

Vertiv™ CoolPhase Ceiling

Guide Specifications

Ceiling-Mounted Environmental Control System

1.0 GENERAL

1.1 Summary

These specifications describe requirements for a ceiling-mounted thermal management system. The system shall be designed to control the temperature conditions in rooms containing electronic equipment, with good insulation and vapor barrier. The system is also available with an optional humidity control package. 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 CSA-Listed to the harmonized U.S. and Canadian product safety standards "CSA C22.2 No. 60335-1/UL60335-1 Household and similar electrical appliances - Safety - Part 1: General requirements & CSA C22.2 No. 60335-2-40/UL 60335-2-40 Household and similar electrical appliances - Safety - Part 2: Particular requirements for electrical heat pumps, air conditioners and dehumidifiers" and be marked with cCSAus logo.

The system shall be AHRI Listed, the trusted mark of performance assurance for heating, ventilation, air conditioning and commercial refrigeration equipment, using AHRI Standard 1360.

1.3 Submittals

Submittals shall be provided with the proposal and shall include: Single-Line Diagrams; Dimensional, Electrical, and Capacity Data; Piping and Electrical Connection Drawings.

2.0 PRODUCT

2.1 Cooling System

2.1.1 Air-Cooled Refrigeration System

Refrigeration System

The single refrigeration circuit shall include a hydrophilic-coated Evaporator coil, a liquid-line filter drier, an electronic expansion valve, and from the 3 Ton to 8 Ton units: a liquid-line solenoid valve. The indoor evaporator refrigerant piping shall be with a nitrogen holding charge. Field relief of the Schrader valve shall indicate a leak-free system.

Hydrophilic-Coated Evaporator Coil

- Indoor Evaporator Unit 1 Ton Models:** The evaporator section shall include evaporator coil, electronic expansion valve and filter drier. The evaporator coil shall have 2.45 sq ft (0.23 m²) face area, three rows deep. It shall be constructed of internally rifled copper tubes and lanced-type aluminum fins and have a maximum face velocity of 485.81 FPM (2.47 m/s) at 1186 CFM (2015 CMH). The fan motor shall be 0.60 hp (500 W), maximum rating.
- Indoor Evaporator Unit 2 Ton Models:** The evaporator section shall include evaporator coil, electronic expansion valve and filter drier. The evaporator coil shall have 3.1 sq ft (0.28 m²) face area, five rows deep. It shall be constructed of internally rifled copper tubes and lanced-type aluminum fins and have a maximum face velocity of 476 FPM (2.4 m/s) at 1451 CFM (2465 CMH). The fan motor shall be 1.00 hp (747 W), maximum rating.
- Indoor Evaporator Unit 3 Ton Models:** The evaporator section shall include evaporator coil, electronic expansion valve, shut-off valve and filter drier. The evaporator coil shall have 3.1 sq ft (0.28 m²) face area, five rows deep. It shall be constructed of internally rifled copper tubes and lanced-type aluminum fins and have a maximum face velocity of 500 FPM (2.5 m/s) at 1530 CFM (2599 CMH). The fan motor shall be 4.43 hp (3,300 W), maximum rating.
- Indoor Evaporator Unit 4 Ton Models:** The evaporator section shall include evaporator coil, electronic expansion valve, shut-off valve and filter drier. The evaporator coil shall have 5.6 sq ft (0.52 m²) face area, six rows deep. It shall be constructed of internally rifled copper tubes and lanced-type aluminum fins and have a maximum face velocity of 488 FPM (2.5 m/s) at 2706 CFM (4597 CMH). The fan motor shall be 4.43 hp (3,300 W), maximum rating.
- Indoor Evaporator Unit 5 Ton Models:** The evaporator section shall include evaporator coil, electronic expansion valve, shut-off valve and filter drier. The evaporator coil shall have 5.6 sq ft (0.52 m²) face area, four rows deep. It shall be constructed of internally rifled copper tubes and lanced-type aluminum fins and have a maximum face velocity of 494 FPM (2.5 m/s) at 2739 CFM (4654 CMH). The fan motor shall be 4.43 hp (3,300 W), maximum rating.
- Indoor Evaporator Unit 8 Ton Models:** The evaporator section shall include evaporator coil, electronic expansion valve, shut-off valve and filter drier. The evaporator coil shall have 7.64 sq ft (0.71 m²) face area, six rows deep. It shall be constructed of internally rifled copper tubes and lanced-type aluminum fins and have a maximum face velocity of 489 FPM (2.5 m/s) at 3741 CFM (6356 CMH). The fan motor shall be 6.97 hp (5,200 W), maximum rating.

The evaporator coil shall be factory charged with nitrogen and sealed.

The system shall be field charged with field supplied R-32 refrigerant. 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 evaporator upon high water condition.

2.1.2 Air-Cooled Free-Cooling System

Free-Cooling System

The single Free-Cooling circuit shall include a 3-Way Valve, Inlet Fluid Pipe and Outlet Fluid Pipe. The indoor coil Free-Cooling piping shall be with a nitrogen holding charge. Field relief of the Schrader valve shall indicate a leak-free system.

Hydrophilic-Coated Free-Cooling Coil

- Indoor Free-Cooling Coil Unit 1 Ton Models:** The coil section shall include coil, 3-Way Valve and Fluid Inlet and Outlet Piping. The coil shall have 2.45 sq ft (0.23 m²) face area, three rows deep. It shall be constructed of internally soft copper tubes and lanced type aluminum fins and have a maximum face velocity of 485.81 FPM (2.47 m/s) at 1186 CFM (2015 CMH).
- Indoor Free-Cooling Coil Unit 2 Ton Models:** The coil section shall include coil, 3-Way Valve and Fluid Inlet and Outlet Piping. The coil shall have 3.1 sq ft (0.28 m²) face area, three rows deep. It shall be constructed of internally soft copper tubes and lanced-type aluminum fins and shall have a maximum face velocity of 476 FPM (2.4 m/s) at 1451 CFM (2465 CMH).
- Indoor Free-Cooling Coil Unit 3 Ton Models:** The coil section shall include coil, 3-Way Valve and Fluid Inlet and Outlet Piping. The coil shall have 3.1 sq ft (0.28 m²) face area, three rows deep. It shall be constructed of internally soft copper tubes and lanced-type aluminum fins and shall have a maximum face velocity of 500 FPM (2.5 m/s) at 1530 CFM (2599 CMH).
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Fan Motors

Each unit will have 1 coaxial fan: direct-driven centrifugal fans with diagonal shape impeller and electronically commutated motors. The fan speed shall be variable and automatically regulated by the Vertiv™ iCOM™ through all modes of operation. Each fan should have a dedicated motor, fault monitoring circuitry and speed controller, which provides a level of redundancy. The EC centrifugal fans shall be mounted in front of the coil assembly and draw air through.

2.1.3 Cabinet Construction

The cabinet shall be constructed of heavy gauge galvanized steel and shall be serviceable from one side. Mounting brackets shall be integral to the cabinet design. Internal cabinet insulation shall meet ASHRAE 62.1 requirements for Mold Growth, Humidity & Erosion, tested per UL 181 and ASTM 1338 standards.

2.1.4 Serviceability

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.

2.2 Fan Section

The fan shall be plug/plenum type, with direct-drive variable-speed motorized impeller, single inlet and dynamically balanced. The fans shall be located to draw air over the coil to ensure even air distribution and maximum coil performance.

The evaporator system shall be capable of delivering the airflows at external static pressures shown in section 2.0.

System shall be suitable for ducted supply and return air distribution. Supply air location shall be field selectable, configured in one of three outlet locations: right side, back of cabinet (4, 5 and 8 Ton only), or right side, bottom of cabinet (1, 2 and 3 Ton only). The bottom supply configuration will require an additional kit (ordered and shipped separately).

2.3 Locking Disconnect Switch

A manual disconnect switch shall be mounted in the electrical panel and be capable of disrupting the flow of power to the unit. The electric panel compartment shall be accessible only with the switch in the Off position. It shall be located behind the main electrical panel box door for quick access.

2.4 Short-Circuit Current Rating (SCCR)

MMI12, 24, 36, 48, 60 and MMI96 Models: The electrical panel shall provide at least 65,000 A SCCR with disconnect switch (Option Disconnect – 2).

2.5 Electronic Expansion Valve

The electronic expansion valve (EEV) shall be selected for precise modulation of refrigerant mass flow in response to varying system loads. The EEV shall incorporate sensors for simultaneous collection of temperature and pressure signals to accurately regulate refrigerant flow. The valve shall operate within a wide envelope, enabling it to reduce condensing pressure when conditions allow, thereby optimizing energy consumption.

2.6 Steam Generating Canister Humidifier

The environmental control 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, steam distributor and electronic controls. The need to change canister shall be announced on the microprocessor wall box control panel. The humidifier shall have a capacity for MMI12, MMI24 and MMI36 of 5 lb/h (2.27 kg/h) and 12 lb/h (5.44 kg/h) for MMI48, MMI60 and MMI96. A LED 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.

2.7 Refrigerant Filter Drier

A factory installed filter drier shall be designed to remove moisture and contaminants from refrigeration system that may otherwise clog or damage the refrigeration system.

2.8 R-32 Refrigerant

The system shall use R-32 refrigerant with a GWP of 675. Refrigerant shall be field supplied and field charged.

2.9 Smoke detector

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

2.10 Filter clog

The filter clog switch senses pressure drops across the filters and shall annunciate the wall controller upon exceeding the adjustable setpoint.

2.11 Ship Loose Accessories

2.11.1 Air Filter Box/Duct Flange

The evaporator section shall be supplied with an optional air filter box for use with ducted installations.

Pleated filters shall be supplied depending on each capacity:

- **1 Ton (MMI12):** One (1) filter 4 in x 16 in x 20 in (102 mm x 406 mm x 508 mm)
- **2 and 3 Ton (MMI24 and MMI36):** One (1) filter 4 in x 16 in x 20 in (102 mm x 406 mm x 508 mm)
- **4 and 5 Ton (MMI48 and MMI60):** Two (2) filters 4 in x 20 in x 20 in (102 mm x 508 mm x 508 mm) each.
- **8 Ton (MMI96):** Two (2) filters 4 in x 20 in x 25 in (102 mm x 508 mm x 635 mm) each.

All 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.

2.11.2 Condensate Pump

The condensate pump shall have the capacity of:

- **1 Ton (MMI12):** ___ GPH (___ l/h) at ___ ft. head (___ kPa).
- **2 and 3 Ton (MMI24 and MMI36):** ___ GPH (___ l/h) at ___ ft. head (___ kPa).
- **4, 5 and 8 Ton (MMI48, MMI60 and MMI96):** ___ 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 shall be provided to permit field wiring to the unit control to shut down the evaporator upon a high-water level condition.

2.11.3 Condensate Pump Bracket

For the 4, 5 and 6 Ton (MMI48, MMI60, MMI96) models, 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.

2.11.4 Duct Flanges

A pair of duct flanges shall be supplied for use on the supply and return air openings of the unit. Filters and box should be field-supplied.

2.11.5 Supply and Return Grille

For the 1, 2 and 3 Ton (MMI12, MMI24, MMI36) models, a factory-supplied supply and return grille kit shall be provided for supply and return air delivery through a 2 ft x 4 ft (0.6 m x 0.6 m) T-bar ceiling grid. Kit shall include an air baffle plate, supply grille, hinged return grille, 1 in x 20 in x 20 in (25.4 mm x 508 mm x 508 mm) MERV 8 (ASHRAE 52.2-2007) filter and mounting frame.

2.11.6 Air Distribution Plenum

For the 1, 2 and 3 Ton (MMI12, MMI24, MMI36) models, an air distribution plenum shall be supplied with an integral filter. The plenum shall be 24 in x 48 in (610 mm x 1219 mm) in size and shall provide 3-way air distribution for installation into a standard 24 in x 48 in (610 mm x 1219 mm) ceiling grid. Filter size shall be 4 in x 16 in x 25 in (102 mm x 406 mm x 535 mm), deep-pleated type with a MERV 8 rating, based on ASHRAE 52.2-2007.

3.0 CONTROLS

3.1 Vertiv™ iCOM™ Microprocessor Control with 7-inch color touchscreen

The Vertiv™ iCOM™ shall be microprocessor-based with a 7" color touchscreen display and shall be mounted in an ergonomic, aesthetically pleasing housing. The controls shall be menu-driven. The system shall display user menus for active alarms, event log, graphic data, unit view/status overview (including the monitoring of room conditions, operational status in percentage of each function, date, and time), total run hours, various sensors, display setup and service contacts. A password shall be required to make system changes. Service menus shall include setpoints, standby settings (lead/lag), timers/sleep mode, alarm setup, sensor calibration, maintenance/wellness settings, options setup, system/network setup, auxiliary boards, and diagnostics/service mode.

- **Password Protection** - The Vertiv™ iCOM™ shall contain two unique passwords to protect against unauthorized changes. An auto hide/show feature shall allow the user to see applicable information based on the login used.
- **Unit Backup and Restore** - The user shall be able to create safe copies of important control parameters. The ICOM™ shall have the capacity for the user to automatically backup unit configuration settings to internal memory or USB storage drive. Configuration settings may be transferred to another unit for a more streamlined unit startup.
- **Parameter Download** - The ICOM™ shall enable the user to download a report that lists parameter names, factory default settings, and user-programmed settings in .csv format for remote reference.
- **Parameter Search** - The ICOM™ shall have search fields for efficient navigation and parameter lookup.
- **Setup Wizards** - The ICOM™ shall contain step-by-step tutorials or wizards to provide easy setup of the control.
- **Context-Sensitive Help** - The ICOM™ shall have an on-board help database. The database shall provide context-sensitive help to assist with setup and navigation of the menus.
- **Display Setup** - The user shall be able to configure the display information based on the specific user's preference. Language, units of measure, screen contrast, home screen layout, back-light timer and the hide/show of certain readouts shall be configurable through the display.
- **Additional Readouts** - The display shall enable the user to configure custom widgets on the main screen. Widget options will include items such as fan speed, call for cooling, maintenance status, call for electric reheat, call for dehumidification, call for humidification, airflow, static pressure
- **Status LED's** - The ICOM™ shall show the unit's operating status using an integral LED. The LED shall indicate if the unit has an active alarm; if the unit has an active alarm that has been acknowledged; or if the unit is On, Off or in standby status.
- **Event Log** - The ICOM™ shall automatically store the last 400 unit-only events (messages, warnings, and alarms).
- **Service Contact Information** - The ICOM™ shall be able to store the local service or sales contact information.
- **Upgradeable** - ICOM™ upgrades shall be performed through a USB connection.
- **Timers/Sleep Mode** - The menus shall allow various customer settings for turning the unit On or Off.

- **Menu Layout** - The menus shall be divided into two main menus: User and Service. The User screen shall contain the menus to access parameters required for basic unit control and setup. The Service screen shall be designed for service personnel and shall provide access to advanced control setup features and diagnostic information.
- **Sensor Calibration** - The menus shall allow unit sensors to be calibrated with external sensors.
- **Maintenance/Wellness Settings** - The menus shall allow reporting of potential component problems before they occur.
- **Options Setup** - The menus shall provide operation settings for the installed components.
- **Auxiliary Boards** - The menus shall allow setup of optional expansion boards.
- **Diagnostics/Service Mode** - The ICOM™ control shall be provided with self-diagnostics to aid in troubleshooting. The microcontroller board shall be diagnosed and reported as pass/not pass. Control inputs shall be indicated as On or Off at the front display. Control outputs shall be able to be turned On or Off from the front display without using jumpers or a service terminal. Each control output shall be indicated by an LED on a circuit board.

3.2 Alarms

All unit alarms shall be annunciated through both audio and visual cues, clearly displayed on the screen, automatically recorded in the event log, and communicated to the customer's Building Management System/Building Automation System. The Vertiv™ iCOM™ shall activate an audible and visual alarm in event of any of the following conditions:

- High or Low Pressure
- Discharge High Temperature
- Low discharge superheat
- High- or Low-pressure lock
- Discharge high temperature lock alarm
- Discharge low super heat lock alarm
- Return air high or low temperature alarm
- Remote air high or low temperature alarm
- Filter clogged
- Remote powering off alarm
- Return air temperature sensor failure
- Return air humidity sensor failure
- High- or low-pressure sensor failure
- Suction temperature sensor failure
- Discharge temperature sensor failure
- EEV communication failure
- Compressor driver communication failure
- Water leakage alarm
- Return air high or low humidity alarm

- Air flow loss alarm
- Fan detection board communication failure
- Fan failure alarm
- High condensate water alarm
- Teamwork addresses duplicated
- Teamwork primary unit loss
- Teamwork secondary unit loss
- Smoke alarm
- Custom Alarms
- Humidifier failure alarm
- CP driver protect
- CP driver lock
- EEV driver abnormal
- Air pressure sensor failure
- Filter maintenance
- Refrigerant Leak
- Cooling Disabled
- Condensate Pump High Water
- FreeCooling Lockout
- Reduced ECO Airflow

3.3 Vertiv™ iCOM™ Control Methods and Options

The Vertiv™ iCOM™ shall be factory-set to allow precise monitoring and control of the condition of the air entering and leaving the unit. This control shall include predictive methods to control air flow and cooling capacity-based control sensors installed. Proportional and Tunable PID shall also be user-selectable options.

3.4 Controlling Sensor Options

The Vertiv™ iCOM™ shall be flexible in the sense that it shall allow for controlling the capacity and fan from multiple different sensor selections. The sensor selections shall be:

Cooling Capacity

- Remote
- Return

Fan Speed

- Remote
- Return
- Manual (for diagnostic or to receive a signal from the BMS through the Liebert remote monitoring devices or analog input)

3.4.1 Temperature Compensation

The Vertiv™ iCOM™ shall be able to adjust the capacity output based on Return or Remote temperature conditions to meet SLA guidelines while operating to highest efficiency.

3.4.2 Humidity Control

Dew point and relative humidity control methods shall be available (based on user preference) for humidity control within the conditioned space

3.5 Multi-Unit Coordination

Vertiv™ iCOM™ teamwork shall save energy by preventing multiple units in an area from operating in opposing modes. Teamwork allows the control to optimize a group of connected cooling units equipped with Vertiv™ iCOM™ using the U2U (Unit-to-Unit) network. There shall be three modes of teamwork operation:

- **Teamwork Mode 1:** Is best in small rooms with balanced heat loads. The controlling temperature and humidity sensor readings of all units in operation (fan on) are collected to be used for an average or worst-case sensor reading (user selectable). The master unit shall send the operating requirements to all operating units in the group. The control band (temperature, fan, and humidity) is divided and shared among the units in the group.
- **Teamwork Mode 2:** The iCOM™ calculates the worse-case demand for heating, cooling humidification and dehumidification. Based on the greatest demand within the group, each unit operates independently, meaning that the unit may respond to the thermal load and humidity conditions based on the unit's controlling sensors.

3.6 Standby/Lead Lag

The Vertiv™ iCOM™ shall allow scheduled rotation to keep equal run time on units and provide automated emergency rotation of operating and standby units.

3.7 Standby Unit Cascading

The Vertiv™ iCOM™ cascade option shall allow the units to turn On and Off based on heat load when utilizing Optimized Aisle, Teamwork Mode 3 and remote temperature sensors. Cascade mode dynamically coordinates the fan speed to save energy and to meet the cooling demands. For instance, with a Vertiv™ iCOM™ group of six units and only 50% of the heat load, the iCOM™ shall operate only four units at 80% fan speed and leave the other two units in standby. As the heat load increases, the iCOM™ shall automatically respond to the additional load and bring on another unit, increasing the units in operation to five. As the heat load shifts up or down, the control shall meet the needs by cascading units On or putting them into standby.

3.8 Virtual Primary

As part of the robust architecture of the Vertiv™ iCOM™ control, it shall allow for a virtual primary that coordinates operation. The Virtual Primary function shall provide smooth control operation if the group's communication is compromised. When the lead unit, which is in charge of component staging in teamwork, unit staging and standby rotation, becomes disconnected from the network, the iCOM™ shall automatically assign a virtual primary. The virtual primary shall assume the same responsibilities as the primary until communication is restored.

3.9 Compressor Short Cycle Control

To help maximize the life of the compressor, there shall be start-to-next start delay for the compressor. The control shall monitor the number of compressor starts in an hour. If the compressor starts more than 6 times in 60 minutes, the local display and remote monitoring shall notify the user through a Compressor 1 Short Cycle event. The Compressor 1 Short Cycle event will remain active for at least 1 hour after being enabled.

3.10 Vertiv™ CoolPhase Condensing Unit

Units may be matched to a premium efficiency condenser control with enhanced monitoring, alarming, and diagnostics. The condenser control shall have an automated, low-noise mode and fan reversal for cleaning mode.

3.11 System Auto Restart

The auto restart feature shall automatically restart the system after a power failure. Time delay shall be programmable.

3.11.1 Sequential Load Activation

On initial startup or restart after power failure, each operational load shall be sequenced with a minimum delay of one second to minimize total inrush current.

3.11.2 Low Pressure Monitoring

Units shall ship standard with low-pressure transducers for monitoring compressor suction pressure. If the pressure falls due to loss of charge or other mechanical cause, the corresponding circuit shall shut down to prevent equipment damage. The user shall be notified of the low-pressure condition through the local display and remote monitoring.

3.12 Winter Start Time Delay - Air - Cooled Models

An adjustable software timer shall be provided to assist with compressor starting during cold weather. When the compressor starts, the low-pressure input shall be ignored for the period set in the user-adjustable timer. Once the time period has elapsed after the compressor start, the low-pressure input should remain in the normal state. If the low-pressure input does not remain in the normal state when the time delay has elapsed, the circuit shall lock out on low pressure. The low-pressure alarm shall be announced on the local display and communicated to remote monitoring systems.

3.12.1 Advanced Freeze Protection

Units shall ship standard with advanced freeze protection enabled. The advanced freeze protection shall monitor the circuit pressure using a transducer. The control shall interact with the fan and compressor to prevent the unit coil from freezing if circuit suction pressure drops. If a freeze condition is detected, the user shall be notified through the local display and remote monitoring systems.

3.13 Refrigerant Pressure Transducer Failure

The control shall monitor the high-side and low-side refrigerant pressure transducers. If the control senses the transducer has failed, has been disconnected, has shorted or the reading has gone out of range, the user shall be notified through an event on the local display and remote monitoring. The corresponding circuit in which the failure has occurred shall be disabled to prevent unit damage.

3.14 Oil Return Protection

The control shall monitor compressor operation and staging to ensure that liquid and hot gas velocity are maintained for proper oil return to the compressor.

3.15 Digital Scroll High Temperature Protection

The control shall monitor digital scroll temperature during unit operation. A compressor temperature limit shall be imposed to help prevent damage to the compressor. If the temperature reaches the maximum temperature limit, the compressor shall be locked out and an alarm shall be annunciated on the local display and through monitoring. After the initial lockout, the control shall continue to monitor compressor temperature during the off-cycle and re-enable the circuit once a safe operating temperature is reached. The control shall store the number of high temperature trips. The number of trips shall be accessible through the local display.

3.16 Digital Scroll Sensor Failure

The control shall monitor the status of the digital scroll sensor. If the control senses that the thermistor is disconnected, shorted or the reading goes out of range, the user shall be notified through an event on the local display and remote monitoring.

3.17 Compressor High and Low Temperature Limit Protection

The control shall monitor the return air to ensure that the compressor(s) are operated within the manufacturer's defined window of operation. If the return air temperature deviates from the manufacturer's window of operation, the Vertiv™ iCOM™ shall automatically adjust to prevent damage to the cooling unit or reduction in its reliability.

3.18 Compressor Run Time Monitoring

- The control shall log these compressor statistics:
 - Number of compressor starts
 - Run hours
 - Average run time
 - Starts per day
 - Starts per day worst
 - Number of high-pressure alarms
 - Operating phase in which the high-pressure alarm occurred
 - Number of low-pressure alarms
 - Operating phase in which the low-pressure alarm occurred
 - Number of compressor overloads
 - Number of high-temperature alarms

The user shall have the ability to monitor compressor operating temperature and pressure from the local display to be used as a diagnostic tool.

3.19 Return Temperature/ Humidity Sensor

The Vertiv™ CoolPhase Ceiling shall be provided with the Vertiv™ Liebert® Return Temperature/Humidity sensor. The sensor shall provide real-time, direct feedback to the cooling unit to optimize the amount of cooling and airflow provided. The sensor data shall be available to remote BMS and monitoring systems. The sensor network shall consist of one CAN wire leaving the cooling unit and connecting to the Return Temperature/Humidity Sensor. Additional CAN based sensors (Remote) shall be connected to this sensor.

3.20 Communication Interface

3.20.1 Remote Shutdown Terminal

The remote shutdown terminal shall provide a location to remotely shut down the unit, complying with the National Fire Code.

3.20.2 Common Alarm Contact

The common alarm contact shall provide a set of normally open contacts for remote indication of unit alarms.

3.20.3 Vertiv™ CoolPhase Ceiling One Extra Common Alarm Contact

One additional contact (total of two sets) of normally open (n/o) contacts for remote indication of unit alarms shall be provided.

3.21 10DI Digital Input Expansion Module

The 10DI Digital Input Expansion Module is an optional accessory designed to extend the digital input capabilities of system's main controller. It features 10 digital input channels and communicates with the main controller via Modbus RTU protocol over RS-485. The module is primarily used to monitor external feedback signals from EC (Electronically Commutated) fans and customer-installed Water Underflow accessory.

Core Functions:

- Provides 10 additional digital inputs for system integration
- Supports two types of digital input signals:
 - Frequency-based feedback (tachometer) from EC fans for fan status monitoring
 - Dry contact input for user-defined alarms (e.g., Water Underflow)
- Real-time status update of all input signals via Modbus communication
- Facilitates system diagnostics and enhances fault detection capabilities

Communication and Integration:

- Protocol: Modbus RTU (RS-485)

3.22 Refrigerant Leak Detection (RLS) System

Due to the slightly flammable nature of Refrigerant R-32, a refrigerant leak detector is installed into the unit.

Operation

When the sensor is powered up, an LED will indicate the sensor status. The LED is located on the reverse side of the sensor near the sensor membrane. While the sensor is mounted, the LED will backlight the sensor and be visible by the reflection from the mounting surface.

Item	Description
Solid green	Sensor power-up and self-test
Blinking green	Normal operation (heartbeat)
Solid red	Alarm state – gas detected
Blinking red	Sensor fault

In case of leakage the following actions will be taken:

- The compressor will shut down
- The evaporator and condenser fans will operate at 100% of their allowable speed
- The EEV will be closed completely
- Safety Shut-off Valve deactivates and will close completely, preventing additional refrigerant flow

NOTE: In case of leakage the unit will start mitigation actions and will send an alarm:

- The mitigation actions will continue for 5 minutes after detected gas levels drop below the sensor's factory default threshold setting

- Once the detected gas levels are below threshold and the 5-minute delay expires, the sensor will reactivate its status relay.
- Once the sensor's status relay is reactivated, the refrigerant leak related alarms are automatically cleared, the Evaporator and Condenser fans will be deactivated and turned Off, and Cooling Lockout alarms are displayed on the HMI
- Authorized personnel will clear the Cooling Lockout by pushing the refrigerant leak clear push button for 10 seconds. The push button is located in the EBOX
- Once cleared, the Safety Shut Off Valve will reactivate and open completely, the Cooling Lockout alarms are cleared automatically and the system will return to normal cooling operation, if the unit was previously actively cooling prior to the refrigerant leak.

4.0 HEAT REJECTION

4.1 Vertiv™ CoolPhase Condensing Unit

4.1.1 Standard Features

The condenser shall consist of microchannel condenser coil(s), propeller fan(s) direct driven by individual fan motor(s), electrical controls, housing. Microchannel coils shall provide superior heat transfer, reduce air side pressure drop, increase energy efficiency, and shall significantly reduce the system refrigerant volume required. EC fans and fan operating techniques shall provide reduced maximum sound levels. Various methods shall be available to match indoor unit type, maximum outdoor design ambient and maximum sound requirements.

The unit includes service valves, low-pressure and high-pressure transducer, crankcase and heating belt for low/ambient application.

4.1.2 Compressor

The compressor shall be scroll-type with variable-capacity operation from 20% to 100%, commonly known as a variable-speed scroll compressor. The compressor shall include vibration isolators and shall operate at 100% speed at 60 Hz as follows: 1440 RPM for CU03, 1910 RPM for CU07, 2400 RPM for CU11, 2640 RPM for CU15, 3900 RPM for CU21, 5100 RPM for CU28, and 6000 RPM for CU35. The compressor shall be removable and serviceable from the front of the unit.

4.1.3 R-32 Refrigerant

The system shall be designed for use with R-32 refrigerant, which meets the U.S. Clean Air Act for phaseout of HCFC refrigerants.

4.1.4 Condenser Coil

Aluminum Microchannel Coil

Microchannel coils shall be constructed of aluminum microchannel tubes, fins, and manifolds. Tubes shall be flat and contain multiple, parallel flow microchannels and span between aluminum headers. Full-depth, louvered aluminum fins shall fill spaces between the tubes. Tubes, fins, and aluminum headers shall be oven-brazed to form a complete refrigerant-to-air heat exchanger coil. Copper stub pipes shall be electric resistance welded to aluminum coils and joints protected with polyolefin to seal joints from corrosive environmental elements. Complete coil/piping assembly shall be filled and sealed with an inert gas holding charge for shipment.

Aluminum Microchannel Coil with E-Coat

Aluminum microchannel coil with E-coat 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. E-coat shall increase coil corrosion protection and shall reduce heat rejection capacity degradation to less than 10% after a severe 2000-hour 5% neutral salt spray test (ref. ASTM B117). The coating process shall ensure complete coil encapsulation.

4.1.5 Fan Motor/Blade Assembly

The fan motor/blade assembly shall have an external rotor motor, fan blades and fan/finger guard. Fan blades shall be constructed of cast aluminum or glass-reinforced polymeric material. Fan guards shall be heavy gauge, close-meshed steel wire, coated with a black, corrosion-resistant finish. Fan terminal blocks shall be enclosure located on the top of the fan motor. Fan assemblies shall be factory-balanced, tested before shipment and mounted securely to the condenser structure.

EC Fan Motor

The EC fan motors shall be electronically commutated for variable speed operation and shall have ball bearings. The EC fans shall provide internal overload protection through built-in electronics. Each EC fan motor shall have a built-in controller and communication module, linked via RS-485, allowing each fan to receive and respond to precise fan speed inputs from the controller.

4.1.6 Electrical Controls

Electrical controls and service connection terminals shall be provided and factory-wired inside the attached control panel section. A locking disconnect switch shall be factory-mounted and wired to the electrical panel and controlled via an externally mounted locking and lockable door handle. Only high-voltage supply wiring and low-voltage indoor unit communication/interlock wiring shall be required at condenser installation.

Premium Control

The EC fan/Premium Control System shall include an electronic control board, EC fan motor(s) with internal overload protection, refrigerant and ambient temperature thermistors, and refrigerant pressure transducers. The control board shall receive an indoor unit run signal via field-supplied low voltage interlock wires to the compressor side switch via field-supplied CANbus communication wires from the indoor unit's Vertiv™ iCOM™ or via both. The control board shall use sensor and communication inputs to maintain refrigerant pressure by controlling each EC fan on the same refrigerant circuit to the same speed.

Locking Disconnect

A locking-type disconnect switch shall be factory-mounted and wired to the electrical panel. The switch shall be accessible from the outside of the unit with the door closed and shall prevent access to the high-voltage electrical components until switched to the Off position. The locking disconnect shall be lockable in support of lockout/tag-out safety programs.

Short Circuit Current Rating

The electrical panel shall provide at least 65,000A SCCR.

4.1.7 Cabinet

The condenser cabinet shall be constructed of galvanized steel sheet with powder coating finish and shall have a fan. Internal structural support members including microchannel supports and wire grille to protect microchannel, shall be galvanized steel with powder coating finish for strength and corrosion resistance. A panel door shall be provided next to the electrical enclosure to permit microchannel cleaning. And an electrical panel shall be contained inside a factory mounted, IP54 weatherproof electrical enclosure.

5.0 EXECUTION

5.1 Installation of Vertiv™ Thermal Management Units

5.1.1 General

Install cooling units in accordance with manufacturer's installation instructions. Install units plumb and level, firmly anchored in locations indicated and maintain manufacturer's recommended clearances.

5.1.2 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.

5.1.3 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.

5.1.4 Refrigerant Charging

Charge completed cooling system in accordance with manufacturer's refrigerant charging instructions.

5.1.5 Field Quality Control

Start-up cooling units in accordance with manufacturer's startup instructions. Test controls and demonstrate compliance with requirements. These specifications describe requirements for a computer room environmental control system. The system should be designed to maintain temperature and humidity conditions in the rooms containing electronic equipment.

The manufacturer shall design and furnish all equipment to be fully compatible with heat dissipation requirements.

5.1.6 Supply and Drain Water Piping

Connect water supply and drains to air conditioning unit. Provide pitch and trap as manufacturer's instructions and local codes require.

5.1.7 Vertiv™ CoolPhase Condensing Unit

Install condenser in accordance with manufacturer's installation instructions provided with seismic option. Firmly anchor, maintaining manufacturer's recommended clearances. Mounting requirement details such as anchor brand, type, embedment depth, edge spacing, anchor-to-anchor spacing, concrete strength, special inspection and attachment to non-building structures must be outlined and approved by the Engineer of Record for the projection or building. Wiring and piping connections must permit movement in three dimensions and isolate the unit from field connections. Electrical conduits shall be flexible, having at least one bend between the rigid connection at the unit cabinet and the connection to rigid conduit or foundation. The piping flexible connection or loop must be suitable for the operation pressure and temperature of the system. Furnish copy of manufacturer's piping connection diagram submittal to piping contractor.