Vertiv™ Liebert® PEX3 DX Precision Air Conditioning

User 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

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Vertiv Co. Ltd.

China

Homepage: www.vertiv.com

E-mail: support@vertiv.com

Customer service hotline: 4008876510

Asia Pacific

Homepage: www.vertiv.com.

E-mail: overseas.support@vertiv.com

Australia

Customer service hotline: 1300367686

New-Zealand

Customer service hotline: 0800100877

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Purpose of the Document

This document applies to the series of precision air conditioners and cooling solutions which maintain optimal environmental control of technological ecosystems at minimal operating costs. This document gives an overview of the specifications, installation, commissioning, and maintenance procedures with troubleshooting from the user's perspective. The figures used in this document are for reference only.

Please read this manual carefully before installing, maintaining, and troubleshooting.

Liebert® PEX3 DX series precision CRAC is a professional device, only professionals are permitted to access the unit and is placed where access is restricted to common people.

Styling used in this Guide

The styles used in the manual will be defined as mentioned in the following table:

Situation	Description
Warning/Danger/Caution	 **WARNING! The Warning/Danger/Caution note indicates a hazardous or potentially harmful situation that can result in death or injury. It also indicates instructions that need to be adhered to, failing which may result in danger and safety issues thereby having an adverse effect on the reliability of the device and security. Even for practices not related to physical injury, to avoid equipment damage, performance degradation, or interruption in service, follow the warning instruction.**
Note	**NOTE: The Note section indicates additional and useful information. It also calls attention to best practices and industry-best protocols that are standardized and help make maximum utilization of the resources at hand. Helpful information related to the product also comes under the Note heading, helping the users with the definitions, concepts, and terminologies used in the manual.**

Version History

Version	Revision Date	BOM No.
1.0	25.08.2019	31013890
2.0	05.01.2023	31013890

Safety Precautions and Measures

The important safety precautions and measures that should be followed during the installation and maintenance are described in the following sections.

Read the manual prior to installation and operation of the unit. Only qualified personnel should move, install, or service this equipment.

Before working on the equipment, the user must read and consider all precautions, compliance, and safety measures. The unit control must be used exclusively for the purpose which it is intended for; the manufacturer takes no liability for incorrect use or a modification to the unit control.

Adhere to all the Warnings and Cautionary measures included in the manual.

WARNING! Please read this manual carefully before installing, maintaining, and troubleshooting; especially the Warning/Danger/Caution information in the User Guide. Apart from the User Guide, also pay attention to the warning labels on the unit and its components.

This manual is retained for the entire service life of the unit. The user must read all the precautions, dangers, warnings, and cautionary measures mentioned in the manual prior to carrying out any operations on the unit. Each unit is equipped with electric insulation which allows the users to work in safe conditions. The main switch is positioned on the electrical panel cover; to access it, open the right door. Before any maintenance operation, switch off the unit with this electrical insulation device to eliminate risks such as electrical shocks, burns, automatic restarting, moving parts, and remote control. The panel key, supplied along with the unit, must be kept by the personnel responsible for the maintenance. The protective covers can be removed after the electric power has been cut off by opening the main switch.

In the following sections, notice the various cautionary measures and warnings that need to be read carefully prior to installing or operating the system.

Disconnect the local and remote power supplies prior to working with the unit.

Prior to the installation process, read all the instructions, verify if all the parts are in place, and check the nameplate to ensure the voltage matches the available utility power for the unit.

The controller doesn't isolate power from the unit even in the Off mode, and some internal components still require and receive power during the Off mode.

If the unit door is open while the fans are operating, the airflow may result in the abrupt slamming of the door resulting in injury. Another aspect is the presence of small objects in the fans bay that can result in object ejection during the fan start-up and there is a probable risk of being hit by these objects resulting in grievous injury and causing equipment damage.

The unit contains fluids and gases under high pressure. Therefore, the pressure should be relieved before working with the piping.

Various components such as compressors, refrigerant discharge lines, and humidifiers are extremely hot during the unit operation. Therefore, allow sufficient time for the unit to cool down before working with the unit cabinet. Handle the unit with extreme caution and wear safety equipment such as protective gloves, safety shoes, and arm protection while working with the hot compressors, discharge lines, and reheats.

There is a risk of water leaking that can damage both the equipment and the building. Effective water drain connections and facilities should be available. Installation should be precise. Implementation of the application and service practices should be appropriate and fault-free. Failure to comply with these norms will result in water leakage from the unit. Water leakage can lead to massive damage and loss of critical equipment in the hosting ecosystem. Therefore, care should be taken to ensure that the unit is not located directly above any equipment that could sustain damage due to water and excessive moisture. The use of a leak detection system for the unit and system supply lines is recommended by Vertiv.

2 Product Overview

2.1 Product Introduction

The 'Liebert® PEX3 series' is the next generation series of air conditioners that provide precise environmental control. The Liebert PEX3 models are the latest enterprise-grade products from the Liebert family. Incorporating the high standards associated with the Liebert name, the PEX3 series utilizes the latest technology, system components, and streamlined manufacturing process.

Liebert PEX3 air conditioners are specifically created and designed for data centers, equipment rooms, server rooms, and similar ecosystems that require high control accuracy in terms of inside environment condition. It caters to sensitive applications that require a suitable environment for optimal performance. Therefore, care should be taken while testing these sensitive products or maintaining a favorable environment for mission-critical equipment, as even a slight deviation may lead to inaccurate results. Precision Air Conditioning must not only keep room conditions within a specific range but also be able to react quickly to a drastic change in heat load and prevent wide temperature fluctuations.

The PEX3 unit comes with the features such as high reliability, a high sensible heat ratio, and large airflow. It is an excellent system that adheres to the standards of Precision Air Cooling in terms of energy-efficiency, space requirements, and reliability.

Air-cooled series

The Liebert PEX3 air-cooled series air conditioner comprises indoor and outdoor units with the standard configuration of Liebert PEX condenser unit, it can reduce noise pollution to the minimum while meeting system cooling requirements through the pressure regulating the fan speed.

Water-cooled series

The Liebert PEX3 water-cooled series air conditioner uses integrated structure and highly effective brazed-plate heat exchanger (BPHE), thus it is a compact, efficient and quiet in the operating conditions (only P1030 unit).

2.2 Model Description

This chapter introduces the model, appearance, components, optional configuration and refrigerant requirements of Liebert® PEX3. The 'Liebert® PEX3 Series Precision Air Conditioner' ("PEX3" for short hereafter) is a cooling equipment, a medium-large sized precision environment control system, adapted to the environment control of the equipment room or server room, featuring high reliability, high sensible heat ratio and large airflow. The appearance of Liebert PEX3 models are shown in Figure 2.1 below

Figure 2.1 Liebert PEX3 Models

2.3 Model Nomenclature

The Liebert® PEX3 series model is fully-defined by 25 digits, as represented in Table 2.1 below

Table 2.1 Liebert PEX3 Model Nomenclature

1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19	20	21	22	23	24	25
P	1	0	3	0	D	A	1	0	6	H	9	1	2	E	1	D	L	0	0	C	E	0	3	2

Digit 1,2 Product Model		**Digit 17 Mains Switch High Voltage Option**	
P	***PEX3***	0	None
1-2	***Number of Modules/Bays***	***D***	***Main non-Locking Disconnect***
Digit 3 Net Cooling Capacity kW		P	Dual Power Supply Parallel
0-9	***Nominal Net Cooling Capacity- kW***	A	Dual Power Supply Interlocking Contactor
Digit 4 Net Cooling Capacity kW		T	Dual Power Supply Auto Transfer Switch
0-9	***Nominal Net Cooling Capacity- kW***	**Digit 18 Installation Option**	
Digit 5 Net Cooling Capacity kW		0	None, Standard Pipe, No Low Ambient Kit
0-9	***Nominal Net Cooling Capacity- kW***	H	Re-heat & Humidity Lockout
Digit 6 Air Discharge		***L***	***Air-cooled, Long pipe> 30 m***
U	***Upflow***	**Digit 19 Monitoring**	
D	***Downflow***	***0***	***Embedded Unity***
Digit 7 System Type		**Digit 20 Sensors**	
A	***Air Cooled***	***0***	***None***
W*	Water Cooled	A	Supply Air Pressure Sensor
Digit 8 Airflow		S	Smoke Sensor
1	***EC Plug Fan***	H	High Temperature
Digit 9 Power Supply		F	Smoke & High Temp
0	***400 V/3 Ph/50 Hz+N***	N	Supply Air Temperature Sensor
7	380 V/3 Ph/60 Hz+N	1	A+S
C	208 V/3 Ph/60 Hz	2	A+H
D	230 V/3 Ph/60 Hz	3	A+F
A	460 V/3 Ph/60 Hz	4	N+S
8	400 V/3 Ph/50 Hz	5	H+N
Digit 10 Cooling System		6	A+N
4	Compliant Scroll Dual Circuit, R410A	7	H+N+S
6	***Compliant Scroll Single Circuit, R410A***	8	A+N+S
Digit 11 Humidification		9	A+H+N
0	None	B	A+F+N

Table 2.1 Liebert PEX3 Model Nomenclature (continued)

1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19	20	21	22	23	24	25
P	1	0	3	0	D	A	1	0	6	H	9	1	2	E	1	D	L	0	0	C	E	0	3	2

H	***Infrared Humidifier***	**Digit 21 Packaging**	
S	*Electrode Humidifier*	P	Package- Standard Cardboard and Wooden Pallet
Digit 12 Display		***C***	***Packaging– Wooden Crate***
9	***9-inch HMI Display***	**Digit 22 Special Requirements**	
Digit 13 Re-heating		A	SFA- None
0	None	P	For Export with Condensate Pump
1	***Electrical Heating Std. 1 Stage***	***E***	***For Export***
2	Electrical heating Opt. 2 Stage	**Digit 23 Order Identifier**	
Digit 14 Filtration		***0***	***Standard ESP***
2	***G4***	1	50 Pa ESP
3	F5	2	100 Pa ESP
Digit 15 Coil and Valves		3	150 Pa ESP
E	***Standard DX Air Cooled Coil, EEV***	4	200 Pa ESP
6	Water-cooled, 2-way valve	**Digit 24 Order Identifier**	
Digit 16 Enclosure Option		***3***	***Factory Code***
1	***Standard Color Black Orange Peel Grain Coating***	**Digit 25 Order Identifier**	
2	White orange peel grain coating	***2***	***Factory Code***
6	Color charcoal grey w/double skin		

The standard components are represented in ***Bold Italic*** font in Table 2.1 on the previous page.

NOTE: DX Water-cooled version is applicable for 30 kW.

2.4 Components of PEX3 Model

An overview of the main components, optional components, and features of the Liebert® PEX3 is mentioned in this section. Liebert PEX3 components include indoor unit, outdoor unit, and remote monitoring software Figure 2.2 below shows main components of PEX3 model.

Figure 2.2 Main Components of PEX3 Model

No.	Description
1	Evaporator Coil
2	Compressor
3	Electrical Panel
4	HMI Display
5	Filter
6	Electronic Expansion Valve (EEV)
7	EC Fan

2.4.1 Indoor Unit Parts

The Liebert® PEX3 Air-cooled indoor unit includes Compressor, Evaporator, Electronic Expansion Valve, Infrared Humidifier, EC Fan, Electrical Heating, Sight Glass, Filter Dryer, and Liebert® iCOM™ Controller. The description of the main components is tabulated in the Table 2.2 . In case of the water-cooled series indoor unit also includes BPHE and MBV (2-way).

Table 2.2 List of Indoor Unit Components

Component	Description
Cabinet	The cabinet frame is constructed from 2.5 mm, 2.0 mm and 1.2 mm folded galvanized steel. The exterior panels are constructed from 1.2 mm zinc coated sheet of steel and insulated with foam insulation. The cabinet is powder coated in Charcoal Grey color and has a textured finish. The hinged front doors can be removed, and includes captive 1/4 turn fasteners.
Compressor	Equipped with compliant scroll compressor, it withstands high vibration, and features low noise and high reliability.
Evaporator	Uses parallel flow micro-channel evaporator with higher heat transfer efficiency. The material used for evaporator is Aluminum. Detailed design and verification for internal distributor of the evaporator to ensure uniformity of distribution of the refrigerant, the utilization of the evaporator is considerably improved.
Electronic Expansion Valve (EEV)	The EEV is designed for precision modulating control of the refrigerant mass flow. The EEV simultaneously collects temperature and pressure signals to accurately regulate the refrigerant flow. The EEV's wide operating envelope also reduces the condensing pressure, thereby resulting in significant energy savings.
Infrared Humidifier	Infrared humidifier structure is simple, easy to disassemble, clean, and maintain. The infrared humidifier application reduces the dependence on water quality, it takes a very short time to start up and reach the humidification requirement, it has the performances like high humidifying capacity and high efficiency.
EC Fan	Uses EC fans with PP plastic blade material that enable high efficiency, space-saving, low noise characteristics. The structure of EC fan unit is carefully designed, downflow unit adopts a "in-floor" design, this design can lower the EC fan below the floor to supply air, to further improve the efficiency of air supply.
Electrical Heating	Electrical heating features faster heating rate, uniform heating, safety and reliability. The material used for electrical heating is PTC ceramic heating element and aluminum pipe.
Sight Glass	The windows of the system loop observe the state of the refrigerant, detects the system's moisture content. The background color of sight glass changes once the moisture of the system exceeds permissible limits.
Filter Dryer	It can effectively remove moisture present in the system, while the system is operating for long-term. To ensure the normal operation of the system removal of impurities is vital.
BPHE (Water Cooled)	The brazed plate auto-cleansing BPHE is used, where plates are constructed by 316 stainless steel and brazing material is copper. It features compact structure and high heat exchanging efficiency. The maximum working pressure for BPHE is 46 bar. Rotalock connections are provided for water and refrigerant sides.
MBV (Water Cooled)	The 2-way motorized ball valve is used. The water flow in the BPHE can be regulated through the intelligent valve position control of the control board, so as to ensure stable system operation, and the maximum working pressure for MBV is 40 bar.
Long Pipe Kit	The long pipe kit can prevent the refrigerant from returning and concentrating after the compressor is turned off, ensuring normal start of the compressor and making the system safer. The solenoid valve is installed internally, and the check valve is supplied loose for installation on site.

2.4.2 Condenser

Two types of condensers are available, for details, refer to “Liebert® PEX Condenser User Manual” and “LVC Series Condenser User Manual”.

2.4.3 Remote Monitoring Software

Liebert® PEX3 units interface with the BMS system through Modbus/SNMP/BACnet communication protocol by Embedded Unity, which enables Liebert PEX3 to communicate with the host computer and receive the control instructions from the host software. By default one unity card is configured in the unit, but on the request two unity cards can be configured.

2.5 Optional Components

2.5.1 Electrode Humidifier

The electrode humidifier uses the electrodes to boil the water in humidifier bottle to produce steam for humidification purpose. It has specific (soft water) requirements in terms of water quality and sizes of inlet/outlet pipes as compared to the standard infrared humidifier.

2.5.2 2-stage Electrical Heating

The 2-stage electrical heating can be selected based on the heating requirement. The electrical heating can be divided into two stages by configuring the controller. The heater starts step-wise according to the heating requirement. It not only maintains the room temperature but also reduces energy consumption.

2.5.3 Dual Power Supply - ATS

The dual power ATS can automatically detect both the power sources (source 1 and source 2). In case of a break-down of the preferred power source, ATS is equipped to automatically switch to the source 2. It can also provide an output signal associated with power alarm.

2.5.4 Dual Power Supply - Parallel

In dual power supply parallel, there are two sources of power: One is connected through UPS to the fan and the control board, while the components such as electrical heating and humidifier are connected to other power sources which are directly coupled with the main supply. Hence, the fan and the control board can still be operated when the main connection fails without affecting the room's ventilation.

2.5.5 Plenum Configuration

All plenums have grills at the outlet to streamline the air-flow movement across the room. The plenum grills can be manually regulated by changing the direction of the air-flow as per the site requirement. In the case of customized design requirements for the Plenum, contact Vertiv's local representative.

2.5.6 Dual Power (Interlocked Contactors)

It consists of the dual power supply (interlocking contractor 3P). It uses an automatic power switching circuit between the common power supply and the backup power supply that is activated if an emergency power supply is required.

2.5.7 Smoke Detectors

Smoke detection system facilitates the data center to detect smoke in the unique air-flow environment. The equipment room is outfitted with hot and cold aisles, underfloor and overhead spaces, each separated to contain airflow within the space. The active smoke detection technique triggers an alarm with the first sign of smoke.

2.5.8 Fire Detectors

The fire detector can check the field return air temperature. It triggers fire alarm when the smoke level continues to rise along with elevated room temperature, or the temperature is too high and reaches the fire alarm threshold. The primary purpose of the sensor is to examine the air temperature and to initialize the anti-fire measures installed in the facility.

2.5.9 Supply Air Pressure Sensor

Supply Air Pressure Sensor is only used for downflow units. It detects the static pressure under the floor of equipment room. The controller can read the values of static pressure.

2.5.10 Supply Air Temperature Sensor

Supply Air Temperature Sensor is used to modulate the heating and cooling effect of the unit by controlling the supply air temperature through plenum. Temperature limits are field adjustable via display interface. The heating or cooling warning activates when the temperature exceeds the thresholds.

NOTE: According to the requirements, Liebert® PEX3 series can be provided without heating and humidification options.

2.6 Refrigerant Requirement

The unit has a specifically designed air conditioning system that requires a desired per-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 Charging Refrigerant below

NOTE: Do not use inferior quality refrigerant.

NOTE: For any consequences resulting from inferior quality refrigerant, Vertiv does not assume warranty responsibility.

2.6.1 Charging Refrigerant

Air-cooled series

The Liebert® PEX3 air-cooled series air conditioner is charged in the factory with 2 bar nitrogen for shipping. Table 2.3 below and Table 2.4 below show the standard refrigerant charge for indoor and outdoor unit respectively.

Table 2.3 Indoor Refrigerant Charge (Unit: kg)

Indoor Model	P1030	P1040	P1050	P1050	P2060	P2070	P2080	P2090	P2100
	Single Circuit	Single Circuit	Single Circuit	Double Circuit	Double Circuit	Double Circuit	Double Circuit	Double Circuit	Double Circuit
Standard Charge	3.03	3.32	3.32	2x1.66	2x3.03	2x3.03	2x3.32	2x3.32	2x3.32

Table 2.4 Outdoor Refrigerant Charge (Unit : kg)

Outdoor Model	LSF38	LSF42	LSF52	LSF62	LSF70	LSF76	LSF85	LDF76	LDF85	LVC 088SE4	LVC 106SE4	LVC 140 SE4	LVC 152SE4
Standard Charge	2.99	4.65	6.19	5.64	5.64	7.30	9.73	2x3.65	2x4.87	2x4.79	2x6.39	2x6.10	2x7.19

Refrigerant Charge = Charge of Indoor Unit + Charge of Outdoor Unit + (Refrigerant Charge per Unit Length of Liquid Pipe x Length of Extended Pipe)

Table 2.5 Amount of Refrigerant per Unit Length of Liquid Pipe (Unit: kg/m)

Liquid Pipe OD (mm)	Refrigerant Charge per Unit Length of Liquid Pipe (kg/m)
16	0.17
19	0.24
22	0.32
25	0.42

Water-cooled series

The Liebert® PEX3 Water-cooled series air conditioner is charged in the factory with 1 bar to 2 bar nitrogen for shipping. Table 2.6 below show the standard refrigerant charge for the unit on-site.

Table 2.6 Indoor Refrigerant Charge Water-cooled (Unit: kg)

Indoor Model	P1030
	Single Circuit
Standard Charge	4.0

2.7 Storage & Operating Environment Requirements

Refer Table 2.7 belowand Table 2.8 below for storage environment and operating environment requirement.

Table 2.7 Storage Environment Requirements

Item	Requirement
General requirements	Clean room (no dust)
Environment humidity	Less than 95% RH (30 °C)
Ambient temperature	-25 °C to +55 °C
Storage time	Total transportation and storage time should not exceed six months, otherwise the performance of the system needs to be re-calibrated.

Table 2.8 Operating Environment Requirements

Item	Requirement
Ambient temperature	Indoor temperature: 18 °C to 35 °C, Outdoor (air cooling): -15 °C to +45 °C, the minimum operating of outdoor is -35 °C, when equipped with low temp kit. Cooling water inlet temperature: 10 °C to 34 °C.
Protection level (cooling unit)	IP20
Altitude	<1000 m, derating is required when located altitude is above 1000 m.
Operation voltage range	400 V, 3 Ph + N~50 Hz

NOTE: Please contact Vertiv local representative when operating in the following conditions: The voltage of the air conditioning unit is beyond the range of the operating voltage. The altitude is higher than 1000 m. If the operating condition is not as per Table 2.8 .

3 Installation

The installation process consists of the following procedures, namely:

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

3.1 Pre-installation

3.1.1 Transportation & Movement

Railways and shipping are the preferable transport options for the CRAC. 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.

Liebert® PEX3 unit is heavy, it is recommended to use the mechanical equipment like electrical forklift to move the unit.

Move the equipment to the location near the installation site.

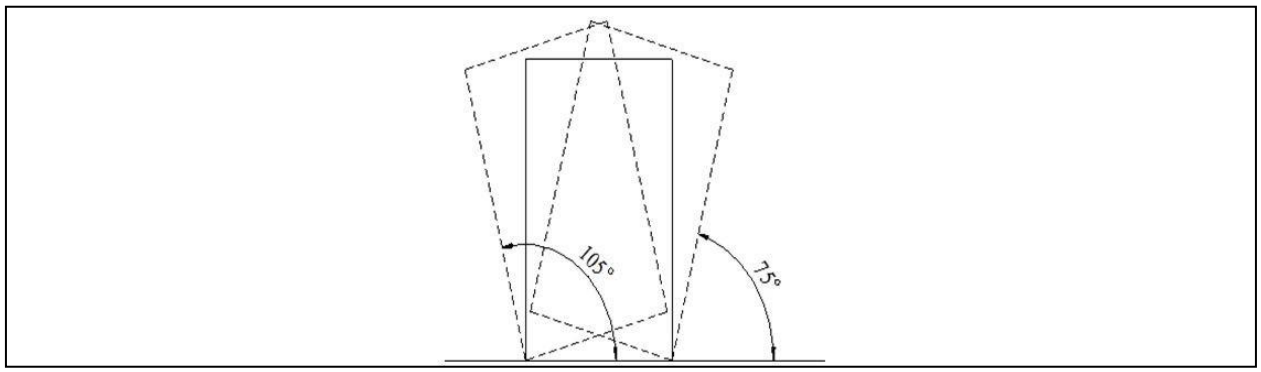
If an electric forklift is used, insert the tines of the forklift below the pallet as displayed in Figure 3.1 below.

Figure 3.1 below shows how the forklift tines are inserted underneath the pallet and shows in the same picture the illustration to the right that the tines should be aligned with the center of gravity to prevent the equipment from falling over.

Figure 3.1 Moving an Equipment Using a Forklift Truck

While moving the indoor unit, keep the obliquity within the range of 75° to 105°, as shown in Figure 3.2 on the next page

Figure 3.2 Obliquity of the System



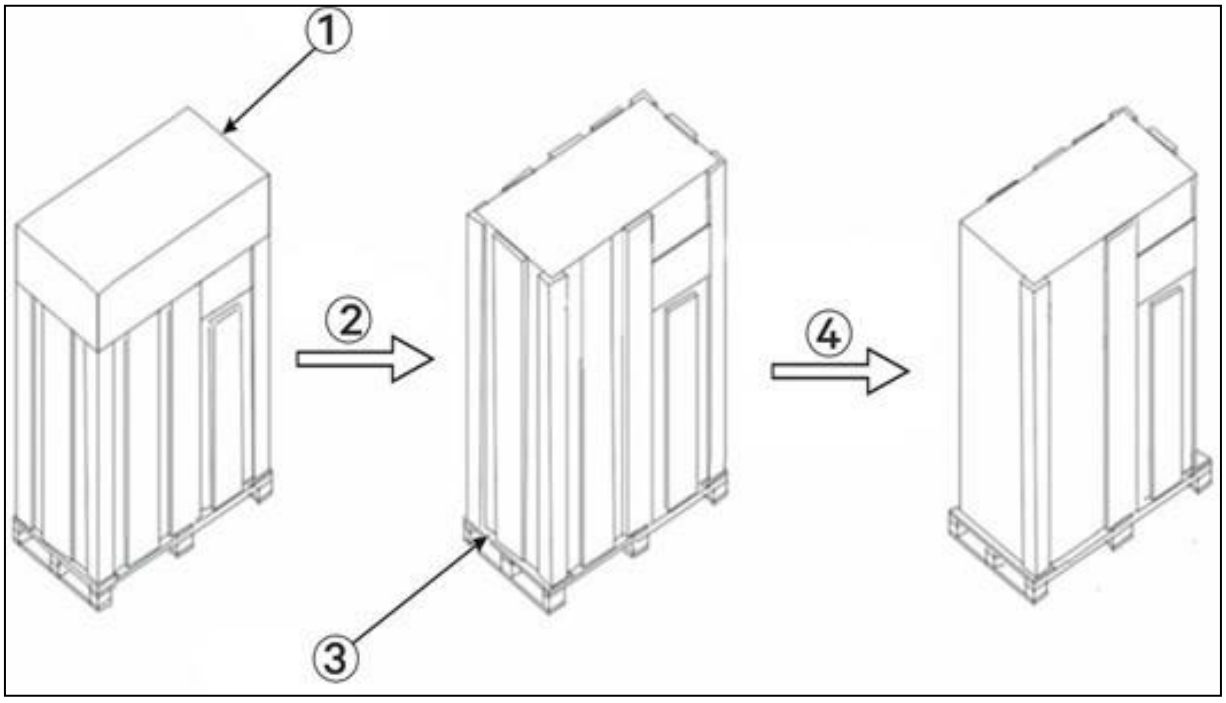
3.1.2 Unpacking

Move the equipment to the location nearest to the final installation site and unpack it. Follow the procedures below for unpacking.

Removal of Paper Packaging

Remove the packaging tape and carton at first, then remove the top cover followed by dismantling the unit on the sealing plastic, finally, remove the Honey Comb Paper Board. For better understanding see Figure 3.3 below.

Figure 3.3 Removal of Honey Comb Paper Board

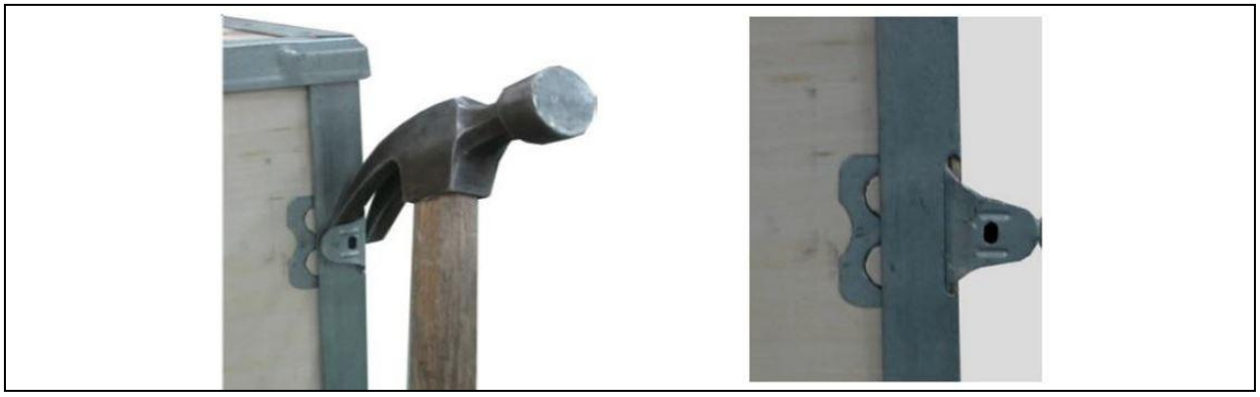


No.	Description	No.	Description
1	Top Cover	3	Honey Comb Paper Board
2	Remove Top Cover	4	Remove sealing plastic film and Honey Comb Paper Board

Removal of Wood Packaging

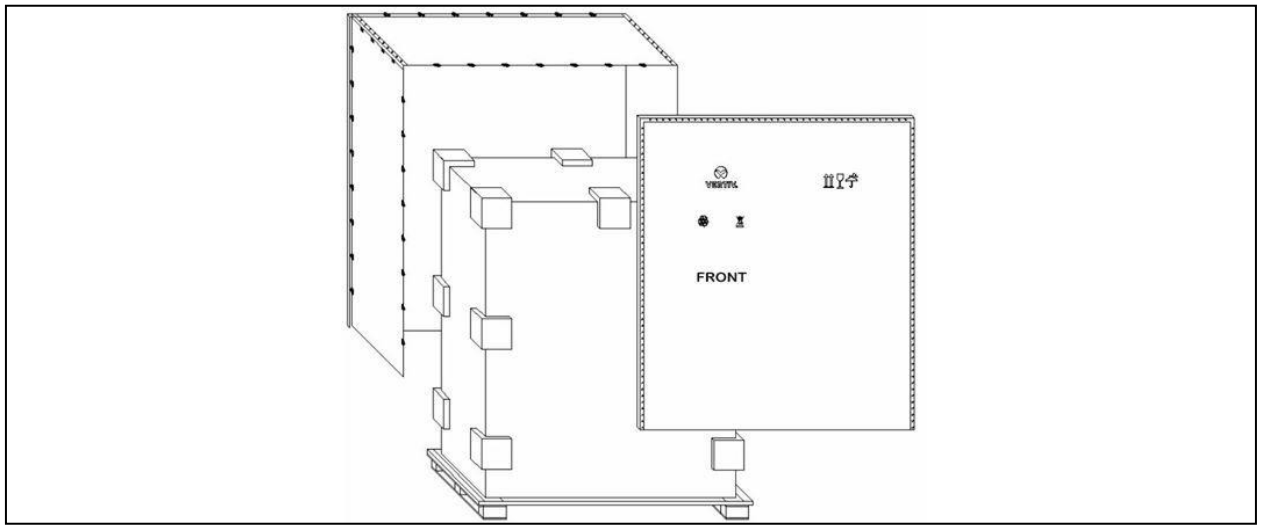
Use a claw hammer or straight screwdriver to straighten the connection hook that holds the side panels to the top cover, as shown in Figure 3.4 below.

Figure 3.4 Straightening the Hook



Firstly, straighten all the hooks that hold side panel-I and remove side panel-I. Then straighten all the hooks that hold side panel-II and remove side panel-II. At last remove top cover-III, as shown in Figure 3.5 below.

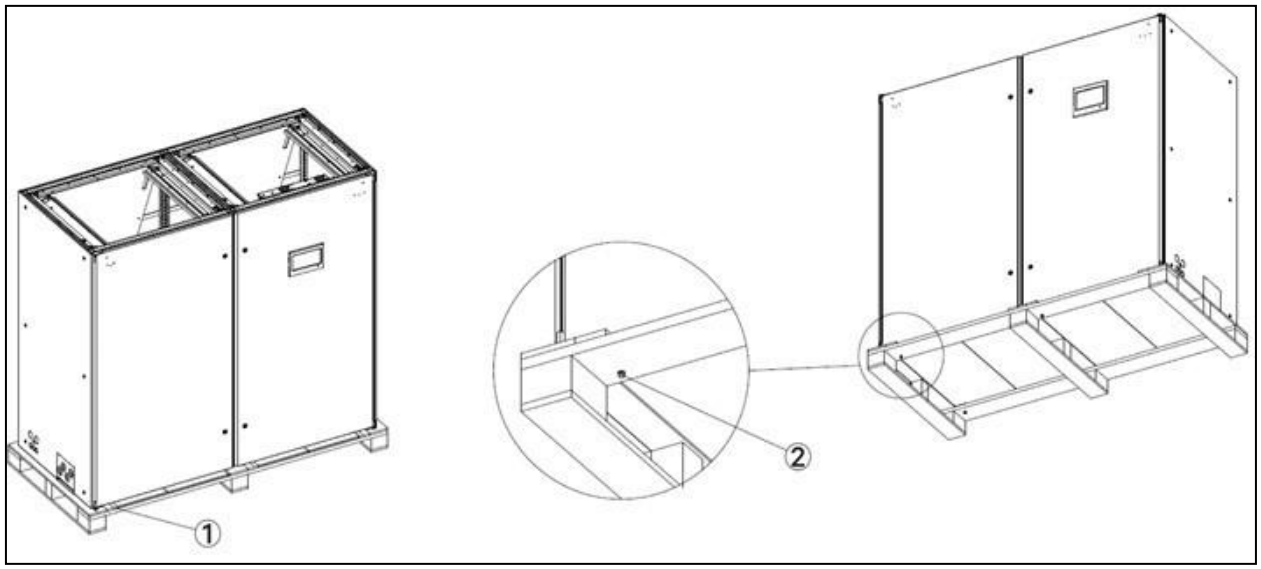
Figure 3.5 Removing Side Panel and Top Cover



Remove the Base Pallet

The unit is fixed onto the base pallet with M8×65 bolts or M8×90 screw, as shown in Figure 3.6 below for air-cooled, it will be same for water-cooled model (single bay) as well. Use a 17 mm open-end spanner, ratchet spanner, or sleeve to remove the fixing bolts.

Figure 3.6 Pallet Screws Fixing Position for Air Cooled



No.	Description	No.	Description
1	Pallet Screw Position Marking	2	Pallet Screw

3.1.3 Inspection

Check that the fittings are complete and the components are intact against the packing list. If any parts are missing or damage is found, please report immediately to the local offices of the carrier and Vertiv local representative.

3.2 Installation Preparation (Site Preparation)

Liebert® PEX3 series is streamlined for maintaining a favorable environment for equipment rooms, computer rooms, and similar ecosystems. Strict adherence to the installation procedures is mandatory to ensure that the air conditioner is installed properly.

3.2.1 Equipment Room Requirements

Before installation, the equipment room must be prepared to ensure a smooth operating flow and to achieve the expected results. The equipment room must meet the standards, to get proper ventilation and heating. The design specifications for the air conditioners must be ideal and should match the energy-efficient design standards.

Following are the requirements to maintain a favorable room environment prior to the installation.

1. The Equipment room should have suitable and effective heat insulation.
2. The equipment room should have a sealed and damp-proof layer. Polyethylene film should be used for the damp proof layer of the ceiling and walls. Alternatively, moisture-proof paint can be used to simulate the same effect akin to Polyethylene. It is important to ensure that the coating on the concrete wall and floor is damp-proof.
3. Outdoor air significantly increases the load of heating, cooling, humidification, and dehumidification. Therefore, all the doors and windows must be closed. Gaps and seams must be very narrow to prevent the outdoor air from entering the equipment room. It is an industry best practice to keep the infiltration of the outdoor air below 5% of the total indoor airflow. Apply appropriate thermal insulation and antifreeze measures for outdoor water pipes to avoid poor drainage and insufficient water supply caused by freezing.

NOTE: Vertiv recommends that the site preparation is defined as per the requirements. However, if these requirements are not met, Vertiv suggests that rectifications to be made on the site in order to comply with the specified requirements and conditions.

NOTE: However, if the rectifications or modifications are not implemented, then Vertiv does not guarantee the accuracy and precision of the temperature and humidity provided by the unit.

3.2.2 Installation Space Requirements

Adequate installation space for the indoor unit must be provided. The indoor unit of the Liebert® PEX3 DX product must be installed on the floor of Equipment room or Server Room and the outdoor unit must be installed outside data center, open to the external ambient.

WARNING! 1. Do not use the indoor unit in the open and severe outdoor environment.

2. Avoid locating the indoor unit in concave or narrow areas, which can obstruct the airflow, shorten the cooling cycle, and result in air return short cycle and air noise.

3. Avoid locating multiple indoor units close to each other. This can result in short cycle of air and create load imbalance.

4. Do not install the unit within the vicinity of any other precision cooling equipment to prevent the leakage of condensed water produced due to imbalance load condition.

5. Do not install other devices (such as smoke detector) over the indoor cabinet.

3.2.3 Maintenance Space Requirement

When installing the unit, a minimum maintenance space of 1100 mm must be reserved in-front of the air conditioning unit. The required maintenance space for air-cooled unit is shown in Figure 3.7 below and for water-cooled unit see Figure 3.8 on the next page. Refer Table 3.1 on the next page for maintenance spaces of both types of unit models.

Figure 3.7 Maintenance Space of Unit for Air-cooled Unit

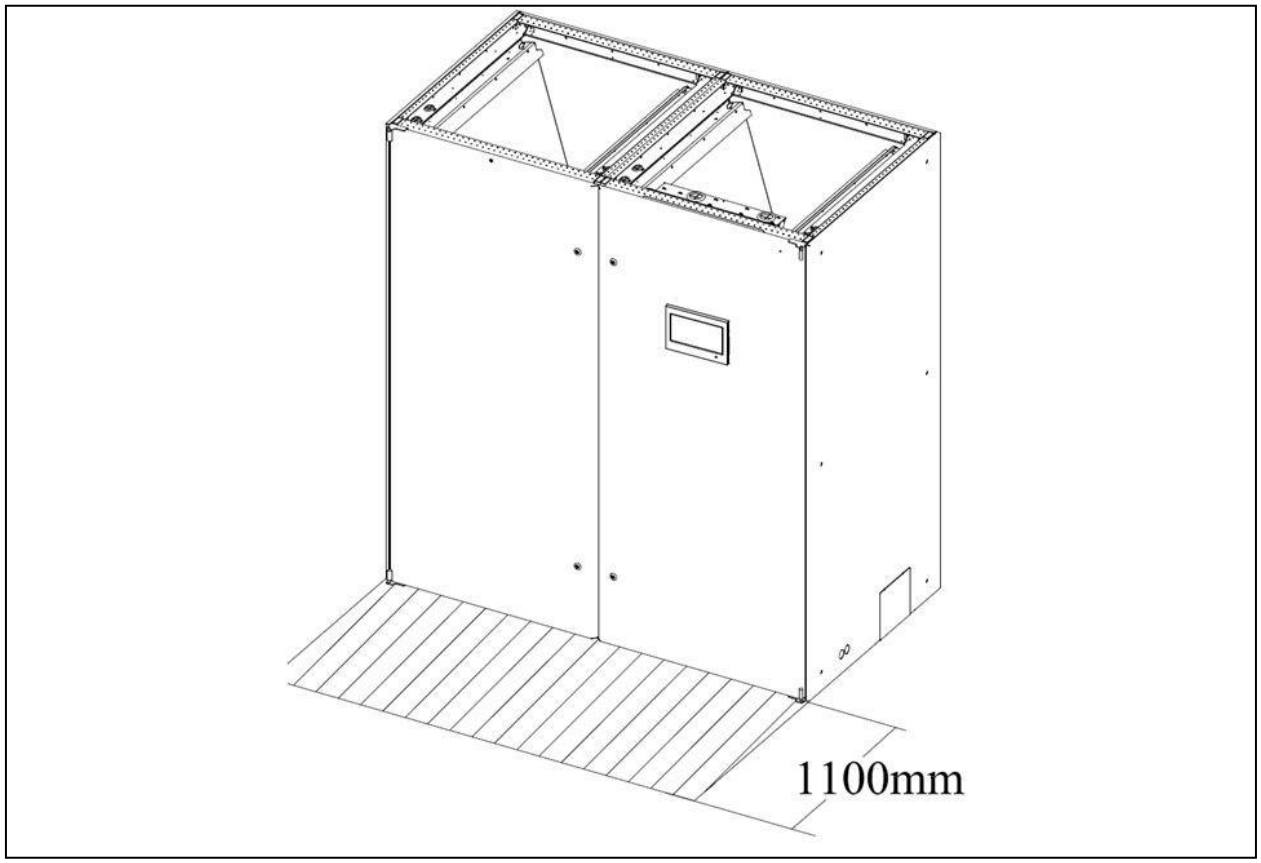


Figure 3.8 Maintenance Space of Unit for Water-cooled Unit

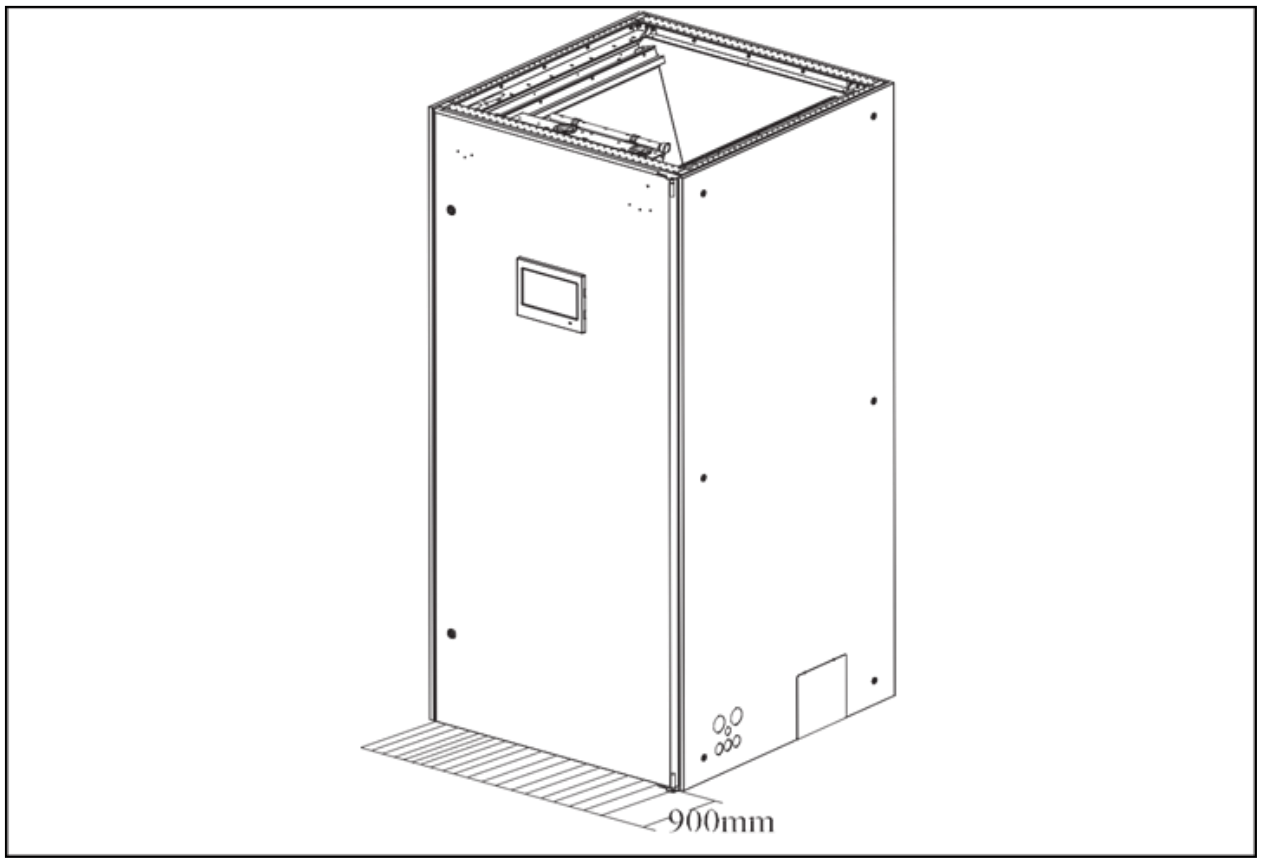


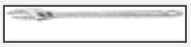
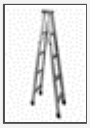
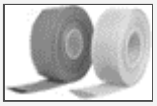
Table 3.1 Normal Maintenance Space (unit: inch/mm)

Product Type	Front	
	mm	inch
P1030	900	35.4”
P1030 (For Water-cooled)	900	35.4”
P1040~P1050	1100	43.3”
P2060~P2070	900	35.4”
P2080~P2100	1100	43.3”

3.2.4 Installation Tools

The following Table 3.2 below shows the generic tool sets and utilities used in the installation and maintenance process.

Table 3.2 List of Generic Tools

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

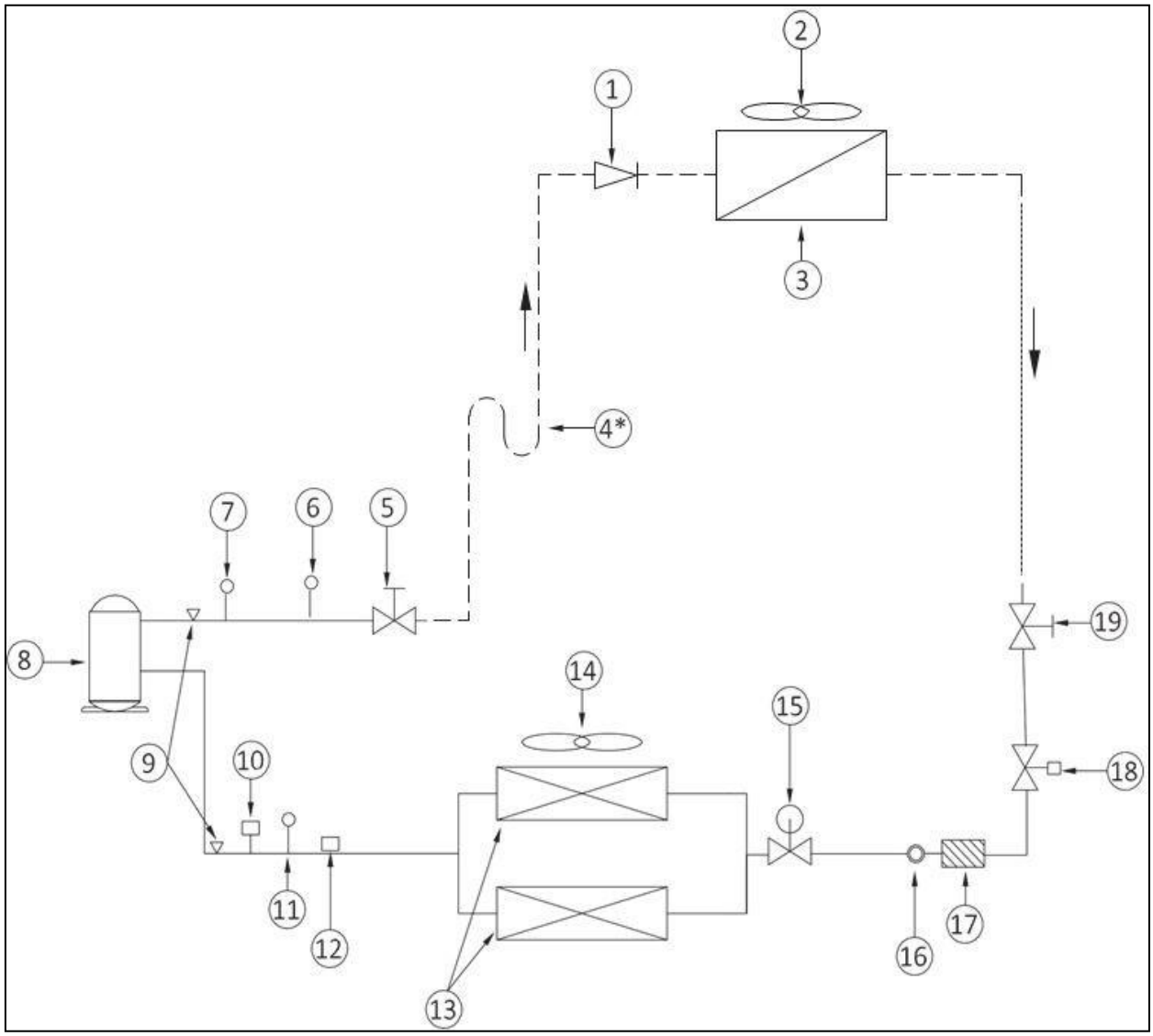
The tools mentioned in Table 3.2 above are generic and commonplace; however, depending on various factors such as site environment, local rules and regulations, cables, installation equipment, and on-site electrical connections these tools may vary in a real- time scenario.

WARNING! Ensure that the tools used in the installation, operation, and maintenance processes are well insulated.

3.2.5 System Arrangement during Installation

The piping for the refrigerant is needed for the indoor and outdoor unit of the air-cooled system. The system arrangement diagram of the refrigeration system is shown in Figure 3.9 below.

Figure 3.9 Air-cooled System Arrangement Diagram

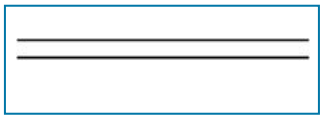


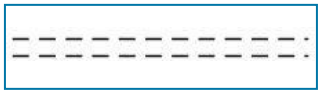
List of the components of system arrangement diagram Figure 3.9 on the previous page is given in the below table.

Table 3.3 List of the components of system arrangement diagram

No.	Description	No.	Description
1	Check valve	11	LP switch
2	EC/ AC fan	12	Suction temperature sensor
3	Condenser Coil	13	Evaporator coil
4*	Oil trap (mounted one at every rise of 7.5 m)	14	EC fan
5	Shutoff valve	15	Electronic Expansion Valve
6	Discharge temperature switch	16	Sight glass
7	HP Switch	17	Filter dryer
8	Scroll Compressor	18	Solenoid valve
9	Schradar Valve	19	Shutoff valve
10	LP transducer		

NOTE: The following points should be considered before checking out the overall layout diagram

NOTE:  **: Factory piping.**

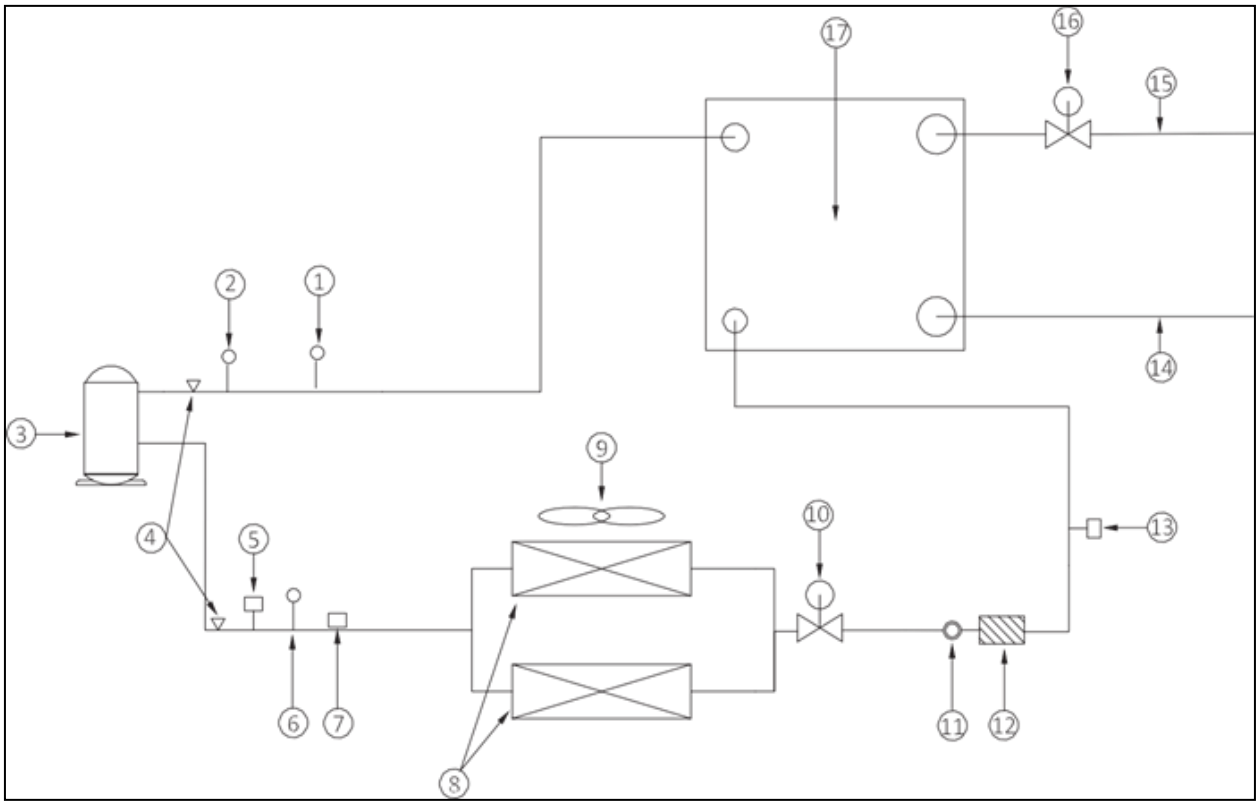
NOTE:  **: Field piping (by technical personnel).**

NOTE: The single system is used as an example.

NOTE: Components (marked with *) are not supplied by Vertiv but are recommended for proper circuit operation and maintenance.

The system arrangement diagram of the refrigeration system for water-cooled is shown in Figure 3.10 below.

Figure 3.10 Water-cooled System Arrangement Diagram

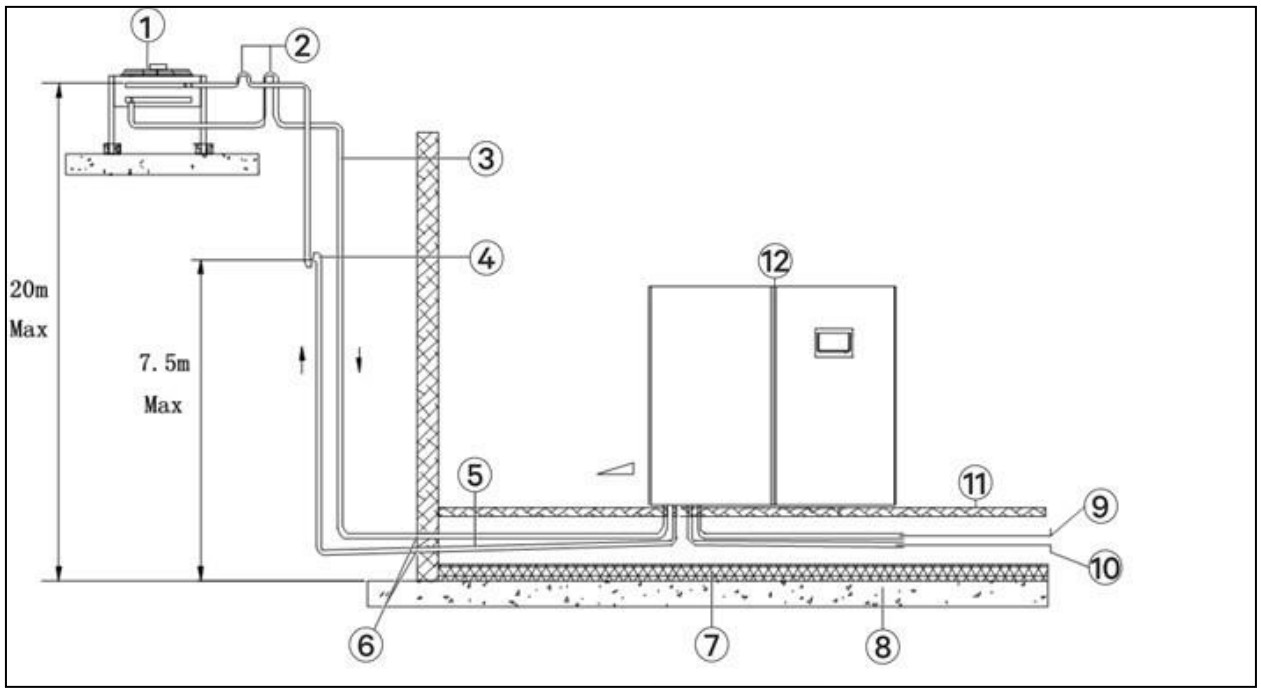


No.	Description	No.	Description
1	Discharge temperature switch	10	Electronic expansion valve
2	HP switch	11	Sight glass
3	Scroll compressor	12	Filter dryer
4	Schrader valve	13	HP transducer
5	LP transducer	14	Welding port of water inlet
6	LP switch	15	Welding port of water outlet
7	Suction temperature sensor	16	Motorized ball valves (MBV)
8	Evaporator coil	17	BPHE
9	EC fan		

3.2.6 System Installation Mode

The system installation schematic diagram explains the process of installation for the outdoor unit.

Figure 3.11 The Outdoor Unit is Placed Higher than the Compressors during Installation

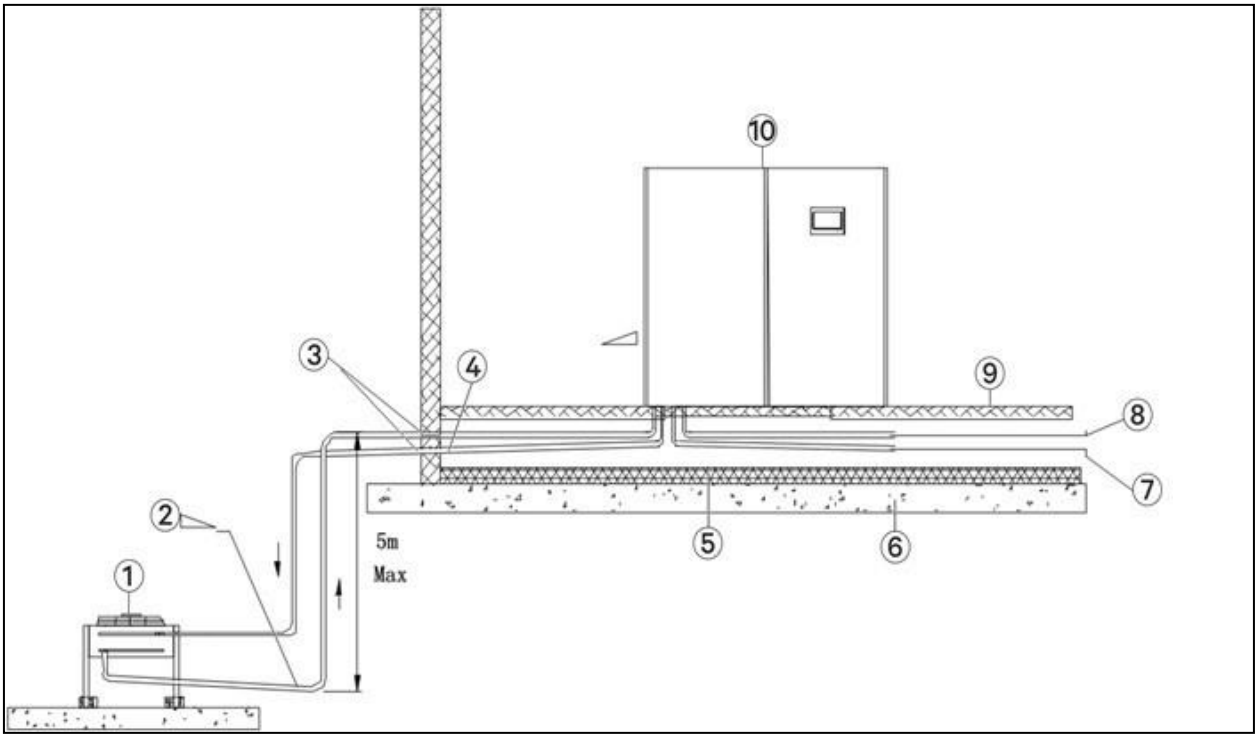


No.	Description	No.	Description
1	Outdoor unit	7	Thermal isolated layer under floor
2	Inverted traps (higher than the top copper pipe of condenser)	8	Slob
3	Liquid pipe (avoid direct sunshine)	9	Humidifier supply pipe
4	Oil trap (oil storage bend)	10	Condensate drain pipe
5	Discharge pipe slope	11	Raised floor
6	Sealed	12	Indoor unit

The outdoor unit should be installed at higher position than the compressor, therefore, an inverted backbend is connected to the discharge line and the liquid line of the condenser. The modification is essential as it prevents the liquid refrigerant from flowing back once the compressor stops. The top end of the inverted backbend should be installed higher than the ultimate level of the copper pipe of the outdoor unit. However, if the outdoor unit is installed lower than the compressor, then no modification is required.

The illustration in Figure 3.11 above depicts the schematic diagram of system installation when the outdoor unit is installed at a higher level than the compressor and Figure 3.12 on the next page when the outdoor unit is installed at a lower level than the compressor.

Figure 3.12 The Outdoor Unit is Placed Lower than the Compressor during Installation



No.	Description	No.	Description
1	Outdoor unit	6	Slob
2	Liquid pipe slope	7	Condensate drain pipe
3	Sealed	8	Humidifier supply pipe
4	Discharge Pipe slope	9	Raised floor
5	Thermal isolation layer under floor	10	Indoor unit

Figure 3.13 shows the arrangement of cooling water system, which requires the water hotter than 10 °C. Use heaters if the water source in site cannot meet this requirement. The cooling tower should be a cooled loop system. List of the components of system arrangement diagram (Figure 3.13 below) is given in the below Table 3.4 below.

Figure 3.13 Arrangement of Water-cooled System

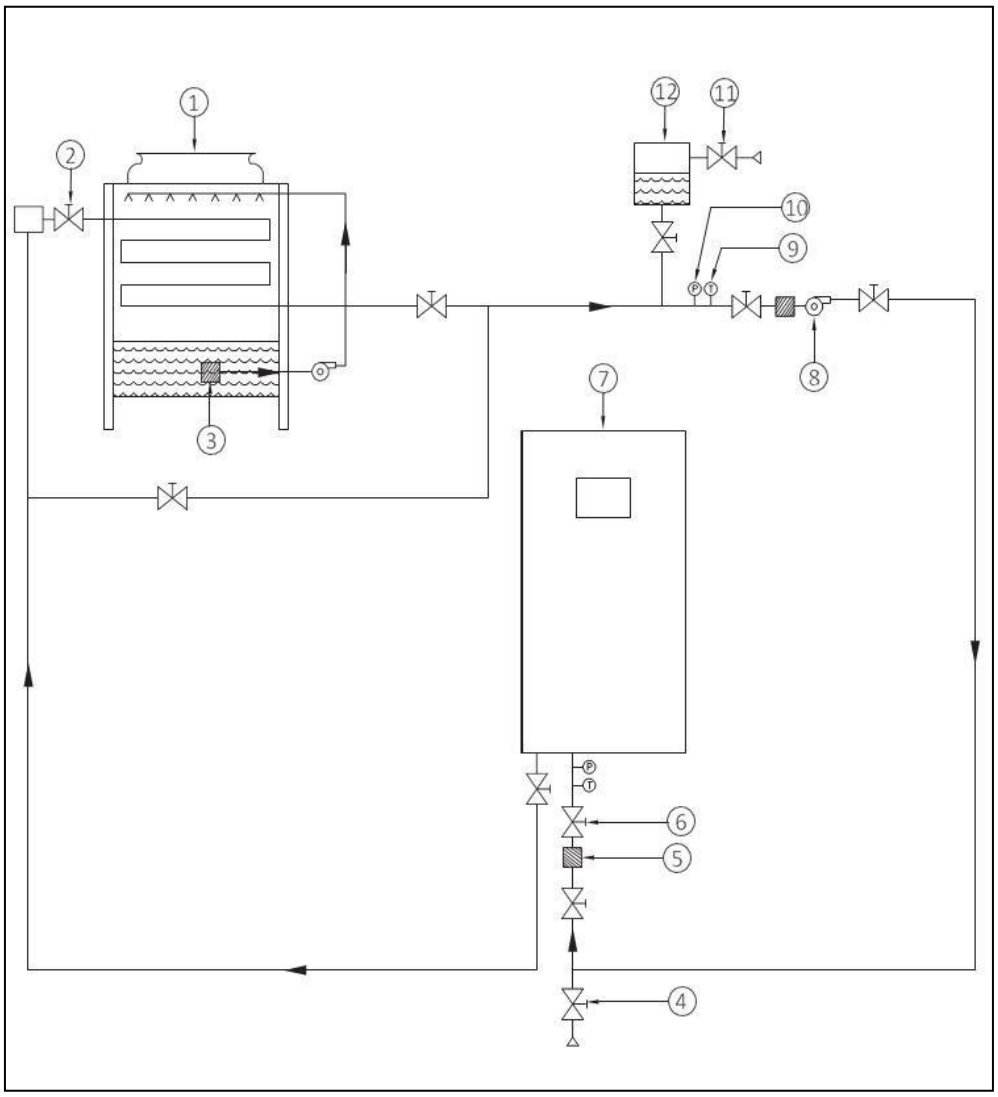


Table 3.4 List of the components of system

No.	Description	No.	Description
1	Closed cooling tower	7	Liebert PEX3 unit
2	Exhaust water valve	8	Pump
3	Strainer	9	Temperature gauge
4	Drain valve	10	Manometer
5	Filter	11	Supplementary valve
6	Ball valve	12	Expansion water tank

3.3 Mechanical Installation

3.3.1 Indoor Unit Size and Weight (Product Dimension)

The dimensions and operational weight of the indoor units are depicted in Figure 3.14 below, Figure 3.15 on the facing page and Table 3.5 on the facing page respectively.

Figure 3.14 Upflow Indoor Unit

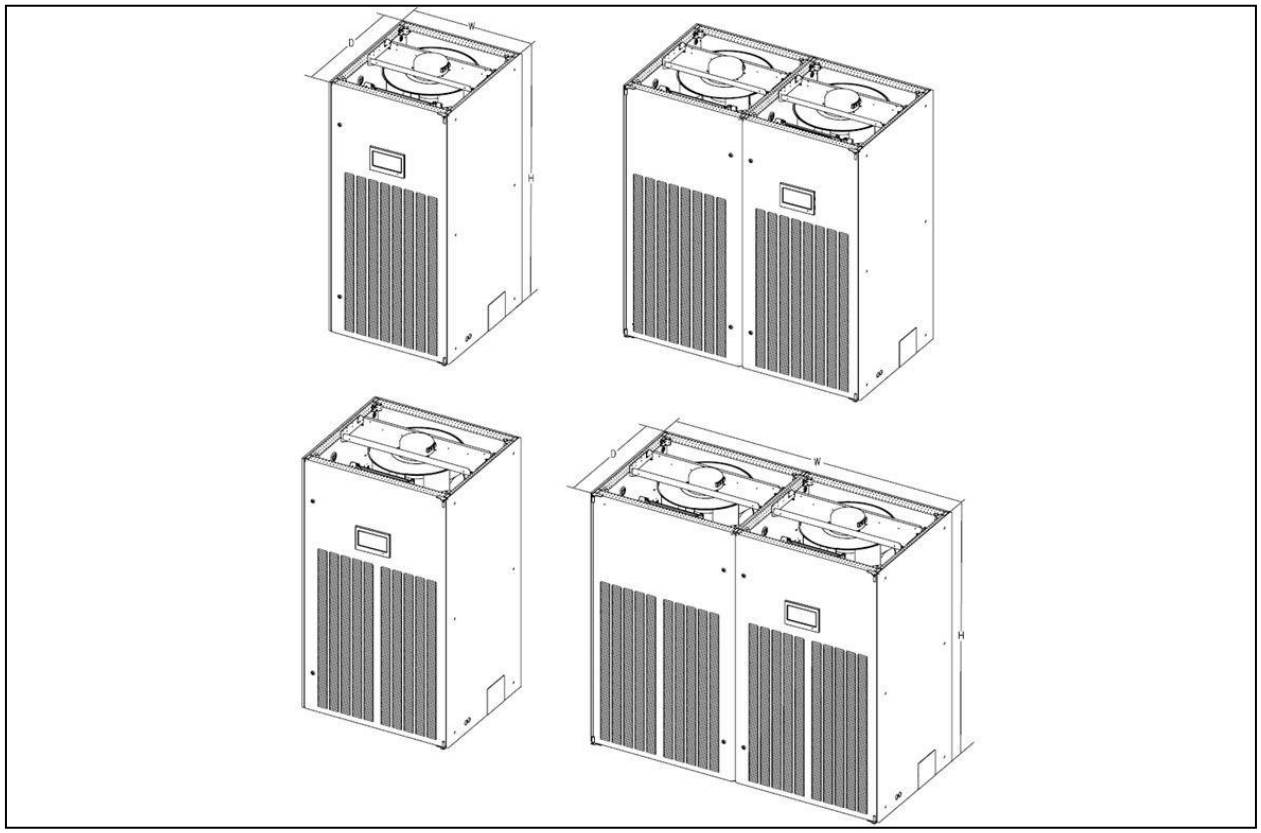


Figure 3.15 Downflow Indoor Unit

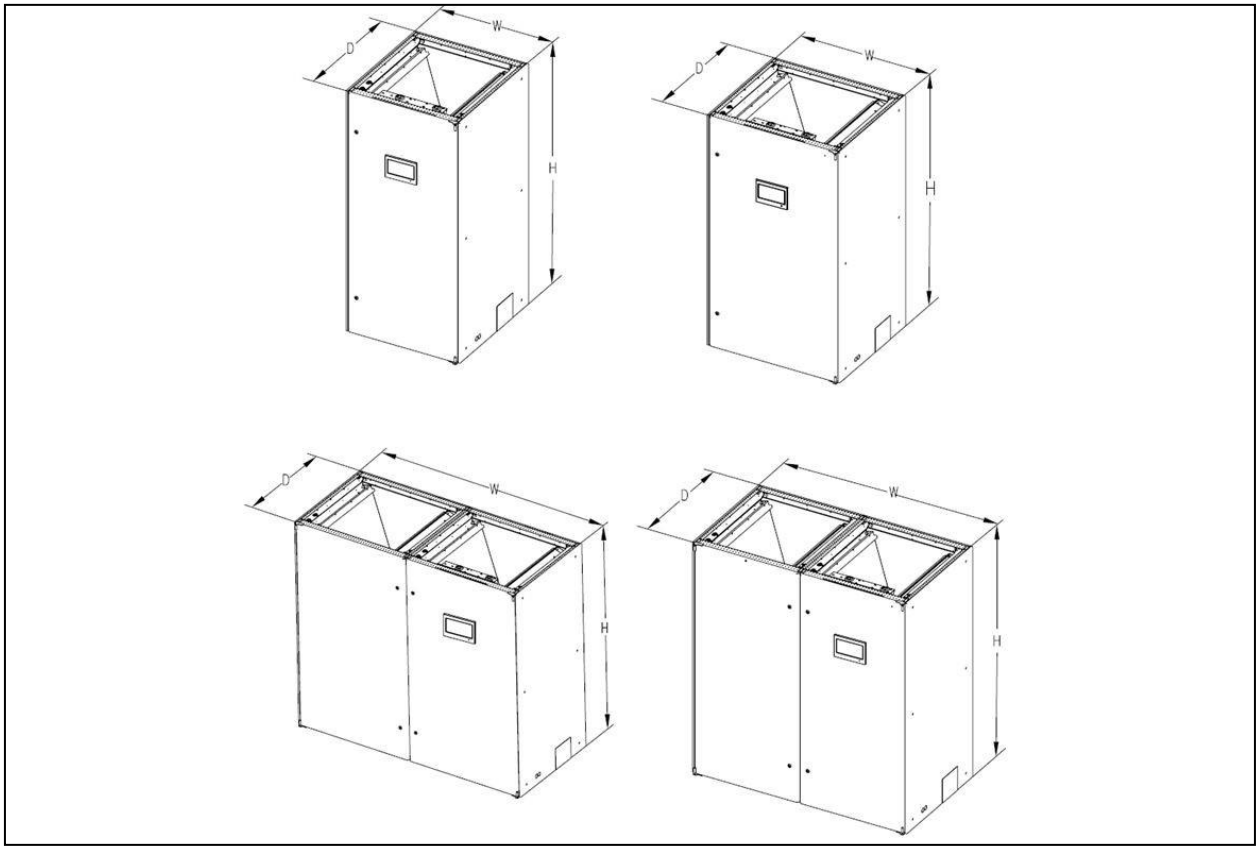


Table 3.5 Indoor Unit Size and Weight

Product Number	Dimensions (W×D×H)		Operational Weight (kg)
	mm	inch	
P1030U/ DA	930 × 995 × 1975	36.6"×39.2"×77.7"	360
P1030U/ DW	930 × 995 × 1975	36.6"×39.2"×77.7"	390
P1040	1130 × 995 × 1975	44.5"×39.2"×77.7"	420
P1050 (S)	1130 × 995 × 1975	44.5"×39.2"×77.7"	440
P1050 (D)	1130 × 995 × 1975	44.5"×39.2"×77.7"	470
P2060	1830 × 995 × 1975	72.0"×39.2"×77.7"	660
P2070	1830 × 995 × 1975	72.0"×39.2"×77.7"	670
P2080	2230 × 995 × 1975	87.8"×39.2"×77.7"	740
P2090	2230 × 995 × 1975	87.8"×39.2"×77.7"	770
P2100	2230 × 995 × 1975	87.8"×39.2"×77.7"	780

3.3.2 Plenum Dimensions (For Upflow Unit)

The dimensions of the Plenum as follows, refer Table 3.6 below.

Table 3.6 Plenum Dimensions

Types	D (depth)		W (width)		H (height)	
	mm	inch	mm	inch	mm	inch
P1030	995	39.2"	930	36.6"	400, 600 (optional)	15.8", 23.6" (optional)
P1040~P1050	995	39.2"	1130	44.5"	400, 600 (optional)	15.8", 23.6" (optional)
P2060 ~ P2070	995	39.2"	1830	72.1"	400, 600 (optional)	15.8", 23.6" (optional)
P2080 ~ P2100	995	39.2"	2230	87.8"	400, 600 (optional)	15.8", 23.6" (optional)

NOTE: If the height of the plenum selected for air conditioner unit exceeds 23.6"/600 mm, consult Vertiv local representative for non-standard requirement.

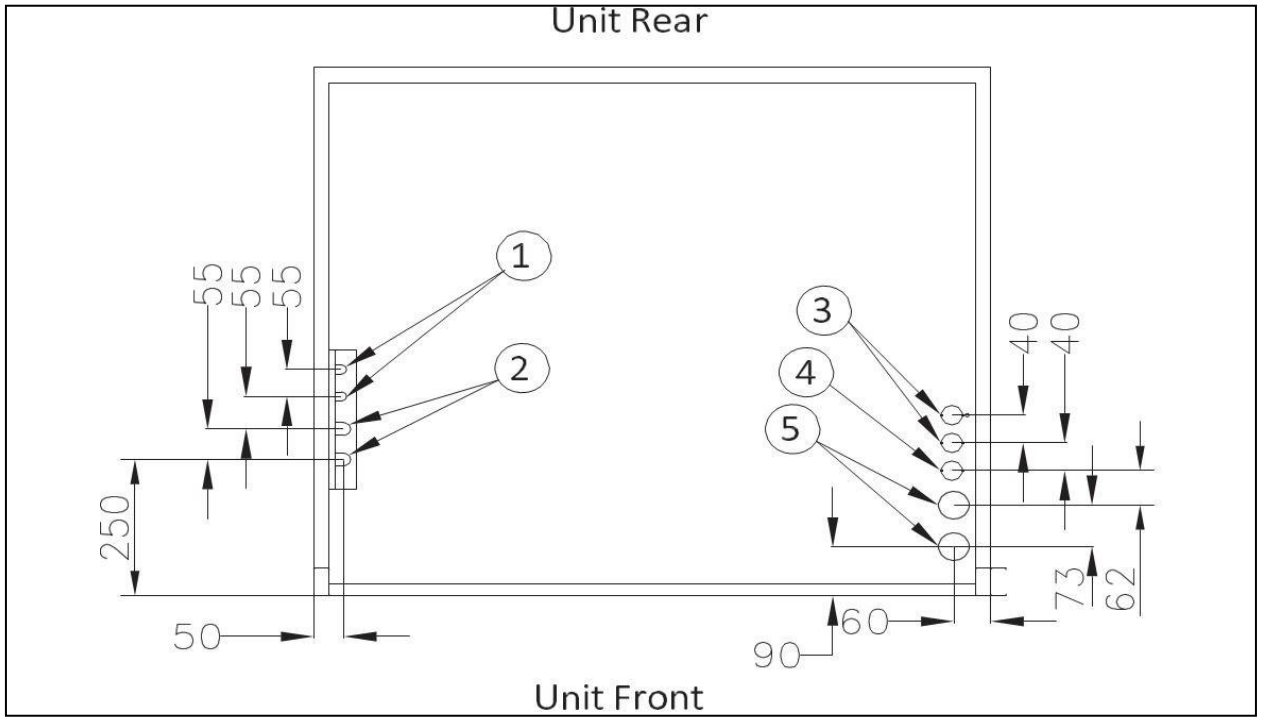
3.3.3 Dimension and Weight of Condenser

Refer to the "Liebert® PEX Condenser User Manual" and "LVC Series Condenser User Manual".

3.3.4 Base Plate Cut-out Position and Dimension

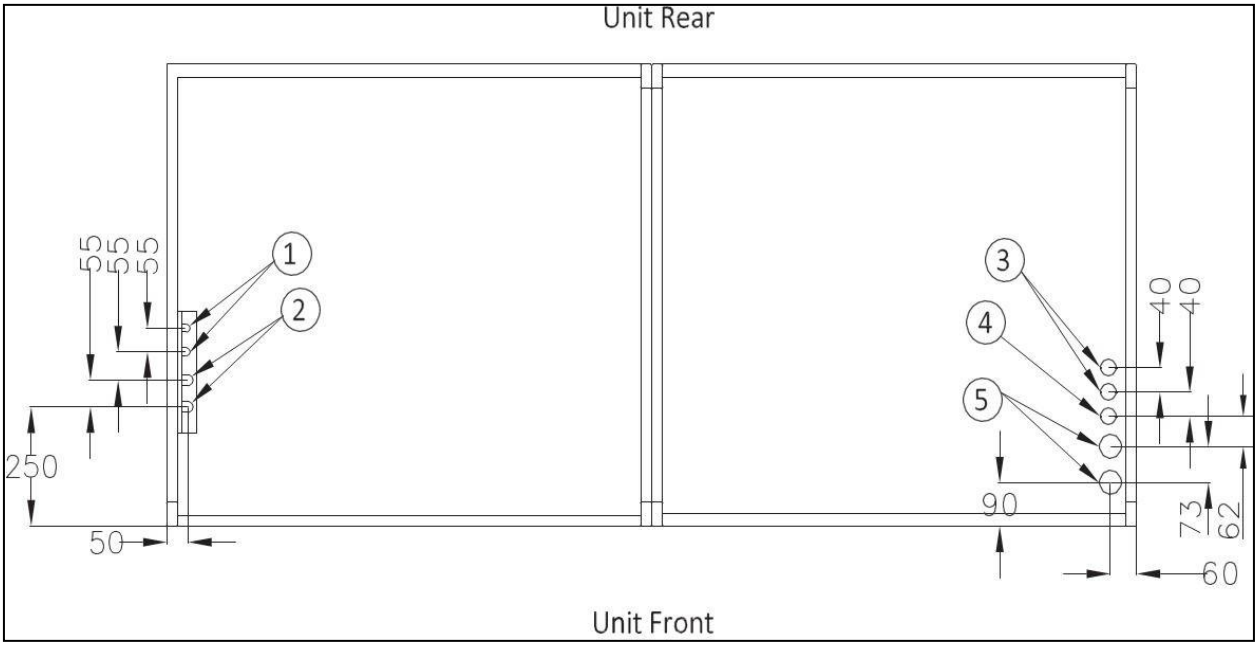
The cut-out position and dimensions are shown in Figure 3.16 below,Figure 3.17 on page 36,Figure 3.18 on page 37.

Figure 3.16 The Position of Pipe Bottom Outlet of Single Cabinet Unit (unit: mm)



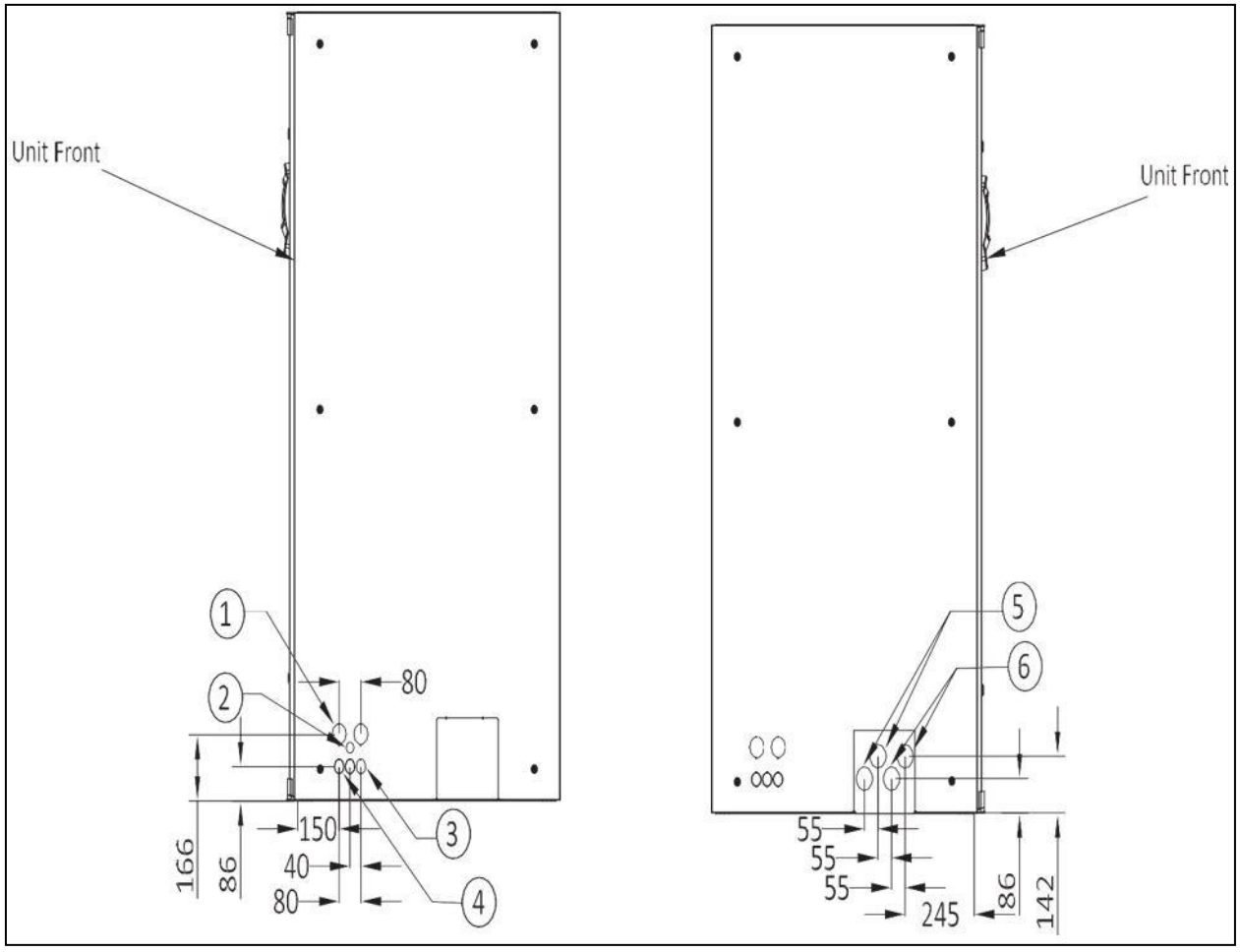
No.	Description	No.	Description
1	Liquid pipe inlet	4	Inlet of humidification inlet pipe ø35
2	Discharge outlet	5	Cable inlet ø50
3	Condensate drain outlet ø35		

Figure 3.17 The Position of Pipe Bottom Outlet of Dual Cabinet Unit (unit: mm)



No.	Description	No.	Description
1	Liquid pipe inlet	4	Inlet of humidification inlet pipe ø35
2	Discharge outlet	5	Cable inlet ø50
3	Condensate drain outlet ø35		

Figure 3.18 Left and Right Panel with Nozzle Position of Cut-out Location Dimensions (unit: mm)

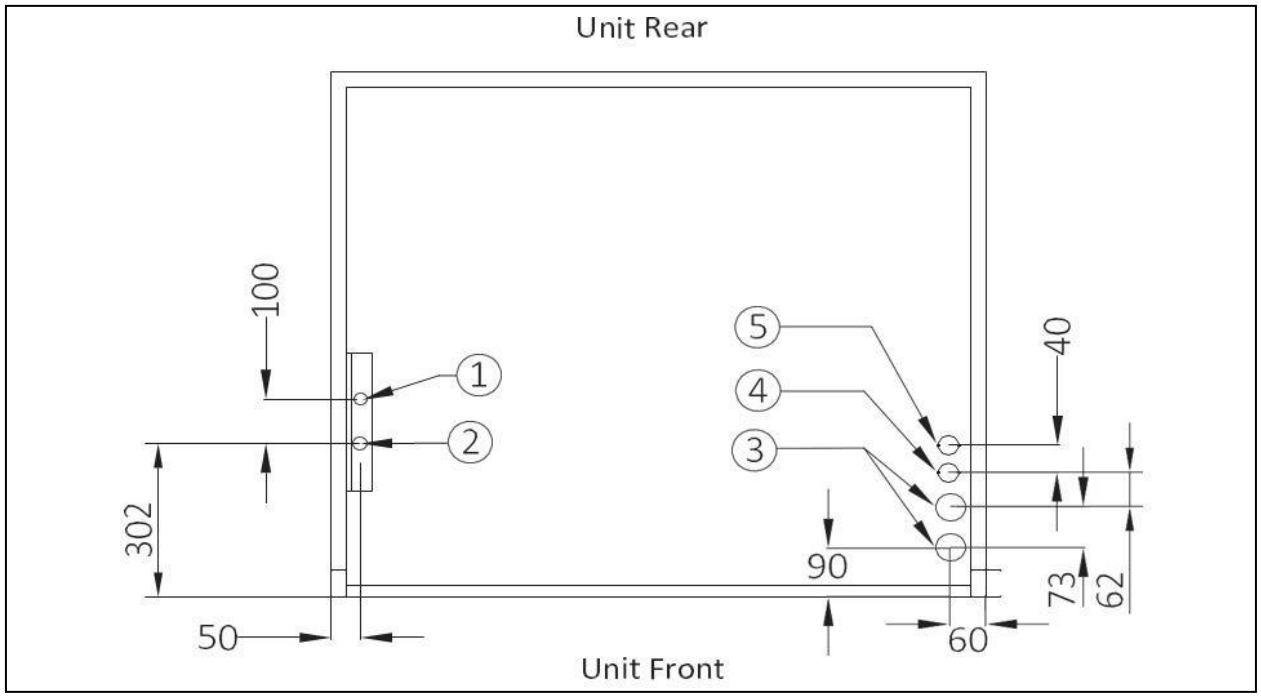


No.	Description	No.	Description
1	Cable Entry ø52	4	Humidifier inlet nozzle ø35
2	Single cable inlet ø25	5	Liquid pipe inlet ø60
3	Condenser drain pipe ø35	6	Discharge inlet

NOTE: The equipment has knock-outs, ensure to mount sleeve to the cable holes to avoid cutting of the cables.

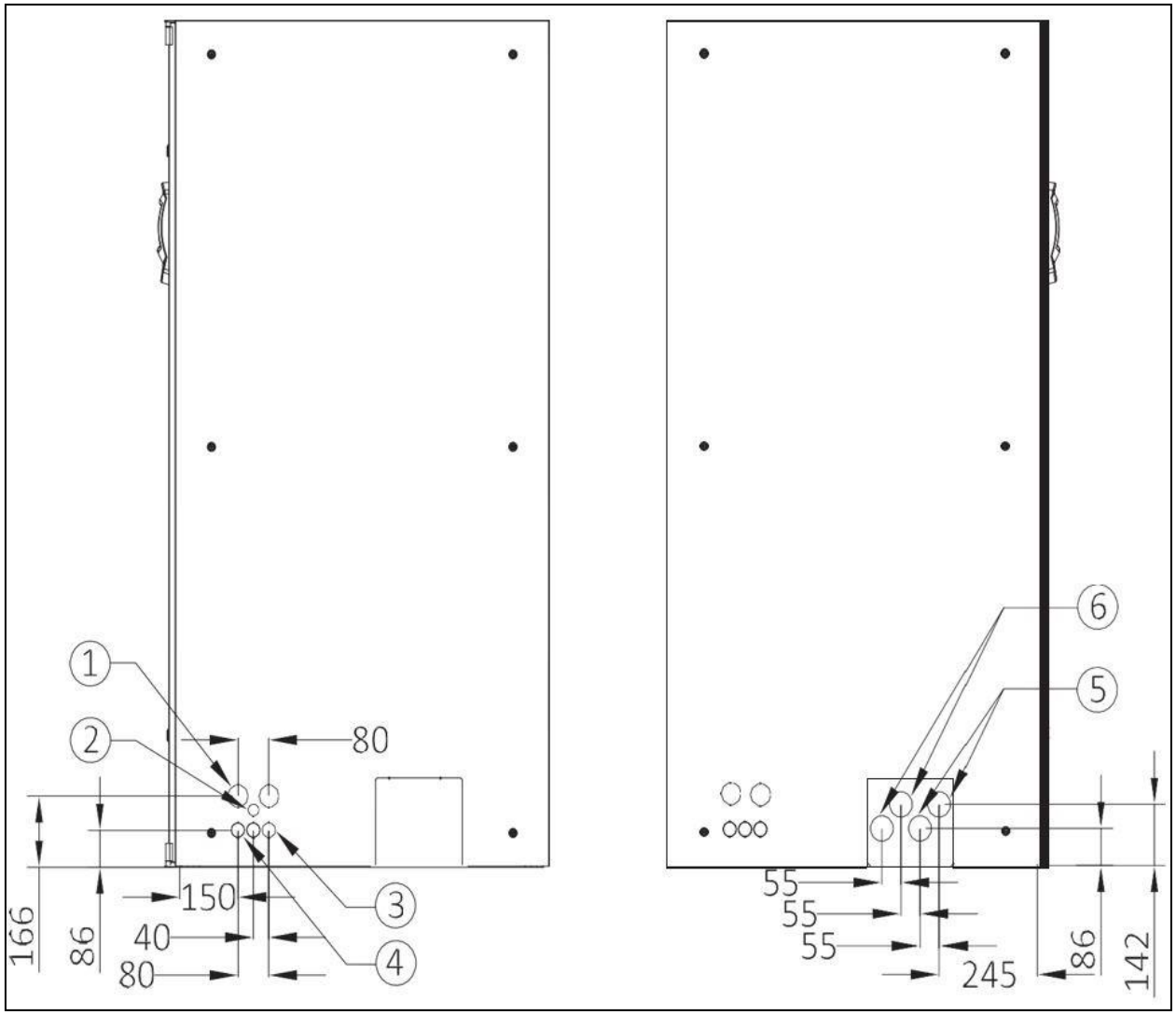
Figure 3.19 and Figure 3.20 on the facing page show the cut-out position and dimensions of water-cooled unit.

Figure 3.19 The Position of Pipe Bottom Outlet of Single Cabinet Unit (unit: mm) of water-cooled unit



No.	Description	No.	Description
1	Water pipe inlet ø50	4	Inlet of humidification inlet pipe ø35
2	Water pipe outlet ø50	5	Condensate drain outlet ø35
3	Cable inlet ø50		

Figure 3.20 Left and Right Panel with Nozzle Position of Cut-out Location Dimensions (unit: mm) of water-cooled unit

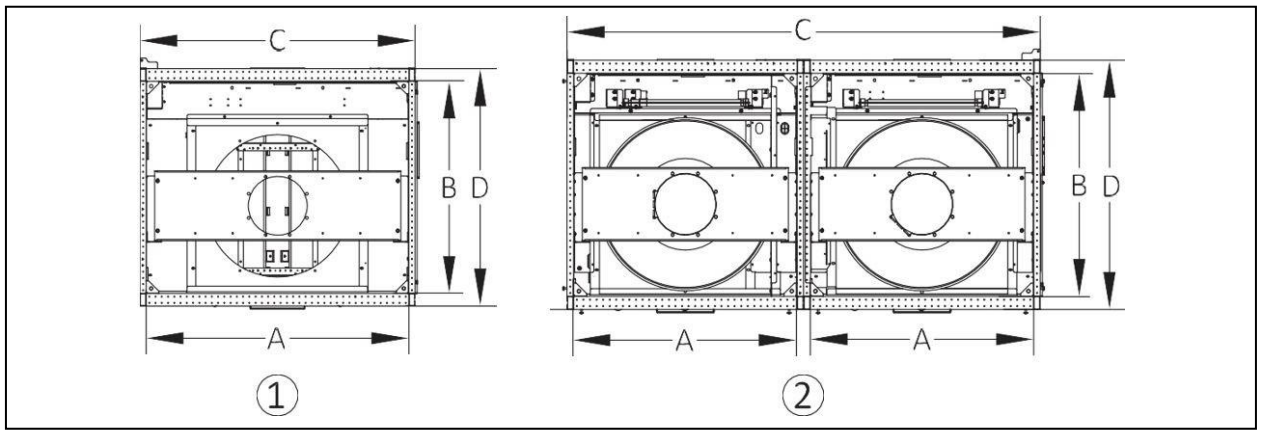


No.	Description	No.	Description
1	Cable Entry ø52	4	Humidifier inlet nozzle ø35
2	Single cable inlet ø25	5	Water pipe outlet ø60
3	Condenser drain pipe ø35	6	Water pipe inlet ø60

3.3.5 Position and Dimension of Air Outlet on Top Cover

The position and dimensions of air outlet on the top cover of upflow for single bay (air-cooled/ water-cooled) and two bay units are shown in Figure 3.21 below and Table 3.7 below respectively.

Figure 3.21 The Position of Air Outlet on Top Cover Upflow Unit



No.	Description	No.	Description
1	Top view of the single bay unit	2	Top view of the double bay unit

Table 3.7 Dimensions of Air Outlet on Top Cover of Upflow Unit

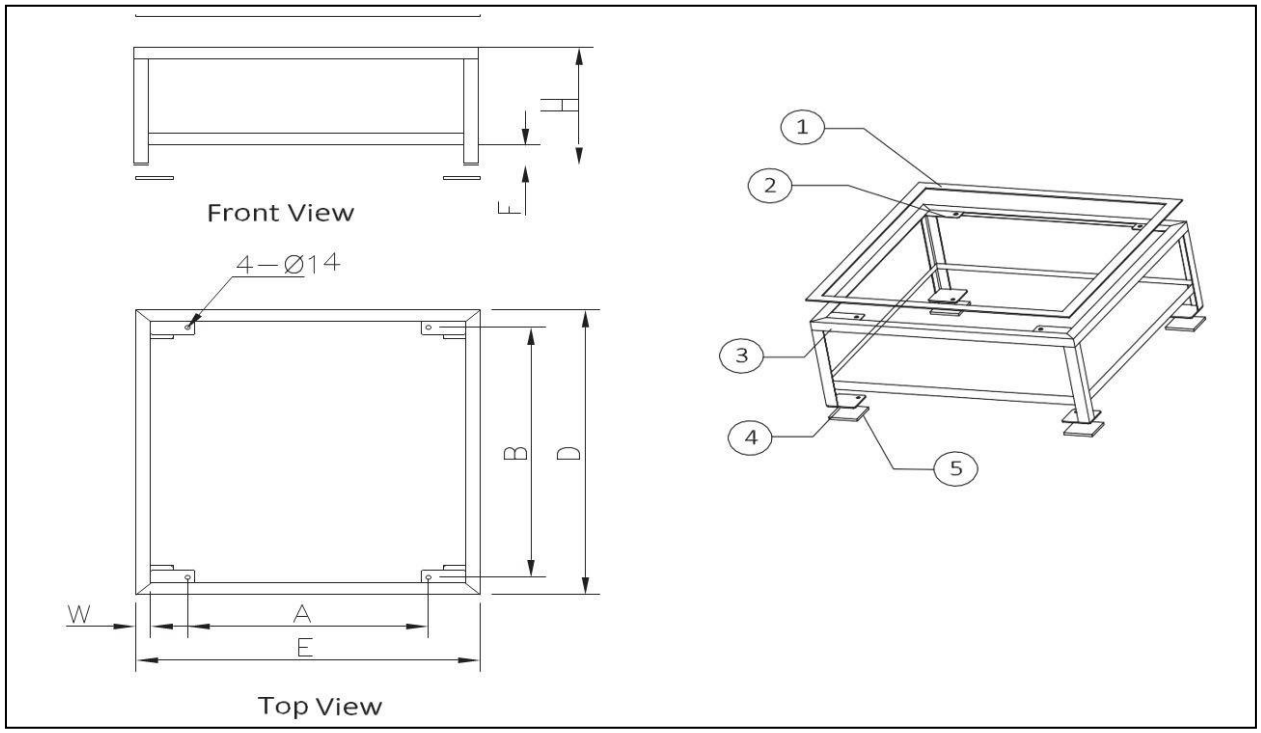
Types of Model	A		B		C		D	
	mm	inch	mm	inch	mm	inch	mm	inch
P1030	850	33.5	850	33.5	900	35.4"	950	37.4"
P1040~P1050	1050	41.3"	850	33.5	1100	43.3"	950	37.4"
P2060~P2070	850	33.5	850	33.5	1800	70.9"	950	37.4"
P2080~P2100	1050	41.3"	850	33.5	2200	86.6"	950	37.4"

3.3.6 Indoor Installation

Floor Stand

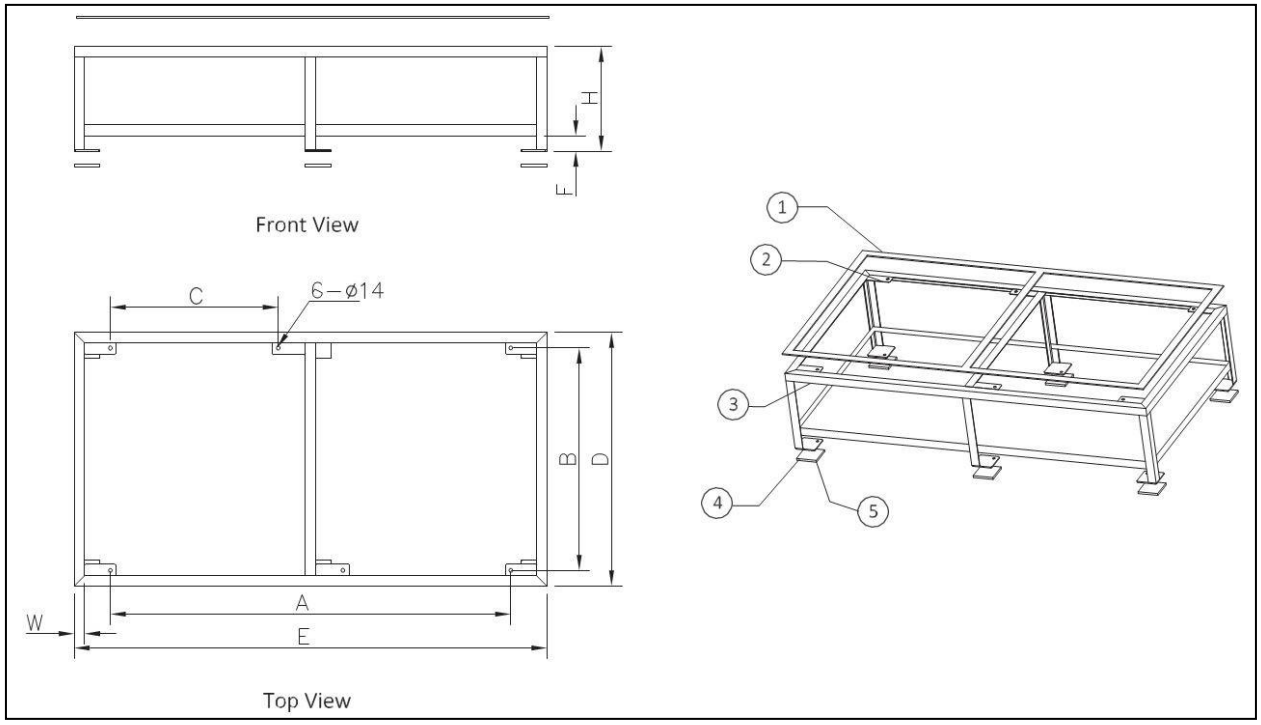
The floor stand is to be prepared by the installation team according to the dimensions, weight, and height of the unit to ensure that the structure is rigid, the floor stand should be sized according to Figure 3.22 below for single bay unit (Air/Water-cooled Unit) and Figure 3.23 on the next page for two bay unit and Table 3.8 on the next page.

Figure 3.22 Floor Stand of the Single Unit



No.	Description	No.	Description
1	Upper rubber damping pad (5 mm thick)	4	Bottom plate (100 mm x 100 mm x 5 mm, 4PCS)
2	Fixed steel plate (3 mm thick 4PCS)	5	Bottom rubber cushion (10 mm thick, 4PCS)
3	Incline tie joint (angle steel 3 mm thick)		

Figure 3.23 Floor Stand of the Double Unit



No	Description	No	Description
1	Upper rubber damping pad (5 mm thick)	4	Bottom plate (100 mm x 100 mm x 5 mm, 6PCS)
2	Fixed steel plate (3 mm thick 6PCS)	5	Bottom rubber cushion (10 mm thick, 6PCS)
3	Angle steel (3 mm thick)		

Table 3.8 Floor Stand Dimensions (inch/mm)

Mode	A	B	C	D	E	F	H	W
P1030	25.6"/ 650	33.9"/ 860	/	38.6"/ 980	36.6"/ 930	/	15.7"/400 <H≤21.6"/550	1.6"/40
						F≤9.4"/240	21.7"/550 <H≤43.3"/1100	2.0"/50
P1040~P1050	33.5"/ 850		/		44.5"/ 1130	/	15.7"/400 <H≤21.6"/550	1.6"/40
						F≤9.4"/240	21.7"/550 <H≤43.3"/1100	2.0"/50
P2060 ~ P2070	61.0"/ 1550		25.6"/ 650		72.0"/ 1830	/	15.7"/400 <H≤21.6"/550	1.6"/40
						F≤9.4"/240	21.7"/550 <H≤43.3"/1100	2.0"/50
P2080 ~ P2100	76.8"/ 1950		33.5"/ 850		87.8"/ 2230	/	15.7"/400 <H≤21.6"/550	1.6"/40
						F≤9.4"/240	21.7"/550 <H≤43.3"/1100	2.0"/50

3.3.7 Installing Floor Stand

Determine the installation position according to the space requirements of the unit, and fix the floor stand onto the selected mounting position. The floor stand is fixed to the ground using expansion bolts or spot welding, and the alignment of the floor stand is calibrated by a horizontal ruler before it is fixed. Ensure that the top surface of floor stand is at uniform level. While designing and installing the downflow unit which requires lowering of EC fan, we must consider the proper gap distance and the base strength of the floor stand.

NOTE: Refer to Table 3.8 A/B/C as the center of the base from the mounting hole D/E is the size of the base frame.

NOTE: H is the height of the base, F is the height of the welding beam.

NOTE: W is the width of the angle, height ≤ 550 mm recommended use size 40 mm x 40 mm x 3 mm, the height of > 550 mm quadrangular column is recommended to use 50 mm x 50 mm x 4 mm specification. The bottom plate is recommended to use 100 mm x 100 mm x 5 mm.

NOTE: For the downflow unit, the base must be greater than the height of 400 mm.

NOTE: For the upflow unit, the base height must be about 200 mm.

NOTE: The side panels are suspended to the frame of the unit, ensure that floor stand should bear the weight of the panels.

NOTE: The distance between the obstacles that may obstruct the air supply around the upper edge of the base and the outer edge of the EC fan shall be greater than 160 mm.

Vibration Absorption Treatment

Place a layer of rubber cushion on the top, side of the base and on the bottom of the steel plate respectively to prevent transmission of vibration during operation of the unit. Refer Table 3.9 below for more details.

Table 3.9 Dimensions of Rubber Cushion for Vibration Absorbing

Item		Specification
Rubber cushion	Top	Thickness: 3 mm to 5 mm
	Lateral	Thickness: 2 mm to 3 mm
	Bottom	Thickness: 10 mm to 12 mm

3.3.8 Installation of Indoor Unit

The indoor unit should be installed on the horizontal base plate, and ensure that all indoor units are at the same level. The indoor unit and the horizontal base do not require any welding or other fixed rigid connections.

3.3.9 Pipe Installation Unit (Air-cooled Units)

There are four kinds of pipe to be joint as follows:

1. Condensed drain piping connection of the indoor unit
2. Humidifier inlet pipe connection
3. Connection of the copper pipe (discharge and liquid pipe) between the indoor and outdoor unit.
4. Long piping kit.

The following points need to be taken into consideration during the piping process:

NOTE: All the joints of the refrigerating pipes must be silver-brazed.

NOTE: The selection, layout, and fixing of the pipes should comply to the industry standards and norms.

NOTE: Vacuum pumping and refrigerant charging operations, and procedures must comply with the industry standards.

NOTE: Pressure drop, compressor oil return, noise, and vibration must be considered during the designing and installation process.

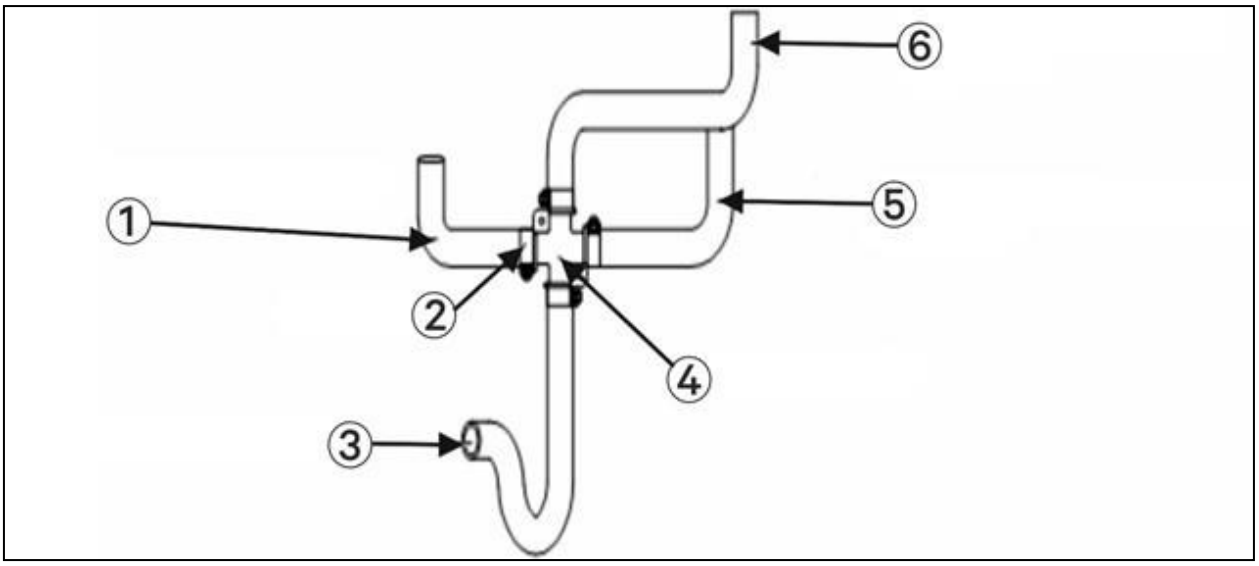
3.3.10 Condensed Drain Piping Connection of Indoor Unit

The condensate of Infrared humidifier and evaporator are connected by a cross connector and drained through the drain pipe, as shown in Figure 3.24 below. The pipe outer diameter is 25 mm. If the drain pipe is used by three or more units, the minimal pipe outer diameter should be 40 mm.

NOTE: When connecting the drain pipe, ensure that the U bend is installed vertically and the 'U' shape is not distorted, so that the condensate can be drained immediately and effectively.

WARNING! Because the Infrared humidifier contains hot flowing water, the water pipe must be resistant to heat higher than 90 °C.

Figure 3.24 Connection of the Drain Pipe of Condensate Water



No.	Description	No.	Description
1	From evaporated condensed water pan	4	Cross connector
2	Hose clamp	5	From evaporated condensed water pan
3	To condensate drain pipe	6	From infrared humidifier water pan

3.3.11 Infrared Humidification Inlet Pipe Connection

Requirements for connecting the water inlet pipe of infrared humidifier:

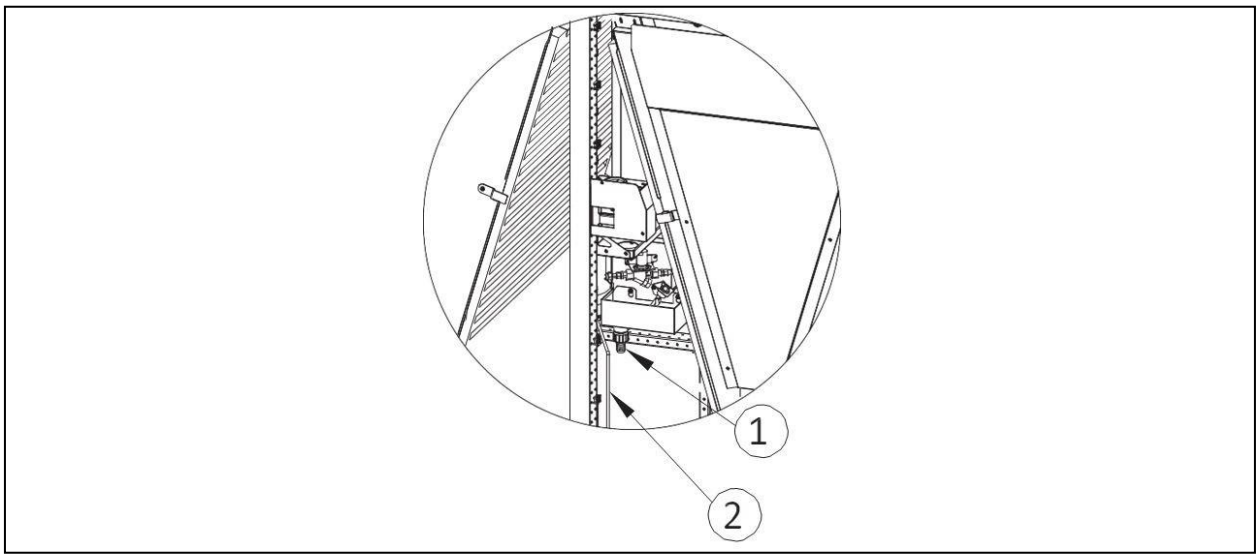
To facilitate maintenance, an isolation valve should be fitted to the water inlet pipe.

Ensure that the water inlet pipe is sealed properly to prevent leakage. The Infrared humidifier reserved a 1/4" copper nut and the 1/4" × 1/2" conversion copper thread connector to avoid loose connection as shown in Figure 3.25 below for air-cooled and water-cooled units.

NOTE: Where the main line pressure may exceed 700 kPa (the main line pressure range should be 100 kPa to 700 kPa), a pressure reducer should be installed.

NOTE: Where the pressure of the main pipe is lower than 100 kPa, there should be a water collecting tank and a water pump system.

Figure 3.25 Water Inlet Pipe of Infrared Humidifier



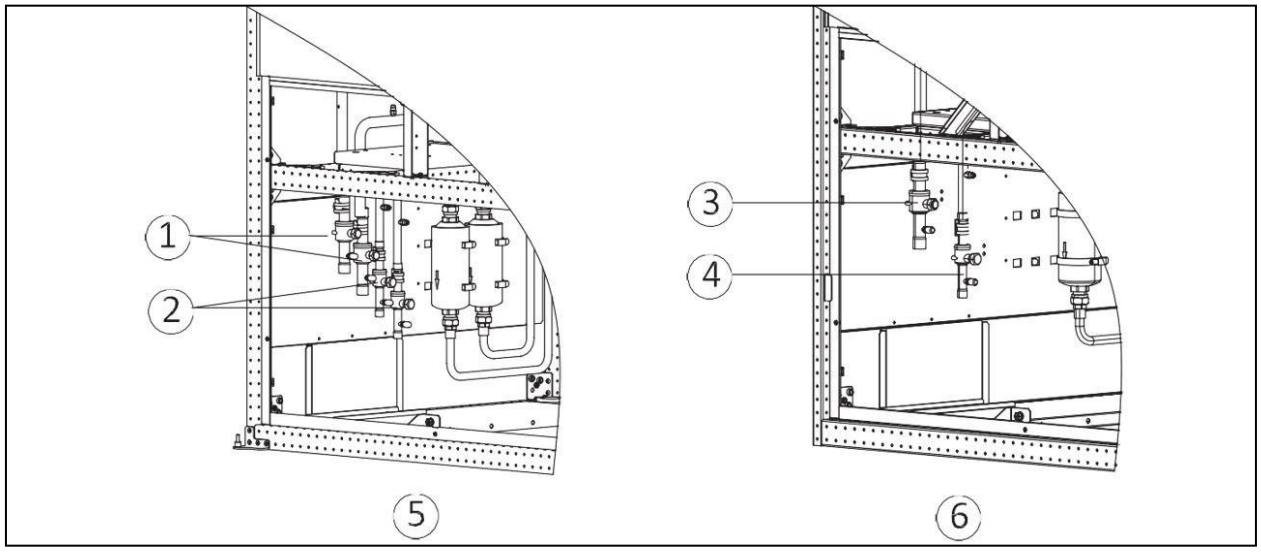
No.	Description	No.	Description
1	Outlet joints	2	Inlet pipe

3.3.12 Connection of Copper Pipe (Discharge and Liquid pipe) between Indoor and Outdoor Unit

1. Select the appropriate dimension (Pipe diameter & Wall thickness) of pipes connecting the indoor and the outdoor unit. Considering the effect of the diameter and wall thickness of copper piping on the pressure drop of the system, the pipe dimensions of the indoor and outdoor unit should be determined according to the specifications in Table 3.11 or consult Vertiv local representative. The recommended dimensions of piping is given inTable 3.10 on the next page.
2. Connect the copper pipes in brazing mode. The connection ball valves of the discharge pipe and liquid pipe of the indoor unit are shown in Figure 3.26 below. Notes and instruction labels are pasted onto the base and the side panel close to the ball valve. Ensure that the ball valve must be wrapped with a wet cloth before brazing to protect the label from burning.
3. Connect the discharge pipe and liquid pipe of the indoor unit according to the instructions on the labels.
4. Horizontal sections of the discharge pipe should be sloped down from the compressor with a slope of at least 1:200 (5 mm down for each 1 m run). The discharge pipes should be insulated where they are routed in the conditioned space (including under a raised floor).

WARNING! The exposure time of system pipes must not exceed 15 min. Longer exposure will lead to the compressor refrigeration oil being affected by moisture, which can affect the life of the key components and the system operation stability.

Figure 3.26 Locations of Discharge Pipe and Ball Valve and Liquid Pipe Ball Valve



No.	Description	No.	Description
1	Discharge ball valve	4	Liquid pipe ball valve
2	Liquid pipe ball valve	5	Double circuit
3	Discharge ball valve	6	Single circuit

Table 3.10 Recommended Pipe Size

Model	P1030 (single system) P2060 (dual system)		P1040 (single system) P2080 (dual system)		P1050 (single system) P2100 (dual system)		P1050 (dual system)		P2070 (dual system)		P2090 (dual system)	
Pipe Length	D	L	D	L	D	L	D	L	D	L	D	L
10m	16/16	16/16	19/19	19/19	19/19	19/19	16/16	16/16	19/19	16/16	19/19	19/19
20m	19/19	16/16	22/22	19/19	22/22	19/19	16/16	16/16	19/19	16/16	22/22	19/19
30m	19/19	16/16	22/22	19/19	22/22	19/19	19/16	16/16	19/19	16/16	22/22	19/19
40m	19/19	16/16	22/22	19/19	25/25	19/19	22/16	16/16	22/19	16/16	22/22	19/19
50m	22/19	16/16	25/22	19/19	25/25	19/19	22/16	16/16	25/19	16/16	25/22	19/19
60m	22/19	16/16	25/22	19/19	25/25	19/19	22/16	16/16	25/19	16/16	25/22	19/19

NOTE: D: Discharge line, L: Liquid line.

NOTE: 22/ 19: horizontal pipe diameter is 22 mm, vertical pipe diameter is 19 mm.

NOTE: If the pipe length exceeds 60 m or drops over 20 m, please consult Vertiv local representative for details.

NOTE: If the outdoor temperature is below -20 °C, use the low temperature kit and consult Vertiv local representative for details.

Table 3.11 Pipe Wall Thickness Requirements

Pipe Dimensions Outer Diameter		Wall Thickness (mm)	
mm	inch	mm	inch
16	5/8	≥1	0.04”
19	>3/4	≥1.2	0.05”
22	7/8	≥1.2	0.05”
25	1	≥1.5	0.06”
28	1-1/8	≥1.5	0.06”
38	>1-1/4	≥1.5	0.06”
35	1-3/8	≥1.5	0.06”

3.3.13 Height Difference Requirements and Equivalent Length Calculation

The long piping kit is the standard component for Liebert® PEX3. Height difference between the indoor and outdoor unit is shown in Table 3.12 below. The equivalent length can be calculated by selecting appropriate dimensions in accordance with the respective diameter, refer Table 3.13 below for the equivalent length of the sub-assembly.

Table 3.12 Height Distance between Indoor and Outdoor Unit

Relative Position	Distance
Condenser above the indoor unit	+ 20 m
Condenser below the indoor unit	-5 m

NOTE: If the vertical distance between indoor and outdoor unit exceeds the values in Table 3.12 , consult Vertiv local representative.

NOTE: 'U' trap should be installed for every 7.5 m of vertical distance consult Vertiv local representative for details.

Table 3.13 Equivalent Length of Each Sub-Assembly

Fluid Pipe Diameter (inch)	Equivalent length (m)		
	Elbow 90°	Elbow 45°	T-piece
3/8	0.21	0.10	0.76
1/2	0.24	0.12	0.76
5/8	0.27	0.15	0.76
3/4	0.3	0.18	0.76
7/8	0.44	0.24	1.1
1-1/8	0.56	0.3	1.4

3.3.14 Pipe Installation Unit (Water-cooled unit)

There are three kinds of pipe to be joint as follow:

1. Condensed drain piping connection of the indoor unit (the same as the Air-cooled unit).
2. Humidifier inlet pipe connection (the same as the Air-cooled unit).
3. Water inlet and outlet pipe of cooling water.

NOTE: The following points need to be taken into consideration during the piping process: The selection, layout, and fixing of the pipes should comply to the industry standards and norms. Vacuum pumping and refrigerant charging operations, and procedures must comply with the industry standards.

3.3.15 Connection between Water inlet and Outlet Pipe of Cooling Water

Each water cooled cooling system uses a BPHE and an MBV. The water supply (inlet) pipe and water return (outlet) pipe of the cooling water should be connected to the system. A filter (Filter mesh: 1 mm) and motorized isolation valves should be mounted on the water supply (inlet) pipe of the cooling water, and this motorized isolation valve acts as a balancing valve. The cooling water system with a balancing valve can control the water distribution more accurately and it also enhances the efficiency of pump.

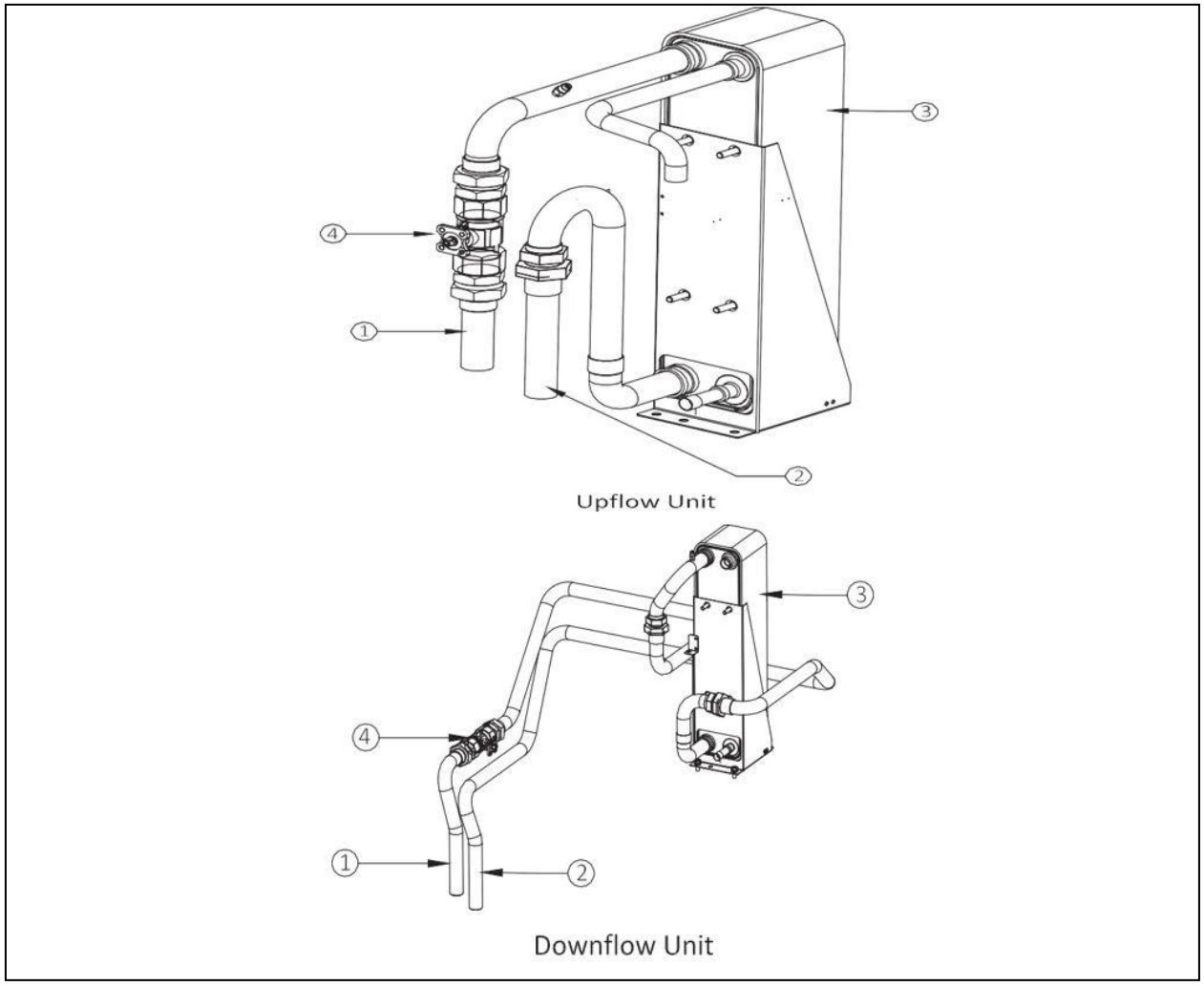
On the other hand, the motorized valve can keep the optimal condensing temperature by regulating the internal water flow. The actuator of the regulating valve also features a manual override to allow water side balancing by the installer. It is recommended to arrange the cooling water piping separately for different systems, so that repairing one pipe will not affect the operation of the other piping.

The water pressure should be high enough to overcome the pressure drops created by all the components of the water system. In addition, because of the sediments and impurities more pressure drop can occur after long term operation, user should arrange a redundancy of 20% to 25% when selecting the pump. Inlet water pressure of 0.1 MPa to 0.3 MPa is recommended, but the water flow of the system should be guaranteed.

Refer Figure 3.10 on page 28 for the system arrangement of the water-cooled unit. The material used for the cooling water inlet and outlet piping of the indoor unit is copper with outer diameter of 32 mm.

As shown in Figure 3.27 on the facing page connect the pipes through direct brazing at the site and ensure that the junction is well-sealed.

Figure 3.27 Unit Connection (Water-cooled)

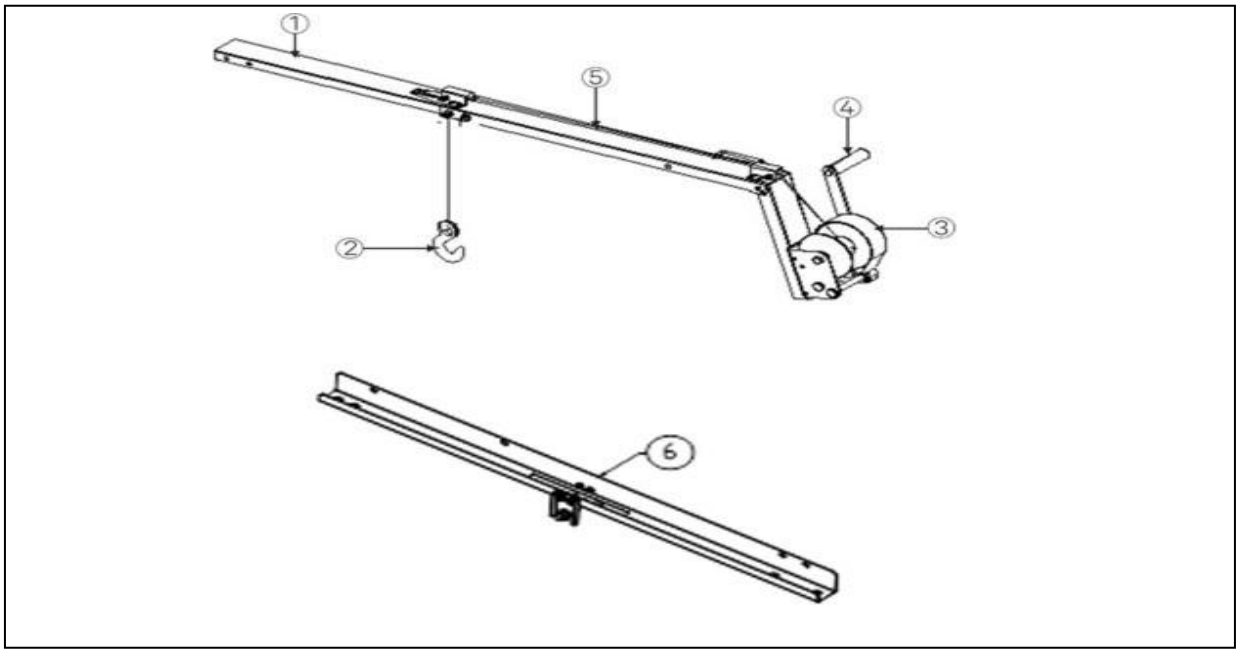


No.	Description	No.	Description
1	Water outlet	3	BPHE
2	Water inlet	4	A filter with motorized ball valve

3.3.16 Lowering the Fan

Before commissioning, the EC fans of the downflow unit must be lowered. The downflow unit is equipped with a lowering tool when it is shipped. The lowering tool that uses winch is shown in Figure 3.28 for air-cooled and water-cooled unit. It mainly includes, winch bracket, hook, sling, hand winch, handle, and a L-shaped lifting component.When the lowering height is not enough in unit, can replace this L-shaped beam to increase the lowering height.

Figure 3.28 Fan Elevator Assembly (Winch mode)

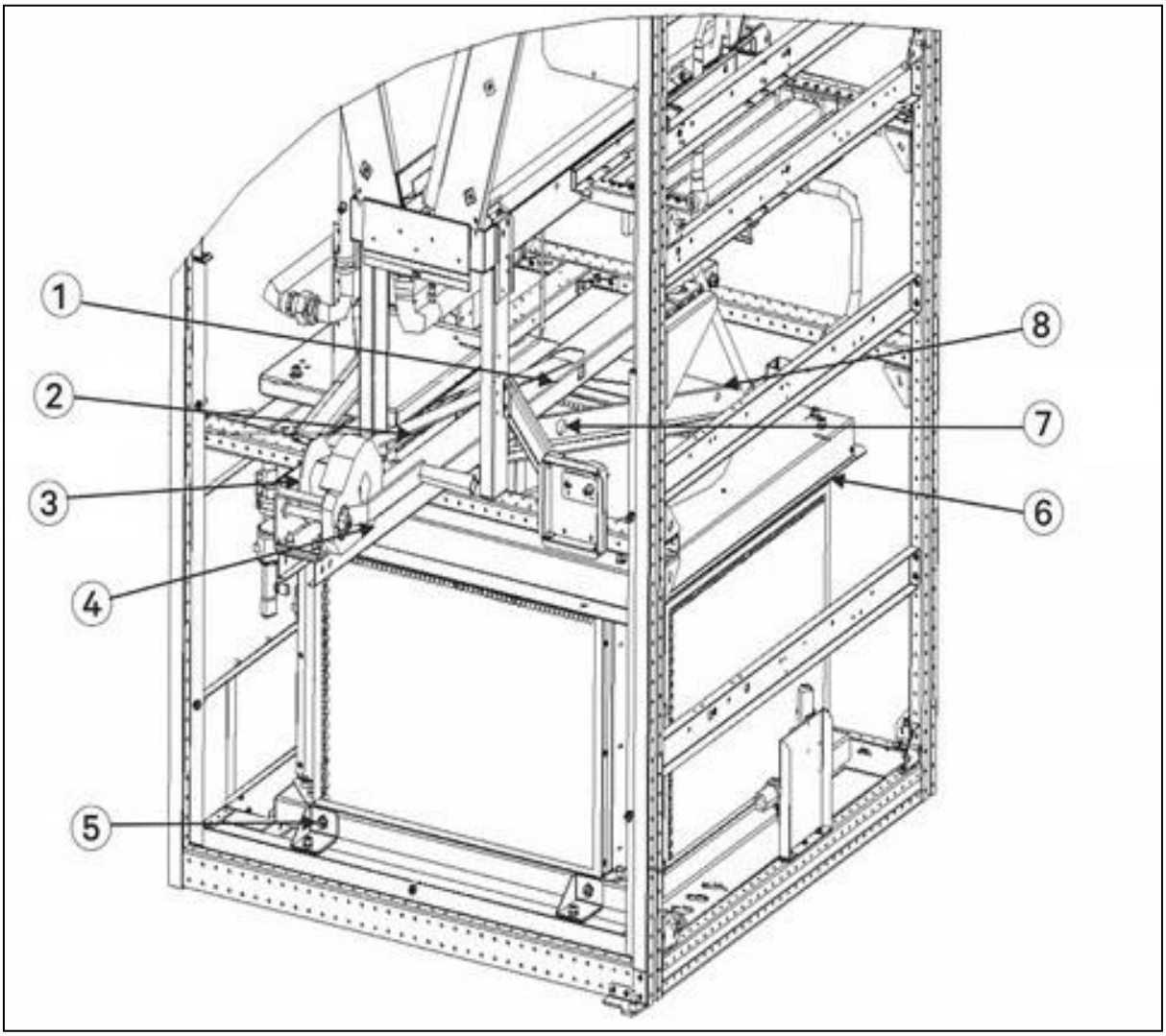


No.	Description	No.	Description
1	Winch bracket	4	Handle
2	Hook	5	Sling
3	Winch	6	L-shaped beam

Lowering Procedure

1. Installing lift and lowering kit for fan: Open the unit maintenance cover, check the fixing bolts (total two PCS) of the L-shaped beam to ensure that it is fixed to fan properly, if there are no L-shaped beam in the unit ,use the beam with winch component instead and fix it on the fan mounted roof,then check whether the fixing bolts (total four PCS) of the winch bracket is fixed well, as shown in Figure 3.29 below.

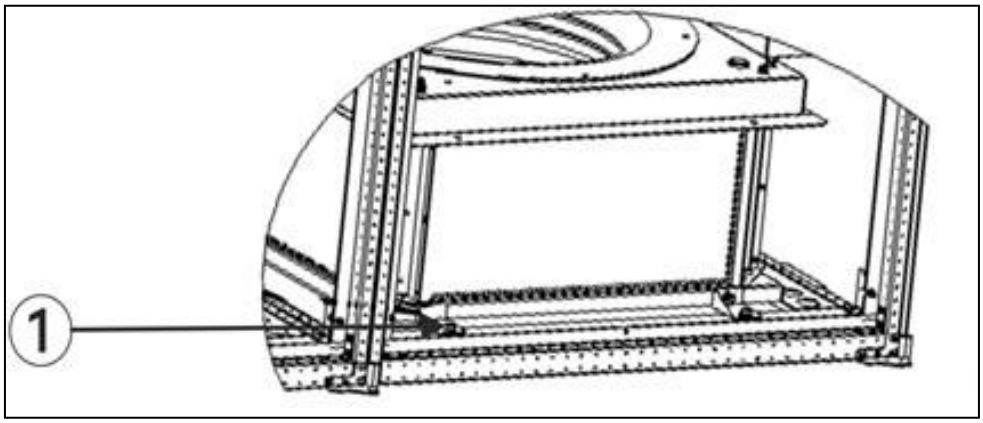
Figure 3.29 Installed Winch Bracket



No.	Description	No.	Description
1	Winch bracket	5	Bolt
2	Lifting rope	6	Fan
3	Winch	7	Hoist hanging hole
4	Winch handle	8	Lifting fastener

2. Turn the handle and use the winch hook to hook the L-shaped lifting component to the middle round hole (refer Figure 3.30 below). Adjust the handle until the sling is completely tight.
3. Cut the cable tie that binds the fan cables to ensure that the cable length meets the fan lowering requirements, and then remove the fixing bolts (refer Figure 3.30 below, total four PCS) for fan lowering.
4. Hold the winch handle firmly, and then turn the handle counterclockwise to lower the fan. The status after the fan has been lowered is shown in Figure 3.31

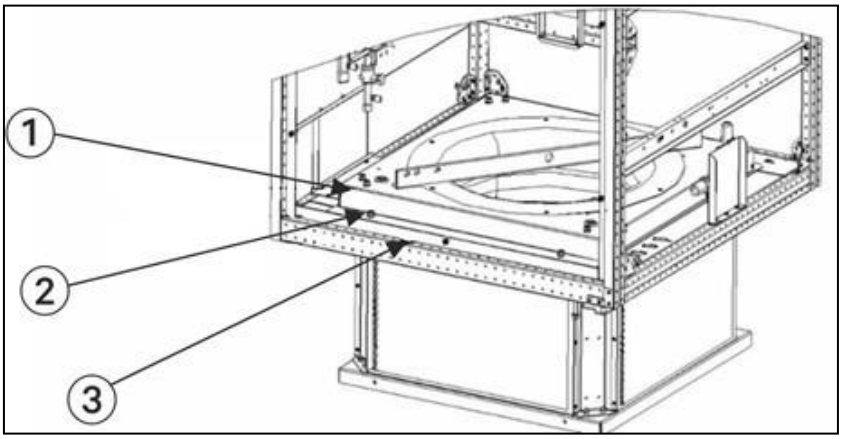
Figure 3.30 Position of Fixing Bolt



No.	Description
1	Bolt

5. Install the fixing bolts, as shown in Figure 3.31 below and hold the arrangement tight during operation with total four PCS of bolts.

Figure 3.31 Lowered Fan



No.	Description	No.	Description
1	Fan mounted roof	3	The unit bottom
2	Bolt		

6. Remove the hook from the L-shaped lifting component, turn the handle clockwise, arranged the sling in order and remove the fixing bolts (refer Figure 3.30 on the previous page: Position of Fixing Bolt, totally two PCS) of the winch bracket, and take out the winch and the bracket assembly.
7. Remove the fixing bolts of the L-shaped lifting component and take out the L-shaped lifting component. At this point, the operation of lowering the fan of the one-bay unit is complete. For the unit with two fans, lower the other fan too, using the fan elevator assembly.
8. Repeat steps 1-7 of the one-bay unit to lower the other fan.
9. After lowering all fans, arrange the fan cables in the correct order and fix them using a cable tie.
10. Confirm whether the EC fan has been lowered and installed and ensure that the blade does not touch the fan housing when the fan rotates.

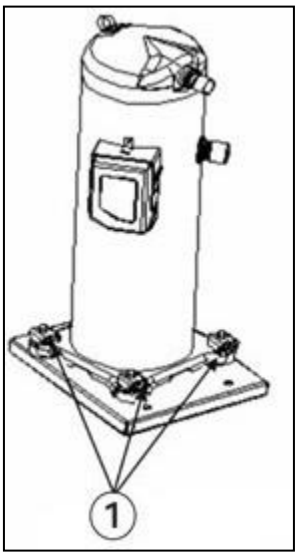
3.3.17 Removing Transportation Fixing Plate of the Compressor

Damping cushions are added to the compressor base to reduce the vibration and noise during operation. However, such method cannot best withstand the vibration while transporting the unit and may result in loosening connections and wearing of certain parts. Hence to ensure the rigidity of the compressor during transportation, three L-shaped fixing plates are added to the compressor base.

NOTE: Remove the three L-shaped fixing plates after installation, and then restore the bolts and washers in reverse sequence of the dis-assembly process.

NOTE: The fastening torque of the bolts is (12±1) Nm.

Figure 3.32 Position of "L" Shape Fixing Plate



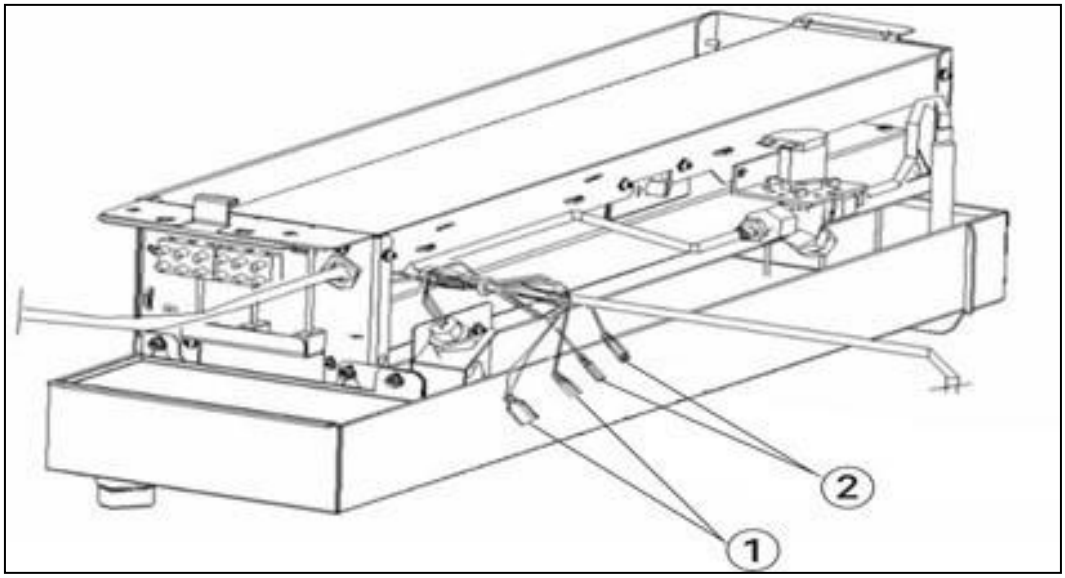
No.	Description
1	Fixed sheet metal (total 3PCS)

3.3.18 Removing of Fasteners of Infrared Humidifier

The floating pole of the humidifier high water-level switch is tightly bound together with a rubber string before delivery, as shown in Figure 3.33 below. Remove the rubber string before the unit operation. Otherwise, the unit will not be able to detect the high water-level alarm.

WARNING! Do not touch the lamps with bare hands.

Figure 3.33 High Water Level Detection Float Switch Lever and Terminal HWA



No.	Description	No.	Description
1	Plug terminal	2	Connect HWA plug terminal to water level switch

3.3.19 Removing Pipe Fasteners

To prevent the long copper pipes from scratching the metal plate and being damaged, the pipes are cushioned with foam or bound before delivery. Remove those materials before power-on commissioning.

3.3.20 Installation Inspection

Table 3.14 Installation Inspection Checklist

Check Items	Results
Leave enough space around the unit for maintenance	
The equipment is installed vertically, and the installation fasteners have been fixed	
The pipes between the indoor and outdoor unit have been connected, and the ball valves of the indoor and outdoor unit have been fully opened	
Condensate pump is installed (if required)	
The drain pipe has been connected	
The water supply pipe for the Infrared humidifier has been connected	
All pipe joints are tightened	
Fasteners for transportation have been removed	
Irrelevant things (such as transportation material, structure material, and tools) inside or around the equipment have been cleared after the equipment is installed	
The airflow distribution system has been installed in each room (e.g. raised floor/grill, duct, etc.)	
The upflow unit must have plenum or air duct connection, and after installation the fan and heater shall not be accessible	

Everything is checked and verified, follow the electrical installation.

3.4 Electrical Installation

In this section, the electrical installation of the Liebert® PEX3 unit is explained in-depth to get familiar with the various tasks such as the installation considerations, indoor wiring, power lines connection to the condenser, and the checklist.

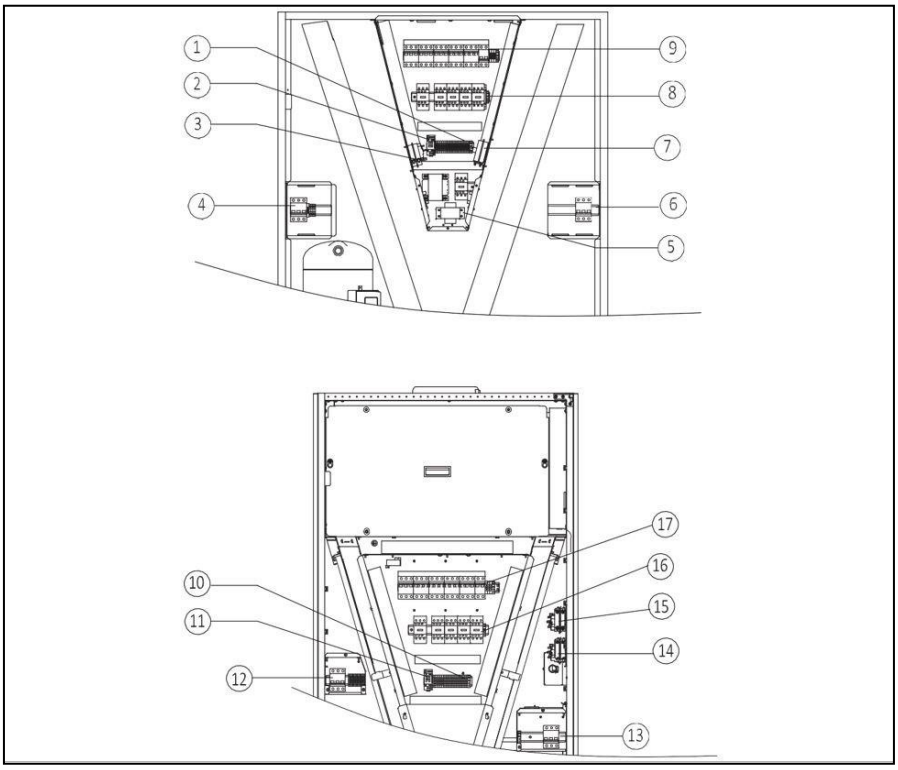
3.4.1 Installation Precautions

- The connection of all power cables, control cables, and ground cables should comply with the local and national electrical regulations.
- The electrical installation and maintenance must be performed by authorized professional/installation personnel.
- See the unit name-plate for the full load current. The cable sizes should meet the local wiring rules.
- Mains supply requirement: 400 V, 3 Ph +N~50 Hz.
- If the soft power cable uses Y-connection, and if the cable is damaged, it must be replaced by professional service personnel.
- Before the wiring, use a volt-meter to measure the power supply voltage and ensure that the power supply has been switched off.
- The applicable grid for this air conditioner, TN, TT star connection power system; consult Vertiv local representative for other connections.
- A breaking device must be provided to disconnect the unit from power supply.
- The short circuit breaking current of the unit is 6 kA.
- Install suitable RCD according to actual installation.

3.4.2 Wiring of Indoor Unit

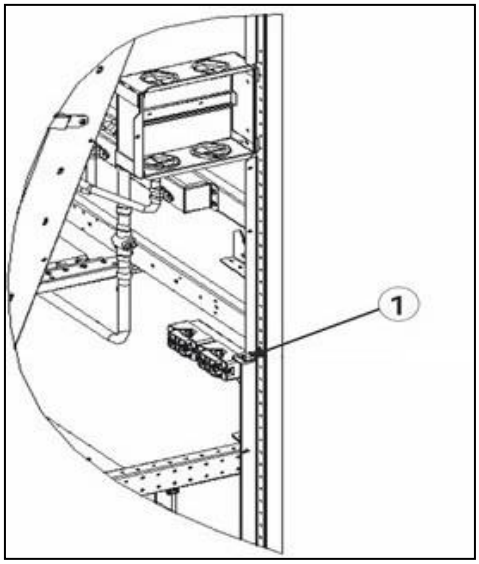
The locations of the low voltage devices are visible after opening the front door of the electrical control box of the indoor unit, as shown in Figure 3.34 below (for air-cooled/water-cooled model). The distribution information of the detailed low voltage components are differentiated according to the labels.

Figure 3.34 Electrical Control Box



No.	Description	No.	Description
1	Terminal row	10	Terminal row
2	Electrical row	11	Electrical relay
3	Differential pressure switch	12	Outdoor machine empty open (Only for Air-cooled)
4	Outdoor machine empty open (Only for Air-cooled)	13	Power connector
5	Transformer	14	Differential pressure switch
6	Power connector	15	Airflow loss switch
7	Airflow loss switch	16	Contact device
8	Contact device	17	Bus/air open
9	Bus/air open		

Figure 3.35 Cable Clamp Position



No.	Description
1	Cable clamp

Figure 3.36 below shows the details of power connectors in electrical control box, connects terminals L1~L3, N, and PE respectively to their counterparts of external power supply. Reserve some redundancy of the incoming cable and fix the cable to the cable clamp located on the inner side panel of the unit, refer Figure 3.35 above. The types of wiring cables are of copper conductor, and the cross-section-area requirements of the copper wires can vary with the different models. For the cable specification, refer the rated Full Load Ampere (FLA) in the Table 3.15 on the facing page. Over-current/Ground fault protection device is recommended to use the air switch with the feature of D-release. Refer Table 3.16 on the facing page for specific model selection.

An enlarged view of outdoor unit MCB (only for Air-cooled) and field terminal array are shown in Figure 3.37 on the facing page. L1~L3, N and PE are respectively connected with the corresponding end of the outdoor unit power line.

Figure 3.36 Enlarged View of Power Connector

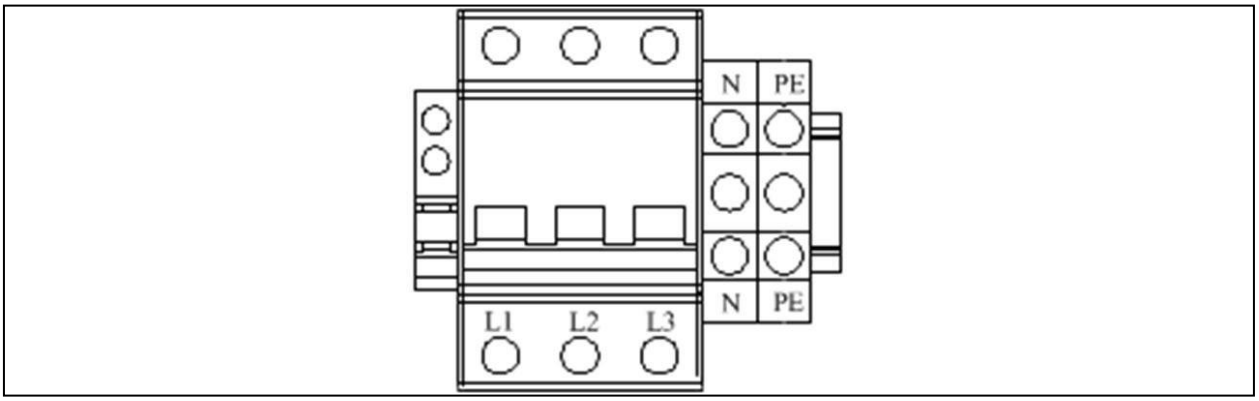
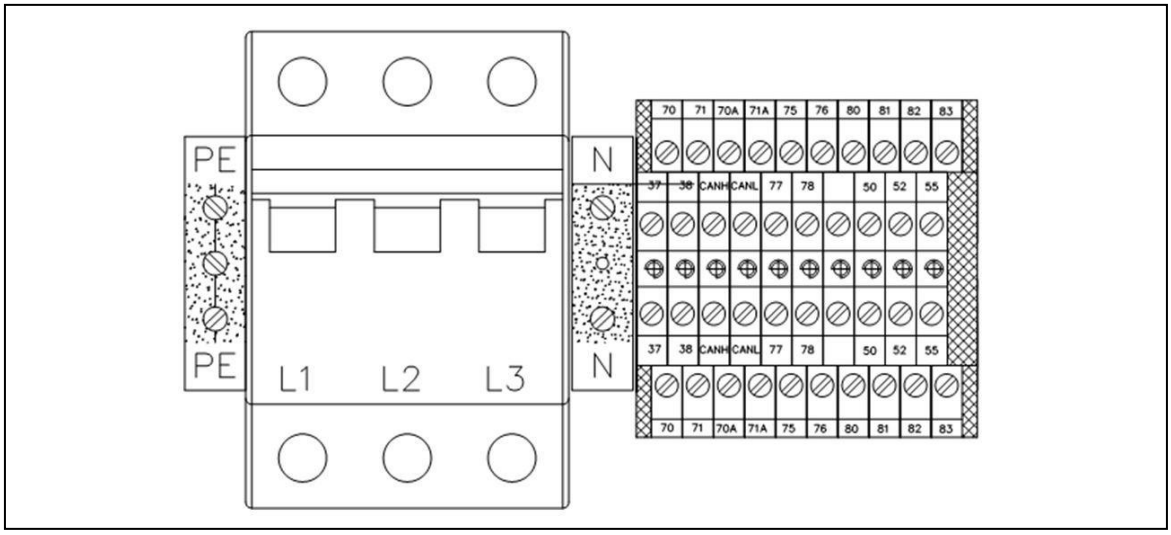


Figure 3.37 Enlarged View of Condenser MCB and Terminal



NOTE: The cable sizes should meet the local wiring regulations.

Table 3.15 Rated Full Load Ampere (FLA)

Unit Type	Standard Models	Electrical Heating			No Electrical Heating		Cross-Section-Area of Copper Wire mm^2
		Standard Model with 2-stage Electrical Heating	1-stage Electrical Heating/No Humidifier	2-stage Electrical Heating/No Humidifier	With Humidifier	Without Humidifier	
P1030	29.6	38.7	29.6	38.7	26.6	20.5	7
P1040	37.8	51.5	37.8	51.5	30.2	24.1	10
P1050 (S)	46.4	60.1	46.4	60.1	38.8	32.7	12
P1050 (D)	46.8	60.5	46.8	60.5	39.2	33.1	12
P2060	54.7	68.4	54.7	68.4	52.4	41.0	14
P2070	57.7	71.4	57.7	71.4	55.4	44.0	14
P2080	66.4	84.7	66.4	84.7	59.6	48.2	17
P2090	76.4	94.7	76.4	94.7	69.6	58.2	19
P2100	83.6	101.9	83.6	101.9	76.8	65.4	21

NOTE: The standard model is configured with compressor, EC fan, humidifier and one-stage electrical heating.

NOTE: Air-cooled unit FLA excludes the outdoor unit current.

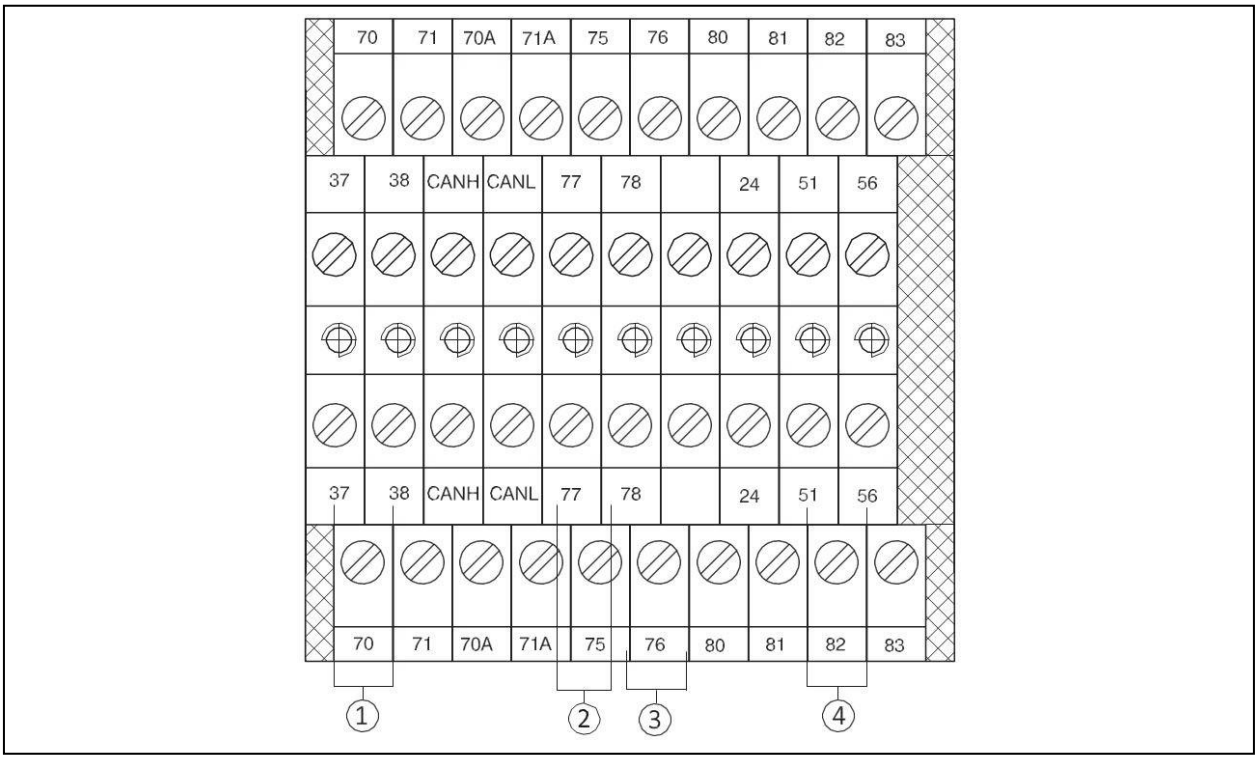
Table 3.16 Rated Current of MCB

Type	Rated Current of MCB (A)
P1030~P2100	125

3.4.3 Connecting Control Cables

The position of field connection terminals is shown inFigure 3.37 on the previous page and the enlarged view of the terminal row is shown in Figure 3.38 below. The upper part of the terminal row is connected with the unit, and the lower part is the interface of the user control signal line.

Figure 3.38 Enlarged View of Terminal Block/Row



No.	Description	No.	Description
1	37/38 short connection, remove this short wire at remote shutdown	3	Access to public alarm
2	RS485 interface	4	Custom alarm end for its common end

NOTE: Before connecting the control line, it is mandatory to perform the corresponding anti-static measures.

3.4.4 Connecting Water-Under-Floor Sensor

Each unit is equipped with a water-under-floor sensor. Connect one end of the sensor to terminal 51# and the other end to the common terminal 24#. The number of sensors in parallel connection is not limited, but each unit has only one water-under-floor alarm.

3.4.5 Remote Shutdown Control Line Connection

As shown in Figure 3.37 on page 61, 37# and 38# terminals can connect to remote shutdown switch, and they have been shorted in the factory and the shorting cable should be removed if the terminals are to be connected to the remote shutdown switch.

NOTE: When 37# and 38# are opened, the unit will shut down.

3.4.6 Customized Alarm Terminal

Terminals 51# and 56# can be connected to two types of sensors, and terminal 24# is their common terminal and can be defined as water-under-floor sensor. If there is an optional smoke detector, the alarm can be involved in any between #56 and # 24 terminal. After the customer terminals are connected to external alarm signals, the corresponding customized alarm should be set through the controller.

When the contact is open, and no external alarm is generated, the input state of the customer terminal is open. But when the contact is closed, and the external alarm is generated, the input state of the customer terminal will be shorted. At this point, the Precision Air Conditioner system will generate an audible alarm, and the controller LCD will display the alarm information.

1. LCD displays the corresponding alarm content.
2. Terminals 37# and 38#: Remote alarm.
3. Terminals 51# and 24#: Water-under-floor sensor by factory settings.

3.4.7 External General Alarm

Terminals 75# and 76# can be connected to the external general alarms. The output signals to external alarm devices, such as alarm indicator. When critical alarm occurs, the contact will be closed to trigger remote alarms, send signals to the building management system or dial the paging system automatically. The power supply of the external general alarm system is user prepared.

3.4.8 Condenser Wiring

1. Condenser Control Signal Terminal

70#/71# and 70A#/71A# are control signal input terminals for two circuits of condensers and their switching status are identical with those of the compressor.

2. Control Signal Line Connected to the Condenser

Open the sealed panel of the electric control box of the condenser to reveal the fan speed controller board, according to the cable connection instructions in the “Liebert® Condenser User Manual”. The signal cable connection of condenser is as follows.

3. Wiring Mode of PEX Condenser of Single System Unit Matches with Indoor Unit of Single System

The digital signal of dry contact J6 on the board (Refer Cable terminals section in “Vertiv PEX+ Condenser User Manual” for the locations) is connected to the control terminals 70#/71# of the indoor unit.

4. Wiring Mode of two PEX Condensers of Single System Unit Matches with Indoor unit of Dual System

The digital signals of dry contacts J6 on the condenser board corresponding to compressor 1# are connected to the control terminals 70#/71# of the indoor unit, and the digital signals of dry contacts J6 on the condenser board corresponding to compressor 2# are connected to the control terminals 70A#/71A# of the indoor unit.

5. Wiring Mode of PEX Condenser of Dual System Unit Matches with Indoor unit of Dual System

Short-connected the terminals 70# & 70A# and 71# & 71A#. The digital signal of dry contact J6 on the board can be connected to the control terminals 70#/71# or 70A#/71A#.

6. Wiring Mode of LVC Condenser matches with two Indoor units of single system

Compressor single terminal row 70#/71# in 1# condenser electrical control box (refer "the LVC Condenser Series User Manual" for external cables) can be introduced from either control interface of indoor unit.

Compressor single terminal row 70/70A#/71/71A# in 2# condenser (refer "the LVC Condenser Series User Manual" for external cables) can be introduced from another 70#/71# control interface of indoor unit.

7. Wiring Mode of LVC Condenser matches with Indoor unit of dual system

The power cables of condenser are connected with the MCBs (Figure 3.37 on page 61) reserved in the indoor unit.

3.4.9 Check the Installation

After completion of the electrical installation, check and confirm as per Table 3.17 below.

Table 3.17 Inspection Checklist

Check items	Results
The power supply voltage meets the rated voltage on the unit name plate	
The system electric loop has no open circuit or short circuit	
Power cables and ground cables to the MCBs, indoor unit and condenser are well connected	
The ratings of the MCBs and fuses are correct	
The control cables are well connected	
All the cables connections are fastened, with no loose screws	

WARNING! Do not power-on the unit, unless the unit has been checked and confirmed by Vertiv Personnel/Vertiv Service Team.

4 Touchscreen Operation

Vertiv™ Liebert® iCOM offers the highest capability for unit control, communication, and monitoring of Liebert Thermal Management Units. It is available as factory-installed on new units and assemblies.

For details about the touchscreen operation, please refer to “Liebert® iCOM™ User Manual”.

5 System Operation and Maintenance

Regular system maintenance is critical to ensure the reliability and the effectiveness of the product. This chapter describes Liebert® PEX3 system maintenance, the content includes routine maintenance inspection items, check the electrical connections, control devices visual inspection, maintenance guide air-cooled condenser, filter maintenance guide, the infrared humidifier dimensional guidance, and electric heating maintenance guidance.

WARNING! During the running of Liebert PEX3, there may be lethal voltage within the device. The system must therefore comply with all cautions and warnings mentioned in this manual or which may cause casualties.

WARNING! Only qualified service and maintenance personnel can perform system operation and maintenance.

5.1 Routine Maintenance Inspection Items (Monthly)

Components of the monthly inspection system, focusing on whether the system function is normal and whether the components show any signs of wear and tear, refer Table 5.1 below the monthly routine maintenance inspection items.

Table 5.1 Monthly Routine Check List of Items

Part	Check Item	Remark
Filter	Check for clogging or damage	
	Check the filter clog switch	
	Clean the filter	
Fan	Check fan blades are not distorted	
Compressor	Check for leakage	
	Listen to the operation sound, observe the operation vibration	
Air-cooled condenser (air-cooled units)	Check the fins are clean	
	The fan base should be firmed	
	The fan vibration absorber is not deteriorated or damaged	
	The SPD board should be effective (in the storming seasons, the SPD board should be check once a week)	
	The refrigerant pipes are properly supported	
Refrigeration cycle system	Check refrigerant pipes. Refrigerant pipes must be properly supported and must not lean against walls, floors or where the frame vibrates	
	Check the moisture content of the system (through a sight glass)	
	Check electronic expansion valve	
	Check the condenser drain pan for dirt blockage	
	Check the suction pressure and temperature	
	Check the discharge pressure and temperature	
	Check the water-cooled unit water inlet temperature	
Electrical heating system	Check the re-heater operation	
	Check the erosion situation of the components	
Infrared humidifier	Check clogging of the drain pipes	
	Check the lamps of the infrared humidifier	
	Check the mineral sediments on the water pan	

5.2 Routine Maintenance Inspection Items (Semi-Annual)

Refer Table 5.2 below for routine maintenance inspection items semi-annually.

Table 5.2 Semi-Annual Routine Check List of Items

Part	Check Item	Remark
Filter	Check for clogging or damage	
	Check the filter clog switch	
	Clean the filter	
Fan	Check fan blades are not distorted	
	Check whether there is bearing wear	
	Check and fasten the circuit connector	
Compressor	Check for leakage	
	Listen to the operation sound, observe the operation vibration	
	Check and fasten the circuit connections	
Air-cooled condenser (air-cooled units)	Check the fins are clean	
	The fan base should be firmed	
	The fan vibration absorber is not deteriorated or damaged	
	The SPD board should be effective (in the storming seasons, the SPD board should be check once a week)	
	The refrigerant pipes are properly supported	
	Check and fasten the circuit connections	
Water-cooled condenser (watercooled unit)	Check the water pipe system	
	Check the MBV	
	Check for leakage	
	Check the water pressure and temperature	
Refrigeration cycle system	Check refrigerant pipes. Refrigerant pipes must be properly supported and must not lean against walls, floors or where the frame vibrates	
	Check the moisture content of the system (through a sight glass)	
	Check electronic expansion valve	
	Check whether refrigerant needs to be added (through the sight glass)	
	Check the condenser drain pan for dirt blockage	
	Check the suction pressure and temperature	
	Check the discharge pressure and temperature	
	Check the water-cooled unit water inlet temperature	
Electrical heating system	Check the re-heater operation	
	Check the erosion situation of the components	
	Check and fasten the circuit connections	

Table 5.2 Semi-Annual Routine Check List of Items (continued)

Part	Check Item	Remark
Infrared humidifier	Check clogging of the drain pipes	
	Check the lamps of the infrared humidifier	
	Check the mineral sediments on the water pan	
	Check and fasten the circuit connections	
Electrical control part	Check and fasten the circuit connections	

5.3 Self-Diagnostic System

The controller provides the diagnostic function of manually opening and closing of components, which is used to self-test the state of the functional components of the system.

5.4 Check the Electrical Connections and Maintenance

Following are the electrical connections to make visual inspection and treatment:

1. Conduct overall electrical insulation test: Find out the unqualified contacts and handle them carefully. Note to disconnect the fuses or MCBs of the control part during the test before the high voltage should damage the control components.
2. Check the contactors before power-on and ensure the contactors can act freely without obstruction.
3. Clean the electric and control elements of dust with brush or dry compressed air.
4. Check the closing of contactors for arcs or signs of burning. Replace the contactor if necessary.
5. Fasten all the electrical connection terminals.
6. Check whether the sockets and plugs are in good conditions. Replace those damaged ones.
7. If the power cables are damaged, to avoid further damage, the cables must be replaced by professional personnel.

5.5 Appearance Inspection and Maintenance of Controller Components

A control section to make visual inspection of the following entries, and a simple function test process:

1. Visually inspect the power transformers and isolation transformers and test the output voltage of the indoor unit and outdoor unit.

2. Check whether there are no signs of aging on the control interface board, control board, temperature and humidity sensor board.

3. Clean the electrical control elements and control board of dust and dirt with brush and electronic dust removing agent.

4. Check and fasten the I/O ports at the control interface board, including the connection between control board and control interface board, as well as between the temperature/humidity sensor board and the interface board.

5. Check the connection between the user terminals (70#, 71#, 70A#, 71A#, 37#, 38#) and the control interface board.

6. Check the output connection between the control interface board and various contactors and solenoid valves for liquid pipes, and the input connection between control interface board and fan overload protector, high pressure switch, heating over-temperature protection switch, humidifier protection switches, discharge air temperature sensor, and low-pressure sensor. In particular, check the connection parts such as high-pressure switches and solenoid valves, and replace the component if it is in poor condition or is faulty.

7. Check and replace electrical components that are faulty, such as control fuses (or MCBs) and control boards.

8. Check the specification and aging condition of the control cable and power cable between the indoor unit and the outdoor unit and replace the cables if necessary.

9. Use temperature and humidity measuring meters with higher precision to measure and calibrate the temperature and humidity sensors.

10. Adjust the setpoints. Check the action of the functional parts and the auto-flush control logic of water pan of the infrared humidifier according to control logic.

11. Simulate and check the operation of the protection devices including high and low-pressure alarm, high and low temperature alarm, high water level alarm and over-temperature protection.

12. Check the water detection sensor. Bridge the water detection sensor probes and confirm the alarm through the controller. The sensor should be placed in low-lying areas near the unit.

NOTE: Set the humidity control mode to relative humidity control during calibration process.

WARNING! Before fastening the connection of any mechanical parts or cables, ensure that the power supply of the control unit has been disconnected.

WARNING! Do not use the water detection sensor adjacent to flammable liquid or use it to detect flammable liquid.

5.6 Air-Cooled Condenser Maintenance Guide

Refer the associated “Liebert® PEX condenser User Manual” and “LVC Series Condenser User Manual”.

5.7 Water-Cooled Condenser Maintenance Guide

BPHE

The turbulence generated in the ducts of brazed BPHE can clean the ducts. However, in case of serious scaling (when scaling is due to the use of hot hard water), it is necessary to use cyclic rinsing device to clean the BPHE. Add weak acid (like 5% phosphoric acid) into a jar and pump the fluid into the BPHE to clean it, thoroughly.

If the BPHE is regularly cleaned, then use 5% oxalic acid.

MBV

The Liebert® iCOM™ controller controls the electronic ball valve position by collecting the refrigerant pressure from the pressure sensor at the BPHE outlet, to control the water flow through the BPHE for system stable.

operation. The higher the load, the more water flow is allowed to flow through the BPHE. The lower the load, the less water flow is allowed to flow through the BPHE.

NOTE: Vertiv maintenance service does not cover the cleaning of BPHE, but user can consult Vertiv local representative for more details.

NOTE: If the electronic ball valve is in abnormal regulation state, consult Vertiv local representative.

5.8 Filter Maintenance Guide

The efficiency of the filter in the unit is 30%, which complies with US ASHRAE52-76 and Eurovent 4/5 standards, and the dust resistance value is 90% (EU4 standards). To ensure efficient operation, the dust filter must be checked once a month, and replaced as required. The filter clogging switch and pressure difference switch are located. You need to adjust the setting point of the filter clogging switch if the new filter is of a different model. It samples the air pressures from front and behind the filter through a black hose and decides the output after comparing the two values.

To adjust the setting point of the filter clogging switch, you should:

1. After replacing the filter, restore and seal all the panels, so that the alarm point can be found precisely.
2. Keep the fan running and rotate the rotary switch of the filter clogging switch counter-clockwise until the filter alarm is triggered.
3. Rotate the rotary switch clockwise for two and half rounds or rotate it to the point where the filter should be replaced.

NOTE: Cut off the power supply before replacing the filter.

NOTE: It is recommended to set airflow switch according to the manual instructions, otherwise there will bean air filter alarm or in the opposite case, the alarm could not be triggered by the dust accumulation on the filter, endangering the system operation due to deteriorated ventilation.

NOTE: If you are unsure about the setting point, consult with Vertiv before using a filter of a different model to replace the old one.

5.9 Infrared Humidifier Maintenance Guide

During the normal operation of the infrared humidifier, sediment such as mineral particles will accumulate on its water pan. To ensure efficient operation of the infrared humidifier, you need to clean the sediment regularly. However, the cleansing cycle varies because the water quality is different in different regions. It is recommended to check, and cleanse (when necessary) the water pan, once a month. The auto-flush function of the infrared humidifier can prolong the cleansing cycle. However, regular checks and maintenance are necessary.

Cleaning Steps:

1. Remove the water level standpipe to drain the water pan.
2. Disconnect the drainage pipe.
3. Remove the safety switch of the water pan.
4. Remove the fixing screws at the two ends of the pan and pull out the water pan. Cleanse the water pan with water and hard brush.
5. Restore the water pan by reversing the preceding procedures.

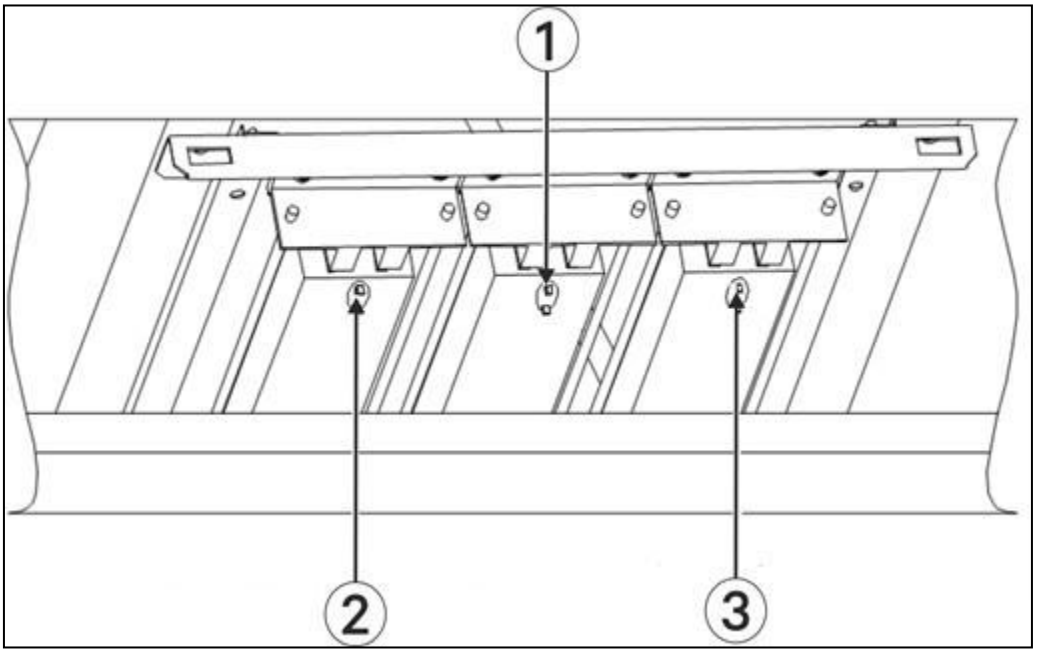
WARNING! Before exercising the corresponding operation, ensure that the power supply has been switched off; also, ensure that the water in the water pan is close to the room temperature before draining the water from the infrared humidifier water pan to avoid the personal injury.

5.10 Electric Heater Maintenance Guide

The electric reheating shown in Figure 5.1 , three temperature switches are serially connected to the control loop inside the electric heater, including two automatic reset switches and one manual reset switch. Check the electrical heating for rust. Use an iron brush to get rid of or replace the rust, if possible, if the rustiness is immense or if some damage occurs.

1. Check the rustiness condition of the electric heater; use the iron brush to get rid of the rust or replace it according to actual conditions.
2. When heating is required, but heating is not effective, or no heating effect is observed, a multimeter should be used to check whether the cable connected to the temperature switch is functioning correctly to ensure that the three temperature switches are normal.
3. If the cable is not functioning properly, remove the electrical heater and check if the manual reset switch is disconnected. Next, check the automatic reset switches or the electric heater pipe for damage or faulty condition.

Figure 5.1 PTC Electrical Heating



No.	Description	No.	Description
1	Manual reset temp switch	3	Auto reset temp switch
2	Auto reset temp switch		

6 Diagnosis and Maintenance

This chapter describes the system operation and maintenance of the Liebert® PEX3 series air conditioner briefly in accordance with the end-user perspective. It includes information related to routine maintenance and inspection, electrical connections inspection, wiring, system diagnosis, visual appearance checks, and drainage maintenance among others; that helps in system fault diagnosis and treatment.

For the diagnosis and treatment of complex fault please contact Vertiv's local representative.

WARNING! Prior to operation and maintenance, the lethal voltage may be present in the equipment which can be fatal. All notes, warnings, and cautions marked on the equipment as well as the ones mentioned in the manual must be considered, otherwise, it may lead to injury and fatality.

NOTE: Qualified and professional maintenance personnel are the ones supposed to operate and handle the equipment.

6.1 Fault Diagnosis and Treatment of Fans

Refer Table 6.1 for fan fault diagnosis and treatment.

Table 6.1 Fault Diagnosis and Treatment of Fans

Symptom	Potential Causes	Check Items or Processing Method
EC fan cannot be started	Circuit breaker disconnection	Check the circuit breaker of the main fan.
	Contactor cannot be closed	Check whether there is 24 Vac voltage between P36-3 and P36-8. If yes, but the contactor still cannot close, then the contactor is damaged. Replace the contactor.
	Control board failure	Check whether there is 24 Vac voltage between P36-3 and P36-8. If yes not, then the control panel is damaged.
		Check whether the green LED beside silicon control Q5 on the control panel is on or off.
	Contactor closed, air flow switch alarm	Check whether there is 0 Vdc to 10 Vdc analog signals output from P51-3, if not, then check the control board carefully.
		Check whether the values of S152 and S153 are set too low, if it is so, then fix it by increasing the setting values properly.
		Check whether the External Static Pressure (ESP) is too high, if it is so, then fix it by optimizing the air channel and increasing the setting values properly.
	EC fan failure	If the EC fan fault alarm triggers and restart automatically then the possible reasons are as follows: • EC fan is blocked. • EC fan is out of phase. • EC Fan internal communication error. • EC fan is under voltage.
		If the EC fan is automatically restarted but there is still EC fan fault alarm, then the reasons are as follows: • EC fan is reversed. • The bus voltage is high. • The power supply harmonic distortion rate is high (THDU>10%). • To determine the specific reasons: Connect to 485 communication port and use the EBM manufacturers software for analysis.

6.2 Fault Diagnosis and Treatment of Infrared Humidifier

6.2.1 Infrared Humidifier Troubleshooting

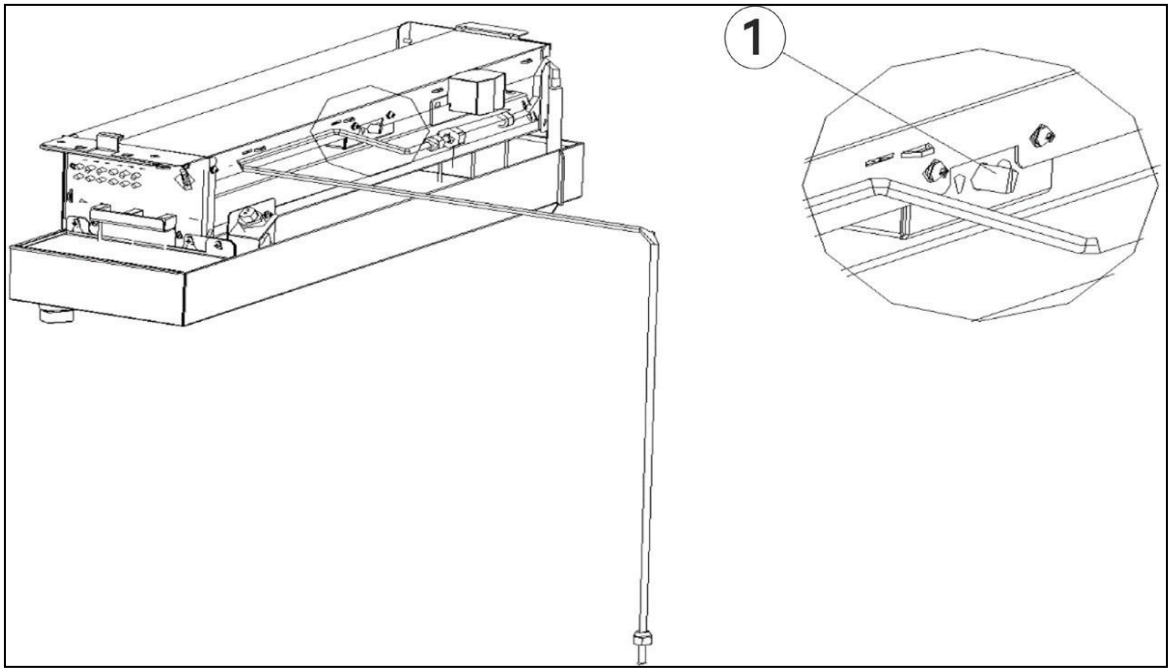
ReferTable 6.2 below for diagnosis and treatment of the infrared humidifier.

Table 6.2 Diagnosis and Treatment of Infrared Humidifier

Symptom	Potential Causes	Check Items or Processing Method
Humidification ineffective	No water in water pan	Check the water supply.
		Check whether the water supply solenoid valve is working.
		Check the state of the high water-level switch and the water level regulator.
		Check whether the water supply pipe is not clogged.
	The humidification contactor does not close	Check the contactor, and check the circuit voltage of the contactor.
		Check the opened safety devices of the infrared humidifier: Water pan over temperature protection switch and lamp over-temperature protection switch. If manual reset or adjustment is reached, the contractor does not close. Use a jumper to shot terminals P35-1 and P35-2. If the contactor is closed, replace the series-connected safety device, and remove the jumper.
	Air flow lose switch failure	Check whether the air flow lose switch connection is normal. Examine whether there is 24 Vac voltage between P36-7 and P36-4 after startup, if it is not, then you should check whether the air flow lose switch is damaged.
	Humidifier main power failure	Check whether the humidifier MCB is closed. In humidifier contactor closed state, check whether L1, L2 and L3 voltages are normal.
	Infrared humidifier lamp burned	Replace the lamp.

6.2.2 High-Temp Switch

Figure 6.1 Infrared Humidifier Reset Button



No	Description
1	Reset button

6.3 Compressor and Refrigeration System - Fault Diagnosis and Treatment

In case of static resistance imbalance, the motor windings may short the circuit. Refer the static resistance of different models of compressor inTable 6.3 below.

Table 6.3 Static Resistance of Compressors of Each Type

Compressor Model	Resistance Line to Line (25 °C)
ZP91KCE-TFD-522	1.79
ZP104KCE-TFD-522	1.38
ZP122KCE-TFD-522	1.173
ZP143KCE-TFD-522	1.14
ZP154KCE-TFD-522	1.10
ZP182KCE-TFD-522	0.8

If the compressor has been shut down for a long time and cannot be started, check the status of resistance, if it is open, then the compressor motor is damaged. In case of the compressor is stopped during operation, then the temperature at the top of the shell is very high, wait for the compressor to cool down for more than an hour. Try to restart the unit, if it can be turned-on, the built-in protection of the compressor will work; if the situation is not improved, that indicates that the compressor motor is damaged.

Refer Table 6.4 belowfor fault diagnosis and treatment of compressor and refrigeration system.

Table 6.4 Compressor and Refrigeration System Fault Diagnosis and Treatment

Symptom	Potential	Causes You Need to Check Items or Processing Method
Compressor does not start	Power supply off	Check the main power switch or circuit breaker connection is normal.
	Loose circuit connections	Check and fix the circuit connectors.
	Power overloaded and MCB tripped	Check the current average value, and manually reset.
	Abnormal supply voltage	Check whether the supply voltage of compressor terminal is normal.
	Static resistance of compressor	If the voltage is normal, check the static resistance of compressor.
	Ground insulation	If the static resistance is normal, check the compressor for ground insulation.
	Motor inspection	If the motor inspection is normal, it is likely to be the moving components such as scroll disks, bearings, etc. are damaged.
The compressor stops functioning	No cooling/dehumidifying demand output	Check the controller status and whether the power demand is greater than 50%.
	High-voltage switch operation	Check if there is high pressure alarm.
	Discharge temperature detecting switch	Check if there is the exhaust/high temperature alarm.
	Low-voltage switch operation	Check if there is low pressure alarm in the history of alarms; investigat, whether there is refrigerant leakage.
	Contactor fault	Check whether the contactor has a supply input of 24 Vac.
	Breaker tripping stopped	Check circuit voltage after checking breaker and contactor.

Table 6.4 Compressor and Refrigeration System Fault Diagnosis and Treatment (continued)

Symptom	Potential	Causes You Need to Check Items or Processing Method
High discharge temperature	Refrigerant leakage	Check whether the suction pressure and discharge pressure are low, find the leakage point and fix it. Add refrigerant if required.
	Discharge pressure is High or pressure ratio is low	If discharge pressure is high and the pressure ratio is high point, check whether the condenser and its fan are functioning normal.
	Compressor current	Check the compressor current. If the current is high and the unit is highly loaded, check whether the condenser and its fan are functioning normal.
Operation of the compressor overheating	Compression ratio is too high	Check the setting of the high and low-pressure switch, and whether the condenser is fouled. Check whether the fans of condenser and evaporator are operating normally.
	Suction superheat is too high	Adjust Electronic Expansion Value or add appropriate refrigerant.
Compressor excessive noise	Compressor base is not fixed	Check if the compressor base is fixed properly, and whether the pipeline collides with the shell.
	Pressure difference at start of unit	Check if the high- and low-pressure difference is small while starting the compressor or any similar conditions.
	System charge is large	If the system charge is large, check if the compressor crankcase heating zone is fully preheated.
	Compressor reversal	Check the compressor terminal wirings are in sequence.
	Compressor current is high	If the compressor current is high, it may be the bearing or scroll has been worn.
High compressor current	Supply voltage	Check the supply voltage.
	AC contactor	Check the AC contactor.
	Discharge pressure	Check the discharge pressure.
	Current of compressor	Check current of compressor according to the standard suction and discharge pressure setting, if the current is high, it is likely to be that the compressor components are damaged.
High-pressure protection	Condenser fouling	Clean condenser or plate and confirm whether the ball valve of the exhaust pipe is opening.
	Condensing equipment is not operating	Check air cooling system and the fan of condenser.
		Check water system. Check the operation procedures.
	Excessive amount of refrigerant charge	Check water system. Check the operation procedures.
	MBV improperly set (water-cooled)	Check whether the HP sensor reading and actual pressure meet ±0.6 bar requirement (the HP sensor value can be read from the SERVICE MENUS/DIAGNOSTICS, which displays the absolute pressure). Check whether the BPHE electric ball valve is normal.

Table 6.4 Compressor and Refrigeration System Fault Diagnosis and Treatment (continued)

Symptom	Potential	Causes You Need to Check Items or Processing Method
The compressor has no suction and discharge pressure difference	Refrigerant leakage	Detect the leakage point, repair it and add refrigerant.
	Discharge temperature difference	Check the discharge temperature of compressor. If the temperature is very high, the built-in temperature protection device ASTP may be triggered. Start the compressor, after cooling for 1 hour and observe whether there is still high or low pressure. If the pressure difference can be established, it may be caused by too high discharge pressure, and check the reason of high discharge temperature.
	Unloading solenoid valve	If digital compressor, check the unloading solenoid valve, maybe it is in active state.
	The compressor reverse or internal gas stirring	If compressor reverse, check if the any two L lines of the compressor are interchanged, and if the inner string and the gas generator cannot be restored, replace the compressor.
Suction and Discharge Pressure is too low or too high	Refrigerant Leakage	Check for refrigerant leakage, if identified do maintenance accordingly.
	Blockage of Check Valve or Throttle Valve	Check if Check valve or Throttle valve is blocked, resulting in high discharge pressure and low suction pressure.
	Compressor reversal	Check the compressor terminal wirings are in sequence, resulting in low discharge pressure and high suction pressure, and generally low discharge temperature.
	Temperature protection ASTP triggers	The built-in temperature protection ASTP triggers, resulting in low discharge pressure and high suction pressure, generally high discharge temperature.
	Digital compressor unloading	Digital compressor unloading, resulting in low discharge pressure and high suction pressure, generally low discharge pressure.
	Lack of refrigerant in the system	Check for leakage. If identified, repair and add refrigerant
	Dirty air filter	Replace the air filter.
	Filter dryer clogged	Replace the filter dryer.
	Improper setting of Electronic Expansion Valve superheat parameters	Check whether it adheres with the standard design of the unit superheat values.
	Electronic Expansion Valve device failure	Replace the Electronic Expansion Valve.
	Poor airflow distribution	Check the supply air and return air system.
	Condensing pressure is too low	Check the condenser.
	Excessive external residual pressure, causing air volume attenuation	Check air duct and evaluate the residual pressure outside the unit.

NOTE: Voltage and current measurement: The output of the AC contactor of the compressor is used to determine whether the supply voltage and start current of the compressor are within the normal range.

NOTE: Static resistance: Disconnect the power line on the compressor terminal, and then measure the resistance value between the terminals with the ohmmeter directly on the compressor terminal.

NOTE: The normal resistance relationship is satisfied: Three-phase compressor, RT1=RT2=RT3, measurement error of three phase does not exceed 15%.

NOTE: Insulation resistance: The resistance of the compressor's copper pipe terminal to the ground can be mesured using 'Ω' position of the multimeter. Under noramal condition the resistance value is greater than 40 MΩ or infinite.

6.4 Heating System - Fault Diagnosis and Treatment

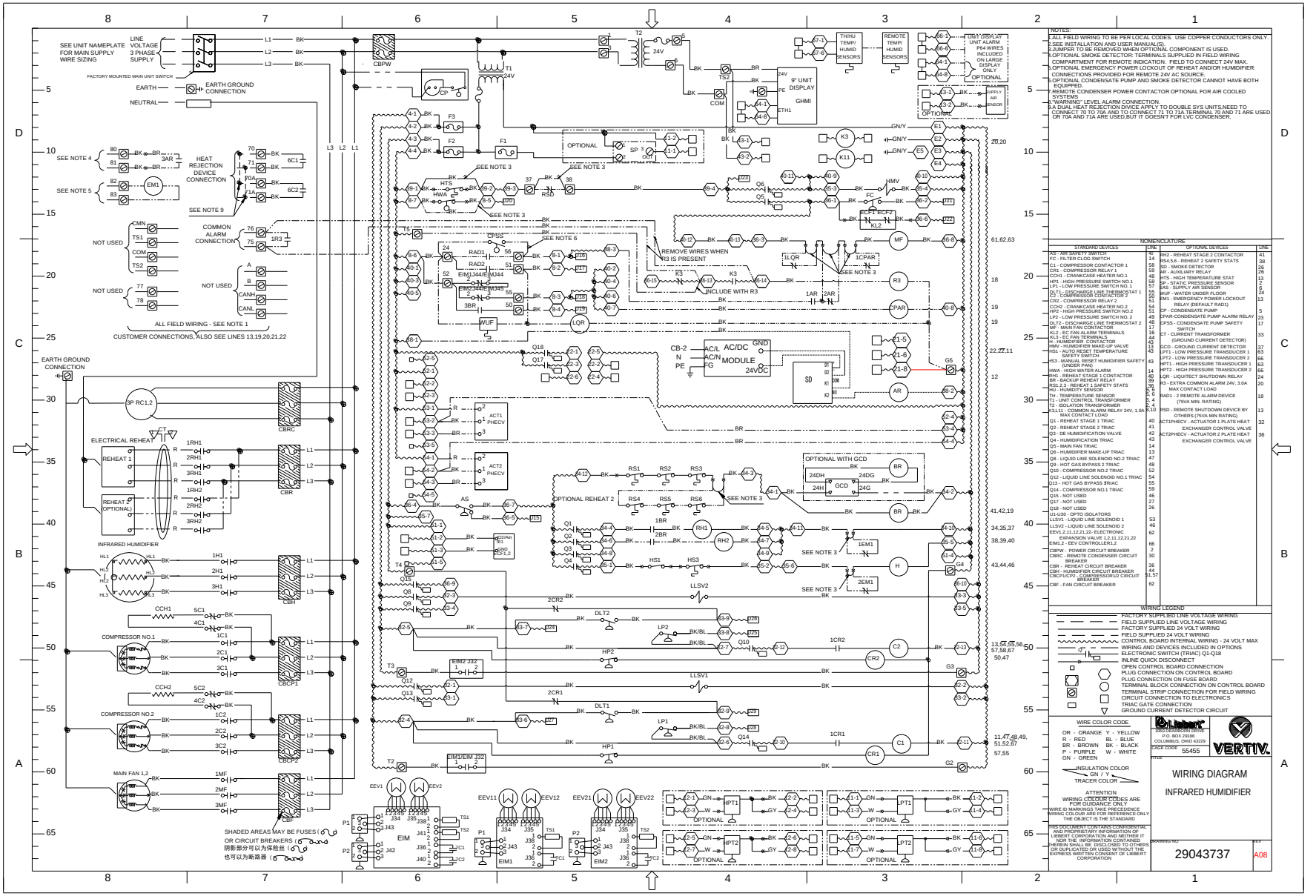
Refer Table 6.5 below for fault diagnosis and treatment of heating system.

Table 6.5 Diagnosis and Treatment of Heating System

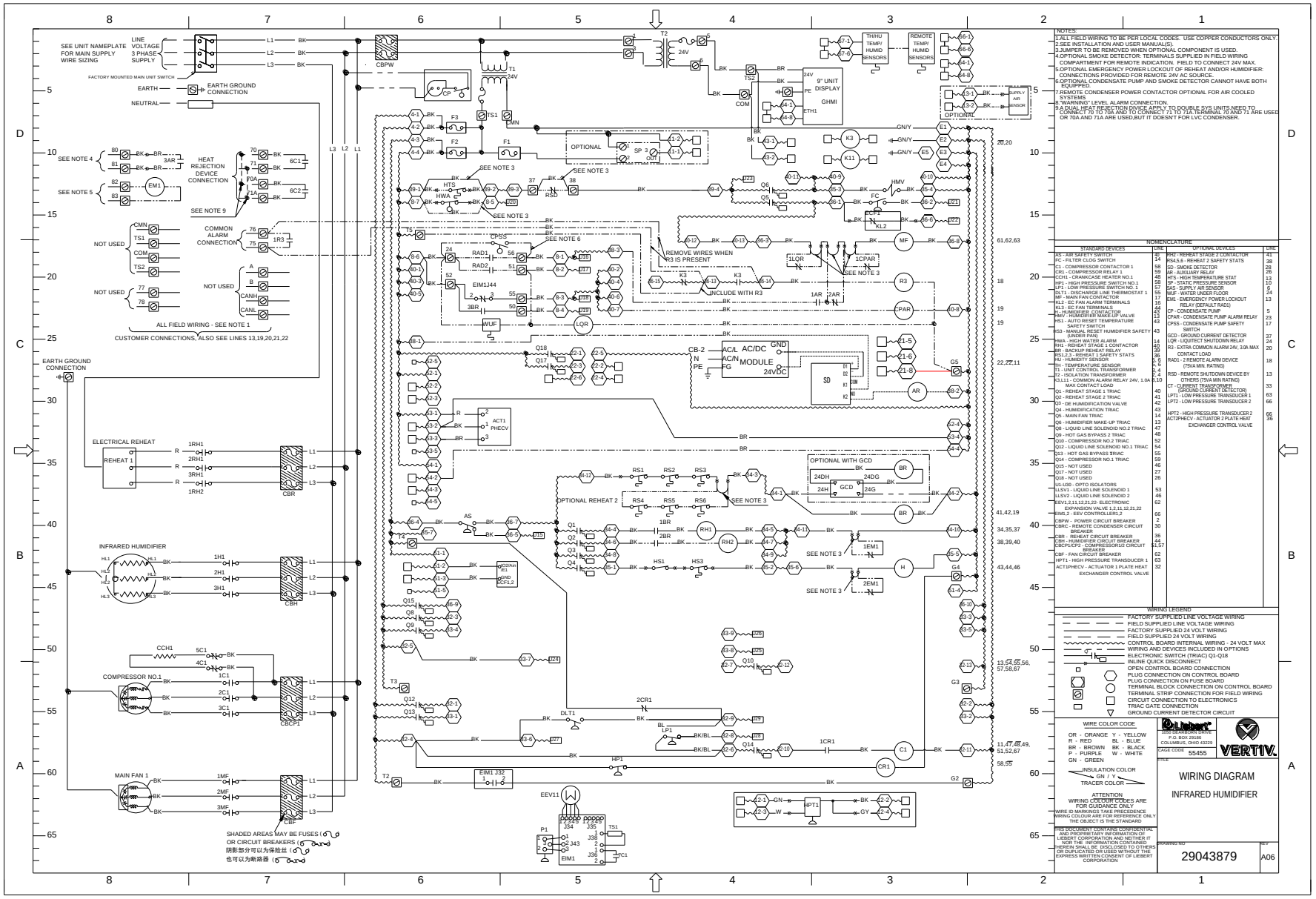
Symptom	Potential Causes	You Need to Check Items or Processing Method
The heating system is not running, the contactor does not pull	No heating required	Check the state of the controller, to confirm whether there is a heating requirement.
	Heating auxiliary relay fault	Check whether the light next to the heating auxiliary relay is on and whether the line is correct.
	Heating system safety device is disconnected	Check if manual reset switch is turned off and check the automatic reset for damage.
Contactor is closed	The heater main is powered off	Check whether the heating air switch is closed or not, and check if the contactor L1, L2, and L3 supply voltage are normal when the heating contactor is closed.
	The heater is burned	Cut off the power, detecting the resistance characteristic of the heater by ohmmeter to judge whether the electrical heating is damaged

Appendices

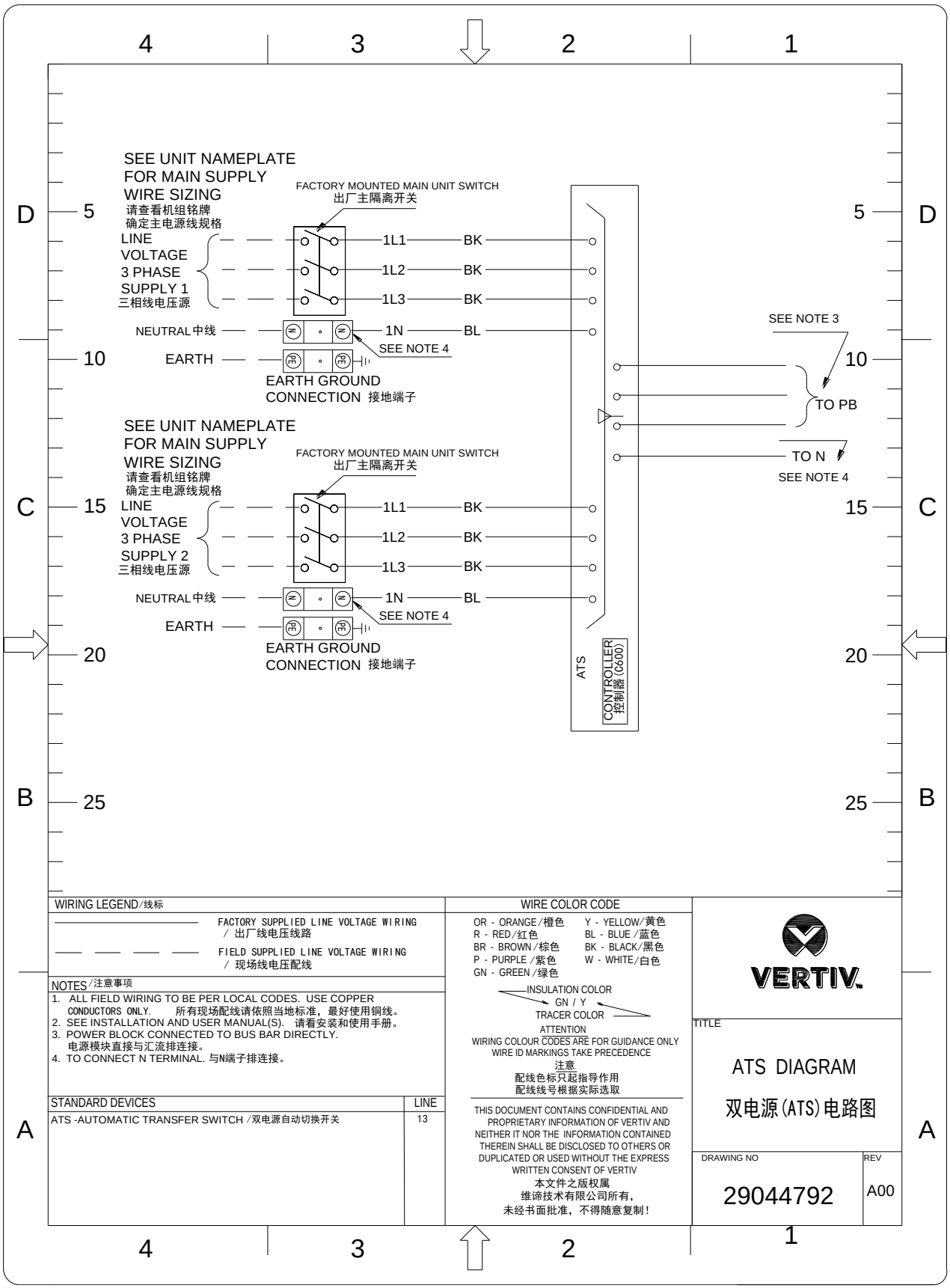
Appendix A: Wiring Diagram Infrared Humidifier (for Air-cooled)



Appendix B: Wiring Diagram Infrared Humidifier (for Water-cooled)



Appendix C: ATS Diagram



WIRING LEGEND/线标	WIRE COLOR CODE
FACTORY SUPPLIED LINE VOLTAGE WIRING / 出厂线电压线路 FIELD SUPPLIED LINE VOLTAGE WIRING / 现场线电压配线	OR - ORANGE/橙色 Y - YELLOW/黄色 R - RED/红色 BL - BLUE/蓝色 BR - BROWN/棕色 BK - BLACK/黑色 P - PURPLE/紫色 W - WHITE/白色 GN - GREEN/绿色 INSULATION COLOR: GN / Y TRACER COLOR

NOTES/注意事项

1. ALL FIELD WIRING TO BE PER LOCAL CODES. USE COPPER CONDUCTORS ONLY. 所有现场配线请依照当地标准，最好使用铜线。
2. SEE INSTALLATION AND USER MANUAL(S). 请看安装和使用手册。
3. POWER BLOCK CONNECTED TO BUS BAR DIRECTLY. 电源模块直接与汇流排连接。
4. TO CONNECT N TERMINAL. 与N端子排连接。

STANDARD DEVICES	LINE
ATS -AUTOMATIC TRANSFER SWITCH /双电源自动切换开关	13

ATTENTION
WIRING COLOUR CODES ARE FOR GUIDANCE ONLY
WIRE ID MARKINGS TAKE PRECEDENCE
注意
配线色标只起指导作用
配线线号根据实际选取

VERTIV.

TITLE

ATS DIAGRAM

双电源(ATS)电路图

DRAWING NO	REV
29044792	A00

Appendix D: Table Names and Content of Harmful Substances in Products

Harmful Substances in Products

Part Name	Harmful Substance					
	Lead (Pb)	Mercury (Hg)	Cadmium (Cd)	Hexavalent chromium (Cr (VI))	Polybrominated biphenyls (PBB)	Polybrominated diphenyl ethers (PBDE)
Cabinets	x	○	○	○	○	○
Refrigeration accessories	x	○	○	○	○	○
Fan unit	x	○	x	○	○	○
Heating unit	x	○	○	○	○	○
ECU	x	○	x	○	○	○
Display	x	x	○	○	○	○
Plate made	x	○	○	○	○	○
Evaporator	x	○	○	○	○	○
Copper tube	x	○	○	○	○	○
Cable	x	○	○	○	○	○

This form is prepared in accordance with the provisions of SJ/T 11364. O: Indicates claim limit concentration of the hazardous substances in homogeneous materials for all components specified in GB/T 26572 or less; X: Represents the hazardous substance content of at least one homogeneous material of the member exceeds the limit requirement GB/T 26572 specified.

Vertiv has been committed to the design and manufacture of environmentally friendly products, we will reduce and eliminate toxic and hazardous substances in products through ongoing research. The following application components, or toxic and hazardous substances is not limited to the current level of technology or no reliable alternative mature solution:

1. Parts of the above reasons lead: Copper alloy member containing lead; high temperature solder of lead; high temperature solder of lead diodes; uranium glass resistor lead (exempt); electronic ceramics containing lead (exempt).
2. The backlight lamp contains Mercury.
3. Distribution of the switch contact portion containing Cadmium and Cadmium compounds.

Notes on environmental protection use period: Environmental protection use period of the product (identified in the body of the product), means that under normal conditions of use and compliance with safety precautions from the date of production of this product (excluding battery) Term toxic and hazardous substances or elements contained no serious impact on the environment, persons and property.

Scope: Liebert® PEX3 DX sseries of Precision Air Conditioning.

Appendix E: Routine Maintenance Inspection Items (Monthly)

Date:_____Prepared by:_____

Model:_____Serial Number:_____

Equipment Maintenance Checklist (Monthly)

Part	Check Item	Remark
Filter	Check for clogging or damage	
	Check the filter clog switch	
	Clean the filter.	
Fan	Check for fan blades are not distorted	
	Check, whether there is bearing wear	
	Check and fasten the circuit connector	
Compressor	Check for leakage	
	Listen to the operation sound, observe the operation vibration	
	Electrical control part	
Air-cooled condenser (air-cooled units)	Check the fins are clean	
	The fan base should be firmed	
	The fan vibration absorber is not deteriorated or damaged	
	The SPD board should be effective (in the storming seasons, the SPD board should be check once a week)	
	The refrigerant pipes are properly supported	
	Check and fasten the circuit connections	
Water-cooled condenser (water-cooled unit)	Check the water pipe system	
	Check the MBV	
	Check for leakage	
	Check the water pressure and temperature	
Refrigeration cycle system	Check refrigerant pipes. Refrigerant pipes must be properly supported and must not lean against walls, floors or where the frame vibrates	
	Check the moisture content of the system (through a sight glass)	
	Check electronic expansion valve	
	Check the condenser drain pan for dirt blockage	
Heating system	Check the re-heater operation	
	Check the erosion situation of the components	
	Check and fasten the circuit connections	

Part	Check Item	Remark
Infrared humidifier	Check clogging of the drain pipes	
	Check the lamps of the infrared humidifier	
	Check the mineral sediments on the water pan	
	Check and fasten the circuit connections	

Signature:_____

NOTE: Please copy this table as a record keeping purposes.

Appendix F: Routine Maintenance Inspection Items (Semi-Annual)

Date:_____Prepared by:_____

Model:_____Serial Number:_____

Equipment Maintenance Checklist (Monthly)

Part	Check Item	Remark
Filter	Check for clogging or damage	
	Check the filter clog switch	
	Clean the filter.	
Fan	Check for fan blades are not distorted	
	Check, whether there is bearing wear	
	Check and fasten the circuit connector	
Compressor	Check for leakage	
	Listen to the operation sound, observe the operation vibration	
	Electrical control part	
Air-cooled condenser (air-cooled units)	Check the fins are clean	
	The fan base should be firmed	
	The fan vibration absorber is not deteriorated or damaged	
	The SPD board should be effective (in the storming seasons, the SPD board should be check once a week)	
	The refrigerant pipes are properly supported	
	Check and fasten the circuit connections	
Water-cooled condenser (water-cooled unit)	Check the water pipe system	
	Check the MBV	
	Check for leakage	
	Check the water pressure and temperature	
Refrigeration cycle system	Check refrigerant pipes. Refrigerant pipes must be properly supported and must not lean against walls, floors or where the frame vibrates	
	Check the moisture content of the system (through a sight glass)	
	Check electronic expansion valve	
	Check the condenser drain pan for dirt blockage	
Heating system	Check the re-heater operation	
	Check the erosion situation of the components	
	Check and fasten the circuit connections	

Part	Check Item	Remark
Infrared humidifier	Check clogging of the drain pipes	
	Check the lamps of the infrared humidifier	
	Check the mineral sediments on the water pan	
	Check and fasten the circuit connections	
Electrical control part	Check and fasten the circuit connections	

Signature:_____

NOTE: Please copy this table as a record keeping purposes.

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