



# Liebert<sup>®</sup> Mini-Mate2 Thermal Management System

## **System Design Catalog**

**5-ton (17.5-kW) Capacity, Air, Water, Glycol, Chilled Water; 50 and  
60 Hz**

The information contained in this document is subject to change without notice and may not be suitable for all applications. While every precaution has been taken to ensure the accuracy and completeness of this document, Vertiv assumes no responsibility and disclaims all liability for damages result from use of this information or for any errors or omissions.

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 relation to the application, installation, and operation of this product.

The products covered by this instruction manual are manufactured and/or sold by Vertiv. This document is the property of Vertiv and contains confidential and proprietary information owned by Vertiv. Any copying, use, or disclosure of it without the written permission of Vertiv is strictly prohibited.

Names of companies and products are trademarks or registered trademarks of the respective companies. Any questions regarding usage of trademark names should be directed to the original manufacturer.

### **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.

## TABLE OF CONTENTS

<b>1 Introduction</b> .....	<b>1</b>
1.1 Designed to Match Computer and Electronic Equipment Needs—from Installation to Operation .....	1
1.2 Agency Listed .....	2
<b>2 Features and Options</b> .....	<b>3</b>
2.1 Standard Features .....	3
2.1.1 Evaporator Section—Split Systems .....	3
2.1.2 Condensing Unit Section—Split Systems .....	3
2.1.3 Chilled Water Units .....	3
2.1.4 System Controls .....	4
2.1.5 Sensors and Switches .....	5
2.2 Optional Factory-Installed Features .....	5
2.2.1 Evaporator/Chilled Water Unit Options .....	5
2.2.2 Free Cooling for Evaporator Units .....	6
2.2.3 Optional Configurations—Prop Fan Condensing Units .....	7
2.2.4 Optional Configurations—Water/Glycol Condensing Units .....	7
2.2.5 Optional Configurations—Chilled Water Units .....	7
2.3 Ship Loose Accessories—Field-Installed .....	7
2.3.1 Remote Monitoring, Autochangeover, and Leak Detection Equipment .....	8
<b>3 Nomenclature</b> .....	<b>9</b>
3.1 System Configurations .....	9
3.2 Nomenclature for Evaporator and Chilled Water Units .....	11
3.3 Nomenclature for Split System Condensing units .....	13
3.3.1 Indoor Condensing Units for Air Cooled Split Systems .....	13
3.3.2 Outdoor Prop Fan Condensing Units for Air Cooled Split Systems .....	14
3.3.3 Water/Glycol Cooled Condensing Units .....	15
<b>4 System Data</b> .....	<b>17</b>
4.1 Air Cooled Systems—Capacity and Performance Data .....	17
4.2 Water/Glycol Cooled Systems—Capacity and Performance Data .....	21
4.3 Chilled Water Systems—Capacity and Performance Data .....	25
4.4 Planning Dimensions .....	27
<b>5 Electrical Data</b> .....	<b>29</b>
5.1 Evaporators and Chilled-water Units Electrical Data .....	29
5.2 Indoor Condensing Units Electrical Data .....	31
5.3 Outdoor Condensing Units Electrical Data .....	32
5.4 Electrical Data for Air Cooled Systems Using a Single-point Power Kit .....	33
5.5 Electrical Data for Water/Glycol Cooled Systems Using a Single-point Power Kit .....	36
5.6 Electrical Field Connections .....	38
<b>6 Piping</b> .....	<b>39</b>

6.1 Refrigerant Piping Data .....	40
6.1.1 Refrigerant Charge Requirements .....	40
6.1.2 Refrigerant Line Sizes and Equivalent Lengths .....	40
6.1.3 Piping when Condensing Unit is Above or Below Evaporator .....	41
6.2 Glycol-loop Piping .....	42
<b>Appendices .....</b>	<b>43</b>
Appendix A: Technical Support and Contacts .....	43
Appendix B: Guide Specifications .....	45
Appendix C: Submittal Drawings .....	47

# 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 System 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

The Liebert® Mini-Mate2 is a split-system evaporator combined with an air-, water- or glycol-cooled condensing unit or is a self-contained, chilled-water unit. Each split system has thermostat-type wiring to controls and condensing unit.

### 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 60-Hz 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 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 & Erosion, tested per UL 181 and ASTM 1338 standards.

The evaporator unit includes an evaporator coil, filter-drier, factory-mounted disconnect switch, adjustable, belt-drive blower assembly, and microprocessor control with wall-mounted display panel. The unit is provided with supply- and return-air openings for field-supplied ducting. Evaporators are designed for R-407C refrigerant and can be configured with canister humidifier and/or reheat. An indoor or outdoor condensing unit must be selected for each evaporator. Suction and liquid lines are spun closed, and filled with an inert gas holding charge.

#### 2.1.2 Condensing Unit Section—Split Systems

##### Outdoor Air Cooled Prop Fan Condensing Units

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.

##### Indoor Air Cooled Condensing Units

Indoor, air cooled, centrifugal-fan condensing units include scroll compressor, condenser coil, factory-mounted disconnect switch, belt-driven centrifugal blower assembly, high-pressure switch, Liebert® Lee-Temp head-pressure control system, hot-gas bypass and liquid-line solenoid valve. Unit must be mounted indoors. Condensing unit is designed for R-407C refrigerant and will operate with outdoor air 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.

##### Indoor Water/Glycol-cooled Condensing Units

Indoor Water/Glycol Condensing Units include scroll compressor, factory-mounted disconnect, coaxial condenser, hot-gas bypass, high-head-pressure switch, and two-way water/glycol-regulating valve designed for 150 psi (1034.3 kPa). Condensing unit is designed for R-407C refrigerant and can be used on a water or glycol cooling loop. Suction and liquid lines are spun closed, and filled with an inert gas holding charge.

#### 2.1.3 Chilled Water Units

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

Chilled water models are self-contained and include a chilled water coil, adjustable belt-driven blower assembly, factory mounted disconnect switch and 2-way slow close motorized valve. Design pressure is 300 psi (2068 kPa), 60 psi (414 kPa) close-off differential.

## 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. A seven-key, membrane keypad for setpoint/program control, unit On/Off, 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, 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 shut-down terminals. The unit automatically restarts after a power outage.

**Figure 2.1 Wall-box**



### Other Standard Control Features

- Adjustable auto restart
- 5 day/2 day setback
- Password protection
- Alarm enable/disable
- Self-diagnostics
- Calibrate sensors
- Predictive humidity control
- Common alarm output
- Remote shut-down 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 filters and activates visual and audible alarms at the wall-box display. The wall-box display annunciates the alarm and flashes a notification upon reaching a customer setpoint.

**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 Evaporator/Chilled Water Unit Options

#### 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. Reheat capacity is up-sized to offset the cooling capacity. (The SCR Electric Reheat is not available on chilled-water, free-cooling, or 575-V units)

**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.**

#### 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.

#### Motors

**2-hp Blower Motor** is available for high static-pressure applications (0.9 to 1.5 in. [23 to 38 mm] w.g.). Standard 1.5-hp motor allows for ESP of 0.5 in. (13 mm). Free-cooling or hot-water-reheat coils reduce the available ESP by 0.3 in. (8 mm). Maximum return-air static pressure should not exceed 0.3 in. (8 mm) for drain to work properly.

## 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 & 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

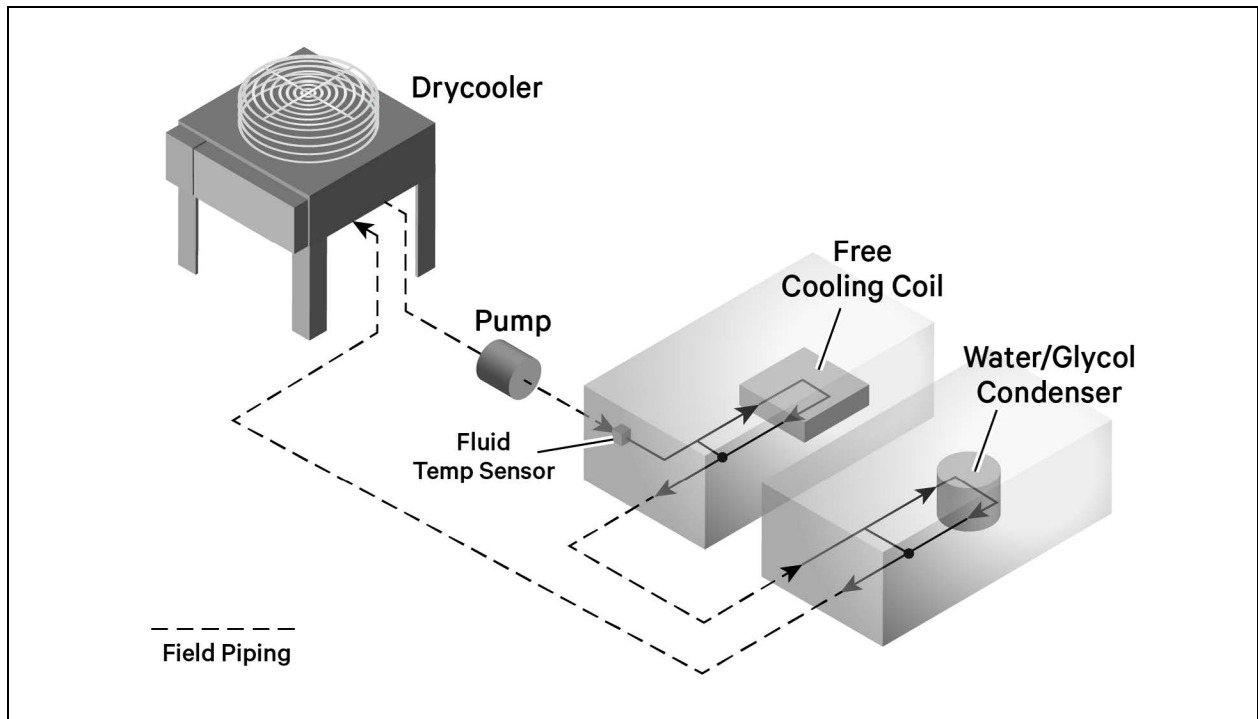
The free cooling option includes separate cooling coil, three-way slow-close valve, and separate supply and return piping. Free-cooling is activated when the water temperature reaches a field-adjustable temperature, typically 45°F (7°C). The valve is rated for 300 psi (2068 kPa) working pressure.

Air-cooled condensing units can be matched with evaporators using free-cooling coils with chilled-water sources to serve as back-up 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.

[Free Cooling Arrangement](#) 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 cupro-nickel (CuNi) coil is required to prevent premature corrosion, or a heat exchanger must separate the tower water from the free-cooling loop. The cupro-nickel 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:

- High-ambient models for providing catalog capacities at ambient temperatures up to 105°F (40°C).
- Liebert® Quiet-Line models for low-noise-level conditions (below 58 dBA) and for providing catalog capacities at ambient temperatures up to 95°F (35°C).
- 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:

- Three-way, slow-close, motorized, chilled-water valve rated for 300 psi (2068 kPa) working pressure. Valve is non-spring return.
- Two-way, modulating, chilled-water valve, rated for 400 psi (2758 kPa) operating pressure, 72 psi (496 kPa) close-off rating. Valve is non-spring return.
- Three-way, modulating, chilled-water valve, rated for 400 psi (2758 kPa) operating pressure. Valve is non-spring return.

## 2.3 Ship Loose Accessories—Field-Installed

**Filter Box** includes filter box with 1-in. (25.4 mm) duct-flange connection, quantity 2, 20-in. x 20-in. x 4-in. nominal (508 mm x 508 mm x 102 mm) filters and a 1-in. (25.4 mm) duct flange for use on the supply air opening. Filters are MERV 8 efficiency per ASHRAE Standard 52.2-2007.

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.

**Condensate Pump Mounting Bracket** mounts condensate pump on the end of the unit for easy alignment and installation of the condensate pump.

A **Remote Temperature and Humidity Sensor** package includes sensors in an attractive case with 30 ft (9 m) of cable. Can be wall- or duct-mounted. Remote sensors 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.**

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

### 2.3.1 Remote Monitoring, Autochangeover, 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 & 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 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.

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

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

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

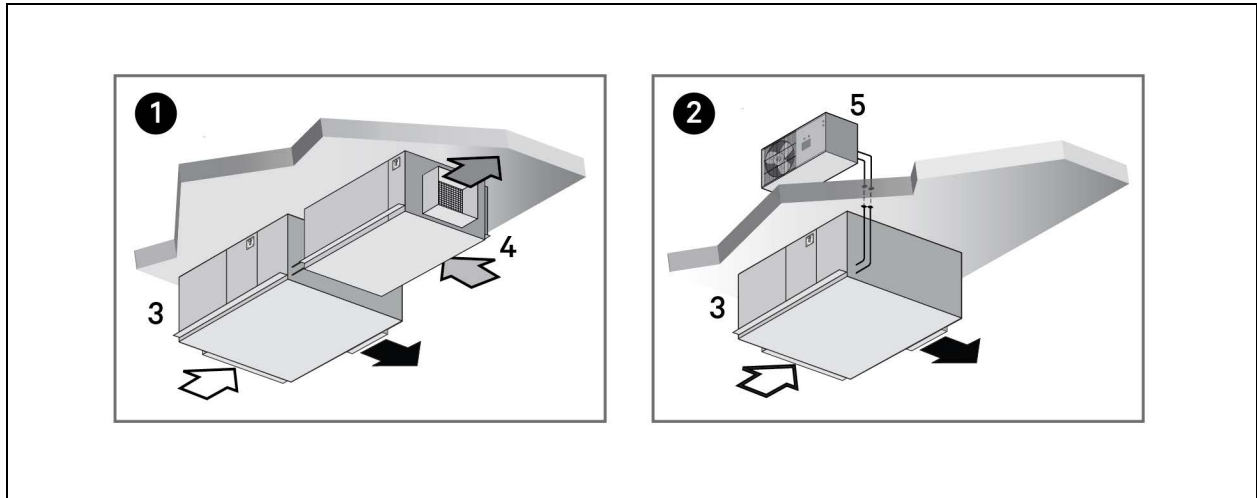
## 3 Nomenclature

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

### 3.1 System Configurations

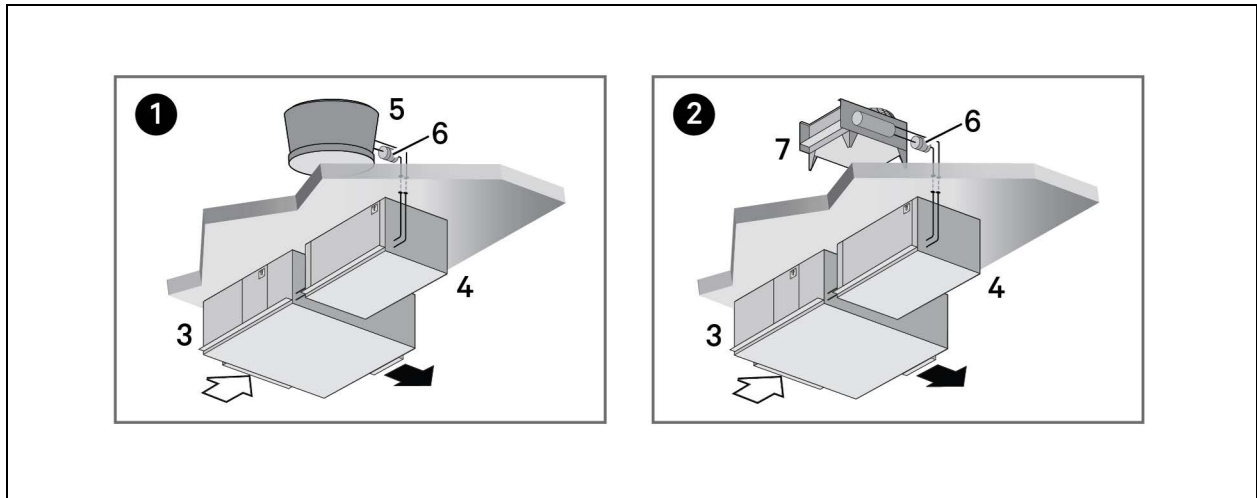
The following figures show the available capacity and cooling options for the Liebert® Mini-Mate2.

**Figure 3.1 Air Cooled Units**



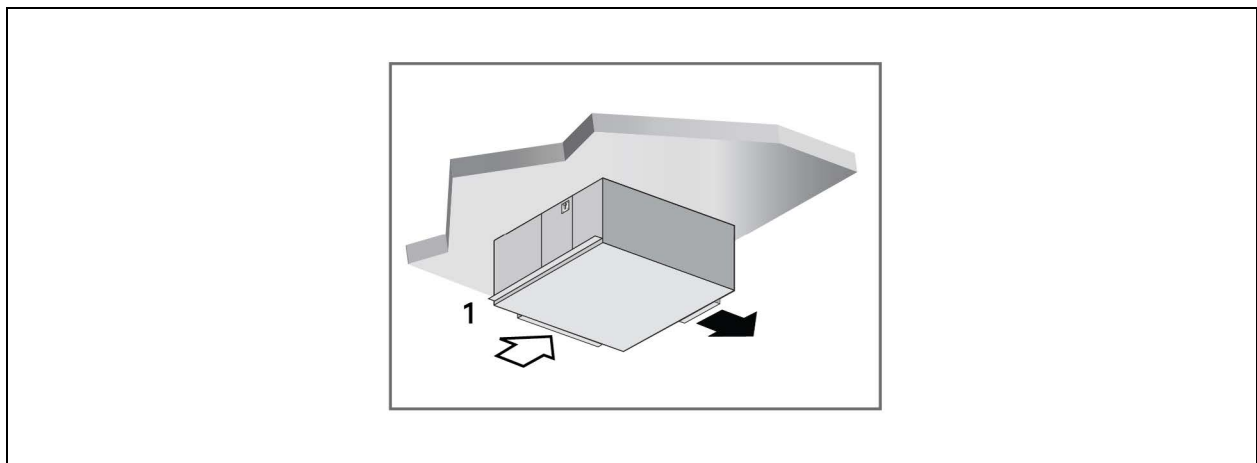
Item	Description
1	Split-system (indoor condensing unit) with ducted supply/return air
2	Split-system (outdoor condensing unit) with ducted supply/return air
3	Evaporator
4	Indoor condensing unit
5	Outdoor condensing unit

Figure 3.2 Water/Glycol Cooled Units



Item	Description
1	Split-system water-cooled with ducted supply/return air
2	Split-system glycol-cooled with ducted supply/return air
3	Evaporator
4	Water/Glycol condensing unit
5	Cooling tower
6	Pump
7	Drycooler

Figure 3.3 Chilled Water Units



Item	Description
1	Chilled-water unit with ducted supply/return air

## 3.2 Nomenclature for Evaporator and Chilled Water Units

Nomenclature Digit Definitions for Evaporator and Chilled Water Units 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	6	0	E	N	C	R	E	L	5

**Table 3.2 Nomenclature Digit Definitions for Evaporator 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 60 = 60 kBtuh, 60 Hz evaporator 59 = 59 kBtuh, 50 Hz evaporator 91 = 91 kBtuh, 50 Hz chilled water 92 = 92 kBtuh, 60 Hz chilled water	
Digit 6 = Cooling type C = Chilled-water cooled E = Split-system evaporator (See <a href="#">Nomenclature for Split System Condensing units</a> on page 13.) K = Split-system evaporator with free-cooling (See <a href="#">Nomenclature for Split System Condensing units</a> on page 13.)	
Digit 7 = Refrigerant/Valve type N = R-407C field-charged, DX evaporator 2 = 2-way standard-pressure chilled-water valve 3 = 3-way standard-pressure chilled-water valve D = 2-way high-pressure chilled-water valve T = 3-way high-pressure chilled-water valve	
Digit 8 = Supply power A = 460 V / 3 ph / 60 Hz B = 575 V / 3 ph / 60 Hz C = 208 V / 3 ph / 60 Hz D = 230 V / 3 ph / 60 Hz M = 380/415 V / 3 ph / 50 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 Evaporator 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 (for DX evaporator without free-cooling option)</li> <li>H = Hot-water reheat (chilled-water systems only)</li> </ul>
Digit 11 = Blower type	<ul style="list-style-type: none"> <li>L = Low-static blower, 1.5-hp motor</li> <li>H = High-static blower, 2-hp motor</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 Condensing units

This section describes the model-number configuration for Vertiv™ Liebert® Mini-Mate2 split system condensing units.

#### 3.3.1 Indoor Condensing Units for Air Cooled Split Systems

[Nomenclature Digit Definitions for Indoor, Air Cooled Condensing Units](#) below describes each digit of the model number.

**Table 3.3 Indoor, Air Cooled Condensing Unit Nomenclature Example**

1	2	3	4	5	6	7	8	9	10
M	C	D	6	5	A	L	A	H	N

**Table 3.4 Nomenclature Digit Definitions for Indoor, Air Cooled Condensing Units**

Digit	Description
Digits 1 to 2 = the base unit	MC = Mini-Mate2 condensing unit
Digit 3 = Disconnect	D = Disconnect switch
Digit 4 and 5 = Nominal Capacity	65 = 65 kBtuh, 60 Hz 64 = 64 kBtuh, 50 Hz
Digit 6 = Cooling type	A = Air-cooled
Digit 7 = Head-pressure control	L = Liebert® Lee-Temp™ Receiver
Digit 8 = Supply power	A = 460 V / 3 ph / 60 Hz B = 575 V / 3 ph / 60 Hz M = 380/415 V / 3 ph / 50 Hz Y = 208/230 V / 3 ph / 60 Hz
Digit 9 = Hot-gas bypass	H = Hot-gas bypass
Digit 10 = Refrigerant	N = R-407C field-charged

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

Nomenclature Digit Definitions for Outdoor, Prop Fan Condensing Units 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	6	7	A	—	A	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 Z = Quiet-Line
Digit 5 and 6 = Nominal Capacity	66 = 66 kBtuh, 50 Hz 67 = 67 kBtuh, 60 Hz
Digit 7 = Cooling type	A = Air-cooled
Digit 8 = Coil type	— = Standard coil C = Coated coil (epoxy with UV topcoat)
Digit 9 = Supply power	A = 460 V / 3 ph / 60 Hz B = 575 V / 3 ph / 60 Hz M = 380/415 V / 3 ph / 50 Hz Y = 208/230 V / 3 ph / 60 Hz
Digit 10 = Ambient rating/Control	L = 95°F Ambient, Liebert® Lee-Temp H = 105°F Ambient, Liebert® Lee-Temp
Digit 11 = Refrigerant	N = R-407C field-charged

### 3.3.3 Water/Glycol Cooled Condensing Units

Nomenclature Digit Definitions for Indoor, Water/Glycol-cooled Condensing Units below describes each digit of the model number.

**Table 3.7 Remote, Indoor Water/Glycol Condensing Unit Nomenclature Example**

1	2	3	4	5	6	7	8	9	10
M	C	D	6	9	W	2	A	H	N

**Table 3.8 Nomenclature Digit Definitions for Indoor, Water/Glycol-cooled Condensing Units**

Digit	Description
Digits 1 to 2 = the base unit	MC = Mini-Mate2 condensing unit
Digit 3 = Disconnect	D = Disconnect switch
Digit 4 and 5 = Nominal Capacity	69 = 69 kBtuh, 60 Hz 68 = 68 kBtuh, 50 Hz
Digit 6 = Cooling type	W = Water/Glycol-cooled
Digit 7 = Head-pressure control	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	A = 460 V / 3 ph / 60 Hz B = 575 V / 3 ph / 60 Hz M = 380/415 V / 3 ph / 50 Hz Y = 208/230 V / 3 ph / 60 Hz
Digit 9 = Hot-gas bypass	H = Hot-gas bypass
Digit 10 = Refrigerant	N = R-407C field-charged

This page intentionally left blank

## 4 System Data

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

Table 4.1 Air Cooled Data, 60-Hz

Evaporator Model		MMD60E or MMD60K	
Condensing Unit Type		PFH - Outdoor	MCD - Indoor
<b>DX Evaporator- Net Capacity Data - kW (Btuh)</b>			
80°F DB, 62.8°F WB(26.7°C DB, 17.1°C WB) 38% RH	Total	19.2 (65,400)	19.3 (65,700)
	Sensible	18.5 (63,000)	18.5 (63,200)
75°F DB, 61°F WB(23.9°C DB, 16.1°C WB) 45% RH	Total	18.4 (62,700)	18.5 (63,000)
	Sensible	16.4 (55,800)	16.4 (56,000)
72°F DB, 60°F WB(22.2°C DB, 15.5°C WB) 50% RH	Total	17.9 (61,200)	18.0 (61,500)
	Sensible	15.0 (51,300)	15.1 (51,500)
<b>Fan Data - Evaporator</b>			
CFM (CMH)		2500 (4248)	
Fan Motor hp (W)		1.5 (1119)	
External Static Pressure, in (mm) water gauge		0.5 (13)	
<b>Evaporator Coil - Copper Tube/Aluminum Fin</b>			
Face Area, ft <sup>2</sup> (m <sup>2</sup> )		5.6 (0.52)	
Coil Rows		4	
Max Face Velocity, fpm (m/s)		444 (2.26)	
Unit Refrigerant Charge, oz. (kg)		4 (0.11)	
Unit Operating Weight		498 (226)	
<b>Electric Reheat Capacity (Includes Fan Motor), kW (Btuh)</b>			
All Voltages		11.5 (39,100)	
<b>SCR Reheat Capacity (Includes Fan Motor), kW (Btuh)</b>			
All Voltages, except 575-3-60		16.5 (56,200)	
<b>Humidifier Data - Steam Generator Type</b>			
Steam capacity, lb/hr (kg/hr)		8 (3.6)	
Electrical Input Power, kW		2.8	
<b>Evaporator Connection Sizes</b>			
Liquid line Diameter, O.D. Cu		1/2"	
Suction Line Diameter, O.D. Cu		7/8"	
Humidifier Supply		1/4" OD Cu Compression Fitting	

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

Evaporator Model	MMD60E or MMD60K	
Condensing Unit Type	PFH - Outdoor	MCD - Indoor
Evaporator/Condensate Drain	3/4" NPT-Female	
MERV 8 Filter - Nominal Size, qty 2; in. (mm)	4x20x20 (102x508x208)	
Condensing Unit Model Number	PFH067A-_LN *	MCD65AL_HN
Condensing Unit Rating Conditions	95°F (35°C) Inlet Air Temperature	
Coil Face Area, ft <sup>2</sup> (m <sup>2</sup> )	10.5 (0.98)	7.3 (0.68)
Rows of Coil	3	4
CFM (CMH)	4200 (7140)	3500 (5947)
Motor, Hp (W)	0.5 (373)	2.0 (1.5)
External Static Pressure, in wg. (mm)	N/A	0.50 (13)
Unit Refrigerant Charge, oz. (kg)	426 (12.1)	432 (12.2)
Unit Operating Weight, lb. (kg)	351 (159)	449 (204)
<b>Condensing-unit Connection Sizes</b>		
Liquid line Diameter, O.D. Cu	1/2"	1/2"
Suction Line Diameter, O.D. Cu	7/8"	7/8"
<b>Free-Cooling Coil Option Net Capacity Data - kW (Btuh) using 45°F (7.2°C) EWT</b>		
80°F DB, 62.8°F WB(26.7°C DB, 17.1°C WB) 38% RH	Total	18.9 (64,500)
	Sensible	18.0 (61,500)
75°F DB, 61°F WB(23.9°C DB, 16.1°C WB) 45% RH	Total	16.3 (55,600)
	Sensible	15.1 (51,500)
72°F DB, 60°F WB(22.2°C DB, 15.5°C WB) 50% RH	Total	14.8 (50,400)
	Sensible	13.3 (45,400)
Flow Rate, GPM (l/m)	12.0 (45.5)	
Pressure Drop, ft. water (kPa)	12.4 (37.1)	
<b>Free-Cooling Coil - Copper Tube/Aluminum Fin</b>		
Face Area, ft <sup>2</sup> (m <sup>2</sup> )	5.6 (0.52)	
Coil Rows	4	
Max Face Velocity, fpm (m/s)	444 (2.26)	
Internal Fluid Volume, gal (l)	2.3 (8.7)	
Free-cooling Coil supply and return connections, in. O.D. Cu	1-1/8	
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%.		
* Capacities are also valid for Liebert® Quiet-Line PFH at 95F (35C) inlet air temperature and for High Ambient PFH models at 105°F (41°C) inlet air temperature.		

Table 4.2 Air Cooled Data, 50-Hz

Evaporator Model		MMD59E or MMD59K	
		With Outdoor Condensing Unit	
Condensing Unit Type		PFH - Outdoor	MCD - Indoor
<b>DX Evaporator-Net Capacity Data, kW (Btuh)</b>			
80°F DB, 62.8°F WB (26.7°C DB, 17.1°C WB) 38% RH	Total	18.1 (61,600)	17.9 (61,000)
	Sensible	17.8 (60,700)	17.7 (60,400)
75°F DB, 61°F WB (23.9°C DB, 16.1°C WB) 45% RH	Total	17.2 (58,800)	17.1 (58,300)
	Sensible	15.8 (53,900)	15.7 (53,700)
72°F DB, 60°F WB (22.2°C DB, 15.5°C WB) 50% RH	Total	16.8 (57,300)	16.7 (56,900)
	Sensible	14.5 (49,500)	14.4 (49,300)
<b>Fan Data - Evaporator</b>			
CFM (CMH)		2500 (4248)	
Fan Motor hp (W)		1.5 (1119)	
External Static Pressure, in (mm) water gauge		0.5 (13)	
<b>Evaporator Coil - Copper Tube/Aluminum Fin</b>			
Face Area ft <sup>2</sup> (m <sup>2</sup> )		5.6 (0.52)	
Coil Rows		4	
Max Face Velocity-fpm (m/s)		444 (2.26)	
Unit Refrigerant Charge, oz. (kg)		4 (0.11)	
Unit Operating Weight		498 (226)	
<b>Electric Reheat Capacity (Includes Fan Motor)-kW (Btuh)</b>			
Input Voltage-380-3-50		10.5 (35,800)	
Input Voltage-400-3-50		9	
<b>SCR Reheat Capacity (Includes Fan Motor)-kW (Btuh)</b>			
Input Voltage-380-3-50		15.0 (51,200)	
Input Voltage-400-3-50		16.5 (56,200)	
<b>Humidifier Data - Steam Generator Type</b>			
Steam capacity - lb/hr (kg/hr)		8 (3.6)	
Electrical Input Power - kW		2.8	
<b>Evaporator Connection Sizes</b>			
Liquid line Diameter, O.D. Cu		1/2"	
Suction Line Diameter, O.D. Cu		7/8"	
Humidifier Supply		1/4" OD Cu Compression Fitting	
Evaporator/Condensate Drain		3/4" NPT-Female	

**Table 4.2 Air Cooled Data, 50-Hz (continued)**

Evaporator Model		MMD59E or MMD59K	
		With Outdoor Condensing Unit	
MERV 8 Filter - Nominal Size, qty 2, in. (mm)		4x20x20 (102x508x208)	
<b>Condensing Unit Model Number</b>		PFH066A-_LN	MCD64AL_HN
Condensing Unit Rating Conditions		95°F (35°C) Inlet Air Temperature	
Coil Face Area ft <sup>2</sup> (m <sup>2</sup> )		10.5 (0.98)	7.3 (0.68)
Rows of Coil		3	4
CFM (CMH)		3600 (6116)	3500 (5947)
Motor Hp (W)		0.5 (373)	2.0 (1.5)
External Static Pressure, in wg. (mm)		N/A	0.50 (13)
Unit Refrigerant Charge, oz. (kg)		426 (12.1)	432 (12.2)
Unit Operating Weight, lb. (kg)		351 (159)	449 (204)
<b>Condensing-unit Connection Sizes</b>			
Liquid line Diameter, O.D. Cu		1/2"	1/2"
Suction Line Diameter, O.D. Cu		7/8"	7/8"
<b>Free-Cooling Coil Option Net Capacity Data - kW (Btuh) using 45°F (7.2°C) EWT</b>			
80°F DB, 62.8°F WB (26.7°C DB, 17.1°C WB) 38% RH	Total	18.9 (64,500)	
	Sensible	18.0 (61,500)	
75°F DB, 61°F WB (23.9°C DB, 16.1°C WB) 45% RH	Total	16.3 (55,600)	
	Sensible	15.1 (51,500)	
72°F DB, 60°F WB (22.2°C DB, 15.5°C WB) 50% RH	Total	14.8 (50,400)	
	Sensible	13.3 (45,400)	
Flow Rate - GPM (l/m)		12.0 (45.5)	
Pressure Drop - ft. water (kPa)		12.4 (37.1)	
<b>Free-Cooling Coil - Copper Tube/Aluminum Fin</b>			
Face Area ft <sup>2</sup> (m <sup>2</sup> )		5.6 (0.52)	
Coil Rows		4	
Max Face Velocity-fpm (m/s)		444 (2.26)	
Internal Fluid Volume - gal (l)		2.3 (8.7)	
Free-cooling Coil supply and return connections, in. O.D. Cu		1-1/8	
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%.			
* Capacities are also valid for Liebert® Quiet-Line PFH at 95F (35C) inlet air temperature and for High Ambient PFH models at 105F (41C) inlet air temperature.			



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

Table 4.3 Water/Glycol Data, 60-Hz

Evaporator Model		MMD60E or MMD60K	
Condensing Unit Fluid		Water-Cooled	Glycol-Cooled
<b>Net Capacity Data DX Evaporator, kW (Btuh)</b>			
80°F DB, 62.8°F WB (26.7°C DB, 17.1°C WB) 38% RH	Total	21.5 (73,500)	18.2 (62,200)
	Sensible	19.6 (67,000)	17.9 (61,200)
75°F DB, 61°F WB (23.9°C DB, 16.1°C WB) 45% RH	Total	20.8 (70,800)	17.4 (59,500)
	Sensible	17.5 (59,600)	15.9 (54,300)
72°F DB, 60°F WB (22.2°C DB, 15.5°C WB) 50% RH	Total	20.3 (69,200)	17.0 (58,000)
	Sensible	16.1 (55,000)	14.6 (49,800)
<b>Fan Data - Evaporator</b>			
CFM (CMH)		2500 (4248)	
Fan Motor, hp (W)		1.5 (1119)	
External Static Pressure, in (mm) water gauge		0.5 (13)	
<b>Evaporator Coil - Copper Tube/Aluminum Fin</b>			
Face Area, ft <sup>2</sup> (m <sup>2</sup> )		5.6 (0.52)	
Coil Rows		4	
Max Face Velocity-fpm (m/s)		444 (2.26)	
Unit Refrigerant Charge, oz. (kg)		4 (0.11)	
Unit Operating Weight		498 (226)	
<b>Electric Reheat Capacity (Includes Fan Motor), kW (Btuh)</b>			
All Voltages		11.5 (39,100)	
<b>SCR Reheat Capacity (Includes Fan Motor), kW (Btuh)</b>			
All Voltages, except 575-3-60		16.5 (56,200)	
<b>Humidifier Data - Steam Generator Type</b>			
Steam capacity, lb/hr (kg/hr)		8 (3.6)	
Electrical Input Power, kW		2.8	
<b>Evaporator Connection Sizes</b>			
Liquid line Diameter, O.D. Cu		1/2"	
Suction Line Diameter, O.D. Cu		7/8"	
Humidifier Supply		1/4" OD Cu Compression Fitting	
Evaporator/Condensate Drain		3/4" NPT-Female	
MERV 8 Filter - Nominal Size, qty 2, in. (mm)		4 x 20 x 20 (102 x 508 x 208)	

**Table 4.3 Water/Glycol Data, 60-Hz (continued)**

Evaporator Model		MMD60E or MMD60K	
Condensing Unit Fluid		Water-Cooled	Glycol-Cooled
Condensing Unit Model Number		MCD69W	
Condenser Fluid Requirements		85°F (29.4°C) EWT	110°F (43.3°C) EGT - 40% PG
THR - kW (Btuh) @ 75F/45%RH		27.6 (94,200)	25.9 (88,400)
Flow Rate, GPM (l/m)		16.4 (62.2)	20.1 (76.2)
Pressure Drop, ft. of H2O (kPa)		21.7 (64.9)	38.9 (116.3)
Water-Cooled Condensing Temperature		105°F (40.6°C)	N/A
Unit Volume, gal (l)		2.0 (7.5)	
Unit Refrigerant Charge, oz. (kg)		94 (2.7)	
Unit Operating Weight, lb. (kg)		282 (128)	
<b>Condensing-unit Connection Sizes</b>			
Liquid line Diameter, O.D. Cu		1/2"	
Suction Line Diameter, O.D. Cu		7/8"	
<b>Free-Cooling Coil Option Net Capacity Data, kW (Btuh) using 45°F (7.2°C) EWT</b>			
Entering Fluid Requirements		45°F (7.2°C) EWT	45°F (7.2°C) EGT - 40% PG
80°F DB, 62.8°F WB (26.7°C DB, 17.1°C WB) 38% RH	Total	18.9 (64,500)	14.1 (48,500)
	Sensible	18.0 (61,500)	14.1 (48,500)
75°F DB, 61°F WB (23.9°C DB, 16.1°C WB) 45% RH	Total	16.3 (55,600)	11.7 (40,000)
	Sensible	15.1 (51,500)	11.7 (40,000)
72°F DB, 60°F WB (22.2°C DB, 15.5°C WB) 50% RH	Total	14.8 (50,400)	10.7 (36,400)
	Sensible	13.3 (45,400)	10.7 (36,400)
Flow Rate, GPM (l/m)		12.0 (45.5)	20.1 (76.2)
Pressure Drop, ft. water (kPa)		12.4 (37.1)	50.4 (150.7)
<b>Free-Cooling Coil - Copper Tube/Aluminum Fin</b>			
Face Area, ft <sup>2</sup> (m <sup>2</sup> )		5.6 (0.52)	
Coil Rows		4	
Max Face Velocity, fpm (m/s)		444 (2.26)	
Internal Fluid Volume, gal (l)		2.3 (8.7)	
Free-cooling Coil supply and return connections, O.D. Cu		1-1/8	
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 4.4 Water/Glycol Data, 50-Hz

Evaporator Model		MMD59E or MMD59K	
Condensing Unit Fluid		Water-Cooled	Glycol-Cooled
<b>Net Capacity Data DX Evaporator- kW (Btuh)</b>			
80°F DB, 62.8°F WB (26.7°C DB, 17.1°C WB) 38% RH	Total	20.7 (70,700)	16.9 (57,800)
	Sensible	19.3 (65,700)	16.9 (57,800)
75°F DB, 61°F WB (23.9°C DB, 16.1°C WB) 45% RH	Total	19.9 (68,000)	16.1 (54,900)
	Sensible	17.1 (58,300)	15.2 (52,000)
72°F DB, 60°F WB (22.2°C DB, 15.5°C WB) 50% RH	Total	19.5 (66,500)	15.7 (53,500)
	Sensible	15.7 (53,700)	14.0 (47,700)
<b>Fan Data - Evaporator</b>			
CFM (CMH)		2500 (4248)	
Fan Motor hp (W)		1.5 (1119)	
External Static Pressure, in (mm) water gauge		0.5 (1.3)	
<b>Evaporator Coil - Copper Tube/Aluminum Fin</b>			
Face Area ft <sup>2</sup> (m <sup>2</sup> )		5.6 (0.52)	
Coil Rows		4	
Max Face Velocity-fpm (m/s)		444 (2.26)	
Unit Refrigerant Charge, oz. (kg)		4 (0.11)	
Unit Operating Weight		498 (226)	
<b>Electric Reheat Capacity (Includes Fan Motor)-kW (Btuh)</b>			
Input Voltage-380-3-50		10.5 (35,800)	
Input Voltage-400-3-50		11.5 (39,100)	
<b>SCR Reheat Capacity (Includes Fan Motor)-kW (Btuh)</b>			
Input Voltage-380-3-50		15.0 (51,200)	
Input Voltage-400-3-50		16.5 (56,200)	
<b>Humidifier Data - Steam Generator Type</b>			
Steam capacity - lb/hr (kg/hr)		8 (3.6)	
Electrical Input Power - kW		2.8	
<b>Evaporator Connection Sizes</b>			
Liquid line Diameter, O.D. Cu		1/2"	
Suction Line Diameter, O.D. Cu		7/8"	
Humidifier Supply		1/4" OD Copper Compression Fitting	
Evaporator/Condensate Drain		3/4" NPT-Female	
MERV 8 Filter - Nominal Size, qty 2; in. (mm)		4x20x20 (102x508x208)	

**Table 4.4 Water/Glycol Data, 50-Hz (continued)**

Evaporator Model		MMD59E or MMD59K	
Condensing Unit Fluid		Water-Cooled	Glycol-Cooled
Condensing Unit Model Number		MCD68W	
Condenser Fluid Requirements		85°F (29.4°C) EWT	110°F (43.3°C) EGT - 40% PG
THR - kW (Btuh) @ 75F/45%RH		25.3 (86,400)	24.7 (84,300)
Flow Rate - GPM (l/m)		15.6 (59.1)	19.0 (72.0)
Pressure Drop - ft. of H2O (kPa)		19.5 (58.3)	34.7 (103.8)
Water-Cooled Condensing Temperature		105°F (40.6°C)	N/A
Unit Volume - Gal (l)		2.0 (7.5)	
Unit Refrigerant Charge, oz. (kg)		94 (2.7)	
Water/Glycol condenser Connection Sizes, in. O.D. Cu		1-1/8	
Unit Operating Weight, lb. (kg)		282 (128)	
<b>Condensing-unit Connection Sizes</b>			
Liquid line Diameter, O.D. Cu		1/2"	
Suction Line Diameter, O.D. Cu		7/8"	
<b>Free-Cooling Coil Option Net Capacity Data - kW (Btuh) using 45°F (7.2°C) EWT</b>			
Entering Fluid Requirements		45°F (7.2°C) EWT	45°F (7.2°C) EGT - 40% PG
80°F DB, 62.8°F WB (26.7°C DB, 17.1°C WB) 38% RH	Total	18.9 (64,500)	14.0 (47,700)
	Sensible	18.0 (61,500)	14.0 (47,700)
75°F DB, 61°F WB (23.9°C DB, 16.1°C WB) 45% RH	Total	16.3 (55,600)	11.8 (40,400)
	Sensible	15.1 (51,500)	11.8 (40,400)
72°F DB, 60°F WB (22.2°C DB, 15.5°C WB) 50% RH	Total	14.8 (50,400)	10.5 (35,900)
	Sensible	13.3 (45,400)	10.5 (35,900)
Flow Rate - GPM (l/m)		12.0 (45.5)	19.0 (72.0)
Pressure Drop - ft. water (kPa)		12.4 (37.1)	45.5 (136.0)
<b>Free-Cooling Coil - Copper Tube/Aluminum Fin</b>			
Face Area ft <sup>2</sup> (m <sup>2</sup> )		5.6 (0.52)	
Coil Rows		4	
Max Face Velocity-fpm (m/s)		444 (2.6)	
Internal Fluid Volume - gal (l)		2.3 (8.7)	
Free-cooling Coil supply and return connections, in. O.D. Cu		1-1/8	
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%.			

## 4.3 Chilled Water Systems—Capacity and Performance Data

Table 4.5 Chilled Water Data, 60-Hz and 50-Hz

CW Model		MMD92C/MMD91C
<b>Net Capacity Data - kW (Btuh) based on 45°F (7.2°C) EWT &amp; 10°F (5.6°C) temperature rise</b>		
80°F DB, 62.8°F WB (26.7°C DB, 17.1°C WB) 38% RH	Total	20.1 (68,700)
	Sensible	18.7 (63,900)
Flow Rate - GPM (l/m)		14.6 (55.3)
Pressure Drop - ft. water (kPa)		18.7 (55.9)
75°F DB, 61°F WB (23.9°C DB, 16.1°C WB) 45% RH	Total	16.3(55,600)
	Sensible	15.1 (51,500)
Flow Rate, GPM (l/m)		12.0 (45.5)
Pressure Drop, ft. water (kPa)		12.9 (38.6)
72°F DB, 60°F WB (22.2°C DB, 15.5°C WB) 50% RH	Total	13.8 (47,200)
	Sensible	12.8 (43,700)
Flow Rate, GPM (l/m)		10.3 (39.0)
Pressure Drop, ft. water (kPa)		9.7 (29.0)
<b>Fan Data - Evaporator</b>		
CFM (CMH)		2500 (4248)
Fan Motor, hp (W)		1.5 (1119)
External Static Pressure, in (mm) water gauge		0.5 (13)
<b>CW Coil - Copper Tube/Aluminum Fin</b>		
Face Area, ft <sup>2</sup> (m <sup>2</sup> )		5.6 (0.52)
Coil Rows		4
Max Face Velocity, fpm (m/s)		444 (2.26)
<b>Electric Reheat Capacity (Includes Fan Motor), kW (Btuh)</b>		
Input Voltage-208/230/460/575-3-60		11.5 (39,100)
Input Voltage-380-3-50		10.5 (35,800)
Input Voltage-400-3-50		11.5 (39,100)
<b>Hot Water Reheat Coil - Copper Tube/Aluminum Fin</b>		
Capacity (with fan motor heat) using 180°F (82°C) EWT, kW (Btuh)		19.6 (66,800)
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> )		5.6 (0.52)
Coil Rows		1

**Table 4.5 Chilled Water Data, 60-Hz and 50-Hz (continued)**

CW Model	MMD92C/MMD91C	
HWRH supply and return connections, in. O.D. Cu	5/8	
<b>Humidifier Data - Steam Generator Type</b>		
Steam capacity, lb/hr (kg/hr)	8 (3.6)	
Electrical Input Power, kW	2.8	
<b>Connections, Volume, Filters, Weight</b>		
CW supply and return connections, in. O.D. Cu	1-1/8	
Humidifier Supply	1/4" OD Copper Compression Fitting	
Evaporator/Condensate Drain	3/4" NPT-Female	
Unit Internal Fluid Volume, gal (l)	2.3 (8.7)	
MERV 8 Filter - Nominal Size, qty 2; in. (mm)	4x20x20 (102x508x208)	
Unit Operating Weight	498 (226)	
Unit Valve Types	On/Off Slow Close	Modulating
Valve Size	1"	1"
Valve Cv	7	11.6
Maximum Static Operating Pressure, psi (kPa)	300 (2068)	400 (2758)
Close-Off Pressure, psi (kPa)	60 (414)	72 (496)
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 4.6 Capacity Correction Factors for MMD91C and MMD92C based on 10°F (5.6°C) water rise**

Return-air Conditions	72°F (22.2°C) 50% RH		75°F (23.9°C) 45%RH	
	Total	Sensible	Total	Sensible
Entering Water Temperature				
42°F (5.6°C)	1.28	1.14	1.23	1.12
43°F (6.1°C)	1.18	1.09	1.14	1.07
44°F (6.7°C)	1.09	1.05	1.07	1.03
45°F (7.2°C)	1.00	1.00	1.00	1.00
46°F (7.8°C)	0.92	0.95	0.93	0.96
47°F (8.3°C)	0.85	0.90	0.87	0.92
48°F (8.9°C)	0.79	0.85	0.81	0.88
49°F (9.4°C)	0.73	0.79	0.77	0.82

## 4.4 Planning Dimensions

The unit dimensions are described in the submittal documents included in the [Submittal Drawings](#) on page 47.

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

**Table 4.7 Dimension Planning Drawings**

Document Number	Title
<b>Split-system Evaporators/Chilled-water Units</b>	
DPN000218	Evaporator/Chilled-water Unit and Filter Box Option Dimensions
<b>Outdoor Condensing Units</b>	
DPN004418	Cabinet Dimensions, Prop-fan Condensing Unit with horizontal air discharge
DPN004419	Cabinet Dimensions, Prop-fan Condensing Unit with top air discharge
DPN003094	Optional Anchorage Plan, Prop-fan Condensing Unit with horizontal air discharge
<b>Indoor Condensing Units</b>	
DPN004422	Cabinet Dimensions, Air-cooled units
DPN004423	Cabinet Dimensions, Water/Glycol-cooled units

This page intentionally left blank



## 5 Electrical Data

### 5.1 Evaporators and Chilled-water Units Electrical Data

Table 5.1 Evaporator and Chilled Water Electrical Data, Standard 1.5-hp motor

	208-3-60	230-3-60	460-3-60	575-3-60	380/415-3-50
Base Evaporator Model Number	MMD60E/K MMD92C	MMD60E/K MMD92C	MMD60E/K MMD92C	MMD60E/K MMD92C	MMD59E/K MMD91C
<b>Cooling Only</b>					
FLA	5.6	5.6	2.8	2	3.2
WSA	7.0	7.0	3.5	2.5	N/A
OPD	15	15	15	15	N/A
<b>with Electric Reheat</b>					
FLA	33.4	30.7	15.4	12.0	17.6
WSA	41.8	38.4	19.3	15.0	N/A
OPD	45	40	20	15	N/A
<b>with Humidifier</b>					
FLA	15.4	14.5	7.2	5.5	8.3
WSA	19.3	18.1	9.0	6.9	N/A
OPD	20	20	15	15	N/A
<b>with Electric Reheat and Humidifier</b>					
FLA	43.2	39.6	19.8	15.5	22.7
WSA	54.0	49.5	24.8	19.4	N/A
OPD	60	50	25	20	N/A
For Chilled Water units with Hot Water Reheat, use appropriate "Cooling Only" or "with Humidifier" values.					
SCR reheat not available with Chilled Water Units or units with free-cooling option					

	208-3-60	230-3-60	460-3-60	575-3-60	380/415-3-50
Base Evaporator Model Number	MMD60E only	MMD60E only	MMD60E only	MMD60E only	MMD59E only
<b>with SCR Reheat</b>					
FLA	47.2	43.3	21.6	N/A	24.9
WSA	59.0	54.1	27.0	N/A	N/A
OPD	60	60	30	N/A	N/A
<b>with SCR Reheat and Humidifier</b>					
FLA	57.0	52.2	26.0	N/A	30.0
WSA	71.3	65.3	32.5	N/A	N/A
OPD	80	70	35	N/A	N/A
For Chilled Water units with Hot Water Reheat, use appropriate "Cooling Only" or "with Humidifier" values.					
SCR reheat not available with Chilled Water Units or units with free-cooling option					

**Table 5.2 Evaporator and Chilled Water Electrical Data, Optional 2-hp Motor**

Base Evaporator Model Number	208-3-60	230-3-60	460-3-60	575-3-60	380/415-3-50
	MMD60E/K MMD92C	MMD60E/K MMD92C	MMD60E/K MMD92C	MMD60E/K MMD92C	MMD59E/K MMD91C
<b>Cooling Only</b>					
FLA	5.8	5.8	2.9	2.3	3.7
WSA	7.3	7.3	3.6	2.9	N/A
OPD	15	15	15	15	N/A
<b>with Electric Reheat</b>					
FLA	33.6	30.9	15.5	12.3	18.1
WSA	42.0	38.6	19.4	15.4	N/A
OPD	45	40	20	20	N/A
<b>with Humidifier</b>					
FLA	15.6	14.7	7.3	5.8	8.8
WSA	19.5	18.4	9.1	7.3	N/A
OPD	20	20	15	15	N/A
<b>with Electric Reheat and Humidifier</b>					
FLA	43.4	39.8	19.9	15.8	23.2
WSA	54.3	49.8	24.9	19.8	N/A
OPD	60	50	25	20	N/A
For Chilled Water Units with Hot Water Reheat, use appropriate "Cooling Only" or "with Humidifier" values.					
SCR reheat not available with Chilled Water Units or units with free-cooling option.					

	208-3-60	230-3-60	460-3-60	575-3-60	380/415-3-50
Base Evaporator Model Number	MMD60E only	MMD60E only	MMD60E only	MMD60E only	MMD59E only
<b>with SCR Reheat</b>					
FLA	47.4	43.5	21.7	N/A	25.4
WSA	59.3	54.4	27.1	N/A	N/A
OPD	60	60	30	N/A	N/A
<b>with SCR Reheat and Humidifier</b>					
FLA	57.2	52.4	26.1	N/A	30.5
WSA	71.5	65.5	32.6	N/A	N/A
OPD	80	70	35	N/A	N/A
For Chilled Water Units with Hot Water Reheat, use appropriate "Cooling Only" or "with Humidifier" values.					
SCR reheat not available with Chilled Water Units or units with free-cooling option.					

## 5.2 Indoor Condensing Units Electrical Data

Table 5.3 Indoor Condensing Unit Electrical Data

	208/230-3-60	460-3-60	575-3-60	380/415-3-50
<b>MCD65A</b>				
FLA	26.5	12.9	9.7	—
WSA	31.7	15.4	11.6	—
OPD	50	25	15	—
<b>MCD69W</b>				
FLA	20.7	10.0	7.4	—
WSA	25.9	12.5	9.3	—
OPD	45	20	15	—
<b>MCD64A</b>				
FLA	—	—	—	13.7
<b>MCD68W</b>				
FLA	—	—	—	10.0

## 5.3 Outdoor Condensing Units Electrical Data

Table 5.4 Outdoor Condensing Unit Electrical Data

	208/230-3-60	460-3-60	575-3-60	380/415-3-50
<b>PFH067A-_LN</b>				
FLA	24.1	11.7	9.1	11.7
WSA	29.3	14.2	11.1	N/A
OPD	45	20	15	N/A
<b>PFH067A-_HN or PFH066A-_HN High Ambient</b>				
FLA	24.2	11.7	9.3	11.7
WSA	29.4	14.2	11.3	N/A
OPD	50	20	15	N/A
<b>PFHZ67A-_LN or PFHZ66A-_LN Quiet-Line</b>				
FLA	22.5	10.9	8.3	10.9
WSA	27.7	13.4	10.2	N/A
OPD	45	20	15	N/A

## 5.4 Electrical Data for Air Cooled Systems Using a Single-point Power Kit

Table 5.5 Air Cooled Using Single-point Power Kit, Standard 1.5-hp Motor

	208-3-60	230-3-60	460-3-60	575-3-60	380/415-3-50
Base Evaporator Model	MMD60E/K	MMD60E/K	MMD60E/K	MMD60E/K	MMD59E/K
Base Condensing Unit Model	MCD65A	MCD65A	MCD65A	MCD65A	MCD64A
<b>Cooling Only</b>					
FLA	32.1	32.1	15.7	11.7	16.9
WSA	37.3	37.3	18.2	13.6	N/A
OPD	50	50	25	20	N/A
<b>with Electric Reheat</b>					
FLA	59.9	57.2	28.3	21.7	31.3
WSA	72.0	68.7	34.0	26.1	N/A
OPD	80	80	40	30	N/A
<b>with Humidifier</b>					
FLA	41.9	41.0	20.1	15.2	22.0
WSA	47.1	46.2	22.6	17.1	N/A
OPD	60	60	30	20	N/A
<b>with Electric Reheat and Humidifier</b>					
FLA	59.9	57.2	28.3	21.7	31.3
WSA	72.0	68.7	34.0	26.1	N/A
OPD	80	80	40	30	N/A

	208-3-60	230-3-60	460-3-60	575-3-60	380/415-3-50
Base Evaporator Model	MMD60E	MMD60E	MMD60E	MMD60E	MMD59E
Base Condensing Unit Model	MCD65A	MCD65A	MCD65A	MCD65A	MCD64A
<b>with SCR Reheat</b>					
FLA	73.7	69.8	34.5	N/A	38.6
WSA	89.3	84.4	41.7	N/A	N/A
OPD	90	90	45	N/A	N/A
<b>with SCR Reheat and Humidifier</b>					
FLA	83.5	78.7	38.9	N/A	43.7
WSA	99.1	93.3	46.1	N/A	N/A
OPD	100	100	50	N/A	N/A

**Table 5.6 Air Cooled Using Single-point Power Kit, Optional 2-hp Motor**

	208-3-60	230-3-60	460-3-60	575-3-60	380/415-3-50
Base Evaporator Model	MMD60E/K	MMD60E/K	MMD60E/K	MMD60E/K	MMD59E/K
Base Condensing Unit Model	MCD65A	MCD65A	MCD65A	MCD65A	MCD64A
<b>Cooling Only</b>					
FLA	32.3	32.3	15.8	12.0	17.4
WSA	37.5	37.5	18.3	13.9	N/A
OPD	50	50	25	20	N/A
<b>with Electric Reheat</b>					
FLA	60.1	57.4	28.4	22.0	31.8
WSA	72.2	68.9	34.1	26.4	N/A
OPD	80	80	40	30	N/A
<b>with Humidifier</b>					
FLA	42.1	41.2	20.2	15.5	22.5
WSA	47.3	46.4	22.7	17.4	N/A
OPD	60	60	30	20	N/A
<b>with Electric Reheat and Humidifier</b>					
FLA	60.1	57.4	28.4	22.0	31.8
WSA	72.2	68.9	34.1	26.4	N/A
OPD	80	80	40	30	N/A

	208-3-60	230-3-60	460-3-60	575-3-60	380/415-3-50
Base Evaporator Model	MMD60E	MMD60E	MMD60E	MMD60E	MMD59E
Base Condensing Unit Model	MCD65A	MCD65A	MCD65A	MCD65A	MCD64A
<b>with SCR Reheat</b>					
FLA	73.9	70.0	34.6	N/A	39.1
WSA	89.5	84.6	41.8	N/A	N/A
OPD	90	90	45	N/A	N/A
<b>with SCR Reheat and Humidifier</b>					
FLA	83.7	78.9	39.0	N/A	44.2
WSA	99.3	93.5	46.2	N/A	N/A
OPD	100	100	50	N/A	N/A

## 5.5 Electrical Data for Water/Glycol Cooled Systems Using a Single-point Power Kit

Table 5.7 Water/Glycol Cooled Using Single-point Power Kit, Standard 1.5-hp Motor

	208-3-60	230-3-60	460-3-60	575-3-60	380/415-3-50
Base Evaporator Model	MMD60E/K	MMD60E/K	MMD60E/K	MMD60E/K	MMD59E/K
Base Condensing Unit Model	MCD69W	MCD69W	MCD69W	MCD69W	MCD68W
<b>Cooling Only</b>					
FLA	26.3	26.3	12.8	9.4	13.2
WSA	31.5	31.5	15.3	11.3	N/A
OPD	50	50	25	15	N/A
<b>with Electric Reheat</b>					
FLA	54.1	51.4	25.4	19.4	27.6
WSA	66.2	62.9	31.1	23.8	N/A
OPD	70	70	35	25	N/A
<b>with SCR Reheat</b>					
FLA	67.9	64.0	31.6	N/A	34.9
WSA	83.5	78.6	38.8	N/A	N/A
OPD	90	80	40	N/A	N/A
<b>with Humidifier</b>					
FLA	36.1	35.2	17.2	12.9	18.3
WSA	41.3	40.4	19.7	14.8	N/A
OPD	60	60	25	20	N/A
<b>with Electric Reheat and Humidifier</b>					
FLA	54.1	51.4	25.4	19.4	27.6
WSA	66.2	62.9	31.1	23.8	N/A
OPD	70	70	35	25	N/A



	208-3-60	230-3-60	460-3-60	575-3-60	380/415-3-50
Base Evaporator Model	MMD60E	MMD60E	MMD60E	MMD60E	MMD59E
Base Condensing Unit Model	MCD69W	MCD69W	MCD69W	MCD69W	MCD68W
<b>with SCR Reheat</b>					
FLA	67.9	64.0	31.6	N/A	34.9
WSA	83.5	78.6	38.8	N/A	N/A
OPD	90	80	40	N/A	N/A
<b>with SCR Reheat and Humidifier</b>					
FLA	77.7	72.9	36.0	N/A	40.0
WSA	93.3	87.5	43.2	N/A	N/A
OPD	100	90	45	N/A	N/A

Table 5.8 Water/Glycol Cooled Using Single-point Power Kit, Optional 2-hp Motor

	208-3-60	230-3-60	460-3-60	575-3-60	380/415-3-50
Base Evaporator Model	MMD60E/K	MMD60E/K	MMD60E/K	MMD60E/K	MMD59E/K
Base Condensing Unit Model	MCD69W	MCD69W	MCD69W	MCD69W	MCD68W
<b>Cooling Only</b>					
FLA	26.5	26.5	12.9	9.7	13.7
WSA	31.7	31.7	15.4	11.6	N/A
OPD	50	50	25	15	N/A
<b>with Electric Reheat</b>					
FLA	54.3	51.6	25.5	19.7	28.1
WSA	66.4	63.1	31.2	24.1	N/A
OPD	80	70	35	25	N/A
<b>with Humidifier</b>					
FLA	36.3	35.4	17.3	13.2	18.8
WSA	41.5	40.6	19.8	15.1	N/A
OPD	60	60	25	20	N/A
<b>with Electric Reheat and Humidifier</b>					
FLA	54.3	51.6	25.5	19.7	28.1
WSA	66.4	63.1	31.2	24.1	N/A
OPD	80	70	35	25	N/A

	208-3-60	230-3-60	460-3-60	575-3-60	380/415-3-50
Base Evaporator Model	MMD60E	MMD60E	MMD60E	MMD60E	MMD59E
Base Condensing Unit Model	MCD69W	MCD69W	MCD69W	MCD69W	MCD68W
<b>with SCR Reheat</b>					
FLA	68.1	64.2	31.7	N/A	35.4
WSA	83.7	78.8	38.9	N/A	N/A
OPD	90	90	40	N/A	N/A
<b>with SCR Reheat and Humidifier</b>					
FLA	77.9	73.1	36.1	N/A	40.5
WSA	93.5	87.7	43.3	N/A	N/A
OPD	100	90	45	N/A	N/A

## 5.6 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 47.

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

**Table 5.9 Electrical Field Connection Drawings**

Document Number	Title
<b>Evaporator and Chilled-water Units</b>	
DPN000221	Electrical Connections
DPN000220	Single-point Power Kit for Close-coupled units
DPN004852	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>Split-system Indoor Condensing Units</b>	
DPN004297	Electrical Connections, Air-cooled units
DPN004298	Electrical Connections, Water/Glycol-cooled units

## 6 Piping

The pipe connection locations, piping general arrangement and schematics are described in the submittal documents included in the [Submittal Drawings](#) on page 47.

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

**Table 6.1 Piping General Arrangement Drawings**

Document Number	Title
DPN004412	General Arrangement, Water/Glycol-cooled
DPN004413	General Arrangement, Air-cooled and Chilled-water
DPN000219	General Arrangement, Freecooling and Hot-water reheat options
DPN003822	Multiple Drycoolers and Cooling Units on Common Glycol Loop

**Table 6.2 Piping Connection Drawings**

Document Number	Title
<b>Evaporator and Chilled-water Units</b>	
DPN004304	Piping Connections
<b>Split-system Indoor Condensing Units</b>	
DPN004422	Piping Connections, Air-cooled units
DPN004423	Piping Connections, Water/Glycol-cooled units
<b>Condensate-pump Connection</b>	
DPN000217	Field-installed pump connection

## 6.1 Refrigerant Piping Data

### 6.1.1 Refrigerant Charge Requirements

Table 6.3 R-407C Refrigerant Unit Charge

Model #		Charge R-407C, oz (kg)
60 Hz	50 Hz	
MMD60E	MMD59E	4 (0.11)
MMD60K	MMD59K	4 (0.11)
MCD65A	MCD64A	432 (12.3)
MCD69W	MCD68W	94 (2.7)
PFH067A-_LN	PFH066A-_LN	426 (12.1)
PFH067A-_HN	PFH066A-_HN	827 (23.4)
PFHZ67A-_LN	PFHZ66A-_LN	827 (23.4)

1. Use [Line Charges of R-407C Refrigerant using Type-L Copper Tube](#) below to determine the charge to be added for field-fabricated refrigerant lines.

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 47.

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

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

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

Source: DPN000788 Rev. 13

**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 [Pipe Length and Condensing Unit Elevation Relative to Evaporator](#) on the next page, for the maximum vertical rise/fall between condensing unit and evaporator.

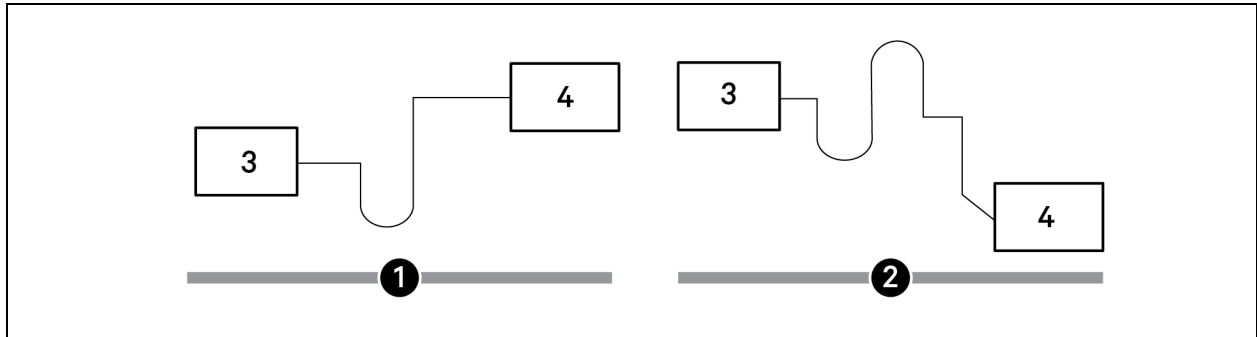
When installing remote condensing units above the evaporator, trap the suction gas line at the evaporator as shown in [Refrigerant Piping Diagram When Condenser is Above or Below Evaporator](#) on the next page. This trap will retain refrigerant oil during the "Off" cycle. When the unit starts, oil in 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 [Refrigerant Piping Diagram When Condenser is Above or Below Evaporator](#) 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)	50 (15)	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 47.

# 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

This page intentionally left blank



## **Appendix B: Guide Specifications**

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

# Vertiv™ Liebert® Mini-Mate2 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 split, with the compressor located in a remote or close-coupled condensing unit.

The evaporator section shall be designed for above dropped-ceiling installation. Condensing units shall be designed for either outdoor or above-dropped-ceiling installation. Refer to Section 2.3 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 on 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, "Hi-Pot" 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 Evaporator Cabinet Construction

The cabinet and chassis shall be constructed of heavy gauge galvanized steel, and shall be serviceable from one side only. 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 & ASTM 1338 standards.

#### 2.1.2 Air Distribution

The fan shall be the centrifugal type, double width, double inlet. The shaft shall be heavy-duty steel with self-aligning ball bearings with minimum life of 100,000 hours. The fan motor shall be 1750 rpm (1450 rpm @ 50Hz) and mounted on an adjustable base. The belt drive package shall be equipped with an adjustable motor pulley. The fan/motor assembly shall be mounted on vibration isolators.

The evaporator system shall be capable of delivering \_\_\_\_CFM (CMH) at \_\_\_ inches (mm) of external static pressure. The fan motor shall be \_\_\_\_hp (W).

System shall be suitable for ducted supply and return air distribution. Refer to 2.5.2 Air Filter Box/Duct Flange.

#### 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. A 7-key membrane keypad for setpoint/ program control 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 controller, 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) 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 or Vertiv™ Liebert® SiteScan™ monitoring systems.

##### Control Setpoint Parameters

- Temp. Setpoint 65-85°F (18 to 29°C)
- Temp. Sensitivity 1 to 9.9°F (1 to 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 program 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 startup 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 Electrical Switches and Sensor

### Disconnect Switch, Non-locking

The non-automatic, non-locking, molded case circuit breaker shall be factory-mounted in the high-voltage section of the electrical panel. The switch handle shall be accessible from the unit front and mounted on:

- \_\_\_\_\_ the evaporator/chilled water unit
- \_\_\_\_\_ the indoor air-cooled centrifugal condensing unit
- \_\_\_\_\_ the water/glycol condensing 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.

### Filter Clog Switch

The filter clog switch senses pressure drop across the filters and shall annunciate the wall-box display upon reaching the adjustable setpoint.

## 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

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 site monitoring system with the following information: date and time of occurrence, unit number and present temperature and humidity.

## 2.2 Direct Expansion System Evaporator Components

### 2.2.1 Direct Expansion Coil

The evaporator section shall include evaporator coil, thermostatic expansion valve and filter drier.

The evaporator coil shall have 5.6 sq.ft. (0.52 sq.m) face area, four rows deep. It shall be constructed of copper tubes and aluminum fins and have a maximum face velocity of 444 FPM (2.26 m/s) at

2500 CFM (4248 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 evaporator unit can be coupled directly with the condensing unit or mounted remote to the condensing unit.

The coil assembly shall be mounted in a condensate drain pan with an 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 Chilled Water System Components

### 2.3.1 Chilled Water Control Valve (On/Off)

The (2-way) (3-way) control valve shall be motorized slow-acting, non-spring return type to reduce water hammer. Design pressure shall be 300psig (2067kPa) static pressure, with a maximum close-off pressure of 60psi (414kPa).

### 2.3.2 Chilled Water Control Valve (Modulating)

A (2-way) (3-way) modulating, non-spring return valve controlled by the microprocessor to position the valve in response to room conditions. Design pressure shall be 400psig (2758kPa) static pressure, with a maximum close-off pressure of 72psi (496kPa).

### 2.3.3 Chilled Water Coil

The cooling coil shall have a minimum of 5.6 sq.ft. (0.52 sq.m) face area, 4 rows deep. It shall be constructed of copper tubes and aluminum fins and have a maximum face velocity of 444 FPM (2.26 m/s) at 2500 CFM (4248 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.

## 2.4 Indoor Air-Cooled Centrifugal Fan Condensing Unit

Condensing unit components shall include condenser coil, scroll compressor, high-pressure switch, Vertiv™ Liebert® Lee-Temp refrigerant receiver, head pressure control valve, hot gas bypass system and liquid line solenoid valve. A non-automatic, non-locking, molded case disconnect switch shall be factory mounted in the high voltage section of the electrical panel. The switch handle shall be accessible from the unit front. The cabinet and chassis shall be constructed of heavy gauge galvanized steel, and shall be serviceable from one side. Mounting brackets shall be integral to the cabinet design and be designed for ceiling mounting.

The hot gas bypass circuit shall be provided to reduce compressor cycling and improve operation under low-load conditions. The hot gas bypass shall be completely contained in the condensing 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 announce 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 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. Condensing unit shall be designed for 95°F (35°C) ambient and be capable of operation to -30°F (-34.4°C). The condensing unit can be coupled directly to the evaporator or can be mounted remote to the evaporator.

The condenser coil shall be constructed of copper tubes and aluminum fins. The condenser fan shall be centrifugal type, double inlet, heavy-duty steel shaft, with self-aligning bearings. The fan motor shall operate at 1750 rpm (1450 rpm @ 50 Hz), shall be equipped with adjustable motor pulley, and shall be mounted on an adjustable base. The fan and motor assembly shall be mounted on vibration isolators. The fan motor assembly shall be belt-drive.

The condenser fan shall be designed for 3500 CFM (5947 CFH) at 0.5" (13mm) w.g. external static pressure.

## 2.5 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 galvaneal 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, high pressure switch, Vertiv™ Liebert® Lee-Temp insulated receiver with internal heater and head pressure control valve, hot gas bypass system and liquid line solenoid valve. The condensing coil shall be constructed of copper tubes and aluminum fins.

The hot gas bypass circuit shall be provided to reduce compressor cycling and improve operation under low-load conditions. The hot gas bypass shall be completely contained in the condensing 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 announce 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 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. Condensing unit shall be designed for 95°F (35°C) ambient and be capable of operation to -30°F (-34.4°C).

(Option) The outdoor condensing unit shall be designed to operate at a sound level less than 58 dBA.

(Option) The outdoor condensing unit shall be designed for design ambient operation of 105°F (40.6°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.

## 2.6 Indoor Water/Glycol-Cooled Condensing Unit

The water/glycol condensing unit components shall include scroll compressor, high-pressure switch, coaxial condenser, water regulating valve, hot gas bypass system and liquid line solenoid valve. A non-automatic, non-locking, molded case disconnect switch shall be factory mounted in the high voltage section of the electrical panel. The switch handle shall be accessible from the unit front. The cabinet and chassis shall be constructed of heavy gauge galvanized steel, and shall be serviceable from one side. Mounting brackets shall be integral to the cabinet design and be designed for ceiling mounting.

The hot gas bypass circuit shall be provided to reduce compressor cycling and improve operation under low-load conditions. The hot gas bypass shall be completely contained in the condensing 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 announce 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.

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 coaxial condenser shall have a total system pressure drop of \_\_\_\_\_ 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 that is head-pressure actuated.

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

## 2.7 Factory-Installed Options

### 2.7.1 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-mounted controller. The humidifier shall have a capacity of 8 lb/hr (3.6 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.

### 2.7.2 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. The capacity of the reheat coils shall be \_\_\_\_\_ BTU/HR (kW), with unit input voltage of \_\_\_\_\_ V, controlled in one stage. A ground current detector shall be factory installed to shut-down the entire unit if a ground fault in the reheat system is detected.

### 2.7.3 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 pre-piped with a 2-way solenoid valve and cleanable Y-strainer. The hot water reheat coil shall only be available on chilled water units.

### 2.7.4 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 an agency-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 unit input voltage of \_\_\_\_\_ V. Not available on chilled water or free-cooling units.

### 2.7.5 Smoke Sensor

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

## 2.7.6 Remote Monitoring and Control – Is-Unity-Dp And Bms

The Vertiv™ Liebert® 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 Liebert® Mini-Mate2 remotely via a web interface and shall support Vertiv™ Liebert® Nform connectivity. The 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.

## 2.7.7 Free-Cooling/Dual 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 a temperature stat and shall include 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. Not available with SCR reheat.

An optional Cu-Ni coil shall be required to prevent premature corrosion if applied to open water tower loop.

A heat exchanger and pump shall be field-supplied to isolate the open water tower loop from the free-cooling loop.

## 2.8 Ship-Loose Accessories

### 2.8.1 Remote Sensors

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

### 2.8.2 Air Filter Box/Duct Flange

The evaporator section shall be supplied with an air filter box for use with ducted installations. Two (2) filters shall be included 4" x 20" x 20" (102 mm x 508mm x 508mm) each, pleated type, with a MERV 8 rating, based on ASHRAE 52.2-2007. A duct flange shall be supplied for use on the supply air opening of the unit.

### 2.8.3 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, pump, motor assembly, discharge check valve, duct/wall mountable bracket 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.

### 2.8.4 Condensate Pump Bracket

A condensate pump bracket shall be provided to mount condensate pump directly to the end of the unit, allowing for easier installation and alignment of the condensate pump.

### 2.8.5 Single Point Power Kit

A single point power kit shall be provided for a close-coupled system to allow a single electrical power feed to supply power to both the evaporator and indoor close-coupled (attached) condensing unit.

### 2.8.6 Remote Monitoring and Control – IS-Unity-DP and BMS – Field-installed Unit-mount Kit

The Vertiv™ Liebert® 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 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.

### 2.8.7 Remote Monitoring and Control – IS-Unity-DP and BMS – Field-installed Wall-mount Kit

The Liebert® 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 Liebert® Nform connectivity. The wall-mount kit for field-installation shall include the 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.

### 2.8.8 Vertiv™ Liebert® SiteScan™ Site Monitoring System

A Liebert® SiteScan™ Site Monitoring System Model \_\_\_\_\_ shall be provided for remote monitoring of the Liebert® Mini-Mate2 unit and monitoring of other Liebert support equipment. The Liebert® SiteScan™ shall have the capability to monitor and change (at the user direction) the temperature and humidity setpoints and sensitivities of each unit. The printer shall provide the user with chronological alarm information. It shall also be capable of being programmed to print out environmental conditions or operating modes at each unit.

Provide indicated quantities of the following:

- \_\_\_\_\_ Leak Detection System(s) Model \_\_\_\_\_
- \_\_\_\_\_ Remote Monitor(s) Model \_\_\_\_\_
- \_\_\_\_\_ Auto-changeover Control(s) Model \_\_\_\_\_

### 2.8.9 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 multiple direct drive fans. All electrical connections and controls shall be enclosed in an integral weather-resistant electric control panel section of the drycooler. The unit is quiet and corrosion resistant.

The drycooler shall be designed for \_\_\_\_ °F (°C) ambient.

### 2.8.10 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 to support the unit's weight in location indicated and maintain manufacturer's recommended clearances. Do not mount units above sensitive electronic equipment to minimize risk of water overflow/leakage damage and improve maintenance/service access.

#### 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.

#### 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 cooling units and water/glycol condensing units.

### 3.2 Field Quality Control

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

This page intentionally left blank

## Appendix C: Submittal Drawings

[Submittal Drawings Contents](#) below, groups the drawings by topic/application.

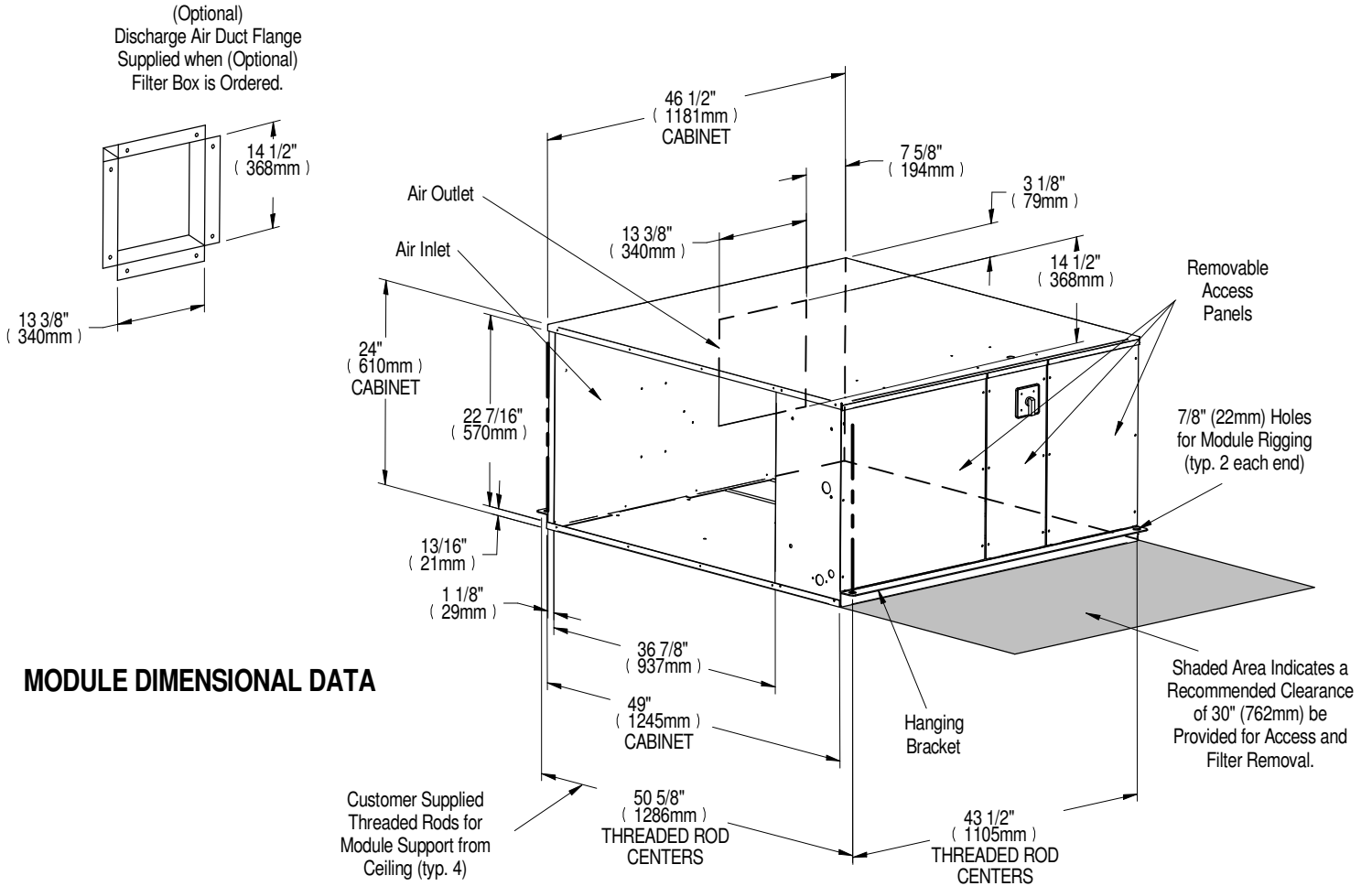
**Table C.1 Submittal Drawings Contents**

Document Number	Title
<b>Planning Dimensions - Split-system Evaporators/Chilled-water Units</b>	
DPN000218	Evaporator/Chilled-water and Option Dimensions
<b>Planning Dimensions - Indoor Condensing Units</b>	
DPN004422	Cabinet Dimensions, Air-cooled units
DPN004423	Cabinet Dimensions, Water/Glycol-cooled units
<b>Planning Dimensions - Outdoor Condensing Units</b>	
DPN004418	Cabinet Dimensions, Prop-fan Condensing Unit with horizontal air discharge
DPN004419	Cabinet Dimensions, Prop-fan Condensing Unit with top air discharge
DPN003094	Optional Anchorage Plan, Prop-fan Condensing Unit with horizontal air discharge
<b>Piping General Arrangement</b>	
DPN004412	General Arrangement, Water/Glycol-cooled
DPN004413	General Arrangement, Air-cooled and Chilled-water
DPN000219	General Arrangement, Freecooling and Hot-water reheat options
DPN003822	Multiple Drycoolers and Cooling Units on Common Glycol Loop
<b>Piping Connections - Evaporator and Chilled-water Units</b>	
DPN004304	Piping Connections
<b>Condensate-pump Connection</b>	
DPN000217	Field-installed pump connection
<b>Piping Connections - Split-system Indoor Condensing Units</b>	
DPN004422	Piping Connections, Air-cooled units
DPN004423	Piping Connections, Water/Glycol-cooled units
<b>Electrical Connections - Evaporator and Chilled-water Units</b>	
DPN000221	Electrical Connections
DPN000220	Single-point Power Kit for Close-coupled units
DPN004852	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 - Split-system Indoor Condensing Units</b>	
DPN004297	Electrical Connections, Air-cooled
DPN004298	Electrical Connections, Water/Glycol-cooled

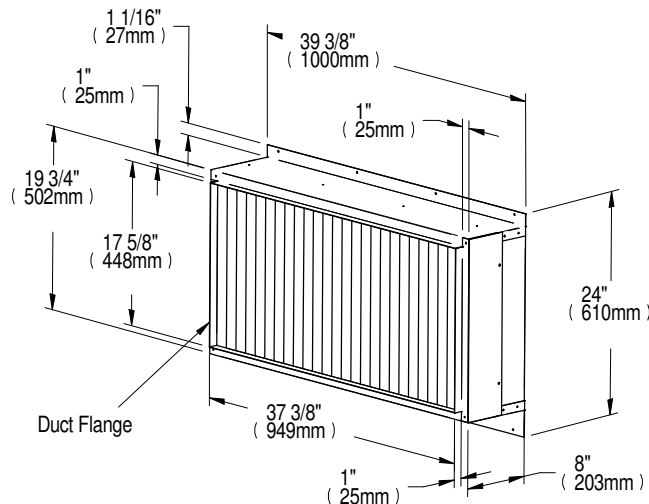
This page intentionally left blank



## CABINET DIMENSIONAL DATA 5 TON CHILLED WATER MODELS



### MODULE DIMENSIONAL DATA



UNIT NET WEIGHT lbs. (kg)	
60 HZ	
MM*92C	498 (226)

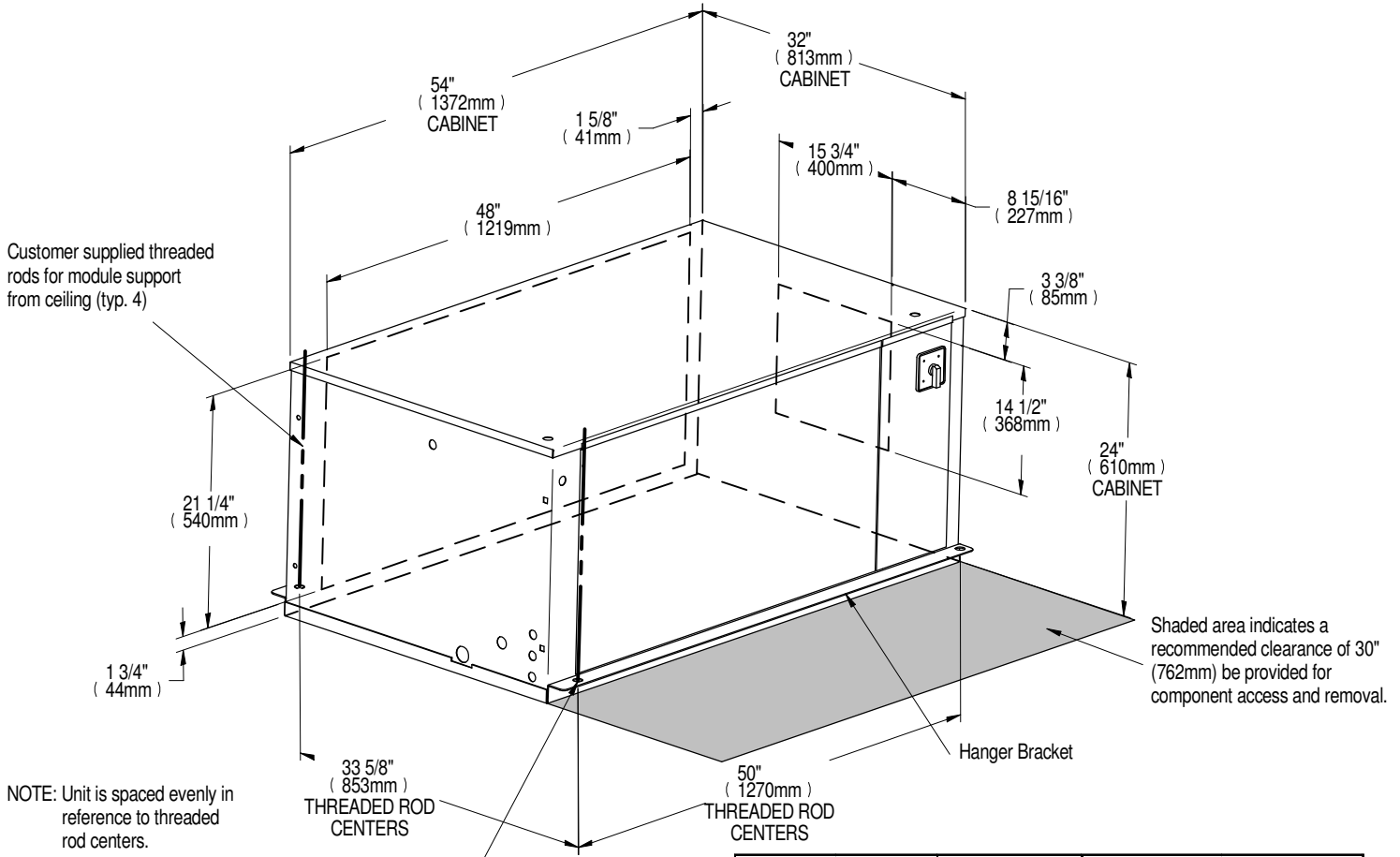
### (OPTIONAL) FILTER BOX



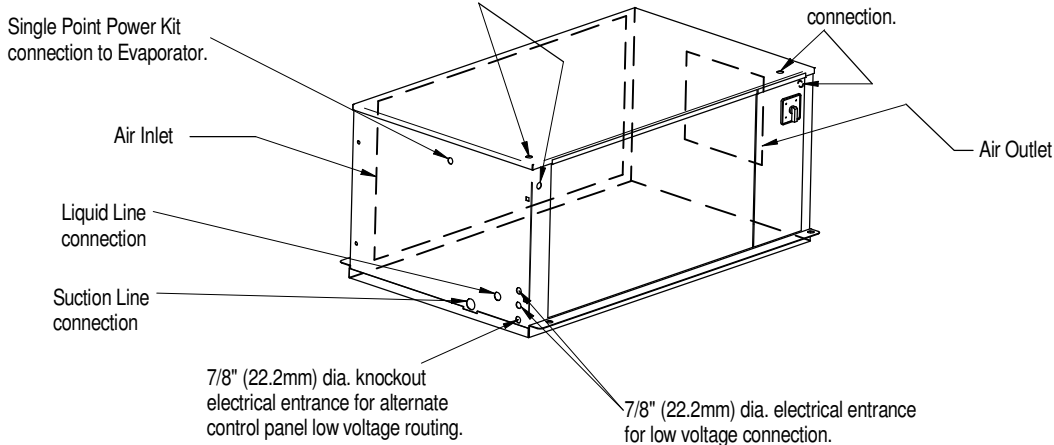
**VERTIV™**

# LIEBERT® MINI-MATE2

## CABINET DIMENSIONAL DATA & PRIMARY CONNECTION LOCATIONS 5 TON AIR COOLED INDOOR CONDENSING MODULE



MODEL #		UNIT NET WT lbs. (kg)	Refrigerant Connection sizes O.D. Cu	
60 HZ	50 HZ		Suction	Liquid
MC*65A	MC*64A	449 (204)	7/8"	1/2"



Form No.: DPN001040\_REV14

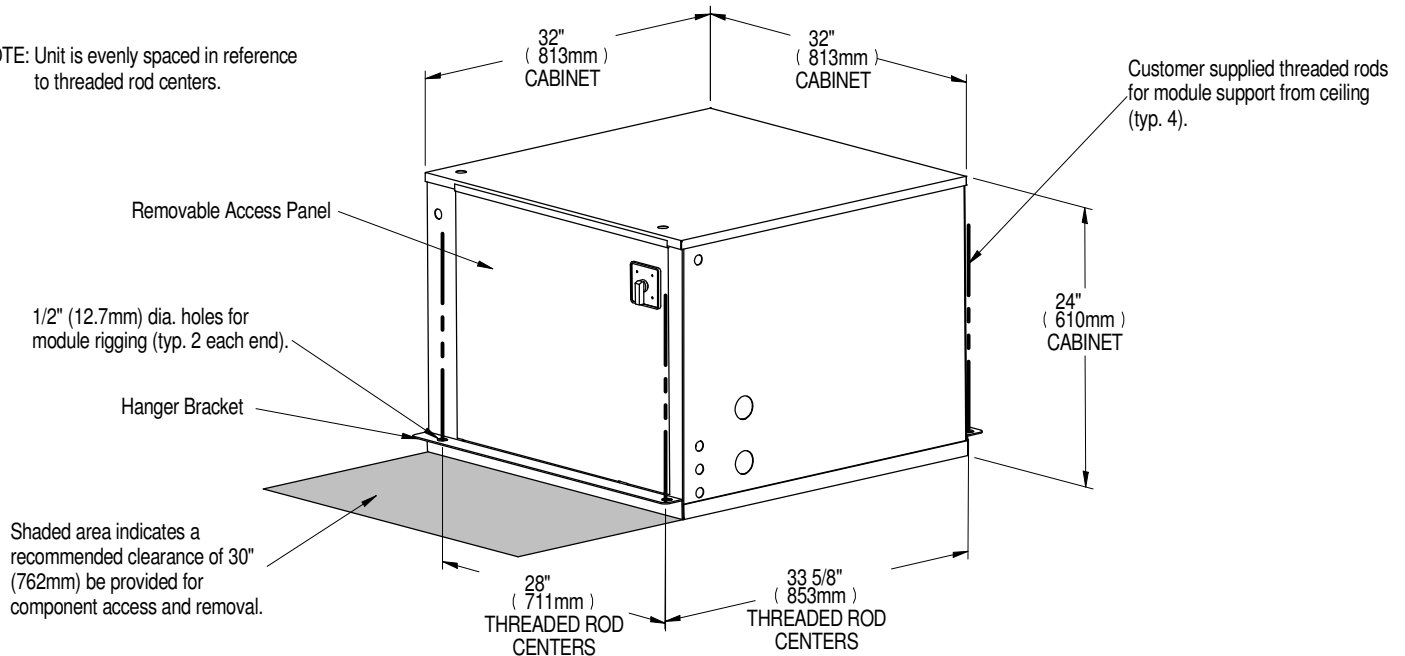


# LIEBERT® MINI-MATE2

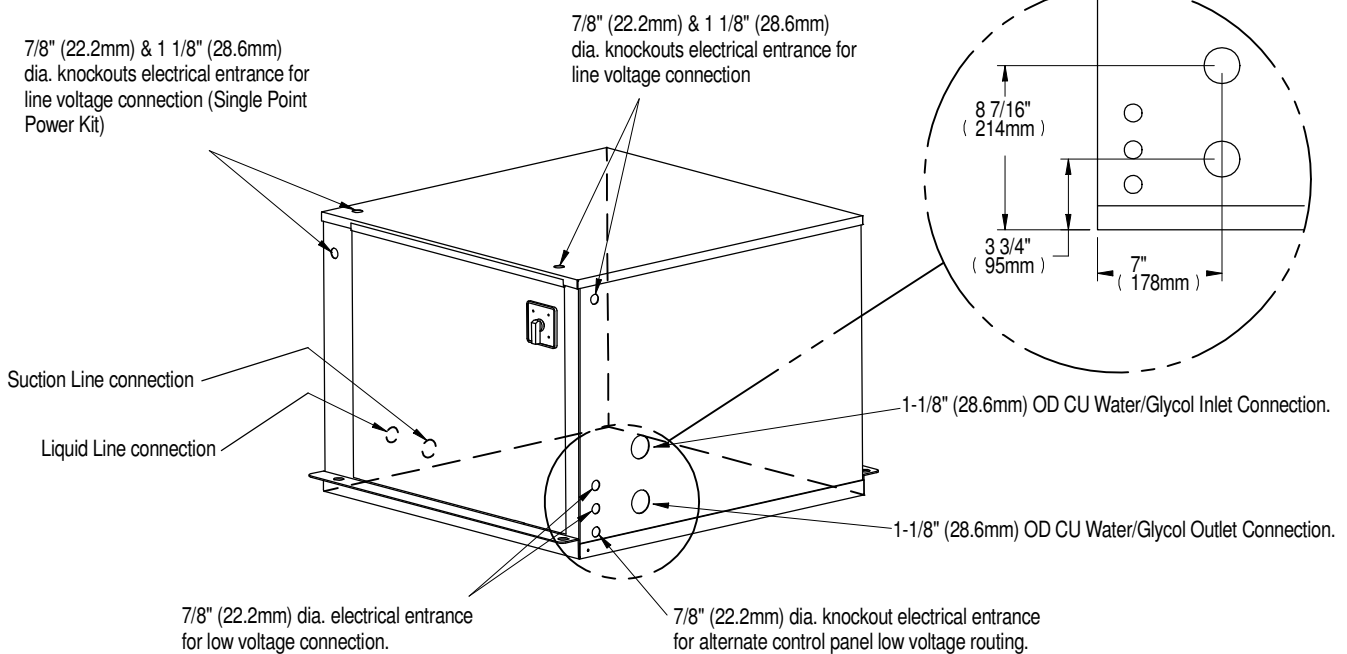
## CABINET DIMENSIONAL DATA & PRIMARY CONNECTION LOCATIONS

### 5 TON WATER/GLYCOL COOLED INDOOR CONDENSING MODULE

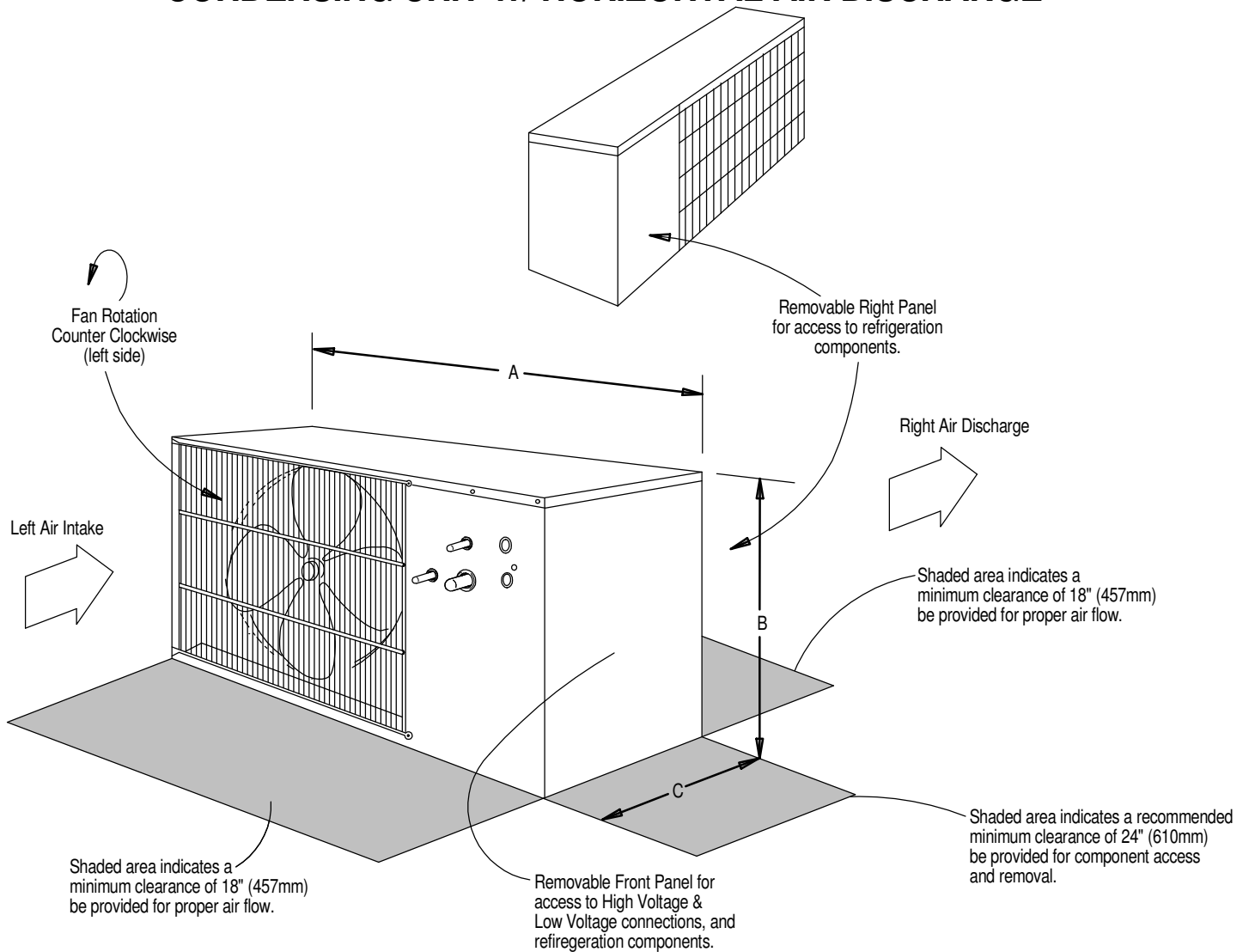
NOTE: Unit is evenly spaced in reference to threaded rod centers.



MODEL #		UNIT NET WEIGHT lbs. (kg)	Refrigerant Connection sizes O.D. Cu	
60 HZ	50 HZ		Suction	Liquid
MC*69W	MC*68W	282 (128)	7/8"	1/2"



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



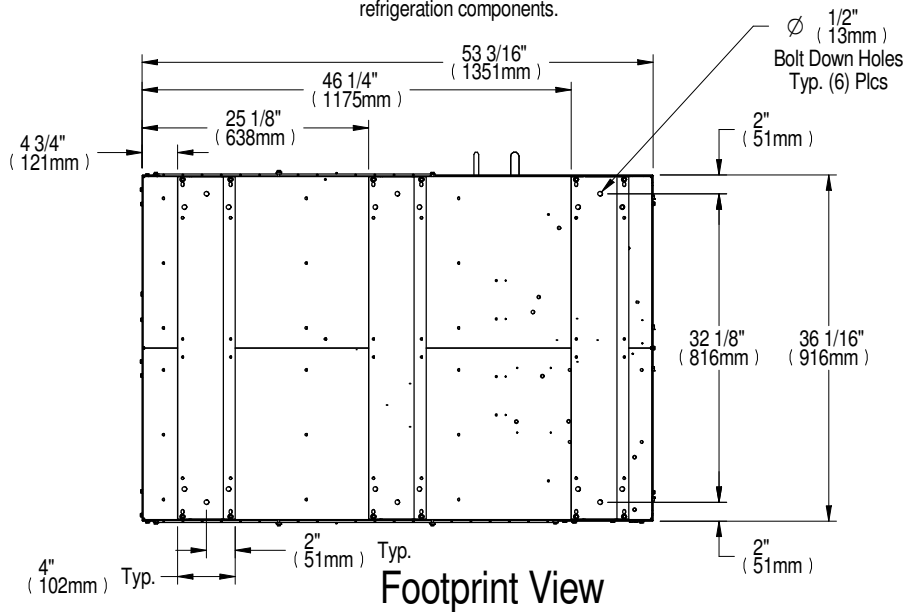
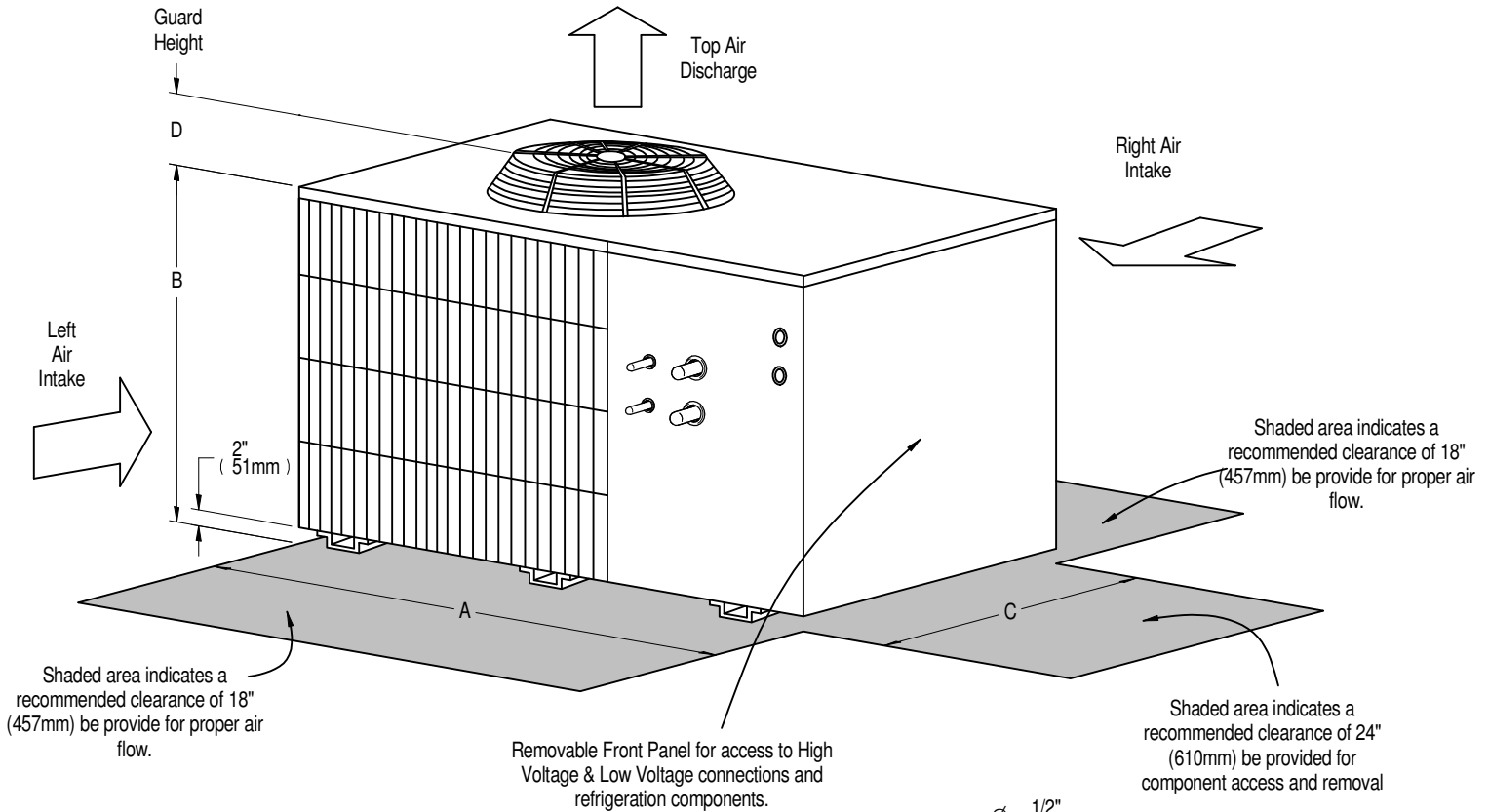
MODEL NUMBERS		DIMENSIONAL DATA IN. (mm)			MODULE WEIGHT
60 HZ	50HZ	A	B	C	lbs. (kg) net
PFH014A-L	NA	40 (1016)	23 1/2 (597)	18 (457)	200 (91)
PFH020A-L	NA				
PFH027A-L	NA				
PFH027A-H	NA	48 (1219)	31 (787)	18 (457)	241 (109)
PFHZ27A-L	NA				
PFH037A-L	PFH036A-L				
PFH042A-L	PFH041A-L	53 (1343)	36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



**VERTIV™**

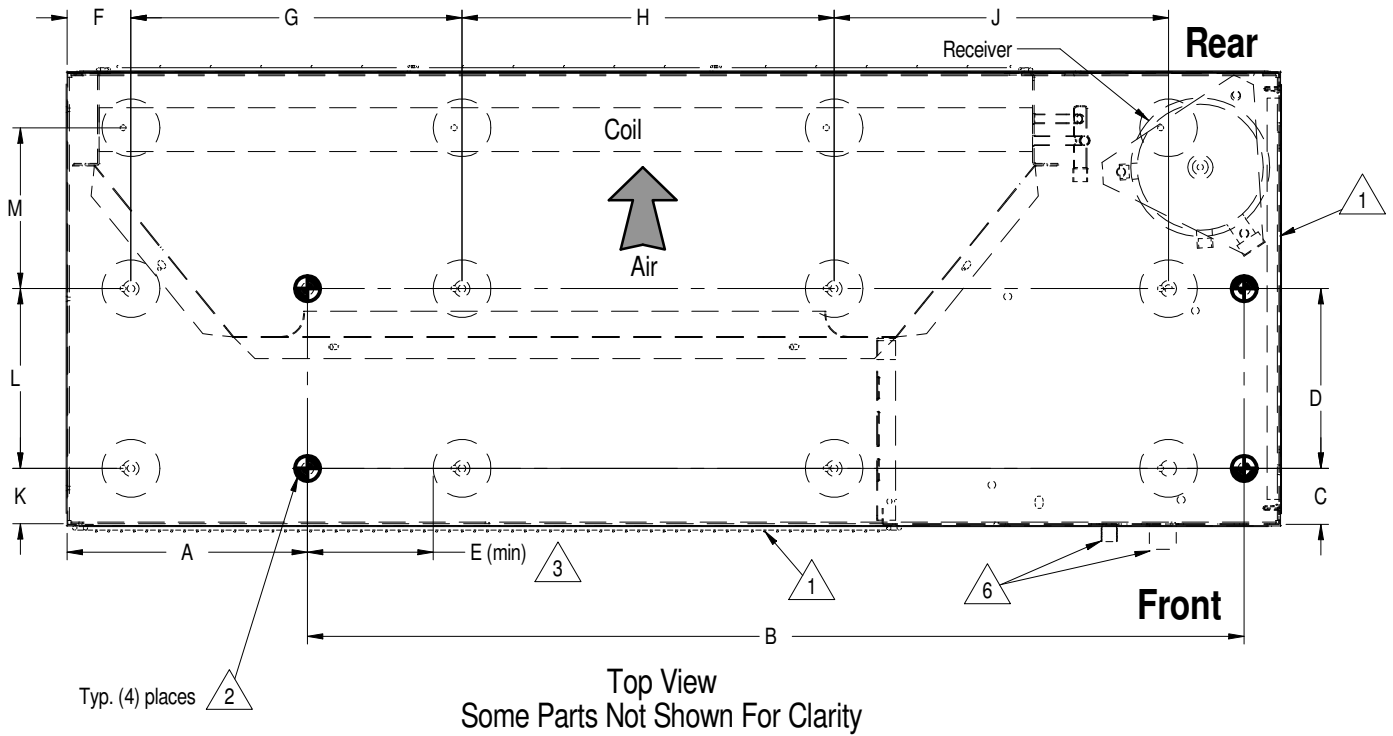
# LIEBERT® PFH

## CABINET DIMENSIONAL DATA CONDENSING MODULES W/ TOP AIR DISCHARGE



MODEL NUMBERS		DIMENSIONAL DATA IN. (mm)				MODULE WEIGHT
60HZ	50HZ	A	B	C	D	lbs. (kg) net.
PFH067A- H	PFH066A- H	53 (1343)	36 1/4 (918)	38 1/2 (978)	5 1/2 (140)	488 (222)
PFHZ67A- L	PFHZ66A- L					570 (259)
PFH096A- L	PFH095A- L					

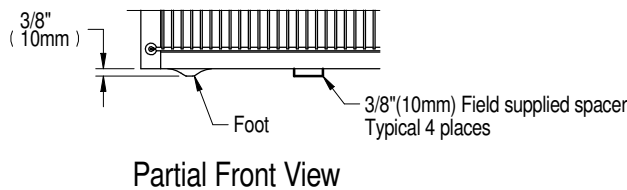
## OPTIONAL ANCHORAGE PLAN



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

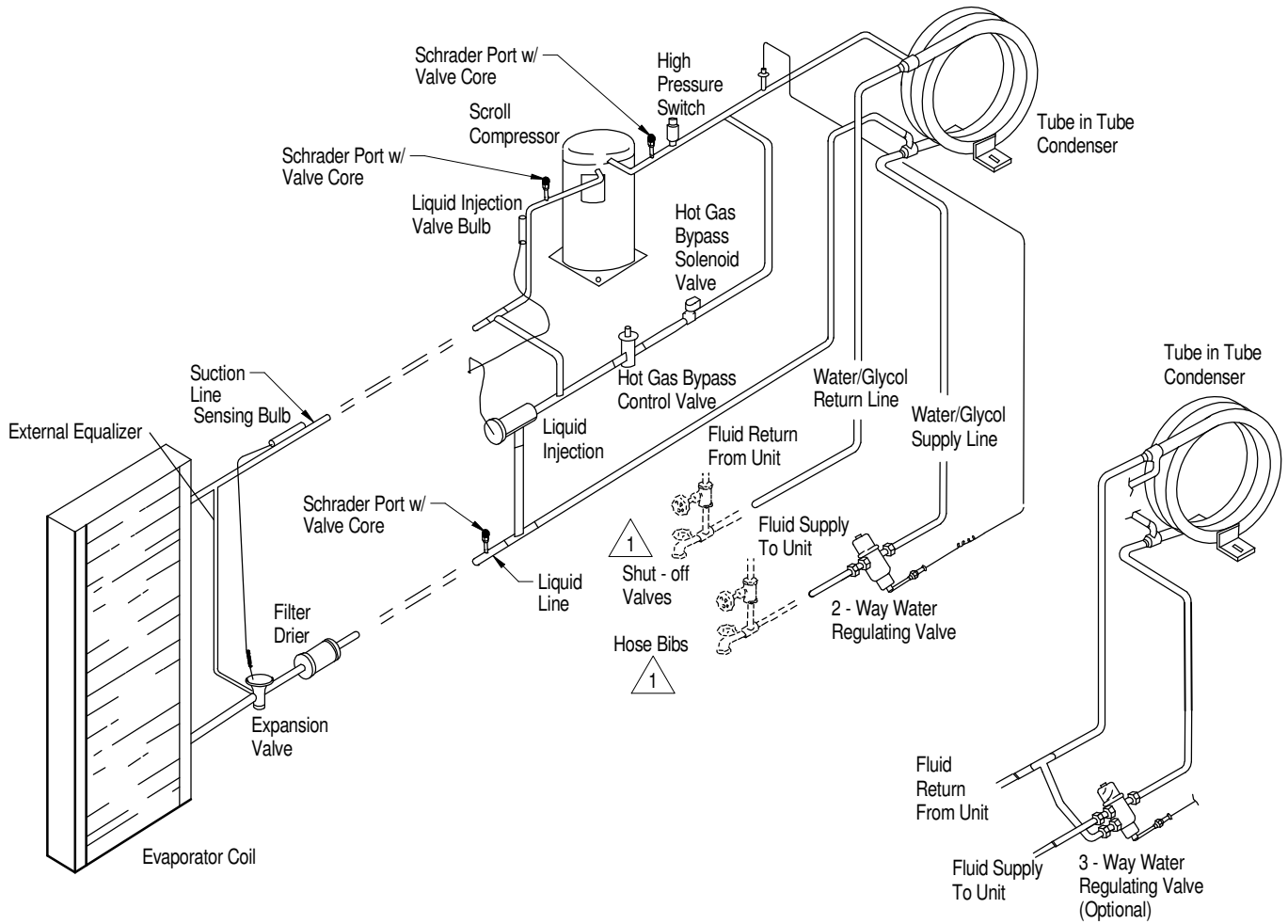




**VERTIV™**

# LIEBERT® MINI-MATE2

## GENERAL ARRANGEMENT DIAGRAM 5 TON SPLIT SYSTEMS WATER/GLYCOL COOLED MODELS



----- FIELD PIPING  
 ===== FACTORY PIPING

Notes:

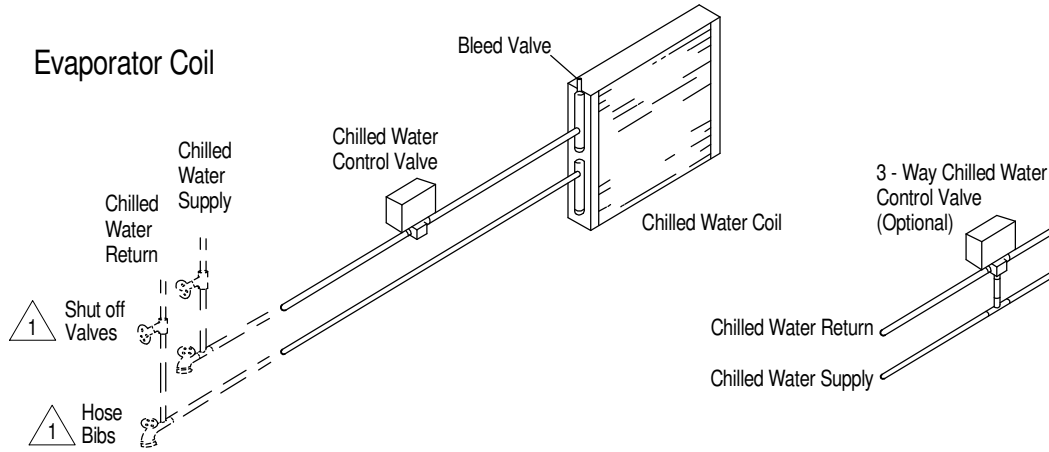
1. Components are not supplied by Vertiv but are required for proper circuit operation and maintenance.



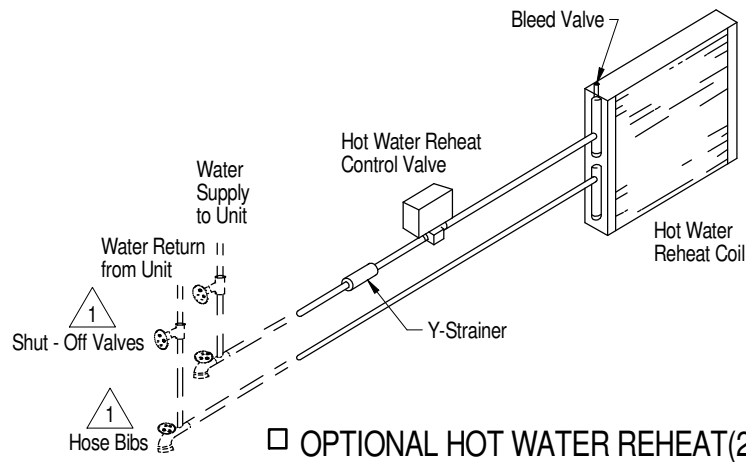
**VERTIV™**

# LIEBERT® MINI-MATE2

## GENERAL ARRANGEMENT DIAGRAM 5 TON CHILLED WATER MODELS



□ CHILLED WATER



□ OPTIONAL HOT WATER REHEAT(2-WAY VALVE)

Notes:

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

--- FIELD PIPING  
==== FACTORY PIPING

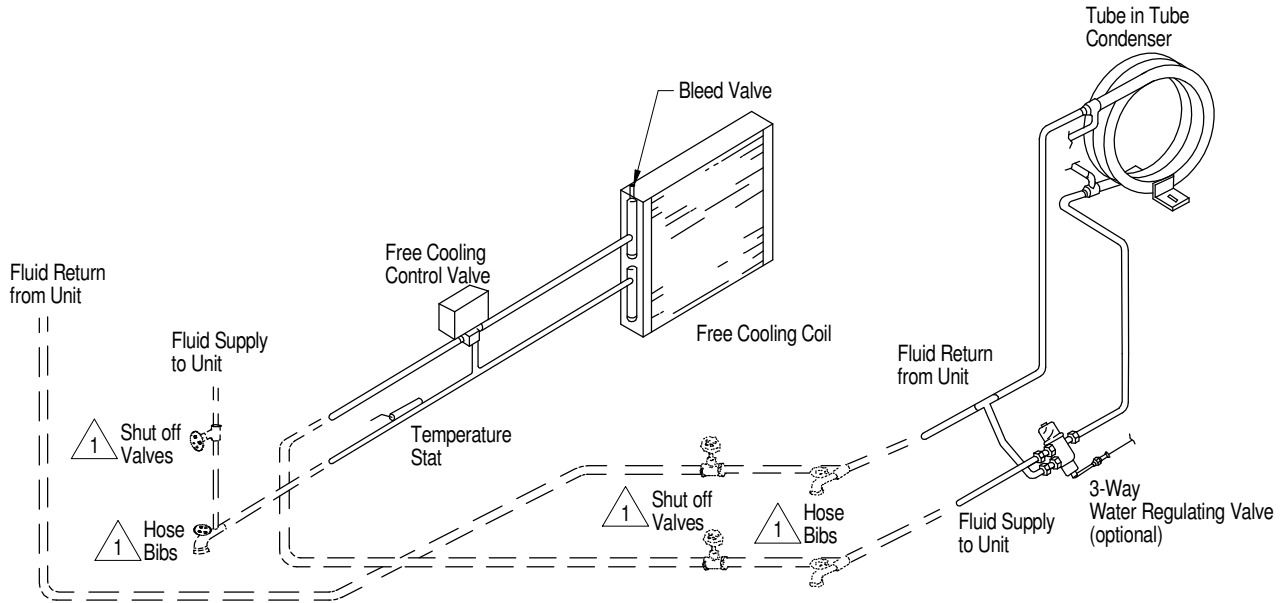




**VERTIV™**

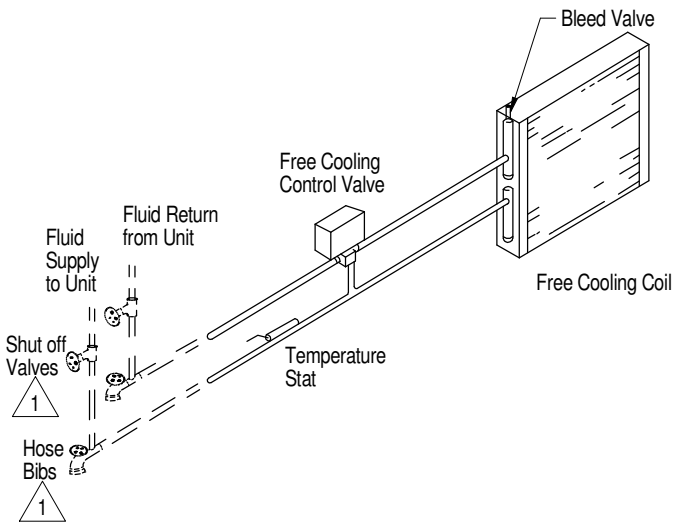
# LIEBERT® MINI-MATE2

## GENERAL ARRANGEMENT DIAGRAM 5 TON FREE COOLING OR HOT WATER REHEAT COIL OPTIONS



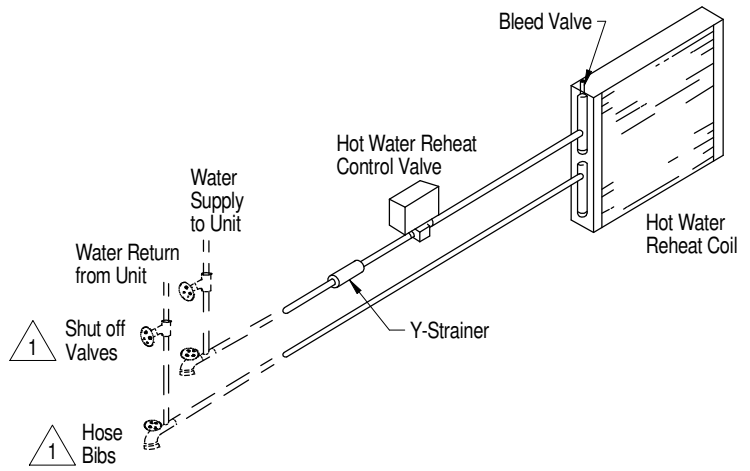
□ OPTIONAL FREE COOLING COIL (3-WAY VALVE)  
ON WATER/GLYCOL UNITS

NOTE: RECOMMENDED PIPING FOR UNITS  
WITH FREE COOLING COIL OPTION  
AND WATER/GLYCOL CONDENSER.



□ OPTIONAL FREE COOLING COIL (3-WAY VALVE)  
ON AIR COOLED UNITS

NOTE: EACH MODULE IS AVAILABLE WITH ONLY  
ONE OF THE ABOVE LISTED OPTIONS.



□ OPTIONAL HOT WATER REHEAT (2-WAY VALVE)  
ON CHILLED WATER UNITS

NOTE: HOT WATER REHEAT ONLY AVAILABLE  
ON CHILLED WATER UNITS.

===== FIELD PIPING  
===== FACTORY PIPING

Notes:

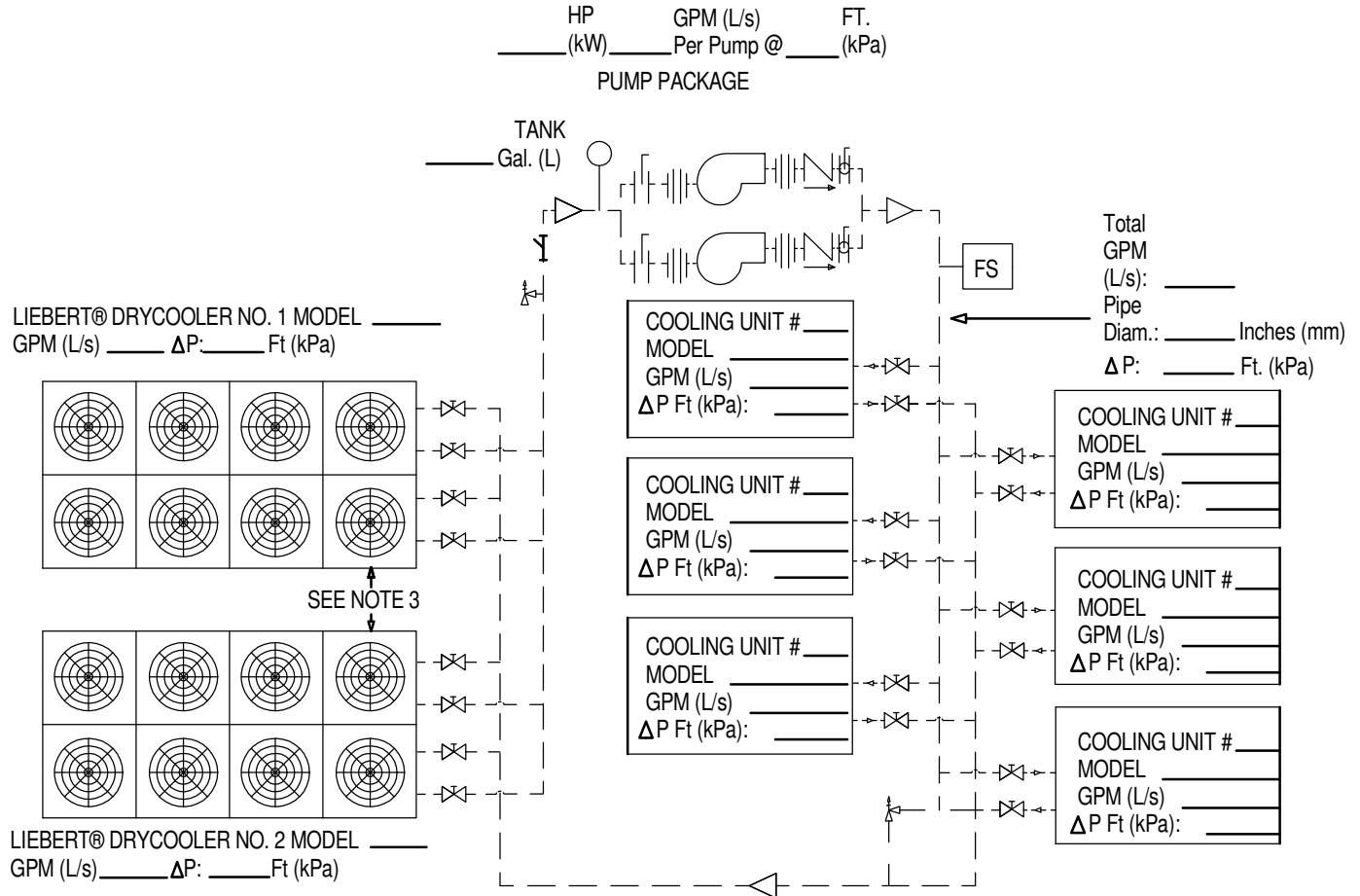
1. Components are not supplied by Vertiv but are required for proper circuit operation and maintenance.



# 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:

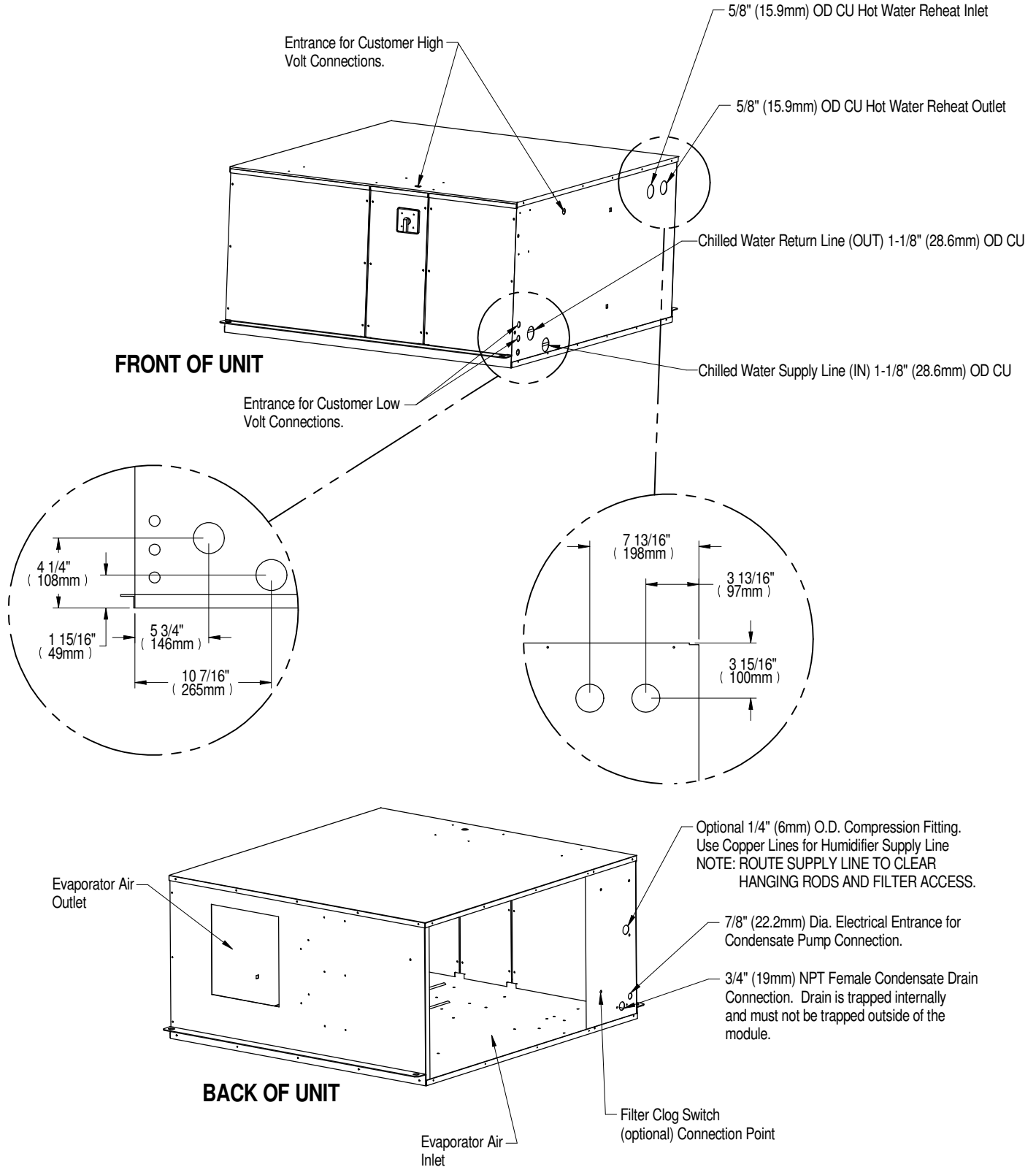
1. PRESSURE AND TEMPERATURE GAUGES (OR PORTS FOR SAME) ARE RECOMMENDED TO MONITOR COMPONENT PRESSURE DROPS AND PERFORMANCE.
2. FLOW MEASURING DEVICES, DRAIN AND BALANCING VALVES TO BE SUPPLIED BY OTHERS AND LOCATED AS REQUIRED.
3. SEE PRODUCT LITERATURE FOR INSTALLATION GUIDELINES AND CLEARANCE DIMENSIONS.
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.



**VERTIV™**

# LIEBERT® MINI-MATE2

## PRIMARY CONNECTION LOCATIONS 5 TON CHILLED WATER MODELS

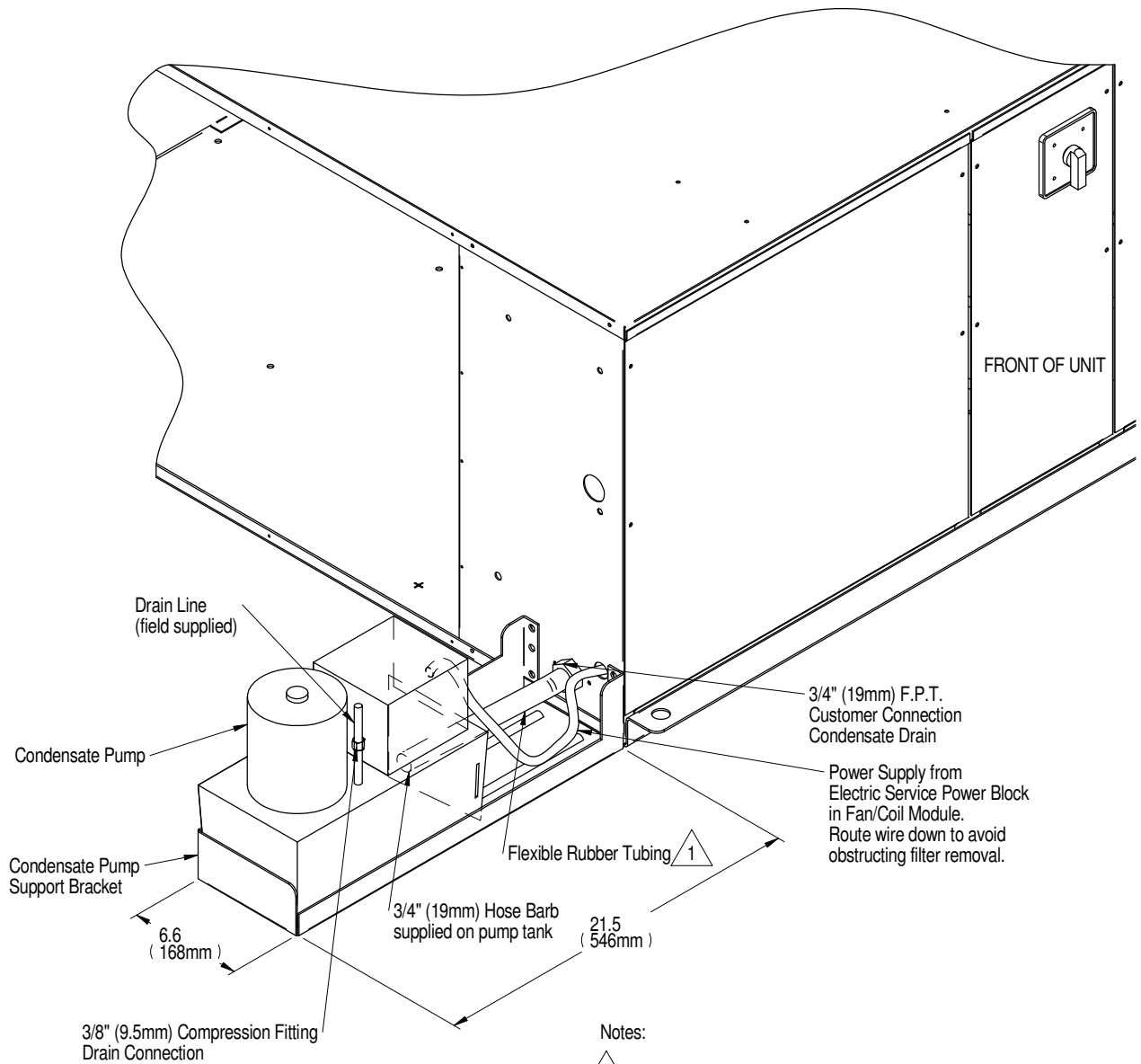




**VERTIV™**

# LIEBERT® MINI-MATE2

## SMALL SYSTEMS 5 TON CONDENSATE PUMP CONNECTION (OPTIONAL FIELD INSTALLED)



Notes:

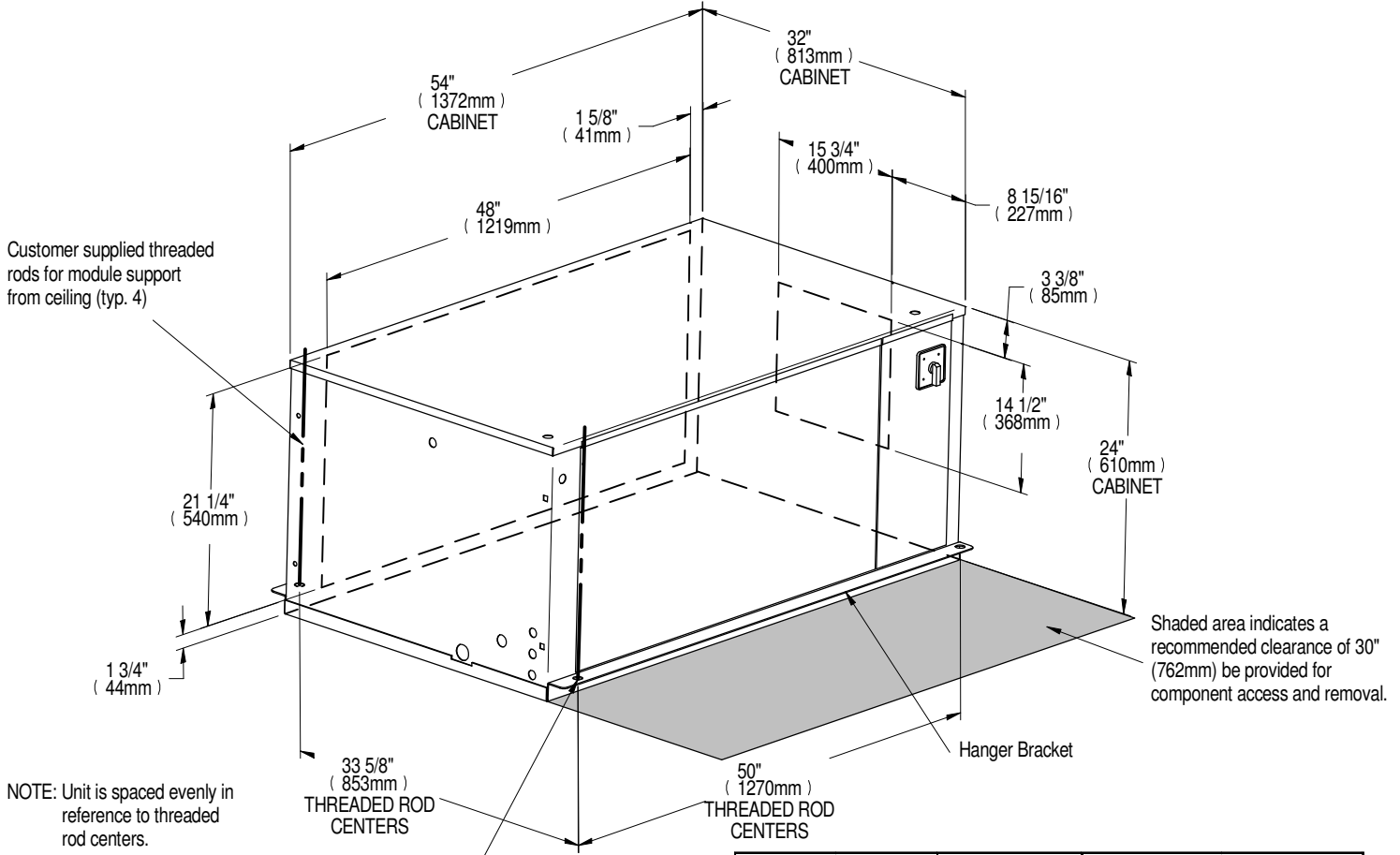
1. 3/4" (19mm) Flexible Rubber Tubing Assembly (supplied with pump kit) must be installed on pump end.
2. The Auxiliary Float Switch included with pump must be field interlocked with unit control to enable unit shutdown feature. Wire to evaporator terminal per unit schematic.
3. Refer to DPN003401 for installation instructions.



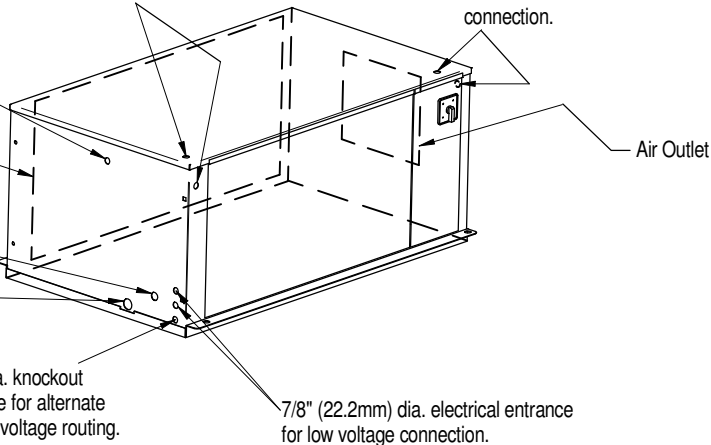
**VERTIV™**

# LIEBERT® MINI-MATE2

## CABINET DIMENSIONAL DATA & PRIMARY CONNECTION LOCATIONS 5 TON AIR COOLED INDOOR CONDENSING MODULE



MODEL #		UNIT NET WT lbs. (kg)	Refrigerant Connection sizes O.D. Cu	
60 HZ	50 HZ		Suction	Liquid
MC*65A	MC*64A	449 (204)	7/8"	1/2"



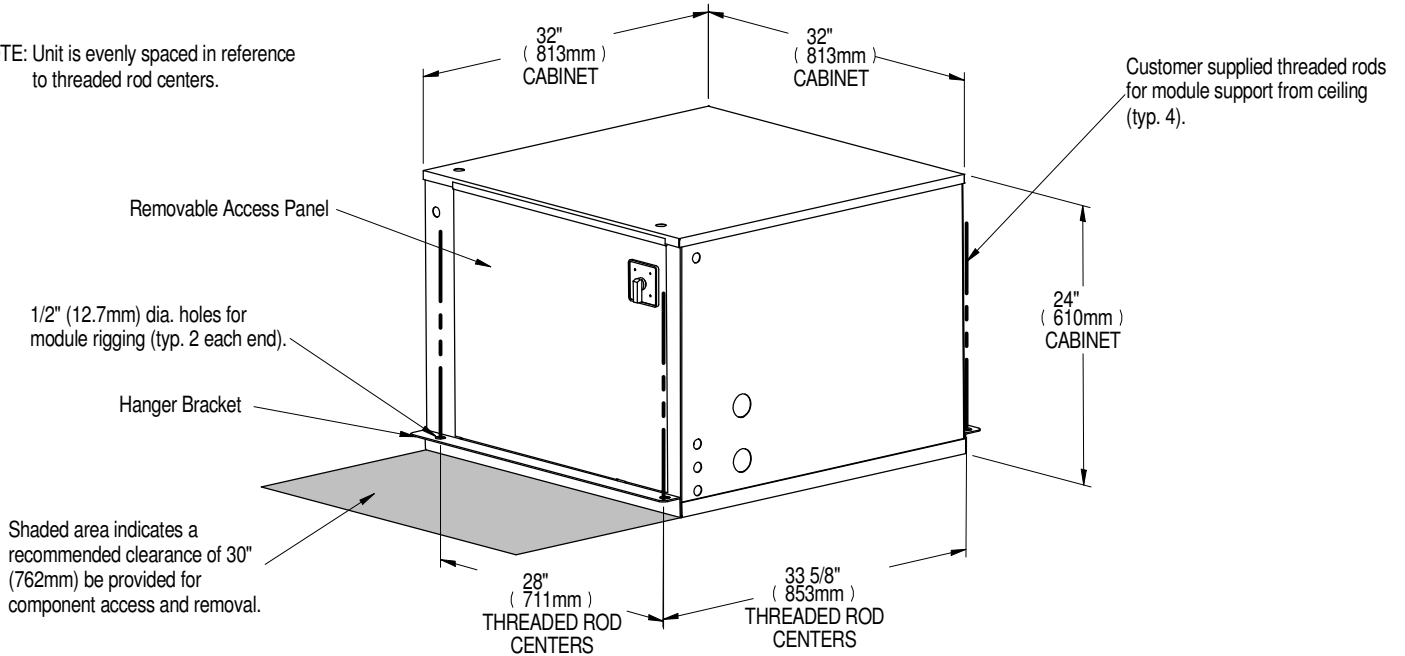
Form No.: DPN001040\_REV14



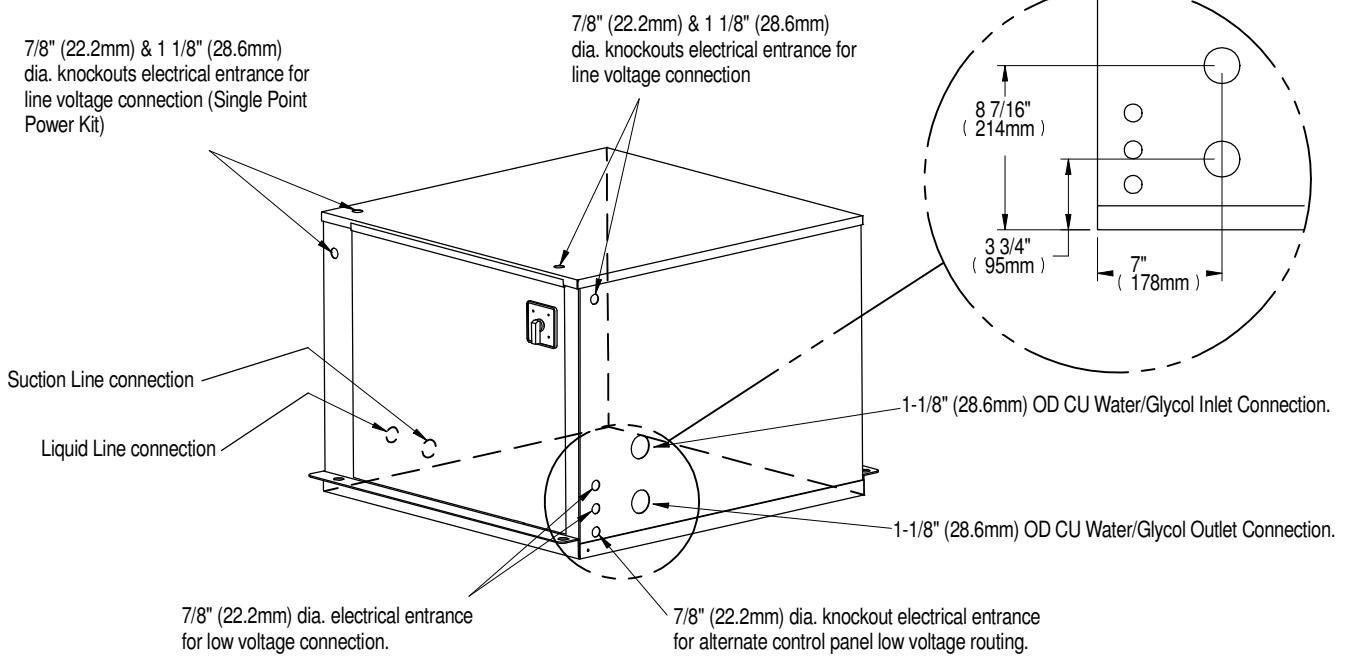
# LIEBERT® MINI-MATE2

## CABINET DIMENSIONAL DATA & PRIMARY CONNECTION LOCATIONS 5 TON WATER/GLYCOL COOLED INDOOR CONDENSING MODULE

NOTE: Unit is evenly spaced in reference to threaded rod centers.



MODEL #		UNIT NET WEIGHT lbs. (kg)	Refrigerant Connection sizes O.D. Cu	
60 HZ	50 HZ		Suction	Liquid
MC*69W	MC*68W	282 (128)	7/8"	1/2"



Form No.: DPN001040\_REV14



**VERTIV™**

# LIEBERT® MINI-MATE2

## ELECTRICAL FIELD CONNECTIONS

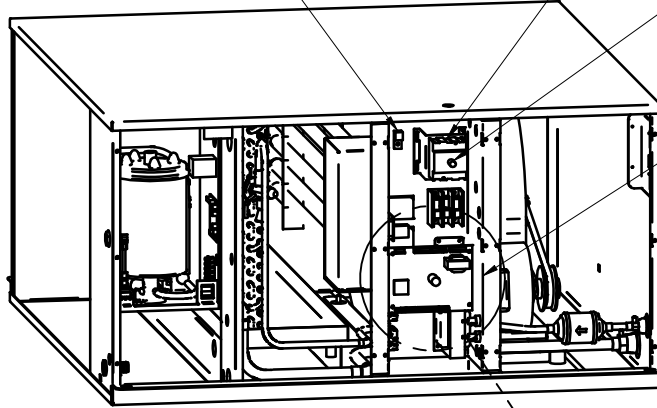
### 5 TON MODELS

Earth Ground Connection  
Connection terminal for field  
supplied earth grounding wire.

High Volt Power Connections  
Electric service connection terminals.

Factory installed  
disconnect switch.

Remote Humidifier Contact  
Field Supplied 24V class 2  
wiring to terminals 11 & 12,  
located in field wire  
compartment.

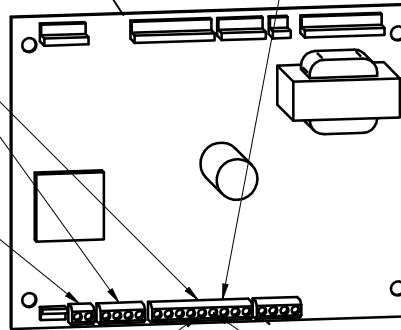


Optional Condensate Pump Auxiliary Float  
Switch Connection to terminal TB1-8 and  
TB1-9.

Customer Remote Alarm Connection. Field supplied 24V Class 2 wiring  
to connection TB1-1, TB1-2 and TB1-3.

Remote Control Panel Connection to TB3-1,2,3,4 connected with field  
supplied Thermostat wire (22ga, shielded/jacketed: available from  
Liebert or others). Unit Control Board terminals marked GND, +5V, T-,  
T+ must be connected to corresponding terminals on Remote Control  
Wall Box.

Site Monitoring Connection. Terminals TB4-1(+) TB4-2(-) are for connection of a 2 wire,  
twisted pair, communication cable (available from Liebert or others) to optional  
Liebert® IS-UNITY-DP or Liebert® SiteScan.



Remote Unit Shutdown. Replace existing jumper between terminals TB1-4 and TB1-5 with  
normally closed switch having a minimum 75 VA rating. Use field supplied 24V Class 1 wire.

Common Alarm Connection.  
Field supplied 24V Class 2 wiring to  
common alarm connection TB1-6 and TB1-7.



Field supplied unit disconnect switch  
when factory unit disconnect switch  
is not supplied.

Entrance for customer high  
volt connections.

Electric service not by Vertiv.

Electrical entrance for  
optional condensate  
pump on back of unit.

Field supplied, field wired thermostat  
wire to remote wall box.

Entrance for customer low  
voltage connections.

Entrance for customer  
low voltage connections.

Optional Liebert® IS-UNITY-DP connection to  
terminals 20 and 21 on lower right outside of electric box.  
Field supplied 24V Class 2 wiring

Field supplied 24V (NEC Class 2 wiring)  
to condensing module. (if applicable)

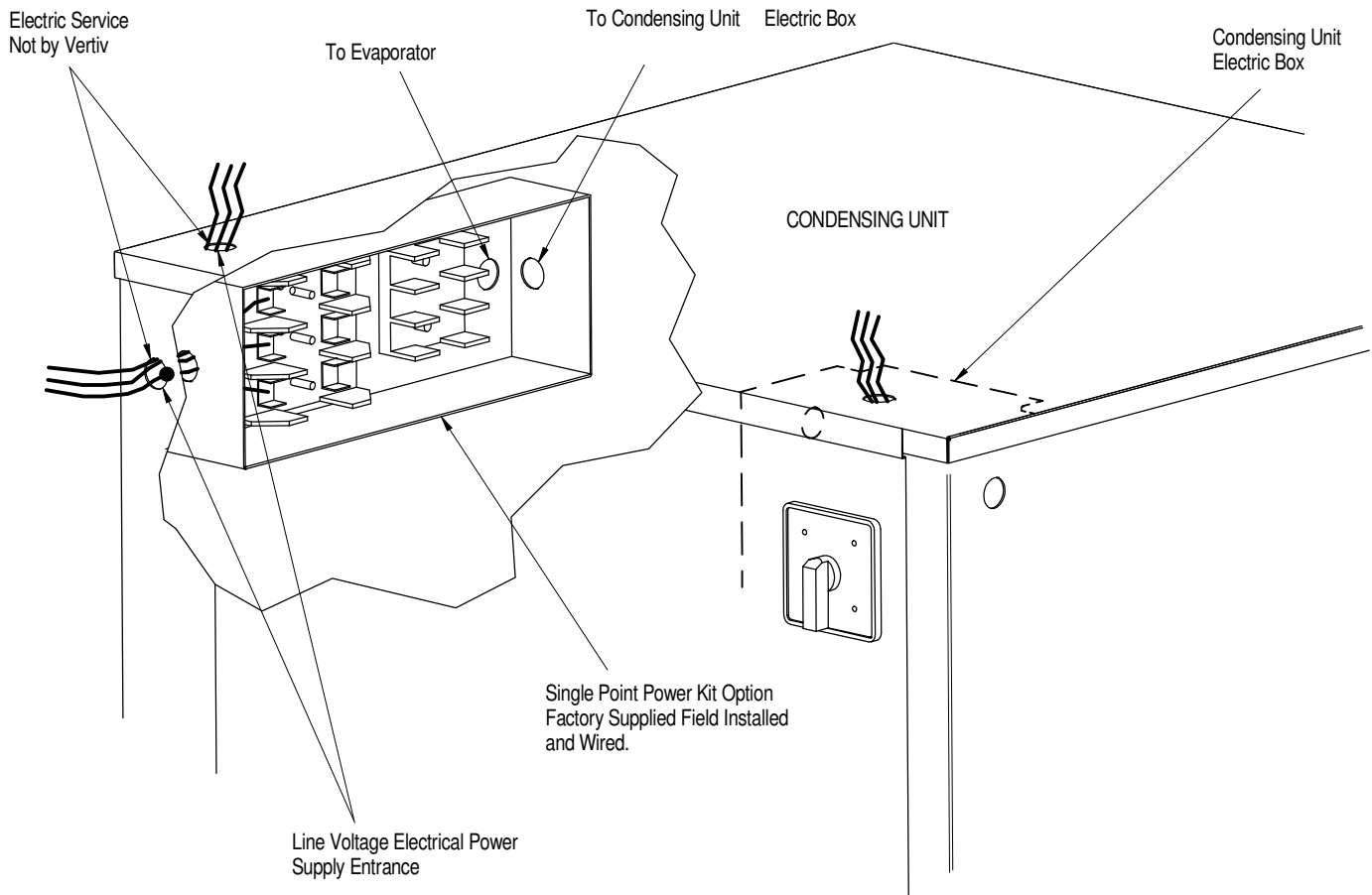
**Notes:**

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



# LIEBERT® MINI-MATE2

## SINGLE POINT POWER KIT 5 TON OPTIONAL FIELD INSTALLED



Notes:

1. Single Point Power Kit should be mounted inside the condensing unit before installing the unit in the ceiling.

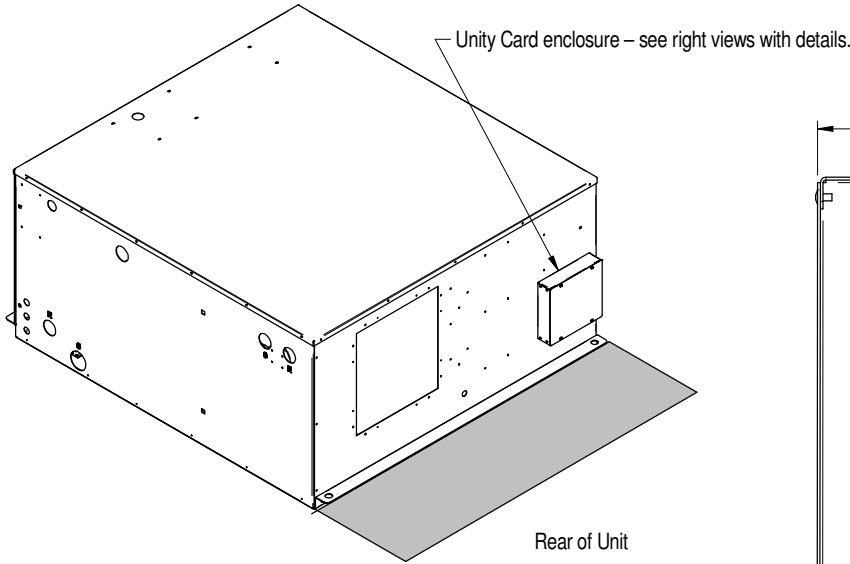




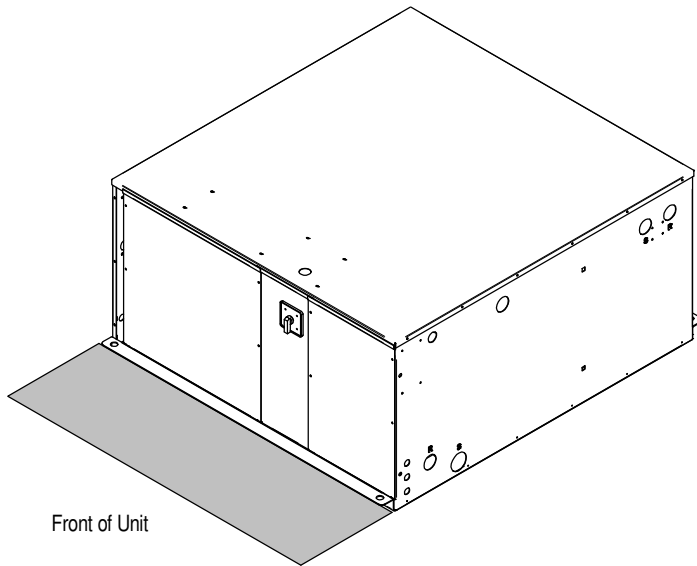
**VERTIV™**

# LIEBERT® MINI-MATE2

## GENERAL ARRANGEMENT & DIMENSIONAL DATA UNIT MOUNTED LIEBERT® IS-UNITY-DP ON 5 TON FOR BMS CONNECTIVITY



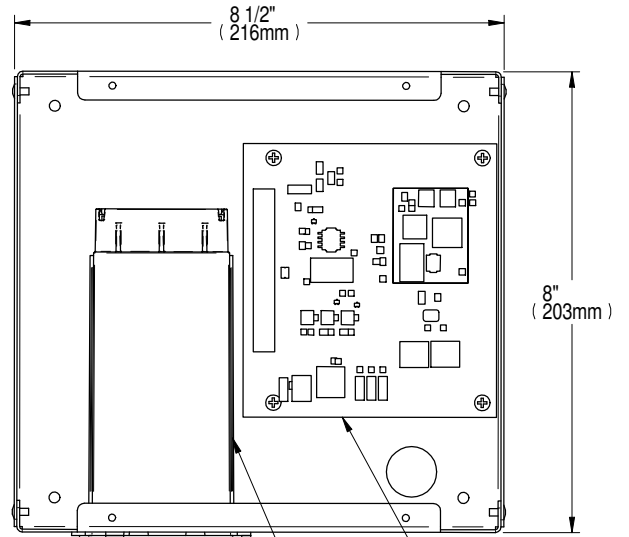
Shaded area indicates a recommended clearance of 30" (762mm) for component access and removal



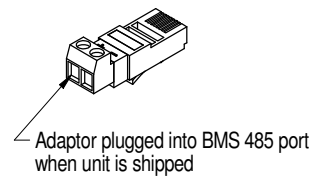
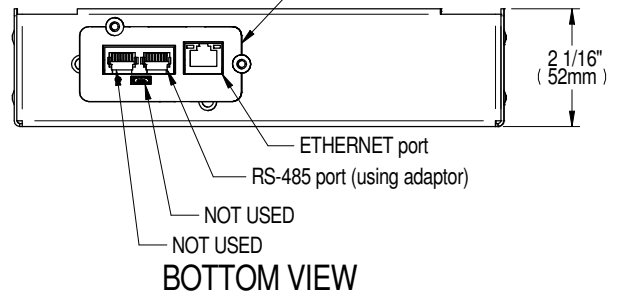
Shaded area indicates a recommended clearance of 30" (762mm) for component access and removal

Notes:

1. Refer to DPN004854 for field communication connections.



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



Form No.: DPN001040\_REV14

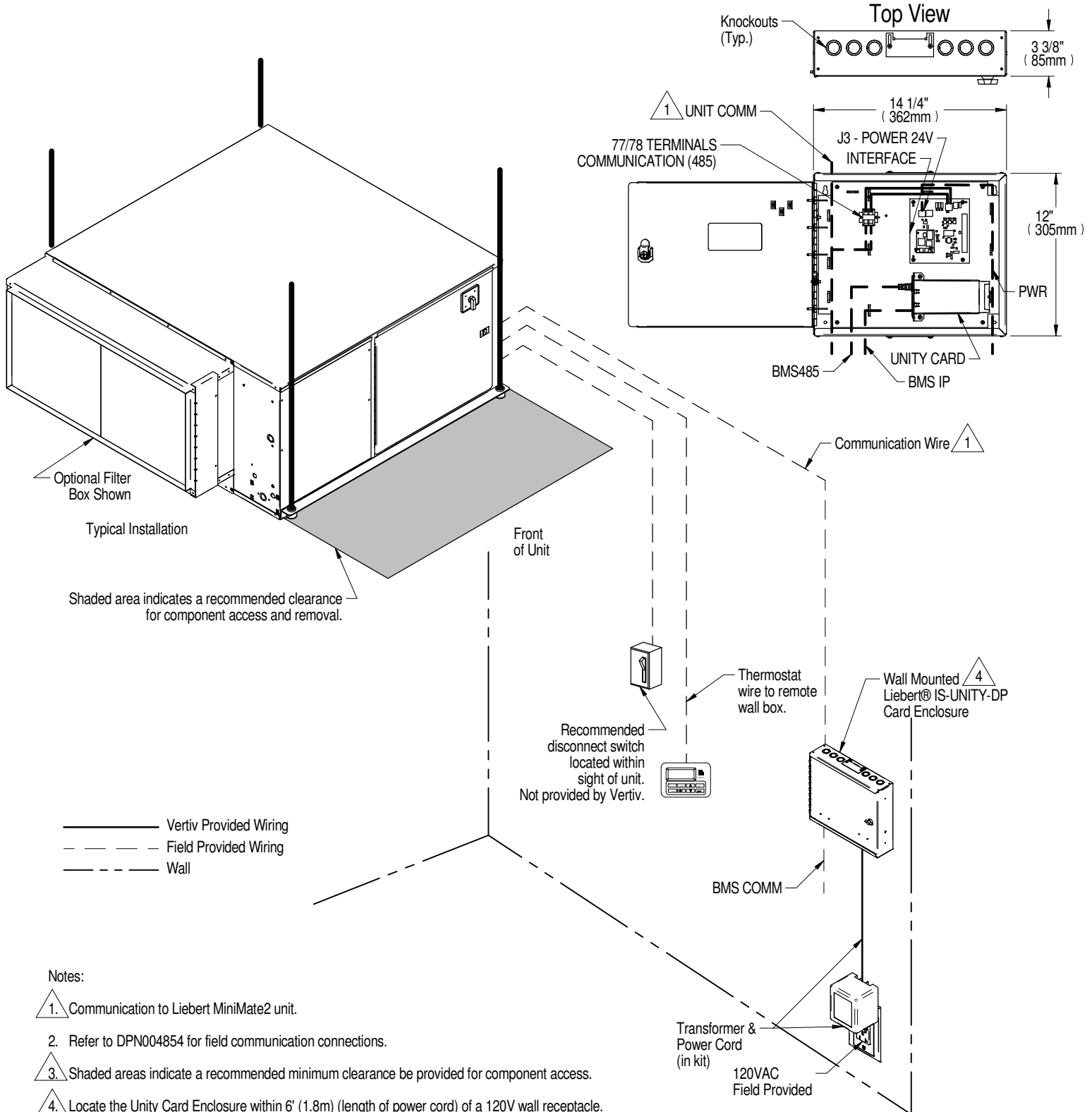


**VERTIV™**

# LIEBERT® MINI-MATE2

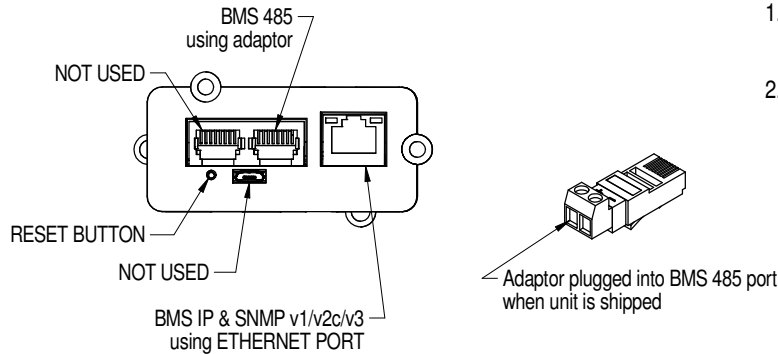
## GENERAL ARRANGEMENT & DIMENSIONAL DATA

### 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

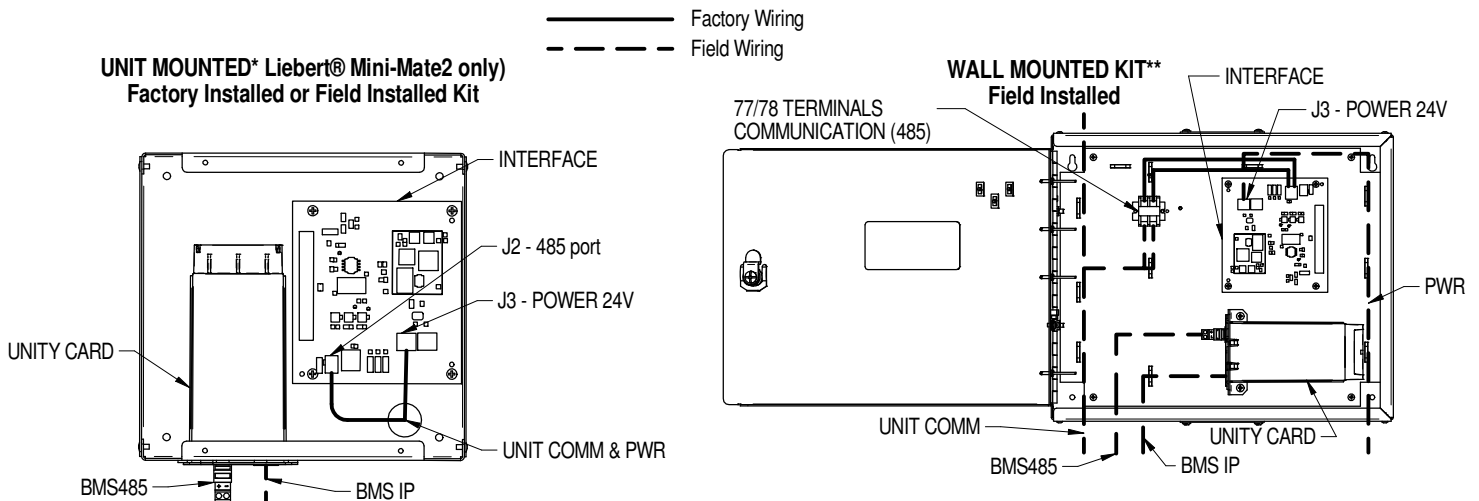
	UNIT		UNIT MOUNTED KITs*		WALL MOUNTED KITs**	
	TERMINAL/PLUG	POSITION	TERMINAL/PLUG	POSITION	TERMINAL/PLUG	POSITION
<b>Liebert® Mini-Mate2 1-5 Ton</b>						
COMMUNICATION (485)	TB4	1 / 2	J2	2 / 1	77 / 78	N/A
POWER 24V	20, 21	N/A	J3	1 / 2	J3	1 / 2
<b>Liebert® Mini-Mate2 8 Ton</b>						
COMMUNICATION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

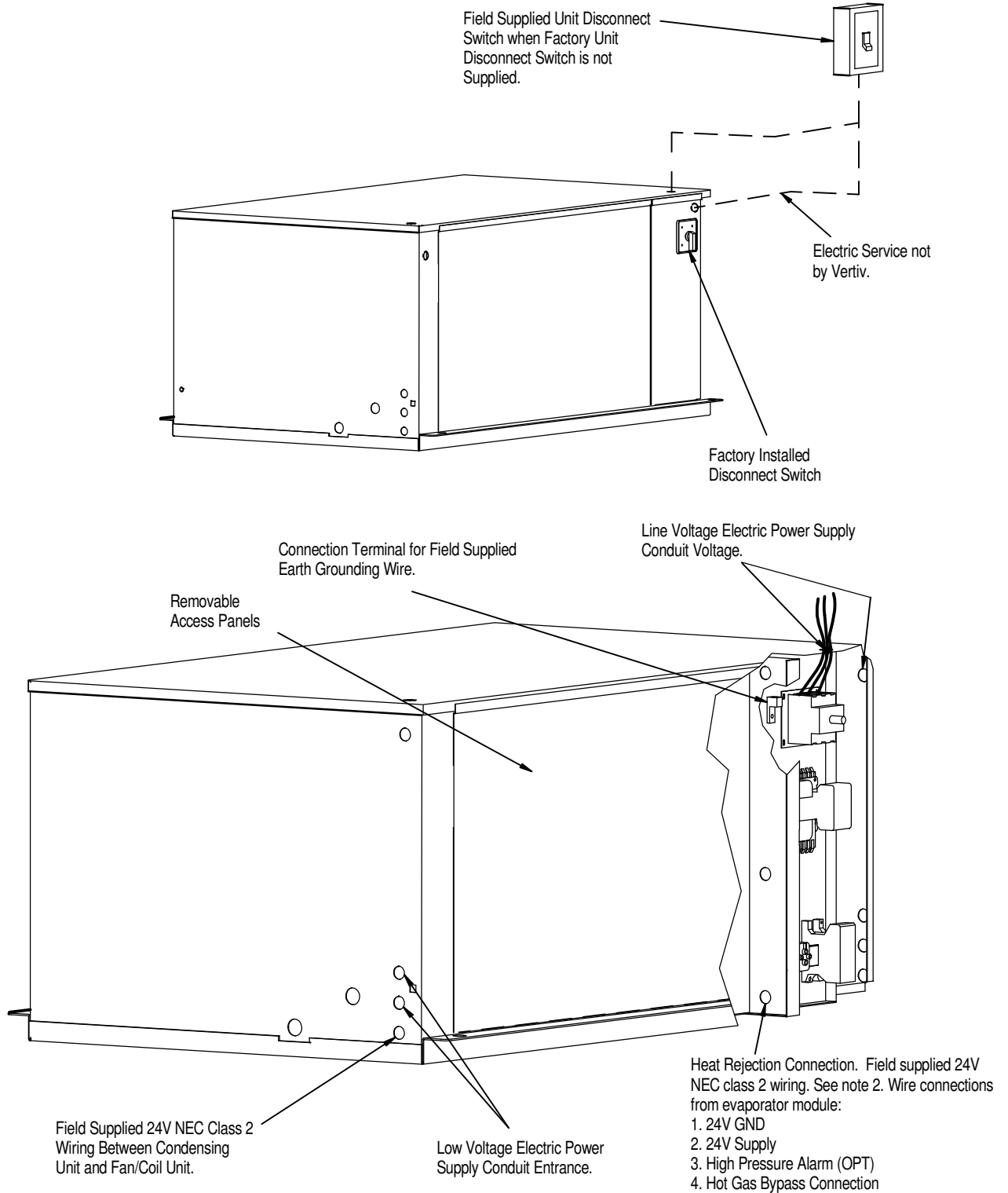
\*\* Wall mounted kits are provided with power wire harness and 120 Volt wall outlet transformer. Unit Comm & BMS Comm are field provided.





# LIEBERT® MINI-MATE2

## ELECTRICAL FIELD CONNECTIONS 5 TON AIR COOLED INDOOR CONDENSING MODULE



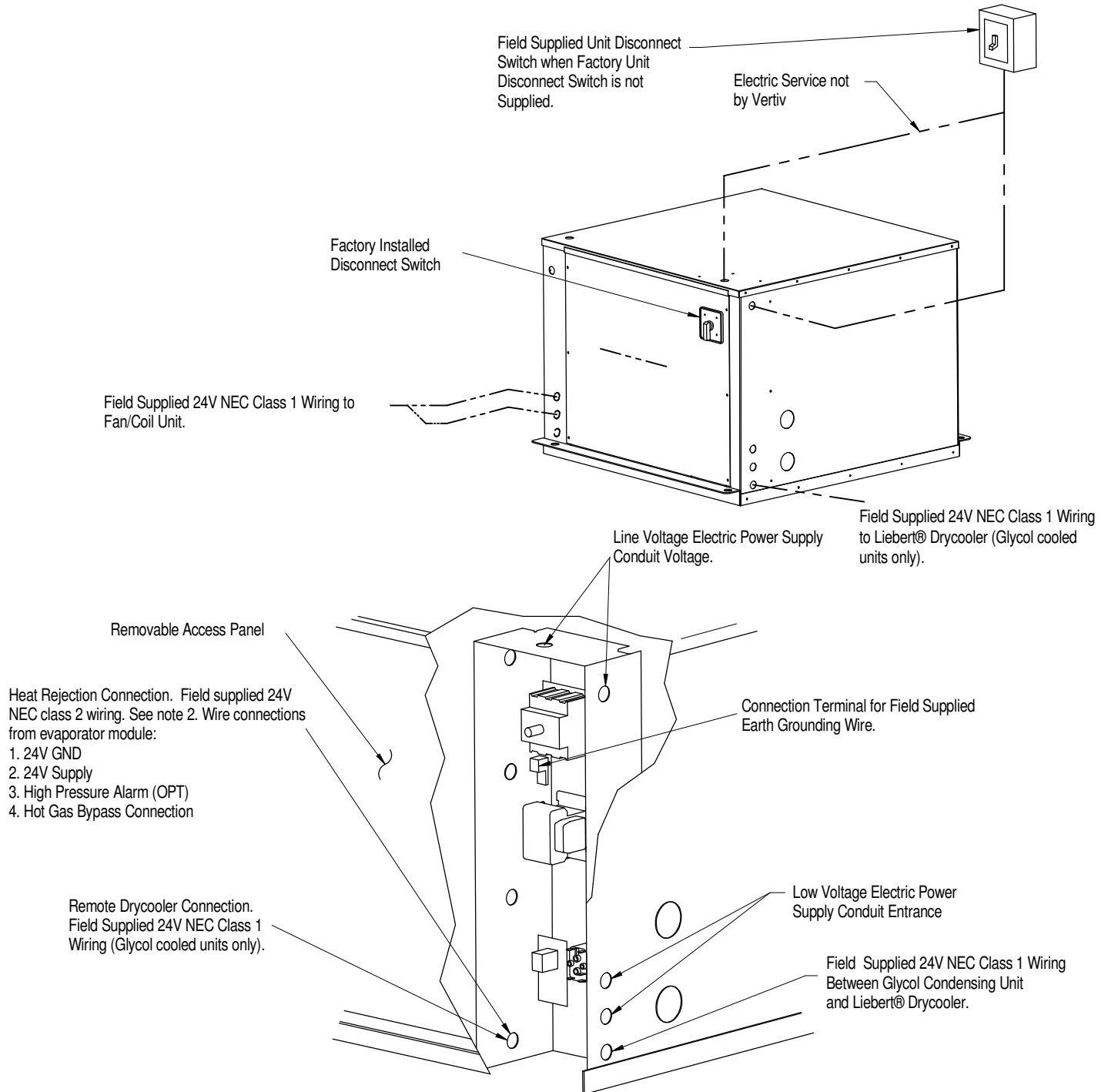
**Notes:**

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



# LIEBERT® MINI-MATE2

## ELECTRICAL FIELD CONNECTIONS 5 TON WATER/GLYCOL COOLED INDOOR CONDENSING MODULE



Notes:

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

### **Connect with Vertiv on Social Media**



<https://www.facebook.com/vertiv/>



<https://www.instagram.com/vertiv/>



<https://www.linkedin.com/company/vertiv/>



<https://www.twitter.com/Vertiv/>



---

Vertiv.com | Vertiv Headquarters, 505 N. Cleveland Ave., Westerville, OH 43082, USA

© 2023 Vertiv Group Corp. All rights reserved. Vertiv™ and the Vertiv logo are trademarks or registered trademarks of Vertiv Group Corp. All other names and logos referred to are trade names, trademarks or registered trademarks of their respective owners. While every precaution has been taken to ensure accuracy and completeness here, Vertiv Group Corp. assumes no responsibility, and disclaims all liability, for damages resulting from use of this information or for any errors or omissions.

SL-10536\_REV11\_05-23