DM16-03.01.46en

INSTALLATION & OPERATION AND MAINTENANCE MANUAL

Air-cooled Screw Chiller Unit

Applicable Model:

MLSC380A-SB3Z/MRH380A-B3Z

MLSC500A-SB3Z/MRH500A-B3Z

MLSC600A-SB3Z/MRH600A-B3Z

Please Keep This Manual Carefully For Future Reference

Notice

- The installation section of this manual is designed for qualified persons only.
- Be sure to read the operating section before conducting operation in order to prevent unit damage and unnecessary accidents.
- The contents of this manual are subject to change without prior notice for further improvement of related models.
- The product introduced in this manual is in compliance with GB/T18430.1-2007.
- Report to and register in the local corresponding administrative organization before and after operating the pressure vessel unit.
- The air source screw water chiller unit is designed based on the following conditions:

	Refrigeration Condition
Water side outlet temperature	5℃-15℃
Air side inlet temperature	10℃-43℃

Warning

Personnel must be fully acquainted with the operation manual before operating the refrigerant system.

Safety Warning

The MLSC_A series units adopt the R134a refrigerant, which is the mid-pressure medium and liquefied gas. The saturated vapor pressure of R134a refrigerant corresponds to the temperature. That is, if the temperature is high and the corresponding saturated vapor pressure is high too. To ensure the safety of units, the ambient temperature cannot be higher than 43℃ during the downtime of units. Otherwise, you should start the chilled water pump to decrease the temperature of the evaporator. When the unit is charged with refrigerant, it is forbidden to perform flame-cut or welding operations on the shell and tube heat exchanger, finned heat exchanger, reservoir, and unit pipes. When the unit operates or bears the pressure, it is forbidden to fasten bolt or nut. If contact surfaces leak, you can fasten the bolt and nut only after the pressure is released. Avoid refrigerant leakage in case of unit debugging and usage. The R134a vapor concentration (AEL) in the air that human body can accept is 1000 ppm. It has no adverse impact on human body within the specified vapor concentration. R134a vapors are concentrated near the low ground when large spills or leakages occur, which may cause hypoxia and make you feel uncomfortable. In this case, improve ventilation or blast air by using fan coil to keep the air near the ground in circulation. Do not enter the polluted area until the refrigerant vapor is discharged, avoiding the adverse impact. The liquid refrigerant cannot be contacted with skin and eyes to avoid frostbite.

Pay more attention to the following conditions to ensure safety when using this series of units in closed areas:

- Install outlet pipes and ventilating pipes outdoors and keep away from the air inlet.
- Keep sufficient ventilation and use auxiliary ventilating devices to remove refrigerant vapor leaked accidentally if necessary.
- If applicable, connect the outlet of safety valve to the outdoors by using pipes.
- If applicable, install the air detector to monitor the refrigerant vapor concentration in the air.

Other precautions:

- Be sure to read and strictly comply with safety requirements.
- Please keep this manual carefully for future reference and read it carefully before operation.
- Ensure that controllers are properly connected to the ground and frequently check whether it is stable, because poor earthing may result in electric shock.
- Please abide by the principle of electricity separation.
- Please install the unit according to the wiring diagram.Do not use sharp objects to press the touch screen or put excess stress on the touch screen, avoiding touch screen

damage.

- Do not drag and distort power cables and communication lines, avoiding major failure.
- Please wring the cloth dampened with neutral water, and wipe the unit to remove fouling. Do not use acidic, alkaline chemicals.
- If fire breaks out accidentally, you should immediately shut down the main power and use fire extinguisher applicable to oil fire and electric fire.
- The units cannot be used in explosive environment.
- Please contact the manufacturer if you need to repair the unit. Do not repair it by yourself.

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1 Introduction

1.1 Function

The air source screw water chiller unit has been forging ahead at the forefront of air-cooled unit. It saves various auxiliary parts such as cooling tower, cooling pump, and corresponding pipe systems. Featuring simple system structure, it saves installation space. In addition, it saves energy and can be maintained and managed conveniently. Therefore, it is especially suitable for the area lack of water. The indoor unit of air source screw water chiller unit adopts the semi-closed twin-screw compressor with advanced technology, low noise, and high efficiency. The twin-screw compressor can deliver the optimal performance when it is used with the evaporator and condenser that are efficient in heat exchange. The outdoor unit adopts refrigerating pipes design and free of anti-freezing fluid. Condenser fins with high effective and low noise fan are placed on the condensing pipes based on a certain gap. The unit framework adopts steel structure with anticorrosive paint on the surface to ensure the reliability and performance during unit operation.

The air source screw water chiller unit is transported to the site in split mode. The refrigerant pipes of indoor units have been properly assembled before delivery, and charged with the necessary refrigerants and lubricants. The air source screw water chiller unit adopts twin-screw compressor designed with the most advanced, industrial third-generation asymmetric technology of 5 gear teeth to 6 gear teeth. The detailed functions are as follows:

- Variable capacity adjustment, high efficiency, and energy saving.
- Human-orientated micro-computer control system with remote control function.
- Ten self-protection functions to ensure the safe and reliable operation.

This full series of units have diversified models and can be customized for you.

The company adheres to the customer-driven design concept to meet customer's various requirements.

This series of units features compact structure, small size, low noise, high COP, long service life, easy operation and maintenance, and other advantages. Therefore, they are widely used in multiple scenarios such as hotels, restaurant, office buildings, shopping malls, hospitals, etc. In addition, they are applicable to air conditioning scenarios such as metallurgical, chemical, mechanical and electronic industry.

1.2 Features

1.2.1 Simple and Economic Apparatus

(1) The compact appearance makes this series of units widely used for various buildings, saving the space for the equipment room.

(2) The bolt joints allow you to rapidly and conveniently assemble and disassemble the units.

(3) Lightweight design simplifies the operation requirements and reduces installation time and cost.

(4) Units have been charged with refrigerants and lubricants before delivery, which reduces the onsite

workload, material, and installation cost.

(5) Customers only need to connect the refrigerant pipes, evaporator water pipes, and power cables between outdoor units and indoor units to use the units, simplifying the entire installation process.

(6) The split design of units is free of larger installation base, and removes the oil cooler and related purification systems, reducing the unit weight. In addition, outdoor units can be installed far away from the master unit, reducing operation noise.

(7) The unit is tested under various conditions before its delivery.

(8) The unit is directly driven. In addition, it operates in a high efficient and reliable way with fewer movable components. Therefore, it can be easily maintained and serviced.

(9) The unit is easily installed without requiring a cooling tower. It releases heat to the air when it is in cooling mode without requiring a cooling tower and cooling pump. Therefore, it is especially suitable for water-deficient areas. The indoor unit requires a dedicated equipment room. The outdoor unit can be installed on the rooftop, ground and other outdoor places.

1.2.2 Technical State and Precise Control

(1) The unit is fitted with sensors and other components related to control before delivery, and it has been tested.

(2) Smart control: Adopts micro-computer controller featuring various automatic control functions such as fault diagnosis, and energy management and monitoring, which ensures efficient running and easy operation of the unit. The unit provides the RS485 communication interface, which allows the host computer to control startup/stop of the unit, minimizing the operation cost.

(3) Complete safety control system: Electrical control elements are of world well-known brands with stable quality and reliable performance. In addition, units are designed with multiple safety protections including high/low pressure, oil differential pressure, antifreeze, water flow volume, anti-phase, and overload, which ensures safe and reliable operation of the unit.

1.2.3 Reliability and Ease Maintenance

(1) The unit is directly driven with a low rev and ease maintenance. In addition, it operates in high efficient and reliable way with less movable components.

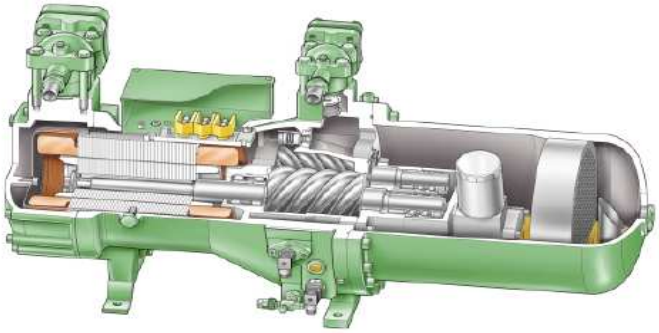
(2) The unit is in stable performance by using the electronic expansion valve technology.

1.2.4 Easy Installation and Simple Structure

The unit has been subject to comprehensive commissioning before delivery, ensuring the reliability of the unit's onsite operation. For onsite installations, you just need to connect the unit to the supply power, refrigerant pipe, and water source. Then the unit starts to work after simple installation and debugging. Additionally, the unit is easy to operate and fitted with automatic protection and adjustment apparatus, which facilitates the management.

1.3 Product Components

1.3.1 Compressor



(1) The unit adopts twin-screw compressor designed with the most advanced, industrial third-generation asymmetric technology of 5 gear teeth to 6 gear teeth. The screw rotor is a patented product based on effective improvement of the German GHH rotor profile. The male and female rotors are designed by using CNC high-precision screw rotor processing equipment, which allows each component to evenly distribute and work in gapless. This minimizes the frictional resistance and ensures the low sound operation and long service life. Compared with single screw compressor, the twin-screw compressor features gapless loss, efficiency in capacity, low noise, and fewer quick-wear parts, which has got the British and American patents.

(2) The differential pressure fuel helps optimize the performance of each movable component in the compressor to achieve the optimal lubrication result without extra oil pump. This saves the complex oil system and makes the entire system simple. Therefore, the maintenance is more convenient and operation is more reliable.

(3) The special high-precision zero clearance bearing ensures the long service life of units.

(4) The SKF compressor bearing from Sweden with long service life is used, ensuring that the screw master units can continuously work more than 30,000 hours for a long term.

1.3.2 Evaporator

Shell-and-tube evaporator adopts high-efficiency heat transfer tubes and special tube layout design. It fully considers the state change, the flow velocity, the pressure drop of the refrigerant in refrigerant condition to ensure sufficient evaporation and strengthen the refrigerating capacity.

1.3.3 Condenser

Copper-fin heat exchanger adopts high- efficiency heat transfer tubes with the feature of high efficiency and so on. The unit is able to adjust the capacity matching with load change to improve the efficiency of compressor, reduce the energy consumption, and increase the unit’s service life.

Fans featuring low noise, stable operation, and slight shaking are installed on the top of condensers, generating low noise and high power.

Aluminous-fin cupreous corrosion resistant tubes are cross banding to supply high coefficient of heat transfer.

1.3.4 Safety Valve

The safety valve of units helps release the dangerous high pressure. To avoid device damage and personal injury, these apparatuses must work in the optimal status.

Therefore, it is necessary to perform the following maintenance tasks:

(1) Disassemble the eduction pipe of the outlet value at least once a year to check whether corrosion, rust, dust, scale deposit, and leakage are found inside the value.

(2) Replace the safety valve instead of repairing it, if corrosion and foreign matter are found.

(3) Check the valve more frequently if the unit is installed in corrosive environment or the safety valve discharges air into corrosive environment.

1.3.5 Economizer

For units with economizer, the cooling capacity and efficiency will be improved through the cooling circulation or two-step cooling circulation. The energy saving effect is noticeable especially at high condensing temperature and low evaporation temperature. The unique economizer access port of screw compressor directly takes the gaseous liquid back to the compressor in the optimum compression ratio for recompression.

1.3.6 Liquid Injection System

The two-step liquid injection system avoids the superheat in case of compressor overload. In addition, the flexible control mode reduces the impact on the energy efficiency of units.

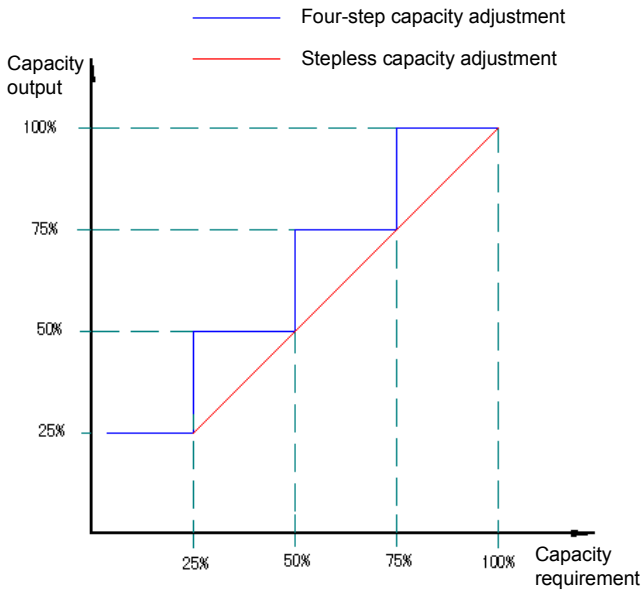
1.3.7 Smart Control

(1) The unit adopts micro-computer controller featuring various automatic control functions such as fault diagnosis, energy management, and antifreeze monitoring, which ensures efficient running and easy operation of the unit. The unit features built-in RS485 communication interface, and multiple units can be controlled through interconnection. With the RS485/RS232 switching interface program, the unit can be controlled by the host computer. The host computer controls the startup/stop of units based on the load requirement and operating time.

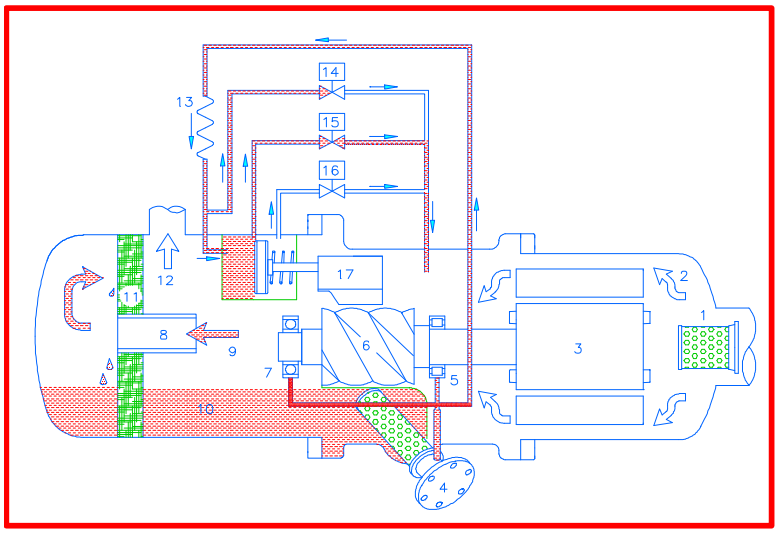
(2) Multiple self-protections ensure the unit’s safe and reliable operation.

1.3.8 Variable Capacity Adjustment, High Efficiency, and Energy Saving

The high-precision capacity control valve traces the unit's load changes and adjusts the refrigerant volume. The capacity adjustment can adopt four-step control mode (25%, 50%, 75%, and 100%) or stepless adjustment (this function must be noted on the order), which saves operating cost for customers.



Capacity adjustment curve



Capacity adjustment diagram for compressor

2 Model, Specifications, and Application Range

2.1 Specifications

2.1.1 Nominal Cooling Capacities

Indoor Unit

Model			MLSC380A-SB3Z	MLSC500A-SB3Z	MLSC600A-SB3Z
Cooling capacity		kW	380	496	594
Cooling input power		kW	124	159	187
Compressor	Type		Semi-hermetic twin-screw compressor	Semi-hermetic twin-screw compressor	Semi-hermetic twin-screw compressor
	Quantity		1	1	1
Energy adjustment mode			Automatic		
Energy adjustment range (%)			(25%, 50%, 75%,100%)		
Refrigerant	Name		R134a		
	Charge (kg)		80	96	135
Power supply			Three-phase five-wire system 380V/3P+N+PE/50Hz		
Safety protection			High pressure/Low pressure/Low water flow/Antifreeze/Motor overload/Low voltage/Open-phase protector/Phase sequence/Oil heater/Safety valve/Oil level		
Water side heat exchanger	Type		Shell-and-tube heat exchanger		
	Water volume (t/h)		65	86	102
	Water side pressure drop (kpa)		50	55	60
	Inlet/outlet pipe diameter (mm)		DN125		
Water side fouling factor (m^2.k/kw)			0.086 (m^2.k/kw)		
Unit dimensions (mm)		Length	3300	3500	3500
		Width	1200	1200	1200
		Height	1830	2113	2130
Unit weight (kg)			2586	2790	3020
Running weight (kg)			2786	2990	3220

Notes:

(1) **Nominal cooling capacities are based on the following conditions: Chilled water inlet/outlet temp: 12℃/7℃; Indoor temp: 35℃.**

(2) **Only performance parameters of the basic module are listed. You can obtain performance parameters of unit combinations by referencing the listed parameters.**

(3) **The design pressure on the chilled water side is 1.0 Mpa.**

(4) **The preceding specifications may be changed due to continuous improvement of products. The specifications on product nameplates and physical objects shall prevail.**

(5) **The "Cooling input power" item include fan power.**

Outdoor Unit

Model			MRH380A-B3Z	MRH500A-B3Z	MRH600A-B3Z
Power supply			Three-phase five-wire system 380V/3P+N+PE /50Hz		
Air side heat exchanger	Type		Internal threaded pipes + aluminum fins		
	Fan Quantity		6	8	10
	Air volume (m^3/h)		23000x6	23000x8	23000x10
	Motor input power (kW)		2.4x6	2.4x8	2.4x10
	Unit dimensions (mm)	Length	3500	4491	5600
		Width	2280	2280	2280
		Height	2370	2370	2370
Unit weight (kg)			1360	2070	2390
Running weight (kg)			1380	2090	2410

Notes:

(1) **Nominal cooling capacities are based on the following conditions: Chilled water inlet/outlet temp: 12℃/7℃; Outdoor temp: 35℃.**

(2) **Only performance parameters of the basic module are listed. You can obtain performance parameters of unit combinations by referencing the listed parameters.**

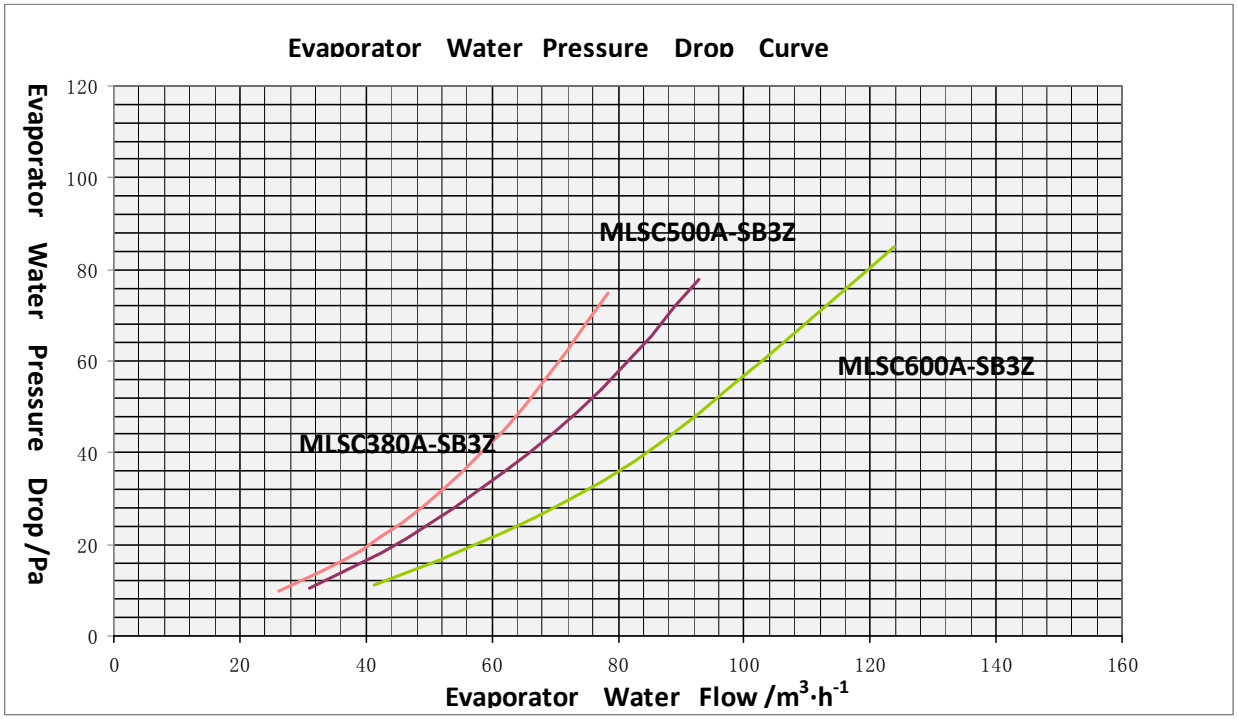
(3) **The design pressure on the chilled water side is 1.0 Mpa.**

(4) **The preceding specifications may be changed due to continuous improvement of products. The specifications on product nameplates and physical objects shall prevail.**

2.2 Application Range

Content	Running Range
Ambient temp.	10℃–43℃
Outlet water temp.	5℃–15℃
Water flow volume	Rated flow volume±20%
Max inlet/outlet water temp. difference	8℃
Voltage tolerance	Rated voltage±10%
Phase tolerance	±2%
Power supply frequency	Rated frequency±2%
Evaporator max working pressure on water side	1.0 MPa
Compressor max. start count	6 times/h
Environment quality	High corrosive environment and high humidity should be avoided.
Drainage system	The height of water drainage should not be higher than the base of the unit on the spot.

3. Evaporator Pressure Drop Curve



4. Accessories and Models with Special Features

4.1 Standard Accessories

S/N	Name	Unit	Quantity	Specifications
1	Product certificate	Piece	1	
2	User manual	Piece	1	
3	Water flow controller	Piece	1	G1"
4	Packing list	Piece	1	

4.2 Optional Accessories

S/N	Name	Unit	Quantity	Specifications
1	Water switch	Piece	As required by customers	
2	Spring shock absorber	Piece	See the foundation diagram in section 7.2.2.	

4.3 Models with Special Features

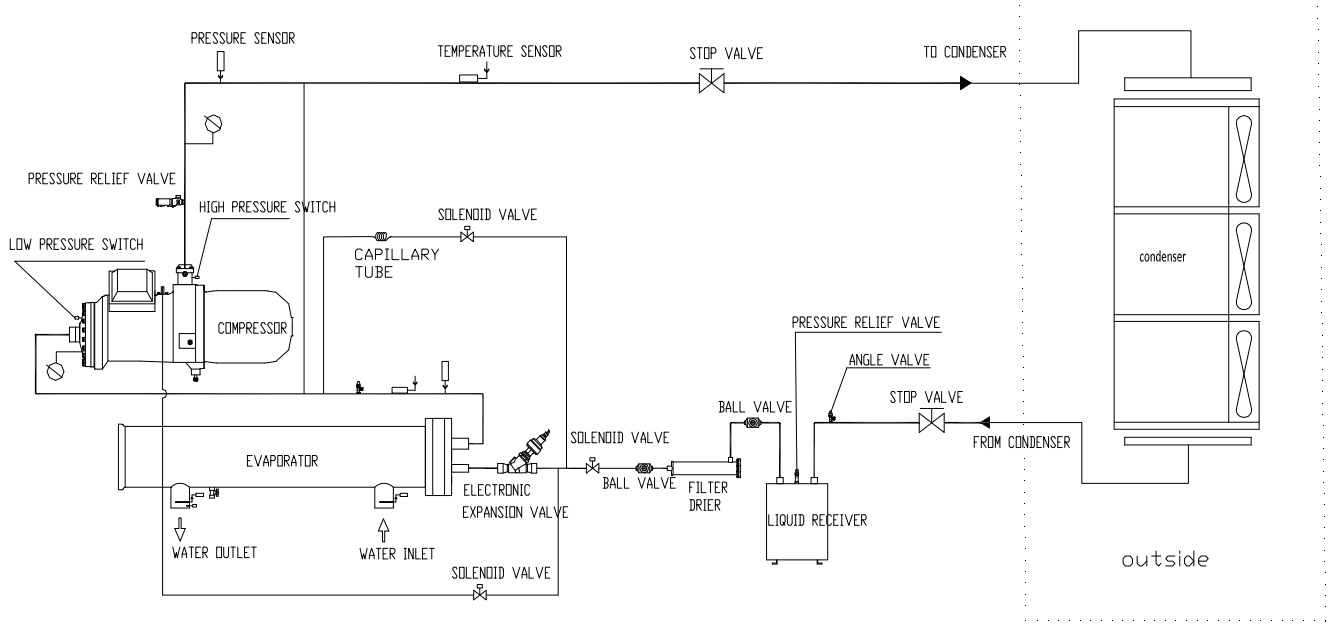
Certain models with special features can provide specific functions to meet various requirements of customers.

S/N	Type	Function	Contents of Order
1	High-temperature refrigerating unit	The maximum allowed ambient temperature for refrigerating is 48°C.	The maximum ambient temperature is specified.
2	Ultra-temperature unit	The maximum allowed ambient temperature for refrigerating is 56°C.	The maximum ambient temperature is specified.
3	Partial heat-recovery unit	The heat of condensation released by the unit that can be partially recovered.	The heat recovery capacity is specified.

5 Operating Principle

Air source screw water chiller comprises five major components including the compressor, finned heat exchanger, electronic expansion valve, shell-and-tube heat exchanger, and electric control system, and some auxiliaries such as the economizer. The basic circulation principle of the unit is shown in the following figure.

Operating principle of MLSC_A series units

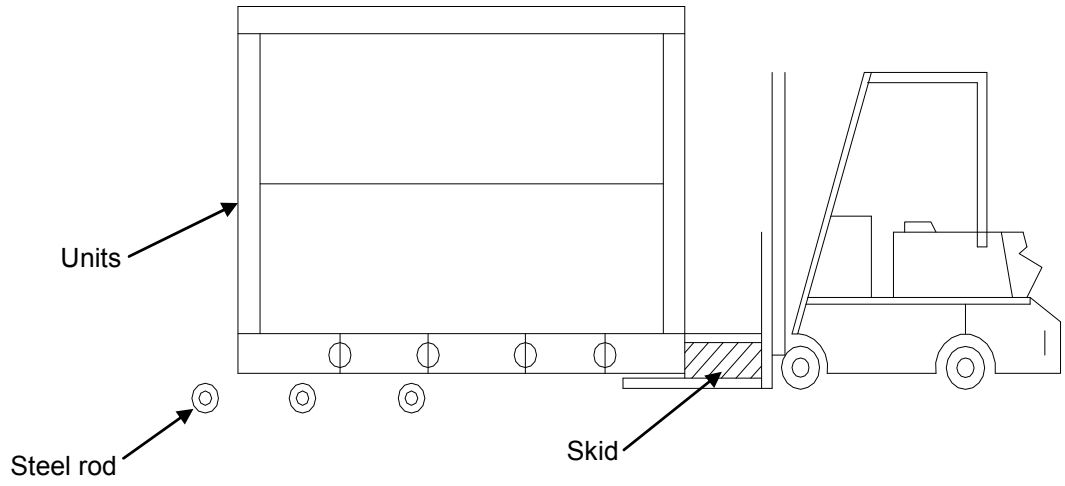


6 Installation

6.1 Loading/Unloading and Hoisting (Diagram)

(1) Units should be loaded and unloaded carefully to avoid causing damage to unit components. Use a crane to load and unload units and use a forklift for short-distance transportation. A skid can ensure that the weight of units is evenly distributed on the base. In addition, three to six steel rods can be placed under the unit base to help slowly move the units, as shown in the following figure.

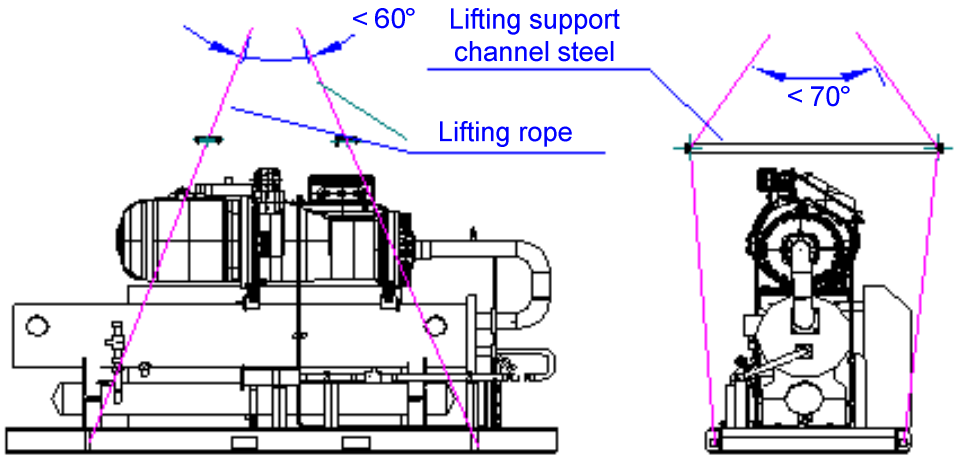
Diagram for horizontal movement



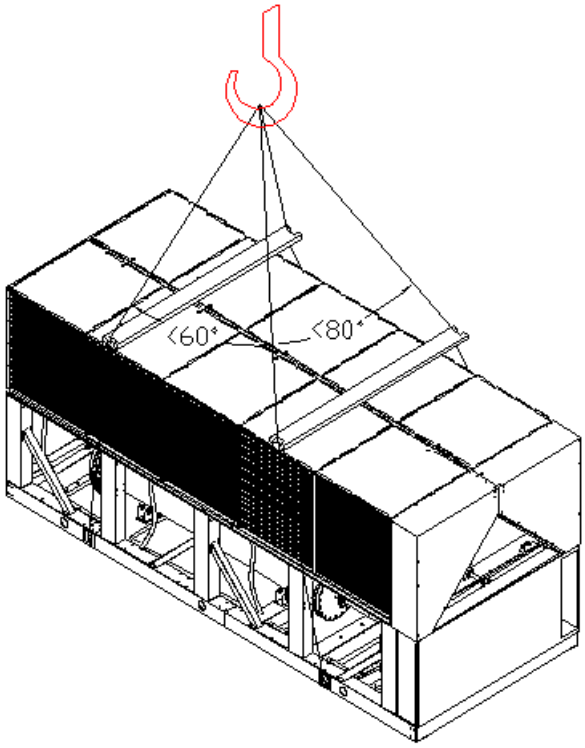
(2) To hoist the units, pay attention to the following instructions:

- Choose a suitable crane based on the unit's weight (buy insurance for it if possible).
- Hoist the unit by using the method shown in the following figure. The steel rope shall wind the lifting hook one circle to prevent danger due to steel rope slipping when the weight is unbalanced.
- Use an enlargement pole to prevent sling damage to the unit.
- Strictly abide by the local safety regulations during hoisting. Only relevant personnel are allowed within the construction area. It is forbidden to stand under the crane or the lifted units.

Indoor units hoisting



Outdoor units hoisting

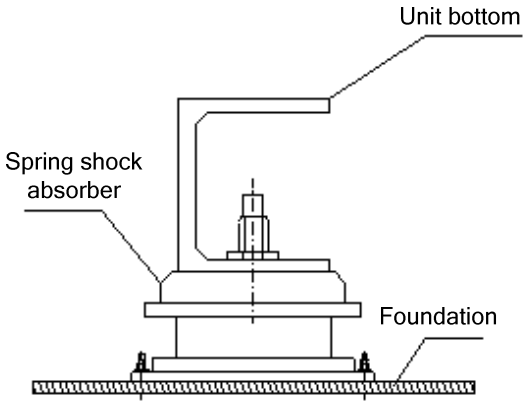


6.2 Requirements for Foundation Installation and Diagrams of Foundation

6.2.1 Requirements for Foundation Installation

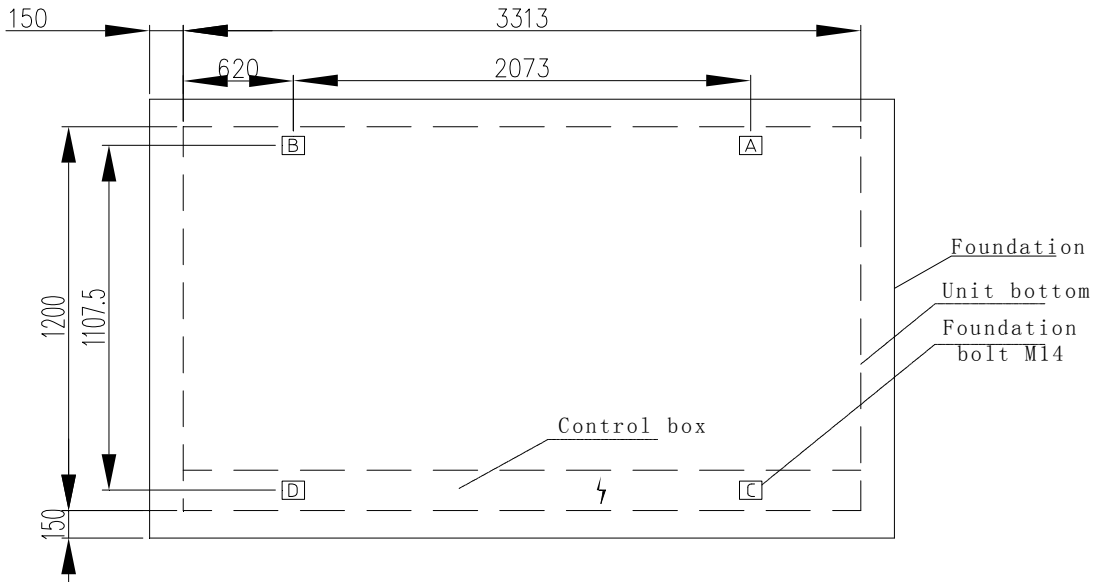
Air-cooled screw units should be installed outdoors, for example, on the rooftop, ground, or near the buildings. Units must be installed on a solid foundation. A block of concrete slab is recommended, whose load-bearing capacity must be sufficient to withstand all the units, as well as the weight of maintenance personnel.

A spring shock absorber must be installed between the unit base and the foundation to avoid unit vibration and to prevent noise during unit installation. The position for placing the spring shock absorber and the points for load bearing are shown in the following figure.



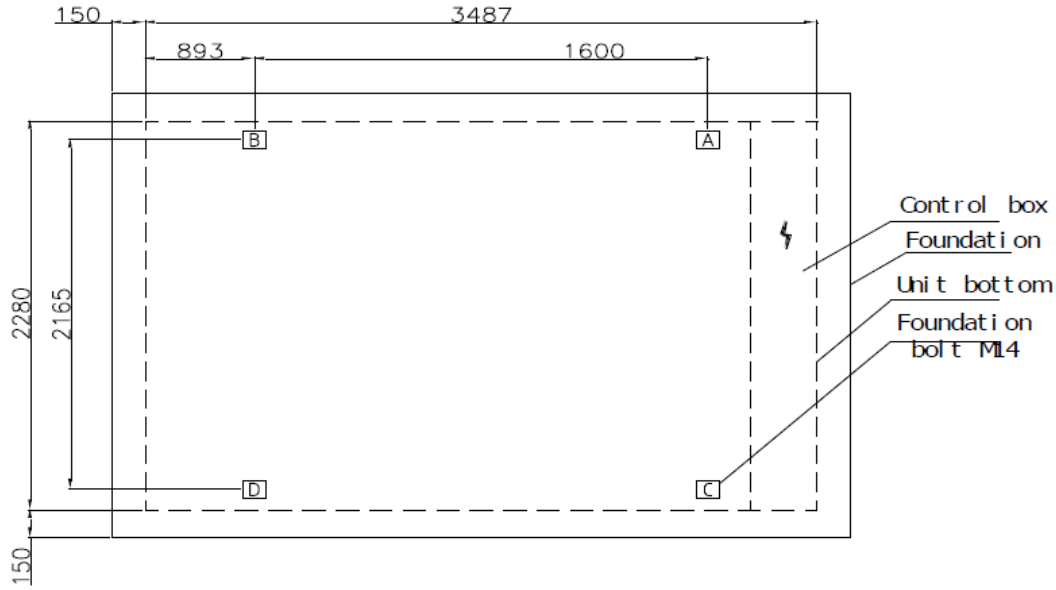
6.2.2 Diagrams of Foundation MLSC380A

Indoor unit



Model	Weight to be supported by spring isolator (kg)			
	A	B	C	D
MLSC380A-SB3Z	MHD-850	MHD-850	MHD-850	MHD-850

Outdoor unit



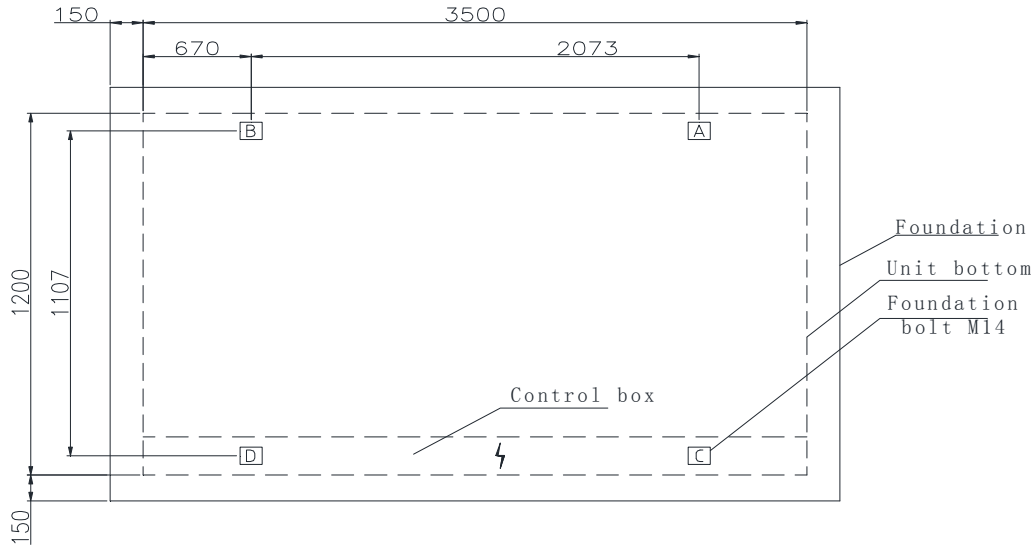
Model	Weight to be supported by spring isolator (kg)			
	A	B	C	D
MRH380A-B3Z	MHD-650	MHD-650	MHD-650	MHD-650

Notes: 1. The spring shock absorber is optional.

2. The value in the type of spring shock absorber indicates the maximum weight that the spring shock absorber can bear (unit: kg). For example, the number 1050 in MHD-1050 indicates that the maximum weight that the spring shock absorber can bear is 1050 kg.

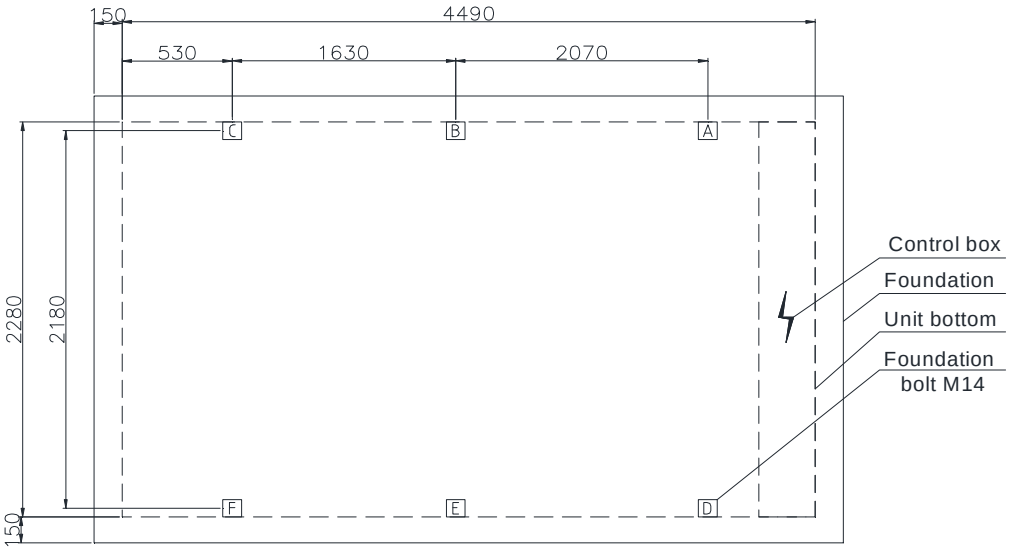
MLSC500A

Indoor unit



Model	Weight to be supported by spring isolator (kg)			
	A	B	C	D
MLSC500A-SB3Z	MHD-1050	MHD-1050	MHD-1050	MHD-1050

Outdoor unit



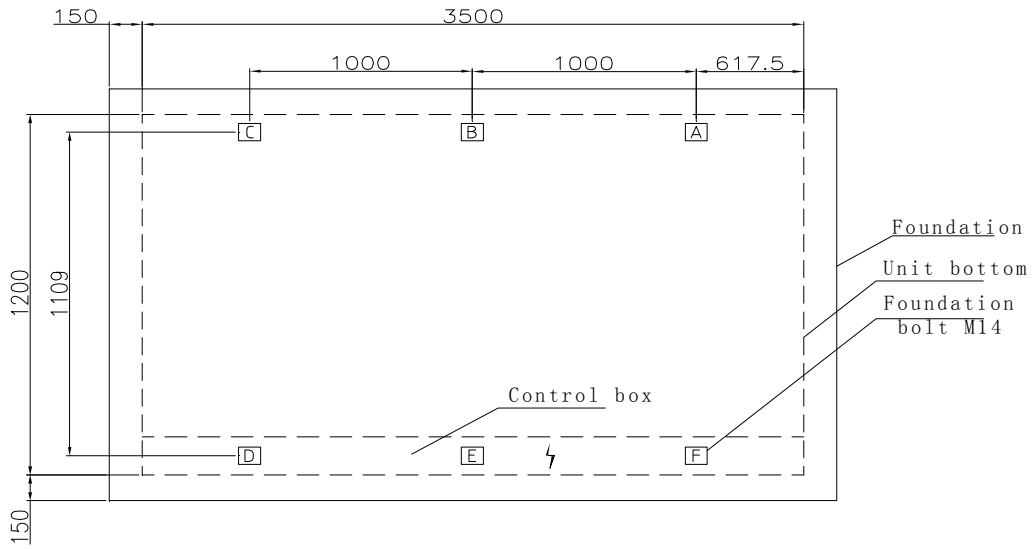
Model	Weight to be supported by spring isolator (kg)					
	A	B	C	D	E	F
MRH500A-B3Z	MHD-650	MHD-650	MHD-650	MHD-650	MHD-650	MHD-650

Notes: 1. The spring shock absorber is optional.

2. The value in the type of spring shock absorber indicates the maximum weight that the spring shock absorber can bear (unit: kg). For example, the number 1050 in MHD-1050 indicates that the maximum weight that the spring shock absorber can bear is 1050 kg.

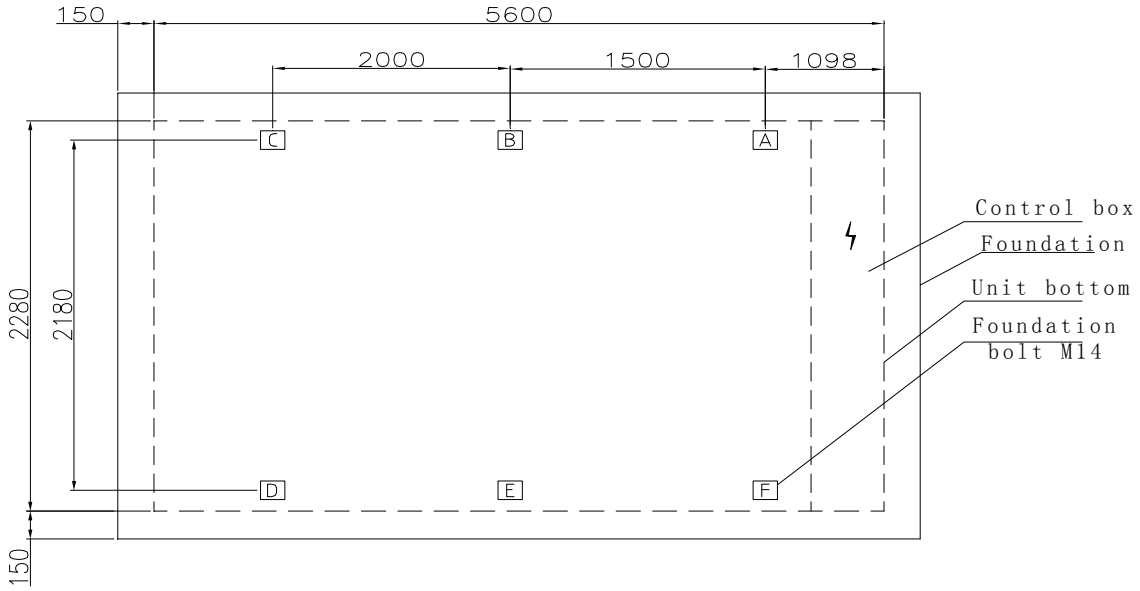
MLSC600A

Indoor unit



Model	Weight to be supported by spring isolator (kg)					
	A	B	C	D	E	F
MLSC600A-SB3Z	MHD-850	MHD-850	MHD-850	MHD-850	MHD-850	MHD-850

Outdoor unit



Model	Weight to be supported by spring isolator (kg)					
	A	B	C	D	E	F
MRH600A-B3Z	MHD-650	MHD-650	MHD-650	MHD-650	MHD-650	MHD-650

Notes: 1. The spring shock absorber is optional.

2. The value in the type of spring shock absorber indicates the maximum weight that the spring shock absorber can bear (unit: kg). For example, the number 1050 in MHD-1050 indicates that the maximum weight that the spring shock absorber can bear is 1050 kg.

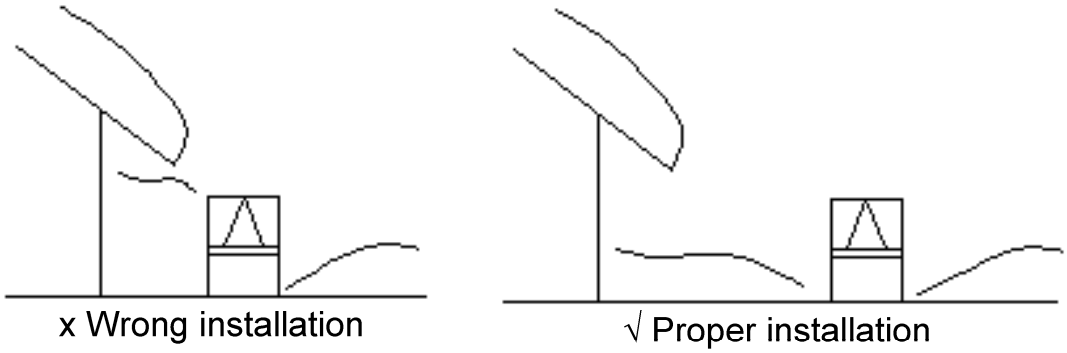
6.3 Installation Space and Appearance

6.3.1 Installation Space Requirements for Outdoor Units

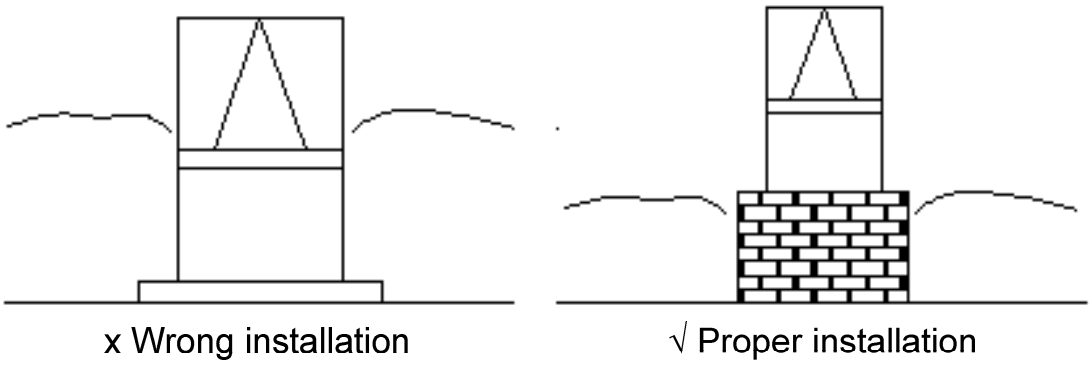
Enough space must be left around units and between units to ensure sufficient fresh air for air-side heat exchangers in units. In addition, the places around units must be kept clean without blocks. Otherwise, units maintenance could be inconvenient.

In areas where snows might fall in the winter, the following instructions should also be followed during unit installation:

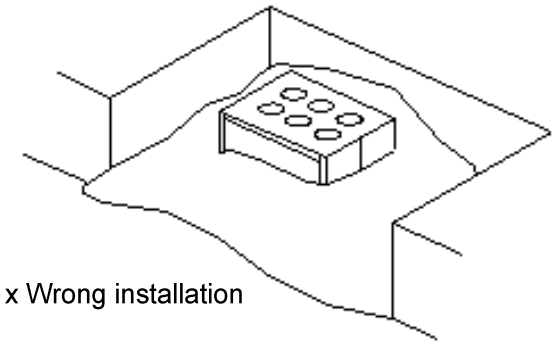
(1) Do not install units under an eave of a house.



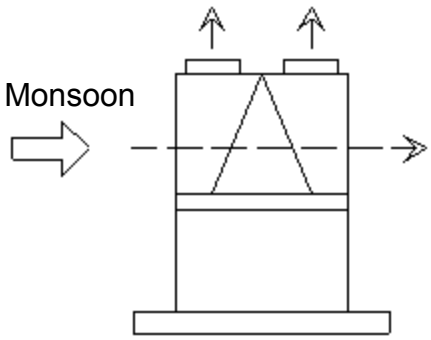
(2) Raise the foundation according to the possible snow height. (The foundation must be at least 1 m higher than the maximum snow height.)



(3) Do not install the unit at a place that might be piled with snow.



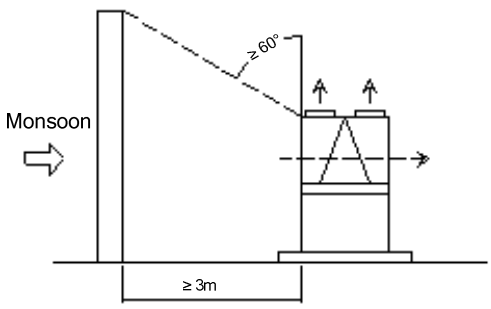
In areas where strong monsoon exists, if the unit's heat exchanger faces the direction from which the monsoon comes, the air flow will occur when the monsoon wind velocity is higher than the fan blowing velocity, as the dashed arrow shown in the following figure.



As a result, the cooled air flow will be cooled by another heat exchanger again. The refrigerating capacity will reduce and the unit can be faulty. Although air-cooled screw water chiller units have been designed to reduce the possibility of such circumstances, avoid installing the heat exchanger directly to the monsoon direction during unit installation.

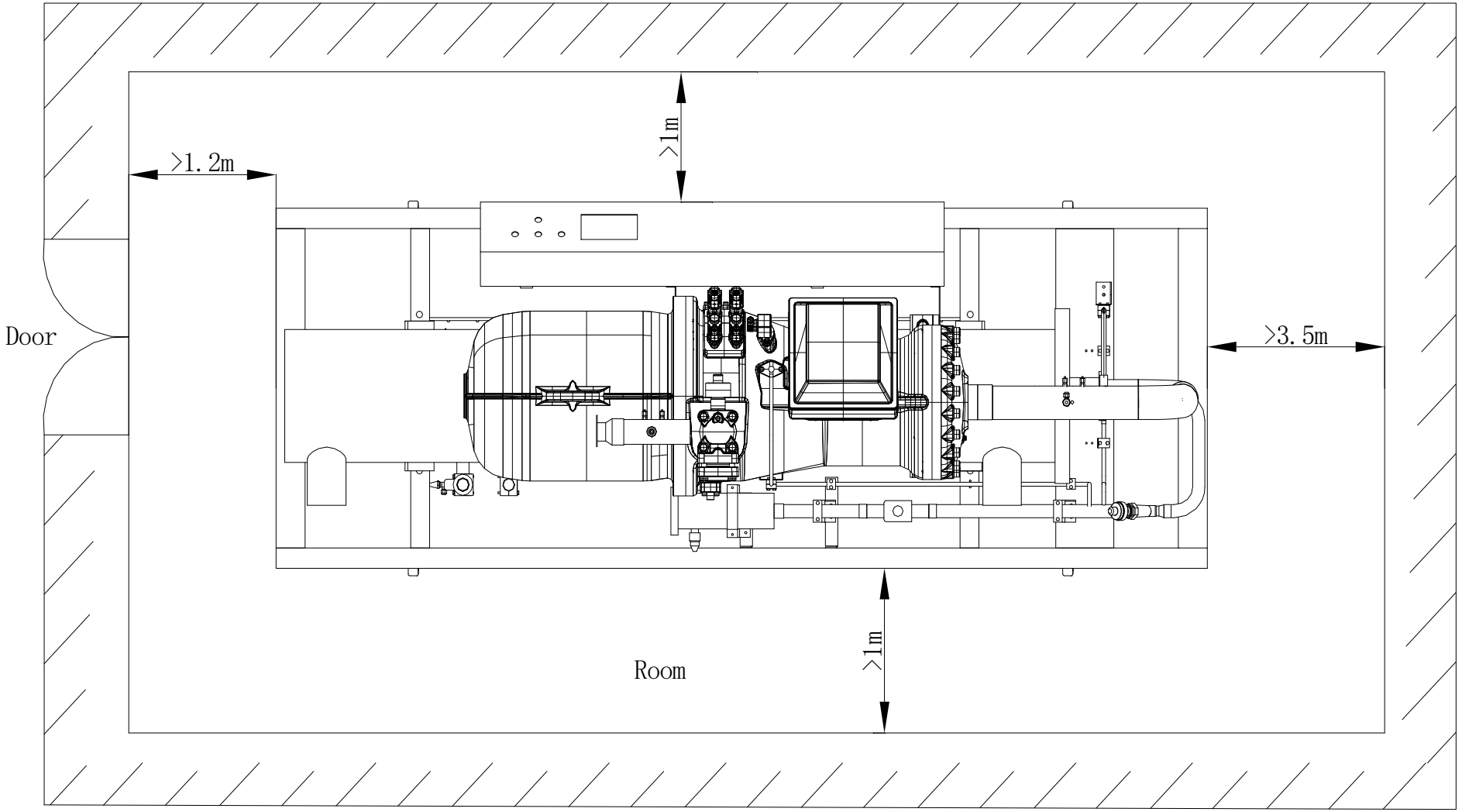
If the heat exchanger must be installed facing to the monsoon direction due to geological limitations, a windbreak must be installed.

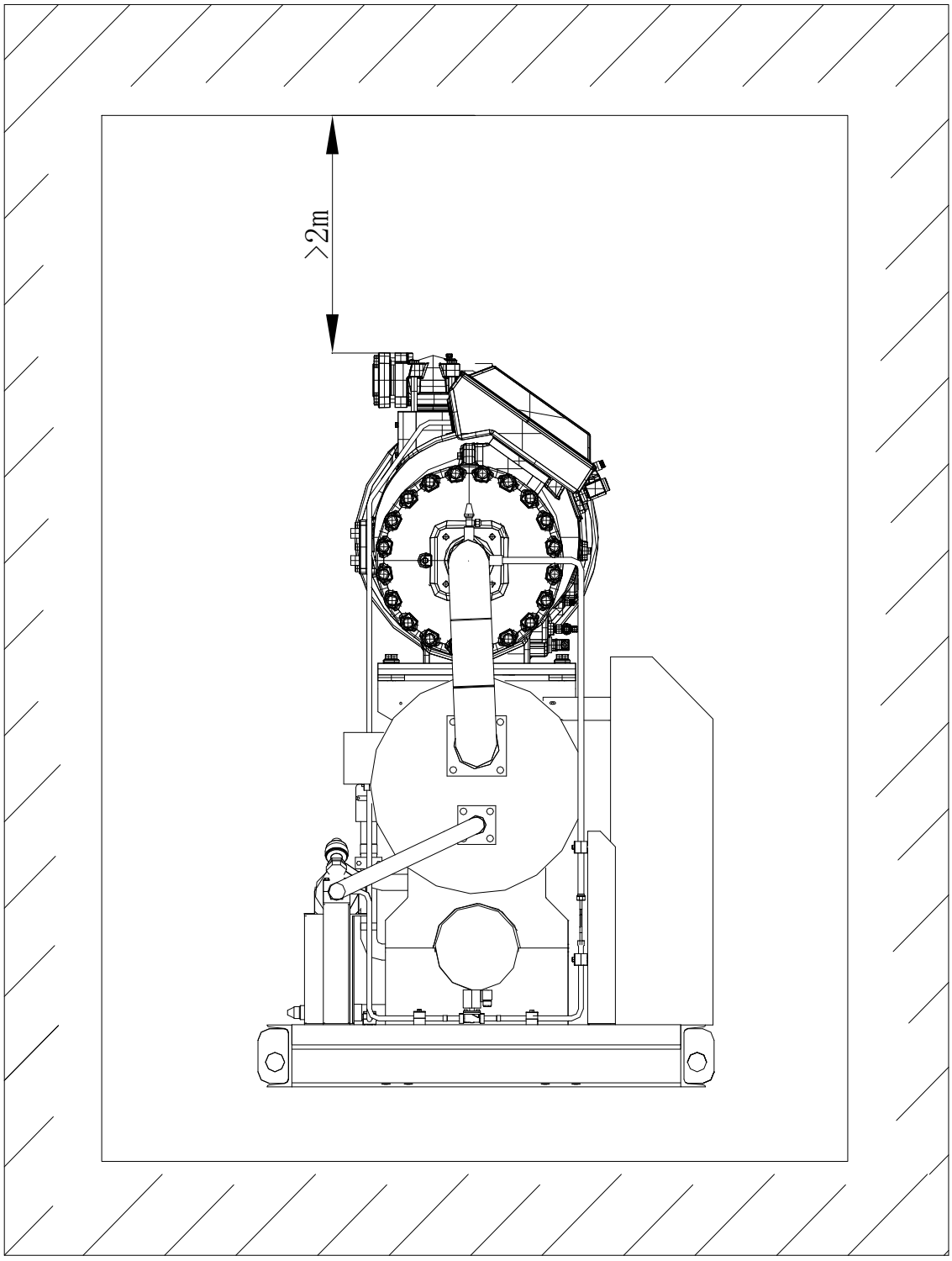
Windbreak installation



(4) Requirements for installing indoor units are as follows:

1. The distance between the power control cabinet and the windbreak must be larger than 1,000 mm.
2. The distance between the unit and the windbreak on the side of shell-and-tube end caps must be larger than 3,500 mm.
3. The distance between the unit and the ceiling must be larger than 2,000 mm.


≥1m
≥1.2m
Door
≥3.5m
Room
≥1m


≥2m

6.3.2 Installation Requirements for the Pipe Connection Between Outdoor Units and Indoor Units (Supplementary)

6.3.2.1 Basic Piping Requirements

Operation processes are as follows:

Specify pipe route and dimensions based on the construction drawing → Prepare and install the pipe supports, hangers, and brackets → Prepare and place the pipe components → Perform nitrogen protection → Braze → Clean pipes → Test the air tightness → Seal the pipes with insulation materials → Perform vacuum drying

6.3.2.2 Piping Principles for Refrigerants

Item	Cause	Handling Procedure
Dryness	Meteoric water ingress\Engineering water ingress\Condensate water generated in the pipe	Standardize the processing of auxiliary pipes. → Blast → Vacuum
Cleanness	Products of oxidation in the pipe during welding, dust, and foreign matters	Introduce nitrogen when welding. Keep clean in processing the auxiliary pipes. → Blast
Gas tightness	Imprecise welding\Unqualified joint seal\Edge leakage	Use qualified welding rods. Strictly follow the welding operation specification. Strictly follow the interface operation specification. → Gas tightness test

6.3.2.3 Horizontal Pipe Fixing

Refrigerant pipes may be deformed during the operation of air conditioners. For example, the length and direction of pipes may change. Hangers or brackets can be used to support the pipes. The installation instruction is shown in the following table.

Pipe Diameter (mm)	< Φ60	Φ60-80	> Φ80
Distance Between Points of Support (m)	3	3.5	4

Typically, the gas pipe and liquid pipe must be suspended in parallel. The distance between points of support is determined based on the diameter of the gas pipe. The temperature of flowing refrigerant varies with the unit's operation and working status, and the refrigerant pipe expands when heated and contracts when cooled. Therefore, proper spaces must be left for the pipes after thermal insulation measures are taken. Otherwise, copper pipes may break due to stress concentration.

6.3.2.4 Riser (Vertical Pipe) Fastening

Risers are fastened along walls. Round mooma, instead of common insulation materials, is used at pipe straps. U-shaped pipe straps are installed outside the mooma. Anti-corrosion processing of mooma is required.

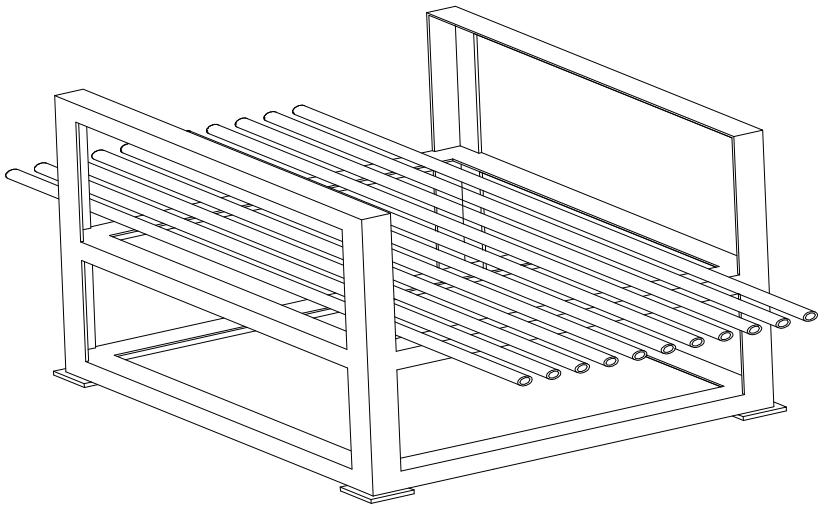
Pipe Diameter (mm)	< Φ60	Φ60-80	> Φ80
Distance Between Points of Support (m)	2.5	3.0	3.5

6.3.2.5 Local Fixing

Local fixing is required near the branch pipe, end pipe, and through hole on the wall to prevent stress concentration due to the stretching of pipes.

6.3.2.6 Moving and Storing of Pipes

1) Do not break the pipes when they are moved to the construction site.
2) Use end caps or adhesive tapes to seal pipe ends before the pipes are stored.
3) The coil must be placed vertically. Otherwise, the coil may become deformed due to its own weight.
4) Use wooden supports or acceptable substitutes to ensure that the copper pipes are placed at a place higher than the floor. This can prevent the pipes from being stained by dust or water.
5) Anti-dust and water-proof measures must be taken on both ends of pipes.
6) Pipes must be placed on a specified shelve in the construction site, or be placed in a specified area and looked after by a specified person.



6.3.2.7 Pipe Sealing

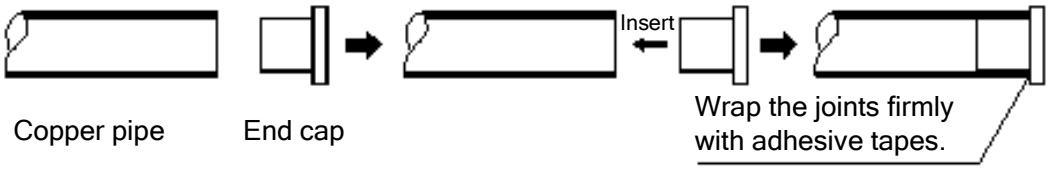
1) **Optional measures of sealing are as follows:**

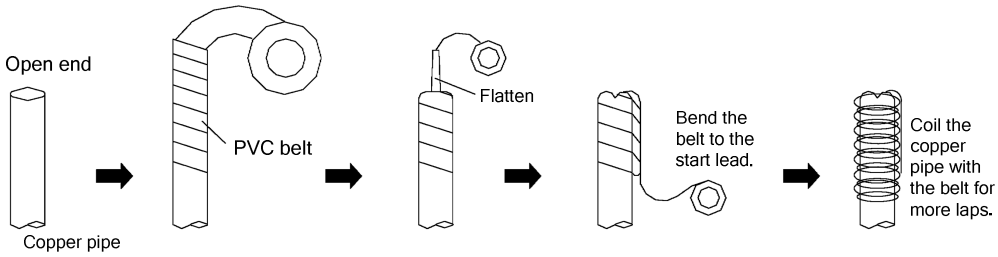
(1) Use end caps and adhesive tapes (for short-period storing)

(2) Solder sealing (for long-time storing)

Note: Copper pipes must be sealed at any time during on-site construction as required.

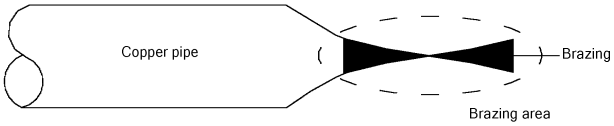
- Sealing with end caps and adhesive tapes





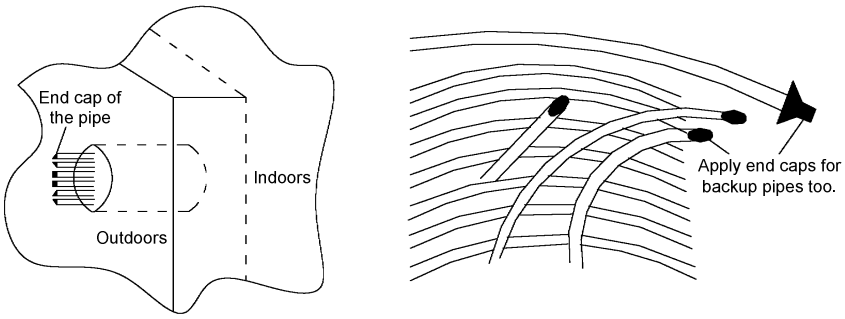
This method is recommended.

- Solder sealing



2) **Pay attention to the following operations:**

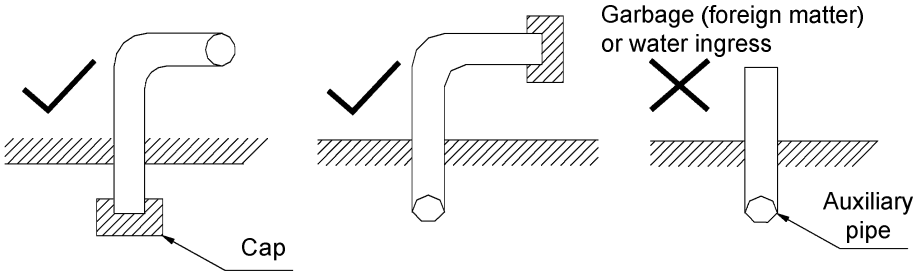
(1) Dirt might be brought in when the pipe passes through a hole.



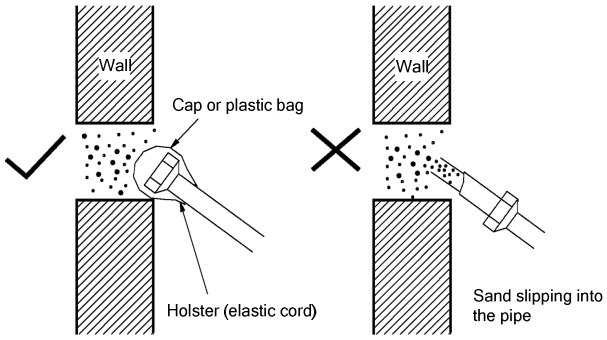
(2) Rain water might enter the copper pipe through the outdoor parts of the pipe, especially when the pipe is installed vertically.

(3) Pipe ends must be covered before finishing the pipe connection.

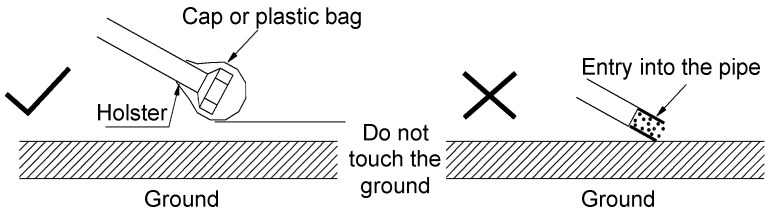
(4) Place the pipe ends horizontally or downward.



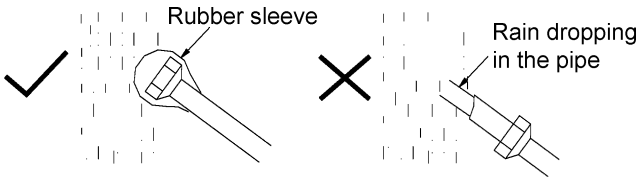
(5) Cover the pipe end temporarily when the pipe is being installed through a wall.



(6) Do not directly place the pipe on the ground. Do not rub the pipe against the ground.



(7) In the case of rain, cover the pipe end before installation.



6.3.2.8 Copper Pipe Processing

1) Pipe Cutting

(1) Tool

Use a drill-pipe cutter, instead of a saw or cutting machine to cut the copper pipe.

(2) Correct operation procedure

Turn the drill-pipe cutter slowly while keep stressing. The copper pipe can be cut without being deformed.

(3) Reasons for not using a saw or cutting machine for pipe cutting

If a saw or cutting machine is used, copper cuttings remained in the pipe may be brought into the compressor and block the flow control components.

2) Copper Pipe End Trimming

(1) Purpose

Remove the burr on pipe ends and clean the inner space of pipe. In this way, no scratch will occur on the sealing interface during pipe end expansion.

(2) Operation method

① Use a scraper to remove the burr in the inner side of the pipe end. Slope the pipe downwards; otherwise, copper cuttings may enter the pipe.

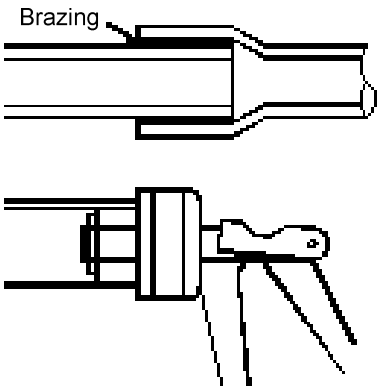
② Chamfer the pipe, and then use cotton gauze to clean the copper cuttings inside the pipe.

③ Do not make any scratches. Otherwise, the pipe may break during end expansion.

④ Cut the part that is severely deformed and start from a new end.

3) Pipe Expanding

1. Purpose: Expand the pipe end to enable the insertion of copper pipe. In this way, less soldering point is required.
2. Note: Parts for connection must be smooth. Remove the burrs in the inner side of pipe end.
3. Operation method: Insert the head of the pipe expander into the pipe. After the pipe is expanded, view the copper pipe from another angle and maintain the pipe end and left a straight line mark.



6.3.2.9 Soldering

Nitrogen protection during copper pipe soldering

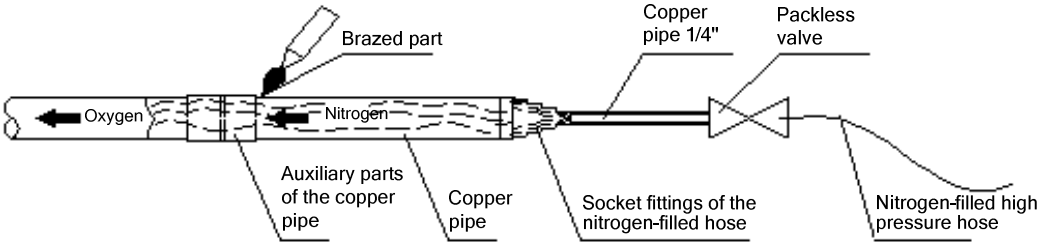
1) Purpose: Prevent the generation of oxide skin inside the copper pipe due to high temperature.

2) Disadvantages of soldering without nitrogen protection:

Without sufficient nitrogen being filled into the refrigerant pipe that is being brazed, the inner surface of copper pipe will be oxidized. The generated oxide will block the refrigerant system and deteriorate the lubricant in the compressor. As a result, the compressor will burn and the performance of air conditioner will decrease.

Therefore, nitrogen must be filled into the refrigerant pipe continuously during soldering. Ensure that the nitrogen flow can reach every soldering point until the soldering is finished and the copper pipe returns to the ambient temperature. Set the nitrogen pressure appropriately. Excessive pressure may cause bubble

and blisters at soldering points, or even soldering failure. Nitrogen protection diagram is as follows.



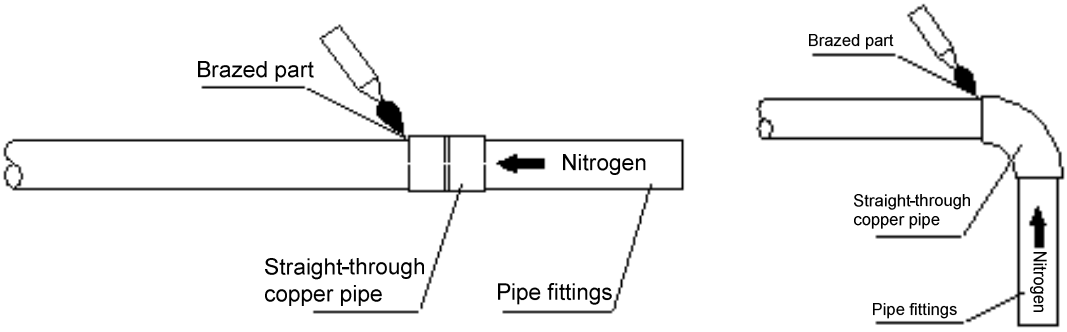
3) Preparing the connector of nitrogen-filled hose

Connect the nitrogen-filled hose to the pipe component to be soldered and seal all other pipe ends except for the soldering end which is used for nitrogen filling.

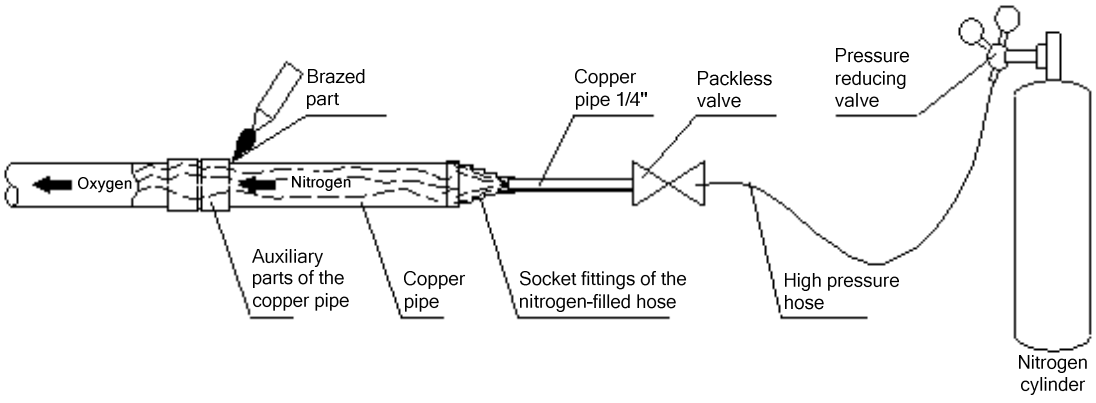
4) Precautions for soldering pipe components

(1) Use the transition fitting instead of flared pipe to connect pipe components.

(2) Fill in the nitrogen from the short pipe side to get a better nitrogen replacement.



5) Standard soldering operations



6) Operation requirements

(1) During soldering, the nitrogen pressure must be controlled within the range of 0.2 kgf/cm² to 0.3 kgf/cm².

(2) Only nitrogen is used. Do not use oxygen or other inflammable or combustible gases. Otherwise, explosion may occur.

(3) A pressure reducing valve is required. The pressure of filled-in nitrogen must be 0.2 kgf/cm².

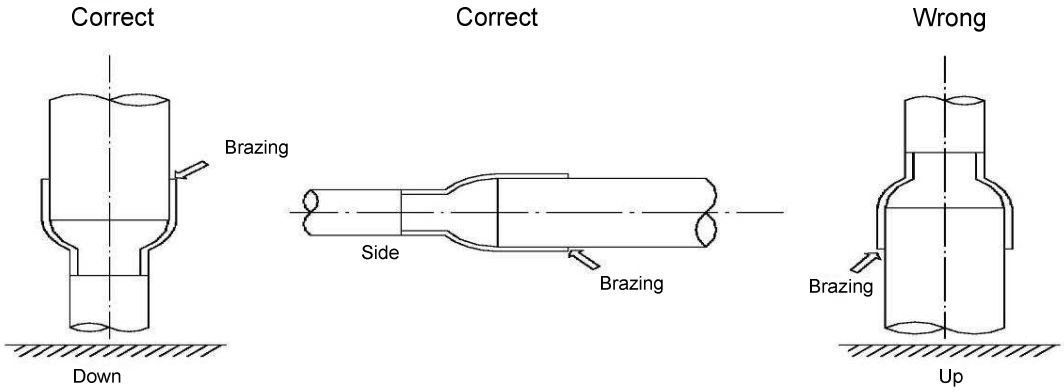
(4) Select a proper place for nitrogen filling.

(5) Ensure that the nitrogen flow can pass the soldering point.

(6) If the distance between the place where nitrogen is filled in and the soldering point on the pipe, fill in enough nitrogen and ensure that all nitrogen flow at the soldering point can be vent.

(7) Keep filling nitrogen after the soldering is completed until the pipe returns to the ambient temperature.

(8) The soldering should be performed from top to bottom, or horizontally. Avoid face-down bonding.



7) Precautions

(1) Watch out for fire during soldering (prepare fire extinguishers as required).

(2) Be careful during soldering and avoid being burned.

(3) Leave proper distances between pipe sockets.

6.3.2.10 Pipe Blowing

1) Blowing of copper pipe

(1) Principle of operation: Blow pressure gas into pipes (raw material pipes or soldered components) to remove the dust and water inside the pipes. (Solid impurities cannot be removed; therefore, relevant protective measures must be taken during implementation.)

(2) Purpose

① Remove the oxide power or part of the oxide skin inside the copper pipe.

② Remove the impurities and moisture inside the pipe.

(3) Reason

If pipe blowing is not performed, solid impurities and water inside the pipes cannot be removed. As a result, ice plug, filth blockage, compressor failure, and other severe problems may occur.

2) Preparation

(1) Install the pressure regulator valve on the nitrogen cylinder. (Use nitrogen instead of any other gas, because Polyter afuoroethyenea or carbon dioxide may cause condensation, and oxygen may cause explosion.)

(2) Use a gas tube to connect the outlet of pressure regulator valve and the inlet of gas pipe/liquid pipe of outdoor unit.

(3) Block the joint of copper pipe with a blind plug and blow each branch pipe. During soldering, blow and clean each pipe after the pipe is soldered. When all pipes are soldered, clean the pipe system again.

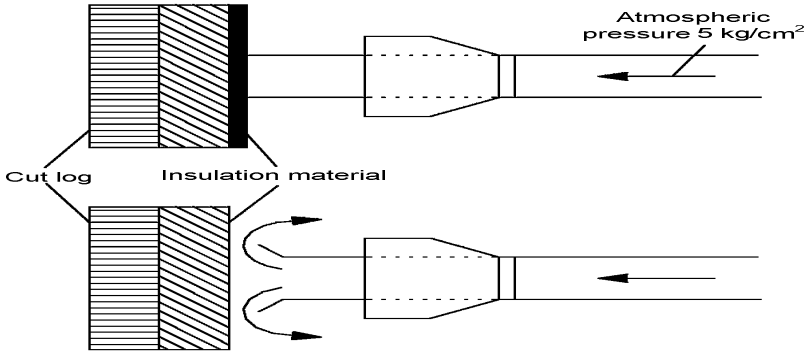
(4) Open the valve of the nitrogen cylinder and set the regulator valve to 5 kgf/cm2.

3) Operation procedure

(1) Use proper plugging materials (for example, a wood brick wrapped with cotton cloth) to block the end of the major air pipe of indoor unit.

(2) Release the plugging materials suddenly when you cannot resist the pressure in the pipe. Until now, the pipe is blown and cleaned for one time.

Then, repeat step 1 and step 2 to blow and clean the pipe many times.



(3) Put a piece of cotton cloth loosely near the pipe end. In this way, you can detect the dirt and

moisture that are cleaned out from the pipe and clean the pipe thoroughly.

Specific measures are as follows:

① Use nitrogen to flush dirt and moisture out of the pipe.

② Perform vacuum drying.

③ Close the main valve of the nitrogen cylinder.

④ Repeat the preceding steps on all connection copper pipes of indoor unit.

⑤ When all pipes are connected and a pipe system is formed, blow and clean the pipe from the far end. That is, the end of the pipe that is the farthest from the master unit.

⑥ Cover all pipe ends that are directly exposed to the external environment when the blowing and cleaning process is finished. Otherwise, dusts, foreign matters, and moisture may enter the pipes again.

6.3.2.11 Air Tightness Test

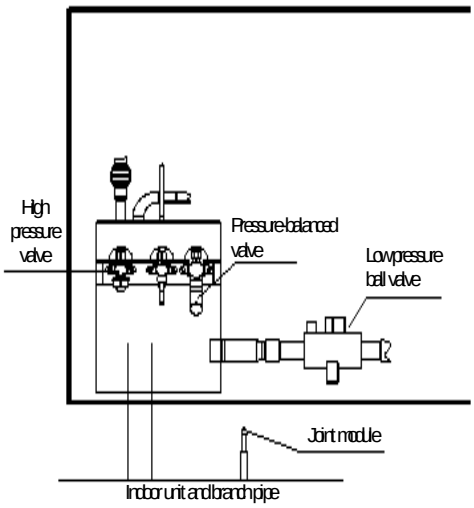
6.3.2.11.1 Purpose and Operational Sequence

1) Purpose

Check the leak source and ensure that no leakage exists in the entire system. In this way, no system failure due to refrigerant leakage will occur.

2) General principle

Inspections in different phases, pressure maintaining for the entire system, and pressure increasing in steps.



3) Operational sequence

(1) Connect the pipes of outdoor unit. Then, use a U-shaped connector to connect the gas pipe and liquid pipe. Meanwhile, increase the air pressure in the pipe by injecting dry nitrogen.

(2) Connect a copper pipe with a joint to the gas pipe or liquid pipe to allow the nitrogen flow.

(3) Inject nitrogen from the joint and start the air tightness test.

6.3.2.11.2 Operation Steps

1) Precautions

(1) Ensure that the valves of gas pipe and liquid pipe are closed. Do not open the ball valve on the indoor unit during pressure increasing, because nitrogen may enter the circulation system of indoor unit.

(2) For a refrigerant system, increase the pressure slowly from both sides of gas pipe and liquid pipe by sequence.

(3) Only dry nitrogen can be used as the medium for air tightness test. The pressure increasing in difference phases is shown in the following table.

S/N	Phase (Pressure Is Increased in Different Phases)	Acceptance Criterion
1	Phase one: Large leak sources can be detected if the air pressure is kept at 3.0 kgf/cm^2 for over three minutes.	No pressure drop after pressure correction
2	Phase two: Relatively large leak sources can be detected if the air pressure is kept at 12.0 kgf/cm^2 for over three minutes.	
3	Phase three: Tiny leak sources can be detected if the air pressure on R134a is kept at 20.0 kgf/cm^2 for over 24 hours.	

2) Pressure observation

(1) Increase the pressure of 20.0 kgf/cm^2 on R134a in the pipe and maintain the pressure for 24 hours. If the pressure does not drop after it is corrected based on the temperature change, the test is passed. If the pressure drops, find and repair the leak source.

(2) Compensating method

The pressure increases/drops by 0.1 kgf/cm^2 when the ambient temperature increases/drops by 1°C.

Compensating formula: Actual value = Pressure during pressure increasing + (Temperature during pressure increasing – Temperature during observation) x 0.1 kgf/cm^2

Compare the compensated value with the original pressure to see whether the pressure drops.

(3) Methods for checking leak sources

During the three phases, if pressure drops, use the following methods to find the leak sources:

① Leak detection by ears: Air leakage of large leak sources can be heard.

② Leak detection by hands: Touch pipe connections to feel whether any air leaks.

③ Leak detection by soapsuds: Apply soapsuds on pipes. Bubbles will appear at leak sources.

④ Leak detection by halogen leak detector

A halogen leak detector is used when a tiny leak source is found, or when the leak source cannot be found in the case of pressure drop during pressure increasing test.

a. Set the nitrogen pressure to 2.0 kgf/cm^2.

b. Add the refrigerant and set the pressure to 3.0 kgf/cm^2.

c. Use the halogen leak detector, alkane gas detector, and electric detector to check for leak sources.

d. If no leak source is found, increase the pressure on R134a to 20.0 kgf/cm^2 and check again.

3) Precautions

① Compressed nitrogen (R134a system: 20 kgf/cm^2) is used for the air tightness test.

② Oxygen, inflammable gases, or toxic gases cannot be used for an air tightness test.

③ Wait until the pressure is stable before you record the temperature, pressure, and time (for correction).

④ After the pressure maintaining is finished, reduce the system pressure to 5 to 8 kgf/cm^2 before sealing the pipes.

⑤ Check long pipes section by section.

6.3.2.12 Vacuum Drying

6.3.2.12.1 Purpose and Key Points

1) Purpose

(1) Remove water from the system and avoid ice plug and copper plating (ice plug will cause system malfunction and copper plating will shorten the lifespan of compressor).

(2) Remove incoagulable gas (air) from the system to avoid system components oxidation, system pressure fluctuation and inefficient heat exchange during operation.

(3) Check for system leakage from the opposite direction and keep the negative pressure.

2) Selection of vacuum pump

(1) The extreme vacuum degree must be –756 mmHg or lower.

(2) The displacement must be 8 liter/s or higher.

(3) The precision must be at least 0.02 mmHg.

3) Vacuum drying of pipe

A vacuum pump is used to change the water (liquid) in pipes to gas and remove the gas from pipes. As a result, the pipes are dry. In the case of atmospheric pressure, the boiling point (vapor temperature) of water is 100°C. The water in a vacuum pump has a lower boiling point. When the boiling point is lower than the ambient temperature, the water in the pipe will evaporate.

Boiling Point of Water (°C)	Air Pressure (mmHg)	Vacuum Degree (mmHg)	Boiling Point of Water (°C)	Air Pressure (mmHg)	Vacuum Degree (mmHg)
40	55	-705	17.8	15	-745
30	36	-724	15	13	-747
26.7	25	-735	11.7	10	-750
24.4	23	-737	7.2	8	-752
22.2	20	-740	0	5	-756
20.6	18	-742			

6.3.2.12.2 Vacuum Drying Procedure

1) Methods

Common vacuum drying and special vacuum drying are applicable to different environments.

Note: The vacuum drying procedure must be strictly performed for all systems. Otherwise, ice plug will occur.

(1) **Procedure for common vacuum drying**

① Vacuum drying (the first time): Connect the pressure measuring set to the stop valve of the liquid pipe and gas pipe. Then, start the vacuum pump and keep it running for over two hours. (The vacuum degree should be lower than –756 mmHg.)

② If the vacuum degree cannot reach a value lower than –756 mmHg after two-hours' pumping, it indicates that water or leak source exits in the pipe system. In this case, keep pumping for another one hour.

③ If the vacuum degree cannot reach a value lower than –756 mmHg after three-hours' pumping, check for leak sources.

④ Perform pumping from the directions of both the liquid pipe and gas pipe.

⑤ Vacuum stability test can be performed when the vacuum degree **reaches –756 mmHg**. If the hand of the vacuum gauge does not point to a larger value after one hour, it indicates that no water or leak source exists. If the hand of the vacuum gauge points to a larger value after one hour, it indicates that water or leak source exists.

Note: It is forbidden to remove the pressure gauge during vacuum pressure maintaining process. Otherwise, external air will be taken in.

(2) **Procedure for special vacuum drying**

Special vacuum drying is applicable to the following scenarios:

① Water is detected during the blowing and cleaning of refrigerant pipe.

② Rain water may enter the pipe in the rainy season.

③ Rain water may remain in the pipe since the pipe is not checked for a long time.

④ Rain water may enter the pipe during construction.

The procedure for special vacuum drying is as follows:

a. Vacuum drying (the first time): Keep the pump running for two hours.

b. Vacuum breaking (the first time): Fill nitrogen into the pipe. The pressure is 0.5 kgf/cm^2.

Dry nitrogen can dry out the inner part of pipe. However, the inner part of pipe cannot be thoroughly dried out by using this method if too much water exists. Therefore, avoid water inflow and condensate water during refrigerant piping.

c. Vacuum drying (the second time): Keep the pump running for one hour.

Determining the result: When the vacuum degree is lower than –756 mmHg, the test is passed. If the vacuum degree cannot be lower than –756 mmHg after two-hours' pumping, repeat step b and step c.

Note: Maintain system pressure after vacuum drying is completed. Keep the pipe in vacuum for one hour. If the pressure does not rebound, the test is passed.

6.3.2.13 Refrigerant Recharge

6.3.2.13.1 Procedure

1) Operation steps

(1) Ensure that vacuum drying is completed.

(2) Calculate the amount of refrigerant to be recharged (based on the recommended value, actual liquid pipe dimensions, and length specified in section 7.3.3.1).

(3) Use an electric balance to weigh up the required refrigerant.

(4) Connect the refrigerant cylinder, pressure gauge, and the service valve of outdoor unit with flexible ducts. Vent out the air in the flexible ducts and the branch of pressure gauge. Then, fill in the refrigerant in liquid state.

(5) Write down the amount of recharged refrigerant on the nameplate of the outdoor unit.

Precautions

① The amount of recharged refrigerant must be calculated based on relevant technical instructions specified in the accessories of indoor unit, instead of based on the current, pressure, or exhaust temperature. Because the system current, pressure, and exhaust temperature vary with the ambient temperature and pipe length.

② If the temperature is low, the refrigerant cylinder can be warmed by using warm water or hot air, instead of being heated up above fires.

6.3.2.14 Thermal Insulation

Common thermal insulation is applied to refrigerating devices and pipes. To be specific, devices and pipes are wrapped by solid and porous thermal materials. Together with proper moisture-proof and protective measures, a thermal insulation structure is created. The thermal insulation structure varies with the type of thermal material. Although the thermal insulation performance of this traditional method is not remarkable, the simple structure, convenient construction, and cost effectiveness make it broadly used in the industry.

6.3.2.14.1 Thermal Insulation of Refrigerant Pipe

1) Operation procedure

Refrigerant pipe construction → Thermal insulation (except for the connectors) →
Air tightness test → Thermal insulation of connectors

Thermal insulation of connectors such as the soldering area, expanding area, and flange can be performed only after the air tightness test is passed.

2) Purposes

(1) When the air conditioner is running, the temperature of gas pipe and liquid pipe can be either too high or too low. Without thermal insulation, the refrigerating performance can be affected. In addition, the compressor may be burned.

(2) The gas pipe temperature is very low during refrigerating. If no thermal insulation measure is

taken, condensation may occur and lead to leakage.

(3) During the heating process, the temperature of outlet pipe (gas pipe) is usually high (50°C to 100°C). People may be burned if they accidentally touch the pipe.

3) Selection of thermal materials

Polyurethane foam (flame retardant: B1; heat resistance: over 120°C)

4) Thickness of insulating layer

When d ≥ Φ40 mm (d indicates the external diameter of the copper pipe), δ ≥ 25 mm (δ indicates the thickness of insulating layer).

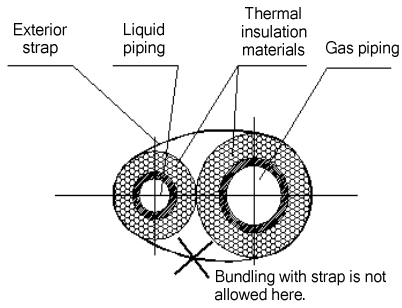
Note: Thicker insulating layer should be used in the hot and humid scenario.

Note: Outdoor pipes must be protected with metal shell to prevent the pipes from the sun, rain, wind, and man-made sabotage.

5) Installation process and precautions

(1) Examples of incorrect operation

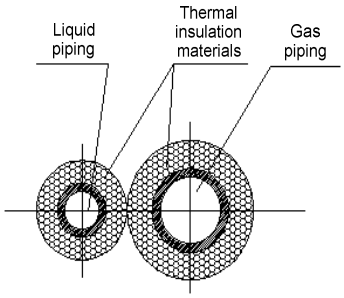
The gas pipe and liquid pipe are bound together. As a result, the insulating performance is bad.



NO

(2) Examples of correct operation

a. Perform thermal insulation on the gas pipe and liquid pipe separately.

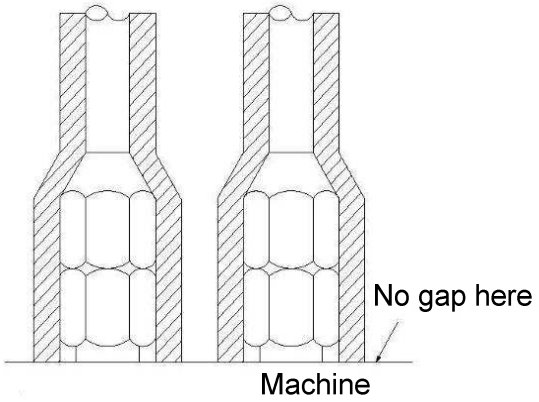


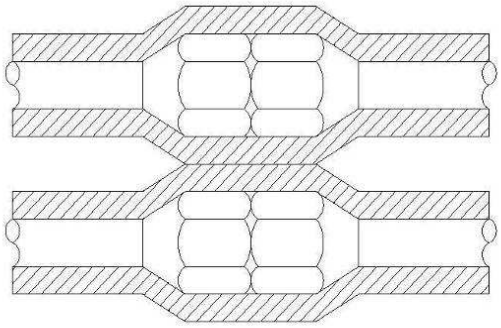
OK

Note: After thermal insulation is performed separately on the gas pipe and liquid pipe,

over-tightened bandage can break the thermal insulation connector. Therefore, do not use bandage.

b. Ensure the insulating performance of pipe connectors.





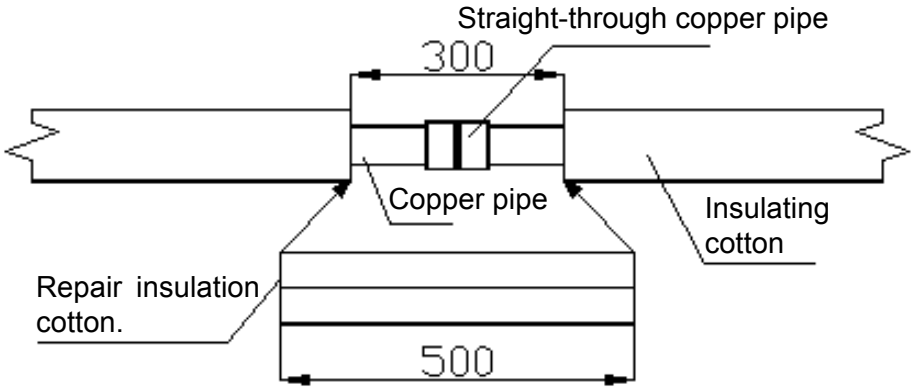
(3) **Precautions**

① There should be no gap between joints of insulating materials.

② If the bandage around the joints of insulating materials is too tight, cracks and condensation may occur, air in the materials will be squeezed out, and the insulating performance will be affected. In addition, the bandage will age and scatter as the time passes by.

③ Bandage is not required in hidden indoor places. Otherwise, the insulating performance will be affected.

Correct method for repairing the insulating cotton is shown in the following figure:



Prepare a piece of insulating cotton that is longer than the gap. Insert the insulating cotton inside the gap and glue the joint.

(4) **Precautions**

① The length of the insulating cotton for gap filling is 5 to 10 cm longer than the gap.

② The cut and section of insulating cotton must be smooth.

③ Insert the insulating cotton tightly into the gap.

④ All cuts and sections must be glued.

⑤ Wrap the joint with bandage.

⑥ Bandage is not required in hidden indoor places. Otherwise, the insulating performance will be affected.

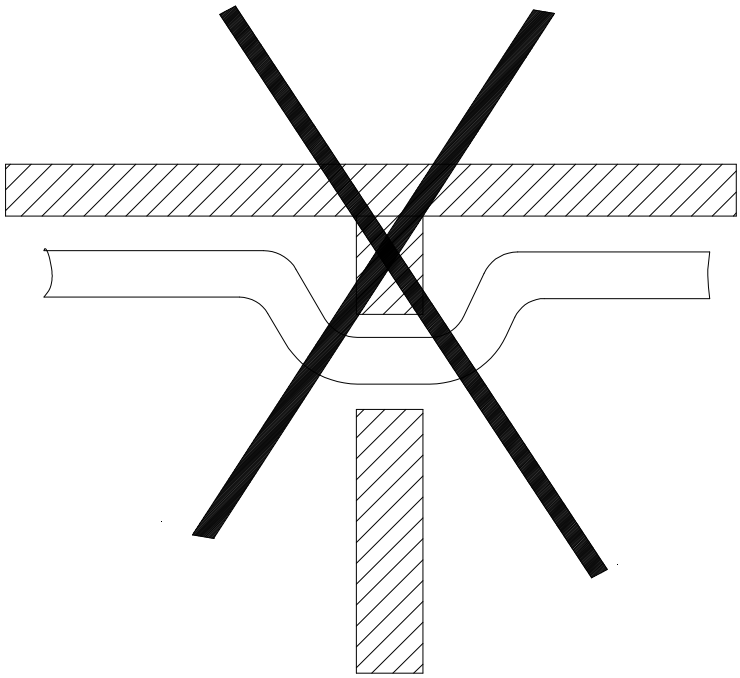
6.3.3 Recommended Pipelines Between Indoor Units and Outdoor Units

6.3.3.1 Dimensions of Connection Pipes

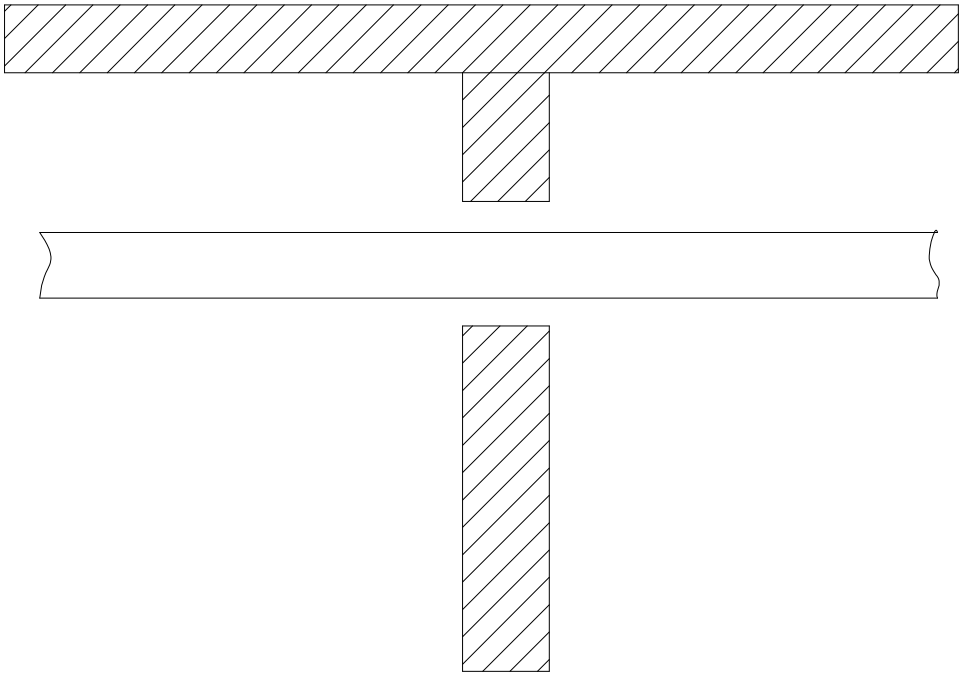
When the distance between the indoor unit and outdoor unit is between 0 to 15 m, 15 to 30 m, or 30 to 50 m, and the difference of the height of indoor unit and outdoor unit is not greater than 6 m, respectively install the recommended connection pipes shown in the following table. Refrigerant and lubricant can be recharged properly based on the dimensions of connection pipes by referring to the table.

Model	0 to 15 m		15 to 30 m		30 to 50 m		Amount of Refrigerant to Be Recharged	Amount of Lubricant to Be Recharged
	Vent pipe	Liquid pipe	Vent pipe	Liquid pipe	Vent pipe	Liquid pipe		
MLSC380A-SB3Z	$2^5/_8$ in	$1^5/_8$ in	$2^5/_8$ in	$1^5/_8$ in	$2^5/_8$ in	$1^5/_8$ in	1.4 kg/m	0.07 L/m
MLSC500A-SB3Z	3 in	$1^5/_8$ in	3 in	$1^5/_8$ in	3 in	$1^5/_8$ in	1.4 kg/m	0.07 L/m
MLSC600A-SB3Z	$3^5/_8$ in	$2^1/_8$ in	$3^5/_8$ in	$2^1/_8$ in	$3^5/_8$ in	$2^1/_8$ in	2.5 kg/m	0.12 L/m

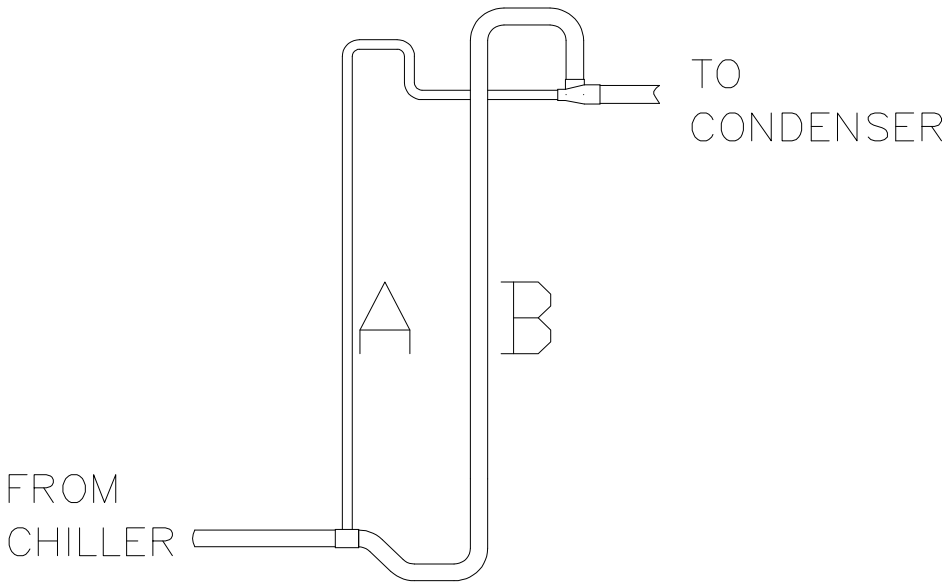
Incorrect installation of vent pipe through a wall



Correct installation of vent pipe through a wall



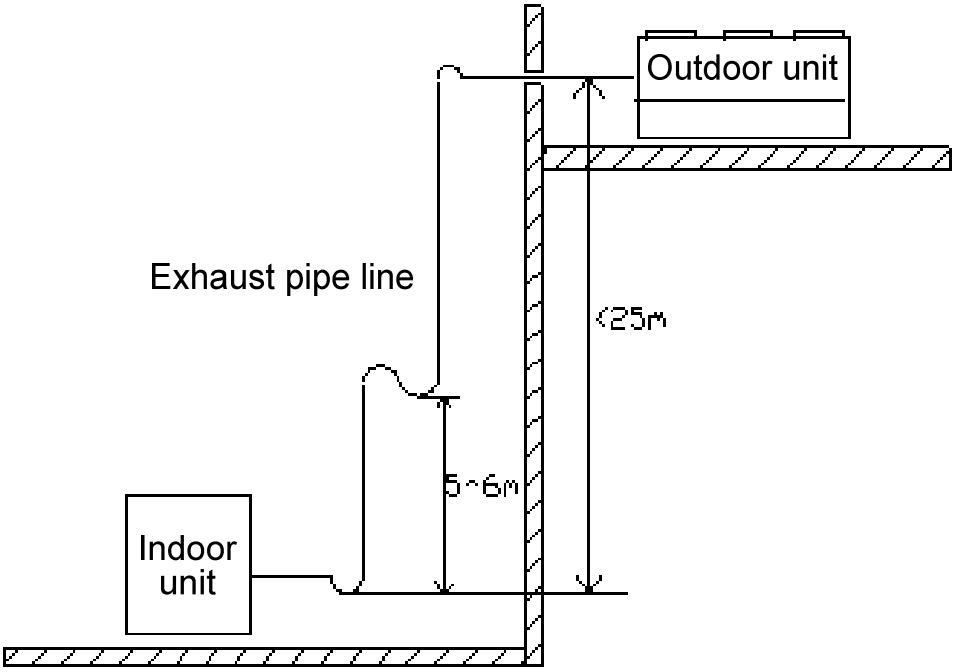
When the difference of the height of indoor unit and outdoor unit is greater than 6 m, you are advised to install the vertical part of the vent pipe in the method shown in the following figure. The specifications of connection pipe are selected by referring to the following table. However, specifications of the horizontal part are still selected by referring to the preceding table.



Recommended external diameters of connection pipes when the vertical part of the vent pipe comprises two pipes

Model	Connection Pipe of Vent Pipe	Length of the Connection Pipe of Vent Pipe (m)			Length of the Connection Pipe of Liquid Pipe (m)
		0~15	15~30	30~50	0~50
MLSC380A	A	$2^1/_8$ in	$2^1/_8$ in	$2^5/_8$ in	$1^5/_8$ in
	B	$2^1/_8$ in	$2^1/_8$ in	$2^5/_8$ in	
MLSC500A	A	$2^5/_8$ in	$2^5/_8$ in	$2^5/_8$ in	$1^5/_8$ in
	B	$2^1/_8$ in	$2^1/_8$ in	$2^1/_8$ in	
MLSC600A	A	3 in	3 in	3 in	$2^1/_8$ in
	B	$2^5/_8$ in	$2^5/_8$ in	$2^5/_8$ in	

Installation diagram when the vertical part of the vent pipe comprises a single pipe



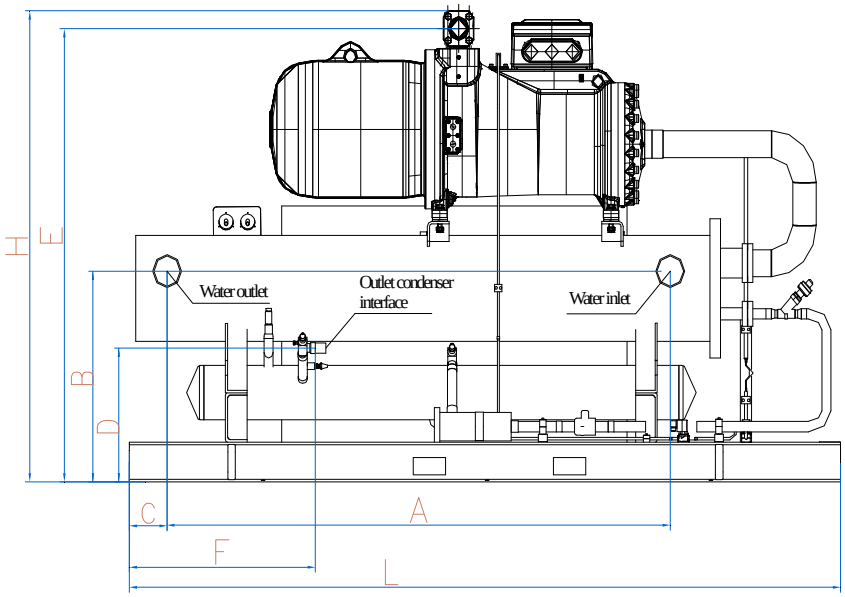
6.3.3.2 Lubricant Recharge

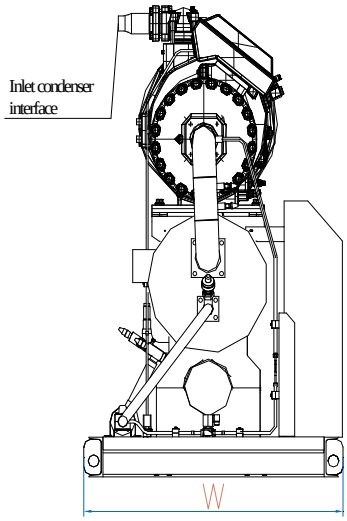
When the connection pipes are installed and the inner part of the pipes are clean and vacuum (the vacuum degree is –756 mmHg or lower), lubricant can be recharged. To recharge lubricant, use an oil pump (either manual or electric) to inject lubricant to the liquid pipe by referring to the recommended amount specified in section 7.3.3.1.

Note: Lubricant brand: BSE 170

6.3.4 Unit Appearance

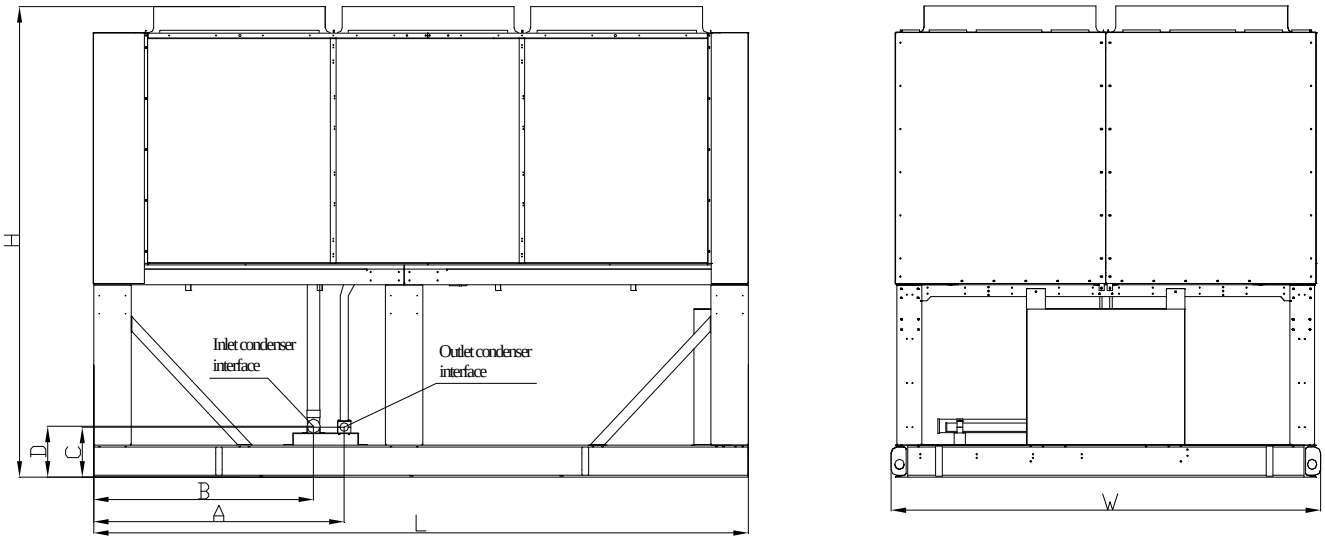
Appearance of MLSC380A(500/600) indoor unit





Model MLSC_A	L	W	H	A	B	C	D	E	F	Inlet condenser interface	Outlet condenser interface	Frozen water interface
380	3300	1200	1830	2330	848	175	539	1824	860	φ67	φ42	DN125
500	3500	1200	2113	2344	1054	197	745	2020	410	φ80	φ42	DN125
600	3500	1200	2130	2345	1053	200	754	2029	410	φ92	φ42	DN125

Appearance of MRH380A-B3Z(500/600) outdoor unit



Model MRH_A	L	W	H	A	B	C	D	Inlet condenser interface	Outlet condenser interface
380	3500	2280	2370	1335	1170	250	255	φ67	φ42
500	4491	2280	2370	1226	1046	250	268	φ80	φ42
600	5600	2280	2370	1244	1020	250	268	φ92	φ42

6.4 Requirements for Water System Installation and Recommended

Diagram for the Water System

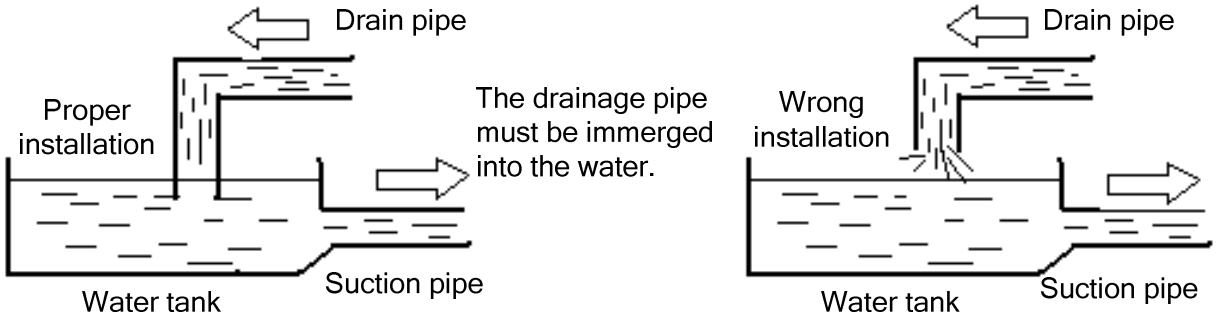
6.4.1 Requirements for Water System Installation

When installing the water system, you must follow general installation rules to achieve the maximum working efficiency. There should be no foreign matter in pipes, and all chilled water pipes must be in accordance with local pipeline engineering procedures and regulations.

- A safety valve with the opening pressure not higher than 1.0 MPa must be installed.
- The chilled water pipeline must be cleaned in a by-pass manner. It is prohibited to connect the evaporator to the water system before pipelines are washed.
- During piping construction, sufficient space must be left for maintenance. In addition, ensure that a water escape valve can be installed and maintained on the piping of the water system of the unit.
- The unit is not equipped with a water pump. You must install a water pump that matches the impedance of the piping.
- All pipelines should be straight and simple, because elbow pipes, tee joints, and valves will reduce pump capacity.
- You are advised to install manual stop valves in all pipelines for easy maintenance.
- A drain pipe must be installed in each low position so that the evaporator and pipeline can drain water thoroughly.
- A deflation valve must be installed on the top position of the chilled water pipe in order to vent the air inside pipelines. For easy maintenance, thermal insulation at deflation and drain pipe joints is not required.
- When the chiller is not in use in winter or stops running at night, you must take anti-freezing measures (such as drainage, water circulation pump running, and heater heating) to protect the water loop if the ambient temperature is lower than 0℃. If the water loop is frozen, the dry expansion evaporator may be damaged. Therefore, you must take an appropriate measure based on actual conditions.
- Measures should be taken to ensure the cold-preservation, heat-preservation, and damp proof of water piping. If cold-preservation and heat-preservation are not sufficient in severe winter, in addition to possible heat loss, the machine may be damaged due to freeze.
- The quality standard for the chilled water is used as the quality standard for the circulating water. Any water leakage may cause corrosion.
- Water quality must comply with the JRA-GL-02 standard.
- The amount of the water retained in the system should be in the operating range. Water insufficiency will result in scale deposition, thereby causing performance loss or pitting corrosion, and finally leading

to refrigerant leakage. An overlarge water flow will cause corrosion.

- Do not expose the water in the circulating system to the air, as shown in the following figure.
- If water is exposed to the air, the amount of the dissolved oxygen will increase, and atmosphere pollutants will coagulate in water. As a result, water may be corrosive.



- Do not connect any other electric appliances to the ground, and then to the water piping of the unit. This may cause electrolytic corrosion of the water piping.
- Anticorrosive measures must be taken for buried piping.
- To prevent generation of air pockets, pay attention to the water flow speed in the water pump system and the positions of the expansion tank and the exhaust plug.
- If the pH value of the water exceeds the standard value, the corrosion of coppers will be accelerated. Therefore, change the water before the pH value reaches the standard value. If the heat storage tank is still in use after expiration, the cracks on the heat storage tank may cause water splashing and leakage. Water leakage will not cause serious problems to water quality control. However, if sea water or polluted underground water spills, microorganisms may breed in the water heat storage tank. This will generate debris in the system and cause the adhesion of calcium carbonate.
- A flexible tube should be installed on the unit and on the water inlet and outlet pipes of the water pump, to prevent the vibration in water pipes from being transmitted to buildings.
- A drainpipe must be installed at all water outlets. Pay attention to the front and behind distribution of the water inlet and outlet. Observe the identification label on the unit carefully. Do not make a mistake.
- Based on engineering requirements, the design of the evaporator's water inlet and outlet pipes must follow the following criteria:
  a) The outlet of the circulation pump in the pipeline must be connected to the inlet of the evaporator. The inlet of the pump must be connected to the water return pipeline instead of the evaporator.
  b) A water stainless steel strainer with more than 25 meshes must be installed on the inlet pipeline of the evaporator.
  c) Before you run the unit, clean all chilled water pipelines thoroughly and remove all foreign matters. Do not crush any foreign matter into the evaporator.

d) For easy inspection and repair, a thermometer and a pressure gauge must be installed on the water inlet and outlet pipes.

e) A water flow switch must be installed on the water outlet pipe of each evaporator. Both ends of the water flow switch must be a horizontal straight pipe with the length more than five times of pipe diameter. The paddle of the water flow switch must be adjusted based on the specifications of the pipe. For details, see the water flow switch manual provided by the manufacturer. The water flow switch is connected to the terminal on the control box. For details, see the electrical wiring diagram.

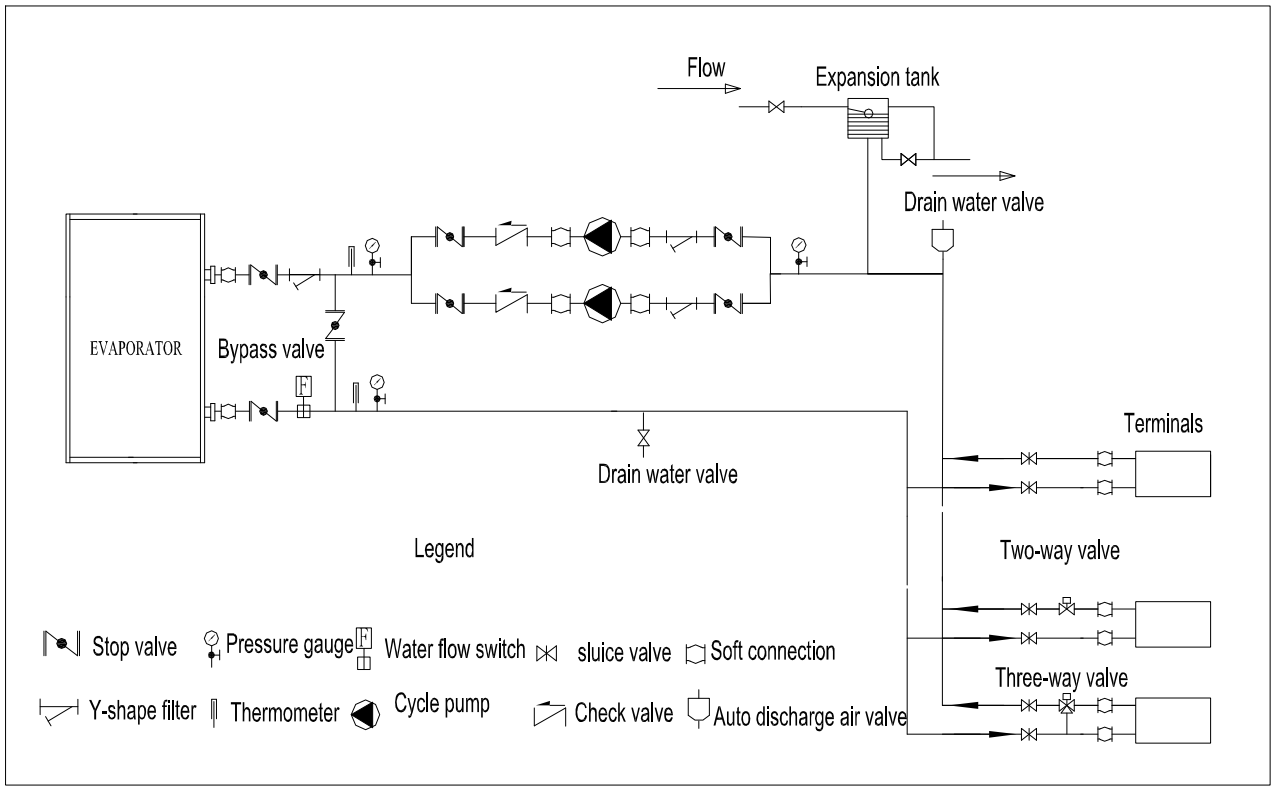
WARNING

When installing the water flow switch, you must confirm the water flow direction.

The water flow switch is just a safety switch. It is prohibited to use it to start or stop the unit.

- When multiple chilled water units share the same water system, the pipes of these units must be connected in different modes, as shown in the following figure, to avoid large unbalance of water flow in the units.

6.4.2 Recommended Diagram for the Water System



6.5 Electrical Installation

6.5.1 Electrical Wiring *Notes:*

(1) A dedicated power supply must be used for the air conditioner. The voltage of the power supply must comply with the rated voltage.

(2) The wiring construction must be carried out by professional technicians based on the circuit diagram label.

(3) The power and ground cables must be tightened by using an appropriate tool with a proper torque.

(4) The power and ground cables must be crimped securely and checked from time to time to prevent looseness.

(5) Only electrical components specified by our company can be used, for which you must request the manufacturer or authorized dealer to provide related installation and technical services. If the wiring does not meet the electrical installation standard, the controller may work improperly or an electric shock may occur.

(6) An incoming circuit breaker must be installed on the fixed line.

(7) Electric leakage protection devices must be set correctly based on the requirements in relevant technical standards of electrical equipment.

(8) The power supply can be connected only when no error is found after all wiring operations are complete.

(9) Read each label attached on the electric control box carefully.

(10) Do not try to repair the machine by yourself. If the controller is repaired improperly, an electric shock may occur or the controller may work improperly. If you have any repair demand, contact the repair center of after-sale.

Cable Selection Criteria for Units

Model	Recommended Power Cable	Recommended Breaker Capacity	Remarks
MLSC380A-SB3Z	BVR120*4+BVR70*1	330 A	**Copper core cables must be used for the unit. If the unit is used in high temperature, the capacity of the breaker may decrease. In this case, you must expand the breaker's capacity appropriately.**
MLSC500A-SB3Z	BVR240*4+BVR120*1	500 A	
MLSC600A-SB3Z	BVR240*4+BVR120*1	500 A	
MRH380A-B3Z	BVR16*4+BVR10*1	100 A	
MRH500A-B3Z	BVR25*4+BVR16*1	100 A	
MRH600A-B3Z	BVR25*4+BVR16*1	100 A	

Common Cables

BVR: Copper core PVC insulated soft wire					
Domestic Model	Conductor Material	Insulator Material	Nominal Cross-Section Area (mm²)	UL Model	Remarks
BVR70	Cu	PVC	70	2/0	Only copper core cables can be used for the unit.
BVR95	Cu	PVC	95	4/0	
BVR120	Cu	PVC	120	250	
BVR150	Cu	PVC	150	300	
BVR185	Cu	PVC	185	400	
BVR240	Cu	PVC	240	500	

Maximum electricity transmission distance

Maximum load time in a year (h)	Length of copper core cable (m)
< 3000 h	264
3000–5000 h	294
> 5000 h	331

6.5.2 Power Supply Specifications and Use Environment

The unit must run in the following environment:

Outdoor temperature: 10℃ to 43℃

Altitude: ≤ 1000 m

Power supply frequency: 50±2% Hz

Voltage: 380±10% V

6.5.3 Power Supply Requirements

The power supply must comply with the calibration values on the nameplate of the unit.

WARNING

The unit will generate an alarm if the voltage is abnormal. If the three-phase voltage unbalance of the unit exceeds 2% or if the current unbalance exceeds 10%, contact the local electric power department immediately and keep the unit in the stopping state.

$$\text{Voltage unbalance} = \frac{\text{Difference between average three-phase voltage and maximum voltage}}{\text{Average three-phase voltage}}$$

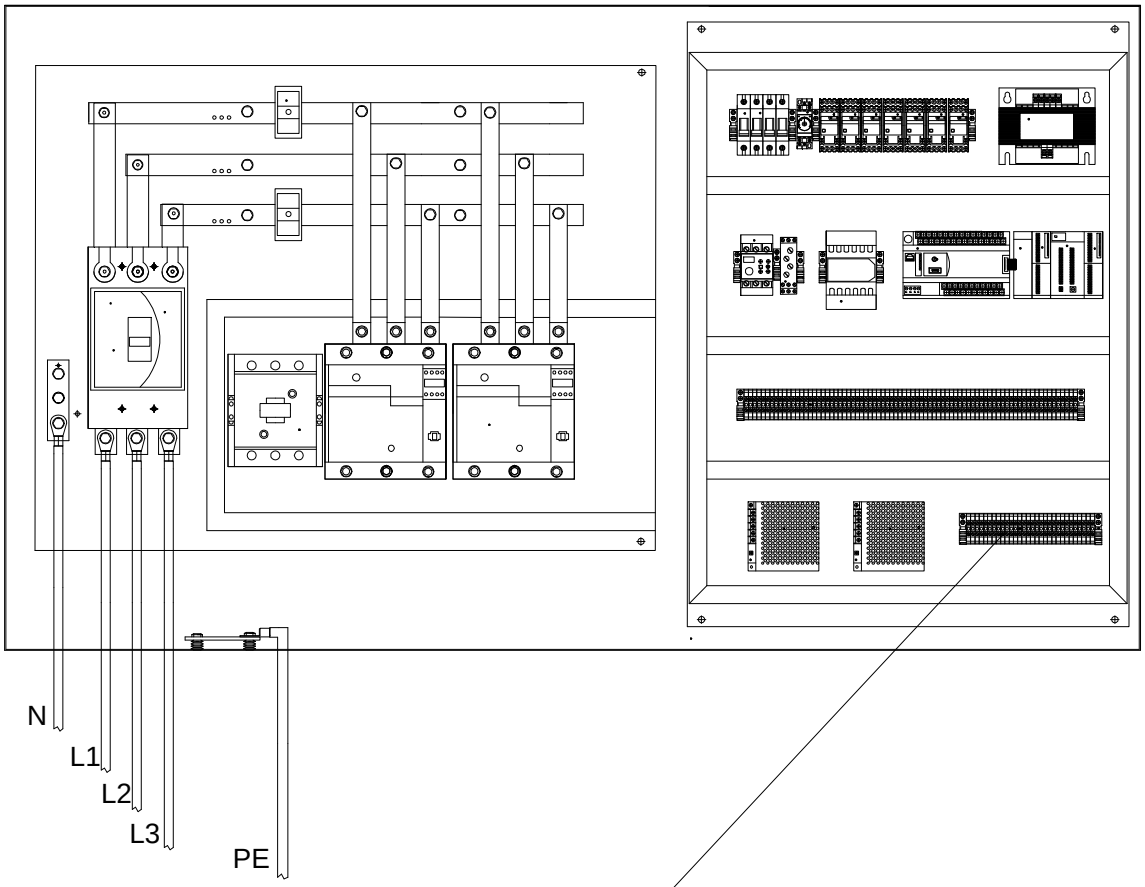
An unbalanced voltage will cause phase-to-phase current unbalance at motor terminals. For a fully loaded motor, current unbalance changes in a range of 6–10 times of voltage unbalance. In this case, the motor current will be overlarge, resulting in overheating of the motor. As a result, the compressor lifespan becomes short, and even the motor may be burnt. In addition, an overlarge unbalanced voltage will reduce the torque. As a result, the operation requirement cannot be met, and the motor fails to run due to low speed.

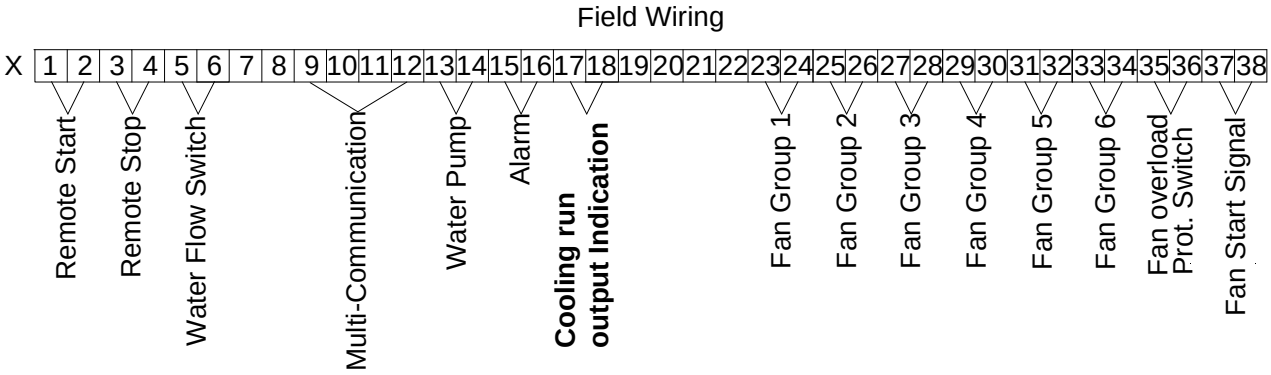
The minimum startup voltage of the unit must be kept higher than 90% of the rated voltage.

6.5.4 Requirements for Wire Connection

(1) Specifications for the main power cable must comply with relevant national regulations. The protective ground power supply must be taken from the site. The grounding resistance must comply with relevant national standards. After the cable connection is complete, install a waterproof, dustproof, and a sealing device in the wire inlet hole of the main power cable. Our company will not take any responsibility for any electrical accident arising from poor ground connection or careless operation.

Wiring diagram for the main power cable of the indoor unit

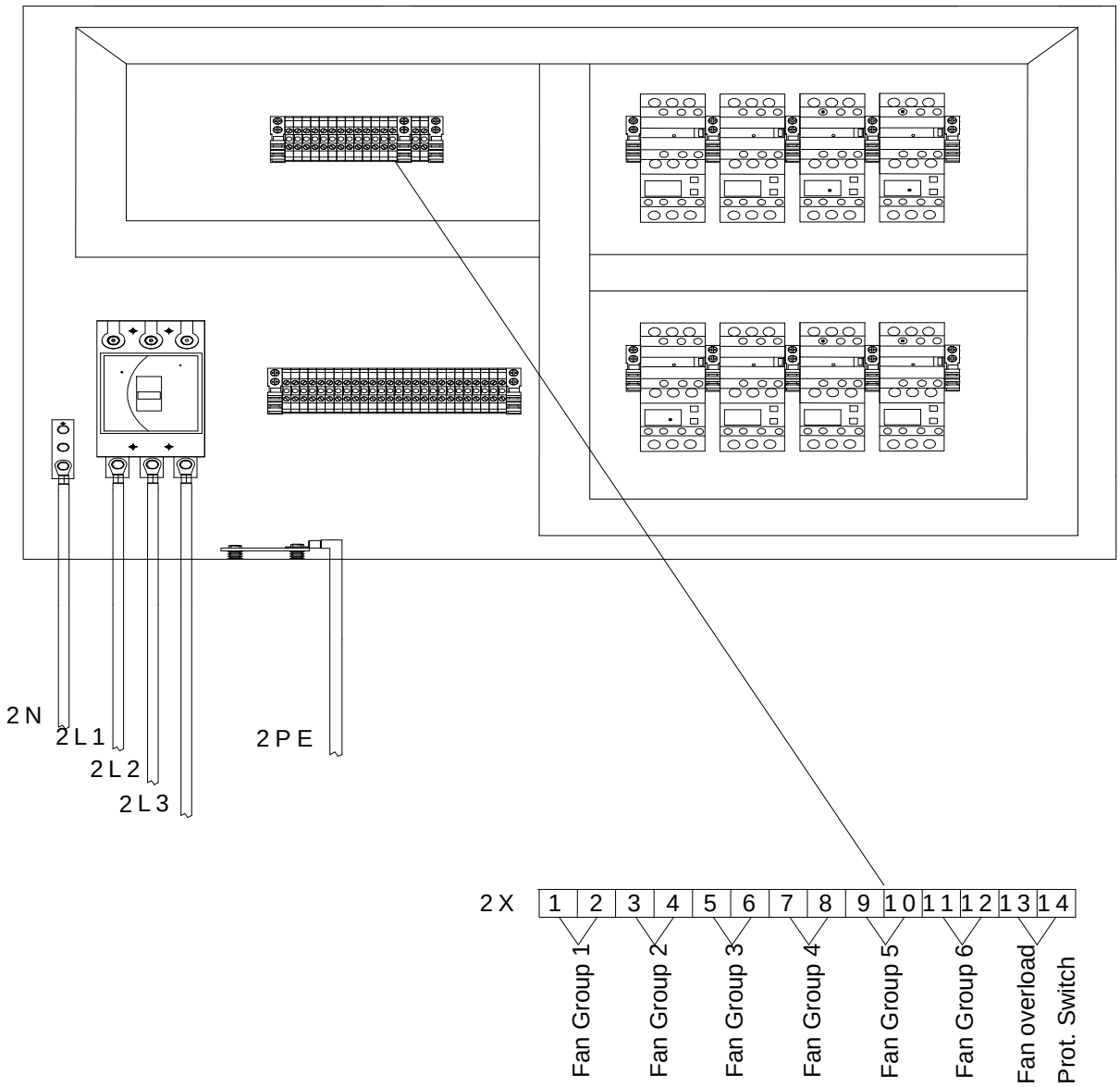




External wiring diagram for indoor units of the MLSC380A-SB3Z, MLSC500A-SB3Z and MLSC600A-SB3Z series.

Note: All inputs must be passive dry contacts, and all outputs must be transferred by using an intermediate relay.

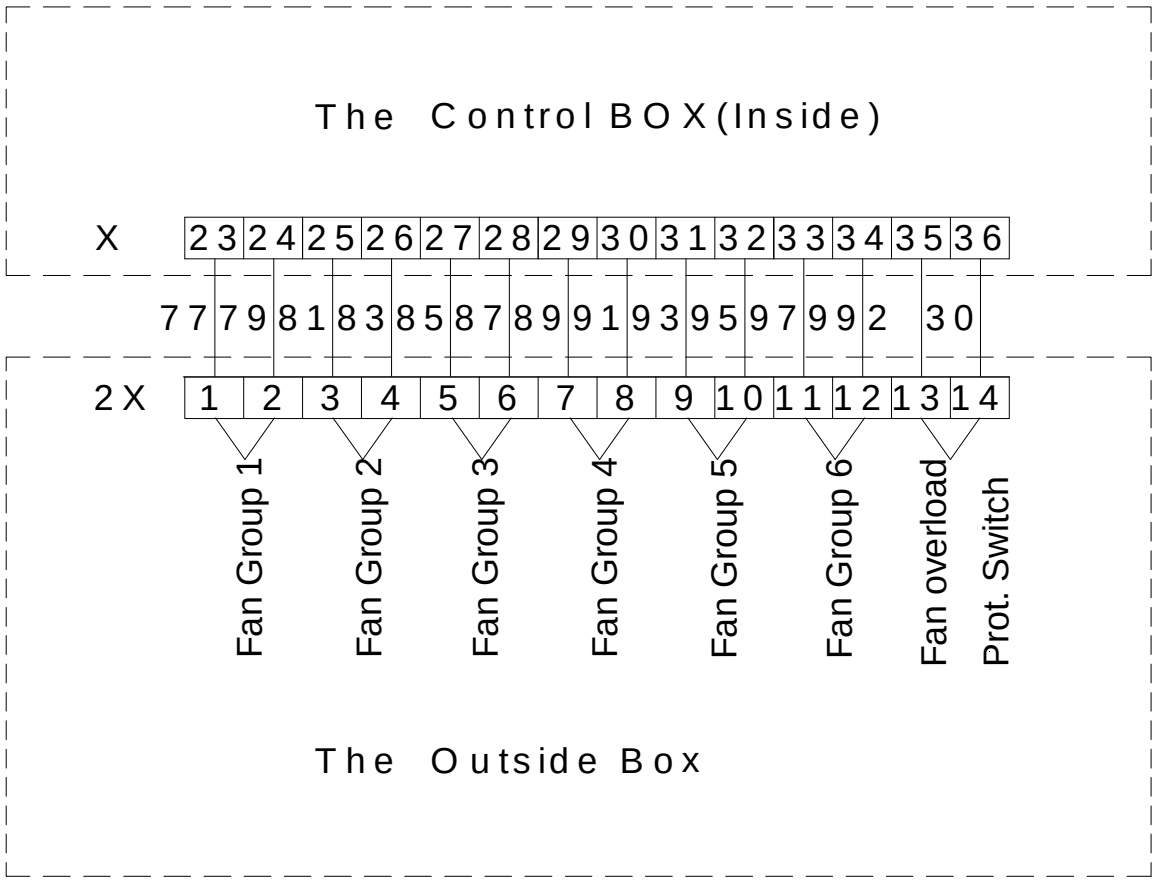
Wiring diagram for the main power cable of the outdoor unit



External wiring diagram for outdoor units of the MRH380A, MRH500A, and MRH600A series.

Note: The indoor and outdoor units must be supplied power independently. If the unit is not in use for a long time, you can cut off the main switch in the power distribution cabinet. When maintaining the unit, you must cut off the main switch and prevent accidental switch-on.

Electrical wiring diagram for the indoor and outdoor units



Electrical wiring diagram for the indoor and outdoor units of the 380/500/600 series

Note: The above figure shows the diagram for connecting the fan's control signal wires and motor overload feedback signal wires. Customers must connect these wires on the installation site by using a shielded wire. (The fan's control signal wires 79, 83, 87, 91, 95, and 99 can share the same wire. For details, see the circuit diagram label delivered together with the unit.)

(2) You must use a cable with correct specifications to provide electric power for the unit. The unit must be supplied power independently. It is prohibited to connect the unit and other appliances to the same power supply. Otherwise, overload risk may be presented.

(3) The power cable length must ensure that the voltage drop between the start and end of the power cable is smaller than 2% of the rated voltage during unit operation. If the power cable cannot be shortened, it must be thickened.

(4) The wiring between the power supply and unit must be constructed strictly according to the National Electrical Code and must be well-insulated. After unit wiring, use a 500 V megger to test the insulation resistance between the electrical accessory terminals and the unit. The insulation resistance must be at least 10 MΩ.

(5) According to the National Electrical Code, the shell of the unit must be protected by a reliable ground device to prevent electric shock accidents, thereby protecting human bodies.

(6) It is prohibited to pass power cables and control wires that are not connected to the electric control box through the electric control box. Otherwise, the unit and controller may be faulty or even be damaged due to electromagnetic interference, and the protection may fail.

(7) All weak electric wires connected to the electric control box must adopt shielded wires, and a ground wire must be installed at the shielded layer. The shielded wires and power cables must be laid in different places to avoid electromagnetic interference.

6.5.5 Wiring Procedure

(1) Ensure that the unit is connected to the ground cable correctly to prevent electric leakage accidents. Constructions for grounding devices must be carried out strictly according to the National Electrical Code. Ground cables can resist electric shocks.

(2) Install the control box of the main power supply switch at an appropriate position.

(3) Install a sealing device in the wire connection hole of the main power supply.

(4) Pass the main power supply, neutral wire of power supply, and ground wire through the wire connection hole, and then connect them to the electric control box.

(5) Keep the phase sequence consistent when connecting the main power supply.

(6) Install the main power supply at a position that can be accessed only by dedicated maintenance personnel to prevent misoperation and ensure safety.

(7) Use an inching switch when connecting remote control wires. For details, see the wiring diagrams in the appendix.

(8) Prepare a water flow switch by yourself when connecting the control wires of the water flow switch. For details, see the wiring diagrams in the appendix.

(9) For details about how to connect the control wires of the water pump, see the following figure.

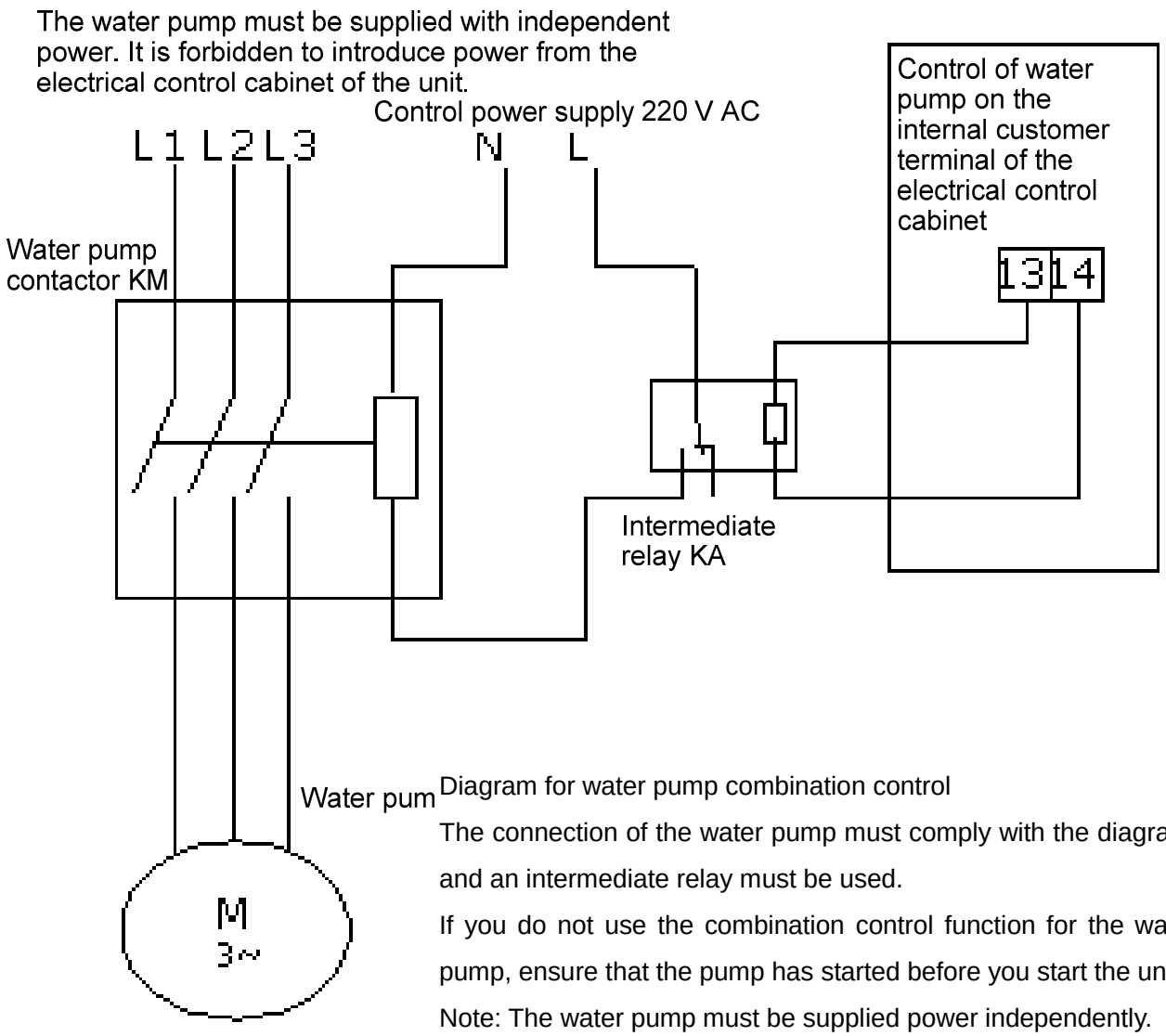


Diagram for water pump combination control

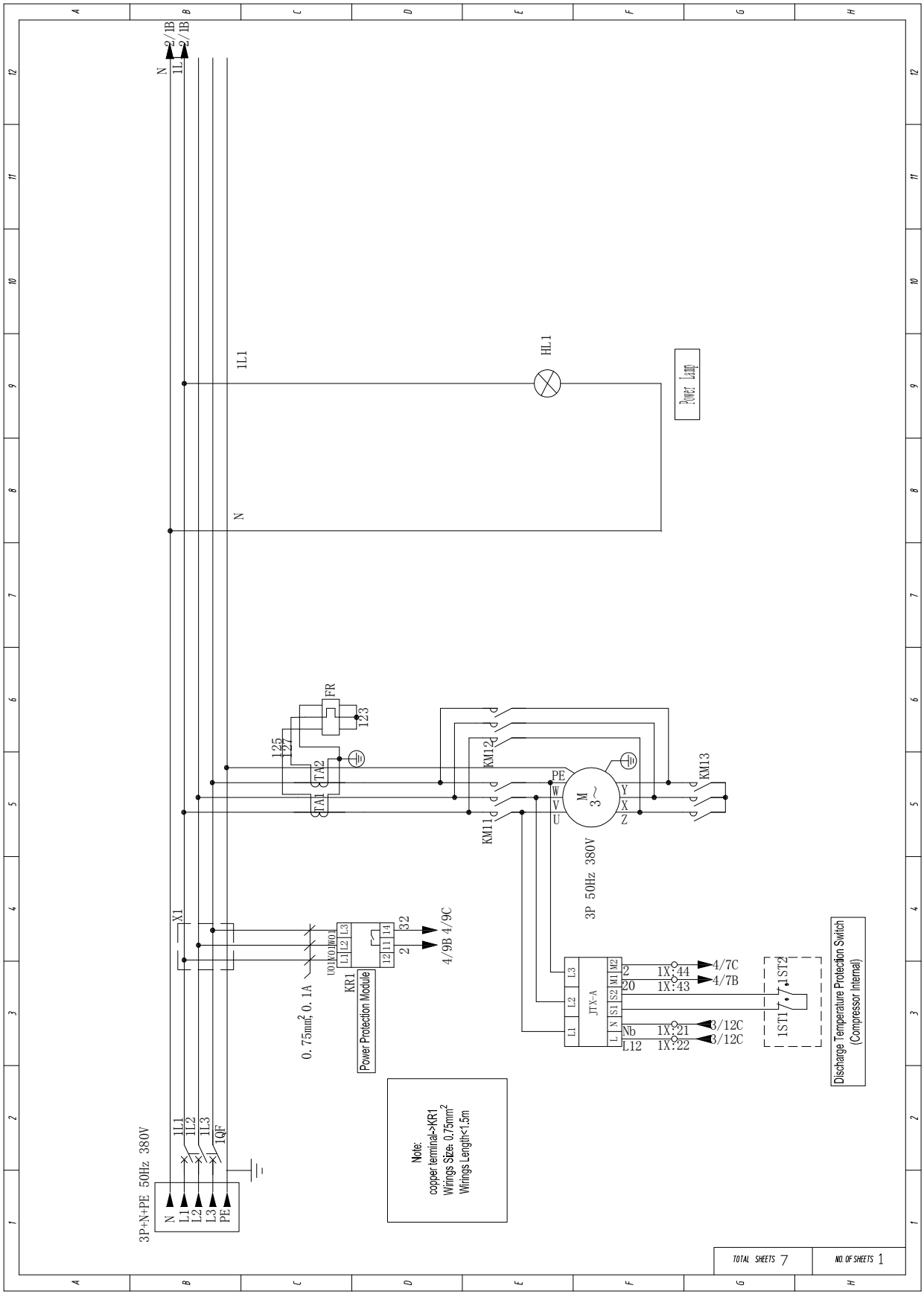
The connection of the water pump must comply with the diagram, and an intermediate relay must be used.

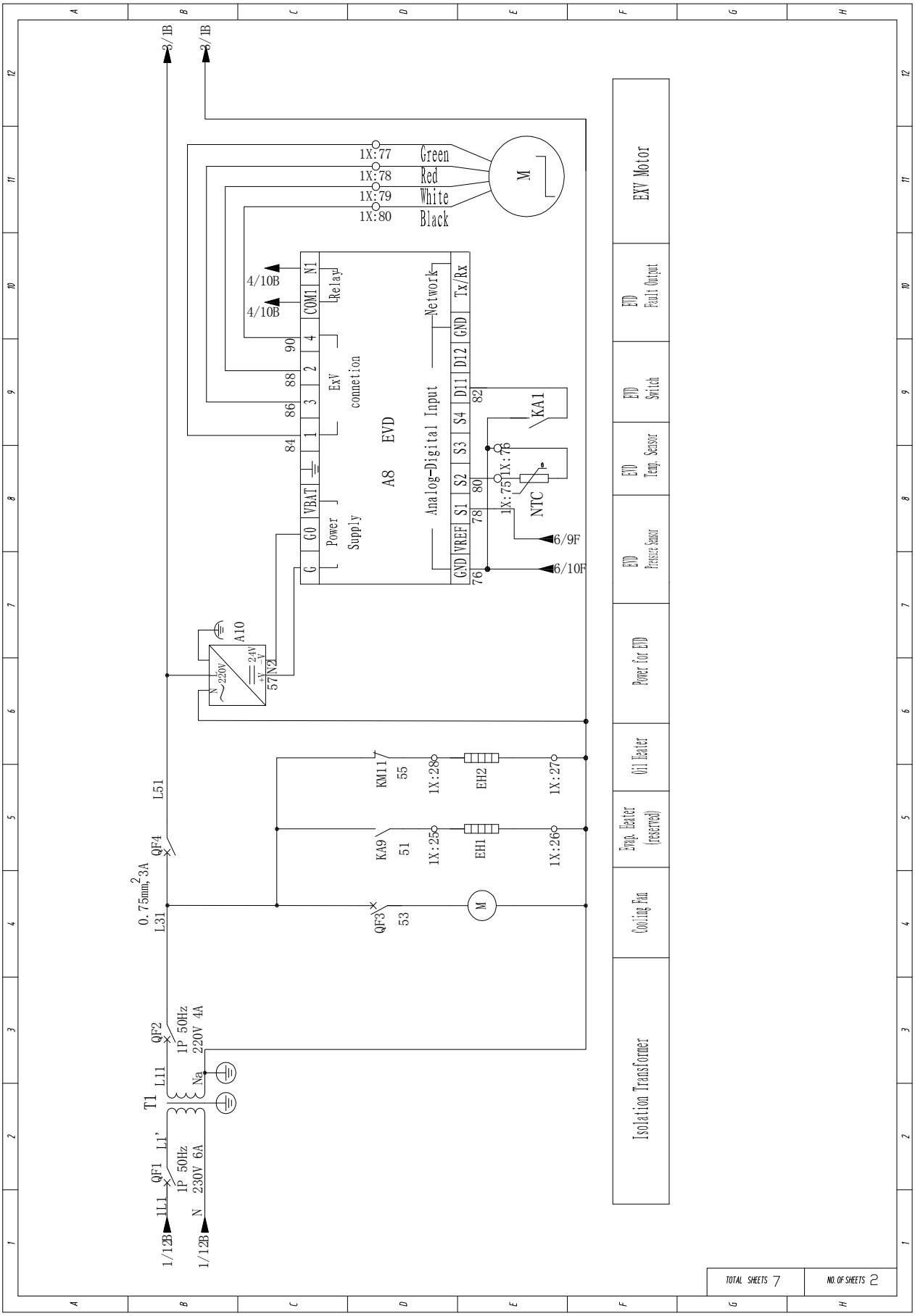
If you do not use the combination control function for the water pump, ensure that the pump has started before you start the unit.

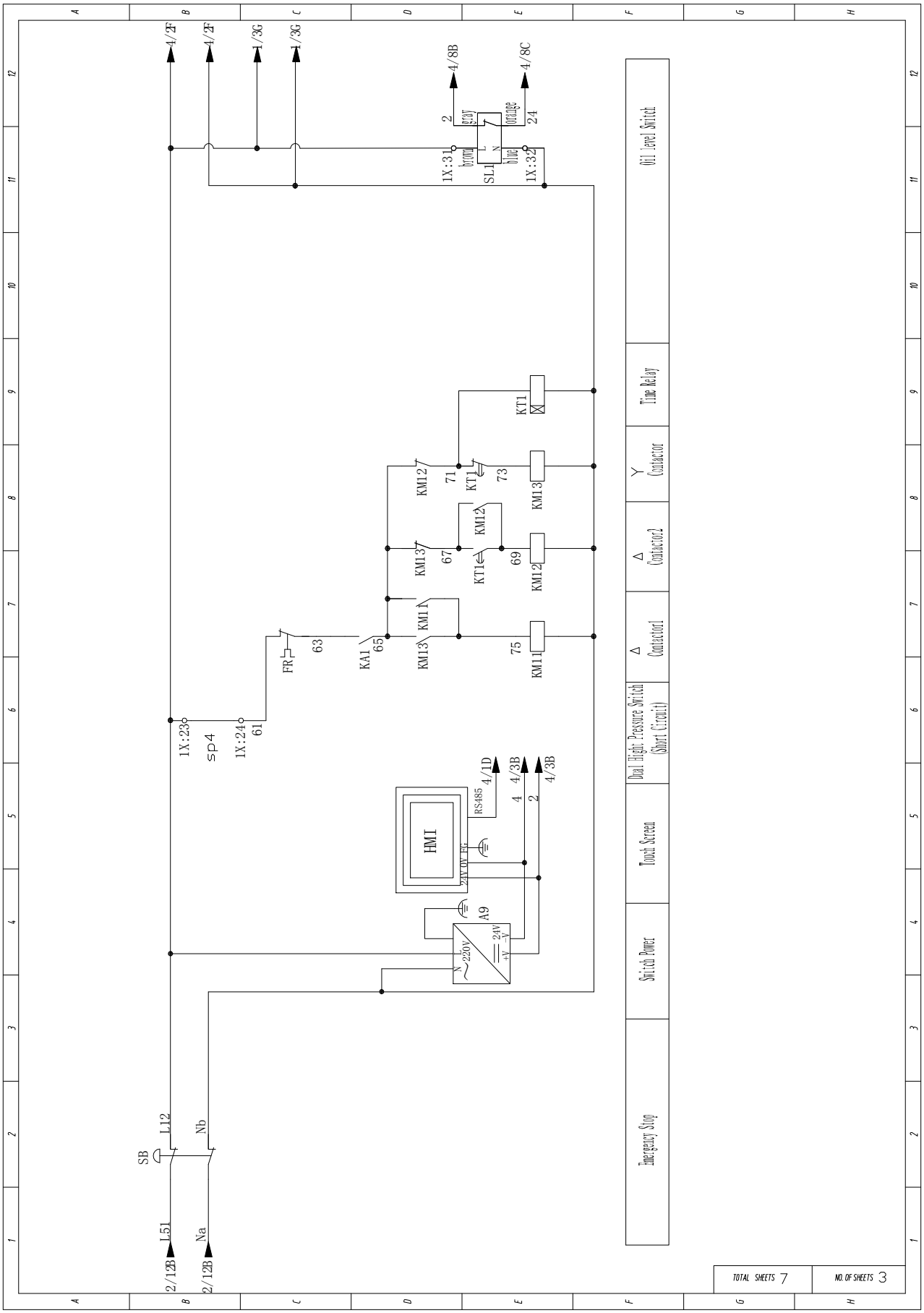
Note: The water pump must be supplied power independently.

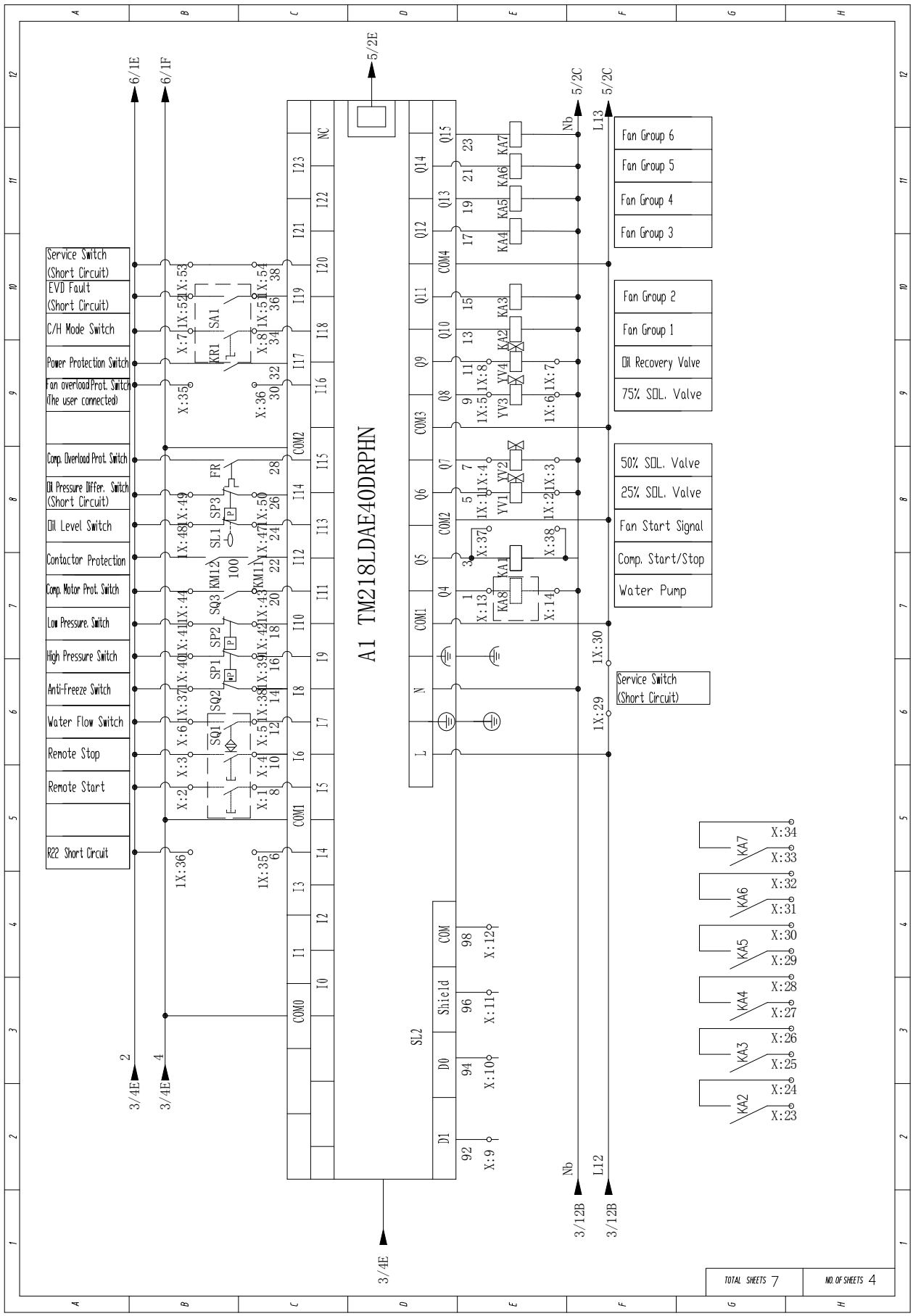
Wiring Diagrams

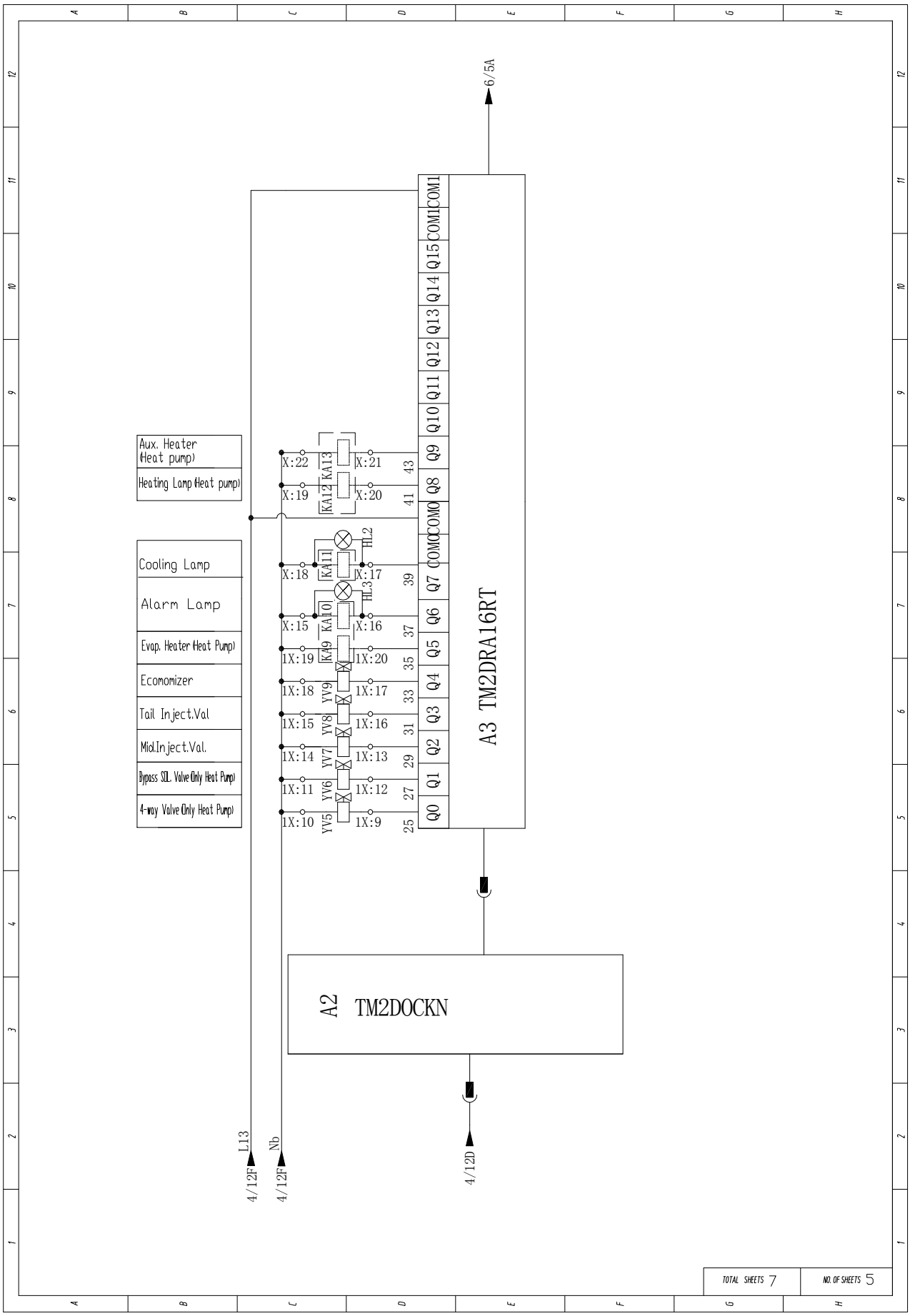
Wiring diagrams for MLSC380A-SB3Z, MLSC500A-SB3Z and MLSC600A-SB3Z

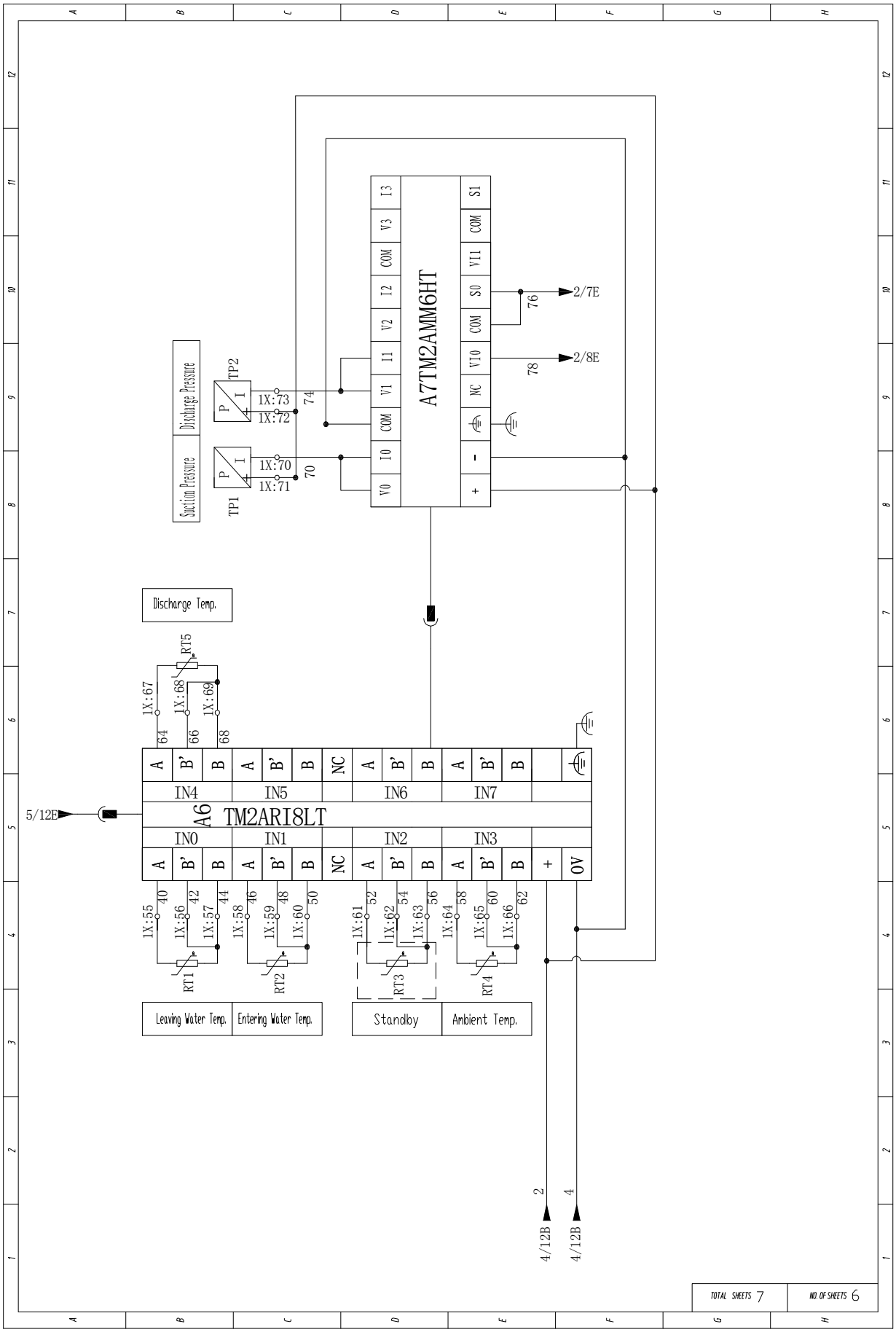


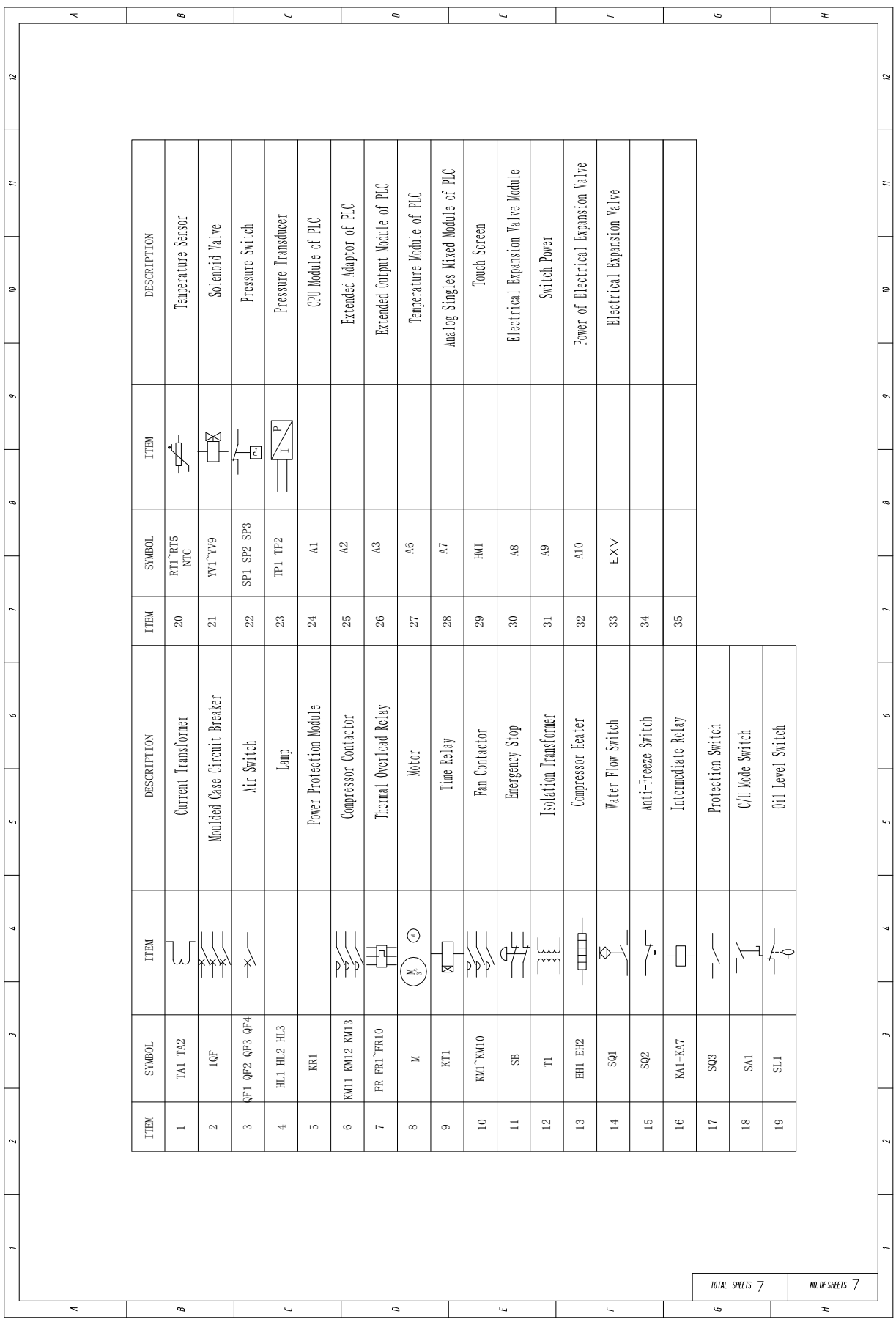

Isolation Transformer
Cooling Fan
Evap. Heater (reserved)
Oil Heater
Power for EVD
EVD Pressure Sensor
EVD Temp. Sensor
EVD Switch
EVD Fault Output
EXV Motor
T1
QF1
QF2
QF3
QF4
KM11
KA9
KA1
EH1
EH2
A8 EVD
A10
NTC
Power Supply
Analog-Digital Input
Network
ExV connetion
Relay
Green
Red
White
Black
TOTAL SHEETS 7
NO. OF SHEETS 2


4/2F
4/2F
4/3G
4/3G
4/8B
4/8C
1X:31
1X:32
SL1
KT1
KM12
KM13
KA1
FR
1X:23
SP4
1X:24
HMI
RS485
4/1D
4/3B
A9
SB
L12
Nb
L51
Na
2/12B
2/12B
Oil Level Switch
Time Relay
Y Contactor
Δ Contactor2
Δ Contactor1
Dual High Pressure Switch (Short Circuit)
Touch Screen
Switch Power
Emergency Stop
TOTAL SHEETS 7
NO. OF SHEETS 3


A1 TM218LDAE40DRPHN
Service Switch (Short Circuit)
EVD Fault (Short Circuit)
C/H Mode Switch
Power Protection Switch
Fan overload Prot. Switch (The user connected)
Comp. Overload Prot. Switch
Oil Pressure Differ. Switch (Short Circuit)
Oil Level Switch
Contactor Protection
Comp. Motor Prot. Switch
Low Pressure. Switch
High Pressure Switch
Anti-Freeze Switch
Water Flow Switch
Remote Stop
Remote Start
R22 Short Circuit
Fan Group 6
Fan Group 5
Fan Group 4
Fan Group 3
Fan Group 2
Fan Group 1
Oil Recovery Valve
75% SOL. Valve
50% SOL. Valve
25% SOL. Valve
Fan Start Signal
Comp. Start/Stop
Water Pump
Service Switch (Short Circuit)
TOTAL SHEETS 7
NO. OF SHEETS 4


6/5A
A3 TM2DRA16RT
COM1
Q15
Q14
Q13
Q12
Q11
Q10
Q9
Q8
COM0
Q7
Q6
Q5
Q4
Q3
Q2
Q1
Q0
Aux. Heater (Heat pump)
Heating Lamp (Heat pump)
Cooling Lamp
Alarm Lamp
Evap. Heater (Heat Pump)
Ecomomizer
Tail Inject.Val
Mid.Inject.Val.
Bypass SOL. Valve (Only Heat Pump)
4-way Valve (Only Heat Pump)
KA13
KA12
KA11
KA10
KA9
YV9
YV8
YV7
YV6
YV5
HL2
HL3
X:22
X:21
X:19
X:20
X:18
X:17
X:15
X:16
1X:19
1X:20
1X:18
1X:17
1X:15
1X:16
1X:14
1X:13
1X:11
1X:12
1X:10
1X:9
43
41
39
37
35
33
31
29
27
25
A2 TM2DOCKN
L13
Nb
4/12F
4/12F
4/12D
TOTAL SHEETS 7
NO. OF SHEETS 5

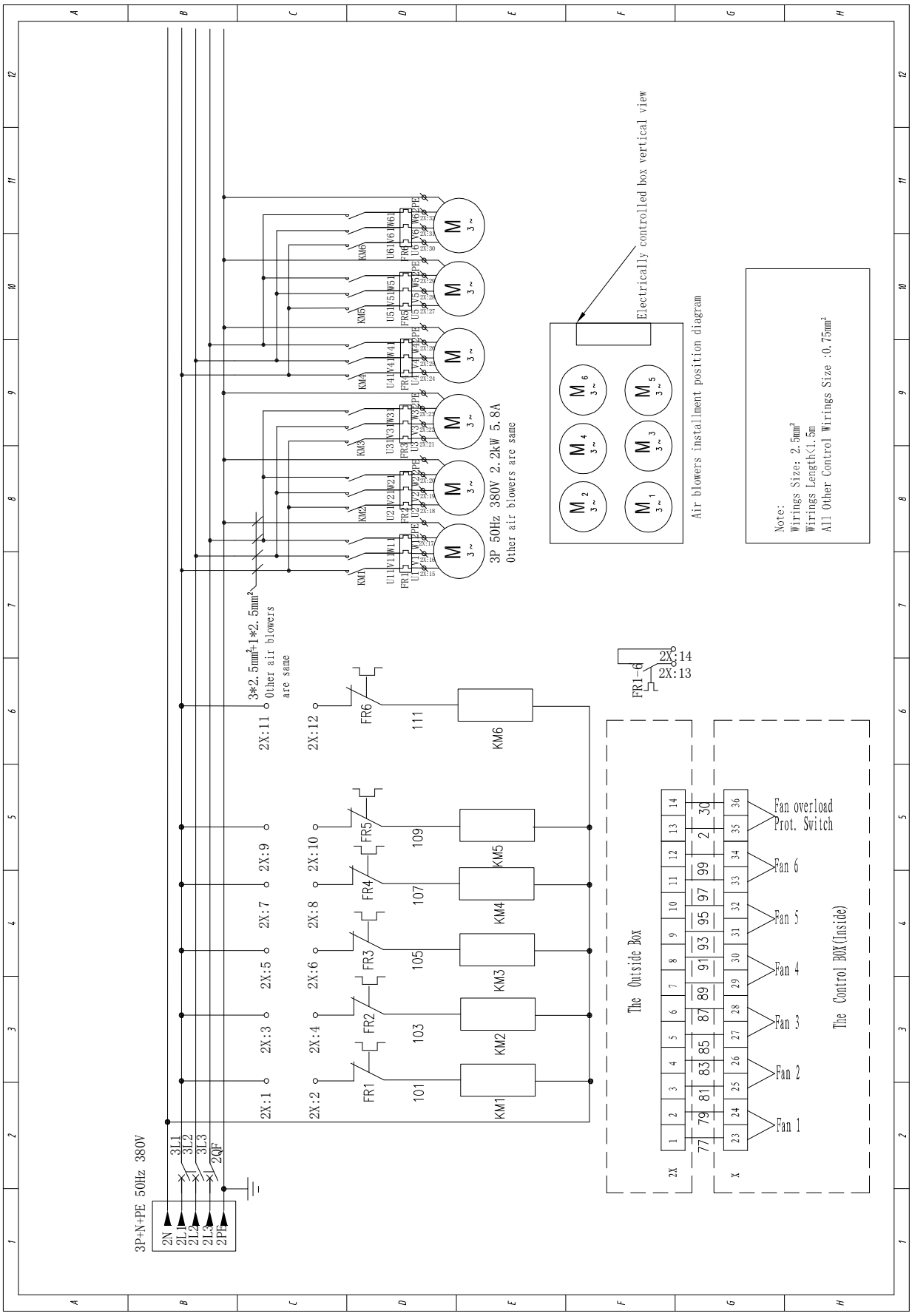

A7TM2AMM6HT
I3
V3
COM
I2
V2
I1
V1
COM
I0
V0
S1
COM
VI1
SO
COM
VI0
NC
-
+
2/7E
2/8E
76
78
Discharge Pressure
Suction Pressure
TP2
TP1
P
I
1X:73
1X:72
1X:70
1X:71
74
70
Discharge Temp.
RT5
1X:67
1X:68
1X:69
64
66
68
5/12E
A6
TM2ARI8LT
IN0
IN1
IN2
IN3
IN4
IN5
IN6
IN7
A
B'
B
NC
+
0V
1X:55
1X:56
1X:57
1X:58
1X:59
1X:60
1X:61
1X:62
1X:63
1X:64
1X:65
1X:66
40
42
44
46
48
50
52
54
56
58
60
62
RT1
RT2
RT3
RT4
Leaving Water Temp.
Entering Water Temp.
Standby
Ambient Temp.
2
4
4/12B
4/12B
TOTAL SHEETS 7
NO. OF SHEETS 6



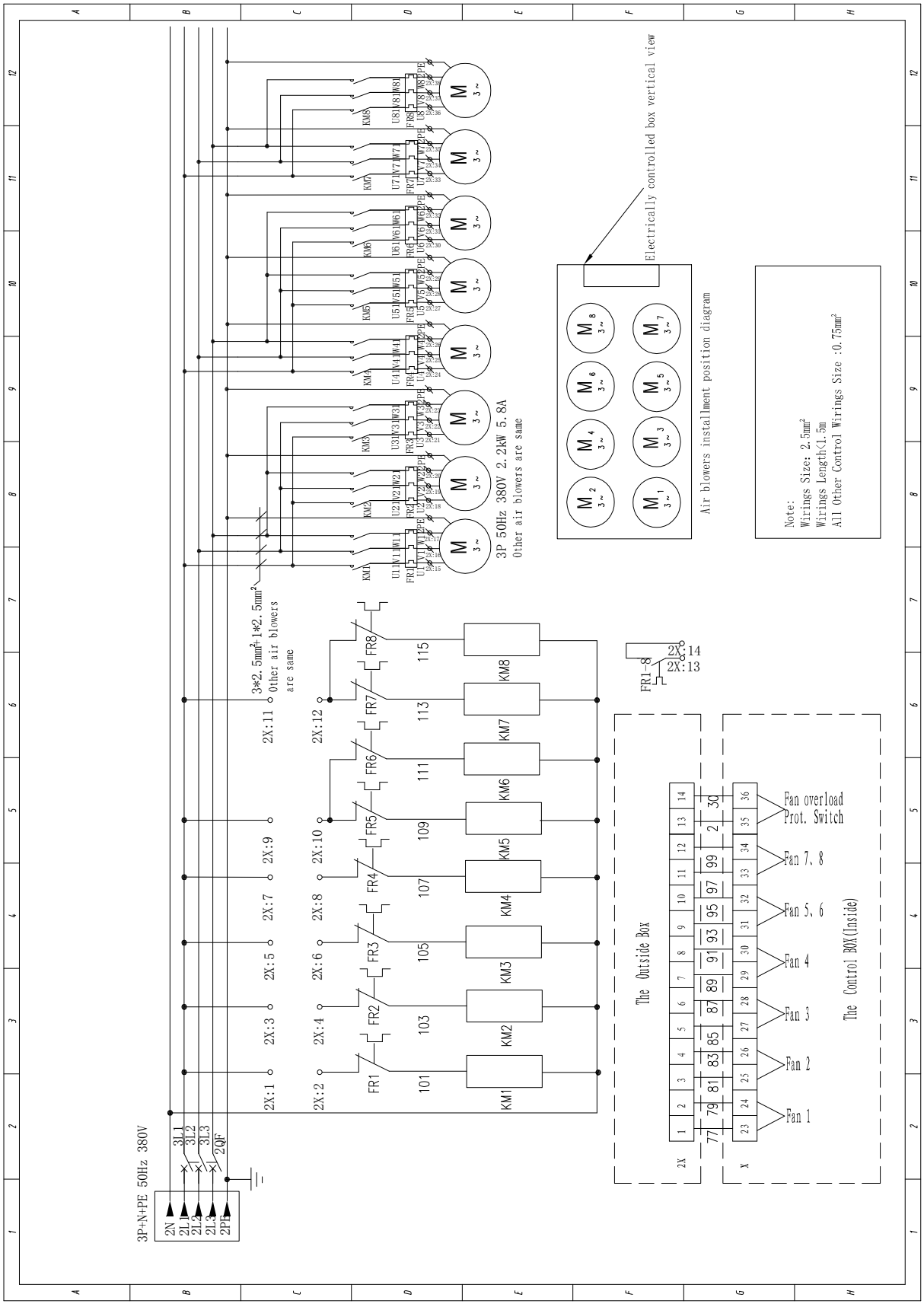
ITEM	SYMBOL	ITEM	DESCRIPTION
1	TA1 TA2		Current Transformer
2	1QF		Moulded Case Circuit Breaker
3	QF1 QF2 QF3 QF4		Air Switch
4	HL1 HL2 HL3		Lamp
5	KR1		Power Protection Module
6	KM11 KM12 KM13		Compressor Contactor
7	FR FR1~FR10		Thermal Overload Relay
8	M	M 3~	Motor
9	KT1		Time Relay
10	KM1~KM10		Fan Contactor
11	SB		Emergency Stop
12	T1		Isolation Transformer
13	EH1 EH2		Compressor Heater
14	SQ1		Water Flow Switch
15	SQ2		Anti-Freeze Switch
16	KA1-KA7		Intermediate Relay
17	SQ3		Protection Switch
18	SA1		C/H Mode Switch
19	SL1		Oil Level Switch
20	RT1~RT5 NTC		Temperature Sensor
21	YV1~YV9		Solenoid Valve
22	SP1 SP2 SP3		Pressure Switch
23	TP1 TP2	P I	Pressure Transducer
24	A1		CPU Module of PLC
25	A2		Extended Adaptor of PLC
26	A3		Extended Output Module of PLC
27	A6		Temperature Module of PLC
28	A7		Analog Singles Mixed Module of PLC
29	HMI		Touch Screen
30	A8		Electrical Expansion Valve Module
31	A9		Switch Power
32	A10		Power of Electrical Expansion Valve
33	EXV		Electrical Expansion Valve
34			
35			

TOTAL SHEETS 7 | NO. OF SHEETS 7

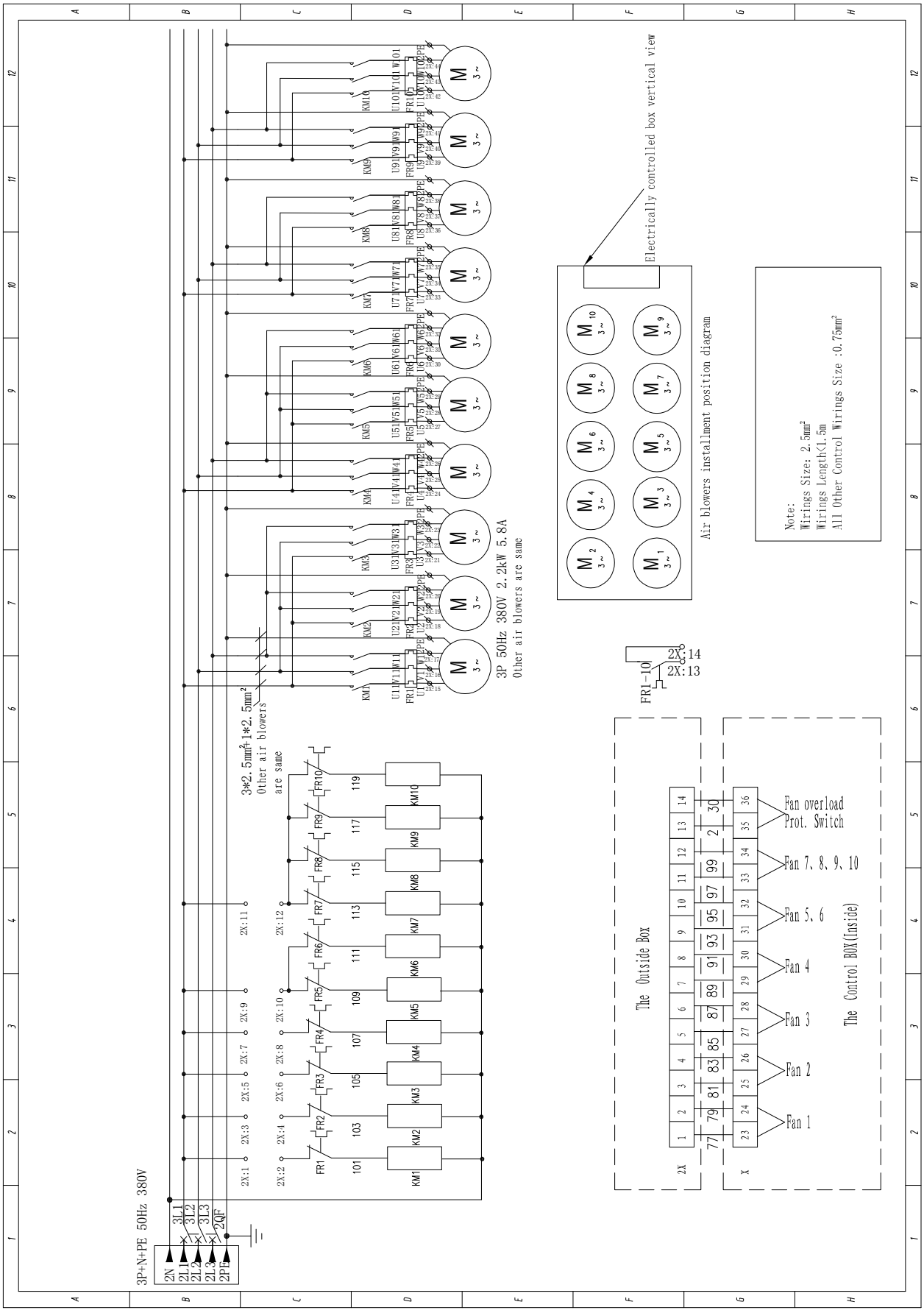
Wiring diagram for MRH380A-B3Z



Wiring diagram for MRH500A-B3Z



Wiring diagram for MRH600A-B3Z



7 Commissioning

7.1 Check Before Commissioning

7.1.1 Water System

- Ensure that all pipelines in the water system are clean and that the pipeline connection and water flow direction are correct.
- Check that the outlet and inlet pipes are in proper connection.
- Start the water valve.
- Start the water pump.
- Check whether water is leaked in pipes and joints.
- Start the discharge valve to discharge the air in the water system, and then stop the discharge valve.
- Detect the loss due to resistance on the cooling water side and check whether the water flow is correct.
- Check whether the inlet and outlet water temperature shown on the control cabinet is consistent with that shown on the thermometer.

7.1.2 Circuits

- Cut off the main power supply, and check each startup and control circuit in the power distribution cabinet. Check whether each component is installed securely and whether each wiring is connected correctly.
- Check whether the power supply of the unit is consistent with that shown on the nameplate. The maximum allowed unbalance between the output voltage and the rated voltage is 10%. The maximum allowed unbalance between phase voltages is 2%. The phase sequence of the power supply must be consistent with that shown on the unit.
- Check whether the power supply capacity is sufficient for the unit startup and full-load operation.
- Check whether the unit is connected to the ground.
- Ensure that all wires and fuses have proper specifications for unit operation. Complete the setting of all interlocking control lines and DIP switches according to the related electric control drawing.
- Ensure that all auxiliary and control devices run properly.

7.1.3 Unit

- Check whether the pressure and oil level inside the unit are normal.
- Check whether all safety control devices are in original states and whether the settings are correct.
- Check whether the valve of the unit is in correct position and whether you can hear fluorine leakage voice.
- Check whether the coil winding resistances (including the phase resistance, phase-to-phase

resistance, and resistance to ground) of the compressor are normal.

- Cut off the power supply of the compressor and then turn on the main power supply.
- Start the unit and check whether the switch between the star and delta AC contactors is normal (that is, check the voltage between the three contacts is 380 V). (Because the power supply of the compressor is cut off, the compressor is not powered on.)
- Check whether there is an open phase (the voltage to the ground of each phase should be 220 V).
- Check whether the onsite settings on the touchscreen conform to the requirements.
- Check whether the expansion valve can be turned on or off properly (control the expansion valve manually and check whether the step motor runs with normal operation voice).
- Check whether the load/unload solenoid valve works properly by performing manual load/unload.
- Check whether the oil heater of the compressor is in normal state and whether oil heating conditions are met.
- If all preceding items are normal, start the auxiliary devices and chilled water pump.
- Cut off the main power supply and turn on the power supply of the compressor.
- Turn on the main power supply again to start the unit.

7.2 Commissioning Operations

- Install a fluorine pressure gauge and a thermometer sensing probe on the unit and start the compressor. Check whether the star and delta AC contactors are started and switched properly. Check the voltage of the wiring at the bottom of each contactor.
- Check the current of the compressor.
- Check whether the fan runs properly and rotates in the correct direction. Then detect the operation current.
- Check whether the oil level is normal and whether the energy adjusting solenoid valve on the compressor operates properly. (You can use a nonmagnetic blade to check whether the valve has magnetism.)
- Let the compressor run more than 20 minutes. During this process, check and monitor all operation parameters, and observe the suction/discharge pressure of the unit.
- Through the return air superheat, check whether the opening of the electronic expansion valve is in a reasonable range.
- After the unit enters working conditions, check whether the return air superheat of the unit is within the range of 5–7. Check whether the discharge superheat and condensation subcooling are normal.
- When the discharge temperature is high, check whether the solenoid valve and expansion valve on the sparge pipe work properly. (You can use a nonmagnetic blade to check whether the valve has magnetism.)

- Stop the unit and check whether the oil level of the compressor is normal.
- To ensure that the unit can run all the time, start all terminal devices to provide sufficient air conditioning load.
- After the commissioning is complete, tighten all valve caps, clean the unit, and remove oil marks at all joints of fluorine systems.

8 Daily Use of the Unit

8.1 Check Before Use

(1) Judge whether the time for heating up the refrigerator oil of the compressor is long enough. When you initially start the unit after it is powered off, the refrigerator oil must be preheated for 24 hours. In other cases, 4 to 8 hours is usually required. The oil temperature must be kept above 23℃. (The time for heating up the refrigerator oil of the compressor varies with the ambient temperature. The lower the ambient temperature is, the more time it requires.) You can obtain the specific heating time from the state information on the touchscreen.

(2) Check whether the water flow meets the unit requirement.

(3) Check whether all control switches and components in the power distribution cabinet are normal.

(4) Check whether the power supply and voltage are normal.

(5) Check whether the pressure gauge of the chiller is normal. In normal cases, when the outdoor temperature is 25℃–28℃, the pressure shown on the pressure gauge is 7–10 kgf/cm^2.

8.2 Unit Startup Sequence

(1) Start the water pump of the water circulating system.

(2) Start the compressor.

(3) Start the fan motor (based on the discharge pressure of the compressor).

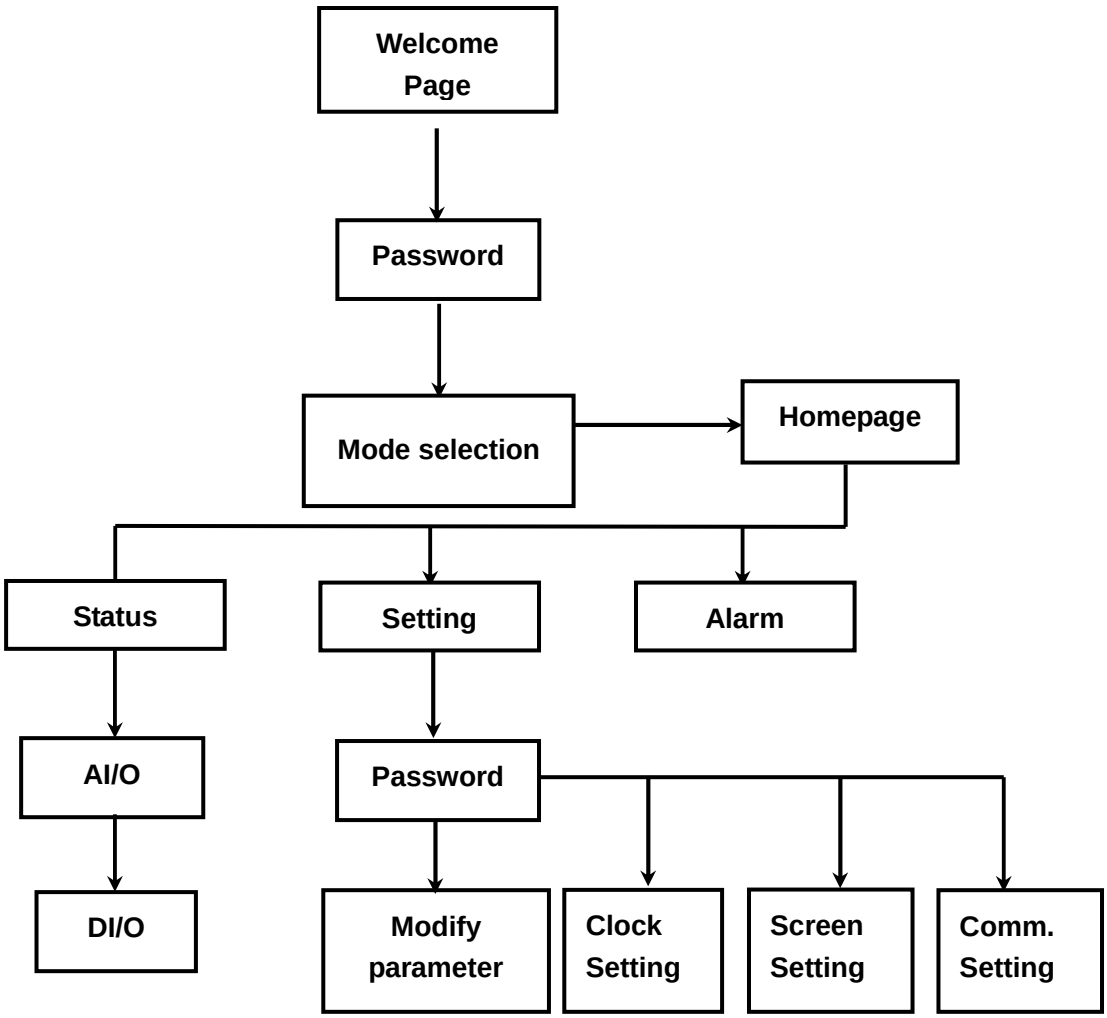
8.3 Unit Stop Sequence

(1) Stop the compressor.

(2) Stop the fan motor (based on the discharge pressure of the compressor).

(3) Stop the water pump of the water circulating system.

8.4 Control Interface Structure



8.5 Operation

Notes:

(1) The touchscreen displays the time of each event. Except programmable logic controller (PLC) events, the time of other events is consistent with that shown on the touchscreen.

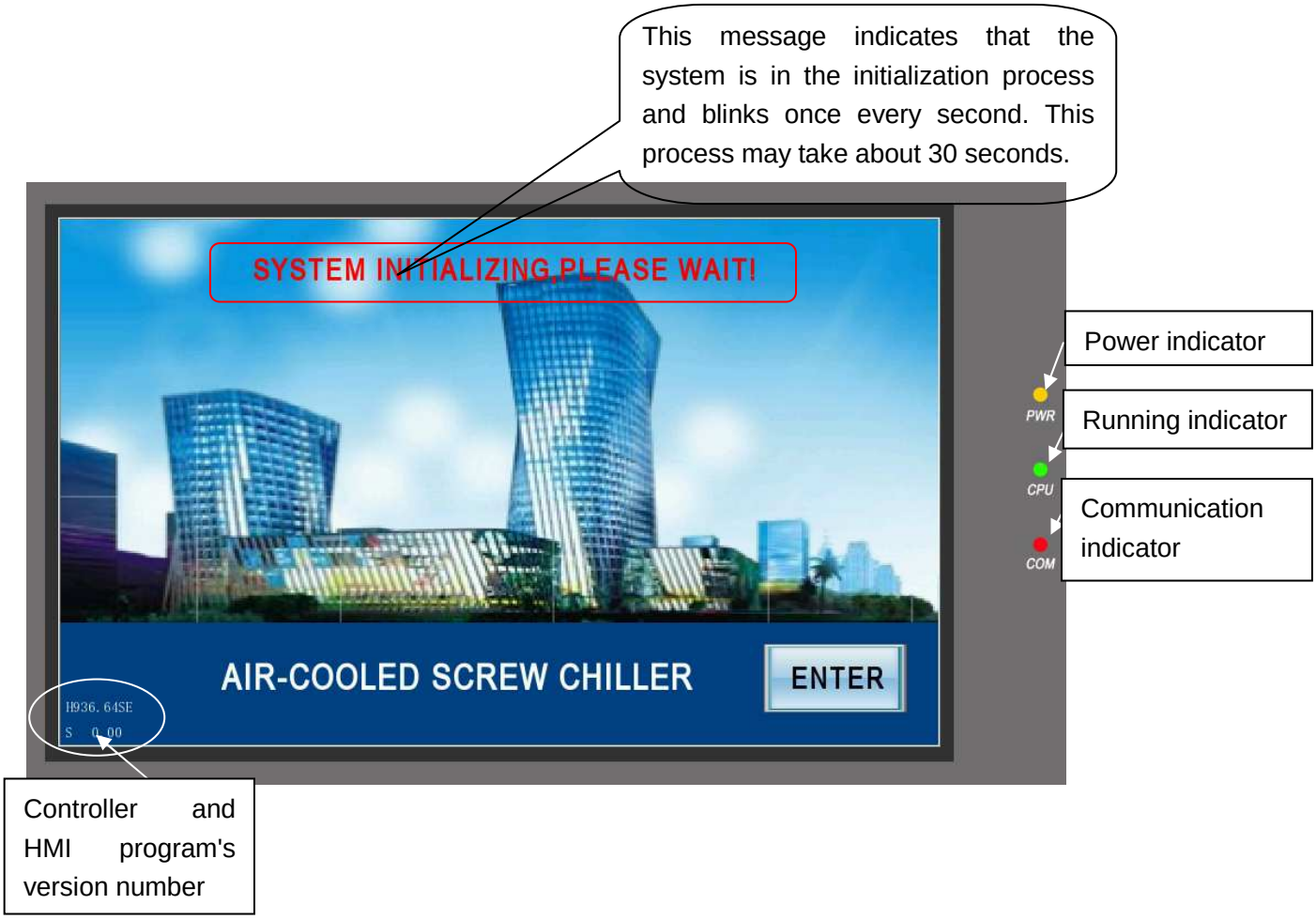
(2) It is prohibited to disassemble the display or add a communication wire for remote control. If you do this, the unit may be faulty due to signal interference. Our company will not take any responsibility for any hurt or consequence arising therefrom. If you really require remote control, you can customize the function from our company.

(3) Be cautious to choose a switch for remote control. Only a point-moving type switch can be chosen. If you choose another type switch, the unit may automatically restart after being powered off. Our company will not take any responsibility for any hurt or consequence arising therefrom. When choosing a switch in remote control mode, you must choose a maintained switch. Otherwise, the unit is likely to work in only one state.

(4) Three indicators (white, green, and red) are installed on the operating panel of the indoor control cabinet. The white indicator is the power indicator of the unit. If the unit is powered on, the white indicator turns on. The green indicator is the running indicator of the unit. If the unit is operating properly, the green indicator turns on. The red indicator is the alarm indicator of the unit. If the unit generates an alarm, the red indicator turns on.

Note: The following figure shows the home page screen of a single unit. If multiple units are in parallel connection, the input/output screen of each unit is displayed. The operation is the same as that performed for a single unit. The screen shown in the following figure is subject to change without notice. The actual screen shall prevail.

After being powered on, the touchscreen automatically enters the home page.



The indicators on the right of the panel are described as follows:

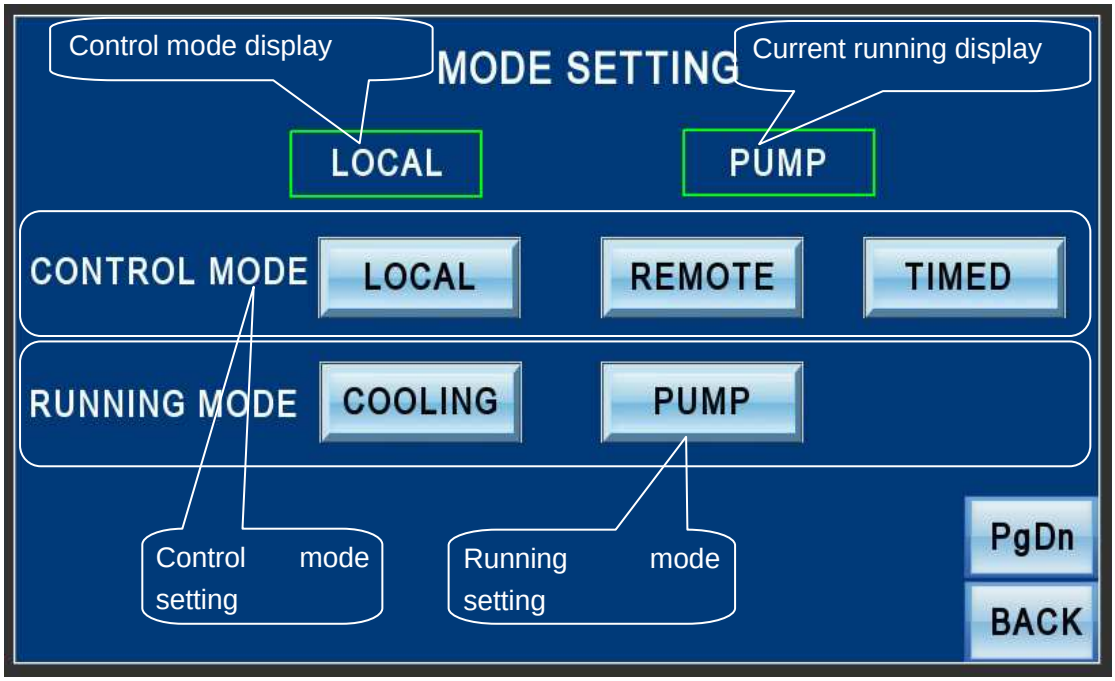
(1) The yellow indicator is the power indicator. It keeps steady on in normal conditions. If it is off, check whether the power cable is connected correctly.

(2) The green indicator is the running indicator of the touchscreen. It blinks at a low frequency in normal conditions.

(3) The red indicator is the communication indicator. It blinks at a high frequency in normal conditions. If it is in other states, check whether the communication cable of the controller is correctly and securely connected to the panel.

After the system initialization is complete, click **ENTER**. The keypad is displayed, prompting you to enter the password, as shown in the following figure.

On the keypad, enter **58806** and click **Enter** to enter the mode setting page.



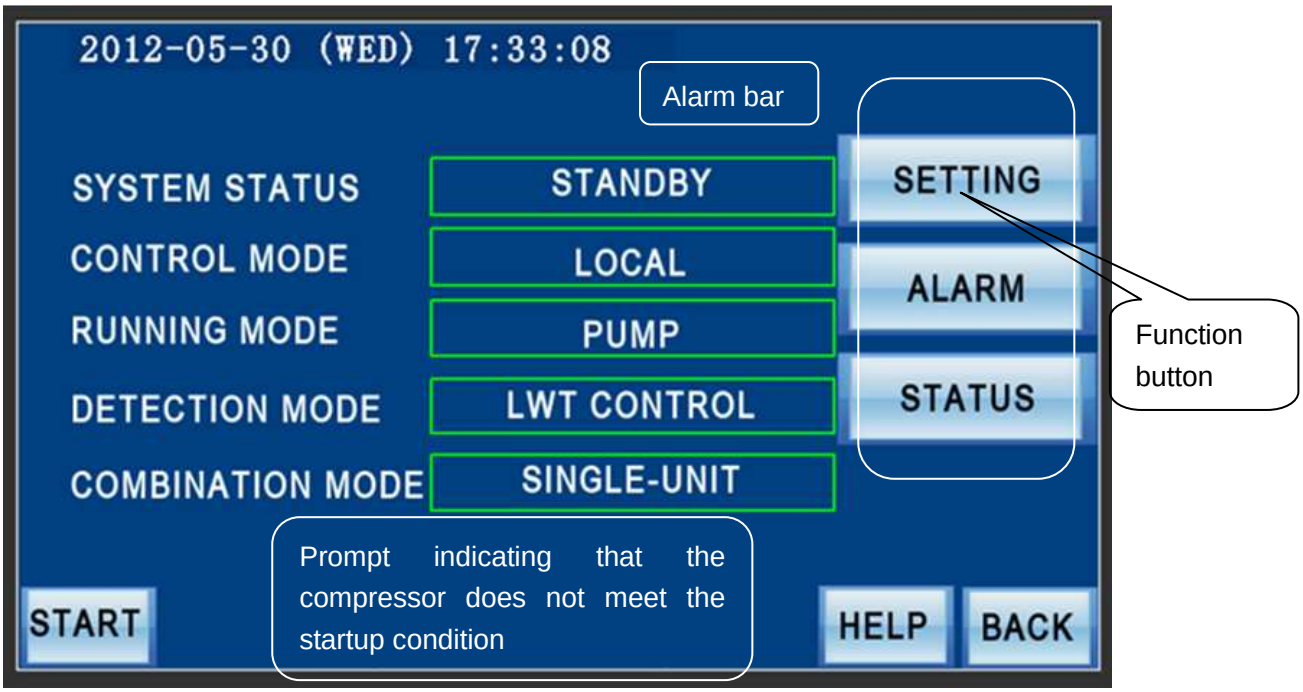
On this page, set a control mode and a running mode. The system's current control and running modes are displayed in the upper part of the screen.

Notes:

(1) If the system is running, you can only change the control mode. Other modes cannot be changed.

(2) The control mode is used to select a startup/shutdown mode for the unit. When the control mode is set to **LOCAL**, you can start or stop the unit by clicking the **START** or **STOP** button. When the control mode is set to **REMOTE**, you can start or stop the unit only through the **REMOTE START** or **REMOTE STOP** hardware interface. When the control mode is set to **TIMED**, you can start or stop the unit by setting a startup or shutdown time.

After setting the control mode, click **PgDn** to enter the next page (that is, the main page), or click **BACK** to return to the previous page (that is, the home page).



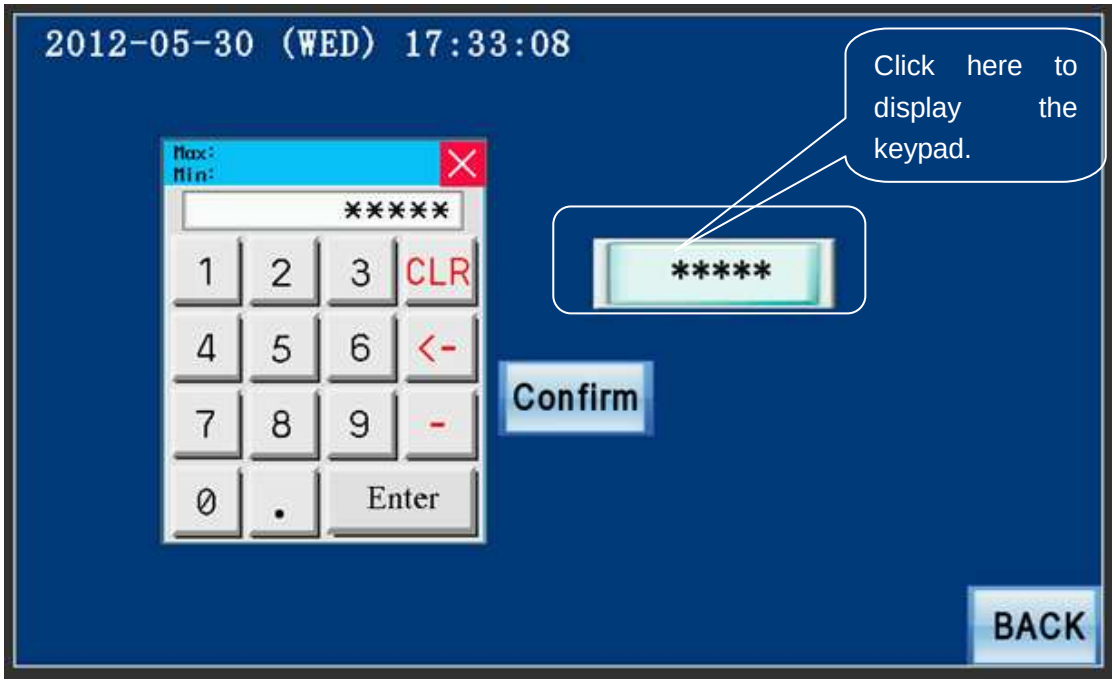
The main page displays unit information such as the current status, control mode, and running status. After you click **BACK**, the system returns to the mode setting page.

The unit's current status includes the following:

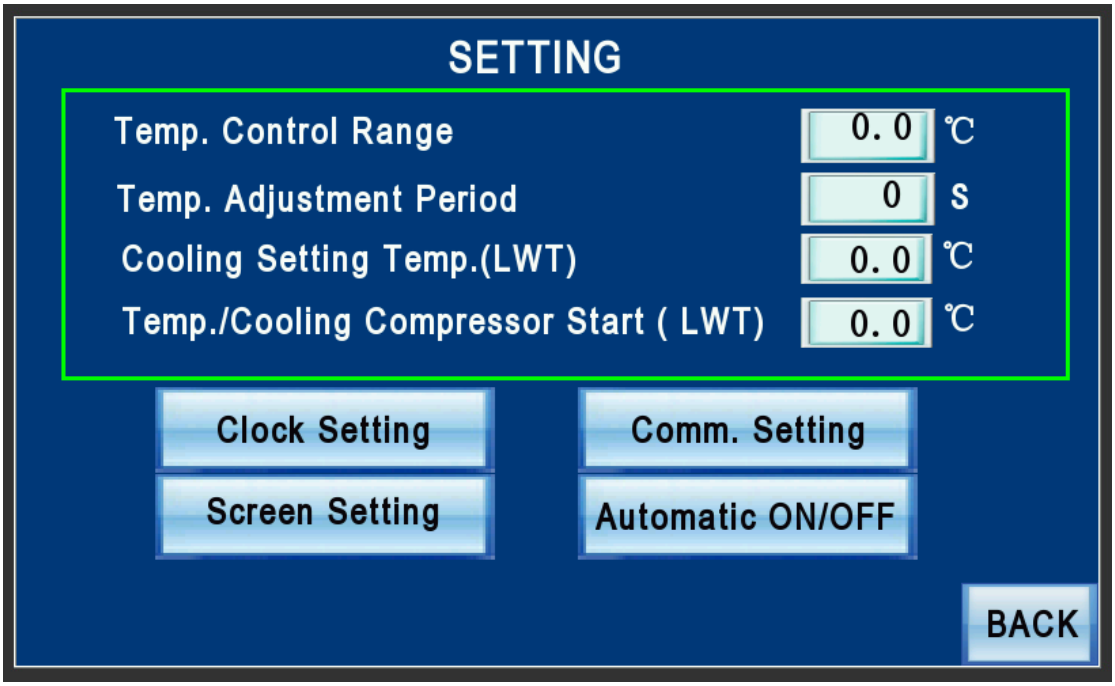
1. STANDBY: indicates that all output status of the unit is OFF, and the unit has been stopped.
2. STARTING UP: indicates that the unit is running based on the startup logic. If the compressor does not meet the startup condition, this status will be displayed all the time until the startup process ends.
3. RUNNING: indicates that the unit is running properly. In water pump mode, it indicates the running status of the water pump.
4. STOP: indicates that the unit is operating based on the power-off logic.

5. PAUSE: indicates that the energy adjustment device is standby and waits for temperature recovery. After the temperature is recovered, the compressor starts automatically.
6. FAULT: indicates that the unit is encountering a fault. After the fault is rectified, the status disappears.

On the main page, click SETTING to enter the password entering page.



On the displayed keypad, enter **40828**, and click **Enter**. The dialog box disappears. Click **Confirm** to enter the parameter setting page.



On this page, you can set the following items:

Temperature control range, temperature control period, control target temperature, and compressor startup temperature.

Notes:

(1) On the password entering page, you can set an upper limit in the **Max** text box, and a lower limit in the **Min** text box. Click **Enter** to confirm your input or press **Esc** to cancel your input. The keypad then disappears.

(2) The Automatic ON/OFF button is available only in timed mode.

Parameters displayed on the above page are described as follows:

Cooling Setting Temp.(LWT): indicates the target water temperature.

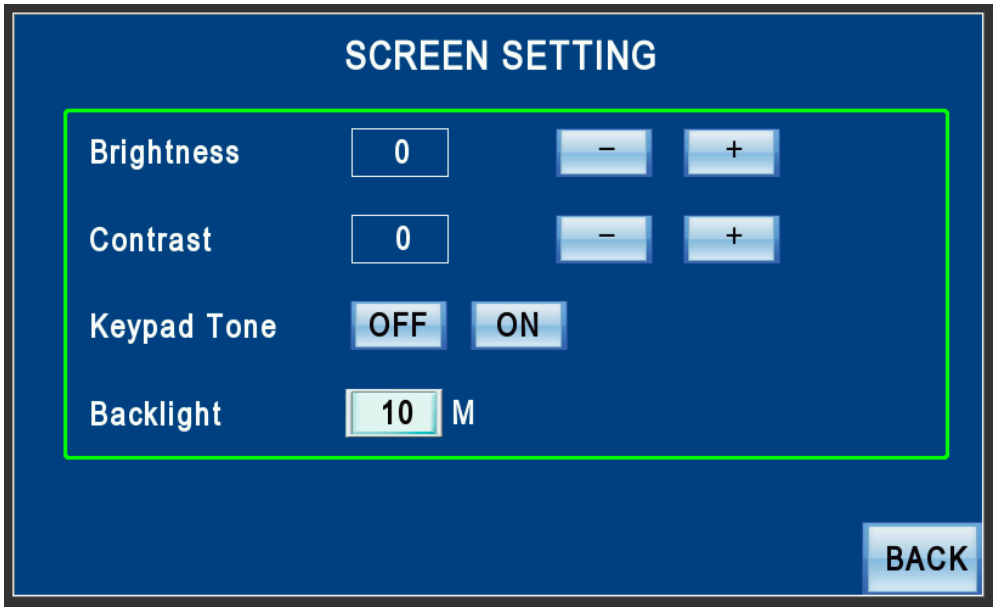
Tem./Cooling Compressor Start (LWT): indicates the (outlet water) temperature at which the unit can start the compressor. In case of cooling, the compressor can start only when the (outlet water) temperature is higher than the compressor startup temperature.

Temp. Adjustment Period: indicates the load/unload judgment cycle. If it is set to 60 seconds, the system judges the unit temperature once every 60 seconds, and checks whether load/unload is required. If yes, the system executes the load/unload immediately. In another 60 seconds, the system performs a judgment again. The cycle is repeated in such way.

Click **Clock Setting** to enter the time setting page.

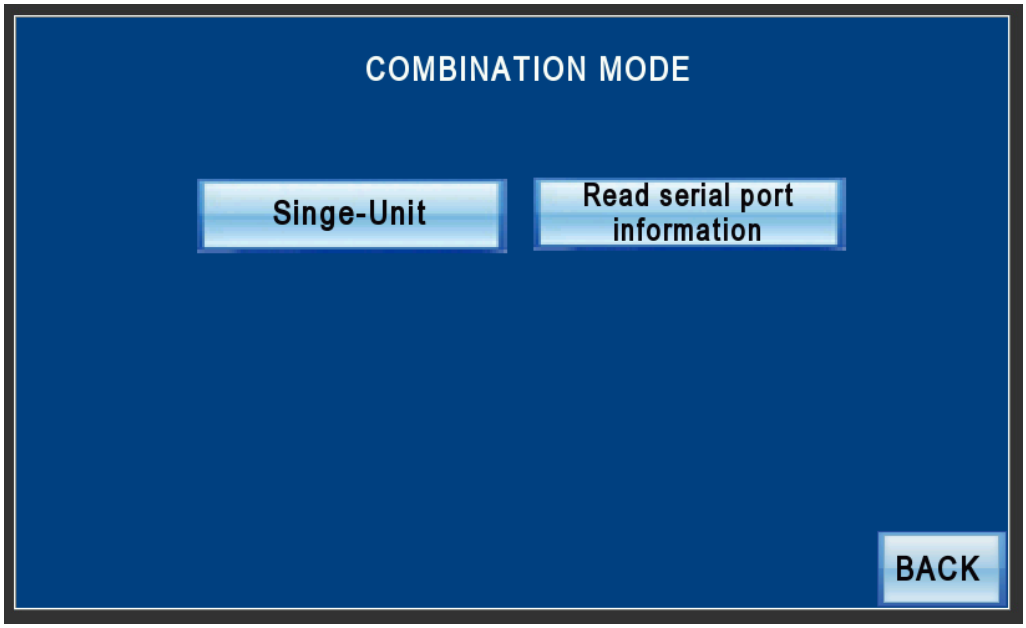
On the user parameter setting page, click **Clock Setting** to set the time and date of the PLC and touchscreen. Note that you must click **Confirm** within 1 minute after you enter the time. **During this process, you must set a valid date and time. If you set an invalid date and time, our company will not take any responsibility for any consequence arising therefrom.**

Click **Screen Setting** to enter the touchscreen setting page.



On this page, you can click **+** or **–** to increase or decrease the brightness and contrast of the touchscreen.
You can also click **ON** or **OFF** to unmute or mute the keypad tone of the touchscreen.
Click the text box in the **Backlight** field. You can then modify the time of the backlight.

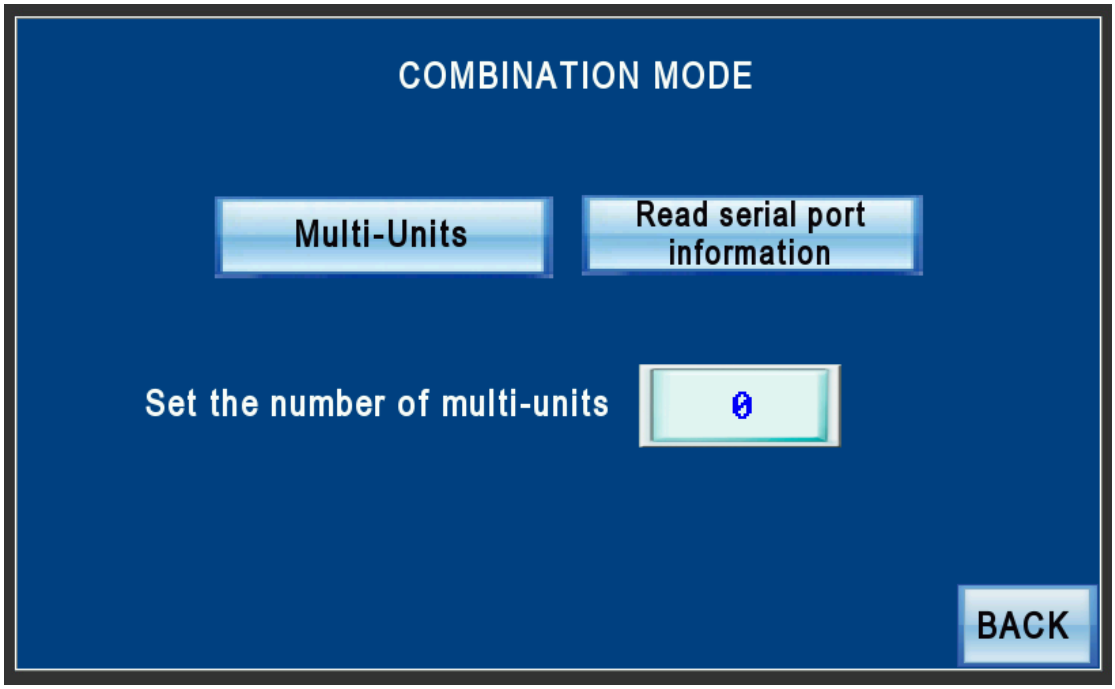
Click **Comm. Setting** to enter the multi-connection setting page.



When multiple units need combination control, contact sales engineers or after-sale service engineers of

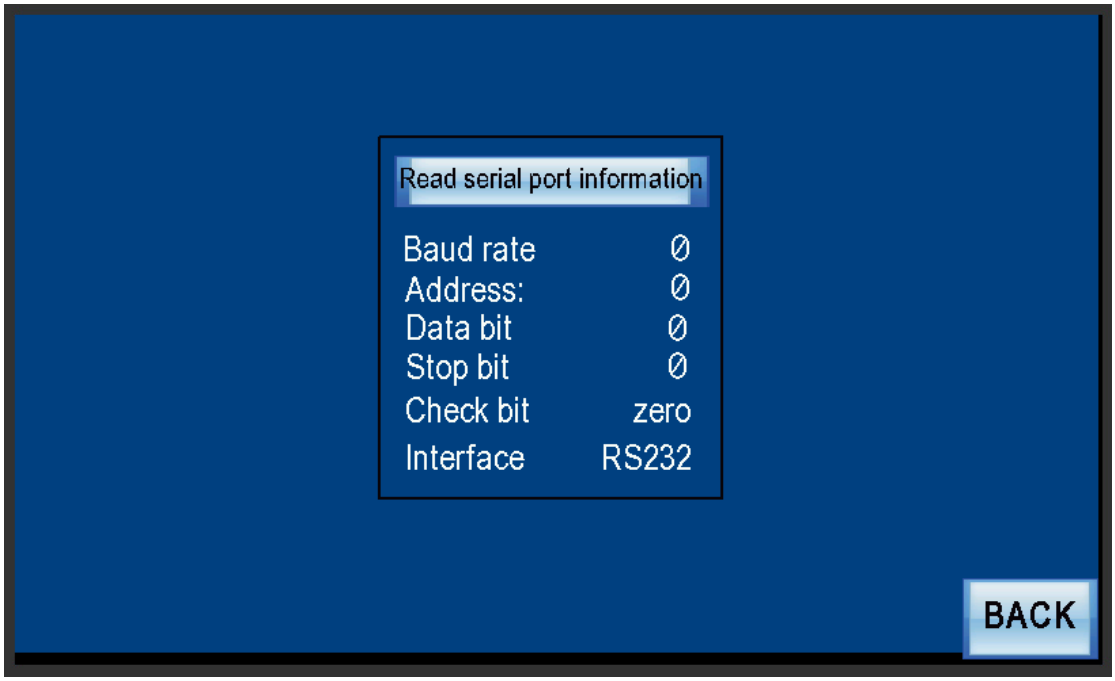
company to perform relevant settings for these units.

After the setting is complete, click Single unit. It then turns to Multi units, indicating that the units are in the combination control state.



Then at the bottom of the screen, set the number of units that need combination control.

You can click Read serial port information to read serial port information when you set multiple units or set the host computer.



The Automatic ON/OFF button is available only when **CONTROL MODE** is set to **TIMED** on the mode

setting page. Click this button to enter the starting/shutdown time setting page.

Starting/shutdown time settings take effect only when **CONTROL MODE** is set to **TIMED**.

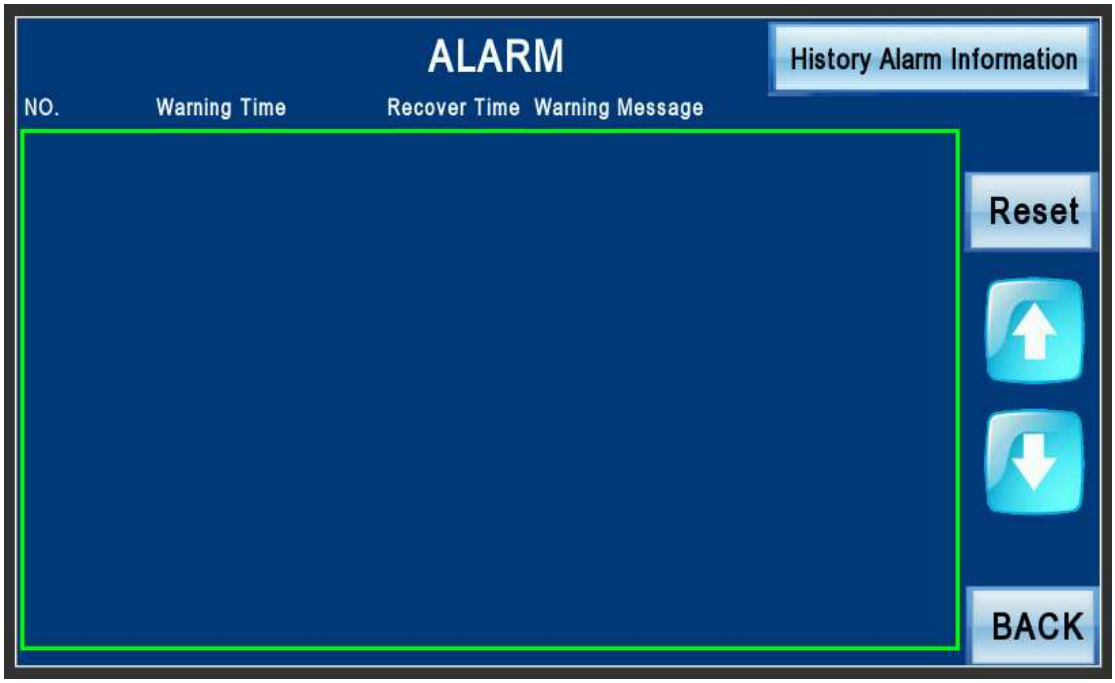
On the above page, you can set the starting and shutdown time of the unit on each day of a week. The unit starts and shuts down based on the settings. If the unit needs to run for more than one day, for example, from 10:00 on Tuesday to 16:00 on Thursday, you can perform the following settings:

1. Set the starting and shutdown time on Tuesday to 10:00 and 00:00 respectively, and click the Invalid button to validate the settings.
2. Keep the starting and shutdown settings on Wednesday invalid.
3. Set the starting and shutdown time on Thursday to 00:00 and 16:00 respectively, and click the Invalid button to validate the settings.

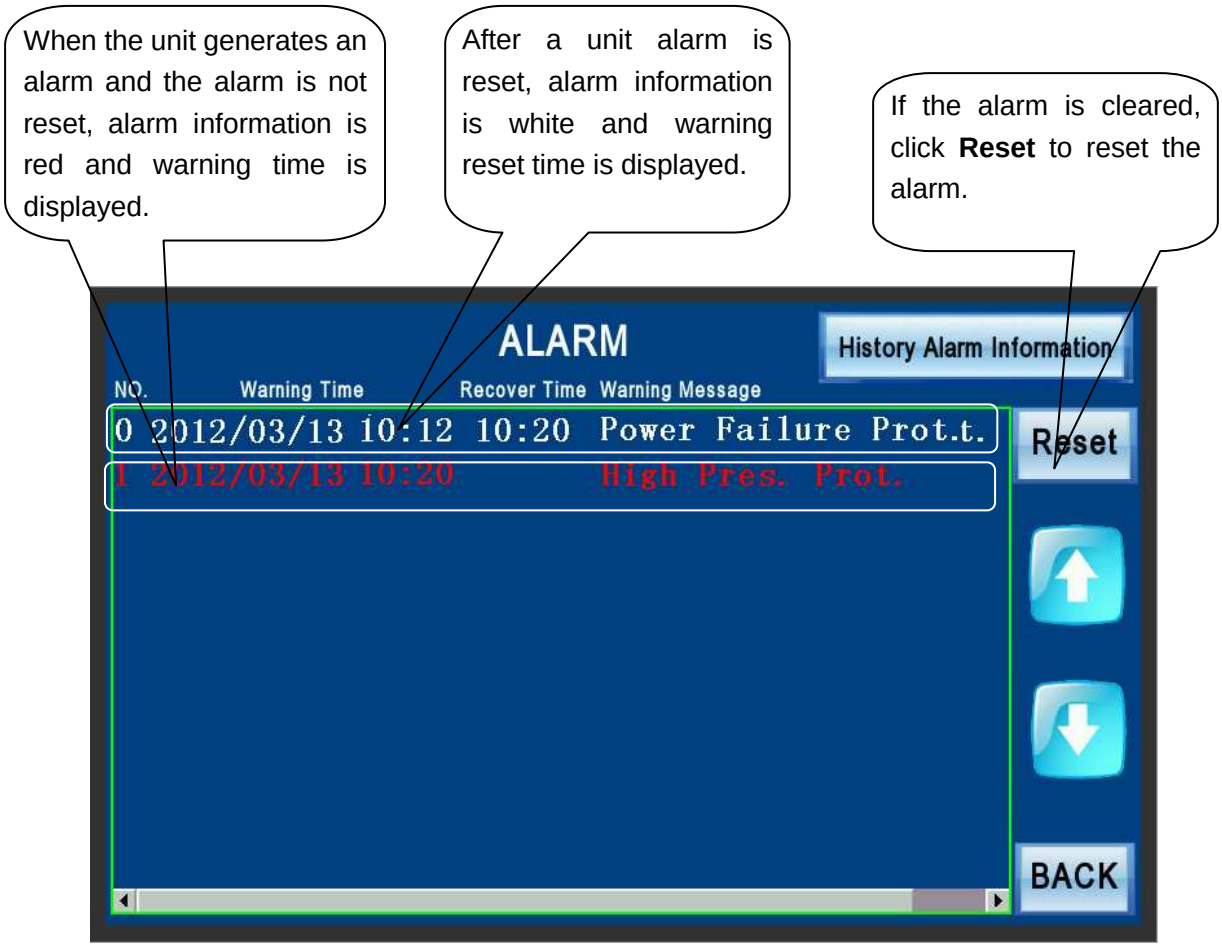
The timed starting and shutdown adopt the PLC's internal time. Therefore, if the unit is always powered off, you must check whether the PLC time is ever reset and whether the PLC battery has power when you use this function. If the PLC battery has no power, replace it.

On the main page, click 

to view alarm information of the unit.



On this page, you can click  or  to view a maximum of 100 historical alarm messages of the unit.



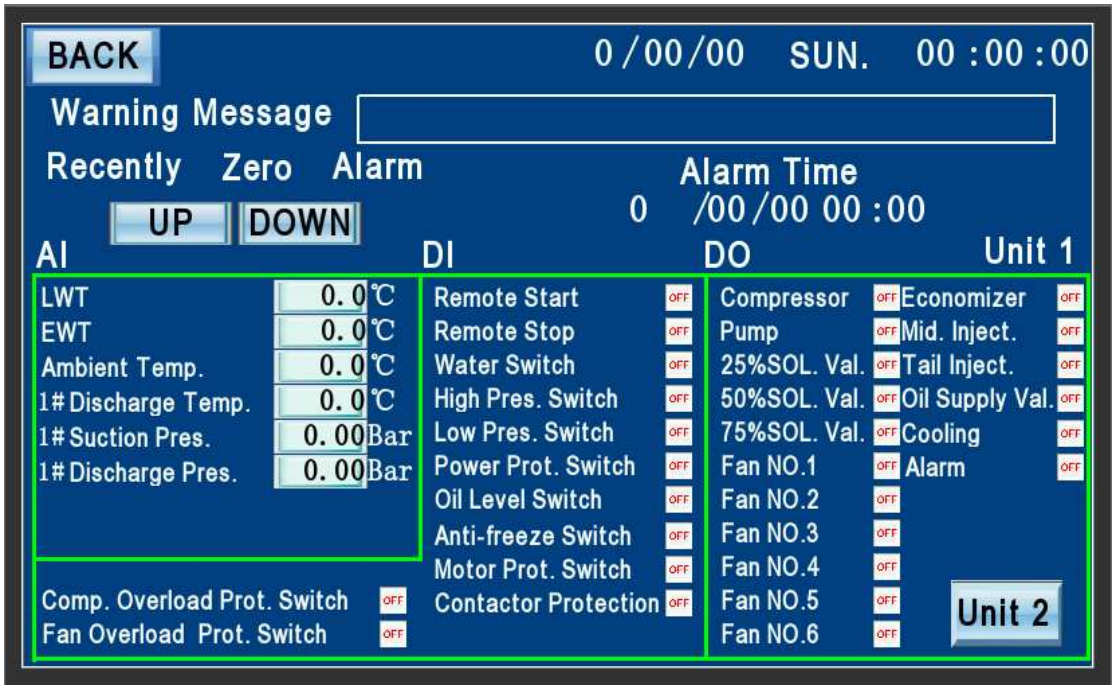
Notes:

(1) The high pressure switch cannot be reset automatically. You need to find this switch on the unit to reset it manually.

(2) The compressor and fan overload protection switches cannot be reset automatically. You need to find the thermal relay in the power control cabinet to reset the two switches manually.

(3) After a PLC module fault is rectified, you must power off and then power on the unit to clear the fault.

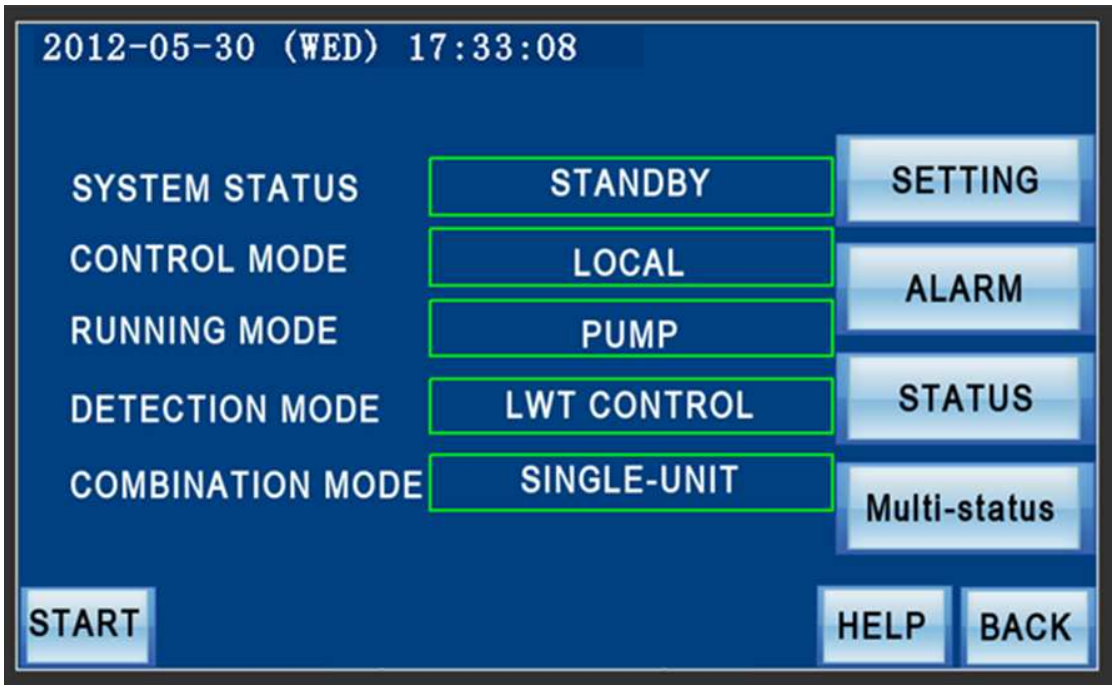
On the above page, click History Alarm Information to enter the page shown in the following figure. You can then view the information about the five latest alarms, such as the temperature and pressure.

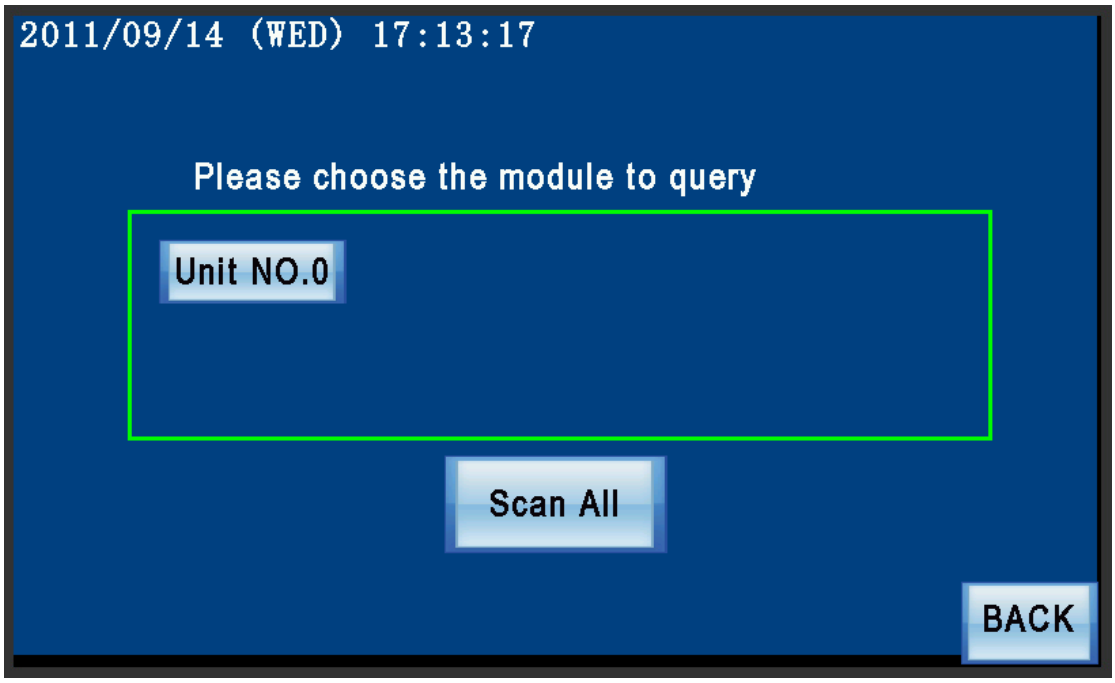


Click 

on the main page to enter the combination mode query page.

Note: The **Multi-status** button is available only when **COMBINSTION MODE** is set to **MULTI-UNIT** on the user parameter setting page.

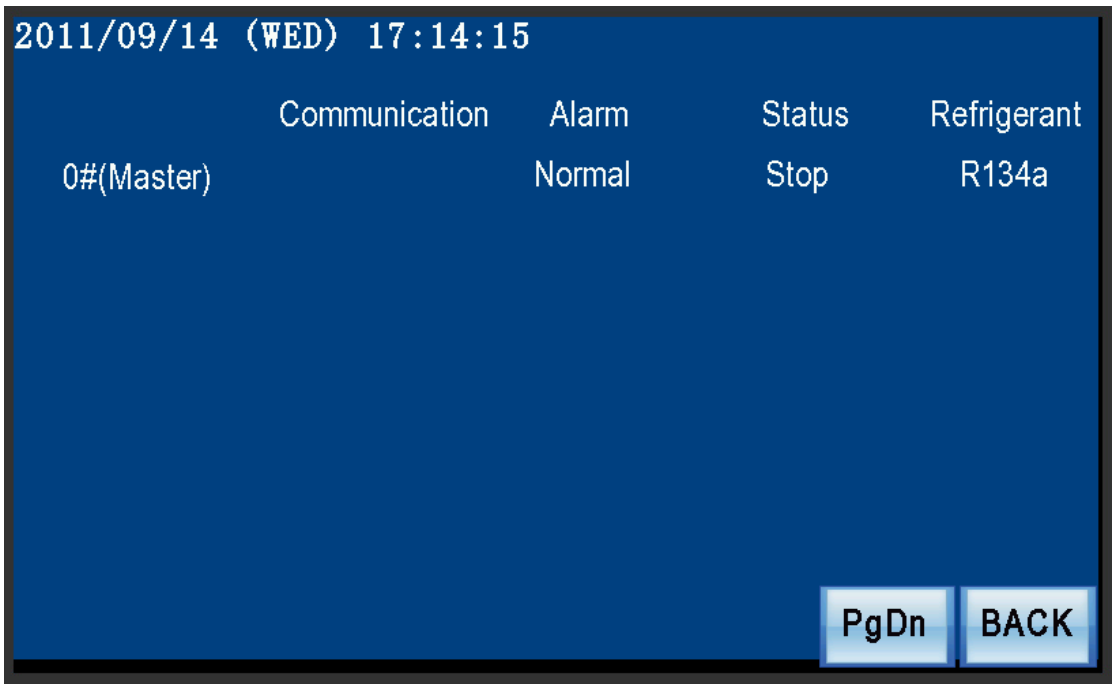




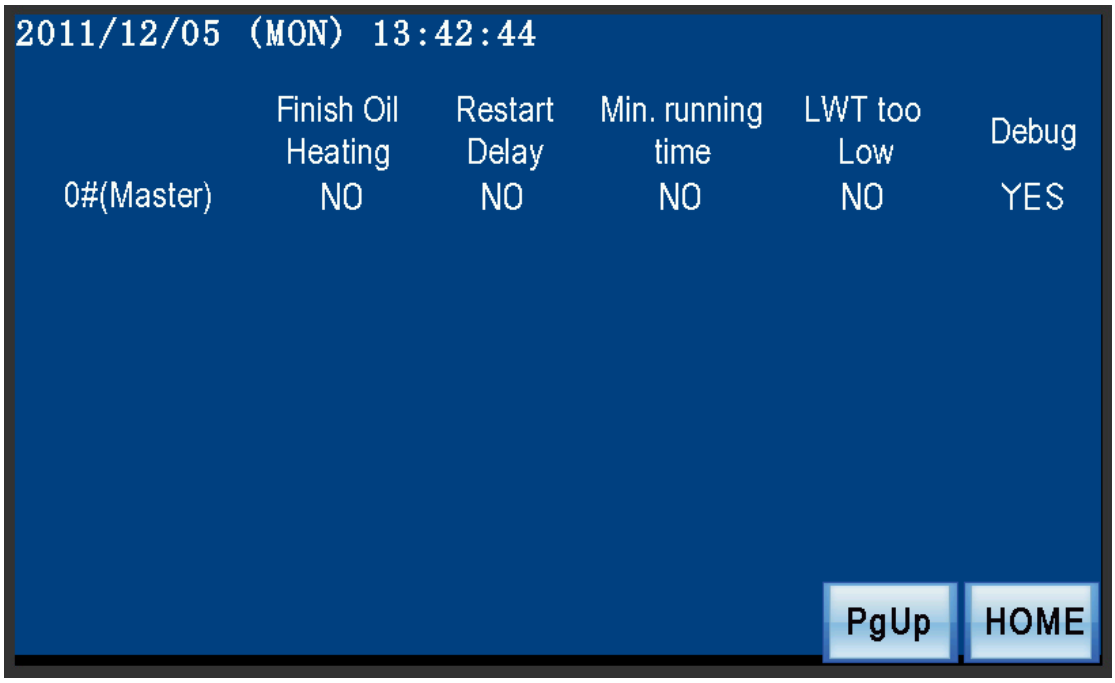
On this page, you can select a module to view its status or monitor the master unit to view the status of each unit.

To do so, click 

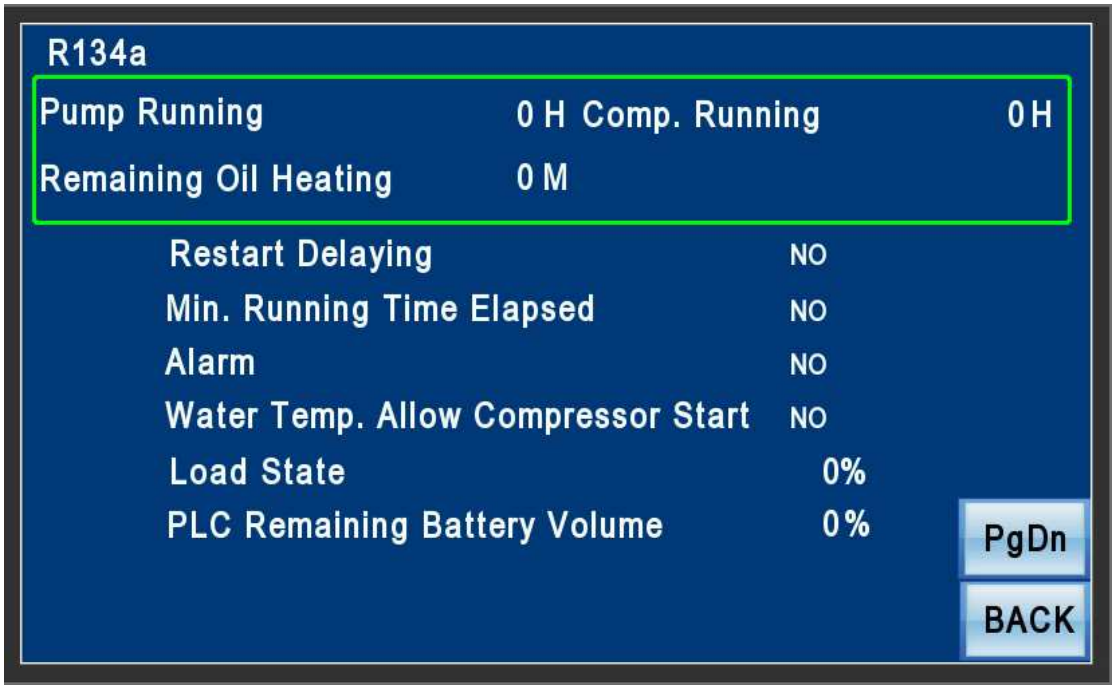
to enter the page shown in the following figure.



Click **PgDn** to enter the page shown in the following figure.



Click Unit NO.0 on the combination mode query page, or STATUS on the main page when a single unit is connected to enter the page shown in the following figure.



On this page, you can view the following information:

- Type of the refrigerant used in the unit, running time of the compressor and pump, and remaining time for heating up the oil in the compressor.
- Whether the unit generates an alarm, whether the compressor startup temperature is met, and whether the compressor startup failure is caused by insufficient restart delay.
- Whether the compressor unload failure is caused because the shortest running time of the unit is not reached.
- Unit running status (25%, 50%, 75%, or 100%)
- Residual electricity of the PLC battery

Notes:

To start the unit, ensure that the following conditions are met:

(1) **Restart Delaying** must be set to **NO**. If it is set to **YES**, the startup delay is not reached.

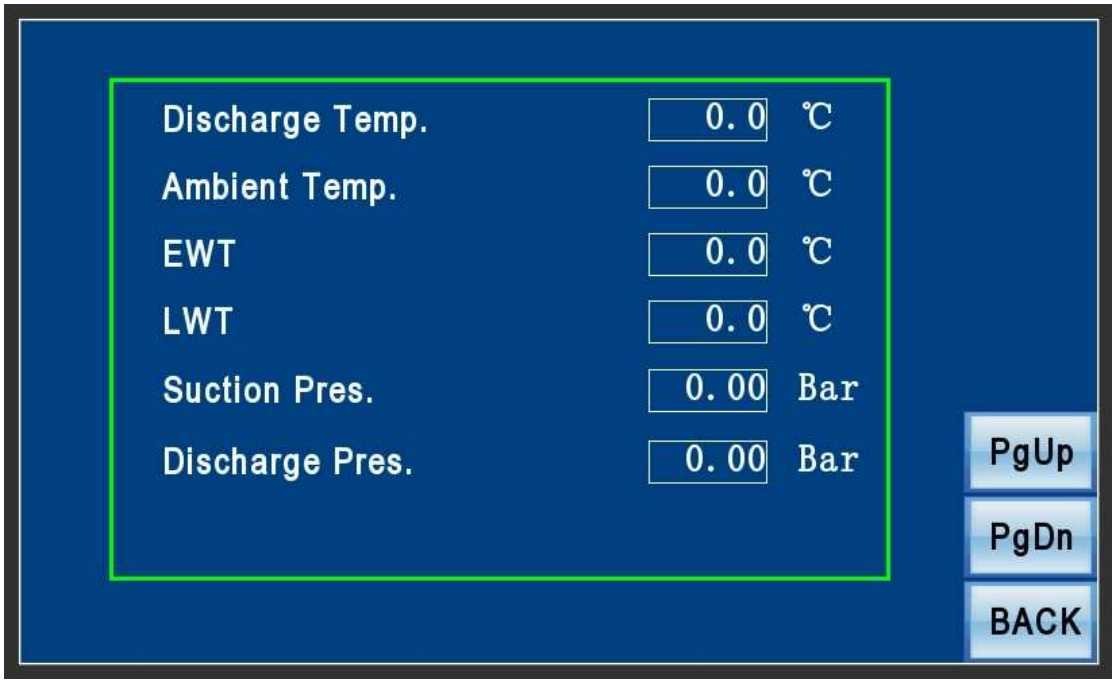
(2) **Water Temp. Allow Compressor Start** must be set to **YES**. If it is set to **NO**, the current temperature does not meet the compressor startup condition.

(3) **Remaining Oil Heating** must be set to **0**. If it is set to a value larger than 0, the oil of the unit is being heated.

To shut down the unit, ensure that the following condition is met:

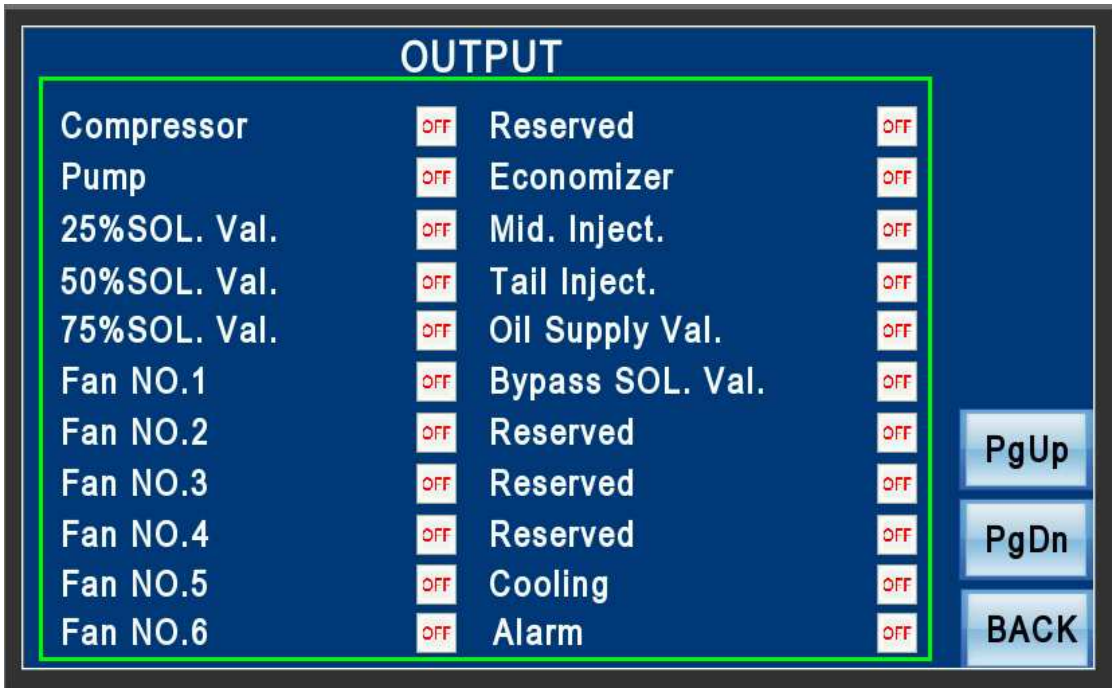
Min. Running Time Elapsed must be set to **YES**. If it is set to **NO**, the shutdown delay is not reached.

Click **PgDn** to enter the page shown in the following figure.



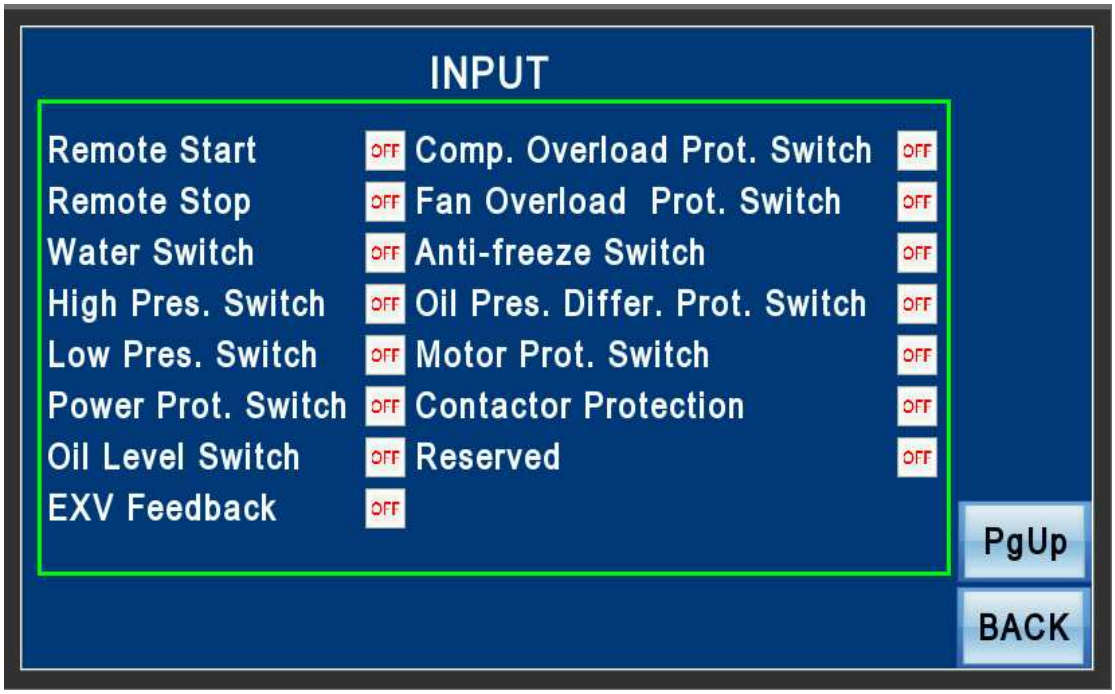
On this page, you can view the unit's temperature and pressure.

Click **PgDn** to enter the page shown in the following figure.



This page displays the output status of the unit. **OFF** indicates that a point has no output. **ON** indicates that a point has output.

Click **PgDn** to enter the page shown in the following figure.



This page displays the input status of the unit. **OFF** indicates that a point has no input. **ON** indicates that a point has input.

Notes:

(1) **Remote Start/Remote Stop:** takes effect in remote control mode.

(2) When there is no water flow, **Water Switch** is set to **OFF**. Otherwise, it is set to **ON**.

(3) After contactors work properly during the compressor operation, **Contactor Protection** is switched from **OFF** to **ON**.

9.6 Fault Alarm Function

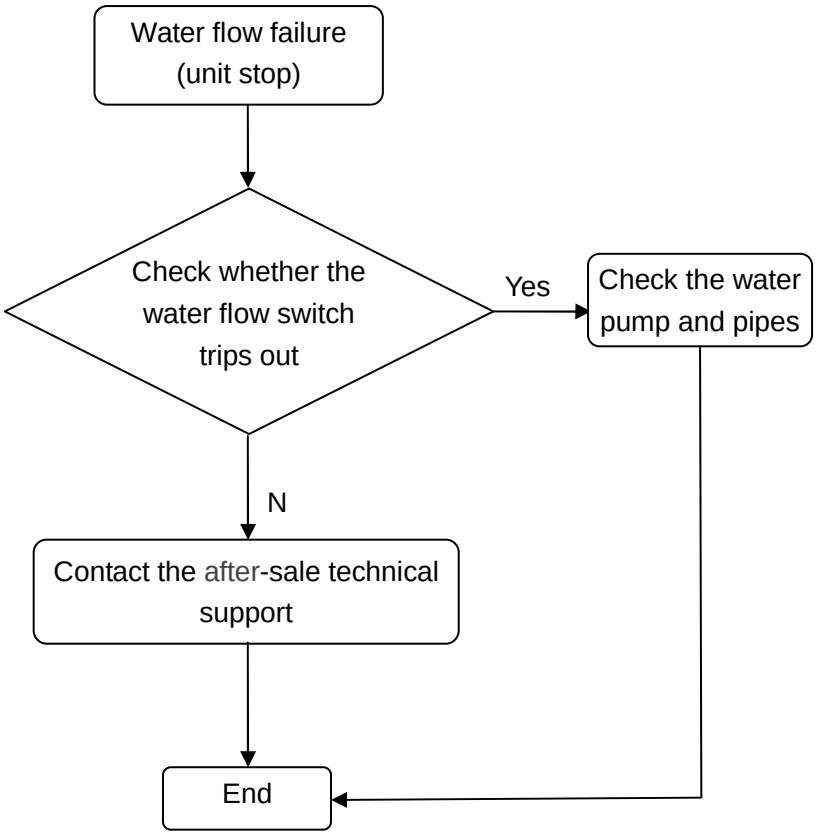
Fault	System's Determination Criteria	System's Handling Method	Possible Causes	Rectifying Way
Water flow failure	After the water pump runs for 3 minutes, the water flow switch trips out for 5 seconds.	Stop the unit.	The water flow is too small. The water flow switch is inserted in a wrong position. The water flow switch is inserted in a shallow position. The water flow switch is faulty. The wiring is loose.	Manual
Anti-freeze protection	The anti-freeze protection switch trips out for 3 seconds.	Stop the unit.	The water temperature is lower than 3℃. The anti-freeze switch is faulty. The wiring is loose.	Manual
High pressure alarm	The high pressure switch trips out for 3 seconds.	Stop the unit.	The discharge pressure of the unit is too high. The high pressure switch is faulty. The wiring is loose.	Manual
Low pressure alarm	The low pressure switch trips out for 1 second.	Stop the unit.	The suction pressure of the unit is too low. The low pressure switch is faulty. The wiring is loose.	Manual
Compressor interior protection alarm	The compressor interior protection switch trips out for 3 seconds.	Stop the unit.	The motor temperature is too high. The motor runs reversely. The power supply has an open phase. The three-phase voltage is unbalanced. The compressor interior protection switch is faulty. The wiring is loose.	Manual

Low oil level protection	The oil level switch trips out for 60 seconds.	Stop the unit.	The oil level of the compressor is too low. The oil level switch is faulty. The wiring is loose.	Manual
Oil pressure difference protection	After the unit starts running, the oil pressure difference protection switch trips out for 30 seconds.	Stop the unit.	The oil filter is blocked. The oil pressure switch is faulty. The wiring is loose.	Manual
Compressor overload	The compressor's thermal overload relay trips out for 3 seconds.	Stop the unit.	The compressor is overloaded. The thermal overload relay's switch is faulty. The wiring is loose.	Manual
Fan overload	The fan's thermal overload relay trips out for 3 seconds.	Stop the unit.	The fan is overloaded. The thermal overload relay's switch is faulty. The wiring is loose.	Manual
Power supply failure	The power protection module trips out for 3 seconds.	Stop the unit.	The three-phase voltage power supply is unbalanced. The voltage is too low. The voltage is too high. The phase is reversed or lost. The power protection module is faulty. The wiring is loose.	Manual
Contactor protection	After the compressor runs for 10 seconds, the contact feedback protection switch trips out for 0.1 second.	Stop the unit.	The absorption of the contactor is unstable. The control wire of the contactor is loose. The absorption of the middle relay before the contactor is unstable. The normally closed contacts of the thermal relay are unstable, or the thermal relay trips out incompletely.	Manual
High temperature of discharge air	The discharge air temperature keeps being higher than 110℃ for 10 seconds.	Stop the unit.		Manual
Open circuit of outlet water temperature sensor	The PT100's resistance is greater than 300 Ω.	Stop the unit.		Manual

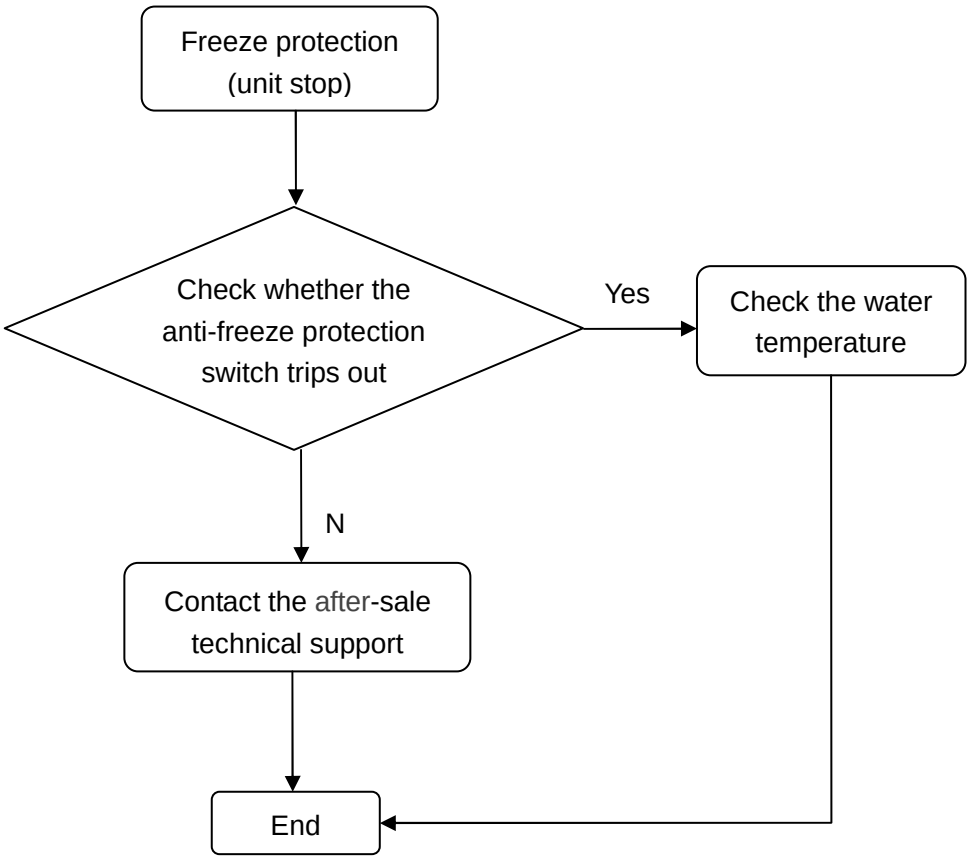
Short circuit of outlet water temperature sensor	The PT100's resistance is smaller than 20 Ω.	Stop the unit.		Manual
Open circuit of inlet water temperature sensor	The PT100's resistance is greater than 300 Ω.	Stop the unit.		Manual
Short circuit of inlet water temperature sensor	The PT100's resistance is smaller than 20 Ω.	Stop the unit.		Manual
Open circuit of ambient temperature sensor	The PT100's resistance is greater than 300 Ω.	Stop the unit.		Manual
Short circuit of ambient temperature sensor	The PT100's resistance is smaller than 20 Ω.	Stop the unit.		Manual
Open circuit of discharge temperature sensor	The PT100's resistance is greater than 300 Ω.	Stop the unit.		Manual
Short circuit of discharge temperature sensor	The PT100's resistance is smaller than 20 Ω.	Stop the unit.		Manual

8.7 Safety Protection Flowchart

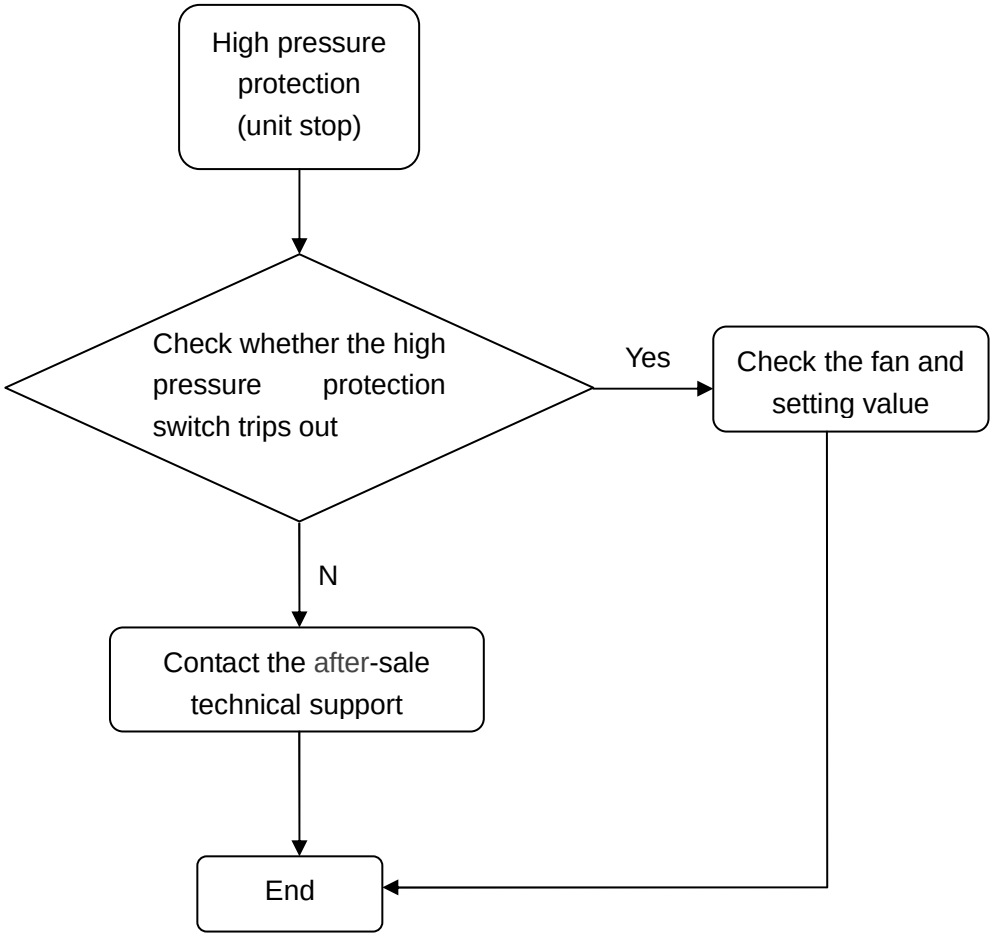
8.7.1 Water Flow Failure



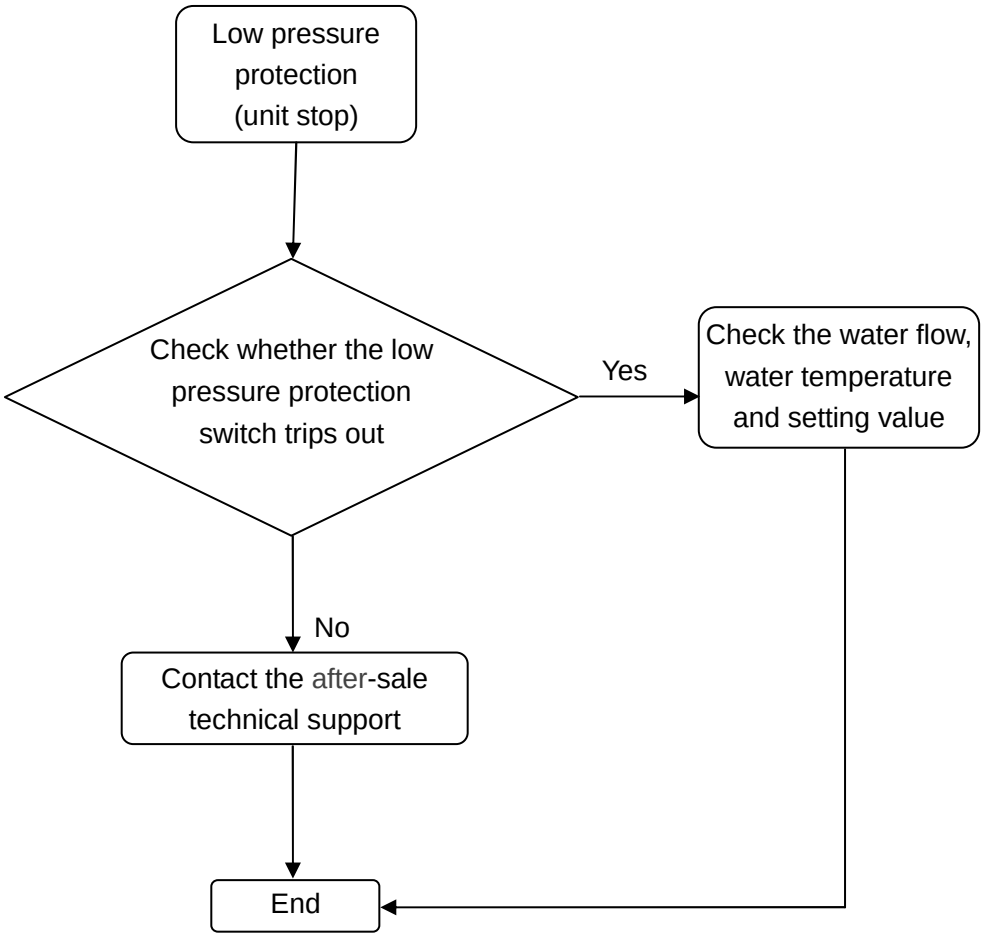
8.7.2 Freeze Protection



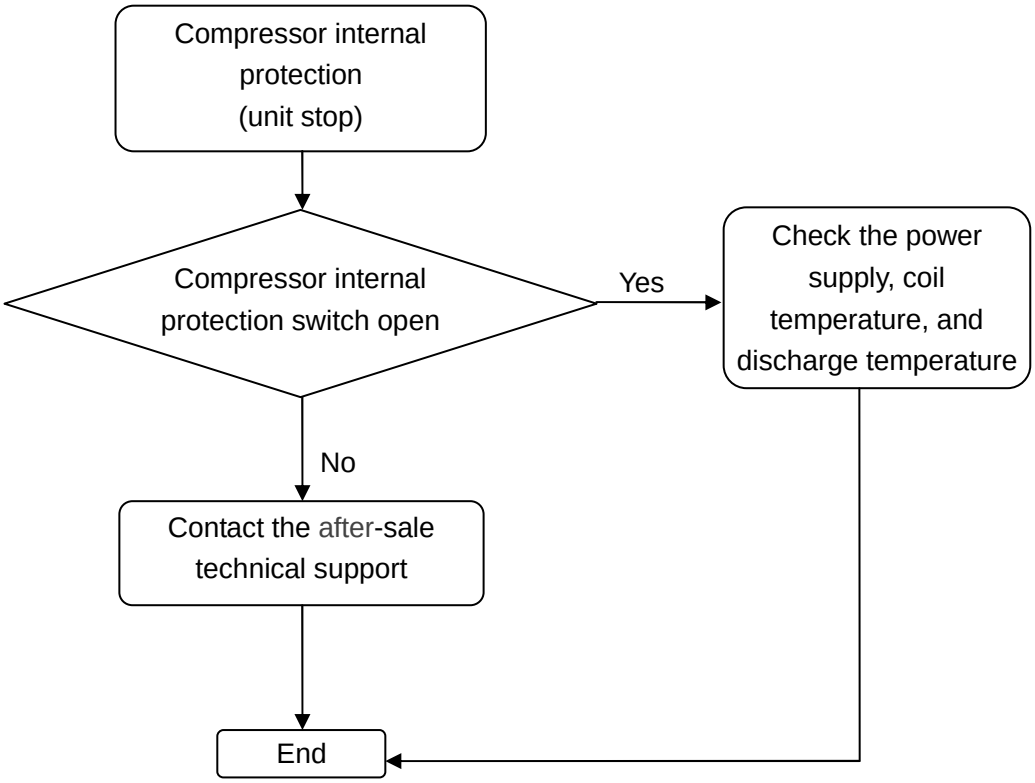
8.7.3 High Pressure Protection



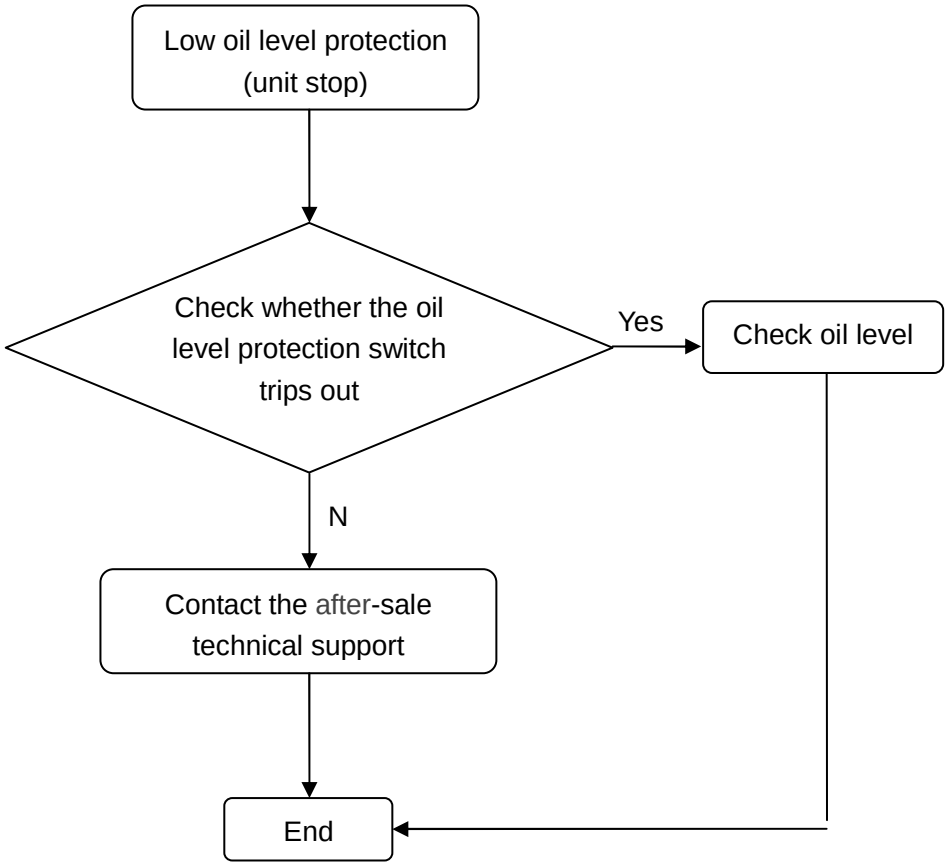
8.7.4 Low Pressure Protection



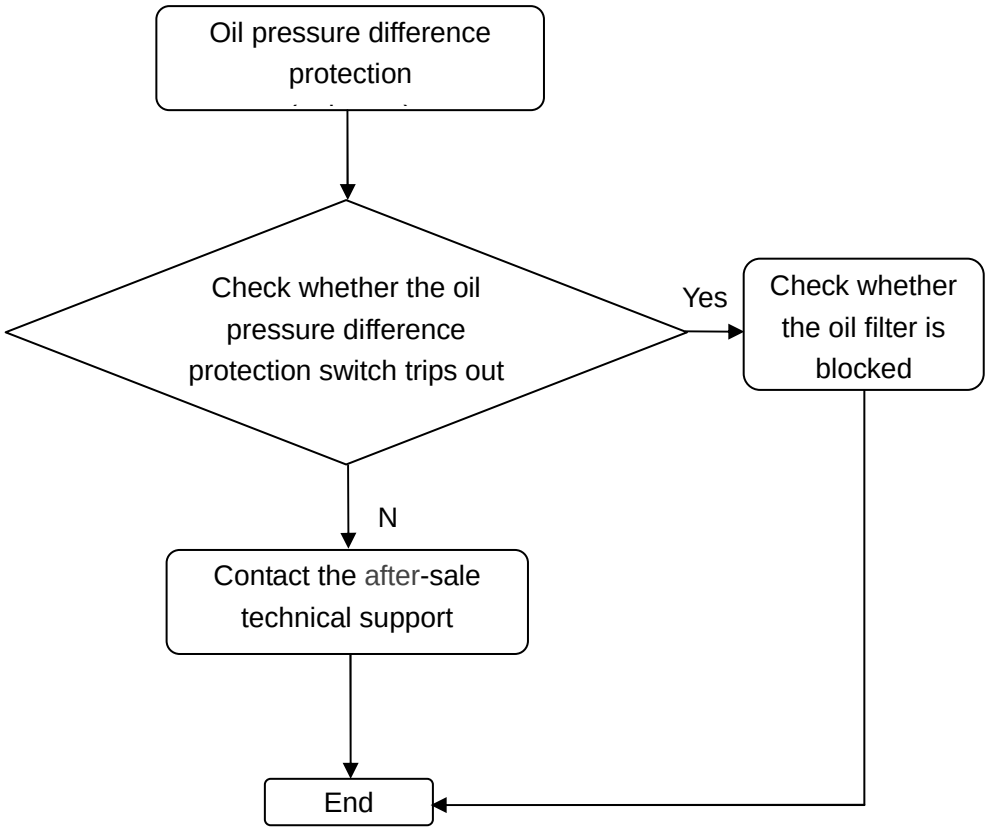
8.7.5 Compressor Internal Protection



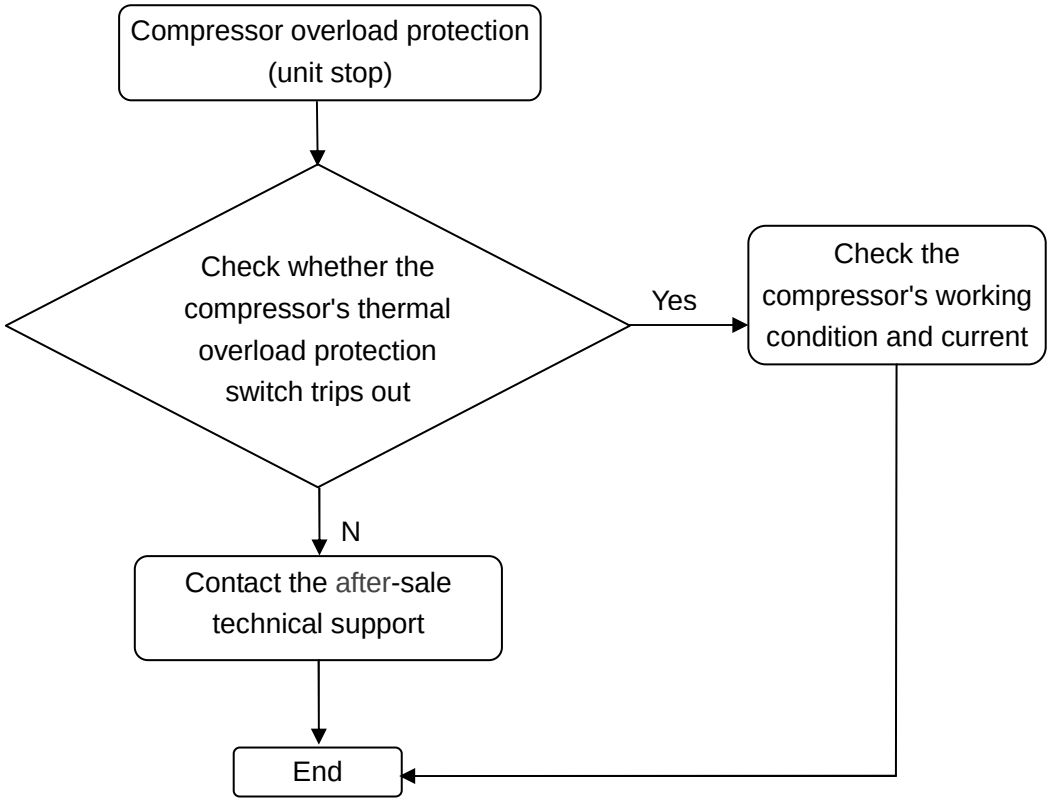
8.7.6 Low Oil Level Protection



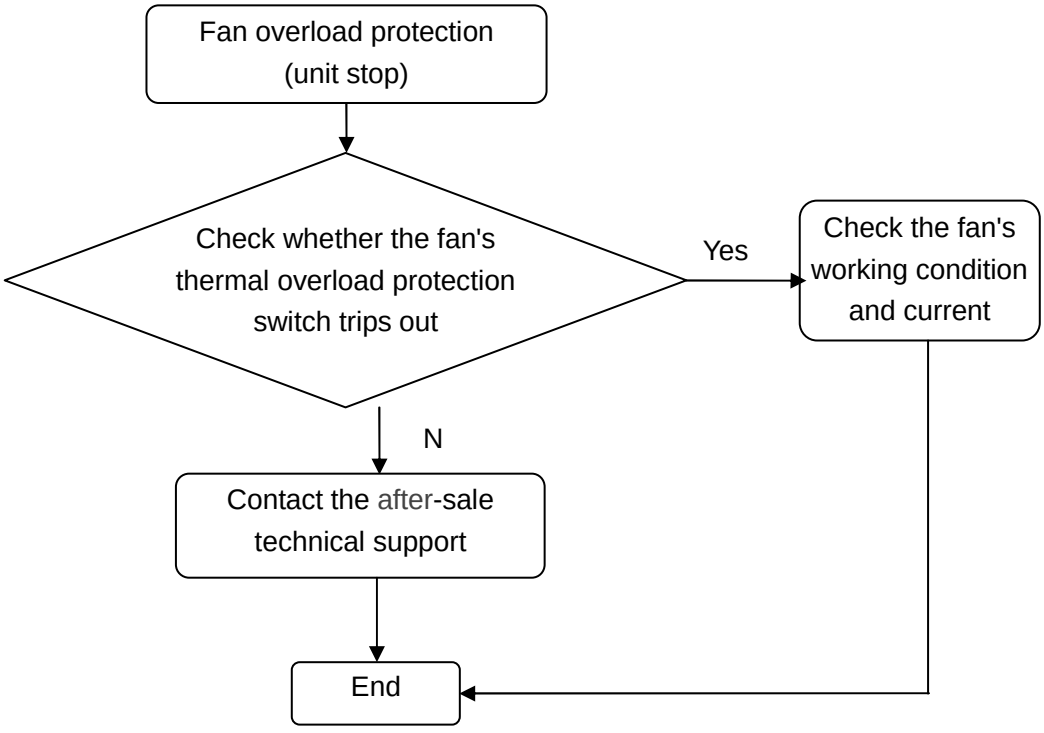
8.7.7 Oil Pressure Difference Protection



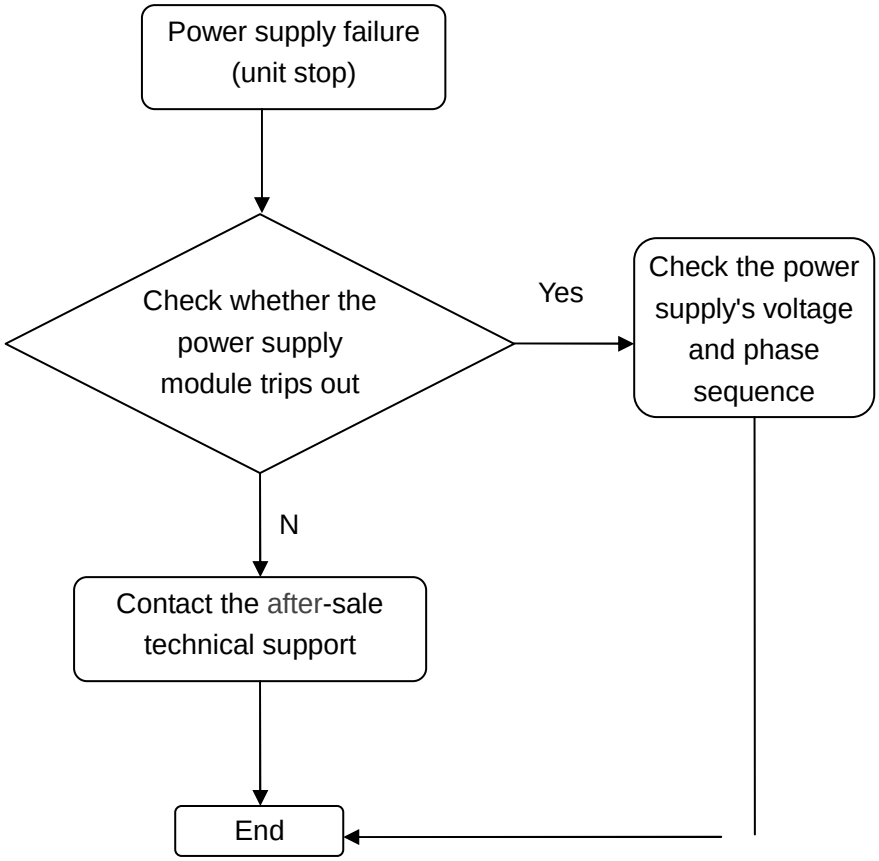
8.7.8 Compressor Overload Protection



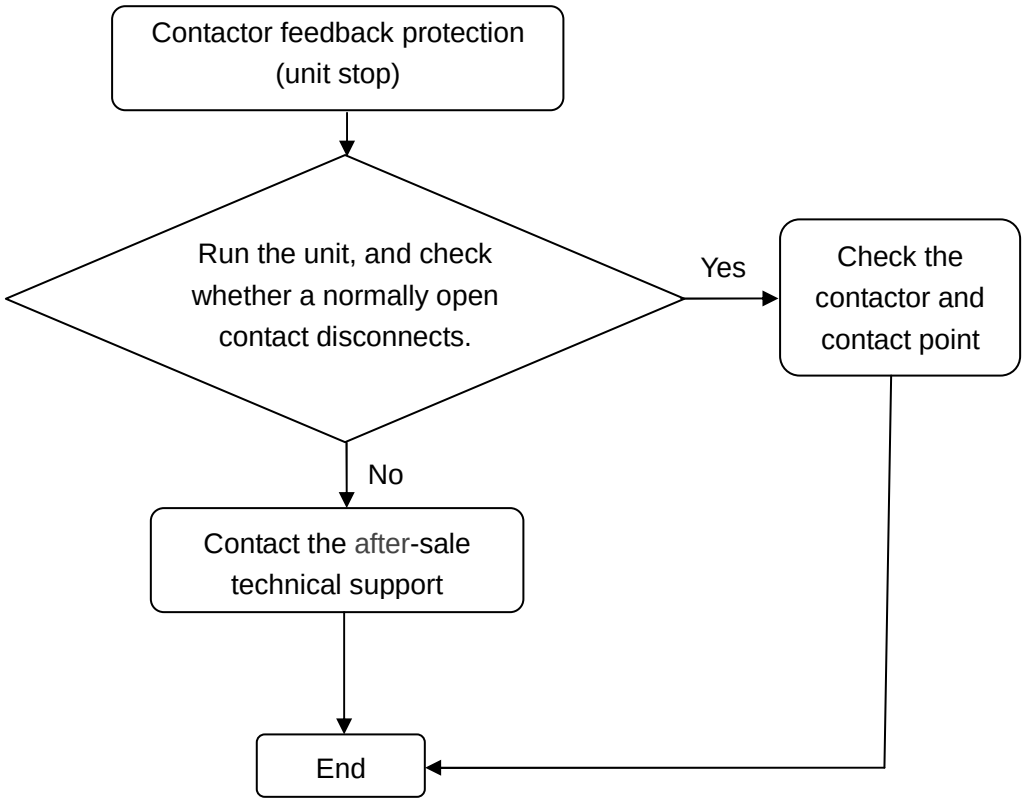
8.7.9 Fan Overload Protection



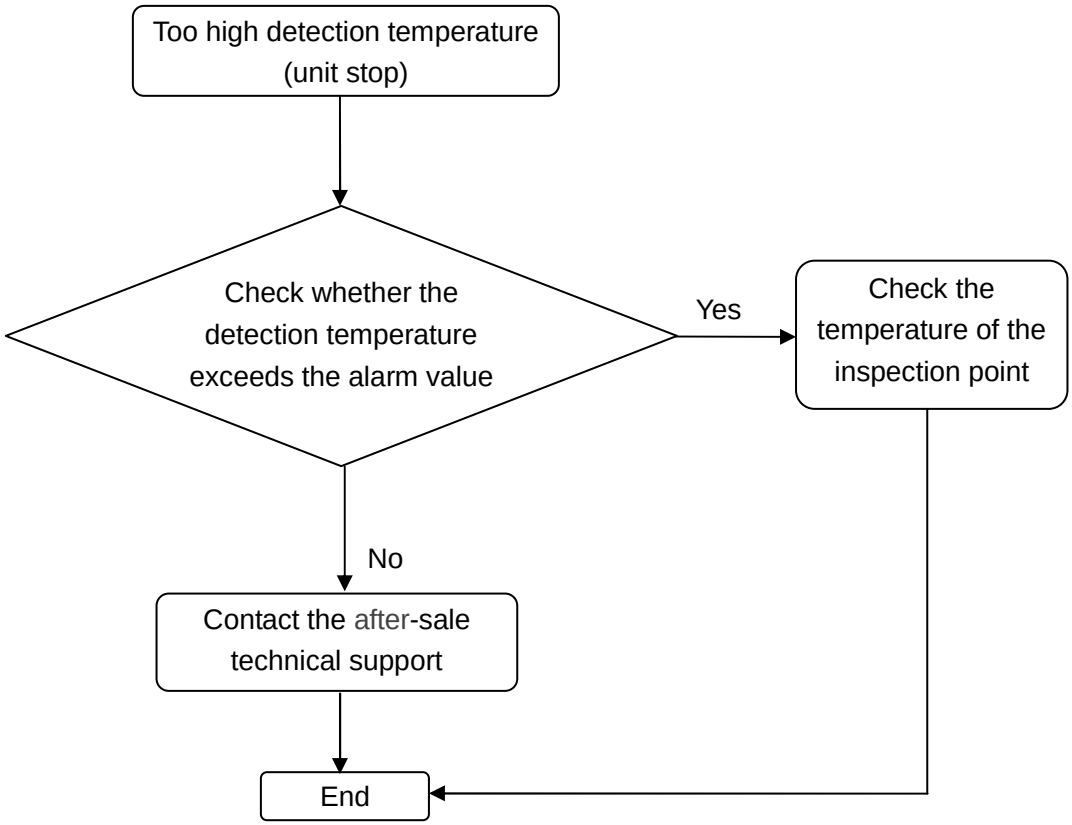
8.7.10 Power Supply Failure



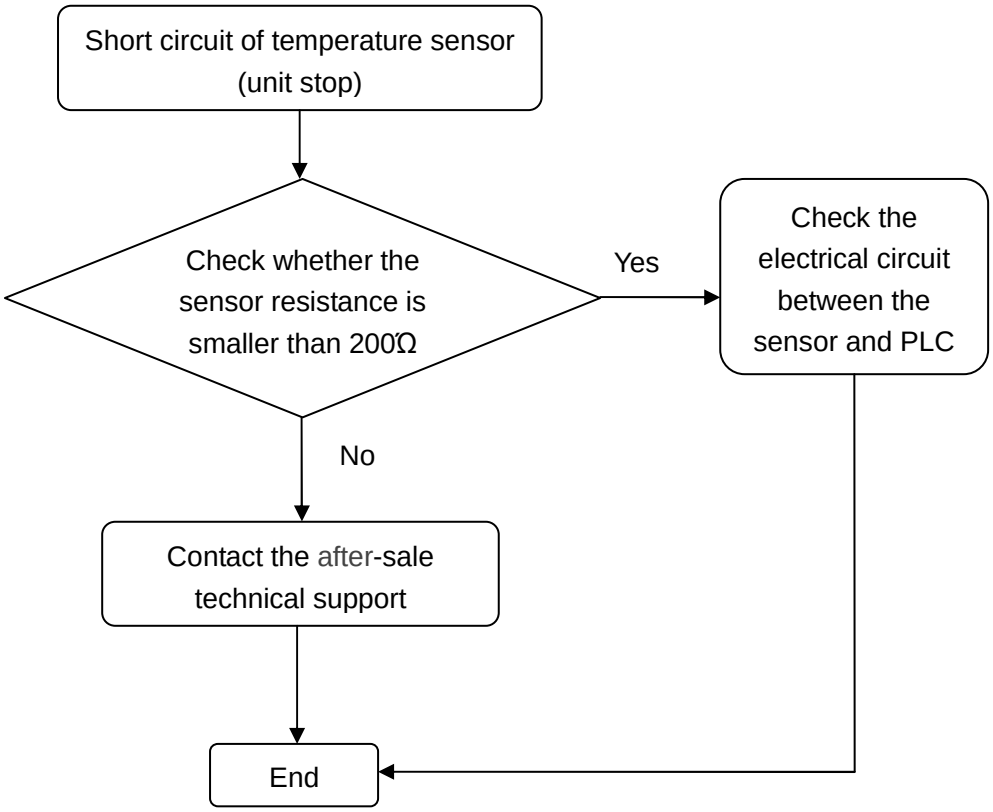
8.7.11Contactor Feedback Protection



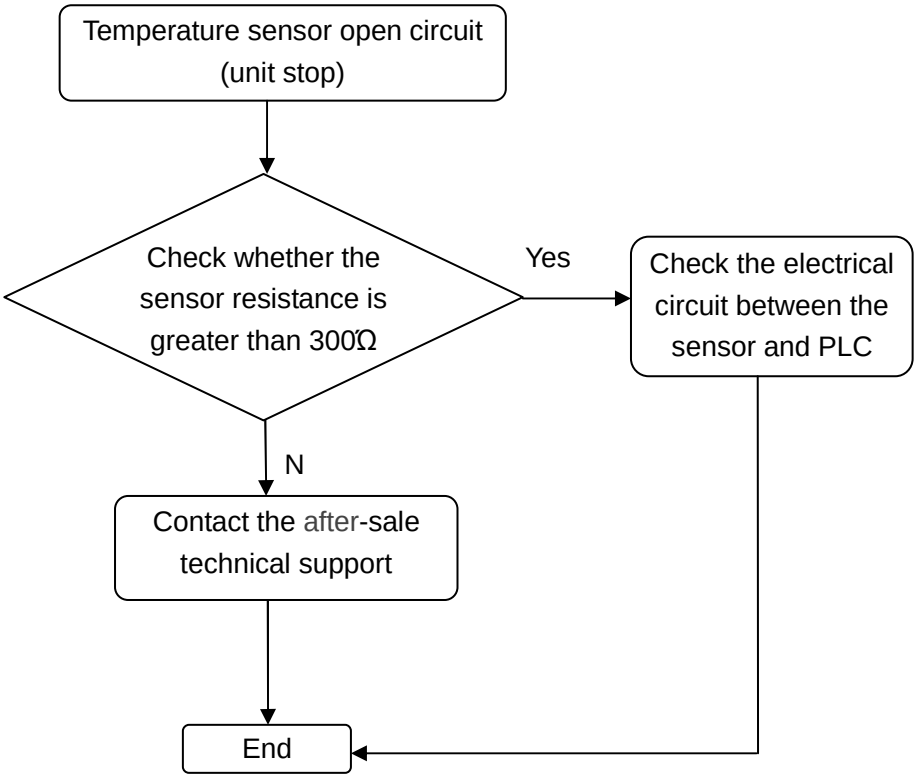
8.7.12 High Temperature of Discharge Air



8.7.13 Short Circuit of the Outlet Water, Inlet Water, Ambient, or Discharge Temperature Sensor



8.7.14 Open Circuit of the Outlet Water, Inlet Water, Ambient, or Discharge Temperature Sensor



8.8 Precautions for Unit Operation

WARNING

To prevent personal injury or death due to contact with any moving or live part, cut off the master power supply before check or maintenance, and suspend a sign "switch-on prohibited" near the switch.

(1) Before initially starting the unit, ensure that it is powered on for more than 8 hours, in order to prevent foam phenomenon of refrigerator oil when the unit starts up. If the unit starts up in low temperature, the oil is very viscous, and the compressor is difficult to start and load. In this case, the oil must be preheated for more than 8 hours. When the system stops, the refrigerator oil heater continues to work. Do not cut off the power supply, because the refrigerator oil heater keeps on working after the system stops. When the unit is not in use for a long time, you can cut off the power supply.

(2) Do not mix refrigerator oil of different brands. Confirm the brand specifications of the refrigerator oil when adding it. If you want to change the refrigerator oil, clean away all the remaining refrigerator oil inside the compressor and that in the system before adding new refrigerator oil and changing the drier-filter. Qualitative change may happen when some synthetic oil mixes up with mineral oil. Therefore, after adding the new refrigerator oil, change the new refrigerator oil to remove all the remaining oil after the unit starts up again.

(3) If an accident occurs during compressor startup, you can click the **Emergency Stop** button on the touchscreen to stop the compressor.

(4) Without the permission of company 's after-sale personnel, it is prohibited to change parameters of the electrical expansion valve. Otherwise, the unit may fail to run properly.

(5) If the safety valve of the store liquid organ is open, ensure that the ambient environment of the unit is well ventilated. When Freon meets fire, harmful phosgene will be generated. Therefore, do not light open fire around the unit.

9. Troubleshooting

Symptom	Cause	Solution
A. Compressor breakdown	No power supply (or power interruption)	Power on after examination.
	On-off action (over current)	Identify the cause for over current. If the contact capacity is too small, replace the contact capacity promptly. If the voltage is too low, improve the voltage.
	Starting switch failure	Repair or replace the switch.
	Fuse that controls the loop melted	Replace the fuse.
	Operation failure of interlocked parts	Check that the interlocked water pump operates properly.
	High-low pressure switch action	Check the set voltage and adjust it if needed.
B. Power-off shortly after startup	High-low pressure switch action	The ambient temperature is too high. Vent the incondensable gas in the system. Clean the expansion valve if blocked or replace it if damaged. Wipe the dusty finned heat exchanger.
C. Too low exhaust pressure	Insufficient refrigerant	Chase leaks and recharge refrigerants.
	High superheat of the expansion valve	Adjust the superheat.
	Too low ambient temperature	Check the ambient temperature and close certain fans if necessary.
	Too low suction pressure	See "F. Too low suction pressure."
D. Too high exhaust pressure	Excessive refrigerants	Suck a moderate amount of refrigerants.
	Mingled with incondensable gas	Vent the incondensable gas.
	Dirty finned heat exchanger	Clean the finned heat exchanger.
	High temperature in the finned heat exchanger	Check the ambient temperature and the surroundings of the finned heat exchanger to ensure unimpeded air intake.
	Insufficient air volume of the finned heat exchanger	Check the running status of the fans.
	Imprecise high voltage meter	Replace the high voltage meter.
	Too high suction pressure	See "E. Too high suction pressure."
E. Too high suction pressure	Over refrigeration load	Adjust the refrigeration load and water circuit.
	Low superheat of the expansion valve	Adjust the superheat.
F. Too low suction pressure	Insufficient refrigerant	Chase leaks and recharge refrigerants.
	Blocked drier-filter	Clean or replace the drier-filter.
	Less refrigeration load	Adjust the refrigeration load.
	Insufficient chilled water	Adjust the chilled water volume.

Symptom	Cause	Solution
	Blocked chilled water filter	Clean the chilled water filter.
G. Malfunction of the automatic capacity adjustment device	Temperature regulator failure	Replace the temperature regulator.
	Solenoid valve wire cut	Replace the wire of the solenoid valve.
	Blocked capillary tube	Clean the capillary tube (by a professional).
H. Overheated compressor	Defective bearing	Upgrade the compressor.
	Too high pressure on the high pressure side	See "D. Too high exhaust pressure."
	Refrigerants with too high pressure and temperature on the low pressure side	Adjust the pressure on the low pressure side and the opening of the expansion valve.
	Overheated motor	See "E. Too high suction pressure."
I. NFB tripping	Short-circuit between distribution cables	Measure the insulation resistance value.
	Signal earthing	Measure the insulation resistance value.
	Motor failure	Measure the motor insulation resistance against ground and phase-to-phase insulation resistance.
J. Overload relay action of the motor used by the compressor	Single phasing due to NFB tripping	Check the NFB.
	Too high, too low, or unbalanced voltage	Check the power distribution status of the motor.
	Single phasing due to the defective electromagnetic switch	Repair or replace the electromagnetic switch.
	Defective motor	Repair or replace the motor. If the motor is burned, clean the refrigerant circulation loop.
	Too high temperature in the power distribution box	Keep the temperature below 60ºC in the power distribution box. Identify and eliminate the cause for overheat.
	Too high operating pressure	See "D. Too high exhaust pressure."
	Frequent startup of the compressor	Check the respective automatic adjustment structures.
	Insufficient refrigerant oil in compressor	Clean the oil strainer.
K. Concatenated communication failure	Telecommunication line cut	Check the telecommunication line.
	Auxiliary engine power-off	Power on the auxiliary engine.

10 Maintenance and Service

WARNING

The water chiller unit must be maintained and serviced by experienced professionals.

CAUTION

Please print and fill in the sheets in appendixes 1 to 3 of this operation manual.

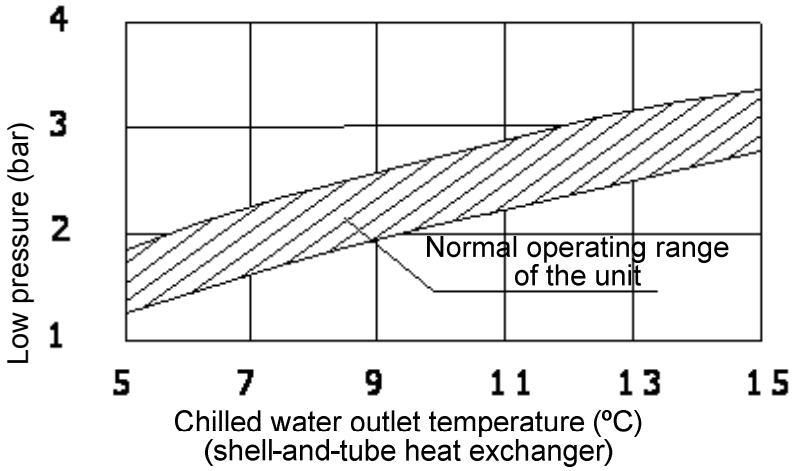
10.1 Normal Operating Pressure

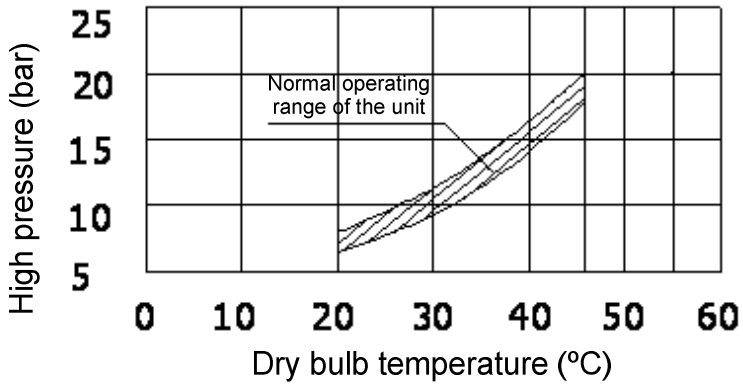
The following figures show the low pressure and high pressure of the water chiller unit.

Low pressure: If the normal operating pressure of the shell-and-tube heat exchanger is lower than 1.5 bar, the water chiller unit is in abnormal status.

High pressure: If the exhaust pressure for normal operating is lower than 6.7 bar or higher than 20.5 bar, the water chiller unit is in abnormal status.

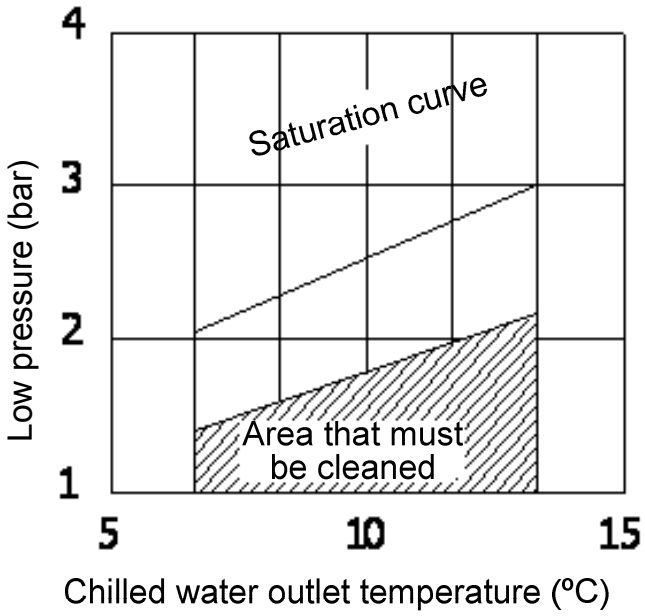
If the pressure is in abnormal status after the water chiller unit operates steadily, see "10. Troubleshooting."





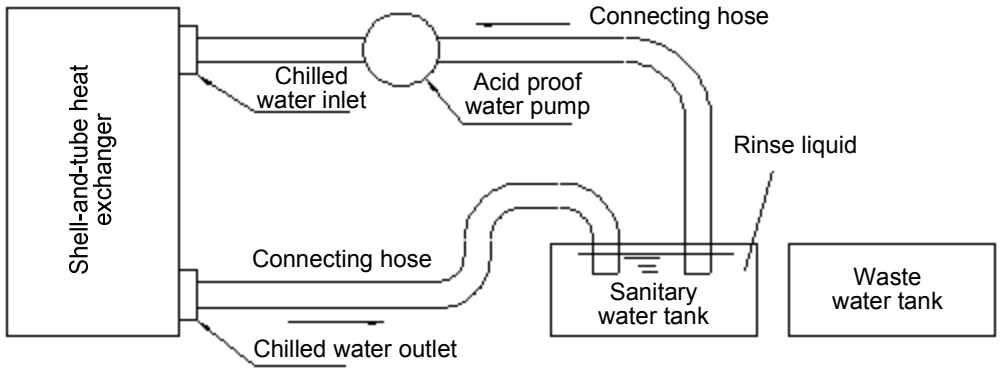
10.2 Cleaning the Shell-and-Tube Heat

Exchanger Operation Procedure:



Stop the water chiller unit and the circulating water pump. Disconnect the water system of the shell-and-tube heat exchanger. Install one acid-proof water pump to form a water circuit as shown in Figure 5.1.

Figure 5.1 System connection diagram for clean water



- Add clean water to the sanitary tank and operate the acid-proof water pump. Check that the water pipe is tightly installed in good ventilation without water leakage between joints and without abnormal sound during the operation. Keep the devices around the water chiller unit away from rinse liquid.
- Drain water from the air conditioning system. Add the diluted rinse liquid in the sanitary tank to the water chiller unit using the acid-proof water pump. Circulate the diluted rinse liquid for a proper duration based on the type and concentration of the rinse liquid, and the thickness of dirt.
- Stop the acid-proof water pump. Release the liquid waste after cleaning to the waste water tank, and add clean water to the sanitary tank. Operate the water pump to clean the system with clean water. Use pH test paper to test hydrogen ion concentration. Add neutralizer gradually to the sanitary tank until the pH is 7. Keep the water pump running to circulate the water until neutralization is complete. Drain the water. Operate the circulating water pump to clean the system with clean water until no scale comes out.
- Release the clean water after cleaning to the waste water tank, and add neutralizer to neutralize the liquid waste. After the neutralization is complete, contact a professional liquid waste disposal company for processing.
- Reconnect the water pipes of the water chiller unit according to the operating status. Check relevant joints to ensure that the unit operates properly.

Precautions for Using Detergents:

- Wear rubber gloves when doing the cleaning work. Prevent detergents from spraying onto clothing, face, or coating surface. Rinse the detergent with clean water immediately in case of contact with it.
- Use a plastic or glass container rather than a lead one to keep detergents.
- For the used detergents, neutralize them with lime or soda, and then contact a professional liquid waste disposal company for processing.
- Preserve detergents beyond children's reach because the detergents are harmful.
- Operate the water chiller unit again after cleaning to verify the cleaning effect. If the intended result is not achieved, clean the unit once more.

10.3 Procedure for Replacing the Dry FilterElement

- Turn off the shutoff valves on both ends of the drier-filter (if the shutoff valve is available only on one end, recycle refrigerants).
- Vent a slight amount of refrigerants out of the drier-filter.
- Open end caps of the drier-filter.
- Replace the old dry filter element with a new one.
- Reinstall the end caps of the drier-filter (check whether the gasket is damaged during removal) and tighten the bolts.
- Evacuate certain sections of the drier-filter.
- Turn on the shutoff valves to make startup ready.

10.4 Lubricant

MLSC_A series air-source screw water chiller units have been charged with sufficient lubricant before they leave the factory.

Model of the lubricant: BSE170

Viscosity: 170

If the water chiller unit in long-term use fails to start or stop upon the low oil level alarm, the causes will be:

- Lubricants have entered the refrigerant system and need to be recovered.
- Lubricant is undercharged and the following measures are required.

Measures:

- Keep the water chiller unit running at full load for one and a half hours. Check whether the oil level of the compressor rises.
- Restart the water chiller unit and ensure that it operates properly. If the oil level is still low, the lubricant in the unit is undercharged.

  If the internal pressure of the compressor is 0 bar, charge lubricants for the compressor using its oil filler plug. If the internal pressure of the compressor is higher than 0 bar, charge lubricants for the compressor using an oil filling machine.
- Use the lubricant brand defined in the technical specifications when maintaining or charging lubricants.

10.5 Charging and Evacuating Refrigerants

Refrigerants have been charged in the MLSC_A series air-source screw water chiller units before the units leave the factory, and passed the units' performance test. This section describes how a professional from the service department charges refrigerants to a moderate level after replacing certain components of the units for maintenance.

Method of charging and evacuating refrigerants:

1. After evacuating the units, use the needle valves of the stop valves on both ends of the drier-filter to charge refrigerants.
2. Evacuate refrigerants from the needle valves of the stop valves.
3. Use a special refrigerant charging and evacuating device to charge refrigerants (R134a) to or evacuate refrigerants from the units.

Charge the R134a evacuated from the units into a fluid reservoir, which is designed to withstand the pressure of the units and comply with related standards of pressure vessels. It is forbidden to drain the R134a directly into air or sewers.

Determining the Amount of Refrigerants:

To check whether the refrigerant charge of the water chiller unit is insufficient, view the mirror on the supplying line and evaporation pressure by performing the following steps:

- Check that the unit operates at full load when the loop is running at full load. See the steps described in the control section.
- When the unit operates at full load, ensure that the outlet water temperature of the evaporator ranges from 5.5℃ to 6.5℃.
- View the mirror on the supplying line.

The refrigerant charge is appropriate if the mirror is clear without bubbles, the liquid lens of the compressor is at the full level, and the evaporation temperature is within the normal range.

However, the refrigerant charge is insufficient if bubbles appear at the bottom of the mirror and the evaporation temperature is below the normal range.

10.6 Routine Maintenance Items

Maintenance Items		**Maintenance Frequency**	**Acceptability Baseline (Handling Method)**	**Remarks**
A. Generality	Noise	Anytime	Check whether an abnormal sound can be heard.	View the items 1 meter to the center of the water chiller unit.
	Vibration	Anytime	Check whether the amplitude of vibration of auxiliary pipes and components is too high.	
	Voltage	Anytime	The voltage must be within ±10% of the rated voltage.	
B. Unit exterior	Stain	Anytime	Keep clean always.	
	Rust	Anytime	Use an iron brush to remove the rust and then apply anticorrosive paint.	
	Looseness	Anytime	Tighten screws.	

Maintenance Items		Maintenance Frequency	Acceptability Baseline (Handling Method)	Remarks
	Flake of insulation materials	Anytime	Use adhesives to paste the insulation materials.	
	Water leakage	Once per month	Check whether the sewer is blocked.	
C. Compressor	Noise	Anytime	Check whether an abnormal sound can be heard when starting, operating, or stopping the unit.	
	Insulation resistance	Once per year	The insulation resistance must be over 5 MΩ when tested using a DC 500 V megger.	
	Aging of the shock absorption rubber	Once per year	Press the shock absorption rubber by hand. If the rubber is resilient, it is acceptable.	
	In-process inspection	Once per 3000 hours	Pay attention to noise vibration and oil level.	
	In-process inspection	Once per 6000 hours	Confirm the actions of safety and protection devices.	
D. Finned heat exchanger	Fan	Anytime	Air volume is normal and high pressure is within the normal range.	
	Cleanness	Once per month	Air resistance is normal and high pressure is within the normal range.	
E. Shell-and-tube heat exchanger	User-side water flow	Anytime	Between –5% and +5%	
	Temperature	Anytime	Within the benchmark range	
	Anti-icing fluid density	Once per month	Over the set density	
	Water quality	Once per month	Within the benchmark range	See appendix 4.
	Cleanness	Anytime	Ensure the low pressure is within the benchmark range during refrigeration.	
	Drainage	Anytime	Drain the water out of the shell-and-tube heat exchanger when the heat exchanger is not used for a long time.	Drain the water out of the auxiliary pipes too.

Maintenance Items		Maintenance Frequency	Acceptability Baseline (Handling Method)	Remarks
F. High-low pressure switch	Action	Once per month	Check based on the action values of various protection devices.	Check whether the joint structures are in good condition during action.
G. Pressure gauge	Pointer	Once every half a year	Compare the pressure gauge with a correct one.	
H. Stop valve	Action	Once per month	Smoothly turn on or off the stop valves.	
I. Refrigeration cycle	Refrigerant leakage	Once per month	Check whether refrigerant leaks in the unit and joints of auxiliary pipes using a leak detector. Drain water out of the shell-and-tube heat exchanger. Check whether water leaks in the water inlet and outlet.	Use an electronic leak detector, a burner leak detector, or soapsuds.
J. Electrical control	Insulation resistance	Once per month	The insulation resistance must be over 1 MΩ when tested using a DC 500 V megger.	
	Wire contact performance	Once per month	Ensure that the insulation layer of the wire is intact in good contact and the bolts are tightened.	
	Auxiliary relay	Once per month	No abnormal action	
	Time limit relay	Once per month	Act based on the set time.	

10.7 Safety Requirements for Maintaining the Water Chiller Unit

- All installation components must be maintained by professionals to avoid damage to the water chiller unit and personal injury. The safety devices of the unit must be examined after each maintenance.

  Once leakage is detected, vent all refrigerants out of the loop and repair leak sources. Then charge sufficient refrigerants based on the dose on the nameplate.

  However, if refrigerants leak on isolatable components of the unit, you do not need to vent all refrigerants out of the loop.

- Confirm the refrigerant model based on the nameplate before charging refrigerants. Charging

improper refrigerants will lead to unit failure or even compressor scrap.

- Use the lubricant brand defined in the technical specifications when maintaining or charging lubricants.
- Do not attempt to introduce oxygen to the supplying line of the unit because oxygen can react violently with oil.
- The operating pressure of the unit must not exceed the specified maximum working pressure.
- Use only refrigerants or dry nitrogen to chase leaks of the unit.
- Do not use electric soldering or flame to cut any refrigerant loops or components unless the unit contains no gas or liquid refrigerants.
- Refrigerants in contact with open fire will produce toxic gas. Appropriate measures must be taken to protect the unit and fire extinguishers must be accessible.
- Wear safety glasses to protect skin or eyes from refrigerants. Flush the refrigerants on skin immediately with soap or water if any. Flush the refrigerants in eyes with water immediately and repeatedly and seek medical attention.
- Use warm water rather than open fire or steam to heat the refrigerant container. Otherwise, the pressure may be too high, presenting potential hazards.
- Do not attempt to remove any end caps of joints when the unit is under certain pressure or in operation. Before performing operations on valves that may communicate with air after being opened, confirm that no pressure exists within the unit.
- When corrosion, foreign matter, dust, stain, or fouling is found within the valves, or the mechanical structure of the valves is damaged, replace the valves immediately instead of attempting to repair or respecify any safety devices.

Appendix 1

Daily Inspection Record Sheet

Date	Ambient Temperature (℃)	Inlet Water Temperature (℃)	Outlet Water Temperature (℃)	Exhaust Pressure (bar)	Suction Pressure (bar)	Exhaust Temperature (℃)	Suction Temperature (℃)
1							
2							
3							
4							
5							
6							
7							
8							
9							
10							
11							
12							
13							
14							
15							
16							
17							
18							
19							
20							
21							
22							
23							
24							
25							
26							
27							
28							
29							
30							
31							

Note: This sheet will be printed and filled by customers. Please keep it carefully.

Appendix 2

Key Component Inspection Record Sheet

Item	Compressor			Water Side Heat Exchanger			Air Side Heat Exchanger			Fan			Valve			Electric Control Cabinet			Others		
Interval	Date	Inspector	Content	Date	Inspector	Content	Date	Inspector	Content	Date	Inspector	Content	Date	Inspector	Content	Date	Inspector	Content	Date	Inspector	Content
6 months																					
1 year																					
2 years																					
3 years																					
4 years																					
5 years																					
6 years																					
7 years																					
8 years																					
9 years																					
10 years																					
11 years																					
12 years																					
13 years																					
14 years																					
15 years																					

Notes:

1. Fill in A, B, or C in the content column. A: Normal B: Replace components C: Repair components
2. Key inspection points: (1) Color of the compressor oil (2) Differential oil pressure (3) Front and rear differential pressure of the drier-filter and color of the test paper of the liquid lens

Note: This sheet will be printed and filled by customers. Please keep it carefully.

Appendix 3

Maintenance (Repair) Record

S/N	Failure Description	Handling Measures	Handling Result	Recorder
1				
2				
3				
4				
5				
6				
7				

Note: Fill in the sheet and keep it carefully.

Relationship Between Water Quality and Scale/Corrosion

S/N	Water Quality	Scale	Corrosion	Remarks
1	Acid water with a pH lower than or equal to 6	Hard scale	Strong	The water can generate $CaSO_4$ easily.
2	Alkali water with a pH higher than or equal to 8	Soft scale	——	Iron ion or aluminum ion generates soft fluid precipitates.
3	Water rich in Ca^{2+} and Mg^{2+}	Hard scale	——	The water can generate hard scale easily.
4	Water rich in Cl^-	Scale	Quite strong	The water can violently corrode copper and iron.
5	Water rich in SO_4^{2-} and SiO_2^{2-}	Hard scale	Strong	The water can generate hard $CaSO_4$ and $CaSiO_2$ easily.
6	Water rich in Fe^{3+}	Much hard scale	Strong	The water can generate $Fe(OH)_3$ and Fe_2O_3 precipitates easily.
7	Water with foreign odor	Much scale	Quite strong	The water can generate sulfide, ammonia, methane, and H_2S that corrodes copper strongly.
8	Water containing organic substances	Much scale	——	The water can generate hard scale easily.
9	Waste gas vented from automobiles, chemical plants, electroplate plants, sewage plants, ammonia refrigeration plants, and fiber plants.		Strong	Poor water quality can easily corrode and puncture the copper pipe of the heat exchanger.
10	Powder from plastics plants and other places that produce a large deal of powder	Much scale		
11	Sulfurous acid gas in the air		Quite strong	