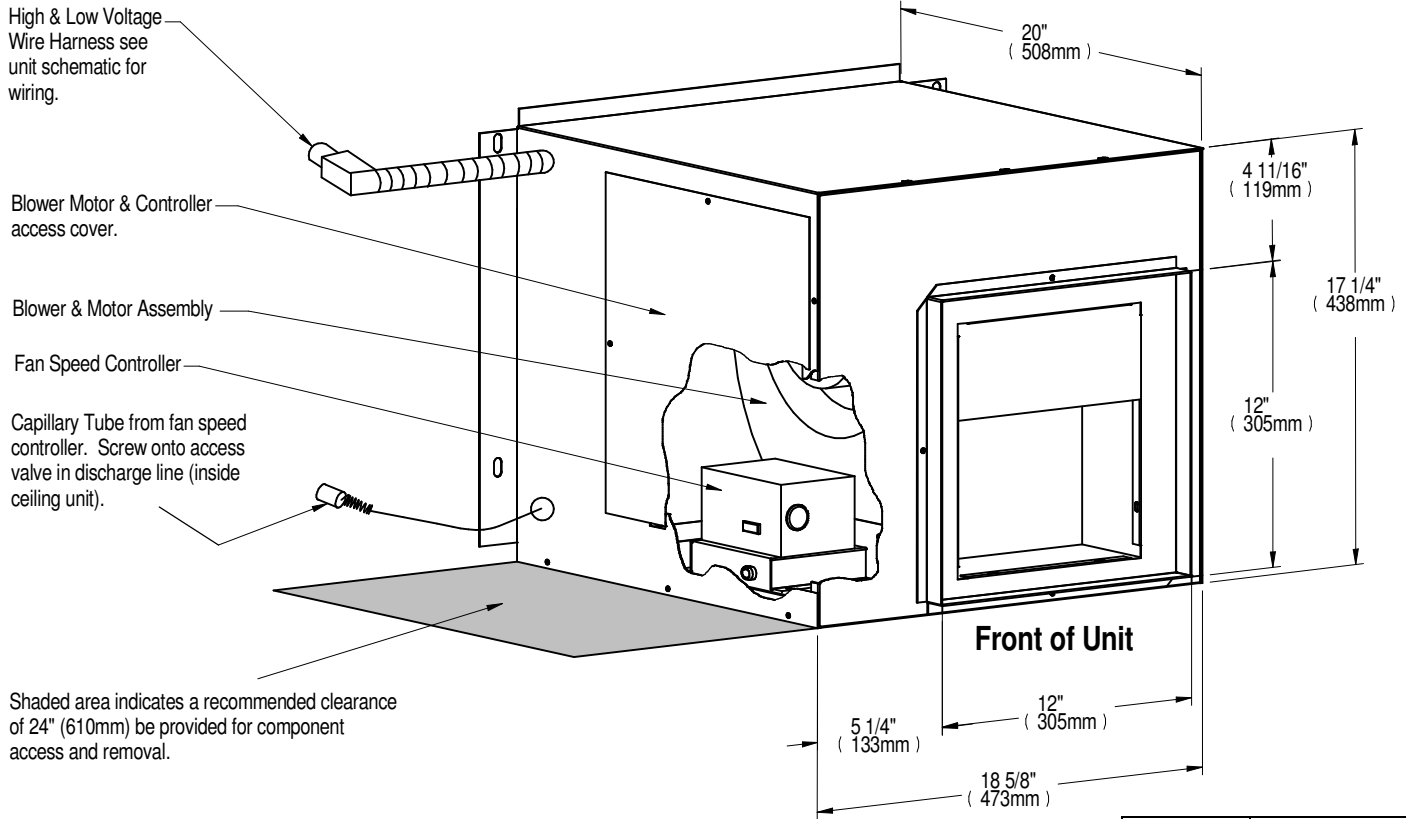
\* Unit mounted kits are provided with Unit Comm & power wire harnesses; BMS Comm are field provided.

\*\* Wall mounted kits are provided with power wire harness and 120 Volt wall outlet transformer. Unit Comm & BMS Comm are field provided.

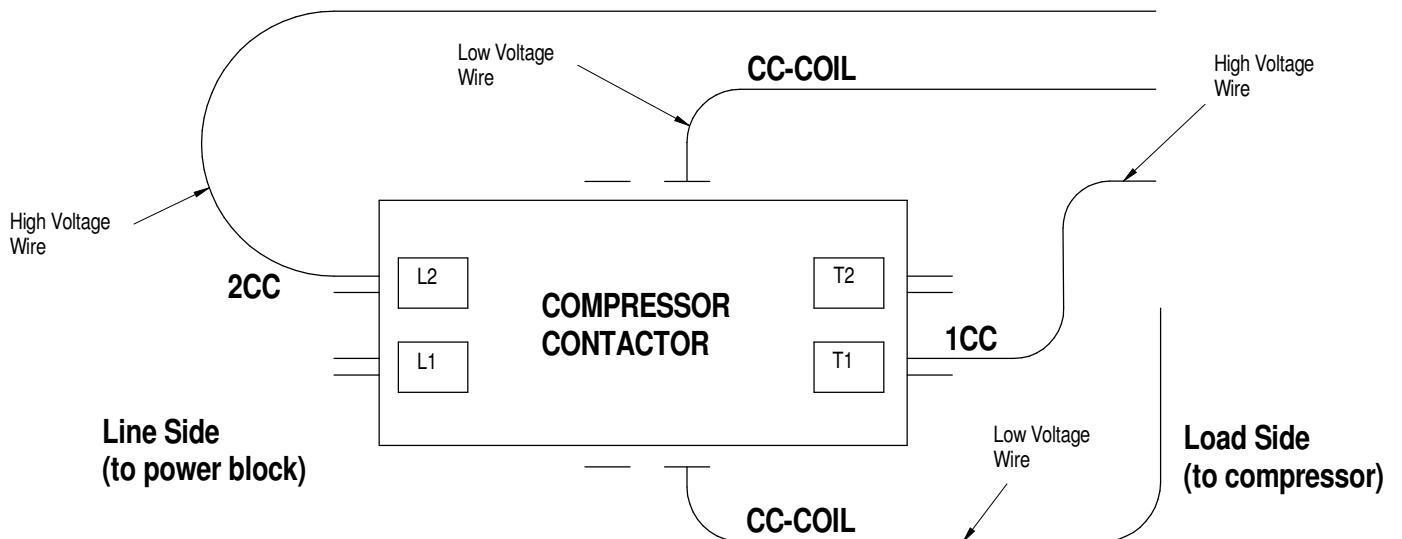


# LIEBERT® MINI-MATE2

## CABINET DIMENSIONAL DATA & ELECTRICAL FIELD CONNECTIONS 1.5 TON FSC CONDENSER FAN MODULE



Model	Unit Net Weight lbs. (kg)
MM2CF	63 (29)



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