Liebert® LPC Series
Precision Air Conditioning

User Manual

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Purpose of the Document

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

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

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 	*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, the content under the Warning heading is used for precautions which need to be taken which, otherwise, could result in equipment damage, performance degradation, or interruption in service.*
Note 	*The **Note** section indicates additional and useful information, including tips and tweaks. 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 mainstream stuff also comes under the Note heading helping the users get to grips with the definitions, concepts, and terminologies used in the manual.*

Version History

Issue	Revision	Change
31013548	V1.0	-

Table of Contents

PART I

GENERAL INFORMATION

1 Product Overview

1.1 Product Introduction

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

Liebert LPC air conditioners are products that are specifically created and designed for the testing laboratories and similar ecosystems which call for a high degree of accuracy and precision (Liebert LPC series offers a temperature precision up to ± 0.5°C and humidity precision up to ± 2 % RH). Various products such as tobacco, textiles, and paper are extremely sensitive and quite fragile in texture and nature. Therefore, care should be taken while testing these products in a laboratory as even a slight deviation in the testing environment may lead to inaccurate results. Precision Air Conditioning must not only keep room conditions within a specific range but also must have the precision to react quickly to a drastic change in heat load and prevent wide temperature fluctuations. Liebert LPC series is a range of air-conditioners specifically tailored for maintaining a suitable environment in the testing labs and addresses the needs and challenges associated with it.

Liebert LPC model is an air conditioner that takes into consideration various factors such as energy overcooling and avoiding hot spots, which are bottlenecks commonly encountered in the precision air conditioning niche. The design of the LPC product is streamlined to support high efficiency.

Figure 1-1 LPC Model

1.2 Model Description

The following section depicts the Model Description and various components that are an integral part of the air conditioner models in the Liebert LPC series. Further on, the working conditions and technical specifications will be discussed in the later sections.

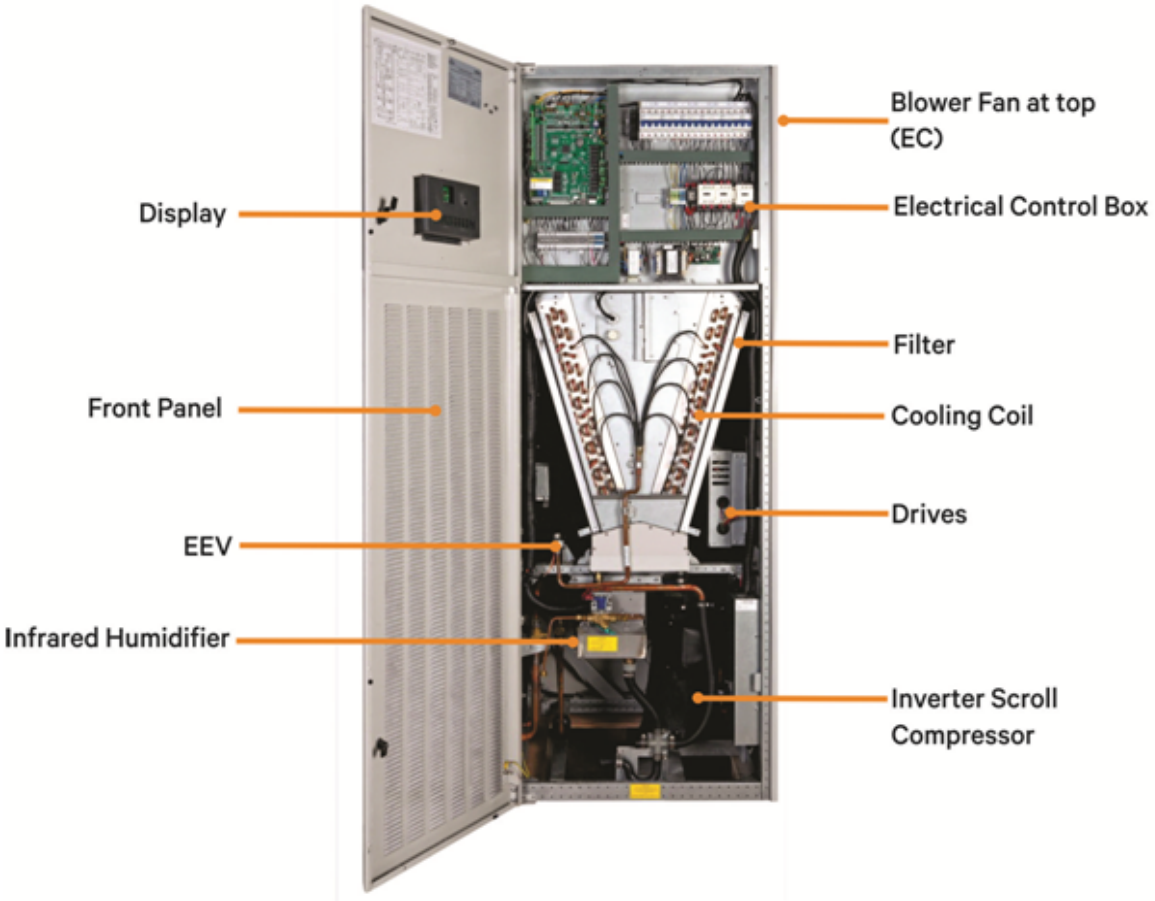


Figure 1-2 Main Components

1.3 Model Nomenclature

The model of the LPC series AC is fully-defined by twenty-five digits, as shown in table 1.1.

Table 1.1

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
L	1	0	1	5	U	A	1	3	8	H	L	1	2	E	2	D	0	0	0	P	A	0	0	0

Digit 1 Product Model

L Liebert LPC

Digit 2 Product Model

1 Number of Modules/Bays

Digit 3 Cooling Capacity kW

0-9 Nominal Net Cooling Capacity - kW

Digit 4 Cooling Capacity kW

0-9 Nominal Net Cooling Capacity - kW

Digit 5 Cooling Capacity kW

0-9 Nominal Net Cooling Capacity - kW

Digit 6 Air Discharge

U Upflow

Digit 7 System Type

A Air Cooled

Digit 8 Airflow

1 EC Plug FAN

Digit 9 Power Supply

N 380-415V / 3ph / 50Hz + N

Digit 10 Cooling System

8 R-410A EC Compressor

Digit 11 Humidification

H Infrared Humidifier

Digit 12 Display

L Large Display

C Color Display

Digit 13 Re-Heating

1 SCR Heater Std. 1 Stage

2 SCR Heater Opt. 2 Stage

Digit 14 Air Filter

2 G4

3 F5

5 F7

Digit 15 Coil and Valves

E Standard DX Air cooled coil, EEV

Digit 16 Enclosure options

2 Gray Orange Peel Grain Coating

Digit 17 Mains Switch High Voltage Option

D Main Non-Locking Disconnect

Digit 18 Lock Out Low Voltage Option

0 None

Digit 19 Monitoring

0 RS485

S SICCard

Digit 20 Sensors

0 None

X Other Sensors

Digit 21 Packaging

P Standard Packaging

C Export Packaging

Digit 22 Special Requirements

A SFA -none

Digit 23 Order Identifier

0 Standard Static

2 High ESP 200 Pa

3 High Airflow/ESP other

X SFA Included

Digit 24 Order Identifier

0 None

L Air cooled-long piping>30m

X SFA Included

Digit 25 Order Identifier

0 None

B Back Air Return

D Bottom Air Return

X SFAIncluded

1.4 Components

This section gives an overview of the main components, optional components and features in the LPC series of air conditioners.

1.4.1 Compressor

The DC Inverter Scroll compressor (with variable frequency) used in the Liebert LPC series. The advanced compressor with a highly efficient motor and wide capacity regulation range is designed to deliver maximum cooling with low noise and significantly less vibration. Its expansive speed range and variable speed design imparts a new level of control for light load efficiency and dehumidification. This compressor is tailored for higher efficiency and reliability. With CoreSense technology baked-in, it continues to function effectively across a wide range of conditions. Its robustness and technology safeguards it even while operating it in adverse conditions.

Figure 1-3 Inverter Scroll Compressor

1.4.2 Evaporator

Heat exchanger design and appropriate air distributions are crucial factors that determine optimum performance. The Evaporator used in the Liebert LPC models consists of a fin-tube heat exchanger for higher efficiency. The sophisticated design of the distributor ensures that the refrigerant is distributed evenly in each loop, thereby improving the effectiveness of the heat exchanger.

1.4.3 Electronic Expansion valve (EEV)

The EEV is designed for modulating control of the refrigerant mass flow with precision. The EEV ensures effective control on super heating at the end of the evaporator and simultaneously ensures that the compressor will never be filled by liquid from 10% to 100% of its normal capacity.

Figure 1-4 shows the appearance of the EEV used in the Liebert LPC models:

Figure 1-4 Electronic Expansion Valve

1.4.4 EC Fans

The EC Fans used in the Liebert LPC models are energy-efficient and innovative with integrated electronics and maintenance-free design. These fans provide a cost-effective way to introduce energy-efficient technology by regulating the airflow and reducing fan input power. Besides, the easy-to-connect facility bundled with the benefit of minimal wiring adds to the high performance with a greater range of possible airflow rates.

Figure 1-5 shows the EC Fans used in the Liebert LPC model:

Figure 1-5 EC Fan

1.4.5 Infrared Humidifier

The infrared humidifier in the Liebert LPC series provides quicker and more responsive operation which is quite important for mission-critical applications. The infrared humidifiers use high intensity quartz over a stainless humidifier reservoir. These humidifiers reduce the dependency of water quality and simultaneously achieve full capacity in quick time using almost any water quality.

Figure 1-6 shows the basic functioning of an infrared humidifier:

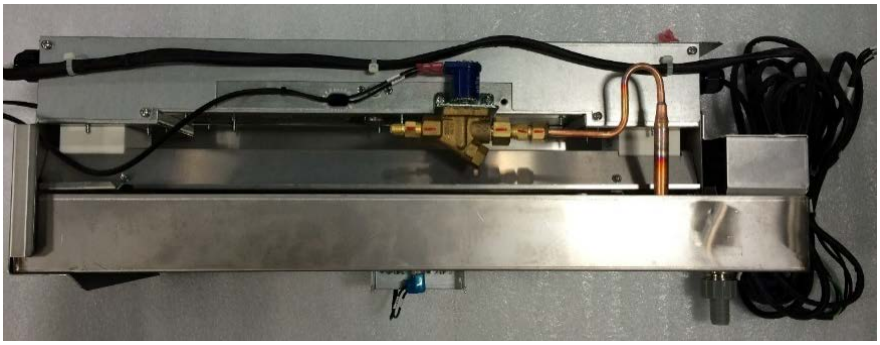


Figure 1-6 Infrared Humidifier

1.4.6 Electric Heaters

The finned electric heaters used in the Liebert LPC series are highly reliable and extremely productive. Stainless steel is the material used for manufacturing these heaters with fin-tubular elements. The heaters perform at a quick pace and reduce the power requirement during mission-critical workflow.

Figure 1-7 shows a sketch of a stainless steel electric heater:

Figure 1-7 Electric Heaters

1.4.7 Filter-driers

Moisture can have an adverse effect on the operation and life of a system in the refrigeration cycle. To counter that effect, Filter-driers are used to filter out particles, and remove and hold moisture to prevent it from circulating through the system.

1.4.8 Controller

The Controller adheres to the latest and highly advanced PID regulation technology. With features, such as the baked-in ability to recover from a power failure and streamlined usability, it has a simplistic user interface making it easy-to-operate. Power-packed with fuzzy logic, it is an intelligent utility with dimensions of 128x64 (dot matrix) with frontal displays and high voltage protection features. The operation time of the main components is available through the menus. Configured with the RS485 port in compliance with the communication protocol of Ministry of Information Enterprise, it ensures top reliability and maximum efficiency.

An interesting development is the compatibility with Vertiv Co.'s remote monitoring-and-management application. SiteWeb (the remote management application) gathers a continuous stream of data related to vital health parameters such as DC Power, batteries, and renewable power sources to name a few.

Figure 1-8 shows the appearance of the controller currently used in the Liebert Models:

Figure 1-8 Controller

1.4.9 Liquid Indicator

The liquid indicator works as a toolset used for observing the refrigerant state, specifically the moisture content of the system. When the moisture content exceeds the standard or a particular limit, the color will be changed indicating the irregularities in the moisture content.

1.4.10 Condenser

The Liebert range of Air Cooled Condensers offer unique benefits including sharp design, antirust aluminum cabinets, low sound levels, and reliable operation over a wide range of ambient conditions.

Figure 1-9 shows a pictorial depiction of the Condenser:

Figure 1-9 Condenser

- **Condenser sizing parameter**

  Sizing of the condenser is based on the ambient temperature as mentioned in the Table 2.1.

Table 2.1

Ambient temperature	L1015
≤ 40 ℃	LSF24-R3
> 40 ℃	LSF32-R3

For more information on the condenser, refer to the separate condenser manual which explains the entire condenser ecosystem in detail.

1.5 Optional Components

The Liebert LPC range of air conditioners has optional components that can be a part of the overall configuration. These include two-stage electric heating, plenum, multiple temperature and humidity sensors, and Air filters

1.5.1 Two stage electric heating

In Liebert LPC, a two-stage electric heater can be used for enhanced heating as per the user requirements.

1.5.2 Plenum

According to the user requirements, the unit will be configured with a plenum as per the dimensions mentioned in section 2.6.1 Plenum Dimensions). For a custom plenum, please contact Vertiv Co. for the solution.

1.5.3 Multiple Temperature and Humidity sensors

As per the user requirements, there is a facility of using up to 5 sensors. Refer to the Remote Temperature and humidity sensor placement section in Chapter 6 (Refer 6 - Appendix)

1.5.4 Air Filter

According to the user requirements, different kinds of filters based on their classification standards such as F5 and F7 can be provided for different levels of filtering.

1.5.5 SIC card

SIC card with #77, #78 control panel is equipped with RS485 interface which is a standard protocol for the MODBUS. RDU-SIC can be equipped with monitoring cards, as shown in figure 1-10. The RJ45 interface is provided for customer access via USB port.

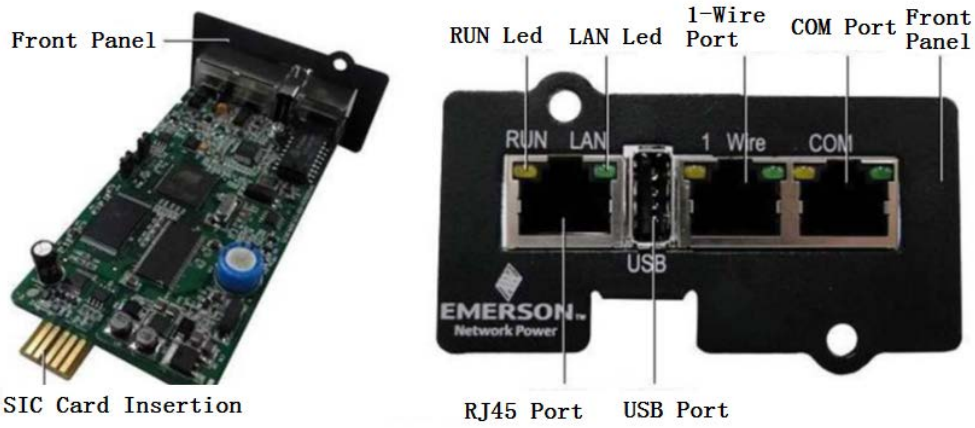


Figure 1-10

1.6 Operating Parameters

In this section, the environmental conditions will be discussed, which includes the Operating and Storage environment:

1.6.1 Storage Environment

The table 1.2 defines the various storage aspects and requirements, which also includes the Ambient Humidity, Ambient temperature, and Storage time conditions.

Table 1.2

Item	Requirements
General Requirements	Indoor, clean and without dust
Ambient Humidity	< 95% RH
Ambient Temperature	-25° C ～ +55° C
Storage Time	Total transportation and storage time should not exceed six months. Otherwise, the performance needs to be re-calibrated

1.6.2 Operating Environment

The table 1.3 defines the various requirements and aspects of the Operating environment, including the Ambient Temperature, Protection Level, Attitude, and the voltage range.

Table 1.3

Item	Requirements	
Ambient Temperature	Indoor	18° C ~ 35° C
	Outdoor	-15° C ~ +45°C, if low temperature kit is used, the lowest outdoor operating temperature is -34°C.
Protection Level	IP20	
Altitude	<1000m. If the altitude is above 1000m, then Derating will occur. Please contact Vertiv™ for this resolution	
Operating Voltage range	380～415 (-10%～+6%)V，3N～50/60Hz	

PART II

INSTALLATION

2 Installation

The Installation process consists of the following procedures, namely -

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

2.1 Pre-installation

Pre-installation contains the following 3 sub sections, namely -

- Transportation & Movement
- Unpacking
- Inspection

2.1.1 Transportation and Movement

When it comes to transporting the system, Railroad is the most preferable choice. However, if railroad transportation is not possible, then the truck transport option is an optimal choice. One precaution is to choose roads that do not have too many bumps and if any, avoid it as much as possible.

Liebert LPC series of air conditions are on the heavier side and therefore, it is recommended that equipment such as an electric forklift is utilized for these heavy-duty systems. Move the equipment to a location which is in the vicinity of the installation site. If an electric forklift is used, insert the tines of the forklift below the pallet as displayed in Figure 2-1. Align the tines with the centre of gravity to prevent the equipment from falling over.

Figure 2-1 depicts the way the tines of the forklift are inserted below the pallet and in the same image, the graphic to the right indicates that the tines are aligned with the center of gravity to prevent the equipment from falling over:

Figure 2-1 Electric Forklift handling a Liebert LPC system

In Figure 2-2, the air conditioner is lifted using the forklift truck and is aligned with the center of gravity. While moving the indoor unit, the obliquity needs to be maintained within an angle inclination of 75° to 105°.

Refer to Figure 2-2 to understand the concept better:

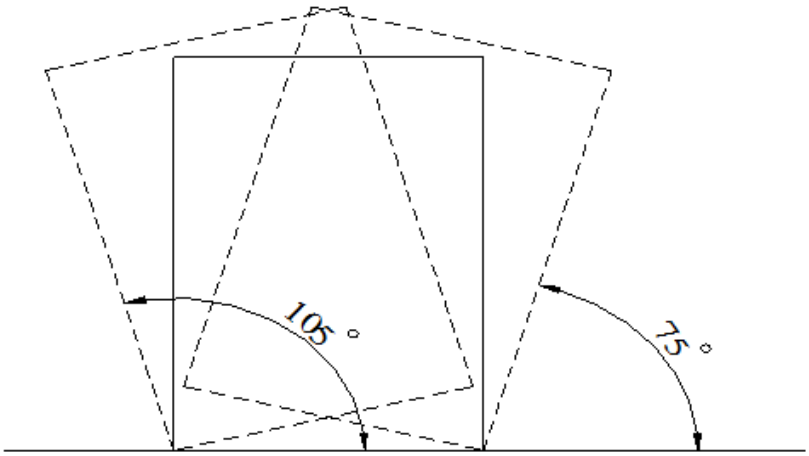


Figure 2-2 Handling Inclination

2.1.2 Unpacking for Paper Packaging

Once the equipment is closest to the final installation site, unpack the system. Following are the important steps to be implemented in the hierarchy mentioned in the following list for unpacking:

- Remove the top cover and tangled stretch film before removing the honeycomb board as shown in Figure 2-3:

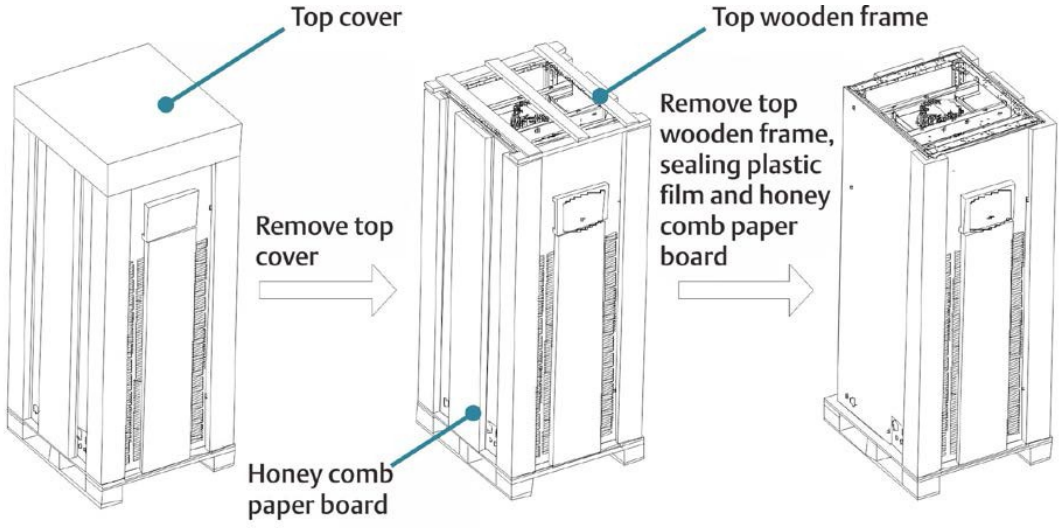


Figure 2-3 Unpacking the system

- The unit is fixed on a base pallet with M8 * 65 bolts. Use a 14mm wrench to remove those bolts. Figure 2-4 shows the unit fixed on the base pallet using the M8 * 65 bolts.

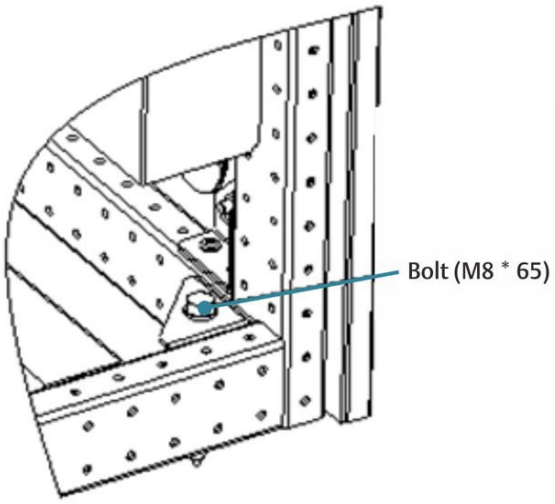


Figure 2-4 Fixing bolt on the base pallet

2.1.3 Unpacking for Wooden Packaging

If a wooden packaging is used instead of paper packaging, the process is slightly different. The following process Is to be adhered if a wooden packaging is used. For export, a wooden packaging is used and the process is slightly different from the process followed in section 2.12.

The Transportation mode is preferably via Railroad or shipping; however, there are times when truck transportation is mandatory for some locations. In such cases, chose roads that are not bumpy to ascertain that there is no damage to the equipment. It is highly recommended that an electric forklift is used to unload and move the product enclosed in the wooden packaging.

Refer to the Figure 2-5 to understand the process better:

Figure 2-5 Transportation for export Wooden-packaged LPC systems

In Figure 2-5, the tines of the forklift are inserted below the pallet. This is done to ensure that the equipment does not fall over leading to injury to the personnel or damage to the equipment.

Similar to the Unpacking explained in the section 2.1.2 in the manual, the obliquity needs to be maintained with an angle inclination of 75% TO 105%.

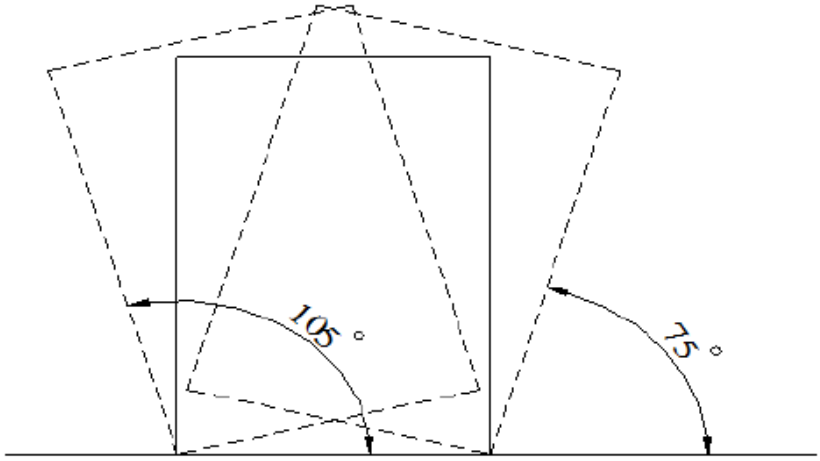


Figure 2-6 Moving obliquity

- *Upon arrival of the unit, prior to unpacking, verify that the labeled matches the bill of lading. Inspect and check all items for damage, either visible or concealed.*
- *Damage should be immediately reported to the carrier. A damage claim needs to be filled and a copy of the same must be sent to Vertiv Co. or the authorized sales representative.*

2.1.4 Removal of external package

The chilled water version uses the international packaging.

Following are the procedures that need to be adhered to strictly for removing the external package:

1) Use a hammer or straight screwdriver to straighten the hook as displayed in Figure 2-7 to view the procedure:

Figure 2-7 Straightening the hook

2) Initially, straighten all the hooks fixed with side board 1. Once the hooks are straightened, removed the sideboard 1.
3) Follow the same procedure with sideboard 2.
4) On straightening all the hooks and removing sideboard 2, remove the top cover 3.

Figure 2-8 shows the process of removing the Sideboards and the top cover:

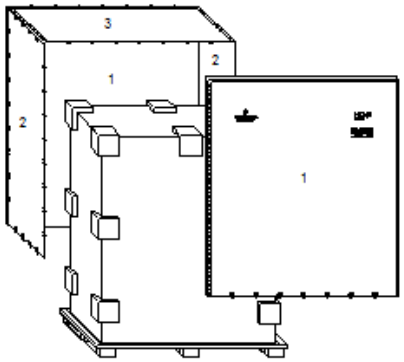


Figure 2-8 Removing the Side boards and Top cover

5) The unit is fixed to the base pallet with an 8*70 screw.

The unit is fixed to the base pallet with an 8*70 screw. Figure 2-9 depicts the positions of the wooden screws.

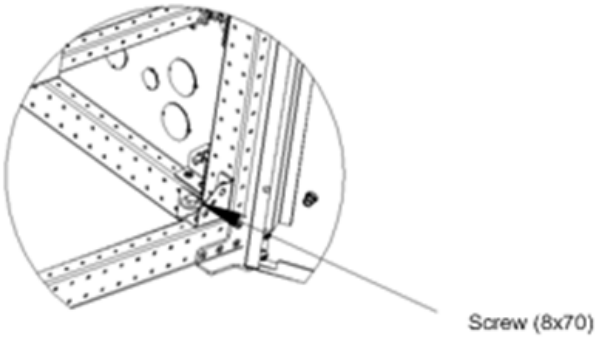


Figure 2-9 Positions of the wooden screws

A 17mm open-end spanner, ratchet spanner, or sleeve can be used to remove the fixing screws.

The plastic bags should not be damaged during the unpacking process for dust protection on the AC unit as per the requirement.

2.1.5 Inspection

Moving forward, check the system fittings and its components against the packing list to ensure that everything is in place and the assembly is intact. If any parts are missing or damaged, immediately report to the carrier about the same. If hidden damages are observed, then contact the local offices of that carrier as well as Vertiv Co. at the earliest.

2.2 Installation Preparation

The Liebert LPC range of air conditioners is streamlined for maintaining a favorable and suitable environment for testing laboratories and similar testing ecosystems. Strict adherence to the installation procedures is mandatory for appropriate installation of the Liebert LPC air conditioners. In the previous section, we looked at the working conditions which included the operating, storage, and technical specifications for the Liebert LPC models. In this section, let's look at the installation preparation before moving on to installing the LPC system to simulate a real-time scenario.

2.2.1 Equipment Room Requirement

The equipment room must be prepared to ensure a smooth operation flow and obtain accurate results. The equipment room must meet the standards for appropriate ventilation and heating. The design specifications for the air conditioners must be apt and should match the energy- efficient design standards.

Following are the requirements for maintaining a favorable room environment prior to installation:

- The room should have suitable and effective heat insulation.
- The equipment room should have a sealed 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. Care should be taken that the coating on the concrete wall and floor must be damp-proof.
- Outdoor air increases the load of heating, cooling, humidification, and dehumidification significantly. Therefore, all the doors and windows must be closed. Gaps and seams must be highly narrow to prevent the outdoor air from entering the equipment room. It is an industry- best practice to keep the inhalation of the outdoor air below 5% of the total indoor airflow. Take appropriate thermal insulation and antifreeze measures for outdoor water pipes to avoid poor drainage and insufficient water supply caused by freezing.

Vertiv recommends that the site preparation is defined as per the requirements. However, if these requirements are not met, Vertiv recommends that rectifications be made on the site so that it complies with the specified requirements and conditions. 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 LPC model.

2.2.2 Installation Space requirements

Air conditioners in the Liebert LPC range are advanced precision air conditioners and the recommended way is to install them as standalone equipment.

- For servicing, repairs, and maintenance, it is imperative that adequate maintenance

space is allocated at the front as well as the right side of the equipment. Allocate a minimum space of 730mm for maintenance purposes in front of the system. Next, allocate a minimum space of 600mm for maintenance on the side (right-side) of the equipment. This allocated space is to facilitate the regular maintenance tasks such as filter replacement, or servicing or repairs to the blower or humidifier among others.

Figure 2-10 shows an illustration of the maintenance space to be allocated:

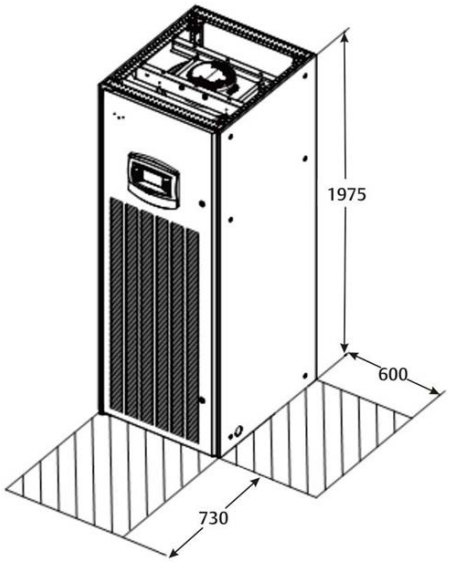


Figure 2-10 Liebert LPC Maintenance space

2.3 Mechanical Installation

The following points discuss some aspects that are taken into consideration during the mechanical installation process:

- Prior to installation, ensure that the installation preparations have been read and implemented. Check if any changes are to be made to the plumbing, wiring, or ventilation facility prior to mounting the equipment. Once the installation preparations have been taken into consideration, then we move on to the next step in the installation process where we need to setup the system.
- The LPC has an indoor as well as an outdoor unit. The Indoor unit comprises of all components excluding the Condenser. The Condenser is the part of the Outdoor unit. The indoor unit must be installed in the application room or a separate room as per the protocols followed in the application laboratory. The outdoor unit must be installed outdoors or on ventilation space on the ground or other floors as per the building architecture.
- Industry-wide standards are followed for the selection, layout, and fixing of pipes.
- Several factors such as pressure drop, compressor oil return, noise reduction, and vibration are considered during the design and installation process.
- The units shall be fixed by screws and mounting rails to avoid vibrations during the start-up or operating processes.

2.4 System arrangement during installation

The overall structure and arrangement of a Liebert LPC air conditioner is depicted in Figure 2-11.

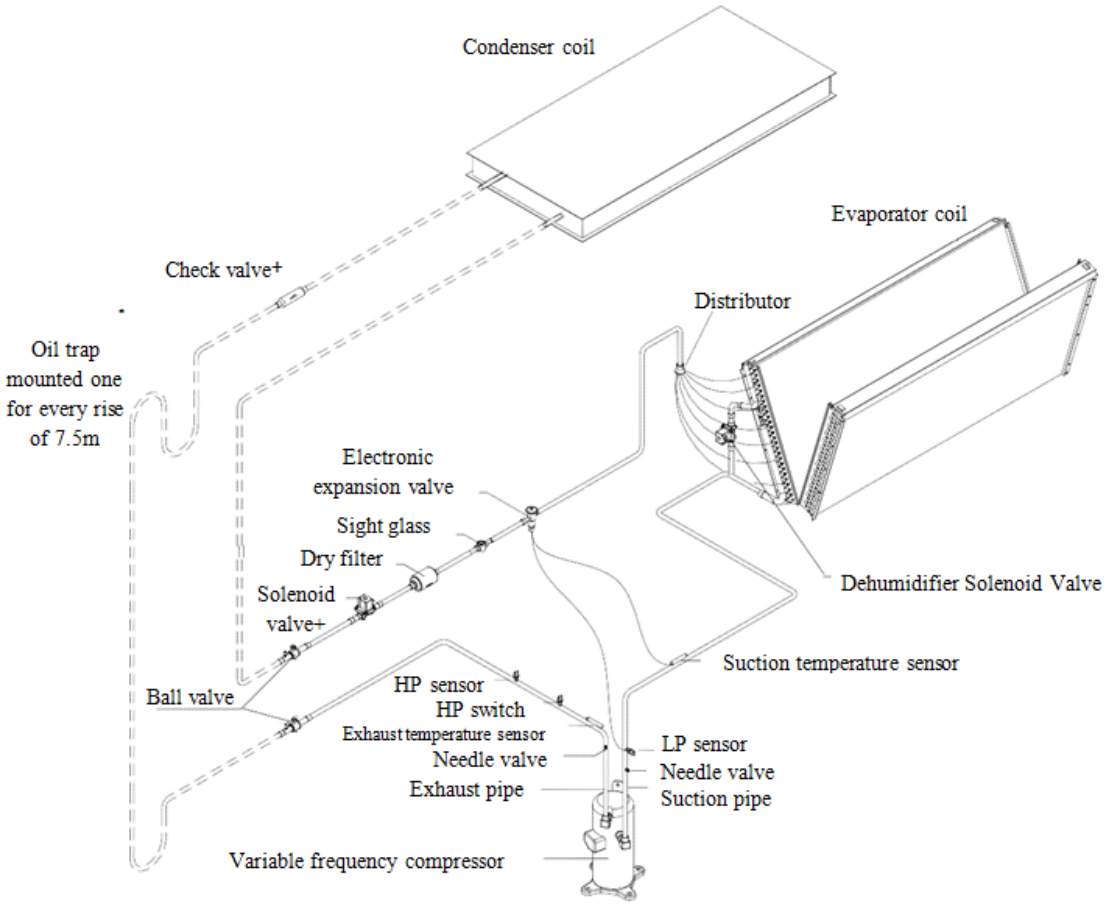


Figure 2-11 Overall Layout diagram

- ═══════: Factory piping
- ----------: Field piping *(by technical personnel)*

The following points should be taken into consideration before checking out the overall layout diagram:

- *The single system is used as an example to describe the entire system.*
- *Vertiv staff and qualified professionals lay out the piping in the laboratory.*
- *Piping is done by technicians.*
- *Components (marked with *) are not supplied by Vertiv Co. but are recommended for proper circuit operation and maintenance.*
- *Additional components (marked with +) are required when the equivalent length exceeds 30m.*

2.5 System Installation

The system installation schema is defined in Figure 2-12:

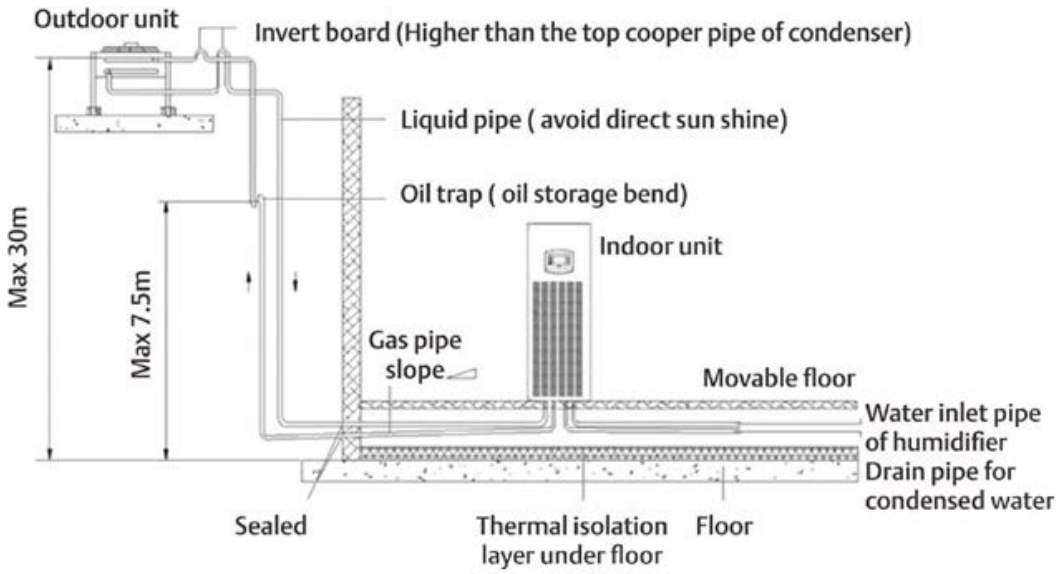


Figure 2-12 The Condenser is higher than the Compressor during installation

- The Condenser is installed higher than the Compressor. Therefore, an inverted back bend is fitted to the discharge line and liquid line of the condenser. This modification is important as it helps prevent the liquid refrigerant from flowing back once the condenser stops. Remember that the top-end of the inverter back-bend must be installed higher than the ultimate level of the copper pipe of the condenser.
- However, if the condenser is installed lower than the compressor, no modification is needed as it fits the bill perfectly.
- Figure 2-13 depicts the schema of system installation when the condenser is installed at a lower level than the compressor:

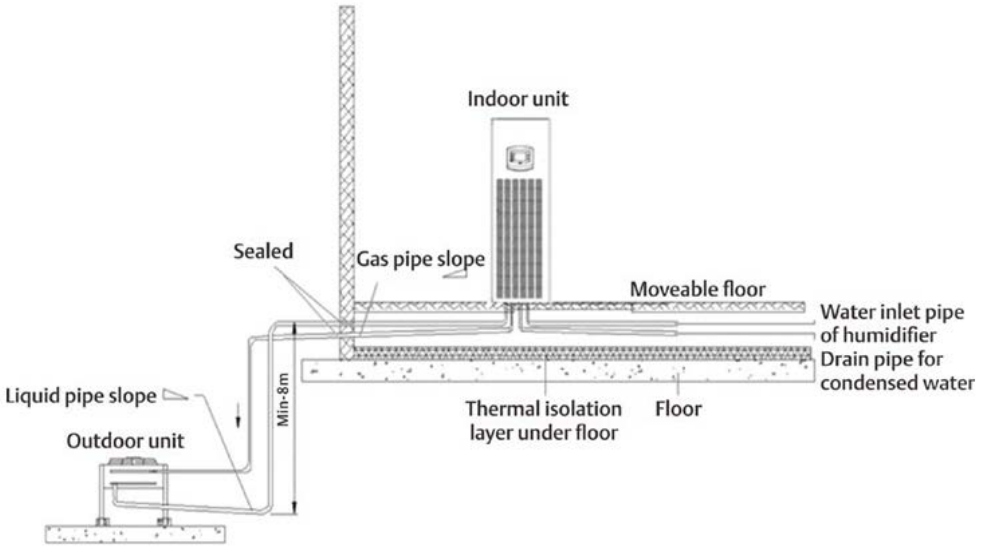


Figure 2-13 The Condenser is lower than the Compressor during installation

2.6 Product Dimensions

The dimensions of the indoor unit are displayed in Figure 2-14:

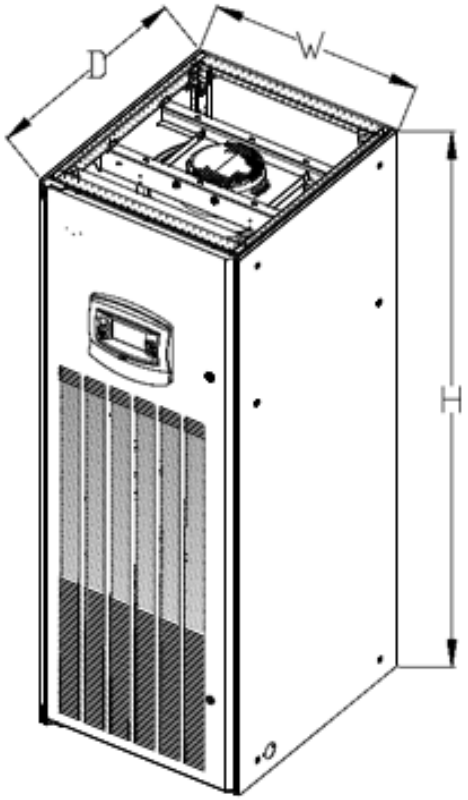


Figure 2-14 Dimensions of the Indoor unit

Specifications are shown in the table displayed in table 2.1

➢ **Dimensions and Weight of the Indoor unit**

Table 2.1

Models	Model Dimensions(mm)	Net Weight (Kg)
L1015	730x845x1975 (WxDxH)	280

2.6.1 Plenum Dimensions

The Plenum is an assembly of all the components in the unit. The following table 2.2 displays the dimensions of a plenum:

Table 2.2

Type	Depth (mm)	Width (mm)	Height (mm)
L1015	850 (D)	730 (W)	400 (600 optional) (H)

Contact Vertiv Co. for non-standard production queries if the height of the platform selected for an air conditioning unit exceeds 600mm.

2.6.2 Base pallet cut-out location dimensions

Following is a schematic diagram that depicts the cut-out location and dimensions of the base pallet. The coil outlet is visible after removing the side panel from the base pallet.

Figure 2-15 shows the dimensions and position of the coil outlet:

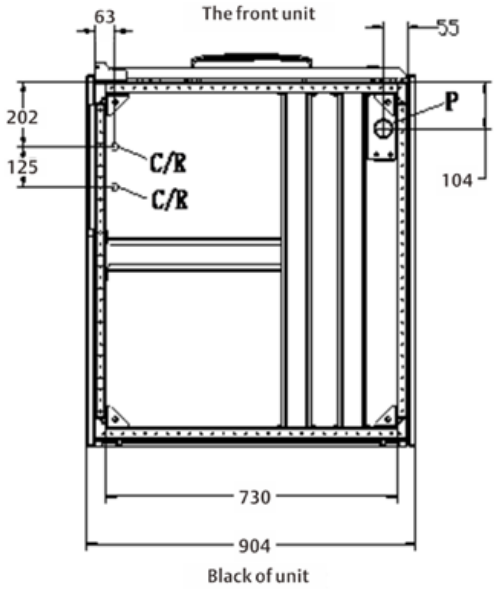


Figure 2-15 Base Pallet cut- out Location dimensions

2.6.3 Positions & Dimensions of the Top-cover

The positions and dimensions of the air outlet on the top cover of the unit are depicted in Figure 2-16 and Table 2.3.

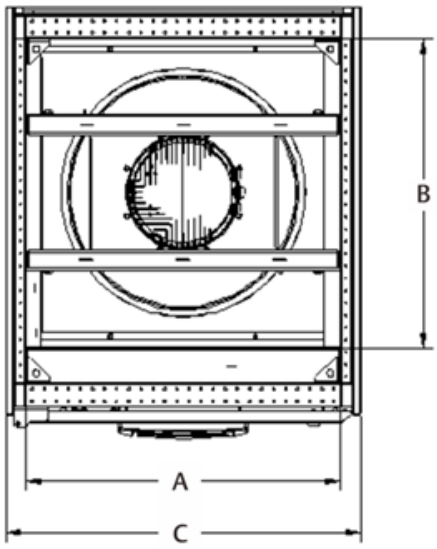


Figure 2-16 Position of the air outlet on the top cover of the unit

Table 2.3

Models	A	B	C
L1015	650	630	730

2.6.4 Side panel Knock-out locations

If there is difficulty in the piping and wiring process from the base, then an alternative option would be a connection from the side panel. The locations and dimensions of the knock-out holes are depicted in Figure 2-17.

The outlet and inlet holes should be selected based on the actual needs. Remember the rule that only one service is used per opening.

P → Power Cable Inlet/Outlet | C/R → Cooling water/ Refrigerant inlet and outlet pipe holes

H → Hole for incoming water pipe of the humidifier

D → Hole for Drain pipe

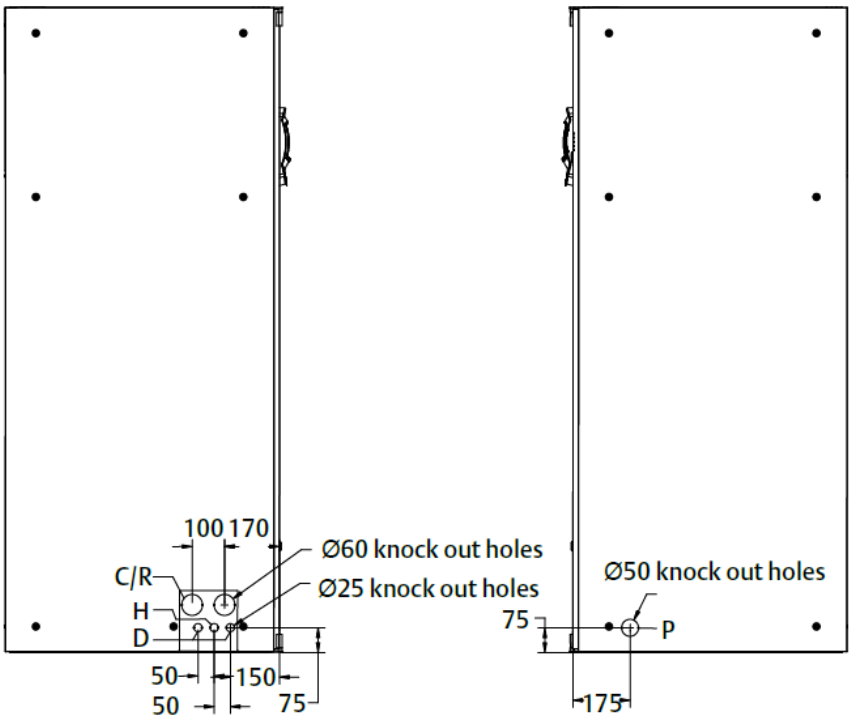


Figure 2-17 Side panel Knockout connection

The equipment has knock-outs, be sure to mount the sleeve to the cable holes to avoid cutting the cables.

2.7 Installation of the Indoor unit

The base shall be created by the installation team according to the dimensions, weight, and height of the units to ensure that structural stability and rigidity meets the requirement. The base can be created by the users; alternatively, Vertiv Co. can be asked to create it too.

Figure 2-18 depicts a schematic diagram of the production base along with the specific dimensions.

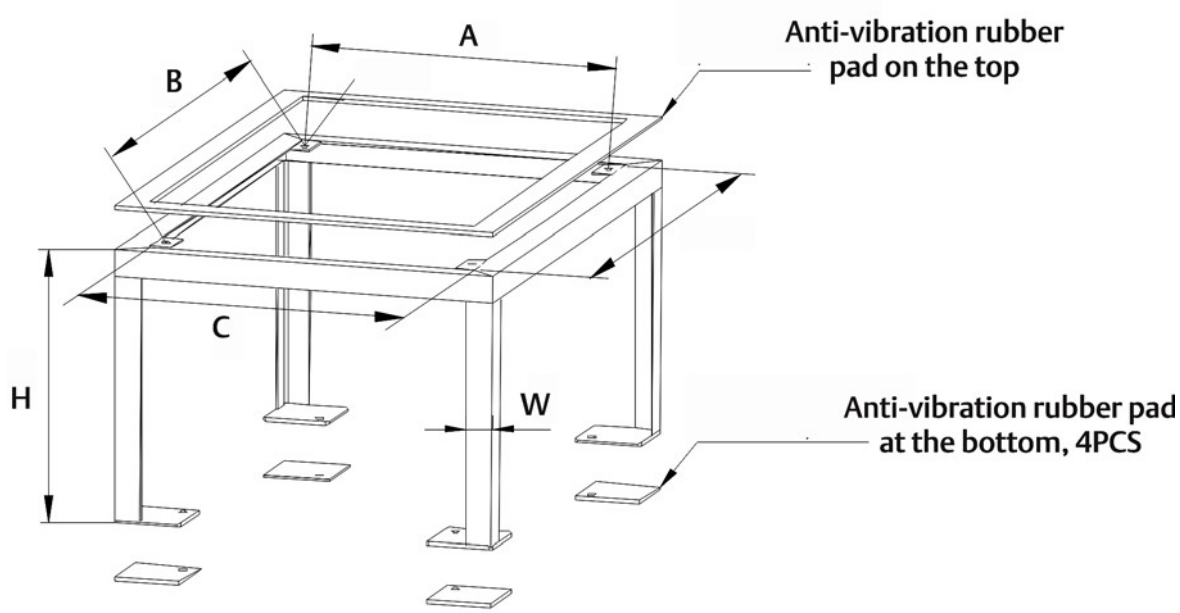


Figure 2-18 Appearance and dimensions of base (unit: mm)

Refer to the table 2.4 to view the base dimensions for the LPC models:

Table 2.4

Models	A	B	C	D	H	W
L1015U	610	710	650	750	350<H<550	40

Remember that the external side boards of the unit cannot bear the weight.

Next, install the stand and the indoor unit cabinet apart from adding a rubber cushion as explained in the following steps:

2.7.1 Installing the base

- Determine the installation position in accordance with the requirements discussed in the Installation Space requirements discussed earlier in the Installation Preparations chapter
- Fix the base on the selected mounting position
- Fix the base to the ground using expansion bolts or spot welding

- Re-calibrate the base using a horizontal ruler before fixing it to ensure that the top surface of the base is leveled.

2.7.2 Vibration absorption

- Add a layer of rubber cushion to the top, side (lateral), and bottom of the steel plate to avoid the transmission of the vibration during the operation of the unit.

Table 2.5 shows the dimensions of the rubber cushion that is used to absorb the vibration:

Table 2.5

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

2.7.3 Installation of the indoor unit cabinet

- Install the indoor unit on a base horizontal plane.
- Post installation, maintain the unit in the same horizontal plane.

There is no need to perform welding or fix other rigid connections between the base and indoor unit.

2.8 Installing the Condenser

Refer the Condenser manual for detailed information on Condenser Installation.

2.9 Piping for the unit

There are four types of pipes that are to be installed in the unit, namely –

- Condensate drain pipe of the indoor unit
- Water inlet pipe of the humidifier
- Copper pipes between the indoor unit and condenser
- Extension kit (optional)

Depending on the conditions for selecting the kit, the users shall decide whether there is a need for the extension kit while installing the pipes.

All the joints of the cooling pipes must be silver-brazed.

2.9.1 Connecting the condensate drain pipe of the indoor unit

The condensate of the infrared humidifier and evaporator converge at a cross-connector following which it is emptied using a drain pipe as reflected in Figure 2-19. The Outer diameter of the pipe is 25mm. However, if the drain pipe is used by 3 or more units, the minimal outer diameter of the pipe should be 40mm.

While 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 quickly in an effective manner.

The water pipe must be resistant to heat above 90° C because the infrared humidifier contains flowing hot water.

Refer to Figure 2-19 which depicts the connection of the drain pipe for condensate water.

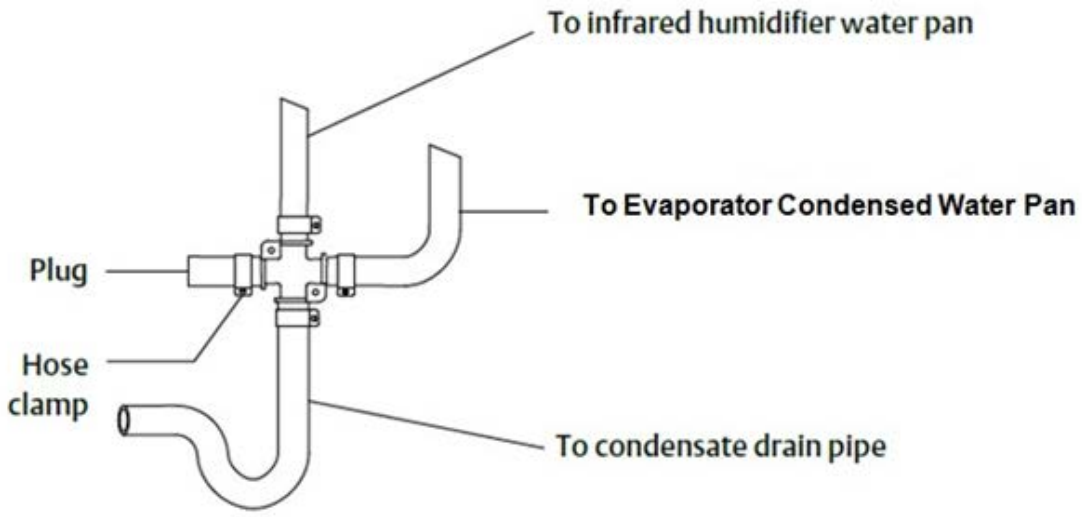


Figure 2-19 Connection of drain pipe for condensate water

2.9.2 Connecting the water inlet pipe of the infrared humidifier

An isolation valve should be fitted to the water inlet pipe to facilitate maintenance. The connection of the water inlet pipe must be sealed to prevent potential leakage. The infrared humidifier has a copper pipe with an outer diameter of 6.35mm. There is a ¼" copper nut at the end of the copper pipe to which we have connected the ¼" * ½" conversion copper thread connector to avoid losing them.

- *When the main pipe pressure rises over 700Kpa, a pressure reducer should be fitted as ideally, the main pipe pressure should be in the range of 100Kpa-700Kpa.*
- *Also, when the main pipe pressure falls below 100Kpa, a water tank and pump system must be used.*

- *Some products may incorporate components due to local regulations.*

Figure 2-20 depicts the connection of the water inlet pipe of the infrared humidifier:

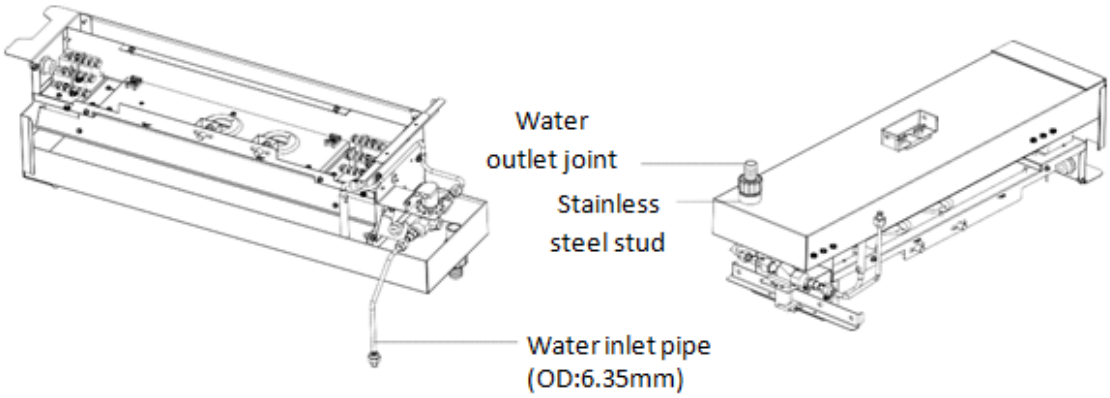


Figure 2-20 Connection of the water pipe of the infrared humidifier

2.9.3 Connecting copper pipes (discharge & liquid) between the indoor unit & condenser

- The pipe diameter is related to the system pressure drop and therefore, the pipe diameter of the indoor unit and outdoor unit should be determined according to specifications listed in the following table (Refer Table 2.6).
- Alternatively, contact the technicians and engineers at Vertiv's local office for the connection.

Table 2.6

Pipe Length	L1015	
	D	L
10m	16	12.7
20m	19	12.7
30m	19	16
40m*	22	16
50m*	22	16
60m*	22	16

- ** denotes extension kit to be added.*
- *D - Discharge Line L - Liquid Line*
- *Consult Vertiv Co. if the line length exceeds 60m*

- Use welding to connect the 2 copper pipes. The connection ball valves of the inlet and liquid pipe of the indoor unit are displayed in Figure 2-21.

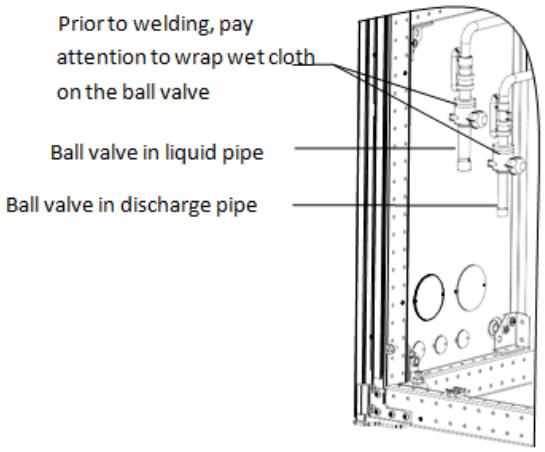


Figure 2-21 Connecting the ball valves of the discharge and liquid pipe of the indoor unit

Notes, Warning, and Instruction labels are pasted on the base and side panel close to the ball valve.

- Wrap the ball valves with a wet cloth before welding to prevent the label from getting burned during the welding operation.
- Connect the discharge pipe and liquid pipe of the indoor unit according to the instructions laid down in the label.
- Horizontal sections of the discharge pipe should be tilted downwards with a slope of at least 1:200 (5mm down for each 1m run). The discharged pipes should be insulated in the conditioned space (including under a raised floor).

The system piping should not be exposed for more than 15 minutes. Longer period of exposure may lead to the compressor refrigeration oil being adversely affected by moisture, which can be detrimental to the life of the key components and stability of the system.

2.9.4 Installing the pipe extension kit

- If the length of the one-way pipe exceeds 30m or the vertical distance between the indoor unit and outdoor unit exceeds the values in the table 2.7, consult Vertiv Co. for the installation.
- The recommended pipe sizes are equivalent lengths that consider the resistance of the bends.

The table 3.7 shows the equivalent length for partial components, and before installation, the sizes mentioned in the table must be taken into account and checked keeping in mind the site conditions.

Table 2.7

- Vertical distance between the Indoor and Outdoor unit

Positioning of the Outdoor Unit	Height
Outdoor unit is higher than the Indoor unit	Maximum: + 30m
Outdoor unit is lower than the indoor unit	Minimum: - 8m

Table 2.8

- Equivalent length of the partial components

Outer diameter (OD) of the liquid pipe (inches)	Equivalent length (meters)		
	90° bend	45° bend	T Type 3-way
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

A trap must be installed every 7.5m of the vertical distance. Please consult Vertiv Co. for inquiry and installation.

- Vertiv Co. recommends the installation of the solenoid valve onto the outdoor project pipe of the ball valve on the liquid pipe to avoid the opening of the pipe during the installation of the pipe extension kit.
- Installation can be done on the outer side or the bottom of the unit. Therefore, there is no necessity of cutting the indoor unit pipes while installing the solenoid valve.
- Once the entire system is installed, open the ball valve to keep the pressure and carry out the vacuum operation. This avoids the moisture absorption of the compressor refrigeration oil. This accounts for operation safety in addition to extending the life of the compressor.

For electrical connections related to the pipe extension kit, refer to the Electrical installation section.

Following are the steps that need to be implemented in the installation procedure of the Solenoid valve in the liquid pipe:

1. The solenoid valve must be as close to the indoor unit as possible. The valve body and coil of the solenoid valve are separated when the valve is shipped out.
2. Mount the valve body horizontally in the refrigerant pipe as shown in Figure 2-22. Pay attention to the arrow on the valve body as the arrow indicates the flow direction of the refrigerant in the valve. Ensure that the arrow points towards the indoor unit.

Figure 2-22 Installing the Solenoid valve horizontally

3. After welding, install the coil and remove the cover of the wiring terminals. Direct the cable through the cable hole on the cover and plug the two terminals and reinstall the cover.

Figure 2-23 shows the process of connecting the cables of the solenoid valve in a liquid pipe:

Figure 2-23 Connecting the cables of the Solenoid valve

4. Finally, clip the coil of the valve body, press the coil tightly to ensure complete contact between the coil and valve body as displayed in Figure 2-24.

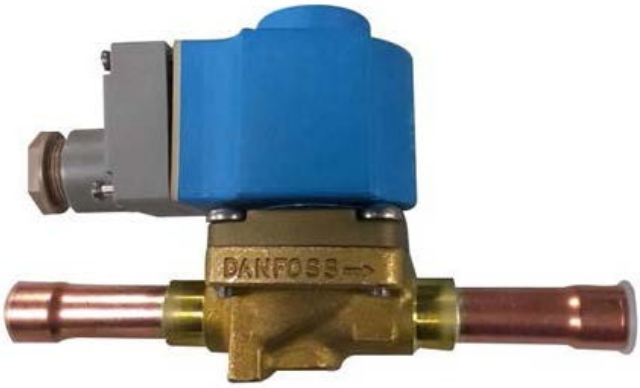


Figure 2-24 Fixing the coil

2.9.5 Charging the refrigerant and adding the refrigerant oil

The Liebert LPC air conditioners come pre-charged in the factory with 2bar Nitrogen. The table 2.9 indicates the standard charged amount. The users can determine the charging amount of the refrigerant according to the system configuration and the length of the connection pipes between the indoor and outdoor unit.

Table 2.9

Model of the Indoor Unit	L1015	
Model of the outdoor unit	LSF24	LSF32
Outdoor Temperature	40 ° C	45 ° C
Standard charged amount (kg)	7.0	9.5

The standard charged amount refers to the sum of the charged amount for the indoor unit, outdoor unit, and the 10m connection pipe.

There are scenarios where the connection pipe between the indoor unit and outdoor unit is longer than 10m. In such cases, refill the refrigerant to the system as displayed in the table in table 2.10 to ensure a smooth operational flow.

Table 2.10

Liquid Pipe (OD)	Refrigerant refilling amount per meter of the Liquid pipe (kg/m)
12.7	0.107
16	0.174
19	0.245
22	0.321
25	0.431
28	NA

Refilling amount of the Refrigerant = Refilling amount of per unit length of the liquid pipe (kg/m) * total length of the extended liquid pipe in meters.

On checking the table in Table 3.9, then the total length of the extended liquid pipe (in meters) = Total length of the liquid pipe -10m

The refilled refrigerant will dilute the POE oil in the system and plays a major role in the lubrication and cooling effects of the POE oil. Thus, it is for this purpose that the refrigerant oil must be added. The added amount of POE oil of the Liebert LPC air conditioner is displayed in the table 2.11.

L1015 use the POE oil. Therefore, contact Vertiv Co. if there is a requirement to add the refrigerant oil.

Adding poor quality oil or oil for a different model will damage the system. The quality issue due to the wrong refrigerant oil will result in the voiding of the warranty.

Table 2.11

Diameter of the liquid pipe in mm	L1015	
	Within 50m	> 50m
12.7	Do not add refrigerant oil	AddedRefrigerantOil=(Added amount of refrigerant for length beyond 50m) *10%
16		
19		
22		

2.9.6 Removing Fastener & Vibration Absorbers

Certain fasteners and vibration absorbers are mounted on the equipment to protect partial components from getting damaged and distorted due to bumping, impact, and resonance. Removal of these fasteners and absorbers is necessary before installation and commissioning.

2.9.7 Removal of the transportation fixing plate from the compressor

Vibration absorbing cushions are added to the compressor base to reduce the vibration and noise during the operation of the compressor. However, at times, such a technique cannot control the vibration during transportation. This may result in loosened connection as well as cause wear and tear of certain parts.

As a preventive measure, 3 U-shaped fixing plates are added to the 3 compressor bases during transportation.

- After the installation process and prior to the beginning of the Commissioning process, remove the 3 U-shaped fixing plates.
- Restore the bolts and washers in the reverse sequence of the disassembly process. The fastening torque of the bolts is approximately (12 +/- 1) N-m.

Refer to the Figure 2-25 in order to view the position of the L-shaped fixing plate on being fixed to the compressor base.

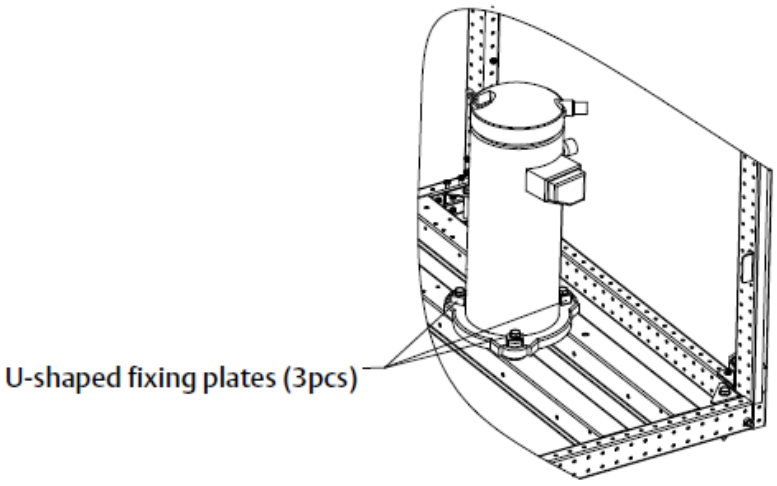


Figure 2-25 Fixed plates of the compressor

2.9.8 Removal of the fastener of infrared humidifier

The floating pole of the high-water level switch is tightly bound together with a rubber string before delivery.

Figure 2-26 depicts the floating pole bound together with a rubber string:

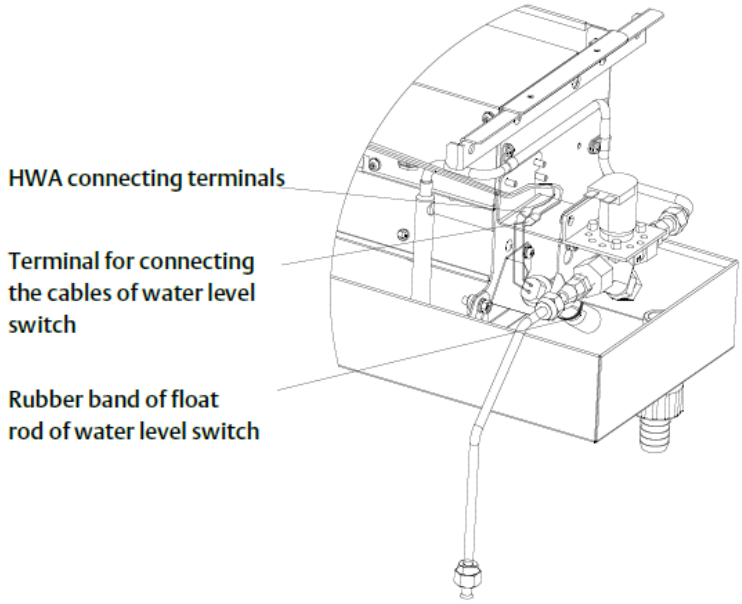


Figure 2-26 Removal of the Fastener of infrared humidifier

Before operating as a unit, remove the rubber string failing which the unit cannot detect the high water-level alarm.

Do not touch the lamps with bare fingers.

2.9.9 Removal of pipe fasteners

The pipes are either cushioned with foam or bound up before delivery. This is done to prevent the long copper pipes from scratching the metal plate resulting in heavy damage. These materials need to be removed before the start of commissioning.

2.10 Inspection of Mechanical Installation checklist

- Start the inspection and checks post the mechanical installation
- Pre-check and confirm that there are no discrepancies or faults
- Ensure that all the points in the sheet are ticked and are in compliance

Refer to the table 2.12 to view the Inspection sheet.

Table 2.12

Items	Results
Sufficient space has been left around the unit for maintenance	
The equipment is installed vertically and the installation fasteners are fixed	
The charged 2 bar Nitrogen has been vacuumed	
The pipes between the indoor unit and outdoor unit have been connected and their respective ball valves have been opened completely successfully	
The Condensate pump has been installed (as per requirement)	
The drain pipes have been connected	
The water supply pipe for the infrared humidifier has been connected	
All the pipe joints and hose connections have been fixed	
The transportation fasteners have been removed	
Irrelevant stuff (such as transportation material, structure material, debris, and tools) have been cleared after installation of the equipment	
The charged amount of refrigerants and lubricants has been roughly calculated	
The unit must have a plenum or air supply pipe connection; Furthermore, the fan as well as the heater must not be accessible after the installation	

2.11 Electrical Installation

The electrical installation process includes the wiring of the indoor unit and condenser power cables.

The following points discuss some aspects that are taken into consideration during the electrical installation process:

- The connection of all the power cables, control cables, and ground cables should be as per the local and national electrical regulations for that location.
- The electrical installation and maintenance must be performed by authorized professional personnel.
- View the unit nameplate for the full load current. The cable sizes must be determined based on the compliance with the local wiring protocols.
- Primary supply requirement: -380Vac (-10% ` to +15%), 50 Hz, 3N.
- In case of damage to the soft power cable using a Y-connection, it must be replaced by professional service experts.
- Prior to wiring, use a voltmeter to measure the power supply. While doing this, ensure that the power supply has been switched off.
- TN and TT type star connections to the power distribution systems are used. If any other type of connection is required, please call the support number for Vertiv Co.
- Use a breaking device in order to get disconnected from the power supply.

2.12 Wiring of the Indoor unit

The following section explains the procedure for the systematic wiring for the indoor unit:

2.12.1 Locating electrical ports of Indoor units

The location of the low voltage devices can be seen on opening the front door of the electrical control box of the indoor unit. The distribution information of the low voltage components is differentiated according to the labels on the cabinet.

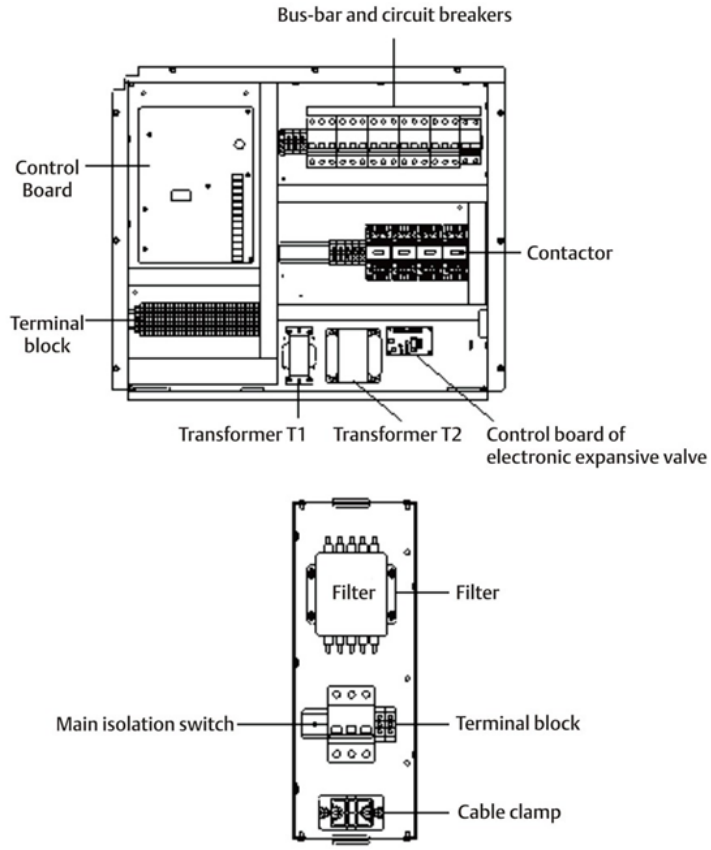


Figure 2-27 Location of low voltage devices & electric control box

2.12.2 Connecting the power cable of the indoor unit

The power connectors are located as displayed in the preceding image (Refer Figure 2-27). The enlarged view of the power connectors is shown in Figure 2-28.

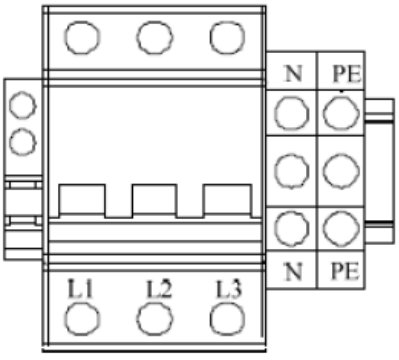


Figure 2-28 Macroscopic view of the power connectors

Connect the terminals L1, L2, and L3, N, PE respectively to the corresponding counterparts of the external power supply. Fix the cable to the cable clamp located at the inner side panel of the unit.

The cable sizes should meet the local wiring regulations.

Table 2.13 shows the cable specifications:

Table 2.13

	Indoor unit (FLA - A)	
Models	**With 1- stage electric heating**	**With 2-stage Electric heating**
L1015	25.8	35.1

The standard model is configured with a humidifier and 1-level electric heating. This cooled unit excludes the condenser current.

2.12.3 Remote Temperature & Humidity Sensor placement

- When it comes to achieving high accuracy, the installation location of the remote temperature and humidity sensors plays a crucial role. If the location is not selected correctly, then the temperature and humidity control precision will not meet the expected requirements. This can be quite critical, especially when there is a need for ultimate temperature and humidity precision.

Moisture of the samples can adversely affect the sensors. Intense care must be taken while installing the sensors.

- Vertiv recommends that the sensors be installed in the test area of the application site. Ensure that the installation location is not affected by Heat dissipation.
- Another aspect is that the installation location must be as far as possible from the staff area.

➢ **Single remote Temperature and Humidity sensor installation**

Figure 2-29 displays the installation of a single remote temperature and humidity sensor:

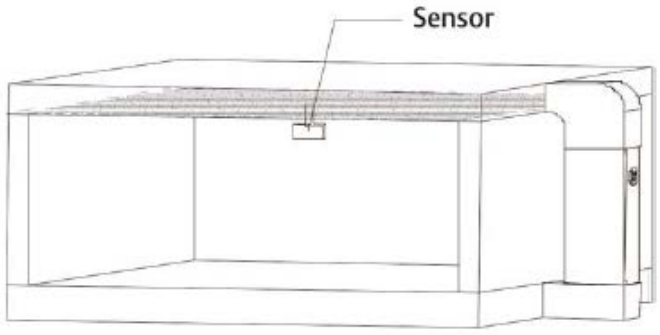


Figure 2-29 Installation of a single remote temperature and humidity sensor

- If the Liebert LPC has one remote temperature and humidity sensor, a 20m sensor cable will be configured by the factory.
- The remote temperature and humidity sensor must be installed 1.8m above the test area floor so that the operator's head on the site will not bump into the sensor. The height should be kept adjustable.

- Another recommendation is that the sensor should be installed at the air return port in the test area. This ensures that the installation location is not affected by fresh air, irrespective of whether it is bottom air return or side air return.

➢ **Multiple remote temperature and Humidity sensors installation**

Liebert LPC supports up to a maximum of 5 Temperature and Humidity sensors (inclusive of the standard sensor, meaning 5-in-all).

- The controller can exercise control by selecting the max/min/average values of the remote sensors.

Figure 2-30 shows the installation of 2 remote temperature and humidity sensors:

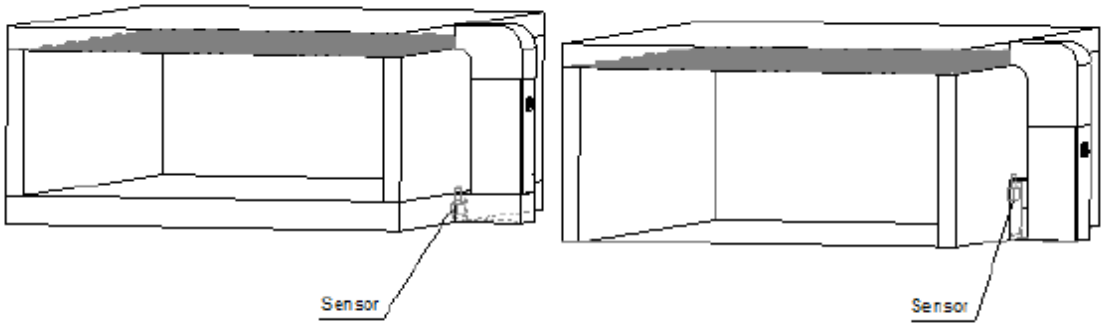


Figure 2-30 Location of 2 remote temperature and humidity sensors

- After the multiple sensors are connected in a series (Resembling a chain connection), take the cable originating from the bottom of the unit.
- Connect the cable to the first sensor and then, from the first sensor to the second sensor in a chain till all the sensors are connected to each other and the unit.
- Figure 2-31 shows multiple sensors connected in a series:

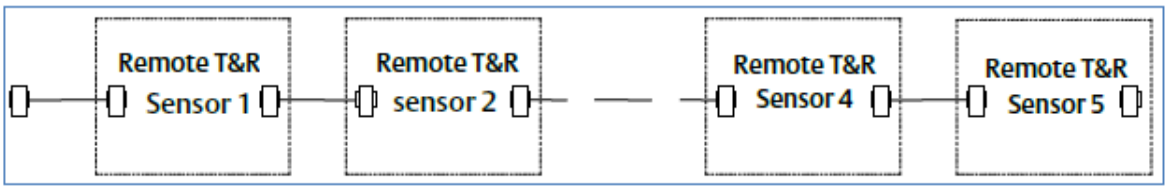


Figure 2-31 Chain connection of sensors in a series

2.12.4 Connecting the Control Cables

Figure 2-32 shows the amplified version of the field connection terminals.

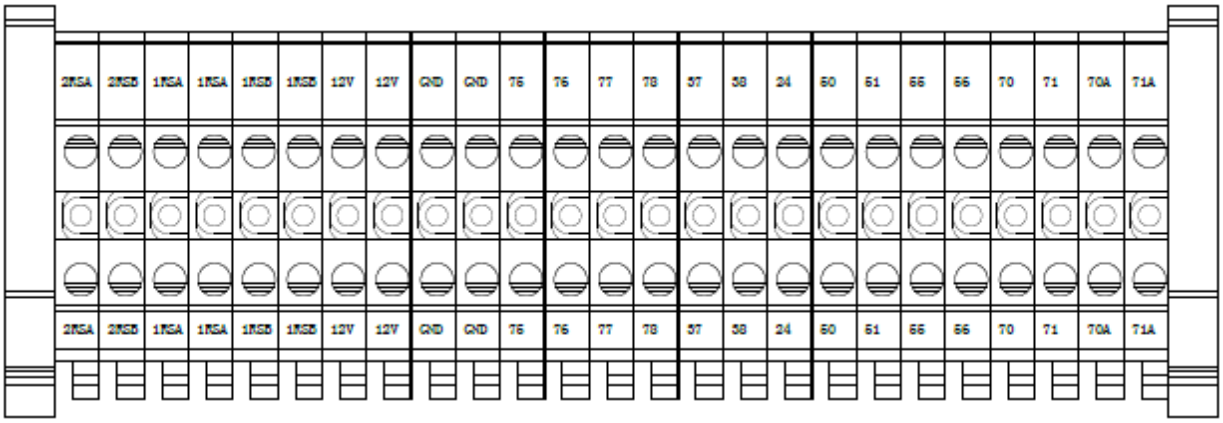


Figure 2-32 Amplified version of Connection terminals

The upper part of the terminal block is connected to the unit whereas the lower part serves as the user control signal interfaces.

The connection personnel must take anti-static measures before connecting the control cables.

2.12.5 Connecting the water-under- floor sensor

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

2.12.6 Remote Shutdown

As shown in Figure 3-22, 37# and 38# can connect to a remote shutdown switch. These have been shorted in the factory. The shorting cables must be removed if the terminals are connected to the remote shutdown switch.

2.12.7 Customized Alarm terminals

- Terminals 50#, 51#, and 56# can be connected to 3 different kinds of sensors and terminal 24# is their common terminal, defined for smoke and water-under-floor sensors.
- After the customer terminals are connected with external alarm signals, set the corresponding customized alarm using the controller.

When the contact is open, the external alarm doesn't get generated. When the contact gets closed, the external alarm is generated. In this case, the input state of the customer terminal

will be shorted. As a result, the air conditioner system will generate an audible alarm with the PACC controller LCD displaying the alarm information.

- Terminals 50# and 24# are allocated for the smoke detector alarm switch.
- Terminals 37# and 38# are allocated for the remote alarm.
- Terminals 51# and 24# are allocated for the water- under-floor sensor as defined in the factory settings.

2.12.8 External General Alarm

- Terminals 75# and 76# can be connected to the external general systems. They relay output signals to the external alarm devices akin to an alarm indicator. When the critical alarm occurs, the contact will get closed to trigger remote alarms and send signals to the building management systems.
- Alternatively, it may dial the paging system automatically. The power supply of the external alarm systems is prepared from the customer end (user-prepared).

2.12.9 SIC Card

➢ Factory-installed

If the LPC unit is pre-installed with SIC card slot in the factory, the SIC card needs to be checked for signal #A, #B. If the connection is directly taken from the control board as depicted in figure 1-11, then, check the connections to the service tooling connection terminals #77 and #78 of the control board.

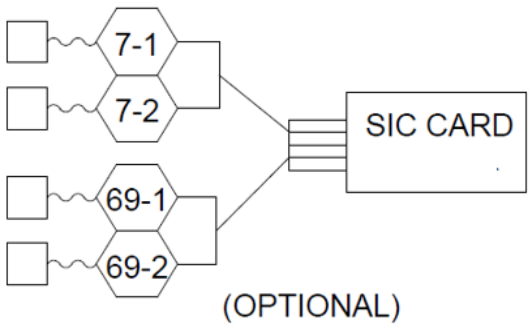


Figure 2-33 SIC monitoring card factory installation wiring diagram

➢ On-site installation

In the case of a SIC card, the customer needs to connect #A, #B, #GND and #12 on the SIC card to #77, #78, #GND and #12V respectively on the terminal block.

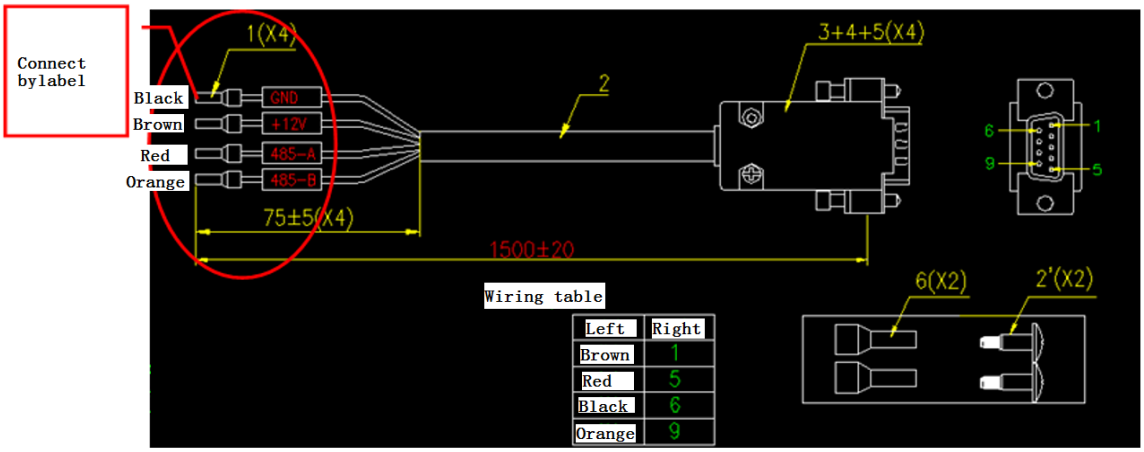


Figure 2-34 On-site installation wiring diagram

2.12.10 Connecting the Solenoid valve of the Pipe Extension kit (Optional)

The Solenoid valve of the pipe extension kit has 2 control cables. These cables are used to connect to the corresponding terminals of the control board. Refer to the Appendix for the circuit diagram to understand it at a micro level.

2.12.11 Outdoor Wiring of the Condenser

This section explains the power supply wiring and connections of the control signal terminals and control signal cables for the condenser:

- **External power supply wiring**

The figure 2-35 depicts the external supply wiring of the condenser:

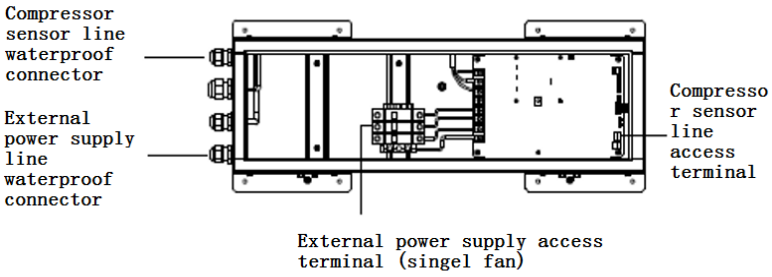


Figure 2-35 Condenser external power supply wiring

- **Connecting Condenser Control Signal Terminals**

The control signal input terminals for the two circuits of the condenser are #70and #71. The switching status is similar to that of the compressor.

- **Connecting Control Signal Cables**

Open condenser electrical box sealing plate, showing the fan speed controller board. A condenser connected to a control signal line wiring as follows:

A signal line required when the compressor enters the condenser through the external electric power line box waterproof connector, the inner diameter of the joint is ϕ6mm.

J6 dry contact switch plate condenser speed control interface from the indoor unit #70 / #71 is introduced.

➢ **Power line connecting the condenser**

Need to go through an external power line when the external power supply line waterproof connector into the condenser electrical box, the inner diameter of the joint is dia.10mm.

To ensure high waterproof performance of the electrical box, if necessary, after the external power source is connected. The waterproof connector is connected to the electrical box by a glue application process. The external power cable from the source is required to be fixed to the clip on the terminal, and the cable retaining clip holding the electrical box gland cable between the U bend downward, as shown in following figure 2-36.

Figure 2-36 Condenser Wiring

2.12.12 Inspection of Electrical installation

Table 2.14 depicts the checklist for the Electrical Installation of the LPC model:

Table 2.14 Electrical Installation Inspection checklist

Items	Results
The power supply voltage meets the rated voltage on the unit nameplate	
The system electric loop has no open or short circuit	
Power cables and ground cables to the circuit breakers (MCBs), indoor unit, and condenser are well connected	
The ratings of the circuit breakers (MCBs) and fuses are correct	
The control cables are well connected	
All the cables connections are fastened and screws fitted correctly	

Do not switch the power on as Vertiv Co. authorized professional technicians have to perform a check and confirm whether it is good to go. The commissioning process will be performed by the Vertiv Co. subject matter experts and technicians, therefore, do not power on the unit.

2.12.13 Pre-Commissioning Checklist

Table 2.15 shows the Pre-Commissioning checklist for the Liebert LPC Model:

Table 2.15

Pre-Commissioning Checklist		
Name of Customer: Site Location: Details:		
S. NO	Indoor Unit positioning & Power cabling, CU piping, GI piping	**Remarks**
1	Indoor units are properly spaced from the maintenance point view, minimum gap of 6" maintained on the back side & in between of the units	
2	Proper levelling of Liebert LPC indoor stand with proper grounding	
3	Drip tray installed properly with silicon sealant applied on the floor stand corner	
4	Units are installed properly with rubber pads in between the unit & the stand	
5	Proper earthing is provided in the mains power supply as well as body earthing for PAC unit	
6	Power cable is provided with proper sizing of the cable to suit the full capacity of CRAC unit	
7	Power supply is connected to the mains switch with proper lugs & termination	
8	Mains power cable is not routed with low voltage cables	
9	Soap leak test on brazing joints & also in Cu piping	
10	Pressure holding time	
11	Quality of copper piping laying, equidistance in between two pipes; Quality of copper piping laying, equidistance in between two pipes, Degree bends & brazing work	
12	Initial U trap provided near the indoor unit	
13	U traps provided after every 7 RMT in vertical length (based on the needs)	
14	Inverted U trap provided near the outdoor unit	
15	Copper pipe with insulation are tagged properly to indicate the brazing joints	
16	Proper support for refrigerant piping is configured	
17	Copper pipes are painted with the proper color code	
18	Additional piping kit installed in case of a vertical distance between indoor to outdoor is more than 20RMT (or equivalent length exceed 30 Rmt)	

19	Cable trays of proper gauges & quality are used. Ensure support is provided at equal distance to avoid the sag on the cable tray	
20	Dressing & proper routing condenser cable	
21	Condenser cable & copper pipes are tagged with unit No & circuit no for easy traceability	
22	Sufficient fresh air for condenser	
23	No hot air short-cycling for condenser	
24	Proper earthling is done for condenser	
25	Proper supporting given for the condenser incase condensers are mounted one above the other	
26	Concrete pedestal are provided for the condenser stand	
27	Rubber pads are provided in between the condenser & the stands	
28	Condenser coils & Copper pipes U bends are painted with anticorrosive paint	
29	Proper slope is maintained for the drain pipes	
30	U traps is provided at the end drain pipe	
31	Isolating valve provided on the inlet of humidifier piping	
32	Fresh water head pressure maintained of 21 - 100 PSI & with PPM level of 80 to 300 (optional)	
33	Ensure no leakage in the humidifier & drain piping before commissioning	

3 Commissioning

3.1 Adding the Refrigerant

3.1.1 Packing

Before packing the unit, high pressure nitrogen gas is filled in the unit at a pressure of 25 bar. With a dwell time of not less than 12 hours, the recorded holding pressure should be same before and after this activity is completed.

3.1.2 Vacuuming the system

When the nitrogen gas is to be evacuated from the system, the ball valve from the indoor unit should be opened simultaneously with the needle valve from the rear side of the electronic expansion valve and the compressor discharge line respectively.

For longer refrigerant piping distances, a replacement operation is required, i.e. a pressure lower than 20 Pa (absolute pressure) is to be maintained to add a small amount of refrigerant charge into the system till the nitrogen evacuation process is complete. This may cause a pressure below 20pa maintained for a considerable amount of time. Upon completion of the evacuation process and charging the refrigerant to the desired pressure, the sight glass is indicated green.

Engineering Standards propose an evacuation time of 4 hours. However, the same needs to be adjusted according to the situation based on the refrigerant piping requirements at site.

3.1.3 Service tools operation on the controller

After completing the vacuuming process, the LPC background service tooling needs to be accessed and in the manual control mode, the menu displays the system as evacuated, refer figure 3-1. Manual mode enable is selected and Mode selection is controlled evacuation.

Signal	Value	Unit	Controllable
Manual Mode Enable	Yes		Controllable
Manual Mode Max Run Time	4.0	h	Controllable
Comp Vacuum Mode Enable	No		Controllable
EEV Manual Mode Enable	No		Controllable
Fan Manual On/Off	Yes		Controllable
Fan Manual Speed	73	%	Controllable
Comp Manual On/Off	Yes		Controllable
Comp Manual Capacity	50	%	Controllable
Heater Manuel On/Off	Open		Controllable
Heater Manual Capacity	0	%	Controllable
DHV Manuel On/Off	Open		Controllable

Figure 3-1

3.1.4 Manual operation for evacuation mode

If evacuation mode is not getting activated, the background service tooling menu needs to be checked to ensure that the line solenoid valve and electronic expansion valve in an open state along with high and low pressure setting of the needle deactivated simultaneously to

perform the vacuuming operation. The flow of the refrigerant to LPC units is metered by a solenoid valve equipped with a desiccant.

Ensure that the power to the unit is activated when the electronic expansion valve is in an open position.

3.1.5 Adding refrigerant oil

LPC air conditioner uses R410A refrigerant, POE refrigeration oil. Adding refrigerant will cause dilution of the system refrigerant oil and lubrication properties but the cooling performance of depends on the quantity of refrigerant oil added to the system.

It is necessary to add lubrication oil to the system based on the details in the table 3.1 below:

Table 3.1

Liquid pipe diameter (mm)	L1015	
	Within 50m	> 50m
12.7	No supplemental refrigeration oil	= The amount of additional refrigerant oil even beyond the tube portion 50m supplemental amount of refrigerant × 10%
16		
19		
16		
19		
22		

3.1.6 The amount of refrigerant charge

LPS units are shipped from the factory with a pre-charged nitrogen gas at 2 bar pressure before packaging. To calculate the amount of refrigerant gas required for LPC units refer table 3.2. The system refrigerant charge depends on the configuration selected and the length of the piping between the indoor and the outdoor units. If the piping length between the indoor and outdoor unit exceed 10m refer table 3.3 for the quantity of additional refrigerant to be charged in the system for proper functioning.

Table 3.2 Standard amount of refrigerant charge

Indoor Model	L1015	
Outdoor Model	LSF24	LSF32
Outdoor temperature	40 ℃	45℃
Standard filling amount (Unit: kg)	6.4	9.5
Note: The standard refers to an amount of charge indoor outdoor + charge amount to suit a piping length upto 10m.		

An additional amount of refrigerant is calculated according to the formula:

The amount of additional cooling agent (kg) = liquid refrigerant amount added per unit length (kg / m) × the total length of the liquid extension pipe (m).

The total length of extension piping for the liquid line (m) = Total length of the liquid pipe (m) - 10m

Table 3.3 depicts the Different liquid line pipe diameters corresponding to the addition amount of the liquid refrigerant per unit length of the tube outer diameter.

Table 3.3

Liquid pipe diameter (mm)	The addition amount of the refrigerant per unit length (kg / m)	Liquid pipe diameter (mm)	The addition amount of the refrigerant per unit length (kg / m)
12.7	0.107	22	0.321
16	0.174	25	0.431
19	0.245	28	/

3.2 Troubleshooting

LPC units operating on the new service operations model, utilizes a computer monitoring and control feature to connect to the LPC units via the service tooling. Commissioning process will monitor and output reports for service can be viewed via computer.

3.2.1 Tooling service connection

When service commissioning tooling terminal switch is connected to the terminal block # 77, #78, open the software and select the corresponding communication parameters. Serial number and computer equipment manager matches the COM port, baud rate consistent with the device (device default 19200), as shown in Figure 3-2.

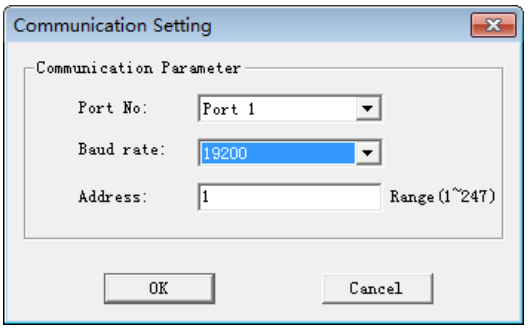


Figure 3-2 LPC services software communication parameters

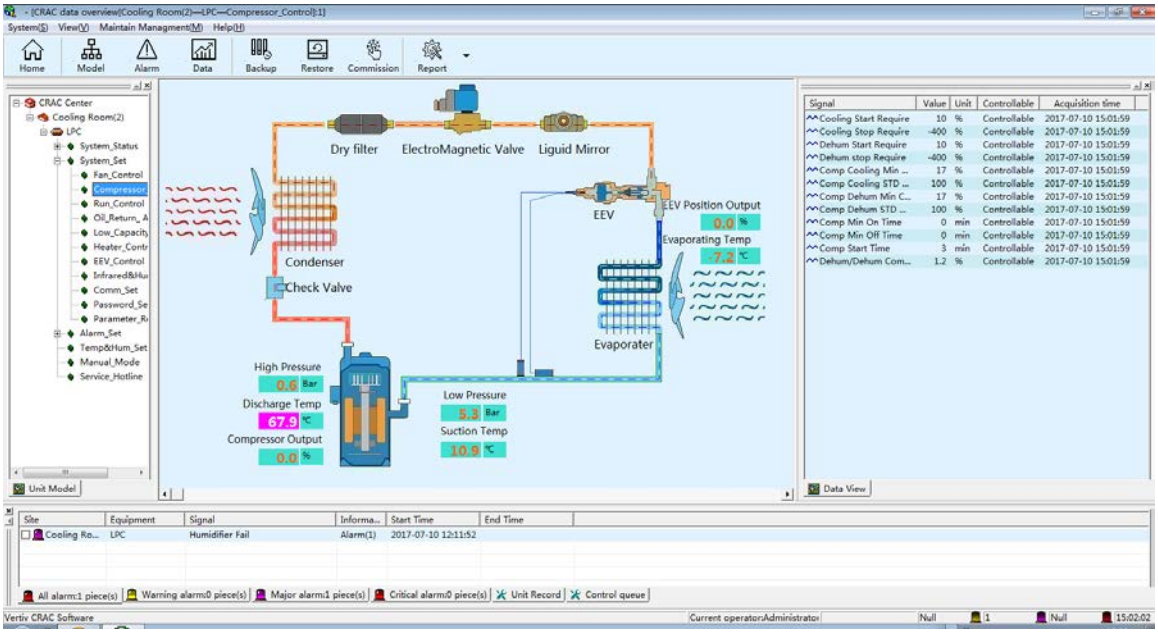


Figure 3-3 Service software display interface

3.2.2 Start-Up Guide

On enabling a key service software debugging function, follow the prompts to step through the various functions of the device detection and quantifying the refrigerant charge. Refer figure 3-4 and figure 3-5

Debugging the functional devices according to step-wise function of detecting. LPC air conditioning has a variety of operating modes. After setting the temperature and humidity of the LPC units, if the output capacity of the compressor starts automatically varying with changes in temperature and humidity, it is not a conducive condition for start-up.

Use a debug function key, the function to fix the output for easy debugging and testing.

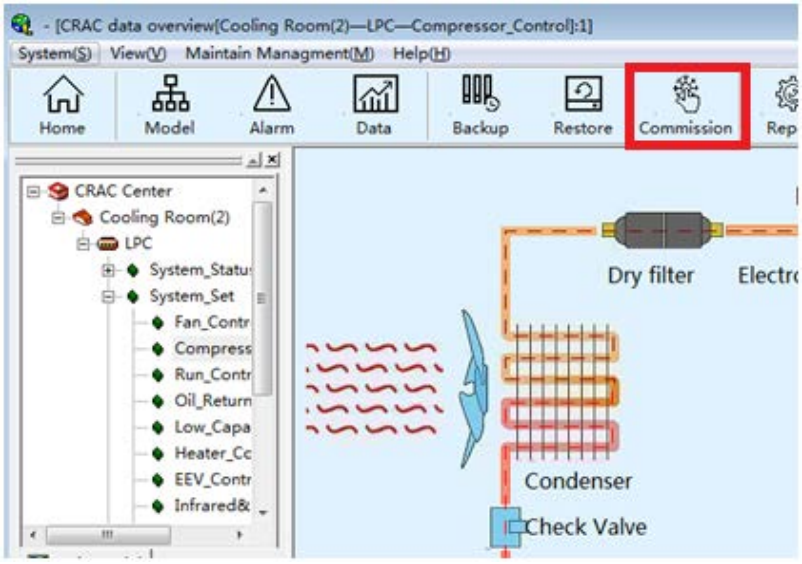


Figure 3-4 Key service software debugging button

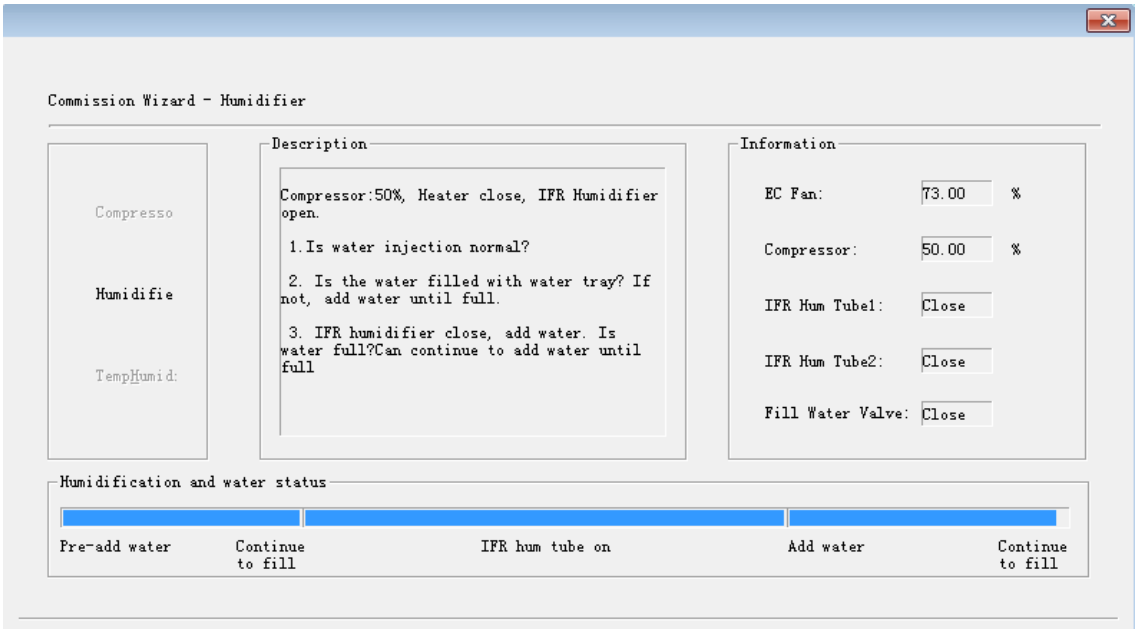


Figure 3-5 Key service software debugging interface

3.3 Commissioning steps

3.3.1 Terms

Exhaust superheat = exhaust gas temperature - the saturation temperature corresponding to the exhaust gas pressure

Suction superheat = intake air temperature - the saturation temperature corresponding to suction pressure (service software for display)

Oil sump temperature superheat = - saturation temperature corresponding to suction pressure

= The degree of sub cooling condensate valve before the pressure corresponding to the saturation temperature - temperature before the valve

3.3.2 Check the power supply

Each component corresponding to disconnect breaker, disconnector is closed and control the total open space, to observe whether the "power alarm phase." If so, check the power cable connection is valid.

3.3.3 Detecting the electrical heating element

On closing the electric heating breaker, change set-point temperature on the controller. This will start the electric heater (or manual start) and then check each phase current to ensure the electrical heating function is on.

3.3.4 Detecting the humidifier

On closing the humidifier breaker, change the set point of the humidity on the controller. This will start the humidifier (or manual start) and then check each phase current to ensure the humidifier function is on.

3.3.5 Condenser detection

Closing the condenser open space, the outdoor fan movable contact point, and to check whether the normal running direction is detected by the input voltage.

3.3.6 Static charge

After the successful completion of vacuuming process, rapidly static charge the amount of liquid refrigerant in the refrigeration system .

The high side and low side of the high and low pressure gauge are connected to the composite needle and the electronic expansion valve needle ball valve at the mouthpiece liquid respectively. The low-pressure valve is closed and the high-pressure valve is opened to release most of the refrigerant charge to the condenser. If incase the condenser is unable to accept the filling of refrigerant charge, the low-pressure valve is opened again, charging refrigerant into the evaporator.

Static filling process to maintain the refrigerant container is placed upside down. Please keep filling during warm-up state of the compressor.

3.3.7 Dynamic filling

If the compressor starting warm-up time is not enough, then one of the following methods should be adopted to prevent compressor damage caused by flooding of the liquid refrigerant:

Method 1: The open space open air conditioning compressor, and then adjust the set temperature of the unit, the unit present cooling demand, the compressor contactor pull, and then the compressor is turned off breaker is closed quickly after 1-2 seconds, wait five minutes and then repeating the above steps (1-2 seconds to open the closed space, open space disconnect, wait 5 minutes), repeated three times until the compressor and the liquid is evaporated to form a film and can be started safely and operation of the compressor.

Method 2: Before starting the compressor housing lower portion with a blow dryer or other heat source of about safety 30min, to vaporize any liquid refrigerant. By setting the temperature / humidity, the unit has only cooling function activates the compressor (or manual start) commissioned.

Compound pressure gauge valve fully closed, manually start the compressor operation (output of the compressor 76%), when the system is operating normally, the low pressure valve to maintain a small opening degree, reduce the risk of damage to the compressor.

Dynamic charging refrigerant gas (of R410A) until no bubbles within the liquid depending on the mirror and the degree of subcooling condensate more than 5 ℃, suction superheat degree of more than 14 ℃, oil superheat above 18 ℃. Real-time observation compressor suction pipe, casing pipe and compressor to ensure no condensation phenomenon to rule out the potential danger of liquid slugging. Units exhaust superheat is in the range of 25 ℃ ~ 40 ℃.

3.3.8 Inspection after completion

1. After commissioning, the unit should focus on checking whether the parameters revert to the default or initial value.
2. If a debugger is used when a manual mode for functional testing, commissioning and after the manual mode should be changed back to automatic mode.
3. Check whether the water supply unit connected to a leak, the fixed line is normal.
4. Check the drainage unit is smooth, condensate drain connections for leaks.
5. Check the compressor intake and exhaust port is loose, whether there is oil leakage.
6. Recording parameters fill in commissioning report and submit it to the customer.

PART III

SYSTEM OPERATION &

GENERAL MAINTENANCE

4 Controller

The Liebert LPC models uses a PACC controller which has a simple user interface. It has an easy-to-operate menu structure.

4.1 Display

The display board uses a 240x128 dot-matrix backlight LCD which has a blue-colored interface, which displays clear texts and graphics on the panel. A color display option is too available as an enhanced feature.

4.2 Control Keys

Figure 4-1 Controller

Table 4.1

Key	Function Description
On/Off	Press this key to Switch on or Switch off the controller
ESC	This key has several functions, namely –
	• Press this key to quit the current menu and hop to the previous menu
	• Press this key to discard changes
	• Holding this key will display the help menu along with info such as the maximum, minimum, or default values along with a brief description of the same
	• Press this key to mute the audio alarm
Up	This key has several functions, namely -
	• Press this key to move the cursor upwards
	• Press this key to increase the value of the displayed parameter
	• Press this key to move up on multi-screen displays
Down	This key has several functions, namely –
	• Press this key to move the cursor downwards
	• Press this key to decrease the value of the displayed parameter
	• Press this key to scroll downwards on multi-screen displays
Enter	• Press this key to move to the next menu
	• Press this key to save the settings after change in the parameters or values

4.3 Indicators

The controller has built-in indicators, namely- Operation indicator and Alarm Indicator. The indicators along with their functionalities are defined in the table 4.2.

Table 4.2

Indicator	Color	Status	Function Description
Operation Indicator	Green	Solid	The controller is working properly
Alarm Indicator	Red	Off	No alarm alert
		Flashing	An alarm alert occurs

4.4 Control Interface

Once the power is turned on, the LCD screen displays the communication state. If there is no communication between the controller and target interface board, the LCD will display the "Communication Failure" notification. However, if the communication is successful, the screen displays the shutdown or main interface based on the On or Off state of the air conditioner. The control interface mainly displays the main interface, shutdown interface, and password.

4.4.1 Main interface

Once the air conditioner is powered on wait for the successful communication following which the main interface will be displayed as depicted in Figure 4-2.

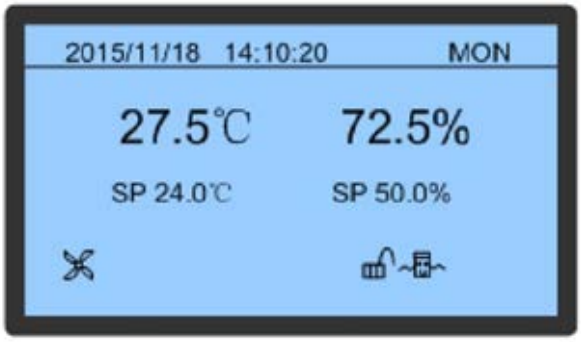


Figure 4-2 Main interface

The Display will be in screen-saver mode in case of no action or if no key is pressed within the initial 10 minutes. The Blue background display eventually turns off. To work with the controller, press Enter to view the main menu. On clicking, the main interface displays the date, time, day of the week, display board address, actual temperature and humidity, humidity set point, and unit work icons (such as fan, cooling, and on/off standby mode).

The main interface consists of three modes related to the operation of the unit, namely-

- Dynamic Running state icons
- Locking state icons
- On/Off/Standby state icons

The following table 4.3 shows the functions and their descriptions for the icons:

Table 4.3

Mode	Icon	Definition
Dynamic Running State		Fan Running
		Cooling
		Heating Status
		Humidifying
		Dehumidifying
		General Alarm
Locking Stat		Locked
		Unlocked
On/Off/Standby State		Standby
		Shutdown
		Running

4.4.2 Shutdown Interface

If the air conditioner is in the Shutdown status, on successful communication, the controller will display the shutdown interface. The Display's Shutdown interface depends on the shutdown mode of the unit, namely –

- Standby Unit Shutdown
- Remote Shutdown
- Unit Shutdown

Figure 4-3 shows the 3 shutdown controller modes based on the shutdown state of the air conditioner:

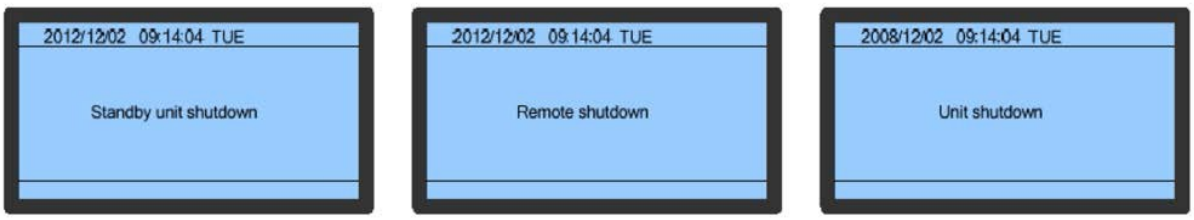


Figure 4-3 Shutdown interface

4.4.3 Password Interface

Figure 4-4 shows the password interface:

Figure 4-4 Password Interface

Press the Enter key on the controller to start working with the main or shutdown interface. Enter the password to start working with the main or shutdown interface. Table 4.4 shows the password level, user type, and initial password for the Liebert LPC model:

Table 4.4

Password Level	User	Initial Password
Level 1	General Operator	0001

Step-by-Step instructions on the password interface are stated below:

- Press the Enter key in the main interface to view the password interface
- Press the Enter key to highlight the input data field in the password interface
- Press the Up or Down keys to change the current number
- Press the Enter key again to confirm the password and enter the Main menu

- *If the password entered is incorrect, press the ESC key to return to the password screen.*
- *If on pressing the Enter key, no password is entered on the password screen, the setting values can be checked but cannot be changed.*
- *LPC air conditioners uses background service software control, without setting advanced password for maintenance.*

4.4.4 Menu Structure

The Controller menu has a step by step structure. After the main interface, press the Enter key to enter the password screen. Type the password and access the main menu and submenus parameter query.

4.5 Main Menu

- On entering the password, the Main menu can be viewed. In the Main Menu Press the Up/Down key to scroll the cursor. Select the required sub-menu.
- Press Enter to gain access to the second level sub-menu.

The Main Menu contains 7 sub-menus, divided into 2 displays as depicted in Figure 4-5.

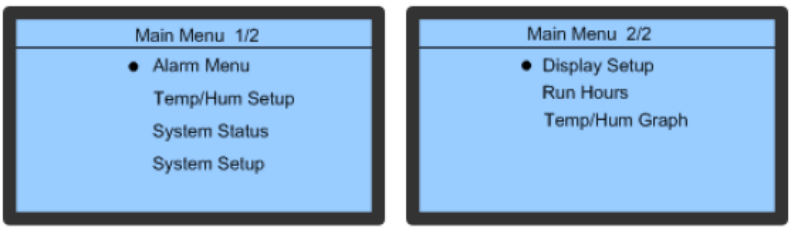


Figure 4-5 Main Menu

- *A black dot is displayed to the left of a menu-item in the preceding Figure 4-5. The black dot indicates that the menu has a sub-menu or settings for the parameters of that menu can be configured/modified/altered.*
- *After changing the parameters, if Enter is not pressed, remote alarm temperature maintains the previous set parameters.*

4.5.1 Setting parameters for the sub-menu

Following is the procedure for setting parameters for a menu item:

- For any menu-item, use the Up/Down key to move to the sub-menu, which needs to be worked upon.
- When the cursor is on the selected menu, a black dot appears on the left-hand side of the sub-menu.
- Next, press the Enter key to further explore the sub-menu or set parameters for that menu.

Consider an example that illustrates the procedure for such a menu:

- Press the Up or Down key in the Main interface to move the cursor to the Alarm menu. Once the cursor moves to that sub-menu, the black dot is displayed to the left of that menu.
- Press the Enter key to explore the Alarm menu interface.
- Press the Up or Down key in the Alarm menu to move the cursor to the Alarm Setup sub-menu.
- Press the Enter key to explore the Alarm Settings sub-menu
- Press the Up or Down key in the Alarm Settings menu to move the cursor to the High Temp Alarm.
- Press the Enter key to highlight the parameter for the High Temp Alarm option.
- Press the Up or Down key to select the required parameter.
- On selecting the parameter, Press the Enter key to confirm and validate the parameter.
- Press the ESC key to move back to the higher-level menu.

4.6 User menu

User menu helps to set the parameters. The various user functions are described in the Table 6.5.

Table 6.5

Path	User sub-menu function	User submenu function
Main Menu --> Alarm Menu	Alarm Status	Query the current Alarm status
	Alarm History	Query the history of the alarm records
	Alarm Settings	Set the Alarm values
	Alarm Process	Clear the Run time of the filter after the maintenance screen
Main Menu	Temperature & Humidity Settings	Query and set the Temperature or Humidity parameters
	Display Settings	Setting the address of the monitor, the contrast in the display, and reminder service hotline
	Operation Hours	Detect the operational time for the main components in the unit
	Temperature & Humidity curve	Query the Temperature/Humidity change trend within a range of 6-48 hours
Main Menu --> System status	Sensor Status	Calibrate the remote temperature and humidity sensors and the return air temperature humidity sensors.
	Power Supply status	Query the input power and frequency of the power
Main Menu --> System Settings	Communication settings	Set the communication, address and baud rate
	Time settings	Set the time
	Password settings	Setting a password

4.6.1 Alarm Menu

In this section, the Alarm menu and its corresponding functionalities, which are an integral part of the controller ecosystem, will be discussed to help understand how it works.

- Press Up or Down in the Main Menu (1/2) to move the cursor to the Alarm menu.
- Press the Enter key to explore the Alarm menu.

Figure 4-6 shows the 4 sub-menus within the Alarm Menu:

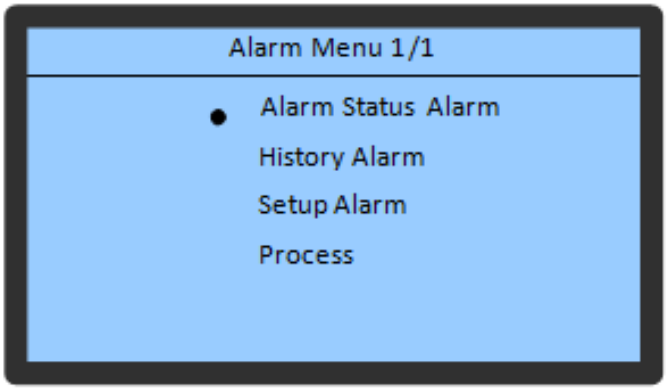


Figure 4-6 Alarm Menu

4.6.2 Alarm Status

The Alarm Status is used to record all the active alarm statuses.

Figure 4-7 shows a sample of the Alarm Status function:

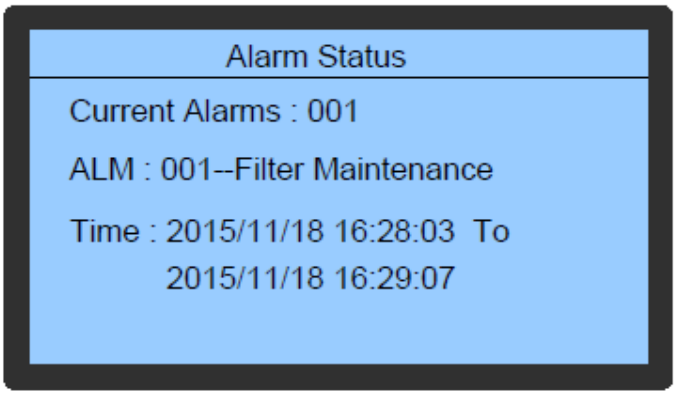


Figure 4-7 Alarm Status

Following are the status types included under this function:

- Active Alarms (Total alarm number)
- ALM (Alarm Serial Number and Type)
- Time (Alarm Start and End Time)

The controller can store up to 100 Alarm Status records at a given point of time.

Alarm statuses will be automatically cleared in case of a power failure.

4.6.3 Alarm History

The Alarm History is used to query the history of the alarm records.

Following is the information included in the Alarm History function:

- Active Alarms (Total number of Alarms)
- ALM
- Alarm Time

Figure 4-8 depicts the Alarm History on the LCD screen of the controller interface:

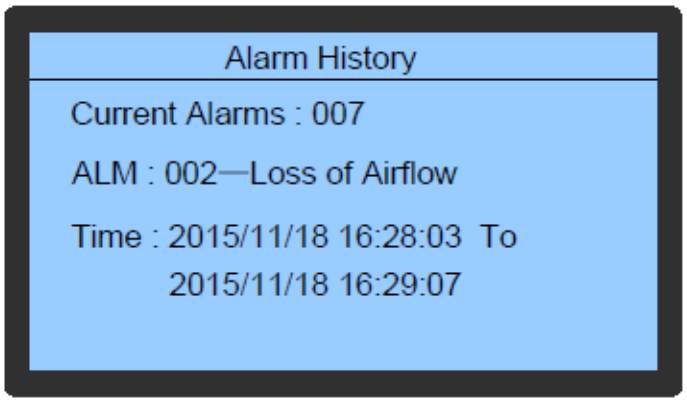


Figure 4-8 Alarm History

At times, several alarms are generated at a given point of time. In such scenarios, the alarm with the biggest alarm SN (read Serial Number) is the latest alarm. Press the Up or Down key to scroll through the alarms. The controller can store up to 500 history alarms and these records will remain intact even in the case of a power failure.

4.6.4 Alarm Setup

The Alarm Setup function contains set points that define the configuration of the system.

Figure 4-9 shows the Alarm Settings interface:

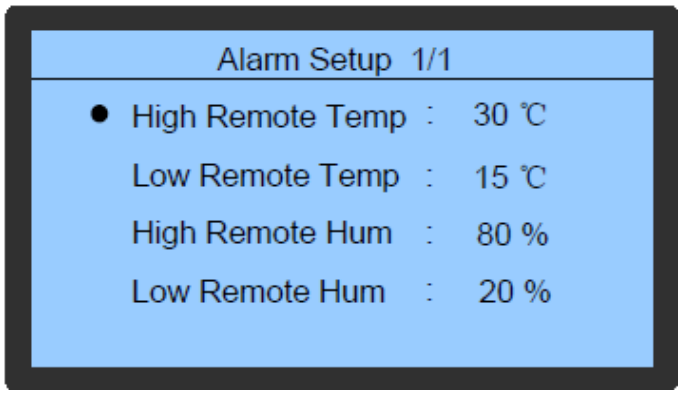


Figure 4-9 Alarm Setup

Do not change the default configurations of the alarm set points. However, if modifying or changing the set points is a requirement, then ensure that the set points are changed under the guidance of trained professionals.

4.6.5 Alarm Process

The Alarm Process function deals with the settings related to the maintenance and replacement of the filter. It can be configured so that an alarm alert will be generated once the due date arrives.

This facilitates the periodic checking and upkeep of the filter. If the Filter Maintenance is set to Yes, clear the filter running time to zero.

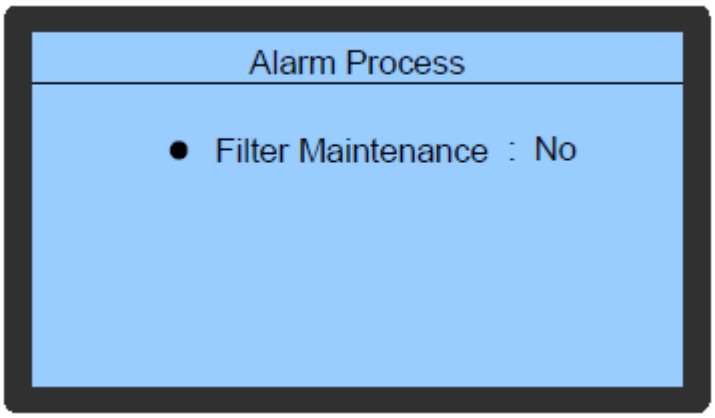


Figure 4-10 Alarm Process

4.6.6 Temperature & Humidity Setup

This function is used to set the temperature and humidity settings.

- In the Main Menu (1/2), move the cursor to the Set Point control by using the Up and Down keys.
- Press the Enter key to explore the sub-menu of the Set Point Control Interface.

The options in the sub-menu are used to set the temperature, humidity, and altitude of the operational unit.

Figure 4-11 shows the interface of the Temperature and Humidity settings menu:

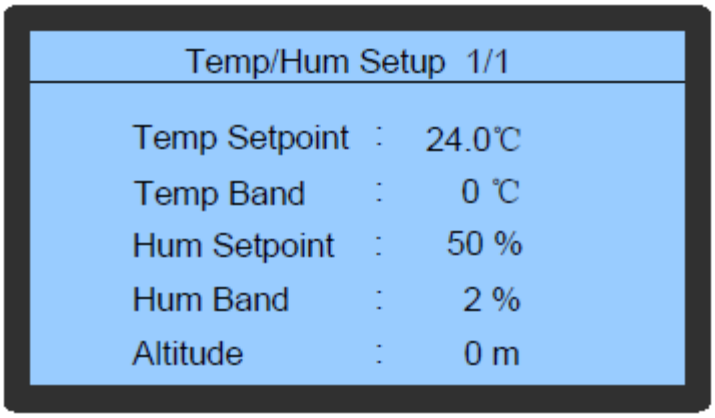


Figure 4-11 Temperature and Humidity Setup

Depending on the requirement, the temperature and humidity must be set appropriately. Do not set the precision temperature or humidity too high as it will result in high energy consumption. Do not set it too low either as the environment cannot be simulated as per the requirement. Altitude must be set based on the local unit of the actual application settings. Set the Altitude value correctly lest it affects the precision required for accurate results.

4.6.7 System Status

The System Status can be viewed in the Main Menu (1/2) screen.

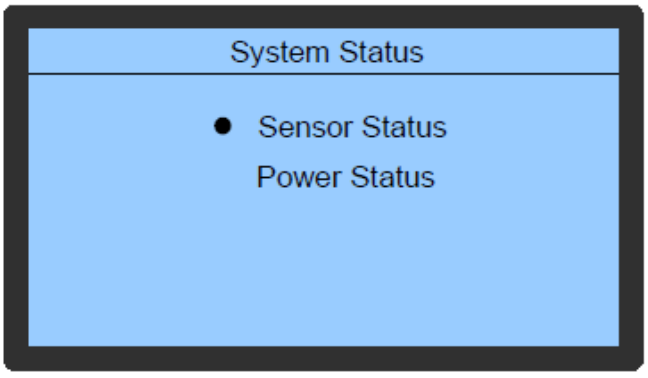


Figure 4-12 System Status

Press the Enter key, following which the unit temperature and humidity sensors can be calibrated. Even the power status parameters can be queried.

4.6.8 Sensor Status

Figure 4-13 shows the Sensor Status.

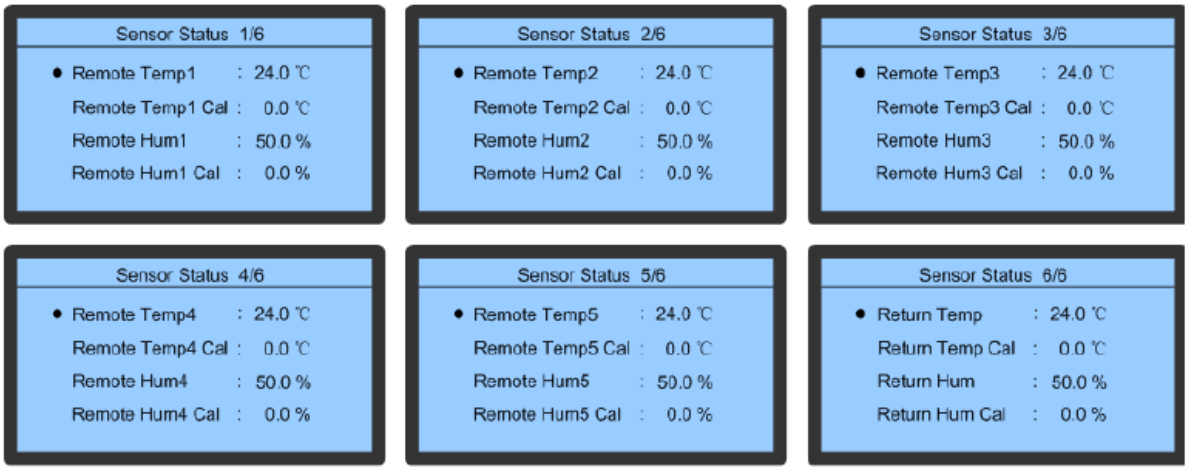


Figure 4-13 Sensor Status

In Figure 4-13, the Sensor Status from 1/6 to 5/6 screens show the detected values of temperature and humidity of remote and calibrated values. The Sensor Status 6/6 screen shows the detected values of the return air and its calibrated values.

4.6.9 Power Status

Figure 4-14 displays the Power Status menu:

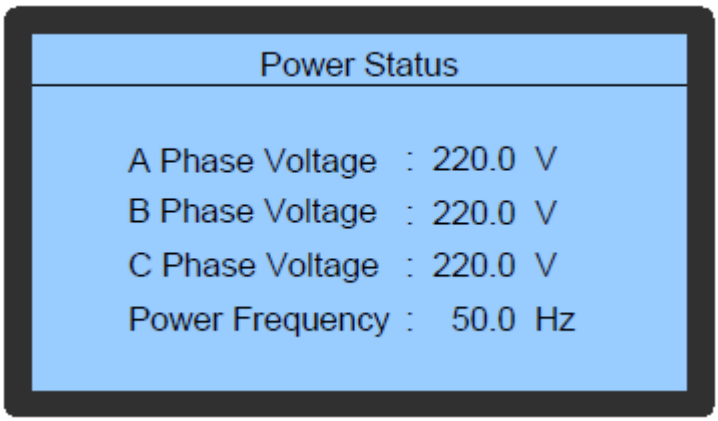


Figure 4-14 Power Status

The Power Status menu is used to browse and view the input power status of the air conditioner such as the A-Phase voltage, B-Phase voltage, C-Phase Voltage, and Power Frequency.

4.6.10 System Setup

Figure 4-15 shows the different options or menu-items of the System Setup screen:

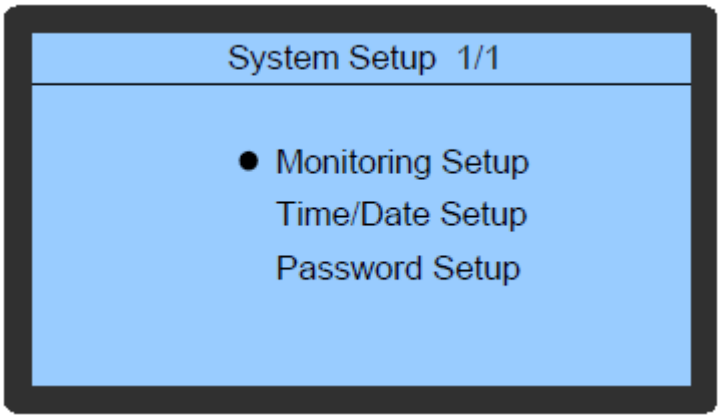


Figure 4-15 System Setup

- Move the cursor to the System Setup menu.
- Press Enter to view the sub-menu of the System Settings menu item.

It contains 3 settings, namely –

- Monitor Setup
- Time/Date Setup
- Password Setup

4.6.11 Monitoring Setup

Figure 4-16 shows the Monitoring Setup menu:

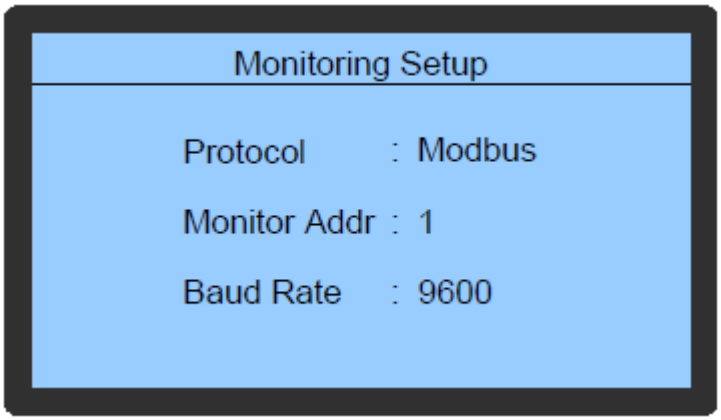


Figure 4-16 Monitoring Setup menu

4.6.12 Time/Date Setup

Figure 4-17 shows the Time/Date settings screen:

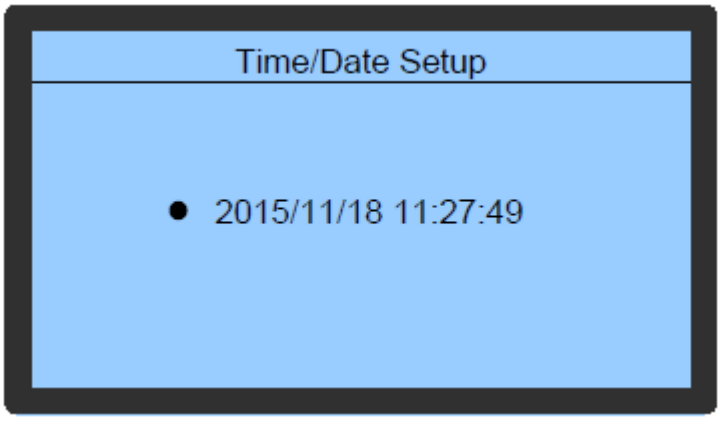


Figure 4-17 Time/Date setup

Set the time and date using these specific settings.

4.6.13 Password Setup

Figure 4-18 shows the Password settings screen:

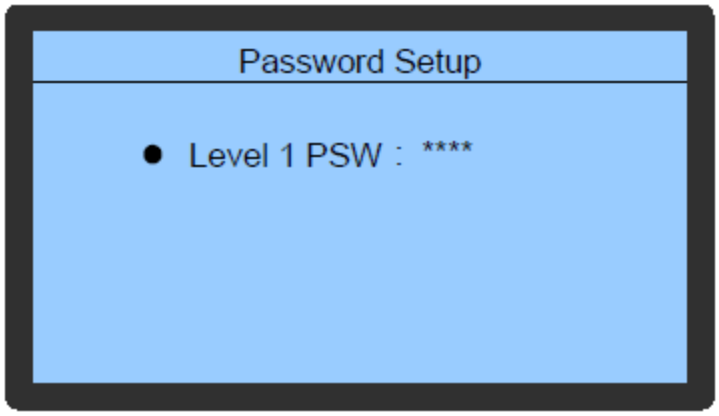


Figure 4-18 Password Setup

Passwords can be setup and modified using this function.

4.7 Display Setup

- Press the Up or Down key on the interface of the Main Menu (2/2) to move the cursor to the Display Setup
- Press Enter to enter the sub-menu of the Display Setup function

Figure 4-19 shows the sub-menu of the Display Setup function:

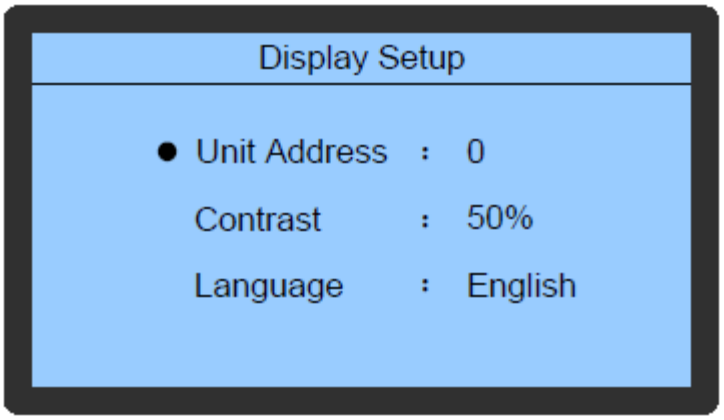


Figure 4-19 Display Setup

The Display Setup function helps in the process of defining the CAN Communication address of the display board and display contrast.

4.8 Run Hours

- Press the Up or Down key to move the cursor to the Main Menu (2/2) and move to the Run Hours option
- Press Enter and on accessing the Run Hours screen, the total run hours of a fan, compressor, heater, humidifier, and the Cumulative run time can be browsed.

Figure 4-20 shows the Run Hours sub-menu:

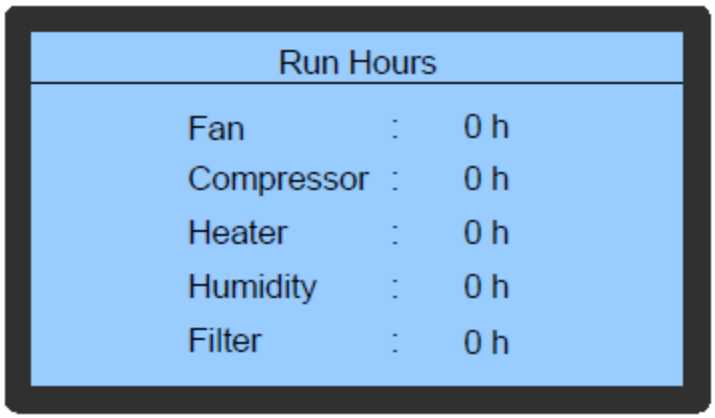


Figure 4-20 Run Hours

4.9 Temperature and Humidity graph

On the main interface (2/2), move the cursor using the Up or Down key to the Temperature and Humidity Graph menu. Through the menu, browse and view the temperature as well as the Humidity graphs. These graphs reflect the change in temperature and humidity over an earlier time period.

Figure 4-21 shows the Temperature/Humidity Graph menu:

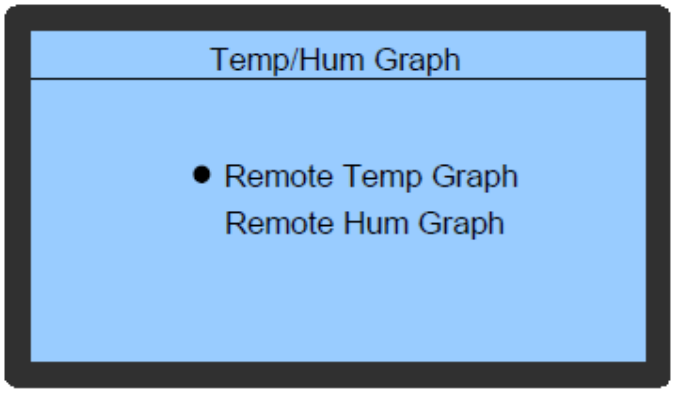


Figure 4-21 Temperature and Humidity Graph menu

In the first option, click on the Remote Temp Graph options to access the Temperature sub-menu as depicted in Figure 4-22. In the graph, the current temperature is the origin, time is the horizontal axis, and temperature is the vertical axis. The graph displays the temperature changes from 6h to 48h through the zooming operation and controlling cursor movement.

Press the Up and Down key to move the cursor to the required zoom-control bar. Press the Enter key to enter the editing mode and zoom in or zoom out the graph using the Up and Down key.

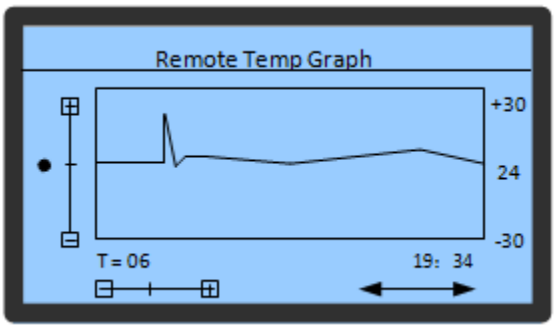


Figure 4-22 Temperature Graph

Back to the Temperature and Humidity Graph menu interface, choose the Hum Graph menu.

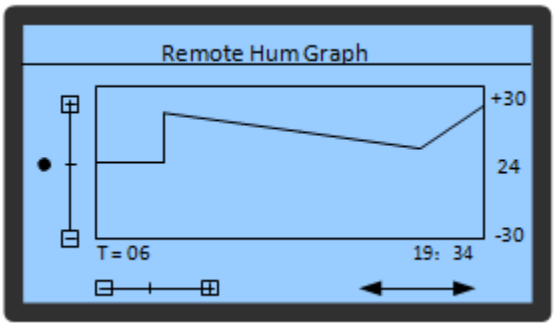


Figure 4-23 Humidity Graph

In the graph, the current humidity is the origin, time is the horizontal axis, and humidity is the vertical axis. The graph displays the humidity changes from 6h to 48h through the zooming operation and controlling cursor movement. Press the Up or Down key to move the cursor to the required zoom-control bar. Press the Enter key to enter the editing mode and zoom in or zoom out the graph using the Up and Down key.

The following is a brief overview of the Remote Monitoring Mode:

The Liebert LPC humidity air conditioners support the multiple monitoring modes:

- Connecting the RDU and SiteWeb - A monitoring system developed by Vertiv Co. Alternatively, A third-party monitoring system can be used in compliance with the standard protocol of the Ministry of Industry and Information technology.
- Connecting RDU and SiteWeb- a monitoring system developed by Vertiv Co. or any third-party application via the Modbus- RTU protocol.
- Connecting the network management software using the SIC card and the SNMP protocol

The communication cables of the remote monitoring system are connected to the #77 and #78 terminals in the electric control box. Refer to the Appendix section for the Circuit Diagram to understand it better.

5 General Maintenance

The operation and maintenance of the Liebert LPC models will be explained in the chapter. It includes the routine maintenance and inspection items, checks related to electric connections and wiring, visual inspection (related to the appearance), and drainage maintenance among other checks, that helps the customer gain sight in to the general maintenance of the LPC series of air conditioners.

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

Qualified and Professional Maintenance personnel are the ones supposed to operate and handle the equipment. Careful and cautionary measures are conveyed to the professional personnel and therefore, only these personnel may perform maintenance on these machines.

5.1 Routine Monthly Inspection

The table 5.1 displays the system components that need to be checked monthly for symptoms of wear and tear and whether the components function correctly.

Table 5.1

Components	Inspection	Notes
Filter	Check the filter for clogging and damage	
	Clean the filter	
Fan	Check if the fan blades are distorted	
	Check bearings for wear and tear	
	Check and fix connectors	
Compressor	Check for Leakage	
	Check and fix connectors	
	Check for noise and vibration	
Air-cooled condenser	Cleaning the Condenser fins	
	Fan Base is rigid	
	Check the vibration absorbing cushion for ageing and damage	
	Check if the SPD board is working correctly	
	Adjust the controller speed	
	Check SPD board once a week during thunderstorms and similar situations	
	Check if refrigerant pipes have suitable support	
Cooling system	Check refrigerant pipes	
	Check if the suction is too hot and check for suction pressure	
	Check moisture conditions in the system using the liquid	
	Check the discharge pressure	
	Check the electronic expansion Valve	
	Check for Exhaust Air pressure	
Heating system	C heck eroding of components	
	Check and fix connectors	
	Check the functioning of electrical heating	
Infrared Humidifier	Check water pan drainage for clogging	
	Check the Humidifier Lamp	
	Check and fix connectors	
	Check the water pan for mineral deposits	

5.2 Routine Bi-annual Inspection

The table 5.2 displays the system components that need to be checked twice a year for symptoms of wear and tear and whether the components function correctly.

Table 5.2

Components	Inspection	Notes
Filter	Check the filter for clogging and damage	
	Clean the filter	
Fan	Check if the fan blades are distorted	
	Check bearings for wear and tear	
	Check and fix connectors	
Compressor	Check for Leakage	
	Check and fix connectors	
	Check for noise and vibration	
Air-cooled condenser	Cleaning the Condenser fins	
	Fan Base is rigid	
	Check the vibration absorbing cushion for ageing and damage	
	Check if the SPD board is working correctly	
	Regulate function of the speed regulator	
	Check SPD board once a week during thunderstorms and similar situations	
	Check if refrigerant pipes have suitable support	
	Check and Fix connectors	
Cooling system	Check refrigerant pipes	
	Check if the suction is too hot and check for suction pressure	
	Check moisture conditions in the system using the liquid indicator	
	Check the discharge pressure and condensing sub cooling degree	
	Check the electronic expansion Valve	
	Check if the refrigerants needs to be added to the system using the liquid indicator or sight glass	
Heating system	Check eroding of components	
	Check and fix connectors	
	Check the functioning of reheat system components	
Infrared Humidifier	Check water pan drainage for clogging and the water pan for mineral deposits	
	Check the Humidifier Lamp	
	Check the water pan for mineral deposits	
Infrared Humidifier	Check and fix connectors	
Electric Control section	Check Fuses, Circuit breakers, and MCBs	
	Check Control Program	
	Check the closing condition of the contactor	

5.3 Inspection of electrical connections

The following checks have to be conducted to ensure that the electrical connections are configured correctly.

- Conduct an overall electrical insulation test. This will help determine the contacts that are not qualified and therefore, these contacts must be handled appropriately. Disconnect the circuit breakers and fuses of the control section during the test as the high voltage can damage the control components.
- Check the contactors before powering-on the unit and ensure that the contactors can act freely without any hindrance or obstruction.
- Clean the electric and control elements with a brush or dry compressed air to remove the dust.
- Check the closing of contractors for arcs or any signs of burning. If there is some discrepancy, replace the contactor if necessary.
- Fasten and fix all the electrical connection terminals.
- Check if the sockets and plugs are in prime condition. Replace the loosened ones.
- Check if the power cables are damaged. To avoid damage, the cables must be replaced by professionals or qualified technicians.

5.4 Visual Inspection of the control components

Visual inspection as well as appearance check of the control components is crucial to chalk out any bottlenecks or hindrances that may arise thereby affecting the smooth flow of operations:

- Check the power transformers and isolation transformers along with the power model. Test the output voltage of the indoor unit and outdoor condenser.
- Check for signs of ageing on the control interface board. Apart from the control interface board, inspect the control board and fuse boards in addition to the temperature and humidity sensor boards.
- Clean the electric control elements and control board with a brush or an electronic dust removal agent to clear the dust and dirt.
- Check, fasten, and fix the I/O (Input/output) ports at the control interface board including the connection between the control interface board and control board. Check and fix the connection between the interface board and the temperature/humidity sensor board.
- Check the connection between the user terminals (70#, 71#, 37#, and 38#) and the control interface boards.
- Check the output connections between the control interface board, and various contactors and solenoid valves for the liquid pipes. Inspect the input connection between the control interface board and fan overload protector, high pressure switch,

excessive heat temperature protection switch, humidifier protection switch, discharge air temperature sensor, and low pressure sensor. If any connection is poor or faulty, replace the components or their connectors depending on the damage. Specifically, check the connection parts such as high pressure switches and solenoid valves on priority.

- Check the electrical components for any fault or damage. Inspect the circuit breakers and fuses as well as the control boards. If any defect is found, then immediately replace those components.
- Inspect the specifications and ageing of the control cable and power cable between the indoor unit and the condenser. If any defect or damage is observed, replace the cables.
- Opt for high precision humidity and temperature measuring meters to calibrate the humidity and temperature sensors to ascertain maximum accuracy in the readings.
- Adjust the set points. Check the functionality of the parts and auto-flush control logic of the water pan of the infrared humidifier.
- Simulate and check the operation flow of the protector devices such as high and low pressure alarms, high and low temperature alarms, high level water alarms, and overheating protection to mention a few.
- Check the water detection sensor and their functionality. The sensor must be placed away from any water pool or drainage trench on the floor (approximately 2.5 meters away from the unit).

- *Before fastening the connections of any mechanical parts or cables, ensure that the power supply of the control unit has been disconnected.*
- *Do not use the water detection sensor to detect any flammable liquid. Keep the sensor away from any flammable liquids.*

5.5 Filter maintenance

The filter in the unit has an efficiency of 30% and is in compliance with the US ASHRAE52-76 and Eurovent 4/5 standards. The dust resistance value of the filter is 90% (EU4 standard). The controller is configured to provide a filter service alarm to ensure the feasible operation of the filter. The default fan running time is set to 2000 hours. When the time is exceeded, the filter service alarm is triggered. The filter needs to be changed if there is clogging or damage. As per the requirement, the filter must be inspected every month and needs to be replaced if it is faulty or clogged.

- *Ensure that the unit is powered off while replacing the filter.*
- *After the filter is replaced, the fan speed reading must be cleared and set to 0.*

5.6 Infrared Humidifier

Sedimentary material (such as mineral particles) accumulates on the water pan during the operational flow. These sediments must be cleaned on a regular basis to ensure efficient operation. However, the cleaning cycle varies because the quality of water differs from region to region. Therefore, it is recommended to check and cleanse the water pan once a month for optimal operation of the infrared humidifier. The auto-flush function of the infrared humidifier can prolong the cleansing cycle. However, regular checks and maintenance are mandatory from an operational point of view.

The following steps need to be implemented in the same hierarchy for maintenance and inspection of the infrared humidifier:

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 both ends of the pan.
5. Pull out the water pan and clean it with water and a hard brush.

Once the water pan is cleaned, restore the water pan in the opposite sequence of steps mentioned in the list, i.e. restore the water pan in its place and fix the fixing screws. Connect the safety switch of the pan and connect the drainage pipe. Fix the water level standpipe to complete the restoration process.

Prior to performing all the mentioned steps explained in the preceding list, ensure that the power is cut off as it may lead to injury and fatality. The water in the pan should be close to the room temperature before draining it from the infrared humidifier to avoid personal injury.

5.7 Electric Heater

The Electrical heater contains three temperature switches that are serially connected to the control loop. While two of the switches are automatic reset ones, the remaining one is a manual reset switch.

Figure 5-1 shows a schematic representation of the three switches inside an electric heater:

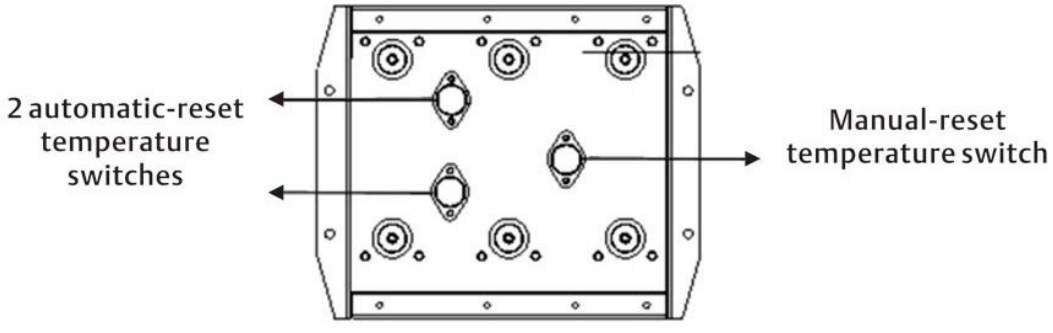


Figure 5-1 Fin-tube type electric heater

The following steps need to be followed during inspection and maintenance of the Electric heater:

- Check the rust on the electric heater. Use an iron brush to get rid of the rust, if possible or replace it if the rustiness is immense or if there is some damage.
- When heating is required but heating is not effective or no heating effect is observed, a multi- meter 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.
- If the cable is not functioning properly, remove the electric 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.

5.8 Drainage check

When inspecting the drainage, check if there are no unwanted substances, debris, alien objects, or particles in the water pan. Check the drainage for leakage too.

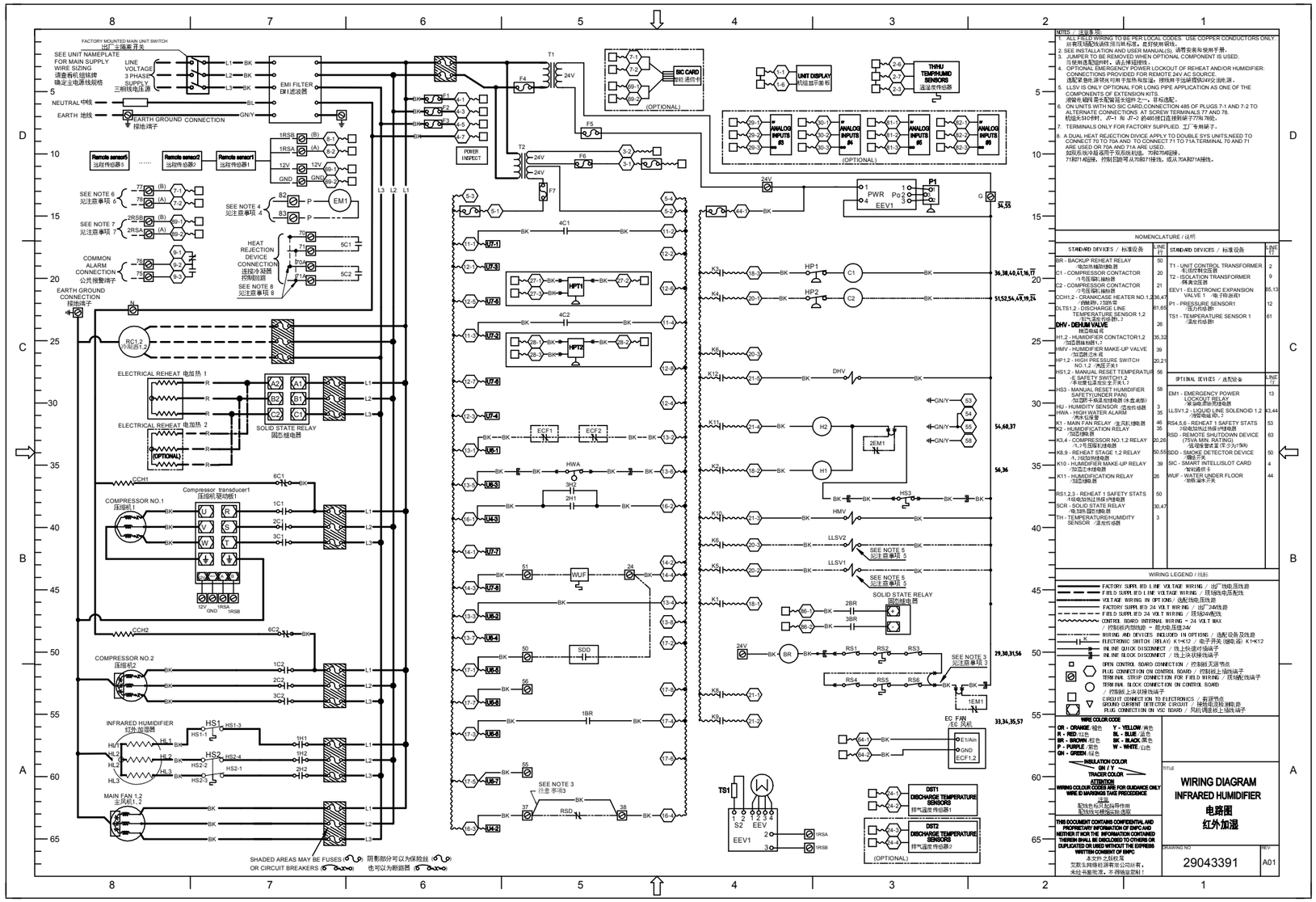
The check has to be conducted periodically on a regular basis.

6 Appendix

6.1 Circuit Diagram

Refer the attached drawing.

其余 12.5



NOTES / 注意事项:

1. ALL FIELD WIRING TO BE PER LOCAL CODES. USE COPPER CONDUCTORS ONLY.
   所有现场配线须依当地法规配置，且好使用铜线。
2. SEE INSTALLATION AND USER MANUAL(S). 请参安装与使用手册。
3. JUMPER TO BE REMOVED WHEN OPTIONAL COMPONENT IS USED.
   只有附选配组件时，请去掉跳线。
4. OPTIONAL EMERGENCY POWER LOCKOUT OF REHEAT AND/OR HUMIDIFIER: CONNECTIONS PROVIDED FOR REMOTE 24V AC SOURCE.
   选配紧急断源锁线可用于加热与加湿；接线用于远端提供24V交流电源。
5. LLSV IS ONLY OPTIONAL FOR LONG PIPE APPLICATION AS ONE OF THE COMPONENTS OF EXTENSION KITS.
   液管长 组件之一，非标选配。
6. ON UNITS WITH NO SIC CARD,CONNECTION 485 OF PLUGS 7-1 AND 7-2 TO ALTERNATE CONNECTIONS AT SCREW TERMINALS 77 AND 78.
   机组无SIC卡时，J7-1 与 J7-2 485信号连接到螺丝77和78处。
7. TERMINALS ONLY FOR FACTORY SUPPLIED. 工厂专用端子。
8. A DUAL HEAT REJECTION DIVICE APPLY TO DOUBLE SYS UNITS,NEED TO CONNECT 70 TO 70A AND TO CONNECT 71 TO 71A.TERMINAL 70 AND 71 ARE USED OR 70A AND 71A ARE USED.
   如双系统冷却选用千兆系统机组，70和70A连接，71和71A连接。控制回路可从70和71接线，或从70A和71A接线。

NOMENCLATURE / 说明

STANDARD DEVICES / 标准设备	LINE #	STANDARD DEVICES / 标准设备	LINE #
BR - BACKUP REHEAT RELAY /电加热辅助继电器	50	T1 - UNIT CONTROL TRANSFORMER /主控制变压器	2
C1 - COMPRESSOR CONTACTOR 1 /1号压缩机1接触器	20	T2 - ISOLATION TRANSFORMER /隔离变压器	9
C2 - COMPRESSOR CONTACTOR 2 /2号压缩机1接触器	21	EEV1 - ELECTRONIC EXPANSION VALVE 1 /电子膨胀阀1	55,13
CCH1,2 - CRANKCASE HEATER NO.1,2 /曲轴加热，1加热带	36,47	P1 - PRESSURE SENSOR1 /压力传感器	12
DLTS1,2 - DISCHARGE LINE TEMPERATURE SENSOR 1,2 /排气温度传感器1，2	61,65	TS1 - TEMPERATURE SENSOR 1 /温度传感器	61
DHV - DEHUM VALVE /除湿电磁阀	26		
H1,2 - HUMIDIFIER CONTACTOR 1,2 /加湿器接触器1,2	35,32		
HMV - HUMIDIFIER MAKE-UP VALVE /加湿器进水阀	39		
HP1,2 - HIGH PRESSURE SWITCH NO. 1,2 /高压开关1	20,21		
HS1,2 - MANUAL RESET TEMPERATUR E SAFETY SWITCH 1,2 /手动复位温控安全开关1，2	58	OPTIONAL DEVICES / 选配设备	LINE #
HS3 - MANUAL RESET HUMIDIFIER SAFETY(UNDER PAN) /加湿盘下手动复位湿度安全开关	58	EM1 - EMERGENCY POWER LOCKOUT RELAY /紧急断源锁定继电器	13
HU - HUMIDITY SENSOR /湿度传感器	3	LLSV1,2 - LIQUID LINE SOLENOID 1,2 /液管电磁阀1，2	43,44
HWA - HIGH WATER ALARM /高水位报警	35	RS4,5,6 - REHEAT 1 SAFETY STATS /1段电加热过热保护继电器	53
K1 - MAIN FAN RELAY /主风机1继电器	35	RSD - REMOTE SHUTDOWN DEVICE /远程停机装置 (75VA MIN. RATING)	63
K2 - HUMIDIFICATION RELAY /加湿1继电器	35	SDD - SMOKE DETECTOR DEVICE /烟感开关	50
K3,4 - COMPRESSOR NO.1,2 RELAY /1,2号压缩机接触器	20,26	SIC - SMART INTELLISLOT CARD /智能通讯卡	4
K8,9 - REHEAT STAGE 1,2 RELAY /1，2加热段继电器	50,55	WUF - WATER UNDER FLOOR /地板漏水开关	44
K10 - HUMIDIFIER MAKE-UP RELAY /加湿器进水继电器	39		
K11 - HUMIDIFICATION RELAY /加湿1继电器	26		
RS1,2,3 - REHEAT 1 SAFETY STATS /1段电加热过热保护继电器	50		
SCR - SOLID STATE RELAY /电加热固态继电器	30,47		
TH - TEMPERATURE/HUMIDITY SENSOR /温湿传感器	3		

WIRING LEGEND / 线标

- FACTORY SUPPLIED LINE VOLTAGE WIRING / 出厂线电压线路
- FIELD SUPPLIED LINE VOLTAGE WIRING / 现场线电压配线
- VOLTAGE WIRING IN OPTIONS / 选配线电压线路
- FACTORY SUPPLIED 24 VOLT WIRING / 出厂24V线路
- FIELD SUPPLIED 24 VOLT WIRING / 现场24V配线
- CONTROL BOARD INTERNAL WIRING = 24 VOLT MAX / 控制板内部线路 = 最大电压值24V
- WIRING AND DEVICES INCLUDED IN OPTIONS / 选配设备及线路
- ELECTRONIC SWITCH (RELAY) K1-K12 / 电子开关 (继电器) K1-K12
- INLINE QUICK DISCONNECT / 线上快速对插端子
- INLINE BLOCK DISCONNECT / 线上块状接线端子
- OPEN CONTROL BOARD CONNECTION / 控制板上开节点
- PLUG CONNECTION ON CONTROL BOARD / 控制板上插线端子
- TERMINAL STRIP CONNECTION FOR FIELD WIRING / 现场配线端子
- TERMINAL BLOCK CONNECTION ON CONTROL BOARD / 控制板上块状接线端子
- CIRCUIT# CONNECTION TO ELECTRONICS / 表示带节点
- GROUND CURRENT DETECTOR CIRCUIT / 接地电流检测电路
- PLUG CONNECTION ON VSC BOARD / 风机调速板上插线端子

WIRE COLOR CODE

OR - ORANGE /橙色 · R - RED /红色 · BR - BROWN /棕色 · P - PURPLE /紫色 · GN - GREEN /绿色 · Y - YELLOW /黄色 · BL - BLUE /蓝色 · BK - BLACK /黑色 · W - WHITE /白色

INSULATION COLOR / 绝缘层颜色: GN / Y

TRACER COLOR / 线条颜色

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
配线线号标识优先选取

TITLE

WIRING DIAGRAM INFRARED HUMIDIFIER 电路图 红外加湿

DRAWING NO 29043391 REV A01

技术要求：
1、丝印清晰，无毛边；
2、按照此墨稿制作菲林；
3、标签大小320X219mm；
4、标签内容丝印颜色为黑色(PANTONE BLACK C)；
5、标签细线位0.2毫米，粗线位0.4毫米；
6、标签底纸要平整,不起皱,无气泡,未注公差为+/-0.2；

版本	更改方式	更改单号	日期
A01	替换	E911609016	2016.09.14
A00	/	新归档	2016.05.11

设计	孙利花 2016.09.14	
审核	刘志鸿	
工艺	刘运发	
标准化	吕妙琼	
批准	林华和	

表面处理

中英文原理图标签

29043391-JL

3M-7871

投影标识

编码 29043391

版本	质量	比例	第 1 张 共 1 张
/		1:1	产品 EMERSON-L1015U

电子文件名: 29043391