GREE
Change for life

Installation, Startup and Maintenance Manual

LHE-S Series Water-cooled Screw Chiller

Thank you for choosing commercial air conditioners.Please read this Owner’ s Manual carefully before operation and retain it for future reference.
If you have lost the Owner's Manual, please contact the local agent or visit www.gree.com or send an email to global@cn.gree.com for the electronic version.



To Users

Thank you for selecting Gree's product. Please read this instruction manual carefully before installing and using the product, so as to master and correctly use the product. In order to guide you to correctly install and use our product and achieve expected operating effect, we hereby instruct as below:

(1) This equipment should be installed, operated or maintained by the qualified servicemen who have had specific training. During operation, all safety issues covered in the labels, User's Manual and other literature should be followed strictly. This equipment is not intended for use by persons (including children) with reduced physical, sensory or mental capabilities, or lack of experience and knowledge, unless they have been given supervision or instruction concerning use of the appliance by a person responsible for their safety. Children should be supervised to ensure that they do not play with the appliance.

(2) This product has gone through strict inspection and operational test before leaving the factory. In order to avoid damage due to improper disassembly and inspection, which may impact the normal operation of unit, please do not disassemble the unit by yourself. You can contact our designated dealer or local service center for professional support if necessary.

(3) When the product is faulted and cannot be operated, please contact our designated dealer or local service center as soon as possible by providing the following information.

- Contents of nameplate of product (model, cooling/heating capacity, product No., ex-factory date).
- Malfunction status (specify the situations before and after the error occurs).

(4) All the illustrations and information in the instruction manual are only for reference. In order to make the product better, we will continuously conduct improvement and innovation without further notice.

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Safety Notices (Please sure to abide)

⚠ **WARNING**: If not abide strictly, it may cause severe damage to the unit or the people.

⚠ **NOTE**: If not abide strictly, it may cause slight or medium damage to the unit or the people.

This sign indicates that the operation must be prohibited. Improper operation may cause severe damage or death to people.

This sign indicates that the items must be observed. Improper operation may cause damage to people or property.

The high-efficiency water-cooled screw chiller can provide safe and reliable service under design conditions. However, because of its complexity, good judgment and safety precautions are required during operation and operation instructions covered in this manual should be strictly complied with so as to prevent property damage or personal injuries by improper operation.

⚠ WARNING

(1) Do not use oxygen or compressed air to clean the pipe or pressurize the unit.

(2) Do not use oxygen for leak test but by refrigerant or dry nitrogen.

(3) Do not close the valve of any safety device, except for repair or pressure test.

(4) Do not exceed the regulated pressure. See the User' Manual or the nameplate for the allowed test pressure.

(5) Be sure all pressure relief valves have installed correctly and can operate normally before putting the unit into operation.

(6) Do not operate any electric element until it is certain that all power supply has cut off and no voltage will release from the capacitor or the solid state device, including the electric control cabinet, the switch, the start cabinet, or oil heater. Never let the high-temperature source higher than 43°C near the unit.

(7) Do not weld or cut any pipe, evaporator or condenser etc. when there is refrigerant inside the unit.

(8) Do not weld or cut any pipe or container before all refrigerant has discharged out. The trapped refrigerant should be replaced by dry air or nitrogen. Do keep good ventilation in the working area, as refrigerant would produce toxic gas once contacting the open fire.

(9) Only the qualified electrician is allowed to operate the high-voltage devices.

(10) Do not use the waste steel cylinder. When it is empty, expel the trapped gas, open the valve and remove the valve stem.

(11) When install the pressurized spring or work near it, care must be practiced. The relieved spring will fly out like a bullet.

⚠ NOTE

(1) R134a is a kind of liquefied gas and its saturation vapor pressure is in direct proportional to the temperature. In view of safety, in order to make sure the inner gage pressure lower than the opening pressure of the safety valve, during shutdown environment temperature around the unit should be kept below 45°C, or the chilled water pump should be kept on to lower the evaporating temperature.

(2) Refrigerant leak is not allowed during operation and commissioning. The allowed adverse effect level of R134a vapor in the air is 1000PPM. However, when refrigerant leaks largely, R134a vapor will largely accumulate near the ground, making people feel anoxic. At this time, keep good ventilation and user the blower to make the air near the ground circulating. Do not enter the polluted area until refrigerant vapor has expelled out to prevent refrigerant vapor from brining adverse effect to the human body.

(3) Before charging, check for the refrigerant type, otherwise incorrect refrigerant would make the unit fail to run normally or lead to damage to the unit.

(4) Charging and discharge should be done with special tools. The discharged refrigerant should be stored in the refrigerant container which meets the design pressure and is designed with corresponding standards. Do not discharge refrigerant directly to air or the sewer.

(5) When the unit is used in the enclosed air, for the consideration of safety, pay attention that:

- The exhaust pipe and ventilation pipe outside should be instead and should be kept far away from the air inlet.
- Be sure ventilation is in good condition. If necessary, use the auxiliary tools to eliminate accidentally leaked refrigerant vapor.
- If allowed, the outlet of the safety valve should be lead to outside with the pipe.
- If allowed, the air detector can be installed, for detecting the concentration of R134a vapor.

(6) Do not liquid R134a contact skin or eyes, otherwise they should suffer frostbite. Once it contacts the skin, rinse it with soup water; once it enters eyes, rinse them with water and then seek medical assistance.

(7) Care must be taken to electric injuries. When the star-delta start cabinet or solid start cabinet is used, even the unit is not operating; there is high voltage at the motor terminals. Do cut off the power supply before contacting the terminal or wiring.

(8) Do not remove the connectors or cover plates when there is pressure for the unit and it is in operating. Be sure the pressure is 0kPa before loosening any connector. The safety valve and other safety devices should be checked at least once every year. When the unit is installed in the corrosive environment, check should be done more frequently. When it is founded that the valve or other organism is corroded or generates other matters outside, do not repair it but replace it.

When there is any problem, please contact the local sales agent, appointed service center or office, or directly contact GREE.

Note: Refrigerant R134a used by this unit is a kind of medium-pressure medium. The evaporator and condenser both are designed, manufactured and installed as per ***NB/T 47012-2020 Pressure vessels for refrigerant device***.

1. General

LHE series screw chillers are used for the air conditioning system required with chilled water, and the cooling device for cooling water should be prepared by the user.

This unit is designed, manufactured and inspected according to GB/T 18430.1-2007 ***Vapor Compressor Hydronic (Heat Pump) Unit, Part one Chilled Water (Heat Pump) Unit for the Industrial or Commercial or Similar Usage*** and ***NB/T 47012-2020 Pressure vessels for refrigerant device***. If there is any alternation, the latest standard will always prevail.

This unit should be used according to related standards of pressure containers.

For the main technical parameters, please refer to the nameplate of the unit.

Before initial operation, the startup, operation and maintenance men should have got well known of this manual and other necessary information. This manual is intended for startup, operation and maintenance.

2. Nomenclature

Take the unit LHE872KKNMKKE-2/Nb for example.

LH	-	E	872	KKN	MKK	E	-	-2	/Nb
1	2	3	4	5	6	7	8	9	10

No.	Description	Options
1	Unit type	LH-Water cooled screw chillers
2	Compressor type	V-Permasyn variable-frequency; Default:fixed-frequency
3	Product function	E-Chiller; P-Heat pump; I-Ice storage
4	Compressor code	/
5	Evaporator code	/
6	Condenser code	/
7	Economizer	E-Economizer available; Default- No economizer
8	Special function	R-Part heat recovery Q-All heat recovery
9	Compressor quantity	Default: Single-system 2: Dual-system
10	Refrigerant	Nb-R134a

3. Introduction to System Components

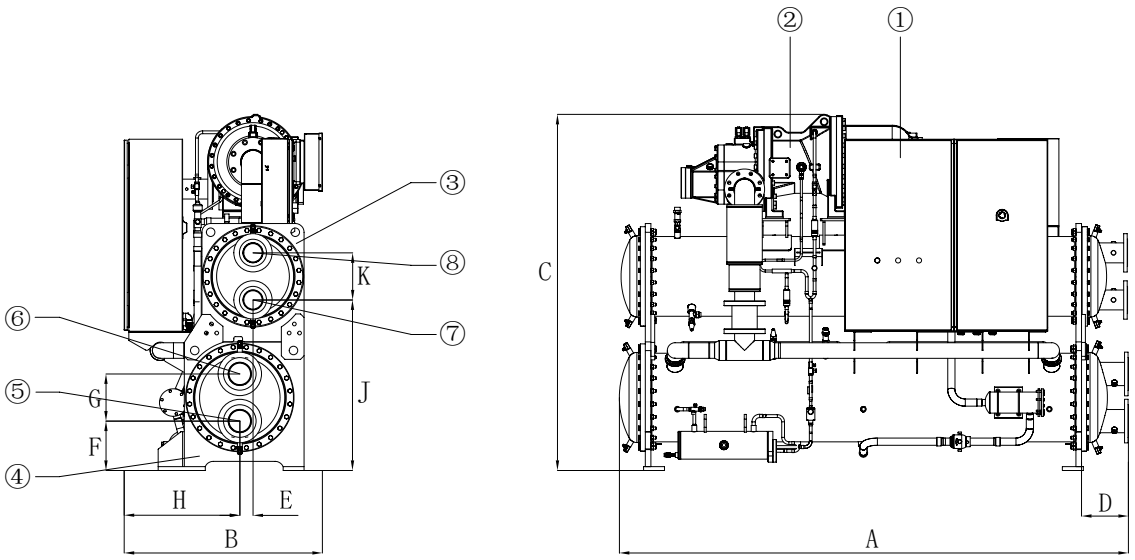


Figure 3.1a Diagram of the Single System (Up and Down Structure)

No.	Name	No.	Name
1	Electric control box	5	Entering cooling water
2	Compressor	6	Leaving cooling water
3	Evaporator	7	Entering chilled water
4	Condenser	8	Leaving chilled water

Unit: mm

Model	A	B	C	D	E	H	F	G	J	K	Connection pipe for chilled water	Connection pipe for cooling water
LHE542DD3ED4/Nb	2950	1160	2070	270	75	665	285	270	980	270	DN100	DN125
LHE632DD2ED3/Nb	2950	1160	2070	270	75	665	285	270	980	270	DN100	DN125
LHE642ED4ED2/Nb	2950	1160	2100	280	50	665	270	300	970	295	DN125	DN125
LHE732EE4EEB/Nb	3250	1200	2170	275	50	660	285	270	970	295	DN125	DN125
LHE742EE6EEA/Nb	3290	1200	2170	305	50	660	270	295	970	295	DN125	DN150
LHE752EE5FEC/Nb	3290	1150	2200	305	60	615	275	300	1000	295	DN150	DN150

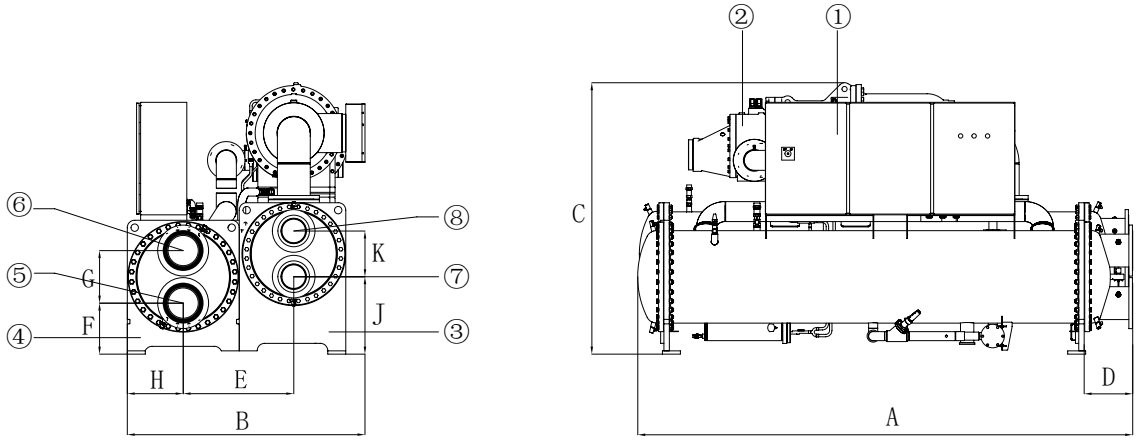


Figure 3.1b Diagram of the Single System (Left and Right Structure)

No.	Name	No.	Name
1	Electric control box	5	Entering cooling water
2	Compressor	6	Leaving cooling water
3	Evaporator	7	Entering chilled water
4	Condenser	8	Leaving chilled water

Unit:mm

Model	A	B	C	D	E	H	F	G	J	K	Connection pipe for chilled water	Connection pipe for cooling water
LHE772FE6FEB/Nb	3300	1520	1620	305	710	345	335	300	410	305	DN150	DN150
LHE842FE5GEC/Nb	3330	1610	1830	325	735	375	340	350	515	305	DN150	DN200
LHE852GE8GEB/Nb	3350	1650	1800	350	775	370	340	350	450	310	DN150	DN200
LHE872GE7GEA/Nb	3350	1650	1800	350	775	370	340	350	450	310	DN150	DN200
LHE872GGBHGCE/Nb	3760	1820	1900	350	930	395	400	360	520	350	DN200	DN200

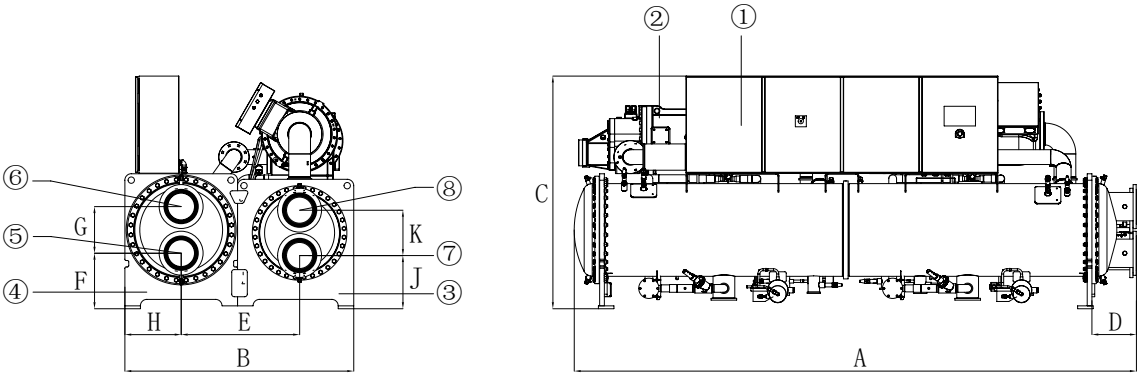


Figure 3.1b Diagram of the Dual System

No.	Name	No.	Name
1	Electric control box	5	Entering cooling water
2	Compressor	6	Leaving cooling water
3	Evaporator	7	Entering chilled water
4	Condenser	8	Leaving chilled water

Unit:mm

Model	A	B	C	D	E	H	F	G	J	K	Connection pipe for chilled water	Connection pipe for cooling water
LHE742HIPJIP-2/Nb	4450	1830	1850	390	915	435	430	360	405	360	DN200	DN200
LHE752HINJIM-2/Nb	4500	1830	1850	390	915	435	430	360	405	360	DN200	DN200
LHE772HIMKIN-2/Nb	4550	1850	1900	425	930	450	440	435	405	360	DN200	DN250
LHE842HKLKKL-2/Nb	5050	1860	1900	390	930	450	440	435	405	360	DN200	DN250
LHE852JKPLKL-2/Nb	5050	1950	1950	390	985	470	450	420	420	415	DN250	DN250
LHE872JKNMKP-2/Nb	5050	2000	1950	390	1010	495	470	420	420	415	DN250	DN250
LHE872KKNMKKE-2/Nb	5050	2130	1950	390	1035	495	470	420	410	435	DN250	DN250

3.1 System Components

3.1.1 Compressor

The semi-hermetic dual-screw compressors are used for most of our water-cooled screw units. See the following statement for their basis structure.

This screw compressor mainly consists of the suction section, the main body and the discharge section. The main body is the key part and contains a pair of rotors, the male rotor and the female rotor. For the male rotor, there are convex teeth outside the pitch circle and there are concave teeth inside the pitch circle fo. Inside the compressor, the male rotor is connected with the motor and driven by the motor. Then, the female rotor rotates with the rotor. Engagement of the male and female rotors realizes compression of refrigerant vapor. The ball bearings support the axial force of the rotor and position the rotor in the axial direction. The cylinder bearings support the radial force of the rotor and position the rotor in the radial direction. There is a helical suction at the front end of the main body of the compressor, and a discharge outlet at the other end connected with the bearing seat.

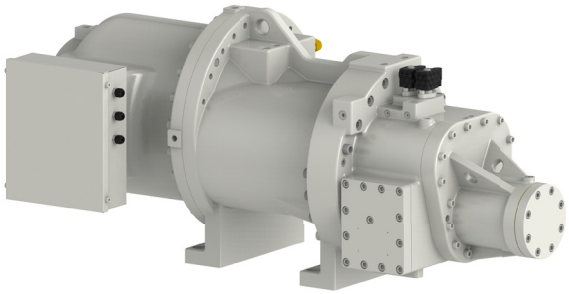


Figure 3.3 Structure Diagram of the Centrifugal Compressor

(1) Drive Mechanism

The figure below shows the drive mechanism of the compressor. For the semi-hermetic compressor, the motor rotor and stator are installed inside the motor housing. The motor rotor is connected with the male rotor. When the compressor is started, the motor will drive the male rotor to rotate. As the female rotor is engaged with the male rotor, so it will rotor together. Engagement of the male and female rotors achieves suction and discharge of refrigerant vapor.

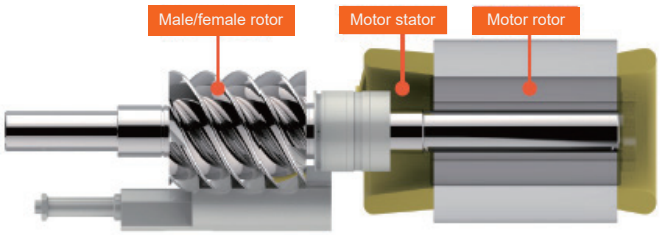


Figure 3.4 Drive Mechanism of the Screw Compressor

(2) Capacity Control Mechanism

The compressor takes the sliding valve as the capacity control system, for capacity control among 25%~100% load. This system consists of the sliding valve, the valve stem, the oil piston and the piston cylinder. The sliding valve is the underneath type. The oil circuit is controlled by the solenoid valve. When the high-pressure oil flows into the piston cylinder, it will push the piston to move. Meanwhile, the piston will push the sliding valve to move through the valve stem, which will control the vapor displacement of the compressor.

(3) Motor Cooling System

See the figure below for the working principle of the motor cooling system. For the semi-hermetic compressor, its motor is cooled by the suction vapor. The arrows represent the flow area. It can be seen that there is a passage between the motor rotor and the main body. Through this passage, refrigerant vapor goes to the rotor chamber. At the end of the passage, there is a structure like a flow guider which will lead the vapor to the motor for cooling. Without extra cooling process, the motor is cooled at the suction process.

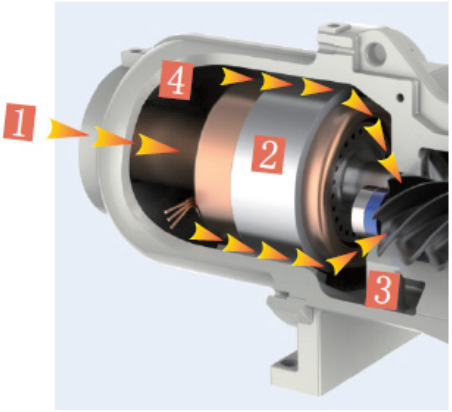


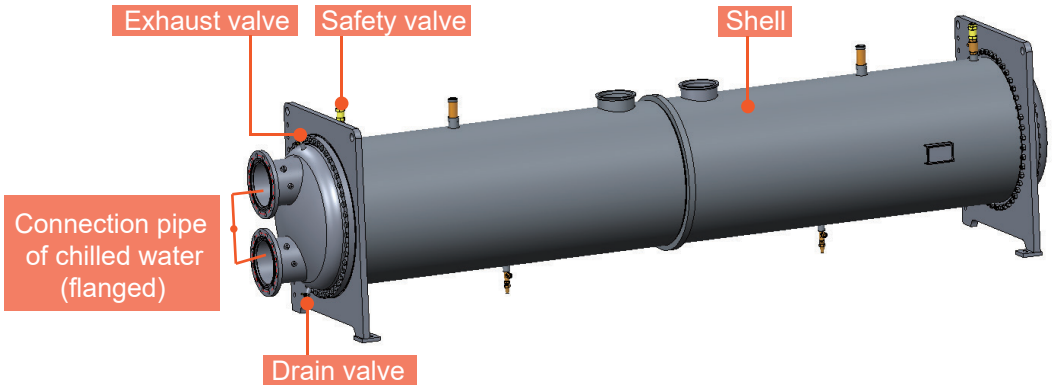
Figure 3.5 Motor Cooling System

No.	Name	No.	Name
1	Suction inlet	3	Main body
2	Motor	4	Suction end cap

3.1.2 Evaporator

The evaporator is beneath the compressor and functions to keep quite low temperature (pressure) so that refrigerant goes through its inner tubes will bring away heat.

Inside it, there are high-efficiency heat exchanging tubes which are hold up by supporters along the length direction. In order to prevent refrigerant from being absorbed into the compressor, there is liquid eliminator at the suction inlet.

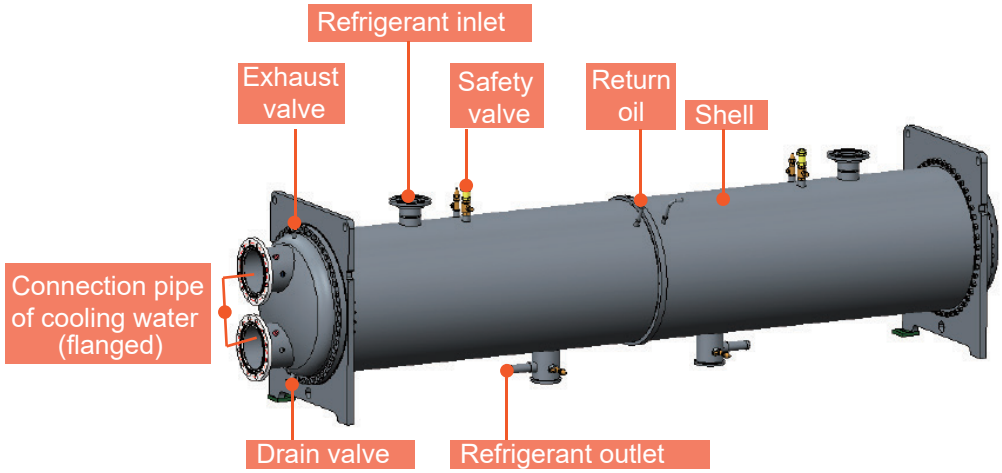


The evaporator is a kind of category II pressure vessels and should be designed, manufactured, and inspected according to ***TSG 21-2016 Supervision Regulation on Safety Technology for Stationary Pressure Vessel*** **and** ***NB/T 47012-2020 Pressure vessels for refrigerant device***.

3.1.3 Condenser

The operation temperature (pressure) of the condenser is quite high and water in the condenser will take heat away from refrigerant in the condenser.

The condenser is a kind of horizontal shell-and-tube heat exchangers. It is integrated with an oil separator which is located above the shell of the condenser. The overheated vapor from the compressor will firstly go into the oil separator and then go into the shell of the condenser for heat exchange. At the bottom of the condenser, there is a throttling device which will turn the high pressure, high temperature liquid refrigerant into low pressure, low temperature one before it goes into the evaporator.



The evaporator is one of the category II pressure vessels. Its design, manufacture and inspection should comply with ***TSG 21-2016 Supervision Regulation on Safety Technology for Stationary Pressure Vessel*** **and** ***NB/T 47012-2020 Pressure vessels for refrigerant device***.

3.1.4 Electronic Expansion Valve

The electronic expansion valve is used for the LHE series screw chiller. At the discharge line of the compressor both temperature and pressure sensors are installed, which functions to detect the super heating degree of the discharge and make the stepping motor to drive the valve piston. The opening angle of the valve can adjust the flow rate of refrigerant. The bigger the opening angle is, the larger the flow rate.

The electronic expansion valve is high control precision and can guarantee enough refrigerant flow.

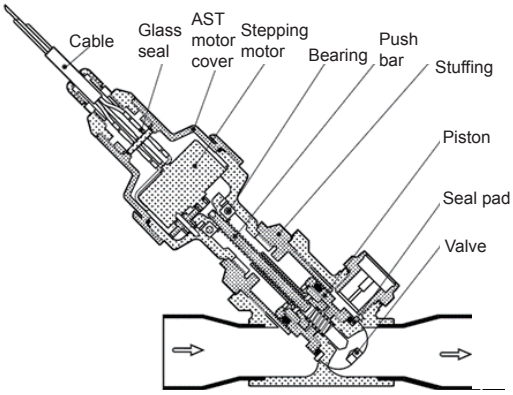


Figure 3.6 Electronic Expansion Valve

3.1.6 Control Cabinet

Located above the condenser, the control cabinet is divided into the weak-current cabinet and strong-current cabinet.

The strong-current cabinet is to control the power supply for the motor of the compressor as well as for the control panel.

The weak-current cabinet is equipped with the color touch screen, through which the user can control operation of the unit and get the operation status. The control cabinet mainly functions to control the capacity of the unit so as to get the leaving water with proper temperature. Its main functions are stated as below:

(1) Do ON/OFF operation under the microcomputer control.

(2) Record the operation status of each component.

(3) Display the operation status of the unit and OFF status against alarms.

(4) Record total runtime of the unit.

(5) Provide the communication interface to the external network.

3.2 Micro-computer System

(1) Function Control Center

- The self-developed and manufactured automatic microcomputer controlled system, combined with the pressure and temperature sensors, can realize automatic precise control to the unit and always make the unit in optimum status.
- This powerful control system can control its load in quick reaction based on not only the water temperature but also change rate of the water temperature.
- Control by either the entering chilled water temperature or leaving chilled water temperature depends on the user's demand.
- Interlock to the chilled water pump, cooling water pump and cooling tower is available.
- The unit can be timed in multiple periods to start or stop. Beside memory upon power failure is available to the unit.
- Operation to the unit is password protected in different levels so as to prevent arbitral operation or modification to the unit.

(2) Colorful Smart Control Center

- Friendly large-sized LCD: simple, direct and convenient operation .
- High resolution: 1024x768; Color: 65536 true color.
- High reliability: operation approved by 1-year test .
- High adaptability: workable under -20°C~70°C.
- Displayed Items

  a. Entering and leaving chilled water temperature.

  b. Entering and leaving cooling water temperature.

  c. Suction and discharge temperature.

  d. Evaporating pressure.

  e. Condensing pressure.

  f. Startup times of the compressor.

  g. Total runtime of the compressor.

  h. Status of the contactor.

  i. Status of the solenoid valve.

  j. Set point of the water temperature.

  k. Curves of the status parameters, historical events

  l. Chinese and English pages can be switched to meet different demand.

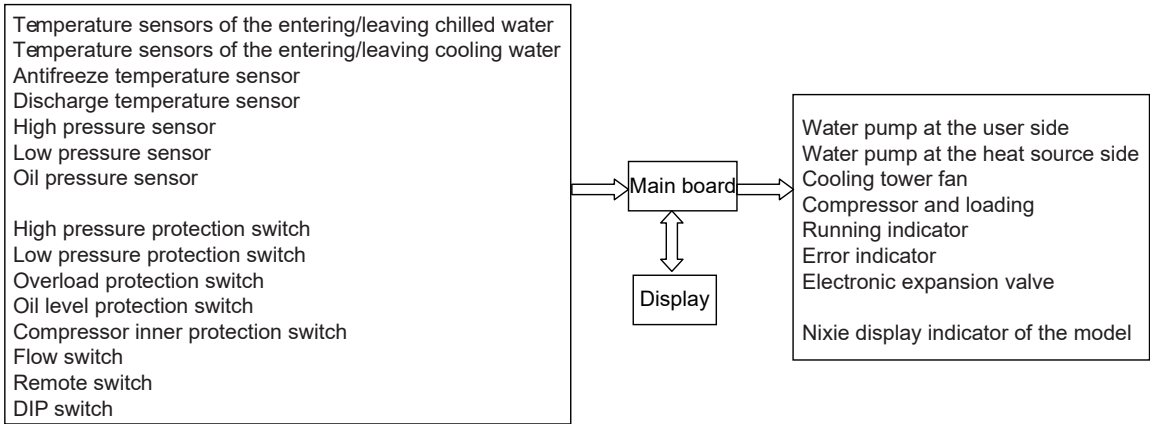
(3) Powerful Protection

Multiple protections are available and make the unit run reliably.

Protection for phase loss	Protection for reverse protection	Protection for motor overloading	Protection for motor overheating
Freeze protection	Protection for the flow switch	Protection for low flow	Protection for high pressure difference
Protection for high pressure	Protection for low pressure	Protection for high discharge temperature	Protection for sensor error
Automatic antifreeze	Protection for oil level switch	Protection for safety valve	

Other protection measures include unloading under too high or low pressure, control to the oil heater of the compressor, control to the shortest run time etc., which can improve reliability of the unit.

See the following figure for the control concept of the unit.



The controller consists of two parts, the main board and the display, which are connected through a communication line.

Display panel: as the human-machine interface, it can perform ON/OFF operation, parameter setting, displaying of the unit status, temperature, pressure, and errors etc.

Main board: based on ON/OFF command, parameter settings, and self-sensed information from temperature and pressure protection switches, it can perform ON/OFF operation, capacity control and error judgment etc.

Remote switch: when “Remote switch” is activated though the display panel and the unit can be remotely turned on or off.

Nixie display indicator and DIP switch: DIP switch setting is different for different models and the nixie display indicator will show the unit model.

3.3 Introduction and Operation Instructions for the Display Panel

3.3.1 Types and Interfaces of the Display Panel

The control system is mainly located at the electric control box, where there is the main board, power supply, communication board and other control boards. The display panel is at the door of the electric control cabinet. The display panel consists of a touch-screen and a communication line.

The display panel can not only control the unit and display unit status but also provide Modbus Slaver interface for the building automation system.

Controller Type	Model	Size	Interface Type	Remark
Touch Screen	Z2G1E5	10 inch	Dual 485, Ethernet, USB	Packaged separately

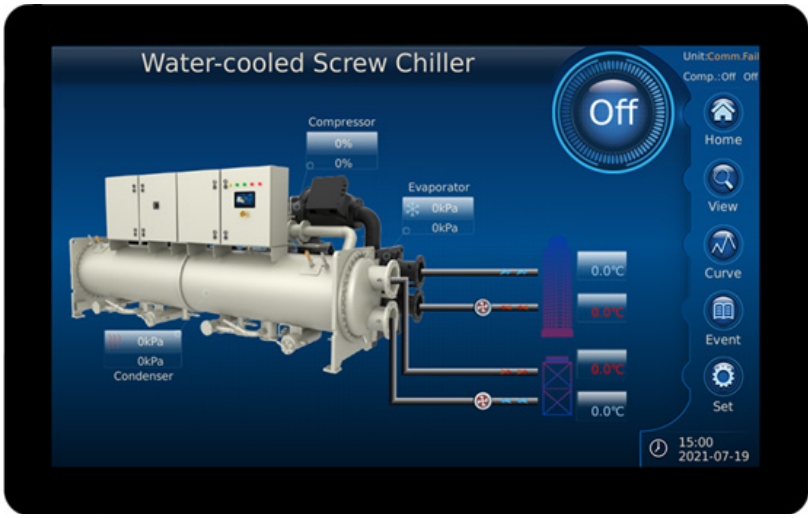


Figure 3.7 Touch-screen Display Panel

3.3.2 Main Menu

The menu of the touch screen includes "**Home**", "**View**", "**Curve**", "**Event**", and "**Set**". The following is the description of each menu.

"Home": touch **Home** to back to the **Home** screen.

"View": touch it to enter the **View** screen to check the current running status of the unit, version information, etc.

"Curve": touch it to enter the **Curve** screen to review the current and history curves of pressure, temp, etc.

"Event": touch it to enter the **Event** screen to review the event record, such as error record and compressor record.

"Set": touch it to enter the **Set** screen to set user parameters or factory parameters.

Version information is at the first page of "View", which provides "", "", "SUP S/N", "", and "".

Note: after entering the "Set" screen, a menu button of "Factory Parameters" will appear, which can be accessed after entering the correct password, but it is not open to users.

3.3.3 Operation Instructions

(1) Home

The Home Screen is a screen for main controls. If you enter other screens but do not operate for 10 minutes, the display will return to Home Screen automatically. Home Screen displays basic information and control information of the system, such as System Time, System Running State (On/Off/Error/Comm.Fail), entering/leaving chilled water temperature, entering/leaving cooling water temperature and the compressor status.

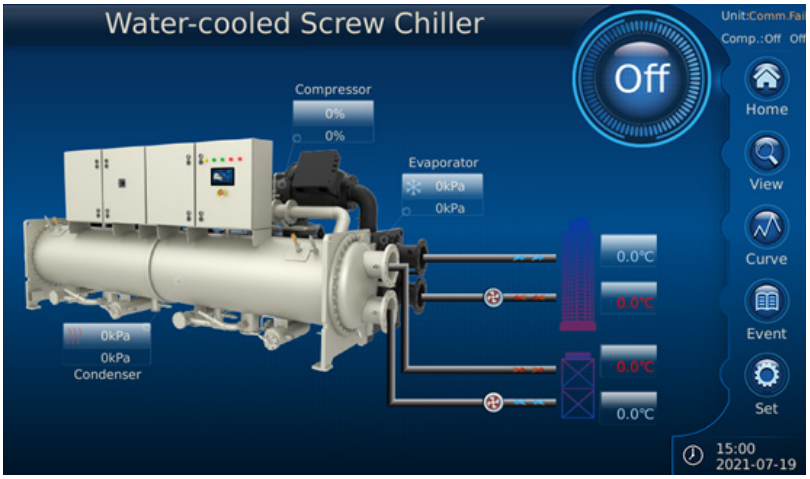


Figure 3.8 Homepage of the Touch-screen Control Panel

(2) View

This Screen provides detailed information about unit's running state, including output, input, erros etc.

There are totally 3 pages, page 1: basic temperature and pressure data for the unit; page 2: water system data; page 3: compressor data; At the first page, slightly touching icons of the compressor, the condenser, and the evaporator, then a window will pop up, which will describe the detailed data, as shown below.

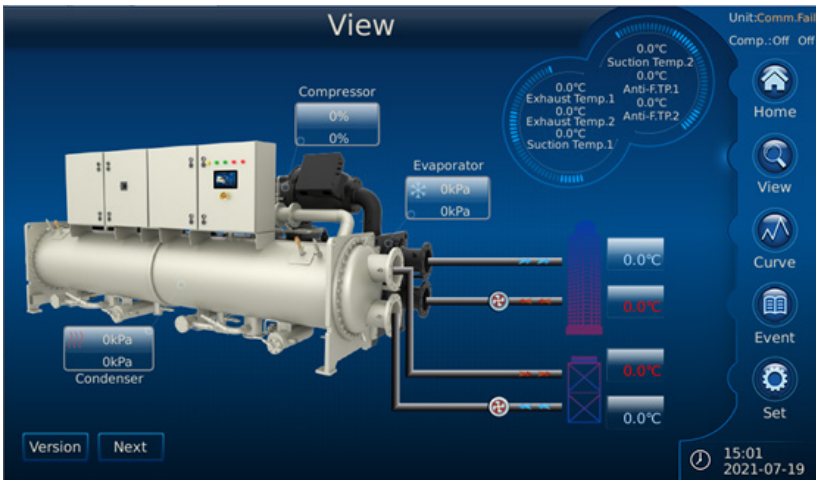


Figure 3.9 View Page with the Pop-up Windows

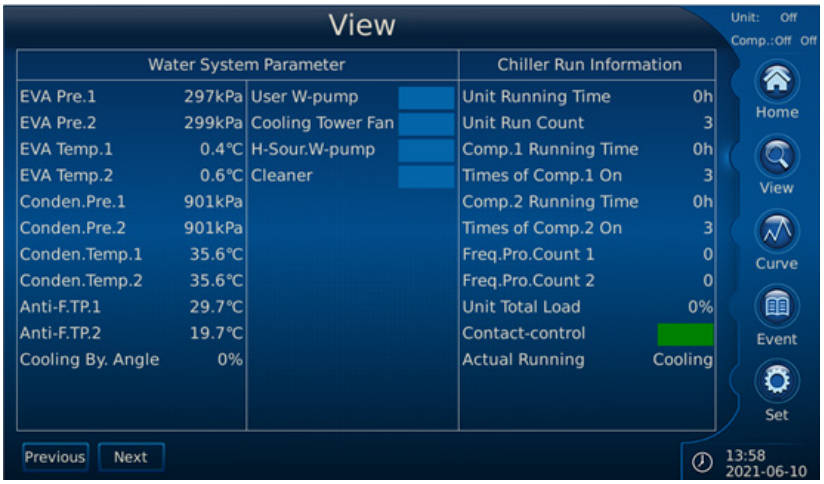


Figure 3.10 View Page without the Pop-up Window

- Curve

Curves are intended to display visually the status of key parameters of the unit (including curves of temperature and pressure).

Curve records are classified into Current Curve and History Curve. Current Curve is used to record the curve data after the touch screen is energized and they can only be found in the History Curve after the touch screen is restarted. History Curve is used to record the events which have happened and would also be saved even if power failure occurs.

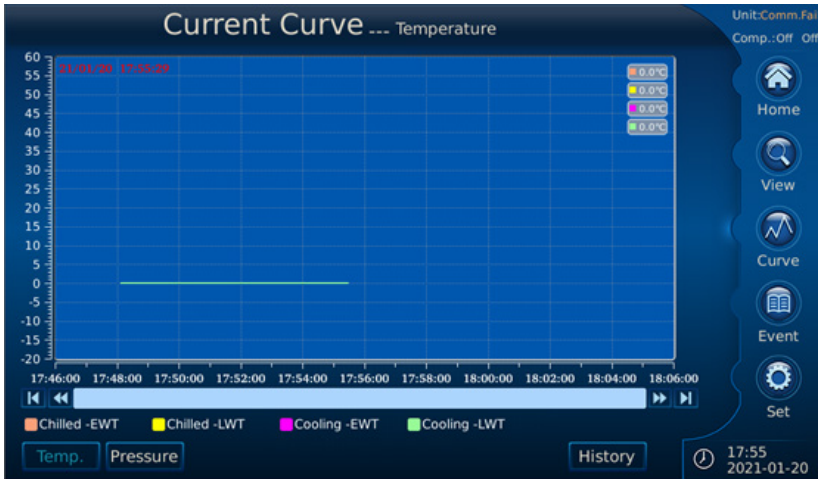


Figure 3.11 Current Curve of the Touch-screen Control Panel

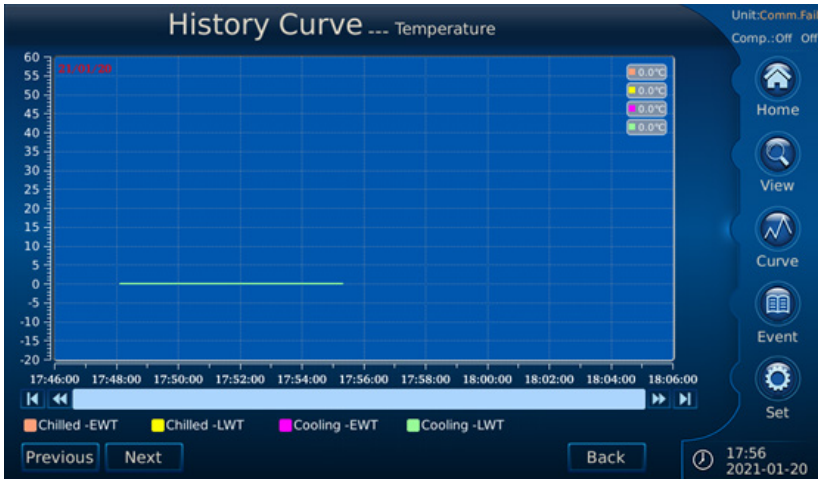


Figure 3.12 History Curve of the Touch-screen Control Panel

- Event

Event records are classified into **Current Event** and **History Event**. **Current Event** displays 100 latest events after energization of the touch screen (Note: only 100 latest current events are limited to be displayed, and those which happen earlier will be cleared). The current events can only be found in the **History Event** after the touch screen is restarted.

Touch History on the **Current Event** screen to enter the **History Event** screen. **History Event** is intended to record the events which have happened and would also be saved even if power failure occurs. In the **History Event** screen, touch **Previous** or **Next** to switch to the previous or next page which is listed in the date order. For **History Event**, those in red indicate the events occurring while those in green indicate recovered events.

Clear: touch it to clear the current error and take the error check again.This function is intended to recheck the system but would not eliminate real errors.

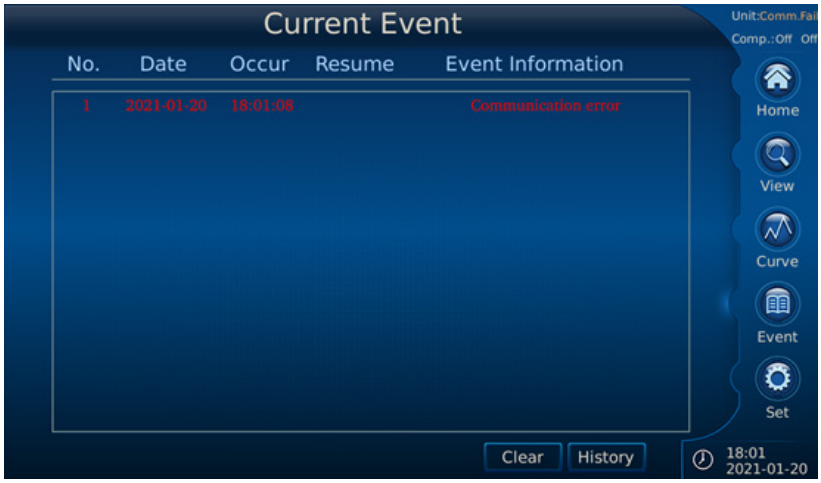


Figure 3.13 Current Event of the Touch-screen Control Panel

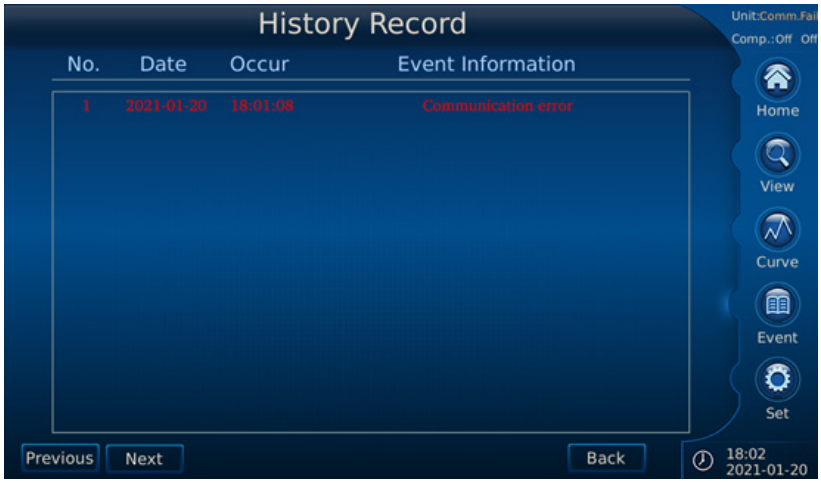


Figure 3.14 History Record of the Touch-screen Control Panel

- Set

Touch **Set** on the menu bar and then a password input dialog box will pop up as shown below. Only after the correct password has been input (default:101010) is it available to go to the setting page.

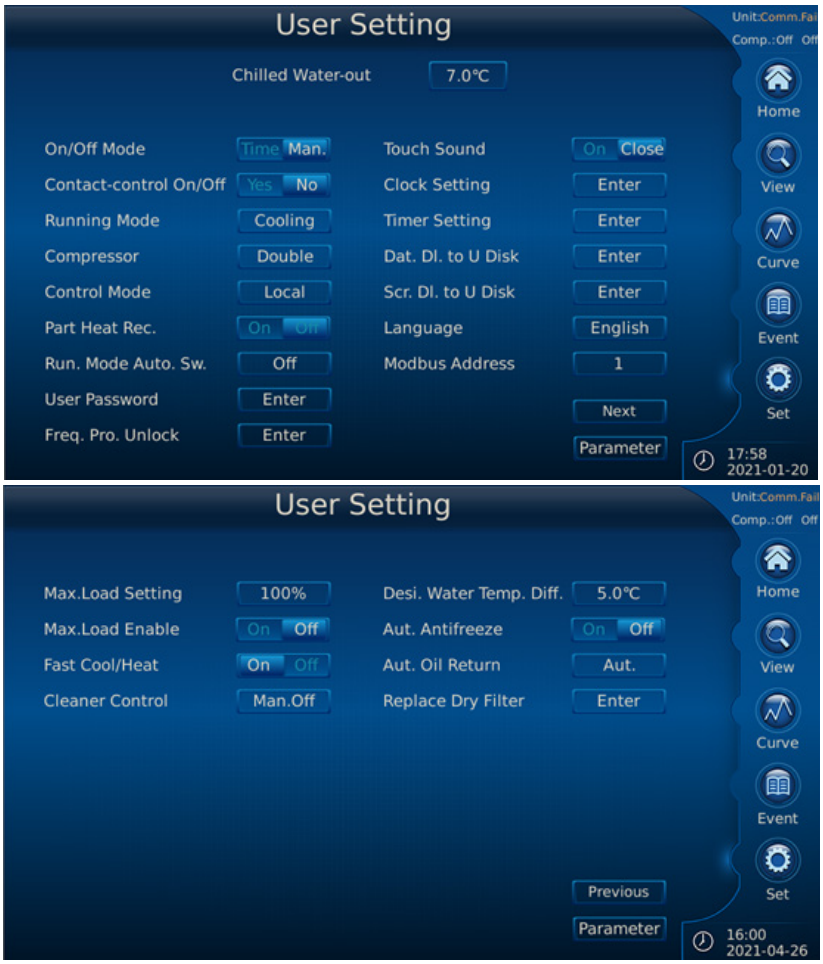


Figure 3.15 User Setting Screens

See the table below for more details about each function.

No.	Displayed Name	Full Name	Range	Introduction
1	Chilled Water-out	Leaving Chilled Water Temperature	4.0~15.0°C	• If the leaving water temperature of the evaporator is out of range, please contact us. • If the leaving water temperature is lower than the lower limit, anti-freezing agent should be added into the circulating water system and contact us for ordering the low-temperature unit.
2	Max.Load Setting	Maximum Load Setting	40~100%	The maximum load setting can limit the capacity output of the unit, especially at the peak hour, and also guarantee stable and reliable operation under low-load operation. For instance, when it is set to "**80%**", the maximum capacity of the unit is 80% of the design capacity at full load.
3	Fast Cool/Heat	Fast Cooling/ Heating	On/Off	When it is set to "**On**", the unit will perform fast loading. When it set to "**Off**", the unit will be under pulse control and the user can do adjustment based on actual demands.
4	Auto.Oil Return	Automatic Oil Return	Aut./Man./Off	• When it is set to "**Aut.**", the unit will do automatic adjustment according to oil level of the compressor. • When it is set to "**Man.**, the unit will perform manually oil return at once. • When it is set to "**Off**", this setting does not work.
5	On/Off Mode	On/Off Mode	Man./Time/ Contact	• When it is set to "**Time**", the unit also can be turned on or off manually. • Only when it set to "**Time**" and timing setting is valid, the unit can be timed on or off. • When "**Contact-control on/off**" is set to "**Yes**", it does not work, with "**Contact**" displayed.
6	User Password	User Password	/	It is used to modify the user passwords, through which the user can go to the parameter setting page and do ON/OFF operation.
7	Running Mode	Running Mode	Cooling/ Heating/Low T./A-H-Rec.	According to the different types of units, it varies for different settings of factory parameters of "**Low Temp. Cooling**", "**Heating**", and "**All Heat Recovery**".
8	Compressor	Compressor	Comp.1/ Comp.2/ Double/Single/ Forbid	For a dual-compressor system, the operation status will be switched between "**Comp.1**", "**Comp. 2**", "**Double**" and "**Forbid** ". For a single-compressor system, it will be switched between "**Single**" and "**Forbid**". Since this function has a serious impact on the operation of the unit, it can only be set when the unit is shut down.
9	Part Heat Rec.	Part Heat Recovery	On/Off	It varies for different types of units. When the factory parameter of "**Part heat recovery**" is set to "**On**", it can be set to "**On**" or "**Off**". When part heat recovery function is unavailable, it is not allowed to be set.
10	Aut.Antifreeze	Automatic Antifreeze	On/Off	It can be set to "**On**" or "**Off**".

No.	Displayed Name	Full Name	Range	Introduction
11	Max. Load Enable	Maximum Load Enable	On/Off	It can be set to “**On**" or “**Off**".
12	Des.Water Temp. Diff.	Designed Water Temperature Difference	2~15°C	It is applicable to all running modes.
13	Run. Mode Auto. Sw.	Running Mode Automatic Switchover	Off/Cooling to A-H-Rec./ Heating to A-H-Rec. (Heating first)/ Heating to A-H-Rec.(A-H-Rec. first)	• When it is not set to “**Off**”, “**Running mode**” cannot be set. • Only when “**All Heat Recovery**” is set to “**On**”, it can be set to “**Cooling to A-H-Rec.**”. • Only when “**All Heat Recovery**” and “**Heating**” are set to “**On**”, it can be set to “**Heating to A-H-Rec.**” • It can be set only when the display panel is turned off.
14	Clock Setting	Clock Setting	/	It is used to set exact year, month, day, hour, minute, and second.
15	Dat.Dl. to U Disk	Data Download to U Disk	/	It is used to save the event records and curve records to the U disc, which then can be viewed through the computer via the “txt” format.
16	Scr. Dl.to U Disk	Screenshot Download to U Disk	/	It is used to save the selected page to the U disc.
17	Touch Sound	Touch Sound	On/Close	It can be set to “**On**" or “**Close**".
18	Language	Language	简体中文 / English/ 繁體中文	It can be set to "简体中文", "**English**", and "繁體中文".
19	Timer Setting	Timer Setting	/	This setting works only when the switch mode is set to “**Timing**”. When the timing ON is the same to timing OFF at the same day, the latter period take priority.
20	Control Mode	Control Mode	Local/Remote	• When it is set to “**Local**”, the display panel will not receive control parameters of BMS, but of itself and DTU. • When it is set to “**Remote**”, the display panel will not receive control parameters of itself (except parameters unrelated with control, like sound, language etc.), but of BMS and DTU. When the control parameter is set at the display panel, a prompt box will pop up, saying “**The current state is contact-control On/Off state, and any operation is forbidden!**” .
21	Contact-control On/Off	Contact-control On/Off	Yes/No	• When it is set to “**No**”, “**On/Off Mode**” can be set to “**Man.**” or “**Time**”. • When it is set to “**Yes**”, “**On/Off Mode**” turns to “**Contact**” and is not allowed to be set.

No.	Displayed Name	Full Name	Range	Introduction
22	Modbus Address	Modbus Address	/	It is used to set the address of the touch-screen control panel between 1~255. This address is used for Modbus communication and remote monitoring to the unit. When remote monitoring is unavailable, this setting does not work.
23	Freq. Pro. Unlock	Frequent Protection Unlock	/	This function is to unlock the frequent protection. When the unit is locked because of frequent protection, the display will go back to the home page and a window will pop up, indicating that the unit is locked and cannot be started. In this case, follow the unlock instructions in the pop-up window and enter the unlock passwords.
24	Cleaner Control	Cleaner Control	Man.Off/Man. On/Aut.	It is applicable to the unit with the on-line cleaner.
25	Replace Dry Filter	Replace Dry Filter	/	It is for replacing the drier filter out of the warranty period. The user is able to perform the replacement following instructions in the prompt box.

4. System Principle

4.1 Refrigeration Circle

As shown in Figure 4.1, the water-cooled screw chiller is a kind of vapor compression refrigerator. It works by energizing the refrigerant vapor via the compressor so that the pressure and temperature increase. Then it is turned to liquid refrigerant of low pressure and temperature by condensing and throttling. When it is evaporated in the evaporator, it obtains heat from the surrounding (secondary refrigerant, such as cool water) to decrease the temperature of the secondary refrigerant so that artificial refrigeration is realized. Therefore, a vapor compression refrigeration cycle includes the four necessary processes of compression, condensation, throttling and evaporation. The principles are detailed as below:

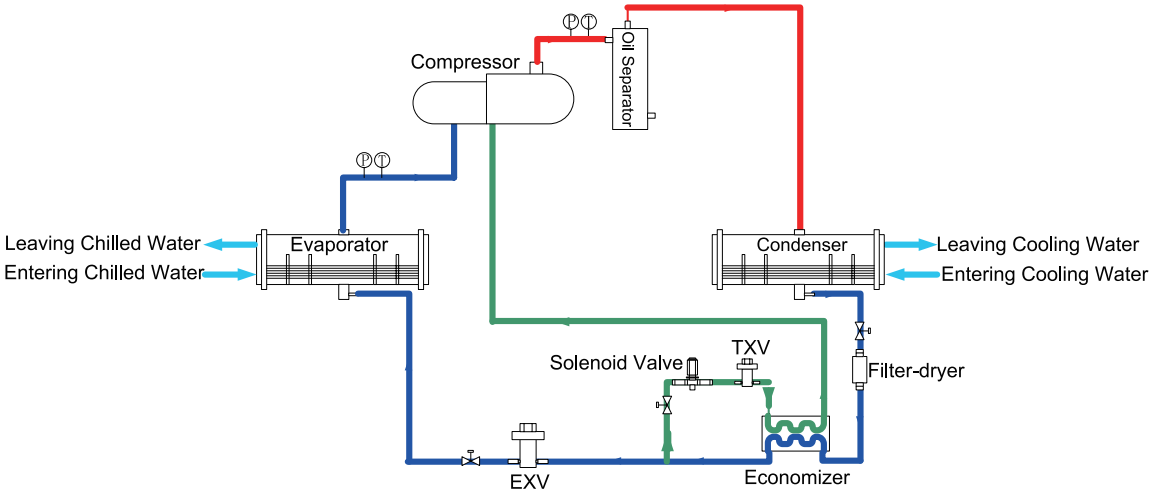


Figure 4.1 Refrigerant Circulation of the High-efficiency Screw Chillers

Compression: after the refrigerant vapor in the evaporator is inhaled by the screw compressor, the electromotor increases its energy via the rotor of the compressor so that the pressure of refrigerant vapor is increased and then it enters the condenser. At the same time, the temperature of refrigerant vapor will increase correspondingly after compression.

Condensation: the high-pressure and high-temperature refrigerant vapor from compressor will release heat in the condenser via the cooling water in the pipe. Meanwhile it will be condensed into liquid under the saturation pressure (the corresponding condensation pressure for condensation temperature). In that case, the temperature of cooling water will increase. The temperature of cooling water is directly related to the condensation temperature (condensation pressure).

Throttling: when the high-pressure and high-temperature liquid refrigerant from the bottom of the condenser flows through the throttle device, its pressure will decrease and it will expand, with both pressure and temperature decreasing. Then the low-pressure and low-temperature liquid enters the evaporator.

Evaporation: the low-pressure and low-temperature liquid refrigerant turns to gas by deriving energy from the secondary refrigerant (e.g. cool water). At the same time, the temperature of secondary refrigerant decreases and the artificial refrigeration is realized. The refrigerant vapor in the evaporator is then inhaled by the compressor for compression. The processes of compression, condensation, throttling and evaporation will repeat circularly to realize the refrigeration.

The cooling capacity is in direct proportion to the suction volume. Therefore, the pre-rotation vane is installed in the screw compressor for suction volume control of the compressor and evaporating capacity control of the refrigerant, so that the cooling capacity is adjustable in a certain range.

4.2 Oil Return System

In the compressor, the refrigeration oil lubricates and cools the bearing and rotor via the differential pressure of the system.

During exhaust of the compressor, refrigeration oil will be discharged out of the compressor together with gassy refrigerant. If the refrigeration oil can not return to the compressor, the compressor will lack oil, which will damage the compressor. with the patented return oil system, Gree screw water-cooled chiller ensures that the refrigeration oil discharged together with the gassy refrigerant return to the compressor and that the unit runs safely and reliably.

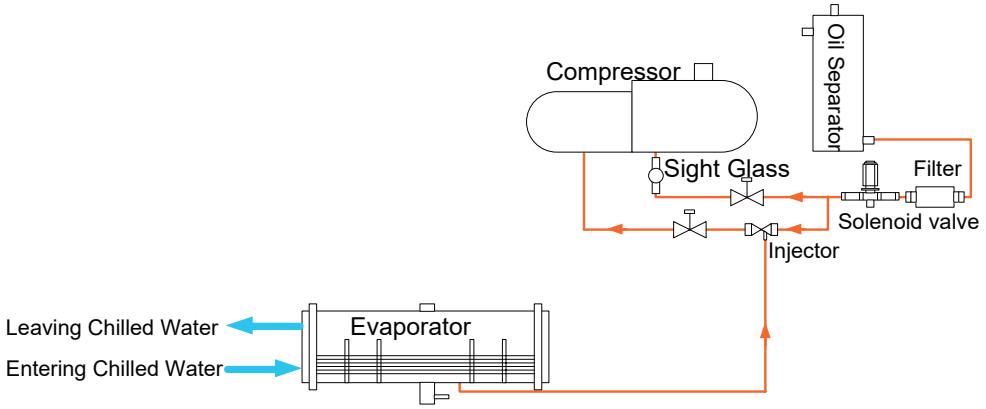


Figure 4.2 Oil Return System

The return oil system includes:

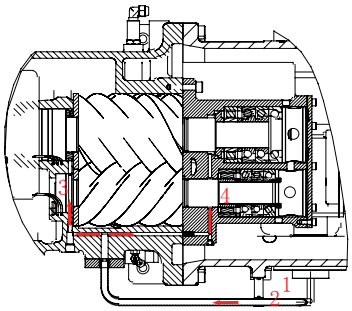
[Oil return via oil separator]: an efficient oil separator is installed between the compressor and condenser. Most refrigeration oil discharged with gassy refrigerant will be hold up by the oil separator and sent back to the compressor via the air inlet.

[Oil return via high-pressure injection]: a small amount of refrigeration oil will enter the condenser and finally gather in the evaporator. Then, with the help of high-pressure of refrigeration oil, it will directly return to the compressor.

4.3 Oil Supply System

The oil supply system is divided into two parts, oil supply for the bearings and for the loading/unloading part of the sliding valve.

See the Figure 4.3 for the oil supply system. Pressure of oil in the oil sink is equal to the discharge pressure and oil will be pushed by the oil pressure through the oil supply line to the bearings. The red arrow in Figure 4.3 indicates the flow direction. Before entering the bearings at both the suction and discharge sides, the oil flow will pass through an orifice plug to limit the oil supply. Oil herein is mainly used to lubricating bearings. If oil for the bearing at the suction side would take up some of the suction volume and would affect the energy efficiency of the compressor, the orifice plug should function to limit the oil supply.



No	Name	No	Name
1	Oil sink	3	Bearing at the suction side
2	Oil supply line	4	Bearing at the discharge side

Figure 4.3 Oil Supply System for the Bearing

See Figure 4.4 for oil supply for loading/unloading of the solenoid valve. Oil in the oil sink flows out through the oil line. Then, it is divided into two branches, one for the bearings, and the other for loading/unloading of the solenoid valve. Before going to the solenoid valve, this branch will pass through the orifice union which is used for controlling the loading item. See Section 3.1.1 for more details about the loading/unloading principle of the compressor.

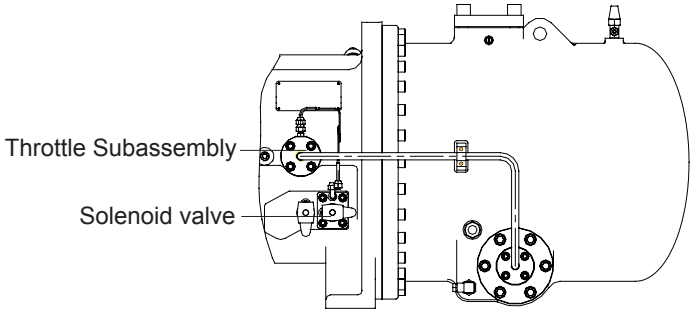


Figure 4.4 Oil Supply by Loading/Unloading of the Solenoid Valve

4.4 Motor Cooling System

See Figure 4.5 for the motor cooling system. It is cooled by the suction. Red arrows indicate the suction flow. There is a passage between the motor stator and the housing. Through this passage, suction will go to the void of the rotor. The suction vapor is low-temperature and can cool the motor effectively. As the cooling effect is satisfying, no extra cooling device is required.

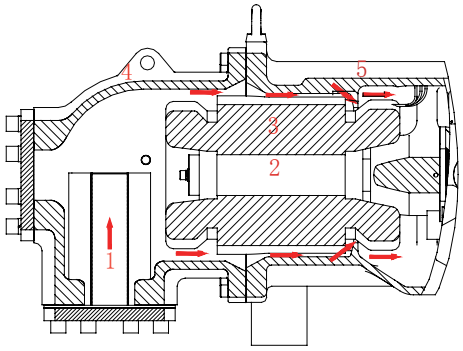


Figure 4.5 Diagram of the Cooling Principe for the Motor

No	Name	No	Name
1	Suction inlet	4	Suction end cover
2	Motor rotor	5	Housing
3	Motor stator		

5. Installation

See the table below for the installation steps and accessories should be provided on site. Any work and accessory omission during installation would possibly damage the unit. Therefore, please check them carefully before installation.

Steps	Details	Provided by GREE	Provided by others
On-site conditions	5.1.2	/	/
On-site confirmation	5.1.3	/	/
Lifting	5.2	/	1.lifting machine 2.lifting beam 3.steel rope 4.U lug
Foundation construction	5.3.2	/	/
Installation	5.3.3	1.rubber pads	1.steel base 2.screw M18 (4 pieces) 3.washer M18 (4 pieces) 4.anchor bolt M18*400 (4 pieces) 5.necessary concrete
Water piping	5.4	1.pipe flanges and bolts	1.manometer 2.flexible connector 3.pipe supporters 4.other element (water valves, filters etc.)
Electric wiring	5.5	/	1.control line 2.power line 3.contact and wiring for the chilled water pump 4.contact and wiring for the cooling water pump 5.grounding line
Insulation	5.6	Insulation (optional)	/

⚠ WARNING

- The users should take the responsibilities for damages caused by improper accessories which should be provided by the user themselves.

5.1 Preparation before Installation

5.1.1 Training on Construction Safety

First priority should be taken to the personal and property safety during installation. The whole installation should comply with national and local safety regulations, to avoid hazards on personal or property safety. Before construction, all participators should receive safety training. Only the qualified servicemen men are allowed for construction. For special work, only the servicemen men with the corresponding certificate are allowed to be done.

⚠ WARNING

- Do not use the fork directly to move the unit.
- Installation should be done by skilled personnel.

5.1.2 Conditions for Installation Locations

The installation foundation and location should meet requirements stated below:

(1) Do not install the unit where there is corrosive, inflammable substances or smog, otherwise the unit would fail to run normally or its service life would be shortened, or even it would lead to fair hazard or even severe injury. When the unit is installed together with the boiler or other heating elements, care must be paid to heat radiation.

(2) The location temperature should not exceed 40°C or be lower than 0°C. The relative humidity cannot be higher than 90%. The temperature change during 1 hour should not exceed 8℃ . When the unit is installed in severely cold area, antifreeze measures should be taken to the devices for the cooling and chilled water.

(3) There should be as little dust as possible.

(4) There should be enough day lighting for inspection and maintenance.

(5) For inspection, cleaning and maintenance of the heat exchanging tubes for the evaporator and condenser, there should be enough space for drawing tubes at any side of the unit, with the length equal to that of the evaporator and condenser.

(6) For facilitating lifting and maintenance, enough space should be reserved for installation, operation and service.

(7) Drainage should be available around the unit and the whole machine room.

(8) Please install proper ventilation equipment to avoid oxygen depletion caused by accidental refrigerant leak.

(9) Corrosion of the heat exchanging tube of the condenser may lead to leak accidents. When river, lake or sea water is used as the cooling water, the corrosiveness should be t taken into consideration.

(10) When the unit is to be installed where the altitude is above 1000m, please contact the local office or sales representative.

(11) Install the unit where it is insensitive to noise and vibration. The machine room should be placed at the bottom layer of the base room. The vibration device and silencing device can be selected based on the installation conditions.

(12) The installation foundation should be capable of supporting the weight of the unit and surface of the foundation should be kept level and smooth (levelness ＜ 2mm/1000mm). Refer to GB 50209 for more details. See the foundation diagram for dimensions and construction of the foundation.

5.1.3 Location Confirmation

In order to perform the installation work safely, correctly and rapidly, the related installers should confirm the following situation beforehand:

(1) Installation site: Confirm whether it accords with requirements in Section 5.1.2.

(2) Hole for carrying: Confirm its size, height and lifting volume. Remove the obstacles.

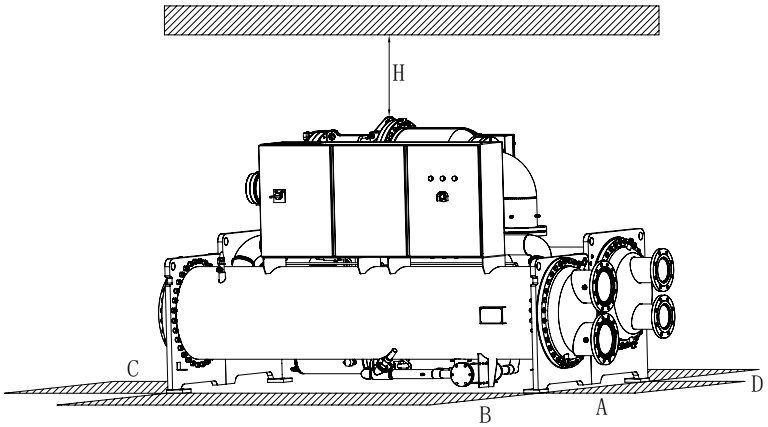
(3) Specialized machine room: measures should be taken to expel heat out of the machine room, and the ventilation device can keep the room temperature not higher than 45°C.

(4) In order to keep the electric elements work normally, do not place the unit where there is heavy dust, corrosive fog and high humidity.

(5) The unit should be installed at the rigid or concrete foundation. See Section 5.3.2 for more details.

(6) It is suggested to keep a certain space for the reserved rubber pipe between the water pipe and the connector of the unit, for facilitating proper construction.

(7) There should be enough space for installation and maintenance, and there should be no pipes and wirings above the unit. See the table below for maintenance dimensions.



(A and C are interchangeable)

Figure 5.1 Diagram for Maintenance Space of LHE Screw Chillers

Table 5.1 Maintenance Space for the LHE Screw Chillers

Model	A	B	C	D	H
LHE542DD3ED4/Nb	600	600	2500	1000	500
LHE632DD2ED3/Nb	600	600	2500	1000	500
LHE642ED4ED2/Nb	600	600	2500	1000	500
LHE732EE4EEB/Nb	600	600	2800	1000	500
LHE742EE6EEA/Nb	600	600	2800	1000	500
LHE752EE5FEC/Nb	600	600	2800	1000	500
LHE772FE6FEB/Nb	600	600	2800	1000	500
LHE842FE5GEC/Nb	600	600	2800	1000	500
LHE852GE8GEB/Nb	600	600	2800	1000	500
LHE872GE7GEA/Nb	600	600	2800	1000	500
LHE872GGBHGCE/Nb	600	600	3200	1000	500
LHE742HIPJIP-2/Nb	600	600	3800	1000	500
LHE752HINJIM-2/Nb	600	600	3800	1000	500
LHE772HIMKIN-2/Nb	600	600	3800	1000	500

Model	A	B	C	D	H
LHE842HKLKKL-2/Nb	600	600	4400	1000	500
LHE852JKPLKL-2/Nb	600	600	4400	1000	500
LHE872JKNMKP-2/Nb	600	600	4400	1000	500
LHE872KKNMKKE-2/Nb	600	600	4400	1000	500

5.2 Lifting

When the unit arrives, open the package and inspect the appearance and accessory of the unit. Then check the quantity according to the packing list to see whether there is some missing (including spare pieces and spare parts).

5.2.1 Offloading and Handling

The unit is generally delivered by the flatbed trailer and the cargo truck to the installation location. After arrival, it is generally offloaded by the truck crane, and then moved to the installation location by the rollarounds or guide rail. When the rollarounds are used, never incline or turn over the unit. Do not remove the outer packing during offloading.

Before delivery, each unit has undertaken strict inspection and test to guarantee its performance and quality. During installation and handling, care must be taken to prevent the unit from suffering impact and prevent the control system and pipes from being damaged.

5.2.2 Safety Precautions for the Truck Cranes

(1) The truck crane should be selected based on the lifting torque, lifting height, lifting breath and lifting distance.
(2) Check the truck crane and safety devices before lifting.
(3) Do not stay at the lifting area except relative persons.
(4) The lifted object should be fastened securely and under preventive measures for dumping. Do not lift slantways.
(5) Do not perform lifting when the average wind speed exceeds 12m/s.
(6) All operators should wear the safety helmets.
(7) Do not let the lifted object pass above the persons and the driving cab.
(8) Do not stand at the crane boom and the lifting object.
(9) The included angle between the lifting ropes should be within 120°.
(10) Do not keep the lifted object in lifting status for long time. The lifting commander is not allowed to leave the site during lifting.

5.2.3 Precautions for Offloading

The unit should be lifted as Figure 5.2 and 5.3.The load should be distributed evenly. Do not damage any part of the unit. Following statements should be paid special attention during lifting:

(1) The lifting location should be located based on the lifting label stuck to the unit. After the foundation, rubber pads and anchor bolts have confirmed to be installed, use the lifting ropes and other devices (capable of enough to supporting the lifting weight and impact) to lift the unit to the rubber pads which are placed at the foundation.

⚠ NOTE

- Please comply strictly with instructions of the labels stuck to the outer packing of the unit; otherwise it would lead to deformation of pipes or leak of refrigerant.

(2) During lifting, in order to avoid damaging connectors of the unit, please lift the unit in strict accordance with the lifting labels.

(3) Do preventive measures to the unit during lifting and do not let the lifting ropes damage the compressor, the control cabinet, and the shell-and-tube heat exchangers etc. Do not use the screw bolts for lifting. Do not incline the unit for lifting. There should be cordons around the lifting area. Do not enter the lifting area except the relative operators.

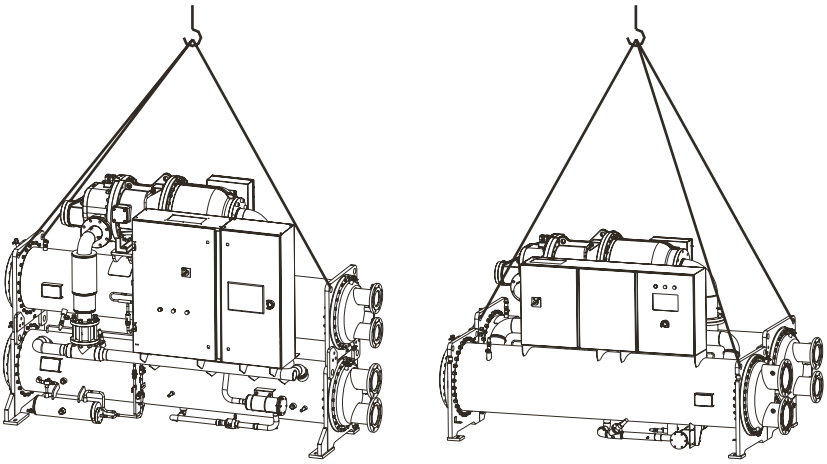


Figure 5.2 Lifting Diagram for the Single-system Unit

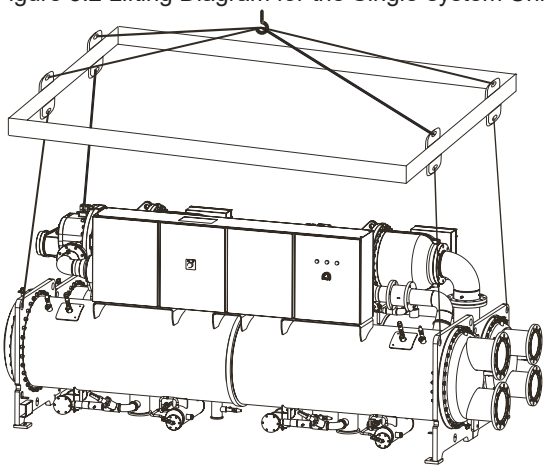


Figure 5.3 Lifting Diagram for the Dual-system Unit

5.2.4 Disassembly and Lifting

The unit is delivered as a whole package. After reaching the installation site, disassemble it if necessary. When lifting, please note that:

(1) Compressor and electromotor shall be taken as a whole. First disassemble the suction and discharge pipe assembly, and then remove the compressor and electromotor from the evaporator and condenser. Perform the disassembly according to Figure 5.4.

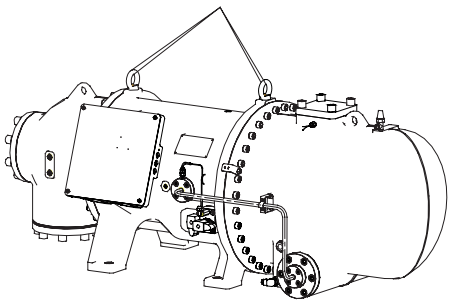


Figure 5.4 Lifting of the Compressor

(2) Lift the evaporator and condenser as a whole according to the general requirements for lifting. If it is not installed in time, the bare nozzle should be sealed with blind flange to avoid dust getting inside the unit. After vacuuming the interior system of the unit to 1kPa, charge dry nitrogen of 30~50kPa (gauge pressure) and inspect it periodically. If the nitrogen leaks out completely, find the leak source and repair it. Then repeat the above step to avoid erosion of the unit.

(3) The period for lifting and exposure should be as short as possible, because the combination of remained refrigerant and air will erode the unit.

⚠ WARNING

- After unit is disassembled, it shall be installed at place in time. Do not disassemble the unit until the installation condition fully meets the requirements. Otherwise, unit may be eroded and thus fails to operate safely.

5.3 Fixing of the Unit and the Foundation

5.3.1 Foundation Type

(1) Concrete Foundation

It is made of sand, stone, and cement etc, which is applicable to taken as the foundation supporting quite small load and deformation.

(2) Reinforced Concrete Foundation

It is made of sand, stone, cement and reinforcing steel etc., which is applicable to taken as the foundation supporting quite large load and deformation.

(3) Hardcore Foundation

It is filled with sand and there are reinforced concrete beams around it, which is applicable to taken as the foundation allowing settlement, like the large-side storage tank.

(4) Steel Foundation

It is made of I steel and channel steel.

5.3.2 Construction of the Foundation

(1) Installation Foundation

See Table 5.2 for dimensions of the foundation. To prevent corrosion of the foundation, drainage around the unit should be available and see the following statements for specific requirements.

- The maximum height difference (levelness) should be within 3mm.
- For easy maintenance and inspection of the refrigeration unit, the base should be higher than 100mm.
- It is necessary to install drain ditch around the unit.
- There should be no space between the base steel and the foot plate of the unit. Insert the adjusting shim between the base steel and the concrete base. Adjust the base steel to be horizontal (the altitude difference should be within 0.5mm every meter.)
- The installation foundation must be concrete or steely structure, which can bear the running weight of the machine. Besides, the top should be horizontal. It is better to prepare a drain ditch in the installation foundation.
- Refer to the diagram of installation foundation. Put the steel plate and anti-vibration cushion in the correct position. Finish the installation of the unit and the foundation bolt before secondary grouting. The foundation bolt is generally exposed for about 100mm.
- The allowed deviation of the foundation both horizontally and vertically is 1/1000.

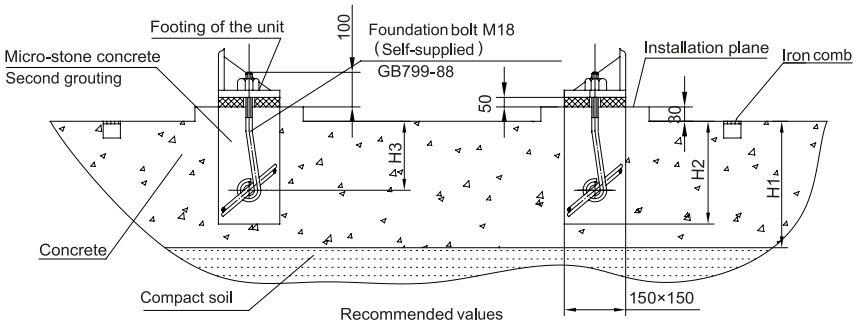


Figure 5.5a Diagram of the Installation Foundation

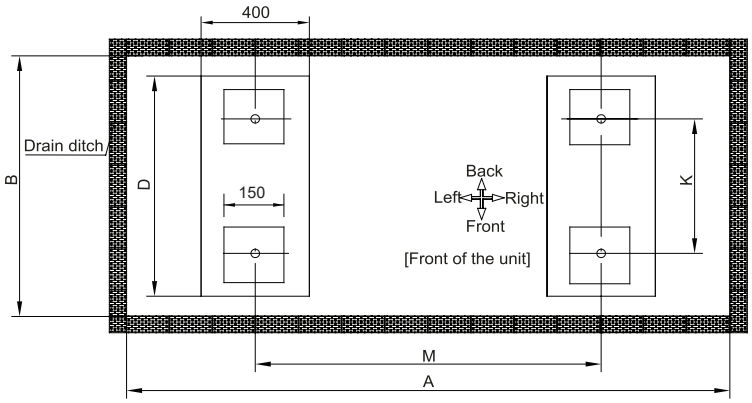


Figure 5.5b Diagram of the Installation Foundation

Table 5.2 Foundation Dimensions of the Single-system Unit (Unit:mm)

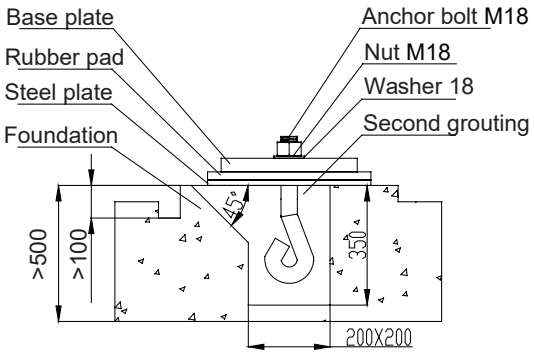
Model	A	B	D	M	K
LHE542DD3ED4/Nb	3150	1270	1070	2360	720
LHE632DD2ED3/Nb	3150	1270	1070	2360	720
LHE642ED4ED2/Nb	3150	1270	1070	2360	720
LHE732EE4EEB/Nb	3450	1270	1070	2660	720
LHE742EE6EEA/Nb	3490	1270	1070	2660	720
LHE752EE5FEC/Nb	3490	1295	1095	2660	745
LHE772FE6FEB/Nb	3500	1830	1630	2660	1280
LHE842FE5GEC/Nb	3530	1890	1690	2660	1340
LHE852GE8GEB/Nb	3550	1965	1765	2660	1415
LHE872GE7GEA/Nb	3550	1965	1765	2660	1415
LHE872GGBHGCE/Nb	3960	2140	1940	3060	1590
LHE742HIPJIP-2/Nb	4650	2200	2000	3660	1650
LHE752HINJIM-2/Nb	4700	2200	2000	3660	1650
LHE772HIMKIN-2/Nb	4750	2225	2025	3660	1675
LHE842HKLKKL-2/Nb	5250	2225	2025	4260	1675
LHE852JKPLKL-2/Nb	5250	2270	2070	4260	1720
LHE872JKNMKP-2/Nb	5250	2320	2120	4260	1770
LHE872KKNMKKE-2/Nb	5250	2445	2245	4260	1895

(2) Anchor Blots

For first grouting of the foundation and the anchor bolts, the anchor bolts should be placed precisely. Therefore, the construction diagram should be completely the same as that of the real object. For this purpose, construction is better to start when the unit has arrived at the job site.

(3) Reserved Holes for the Anchor Bolts

Holes for the anchor bolts should be reserved when the foundation is being concreted. Then, anchor bolts will be put into the holes during installation of the unit. There are some requirements for the anchor bolts.



- Length of the anchor bolt should be 300~1000mm. The bottom end is hooked or forked, and there is a cross bar for some.
- Do not coat the anchor bolt with anti-corrosion paint. When there is oil stain and oxide skin, remove them. Besides, the thread of the anchor bolt should be slightly lubricated.
- The anchor bolt should be placed into the hole vertically. Any part should be kept at least a distance of 15mm away from wall of the hole. The bottom of the anchor bolt should not contact the bottom of the hole.
- Tighten evenly the anchor bolt when concrete reaches at least 75% design strength. After that, the exposed part above the ground should be kept 1/3~2/3 of the diameter of the bolt.

(4) Treatment to the Foundation

Foreign matters, cement-sand mix and accumulated water should be removed. Threads and screws for the anchor bolts should be protected. Where the sizing block will be placed should be smoothed.

5.3.3 Precautions for the Foundation

(1) Check if the foundation complies with the Figure 5.1, 5.5 and Table 5.1 and 5.2 and also if the surface of the unit and the foundation is smooth.

(2) Put the steel base to the specified place.

(3) Put the unit on the steel base.

(4) No clearance is allowed between the steel base and the unit. Each steel base should be adjusted to be horizontally. (The height difference for each steel base should be controlled within 0.5mm).

(5) Lift the unit and put the rubber pads on the steel base and then put the unit at the rubber pads.

(6) Tighten the screw bolts. Do second grouting when the inclination degree of the unit is satisfied.

(7) After installation, the horizontal inclination degree should not exceed 1/1000.

5.4 Piping of the Water System

⚠ WARNING

- Before piping, cleaning and the pressure test should be done. After that, piping is allowed, otherwise foreign matter may enter the unit and lead to block or damage to the heat exchanging tubes.
- During piping, supporters should be used for supporting the pipe and let the unit not bearing this weight.

Based on dimensions of the total piping diagram, connect the water pipes through flanges to the unit. Generally, the inlet and outlet pipes should be equipped with the flexible connector, filter, manometer, valve and thermometer. Precaution should be paid to the following points.

(1) The flexible connectors must be installed at the inlet and outlet pipes. Do not deliver vibration to the pipes so as to prevent combined vibration of the water pump and the unit from affecting service life of the unit.

(2) Filters must be installed at the inlet pipe, avoiding foreign matters from blocking pipes or damaging the unit. Generally, the Y-shaped filter is used. It features with compact structure and easy installation and cleaning. The main body of the filter is made of cast steel and the filtering element is the stainless steel screen. For the filters with smaller diameter, they are generally made of braze or stainless steel. Besides, threaded connection is applicable to the filter with small diameters and flanged connection is for the large diamaters.

⚠ WARNING

- A water filter must be installed at the inlet pipe of the unit to protect the shall-and-tube heat exchanger. The mesh number per unit for the filter element should be no less than 20. Its installation location should be as close as possible to the inlet connection. Also an isolator for local isolation is required to facilitate disassembly and cleaning. Gree takes no responsibility for the unit damaged by debris in the water which has not been treated by a water filter.

(3) Manometers and thermometers for measuring the inlet and inlet pressure difference and temperature must be installed. The ammeter is connected to the pipe through the elbow, which will facilitate judgment of the status of the water system. The manometer should be installed at the vertical tube near the water chamber. The installation point should be kept at least a distance of the pipe size away from the part (like elbow, water valve etc.) which may generate turbulent flow.

(4) It is suggested to install valves upstream and downstream the components which may be replaced frequently, which can save time and labor during replacement.

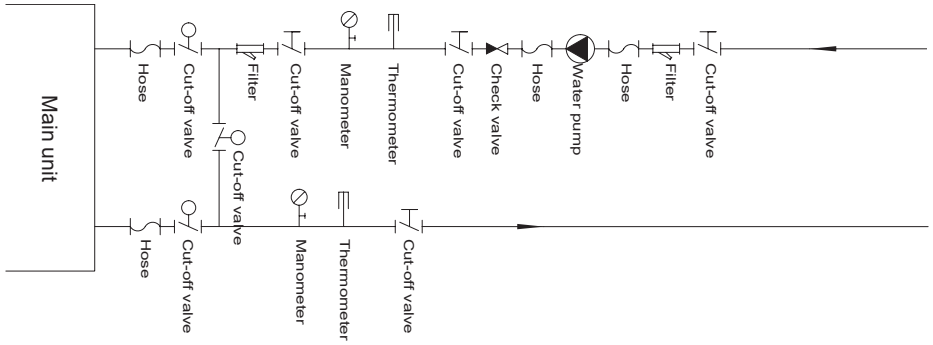


Figure 5.6 Connection Diagram of the Main Unit and the Water System

5.5 Electric Wiring

See the figure below for wiring of LHE screw chillers(The wiring diagram stuck to the unit always prevails).

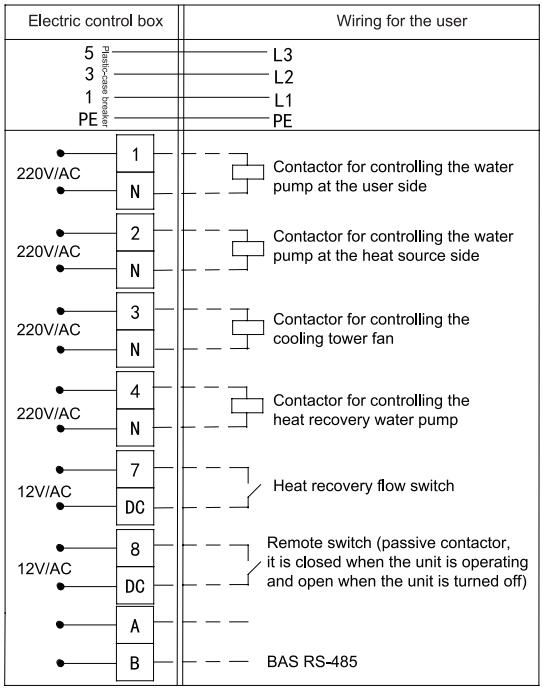


Figure 5.7 Main Power and External Wiring

All wiring should comply with the safety regulations stated below:

(1) All on-site wires, equipment and wiring must be in accordance with applicable rules, regulations and the construction requirements.

(2) The connection of wires must be performed by certified electricians.

(3) Power supply must be cut off before wiring.

(4) Installer shall be responsible for any damage caused by improper connection of external wires.

⚠ WARNING

- Copper conductors must be used.

(5) Power cords must be laid in conduits.

(6) Power cords must be protected by rubber or plastic when it is connected to the electric box of the unit to prevent them from being damaged by sharp edges of metal sheets.

(7) Power cord near unit's electric box must be securely positioned in order to protect the terminal board from external force.

(8) Secure grounding must be ensured. Do not connect the ground wire to gas fuel pipe, water pipe, lightening conductor or ground wire of telephone.

(9) The unit should be powered on 24 hour before it is put into operation. Do not power it off during the whole of seasonal use so as to make the electric heater of the compressor work all the time, which will evaporator liquid refrigerant trapped inside the compressor to avoid liquid slugging and other adverse effects.

5.6 Insulation

5.6.1 Construction of Insulation

There are two situations for insulation of the unit:

(1) The insulation has been finished in the factory.

(2) Due to other reasons, the insulation has to be executed on the installation site. In this case, perform leak inspection, mechanical operation and test operation to the unit prior to the cold insulation. During insulation, pay attention the following points:

- Insulation should not impede the movable parts (e.g. the adjustable device of inlet guide vane, hand grip of the valve);
- Open the cover of water chamber when cleaning the pipe of evaporator. Do not embed the connecting bolt in the insulation layer (also pay attention to the flange that requires frequent disassembly)
- For the convenience of inspection, do not embed the connecting bolt of compressor and inhalation tube in the insulation layer
- Do not embed the leaving chilled water temperature sensor in the insulation layer.
- For the convenience of finding leak source in the air tightness test, do not embed the auxiliary connecting pipe and the connector of the pressure tube in the insulation layer or apply removable insulation layer on it.
- Please do not embed the nameplate in the insulation layer.

5.6.2 Insulation of the Water Pipe

Type		Insulation	Thickness (mm)	
			General environment	Hi-temp and high-humidity environment
Water pipe	DN20~32	Rubber and plastic	25	30
	DN40~50		30	35
	DN65~80		35	40
	DN100 or above		45	45
Duct		Rubber and plastic sheet	20	25
Condensate pipe		Rubber and plastic tube	10	15

1. The insulation should meet fire prevention requirements.
2. Insulation provided by different manufacturers will be of different thickness and should be selected based on opinions of the manufacturer.

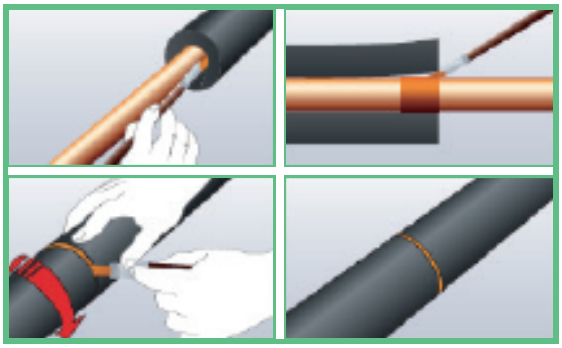
There should be the quality inspection report and qualification certificate for the insulation. Its specifications and performance should meet relative technical standards and design documents.

The average temperature of the insulation should be or lower than 27°C and the thermal conductivity coefficient cannot exceed 0.064W/(m ▪K), and density cannot exceed 180kg/m^3.

The insulation should be of stable chemical performance and not corrode metals.

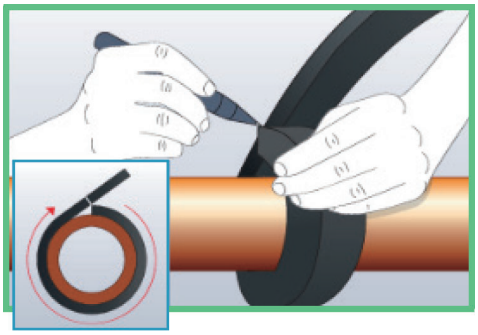
(1) Insulation of Water Pipes

- The pipe with small diameter can be insulated with the insulation sleeve.



- The pipe with large size can be insulated with the insulation sheets.

Note: in order to prevent the seam from rapturing, be sure glue should be applied fully on the seam evenly.



(2) Insulation of the ducts

- Operation instruction of the closed-cell foam insulation sheet

  a. Clean the surface of the duct, remove dust and trapped water and keep it dry.

  b. Tailor the insulation material according to the duct size.

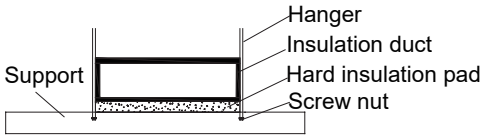
  c. Apply glum on the surface of the duct and insulation evenly, especially the four corners of the duct. Then, stick them together when the glum is a little dry.

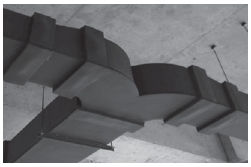
  d. Knock the insulation with the rubber hammer, especially the four corners of the duct.

- Precautions for the ducts

There should be a right insulation block at each contacting point with the duct to prevent the duct weight from thinning the insulation and then from generation condensate. The rigid insulation can be made of rigid PU foam plastic.

Flanges of the duct also should be insulated, as shown in the figure below, so as to prevent of formation of cold bridges and condensate.



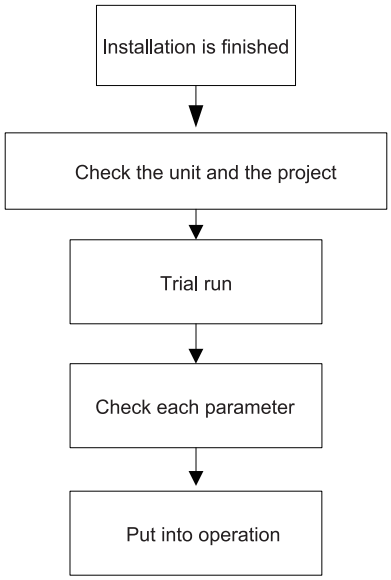


5.7 Protection to the Installation Site

After installation, if commissioning is not done right away, take protection measures to the unit, like, covering the unit with canvas or plastic film, and tag the obvious point with “Do not climb and stamp” and “Danger of electricity” etc.

6. Preparations before Startup

Before initial normal operation, do preparations based on steps listed below.



6.1 Inspection on the Unit

6.1.1 Inspection on the Whole Unit

(1) Can the chilled and cooling water switches be switched normally by the clamp-on ammeter after and before startup of the water pump?
(2) Is the 3-phase voltage deviation within ±10% of rated voltage?
(3) Can the oil heater operate normally?
(4) Is any wiring loosened or damaged?
(5) Is there any damage to the appearance? Is the tubes (especially the small pipes) deformed or cracked? Is the insulation in good condition?
(6) Is the oil level normal?
(7) Can each valve for each system be opened normally?
(8) Read the pressure valve on the touch screen and based on it judging if refrigerant leaks. Besides, the external pressure also can be used to judge if the system pressure is normal or not.

6.1.2 Inspection on the Control Cabinet

(1) Open the control cabinet and check if there are foreign matters or water stains caused during installation. If so, remove the foreign matters. For water stains, dry the cabinet.
(2) Based on the wiring diagram, check wiring inside the control cabinet, and check the size of the power lines and terminals.
(3) Measure the insulation resistance. Remember to cut off power supply of the control cabinet.
- Measure the insulation resistance of control cabinet between each phase and the ground by 500VDC ohmmeter. The insulation resistance should not be lower than 1MΩ.

6.2 Inspection on the Project

6.2.1 Inspection on the Installation Location and Foundation

Check if the installation location, surrounding, foundation and the service spaces meets corresponding requirements covered in Section 5.1.2, 5.1.3, 5.3.2 and 5.3.3.

6.2.2 Inspection on the Water System

The water system should meet following requirements:

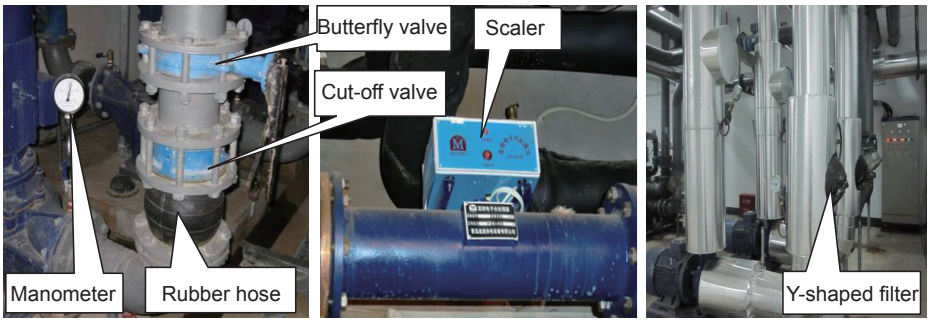
(1) Water pipes should be arranged properly, flow direction should be correct and flow should be smooth.

(2) Water quality should meet standards stated in Table 6.1. If not, treat it and reuse it until it is qualified.

Table 6.1 Water Quality Standards

Item			Cooling/Chilled water		Trend	
			Circulating water	Makeup water	Corrosion	Scaling
Basic items	pH value (25°C)		6.5~8.0	6.5~8.0	○	○
	Electric conductivity (25°C)	μS/cm	<800	<300	○	○
	Chloride ion Cl^-	mg(Cl^-)/L	<200	<50	○	
	Sulfate ion SO_4^{2-}	mg(SO_4^{2-})/L	<200	<50	○	
	Acid consumption (pH4.8)	mg($CaCO_3$)/L	<100	<50		○
	Full hardness	mg($CaCO_3$)/L	<200	<70		○
Reference Items	Ferrum Fe	mg(Fe)/L	<1.0	<0.3	○	○
	Sulfide ion S^{2-}	mg(S^{2-})/L	Undetectable		○	
	Ammonium ion NH_4^+	mg(NH_4^+)/L	<1.0	<0.3	○	
	Silicon dioxide SiO_2	mg(SiO_2)/L	<50	<30		○
Note: "○" indicates there is a possibility of scaling or corrosion.						

(3) The Y-shaped filters, cut-off valve, check valve, by-pass for cleaning and low-level drain valve should be installed at the water pipes based on national standards.

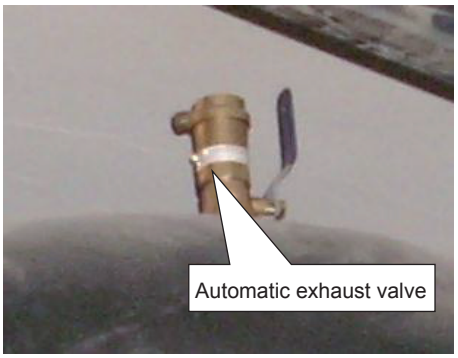


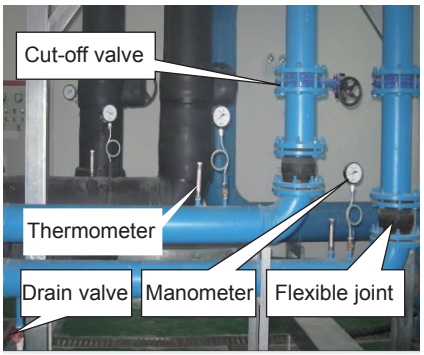
(4) In order to prevent the water system from being blocked and make sure each device and valve can act normally, the water filter, the water treatment system or cleaner is a must to remove foreign matters in water.

(5) Check if the cooling tower, chilled water pump, cooling water pump and expansion water tank are installed correctly and if their capacities can meet the demand and can work normally.

(6) The air exhaust valves should be installed at the highest points of the water circuits.

(7) The manometer, thermometer, cut-off valve and flexible connector should be installed at the inlet and outlet of each unit.





(8) Before starting the water pump, check if all normal-open valves are in proper status.

(9) Get a bottle of water in the lowest point of the water circuit. Waiting for some time, then check it. Normally, it should be clean without foreign matters and abnormal smell.

(10) Connect the unit to the water system until the water system has been cleaned.

(11) Expel air inside the water system, start the water pump and then check the manometer. If the pointer of the manometer swings frequently, it indicates there is air inside the system. If the pointer keeps stable, it indicates most of air has been expelled. If air exists, start the water pump and expel air through the air exhaust valve.

(12) There should be by-passes at the inlet and outlet pipes so as to prevent dirty water from entering the unit.

6.2.3 Inspection on Selection of the Water Pump

When water pumps are installed in parallel, water flow will be reduced, especially three or more water pumps are used. Therefore, it is strongly suggested that

(1) Take the flow reduction into consideration when multiple water pumps are used.

(2) Quantity of water pumps would be better to not exceed 3. That is, the quantity of the chiller is better to not exceed 3.

Table 6.2 Design Temperature and Flow

Item		User side		Heat pump side	
		Flow rate $m^3/(h.kW)$	Outlet temperature (°C)	Inlet temperature (°C)	Flow rate $m^3/(h.kW)$
Cooling	Nominal conditions	0.172	7	30	0.215
	Maximum load condition		15	33	
	Low temperature conditions		5	19	
Heating	Nominal conditions	0.172	45	15	0.134
	Maximum load condition		50	21	
	Defrosting conditions		45	—	—

Generally, Quantity of the cooling and chilled water pump should be the same with that of the unit. However, one more water pump is required for backup. For the water makeup pump, the quantity principle is “one for use, one for backup”.

6.2.4 Inspection on Selection of the Cooling Tower

The following checks should be done:

(1) The quantity of the cooling tower should be same with that of the unit. No more is required for backup.

(2) Flow rate of the cooling tower = flow rate of the cooling water system×1.2~1.5.

(3) There should be good ventilation around the cooling tower. Besides, it should be far away from the outlet of filthy air, with no adverse effect on heat exchanging of the cooling tower.

(4) Deviation of both horizontality and verticality of each cooling tower should not exceed 2/1000. For multiple cooling towers, their height difference should be lower than 30mm.

(5) The location and direction of nozzles at the outlet of the cooling tower should be correct. When multiple cooling towers are installed, inlet and outlet flow rate for each cooling tower should be even.

⚠ WARNING

- It is important to maintain the water quality of the cooling water system

6.2.5 Inspection on Electric Wiring

(1) Check to the Power Supply

⚠ WARNING

- Do not check the power supply until there are proper inspection devices and precautions, otherwise it would lead to severe damages.

Power supply should be provided as per the nameplate. After wiring, check the following points.

- Check sizes of the electric lines and the air switch. They should meet the demand.
- Check the electric wiring. It should comply with relative standards or electric regulations

- Check the phase sequence. They should be wired correctly.
- Check the interlock function to see if it works properly.
- Check the contacts. There should be no foreign matters at the contacts and they can normally pick up and trip off.
- Check the power supply and the insulation.
- Check the control and protection elements. The initialized values for them should be correct.

(2) Check to Electric Wiring

The electric wiring should comply with the following statements.

- Specifications are for the overhead copper-wire cables under 40°C environment temperature. The breaker also should be selected based on this environment temperature.
- Selection of the power lines and the breakers has close relation with the local climates, soil properties and wiring arrangement. Generally, it should be designed by the design institute and finally selected based on the maximum power (current) of the unit.
- The section area of the ground lines should be 50% of that of the phase line. The unit should be reliably grounded.

7. Commissioning and Operation Instructions

7.1 Responsibilities for the Operator

(1) Get well known of the unit and corresponding devices.

(2) Do preparations for startup and turn on and off the units as required.

(3) Record the running status and find out the abnormal readings.

(4) Inspection the unit and do regular adjustment and control commissioning. Keep the level of oil and refrigerant normal.

(5) Do not arbitrarily modify the factory parameters.

(6) Prevent the system from being damaged during shutdown.

7.2 Preparations

When starting the unit, if the start interlock circuit is under one of the following state, the machine will not run even though the ON button in the home page is pressed.

(1) Error protection is not reset.

(2) The leaving chilled water temperature is lower than the set point.

(3) The interval between stop and restart of the unit is less than 10min.

(4) The cooling or chilled water pump does not run.

7.3 Running Methods

When conditions for startup are satisfied, the unit can perform automatic operation as stated below:

(1) Press ON in the home page, input the password, and then the unit will start and run according to the following sequence.

(2) 4 minutes (adjustable if required) after startup of the water pump, the main motor runs.

(3) When the cooling load is smaller than the output cooling capacity, the outlet temperature for chilled water will decrease. The temperature is detected and sent to the control cabinet by the temperature sensor mounted on the outlet pipe for the chilled water. According to this signal, the microcomputer sends the command of unloading the compressor so that the outlet temperature will not decrease any more. When the cooling load increases, the compressor will load to keep the chilled water temperature constant. This is the automatic control of the chilled water temperature.

(4) If the cooling load is small, when the compressor cannot unload further any more, once the outlet temperature of chilled water is lower than the rated temperature (the rated temperature is 7°C), the automatic running will stop. In this case, although the unit is stopped, it is still under the automatic control status. As the cooling load gradually increases, when the leaving chilled water temperature is 3°C (adjustable if required) higher than the set point, the unit will again go to the automatic status. The interval from stop to restart should last at least 10 minutes (adjustable if required).

7.4 Inspection in Running

It is necessary to inspect the following items when the unit is running, and compare them to the values in the nameplate and the requirements in the specifications. If there is abnormality, check the reason so as to ensure the best running state.

Parameter	Reference Value
Entering and leaving chilled water temperature	Value at the nameplate ±0.3°C
Entering and leaving cooling water temperature	Value at the nameplate ±0.3°C
Evaporating pressure	Corresponding refrigerant saturation pressure (Leaving chilled water temperature -1.5°C)
Condensing pressure	Corresponding refrigerant saturation pressure (Leaving cooling water temperature +1°C)
Refrigerant level of the evaporator	Central line of the sight glass
Oil level	Central line of the low-oil sight glass of the compressor
Current of the main motor	90%~95%
Vibration and noise for each part	See the value at the nameplate

The current and outlet pressure of the water pump should be checked routinely.

Inspect the water volume once every month and adjust the water volume to ensure it approaches to the rated one. It is necessary to measure the inlet and outlet pressure of chilled water flowing through the evaporator and the cooling water flowing through the condenser. Compare them to the hydraulic resistance loss in the “Inspecting Items” and calculate the flow of chilled water and cooling water according to the following formula.

$$W' = W \cdot \frac{\triangle h'}{\triangle h}$$

In the formula:

W′—— water volume at the water resistance loss of △ h′ (m^3/h)

W —— rated water volume (m^3/h)

△ h′= P_1-P_2 (kPa)

P_1 —— inlet pressure of chilled water or cooling water (kPa)

P_2 —— outlet pressure of chilled water or cooling water (kPa)

△ h —— water resistance loss at rated flow (kPa)

7.5 Shutdown

When it is intended to stop the unit, press OFF button at the home page of the touch screen. After the unit is stopped, the chilled water pump, the cooling water pump and the cooling tower all will automatically stop.

If the manual stop and malfunction stop are not effective, press Emergency Stop on the cabinet to stop the unit forcibly.

7.6 Precautions for Long-term Stop

(1) Keep good ventilation in the machine room and avoid direct sun lights. If there is heavy dust in the machine room, cover the unit with thin plastic film.

(2) Drain the water pipe and the unit and keep drain valves open during stop.

(3) Keep the control cabinet powered on so as to maintain the temperature of the oil sink.

(4) When it is intended to restart the unit after long-term stop, close the drain valves, clean water pipes, check both the evaporating and condensing pressure, which should be approximate. The saturation temperature figured out based on the pressure is nearly equal to the water temperature. Before startup, simulate the control process. Normal operation is allowed when this simulation is satisfied.

7.7 Handling of the Unit

⚠ WARNING

- Please contact the contractor for repair. Improper repair would lead to electrocution or fire hazard.
- Please contact the contractor for handling and installation. Improper installation would lead to electrocution or fire hazard.
- Do not do retrofitting personally, otherwise it would lead to electrocution or fire hazard.

⚠ NOTE

- Treatment of chilled water, cleaning solution, refrigerant or other waste liquid or gas should comply with local laws and regulations; otherwise it would lead to adverse effect to health and environment.
- Do not misuse refrigerant, as it is one of the causes of fire hazard and explosion.
- Do not reset the safety device, as it is also one of the causes of fire hazard and explosion.
- Do not short-circuit the safety device, as it is also one of the cause of the fire hazard and explosion.
- Care must be taken to air ventilation during repair inside the room, as refrigerant leakage would lead to oxygen under insufficient ventilation.

8. Error List and Troubleshooting

When it is found that the unit runs abnormally, please refer to the table below to find out the possible causes and then make the unit back to normal operation soon.

When any error occurs, but if it is hard to find out the causes, please as soon as possible contact GREE after-sales.

Table 8.1 Error List

Malfunction	Possible Cause	Solution
Exhaust pressure is too high	1.There is air or other incoagulable gas. 2. The fan of cooling tower malfunctions. 3. The suction pressure is too high. 4. The ambient temperature is too high. 5. The flow of cooling water is too small. 6. The oil level of compressor is too low.	1. Release the gas from the Freon inlet and evacuate the system again if necessary. 2. Repair the fan of cooling tower. 3. Refer to “The suction pressure is too high”. 4. Inspect the cooling water system and increase the water flow. 5. Inspect the oil level and increase chilled oil.
Exhaust pressure is too low	1. The suction pressure is too low. 2. The refrigerant is leaked or not enough. 3. The temperature of cooling water is too low.	1. Refer to “The suction pressure is too low”. 2. Perform leak hunting and charge Freon. 3. Check if the capacity of cooling tower is too large or if the ambient temperature is too low.
Suction pressure is too high	1. Exhaust pressure is too high. 2. Too much refrigerant is charged. 3. Liquid refrigerant flows into the compressor through evaporator. 4. The temperature of inlet chilled water is too high.	1. Refer to “Exhaust pressure is too high”. 2. Discharge part of the refrigerant. 3. Inspect and adjust the expansion valve. 4. Ensure the sensor of expansion valve and the air inlet pipe is closely connected and is isolated from the outside.

Malfunction	Possible Cause	Solution
Suction pressure is too low	1. Device for drying and filtering is blocked. 2. The expansion valve is not adjusted or malfunctions. 3. The refrigerant is not enough. 4. The temperature of inlet chilled water is lower than rated value. 5. The flow of chilled water is not enough.	1. Replace the core of dry filter. 2. Adjust the temperature or inspect if the expansion valve leaks. 3. Perform leak hunting and charge Freon. 4. Check if the inlet and outlet pipe pressure of the evaporator is too low.Adjust the chilled water flow.
The compressor stops due to high pressure protection	1. The temperature of chilled water is too high. 2. The fan of cooling tower malfunctions 3. The setting value of high pressure switch is not correct.	1. Inspect and repair the fan of cooling tower. 2. Inspect the high pressure switch.
The compressor stops due to overload of motor	1. The voltage is too high or too low. 2. Exhaust pressure is too high. 3. The temperature of cooling water is too high. 4.The overloaded component malfunctions. 5. Short circuit occurs in motor or connecting terminal.	1. The voltage should not exceed the range of ±10% of the rated voltage. 2. Refer to “Exhaust pressure is too high”. 3. Check if the capacity of cooling tower is too small. 4. Compare the current of the compressor to the specified full load current. 5. Check the corresponding resistance of the motor and terminal.
The compressor stops due to temperature protection	1. The voltage is too high or too low. 2. Exhaust pressure is too high. 3. The temperature of inlet chilled water is too high. 4. There is something wrong with the temperature protection switch inside the compressor. 5. The refrigerant is not enough.	1. Inspect the voltage. It should not exceed the specified range. 2. Refer to “Exhaust pressure is too high”. 3. Replace it. 4. Check if the Freon is leaked.
The compressor stops due to low pressure protection	1. The drier filter is blocked. 2. Malfunction of the expansion valve. 3. Incorrect setting value of low pressure stop. 4. Insufficient refrigerant.	1. Replace the core of dry filter. 2. Adjust or replace the expansion valve. 3. Inspect the low pressure switch. 4. Charge refrigerant.
Too much noise of compressor	1. Insufficient refrigeration oil in compressor.	1. Inspect the oil level and increase refrigeration oil.

Malfunction	Possible Cause	Solution
The compressor can not be started	1. The over-current reply tips or the fuse is burnt out. 2. The control circuit is not connected. 3. No current. 4. High pressure protection or low pressure protection. 5. Contactor loop is burnt. 6. Sequence of power phase is wrong. 7. Water system malfunctions. 8. There is alarm signal in operation display. 9. The setting time of start and stop is wrong. 10.The temperature tested by temperature sensor exceeds setting temperature.	1. Replace it. 2. Inspect the wiring of control system. 3. Inspect the power supply. 4. Refer to the previous section of suction and exhaust pressure error. 5. Replace the damaged parts. 6. Reconnect the wire and adjust two of the wires. 7. Inspect the water system. 8. Inspect the alarm and take corresponding actions. 9. Inspect and reset the time. 10. Inspect and reset the temperature.

9. Maintenance

Regular maintenance plays an important role for maintaining the normal use and service life of the unit. Maintenance for the new unit should be maintained more frequently. After one year, each component has gone to the harmonic state, and then regular maintenance can be applied. After disassembly and replacement of the key components, the unit should be maintained as a new unit.

Table 9.1 List of Maintenance and Inspection Items

Frequency	Item	Details	Operator	Remarks
Every day	Inspection on the start/stop status	Operation instruction for the control panel	○	Upon every startup
Every week	Visual inspection on lubricating oil	9.1.1	○	
	Confirmation of the water flow rate		○	
	Analysis to the running records		○	See maintenance for each component for more details
Every month	Analysis to the water quality	9.5.2	△	
	Inspection and dedusting of control cabinets	9.4.2	○	
	Inspection of the refrigerant level in the evaporator	9.3.1	○	

Frequency	Item	Details	Operator	Remarks
Every quarter	Analysis to the status of the filter at the cooling water line	9.2	○	
	Replacement of desiccant in the startup can control cabinets	9.4.3	○	
	Cleaning of the heat exchanger	9.3.4	☆ /○	
Every year	Inspection on safety valves	9.3.6	○	
	Replacement of filters at the cooling water line	9.2	☆	
	Analysis to the quality of lubricating oil	9.1.2	△	
	Confirmation of insulation of the main motor	9.4.2	☆	
	Analysis to the refrigerant	9.2.3	△	
	Leak test	9.2.3	○	
	Replacement of filter-driers	9.2.4	☆	The leak test should be carried out every 3000 hours of opeartion, and the filter element should be replaced when the pressure difference exceeds 50 kPa.
	Leak test to the heat exchanging tubes	9.3.5	○	
Every three years	Replacement of lubricating oil	9.1.3	☆	
	Check to the main motor		☆	Contact the after-sales center.
	Check to the compressor		☆	Contact the after-sales center.
	Replacement of the oil filter		☆	Contact the after-sales center.

Notes:

(1) ○ indicates it should be performed by the user; △ indicates it should be performed by the third party; ☆ indicates it should be performed by GREE appointed service men.

(2) Frequency listed in the table above is standard. If it is founded during maintenance some part would degrade performance of the unit or lead to abnormal operation, the frequency should be increased.

(3) For the new unit, maintenance frequency for the items listed in the table below should be increased.

Table 9.2 Maintenance Frequency for the Newly Built Unit

Frequency	Record/Check/Maintenance	Details	Performer	Remarks
Daily	Visual inspection of lubricating oil	9.1.1	○	
Weekly	Inspection on the refrigerant level of the evaporator	9.3.1	○	
Monthly	Analysis to the filer status of the cooling water lines	9.2	○	

Frequency	Record/Check/Maintenance	Details	Performer	Remarks
Quarterly	Analysis to the quality of lubricating oil	9.1.2	△	
	Inspection on the safety valve	9.3.6	○	
Yearly	Replacement of lubricating oil	9.1.3	☆	

9.1 Maintenance on the Lubricating Oil

Please read Section 4.2 carefully before maintaining the oil system.

⚠ NOTE

- Improper maintenance on the oil system would affect the normal use of the main unit, like incorrect oil number, being overcharged, unqualified oil, incorrect operation to the oil pipe. Only approved and appointed servicemen are allowed for this maintenance.

9.1.1 Visual Inspection on the Lubricating Oil

Check the appearance of lubricating oil through the sight glass (when the sun light is not enough or there is color light for interference, please use the torch).The normal lubricating oil should be transparent light-yellow liquid. As the unit runs, its color will be more and darker. Sometimes, there will be bubbles in the lubricating oil, which is normal. But when there are solid particles or other foreign mattes, it is abnormal.

When the color of the lubricating oil is apparently dark or blacken or there are quite many foreign matters, please contact GREE for replacement.

9.1.2 Analysis on the Quality of the Lubricating Oil

The quality of the lubricating oil should be checked once every year. Take some oil from at the outlet as the sampling and then send it to the processional detection organization for analysis. The normal lubricating oil should meet requirements listed in the table below.

Table 9.3 Quality Index of Lubricating Oil

Item	Unit	Index
Kinematic viscosity	cst (40°C)	68
Freezing point	°C	39
Flash point	°C	250
Total acid value	mg KOH/g	≤ 0.15
Hydroxyl value	mg KOH/g	2
Water	(PPM)	≤ 50
Chromophore		300

⚠ NOTE

- Lubricating oil used for this unit is special and is never allowed to be mixed with others. Only approved lubricating oil can be put into use. As it is has strong water-absorbing quality, it should be sealed in transport, storage and use so as to prevent moisture of air from permeating into it which then would degrade the lubricating oil, worsen its insulation performance and lead to higher corrosion. The sooner the better is for charging and discharging lubricating oil to minimize the contact time with air.

9.1.3 Replacement of Lubricating Oil

Before replacement, please contact our after-sales center for confirming the lubricating oil. Incorrect lubrication oil will lead to abnormal operation of the unit. Mixed oil is not allowed to be used. For the initial operation, it is suggested to replace the lubrication oil after the unit has run for one year. Then, if the system operation is good, replace it every three years at least. Meanwhile, please decide if to replace it ahead of the schedule based on the detection results.

Do replacement as the following steps:

Step 1: discharge lubricating oil. When the unit breaks down or it is required to be disassembled, discharge oil inside firstly. Care must be taken that refrigerant should be discharged prior to the lubrication oil. When oil has been completely discharge, go to the next step.

Step 2: recharging lubricating oil. Recharging can be performed when only leak test is passed. The recharging is done in the way that: keep the pressure during the vacuum test, put one end of the charging line to the charging valve, and the other end to the oil container, then open the charging oil. After charging volume is reached, close the charging valve. During this process, do not let air entering into the unit. The charging line should be kept as short as possible. Do not overcharge or undercharge.

9.2 Maintenance on the Cooling System

9.2.1 Routine Maintenance

For the first charging of refrigerant, record refrigerant level through the sight glass of the evaporator, and record it again after the unit has started. There records will be taken as the basis for judgment of the further operation of the unit. Then, inspection and record the refrigerant level once every month.

If refrigerant leaks, operation parameters at the same conditions will change. For instance, at the same leaving water temperature, the evaporating pressure will decrease and the cooling capacity will go down. These can be taken as evidences for judging if refrigerant leaks or not.

9.2.2 Leak Test

Generally, little leak will not bring apparent change. Therefore, leak test should be done each year. As there is refrigerant inside the unit, the inner pressure will be higher than that outside. Therefore, foaming agent or soap water can be used for leak test at each connection point of the unit.

Leak test for the heat exchanging tube is a little complicated. It should be done once every three years. When the water quality is quite poor, leak test should be done more frequently. As it is hard to access to the inner side of the heat exchanging tube, it is suggested to use the processional electric leak detector or contact the after-sales center for help.

9.2.3 Analysis to Refrigerant

As purity plays a key important role for operation efficiency of the unit, refrigerant analysis should be done once every year. It is suggested to do it before seasonal use. Take some refrigerant from the charging valve into an enclosed container for sampling. Then, the detection result can decide if refrigerant should be purified or not.

Table 9.4 Purification Standards of Refrigerant

If purified or not	Oil mixed %	Acid (ppm)	Free moisture
Yes	above 5%	above 5ppm	observable
If regenerative or not	3~5%	3~5ppm	3~5ppm
No	below 3%	Below 3ppm	unobservable

Purification of refrigerant requires professional tools. It is suggested to invite the professional organization or contact the after-sales center.

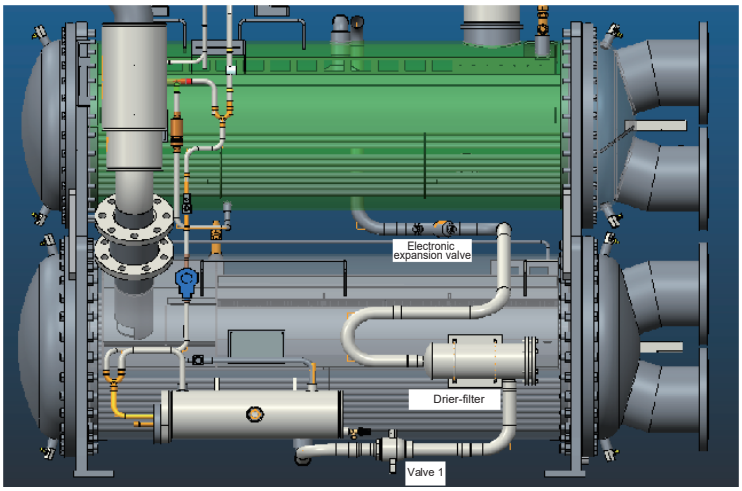
For the unqualified refrigerant, all refrigerant should be discharged for purification and can be reused until it reaches the standards listed at the table above.

9.2.4 Replacement of the Filter-drier

- Power on the display panel, go to the “User Setting” page, and click “Replace Dry Filter”.
- According to the figure below, cut off valve 1 .
- Press the charging connector of valve 1 to expel air inside.
- Loosen bolts at the end cap of the filter-dryer, take out the filtering core and clean the inside.
- Replace the filtering core and tighten the end cap of the filter-drier.
- Vacuum the pipeline.
- Click "OK" at the display panel to finish this replacement.
- The display panel and the electronic expansion valve should be powered on during replacement.

⚠ NOTE

- It would be better to wear gloves when operating the refrigerant charging connector and keep any part of the body (especially hands) far away from it; otherwise the jetted liquid refrigerant would lead to frostbites.



9.3 Maintenance on the Evaporator and Condenser

The refrigerant R134a is a kind of middle/high pressure medium. The evaporator of the unit belongs to class-2 pressure vessel and its design, manufacture, inspection and reception test should comply with ***NB/T 47012-2020 Pressure vessels for refrigerant device.*** Their installation and usage should conform to ***TSG 21-2016 Supervision Regulation on Safety Technology for Stationary Pressure Vessel***. Before usage, it is a must to declare to the local safety supervision department and perform the register procedure of usage. See the nameplate of the evaporator for its main technical data.

9.3.1 Routine Maintenance on the Evaporator and Condenser

(1) External Inspection

Outer inspection refers to the periodical inspection of evaporator and condenser. The inspection should be performed at least once every year and by professional staff recognized by safety inspection agency according to the 20th regulation of Inspection Regulation of Pressure Vessel.

(2) Internal and External Inspection

The first inspection period should be three years. Considering that R134a does not have erosion effect on steel, copper and aluminum, the evaporator and condenser can be inspected with the overall repair of the unit if it is running normally and agreed by safety inspection agency. However, according to ***TSG 21-2016 Supervision Regulation on Safety Technology for Stationary Pressure Vessel***, the inspection should be executed every 6 years. It should be performed by qualified professional staff according to the 23rd regulation of Inspection Regulation of Pressure Vessel.

9.3.2 Maintenance on the Evaporator

The evaporator should be cleaned and checked every year. Based on scaling condition of the evaporator tubes, it is able to estimate the working condition of the water treater and decide if it is required to clean the tubes. Besides, it also able to estimate the scaling condition through the running parameters. Under the same leaving chilled water temperature, if the evaporating temperature goes down by 2°C， then the evaporator tubes is likely to need to be cleaned. Check and cleaning steps are stated as bellows:

(1) Cut off the power supply

(2) Close valves of the chilled water pump and the evaporator, and open the drain valve to drain the trapped water completely.

(3) Disconnect the unit and the water system, remove screw bolts of the water chamber at two ends of the evaporator, and remove the water chamber by lifting.

(4) Check the evaporator tubes and devices of the water system (like flowmeter, thermometer etc.)

(5) Clean the evaporator. If the flow meter, temperature sensor or other devices are corroded or scaled, they should be replaced or cleaned.

9.3.3 Maintenance on the Condenser

As the water loop of the condenser is an open system (the cooling tower contacts with atmosphere), its tubes is likely to suffer scaling. Therefore, it should be cleaned once per year at least. If the water system is detected to be polluted, it should be cleaned more frequently.

The scaling condition of the condenser tubes also can be judged by the operating data. Under the same leaving cooling water, compared with the initial operation, if the condensing temperature goes up by 4°C, it indicates the condenser tubes should be checked. If necessary, it should be cleaned.

Cleaning steps of the condenser is the same as these for the evaporator. During cleaning, care must be taken to protect the condenser tubes, and also check and protect devices at the condenser.

9.3.4 Cleaning of the Heat Exchanging Tube

According to the scaling condition, there are generally two cleaning methods, mechanical cleaning and chemical cleaning.

(1) Mechanical Cleaning

Cleaning steps are: open the covers at both ends and clean the heat exchange tube with a nylon or stainless steel brush.

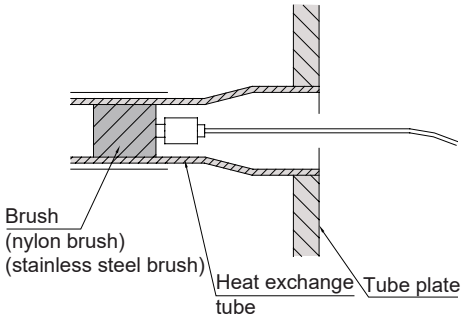


Figure 9.1 Cleaning of Heat Exchange Tubes

(2) Chemical Cleaning

If the scale cannot be removed with a stainless-steel brush, or mechanical cleaning is not available due to site limitation, it is necessary to execute chemical cleaning. As chemical cleaning varies for different water quality, environment, and scaling conditions, proper chemical cleaning detergent and operation should be determined after consulting with the water treatment organization. Generally, chemical cleaning is not recommended. Herein is the most general circulating cleaning method.

Character: although a circulating pump for the water tank is required, it takes less cleaning time and detergent. Cleaning steps are stated below:

- Seal the inlet and outlet pipe of the heat exchanger with stop plate.
- Install the accessory pipe.
- Install the circulating water pump.
- Ensure no leakage for circulating water.
- Adjust the density and temperature of the detergent.
- Circulate detergent and then discharge it.
- Circulate water and then discharge it.
- Inspect and disconnect the pipe.

After it, inspect the inside the tubes. If necessary, clean them again.

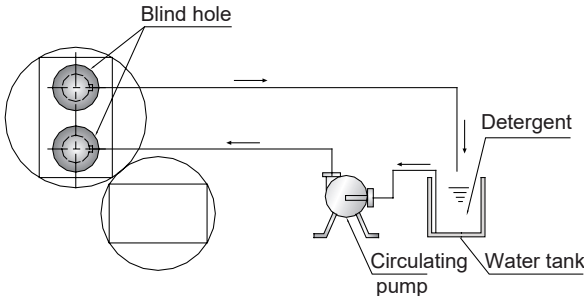


Figure 9.2 Chemical Cleaning of Heat Exchange Tubes

⚠ NOTE

- The heat exchanging tubes should be cleaned with professional tools. It is suggested to invite the professional organization or contact the after-sales service center.

9.3.5 Corrosion Test to the Heat Exchanging Tube

After the unit has run for about 2~3 years or the analyzing results reveal that water in refrigerant exceeds 20ppm, it is necessary to take corrosion leak test. Before test, drain water and refrigerant, then charge dry nitrogen 900kPa(6Kgf/cm^{2}G) to the evaporator and apply soap water or foaming agent at the connection point of each connection point of the tubes to see if there is leak or looseness.

9.3.6 Use, Maintenance and Inspection to Safety Valves and other Safety Devices

Safety parts such as safety valve, liquid level meter and pressure gauge are equipped in this series of unit. There is safety valve and liquid level meter on the condenser. When the pressure is too high, the unit will stop automatically. The unit can restart only after the malfunction is removed. The safety valve is used for pressure relief and fire prevention. Therefore, it is closed in normal situation. According to the ***TSG 21-2016 Supervision Regulation on Safety Technology for Stationary Pressure Vessel***, the inspection of safety valve should be executed every 1 year. It can adopt the site checkout. During checkout, the main technicians and inspectors should check the safety state on site. There should be lead seal on the safety valve passed calibration. The pressure gauge on the unit should be inspected periodically and add lead seal. The liquid level meter of the evaporator is panel liquid level meter. The liquid level meter is applicable in 4.0MPa and -40~180°C. The operator should maintain the liquid level meter and prevent the surface from rusting.

9.4 Maintenance on the Electric System

⚠ WARNING

- Prior to maintenance to the electric system, please cut off the power supply.

9.4.1 Inspection on the Electric Elements

(1) Check on Each Contactor

For the contactor of each electric element in the control cabinet and the startup cabinet, check if it is loosened or torn and worn or not.

(2) Insulation Measurement of Each Electric Element

Measurement tools: 500V megohmmeter, 1000V megohmmeter

Special attention should be paid that the microcomputer control system can be measured as the insulation resistance.

9.4.2 Inspection on the Main Motor

(1) Check on the Main Motor

- Is its insulation resistance normal?
- Is each wiring tightened?
- Does the motor run in correct direction?

(2) Testing of the Insulation Resistance, Drying Treatment and Withstand Voltage Test

Maintenance period depends on operational and environmental conditions. Generally, maintenance should be done every three years. However, measurement of the insulation resistance should be done every year. When measurement is done with the 1000V megohmmeter, the following formula is used as the judging standard.

$$Insulation\ resistance(M\Omega) = \frac{rated\ voltage(V)}{rated\ power\ output(kW)+1000}$$

Insulation resistance = Rated voltage (V) / Rated power output (kW) +1000

When the measured resistance exceeds 10MΩ, it indicates the resistance is acceptable. Under incidental events or the insulation of the main motor is severely damaged, it is required to do the dielectric strength test.

⚠ WARNING

- Please contact Gree and the motor manufacturer prior to the dielectric strength test. The test can be done with the presence and written consent of the representative of the motor manufacturer. In order to prevent the long-term corona discharge from damaging the coil insulation, before the dielectric strength test the inner pressure of the main motor should be equal to the atmospheric pressure.

When the insulation resistance is lower than the value listed above, please do drying treatment as the statement below. It can be used until the retested result is satisfactory.

◆ Vacuum Drying

Evacuate the unit and let the inner pressure of the unit above -93.32kPa (-700mmHg), and then keep this pressure two days and nights.

◆ Current Drying

When the vacuum drying fails to increase the insulation resistance, try the current drying. For the current drying, as the motor is hermetic, the coil temperature cannot be measured directly. In this case, apply 5% extra rated AC voltage to the coils for current drying. During test, keep the temperature of the motor casing within 50°C. Besides, a hot resistance is required at the coils to prevent the coils from over-temperature.

9.4.3 Maintenance on the Control Cabinet

(1) During service period, the control cabinet should be de-dusted every month. Meanwhile, remember to tighten each wiring terminal and check the main circuit and control circuit.

(2) When it is not put into use for long time. After dedusting and checking of wiring terminals, take dustproof and damp-proof measures.

(3) Proper temperature will facilitate safety operation of electric elements. Over-temperature and under-temperature will shorten their service life. Therefore, attention should be paid to the environment temperature change. It is suggested to replace the desiccant inside the electric box every quarter. When the temperature and humidity is quite high, the replacement period should be shorter.

(4) When it is found that some wiring terminal is rusted, replace it in time to prevent poor contact of the terminal from affecting the normal operation of the unit.

9.5 Maintenance on the Water System

9.5.1 Management of Water

The incrustant as a result of bad management of chilled water and cooling water will affect the heat exchange capacity of the heat transferring tube or even lead to erosion of the tube, which consequently cause leakage, rust and insulation deterioration inside the unit. It is necessary to remove the elements that may cause erosion. Below is the general situation.

(1) Situation of Circulating Water

There is less suspended solid material and organic matter in tap water and industrial water, which is favorable for preventing block and incrustant of the pipe. Tap water and industrial water from different areas are also different. Therefore, it is necessary to manage the water condition (incrustant content) and take suitable actions, for example, chemical management, cooling tower water overflowing, changing water, and so on.

(2) Situation of Uniflow Water

There is more suspended solid material, organic matter, incrustant in well water and river water. Thus it must be treated with filter or chemicals, especially the water containing mud and sand. The accumulation of mud and sand will cause stagnation and freezing. Bacterium multiplication and incrustant will increase the erosion, so it must be strictly treated. In the well near the sea, there is polluted sea water intermingled in, so it contains more oxygen ion and sulfate radical ion, and the water near trash treatment areas or toilet is also more erosive because of mixed of alkaline. As a result, it is necessary to take some actions, for example changing water gap position, chemical treatment, and so on. When using tap water as uniflow water, it must notice that the chlorine added to the water for sterilization is one of the factors that cause erosion. (Free chlorine will disappear soon, so this problem does not exist in circulating water.)

9.5.2 Method of Water Quality Management

(1) Frequency of Water Quality Analysis

Analyze the water quality at the beginning of the usage season and once every month from then on.

(2) Analysis of Water Quality

Analysis of water quality can follow method of industrial water testing. Sampling of water is as below:

- Sample the water during running of the unit;
- The container used for sampling should be new, without air. The volume should be more than 2L. Besides, do not clean the container while sampling.

(3) Standard of Water Quality

The heat exchanging tubes for both the evaporator and condenser are made of copper. Requirements for the copper tubes are stated as below:

- See the Table 9.5 for the quality requirements of the cooling water for the condenser.
- The chilled water for the evaporator is used circularly, with stricter requirements compared with the cooling water. It is suggested to use the soft water.

Table 9.5 Water Quality Standards

Item			Cooling/Chilled water		Trend	
			Circulating water	Makeup water	Corrosion	Scaling
Basic items	pH value (25°C)		6.5~8.0	6.5~8.0	○	○
	Electric conductivity (25°C)	μS/cm	<800	<300	○	○
	Chloride ion Cl^-	mg(Cl^-)/L	<200	<50	○	
	Sulfate ion SO_4^{2-}	mg(SO_4^{2-})/L	<200	<50	○	
	Acid consumption (pH4.8)	mg($CaCO_3$)/L	<100	<50		○
	Full hardness	mg($CaCO_3$)/L	<200	<70		○
Reference Items	Ferrum Fe	mg(Fe)/L	<1.0	<0.3	○	○
	Sulfide ion S^{2-}	mg(S^{2-})/L	Undetectable		○	
	Ammonium ion NH_4^+	mg(NH_4^+)/L	<1.0	<0.3	○	
	Silicon dioxide SiO_2	mg(SiO_2)/L	<50	<30		○
Notes: ● "○" indicates there is a possibility of scaling or corrosion.						

9.5.3 Maintenance of Water Quality

(1) Flow Adjustment

As the water evaporates, the density of solvent salt and acid in the cooling water will increase. Periodically discharge the dense liquid and supplement with new water. Adjust the flow as the following methods:

Table 9.6 Method for Flow Control

Type	Method
Overflow	Supply superfluous water
Install spray water	Install successive spray water in the flume or fountain of the cooling tower.
Automatic spray water	Adopt the spray water device equipped with specific conductance gauge or pH gauge or integrate with automatic water quality monitoring device, it become a continuum automatic device which can automatic spray water and automatic add in corrosion inhibitor

The volume of spray water is different according to different ambient condition. It is necessary to discuss with the water treating organ.

(2) Replacement of Water

According to specific running environment, periodically clean the polluted cooling water system and replace the water. As to the cooling tower without water treatment, the standard for changing water is:

In area where there is sulphur dioxide pollution nuisance, change the water once every 5 days.

In general area, change the water once every 10 days.

If there is automatic spray water and manual spray water: In area where there is sulphur dioxide pollution nuisance, change the water once every month.

In general area, change the water once every 3 months.

(3) Treatment during Long-term Stop

During long-term stop, affecting by the environment and water quality, the bacteria in heat transfer pipe will increase, which leads to erosion of the pipe. If the unit stops for more than 15 days, the water should be released completely. If the ambient temperature≤0°C, release the water in evaporator and condenser during stop of the unit.

(4) Chemical Treatment of Circulating Water

The chemical treatment of circulating water includes sterilization

- Clean monthly and add chemical. Before adding the chemical, observe the water quality. If the bottom of cooling tower is covered with lichen or there is too much rust in water, it means that the chemical added last time is not enough. It is necessary to increase the quantity. Clean the system before adding chemical. Steps are: clean the cooling tower with high pressure washer (plastic besom is also acceptable).Clean tower manually, open blow down valve in the bottom of tower after cleaning tower dirt loose, clean and discharge. Use plastic pipe slow move in tower bottom if can't stop unit for cleaning, If there is deposition pool, it must be cleaned. If there is much dust accumulation, clean it according to the above method. If water quality is good, add the original amount of chemical. The amount of chemical should accord with the specification from the supplier. Generally add 30-100g corrosion inhibitor and 10-30g germicide and algicide for each ton of water. (Chemical should be increased in from July to September) Observe the blister after adding the chemical. If the blister cannot cover the whole surface of water in 10 min, it is necessary to increase the chemical. Inversely, the chemical is enough.
- Add remover when cleaning the unit. After it is circulating in the system for 12h, discharge it for eliminating dirt and rust-eaten of tower and pipe, and then charge fresh tap water. Add suitable corrosion inhibitor, germicide or algicide according to the specification.
- Record the added chemical and water quality test for analysis and comparison.
- Safety protection: chemical is harmful to human body in some degree. Therefore, it is a must to take actions for safety protection. Chlorine is strongly smelly and corrosive. Too much intake will lead to death. When dealing with and using biocide, take care to protect the skin, eyes and respiratory system from hurt.

⚠ WARNING

- Arms and legs should be under the clothes when adding chemicals, meanwhle gloves and goggles should be put on for protecting skin, eyes and the respiratory system.

(5) Flow Rate Inside the Tube

The flow rate inside the heat transfer tube is closely related to the corrosion of the tube. The flow rate should be slower than 3m/s. When the flow rate reaches 3.5~4m/s, the tube may be corroded. Thus, it is required to control the water volume. It is possible to judge by differential temperature of inlet and outlet water which is about 5±0.3°C when the unit reaches full load.

9.6 Confirmation after Maintenance

9.6.1 Measurement of Vibration

Measure the vibration of each part and the vibration amplitude should not exceed 0.03mm. (It is necessary to measure the vibration before disassembly and after assembly and confirm if it is normal).

9.6.2 Measurement of Noise

If possible, measure the noise to judge if it is abnormal before disassembly and after assembly. Measurement of noise should follow related regulations in JB/T4330 Measurement of Noise for Refrigerant and Air Conditioning Device.

9.6.3 Air-tightness Test

After assembly, charge dry air or nitrogen into the refrigerant machine so that it reaches 1150kPa. 24 hours later, the pressure drop measured by the 0.4 or above pressure gauge should not exceed 11.5kPa. Otherwise check if there is leakage with soapy water or vesicant.

9.6.4 Vacuum Test

After passing the gas-tight test, vacuum the interior of the unit to be less than 1kPa (7.5mmHg). 24 hours later, the pressure rise should not be more than 0.4kPa (3mmHg).

9.7 Long-term Storage of the Unit

Care must be taken to the following points for the long-term storage:

(1) During long-term storage, pay attention to the environment conditions (refer to Section 5.1.2).

(2) Store the unit in indoor environment.

(3) Select places with good ventilation, low temperature and humidity.

(4) Temperature: below 45°C ; relative humidity: below 85%

(5) As to long-term preservation of centrifugal cooling unit with refrigerant inside, please pay attention to the following items:

- Prevent the dust and rainwater (cover it with plastic film).
- Keep the inside temperature of the unit below 40 °C.

9.7.1 Long-term Storage (more the two years)

If the centrifugal cooling unit needs to be stored for a long time, no matter after running or without running before, please take maintenance inspection to ensure the unit is in good condition.

Table 9.7 List of Working and Inspection Items for Long-term Storage

Item	Time	Contents
Withdraw refrigerant and lubricating oil	Immediately	• Withdraw refrigerant (if there is any) • Discharge lubricating oil
Leak test	Immediately	• Perform air-tight test and vacuum test according to the specification. Ensure that there is no leakage
Charge nitrogen (N_2)	Immediately	• After passing vacuum test, when the absolute pressure inside the unit is below 1kPa (7.5mmHg), charge nitrogen of 0.05kPa superficial pressure to prevent the unit from rusting. It is required to charge nitrogen into each pipe. Pay attention to the opening of each valve.
Discharge chilled water (salt water) and cooling water	Immediately	• Discharge the chilled water and cooling water from the heat transferring tube. Clean the tube with water and purge it with dry air. Close the valve on the inlet and outlet pipe used for repair and keep the pipe in a dry environment. • Check the interior situation of water chamber and repair inner filler.
Cut off power	Immediately	• Cut off all of the high-voltage and low-voltage power after withdrawing the refrigerant.
Store electric parts	Immediately	• Control cabinet of microcomputer and electric performer should be covered and bound with plastic film and filled with desiccant (silica gel. etc). Other electrical parts should also be covered with plastic film to prevent from dust and moisture.
Others	Immediately	• Remove the bar linkage and so on from the electric performer and wrap with plastic film in case of entering of dust. • Apparatus glass, liquid meter glass and gauge should be covered with plastic film to prevent from dust.
Periodical inspection	Once every month	• Check the pressure of nitrogen inside the unit; • Leak test: two weeks after initial charging of nitrogen, if the pressure decreases less than 10kPa, it can be stored as before. From then on, check the pressure once every month. Two weeks later, if the pressure decreases more than 10kPa, it is necessary to supplement nitrogen to the demanded pressure for storage. If the pressure drop of each month is more than 10kPa, it is required to find out the leak point and then supplement the pressure according to Section 3.2.1 and Section 3.2.2. • Check if the appearance is normal.

9.7.2 Long-term Stop (like in winter)

Test all the joint of the unit with leak tester or blister (soapy water). If there is leak, repair it immediately before long-term stop of the unit.

⚠ WARNING

- During long-term stop, inspect the system performance periodically.

(1) Discharge the water in condenser, evaporator, cooling tower, water pump, chilled water pump and piping system. Close the inlet and outlet valve to keep the pipe dry.

Steps:

- Open the air exhaust valve, and then water drain valve to discharge water in the condenser and evaporator to prevent heat exchangers from being frozen.
- Close the air exhaust valve and water drain valve.
- When the unit is going to be used again, open the exhaust valve 1 to expel air before charging water into the unit.

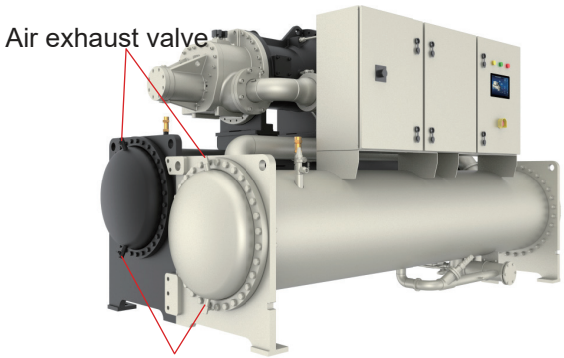


Figure 9.3 Diagram of the Air Exhaust Valve and the Drain Valve

(2) The control cabinet should be kept powered on, so that the oil heater is always under the working status and is able to keep the oil temperature within the allowable range.

9.7.3 Preparation for Running after Long-term Preservation

(1) Inspection after Long-term Preservation

If the preservation period exceeds 2 years, it is necessary to open the inspecting cover on the air intake duct and gear case. After confirming there is no rust or abnormality, it can be run. Otherwise, disassemble it for inspection.

(2) Inspection of Electric Parts

After confirming that any electric part is not defective and connection is normal, measure the insulation resistance. (For alternating-current main of 250V, use 500V DC megohmmeter and the resistance should be more than 3MΩ. For alternating-current main of 500V above, use 1000V DC megohmmeter and the resistance should be more than 10MΩ.)

(3) Inspection of Water System

There will be dust and sand mixed in the chilled water system and cooling water system after long-term stop. Therefore, the water system (water pool, cooling tower, pipe) must be cleaned and inspected (especially for open-style cooling water system).

(4) Confirmation

After inspecting the unit according to Section 6 and instruction of electric control, the unit can be operated.

Appendix 1: Running Record Sheet

Running Record

Year Month Day Week Weather

No			1	2	3	4	5	6
Equipment	Item	Time / Unit						
Compressor	Voltage	V						
	Current	A						
	Oil level	-						
Evaporator	Evaporating pressure	kPa						
	Inlet temperature of chilled water	℃						
	Outlet temperature of chilled water	℃						
	Inlet pressure of chilled water	kPa						
	Outlet pressure of chilled water	kPa						
	Refrigerant level	-						
Condenser	Condensing pressure	kPa						
	Inlet temperature of cooling water	℃						
	Outlet temperature of cooling water	℃						
	Inlet pressure of cooling water	kPa						
	Outlet pressure of cooling water	kPa						
Indoor temperature		℃						
Others	1. Time of startup							
	2. Time of stop							
	3. Running time							
	4. Maintenance							

Note: If possible, test the inlet and outlet differential pressure of chilled water and cooling water; it is more convenient and accurate than just testing their inlet pressure and outlet pressure.

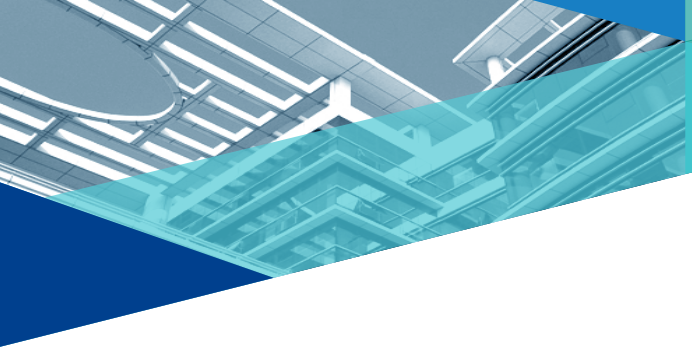
Appendix 2: R134a Temperature and Pressure under the Saturation Status

R134a Temperature and Pressure under the Saturation Status

Temperature (°C)	Absolute pressure (kPa)	Temperature (°C)	Absolute pressure (kPa)	Temperature (°C)	Absolute pressure (kPa)	Temperature (°C)	Absolute pressure (kPa)
0	292.32	16	504.16	32	815.28	48	1252.6
1	303.57	17	520.42	33	838.63	49	1284.8
2	314.62	18	537.08	34	862.47	50	1317.6
3	325.98	19	554.14	35	886.82	51	1351.0
4	337.65	20	571.60	36	911.68	52	1385.1
5	349.63	21	589.46	37	937.07	53	1419.8
6	361.95	22	607.76	38	962.98	54	1455.2
7	374.59	23	626.50	39	989.42	55	1491.2
8	387.56	24	645.66	40	1016.4	56	1527.8
9	400.88	25	665.26	41	1043.9	57	1565.2
10	414.55	26	685.30	42	1072.0	58	1603.2
11	428.57	27	705.80	43	1100.7	59	1641.9
12	442.94	28	726.75	44	1129.9	60	1681.3
13	457.68	29	748.17	45	1159.7		
14	472.80	30	770.06	46	1190.1		
15	488.29	31	792.43	47	1221.1		

Appendix 3: Maintenance Items of the LHE Series Refrigeration Unit

		Monthly	Quarterly	Yearly	Biyearly	Every triennium	Remarks
Compressor	Inspect lubricating oil			○			
	Replace oil filter			⊙	○		
Main electromotor	Insulation determination			○			
Evaporator, condenser	Clean the pipe				○		
	Analyze water quality	○					
	Take a leak test to the tube				○		
	Confirm water volume						Twice every quarter
	Check sensors						
Other electrical parts	Check connection of LED and fuse of control cabinet	○					
	Check wire connection of the oil heater			○			
	Check wire connection and electrical insulation		○				
General	Take a leak test			○			
Others	Clean the refrigerant filter			⊙	○		
	Analyze the main unit			○			



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