



# Liebert® CRD10

Installation Manual

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### **Technical Support Site**

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

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

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# 1 Important Safety Instructions

This section contains important safety instructions that should be followed during the installation and maintenance of the Vertiv™ Liebert® CRV. Read this section thoroughly before attempting to install or operate this unit.

Only qualified personnel should move, install or service this equipment.

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

Any operation that requires opening doors or equipment panels must be carried out only by properly trained and qualified personnel.

To identify the unit model and serial number for assistance or spare parts, locate the identification label on the unit.

A warning label on the front and back panels reminds users that:

- The Liebert® CRV restarts automatically.
- The main switch must be opened before opening the internal compartments for any operation.



**WARNING! Arc flash and electric shock hazard. Open all local and remote electric power supply disconnect switches, verify with a voltmeter that power is Off and wear appropriate, OSHA-approved personal protective equipment (PPE) per NFPA 70E before working within the electric control enclosure. Failure to comply can cause serious injury or death. Customer must provide earth ground to unit, per NEC, CEC and local codes, as applicable. Before proceeding with installation, read all instructions, verify that all the parts are included and check the nameplate to be sure the voltage matches available utility power. The Liebert controller does not isolate power from the unit, even in the Unit Off mode. Some internal components require and receive power even during the Unit Off mode of the controller. The only way to ensure that there is NO voltage inside the unit is to install and open a remote disconnect switch. Refer to unit electrical schematic. Follow all local codes.**



**WARNING! Risk of over-pressurization of the refrigeration system. Can cause explosive discharge of high-pressure refrigerant, loss of refrigerant, environmental pollution, equipment damage, injury, or death. This unit contains fluids and gases under high pressure. Use extreme caution when charging the refrigerant system. Do not pressurize the system higher than the design pressure marked on the unit's nameplate.**



**WARNING! Risk of contact with high speed rotating fan blades. Can cause serious injury or death. Open all local and remote electric power supply disconnect switches, verify with a voltmeter that power is off, and verify that all fan blades have stopped rotating before working in the unit cabinet or on the fan assembly. If control voltage is applied, the fan motor can restart without warning after a power failure.**



**WARNING!** Risk of top-heavy unit falling over. Improper handling can cause equipment damage, injury or death. Read all of the following instructions and verify that all lifting and moving equipment is rated for the weight of the unit before attempting to move, lift, remove packaging from or prepare the unit for installation.



**WARNING!** Risk of unsecured unit rolling off pallet. Can cause equipment damage, injury or death. The unit is on casters. Ensure that the unit/pallet is located on a flat surface before loosening the hardware securing the to its shipping pallet.



**WARNING!** Risk of hair, clothing and jewelry entanglement with high speed rotating fan blades. Can cause equipment damage, serious injury or death. Keep hair, jewelry and loose clothing secured and away from rotating fan blades during unit operation.



**WARNING!** Risk of contact with extremely hot and/or cold surfaces. Can cause injury. Verify that all components have reached a temperature that is safe for human contact or wear appropriate, OSHA-approved PPE before working within the electric connection enclosures or unit cabinet. Perform maintenance only when the system is de-energized and component temperatures have become safe for human contact.



**WARNING!** Risk of improper wiring, piping, moving, lifting and handling. Can cause equipment damage, serious injury or death. Installation and service of this equipment should be done only by qualified personnel who have been specially trained in the installation of air-conditioning equipment and who are wearing appropriate, OSHA-approved PPE.



**WARNING!** Risk of improper wire sizing/rating and loose electrical connections. Can cause overheated wire and electrical connection terminals resulting in smoke, fire, equipment and building damage, injury or death. Use correctly sized copper wire only and verify that all electrical connections are tight before turning power On. Check all electrical connections periodically and tighten as necessary.



**WARNING!** Risk of electric shock. Can cause equipment damage, injury or death. Open all local and remote electric power supply disconnect switches and verify with a voltmeter that power is off before working within any electric connection enclosures. Service and maintenance work must be performed only by properly trained and qualified personnel and in accordance with applicable regulations and manufacturers specifications. Opening or removing the covers to any equipment may expose personnel to lethal voltages within the unit even when it is apparently not operating and the input wiring is disconnected from the electrical source.





**WARNING!** Risk of electric shock. Can cause injury or death. Open all local and remote electric power- supply disconnect switches and verify that power is Off with a voltmeter before working within the condensate pump electrical connection enclosure. The Liebert controller does not isolate power from the unit, even in the Unit Off mode. Some internal components require and receive power even during the Unit Off mode of the Liebert controller.



**CAUTION:** Risk of contact with sharp edges, splinters, and exposed fasteners. Can cause injury. Only properly trained and qualified personnel wearing appropriate, OSHA-approved PPE should attempt to move, lift, remove packaging from or prepare the unit for installation.



**CAUTION:** Risk of exposure to harmful noise levels. Can cause hearing injury or loss. Depending on the installation and operating conditions, a sound pressure level greater than 70 dB(A) may arise. Take appropriate technical safety measures. Operating personnel must wear appropriate, OSHA-approved PPE and observe all appropriate hearing-protection safety requirements.



**CAUTION:** Risk of excessive refrigerant line pressure. Can cause tubing and component rupture resulting in equipment damage and personal injury. Do not close off the refrigerant-line isolation valve for repairs unless a pressure-relief valve is field installed the line between the isolation valve and the check valve. The pressure-relief valve must be rated 5% to 10% higher than the system-design pressure. An increase in ambient temperature can cause the pressure of the isolated refrigerant to rise and exceed the system-design pressure rating (marked on the unit nameplate).

## NOTICE

Risk of improper power supply connection. Can cause equipment damage and loss of warranty coverage. Prior to connecting any equipment to a main or alternate power source (for example: Back-up generator systems) for startup, commissioning, testing, or normal operation, ensure that these sources are correctly adjusted to the nameplate voltage and frequency of all equipment to be connected. In general, power-source voltages should be stabilized and regulated to within  $\pm 10\%$  of the load nameplate nominal voltage. Also, ensure that no three-phase sources are single-phased at any time.

## NOTICE

Liebert® CRD10 unit 96 VA transformer default wiring is orange cable (230 V to 24 V). If the unit rated voltage is 208 V, a properly trained and qualified electrician must change the transformer wiring from orange to red cable (208 V to 24 V). See [Transformer Connection Cable](#) on page 66 for details.

**NOTICE**

Risk of oil contamination with water. Can cause equipment damage. Liebert® CRV systems require the use of PVE (FV50S) oil. PVE oil absorbs water at a much faster rate when exposed to air than previously used oils. Because water is the enemy of a reliable refrigeration system, extreme care must be used when opening systems during installation or service. If water is absorbed into the PVE oil, it will not be easily removed and will not be removed through the normal evacuation process. If the oil is too wet, it may require an oil change. PVE oils also have a property that makes them act as a solvent in a refrigeration system. Maintaining system cleanliness is extremely important because the oil will tend to bring any foreign matter back to the compressor.

**NOTICE**

Risk of improper refrigerant charging. Can cause equipment damage. Refrigerant charge must be weighed into air-cooled compressorized systems before they are started. Starting compressors without proper refrigerant charging can cause the compressors to operate at less than 5 °F (-15 °C) evaporator temperature and at less than 20 psig (138 kPa). Operation for extended periods at less than 20 psig (138 kPa) can cause premature compressor failure.

**NOTICE**

Risk of clogged or leaking drain lines and leaking water supply lines. Can cause equipment and building damage. This unit requires a water drain connection. Drain lines must be inspected at startup and periodically, and maintenance must be performed to ensure that drain water runs freely through the drain system and that lines are clear and free of obstructions and in good condition with no visible sign of damage or leaks. This unit may also require an external water supply to operate.

Improper installation, application and service practices can result in water leakage from the unit. Water leakage can result in catastrophic and expensive building and equipment damage and loss of critical data center equipment.

Do not locate unit directly above any equipment that could sustain water damage. We recommend installing a monitored fluid detection system to immediately discover and report coolant-fluid system and condensate drain line leaks.

**NOTICE**

Risk of doorway/hallway interference. Can cause unit and/or structure damage. The unit may be too large to fit through a doorway or hallway while on the skid. Measure the unit and passageway dimensions, and refer to the installation plans prior to moving the unit to verify clearances.

**NOTICE**

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

**NOTICE**

Risk of improper storage. Can cause unit damage. Keep the unit upright, indoors and protected from dampness, freezing temperatures and contact damage.

**NOTICE**

Risk of improper maintenance. Can cause equipment damage. Installation and service of this equipment should be done only by qualified personnel who have been specially trained in the installation of air-conditioning equipment and who are wearing appropriate, OSHA-approved PPE. Ignoring safety instructions is dangerous. Soiled parts cause a loss of performance and, for switch or control devices, can lead to the breakdown of the unit performance and operation.

**NOTICE**

Risk of release of hazardous substances into the environment. Can cause environmental pollution and violation of environmental regulations. The Liebert® CRV contains substances and components hazardous for the environment (electronic components, refrigerating gases and oils). At the end of its useful life, the Liebert® CRV must be dismantled by specialized refrigerating technicians. The unit must be delivered to suitable centers specializing in the collection and disposal of equipment containing hazardous substances.

Agency Listed Standard 60 Hz units are UL 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 UL logo.



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## 2 Product Overview

The Vertiv™ Liebert® CRV CRD10 is the next generation of air conditioner that provides precise environmental control. The Liebert® CRV CRD10 models are the latest enterprise grade products from the Liebert family. The Liebert® CRD10 utilizes the latest technology, system components, and streamlined manufacturing process.

### 2.1 Product Introduction

The Liebert® CRD10 air conditioners are specifically created and designed for small to medium data centers, computer rooms, equipment room, modularized machine room and similar high heat density systems, requiring a high degree of accuracy and precision. It is designed for sensitive applications that require a suitable environment for optimal performance. Therefore, carefully test the product to maintain favorable conditions for mission critical equipment. Thermal management units should react quickly to drastic changes in the heat load and should prevent wide temperature fluctuations.

The Liebert® CRD10 air-cooled AC unit has is features like high reliability, high sensible heat ratio, and large airflow. The Liebert® CRD10 is an advanced row-based cooling unit. It provides a 10 kW cooling capacity under designed condition. It adjusts the cooling capacity by changing the output of inverter compressor and EC fans, depending on the change in the heat load.

The Liebert® CRD10 air-cooled unit requires a condenser. The condenser is powered and controlled by indoor unit.

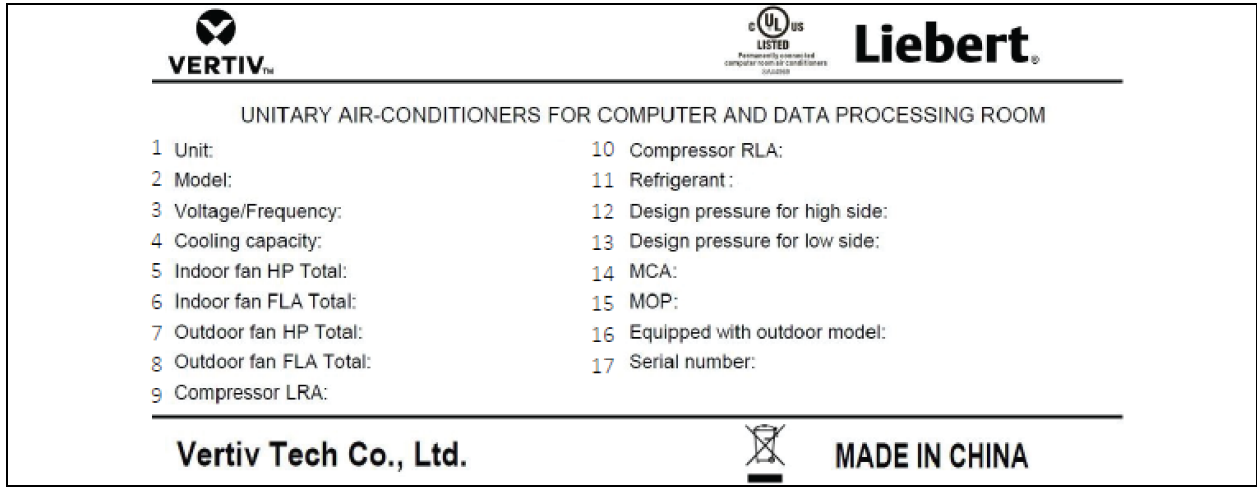
**Figure 2.1 Liebert® CRD10 Air Conditioner**



Item	Description
1	Front
2	Rear

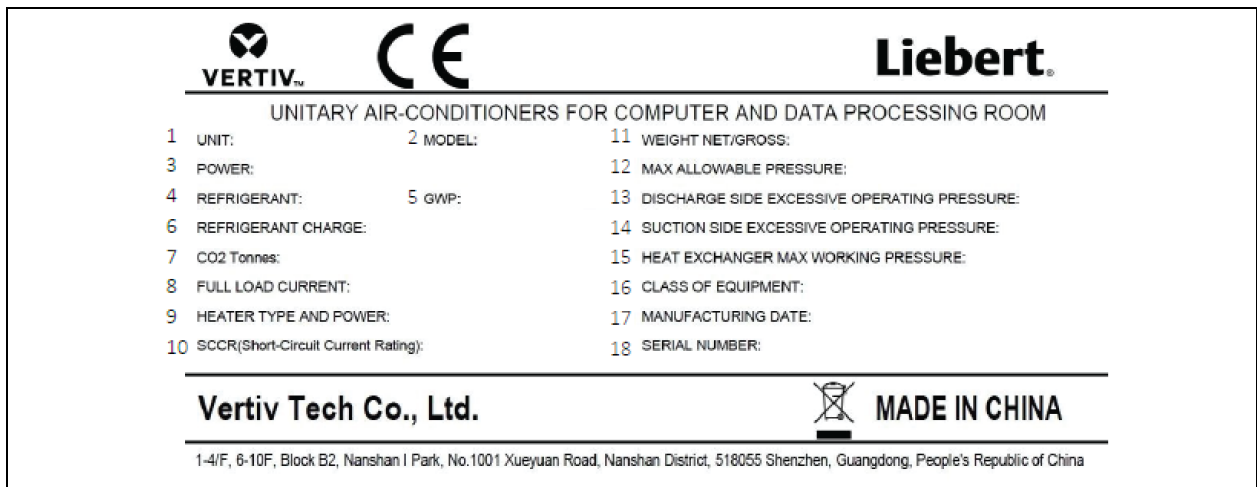
Refer **Figure 2.2** below for the nameplate description of the Vertiv™ Liebert® CRD10 model.

**Figure 2.2 Product Nameplate and Model Description (UL Model)**



Item	Description	Item	Description
1	Unit defined by 6 digits	10	Rated load current of compressor
2	Model defined by 12 digits	11	Refrigerant amount charged on site
3	Supply power	12	Discharge side excessive operating pressure
4	Cooling capacity	13	Suction side excessive operating pressure
5	Indoor fan power in total	14	Minimum circuit amps
6	Indoor fan full load current in total	15	Maximum over current protection
7	Outdoor fan power in total	16	Equipped with outdoor model
8	Outdoor fan full load current in total	17	Serial number
9	Locked rotor current of compressor		

**Figure 2.3 Product Nameplate and Model Description (CE Model)**

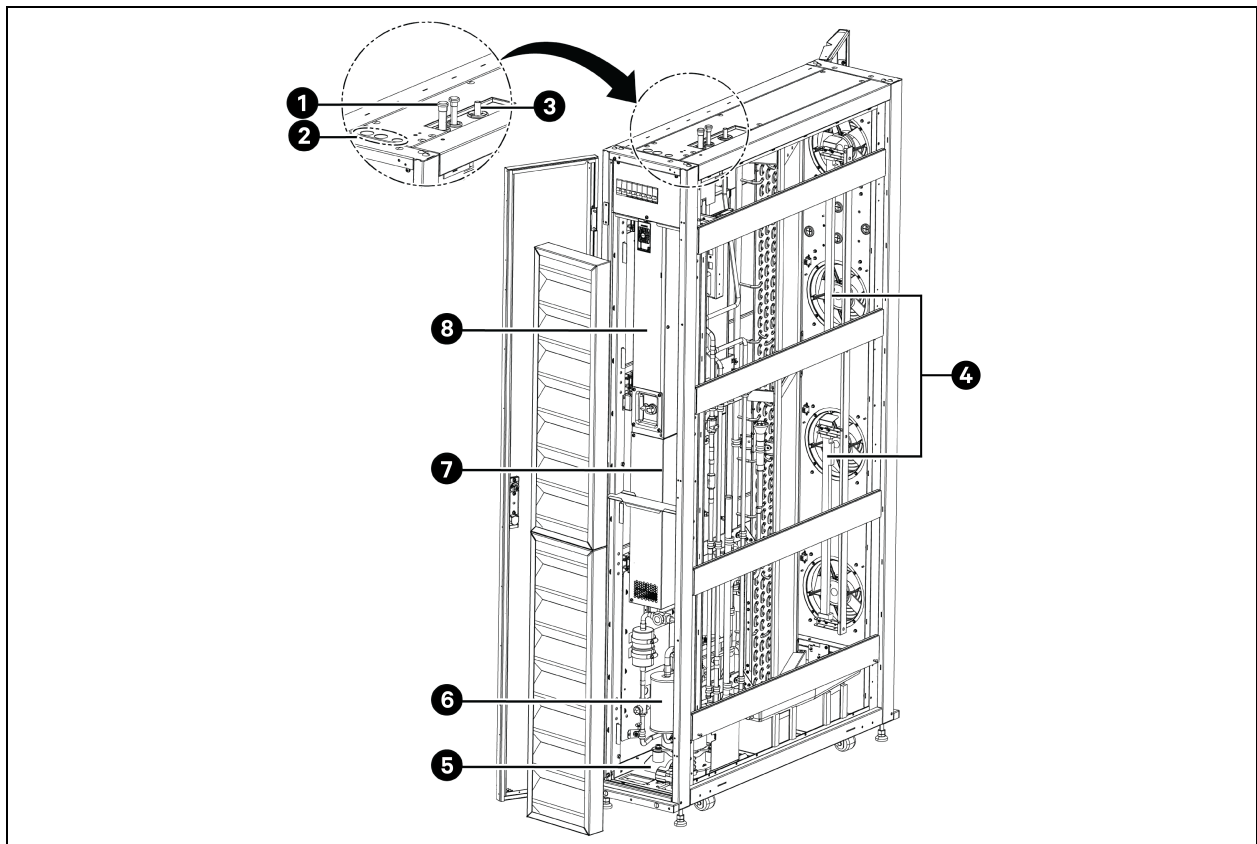


Item	Description	Item	Description
1	Unit defined by 6 digits	10	Short circuit current rating
2	Model defined by 12 digits	11	Net weight and gross weight
3	Supply power	12	Maximum allowable pressure of the unit
4	Refrigerant category	13	Discharge side excessive operating pressure
5	Global warming potential	14	Suction side excessive operating pressure
6	Refrigerant amount charged on site	15	Heat exchange maximum working pressure
7	CO <sub>2</sub> tonnes	16	Class of equipment
8	Full load current	17	Manufacturing date
9	Heater type and power	18	Serial number

## 2.2 Product Description

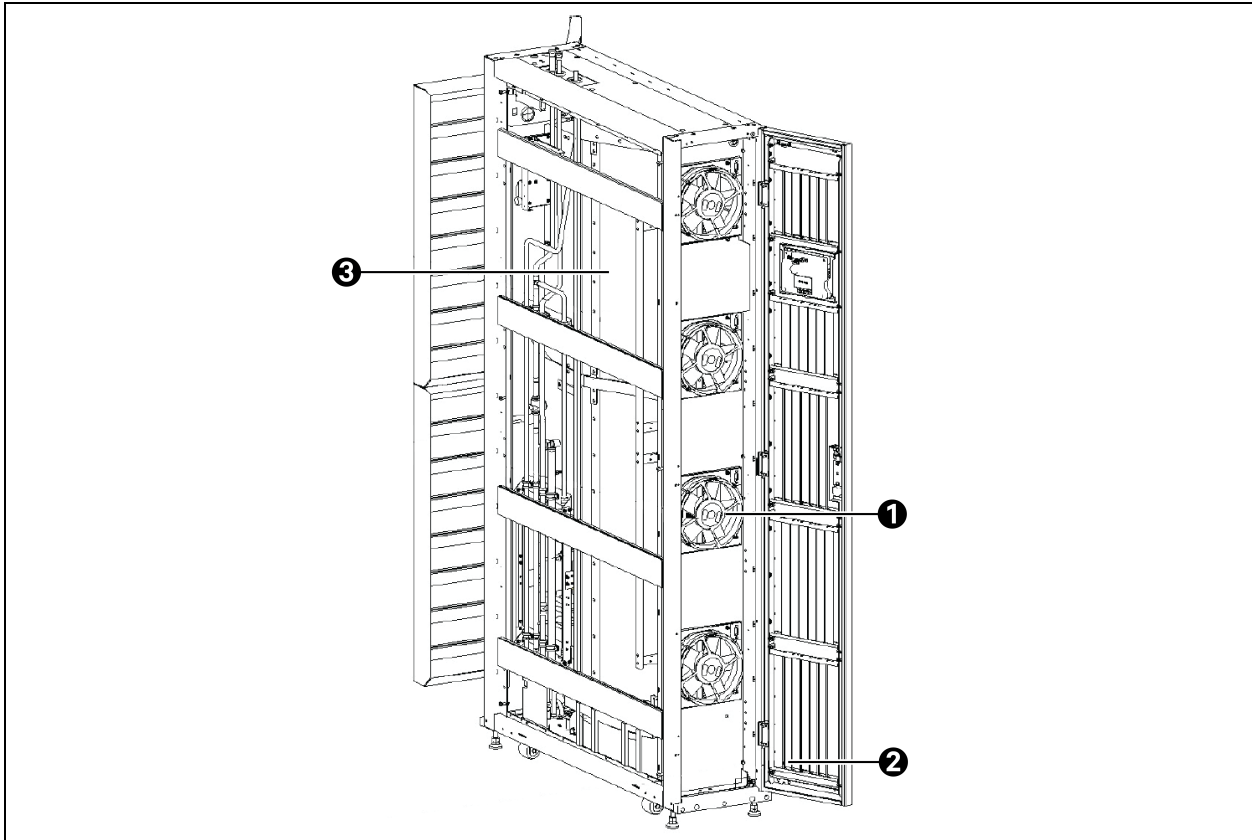
The Vertiv™ Liebert® CRD10 air conditioner includes all the main functions fundamental to precision cooling units such as cooling, dehumidification, reheating (CE certified model only), air filtration, condensation management, temperature control, alarm functions and compatibility with data communications. Liebert® CRD10 is designed to comply with mission critical requirements and ensure that servers are maintained at the correct temperature and humidity levels. **Figure 2.4** below and **Figure 2.5** on the next page shows the various components and their locations.

**Figure 2.4 Components at the Rear of the Unit**



Item	Description	Item	Description
1	Supply and return refrigerant pipe	5	Condensate pump
2	Top electrical entrance	6	Compressor
3	Drainage pipe of pump	7	Compressor driver
4	Electric heaters (optional)	8	Electric box

Figure 2.5 Components at the Front of the Unit



Item	Description
1	EC plug fans
2	Baffles
3	Evaporative coil

Table 2.1 Liebert® CRD10 Dimensions

Model	Unit Dimensions (W x D x H) mm (in.)	Package Dimensions (W x D x H) mm (in.)	Net Weight kg (lb)	Gross Weight kg (lb)
CRD100-0D00A	300 x 1132 x 2000 (11.8 x 44.6 x 78.7)	776 x 1276 x 2228 (30.6 x 50.2 x 87.7)	231 (509)	313 (690)
CRD101-0D00A				
CRD102-1D00A				



## 2.3 Model Nomenclature

The model of the Vertiv™ Liebert® CRD10 air conditioner indoor unit is defined by 12 digits as shown in **Table 2.2** below , and details of the condenser is given in **Table 2.3** below .

**Table 2.2 Model Nomenclature Indoor Unit**

Digit	1	2	3	4	5	6	7	8	9	10	11	12
Example	C	R	D	1	0	0	-	0	D	0	0	A

Digit	Variable	Description of Variable
1	CR	Liebert® CRV
2		
3	D	D- DX (Air-cooled) W- (Water- cooled) C- (Chilled water)
4	10	Model Number: 10
5		
6	0	0- 208/230 V/ 1 Ph/ 60 Hz, UL
	1	1- 208/230 V/ 3 Ph/ 60 Hz, UL
	2	2- 230 V/ 1 Ph/ 50/60 Hz, CE
7	-	Separator
8	0	0- Cooling only
	1	1- Reheat only
9	D	D- Dual power supply
10	0	0- R410A refrigerant
11	0	Free digit (future)
12	A	Revision

**Table 2.3 Model Nomenclature of Condenser Unit**

Digit	1	2	3	4	5	6	7	8	9	10	11
Example	C	C	D	1	0	0	S	-	0	0	A

Digit	Variable	Description of Variable
1	CCD	Liebert® CRV Condenser
2		
3		
4	10	Model Number: 10
5		

Digit	Variable	Description of Variable
6	0	0- 208/230 V/ 1 Ph/ 60 Hz, UL
	1	1- 230 V/ 1 Ph/ 50/60 Hz, CE
7	S	S- Standard temperature : -15 °C to 45 °C (5 °F to 113 °F)
8	-	Separator
9	0	0- R410A refrigerant
10	0	Free digit (future)
11	A	Revision

## 2.4 Performance Parameters

The performance parameters of the Vertiv™ Liebert® CRD10 are given in **Table 2.4** below .

**Table 2.4 Performance Parameters**

Certification	UL		CE
Unit	CRD100	CRD101	CRD102
Model	CRD100-0D00A	CRD101-0D00A	CRD102-1D00A
Voltage/Frequency	208/230 V/ 1 PH/ 60 Hz	208/230 V/ 3 PH/ 60 Hz	230 V/ 1 PH/ 50/60 Hz
Cooling Capacity (kW)	10.0	10.0	10.0
Heating Capacity (kW)	-	-	2.0
Power Input (kW)	3.2	3.2	3.2 (without the heater)
Full Load Current (A)	-	-	38 (with the heater), 28 (without the heater)
MCA (A)	29	21	-
MOP (A)	40	30	-

**Test Condition:** Return air 29.4 °C (85 °F), 32% RH and 35 °C (95 °F) outdoor temperature.

**NOTE:** The allowed thermal load must not be lower than 20% of nominal air conditioner cooling capacity. Lower thermal load drives to imprecise temperature and humidity control and frequent compressor switch on/off.

The performance data of Liebert® CRD100 and Liebert® CRD101 rated with the AHRI standard 1360 are given in **Table 2.5** on the facing page .

**Table 2.5 Performance Data of AHRI**

Model Number	CRD100-0D00A		CRD101-0D00A	
Voltage (Volts/Phase/Hz)	208/1/60	230/1/60	208/3/60	230/3/60
Net Total Cooling Capacity, kW (kBtuh)	10.0 (34.1)	9.98 (34.0)	10.32 (35.2)	10.41 (35.5)
Net Sensible Cooling Capacity, kW (kBtuh)	9.92 (33.8)	9.96 (33.9)	10.08 (34.4)	10.12 (34.5)

**Table 2.5 Performance Data of AHRI (continued)**

Model Number	CRD100-0D00A		CRD101-0D00A	
	Net Sensible Coefficient of Performance (NSenCOP), kW/kW	3.57	3.62	3.69
Unit Airflow, ACFM	1960	1961	1897	1898
Unit Airflow, SCFM	1896	1887	1835	1836
Ext. Static Pressure, Pa	0.0		0.0	
Humidification	None		None	
Refrigerant	R-410A		R-410A	
<b>NOTE: Return Air Conditions 95 °F DB (35 °C DB), 52 °F DP ( 11.1 °C DP) 32% RH.  Outdoor Ambient Temperature 95 °F (35 °C).  Certified in accordance with the AHRI Datacom Cooling Certification Program at AHRI Standard 1360 Standard Rating Conditions. See the AHRI Directory at <a href="http://www.ahridirectory.org">www.ahridirectory.org</a> for certified units.</b>				

## 2.5 Sound Parameters

The sound parameters of the Vertiv™ Liebert® CRD10 are given in **Table 2.6** below .

**Table 2.6 Sound Parameters**

1/3 Octave and Center Frequency (Hz)	Air Volume		50 dB	63 dB	80 dB	100 dB	125 dB	160 dB	200 dB	250 dB	315 dB	400 dB	500 dB	630 dB
	m <sup>3</sup> /h	SCFM												
IDFAN 75%	3250	1913	28.6	25.4	33.8	33.7	32.3	40.2	42.7	46.4	52.9	68.3	67.3	58.0
IDFAN 70%	3000	1766	29.1	24.5	34.7	31.2	30.9	38.2	40.5	45.2	53.6	64.4	58.9	56.2
IDFAN 60%	2500	1471	24.8	26.8	28.9	28.9	30.9	33.9	39.3	45	59.3	59.5	53.2	59.4

1/3 Octave and Center Frequency (Hz)	800 dB	1000 dB	1250 dB	1600 dB	2000 dB	2500 dB	3150 dB	4000 dB	5000 dB	6300 dB	8000 dB	10000 dB	dB (A)
IDFAN 75%	63	63.1	67.8	65.7	65.4	66.4	63.7	61.8	59.8	57.4	55.2	49.4	76.3
IDFAN 70%	62.1	58.7	64.4	64.4	63.6	64.1	61.5	60.1	57.8	55.2	52.6	47.2	73.1
IDFAN 60%	60	59.2	59.7	60.4	59	59.7	57.4	55.4	53.1	50.1	47.1	42.3	70.1

### Test Conditions:

- Semi-anechoic chamber environmental test.
- The test point is 2 m (6.6 ft.) away from the unit and 1 m (3.3 ft.) away from the ground.

## 2.6 Main Components of Indoor Unit

This section list the components used in the Vertiv™ Liebert® CRD10 Precision Air conditioning models.

### 2.6.1 DC Brushless Compressor

The Liebert® CRD10 air conditioning models comprise of a DC brushless compressor which has below features.

- Low operational noise
- Rapid cooling
- Less vibration

**Figure 2.6 DC Brushless Compressor**



### 2.6.2 Fan

The EC Fan in the Liebert® CRD10 models are energy efficient and innovative with integrated electronics and a maintenance free design.

- Ability to regulate the airflow and reduce the fan input power leading to high energy efficiency.
- Hot swappable, easy-to-connect facility with minimal wiring resulting into high performance with a wide range of possible air flow rates. **Figure 2.7** below shows the EC Fan used in Liebert® CRD10 model.

**Figure 2.7 EC Fan**

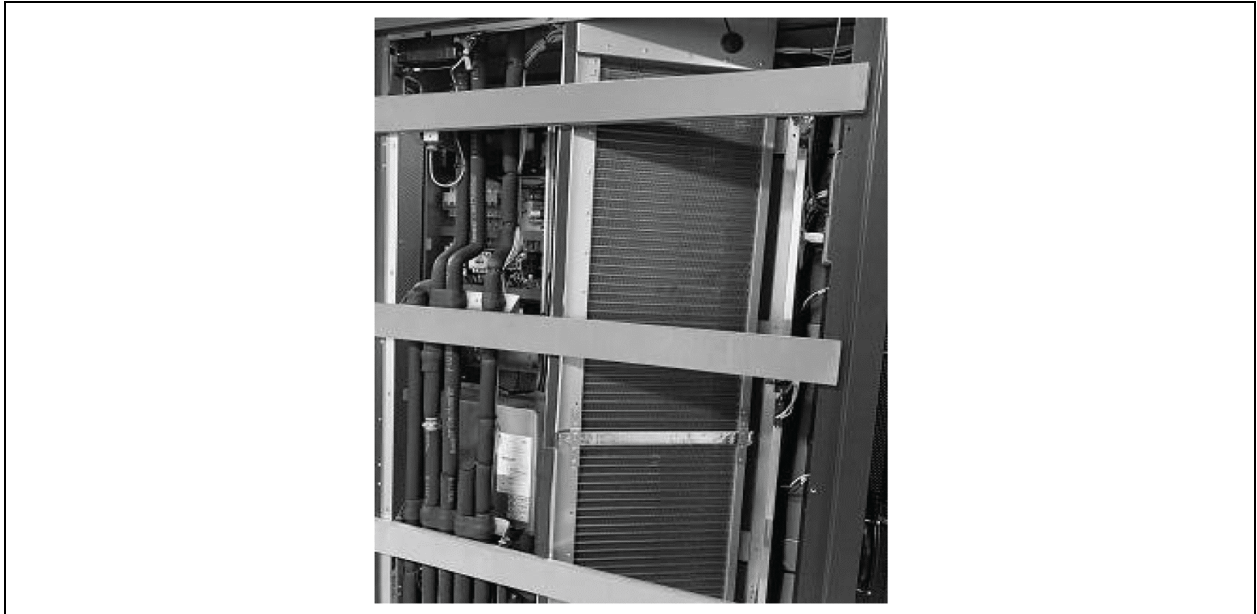


### 2.6.3 Evaporator

The design of the distributor ensures that the refrigerant is evenly distributed in each loop, which improves the effectiveness of the heat exchanger.

- Streamlined heat exchanger design and air distribution for optimum performance.
- Fin tube heat exchanger for higher efficiency. **Figure 2.8** below shows an evaporator.

**Figure 2.8 Evaporator**



### 2.6.4 Electronic Expansion Valve (EEV)

The EEV is designed for modulating control of the refrigerant mass flow with precision. The EEV simultaneously collects temperature and pressure signals to regulate the refrigerant flow accurately. The wide operating range of EEV reduces the condensing pressure, resulting in significant energy savings.

- Designed for modulating control of the refrigerant mass flow with precision.
- Ensures effective control on super-heating at the end of the evaporator.
- Better low load capacity.
- Designed for easy Installation and service. **Figure 2.9** below shows the EEV used in the Vertiv™ Liebert® CRD10 models.

**Figure 2.9 Electronic Expansion Valve**

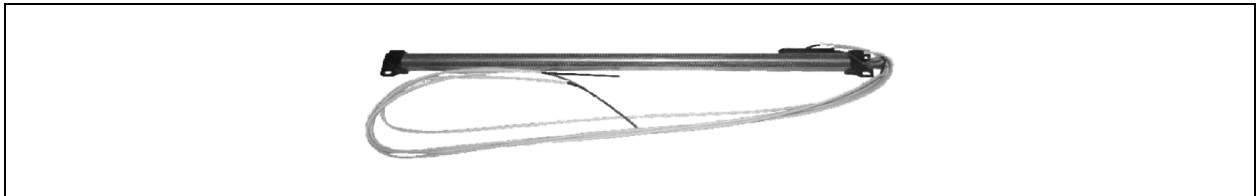


## 2.6.5 Electric Heater

In the Vertiv™ Liebert® CRD10 models, the positive temperature coefficient (PTC) heater is used on models equipped with reheat, as they have lower running temperatures, to operational safety.

- Less susceptible to overheating and long lasting due to less wear.
- Lower maintenance and smooth operation, **Figure 2.10** below shows an electric heater.

**Figure 2.10 PTC Heater**



## 2.6.6 Sight Glass

The sight glass is a utility for observing the refrigerant state, specifically, the moisture content of the system. If the moisture content exceeds the defined standards, the color changes, that indicates irregularity in the moisture content.

## 2.6.7 Filter Drier

Moisture in the refrigeration lifecycle can adversely affect the operations and service life of a system. To rectify this condition, filter driers are used to filter out particles, remove, and hold moisture to prevent it from circulating through the system.

## 2.6.8 Microcontroller

The microcontroller used in Liebert® CRD10 provides a simple operational user interface and is developed using the latest and highly advanced proportional integral derivative (PID) regulation technology.

The feature of microcontroller are:

- Multilevel password protection.
- Self-recovery upon power failure, high voltage, low voltage protection, and phase loss protection.
- Automatic phase sequence switching upon the anti-phase and rotate speed control of the outdoor fan.
- High-end fault diagnostic system to facilitate easy equipment maintenance **Figure 2.11** on the facing page shows the microcontroller.

Figure 2.11 Display Panel of the Controller



## 2.6.9 Unity Card

The Vertiv™ Liebert® CRD10 unit is equipped with a Unity card. Unity card employs the Modbus protocol to monitor and manage a wide range of operating parameters, alarms, and notifications from the microcontroller. The card communicates with building management systems and network management systems via Vertiv™ IntelliSlot™ BACnet, Vertiv™ Liebert® IntelliSlot™ Modbus, SNMPv1/v2c/v3, Vertiv™ LIFE™, remote services, and YDN23 protocols.

The Unity card monitors up to 10 Liebert® SN modular and integrated sensors. Available sensor types include temperature, humidity, door closure, contact closure and leak detection. Sensor tab menus permit configuring sensors and putting them in user-configured order for easier checking of high priority conditions. Sensor data is available via SNMP and the web user interface.

## 2.6.10 Remote Temperature Sensor

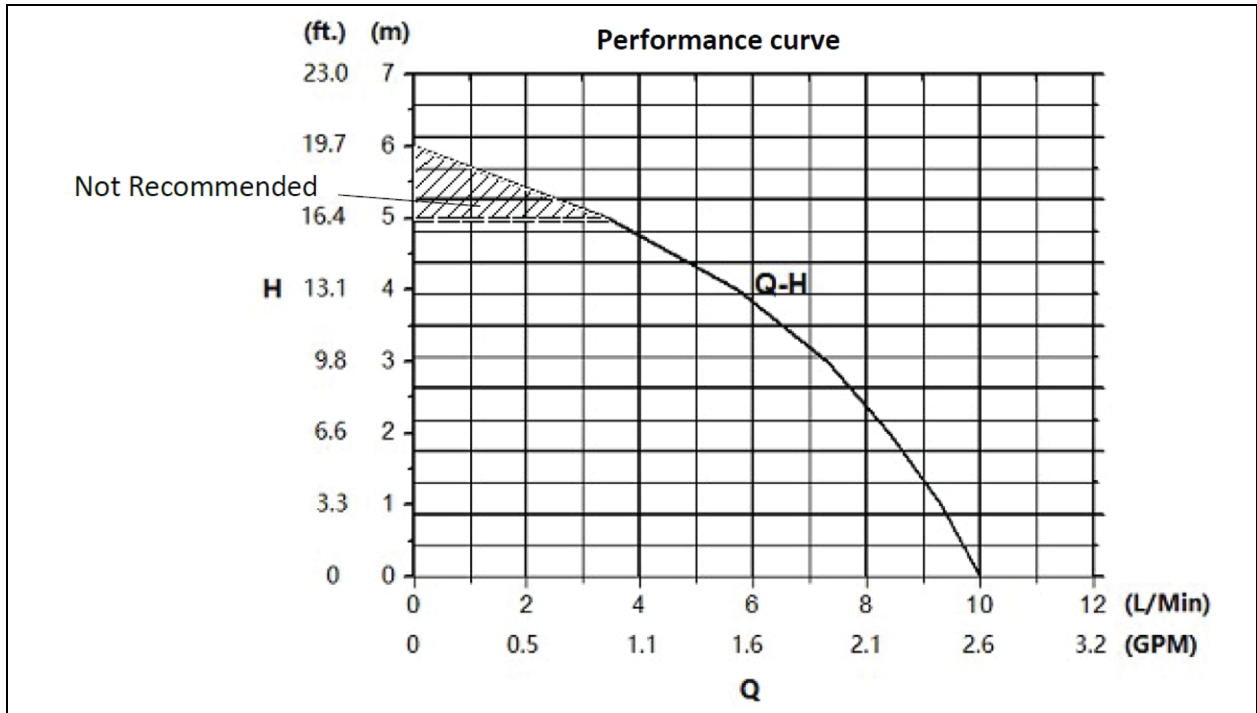
The Liebert® CRD10 models are compatible with multiple temperature sensors according to the requirement. Each unit can be connected up to maximum 10 temperature sensors.

## 2.6.11 Condensate Pump

The Vertiv™ Liebert® CRD10 models include a condensate pump used for drainage. The performance curve is shown in **Figure 2.12** on the next page.

**NOTE:** Maximum recommended vertical rise is 5 m (16.4 ft.).

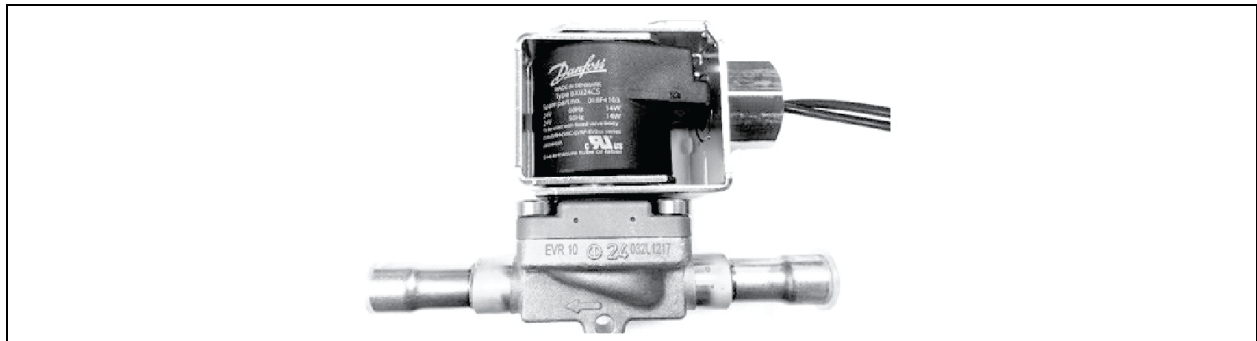
Figure 2.12 Performance Curve of Condensate Pump



### 2.6.12 Liquid Line Solenoid Kit

The liquid line solenoid kit is a solenoid valve used to prevent refrigerant from condensing into liquid line in condenser and pipe of outdoor when the unit is turned off at the condition of low ambient temperature. Figure 4.1 on page 32 shows the installation location of solenoid valve in the system. Figure 2.13 below shows the solenoid valve.

Figure 2.13 Solenoid Valve



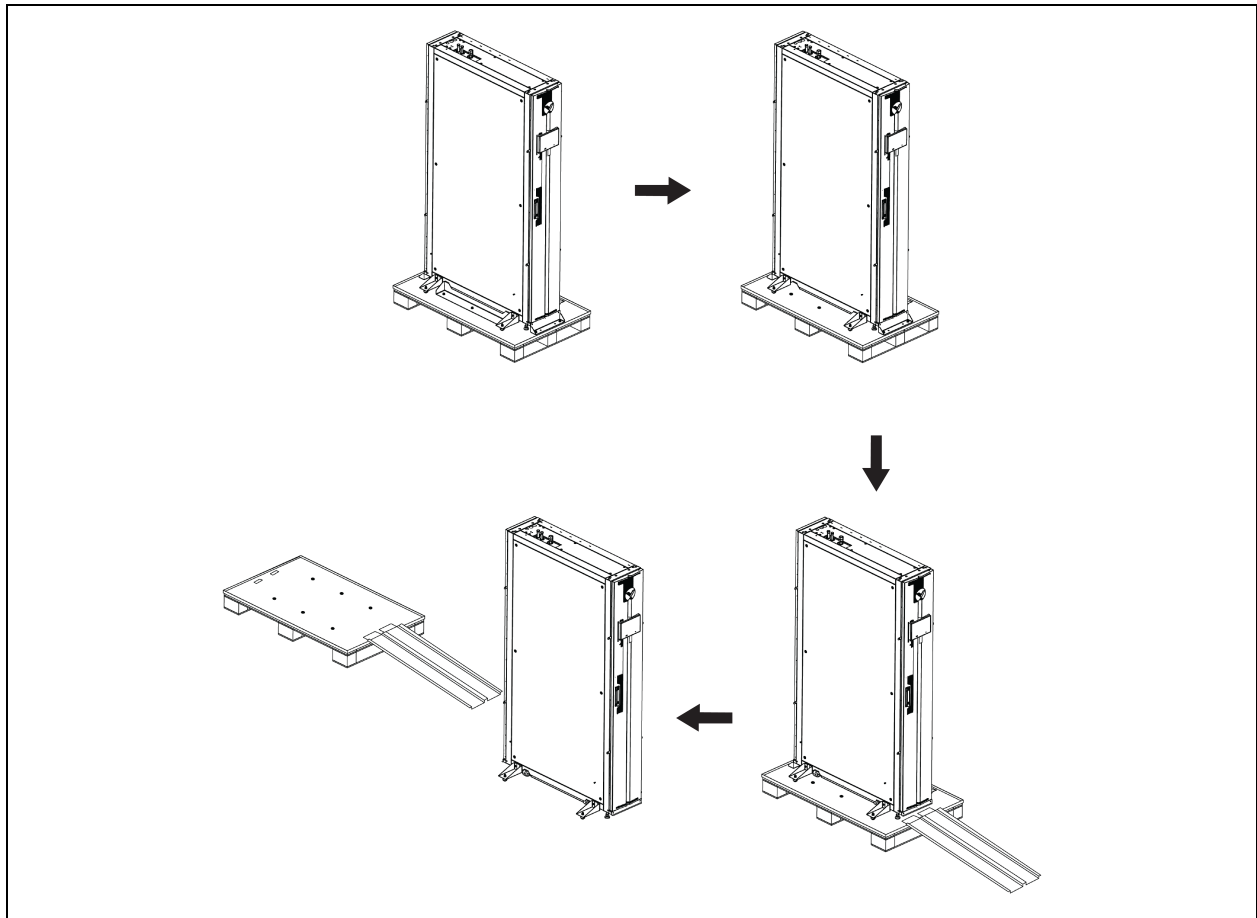
### 2.6.13 Ramp

Ramp is used to remove the unit from the pallet, the operation process is shown in Figure 2.14 on the facing page .

1. Remove the fixing screws and sheet metal.
2. Place a slope and connect it with pallet.
3. Push the cabinet slowly from the pallet down to the ground along the slope.



Figure 2.14 Ramp Unloading



## 2.7 Technical Specification

The mechanical and electrical technical specifications are mentioned in the **Table 2.7** on the next page .

**Table 2.7 Technical Specifications of the Unit**

Parameters	Specifications		
Unit	CRD100	CRD101	CRD102
Model	CRD100-0D00A	CRD101-0D00A	CRD102-1D00A
Certification	UL		CE
Cooling Type	Air- cooled		
Cold Source Type	DX		
Refrigerant	R410A		
Compressor Type	Double rotor DC inverter compressor		
Flow Control	Electronic expansion valve		
Fan Type	EC fan		

**Table 2.7 Technical Specifications of the Unit (continued)**

Parameters	Specifications	
Air Filter	MERV8	G4
Air Discharge Baffles	Standard	
Drain Pump	Standard	
Air Pressure Switch	Standard	
Unity Card	Standard	
Remote Sensors	Standard	
Reheat	No	Standard
Matched with Outdoor Model	CCD100S-00A	CCD101S-00A

## 3 Installation



**WARNING! Risk of improper wiring, piping, moving, lifting and handling. Can cause equipment damage, serious injury or death. Installation and service of this equipment should be done only by qualified personnel who have been specially trained in the installation of air-conditioning equipment and who are wearing appropriate, OSHA-approved PPE.**

### NOTICE

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

**NOTE: Read this chapter carefully before installation.**

The Installation process consists of the following procedures as follows.

- Pre-installation
- Installation Preparation
- Mechanical Installation
- Electrical Installation

### 3.1 Pre-Installation

The Vertiv™ Liebert® CRD10 precision air conditioner is an engineered equipment and requires installation work for which the preliminary preparation is very important. This chapter describes the pre-installation, including how to prepare the installation environment, space and reserve the maintenance space, the air conditioner running and storage environment requirement, and how to unpack and inspect.








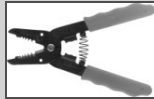














Pre-installation contains the following three subsections:

- Transportation and Movement
- Unpacking
- Inspection

### 3.2 Installation Tools

**Table 3.1** on the next page shows the standard tools used in the installation and maintenance process.

**Table 3.1 Standard Tool Sets**

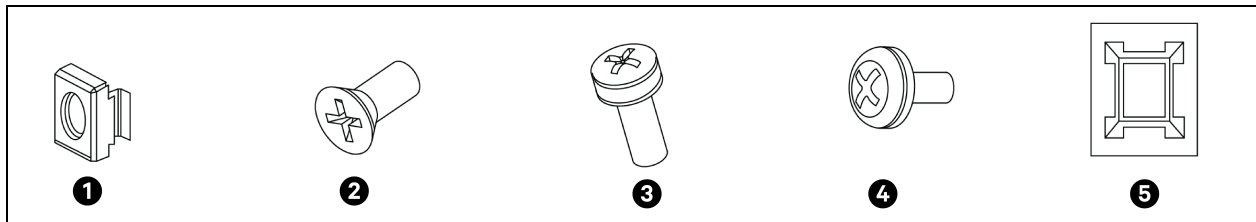
Name	Illustration	Name	Illustration
Electric hand drill		Adjustable wrench	
Slotted screwdriver		Cross head screwdriver	
Stepladder		Forklift	
Drill		Wire cutting pliers	
Claw hammer		Diagonal cutting pliers	
Insulating shoes		Antistatic gloves	
Electrician knife		Cable ties	
Insulating tape		Insulating gloves	
Crimping pliers		Heat shrinkable tube	
Insulated torque wrench		Torque screwdriver	
Multimeter		Clip-on ammeter	

The tools mentioned in **Table 3.1** on the previous page are standard and commonplace, however, depending on various factors such as site environment, cables, installation equipment, and on-site electrical connections these tools may vary in a real-time scenario.

### Fasteners

The fasteners are shown in the **Figure 3.1** below .

**Figure 3.1 Fasteners**



Item	Description
1	Floating nut
2	M5 countersunk head screw
3	M6 panel screw
4	M6 panel head screw
5	Cable tie fixture kit

The fastener nuts and their usage are shown in **Table 3.2** below .

**Table 3.2 Fitting Utilities**

Fasteners	Usage
Floating Nut	Used together with the M6 screw, used to install the parts in the cabinet.
M5 Countersunk Head Screw	Used to install the cabinet connector.
M6 Panel Screw	Used to install the power distribution unit, monitoring system, and user equipment.
M6 Pan Head Screw	Used to connect and fix the frame.
M6 Flange Nut	Used together with the M6 Pan head screw, used to install the L Fastener.
Adhesive Tape	Used to seal the gap between the connected frames.
Cable Tie Fixture Kit	Used to fix and bind the cables.


## 3.3 Prerequisite Arrangements


The cables routed from the room to the Vertiv™ Liebert® CRD10 unit and the circuit breakers must be prepared at the customers site or obtained by the customer, the specifications for the site preparation are given in the **Table 3.3** on the next page .


**Table 3.3 Prerequisite Material Requirements**

Parts	Prerequisite Reference
Input power supply cables	Refer to FLA (MCA) of the unit.
System grounding cables	Prepare the yellow/green cable.
Liquid copper pipes	Refer to pipe connection of unit.
Gas copper pipes	Refer to pipe connection of unit.
External drainage pipe	External drainage pipe with screws, refer to drainage pipe connection.

### 3.4 Transportation and Movement

 **WARNING!** Risk of top-heavy unit falling over. Improper handling can cause equipment damage, injury or death. Read all of the following instructions and verify that all lifting and moving equipment is rated for the weight of the unit before attempting to move, lift, remove packaging from or prepare the unit for installation.

 **WARNING!** Risk of unsecured unit rolling off pallet. Can cause equipment damage, injury or death. The unit is on casters. Ensure that the unit/pallet is located on a flat surface before loosening the hardware securing the to its shipping pallet.

 **CAUTION:** Risk of contact with sharp edges, splinters, and exposed fasteners. Can cause injury. Only properly trained and qualified personnel wearing appropriate, OSHA-approved PPE should attempt to move, lift, remove packaging from or prepare the unit for installation.

**NOTICE**

Risk of doorway/hallway interference. Can cause unit and/or structure damage. The unit may be too large to fit through a doorway or hallway while on the skid. Measure the unit and passageway dimensions, and refer to the installation plans prior to moving the unit to verify clearances.

**NOTICE**

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

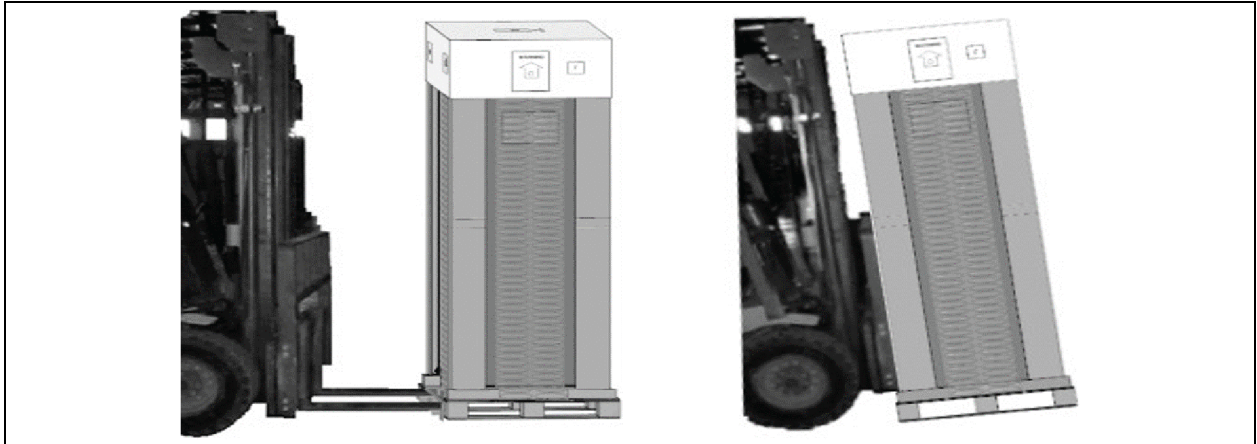
**NOTICE**

Risk of improper storage. Can cause unit damage. Keep the unit upright, indoors and protected from dampness, freezing temperatures and contact damage.

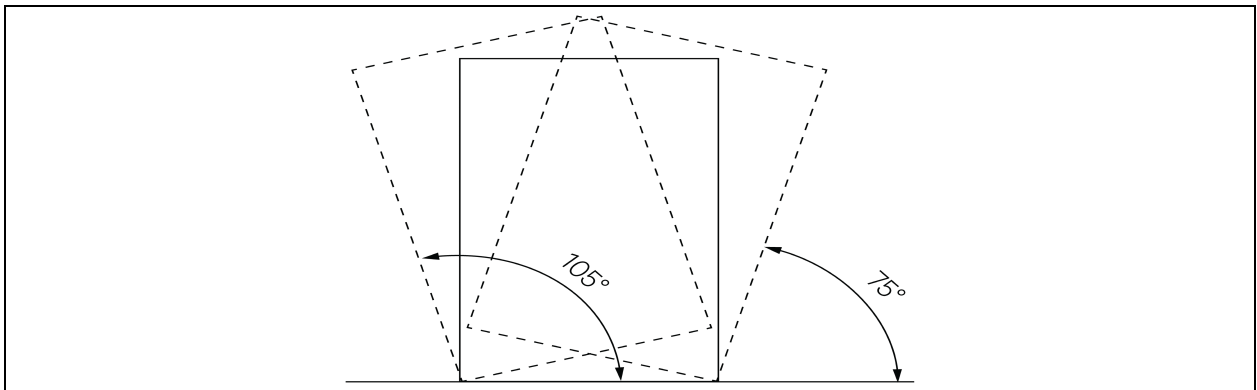
**NOTICE**

Transportation by rail or by ship are the preferred options for the units. If transport by rail or by ship is unavailable, transport by road is recommended. When selecting road transport, roads without too many bumps are highly recommended.

It is recommended to use mechanical equipment like forklift to move the unit to the location nearest to the installation site. Insert the tines of the forklift under the pallet, as shown in **Figure 3.2** on the facing page .

**Figure 3.2 Moving the Equipment Using a Forklift Truck**

While moving the indoor unit, keep the obliquity within the range of 75° to 105°, as shown in **Figure 3.3** below .

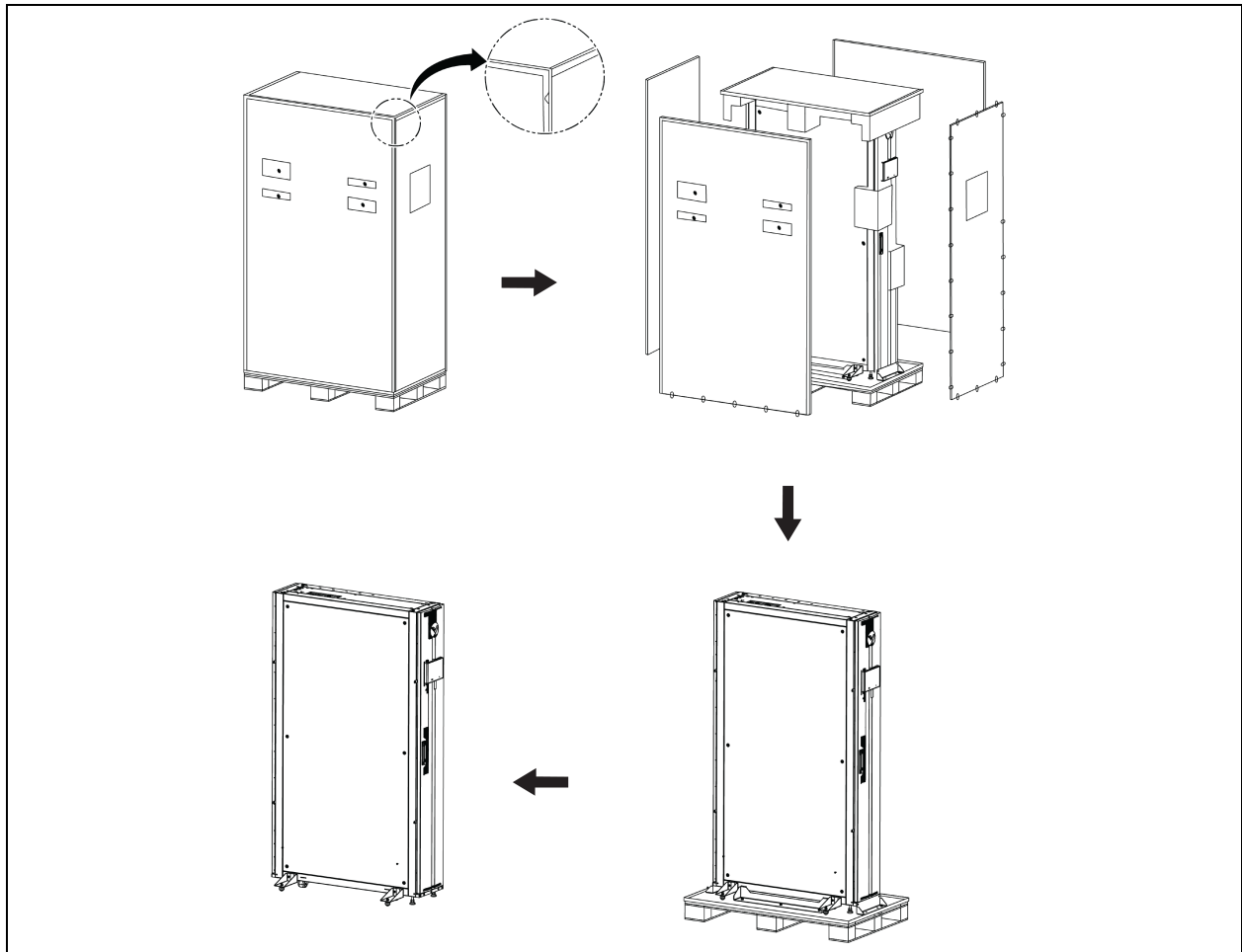
**Figure 3.3 Obliquity of the System**

## 3.5 Unpacking

Move the product to a location closer to the final installation site prior to unpacking the unit.

1. Open all the latches on the shipping crate.
2. Remove top and later wooden panels of shipping crate as depicted in **Figure 3.4** on the next page .
  - a. Remove the side wooden panel.
  - b. Remove the top wooden panel.
  - c. Remove the screws.

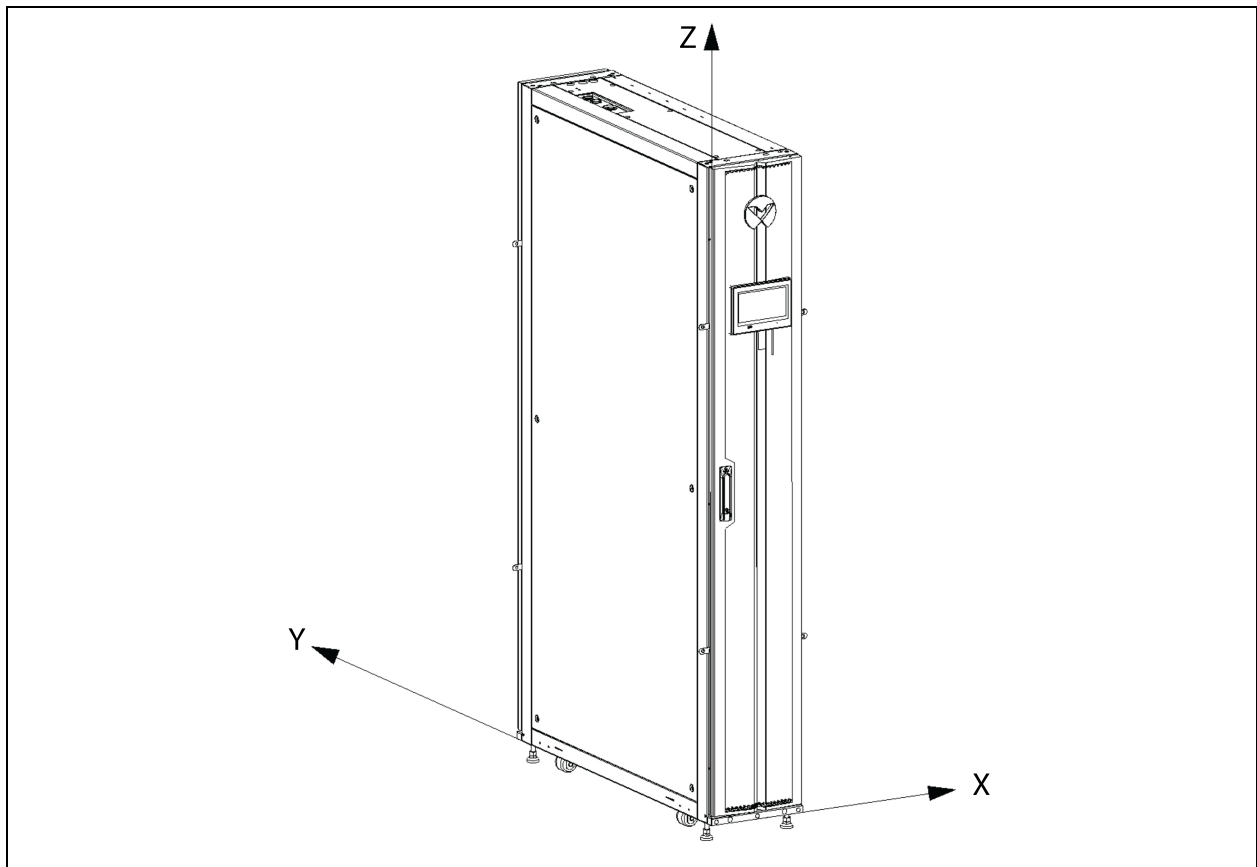
Figure 3.4 Unpacking the Outer Package



3. Consider the center of gravity of the product and move the product in balanced position.



Figure 3.5 Axis of Coordinates



Center of Gravity ±10 mm (0.4 in.)		
X	Y	Z
150 mm (5.9 in.)	550 mm (21.7 in.)	970 mm (38.2 in.)

### 3.5.1 Inspection

Check the system fittings and its components against the packing list to ensure that all items are delivered and the assembly is intact. If any parts or components are missing or damaged, immediately report the issue to the carrier and the local office of Vertiv.

### 3.6 Installation Preparation (Site Preparation)

The Vertiv™ Liebert® CRD10 models of air conditioners are streamlined for maintaining a favorable environment for data centers, computer rooms, and similar systems.

**NOTE:** Follow the installation guidelines to ensure proper installation of the air conditioner.

### 3.6.1 Equipment Room Requirement

The equipment room must be prepared to ensure smooth operation and obtain accurate results. The equipment room must meet the standards for appropriate ventilation and heating. The design specifications for the air conditioners must be ideal and should be in-line with energy efficient design standards. The requirements for maintaining a favorable room environment prior to installation as follows:

1. The equipment room should be well-insulated and have a sealed dampproof layer.
2. The outdoor air entering in should be kept at a minimum. The outside air will add the loads of heating, cooling, humidifying, and dehumidifying of the system. It is recommended that the inhalation of outside air be kept below 5% of the total indoor airflow.
3. All doors and windows should be properly sealed to minimize leakage. The seams should be as narrow as possible.

**NOTE: Vertiv recommends defining the site preparation as per the requirements. However, if these requirements are not met, the site must be rectified to meet the specified requirements and conditions.**

**NOTE: If the recommended rectifications or modifications are not implemented, then Vertiv does not guarantee the accuracy and precision of the temperature and humidity provided by the Vertiv™ Liebert® CRD10 models.**

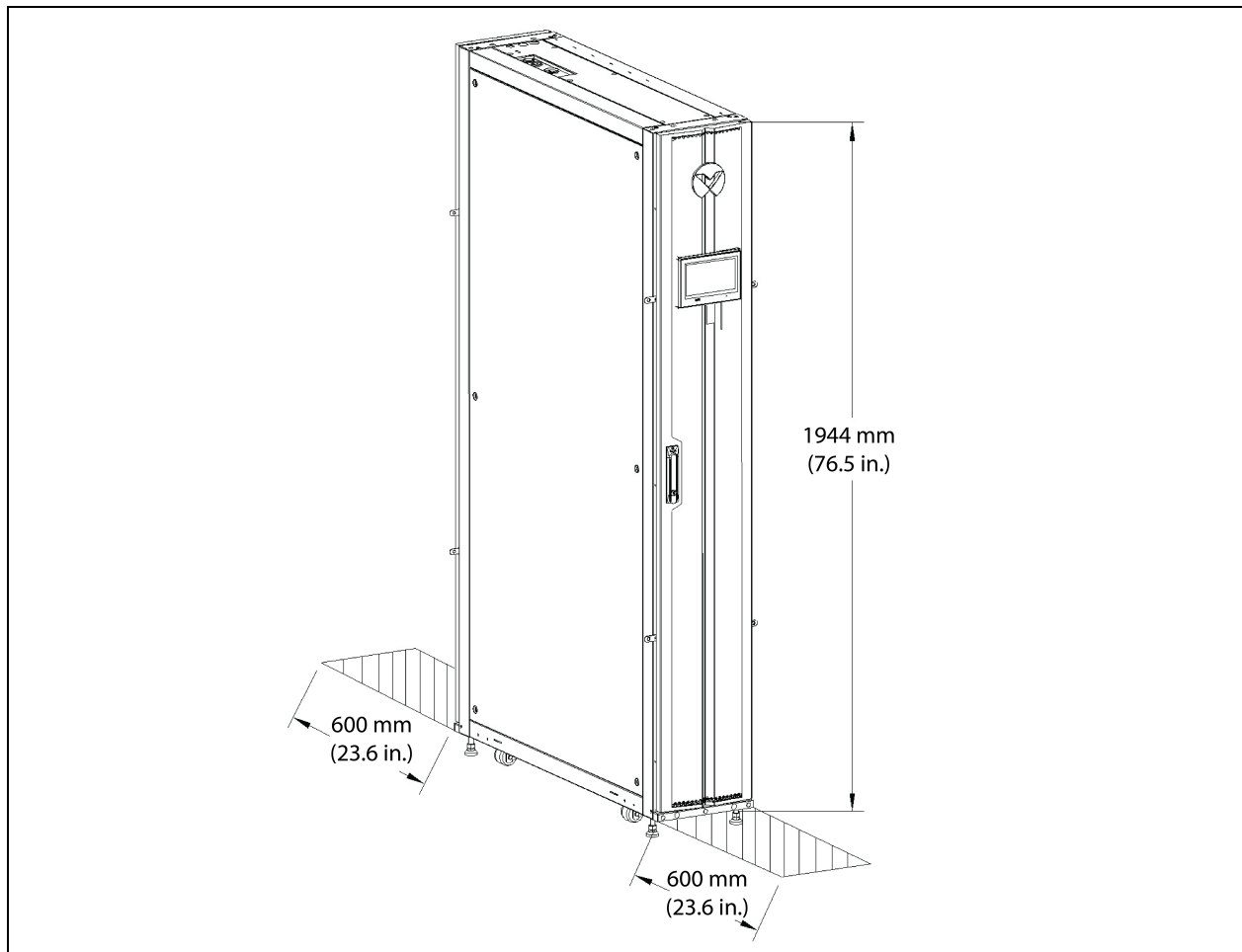
**NOTE: An important aspect to be considered is that the indoor unit must not be used for the outdoor environment.**

### 3.6.2 Installation Space Requirements

The Liebert® CRD10 models are advanced precision air cooling units and therefore, air conditioners must be installed, preferably in a row of cabinets with high heat density and in a hot aisle and cold aisle arrangement. Allocate space to make it accessible to qualified service staff for repair, maintenance, and service.

A minimum space of 600 mm (23.6 in.) must be assigned for maintenance at the front of the system and at the rear of the system. The allocated space is to facilitate regular maintenance tasks such as removing filters for cleaning, fans or compressor. **Figure 3.6** on the facing page shows the space allocation for servicing and maintenance.

Figure 3.6 Liebert® CRD10 Maintenance Space



## 3.7 Operating and Storage Environment Conditions

### 3.7.1 Operating Condition

**Table 3.4** below defines the operating condition parameters including the ambient temperature, protection level, altitude and voltage range.

**Table 3.4 Operating Parameters**

Item	Requirement		
Ambient Temperature	<b>Indoor:</b> Temperature 18 °C (64.4 °F) to 40 °C (104 °F), Relative humidity 17% to 60%. <b>Outdoor:</b> Temperature -15 °C (5 °F) to 45 °C (113 °F) without low ambient kit, Temperature -34 °C (-29.2 °F) to 45 °C (113 °F) with low ambient kit.		
Protection Level	<b>Indoor Unit:</b> IP20, <b>Outdoor Unit:</b> IPX4.		
Altitude	< 2000 m (6561.6 ft.). Above that, contact to Vertiv.		
Operation Voltage Range	CRD100-0D00A	CRD101-0D00A	CRD102-1D00A
	208/230 V/ 1 PH/ 60 Hz	208/230 V/ 3 PH / 60 Hz	230 V/ 1 PH / 50/60 Hz

### 3.7.2 Storage Condition

**Table 3.5** below defines the storage condition parameters including the ambient humidity, ambient temperature, and storage time conditions.

**Table 3.5 Storage Parameters**

Item	Requirement
Storage Environment	Indoor, clean (without dust)
Ambient Humidity	< 95% RH at 30 °C (86 °F)
Ambient Temperature	-40 °C (-40 °F) to 70 °C (158 °F)
Storage Time	Total transportation and storage time should not exceed six months. Otherwise, the performance needs to be re-calibrated.

### 3.8 Weight Bearing Capacity

The Vertiv™ Liebert® CRD10 unit is installed on the floor of the computer room. The weight bearing capacity of the floor of the computer room must be taken into consideration.

If the weight bearing capacity cannot be estimated, consult Vertiv customer service/support center.

### 3.9 Refrigerant Charging Requirement

The Liebert® CRD10 unit has a specifically designed air conditioning system that requires a desired pre-specified quality of refrigerant (R410A) to perform continuously at the most optimum efficiency. For the details on the quantity of refrigerant to be charged inside the system, refer to the **Table 4.9** on page 55.

**NOTE: Do not use refrigerant of low quality, Vertiv does not assume responsibility for warranty or any consequences resulting from using low quality refrigerant.**

### 3.10 Inspection

**NOTE: Make sure that everything is in its designated position and that the entire product assembly is intact, check the system fittings and their components against the packing list.**

**NOTE: Check that the fittings are complete, and the components are intact against the packing list. Report immediately to the carriers local offices and Vertiv if any parts are missing, or damage is found.**

## 4 Mechanical Installation

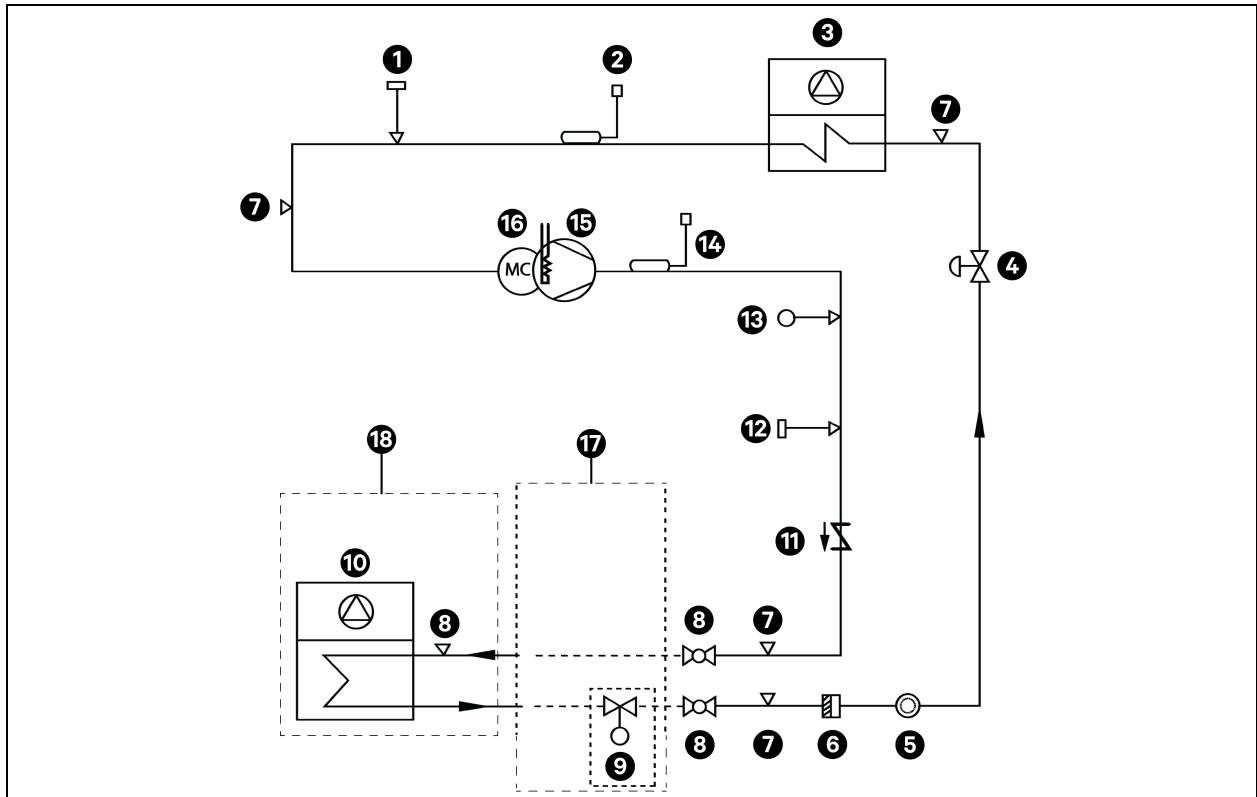
### 4.1 Installation Notes

- Prior to installation, ensure that the installation preparations is read and implemented. Refer to [Installation Preparation \(Site Preparation\)](#) on page 27 for the details. Check if any modifications are made to the plumbing, wiring, or ventilation facility before mounting the equipment. After the preparation has been completed, continue with installation.
- The Vertiv™ Liebert® CRD10 is designed as a split system. The indoor unit must be installed on the floor of the equipment room or computer room. The outdoor unit must be installed outdoors or on the floor of the other rooms as per the building architecture.
- Industry-wide standards are followed for the selection, layout, and fixing of pipes.
- During the design and installation process, various factors such as pressure drop, compressor oil return, noise reduction, and vibration must be considered.
- When installing the equipment, refer the design drawings. Reserve space for the maintenance and servicing as mentioned in the [Installation Preparation \(Site Preparation\)](#) on page 27 . The manufacturing engineering dimension drawings must be taken as a reference while installing the equipment.

### 4.2 System Arrangement during Installation

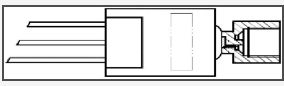



The general arrangement of the Liebert® CRD10 air-cooled AC unit is shown in **Figure 4.1** on the next page , and the **Table 4.1** on page 33 shows the calibration of safety components.

Figure 4.1 System Arrangement of the Unit System



Item	Description	Item	Description
1	Low pressure transducer	10	Air-cooled condenser
2	Suction temperature sensor	11	Check valve
3	Evaporating coil	12	High pressure transducer
4	Electronic expansion valve	13	High pressure switch
5	Sight glass	14	Discharge temperature sensor
6	Filter drier	15	Compressor
7	Schrader valve	16	Crankcase heater
8	Ball valve	17	Connection pipe
9	Solenoid valve (connection on site)	18	External to CCD condenser

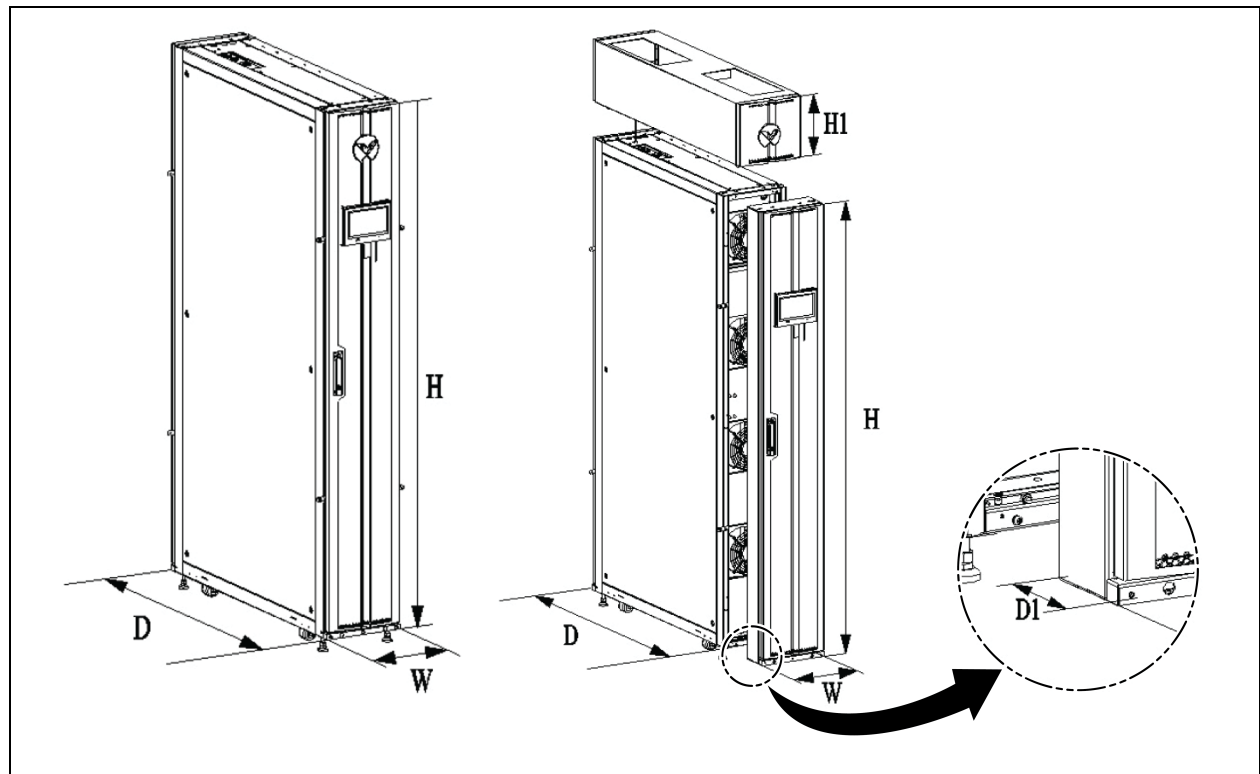
**Table 4.1 Calibrations of Electrical Components**

Refrigeration Circuit Item No	Component	Setting	Notes	Contact
4	High Pressure Switch	Open 4.1±0.1 MPa Close 3.3±0.1 MPa		Normally closed
5	High Pressure Transducer	Range 0-4.5 MPa 0.5-4.5 VDC		-
16	Low Pressure Transducer	Range 0-1.73 MPa 0.5-4.5 VDC		-
-	Clogged Filter Different Pressure Switch	Set Point Range 50-400 Pa		Normally closed

### 4.3 Product Dimensions

The dimensions and weight of the indoor unit are shown in **Figure 4.2** below and in **Table 4.2** on the next page .

**Figure 4.2 Dimensions of the Indoor Unit**



**Table 4.2 Dimension Table of the Indoor Unit**

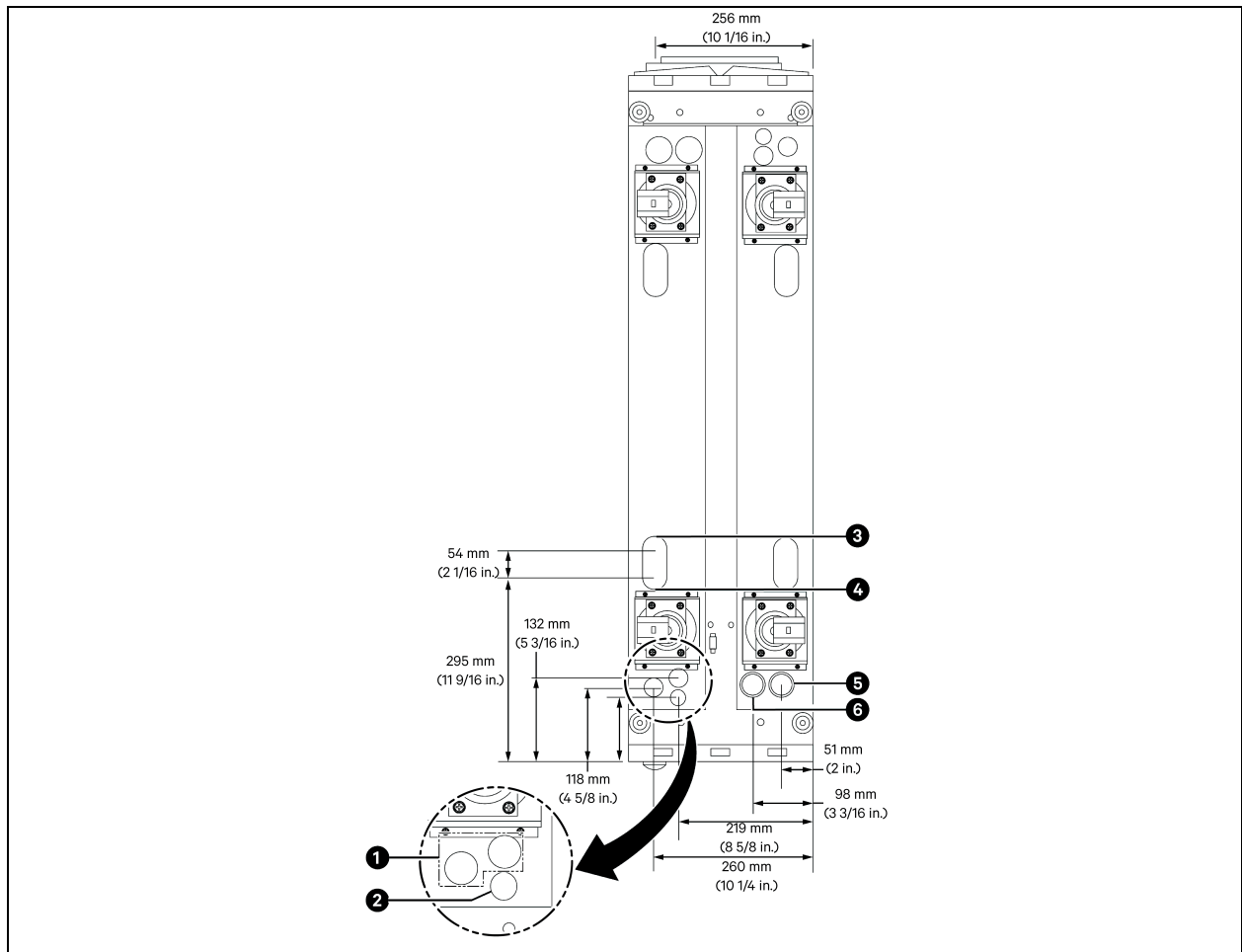
Model	H mm (In.)	H1 mm (In.)	D mm (In.)	D1 mm (In.)	W mm (In.)	Net Weight kg (lb)	Gross Weight kg (lb)
CRD100-0D00A	2000 (78.7)	267 (10.5)	1132 (44.6)	100 (3.9)	300 (11.8)	231 (509)	313 (690)
CRD101-0D00A							
CRD102-1D00A							

**NOTE:** H1 and D1 dimensions are associated with optional frame extension kits allowing Vertiv™ Liebert® CRD10 to match rack heights or depths.

### 4.3.1 Base Plate Pipe Outlet Location and Dimensions

The locations of the pipe inlets and outlets on the unit base plate are shown in **Figure 4.3** below and corresponding dimensions of the base plate pipe outlet are tabulated in **Table 4.3** on the facing page .

**Figure 4.3 Base Plate Location for Pipe Outlets**





Item	Description
1	HVT
2	LVT
3	RGT
4	RLT
5	CGT
6	CPT

**Table 4.3 Dimension of Base Plate Location for Pipe Outlets**

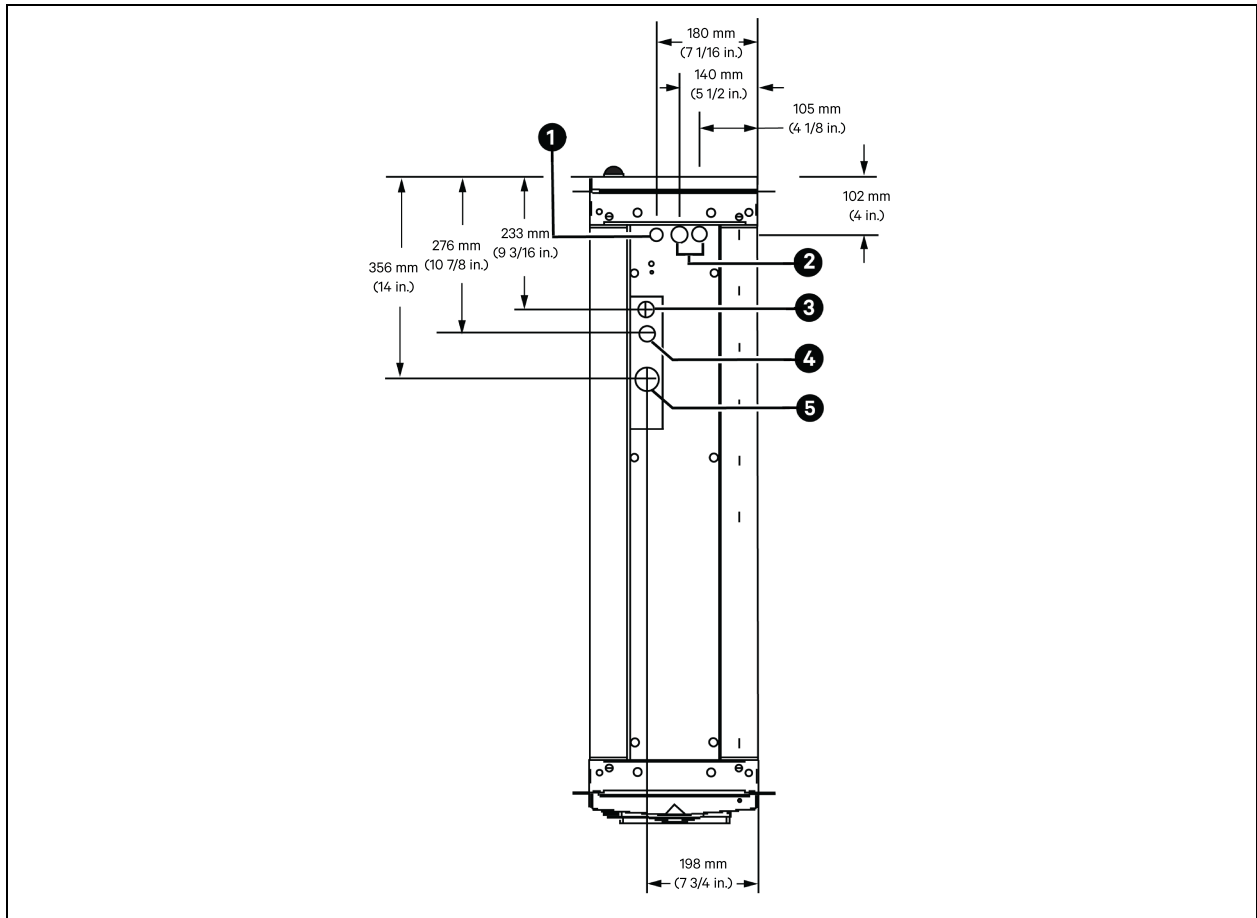
Unit Bottom Connections		CRD10
RLT	Refrigerant Liquid Line Inlet	1/2 in. O.D. Copper
RGT	Refrigerant Gas Line Outlet	5/8 in. O.D. Copper
CPT	Condensate Pump	NPT 1/2 in. (Rc 1/2 in.) female copper threaded joint
CGT	Condensate Gravity	NPT 1/2 in. (Rc 1/2 in.) female copper threaded joint
HVT	High Voltage Bottom Connection	Combination knockout
		1-1/8 in. (29 mm)
LVT	Low Voltage Bottom Connection	Knockout hole diameter
		7/8 in. (22 mm)

**NOTE:** NPT threaded joint is for UL model, Rc threaded joint is for CE model.

### 4.3.2 Top Plate Pipe Outlet Locations and Dimensions

The locations of the pipe inlets and outlets on the unit top plate are shown in **Figure 4.4** on the next page and corresponding dimensions of the top plate pipe outlet are tabulated in **Table 4.4** on page 37.

Figure 4.4 Top Plate Locations for Pipe Outlets



Item	Description
1	LVT
2	HVT
3	RGT
4	RLT
5	CPT

Table 4.4 Dimension of Top Plate Pipe Outlet

Unit Top Connections		CRD10
RLT	Refrigerant Liquid Line Inlet	1/2 in. O.D. Copper sweat
RGT	Refrigerant Gas Line Outlet	5/8 in. O.D. Copper sweat
CPT	Condensate Pump	NPT 1/2 in. (Rc 1/2 in.) female copper threaded joint
HVT	High Voltage Top Connection	Combination knockout

Table 4.4 Dimension of Top Plate Pipe Outlet (continued)

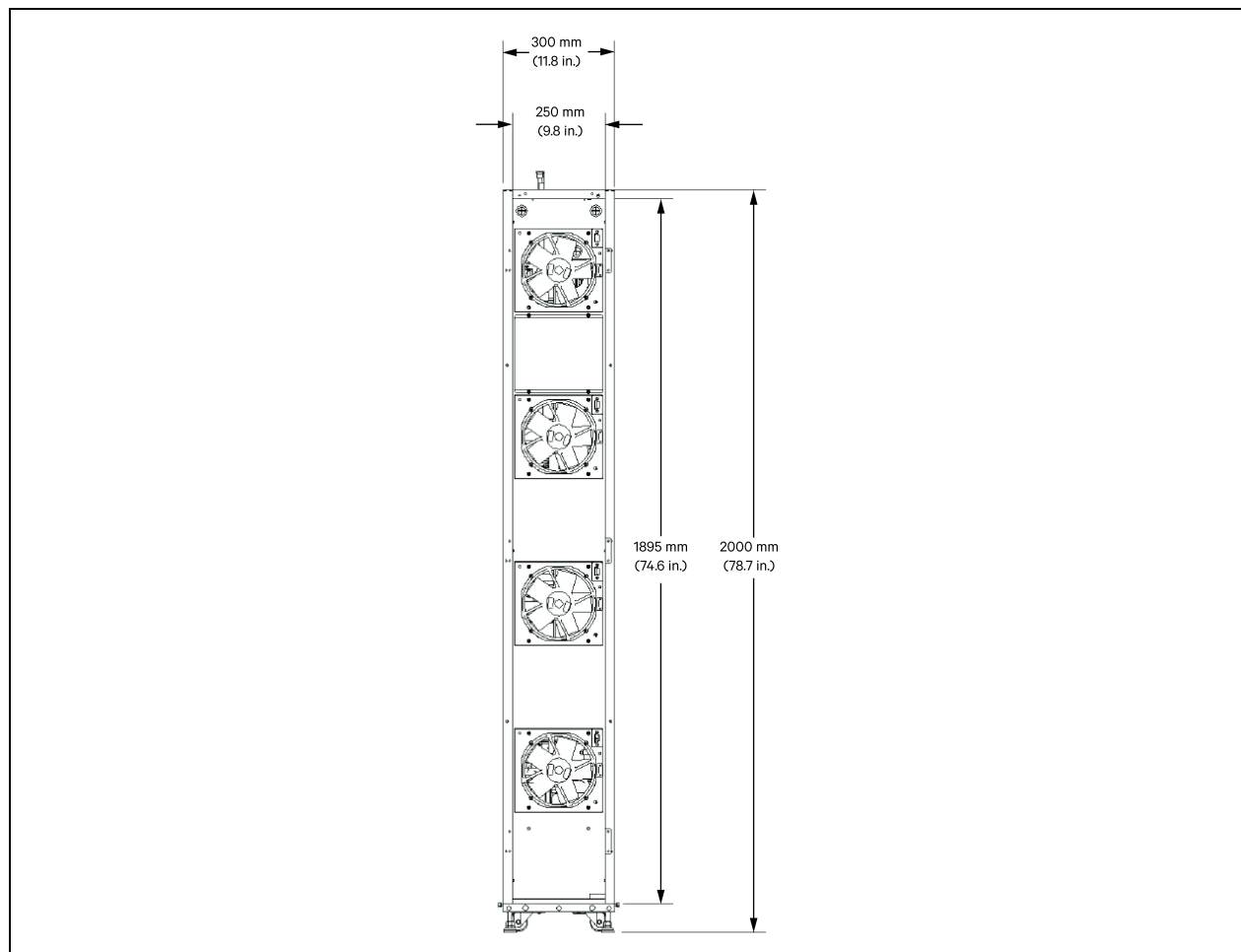
Unit Top Connections		CRD10
		1-1/8 in. (29 mm)
LVT	Low Voltage Top Connection	Knockout hole diameter
		7/8 in. (22 mm)

**NOTE:** NPT threaded joint is for UL model, Rc threaded joint is for CE model.

### 4.3.3 Front Air Outlet Locations and Dimensions

The location and dimensions of the air outlet at the front are shown in **Figure 4.5** below .

**Figure 4.5 Front Air Outlet Locations and Dimensions**



## 4.4 Top Frame and Front Frame

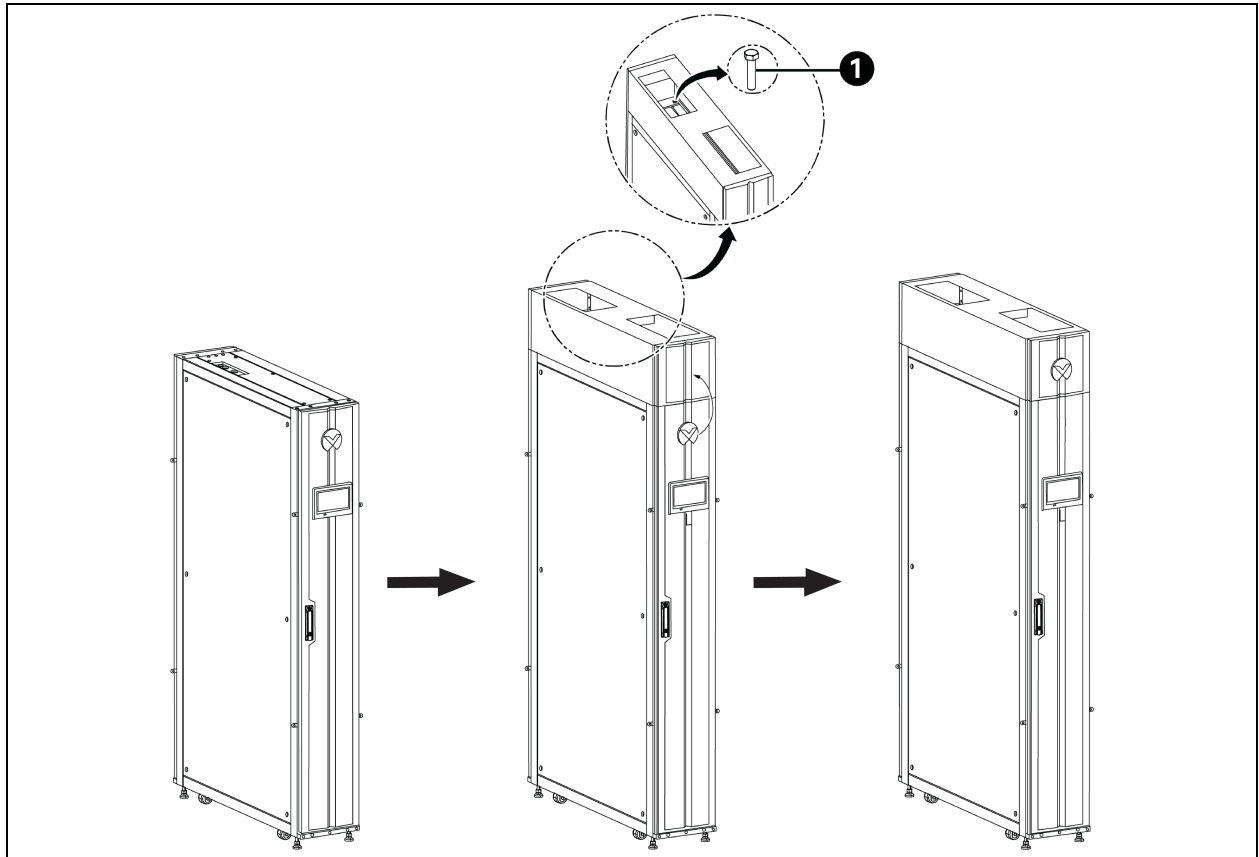
The Vertiv™ Liebert® CRD10 unit can be optionally field configured with a top frame and a front frame. The top frame and front frame are installed as follows.

### 4.4.1 Top Frame Installation without Front Frame

The 267 x 1132 mm (10.5 x 44.6 in.) specification top frame installation does not require the front frame to be installed, and the top frame can be directly installed. The installation method is as follows in **Figure 4.6** below .

1. Install the top frame and fixed it with M12 x 30 screws (4 pieces).
2. Move the V logo to the top frame.

**Figure 4.6 Top Frame Installation without Front Frame**



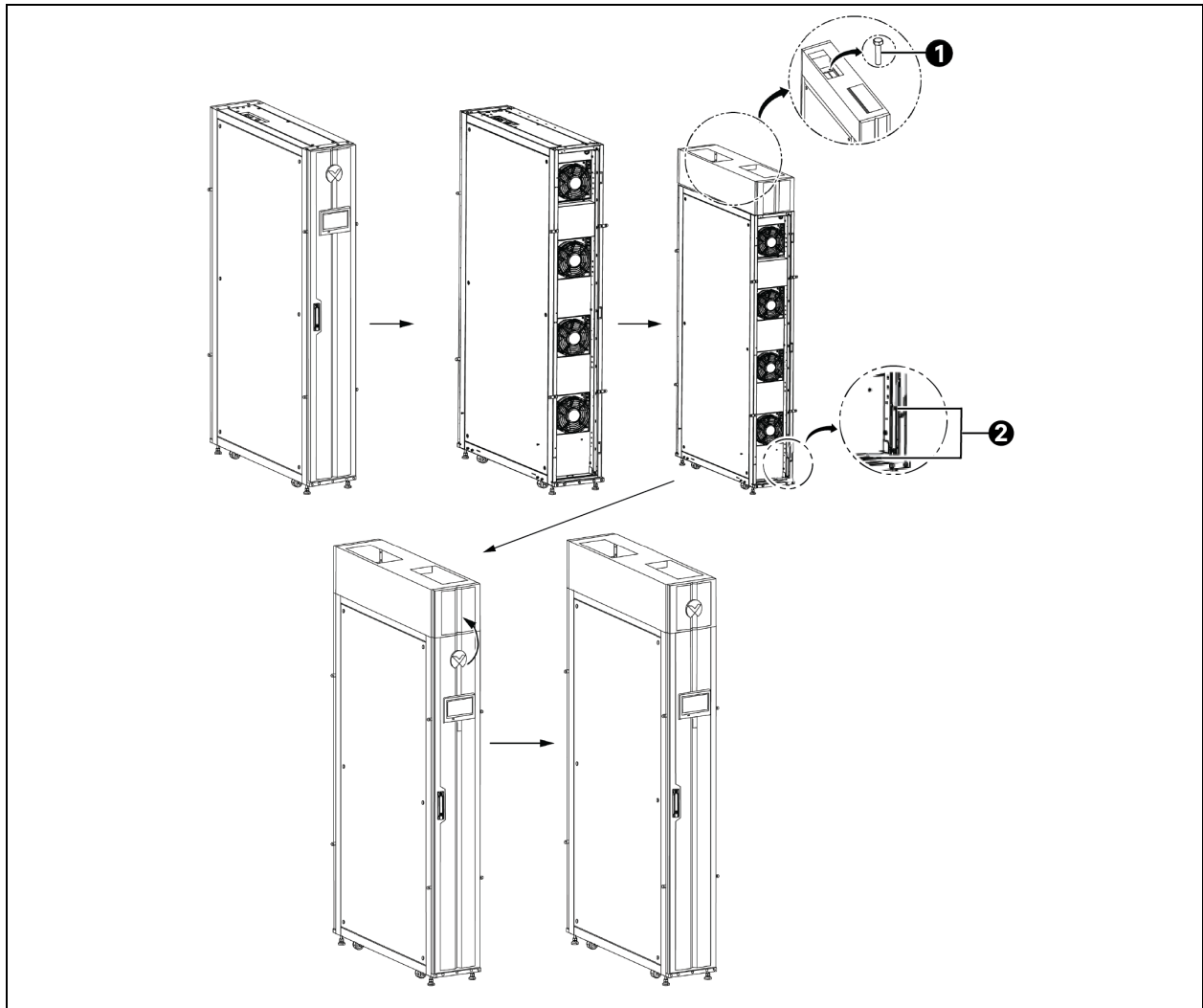
Item	Description	Quantity
1	Screw (M12 x 30)	4

### 4.4.2 Top Frame Installation with Front Frame

When installing the 267 x 1232 mm (10.5 x 48.5 in.) specification top frame, the front frame needs to be installed at the same time. The installation method is as shown in **Figure 4.7** on the facing page . The door is linked to the cabinet by hinges, and the display and foot rail is fixed with screws. To remove them, pull out the hinges and loosen the screw.

1. Remove front door, display and foot rail from the unit.
2. Fix front frame with M5 x 12 screws (10 pieces). And fix the top frame with M12 x 30 (4 pieces). Then re- install the front door, display and foot rail.
3. Move the V logo to the top frame.

Figure 4.7 Top Frame Installation with Front Frame

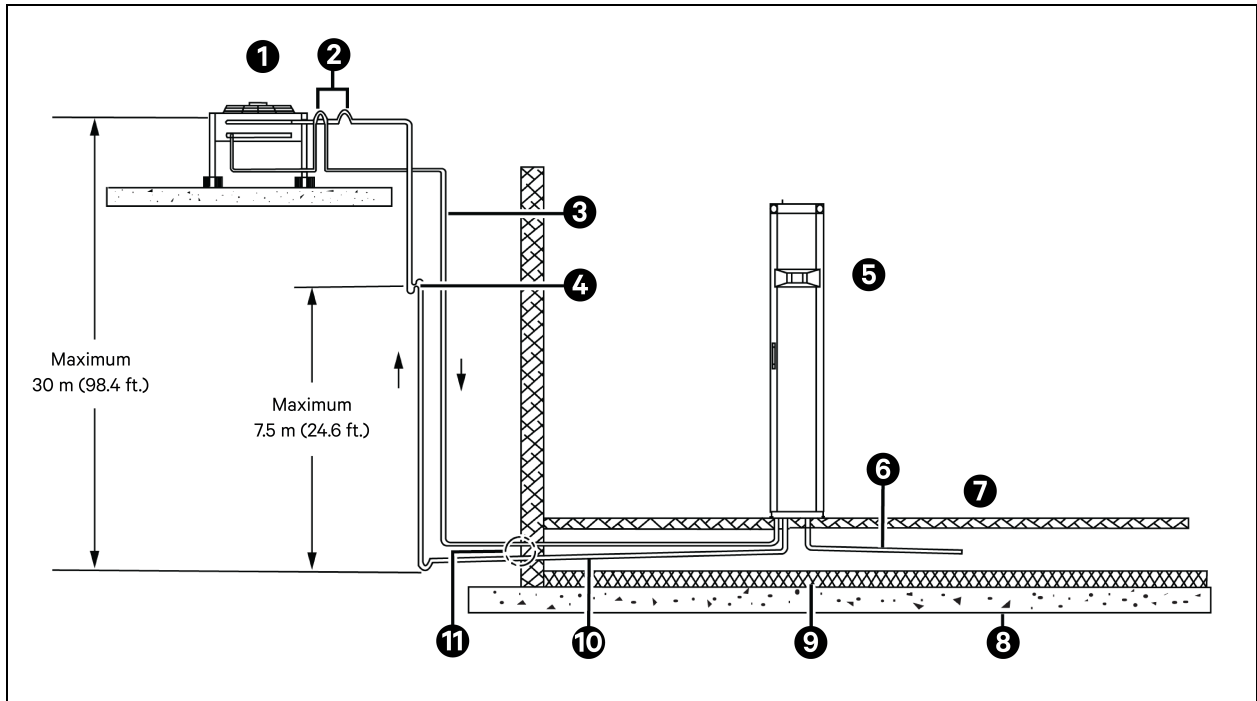


Item	Description	Quantity
1	Screw (M12 x 30)	4
2	Screw (M5 x 12)	10

## 4.5 System Installation Layout

The installation layouts of the Vertiv™ Liebert® CRD10 unit are shown in **Figure 4.8** on the next page and **Figure 4.9** on page 41.

**Figure 4.8 Condenser is Placed Higher than the Compressors during Installation**

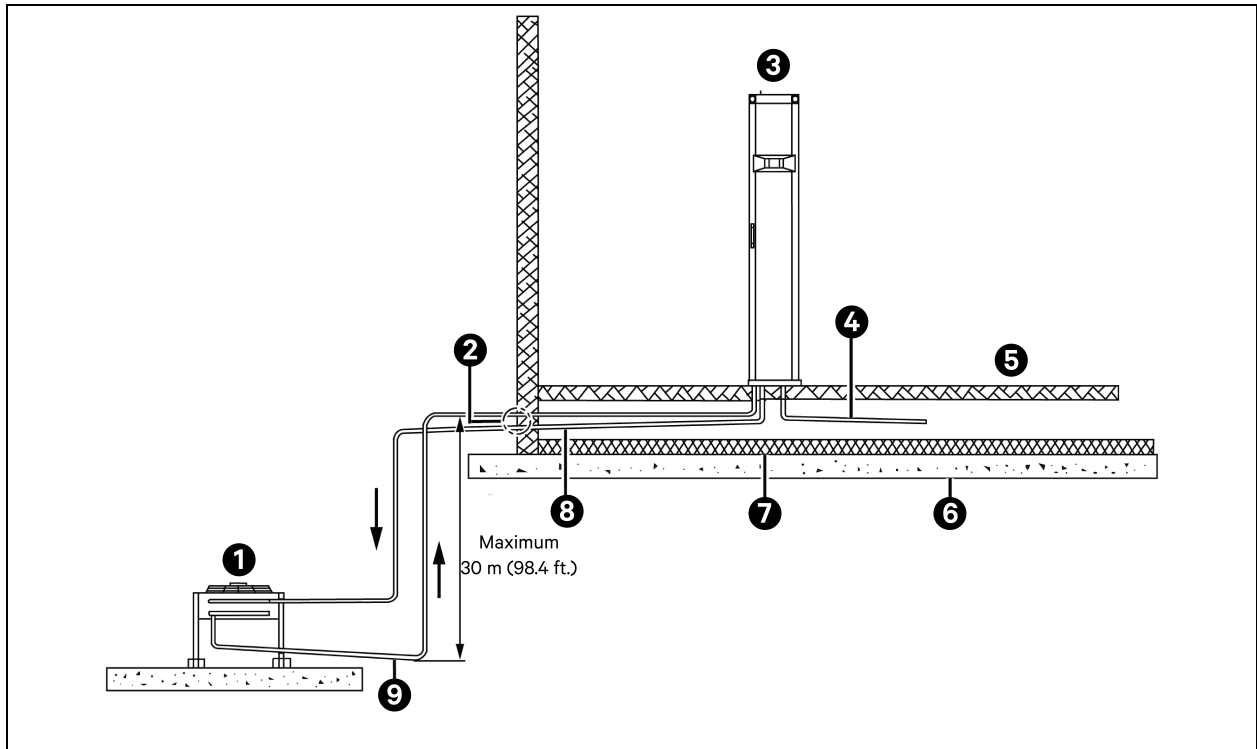


Item	Description	Item	Description
1	Outdoor unit	7	Raised floor
2	Inverted trap (must higher than the highest copper pipe of the condenser)	8	Floor
3	Liquid line (avoid exposure to direct sunlight)	9	Heat insulation floor
4	Trap	10	Slope discharge
5	Indoor unit	11	Sealed
6	Condensed water		

In **Figure 4.8** above, the condenser is installed higher than the compressor. Therefore, an inverted trap is fitted to the discharge line and the liquid line of the condenser. The inverted trap is essential as it helps prevent the liquid refrigerant from flowing back once the condenser stops. The top end of the inverted trap must be installed higher than the ultimate level of the copper pipe of the condenser. The recommended minimum height difference is 150 mm (5.9 in.). A trap must be installed every 7.5 m (24.6 ft.) of the vertical discharge line.

However, if the condenser is installed lower than the compressor, then no modification is required. **Figure 4.9** on the facing page shows the schematic diagram of system installation when the condenser is installed at a lower level than the compressor. If using low ambient kit when mounting condenser below level of the indoor unit, the allowable height is given in the **Table 4.5** on the facing page.

Figure 4.9 The Condenser is Lower than the Compressor during Installation



Item	Description	Item	Description
1	Outdoor unit	6	Floor
2	Sealed	7	Heat insulation floor
3	Indoor unit	8	Slope discharge
4	Condensed water	9	Slope liquid
5	Raised floor		

Table 4.5 below shows the allowable vertical distance between condenser and indoor unit.

Table 4.5 Vertical Distance between Condenser and Indoor Unit

Positioning of the Outdoor Unit		Height						
Outdoor unit is higher than the indoor unit		Maximum: +30 m (98.4 ft.)						
Outdoor unit is lower than the indoor unit		Maximum: -8 m (-26.2 ft.)						
Outdoor unit with low ambient kit is lower than the indoor unit	Piping equivalent length m (ft.)	10 (33)	15 (49)	30 (99)	45 (147)	60 (197)	75 (246)	91 (300)
	Maximum height m (ft.)	-5 (-16)	-4.7 (-15)	-3.7 (-12)	-2.8 (-9)	-1.9 (-6)	-1 (-3)	0 (0)

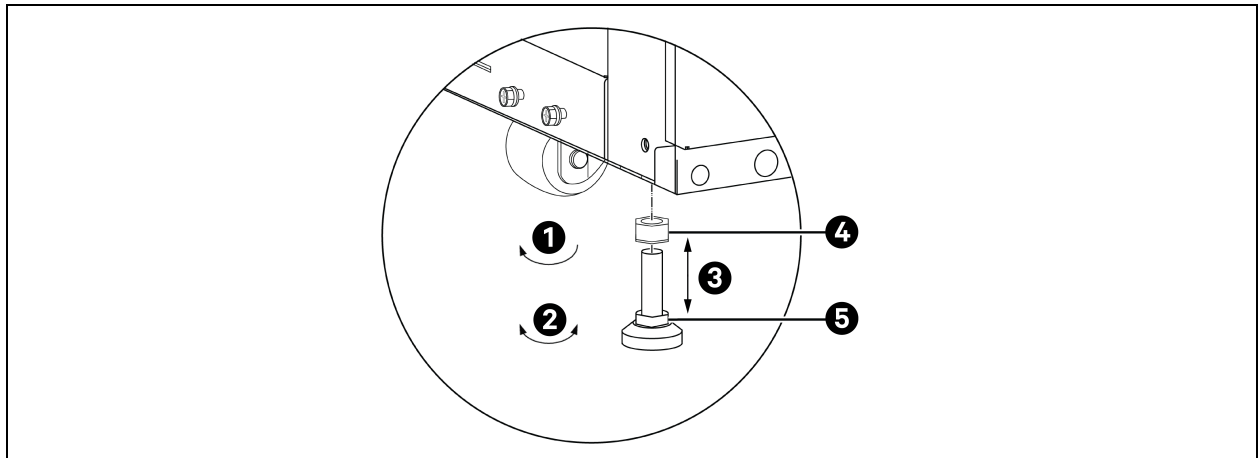
## 4.6 Installation Procedure

The Vertiv™ Liebert® CRD10 models of air conditioners are used between racks and one side of it is adjacent to the server cabinet. The Liebert® CRD10 models of air conditioners are targeted for small to medium data centers, computer rooms, and similar systems.

### 4.6.1 Leveling the Cabinet

1. Use an adjustable wrench to loosen the fixing nut on each foot in counterclockwise direction.
2. Rotate the hex bolt on the base of each foot in clockwise or counterclockwise direction until the foot rises or falls to a suitable position. Use a gradient measuring tool to ensure that the cabinet is level.
3. Tighten the fixing nut on each foot.
4. Screw down the fixing nuts on the foot bolts counter-clockwise until the leveling gets completed.
5. If the machine room has a mounting bracket, and its width does not exceed 30 mm, remove the feet and fix the cabinet onto the mounting bracket.

Figure 4.10 Leveling the Cabinet



Item	Description
1	Clockwise
2	Counter clockwise or clockwise
3	The feet rise or drop
4	Fixing nut
5	Hexagonal nut

### 4.6.2 Removing the Feet and Fixing the Cabinet

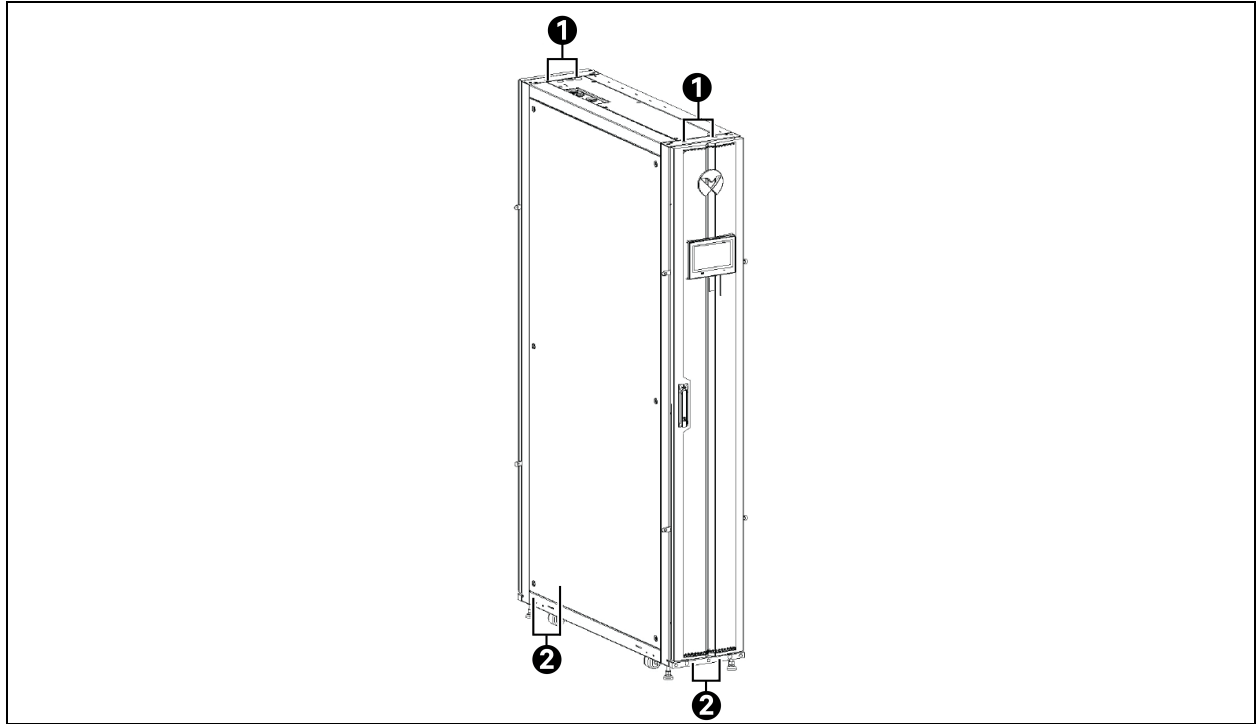
**NOTE:** Before removing the feet and fixing the cabinet, two technicians are required for this operation to avoid personal injury and cabinet damage.

Follow the instructions to remove the feet and fixing the cabinet:



- **Removing the feet:** Use a movable wrench to loosen the fixing nuts on the four feet bolts in a clockwise direction. Rotate the hexagon bolts at the bottom of the feet clockwise until the feet drops from the cabinet frames.
- **Fixing the cabinet:** As shown in **Figure 4.11** below , the cabinet provides two holes (diameter: 13.5 mm) on top, bottom, front and rear respectively.

**Figure 4.11 Fixing Holes of the Cabinet**



Item	Description
1	Top fixing hole
2	Bottom fixing hole

Install bolts in the four holes at the bottom to fix the cabinet onto the floor bracket of the equipment room. Install bolts in the four holes at the top to fix the cabinet with the top bracket of the machine room.

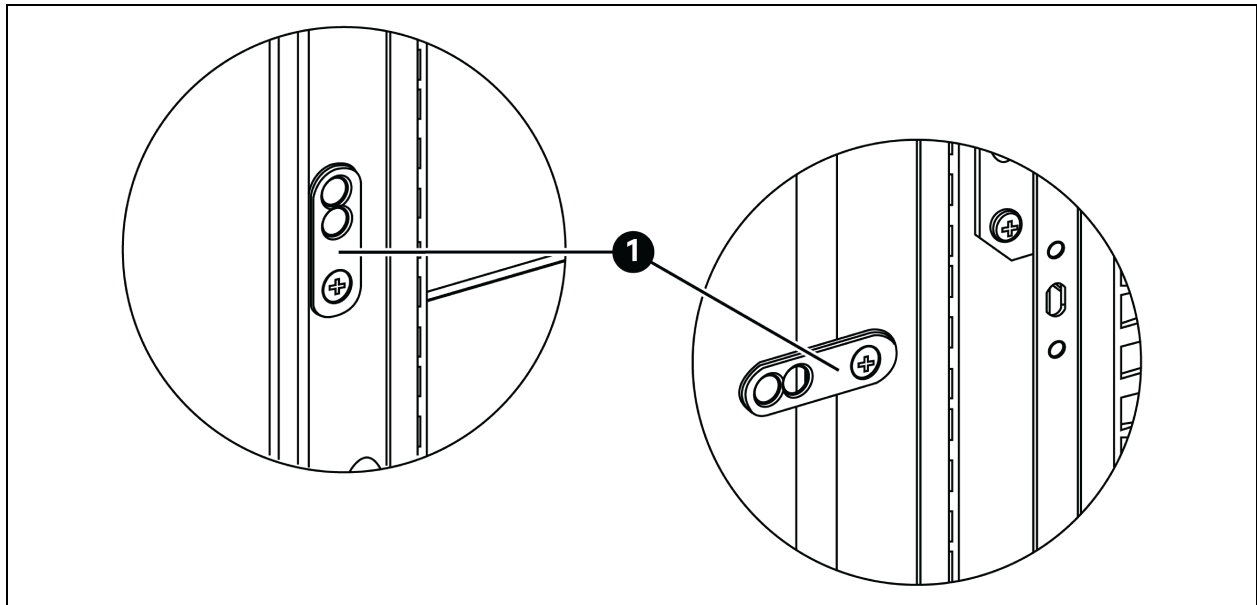
## 4.7 Cabinet Connection

**NOTE:** Ensure the cabinet has been leveled. See [Leveling the Cabinet](#) on the previous page .

The cabinet connectors come along with the accessories. Connect the unit with adjacent cabinets using the cabinet connectors. Refer the following procedures for connecting the cabinet.

1. Loosen the fixing screw of the cabinet connector on the frame of the cabinet. Rotate the cabinet connector to 90° horizontally. Use the M5 countersunk head screws to fix it on the cabinet frame (side of the door lock) as shown in **Figure 4.12** on the next page .

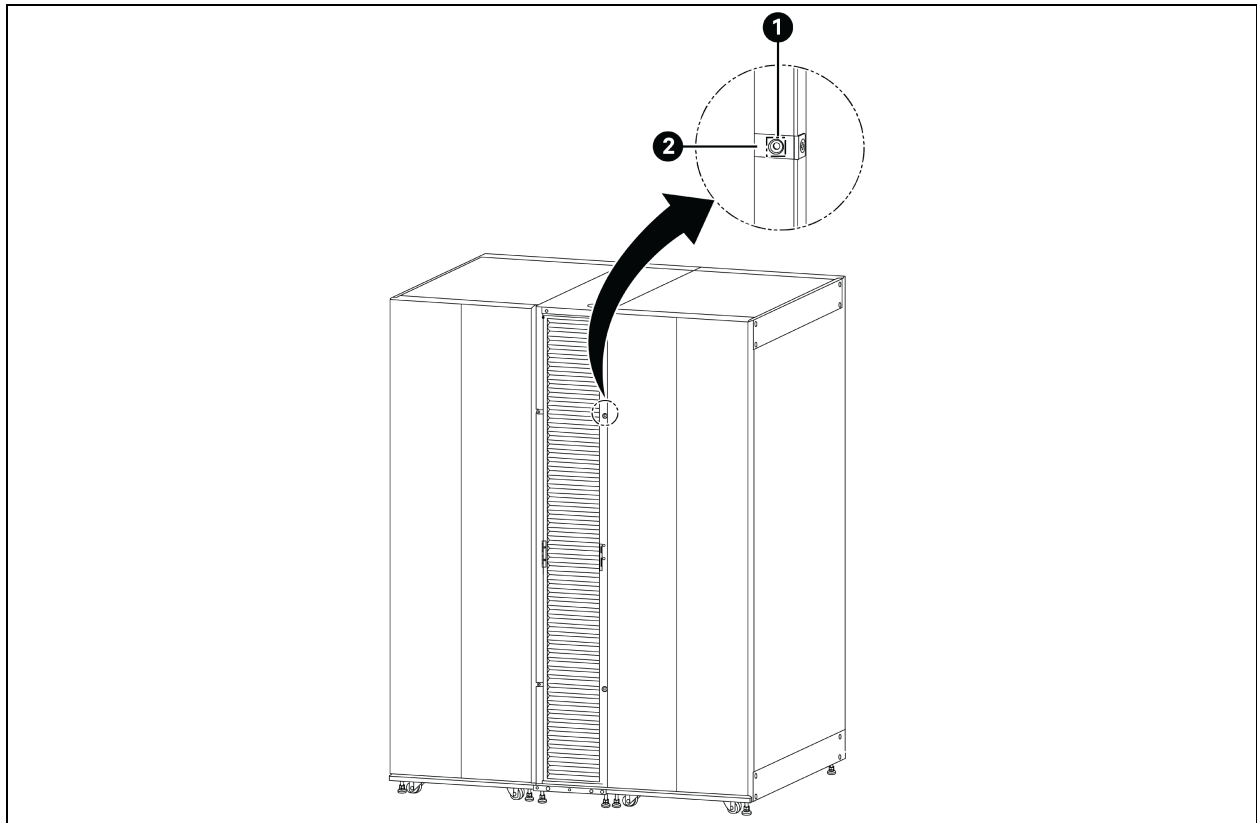
**Figure 4.12 Rotating the Cabinet Connector**



Item	Description
1	Cabinet connector

2. Use the M5 countersunk head screws to fix the cabinet connector (L-shaped) in the installation holes of the cabinet frame (side of the hinge) and rack frame adjacent to the cabinet as shown in **Figure 4.13** on the facing page .

Figure 4.13 Schematic Diagram for the Cabinet Connection



Item	Description
1	Mounting screw M5 x 12
2	Cabinet connector

3. Repeat step 1 and 2 to install the other six cabinet connectors based on the same method.

### 4.7.1 Connecting Pipelines



**WARNING! Risk of over-pressurization of the refrigeration system. Can cause explosive discharge of high-pressure refrigerant, loss of refrigerant, environmental pollution, equipment damage, injury, or death. This unit contains fluids and gases under high pressure. Use extreme caution when charging the refrigerant system. Do not pressurize the system higher than the design pressure marked on the unit's nameplate.**

The pipes to be included in the piping process of the AC are listed below:

- Condensed water drainage pipe of the indoor unit.
- Connection of the copper pipe (discharge pipe and liquid pipe) between the indoor unit and outdoor unit.
- Liquid line solenoid valve kit.

**NOTE: The on-site pipeline connection must be completed by qualified technician.**

**NOTE: On-site pipeline connection must comply with local regulations, such as ASHRAE 15, CSA B52 and local construction laws. It must be completed by a qualified technician.**

**NOTE: Pipeline welding will cause overheating of the pipeline and open flame. If the installation environment does not allow, installation is prohibited. The installation environment must be free of combustible materials to avoid fire.**

Note the following during the piping process:

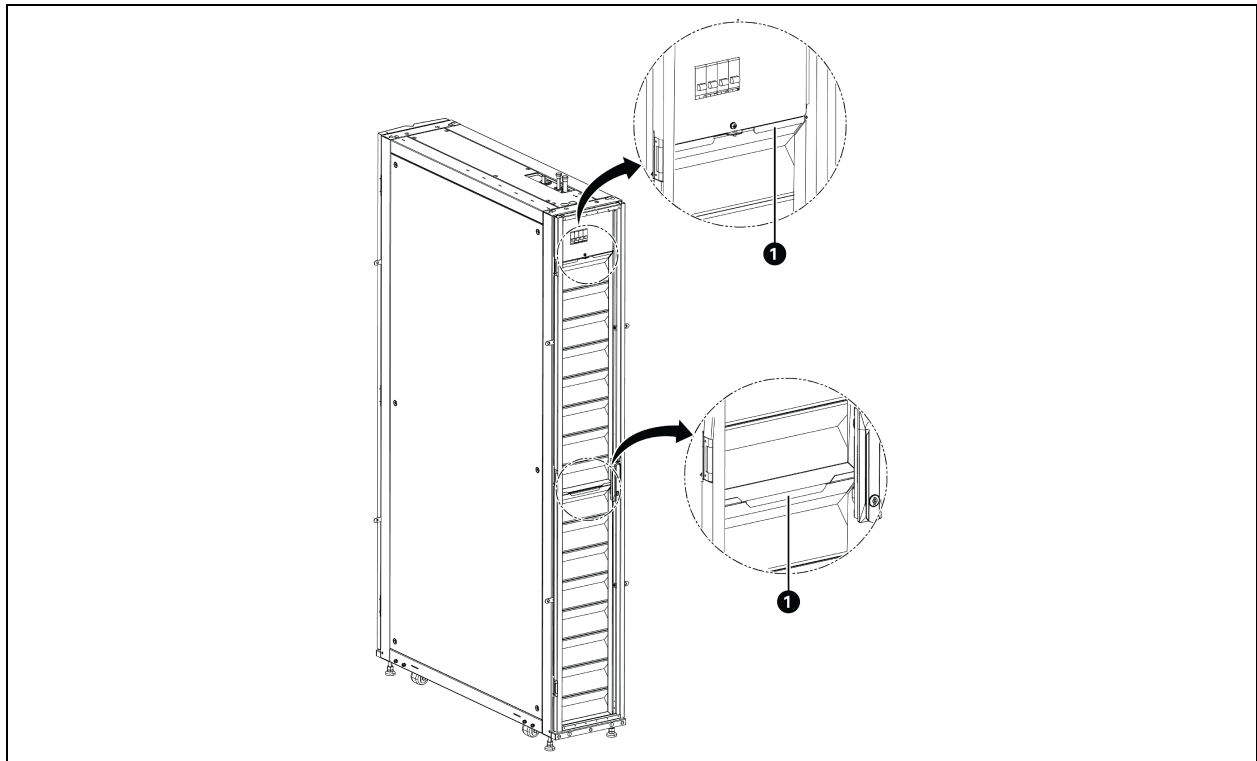
- All the joints of the refrigerating pipes must be silver-brazed.
- Use a flow of dry nitrogen through the piping during brazing to prevent formation of copper oxide scale inside the piping. When copper is heated in the presence of air, copper oxide forms. PVE oils will dissolve these oxides from inside the copper pipes and deposit them throughout the system, clogging filter driers and affecting other system components.
- A pure dry nitrogen flow of 1 to 3 ft<sup>3</sup>/min (0.5 to 1.5 l/s) inside the pipe during brazing is sufficient to displace the air. Control the flow using a suitable measuring device.
- The selection, layout, and fixing of the pipes must conform to industry standards and norms.
- Vacuum pumping and refrigerant charging operations and procedures must conform to the industry standards.
- Pressure drop, compressor oil return, noise return, and vibration must be considered during the designing and installation process.

## 4.7.2 Removing Filters

Remove the filters, before the connection of the pipes in the indoor unit:

1. Open the rear door of the cabinet to access the top and bottom filters.
2. Before the fixing flake is removed, the screws of the flake must be loosened.
3. Remove the fixing flake of the top filter.
4. Repeat step 1 to 3 to remove the bottom filter. **Figure 4.14** on the facing page shows the fixing flake of the filters.

Figure 4.14 Removing the Filters



Item	Description
1	Fixing flake of the filter

### 4.7.3 Connecting the Condensate Drainage Pipe of the Indoor Unit

The condensate water drains into a drain pan. Then it is drained through the top or bottom of the unit.

1. Connect the drainage pipe of the pump upwards to the top drainage copper pipe (top drain mode by default).
2. Fix the drainage pipe to the drainage pipe connector with the hose clamps. The torque of the hose clamp is 15 kg/cm (83 lb/in.).
3. Connect the drainage pipe to the drainage hole on the top of the cabinet.
4. To drain water from the bottom, direct the rubber drainage hose of gravity through the drainage hole. Or connect the rubber drainage hose with the outlet of pump and direct it through the bottom drainage hole. When applying the gravity drainage, also applying pump drainage from bottom is recommended, otherwise, disable the pump function from HMI display.
5. Fix the pipe with the hose clamp to the copper pipe connector then, connect it to the outer drainage pipe.
6. **Table 4.6** below provides the details of piping connection of water drainage pipe with condensate pump.

**Table 4.6 Standards for Water Drainage Pipe and Condensate Pump**

Connection	UL Model	CE Model
Water drainage pipe with condensate pump	NPT 1/2 Female *	Rc 1/2 Female

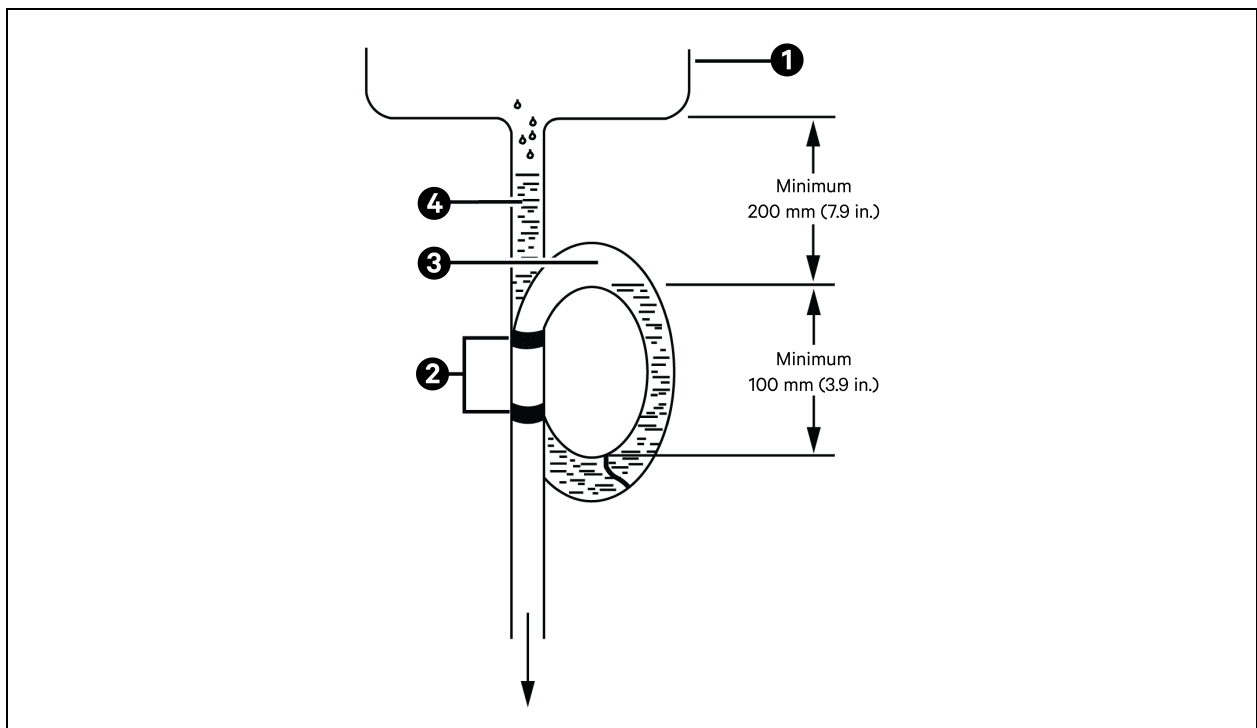
The outer diameter of the copper pipe is 12.7 mm (0.5 in.), the internal diameter of the rubber drain hose of condensate gravity and pump are 16 mm (0.6 in.) and 9 mm (0.35 in.) respectively. However, the rubber hose is equipped with threaded joint which has the same interface diameter 12.7 mm (0.5 in.). If using condensate gravity rather than pump, the rubber drain hose of the water tray should pass through the drainage hole of the tray and connect to the outer drainage pipe.

**NOTE: Maximum 9 mm ID size field installed tubing must be used to maintain the pumps head specification of 5 meters (16.4 ft). The pump head specification of 5 meters (16.4ft) is based on the use of 9mm ID hose.**

The trap is essential to drain the condensate water. For the trap either a galvanized steel pipe or PVC or poleyethylene pipe with a fair amount of flexibility must be used. Tilt 2° toward the direction of drainage flow.

The trap is mandatory and should be located 300 mm (11.8 in.) below the water tray. The trap must be kept under the raised floor as shown in **Figure 4.15** below .

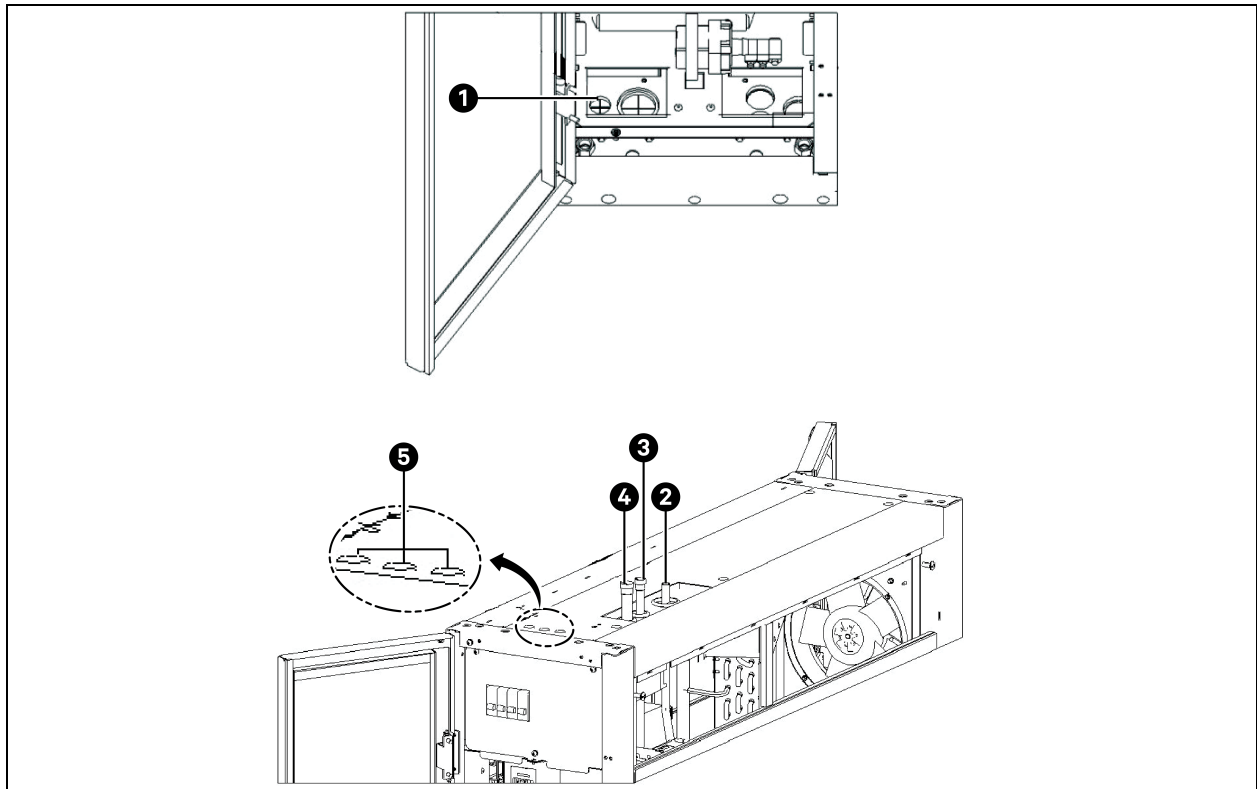
**Figure 4.15 Process of Draining the Condensate Water**



Item	Description
1	Water tray
2	Bracket 2 pieces
3	Trap
4	Water trap inlet

**NOTE: Do not cut off the brackets of the trap lest affecting the drainage. Filling the trap with water to avoid blowing water before the unit is powered on. Use teflon tape between the flexible pipes and connector to avoid water leakage.**

Figure 4.16 Connection of Drainage Pipes



Item	Description
1	Drainage hole of pump
2	Drainage hole
3	Liquid pipe hole
4	Discharge pipe hole
5	Cable holes

#### 4.7.4 Connecting the Copper Pipes between the Indoor and Outdoor Unit

The indoor and outdoor units are connected through the silver-braced copper pipes. Piping must be type ACR copper tubing. **Table 4.7** on the next page shows the standard pipe diameters for connection between the indoor unit and the remote condenser. The pipe diameter of the indoor unit and outdoor unit should be determined by the specifications mentioned in **Table 4.7** on the next page, taking into account the effect of the pipe diameter on the system pressure drop. Alternatively, consult Vertiv technician for details.

**Table 4.7 Recommended Refrigerant Line Sizes**

Model	Liebert® CRD10	
Pipe Length L (m (ft.))	External Diameter X Pipe Thickness mm (in.)	
	Discharge Pipe	Liquid Pipe
0 < L ≤ 40 (131.2)	16 (5/8) X 1 (0.04)	12.7 (1/2) X 1 (0.04)
40 (131.2) < L ≤ 91 (300.0)	18 (3/4) X 1 (0.04)	16 (5/8) X 1 (0.04)

**NOTE: Pipe length = Actual length + Equivalent Length of Partial Components**

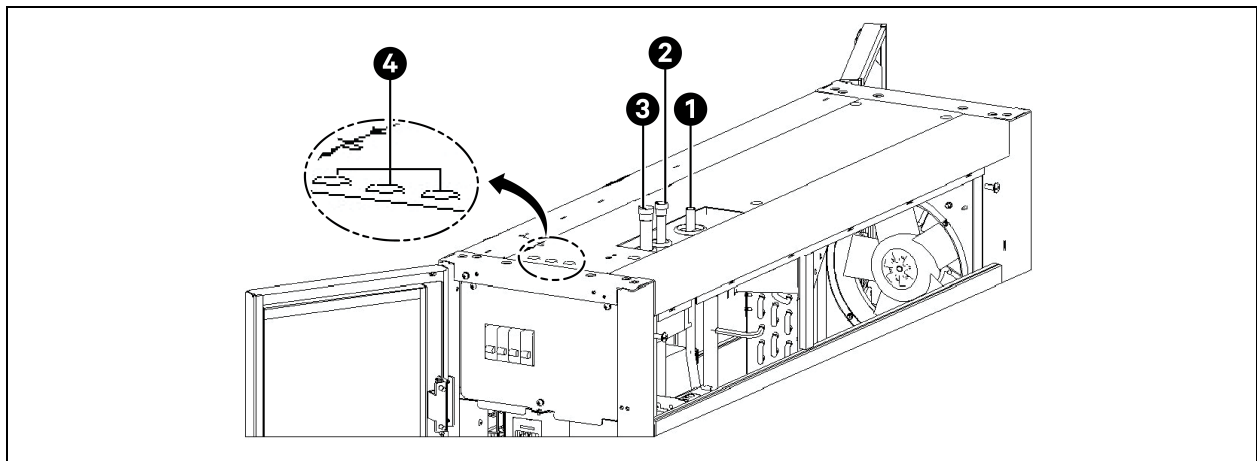
Recommended equivalent length of the partial components for the different pipe diameters which include resistance loss from the elbow joints are listed in **Table 4.8** below . Before installation, make a choice according to site condition.

**Table 4.8 Equivalent Length of Partial Components**

Liquid Pipe, External Diameter x Pipe Thickness mm (in.)	Equivalent Length (m (ft.))		
	90° bend	45° bend	T Type 3-way
12.7 (1/2) X 1 (0.04)	0.5 (1.64)	0.25 (0.82)	0.76 (2.49)
16 (5/8) X 1 (0.04)	0.55 (1.8)	0.27 (0.88)	0.76 (2.49)
18 (3/4) X 1 (0.04)	0.6 (1.96)	0.3 (0.98)	0.76 (2.49)
22.2 (7/8) X 1.2 (0.05)	0.7 (2.29)	0.35 (1.14)	1.1 (3.6)

As shown in **Figure 4.17** below and **Figure 4.18** on the facing page , the unit has refrigerated pipe connectors and labels on top and bottom. Do not expose labels to heat during brazing. These labels assist and point out the connections to the discharge pipe and liquid pipe of the indoor unit. The horizontal sections of the discharge pipes must be tilted downwards from the compressor with a slope of at least 1:200 (5 mm down for every 1 m run). The discharge pipes must be insulated from heat at the location where they are routed in the conditioned space (including the raised floor).

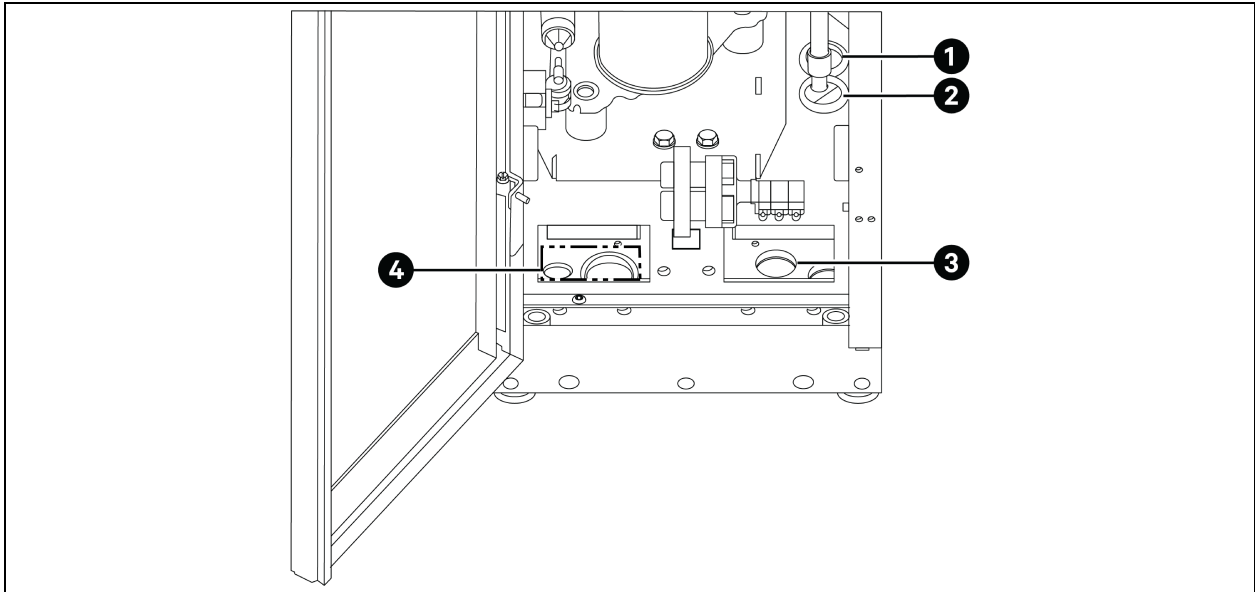
**Figure 4.17 Top Pipe Connectors**





Item	Description
1	Drainage hole
2	Liquid pipe hole
3	Discharge pipe hole
4	Cable holes

Figure 4.18 Bottom Pipe Connectors



Item	Description
1	Discharge pipe hole
2	Liquid pipe hole
3	Cable hole
4	Drainage hole

**NOTE:** For bottom piping, before brazing the compressor discharge pipe and liquid pipe, follow the requirement labeled on the copper pipe, cut the copper pipe using a cutter (a little bit of the compressor lubricating oil may leak), however, do not braze weld the copper cap on the seal directly as it may result in heating of the oil following that may catch fire.

**NOTE:** The exposure time of the system pipes should not exceed 15 minutes. If exposed for too long, it will lead to the PVE refrigeration oil absorbing moisture from the air and contaminating the refrigerant system. It may result in an adverse effect on the life of the key components and the stability of the system operation.

## 4.8 Installing Liquid Line Solenoid Valve Kit and Low Ambient Kit

### 4.8.1 Installing Solenoid Valve Kit (for Site Installation)

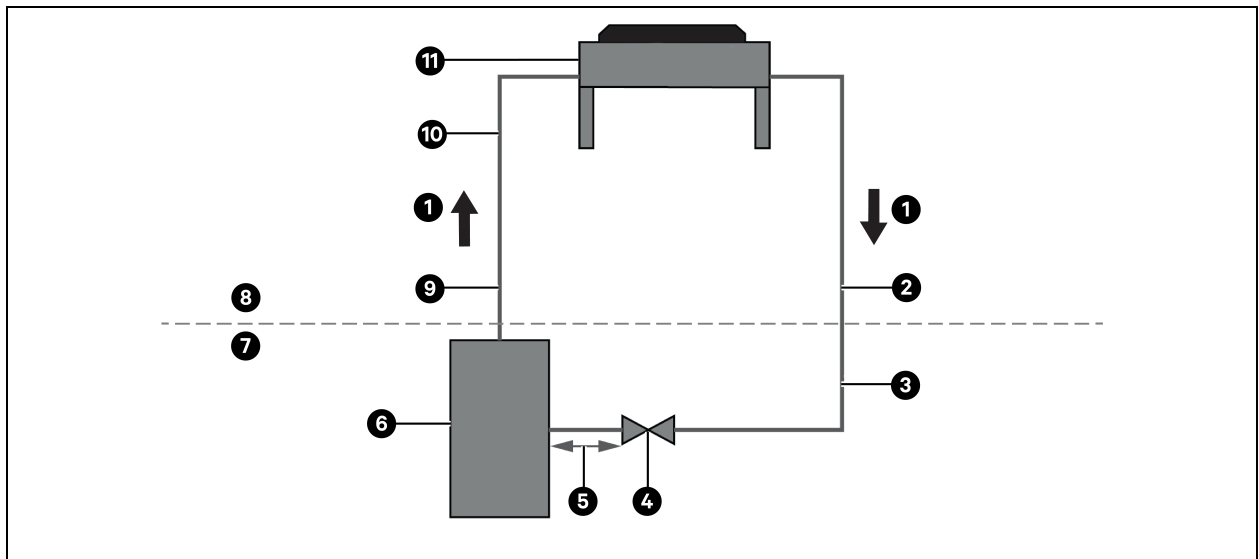
To prevent the opening of the pipe, it is recommended that the solenoid valve be installed outside the ball valve of the liquid pipe. After the entire system is installed, open the ball valve to keep the pressure and carry out the vacuum operation, thereby avoiding the moisture absorption of the compressor refrigeration oil. Thus, it accounts for operational safety and extends the service life of the compressor (for electrical connections related to the solenoid kit, refer to [Electrical Installation](#) on page 61).

**NOTE: The solenoid valve is a standard accessory, and it needs to be installed for all installations. The solenoid valve is recommended to be installed horizontally, and the valve body must be upward.**

Following is the procedure for installing the solenoid valve in the liquid pipe:

1. The solenoid valve needs to be installed to the liquid pipe. The solenoid valve must be as close to the indoor unit as possible, and the distance from the solenoid valve to the indoor unit pipe does not exceed 2 m (6.6 ft.), as shown in **Figure 4.19** below . The valve body and coil of the solenoid valve are separated when the valve is shipped out.

**Figure 4.19 Installation Position of Solenoid Valve and Pipe Dimensions**



Item	Description	Item	Description
1	Refrigerant flow	7	Indoor
2	12.7 mm (1/2 in.) or 16 mm (5/8 in.) according to <b>Table 4.6</b> on page 47	8	Outdoor
3	Liquid pipeline	9	16 mm (5/8 in.) or 18 mm (3/4 in.) according to <b>Table 4.6</b> on page 47
4	Solenoid valve	10	Hot gas pipeline
5	Maximum 2 m (6.6 ft.)	11	Condenser
6	CRV		

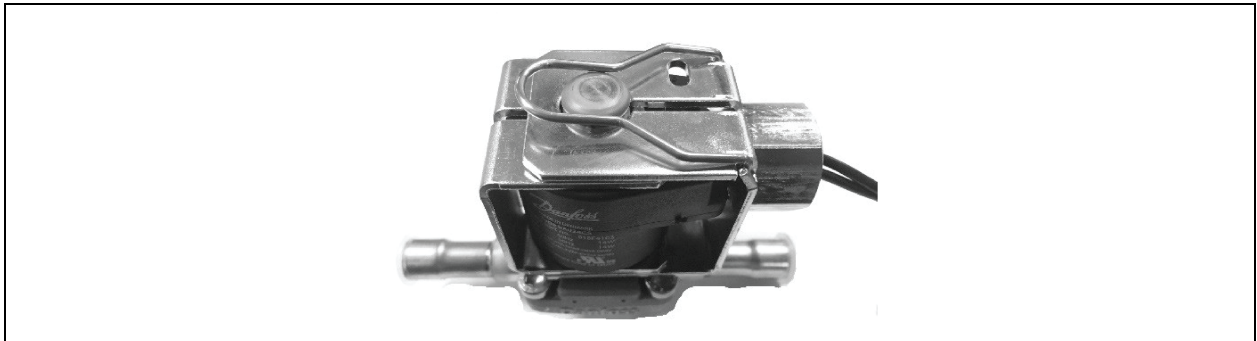
2. Mount the valve body horizontally in the refrigerant pipe as shown in **Figure 4.20** below . Pay attention to the arrow on the valve body as the arrow indicates the flow direction of the refrigerant in the valve. Ensure that the arrow points towards the indoor unit. The connection pipe diameter of the valve body is 12 mm (1/2 in.).

**Figure 4.20 Installing the Solenoid Valve Horizontally**



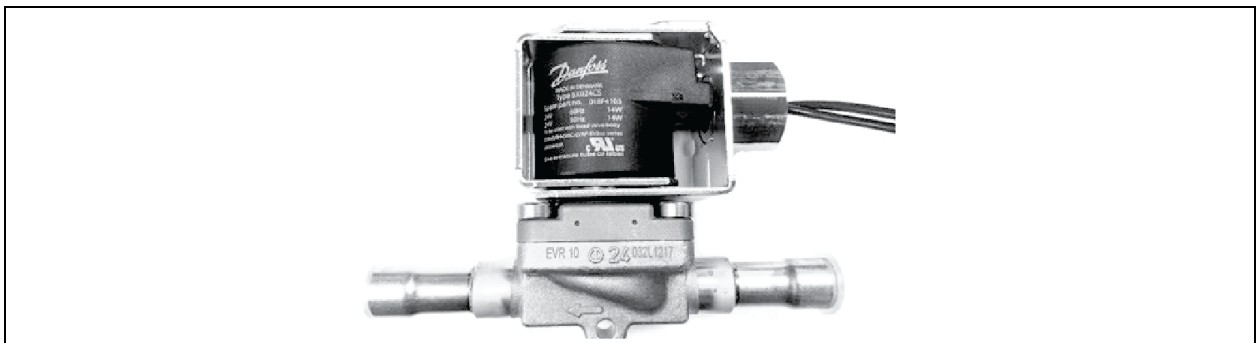
3. After brazing, install the coil and the wiring terminals. **Figure 4.21** below shows the process of connecting the cables and coil of the solenoid valve.

**Figure 4.21 Install the Coil of the Solenoid Valve**



4. Finally, as shown in **Figure 4.22** below , clip the valve body coil, press the coil tightly to ensure full contact between the coil and valve body.

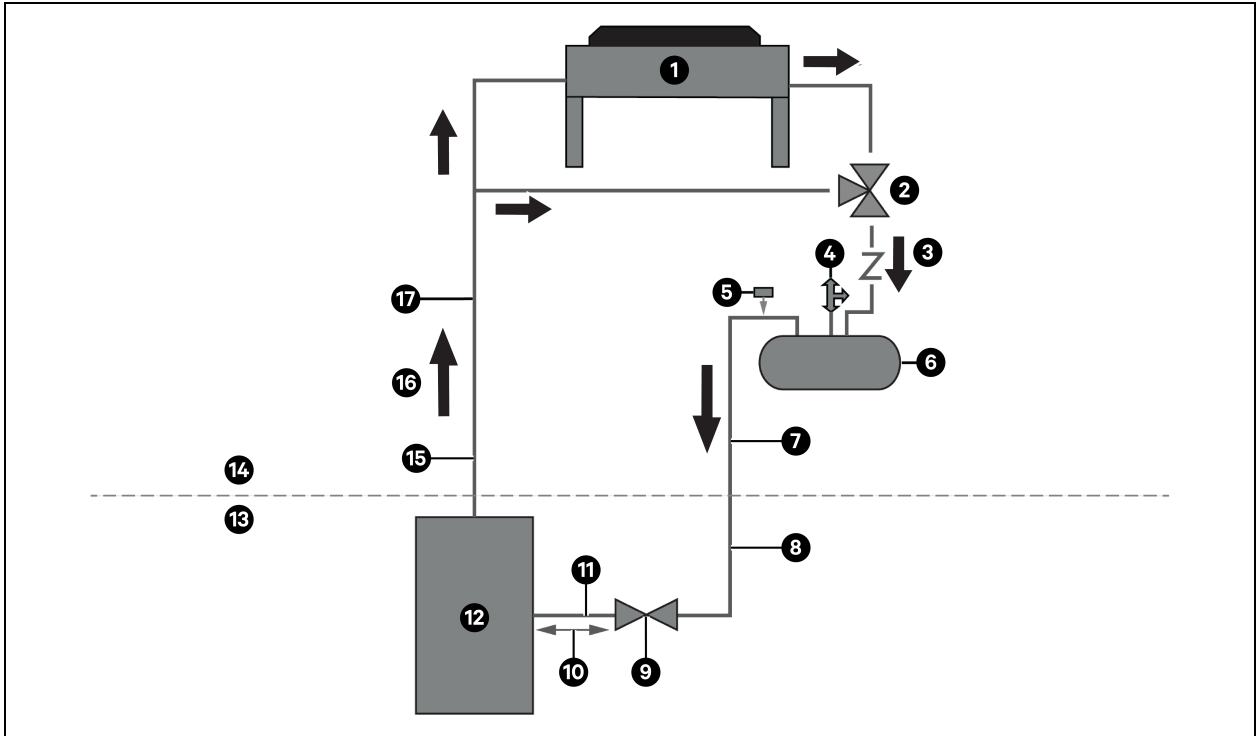
**Figure 4.22 Fixing the Coil**



### 4.8.2 Installing Low Ambient Kit (for Site Installation)

The low ambient kit consists of a liquid receiver (with electric heater for outdoor installations), check valve, and a head pressure valve to bypass the condenser. When low ambient kit is a part of the system, **Figure 4.23** below shows the installation position. The low ambient kit is installed with the condenser, for the detailed installing instruction, refer to the CCD10 condenser user manual.

**Figure 4.23 Installation Position of Low Ambient Kit and Pipe Dimensions**



Item	Description	Item	Description
1	Condenser	10	Maximum 2 m (6.6 ft.)
2	Head pressure valve (head pressure valve to bypass the condenser)	11	12.7 mm (1/2 in.)
3	NRV	12	CRV
4	Safety valve	13	Indoor
5	Pressure switch	14	Outdoor
6	Liquid receiver	15	16 mm (5/8 in.) or 18 mm (3/4 in.) according to <b>Table 4.6</b> on page 47
7	12.7 mm (1/2 in.) or 16 mm (5/8 in.) according to <b>Table 4.6</b> on page 47	16	Refrigerant flow
8	Liquid pipeline	17	Hot gas pipeline
9	Solenoid valve		

## 4.9 Recommended Refrigerant and Oil Charging Amount of the System



**WARNING! Risk of over-pressurization of the refrigeration system. Can cause explosive discharge of high-pressure refrigerant, loss of refrigerant, environmental pollution, equipment damage, injury, or death. This unit contains fluids and gases under high pressure. Use extreme caution when charging the refrigerant system. Do not pressurize the system higher than the design pressure marked on the units nameplate.**

### NOTICE

Risk of oil contamination with water. Can cause equipment damage. Liebert® CRV systems require the use of PVE (FV50S) oil. PVE oil absorbs water at a much faster rate when exposed to air than previously used oils. Because water is the enemy of a reliable refrigeration system, extreme care must be used when opening systems during installation or service. If water is absorbed into the PVE oil, it will not be easily removed and will not be removed through the normal evacuation process. If the oil is too wet, it may require an oil change. PVE oils also have a property that makes them act as a solvent in a refrigeration system. Maintaining system cleanliness is extremely important because the oil will tend to bring any foreign matter back to the compressor.

### NOTICE

Risk of improper refrigerant charging. Can cause equipment damage. Refrigerant charge must be weighed into air-cooled compressorized systems before they are started. Starting compressors without proper refrigerant charging can cause the compressors to operate at less than 5 °F (-15 °C) evaporator temperature and at less than 20 psig (138 kPa). Operation for extended periods at less than 20 psig (138 kPa) can cause premature compressor failure.

The Vertiv™ Liebert® CRD10 comes with pre-charged 2 bar of nitrogen in the factory. Discharge the nitrogen before the plugs are unsoldered. The users can determine the charging amount of the refrigerant according to the system configuration and the length of the connection pipes between the indoor and outdoor unit. **Table 4.9** below represents the recommended refrigerant and oil charging amount of the Liebert® CRD10 unit.

**Table 4.9 Refrigerant and Oil Charging Amount**

Model	Base Refrigerant Charging without Low Ambient Kit kg (lb)	Base Refrigerant Charging with Low Ambient Kit kg (lb)	Base Refrigerant Oil Charging with Low Ambient Kit Fluid Ounces ml (oz)	Additional Refrigerant Oil Charging ml (oz)	Total Refrigerant Charging kg (lb)
CRD10+CCD100S/CCD101S	4.1 (9.0)	9.0 (19.8)	1000 (33.8)	b	c

The refrigeration oil used in the Liebert® CRD10 air conditioner is PVE (FVS0S). The refilled refrigerant dilutes the PVE oil in the system and plays a major role in the lubrication and cooling effect of the PVE oil. Therefore, the refrigerant oil must be extra added for this reason.

When the liquid pipe length of the connection between the indoor unit and the outdoor unit is shorter than 30 m (98.4 ft.), and the system is not equipped with low ambient kit, then the additional refrigerant oil charging is not needed, alternatively, the base refrigerant oil charging is 1000 ml (33.8 oz). When the liquid pipe length of the connection between the indoor unit and the outdoor unit is longer than 30 m (98.4 ft.), the extra additional refrigerant oil charging is b ml (oz). The filling amount of the extra additional refrigerant oil (b) is calculated using the following formula:

Value **b** (ml) = Refrigerant filling amount of per meter liquid pipe kg (m) x (Total length of liquid pipe (m) - 30 m) x 1000 x 25%

Value **b** (oz) = Refrigerant filling amount of per meter liquid pipe lb (ft) x (Total length of liquid pipe (ft) - 98.4 (ft) x 3.84

The filling amount of the refrigerant is calculated using the following formula:

Refrigerant filling amount **c** (kg) = Base Refrigerant Charge (kg) + Refrigerant filling amount of per meter liquid pipe kg (m) x (Total length of liquid pipe (m) - 10 (m))

Refrigerant filling amount **c** (lb) = Base Refrigerant Charge (lb) + Refrigerant filling amount of per meter liquid pipe lb (ft) x (Total length of liquid pipe (ft) - 32.8 (ft))

**Table 4.10 Refrigerant Charge Required per Meter/Foot of Pipe**

Liquid Pipe Diameter x Thickness	Unit Length Refrigerant Additional Amount
12.7 x 1 mm 1/2 x 0.04 in.	0.107 kg/m 0.0719 lb/ft
16 x 1 mm 5/8 x 0.04 in.	0.145 kg/m 0.0974 lb/ft

If the liquid pipe length of the connection between the indoor unit and the outdoor unit is shorter than 10 m (32.8 ft.), the refrigerant is charged according to the base refrigerant charge. **Table 4.11** on the facing page is the quick checklist of refrigerant and oil filling amount.

**NOTE:** 1270 ml of basic refrigerant oil has been added to the unit in the factory. So at the installation site installers only need to charge with an additional amount of refrigerant oil **b** ml(oz) without the low ambient kit. If equipped with a low ambient kit, the oil charging amount is 1000 ml (33.8 oz) + **b** ml (oz).

**NOTE:** If the unit was not charged with refrigerant at the factory, then the total amount of refrigerant **c** kg (lb) needs to be charged on site installation.

**NOTE:** Refill the oil from the Schrader valve of the liquid pipe ball valve.

**NOTE:** Select the right make and type of refrigeration oil depending on the model. Do not use poor quality refrigeration oil as it can damage the system.



**CAUTION:** If any error or damage occurs due to usage of the incorrect make and type of oil, the warranty will be void.

**Table 4.11 Refrigerant and Oil Filling Amount**

Liquid Pipe Length (m)	Total Refrigerant Filling Amount		Additional Oil Filling Amount		Liquid Pipe Length (ft)	Total Refrigerant Filling Amount		Additional Oil Filling Amount	
	Without Low Ambient Kit (kg)	With Low Ambient Kit (kg)	Without Low Ambient Kit (ml)	With Low Ambient Kit (ml)		Without Low Ambient Kit (lb)	With Low Ambient Kit (lb)	Without Low Ambient Kit (oz)	With Low Ambient Kit (oz)
<10	4.1	9.0	-	1000	<32.8	9.0	19.8	-	33.8
15	4.6	9.5	-	1000	45	9.9	20.7	-	33.8
20	5.2	10.1	-	1000	60	11.0	21.8	-	33.8
25	5.7	10.6	-	1000	75	12.0	22.8	-	33.8
30	6.2	11.1	-	1000	98.4	13.7	24.5	-	33.8
35	6.8	11.7	134	1134	120	15.3	26.1	6.0	39.8

Table 4.11 Refrigerant and Oil Filling Amount (continued)

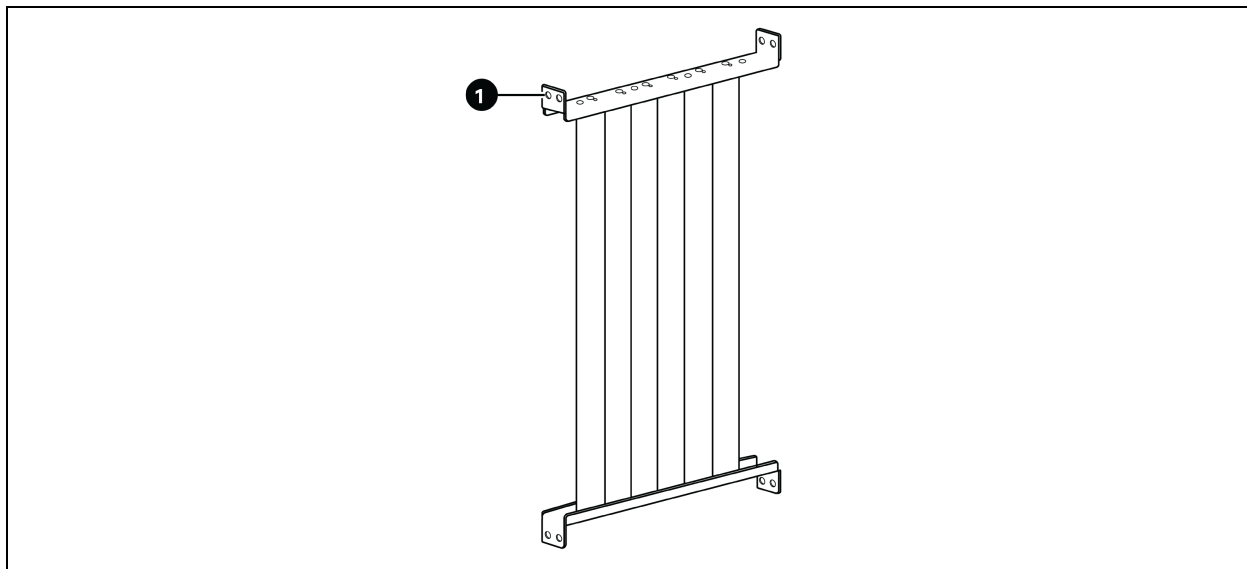
Liquid Pipe Length (m)	Total Refrigerant Filling Amount		Additional Oil Filling Amount		Liquid Pipe Length (ft)	Total Refrigerant Filling Amount		Additional Oil Filling Amount	
	Without Low Ambient Kit (kg)	With Low Ambient Kit (kg)	Without Low Ambient Kit (ml)	With Low Ambient Kit (ml)		Without Low Ambient Kit (lb)	With Low Ambient Kit (lb)	Without Low Ambient Kit (oz)	With Low Ambient Kit (oz)
40	7.3	12.2	268	1268	131.2	16.1	26.9	9.1	42.9
45	9.2	14.1	544	1544	150	20.4	31.2	19.3	53.1
50	9.9	14.8	725	1725	165	21.9	32.7	24.9	58.7
55	10.6	15.5	906	1906	180	23.3	34.1	30.5	64.3
60	11.4	16.3	1088	2088	195	24.8	35.6	36.1	69.9
65	12.1	17.0	1269	2269	210	26.3	37.1	41.7	75.5
70	12.8	17.7	1450	2450	225	27.7	38.5	47.4	81.2
75	13.5	18.4	1631	2631	240	29.2	40.0	53.0	86.8
80	14.3	19.2	1813	2813	255	30.6	41.4	58.6	92.4
85	15.0	19.9	1994	2994	270	32.1	42.9	64.2	98.0
91	15.8	20.7	2211	3211	285	33.6	44.4	69.8	103.6
					300	35.0	45.8	75.4	109.2
- represents no need to fill oil.									

## 4.10 Adjusting the Supply Air Baffle and Sealing the Holes

### 4.10.1 Adjusting the Supply Air Baffle

1. Adjust the direction of the supply air baffle to lead wind to the left or right depending on the installation location of the Vertiv™ Liebert® CRD10 air conditioners.
2. The supply air baffle is composed of several pieces. Remove the mounting screws from both sides of the single piece of the supply air baffle, rotate it by 180°.
3. Install it back to change the wind direction. **Figure 4.24** on the next page shows the mounting screws of a single piece of the supply air baffle.

Figure 4.24 Fixed Mode of the Supply Air Baffle



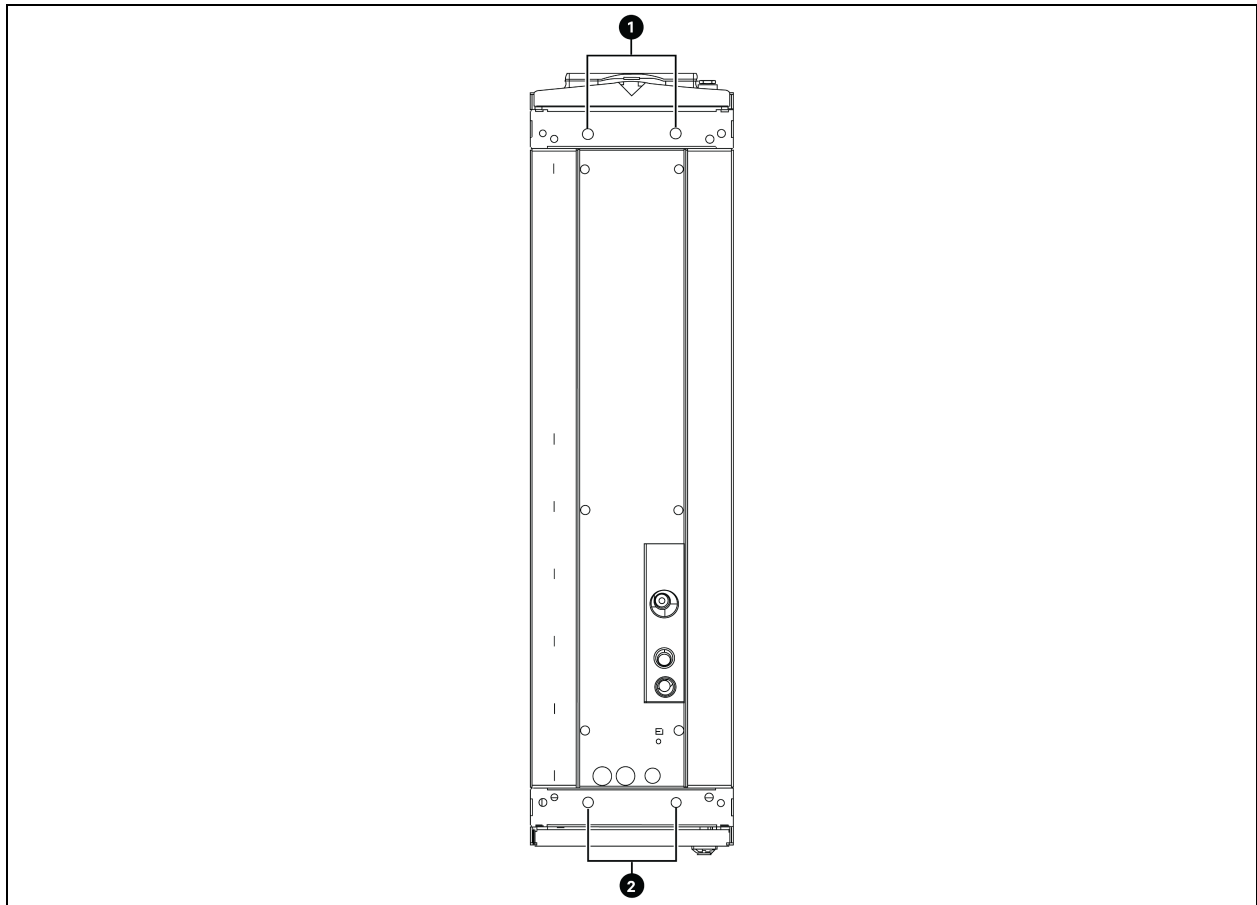
Item	Description
1	M5 screw (8 pieces)

#### 4.10.2 Sealing the Holes of the Top Plate of the Cabinet

1. Use rubber plugs and bolts to seal the remaining holes after the cabinet is installed on the site.
2. Use the provided M13.5 rubber plugs to seal the four holes at the top of the cabinet. Use the provided M12x30 bolts to seal the eight holes at the top plate of the cabinet. This prevents water from entering the cabinet.
3. **Figure 4.25** on the facing page shows the schematic diagram of sealing the holes on the top plate of the cabinet.



Figure 4.25 Sealing the Top Holes of the Cabinet



Item	Description
1	Use the provided four M13.5 rubber plugs to seal the holes
2	Use the provided eight M12x30 bolt plugs to seal the holes

## 4.11 Checklist for Completed Mechanical Installation

**Table 4.12** on the next page below indicates points in the checklist that need to be verified and confirmed to ensure mechanical installation was implemented successfully.

**Table 4.12 Mechanical Installation Checklist**

Item	Result
Sufficient space is kept for maintenance, according to the user manual.	
The equipment is placed vertically and mounting fasteners are fastened.	
The pipes between the indoor unit and outdoor unit are completed. The ball valves of the indoor unit and outdoor unit are fully opened.	
The wind direction of the wind leading grill has been adjusted (if required).	
Drainage pipe is connected.	

**Table 4.12 Mechanical Installation Checklist (continued)**

Item	Result
All pipe connectors are tight.	
The fasteners used for transportation have been removed.	
After installation, foreign materials in and around the equipment are removed (such as shipping materials, construction materials, tools, and so on).	

## 5 Electrical Installation

Electrical installation of the Vertiv™ Liebert® CRD10 air conditioners are provided here for the cable connections of the indoor unit. The air conditioners of the Liebert® CRD10 models are professional devices used in industrial, commercial, or other professional applications. They are not intended for the general public. A ratio of greater than a 350 short circuit ratio is required between the user power and the grid. Permission is required from the power supply department to ensure that the air conditioner is connected to a power greater than 350 short circuit ratio.



**WARNING! Arc flash and electric shock hazard. Open all local and remote electric power supply disconnect switches, verify with a voltmeter that power is Off and wear appropriate, OSHA-approved personal protective equipment (PPE) per NFPA 70E before working within the electric control enclosure. Failure to comply can cause serious injury or death. Customer must provide earth ground to unit, per NEC, CEC and local codes, as applicable. Before proceeding with installation, read all instructions, verify that all the parts are included and check the nameplate to be sure the voltage matches available utility power. The Liebert controller does not isolate power from the unit, even in the Unit Off mode. Some internal components require and receive power even during the Unit Off mode of the controller. The only way to ensure that there is NO voltage inside the unit is to install and open a remote disconnect switch. Refer to unit electrical schematic. Follow all local codes.**



**WARNING! Risk of improper wire sizing/rating and loose electrical connections. Can cause overheated wire and electrical connection terminals resulting in smoke, fire, equipment and building damage, injury or death. Use correctly sized copper wire only and verify that all electrical connections are tight before turning power On. Check all electrical connections periodically and tighten as necessary.**

### NOTICE

Risk of improper power supply connection. Can cause equipment damage and loss of warranty coverage. Prior to connecting any equipment to a main or alternate power source (for example: back-up generator systems) for startup, commissioning, testing, or normal operation, ensure that these sources are correctly adjusted to the nameplate voltage and frequency of all equipment to be connected. In general, power-source voltages should be stabilized and regulated to within  $\pm 10\%$  of the load nameplate nominal voltage. Also, ensure that no three-phase sources are single-phased at any time.

### 5.1 Installation Notes

1. The connections of all power cables, control cables, and ground cables should comply local and national electrical regulations.
2. Observe the unit nameplate for the full load current. The cables sizes must meet the conditions as specified in the local wiring protocols and rules.



**CAUTION: The power supply of the unit must be consistent with the power supply specifications of the nameplate, otherwise the unit will be damaged.**

**Table 5.1 Mains Power Supply Requirement**

Model	CRD100-0D00A	CRD101-0D00A	CRD102-1D00A
Power Supply	208/230 V/ 1 Ph/ 60 Hz	208/230 V/ 3 Ph/ 60 Hz	230 V/ 1 Ph/ 50/60 Hz

3. Damaged power cables should be replaced by authorized personnel to eliminate the risks.
4. The electrical installation and maintenance should be carried out by authorized personnel or a trained engineer.
5. Prior to the wiring, a voltmeter must be used to measure the power supply voltage and ensure that the power supply is switched off.
6. Use screws, guide rails, or other modes to fix the device firmly during the installation process to avoid the movement or shaking during the startup or operation mode.
7. For the air conditioner configured with EC fans, the unit power grid adheres to the TN or TT star connection power distribution system. However, contact Vertiv if there is a need to configure another type of power grid.
8. A rated circuit breaker must be provided to disconnect the power supply.
9. Short circuit current rating (SCCR) of the Vertiv™ Liebert® CRD10 air-cooled unit, 6 kA (CE Model) or 10 kA (UL Model).

## 5.2 Liebert® CRD10 Wiring Connections

Followings are the intricate cable connections to all the critical components inside the Liebert® CRD10 unit:

- Power cable and control cabinet of the indoor unit.
- Solenoid valve cable of the liquid line solenoid valve kit.
- Low ambient kit power cable from indoor to outdoor (if configured).
- Input and output control cable of the unit.

### 5.2.1 Power Cable and Control Cabinet of the Indoor Unit

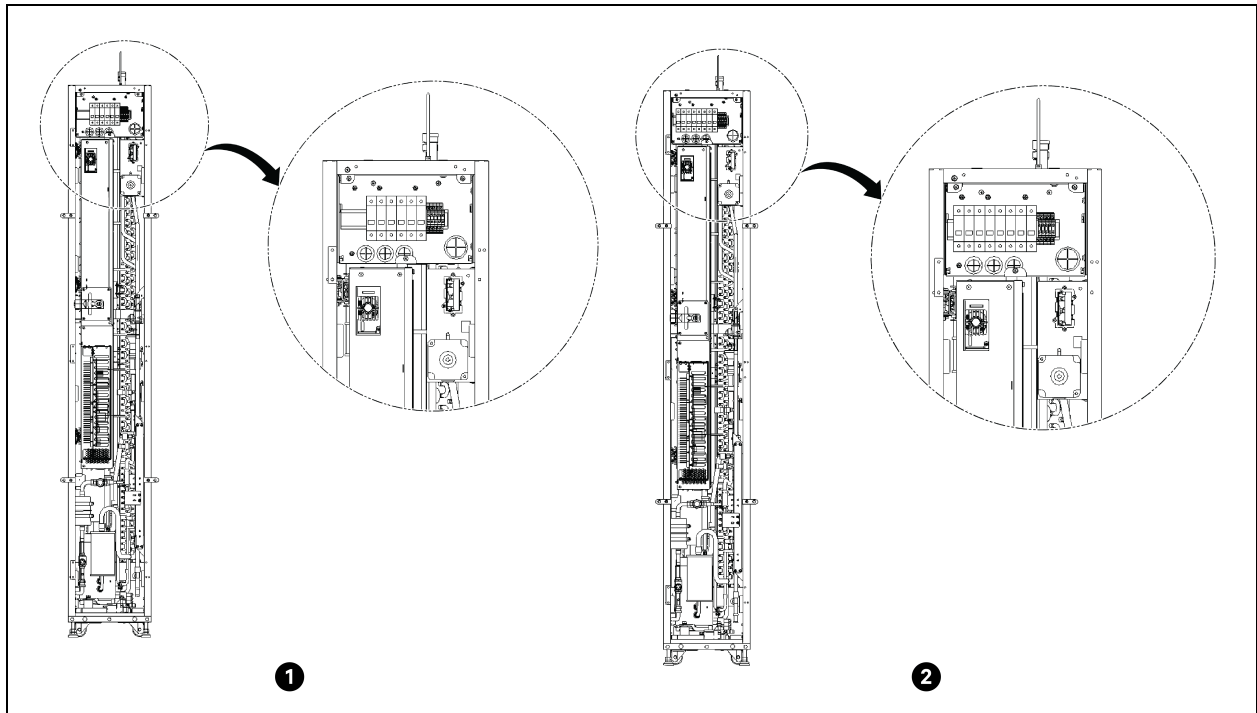
This section explain the different types of connections related to the indoor unit:

- Electrical port location of the indoor unit.
- Connecting the power cables of the indoor unit.
- Connecting the control cables.
- Connecting the solenoid valve of the liquid line solenoid valve kit.
- Confirm the transformer connection cable according to voltage of power supply.
- Connecting the outdoor unit and the indoor unit.
- Teamwork control.

### 5.2.2 Electrical Port Location of the Indoor Unit

For any model of the Liebert® CRD 10kW, open the rear door of the indoor unit to see the specific layout and locations of the low voltage components, such as the dual power supply input breaker, outdoor breaker, and terminal blocks as shown in **Figure 5.1** on the facing page . For detailed layout information on low voltage components, refer to the labels on the cabinets and units. The specific location of the power port of the indoor unit is shown in **Figure 5.1** on the facing page .

Figure 5.1 Unit Electrical Control Box and Cable Connection (Open the Back Door 120 degrees)



Item	Description
1	Single-phase unit
2	Three-phase unit

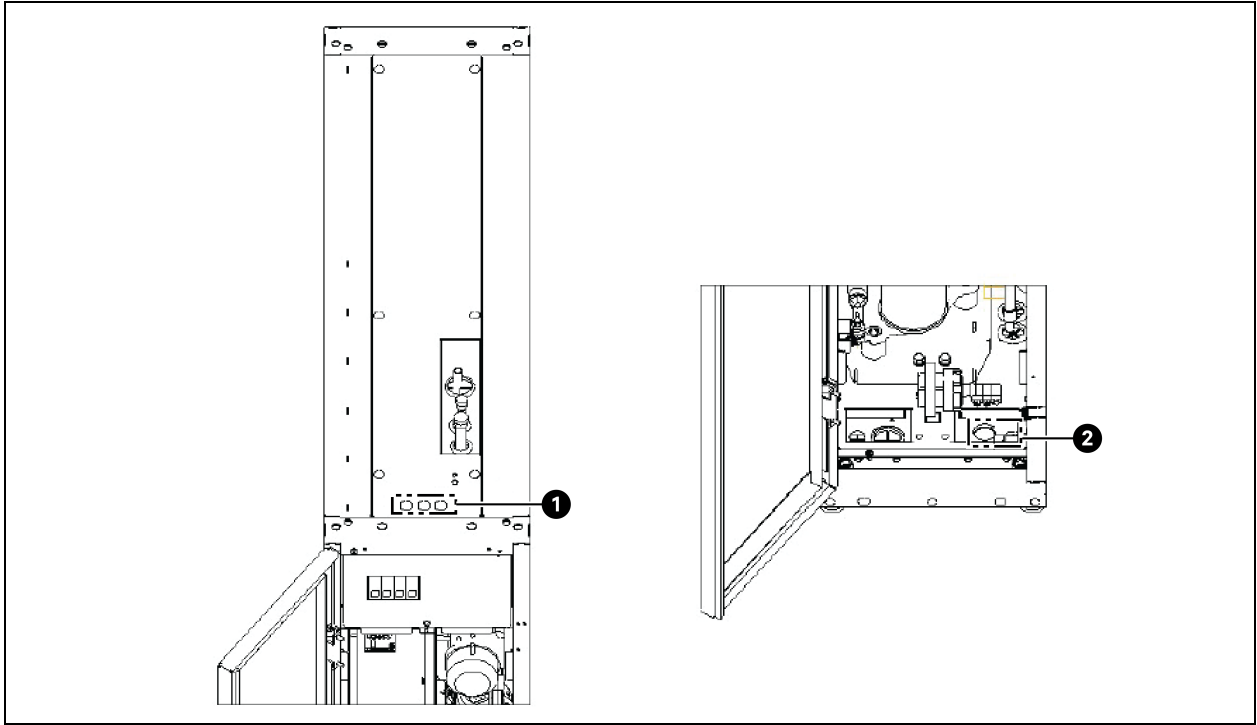
Table 5.2 MCB Current Rating

Model	MCB	Current (A)
CRD100-0D00A	NDB2-63C40/2	40
CRD101-0D00A	NDB2-63C25/3	25
CRD102-1D00A	NDM1-63C50/2	50

### 5.2.3 Connecting the Power Cable of the Indoor unit

Connect the supply terminals L, N (or L1, L2 or L1, L2, L3) and PE (or G) to their respective counterparts of the external power supply. Fix the input cables to the cable clamp, located on the inner side panel of the unit. The top cable entry hole and bottom cable entry hole are shown in **Figure 5.2** on the next page. For the cable specifications, refer to the full load current (FLA), MCA, MOP described in the **Table 5.3** on the next page.

**Figure 5.2 Top and Bottom Cable Entry Holes**



Item	Description
1	Top cable entry holes
2	Bottom cable entry holes

The cable sizes should meet to the local wiring regulations and protocols for every connection.

**Table 5.3 Full Load Current (Unit A)**

Region	UL		CE
Model	CRD100-0D00A	CRD101-0D00A	CRD102-1D00A
Full Load Current (A)	-	-	38 (With the heater) 28 (Without the heater)
MCA (A)	29	21	-
MOP (A)	40	30	-

**5.2.4 Connecting the Power Cable of the Outdoor Unit**

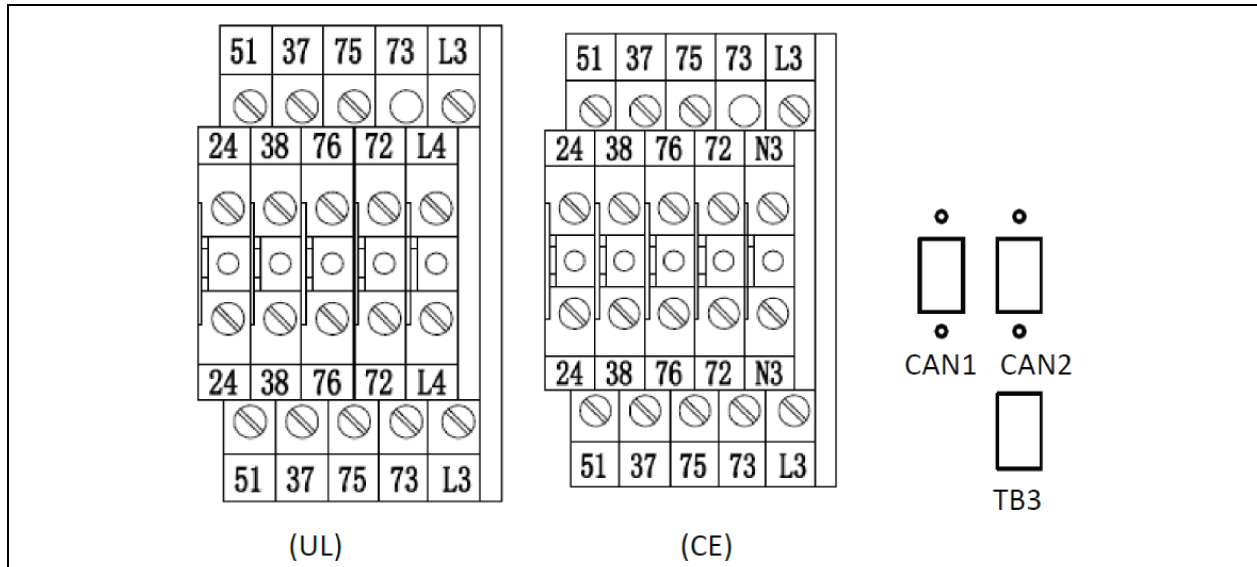
The outdoor unit (CCD10) is controlled by indoor unit, the specific location of the power port of the outdoor unit is also shown in **Figure 5.1** on the previous page . Connect the outdoor breaker terminals (L, N or L1, L2) and PE (or G) to their respective counterparts of the outdoor respectively. For detailed specification of cables, refer to CCD10 user manual.

## 5.3 Connecting Communication Cables

For cable connections the location of the terminal block in the site is shown in **Figure 5.1** on page 63 . The terminal view is shown in **Figure 5.3** below .

**NOTE:** Take anti-static measures when connecting communication cables.

**Figure 5.3 Terminal Block**



Item	Description
L3, L4/L3, N3	Low ambient kit heating belt
72, 73	LLSV
75, 76	Common alarm
37, 38	Remote shutdown
51, 24	Water under floor
CAN-1, CAN-2	CAN communication
TB3	Rack sensor

### 5.3.1 Connecting the Water Under Floor Sensor

#### NOTICE

Risk of clogged or leaking drain lines and leaking water supply lines. Can cause equipment and building damage.

This unit requires a water drain connection. Drain lines must be inspected at startup and periodically, and maintenance must be performed to ensure that drain water runs freely through the drain system and that lines are clear and free of obstructions and in good condition with no visible sign of damage or leaks. This unit may also require an external water supply to operate.

Improper installation, application and service practices can result in water leakage from the unit. Water leakage can result in catastrophic and expensive building and equipment damage and loss of critical data center equipment.

Do not locate unit directly above any equipment that could sustain water damage.

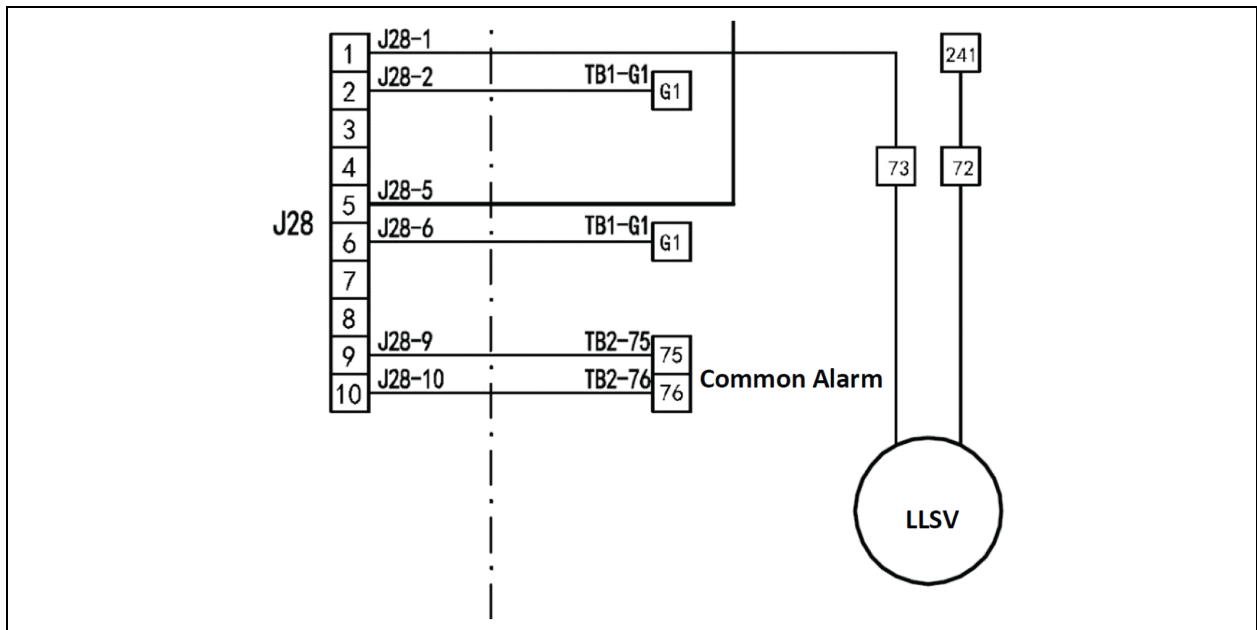
We recommend installing a monitored fluid detection system to immediately discover and report coolant-fluid system and condensate drain line leaks.

The unit accessories are equipped with a under water sensor, connect one end of the sensor to terminal 51 and the other end to common terminal 24. Each unit can relate to multiple sensors in parallel, but there would be only one under water alarm.

### 5.3.2 Solenoid Valve Kit

When installing the solenoid valve kit (LLSV), connect one end of the solenoid valve coil cable to terminal 72 and the other end to terminal 73. **Figure 5.4** below shows the liquid line solenoid valve connection with the respective terminals.

**Figure 5.4 Freon Solenoid Connection with Terminal**



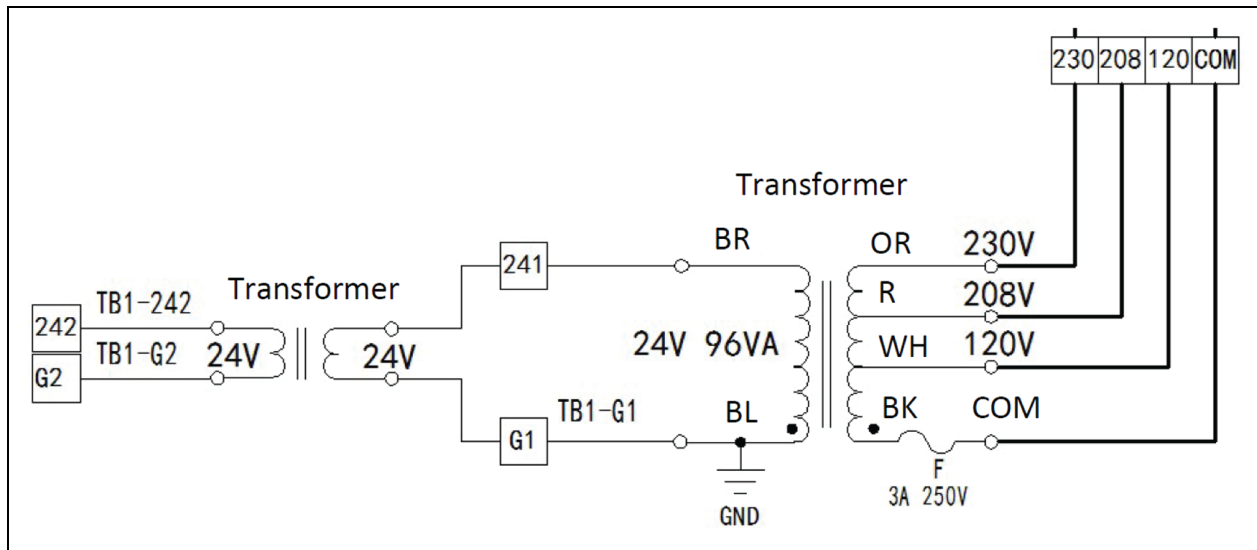
### 5.3.3 Transformer Connection Cable

**NOTICE**

Vertiv™ Liebert® CRD10 unit 96 VA transformer default wiring is orange cable (230 V to 24 V). If the unit rated voltage is 208 V, a properly trained and qualified electrician must change the transformer wiring from orange to red cable (208 V to 24 V).



Figure 5.5 Transformer Wiring Diagram



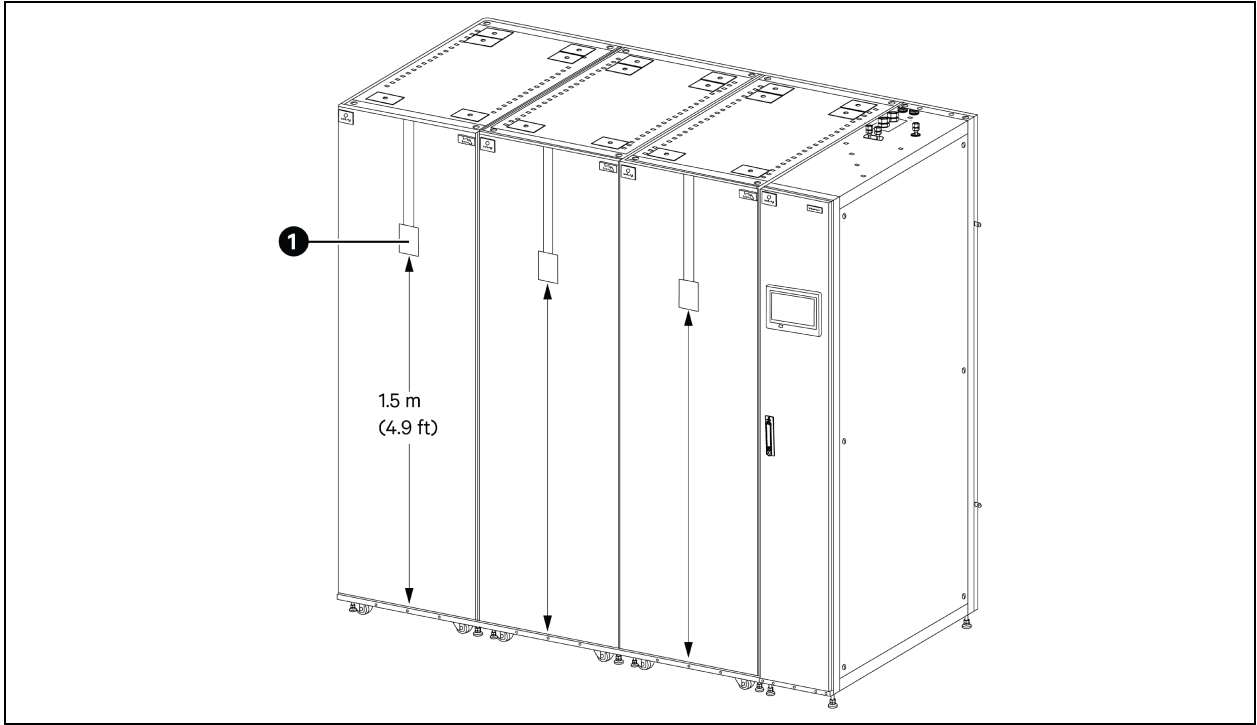
### 5.3.4 Low Ambient Kit

Power is supplied to the low ambient kit by the indoor unit. Connect the cable of low ambient kit to terminal L3, L4 (or L3, N3).

### 5.3.5 Rack Sensor

Each unit has a remote temperature sensor, and can be connected with a maximum of 10 temperature sensors. It is recommended that the sensors should be located in front of the heat loads to achieve the most precise temperature. If the sensors are connected in series (refer to **Figure 5.6** on the next page), each temperature sensor monitors the temperature of air entering each rack, and the read temperature value is used to control unit operation. The standard location of the sensor is 1.5 m (4.9 ft.) height from the end of the unit base. Sensors should be placed in positions as shown in **Figure 5.6** on the next page, otherwise the devices cannot operate appropriately.

Figure 5.6 Layout of Rack Sensors



Item	Description
1	Sensor

Procedure to connect sensors for Liebert® CRD 10kW model:

1. Insert the connector of the rack temperature sensor into the TB3 point. After connecting the cable, route the cable through the top or bottom of the unit, after which it should be connected to the first sensor. Connect the first sensor to the second sensor. Sensors are connected in a series.
2. Set the temperature in front of the hottest source inside the rack. Do not fix it in front of the empty sub-rack. Attach the sensor on the rack surface using the magnets provided in the kit. The sensor must be fixed in a position with minimal cool air flow. Rack temperature sensor IRM-S01 address settings are tabulated in the **Table 5.4** on the facing page .

**Table 5.4 Rack Temperature Sensor Address**

Sensor	1	2	3	4	5	6	ID	Notations
Rack temperature 1	0	0	0	1	0	0	10	ON - 1, OFF - 0
Rack temperature 2	0	0	0	1	0	1	11	
Rack temperature 3	0	0	0	1	1	0	12	
Rack temperature 4	0	0	0	1	1	1	13	
Rack temperature 5	0	0	1	0	0	0	20	
Rack temperature 6	0	0	1	0	0	1	21	
Rack temperature 7	0	0	1	0	1	0	22	
Rack temperature 8	0	0	1	0	1	1	23	
Rack temperature 9	0	0	1	1	0	0	30	
Rack temperature 10	0	0	1	1	0	1	31	

### 5.3.6 Remote Shutdown

Terminals 37 and 38 can be connected to the remote shutdown switch, as shown in **Figure 5.4** on page 66. Short the terminals before delivery. Remove the short connect cable to connect the remote shutdown signal.

**NOTE: Opening the terminals 37 and 38 will shutdown the unit.**

### 5.3.7 External Common Alarm

Terminals 75 and 76 can be connected to the external common alarms. They provide signals to external alarm devices such as an alarm indicator. When the critical alarm occurs, the contact will be closed to trigger remote alarms and send signals to the building management system, or automatically dial the paging system. Users must get the power supply of external common alarm system. For an in-depth definition of the other terminals, refer to the circuit schematic.

### 5.3.8 Teamwork Control

#### Teamwork function

Teamwork control has four functions: Standby, Rotation, Avoid fighting, and Cascade.

#### 1. Standby

One or several units can be defined as standby unit. The standby unit fan runs at a default speed of 20%. If a running unit generates an alarm that indicates that a unit cannot operate normally, a standby unit will start to run. The critical fault alarms cause the unit to go into standby. The secondary fault alarms not cause the unit to go into standby, but continue running.

The list of critical and secondary fault alarms is as follows:

- a. **Critical fault alarms:** High pressure lock, low pressure lock, high discharge temperature lock, low discharge superheat lock, low pressure sensor fail lock, compressor drive fail lock, fan fail alarm (alarm process setting is shutdown), water underfloor alarm (alarm process setting is shutdown), power fail alarm (alarm process setting is shutdown).

- b. **Secondary fault alarms:** High discharge temperature alarm, air flow temperature sensor failure, air flow loss alarm, discharge temperature sensor failure, suction temperature sensor failure, low pressure sensor failure, EEV drive communication failure, compressor drive communication failure, compressor temperature control sensors failure, fan temperature control sensors failure, power fail alarm (alarm process setting is fan only), high supply temperature alarm, high return temperature alarm.

2. **Rotation function**

Rotation function ensures that all the units have an equal run time.

3. **Avoid fighting function**

Prohibits units from performing conflicting operations.

For example:

- a. Units are not allowed to heat if other units are cooling.
- b. Units are not allowed to humidify if other units are dehumidifying and vice versa, so the primary will calculate the number of cooling run unit and heat run unit, if the cooling run unit number is bigger than heat run unit, so in the team group, it keep all the cooling unit run, and stop all the heat unit. It is the same with humidify/dehumidify run unit.

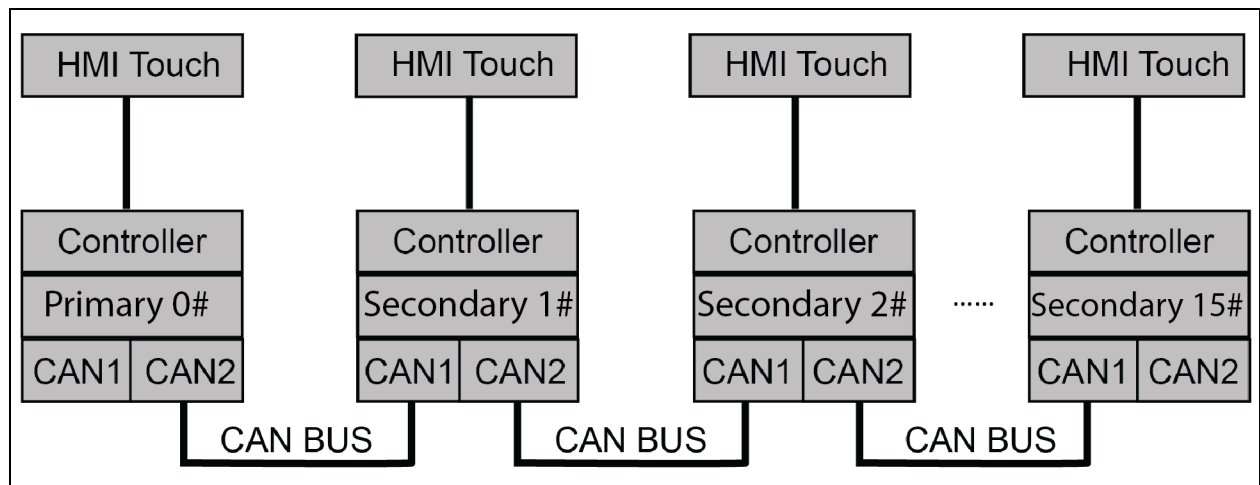
4. **Cascade function**

If the unit that is running is experiences a high temperature alarm, then a standby unit is auto-started.

**Teamwork connection and setting**

To use the teamwork control function, connect the communication cable to terminals CAN1 and CAN2 port on the unit. The connection diagram as shown in Figure 5.7 below .

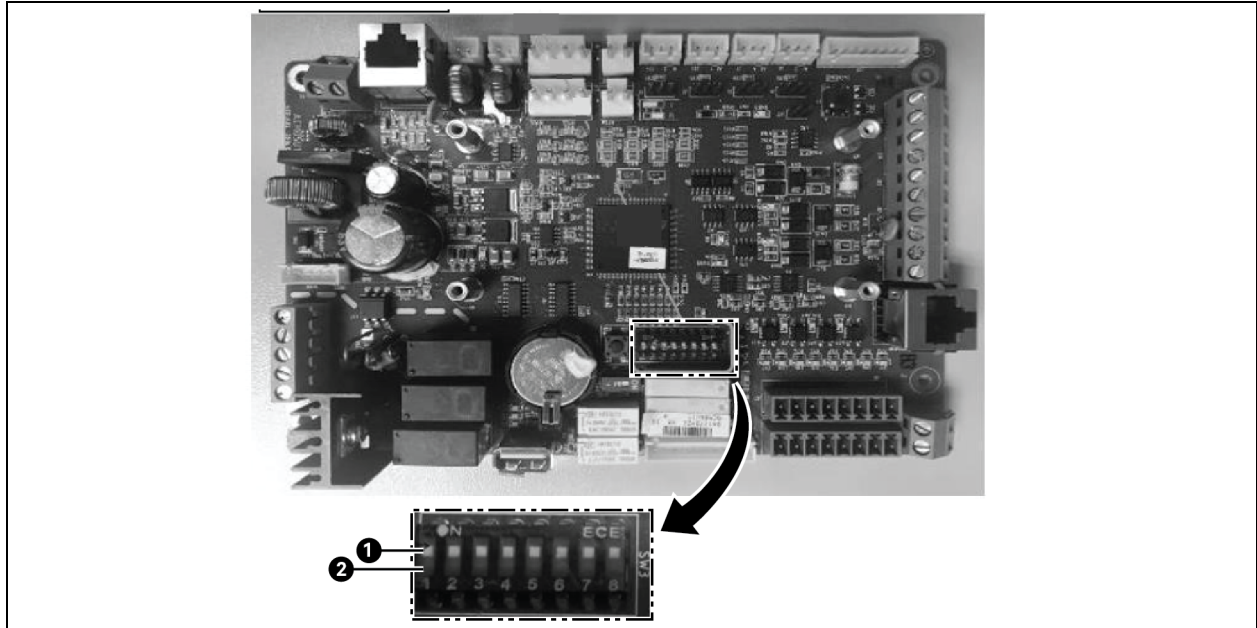
**Figure 5.7 The Connection Diagram of the Teamwork Control**



primary unit shares teamwork parameters, temperature and humidity set point, proportional band, dead band, fan control mode, compressor control mode with the secondary unit. The secondary unit uploads run status, alarm signs to the primary unit.

The unit with address 0 is defined as the primary unit. Units with the non-zero address are defined as the secondary units. Teamwork parameters only can be set in primary unit and share to the secondary units. The secondary units can only set their own unit address. After the teamwork connection is completed, set the unit CAN ID through the DIP SW3 of the PACC board. The address setting method is shown in the **Figure 5.8** below and **Table 5.5** on the next page .

**Figure 5.8 Significance of the DIP SW3 Position**



Item	Description
1	This position is OFF
2	This position is ON

**Table 5.5 Correspondence between Unit CAN ID and DIP SW3 Address**

CAN ID	SW3-1	SW3-2	SW3-3	SW3-4	SW3-5	SW3-6	SW3-7	SW3-8	Comment
0	OFF	OFF	OFF	OFF	OFF	OFF	OFF	OFF	primary Unit
1	ON	OFF	OFF	OFF	OFF	OFF	OFF	OFF	secondary Unit 1
2	OFF	ON	OFF	OFF	OFF	OFF	OFF	OFF	secondary Unit 2
3	ON	ON	OFF	OFF	OFF	OFF	OFF	OFF	secondary Unit 3
4	OFF	OFF	ON	OFF	OFF	OFF	OFF	OFF	secondary Unit 4
5	ON	OFF	ON	OFF	OFF	OFF	OFF	OFF	secondary Unit 5
6	OFF	ON	ON	OFF	OFF	OFF	OFF	OFF	secondary Unit 6
7	ON	ON	ON	OFF	OFF	OFF	OFF	OFF	secondary Unit 7
8	OFF	OFF	OFF	ON	OFF	OFF	OFF	OFF	secondary Unit 8
9	ON	OFF	OFF	ON	OFF	OFF	OFF	OFF	secondary Unit 9
10	OFF	ON	OFF	ON	OFF	OFF	OFF	OFF	secondary Unit 10

**Table 5.5 Correspondence between Unit CAN ID and DIP SW3 Address (continued)**

CAN ID	SW3-1	SW3-2	SW3-3	SW3-4	SW3-5	SW3-6	SW3-7	SW3-8	Comment
11	ON	ON	OFF	ON	OFF	OFF	OFF	OFF	secondary Unit 11
12	OFF	OFF	ON	ON	OFF	OFF	OFF	OFF	secondary Unit 12
13	ON	OFF	ON	ON	OFF	OFF	OFF	OFF	secondary Unit 13
14	OFF	ON	ON	ON	OFF	OFF	OFF	OFF	secondary Unit 14
15	ON	ON	ON	ON	OFF	OFF	OFF	OFF	secondary Unit 15

**NOTE:** The PACC can connect up to 16 units, and the unit CAN ID address must be set in sequence from 0 to 15.

## 5.4 Checklist for the Completed Electrical Installation

Confirm the items listed in **Table 5.6** below on completion of the electrical installation.

**Table 5.6 Electrical Installation Checklist**

Items to be Inspected
The power voltage is same as the rated voltage on the unit nameplate.
No open circuit or short circuit exists in the electrical connection.
Confirm that power cables and earth cables are connected to the disconnect switch, indoor unit, and outdoor unit correctly.
The circuit breakers or fuses have correct ratings for the installed equipment.
The control connections are configured and, fixed properly.
All the wiring and connector connections, including the fixing blocks, are fixed firmly.

**NOTE:** Do not power on or operate the installed unit as Vertiv authorized professional technicians have to perform a check and confirm whether it is good to go. Starting up and operating the unit should only commence if the commissioning process is successful, and confirmed by Vertiv engineers.

## 6 Commissioning Overview

This chapter explains about starting with Self check, Pre-commissioning , Inspection of auxiliary parts and cables, Startup inspection, and Refrigerant oil re-filling instructions.

**NOTE: Remember that only authorized Vertiv staff and engineers can carry out the commissioning process. This section is for information purposes only.**

### 6.1 Self Check

In self check, verify whether the construction and installation meet the standard requirements to ensure normal operation and enhanced service life of the unit. Vertiv engineers and personnel need to perform the checkup as per the **Table 6.1** below .

**Table 6.1 Startup Inspection Checklist**

Items	Inspection Contents
Room Environment	Thermal isolation, moisture proof and sealing performances of protective structure.
Mounting Base	Whether the fixing is reliable and whether the vibration absorbing material between the base and the unit is well installed.
Display Panel	Check for any sign of damage, check whether it has good insulation and clean surface.
Compressor	The fixing metal plate at the bottom has been removed and the compressor has been fixed as well.
Filter Net	All the filter nets have been installed in the right positions, not damaged and clean surface.
Outdoor Unit	The outdoor unit has been installed in the right position, pipes are properly supported with suitable inclination, the oil trap has been installed in the right position.
Fan	The air inlet and outlet areas are not blocked, the blades must not be stuck or have abnormal noises when rotating the blades.
Heater (if installed)	The heating component has been firmly fixed and the heating cables are reliably connected.
Power Supply	Check that the voltage, phase rotation and frequencies of the front end power supplies for the indoor and outdoor units are normal. Check that the power supply cables are well connected. Check that each functional circuit breaker and contactor are reliably connected.
SPD (if installed)	The SPD module should not be loosened and the alarm terminals should be correctly connected.
Controller	All the control wirings are reliable.
Pipes	The pipes are connected and supported reliably. The solenoid valve kit is installed in the right positions and directions. There are no exposed copper pipes and thermal insulation cotton is well attached.

### 6.2 Pre-commissioning

#### 6.2.1 Inspection of Pipes

##### Installing the connection pipes

- Check that the length of one-way pipe from the air-cooled unit exceeds 30 m (98.4 ft.).
- Check that the solenoid valve kit and oil trap are installed.

- Check whether refrigerant oil needs to be re-filled.
- Check if the rated voltage of the solenoid valve on the liquid pipe meets requirements.
- Check the relative positions between the indoor and the outdoor unit. If the condenser is higher than the indoor unit, the liquid pipe should be at a greater height than the U bend of the condenser coil.

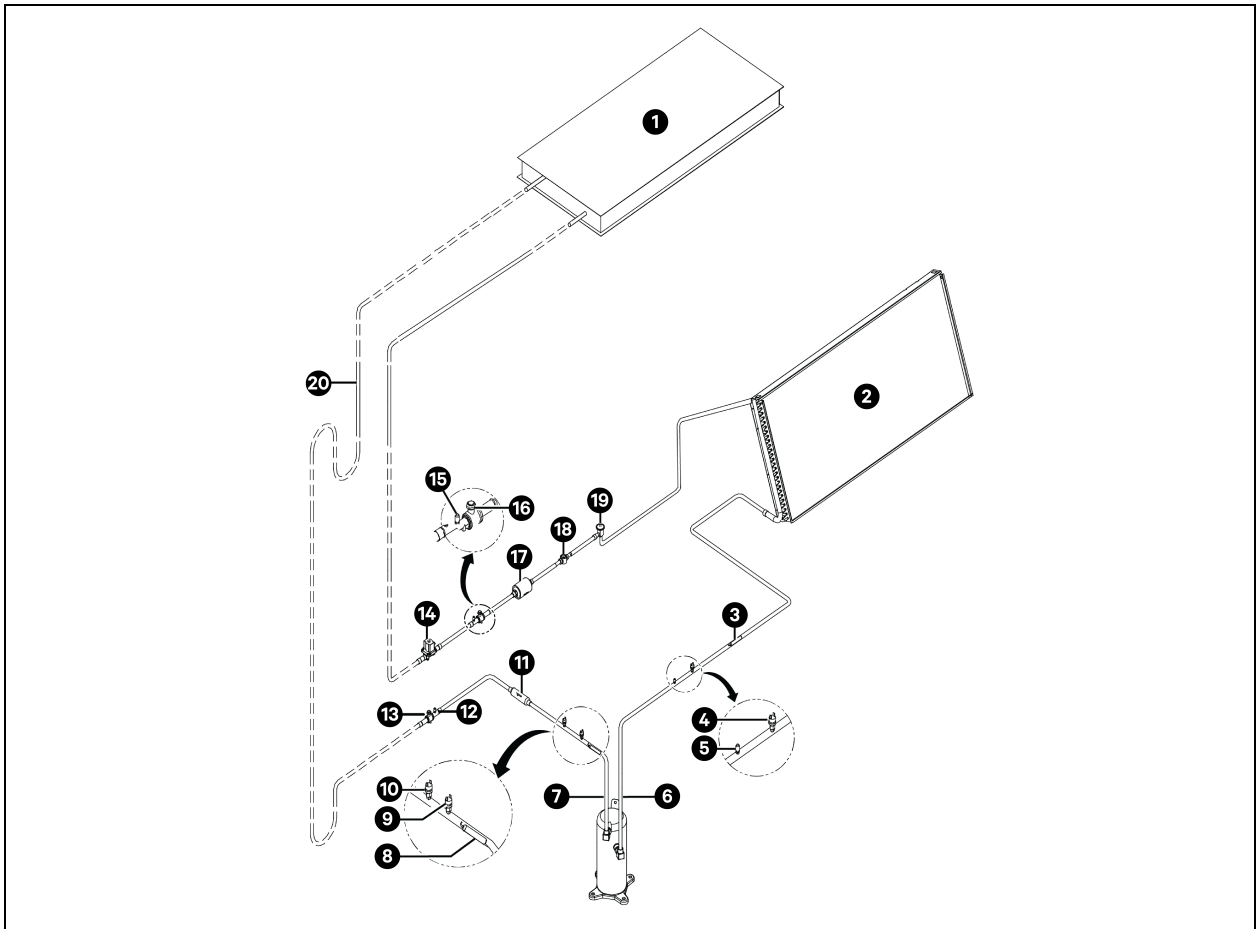
### Vacuuming

- Open all the ball valves, EEV, and solenoid valve of the system. Enter vacuum mode.
- Connect the compound pressure gauge to the corresponding high and low pressure schrader valves. Vacuum from both the high and low pressure locations (shown in **Figure 6.1** below ) as indicated by the labels.

#### Requirements:

- Pull an initial deep vacuum of 500 microns on the system with a suitable pump.
- After 4 hours, check the pressure readings. If they have not changed, break vacuum with dry nitrogen. Pull a second and third vacuum to 500 microns or less. Re-check the pressure after 2 hours.
- When the 3 checks are complete, proceed to charging.

**Figure 6.1 Connection Point of Compound Pressure Gauge on the System**





Item	Description	Item	Description
1	Condenser coil	11	Check valve
2	Evaporator coil	12	Schrader valve
3	Suction temp. sensor	13	Ball valve
4	Low pressure sensor	14	Solenoid valve
5	Schrader valve	15	Schrader valve
6	Suction pipe	16	Ball valve
7	Compressor	17	Filter drier
8	Discharge temp. sensor	18	Sight glass
9	High pressure switch	19	EEV
10	High pressure sensor	20	Trap

Now the machine is ready for completing the charge and the startup.

**NOTE: When the unit is switched on, the vacuum model with the micro-controller can be switched on. This model opens the EEV and solenoid valve automatically. If the EEV and solenoid do not automatically open, open the valves manually.**

**NOTE: Using the compressor to create a vacuum invalidates the unit's warranty.**

### Inspection of auxiliary parts and cables

1. Check that the drainage is normal.
2. Check the electric circuits. Fasten all the electrical connections, and ensure that there is no short circuit and open circuit and the insulation is good.
3. Check the main power supply voltage of the unit.

### 6.2.2 Startup Inspection

1. Open the corresponding circuit breaker of each component of the unit, close the general circuit breaker and the transformer circuit breaker, and check the control voltage.
2. Check the indoor fan. Close the fan circuit breaker, manually set output value to 75% to check the fan running current.
3. Check the electric heating kit. Close the electric heating circuit breaker, start the electric heating device manually, check the electric heating running current, and close the electric heating device after completion of the operation.
4. Check the air-cooled condenser. Check if the condenser is installed correctly, including whether the wiring is correct, whether the fan is reliably fixed, and whether the fan blades is in contact with the fan frame, and whether the obstacles near the condenser have been cleared away.
5. Run the fan to check if the fan rotates normally and check the input voltage.
6. Charge refrigerant and startup.

## 6.3 Refrigerant Charge

The air-cooled unit must be charged on-site with refrigerant. Charge the unit with the suitable quantity of liquid refrigerants as indicated on the label. Depending on the different connecting conditions, there is a standard charge amount for the air-cooled unit, so be sure to refer to the calculated charge amount to avoid overcharge. Follow the the procedure below.

1. **Charging refrigerant statically:** The refrigerant system should be charged quickly with a suitable amount of liquid refrigerant after vacuuming the system. Usually, the system pressure can be charged equal to the tank pressure. Connect the high-low pressure compound pressure gauge to the refrigerant cylinder. Drain air from the hoses connected to the gauge. Connect the high-low pressure compound pressure gauge to the Schrader valve behind electronic expansion valve and ball valve of the liquid tube, keep the cylinder handstand at the process of charging statically. Stop charging when the charge amount is more than the calculated value.

**NOTE: After charging the refrigerants statically, do not turn on the compressor and charge the refrigerant dynamically until the crank case heating device has been pre-heated for longer than 12 hours.**

**NOTE: For dynamic filling of the refrigerants, the charging speed should not be too high to avoid the compressor damage.**

2. **Charging refrigerant dynamically:** Keep the refrigerant cylinder handstand, manually start the unit to charge refrigerant dynamically by manually setting the output value to 75% for the fan. Start the compressor wait five minutes and then adjust the compressor output to 72%. After compressor operation, refrigerant will be suctioned to the system until there are no bubbles in the sight glass and condensation supercooling is more than 3 K, the superheat is more than 7 K. Observe the suction pipe of the compressor, ensure that there is no frost on the surface of pipe and compressor. Ensure that discharge superheat is from 25 to 40K.

Record the running parameters of the cooling system according to the requirements of Vertiv™ Liebert® CRD10 Air-cooled AC Startup and Commissioning Report.

Record operating parameters using the following steps:

1. **Start the manual mode:**
  - a. Startup from the panel.
  - b. Enter level 2 password.
  - c. Set the system to Manual Mode.
  - d. Manual Mode Enabled.
  - e. Set to Y.
2. **Start vacuum mode:**
  - a. Enable Manual Mode
  - b. Vacuum mode
  - c. Set to Y.
  - d. Close the transformer circuit breaker.
  - e. Ignore the fan/power failure alarm after startup.
  - f. If the vacuuming starts before the vacuuming mode is started, low pressure sensor fault alarm will occur after startup, and then ignore this alarm.
3. **Manually start/stop each component:**
  - a. Enable Manual Mode. Start/Stop the output of corresponding component. The output percentage value of the compressor and fan can be adjusted after they are started up.

- b. Output percentage value of the compressor cannot be adjusted until the compressor has started up for about 5 minutes (the soft start is over).
- c. After the compressor is off (including manual turn-off and unit shutdown), the compressor will be in soft shutdown status (in manual mode, the soft shutdown status is displayed as Y). The derated speed output still remains to. After the soft shutdown phase is ended (between 5-10 minutes), the compressor is off. To ensure the reliability of the compressor, avoid directly turning off the circuit breaker of the compressor.

**NOTE:** Refer **Recommended Refrigerant and Oil Charging Amount of the System** on page 55 for the calculations of the refrigerant refill and charging.

**NOTE:** Once the commissioning is completed, the Vertiv representative will confirm the unit is charged and operating correctly before the unit is put into operation.

**Table 6.2 Commissioning Confirmation Checklist**

Check item
Check and confirm that all the output functions are automatic.
Check that the temperature and humidity settings as well as the control precisions are configured correctly.
Ensure that all the other functions are configured and set correctly.

## 6.4 Startup Procedure



**WARNING!** Risk of hair, clothing and jewelry entanglement with high speed rotating fan blades. Can cause equipment damage, serious injury or death. Keep hair, jewelry and loose clothing secured and away from rotating fan blades during unit operation.

### 6.4.1 First Startup (or Startup after Long Standstill)

To prevent compressor damage, the crankcase must be preheated for at least 12 hours before conditioner startup. Start the air conditioner as follows:

1. Open all valves in the refrigerant circuit according to the instruction label attached to the valve.
2. Ensure that refrigerant charge is correct.
3. Using a leak detector, verify that there are no refrigerant leakages.
4. At least 12 hours before startup, the main switch should be closed.
5. Verify the operation of the crankcase heater.
6. Check that there are no water leakages.
7. Ensure that the indoor temperature is higher than 18 °C (64.4 °F) and there are thermal load exists. If this situation doesn't exist, preheat the indoor by using other heating device or heater of the unit manually.
8. Close all MCBs on the electrical panel.
9. Check the supply voltage on all phases.
10. Ensure that the compressor has been preheated for at least 12 hours before starting the unit.
11. Start the unit by pressing the *ON/OFF* icon on the micro-control for 3 seconds.
12. Press *Enter* icon to highlight the input data field in the password screen. Set the target value of temperature and humidity.
13. Ensure that all control system settings are correct and that there are no alarms.

14. Once the system is operating under load, carry out the following checks:
  - Verify that the fans are operating properly.
  - Ensure that the temperature and relative humidity are being reached, and the heating steps operate when required.

### **6.4.2 Automatic Restart**

The unit will automatically restart after a power supply interruption. If the power interruption lasts several hours to avoid automatic cold restart of the compressor. Preheat the compressor before restarting the unit.

## 7 Controller

### 7.1 Features

1. The microcontroller is used for monitoring and displaying the operation status of the Vertiv™ Liebert® CRD10 unit to maintain the environment within a setting range.
2. The Liebert® CRD10 has a 7-in. HMI color screen to make user operations simple.
3. microcontroller provides three-level password protection to prevent unauthorized operation.
4. Main parameters and operating status of the system is easy to understand through menu operation.
5. Temperature and humidity curves are displayed in real time.
6. Critical component running time is displayed via menu operation.
7. Real time fault information for service and repair is provided through the fault diagnosis system.
8. It can store up to 500 historical alarm records.

### 7.2 HMI Display

The HMI display color screen is shown in **Figure 7.1** below .

**Figure 7.1 Color Screen**



The display indicator light has 4 colors. The corresponding color and function are described in the **Table 7.1** below .

**Table 7.1 Function Description**

Indicator Color	Description
Blue	Display is starting.
Yellow	Unit is shutdown or there is a failure in the control panel communications.
Green	Unit is operating normally.
Red	An alarm has been generated and the buzzer keeps generating sound. You can tap the display to stop the buzzer.

## 7.3 Main Function

### 7.3.1 Home Page

After the HMI displays is powered on for one minute, press *Unlock* icon and input password. The homepage will be displayed, as shown in **Figure 7.2** below . User can power on or off the unit by pressing and holding the ON/OFF icon for 3 seconds.

As shown in the left half of **Figure 7.2** below ,

- The humidity control mode (air supply humidity control) is displayed.
- The right side of the display shows the temperature control mode (default air supply control mode, and is consistent with the compressor control mode).
- The temperature value in the circle shows the measured temperature / humidity values (default is air supply temperature) in current mode, and the humidity value means the air supply humidity.
- For the two triangles on the circumference, the left one means the air supply humidity setpoint and the right one means the temperature setpoint in current mode.
- Click *Toggle icon 1* to switch the display between the graphic display and table display. It provides setting icon to adjust the temperature and humidity.

As shown in the right half of **Figure 7.2** below , the sensor data or alarm data is displayed. Click *Toggle icon 2* to switch between the sensor data and the alarm data.

**Figure 7.2 Color Display Screen - Unlock**



Item	Description	Item	Description
1	Menu icon	9	Unlock icon
2	Setting icon	10	Toggle icon 2
3	Graph data	11	Alarm data
4	Toggle icon 1	12	Status display
5	Time display	13	Control mode
6	Unit address	14	Operating status
7	Display address	15	Home icon
8	ON/OFF icon		

**Table 7.2** below provides the list of menu keys and its functional description.

**Table 7.2 Functional Description**

Touch Keys	Functional Description
Home Icon	Press this icon to enter the main page to see the systems primary data readings.
Menu Icon	Press this button to display the main menu page by page and enter the various sub-menus.
Setting Icon	Press this icon to enter the temperature and humidity settings page, which can set the system temperature and humidity and the control mode.
Graph Icon	Click this icon to enter the curve interface, user can view the average return air temperature, the remote average temperature, the average air supply temperature, and the average air supply humidity of 0 to 48 Hour.
Time Display	Displays the current time.
Unit Address	Displays the unit address.
Display Address	Displays the display address.
ON/OFF Icon	Unit is turned off, press the icon at least 2 seconds , the unit will boot, the unit is running, press on the icon at least 2 seconds, the unit will shutdown.
Unlock Icon	Press the <i>Unlock</i> icon, enter the correct user login password to log in, the menu icon appears after logon to set parameters, click the <i>Unlock</i> icon to enter the unlocked interface.
Operating Status	Display the current operating status of the unit (shutdown, operation, standby, lock, communication interruption).
Toggle Icon 1	Press the <i>Toggle</i> icon to switch between the graphical display mode and the list display mode.
Toggle Icon 2	Press this icon to switch between the current sensor readings and alarm pages.
Control Mode	Display the current setting value of the unit and the environmental conditions of the equipment, as described in the following main interface control mode.
Status Display	Displays the current state of the unit.
Sensor Reading List	Displays the current operating status of each sensor and its respective components.
Alarm List	Displays all the current alarms and its occurrence time.

### 7.3.2 Control Mode

The compressor and fan are controlled according to temperature (supply air temperature, return air temperature, and remote temperature) and humidity (supply air humidity, return air humidity, and remote humidity).

Figure 7.3 Control Mode Diagram

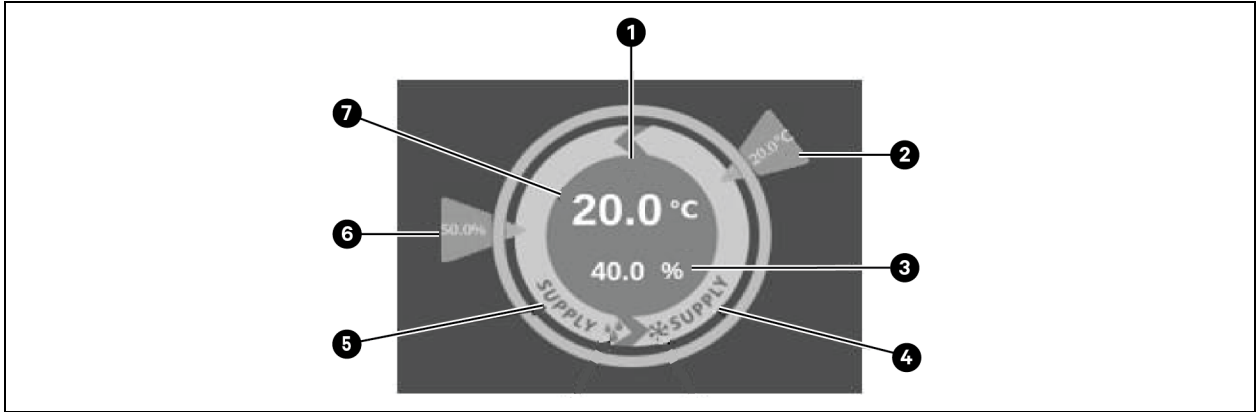


Table 7.3 Description of Control Mode Diagram

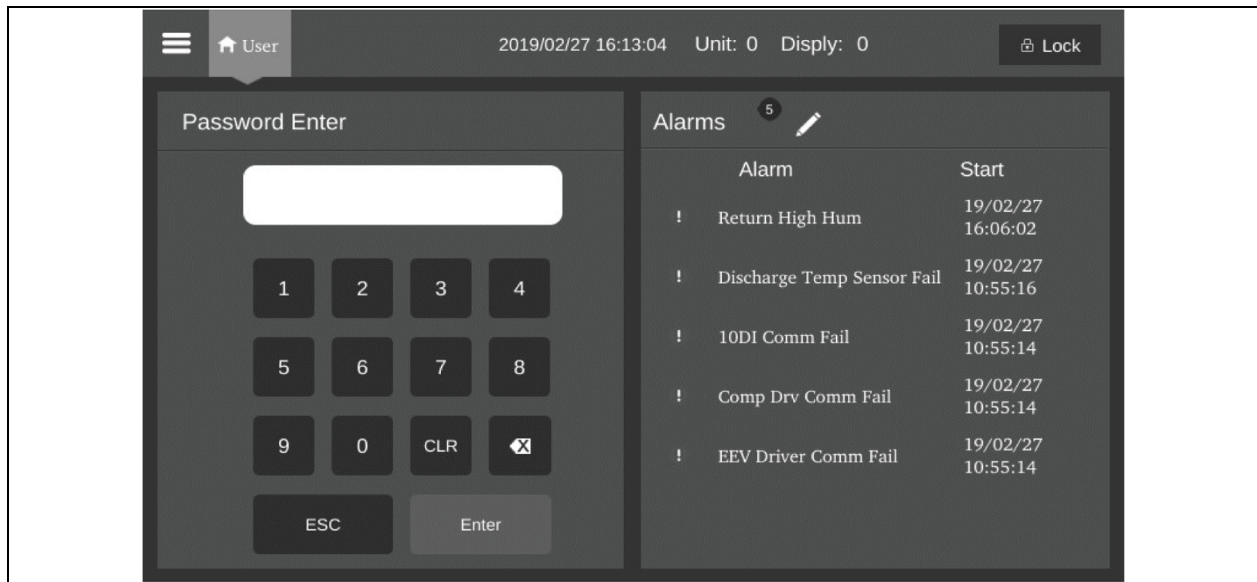
Item	Description
1	Each color of this area indicates different status: <ul style="list-style-type: none"> <li>• Green: The unit is On and the temperature within normal range</li> <li>• Red: The unit is On and the temperature is not within normal range</li> <li>• Grey: The unit is Off</li> </ul>
2	Desired supply air temperature, return air temperature, or remote temperature set by user.
3	Theoretical air supply humidity value calculated according to current data.
4	Control mode: Compressor is controlled according to supply air temperature, return air temperature, or remote temperature.
5	Control mode: Compressor is controlled according to supply air humidity
6	Desired humidity set by user.
7	Supply air temperature, return air temperature, or remote temperature, depending on the control mode.

### 7.3.3 Password Interface

When user click the *Unlock* icon in the top-right corner of the screen, the password interface appears as shown in **Figure 7.4** on the facing page .



Figure 7.4 Password Interface



The **Table 7.4** below reflects the 2 levels of passwords for accessing the menu.

Table 7.4 Password Level

Password level	User	Initial Password	Remark
Level 1	General operator	1490	Browse all menu information. Set all parameters except running and maintenance menu.
Level 2	Maintenance personnel	-	Browse all menu information. Set some running and maintenance menu parameters.

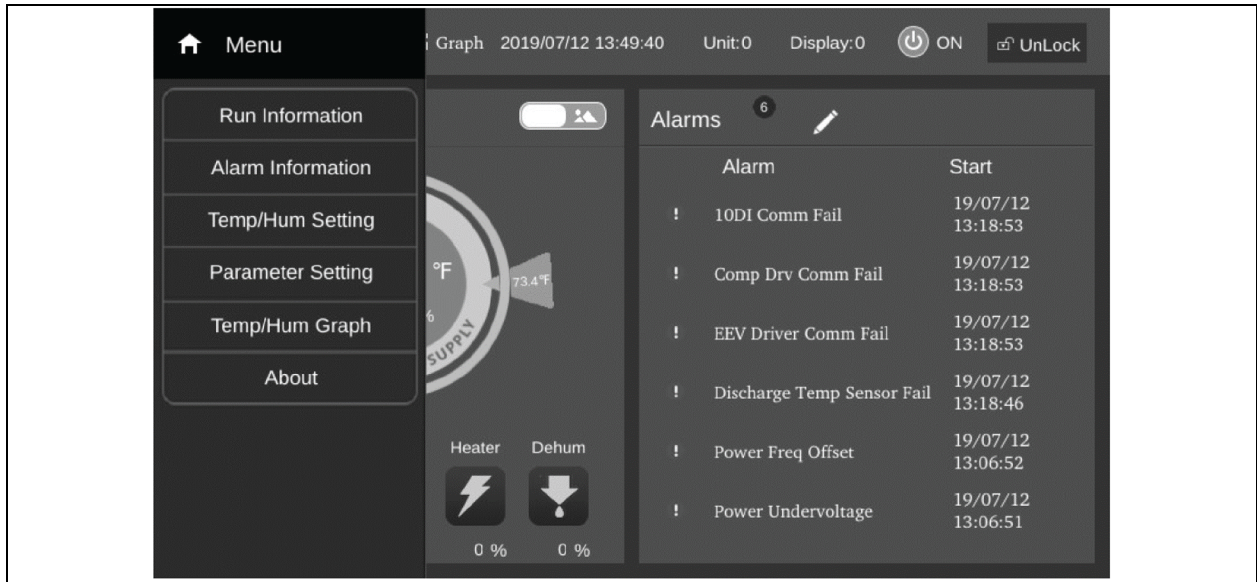
If the password is entered incorrectly, the menus appear as view only. To re-enter the password press the *Esc* icon to return to the main screen and then click the *Enter* icon to open the password interface once more.

**NOTE:** If user do not enter a password but press *Enter*, user can view menu settings but cannot change parameters.

## 7.4 Menu Structure

The main menu screen is shown in **Figure 7.5** on the next page . For more information, see the **Figure 10.1** on page 114 .

Figure 7.5 Main Menu



The menu structure is described in Table 7.5 below .

Table 7.5 Main Menu Description

Menu Item		Descriptions
Menu	Run Information	View temperature/humidity information, switch status, power information, teamwork information.
	Alarm Information	View system active alarms and history alarms.
	Temp and Hum Setting	Set the temperature/humidity value.
	Parameter Setting	Set teamwork control settings, some alarm setpoint settings, some alarm attribute settings, communication settings, time settings, display settings and password settings.
	Temp and Hum Graph	View return air temperature curve, return air humidity curve, supply air temperature curve, and remote temperature curve.
	About	View the controller software and hardware version number, and the software and hardware version number of the display.
Homepage		Display operating status, operating data, alarm data, sensor data.
Setting		Temperature/humidity setting under the same menu.
Curve		Temperature/humidity curve under the same menu.

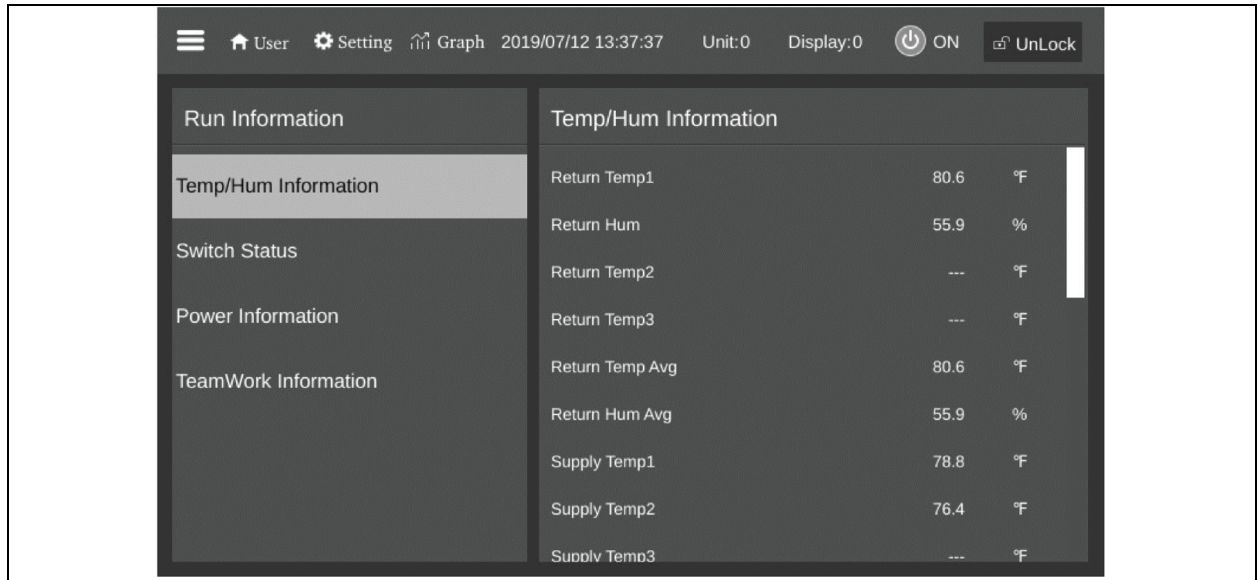
## 7.5 Run Information

From the main menu, select Run Information as shown in Figure 7.6 on the facing page . From here, the temperature humidity information, switch status, power information, and teamwork information is displayed.

## Temperature Humidity

The Temp/Hum Information displays the temperature/humidity parameters of the device in real time, including return air temperature/humidity, supply air temperature, remote temperature and other information. See **Figure 7.6** below . Use the scrollbar to the right to navigate up and down on the screen.

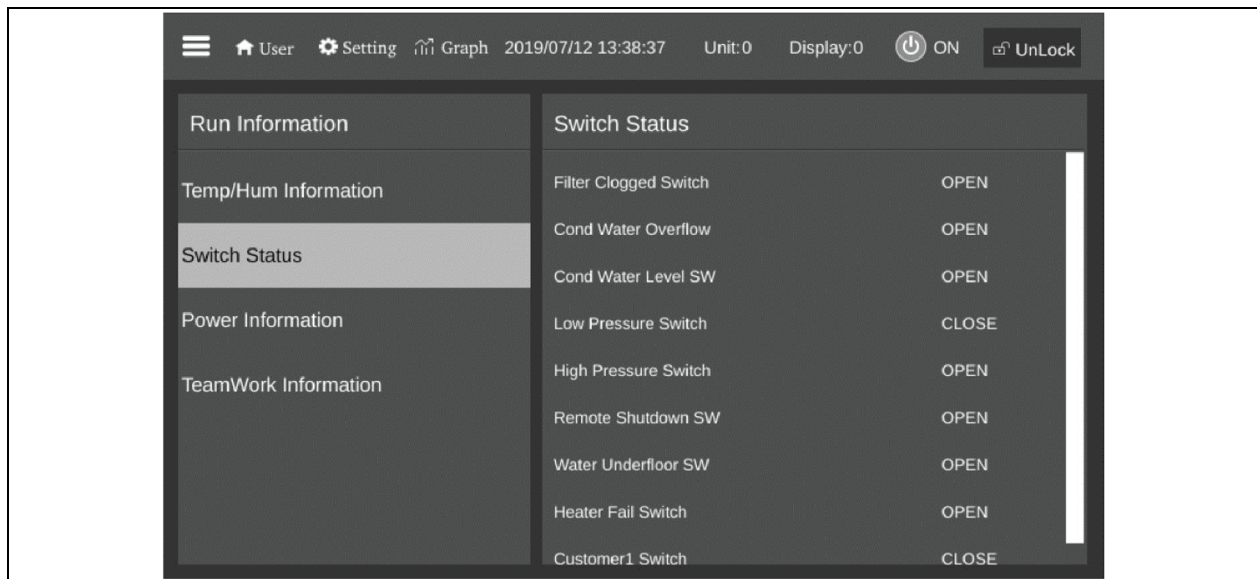
**Figure 7.6 Temperature Humidity Information**



## Switch Status

The Switch Status tab displays the current input and output states of devices. **Figure 7.7** below shows the screen for the digital signal function.

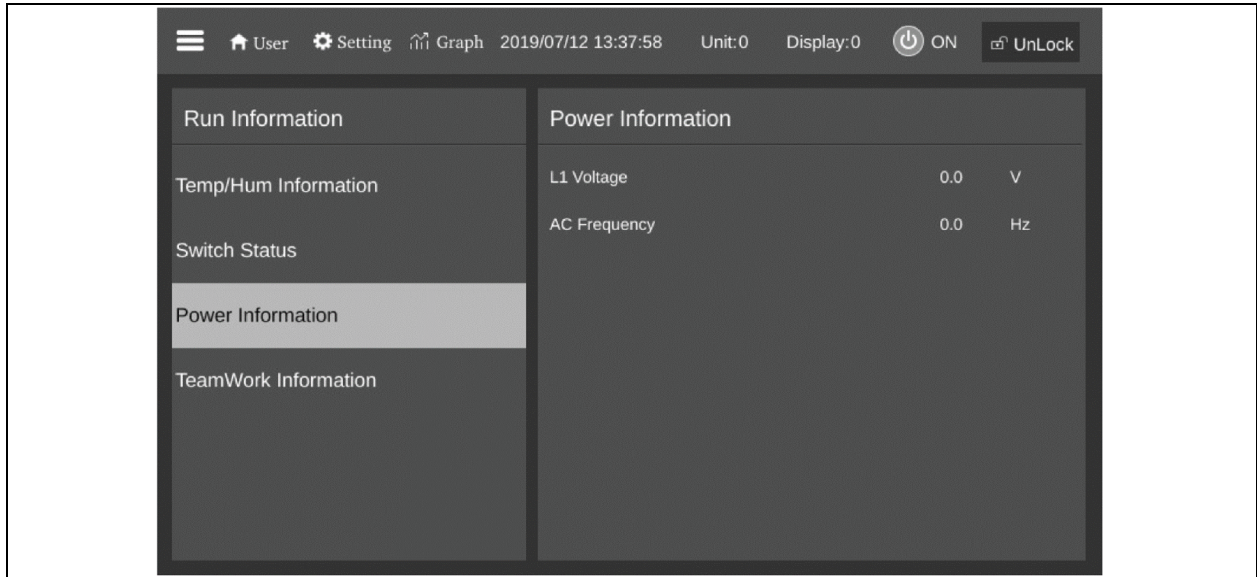
**Figure 7.7 Switch Status Information**



### Power Information

The Power Information menu displays the voltage and frequency, as shown in **Figure 7.8** below .

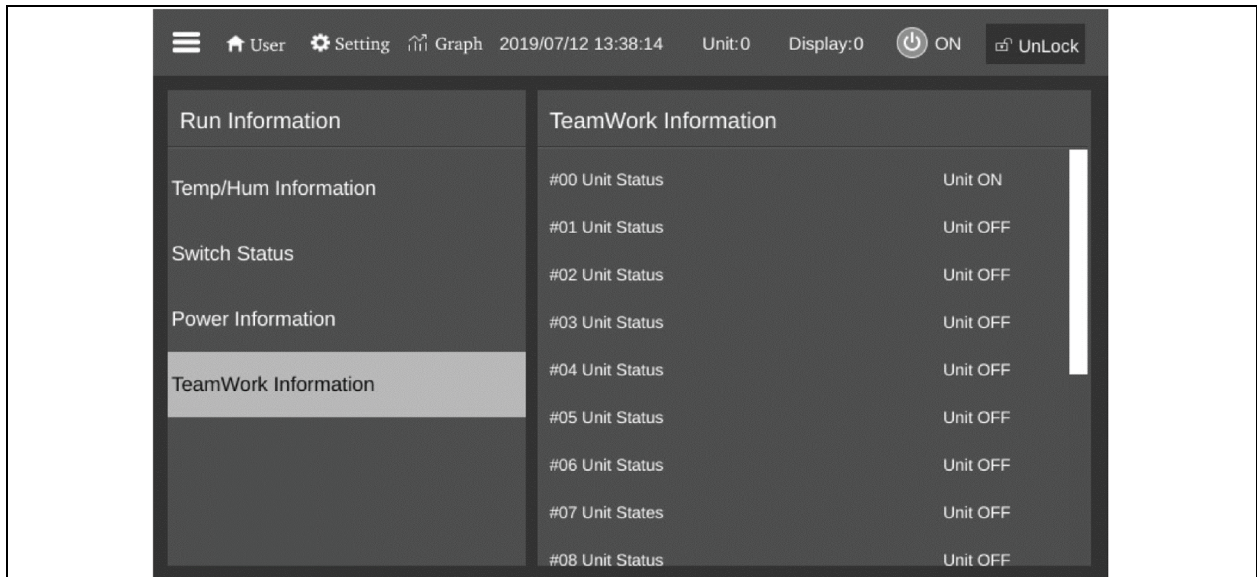
**Figure 7.8 Power Information**



### Teamwork Information

The Teamwork Information menu displays the status of the group information, as shown in **Figure 7.9** below .

**Figure 7.9 Teamwork Information**



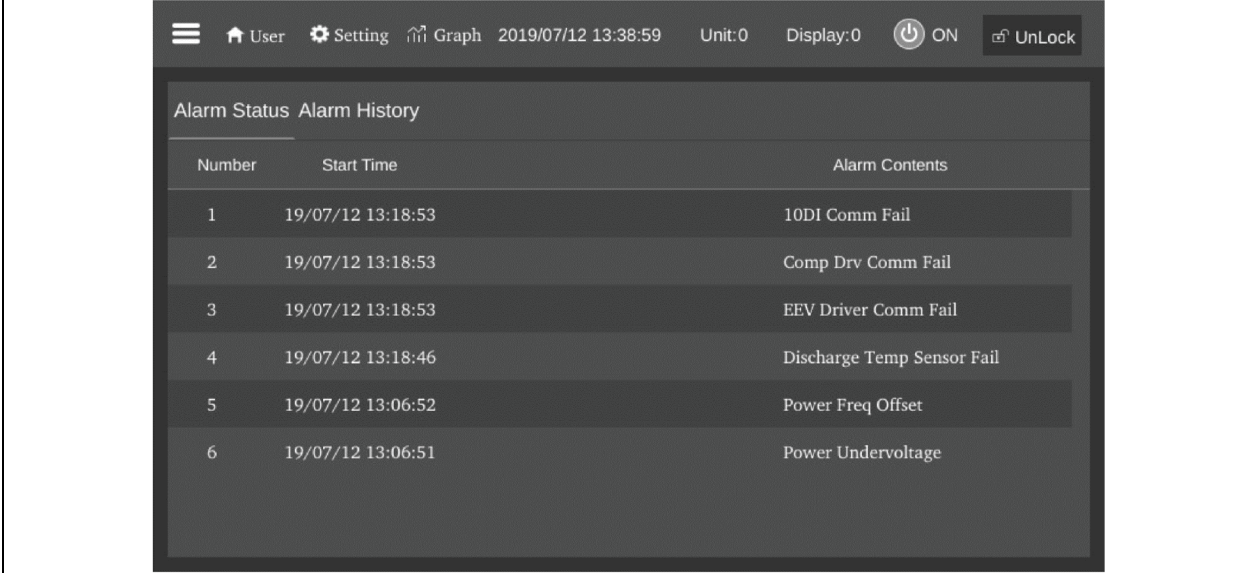
## 7.6 Alarm Information

From the main menu, select Alarm Information. It contains two pages: Alarm Status and Alarm History.

## Alarm Status

The Alarm Status page is used to monitor the current alarm status record of the AC unit, indicating no alarm or specific alarm status information. Specific alarm status information includes serial number, alarm content, alarm time, as shown in **Figure 7.10** below .

**Figure 7.10 Alarm Status**



Number	Start Time	Alarm Contents
1	19/07/12 13:18:53	10DI Comm Fail
2	19/07/12 13:18:53	Comp Drv Comm Fail
3	19/07/12 13:18:53	EEV Driver Comm Fail
4	19/07/12 13:18:46	Discharge Temp Sensor Fail
5	19/07/12 13:06:52	Power Freq Offset
6	19/07/12 13:06:51	Power Undervoltage

**NOTE:** The latest Alarm SN is the least number. Press the *Up* or *Down* button to scroll through the status records if more than one alarm is activated.

**NOTE:** Alarms are cleared when system is powered off.

## Alarm History

The Alarm History is used to view historical alarm, including the alarm status number (quantifiable number of history alarms), alarm serial number and alarm type, alarm time (start and end time) as shown in **Figure 7.11** on the next page .

Figure 7.11 Alarm History

Number	Start Time	End Time	Alarm Contents
1	19/07/12 13:18:53	00/00/00 00:00:00	10DI Comm Fail
2	19/07/12 13:18:53	00/00/00 00:00:00	Comp Drv Comm Fail
3	19/07/12 13:18:53	00/00/00 00:00:00	EEV Driver Comm Fail
4	19/07/12 13:18:46	00/00/00 00:00:00	Discharge Temp Sensor Fail
5	19/07/12 13:18:46	19/07/12 13:35:05	Remote Temp Sensor1 Fail
6	19/07/12 13:06:52	00/00/00 00:00:00	Power Freq Offset
7	19/07/12 13:06:51	19/07/12 13:18:43	Remote ShutDown

Total 9            Goto  / 1 Page

**NOTE:** Press the *Up* or *Down* button to scroll through the status records if more than one alarm is activated.

**NOTE:** Up to 500 historical alarm records can be stored. They will not be cleared when system is powered off.

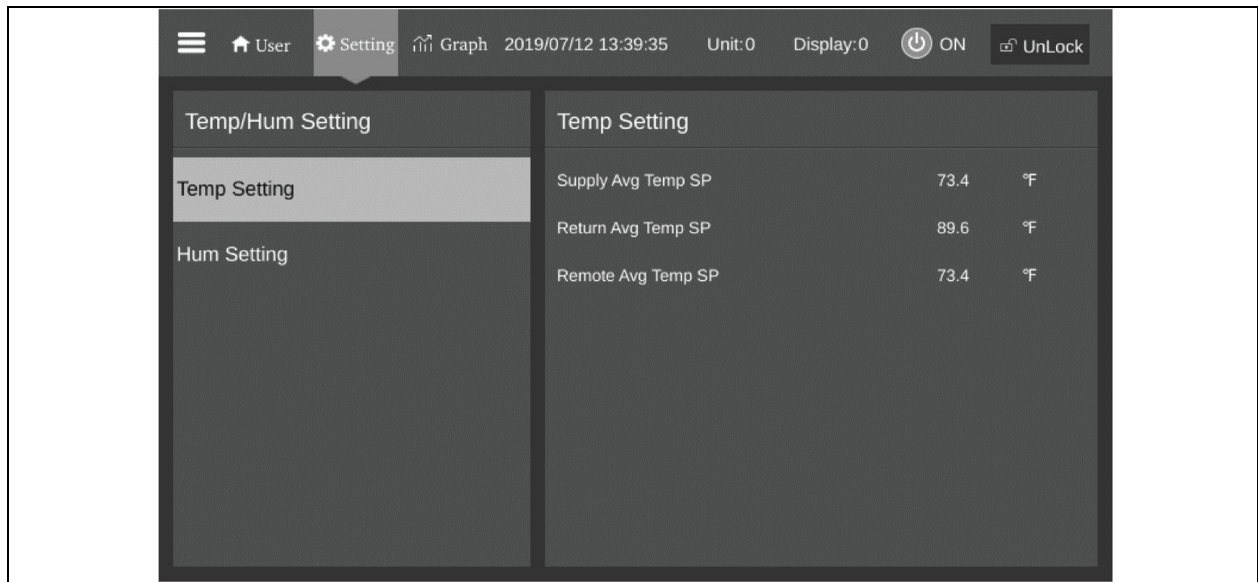
## 7.7 Temperature and Humidity Setting

From the main menu, select Temp/Hum Setting for the temperature and humidity settings as shown in **Figure 7.12** on the facing page, to enter the setting of temperature and humidity.

### Temp Setting (Temperature setting)

Set the return air temperature, remote temperature, supply air temperature, and temperature difference in this menu. The Temp Setting menu interface is shown in **Figure 7.12** on the facing page.

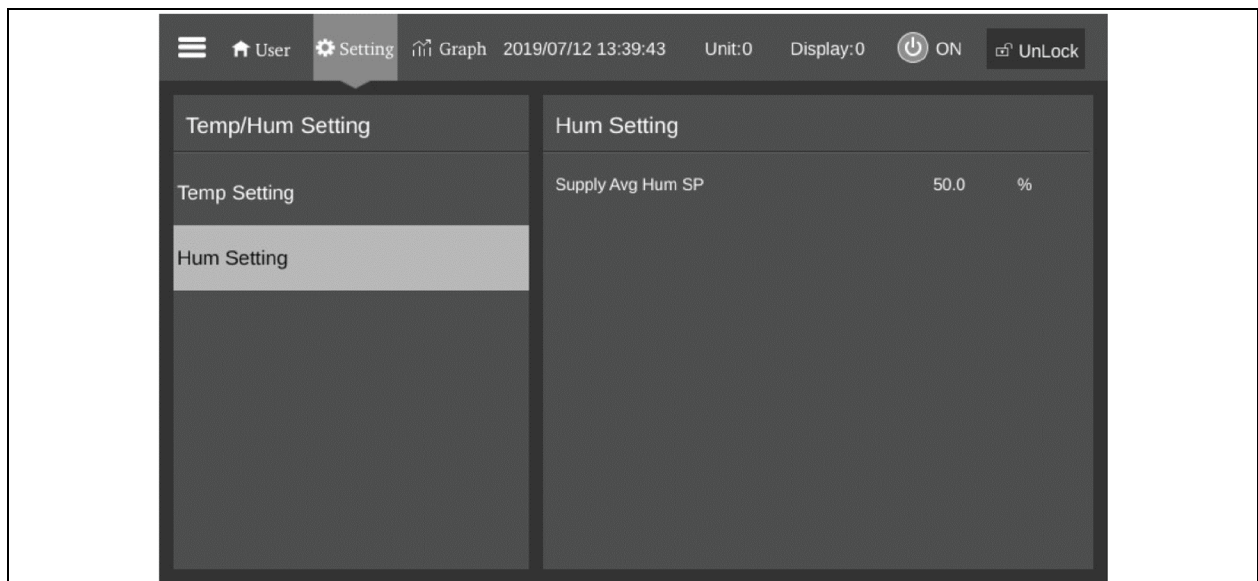
Figure 7.12 Temp Setting



### Hum Setting (Humidity setting)

Set the humidity setting value in this menu. See **Figure 7.13** below .

Figure 7.13 Hum Setting



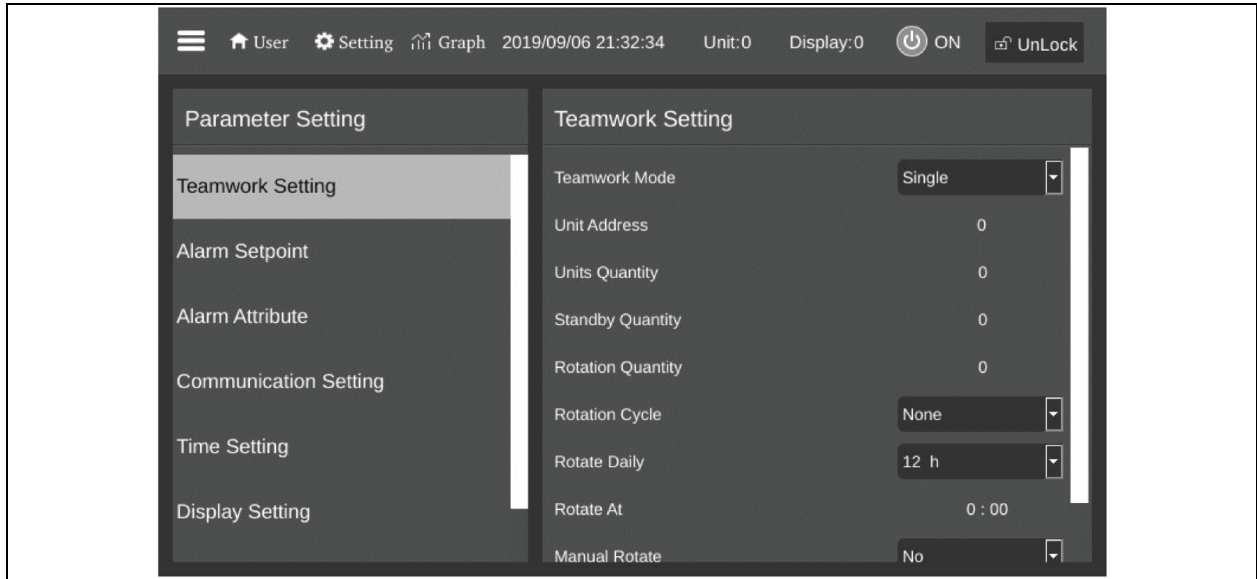
## 7.8 Parameter Setting

From main menu, select the Parameter Setting to enter parameter settings, as shown in **Figure 7.14** on the next page . This tab displays teamwork settings, alarm setting, alarm attributes, communication settings, time setting, display settings, and password settings.

### Teamwork Setting

The Teamwork Setting menu is shown in **Figure 7.14** below . System setting screen, monitoring protocol, baud rate monitoring address, date and time and the display monitor address is configured by the system parameters.

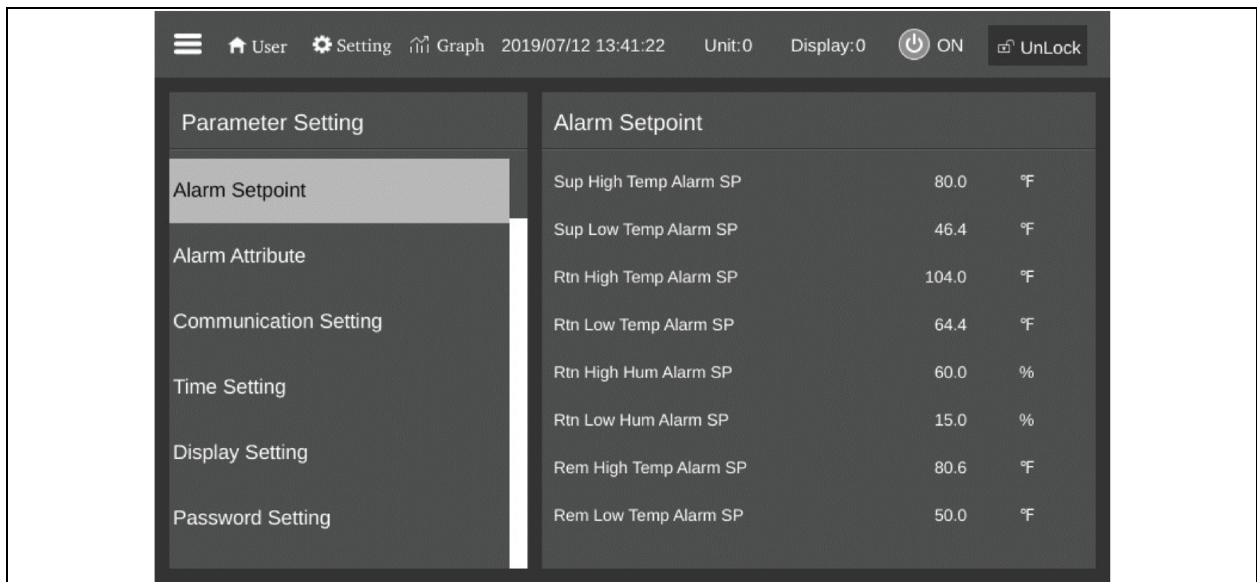
**Figure 7.14 Teamwork Setting**



### Alarm Setpoint

The Alarm Setpoint menu interface is shown in **Figure 7.15** below .

**Figure 7.15 Alarms Setpoint**



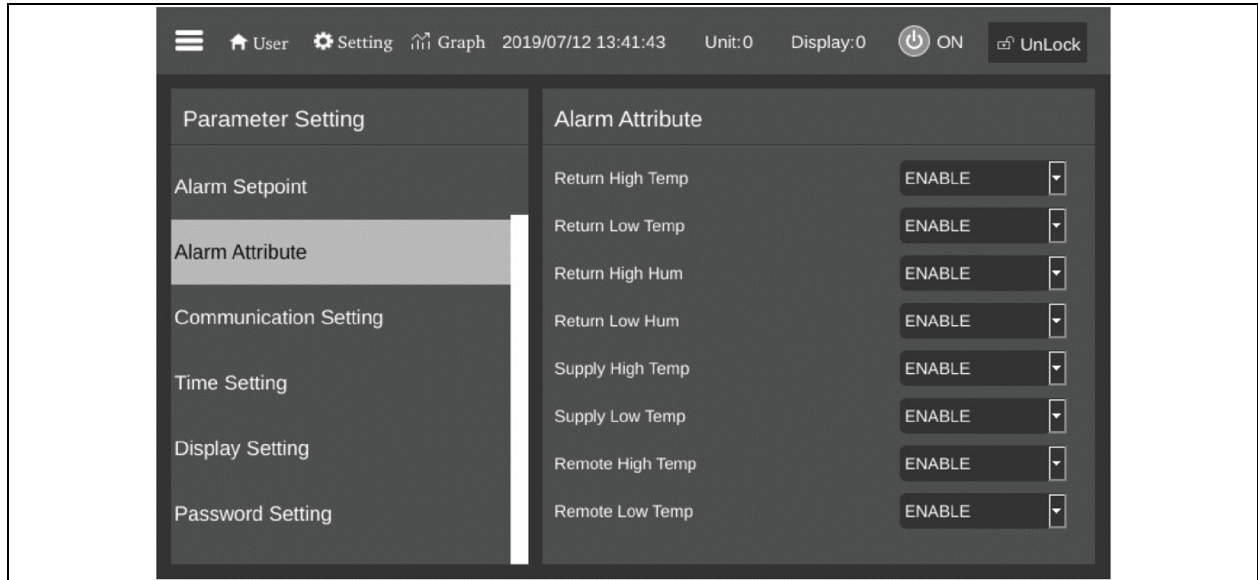
**NOTE: Do not change the default values. It is recommended to change the settings only under the guidance of qualified Vertiv service professional.**



## Alarm Attribute

The Alarm Attribute menu is shown in **Figure 7.16** below .

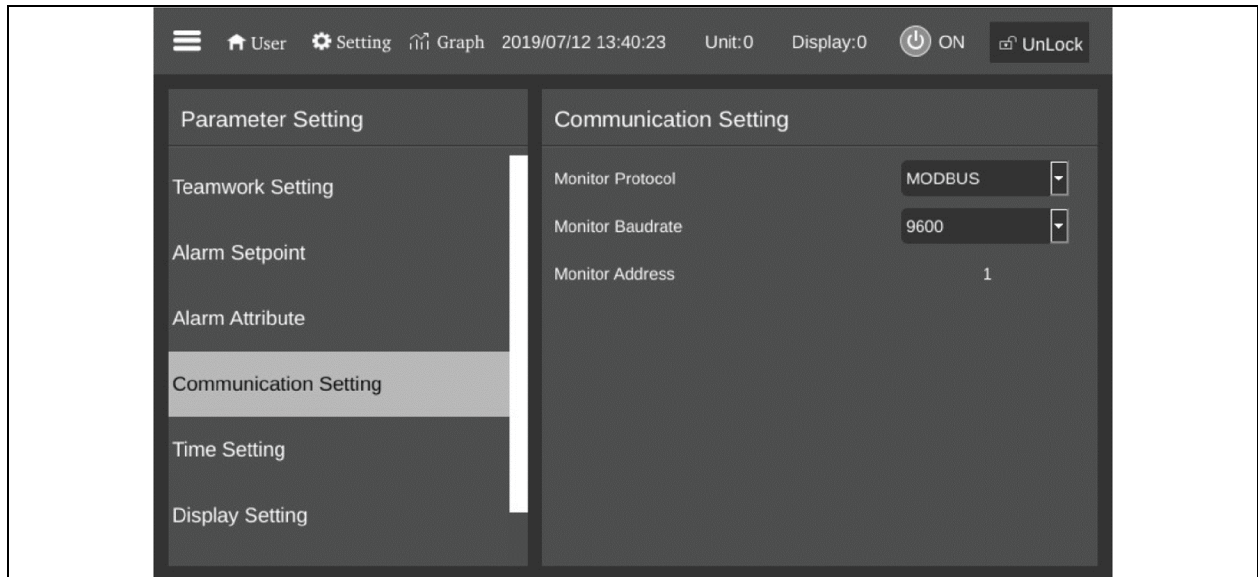
**Figure 7.16 Alarm Attribute**



## Communication Setting

The Communication Setting menu is shown in **Figure 7.17** below .

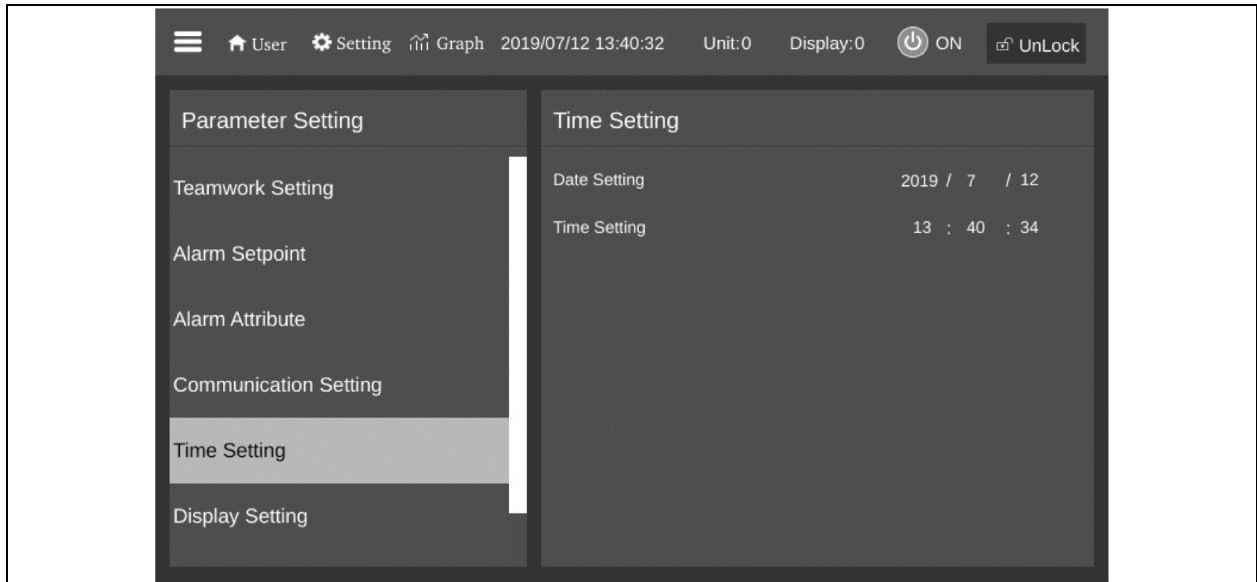
**Figure 7.17 Communication Setting**



## Time Setting

The Time Setting menu is shown in **Figure 7.18** on the next page .

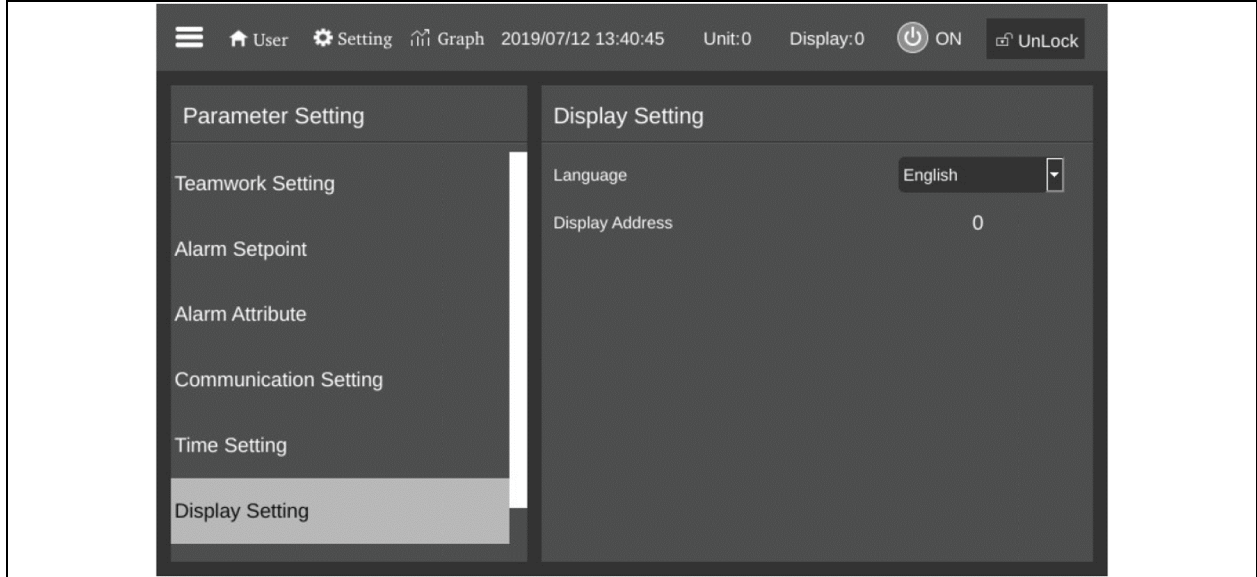
Figure 7.18 Time Setting



### Display Setting

The Display Setting menu is shown in Figure 7.19 below .

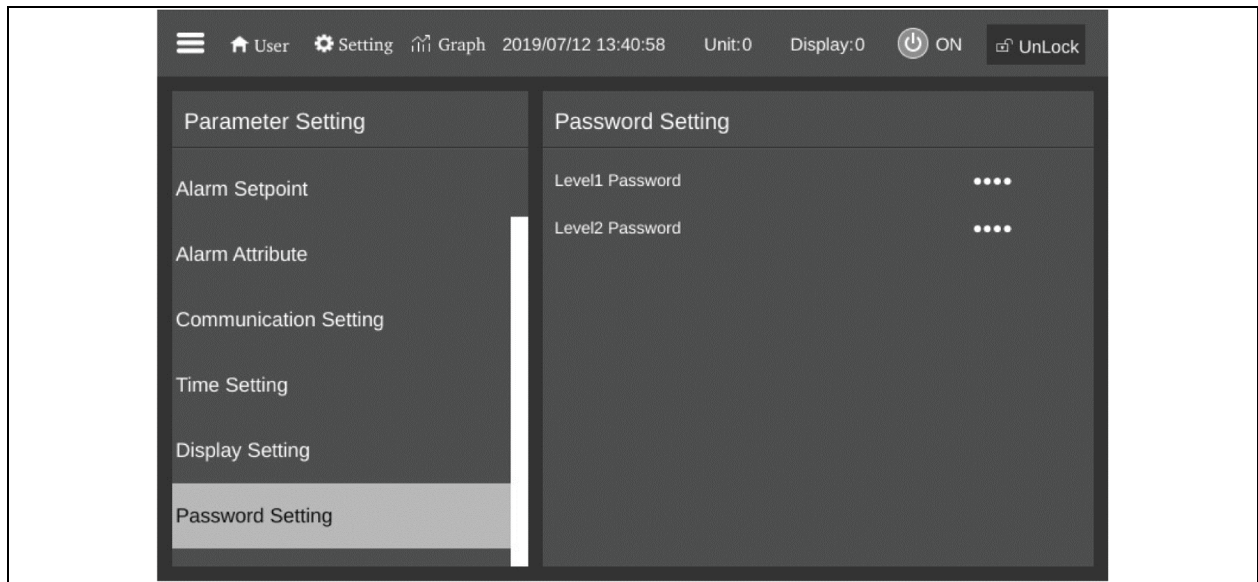
Figure 7.19 Display Setting



### Password Setting

The Password Setting menu is shown in Figure 7.20 on the facing page .

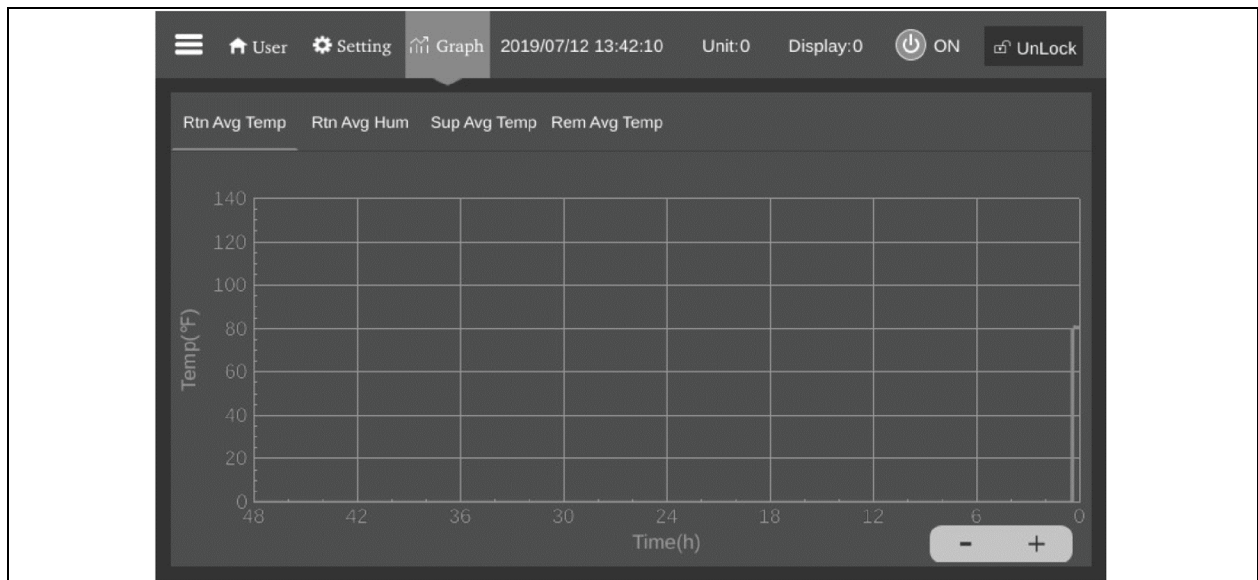
Figure 7.20 Password Setting



## 7.9 Graph

From the main menu, select Graph to view the curve of return temperature, return humidity, supply temperature, and remote temperature of 0 to 48 Hours. See 7.9 above .

Figure 7.21 Graph



## 7.10 About

The About menu is used to get software information and service information, as shown in **Figure 7.22** on the next page and **Figure 7.23** on the next page .

Figure 7.22 Version Information

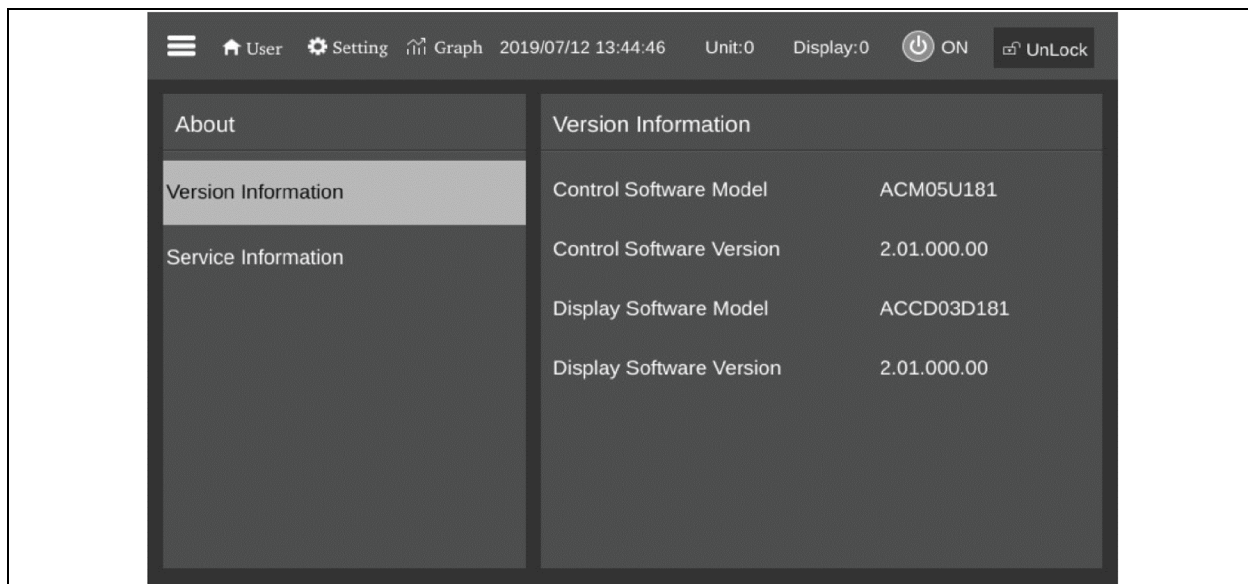
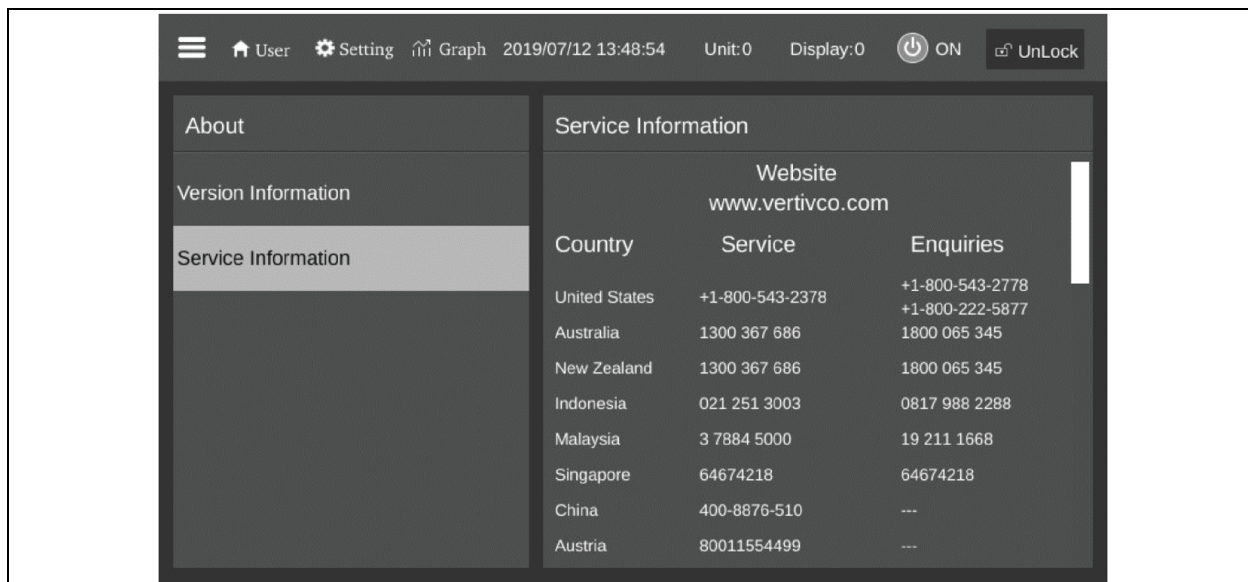


Figure 7.23 Service Information



## 8 Maintenance and Troubleshooting

This chapter provides the system operation and maintenance of the Vertiv™ Liebert® CRD10 range of air conditioners. In this chapter, the following points or items are described to help users for the routine inspections and checks from an end user perspective. It includes the maintenance of electrical parts and connections, refrigerant system maintenance guidelines, routine monthly and semi-annual checklists, and drainage system maintenance among others. It also provides the basic troubleshooting which can be understood from a user perspective.



**WARNING!** Arc flash and electric shock hazard. Open all local and remote electric power supply disconnect switches, verify with a voltmeter that power is Off and wear appropriate, OSHA-approved personal protective equipment (PPE) per NFPA 70E before working within the electric control enclosure. Failure to comply can cause serious injury or death. Customer must provide earth ground to unit, per NEC, CEC and local codes, as applicable. Before proceeding with installation, read all instructions, verify that all the parts are included and check the nameplate to be sure the voltage matches available utility power. The Liebert controller does not isolate power from the unit, even in the Unit Off mode. Some internal components require and receive power even during the Unit Off mode of the controller. The only way to ensure that there is NO voltage inside the unit is to install and open a remote disconnect switch. Refer to unit electrical schematic. Follow all local codes.



**WARNING!** Risk of contact with high speed rotating fan blades. Can cause serious injury or death. Open all local and remote electric power supply disconnect switches, verify with a voltmeter that power is off, and verify that all fan blades have stopped rotating before working in the unit cabinet or on the fan assembly.

**NOTE:** If control voltage is applied, the fan motor can restart without warning after a power failure.



**WARNING!** Risk of contact with extremely hot and/or cold surfaces. Can cause injury. Verify that all components have reached a temperature that is safe for human contact or wear appropriate, OSHA-approved PPE before working within the electric connection enclosures or unit cabinet. Perform maintenance only when the system is de-energized and component temperatures have become safe for human contact.



**WARNING!** Risk of hair, clothing and jewelry entanglement with high speed rotating fan blades. Can cause equipment damage, serious injury or death. Keep hair, jewelry and loose clothing secured and away from rotating fan blades during unit operation.



**CAUTION:** Risk of excessive refrigerant line pressure. Can cause tubing and component rupture resulting in equipment damage and personal injury. Do not close off the refrigerant-line isolation valve for repairs unless a pressure-relief valve is field installed in the line between the isolation valve and the check valve. The pressure-relief valve must be rated 5% to 10% higher than the system-design pressure. An increase in ambient temperature can cause the pressure of the isolated refrigerant to rise and exceed the system-design pressure rating (marked on the unit nameplate).

**NOTICE**

Risk of improper maintenance. Can cause equipment damage. Installation and service of this equipment should be done only by qualified personnel who have been specially trained in the installation of air-conditioning equipment and who are wearing appropriate, OSHA-approved PPE. Ignoring safety instructions is dangerous. Soiled parts cause a loss of performance and, for switch or control devices, can lead to the breakdown of the unit performance and operation.

**NOTICE**

Risk of release of hazardous substances into the environment. Can cause environmental pollution and violation of environmental regulations. The Liebert® CRV contains substances and components hazardous for the environment (electronic components, refrigerating gases and oils). At the end of its useful life, the Liebert® CRV must be dismantled by specialized refrigerating technicians. The unit must be delivered to suitable centers specializing in the collection and disposal of equipment containing hazardous substances.

**8.1 Routine Maintenance and Inspection (Monthly)**

To ensure correct functionality follow the checklist which lists the parts and components that are to be checked. In addition, there may be wear and tear of the equipment. Therefore, it is essential that all the checks are performed to ensure a smooth flow in operations. **Table 8.1** below listed the inspection tasks and actions to be implemented and carried out every month during maintenance of the various components in the CRD series of air conditioners.

**Table 8.1 Routine Maintenance and Inspection (Monthly)**

Components	Inspection	Remark
Air Filter	Check for clogging or damage.	
	Check the filter clogging switch.	
	Clean the filter.	
Fan	The fan blades are not distorted.	
	The bearings are not worn out.	
Compressor	Check for leakage.	
	Listen compressor sound while compressor is in operation and observe the vibrations.	
Air-Cooled Condenser	Make sure that the condenser coil is clear from dirt and debris. Clean if required.	
	The fan base should be stable.	
	The fan vibration absorber is not degraded or damaged.	
	The refrigerant pipes are properly supported.	
Refrigeration System	Check the suction pressure.	
	Check the discharge pressure.	
	Check the refrigerant pipes for signs of leaks.	
	Check the moisture condition in the system through the sight glass.	
	Check the electronic expansion valve.	
Heating System	Check the re-heater operation.	
	Check the erosion on the components.	

## 8.2 Routine Maintenance and Inspection (Semi-Annually)

To ensure a smooth operational flow and check the functionality and the wear-and-tear of the components in the Liebert® CRD 10kW range of air conditioners, refer the below checklist see **Table 8.2** below for the items and the functions that need to be checked semi-annually.

**Table 8.2 Routine Maintenance and Inspection (Semi-Annually)**

Components	Inspection	Remark
Air Filter	Check for clogging or damage.	
	Check the filter clogging switch.	
	Clean the filter.	
Fan	The fan blades are not distorted.	
	The bearings are not worn out.	
	Check and fasten the circuit connections.	
Compressor	Check for leakage.	
	Listen to the operation sound, observe the operation vibration.	
	Check and fasten the circuit connections.	
Air-Cooled Condenser	Check the fins cleanness.	
	The fan base should be firm.	
	The fan vibration absorber is not deteriorated or damaged.	
	Check the voltage regulating function of the rotation speed controller.	
	The temperature switch is set at the required position.	
	The refrigerant pipes are properly supported.	
	Check and fasten the circuit connections.	
Check the suction pressure.		
Refrigeration System	Check the discharge pressure.	
	Check the refrigerant pipes.	
	Check the moisture condition in the system through the sight glass.	
Heating System	Check the re-heater operation.	
	Check the erosion situation of the components.	
	Check and fasten the circuit connection.	
Electric Control Part	Check the fuse and the MCB.	
	Check and fasten the circuit connections.	
	Check the control program.	
	Check the contactor action.	
Pump Filter	Check if there is any foreign matter in the water tray.	
	Check pump filter.	

## 8.3 Self-Diagnosing Functions

The microcontroller has a built-in diagnostic function that turns the components off and on checks their functionality.

## 8.4 Maintenance of Electrical Control Utilities

### 8.4.1 Maintenance of Electric Parts

Visual checks and handling must be carried out to check the electrical connections for the following items:

1. To find bad electrical connections and contacts and conduct an electrical insulation test on the system.
2. Disconnect all the fuses and MCBs of the electrical controller part during the test as high voltage from the insulation test could damage the components.
3. Check the ability of the contactors to hold and unhold freely before turning on the device.
4. Clean the electrical and control components of dust by brushing or using dry compressed air.
5. Check the closing of contactors for arcs or signs of burning. Replace the contactors, if required.
6. Fasten all electrical connection terminals.
7. Check that sockets and plugs are in good condition. Replace the contactors, if required.
8. If the power cables are damaged, get them replaced by a qualified/certified electrician.

### 8.4.2 Maintenance of Control System

The following checks must be carried out for maintenance of the control system.

1. Carry out visual checks on the power transformers and isolation transformers for any burn marks followed by testing the output voltage of the indoor unit and outdoor condensers.
2. Inspect the control interface board, control board, temperature and humidity sensor boards, and fuse boards for any signs of aging.
3. Clean the electrical control components and control board to remove dust. Debris, dust, and dirt must be removed, preferably by a brush or compressed air.
4. Inspect and secure the control interface boards input/output ports. Inspect the connections between the control board and control interface boards as well as between the temperature/humidity sensor boards and the control interface board.
5. Check the connection between the user terminals (24, 51, 37, 38, 72, 73, 75 and 76) and the control interface board.
6. Check the output connections between the control interface board and various components including contactors and solenoid valves for liquid pipes. Inspect the input connection between the control interface board and various components, including high pressure switches, heating overtemperature protection switches, discharging temperature and high pressure sensors. Specifically, check the inserting terminals such as high pressure switches and heating over temperature switch followed by replacing the component if it is loosened or in poor condition.
7. Replace faulty electric components such as faulty control fuses (or MCBs) and control boards.
8. Check that power and control cables are connected to the condenser from the indoor unit for insulation or trunking issues. Replace the cable, if required.
9. Use a temperature/humidity measuring meter with high precision to calibrate the temperature/humidity sensor.
10. Regulate the setting point. Meanwhile, check the action of the various function components according to the control logic.



11. Simulate and inspect the operation and working states of protecting units such as High/Low pressure alarm, High/Low temperature alarm, High Water Level alarm, and over-temperature alarm and over-temperature protection.
12. Check the sensors.

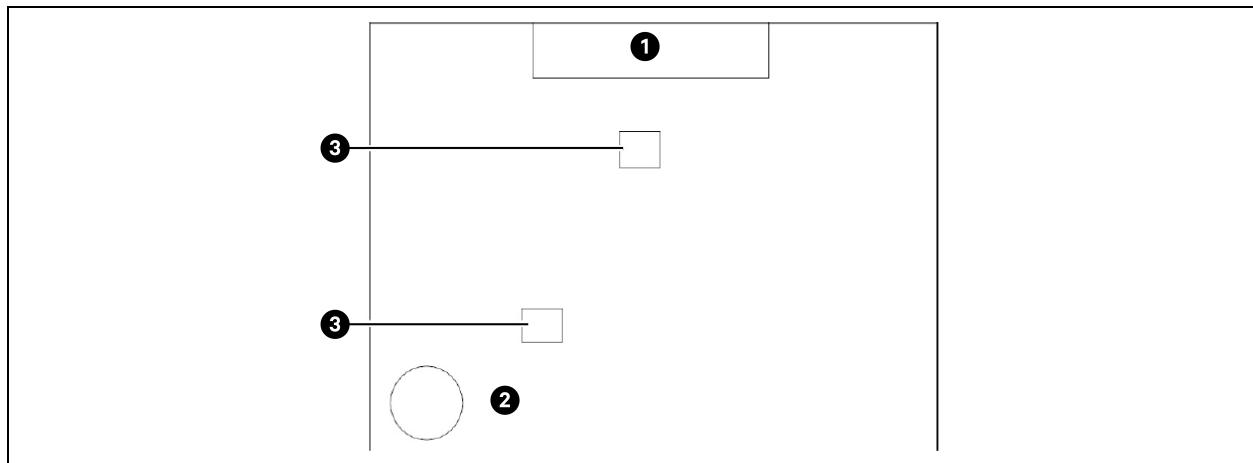
### 8.4.3 Water Leak Detector

The water leak detector is arranged according to below conditions:

- When the unit is installed on the raised floor, the water leak detector is installed on the ground under the floor.
- When the unit is installed on the floor, the leakage water detector are installed on the floor.

Confirm the alarm information through the controller. The detector should be located away from any water pool or drainage discharge on the floor, 2 to 2.5 meters away from the unit. Do not place it directly under the machine. **Figure 8.1** below shows the recommended location for the water leak detector.

**Figure 8.1 Recommended Location for the Water Leak Detector**



Item	Description
1	Thermal unit
2	Drain pipes on the ground
3	Location of water leak detector

**NOTE:** Do not use the water leak detector in the vicinity of flammable liquids and do not use it to detect any flammable liquids.

## 8.5 Air Filter Maintenance



**WARNING!** Risk of contact with high speed rotating fan blades. Can cause serious injury or death. Open all local and remote electric power supply disconnect switches, verify with a voltmeter that power is off, and verify that all fan blades have stopped rotating before working in the unit cabinet or on the fan assembly. If control voltage is applied, the fan motor can restart without warning after a power failure.

Air filter filtration class is America MERV8/Europe G4 standard.

1. Set the filter maintenance and alarm logic to ensure efficient operation. The fan operating time is 90 days by default, although the time is set and customized based on the local operating environment. The filter maintenance alarm is triggered based on the configuration and settable operation time.
2. Check filter for dust and clogging and replace the filter, if needed.
3. Check the filter once a month during normal operations. Replace as needed.

**NOTE:** Turn off the power before replacing the filter. Clear the fan operating time after replacing the filter.

## 8.6 Fan Kit Maintenance



**WARNING! Risk of electric shock. Can cause equipment damage, injury or death. Open all local and remote electric power supply disconnect switches and verify with a voltmeter that power is off before working within any electric connection enclosures. Service and maintenance work must be performed only by properly trained and qualified personnel and in accordance with applicable regulations and manufacturers specifications. Opening or removing the covers to any equipment may expose personnel to lethal voltages within the unit even when it is apparently not operating and the input wiring is disconnected from the electrical source.**



**WARNING! Risk of contact with high speed rotating fan blades. Can cause serious injury or death. Open all local and remote electric power supply disconnect switches, verify with a voltmeter that power is off, and verify that all fan blades have stopped rotating before working in the unit cabinet or on the fan assembly. If control voltage is applied, the fan motor can restart without warning after a power failure.**

Regularly checking EC fans includes inspecting of the motor operating status, fan impeller state, and the cooperative clearance between the fan and wind leading ring.

Check whether the fan or the wind leading ring has been installed properly and firmly. Ensure that the fan blades do not hit the adjacent metal plates under any conditions.

To avoid damage to the refrigerating system and other system kit due to reduced air volume, clear the clogging element of the air duct.

In addition, the fan fault alarm of the control board and alarm point of the EC fan is connected in series. If the rotating speed is abnormal, the unit will ideally generate an EC fan fault alarm.

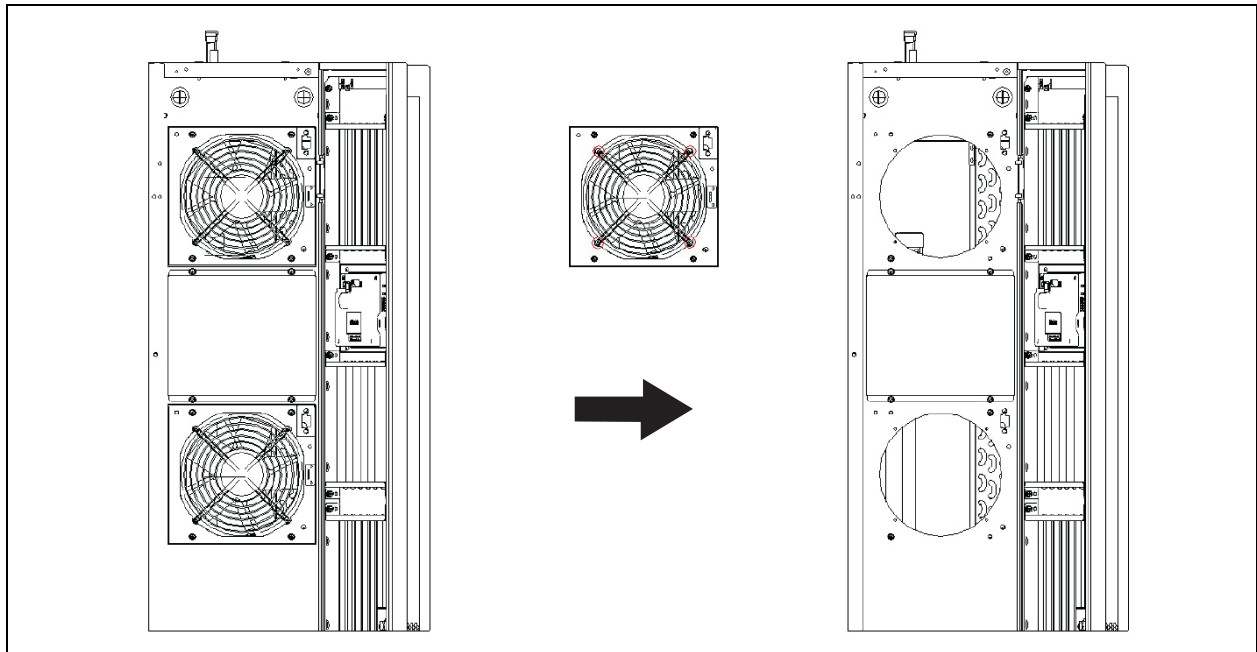
If a fans breaks down, it can be repaired or replaced it because all fans of the unit are equipped independently.

### To replace the fan:

1. Shut off all power to the unit by closing the main disconnect switch on the electrical panel.
2. Open the front door of the unit.
3. Remove the fan screws and remove fan from fixed frame.

This procedure is same for all fans.

Figure 8.2 Removing the Fan



## 8.7 Electrical Heater Maintenance (CE Model)



**WARNING! Risk of electric shock. Can cause equipment damage, injury or death. Open all local and remote electric power supply disconnect switches and verify with a voltmeter that power is off before working within any electric connection enclosures. Service and maintenance work must be performed only by properly trained and qualified personnel and in accordance with applicable regulations and manufacturers specifications. Opening or removing the covers to any equipment may expose personnel to lethal voltages within the unit even when it is apparently not operating and the input wiring is disconnected from the electrical source.**

These are the basic maintenance steps for the electrical heater:

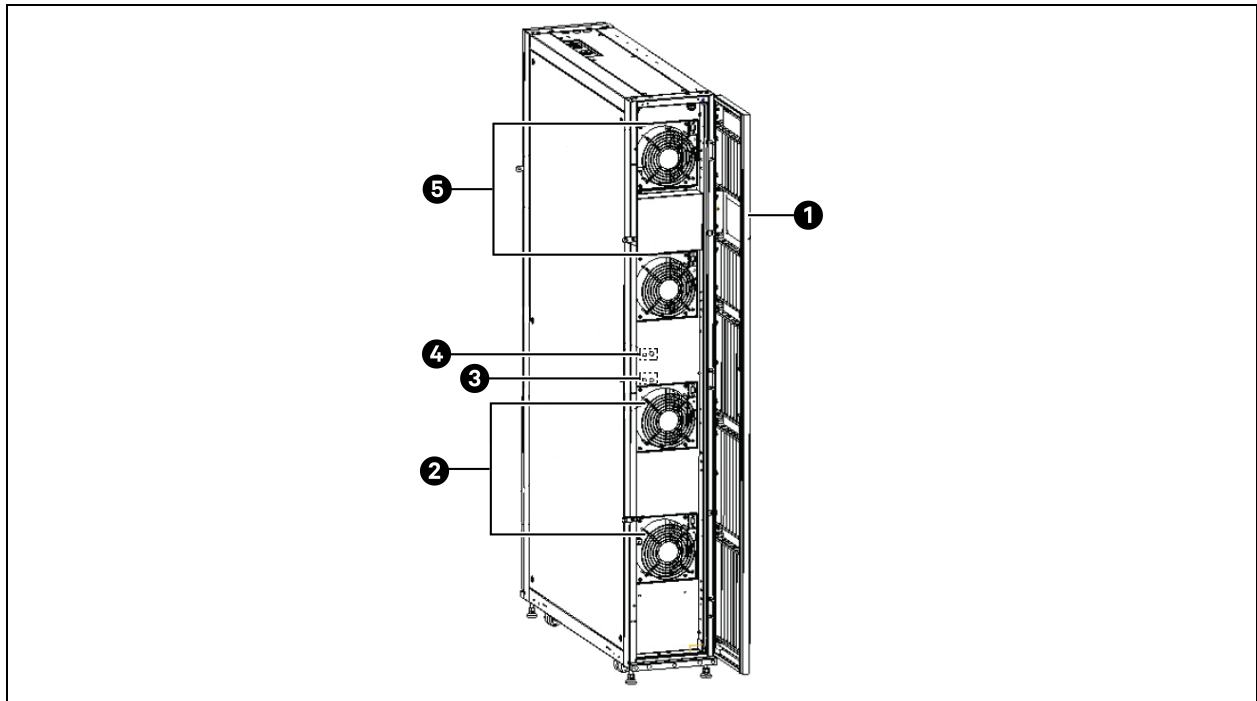
1. Monitor the heater periodically.
2. Keep the surface free of dust, debris, and foreign matter. The heater elements heat continuously in the normal state.
3. Inspect the heater every six months for functionality.

If the heating is not effective, the electric heater needs to be replaced.

### To replace electrical heater:

1. Shutdown power to the unit by closing the main switch.
2. Open the front door and remove the fan assemblies. If replacing the electrical heater above, remove the upper two fan assemblies,  
-or-  
If replacing the electrical heater below, remove the lower two fan assemblies.

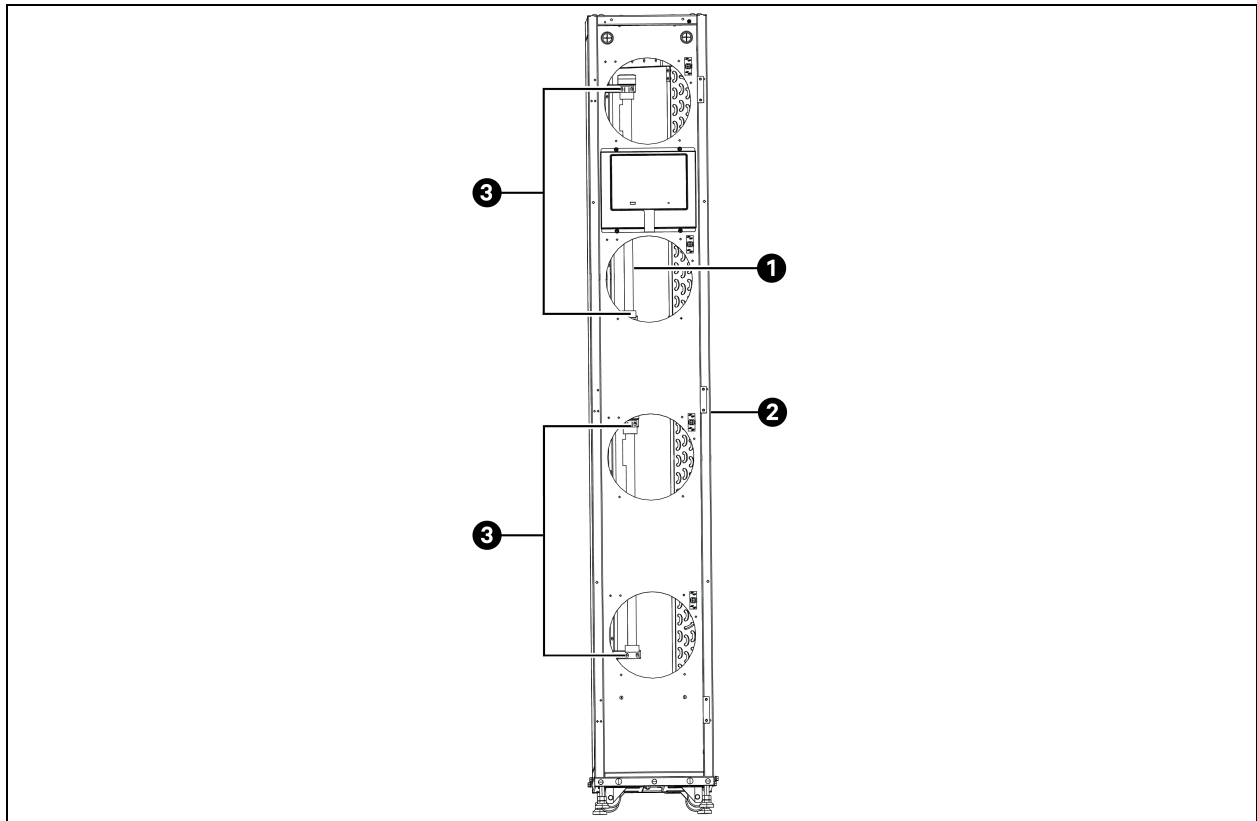
Figure 8.3 Removing the Fixed Plate



Item	Description
1	Front door
2	Fan assembly (below 2 pieces)
3	Hole plug (below 2 pieces)
4	Hole plug (up 2 pieces)
5	Fan assembly (up 2 pieces)

- Remove the electric heater by removing the fixed screws. **Figure 8.4** on the facing page shows the location of the electric heater screws.

Figure 8.4 Removal the Electric Heater



Item	Description
1	Electrical heater
2	Front door (opened)
3	Screw (8 pieces)

For replacement, contact the maintenance personnel and Vertiv support team.

## 8.8 Condensate Pump Maintenance

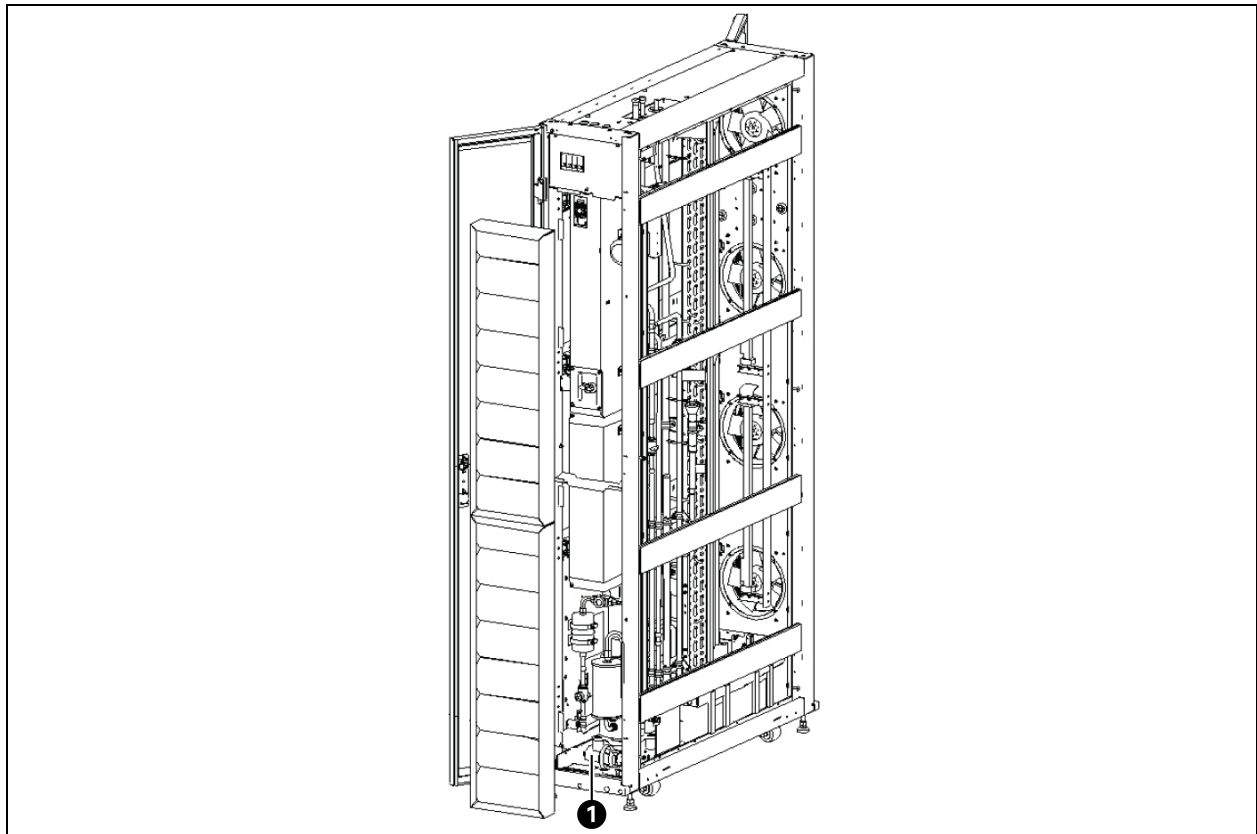


**WARNING!** Risk of electric shock. Can cause injury or death. Open all local and remote electric power- supply disconnect switches and verify that power is Off with a voltmeter before working within the condensate pump electrical connection enclosure. The Liebert controller does not isolate power from the unit, even in the Unit Off mode. Some internal components require and receive power even during the Unit Off mode of the Liebert controller.

### 8.8.1 Pump Replacement:

1. Turn off the power supply of unit.
2. Open the rear door.

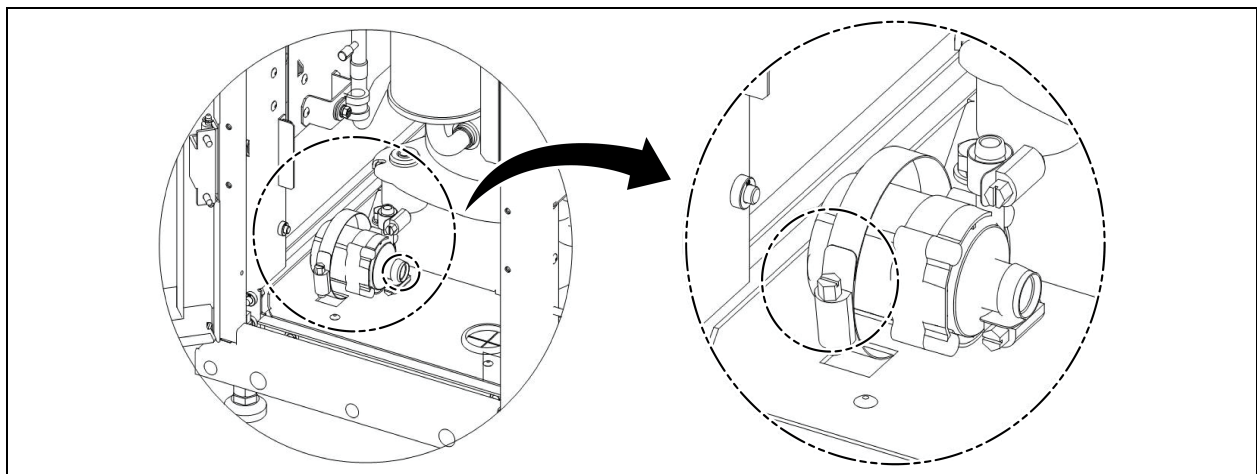
**Figure 8.5 The Location of Condensate Pump**



Item	Description
1	Condensate pump

3. Remove the screws of hose clamp which holds the pump at place.
4. Remove the pipe of the pump by unscrewing the hose clamp.

**Figure 8.6 Removal the Condensate Pump**



## 8.9 Pump Maintenance

1. Turn off the power supply of unit.
2. Open the rear door.
3. Check and clear any obstructions in the main line of the condensate pump.
4. Remove the pump and clean it with a mild cleaning solution.
5. Ensure the float mechanism is clean and free from the foreign particles.
6. Re-install the pump and check the operation.

## 8.10 Refrigerating System Maintenance

1. Check the refrigerating system once a month to ensure the system functionality.
2. Inspect the refrigeration system to detect the signs of wear and tear.
3. Regularly inspect the refrigeration system to ensure long service life.
4. Check the refrigerant pipes every six months to ensure there is no wear and tear.

## 8.11 Drainage System Maintenance

Inspect the water tray periodically to ensure normal operation of the drainage pipe. Ensure no sediments, debris, foreign matter, or leakage occurs in the water tray.

## 8.12 Dismantling the Unit

The machine has been designed and built to ensure continuous operation. The working life of the main components, such as the fan and the compressor, depends on the operation and maintenance that they receive. The unit contains environmentally hazardous substances and components (electronic components, refrigerating gases and oils). At the end of the useful life, when the unit is dismantled, the operation must be carried out by specialized refrigerating technicians. The unit must be delivered to designated/authorized centers specialized in the collection and disposal of equipment containing hazardous substances. The refrigerating fluid and the lubricating oil inside the circuit must be recovered according to the laws applicable respective relevant country. To recover the gas follow all the connections described in the user manual.

## 8.13 Troubleshooting

Troubleshooting is to be performed by trained and qualified service personnel.

**NOTE: If jumpers are used for troubleshooting, ensure they are removed after the troubleshooting. If the jumpers are not removed properly the jumpers may bypass critical control functions and increase the risk to the equipment.**

**Table 8.3 Troubleshooting the Fan**

Symptom	Possible Causes	Items to be Checked	
EC fan cannot be started	Power supply disconnected	Check whether the fan MCB is closed, If the MCB is closed, check if the power voltage of each phase is normal	
	Control board faulty	Check J16 on the micro-processing control board, to determine whether the control board is faulty or functions correctly	
	Fan power module faulty	Check the alarm light on the fan power module to determine whether it is faulty or functioning correctly	
	EC fan faulty		In case of power failure, phase loss, and low voltage check power cable of fan.
			Check whether the analog output is within the range of 0 Vdc to 10 Vdc as per the requirement
		Check whether the motor is clogged (due to large current)	
		Check whether the motor is overheated.	

**NOTE: If Motor clogging, overheating, or power failure occurs, the motor will resume normal operation after the faults are cleared.**

**NOTE: If the motor is overheated, turn off the fan power. Once motor is cooled down, proceed to power the motor on again for normal function.**

**NOTE: In the event of a hall failure, factory service is required to fix the issue.**

### 8.13.1 Troubleshooting of the Heating System

**Table 8.4 Troubleshooting the Heating System**

Symptom	Possible Causes Problem	Items to be Checked or Handling Method
Heating system does not start, the contactor does not close	No heating demand	Examine the status of the micro-processing controller and determine if a heating command is necessary.
	Safety device of the heating system is open	Use a multi-meter to measure the resistance on both ends of the temperature controller. If the resistance is, it indicates that the safety device may be open. Next, check whether the fuse is open and the temperature controller is damaged. Measure the resistance of the heater with an ohm meter to judge if the heater is damaged.
The contactor closes, but heating is ineffective	Heater main power is off	Check if the heaters MCB is turned ON. Check whether the voltages are normal when the contactor is energized.
	Electric heater burned	Turn off the power, then physically check the condition of the heater.



## 8.13.2 Troubleshooting the Compressor and Cooling System

**Table 8.5 Troubleshooting the Cooling System**

Symptom	Possible Causes	Items to be Checked or Handling Method
Compressor cannot be started	Does not power-on (shutdown)	Check the main power against under-voltage, over-voltage, and phase loss.
	MCB and contactor faulty	Check the compressor MCB, contactor, and connecting cables.
	Alarm lock	View the unit alarm records, replace the damaged component and power it ON again.
	Compressor coils shorted and burnt	Check the motor and replace it in case of any defects or malfunction.
The contactor does not get closed, and the compressor does not start	Low discharging overheat degree alarm	Check the state of the micro-processing controller.
	High pressure MCB action	Check if there is an HP alarm.
	Discharging temperature alarm	Check whether a discharging low/high temperature alarm exists.
	Low pressure alarm	View if a low-pressure alarm exists in the history alarm.
	Contactor faulty	Check if the contactor is able to energize.
	Compressor driver faulty	Check the compressor driver.
The compressor stops after running for 3 minutes. Contactor open	Refrigerant leaked, the low-pressure check is too low or abnormal	Check the suction pressure.
		Check the circuit of the low-pressure sensor.
		Calibrate the low-pressure sensor as it reads within range of $\pm 0.3$ bar of the actual pressure.
High pressure protection	Condenser clogged	Clean the condenser.
	Condenser system does not start	Check the condenser fan for the air-cooled system.
	Too much refrigerant has been charged	Check whether the sub-cooling degree is too high.
Low discharge pressure	Refrigerant leaked	Locate the leakage point, repair it and add the refrigerant.
	The fan speed controller of the outdoor unit is faulty, while the output voltage remains 100%, irrespective of the change in the condensing pressure	If the fan speed controller is found faulty, then it has to be replaced.
The suction and discharge pressures do not change after startup	Either the compressor is reversed or the internal air seal of the compressor has failed	If the compressor is reversed, exchange any two L lines of the compressor. If the internal air seal of the compressor has failed and cannot be restored, replace the compressor.
Low suction pressure or liquid returned	Insufficient refrigerant in the system	Check for leaks. Seal the leaking point and add the refrigerant.
	Air filter too dirty	Replace the air filter.
	Filter drier clogged	Replace the filter drier.
	Improper superheating degree	Check the control EEV.
	Sensing element of expansion valve faulty	Replace the sensing element.
	Improper air flow distribution	Check the air supply and return system.
	Low condensing pressure	Check whether the condenser is faulty.

**Table 8.5 Troubleshooting the Cooling System (continued)**

Symptom	Possible Causes	Items to be Checked or Handling Method
Compressor too noisy	Liquid returned	Refer to the handling methods of <b>Low suction pressure or liquid returned</b> .
	Bearing worn out due to lubricant loss	Add lubricant.
Compressor over temperature	Too high compression ratio	Check the settings of the HP value and LP value, and inspect if the condenser is clogged.
		Check that the fans of the evaporator and condenser are normal.
	Too high suction overheat degree	Add proper amount of refrigerant.

## 9 Regulation (EU) No. 517/2014 (F-Gas)

### 9.1 Introduction

Stationary air conditioners placed into the European community market and operating with fluorinated greenhouse gases (F-gas, such as R407C, R134a, R410A), have to comply with the F-gas (fluoride gas) Regulation (EU) No. 517/2014.

This regulation is in force since Jan 1, 2015 as it replaces the Re. (EU) no. 342/2006.

This section summarizes the responsibility for the operators that are responsible for the equipment throughout its operational life until its disposal.

### 9.2 Normative References

**Table 9.1 Normative References**

F-gas	517/2014	Regulation (EU) No 517/2014 of the European Parliament and of the Council of 16 April 2014 on fluorinated greenhouse gases and repealing Regulation (EC) No 842/2006.
Certified personnel and companies	2015/2067	Commission Implementing Regulation (EU) 2015/2067 of 17 November 2015 establishing, according to Regulation (EU) No 517/2014 of the European Parliament and of the Council, minimum requirements and the conditions for mutual recognition for the certification of natural persons as regards stationary refrigeration, air conditioning and heat pump equipment, and refrigeration units of refrigerated trucks and trailers, containing fluorinated greenhouse gases and for the certification of companies as regards stationary refrigeration, air conditioning and heat pump equipment, containing fluorinated greenhouse gases.
Leak check air conditioning	1516/2007	Commission Regulation No 1516/2007 of 19 December 2007 establishing, according to Regulation (EC) No 842/2006 of the European Parliament and of the Council, standard leakage checking requirements for stationary refrigeration, air conditioning and heat pump equipment containing certain fluorinated greenhouse gases.
Leak check fire protection systems	1497/2007	Commission Regulation No 1497/2007 of 18 December 2007 establishing, according to Regulation (EC) No 842/2006 of the European Parliament and of the Council, standard leakage checking requirements for stationary fire protection systems containing certain fluorinated greenhouse gases. From 01/01/2017 to be replaced by: Commission Implementing Regulation (EU) 2015/2068 of 17 November 2015 establishing, according to Regulation (EU) No 517/2014 of the European Parliament and of the Council, the format of labels for products and equipment containing fluorinated greenhouse gases.

### 9.3 Fluorinated Greenhouse Gases

Following notes have to be considered when operating with the above mentioned equipments:

- Fluorinated greenhouse gases are covered by the Kyoto Protocol.
- The fluorinated greenhouse gases in this equipment should not be vented to the atmosphere.
- Referring to the value noted in Annex I and Annex IV of Regulation (EU) No 517/2014 here below the global warming potential (GWP) of some major F-gases or mixtures:
  - R-134a GWP 1430
  - R-407C GWP 1774
  - R-410A GWP 2088

**NOTE: The refrigerants as R22 are not F-gas and their relevant regulation is Reg. (EU) no. 1005/2009.**

## 9.4 Operators

### 9.4.1 Definitions

- Operator, according to Regulation 517/2014 Article 2, point 8, means the natural or legal person exercising actual power over the technical functioning of products and equipment covered by this regulation.
- The state may, in defined, specific situations, designate the owner as being responsible for the operators obligations.
- Where large installations are involved, service companies are contracted to carry out maintenance or servicing. In these cases the determination of the operator depends on the contractual and practical arrangements between the parties.

### 9.4.2 Obligations

Operators of stationary air conditioners, which contain fluorinated greenhouse gases, shall use all measures which are technically feasible and do not involve disproportionate cost:

- Prevent leakage of F-gases and as soon as possible repair any detected leakage.
- Ensure that air conditioners are checked for leakage by certified personnel.
- Ensure for putting in place arrangements for the proper recovery by certified personnel.
- According to Regulation 517/2014 the operators shall ensure that the equipment is checked for leaks as following:
  - Case 1: Non-sealed equipment contains less than 5 tonnes of CO<sub>2</sub> equivalent of fluorinated greenhouse gases.
    - Leakage test is not required.
  - Case 2: Hermetically sealed equipment contains less than 10 tonnes of CO<sub>2</sub> equivalent of fluorinated greenhouse gases.
    - Leakage test is not required.
  - Case 3:
    - Leakage test required.

Check the equipment for leaks with the minimum frequency given in the **Table 9.2** below :

**Table 9.2 Minimum Frequency for Leak Check**

X = Tonnes of CO <sub>2</sub> Equivalent	Y = Equivalent Amount of Refrigerant (kg)			Minimum Frequency for Leak Check	
	R134a	R410A	R407C	With Leakage Detection	Without Leakage Detection
5 ≤ X < 50	3,5 ≤ Y < 35	2,4 ≤ Y < 24	2,8 ≤ Y < 28	12 Months	24 Months
50 ≤ X < 500	35 ≤ Y < 350	24 ≤ Y < 240	28 ≤ Y < 282	6 Months	12 Months
X ≥ 500	Y ≥ 350	Y ≥ 240	Y ≥ 282	3 Months	12 Months

Recovery for the purpose of recycling, reclamation or destruction of the fluorinated greenhouse gases, pursuant to Art. 8 of the Regulation 517/2014 shall take place before the final disposal of that equipment and, when appropriate, during its servicing and maintenance.

## 9.5 Leakage Detection

The manufacturer approves the following leakage check methods according to Reg. 1516/2007 and Reg. 1497/2007:

Method	Specifications
Check of circuits and components representing a risk of leakage using gas detection devices adapted to the refrigerant in the system	Gas detection devices should be checked every 12 months to ensure their proper functioning. The sensitivity of portable gas detection devices shall be at least five grams per year.
Application of ultraviolet (UV) detection fluid or suitable dye in the circuit	The method shall only be undertaken by personnel certified to undertake activities which involve breaking into the refrigeration circuit containing fluorinated greenhouse gases.
Proprietary bubble solutions/soapsuds	NA

## 9.6 Labelling

The label applied on the unit (see Onboard Label) is designed to fill-in the relevant amounts of refrigerant according to Regulation 1494/2007 (2015/2068):

1. Where fluorinated greenhouse gas is expected to be added to the equipment outside of the manufacturing site at the point of installation, a dedicated label accommodates notation of both the quantity (kg) pre-charged in the manufacturing plant and of the quantity charged at the installation site as well as the resulting total quantity of Fluorine gas as a combination of the above mentioned quantities, in a manner which conforms to the easy to read and indestructible.

Our split units are usually not pre-charged on factory, in this case the total quantity of refrigerant charged in the unit has to be written in the relevant label, during the commissioning operation at the installation site.

All of the quantities of must be given both as mass of refrigerant (kg) and as tonnes of CO<sub>2</sub> equivalent. Use the following rule for computation:

$$\text{Tonnes of CO}_2 = \text{kg of refrigerant} \times \text{GWP of refrigerant} / 1000$$

where:

Refrigerant	GWP
R-134a	1430
R-407C	1774
R-410A	2088

2. Our packaged units (not split) operating with F-gas are usually fully charged at the factory and the total amount of refrigerant charge is already reported on the label. In this case, the label has no need of further written information.
3. In general, the above mentioned information has been located in the main nameplate of relevant unit.
4. For equipment with double refrigeration circuits, in regards to differing requirements on the basis of the quantity of F-gas contained, the required information about refrigerant charge quantities has to be listed separately for each individual circuit

5. For equipment with separate indoor and outdoor sections connected by refrigerant piping, the label information will be on that part of the equipment which is initially charged with the refrigerant. In case of a split system (separate indoor and outdoor sections) without a factory pre-charge of refrigerant, the mandatory label information will be on that part of the product or equipment which contains the most suitable service points for charging or recovering the fluorinated greenhouse gases.

**NOTE: Safety data sheets of F-gases used in the products are available on demand.**

## 9.7 Record Keeping

Operators of equipment which is required to be checked for leaks (see [Leakage Detection](#) on the previous page ), should establish and maintain records for each piece of such equipment specifying the following information:

- The quantity and type of fluorinated greenhouse gases installed.
- The quantities of fluorinated greenhouse gases added during installation, maintenance or servicing or due to leakage.
- Whether the quantities of installed fluorinated greenhouse gases have been recycled or reclaimed, including the name and address of the recycling or reclamation facility and, where applicable, the certificate number.
- The quantity of fluorinated greenhouse gases recovered.
- The identity of the undertaking which installed, serviced, maintained and where applicable repaired or deactivated the equipment, including, where applicable, the number of its certificate.
- The dates and results of the leak checks carried out (see [Leakage Detection](#) on the previous page ).
- If the equipment was deactivate , the measures taken to recover and dispose of the fluorinated greenhouse gases unless the records are stored in a database set up by the competent authorities of the member states the following rules apply:
  - The operators shall keep the records for at least five years.
  - Undertakings carrying out activities for operators shall keep copies of the records for at least five years.

# 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

#### 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





## Appendix C: Display Parameter List

Lv.1 Menu	Lv.2 Menu	Parameter
Run Information	Temp/Hum Information	Return Temp1
		Return Hum
		Return Temp2
		Return Temp3
		Return Temp Avg
		Return Hum Avg
		Supply Temp1
		Supply Temp2
		Supply Temp3
		Supply Temp Avg
		Supply Hum Avg
		Remote Temp1
		Remote Temp2
		Remote Temp3
		Remote Temp4
		Remote Temps
		Remote Temp6
		Remote Temp7
		Remote Temp8
		Remote Temp9
Remote Temp10		
Remote Hum1		
Remote Temp Avg		
Remote Hum Avg		

Lv.1 Menu	Lv.2 Menu	Parameter
	Switch Status	Filter Clogged Switch
		Cond Water Overflow
		Cond Water Level SW
		Low Pressure Switch
		High Pressure Switch
		Remote Shutdown SW
		Water Underfloor SW
		Heater Fail Switch
		Customer1 Switch
	Power Information	L1 Voltage
AC Frequency		
Run Information	Teamwork Information	00 Unit Status
		01 Unit Status
		02 Unit Status
		03 Unit Status
		04 Unit Status
		05 Unit Status
		06 Unit Status
		07 Unit Status
		08 Unit Status
		09 Unit Status
		10 Unit Status
		11 Unit Status
		12 Unit Status
		13 Unit Status
		14 Unit Status
15 Unit Status		
Alarm Information	Alarm Status	
	Alarm History	
Temp/Hum Setting	Temp Setting	Supply Avg Temp SP, Default 23 °C (73.4 °F), Range 15 °C to 32 °C (59 °F to 89.6 °F)
		Return Avg Temp SP, Default 32 °C (89.6 °F), Range 18 °C to 40 °C (64.4 °F to 104 °F)
		Remote Avg Temp SP, Default 23 °C (73.4 °F), Range 15 °C to 32 °C (59 °F to 89.6 °F)
	Hum Setting	Supply Avg Hum SP, Default 50%, Range 20% to 60%

Lv.1 Menu	Lv.2 Menu	Parameter
Parameter Setting	Teamwork Setting	Teamwork Mode
		Unit Address
		Units Quantity
		Standby Quantity
		Rotation Quantity
		Rotation Cycle
		Rotate Daily
		Rotate At
		Manual Rotate
		Run Standby Delay
		Cascade Mode
		Cascade Start Require
		Cascade Stop Require
		Cascade Max Require
		Cascade Start Delay
		Cascade Stop Delay
	Cascade Min Time	
	Alarm Setpoint	Sup High Temp Alarm SP, Default 27 °C (80.6 °F), Range 20 °C to 35 °C (68 °F to 95 °F)
		Sup Low Temp Alarm SP, Default 8 °C (46.4 °F), Range 5 °C to 20 °C (41 °F to 68 °F)
		Rtn High Temp Alarm SP, Default 40 °C (104 °F), Range 30 °C to 45 °C (86 °F to 113 °F)
		Rtn Low Temp Alarm SP, Default 18 °C (64.4 °F), Range 5 °C to 25 °C (41 °F to 77 °F)
		Rtn High Hum Alarm SP, Default 60%, Range 50% to 99%
		Rtn Low Hum Alarm SP, Default 15%, Range 1% to 50%
		Rem High Temp Alarm SP, Default 27 °C (80.6 °F), Range 20 °C to 45 °C (68 °F to 113 °F)
		Rem Low Temp Alarm SP, Default 10 °C (50 °F), Range 5 °C to 20 °C (41 °F to 68 °F)

Lv.1 Menu	Lv.2 Menu	Parameter
Parameter Setting	Alarm Attribute	Return High Temp
		Return Low Temp
		Return High Hum
		Return Low Hum
		Supply High Temp
		Supply Low Temp
		Remote High Temp
		Remote Low Temp
	Communication Setting	Monitor Protocol
		Monitor Baudrate
		Monitor Address
	Time Setting	Date Setting
		Time Setting
	Display Setting	Language
		Display Address
Password Setting	Level 1 Password	
	Level 2 Password	
Temp/Hum Graph	Rtn Avg Temp	
	Rtn Avg Hum	
	Sup Avg Temp	
	Rem Avg Temp	
About	Version Information	Control Software Model
		Control Software Version
		Display Software Model
		Display Software Version
	Service Information	

## Appendix D: Alarms Table

Alarm Table			
High Pressure Alarm	Low Pressure Alarm	Discharge High Temp	Discharge Low SH
Dsch High Temp Lock	High Pressure Lock	Low Pressure Lock	Dsch Low SH Lock
Return High Hum	Return Low Hum	Return High Temp	Return Low Temp
Supply High Temp	Supply Low Temp	Remote High Temp	Remote Low Temp
Loss Of Power	Power Overvoltage	Power Undervoltage	Power Freq Offset
Filter Clogged Alarm	Clogged Maintenance	Water Underfloor	Cond WOF
Loss Of Airflow	Loss Of Primary Unit	Loss Of Secondary Unit	Remote Shutdown
Return Temp Sensor1 Fail	Return Hum Sensor1 Fail	Supply Temp Sensor1 Fail	Supply Temp Sensor2 Fail
High Pressure sensor Fail	Low Pressure sensor Fail	Discharge Temp Sensor Fail	Suction Temp Sensor Fail
Remote Temp Sensor1 Fail	Remote Temp Sensor2 Fail	Remote Temp Sensor3 Fail	Remote Temp Sensor4 Fail
Remote Temp Sensor5 Fail	Remote Temp Sensor6 Fail	Remote Temp Sensor7 Fail	Remote Temp Sensor8 Fail
Remote Temp Sensor9 Fail	Remote Temp Sensor10 Fail	Heater Fail	10D1 Comm Fail
EEV Driver Comm Fail	Comp Drv Comm Fail	Unit Addr Repeat	Comp Drv Protect00
Comp Drv Protect01	Comp Drv Protect02	Comp Drv Protect03	Comp Drv Protect04
Comp Drv Protect05	Comp Drv Protect06	Comp Drv Protect07	Comp Drv Protect08
Comp Drv Protect09	Comp Drv Protect10	Comp Drv Protect11	Comp Drv Protect12
Comp Drv Protect13	Comp Drv Protect14	Comp Drv Protect15	Fan1 Fail
Fan2 Fail	Fan3 Fail	Fan4 Fail	Customer1 Alarm
Smoke Sensor Fail	Fire Sensor Fail		

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