# Vertiv™ Liebert® Mini-Mate2 - 1 and 1.5 Ton
# GUIDE SPECIFICATIONS

## 1.0 GENERAL

### 1.1 Summary

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

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

### 1.2 Design Requirements

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

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

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

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

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

The system model number(s) shall be:

Evaporator _____

Condensing Unit _____

### 1.3 Submittals

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

### 1.4 Quality Assurance

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

## 1.5 Acceptable Alternatives

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

# 2.0 PRODUCT

## 2.1 Standard Features/All Systems

### 2.1.1 Cabinet Construction

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

### 2.1.2 Air Distribution

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

Air delivery shall be minimum ____ CFM (____ CMH) at high fan speed. For ducted applications air delivery shall be ____ CFM (____ CMH) at _____ " (_____mm) external static pressure.

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

### 2.1.3 Microprocessor Control

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

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

#### Monitoring

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

### Control Setpoint Parameters

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

### Unit Controls

#### 1. Compressor Short-Cycle Control

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

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

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

#### 3. Setback Control

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

#### 4. Temperature Calibration

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

#### 5. System Auto Restart

For 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 Factory installed sensors

### Filter Clog Switch

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

### High-Temperature Sensor

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

### 2.1.5 Alarms

#### Unit Alarm

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

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

#### Custom Alarms (2x)

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

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

#### Alarm Controls

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

#### Audible Alarm

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

#### Common Alarm

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

#### Remote Monitoring

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

## 2.2 Direct Expansion Self-Contained System Components

### 2.2.1 Refrigeration System

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

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

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

### 2.2.2 Evaporator Coil

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

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

### 2.2.3 Air-Cooled Condenser Coil

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

#### Air-Cooled Condenser Fan

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

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

### 2.2.4 Water/Glycol-Cooled Condenser

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

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

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

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

## 2.3 Direct Expansion Split System Components

### 2.3.1 Evaporator Unit

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

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

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

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

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

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

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

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

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

## 2.4 Chilled Water System Components

### 2.4.1 Chilled Water Control Valve

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

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

### 2.4.2 Chilled Water Coil

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

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

## 2.5 Factory – Installed Options

### 2.5.1 Steam Generating Humidifier

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

### 2.5.2 Electric Reheat

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

### 2.5.3 Hot Water Reheat

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

### 2.5.4 SCR Electric Reheat

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

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

### 2.5.5 Hot Gas Reheat

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

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

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

### 2.5.7 Smoke Sensor

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

### 2.5.8 Free-Cooling-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 an adjustable aquastat, and shall include a factory-piped, three-way valve and separate supply and return piping.

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

## 2.6 Ship-Loose Accessories

### 2.6.1 Remote Sensors

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

### 2.6.2 Supply and Return Grille

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

### 2.6.3 Filter Box and Duct Kit

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

### 2.6.4 Duct Collar Kit

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

### 2.6.5 Condensate Pump

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

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

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

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

The IS-UNITY-DP 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 Liebert® IS-UNITY-DP card, power/communication interface card, painted enclosure, 120V wall outlet transformer with 6ft (2m) low voltage power wire, and full instructions. Power shall be supplied from unit using field-supplied wiring or from single phase power (120 V) source using included transformer. Field-supplied wiring for communication to the Liebert® Mini-Mate2 and to other systems shall be required to access features.

### 2.6.8 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_____

### 2.6.9 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 single direct drive fan. All electrical connections and controls shall be enclosed in an integral, NEMA 3R rated electrical panel section of the drycooler. The drycooler shall be quiet and corrosion resistant. The drycooler shall be designed for _____°F (___°C) ambient.

### 2.6.10 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 in location indicated, and maintain manufacturer’s recommended clearances.

### 3.1.2 Electrical Wiring

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

### 3.1.3 Piping Connections

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

### 3.1.4 Supply and Drain Water Piping

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

### 3.1.5 Field-Supplied Pan

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

## 3.2 Field Quality Control

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